This document was too large to scan as a single document. It has been divided into smaller sections.

Section 1

Document Information			
Document #	FOI 2011-00105	**Revision**	
Title	Freedom of Information Act Request (FOI 2011-00105)		
Date	12/16/2010		
Originator	Riehle D	**Originator Co.**	DOE-RL
Recipient	Hackett S	**Recipient Co.**	Other
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Other Information			

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

December 16, 2010

CERTIFIED MAIL

Mr. Sean Hackett
Gonzaga University
P.O. Box 3528
Spokane, Washington 99220-3528

Dear Mr. Hackett:

FREEDOM OF INFORMATION ACT REQUEST (FOI 2011-00105)

You requested, pursuant to the Freedom of Information Act (FOIA), the following records on behalf of Heart of America Northwest relating to the U.S. Department of Energy's (DOE) 2004 Final Hanford Solid Waste Environmental Impact Statement (EIS):

1) The adequacy of DOE's 2004 EIS including:

a. All correspondence between DOE and Battelle (the primary contractor for the Final EIS) in 2004 and 2005 relating to the adequacy of analysis, quality assurance, monitoring, and/or compliance with NEPA in preparing the final EIS.
b. All correspondence between DOE and the State of Washington between 2004 and 2005 relating to the above-referenced conclusion including any records relating to the adequacy of analysis, quality assurance, monitoring, and/or compliance with NEPA in preparing the EIS.
c. Information pertaining to DOE's July 2005 conclusion that the information in the groundwater cumulative impact analysis published in Appendix L of DOE's 2004 EIS was different than certain input parameters employed in the System Assessment Capability (SAC) computer model files that were used to prepare that analysis.
d. Any correspondence or analysis during the 2004 to August 2005 time period between Battelle/Pacific Northwest National Laboratory for information (PNNL) pertaining to any inadequacies of the final EIS (not just on groundwater analysis i.e. quality assurance issues including but not limited to groundwater analysis).

A partial response was provided to you on December 2, 2010. Included as Enclosure I are documents responsive to item 1c of your request. Included as Enclosure II are documents responsive to item 1d of your request.

In a letter to you dated November 3, 2010, we notified you that requests for records generated or in the possession of the Pacific Northwest National Laboratory and/or Battelle fall under the jurisdiction of DOE's Pacific Northwest Site Office (PNSO). Therefore, a copy of your request was forwarded to the DOE Oakridge Office (PNSO's FOIA Service Center) by this office on October 21, 2010, and its FOIA Officer will respond directly to you.

We have conducted a thorough search and no other documents were located. This search was conducted by those within the agency who are most familiar with the subject matter of your request, in locations where documents would most likely be found including the RL's Office of Chief Counsel, administrative record for the HSW EIS, Waste Management Project, Groundwater Project, Assistant Manager for the Central Plateau, River Corridor Closure Project, Environmental Management Division and the Office of River Protection's Environmental Compliance Division, Office of the Manager, Office of the Deputy Manager, Chief of Staff, Tank Farms Project, Waste Treatment and Immobilization Plant Project, Acquisition Management, Project Administration, Public, Internal, and Intergovernmental Affairs, and Environmental Safety and Quality. During our search was used the following keywords: HSW EIS, Hanford Site Solid Waste Program Environmental Impact Statement, U.S. DOE and Battelle, Quality Assurance, National Environmental Policy Act (NEPA), U.S. DOE and the State of Washington, and Groundwater Cumulative Impact Analysis.

In addition, you requested any and all information related to your request. The FOIA requires that an agency conduct a thorough search for documents responsive to a request, not an exhaustive search. We cannot guarantee that you have been provided all information related to your request, as we did not conduct an exhaustive search. A search was conducted, however, by representatives of the agency who are familiar with the subject areas of your request, in locations where responsive documents would most likely be found.

The undersigned individual is responsible for this determination. You have the right to appeal to the Office of Hearings and Appeals, as provided in 10 CFR 1004.8, for the adequacy of our search. Any such appeal shall be made in writing to the following address: Director, Office of Hearings and Appeals (HG-1), U.S. Department of Energy, L'Enfant Plaza Building, 1000 Independence Avenue SW, Washington, D.C. 20585-1615, and shall be filed within 30 days after receipt of this letter. Should you choose to appeal, please provide this office with a copy of your letter.

This letter completes your response dated October 8, 2010. If you have any questions regarding your request, please contact me at our address or on (509) 376-6288.

Sincerely,

Dorothy Riehle

Dorothy Riehle
Freedom of Information Act Officer
Office of Communications
and External Affairs

OCE:DCR

Enclosures

DOE-0156

Environmental Impact Statement for Retrieval, Treatment, and Disposal of Tank Waste and Closure of Single-Shell Tanks at the Hanford Site, Richland, WA **NEW OR CHANGED, DATA FORM 139**

Relevant document, section, and page number: *Final Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, Benton County, Washington* (DOE/EIS-286F)	
New data request or notice of change to data submitted by: Mary Burandt (DOE-ORP)	**Submittal date:** May 5, 2004
Description of new data request or data change notice: Ms Burandt verbally requested an analysis of public comments received on the Hanford Solid Waste EIS to identify those that may be relevant to the TC EIS.	
Response from CH2M HILL: A team led by Dee Willis of CEES reviewed the public comments documented in Volume III, "Comment Response Document," against five criteria to identify comments relevant to the Tank Closure EIS. The five criteria were: (1) Cumulative Impacts (shared by both EIS's), (2) Groundwater Impacts, (3) Acceptance of Tank Farm Waste Forms, (4) Long-Term Mitigation, and (5) Other Comments Expected to Be Received Again. Based on the judgment of the team, a listing of 41 "representative" comments were identified.	
Submitted by: Dee Willis representing CH2M HILL	**Submittal date:** June 8, 2004
Distribution: Danny Parker, CH2M HILL Greg McLellan, CH2M HILL Mary Burandt, ORP Charlotte Johnson (2), SAIC Diane Stock, Administrative Record	
Administrative Record Filing Number: TBD	

HSW EIS COMMENTS RELEVANT TO THE TC EIS

BACKGROUND

DOE's Draft Tank Closure EIS (*Draft Environmental Impact Statement for Retrieval, Treatment, and Disposal of Tank Waste and Closure of Single-Shell Tanks at the Hanford Site, Richland, Washington*, DOE/EIS-0356D) is scheduled to be published and ready for public comment on October 7, 2004. In preparation for receiving and responding to public comments on the Draft Tank Closure EIS, DOE-ORP requested a review of the public comment and response record of the Revised Hanford Solid Waste EIS (*Revised Draft Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, Richland, Washington* DOE/EIS-0286D2) to identify those comments that may have some relevance to the Draft Tank Closure EIS. This document provides the results of that review.

The first step in the review was to read all the public comments offered on the Solid Waste EIS. Those comments are compiled in Volume III, "Comment Response Document", of *Final Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, Benton County, Washington* (DOE/EIS -286F). Next, the review team developed five criteria for selecting comments relevant to the Draft Tank Closure EIS:

Criterion 1: Cumulative Impacts (shared by both EIS's)
Criterion 2: Groundwater Impacts
Criterion 3: Acceptance of Tank Farm Waste Forms
Criterion 4: Long-Term Mitigation
Criterion 5: Other Comments Expected to Be Received Again

Using these criteria, the reviewers identified 41 "representative" comments. Almost all of the 41 comments represent numerous other comments that addressed the same theme and contained similar substantive remarks.

This document summarizes the major themes, by criterion, of the 41 representative comments, and provides a verbatim listing of the 41 comments and DOE-RL's responses to each of those comments. Only the portions of the comments and responses that directly addressed the issues were included. Significant background and explanatory material was omitted.

HSW EIS COMMENTS RELEVANT TO THE TC EIS

Major Themes by Criterion

Cumulative Impacts

- Groundwater impacts are unknown.
- All existing waste is unaccounted for; an inventory of existing waste is needed.
- Characterization and monitoring needs are not described in the HSW EIS.
- Quantitative analysis of air and noise impacts is needed.
- The HSW EIS does not include all relevant contaminants of concern.

Groundwater Impacts

- The Nez Perce will not sacrifice the groundwater resource.
- Irretrievable and irreversible commitment of the groundwater is unacceptable.
- DOE must remove the sources of groundwater contamination, monitor for releases, and implement mitigation measures.
- The groundwater flows in different directions depending on which model is used.
- The SAC model is unable to integrate contaminants of concern other than uranium and Tc-99 into the modeling analysis.
- A 1-km point of analysis down gradient is not conservative enough; the impact at facility boundaries needs to be modeled.
- WTP salt waste from the LETF is not included in the analysis and is the largest single contributor to contamination.
- The HSW EIS should include plans to retrieve or mitigate the impacts of pre-1970 transuranic waste.

Tank Farm Waste Forms

- We assume that DOE is committed to waste forms “as good as glass.”
- Grout is not a recommended process for immobilizing waste.
- Do not assume that WIR assumptions in Order 435.1 will be upheld.
- If tech-99 is not removed from the waste, ILAW disposal in 200-W is not viable.
- We will want to revisit the HSW EIS if ILAW is not vitrified.
- WTP’s HLW melters may not meet RCRA requirements.

Long-Term Mitigation

- EIS says very little about resolving cumulative impacts.
- No adequate plan for prevention or mitigation of long-term risks.
- Disagreement with DOE contention that tank residuals will contribute small amounts to drinking water dose.
- I&I claim is not a basis for avoiding mitigation.

HSW EIS COMMENTS RELEVANT TO THE TC EIS

Major Themes by Criterion

Other Comments That May Be Received Again

- The HSW EIS does not evaluate the impacts of a terrorist strike.
- It is not certain that Yucca and WIPP will be able to take all the waste planned for shipment there; what are the contingency plans?
- There should be a long-term stewardship plan that extends beyond 100 years.
- All scenarios in the HSW EIS show unacceptable future risk to Native Americans.
- DOE's non-responsiveness has endangered tribal treaty rights.
- The piece-meal approach to Hanford EIS's and decisions raises NEPA concerns about segmentation and connected actions.
- The complexity and lack of clarity of the HSW EIS preclude ease of review.

HSW EIS COMMENTS/RESPONSES THAT ARE RELEVANT TO THE TC EIS

Number/Author	Comment Category	Representative Comment	RL Response
TSP-0006/005 J. Cunningham L-0041/009 P. Sobotta (NPT)	Cumulative Impacts	• The wastes will go through the groundwater into the river, and effects are unknown. • DOE's own best case scenarios show unacceptable future risk.	In all cases the water quality of the Columbia will be virtually indistinguishable from the current river background levels.
E-0050/005 L. Vigue (WDF&W)	Cumulative Impacts	Cumulative analysis does not take into account all existing waste at the site. Create an inventory of all nuclear waste stored at Hanford, including leakage into the groundwater and soils.	The HSW EIS uses the definition of cumulative impacts as defined by the CEQ regulations….For most resource and potential impact areas, the combined effects from the alternative groups…, when added to the impacts of other activities, are small.
L-0052/004 K. Niles (ODOE)	Cumulative Impacts	It remains unclear how truly comprehensive these analyses of cumulative affects are, in spite of the monumental effort by DOE to deal with impacts across the site.	Same as above.
L-0044/114 T. Fitzsimmons (Ecology)	Cumulative Impacts	The discussion of cumulative impacts does not provide sufficient analyses of all wastes and total risks.	Same as above. The HSW EIS, as a NEPA document, is not intended to function as, or contain the same information as, a compliance agreement, a permit application, or a management plan….
E-0043/021 <u>et al</u> T. Carpenter (GAP)	Cumulative Impacts	….the necessary precursor to an accurate cumulative impact analysis is an understanding of what waste already exists at Hanford. However, there is no such inventory of existing waste at Hanford.	The HSW EIS uses the definition of cumulative impacts as defined by the CEQ regulations….For most resource and potential impact areas, the combined effects from the alternative groups…, when added to the impacts of other activities, are small. Hazardous chemicals in MLLW have been characterized and documented since the implementation of RCRA at DOE facilities beginning in 1987….Inventories of hazardous chemicals in radioactive waste were not required

			to be determined or documented before…late 1987…. Waste sites and residual soil contamination remaining at Hanford over the long term, and which are not specifically evaluated as part of the HSW EIS alternatives, have been evaluated previously as part of NEPA and CERCLA reviews…. DOE plans to characterize pre-1970 inactive burial grounds and contaminated soil sites, as well as the active LLBGs considered in the HSW EIS alternatives, under the RCRA past practice or CERCLA processes to determine whether further remedial action would be required…. DOE believes this HSW EIS complies with applicable NEPA requirements.
L-0044/120 T. Fitzsimmons (Ecology)	Cumulative Impacts	While the SAC seems to be the right tool for the cumulative impacts analysis, the analysis failed to provide the desired results of total cum impacts from the current and future waste of these burial grounds under different alternative scenarios. We request that DOE make the following revisions…that will make the results more understandable. The EIS must include all of the radionuclides and chemicals that are potential COC's. The current approach is limited to technetium and uranium. Contaminants such as I-129, Pu, and Cs should be addressed….Ecology strongly disagrees with the approach and finds the current evaluation to be grossly inadequate.	The SAC…is being continuously refined…. The LLBGs contain over 100 radioactive and non-radioactive constituents that potentially could impact groundwater….Contaminant groupings were used, rather than individual mobility of each contaminant, primarily because of the uncertainty involved in determining the mobility of individual constituents. The waste constituents were grouped according to estimated or assumed Kd of each constituent….

L-0044/130 T. Fitzsimmons (Ecology)	Comments that will be repeated	The scenarios evaluated do not address other measures that terrorist might take (e.g., dirty bombs) that would have significant adverse effects to public health and psyche, the environment, and the economy….	The consequences of a malevolent event are expected to be within the range of accidents including severe (low probability, high consequences) accidents already evaluated in this HSW EIS. The HSW EIS analyzes several accident scenarios; including onsite facility fires, explosions, and earthquakes….However, in general, the LLW, MLLW, and TRU waste do not present an attractive target….
E-0054/001 R. Jim (YN)	Comments that will be repeated	The EIS fails to describe the characterization and monitoring needs to meet regulatory compliance, characterization, assessment, and other pertinent data gaps for the assessment and associated implications.	The HSW EIS, as a NEPA document, is not intended to function as, or contain the same information as, a compliance agreement, a permit application, or a management plan under other Hanford regulatory programs….
L-0055/037 R. C. Gay (CTUIR)	Comments that will be repeated	It is very difficult to understand this decision without knowledge of the total volume of waste nation wide: how much existing capacity is at the EIPP in New Mexico, Yucca Mountain and the Nevada Test Site and what the limits may be….Will WIPP be able to receive all of Hanford TRU waste including remote handled and oversized containers?	The HSW EIS evaluates the consequences of various site-specific alternatives to the ongoing waste management program at Hanford, consistent with the WM PEIS decisions regarding certain TRU, LLW, and MLLW streams…. …Shipments of TRU waste from Hanford to WIPP have started. Project volumes of HLW and available disposal capacity at Yucca Mountain are addressed in the Repository EIS….
L-0054/004 R. Jim (YN)	Comments that will be repeated	DOE's non-responsiveness has denied Tribal policy makers from ensuring that Treaty rights and resources are protected as part of the action. DOE's actions are inappropriate given the significance of impacts associated with the proposed action that include: tribal human health, cultural and ecological resources, direct and indirect cumulative impacts, and environmental justice.	DOE is cognizant of the concerns of Native Americans and others that operations at Hanford, including those discussed in this HSW EIS, could potentially adversely impact Native Americans and their lifestyle. This EIS includes discussion of potential impacts to cultural resources in Volume I Section 5.7, aesthetic and scenic resources in Volume I Section 5.12, and environmental justice in Volume I Section 5.13…. …None of the activities involved in the HSW EIS would occur on open and unclaimed lands.

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E-0043/039 <u>et al</u> T. Carpenter (GAP)	Comments that will be repeated	Any plan to clean up nuclear waste is incomplete without a long-term stewardship plan. The HSW EIS fails to address the need for an ongoing, long-term mechanism in order to ensure that long-term stewardship continues for hundreds of years into the future.	…Most of the analyses in the HSW EIS are based on the assumption that long-term institutional controls would no longer be in effect 100 years after closure. Long-term…impacts were determined based on the assumption that caps would degrade and eventually provide no protection….
E-0043/033 T. Carpenter (GAP)	Comments that will be repeated	The EIS should quantitatively analyze all possible air and noise quality impacts compared to current air and noise quality. Instead the EIS merely states that certain standards have not been exceeded….	Volume I Section 4 provides a description of the environment that might be affected by the alternatives described in Volume I Section 3….
L-0054/005 R. Jim (YN)	Comments that will be repeated	CDC (2001) says that tribal members are exposed to more cancer-causing ionizing radiation from Hanford than other people living near Hanford.	EPA says that risks to tribal members are from organic chemicals from agriculture.
E-0049/009, L-0048/009 S. Cimon M. Pirzadeh (EPA)	Comments that will be repeated	The Board is troubled that all scenarios show unacceptable future risk to Native Americans.	The HSW EIS uses the definition of cumulative impact as defined by the CEQ Regulations…the impact that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions….Potential cumulative impacts associated with implementing the HSW EIS alternative groups are summarized in Volume I Section 5.14. Past, current, and future Hanford activities include treatment and disposal of tank waste, decontamination and decommissioning of the Hanford production reactors and other facilities, waste in the PUREX tunnels, operation of a commercial LLW disposal facility by U. S. Ecology, and operation of the Columbia Generating Station by Energy Northwest. For most resource and impact areas, the combined effects from the alternative groups for the Hanford Only, Lower Bound and Upper Bound waste volumes, or for the No Action Alternative for the Hanford Only and lower

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			Bound waste volumes, when added to the impacts of these other activities, are small. Groundwater contamination beneath the Hanford site is being studied and remediated by the ongoing CERCLA program in accordance the TPA…Any decisions reached by DOE on the basis of analysis in the HSW EIS would be implemented in accordance with applicable Federal, State, and local laws and regulations….
L-0041/007 P. Sobotta (NPT)	Comments that will be repeated	We are concerned about a piecemeal approach to decision-making on Hanford cleanup issues. We asked DOE to address CEQ regulations on "connected actions" to prevent minimizing potential environmental consequences by segmenting actions. The draft HSW EIS fails to do that.	The HSW EIS evaluates the consequences of various site-specific alternatives to the ongoing waste management program at Hanford…. DOE believes this HSW EIS complies with applicable NEPA requirements.
L-0055/010 R. C. Gay (CTUIR)	Comments that will be repeated	Under the current plan Hanford will send its HLW and SNF to a national geologic repository at Yucca Mountain. What if this repository is already filled? Does Hanford have contingency plans?	DOE is responsible for the cleanup of dozens of sites around the country. DOE's approach is to consolidate and dispose of radioactive waste from all its cleanup efforts in the safest and most cost-effective manner possible….
E-0049/010, L-0048/010 S. Cimon M. Pirzadeh (EPA)	Comments that will be repeated	The Board believes that the revised EIS is based on incomplete and inadequate data. We are concerned that, lacking this data, DOE's proposed actions could result in devastating environmental damage to the area, and in particular, to the Columbia River. As a result, we urge DOE to hold off on issuing a final ROD until these analyses can be completed.	The HSW EIS uses the best available data, computer modeling, assumptions, and related methods to produce estimates of reasonably foreseeable environmental impacts. The modeling approach was consistently applied to each alternative, and it provided information that allowed comparison of the alternatives.

L-0044/037 T. Fitzsimmons (Ecology)	Comments that will be repeated	It is surprising that a complete Native American scenario was omitted, considering its sensitivity (both in terms of risk and environmental justice issues)….	The HSW EIS uses two exposure scenarios to evaluate the potential impacts to humans from solid waste management activities: industrial and resident gardener (agricultural)….These scenarios are based on the concept of reasonable maximum exposure as recommended by EPA for which the most conservative parameter is not always used….
L-0044/134 T. Fitzsimmons (Ecology)	Comments that will be repeated	A provision in WAC requires that EIS's be "concise, clear, and to the point". The complexity of the RHSW EIS and its supporting Appendices preclude ease of review by the public and the agencies.	The HSW EIS summarizes its analyses in seven section in a first volume….The summary has been substantially revised in response to comments…and presents the major conclusions, areas of controversy, including issues raised by the public and highlights of the analyses of the EIS. DOE believes this HSW EIS complies with applicable NEPA requirements.
L-0052/015 K. Niles (ODOE)	Comments that will be repeated	The ERWM staff recently toured WIPP and Yucca and after hearing the various presentations we are under the impression that there is still a large degree of uncertainty associated with licensing and whether or not these sites will be accepted for their intended purposes. It would be prudent to inform people about this situation in the EIS. This document continues to assume that TRU wastes will be exported.	EPA authorization to dispose of RH-TRU waste at WIPP is pending. Approval of the permit by New Mexico Environment Department is expected in the FY 2006 timeframe.
L-0052/006 K. Niles (ODOE)	Groundwater Impacts	Water is a sacred resource for the NPT. The tribe is not interested in sacrificing such a resource.	The impact of the proposed action at the 1-km line of analysis would be below benchmark drinking water standards.
E-0047/021 C. Jones	Groundwater Impacts	Groundwater and the VZ under the Hanford Site are declared irretrievably and irreversibly committed due to long-lived radionuclides in existing disposal areas.	As a result of additional mitigation measures incorporated into the action alternatives, the impact of the proposed action on groundwater at the 1-km line of analysis would be below benchmark drinking water standards.

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L-0044/016 T. Fitzsimmons (Ecology)	Groundwater Impacts	Ecology will insist that DOE remove the waste that are sources of contamination in the groundwater, monitor for the releases, and implement short- and long-term mitigation measures.	Same as above
L-0055/046 R. C. Gay (CTUIR)	Groundwater Impacts	DOE's groundwater flow directions do not match some of the historical groundwater flow directions. It is possible that there are different flow directions depending on the time scale used in the analysis. The regional flow has traditionally been to the southeast….	Given the expected long delay of contaminants reaching the water from the LLBGs, the hydrologic framework of all groundwater transport calculations was based on postulated post-Hanford steady-state water table as estimated with the three-dimensional model….
L-0055/049 R. C. Gay (CTUIR)	Groundwater Impacts	The long-lived radionuclides selected with which to make these estimates were tech-99 and uranium isotopes using the SAC. Other long-lived radionuclides occur in sufficient quantity…to also be of interest (such as iodine 129). However, the SAC program had not completed the inventory and classification of waste forms in time to integrate these other radionuclides into the analysis….	The SAC, as a groundwater modeling capability, is being continuously refined. The initial SAC assessment demonstrated that a relatively small number of input parameters could determine most of the variability in calculated performance measures. SAC has been updated since the initial assessment and, for the purposes of this EIS, an additional 25 runs were made using the more refined model….
E-0055/022 G. Pollett (HANW)	Groundwater Impacts	DOE lacks basic knowledge about subsurface fate and transport. DOE has repeatedly been embarrassed by the failure of models to withstand the tests of time. The Board has little confidence that DOE can predict the future impacts or risks from its proposed actions with any certainty.	The impact evaluation models are discussed in Volume I Section 5 and the Volume II appendices….
L-0044/061 T. Fitzsimmons (Ecology)	Groundwater Impacts	…Use of points of analysis located along lines approximately 1 km down gradient from waste management units results in dilution of impact concentrations. This approach is not conservative.	…To model the groundwater impacts from multiple and widely dispersed disposal units over long periods of time, a 1-km point of analysis location was deemed to be more appropriate and representative than a regulatory point of compliance well location, got purposes of NEPA analysis. The point of analysis approach is considered technically appropriate for NEPA evaluation of groundwater impacts over the long-term (10,000 years) time period analyzed….

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E-0055/015 G. Pollett (HANW)	Groundwater Impacts	WDOE and EPA, for instance, have concurred with the analysis that this revised draft fails to provide the legally required minimum analysis of the impacts of proposed landfill sites, size, disposal quantities and design. Hundreds of commenters, the HAB…all urged DOE to clearly disclose and consider the impact of the proposed landfill alternatives on groundwater meeting the standards in Sec. 3004 and 3005 of RCRA…requiring that the impact on groundwater be analyzed under the facility and at the proposed facility boundaries. Without analysis of the impacts on groundwater at the current and proposed new facilities' boundaries it is impossible to ascertain what the impacts are.	The maximum point of impact from multiple and widely dispersed sources may not necessarily be directly underneath the LLBGs or at the LLBG boundary. To model the groundwater impacts from multiple and widely dispersed disposal units over long periods of time, a 1-km point of analysis location was deemed to be more appropriate and representative than a regulatory point of compliance well location, for purposes of NEPA analysis…. …Groundwater monitoring will be expanded as necessary according to agreements between DOE and regulatory agencies to support future waste management operations. In 2001 alone, samples were collected from 735 groundwater monitoring wells to determine the distribution and movement of existing radiological and chemical constituents in Hanford Site groundwater….
E-0019/003 (A. Boldt)	Groundwater Impacts	The draft HSW EIS has failed to include as a waste source the largest single contributor to groundwater contamination. The excluded source term is the packaged WTP salt waste from the Liquid Effluent Treatment Facility (LETF). WTP process condensates containing technetium and iodine are treated in LETF and soluble salts removed as a solid salt and packaged for disposal. All the WTP processes produce process condensate and scrubber solutions treated by the LETF….Some of the processes may result in exceeding the regulatory limit for groundwater radiation exposure.	The Solid Waste Integrated Forecast Technical (SWIFT) Report was the basis for solid radioactive waste expected to be generated in the future at the Hanford Site. This report includes estimates of waste expected from the LETF, including salt wastes associated with the treatment of liquid effluents from the WTP….the radionuclide inventory associated with the salt waste from LETF is a substantial contributor to the 3,200 curies of technetium and 5 curies of iodine in the Hanford Only Inventory.

L-0052/005 K. Niles (ODOE)	Groundwater Impacts	There appear to be no plans to retrieve or mitigate impacts from pre-1970 TRU. We submit that the level of risk associated with these burials remains significantly uncertain. DOE may be confident that contamination from alternative actions presented in this EIS will not compound already existing contamination because the existing plumes should have moved by the time the new contamination would reach those areas. However, we content that the overall uncertainties of inventory and its status already in the vadose zone and/or groundwater at Hanford do not leave room for such sweeping confidence the zones will be relatively clean when new contaminants enter them.	Waste in inactive burial grounds closed before 1970, tank waste residuals, and other contaminated soil sites are not within the scope of alternatives considered in the HSW EIS. Wastes placed in the LLBGs before 1970 consist of a relatively small volume (less than 10,000 m3) and the radionuclide inventories have been included in the HSW EIS alternatives analysis. Wastes placed in the LLBGs before late 1987 have not been specifically characterized for hazardous chemical content, but they have been evaluated in the EIS alternatives relative to their radionuclide inventories. In addition, preliminary estimates of chemical inventories in this waste have been developed for analysis in the HSW EIS, and a summary of their potential impacts on groundwater is presented in Volume I Section 5.3….
L-0039/017 T. Martin (HAB)	Tank Farm Waste Forms	This draft EIS assumes all ILAW will be in the borosilicate glass form. Should DOE proceed with decisions based on this draft of the HSW EIS, the Board believes DOE is committing to a performance standard equivalent to glass, regardless of the waste form.	The HSW EIS evaluates disposal of ILAW in a form that has performance characteristics equivalent to borosilicate glass….It is expected that potential environmental impacts associated with any changes from this waste form will be evaluated in (the Tank Closure EIS).
L-0055/057 R. C. Gay (CTUIR)	Tank Farm Waste Forms	Grouting is not a recommended process for immobilizing waste. The grout will eventually break down and this waste will once again be mobilized into the environment.	Same as above

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L-0041/010 P. Sobotta (NPT)	Tank Farm Waste Forms	The HSW EIS makes two assumptions regarding the analysis of tank waste disposal that are vulnerable to invalidation….The first of these assumptions is that the WIR provisions of 435.1 will be upheld in the current litigation. The second assumption is that all the low activity tanks waste will be immobilized as borosilicate glass….DOE needs to explicitly acknowledge the vulnerability of both assumptions and discuss the actions that will be taken if either is invalidated.	Same as above
L-0044/014 T. Fitzsimmons (Ecology)	Tank Farm Waste Forms	If the Tc-99 is not removed from the waste, picking an ILAW disposal location in 200-W is not viable.	The HSW EIS evaluates…a maximum inventory of Tc-99 in ILAW that assumes the Tc-99 is not removed prior to vitrification. For comparison, the preferred alternative evaluates both the maximum inventory of Tc-99 and a lower inventory of Tc-99 in ILAW that assumes the Tc-99 is removed prior to vitrification.
L-0052/012 K. Niles (ODOE)	Tank Farm Waste Forms	Adding ILAW to this draft EIS is a highly significant change from the prior version. We are aware that the analyses in this EIS assume all ILAW will be vitrified, but that Tc-99 is not removed. As supplemental technologies are currently being tested, we have concerns about the form the ILAW will take, and how this EIS will be revisited if ILAW is not vitrified.	ILAW disposal has been evaluated in the HSW EIS based on the expectation that it will be a borosilicate waste form. Outside the scope of the HSW EIS, DOE has been considering adjustments to the ILAW waste form and its chemical and radionuclide composition. It is expected that potential environmental impacts associated with such changes in the ILAW waste form will be evaluated in the EIS for Tank Closure.

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L-0041/022 P. Sobotta (NPT)	Tank Farm Waste Forms	The EIS discusses the disposition of failed low-activity waste melters but does not include any information on the fate of the high-level waste (HLW) melters. This discussion should include the proposed waste classification of the HLW melters, how this classification was arrived at, and where the HLW melters will be disposed.	For purposes of analysis, this HSW EIS analyzed the disposal of 6,825 cubic meters of Hanford WTP melters that would meet applicable requirements, such as those under the HSSWAC for onsite disposal of MLLW. The disposition of all melters from vitrification at Hanford will be addressed in DOE's TC EIS. In addition, the Yucca Mountain Repository EIS evaluated transportation and disposal of melters from Hanford as part of the cumulative impacts analysis….
L-0059/004 L. C. Davenport	Tank Farm Waste Forms	The HLW melters removed from the WTP will not necessarily meet the requirements for disposal in a RCRA-compliant facility at Hanford. This is particularly true if the outlet of the melter plugs and HLW solidifies inside the melter. I understand that this subject is to be addressed in the TC EIS.	Same as above
TSE-0031/011 T. Takaro	Long-Term Mitigation	The document does note that there is a lot of uncertainty about the cumulative impacts, but it does very little towards resolving those uncertainties.	Several mitigation measures have been built into the alternatives…including installation of barriers, liners, and leachate collection systems…treatment of MLLW…and in-trench grouting or use of HIC's for Cat 3 LLW and MLLW. Revised analyses…indicate that such measures would reduce the estimated releases and levels of groundwater contamination….constituent concentrations in groundwater at 1 km from the disposal facilities are expected to be below the benchmark drinking water standards. Water quality in the Columbia River would be virtually indistinguishable from the current background levels.
TPO-0013/004 H. Clawson	Long-Term Mitigation	We have no adequate plan for prevention or mitigation of the risks involved, the ones of which we're already aware. And we will continue to discover, in the future, many additional risks of which we're not now aware.	Same as above An expanded discussion of potential mitigation measures is in Volume I Section 5.18.

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L-0044/119 T. Fitzsimmons (Ecology)	Long-Term Mitigation	Ecology does not support the USDOE's contention that tank residuals will contribute less than 1 mrem to the drinking water dose 7,000 years onward.	Drinking water doses reported in Volume I Section 5.11 are reported as CEDE for comparison with the DOE standard dose to members of the public in DOE Order 5400.5. The 4 mrem/y DOE drinking water standard is intended to provide a level of protection comparable to the 4 mrem/y total body standard in 40 CFR 141….
L-0044/113 T. Fitzsimmons (Ecology)	Long-Term Mitigation	It appears to us that USDOE is asserting that the groundwater under Hanford is irretrievable and irreversible committed due to long-lived mobile radionuclides in existing disposal areas. If this is DOE's assertion, it is not supported by data, and more importantly, such a claim is not a basis to avoid mitigation.	Several mitigation measures have been built into the alternatives…including installation of barriers, liners, and leachate collection systems…treatment of MLLW…and in-trench grouting or use of HIC's for Cat 3 LLW and MLLW. Revised analyses…indicate that such measures would reduce the estimated releases and levels of groundwater contamination…constituent concentrations in groundwater at 1 km from the disposal facilities are expected to be below the benchmark drinking water standards. Water quality in the Columbia River would be virtually indistinguishable from the current background levels. At disposal boundary facilities, benchmark drinking water standards would not be exceeded as a result of future disposal of waste. However, these standards could potentially be exceeded due to previously disposed of waste. Previously disposed of waste will be addressed by CERCLA or RCRA past-practice remedial action processes prior to closure of the LLBGs. The discussion of Irreversible and Irretrievable Commitments of Resources in Volume I Section 5.15 has been revised in this EIS.

PNNL-14760, Rev. 0, Release Data Package for the 2004 Composite Analysis

PNNL-14824, River Data Package for the 2004 Composite Analysis

PNNL-14753, Rev. 0, Groundwater Data Package for the 2004 Composite Analysis

PNNL-14725, Rev. 0, Geographic and Operational Site Parameters List (GOSPL) for the 2004 Composite Analysis

PNNL-14702, Rev. 0, Vadose Zone Hydrogeology Data Package for the 2004 Composite Analysis

PNNL-14618, Rev. 0, A Geostatistical Analysis of Historical Field Data on Tritium, Technetium-99, Iodine-129, and Uranium

PNNL-14599, Rev. 0, Atmospheric Data Package for the 2004 Composite Analysis

PNNL-14618, Rev. 0

Pacific Northwest
National Laboratory
Operated by Battelle for the
U.S. Department of Energy

A Geostatistical Analysis of Historical Field Data on Tritium, Technetium-99, Iodine-129, and Uranium

C. J. Murray
Y.-J. Chien
P. D. Thorne

April 2004

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RL01830

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Executive Summary

Pacific Northwest National Laboratory performed a geostatistical study for the Groundwater Remediation Project (formerly the Groundwater Protection Program) managed by Fluor Hanford, Inc., and the U.S. Department of Energy (DOE). The objective of the study was to generate history matching data needed to test the performance of the System Assessment Capability (SAC) model that forms the basis for the Hanford Site 2004 Composite Analysis for low-level radioactive waste disposal in the Central Plateau at the Hanford Site. The SAC model is a stochastic model that uses probabilistic descriptions of inventory and transport parameters from the Hanford Site to generate predictions of the expected movement of contaminant plumes at the site. The history matching data generated by the study are based on geostatistical analysis of historical measurement of radionuclide concentrations in groundwater samples at Hanford.

The history matching study focused on concentration data for two points in time, fiscal year (FY) 1992 and FY 2001, and considered four radionuclides: tritium, technetium-99, iodine-129, and uranium. Geostatistical methods were used to analyze and model the spatial distribution of each radionuclide and then use that model to generate a suite of stochastic simulations of the concentrations. The simulations covered the entire Hanford Site in a series of regional grids that had similar properties in aquifer geology and contaminant transport. Each simulation would reproduce the data at the known measuring points; between those points the simulated values would reproduce the global probability distribution and the spatial correlation of the radionuclide data identified in the geostatistical model. The simulated concentrations were used together with estimates of the subsurface geology and the probability distributions for the porosity of each geologic unit to generate Monte Carlo realizations of the mass or activity of each contaminant. The suite of Monte Carlo realizations were used to estimate several metrics for the radionuclides that could be tested against the SAC model. Those metrics included the total mass or activity, the location of the center of mass, the area above the drinking water standard (DWS) for each contaminant, and, where relevant, the length of the Columbia River shoreline above the DWS. These metrics were calculated for several individual plume areas at the Hanford Site for FY 1992 and FY 2001. Each metric was calculated over the suite of realizations so that the average value for the metric could be provided along with a measure of uncertainty for the metric.

The history matching data generated by this study can be used to evaluate the ability of the SAC Rev. 1 model to produce simulated concentration histories over time that match the historical data. In addition, the study provides measures of the uncertainty in each of those metrics that can be used to determine if the predictions from the SAC model fall within the uncertainty bands expected due to spatial uncertainty in the historical contaminant concentration data.

This report also discusses several areas of uncertainty in the data and the modeling process that were not addressed by the current study. Several possible improvements or extensions of the approach are recommended for future study. These include:

- Generate results for additional time points beyond the two points in time considered in the present study. History matching data should be generated for earlier points in time, although the areas covered might need to be restricted due to the sparse distribution of data for earlier time periods.

- Examine the effect of vertical contaminant distribution assumptions on uncertainty bounds for history matching data.

- Perform an uncertainty analysis to examine the effect on uncertainty bounds for the various metrics that might arise from uncertainty in geologic structure. This should be done by using the results of work being performed in FY 2004 for the sitewide Groundwater Modeling task to develop stochastic alternative conceptual models of the geologic structure.

- Examine the sensitivity of history matching metrics to variation in parameters of the variogram models fit to the experimental variograms.

- Produce a set of metrics based on the SAC model runs that accounts for the sparseness of the concentration data available for geostatistical modeling. The suggested approach includes sampling concentration fields from the SAC model runs at historical well locations and over screened intervals that were used to sample groundwater. Geostatistical analysis of the sampled model runs would then be used to generate a set of metrics using the same methods described in this report. The metrics calculated from historical groundwater data and sampled SAC model runs would then be compared to evaluate the ability of the SAC model to reproduce historical groundwater concentration data.

Contents

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1.0 Introduction

A composite analysis is required by U.S. Department of Energy (DOE) to ensure public health and safety through the management of low-level radioactive waste disposal facilities associated with the Hanford Site (DOE Order 435.1). A major component of the Hanford Site 2004 Composite Analysis (Kincaid et al. 2004) will be the use of the System Assessment Capability (SAC). The SAC is a stochastic risk assessment program consisting of several modules that address contaminant inventory, contaminant release, atmospheric transport, vadose zone flow and transport, groundwater flow and transport, the Columbia River shore environment, Columbia River flow and transport, and risk and impact assessment. During application of SAC to the composite analysis, predictions of the concentrations of radioactive contaminants in groundwater will be generated as a function of time. These predictions are based on an assumed release of inventory, and then simulates the migration of contaminants through the various transport modules. The results of these predictions will be evaluated by matching (comparing) them against historical groundwater contaminant data.

There is a large amount of historical data on the concentration of contaminants in groundwater at the Hanford Site. The most recent annual report, summarizing the groundwater data collected in 2002, can be found in Hartman et al. (2004) with background information on the purposes and methods for the groundwater monitoring effort given in Hartman (2000).

The purpose of the study described in this report was to generate maps and statistics that quantify contamination in groundwater, based on historical groundwater concentration data for multiple points in time. The maps and statistics could then be compared to predictions from the SAC model, and used for verification of SAC results that will be incorporated in the 2004 Composite Analysis. The results generated from this study include several quantitative summaries of contaminant distributions (e.g., the location of the center of mass of contaminant plumes and the total mass of contaminants in the plume) and are collectively referred to as history matching data. A primary goal of this study was to use geostatistical and Monte Carlo methods that allow one to provide an estimate of uncertainty in the history matching data generated.

This work was conducted as part of the Characterization of Systems Task of the Groundwater Remediation Project (formerly the Groundwater Protection Program) managed by Fluor Hanford, Inc. The scope of the study focused on four radioactive contaminants with a wide distribution at Hanford: tritium, technetium-99, iodine-129, and uranium. All four are current contaminants of concern at Hanford that will be examined in detail by the 2004 Composite Analysis (Kincaid et al. 2004, Table A.4). Results were generated for two time periods, fiscal year (FY) 2001 and FY 1992. To support the geographic scope of the 2004 Composite Analysis, the scope of this study covered the entire Hanford Site including the 200 West and East Areas in the Central Plateau, and the 100 Areas and 300 Area in the Columbia River corridor. Figure 1.1 shows the major features at the Hanford Site.

The purpose of this report is to document the source of the groundwater concentration data employed in the history matching data analysis, the geostatistical approach used for analyzing the spatial distribution of the contaminants, the Monte Carlo methods used to convert stochastic simulations of concentration to mass or activity, the approach used to calculate the metrics reported by the study, and the results generated for each of the four contaminants.

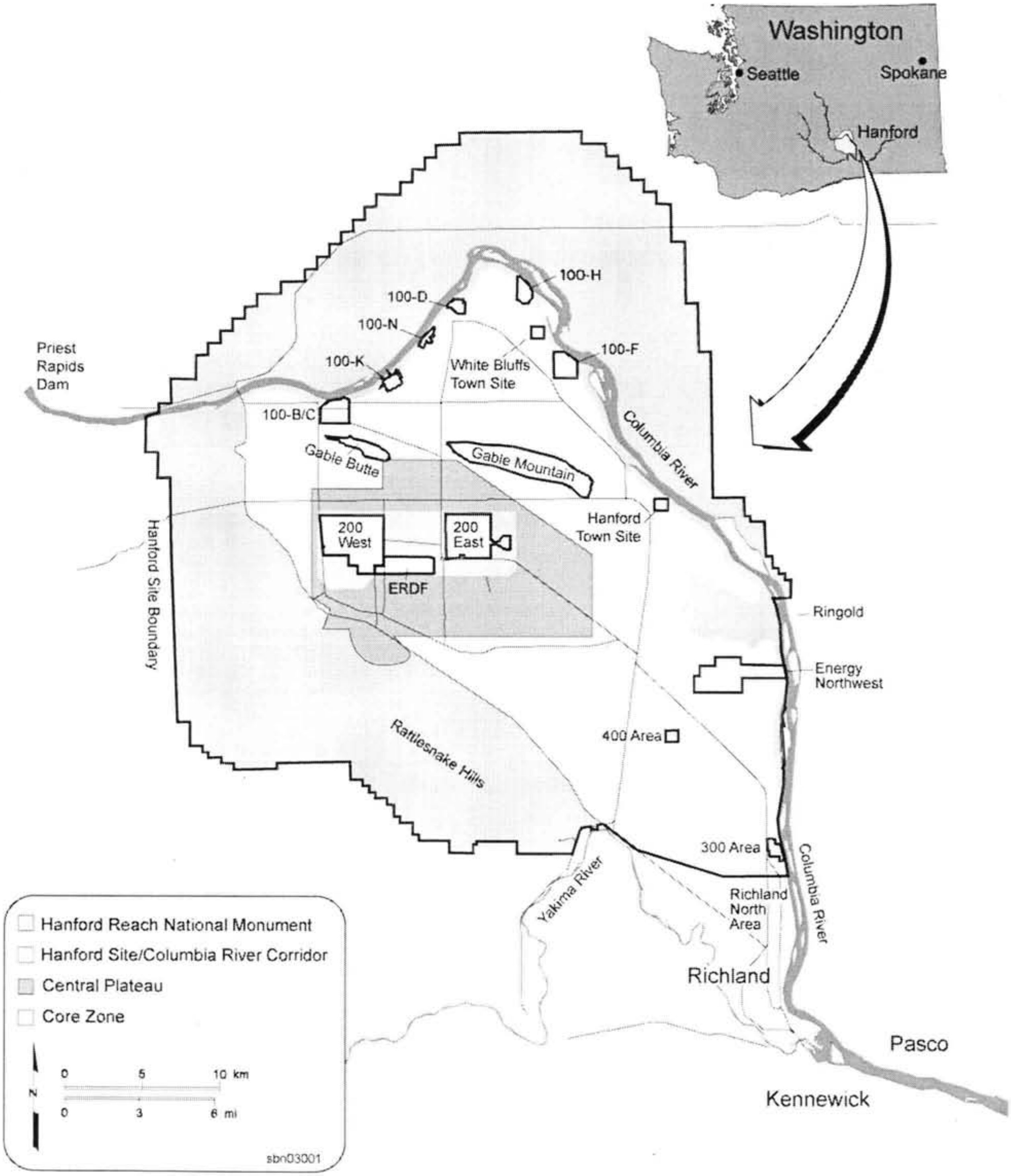

Figure 1.1. Major Areas at the Hanford Site (from Kincaid et al. 2004)

2.0 Approach

This study used a Monte Carlo approach to generate suites of realizations of mass or activity for four radioactive contaminants at the Hanford Site. These realizations were generated on a series of regular grids covering the Hanford Site. The foundation for the approach was geostatistical modeling and simulation of the spatial distribution of the concentrations of contaminants. Mass or activity estimates based on the geostatistical simulations were generated for several plume thickness assumptions using Monte Carlo sampling of porosity distributions for each hydrogeologic unit present in a grid cell. Aggregate metrics were computed for a series of sub-areas of the Hanford Site associated with major contaminant plumes. This section of the report provides detail on the data used in the study and the methods employed.

2.1 Data Compilation

Data for each contaminant were retrieved from the Hanford Environmental Information System (HEIS). All measurements of tritium, technetium-99, and iodine-129 data available at the Hanford Site were retrieved from the database (in pCi/L), along with all measurements of uranium concentration (μg/L). Data were included in this study in accordance with selection criteria generally employed for the Hanford Site Groundwater Monitoring Reports (e.g., Hartman et al. 2004). The data were reviewed for data quality, and only data meeting the qualifications generally accepted for inclusion in the annual monitoring reports(a) were included. This involved exclusion of data with "Y" or "R" review qualifiers, which indicate that the data quality review indicated that the data were invalid, or that the results were suspect with insufficient evidence to show if the results were valid or invalid, respectively. The hydrogeologic zone from which the samples were taken was also examined, and samples were retained that were from the upper portions of the unconfined aquifer, again in accord with criteria used to select groundwater concentration data for inclusion in the annual monitoring reports.(a) The selection criteria for the well zone included samples designated "TU" (Top Unconfined), "UU" (Upper Unconfined), and "U" (Undifferentiated Unconfined), together with samples for which the zone was not recorded on the assumption that wells that test the lower portions of the unconfined aquifer and/or the confined aquifers have been identified by scientists working for the Groundwater Performance Assessment Project.(a) This selection provides a two-dimensional dataset for the concentrations in the upper portion of the unconfined aquifer. While it would be preferable to map the concentrations in three dimensions, there is insufficient data available with discrete measurements of concentration with depth in the aquifer to make that feasible. As discussed in the following sections, the amount of three dimensional data in the aquifer are insufficient to determine the total thickness of the contaminant plumes, let alone to map the plumes in three dimensions.

Data for each contaminant were summarized on a fiscal year basis, averaging all observations for each well for each fiscal year for which data were available. Because a number of wells at the Hanford Site are not sampled on an annual basis, an algorithm was used to select data from the most recent year in order to represent the concentration at a well for a given fiscal year. The algorithm selects the annual average for a given fiscal year, or if this is not available, the most recent of the annual averages from the

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(a) Personal communication from J Rieger to the authors, 2002.

two preceding fiscal years. This algorithm is also used to select the annual fiscal year average data for inclusion in the annual groundwater monitoring reports.[a]

Once the fiscal year annual average concentration data were calculated for each contaminant, the distribution of the number of data points with time was examined to select years for which history matching data would be generated. Figure 2.1 plots the number of wells for which an annual average is available for each fiscal year for the four contaminants. Two years were selected to generate history matching data, FY 1992 and FY 2001, which are highlighted in Figure 2.1. At the time this study was initiated, FY 2002 data were not yet available, and FY 2001 was the most recent year with available data. FY 1992 was selected because it represented the earliest date for which a high number of tritium observations (~700) were available. In addition, that year has among the highest number of observations ever recorded for both technetium-99 and uranium (Figure 2.1).

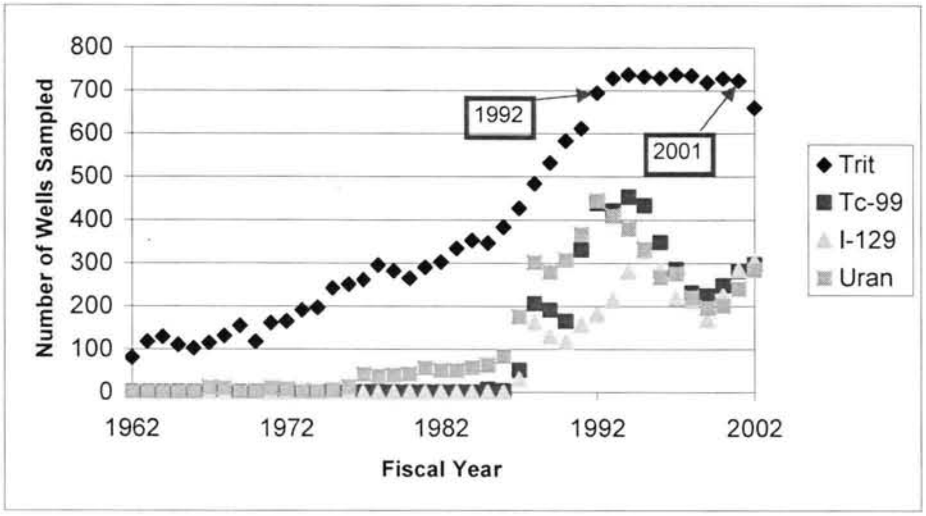

Figure 2.1. **Number of Wells in Each Fiscal Year for Each Contaminant for Which An Annual Average is Available**

2.2 Geostatistical Simulation Method for Concentration Distributions

The geostatistical analysis of the contaminant plume included variogram analysis and modeling to define a mathematical model of the spatial continuity of the contaminant concentration data. The most commonly used tool for describing the spatial continuity of geologic properties is the experimental variogram (Isaaks and Srivastava 1989; Davis 1986; Goovaerts 1997), which is a measure of the average dissimilarity between pairs of points separated by a given vector distance, as a function of that distance. The variogram is calculated as:

$$\gamma(\mathrm{h}) = \frac{1}{2N(\mathrm{h})} \sum_{\alpha=1}^{N(\mathrm{h})} \left[z(\mathrm{u}_\alpha) - z(\mathrm{u}_\alpha + \mathrm{h}) \right]^2 \tag{2.1}$$

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[a] Personal communication from J Rieger to the authors, 2002.

where γ(h) is the variogram value for a lag distance of h, and *N*(h) is the number of pairs of concentration values (*z*) separated by a lag distance of h. Variables that result from the operation of geologic processes that vary spatially (e.g., contaminant transport by groundwater) often display spatial continuity that can be identified by variogram analysis. If a variable exhibits spatial continuity, then points that are close to one another will have smaller differences, and, therefore, lower variogram values than pairs of points that are separated by greater distances. In variogram analysis, models are fit to the experimental variograms that quantify the spatial continuity of the variable. Variogram models are required for geostatistical estimation (i.e., kriging) or simulation algorithms because it is rare that experimental variogram values will be available for all lag distances for which estimates or simulations may be desired (Isaaks and Srivastava 1989). Figure 2.2 explains some of the important features of a variogram model. All but one of the variograms in this study were fit using a spherical model (Isaaks and Srivastava 1989), which is defined as follows:

$$\gamma(h) = \begin{Bmatrix} 1.5\frac{h}{a} - 0.5\left(\frac{h}{a}\right)^3 & \text{if } h \le a \\ 1 & \text{otherwise} \end{Bmatrix} \qquad (2.2)$$

where h is the lag distance and a is the range of the spherical variogram model. The other model used was the Gaussian variogram (Isaaks and Srivastava 1989), which has the following form:

$$\gamma(\mathrm{h}) = 1 - \exp\left(-\frac{3h^2}{a^2}\right) \qquad (2.3)$$

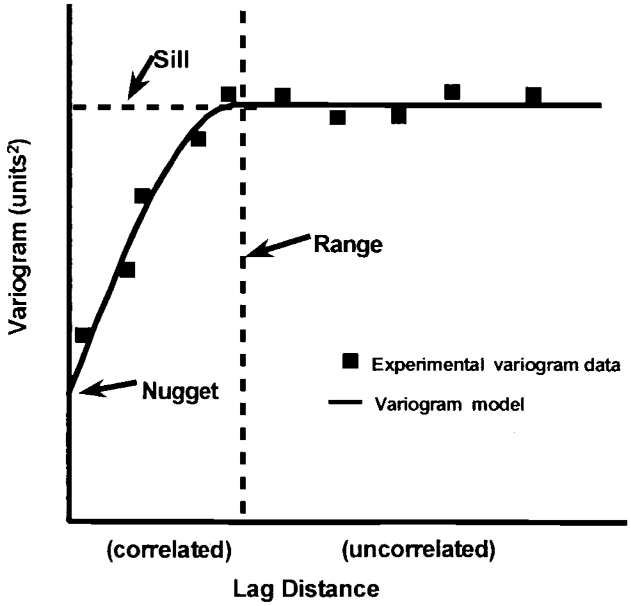

Figure 2.2. **The Variogram is a Geostatistical Tool to Measures Average Squared Difference Between Pairs of Data Values Separated by a Given Lag Distance. At distances less than the range, the variogram is a function of distance related to the degree of spatial correlation. Points separated by distances greater than the range are uncorrelated.**

The variogram analysis for each contaminant at the Hanford Site was performed for three separate areas. The three areas were 200 West Area (designated Grid 1), 100 Areas (Grid 2), and 200 East Area and the plumes that traveled northwest and southeast from it (Grid 3). Figure 2.3 shows the three grid areas for tritium in 2001. These areas were chosen because of differences in their hydrogeological properties. For example, Figure 2.3 is a map of the geological units exposed at the water table. The map shows that the area of Grid 1, which includes 200 West Area, is predominantly Ringold Formation at the

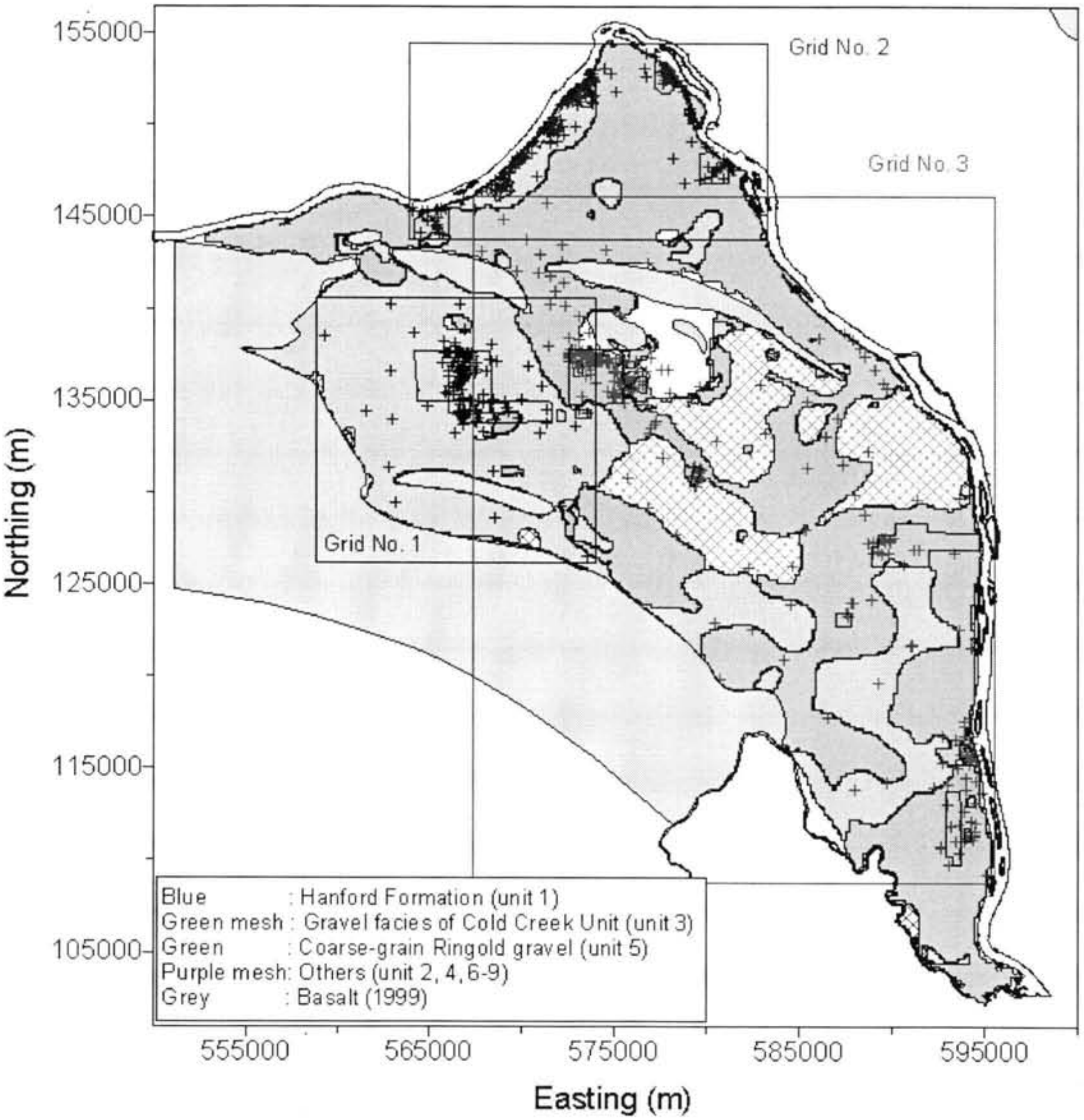

Figure 2.3. Subcrop Formation Units at FY 2001 Water Table

water table, while Grid 3 is predominantly Hanford formation. The hydraulic conductivity of the Ringold Formation is much lower than that of the Hanford formation, so the plumes in 200 West Area tend to be smaller and move more slowly than those emanating from 200 East Area. This difference in the plumes was expected to be reflected in the spatial continuity of the plumes measured by variogram analysis.

A multi-Gaussian sequential simulation (Gomez-Hernandez and Journel 1993; Goovaerts 1997) approach was used to simulate the distribution of contaminants at the Hanford Site. Because of the large number of separate geostatistical studies and large numbers of simulations generated for each study, Gaussian simulation was used as the default modeling approach because of the simplicity of the modeling approach and computational speed of the simulation algorithm relative to indicator geostatistical methods. All simulations were performed on square grids with a grid resolution of 50 meters. The multi-Gaussian simulation approach requires that the data exhibit a Gaussian distribution. Because the contaminant data are not normally distributed, the variogram modeling described above and the subsequent simulations were performed on a normal-score transformation of the contaminant data (Goovaerts 1997, p. 268), which transforms the variable so that it fits a univariate normal distribution. The normal score transform is a more general transformation than the lognormal transform often used in hydrogeologic studies and it has the advantage that it avoids most problems associated with back-transformation from the logarithmic space to the original data space (see Goovaerts 1997, p. 17, for a discussion of those problems).

Sequential Gaussian simulation is a stochastic simulation method that allows one to generate equally probable realizations of the spatial distribution of a variable that honor both the data and the variogram model fit to the data. The simulations are generated by taking a random path through the grid cells that are to be simulated (Figure 2.4). At each grid cell in the simulation domain, the surrounding data and the variogram model are used to estimate the conditional cumulative distribution function (CDF) of the variable at that cell (Figure 2.4) by estimating the conditional mean and variance of the distribution. The estimation of the conditional mean and variance are performed by kriging. Although simple kriging is theoretically the preferred form of kriging to estimate the conditional mean and variance, ordinary kriging can be used when sufficient data are available for local re-estimation of the mean (Deutsch and Journel 1998, p. 174). Ordinary kriging can be used to re-estimate the local mean when a spatial trend is present in the data (Journel and Rossi 1989), rather than using a single unchanging mean as occurs in simple kriging. In the simulations generated for this study, the mean and variance of the conditional distribution at each grid cell was estimated by ordinary kriging, with the conditional mean equal to

$$Z_{OK}^{*}(u)=\sum_{\alpha=1}^{n(u)}\lambda_{\alpha}^{OK}(u)Z(u_{\alpha}) \text{ with } \sum_{\alpha=1}^{n(u)}\lambda_{\alpha}^{OK}(u)=1 \qquad (2.4)$$

where Z_{OK}^{*} is the ordinary kriging mean at location u. Thus, the ordinary kriging mean at each location u is a weighted linear combination of the nearby data ($Z(u_{\alpha})$), with the ordinary kriging weights ($\lambda_{\alpha}^{OK}(u)$) constrained to sum to 1 and found by minimization of the error variance. The variance of the conditional distribution of the simulated cell was estimated by the ordinary kriging variance σ_{OK}^{2}:

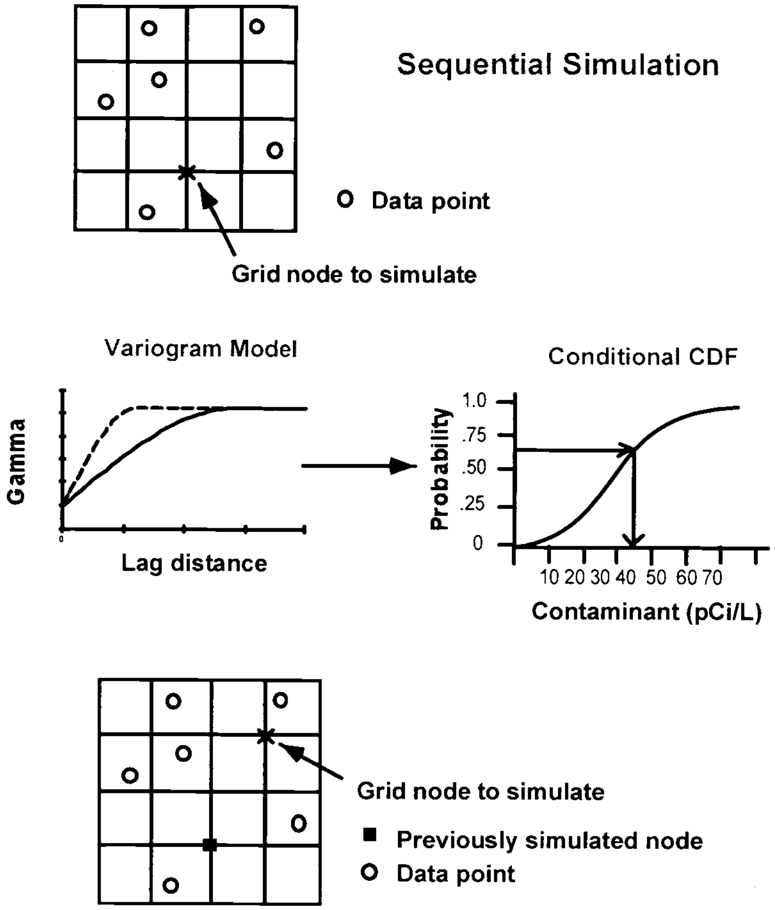

Figure 2.4. **Diagram of Basic Elements of the Sequential Simulation Algorithm**

$$\sigma_{OK}^2 = C(0) - \sum_{\alpha=1}^{n(u)} \lambda_\alpha^{OK}(u)\, C(u_\alpha - u) - \mu_{OK}(u) \qquad (2.5)$$

where C(0) is the covariance at zero separation distance, $C(u_\alpha - u)$ is the covariance between the data point at location α and the cell being simulated and $\mu_{OK}(u)$ is a Lagrange parameter that accounts for the constraint on the weights in ordinary kriging (see Goovaerts 1997, p. 133 for further detail on ordinary kriging). A uniform random number between 0 and 1 is then used to draw a value from the conditional distribution, which has been estimated by the ordinary kriging mean and variance (Figure 2.4). The simulated value then becomes a data point for the simulation of the remaining grid cells, and the process is repeated, moving to each cell in the domain until all cells in the grid have been evaluated. The sequential algorithm ensures reproduction of the variogram and histogram of the data through a recursive application of Bayes theorem. Additional simulations can be generated by taking different random paths through the simulation grid. A more detailed discussion of the sequential Gaussian simulation algorithm can be found in Goovaerts (1997, p. 376).

During the geostatistical modeling of the contaminant distributions, the results for the Gaussian simulations of technetium-99 in 200 East Area for FY 2001 did not agree with those provided by previous geostatistical modeling of that plume. Previous study of the technetium-99 distribution in that area for FY 2001 had been performed using sequential indicator simulation rather than sequential Gaussian simulation (DOE 2003). To be consistent with the results, which were felt to be more representative of the concentrations in the plume, sequential indicator simulation (Goovaerts 1997) was used for geostatistical simulations of technetium-99 in 200 East Area for FY 2001.

2.2.1 Post-Processing of Contaminant Concentration Simulations

The set of simulated values of the contaminant concentration for each 50 meters by 50 meters grid cell can be used as a model of the conditional probability distribution of the concentration in that cell (Journel 1987, 1989). The conditional probability distributions can be summarized in several ways. For example, they can be used to estimate the mean or median concentration at each grid cell and the uncertainty in that estimate, e.g., by calculating the variance of the simulated values or the 5th and 95th percentiles of the simulated concentration values. The suite of simulations can also be used to estimate the probability that the concentration exceeds some cutoff value, e.g., the drinking water standard (DWS) for a contaminant, by calculating the frequency with which the simulated values at each location exceed that cutoff. Each of these statistics of the local conditional distributions can be mapped, and they provide valuable information about the spatial distribution of the contaminant plume.

A large number of simulations, at least several hundred, were generated for each contaminant/grid/year combination. The number of realizations generated for each variable/year combination was determined by plotting the results for one of the metrics as a function of the number of simulations generated to determine if there was an obvious break in the curve that would indicate that the space of uncertainty was well-sampled. For example, Figure 2.5 shows a plot of the average of one of the metrics calculated

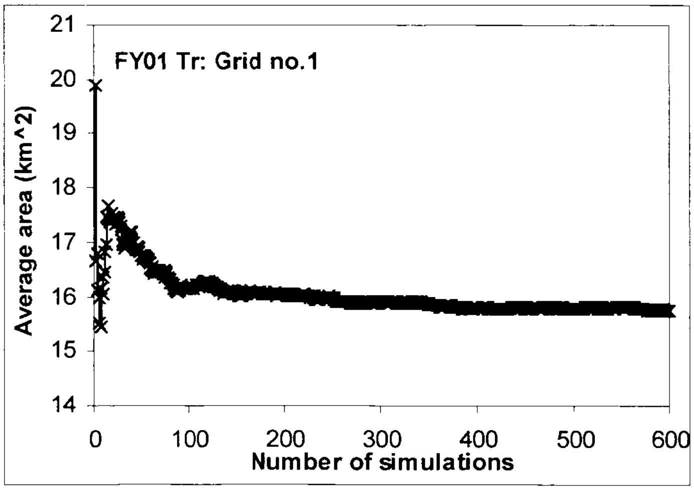

Figure 2.5. **Plot of the Average Area Above the Tritium Drinking Water Standard as a Function of the Number of Simulations Generated for One of the FY 2001 Tritium Simulation Grids**

for FY 2001 tritium (the area above the drinking water standard, see Section 2.2.3 for information on the procedure used to calculate that metric). The average area is relatively unstable early in the process with a large amount of variability, especially for less than 100 simulations, but appears to have stabilized after about 300 simulations have been generated.

2.3 Monte Carlo Simulation Method for Mass and Activity

The simulations of contaminant concentration generated using sequential Gaussian simulation were used as the basis to develop simulations of the mass and activity of contaminants in the study areas for FY 1992 and FY 2001.

To convert concentration values to mass or activity estimates, several factors need to be determined, including the thickness of the plume, vertical distribution of contaminant concentration within the plume, and porosity of the sediment.

2.3.1 Plume Thickness Scenarios

Information on the thickness of contaminant plumes at the Hanford Site is limited. One relatively simple way to address both the plume thickness and vertical distribution of contaminants is to examine the distribution of contaminant concentrations for samples taken from different hydrogeological zones. The hydrogeological zones used in this study were those identified by scientists working for the Groundwater Performance Assessment Project.[a] Table 2.1 gives the definitions of the hydrogeological zone in the unconfined aquifer that are plotted in Figure 2.6. Figure 2.6 is a plot of the median and average tritium concentration during FY 2001 for all samples at the Hanford Site taken within four hydrogeological zones in the unconfined aquifer. Thus, Figure 2.6 gives a rough idea of the distribution of tritium with depth in the unconfined aquifer for FY 2001. The median concentration falls off rapidly with depth in the aquifer, with median UU concentrations that are about one-third of those in the TU. However, the high average concentration for MU samples indicates that there are still some high concentration samples that occur at depths greater than 15.2 meters below the water table.

Table 2.1. Definitions of Aquifer Hydrogeological Zones

Zone	Definition
TU (Top Unconfined)	Screened across the water table with less than 9.1 m of the open interval extending below the water table.
UU (Upper Unconfined)	Screened across the water table for which the open interval is between 9.1 and 15.2 m below the water table.
	Screened below the water table for which the open interval extends less than 15.2 m below the water table.
MU (Middle Unconfined)	Open interval begins at greater than 15.2 m below the water table and does not extend below the middle coarse of the Ringold Formation (unit 7) or to within 15.2 m of the top of basalt.
LU (Lower Unconfined)	Open interval begins at greater than 15.2 m below the water table and below the middle coarse unit of the Ringold Formation (unit 7) or within 15.2 m of the top of basalt and does not extend more than 3 m below the top of basalt.

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[a] Personal communication from J Rieger to the authors, 2002.

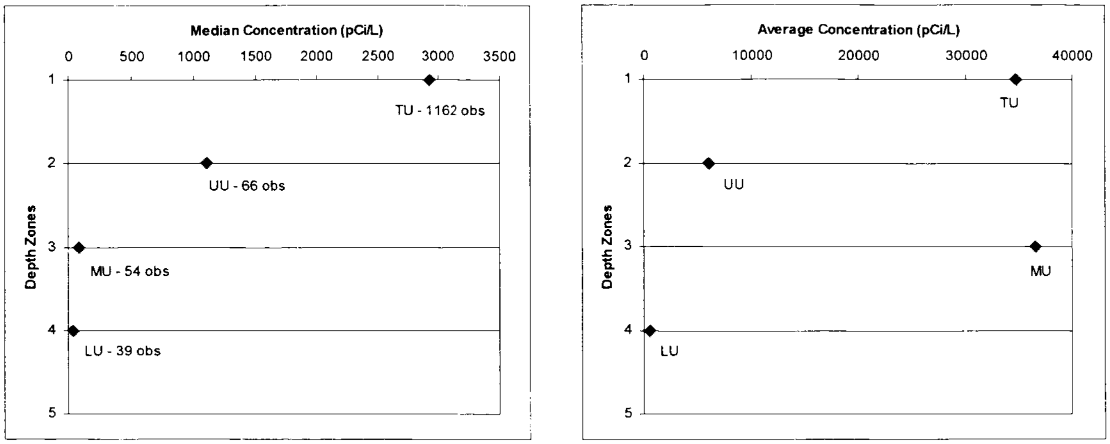

Figure 2.6. FY 2001 Tritium Distribution by Hydrogeological Zones

Other data compiled for this study provided insight into the thickness and concentration variations with depth of the contaminant plumes. Data from the tritium plume near the PUREX facility indicate the thickness of the tritium plume is at least 8 meters, but concentrations tend to be low for samples more than 10 meters below the water table:

- Data from well 299-E25-28 indicate some tritium at 18 meters, but the concentration is low at that depth and also at the water table.
- Data from well 299-E25-29 show the plume is more than 8 meters thick.
- Data from wells 699-24-1S and 699-24-1T show concentration at 10 meters below the water table of 15 to 30% of concentration at water table and none at 30 meters below the water table (note that well 699-24-1P, Q and R go to basalt).
- Data from well 699-28-40 P show a few sporadic high results, but generally does not show any peak in the late 1980s corresponding to that in the earlier well 699-28-40 data. It appears that plume thickness at that location is less than 50 meters.
- Data from well 699-26-34B show the plume thickness is greater than 8 meters.

Indications from discrete depth sampling conducted in FY 1999 at Waste Management Area S-SX suggest that the maximum concentrations of contaminants occur within the upper 2.5 to 7 meters of the aquifer (Johnson and Chou 2000). Some contaminants were found up to 30 meters deep and even below the Ringold lower mud unit (an aquitard deep in the unconfined aquifer); however, concentrations at these greater depths were low.

However, data from well 699-48-77C show that the tritium plume from the State-Approved Land Disposal Site (SALDS, north of 200 West) has gone to depths greater than 25 meters with peak concentrations at depth of about 1 million pCi/L compared to 2 million pCi/L near the water table. There is a large downward driving force from the discharge at the disposal site and the Ringold mud units are missing in this location, which may contribute to the high concentrations with depth. Williams et al. (2002) discuss additional evidence from 200 West Area suggesting that significant concentrations of contaminants may be present at depth within the aquifer, with greater concentrations found at depth than occur at the water table in some locations.

The following approach was adopted for this study, based on the available data and the approach used in the history matching study performed for SAC Rev. 0 (Bryce et al. 2002). The concentration within a contaminant plume was assumed to be constant with depth over a finite plume thickness. In mass calculations, the mass of a contaminant within a plume was calculated for four different plume thickness scenarios of 5, 10, 15, and 20 meters. Although all four cases will be presented, the major focus will be on the results generated for the 5 meters plume thickness, because the limited data that are available tend to suggest the majority of contaminant mass is within 5 meters of the top of the aquifer (e.g., Eddy et al. 1978; Johnson and Chou 2000), although Williams et al. (2002) make a case for a deeper distribution of contaminants in the aquifer. Work will be performed within the characterization of systems groundwater task during FY 2004 to examine the vertical contaminant distribution in more detail; the assumptions about the distribution used to generate the history matching data should be revisited when the results of the characterization of systems study are available.

2.3.2 Probability Distributions of the Porosity of Sedimentary Units

The major factors that control the mass of contaminants present within the contaminant plume are contaminant concentrations, which were simulated using the methods discussed in Section 2.1 (and then assumed to be constant with depth over a specified plume thickness), and sediment porosity. The sediment porosity varies between the different geological units and also varies within each unit. The identification of the unit thicknesses that are present in the aquifer were taken from the current sitewide groundwater model (Vermeul et al. 2003). A grid of the thickness of each unit at each grid location was generated from the model using EarthVision and then downloaded as a text table. The table identified the thickness of each hydrogeologic unit below the elevation of the water table that was present in FY 1992 and FY 2001.

Using information from several sources, including data from Freeman et al. (2002) and Thorne and Newcomer (2002), a probability distribution was developed for the porosity of each hydrogeologic unit. Table 2.2 shows the probability distributions for each unit, which were assumed to be normal for each unit, with mean and standard deviation as specified. The data on which each probability distribution is based are provided in the last column of the table. No data were available for Unit 3, and the assumption was that the pre-Missoula gravels in that unit (now part of the Cold Creek unit) would have a porosity distribution similar to that of the coarse-grained units of the Ringold Formation (5, 7, and 9). No porosity or specific yield data were available for the fine-grained units of the Ringold Formation (4, 6, and 8), and the porosity of those units was assumed to be similar to that of the fine-grained portions of Unit 2.

Although porosity occurs in the fine-grained units of the sequence, the majority of that porosity was assumed to not be effective porosity. That implies only small amounts of contaminants would be transported into and out of the mud units. Therefore, for this study, it was assumed that there would be no mass or activity of contaminants contained within the mud units, so that the thickness of the mud units in

Table 2.2. **Probability Distributions Assumed for Each Unit in the Unconfined Aquifer**

Unit	Mean	Std Dev	Source
1	0.27	0.087	Pump tests (3)
2	0.42	0.081	Khaleel and Freeman (1995)
3	0.13	0.033	Assume Ringold porosity
4	0.42	0.081	Assume similar to Unit 2
5	0.13	0.033	Pump tests (10)
6	0.42	0.081	Assume similar to Unit 2
7	0.13	0.033	Pump tests (10)
8	0.42	0.081	Assume similar to Unit 2
9	0.13	0.033	Pump tests (10)

a grid cell would have zero concentration. This approach follows that developed for the earlier history matching studies that supported SAC Rev. 0 (Bryce et al. 2002).

2.3.3 Monte Carlo Calculations of Contaminant Mass

Monte Carlo simulations of contaminant mass or activity were produced as follows for each simulation of the concentration of a contaminant generated by the stochastic sequential algorithm described in Section 2.1. For each concentration simulation, porosity values were drawn from the porosity distributions for each of the non-mud sedimentary units present in the sitewide Groundwater Model (see Section 2.2.2) and were assumed to be constant for that sedimentary unit for all cells in that simulation. For each cell in the grid, the thickness of each unit present below the water table would be retrieved from the table of unit thicknesses described in Section 2.2.2. The total volume of pores within the cell would be determined by adding the products of the unit porosity times the unit thickness for each non-mud unit below the water table and above the base of the assumed plume thickness, then multiplying that sum by the area of the cell (2500 m^2). The total mass or activity in the cell would then be the product of the simulated concentration in the cell and the total porous volume. For each cell, four estimates of the mass or activity would be generated, one for each assumed plume thickness (i.e., 5, 10, 15, or 20 meters). This procedure was followed for each cell in each simulation, yielding a suite of simulated contaminant mass or activity values for each cell.

2.3.4 Calculation of Metrics

Several metrics were identified for use in the history matching effort, each of which would allow a quantitative assessment of the agreement between the SAC model and historical groundwater contamination data. The metrics included:

1. Total mass/activity
2. Location of center of mass
3. Area above DWS
4. Length of shoreline above DWS

The metrics were calculated for specific plume areas within the individual simulation grids. For example, Figure 2.7 shows the location of two plume-areas for which separate calculations were made within Grid 1, which covers 200 West Area.

An estimate of the spatial moments of a concentration field is found by numerical approximations to integral equations of the form (Rajaram and Gelhar 1991):

$$M_{ijk} = \iiint_{-\infty}^{\infty} nC(x,y,z)\,x^i y^j z^k \,dx\,dy\,dz \tag{2.6}$$

where M_{ijk} = the ijk^{th} moment
n = the porosity
$C(x,y,z)$ = the concentration for the cell with coordinates x, y, and z

The moments calculated for the current study were the zero order moment, which is the total mass and first order moments, which corresponds to the center of mass. The total mass or activity was calculated as the sum of the mass in each cell in the grid area for a given simulation, with the mass calculated according to the scheme discussed in Section 2.2.3. By calculating the total mass for each simulation of contaminant concentration, a range of total mass values were calculated that provided information on the uncertainty in the total mass. Standard univariate statistics were then reported on that distribution,

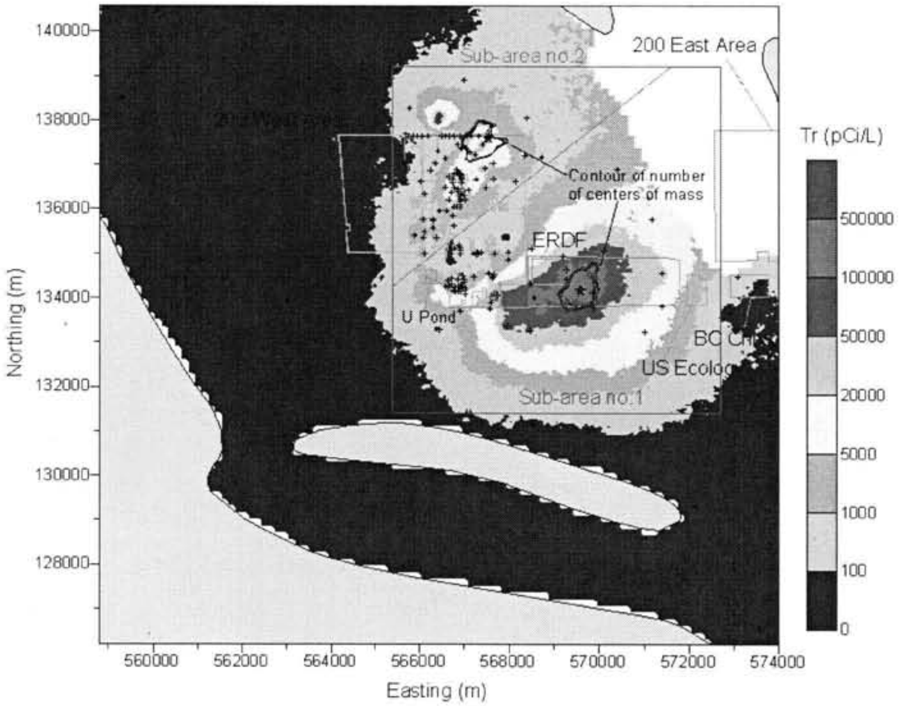

Figure 2.7. **Median of Simulations of FY 2001 Tritium in Grid 1 (200 West Area) and Contour of Number of Centers of Mass within the Sub-Areas with the Average Centers of Mass Denoted by Black Stars**

including the mean and median of the total mass and several uncertainty measures, including the standard deviation and 2.5th and 95th percentiles of the distribution.

The center of mass calculations were based on the cell mass estimates calculated assuming that the plume thickness is 5 meters. Given the two dimensional nature of the grid of mass values calculated in Section 2.2.3, the location of the center of mass of each simulation was calculated using the following approximation to equation 1:

$$xcmass = \sum_i x_i M_i / \sum_i M_i$$

$$ycmass = \sum_i y_i M_i / \sum_i M_i \qquad (2.7)$$

where *xcmass* and *ycmass* = the x and y coordinates of the center of mass, respectively
I = the cell number
x_i = the x coordinate of cell *i*
y_i = the y coordinate of cell *i*
M_i = the mass of cell *i*

Similar to the approach used for the total mass, the center of mass was calculated for each simulation in the suite of geostatistical simulations that were generated, providing a measure of the uncertainty in the location of the center of mass. This uncertainty was captured in two forms, graphically and in tabular form. Graphically, the mean center of mass was represented by a star, and the uncertainty is captured by contouring the number of times the center of mass occurred in each cell of a coarser grid covering the area of interest. The coarse grid for Grid 1 (200 West Area) and Grid 2 (100 Areas) was 200 meters by 200 meters, and for Grid 3 (200 East Area) the coarse grid was 400 meters by 400 meters. Figure 2.7 shows the average center of mass and the contours of the center of mass for two sub-areas of 200 West Area. In addition to the graphical display, the tabular information included the average x and y coordinates of the center of mass and confidence intervals for the location of those coordinates.

The remaining two metrics addressed the probability that the concentration within local areas exceeded the DWS. The DWS values used for this study are listed in Table 2.3, which is based on information listed in Hartman et al. (2004). One metric was the area above the DWS for each simulation, calculated by summing the area of the cells within each realization that exceeded the DWS, with each grid cell having an area of 2,500 m^2. This calculation was performed separately for each sub-area of a grid,

Table 2.3. Drinking Water Standards Used for Radionuclides

Constituent	Drinking Water Standard
Tritium	20,000 pCi/L
Technetium-99	900 pCi/L
Iodine-129	1 pCi/L
Uranium	30 μg/L

where sub-areas were defined. Statistical summaries of the mean and variability of the area above the DWS were reported for the suite of stochastic simulations. Another metric reported for Grid 2 (100 Areas) and Grid 3 (200 East Area plume) was the length of the Columbia River shoreline that exceeded the DWS. For each simulation of a grid that was bounded by the Columbia River, the number of grid cells intersecting the river that had concentrations exceeding the DWS were counted and multiplied by the average length of a cell intersected by the river. The average cell length is assumed to be the average of the edge (50 meters) and diagonal (70.7 meters) lengths of a cell, or 60.4 meters. As with the other metrics, the statistics for the distribution of shoreline lengths above the DWS were reported for the suite of simulations that were generated, providing an estimate of the most likely value as well as a measure of the uncertainty in the length.

The procedures used to compare the metrics generated in this study from the historical data and the predictions from the SAC model, as well as the results of the comparison, will be reported by the SAC project in the 2004 Composite Analysis.

3.0 History Matching Data for SAC/CA

A large number of maps, figures, and tables were prepared for this history matching data package. This chapter presents the results for tritium concentrations as an example of the results provided, focusing in particular on the results obtained for FY 2001. Section 3.6 identifies the appendices containing the results for other years and contaminants.

3.1 Definition of Grid Areas for Tritium Analysis

The Hanford Site was divided into three grids for the geostatistical analysis, with the primary basis for the grids being the differences in the type of sediment present at the top of the water table (Figure 3.1). Grid 1 occupied the area in the western portion of the Hanford Site where Ringold Formation sediment occurs at the FY 2001 water table, and the grid includes 200 West Area. Because the Ringold Formation

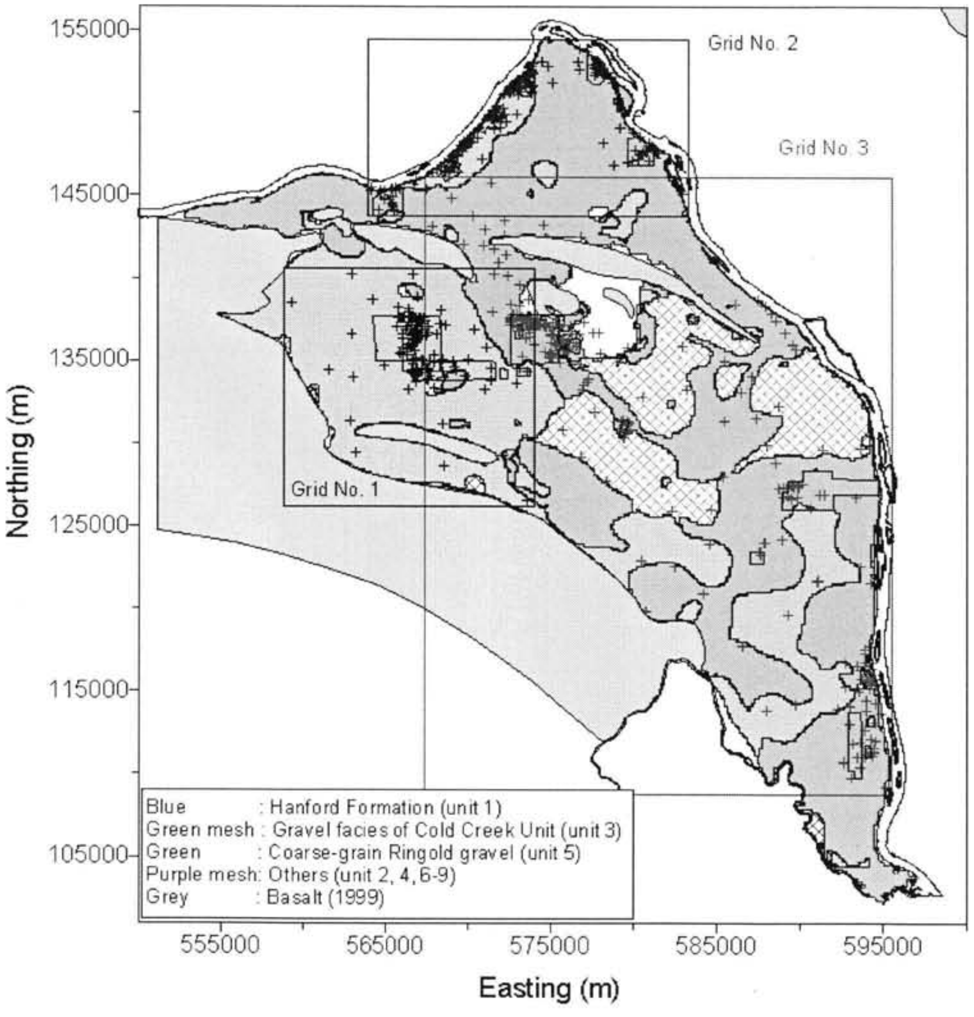

Figure 3.1. **Subsets of FY 2001 Tritium Data and the Subcrop Formation Units at the FY 2001 Water Table**

has relatively low hydraulic conductivity, plumes that occur within Grid 1 are spreading relatively slowly and tend to remain small. Grid 2 contains the contaminated areas along the Columbia River associated with the former nuclear reactors in the 100 Areas. Grid 2 has both Ringold and Hanford formations present at the water table. The plumes in this grid also tend to be small, in large part because they are constrained by their proximity to the Columbia River. In contrast to the first two grids, Grid 3 is dominated by high hydraulic conductivity sediment of the Hanford formation, which allows relatively rapid migration of contaminants and the development of larger plumes. For example the tritium plume in Grid 3 has migrated from its source in 200 East Area to the Columbia River. The differences in plume size in the three grid areas lead to differences in the ranges of the variograms, so the areas were treated separately for the geostatistical analysis. Figure 3.1 shows that there was overlap between the three grids. However, the boundary between Grids 1 and 3 was irregular, so that the areas on the eastern portion of Grid 1 where Hanford formation sediment was present were excluded from Grid 1, and the area at the western edge of Grid 3 where Ringold Formation sediment was present was excluded from Grid 3.

Similar decisions were made for analysis of FY 1992 tritium concentrations. Figure 3.2 shows the subcrop of different geologic units for the FY 1992 water table, which was at a higher elevation than the FY 2001 water table used to construct the subcrop map in Figure 3.1. The grid areas that were used for geostatistical analysis of the 1992 concentration data are shown in Figure 3.2. The three grid areas that were used for analysis in FY 1992 are similar to those used in FY 2001, but they are not identical, principally because of differences between the elevation of the water table in the two different years.

3.2 Variogram Analysis and Geostatistical Simulations of Tritium Concentration Data

The results of the variogram analysis of tritium concentrations for each of the three grid areas in FY 2001 are shown in Figure 3.3. As expected from the previous discussion, the variogram models fit to the experimental variograms are very different for the three areas. The total sill of the models fit to all three variograms are constrained to equal 1.0, as required for the sequential Gaussian simulation algorithm (Deutsch and Journel 1998). The variogram fit to the tritium concentration in Grid 2 has the shortest range, less than 1,000 meters. Grid 1, which contains the 200 West Area plumes, has a longer range of 2,000 meters but also has a short range structure of 200 meters that accounts for 40% of the total variance, indicating significant patchiness or variability of the plume at short distances. The variogram model fit to the data from Grid 3 is more continuous at short distances and has a longer total range of 6,000 meters. Although not explicitly modeled, a hole effect can be seen in Figures 3.3a and 3.3c, which results in lower variogram values for intermediate distances (e.g., at distances of about 2,500 meters in Figure 3.3a). This occurs in part because most variogram pairs for those distances tend to match low values on either side of the large central plumes emanating from facilities in 200 West and 200 East Areas. The hole effect and other differences between the long- and short-range variogram structure may also be caused by different variogram structures close to the source versus farther away from the source. This may have occurred because many local recharge areas associated with discrete waste facilities in the source area probably create complex local groundwater flow directions that affect the short-range variogram structure, whereas farther away from the source, the contaminant distribution and variogram structure associated with it was affected only by the regional groundwater flow.

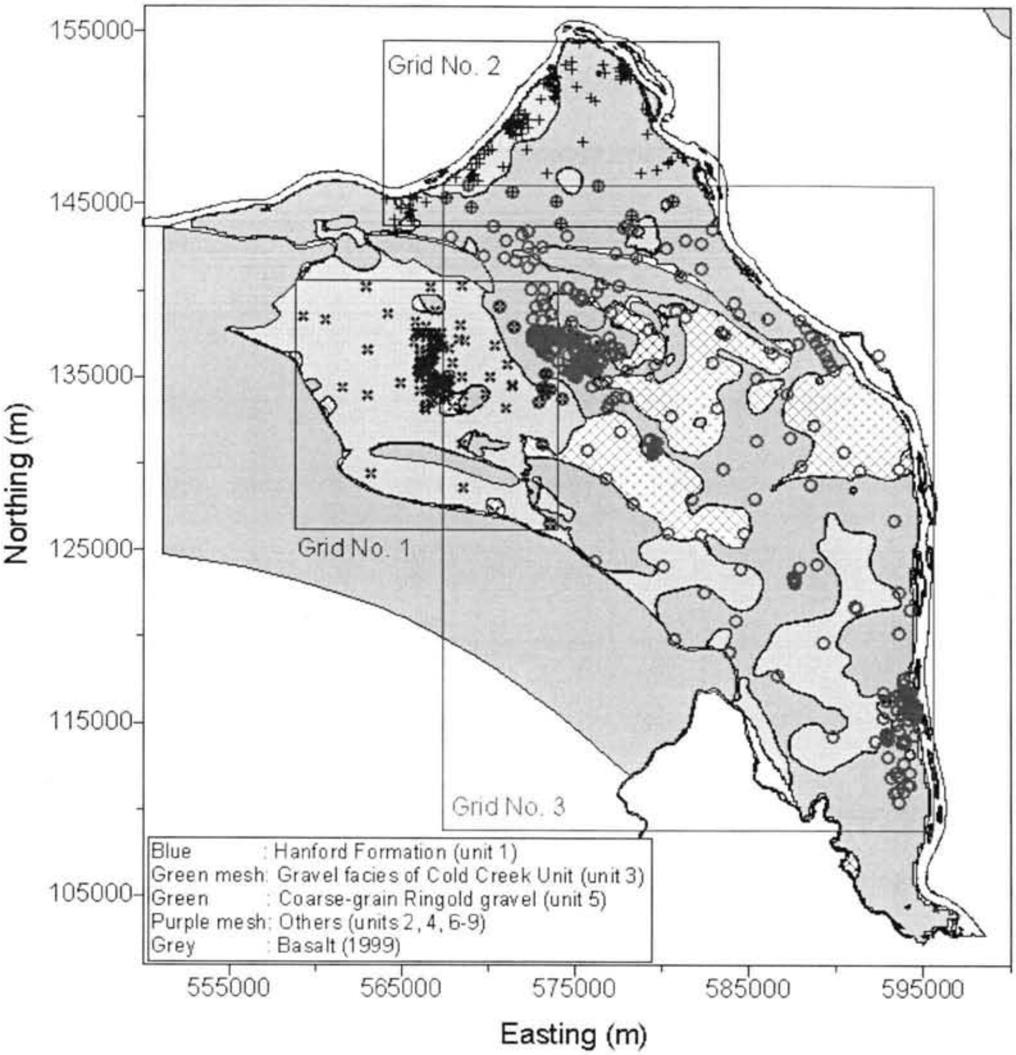

Figure 3.2. Subsets of FY 1992 Tritium Data and the Subcrop Formation Units at the FY 1992 Water Table

The variogram models shown in Figure 3.3 were used as input to sequential Gaussian simulations of the FY 2001 tritium concentrations. Figure 3.4 shows the median simulated values for all three grids, which were based on 300 simulations for Grid 1, and 400 simulations each for Grids 2 and 3. For comparison, Figure 3.5 shows the map of median simulated tritium concentration for FY 1992. Note the higher median tritium concentrations found in that map, especially in the plume emanating from 200 East Area in Grid 3. The decrease in tritium concentrations from FY 1992 to FY 2001 is primarily caused by radioactive decay of the tritium, which has a half-life of 12.35 years (Hartman et al. 2004).

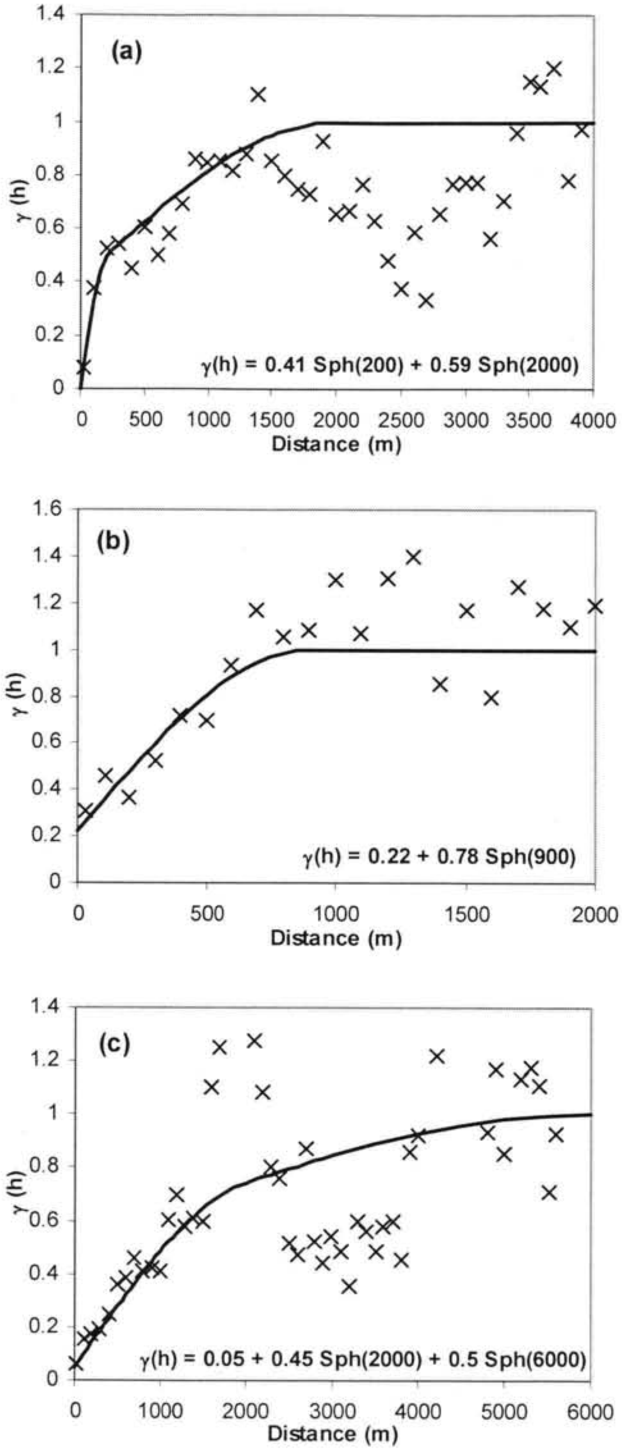

Figure 3.3. **Variograms and Models of Normal Scores of the Subsets of FY 2001 Tritium Data in the Local Grids 1 (a), 2 (b), and 3 (c). Experimental variogram values designated by x, with the models fit to data denoted by solid black lines.**

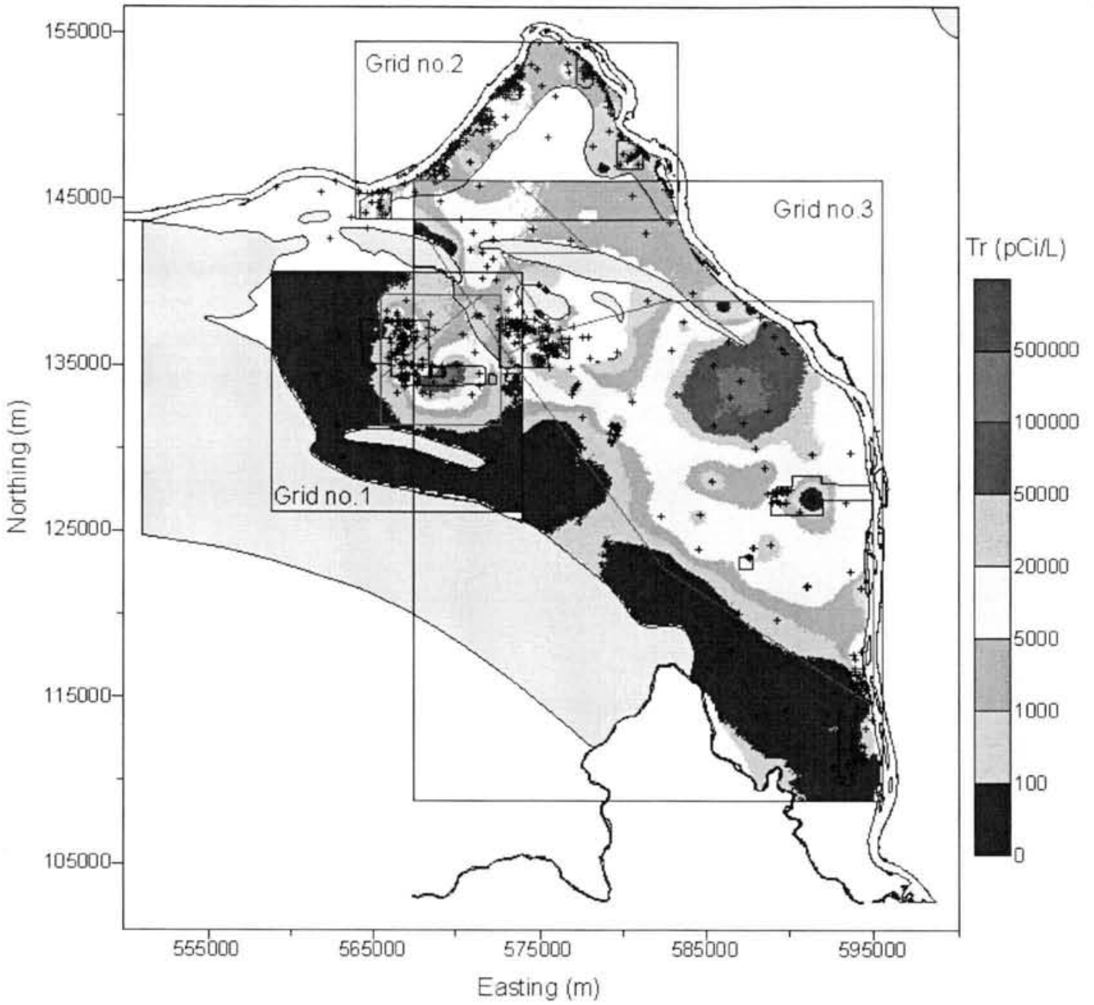

Figure 3.4. **Median of Simulations of FY 2001 Tritium Concentrations for Grids 1, 2, and 3**

3.3 Metrics for Tritium Concentration and Activity in Grid 1

Three hundred simulations of the FY 2001 tritium concentration were used as the basis for calculation of metrics for Grid 1. Grid 1 contains two distinct tritium plumes associated with 200 West Area (Figure 3.6), one to the southeast located near the REDOX plant and associated facilities and one to the northwest in the area of Waste Management Areas T-TX-TY. The areas containing those plumes are labeled sub-areas 1 and 2, respectively (Figure 3.6), and metrics were calculated separately for each sub-area. The XY coordinates of the digitized outlines of sub-areas 1 and 2 are contained as tables in Appendix A. All XY coordinates are Washington State Plane Coordinates (South, UTM Zone 11), in meters.

Figure 3.6 contains a map of the median simulated value for each grid cell, while Table 3.1 presents detailed statistics about the locations of the centers of mass that are contoured in Figure 3.6 for the 300 simulations of tritium for FY 2001. The statistics in Table 3.1 assume that the thickness of the tritium

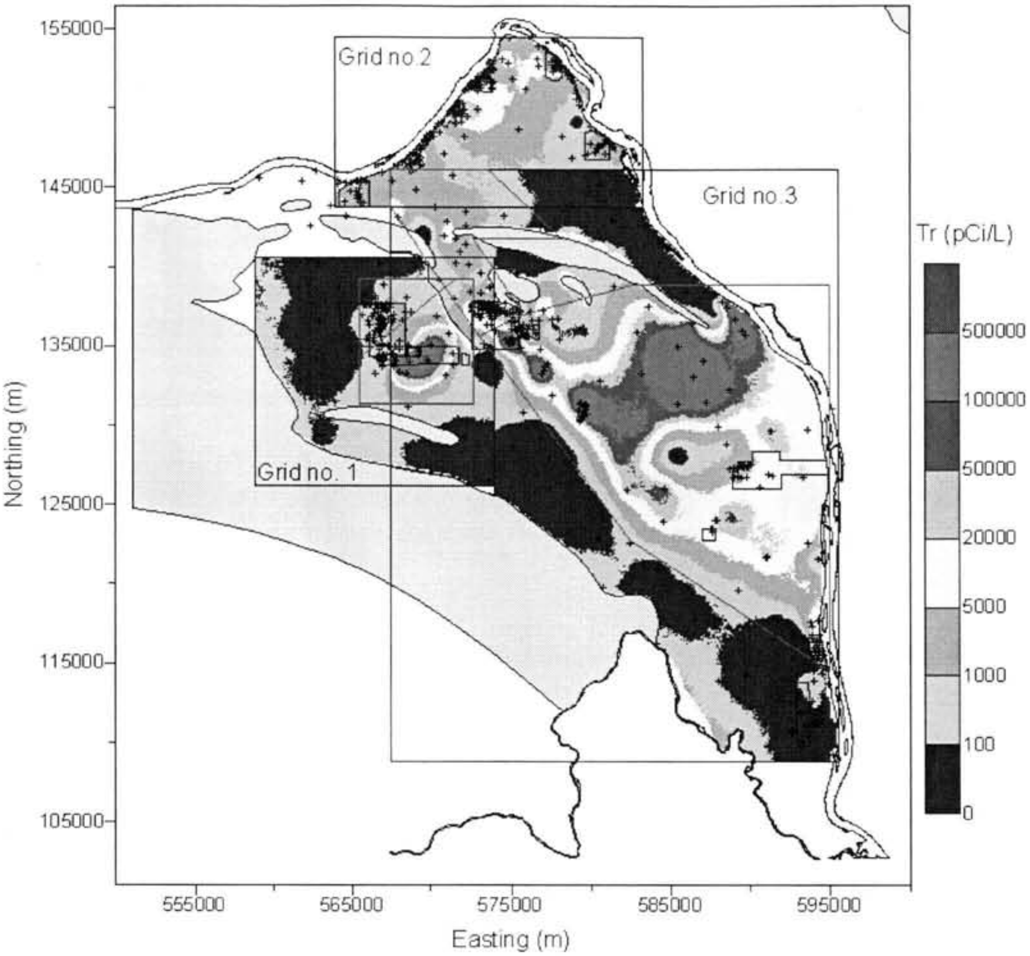

Figure 3.5. Median of Simulations of FY 1992 Tritium for Grids 1, 2, and 3

plume is 5 meters. Figure 3.7 shows a map of the probability that the tritium concentration exceeds the DWS within the grid area, based on the proportion of simulated values that exceeded the DWS for each grid cell. Table 3.2 shows statistics for the area exceeding the DWS of 20,000 pCi/L for FY 2001 tritium for each simulation within the two sub-areas of Grid 1 (200 West Area).

Figures 3.8 and 3.9 present histograms that show the total activity of tritium in FY 2001 for each simulation in sub-areas 1 and 2, respectively. There are four histograms for each sub-area, showing the results for each of four different depth assumptions, with thickness varying from 5 to 20 meters. Tables 3.3 and 3.4 show the corresponding statistics for the total activity for the four thickness assumptions for the two sub-areas of Grid 1. For example, Table 3.3 indicates that a 95 percent probability interval for the total activity of tritium in sub-area 1 of Grid 1 for FY 2001 is 1,104.6 Ci to 4,720.7 Ci, assuming that the tritium plume is 5 meters thick. Predicted total activity from the SAC model, either a single estimate or a range of values from a series of realizations, will be compared with the probability interval based on geostatistical modeling of the historical concentration data to determine if the simulated

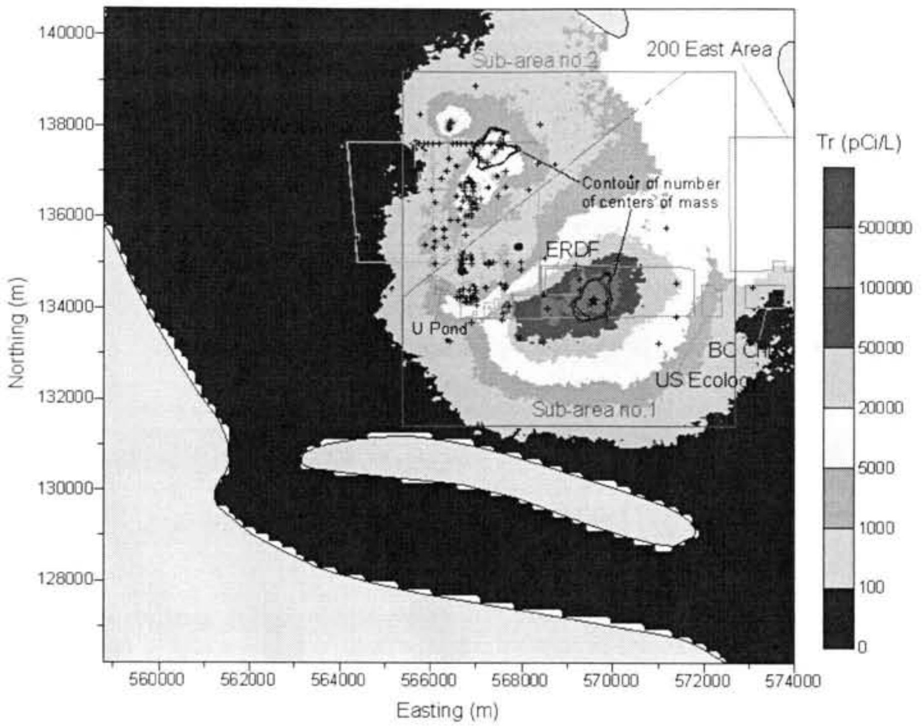

Figure 3.6. **Median of Simulated FY 2001 Tritium Concentrations in Grid 1 (200 West Area). Contours of the number of times that the center of mass within the sub-areas occurred within each cell of a coarser grid are shown. The average centers of mass are shown by black stars in each sub-area.**

Table 3.1. **Statistics of Locations of Centers of Mass of Individual Simulations of FY 2001 Tritium Calculated for a Depth of 5 m for Each Sub-Area of Grid 1 (200 West Area)**

Coordinate (m)	Sub-Area 1		Sub-Area 2	
	Easting	Northing	Easting	Northing
Mean	569569.5	134151.3	567542.4	137594.2
Standard Error	17.0	19.7	29.3	18.6
Median	569575.0	134137.5	567424.4	137555.8
Standard Deviation	294.0	340.4	507.8	322.4
Kurtosis	0.31	0.12	0.58	-0.28
Skewness	-0.37	0.10	0.97	0.12
Range	1776.3	1967.1	2590.7	1724.7
Minimum	568533.4	133216.6	566662.4	136752.1
Maximum	570309.6	135183.7	569253.1	138476.8
Count	300	300	300	300
97.5th Percentile	570079.0	134815.7	568741.2	138207.9
2.5th Percentile	568917.6	133430.9	566812.3	136980.6
Confidence Level of Mean (95.0%)	33.4	38.7	57.7	36.6

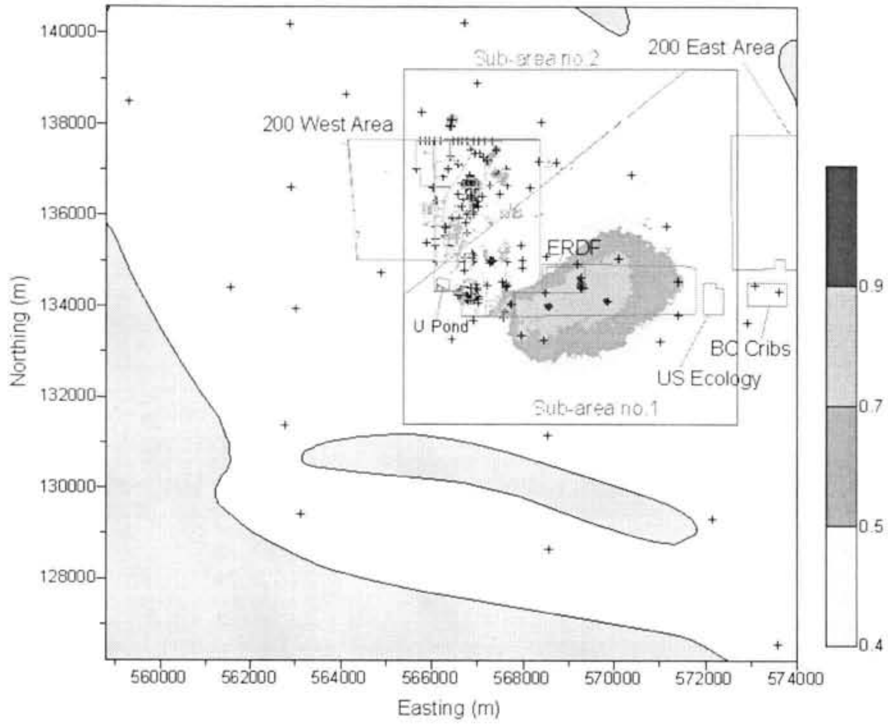

Figure 3.7. Probability of Exceeding 20,000 pCi/L Based on Simulations of FY 2001 Tritium in Grid 1 (200 West Area)

Table 3.2. Area Exceeding 20,000 pCi/L for FY 2001 Tritium for Each Simulation Within Two Sub-Areas of Grid 1 (200 West Area)

Area (km^2)	Sub-Area 1	Sub-Area 2	Grid 1
Mean	10.62	2.13	15.91
Standard Error	0.11	0.03	0.15
Median	10.62	2.01	15.87
Standard Deviation	1.94	0.60	2.67
Kurtosis	-0.04	1.12	0.39
Skewness	0.25	1.01	0.41
Range	10.39	3.14	16.50
Minimum	6.20	1.06	9.75
Maximum	16.59	4.21	26.25
Count	300	300	300
97.5th Percentile	14.42	3.58	21.60
2.5th Percentile	7.07	1.26	11.05
Confidence Level of Mean (95.0%)	0.22	0.07	0.30

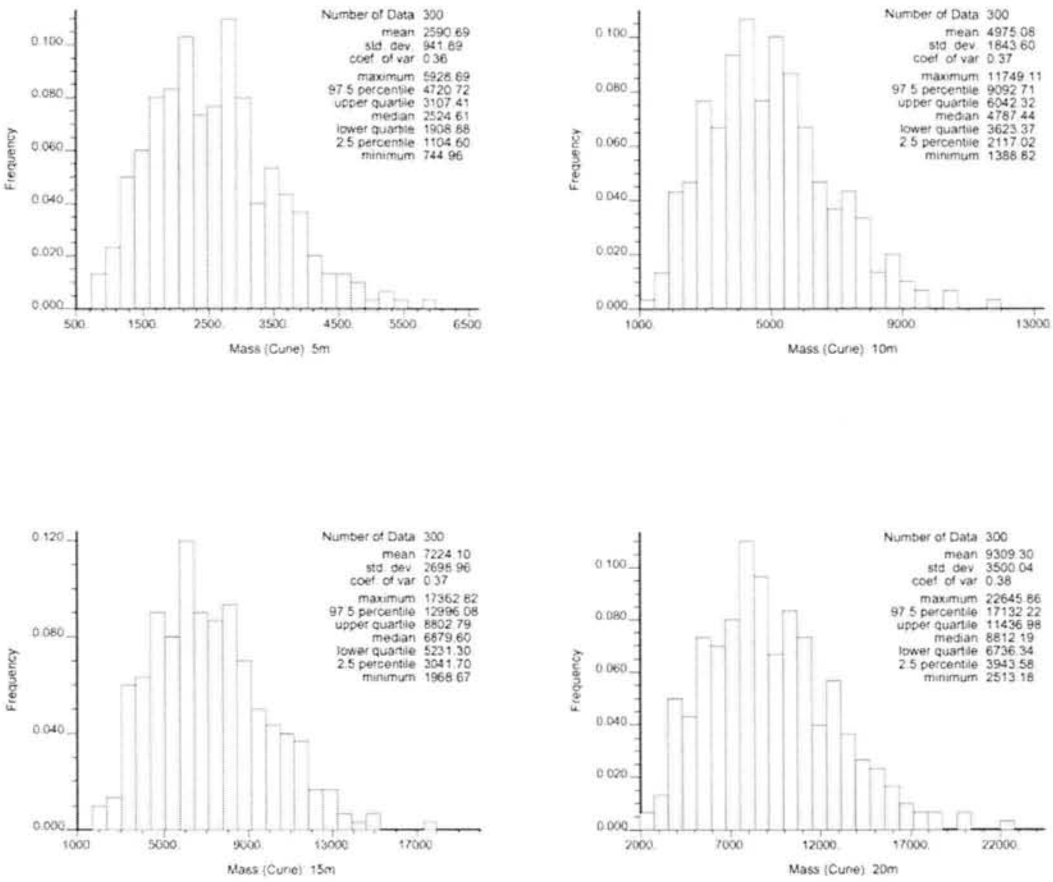

Figure 3.8. **Histograms of Total Activity in Simulations of FY 2001 Tritium Within Sub-Area 1 of Grid 1 (200 West Area), Four Thickness Assumptions**

Table 3.3. **Statistics of Total Activity of Simulations of FY 2001 Tritium Within Sub-Area 1 of Grid 1 (200 West Area), Four Thickness Assumptions**

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	2,590.69	4,975.09	7,224.10	9,309.30
Standard Error	54.47	106.62	156.08	202.41
Median	2,524.61	4,787.44	6,879.59	8,812.19
Standard Deviation	943.46	1,846.68	2,703.47	3,505.88
Kurtosis	0.18	0.18	0.24	0.33
Skewness	0.57	0.57	0.59	0.61
Range	5,183.72	10,360.29	15,394.15	20,132.69
Minimum	744.96	1,388.82	1,968.67	2,513.18
Maximum	5,928.69	11,749.11	17,362.82	22,645.86
Count	300	300	300	300
97.5th Percentile	4,720.72	9,092.70	12,996.05	17,132.18
2.5th Percentile	1,104.60	2,117.02	3,041.70	3,943.58
Confidence Level of Mean (95.0%)	107.19	209.82	307.16	398.33

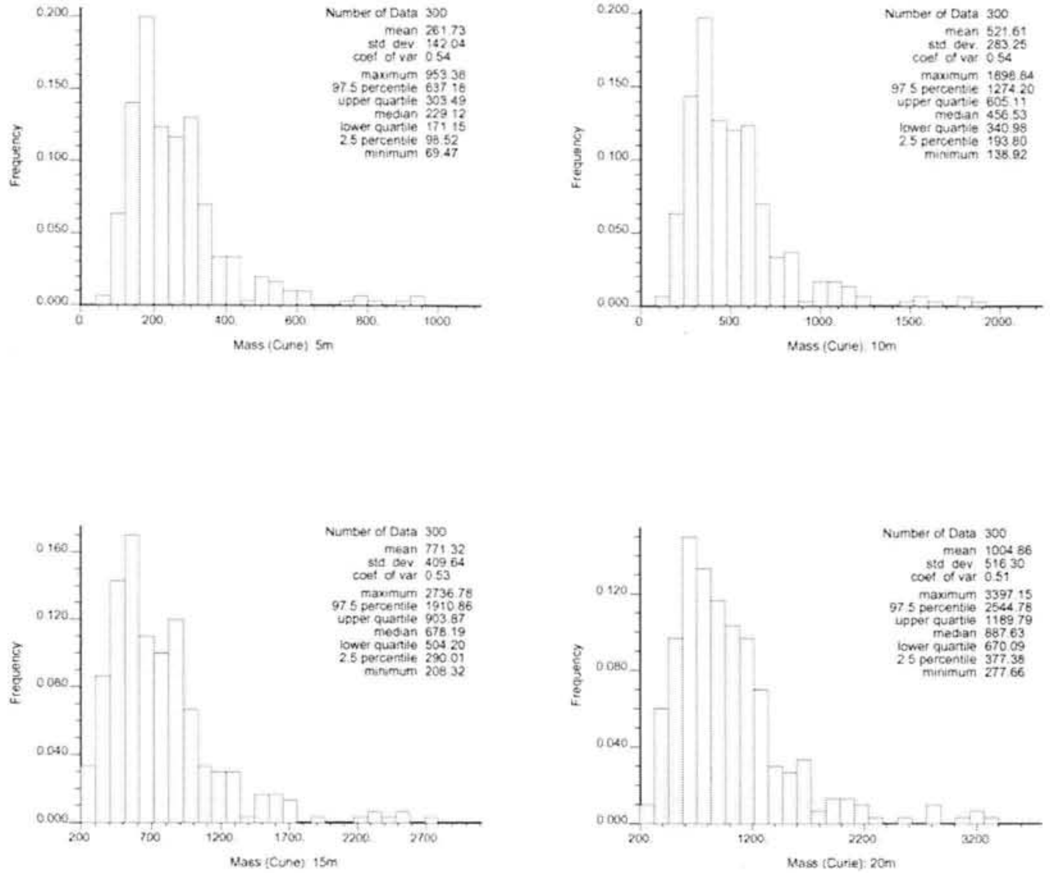

Figure 3.9. Histograms of Mass of Simulations of FY 2001 Tritium Within Sub-Area 2 of Grid 1 (200 West Area), Four Depth Assumptions

Table 3.4. Mass of Simulations of FY 2001 Tritium Within the Sub-Area 2 of Grid 1 (200 West Area), Four Depth Assumptions

Mass (Ci) in Depth	5 m	10, m	15 m	20 m
Mean	261.73	521.61	771.32	1,004.86
Standard Error	8.21	16.38	23.69	29.86
Median	229.11	456.53	678.19	887.63
Standard Deviation	142.28	283.72	410.33	517.16
Kurtosis	5.81	5.78	5.15	4.58
Skewness	2.05	2.05	1.94	1.83
Range	883.91	1,759.92	2,528.46	3,119.49
Minimum	69.47	138.92	208.32	277.66
Maximum	953.38	1,898.84	2,736.78	3,397.15
Count	300	300	300	300
97.5th Percentile	637.15	1,274.15	1,910.79	2,544.70
2.5th Percentile	98.52	193.80	290.01	377.38
Confidence Level of Mean (95.0%)	16.17	32.24	46.62	58.76

values from the SAC model fall within the 95 percent probability interval from the geostatistical study. Comparison of Tables 3.3 and 3.4 indicates that there is approximately an order of magnitude more tritium in sub-area 1 than there is in sub-area 2.

Figure 3.10 shows smooth curves fit to the histograms for the four thickness assumptions for each sub-area of Grid 1. The figure shows that in addition to the increase in mean total activity for greater thickness, there is also a large increase in the variability in the simulated total activity for increasing thickness assumptions of the plume.

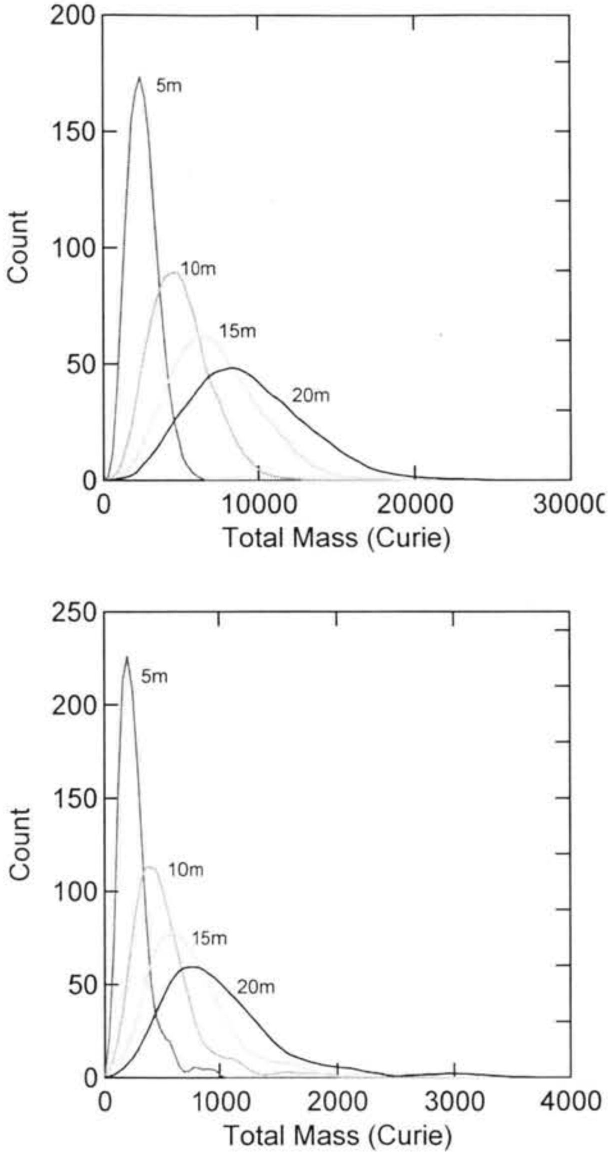

Figure 3.10. Curves Fit to Histograms of the Mass of FY 2001 Tritium at Four Depths within Sub-Areas 1 (upper) and 2 (lower) of Grid 1 (200 West Area)

3.4 Metrics for Tritium Concentration and Activity in Grid 2

The tritium concentration and activity were also simulated for Grid 2, and metrics were calculated for the entire area together. Sub-areas within Grid 2 were not identified during the study; however, if those areas are identified in the future it would be possible to calculate metrics for them (e.g., the area around one of the reactors). Figure 3.11 shows the median simulated tritium value within the simulation grid based on 400 simulations of the tritium concentration. The central portion of the grid was blanked after simulation because of the sparse data coverage in that area. Figure 3.12 shows the probability that tritium concentration in FY 2001 exceeded the DWS. Table 3.5 contains the statistics for the area exceeding the DWS and the locations of the center of mass based on the suite of simulations generated in Grid 2. Because the simulation grid is bounded on one side by the Columbia River, an additional metric was generated for Grid 2 that was not relevant for Grid 1. That metric is the length of the shoreline for which the tritium concentration exceeded the DWS for each simulation; a histogram and statistics of the distribution of results is given in Figure 3.13. Figure 3.14 and Table 3.6 provide the histograms and statistical summaries of the total tritium activity in the simulation grid for plume thicknesses of 5, 10, 15, and 20 meters.

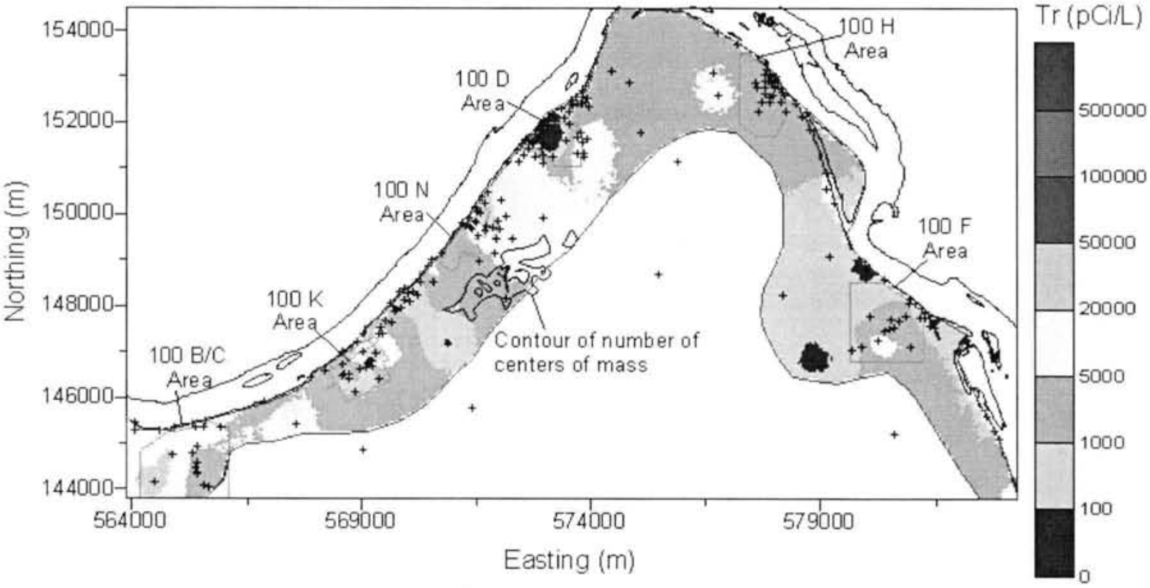

Figure 3.11. Median of Simulated FY 2001 Tritium Concentrations in Grid 2 (100 Areas). Contours of the number of times that the center of mass occurred within cells of an upscaled grid are shown with the average center of mass shown by a black star.

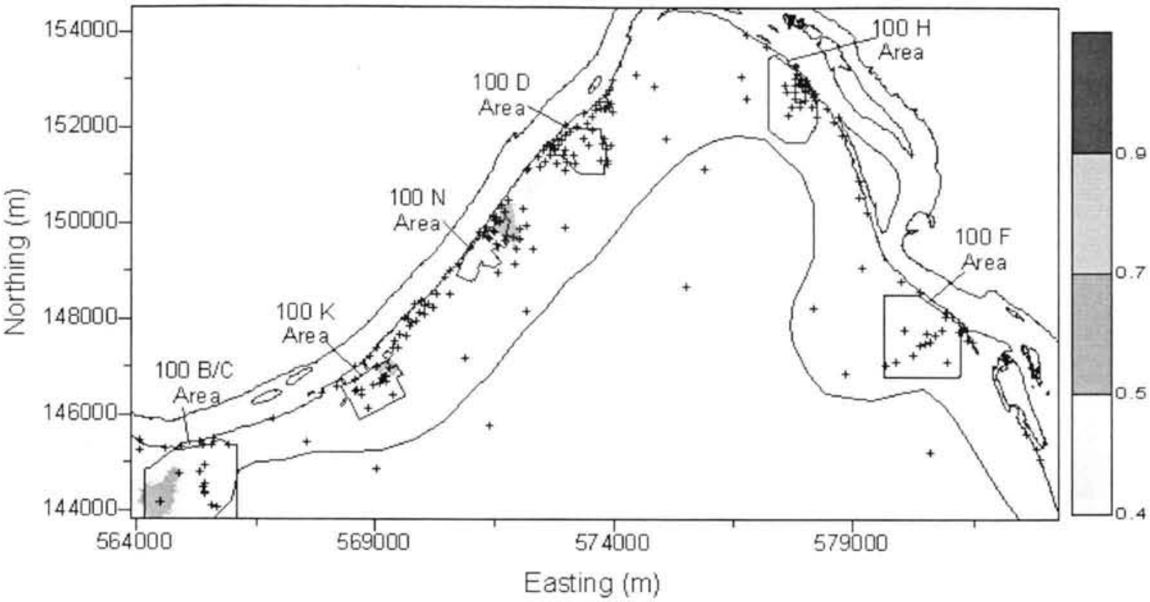

Figure 3.12. Probability of Exceeding 20,000 pCi/L Based on Simulations of FY 2001 Tritium in Grid 2 (100 Areas)

Table 3.5. Statistics of the Area Exceeding 20,000 pCi/L and Locations of Centers of Mass for Simulations of FY 2001 Tritium Within Grid 2 (100 Areas)

	Area (km^2)	Center of Mass (unit: m)	
		Easting	Northing
Mean	6.43	572143.8	148421.2
Standard Error	0.06	73.3	45.9
Median	6.40	572245.4	148399.7
Standard Deviation	1.19	1466.4	917.1
Kurtosis	-0.12	0.74	0.71
Skewness	0.16	-0.25	0.30
Range	6.75	9448.0	5894.6
Minimum	3.07	567631.9	145907.6
Maximum	9.82	577079.9	151802.2
Count	400	400	400
97.5th Percentile	8.92	575177.7	150316.4
2.5th Percentile	4.14	568673.3	146620.1
Confidence Level (95.0%)	0.12	144.1	90.2

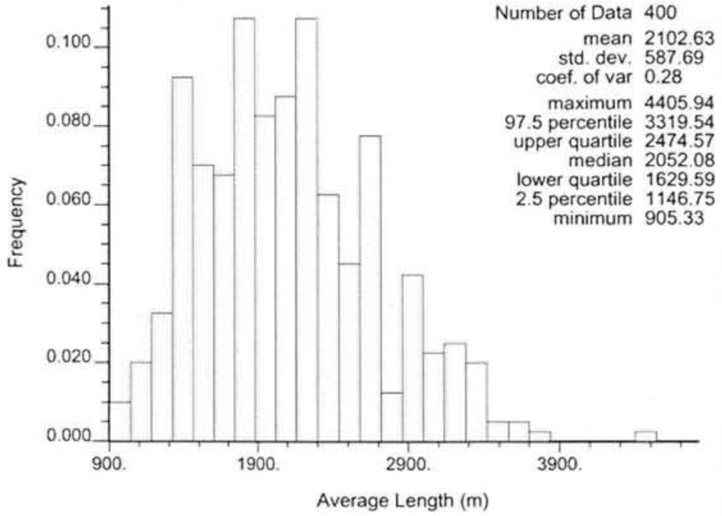

Figure 3.13. Histogram of the Average Length of Columbia River Shoreline Exceeding 20,000 pCi/L for FY 2001 Tritium in Grid 2 (100 Areas)

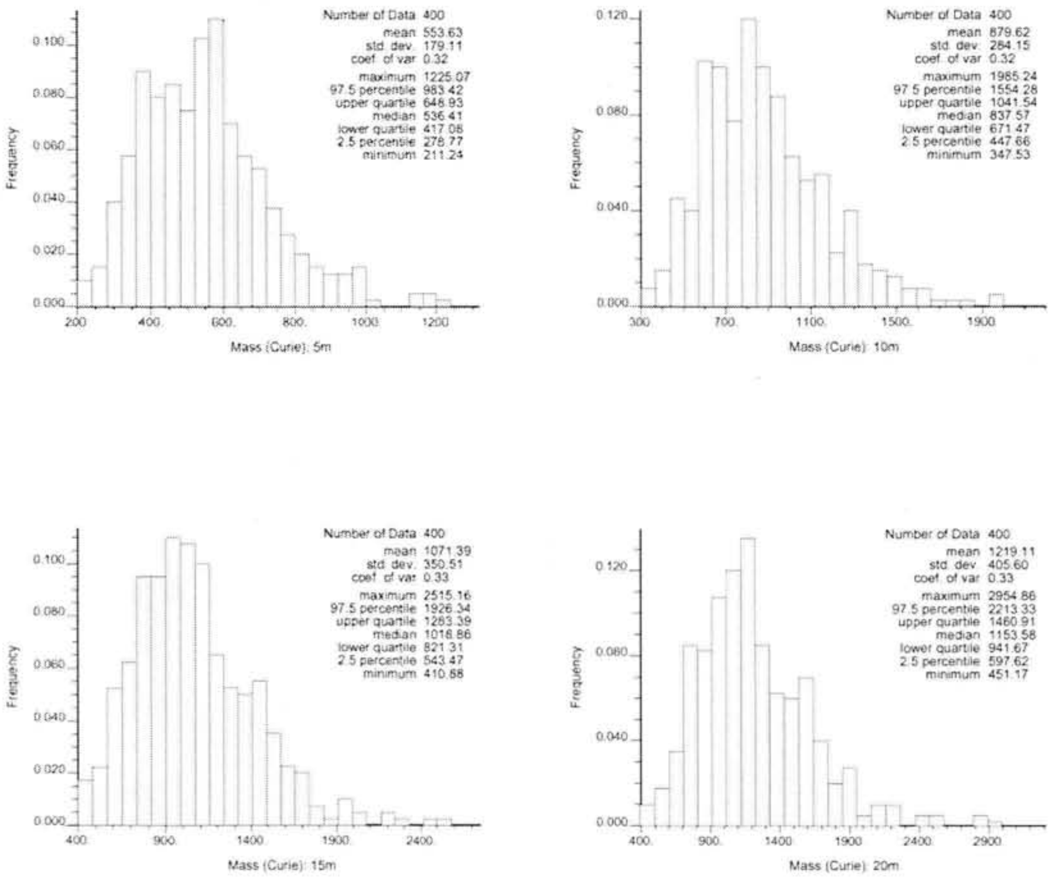

Figure 3.14. Histograms of Total Activity in Simulations of FY 2001 Tritium Within Grid 2 (100 Areas), Four Thickness Assumptions

Table 3.6. **Statistics of Total Activity of Simulations of FY 2001 Tritium Within Grid 2 (100 Areas), Four Thickness Assumptions**

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	553.63	879.62	1,071.39	1,219.11
Standard Error	8.97	14.23	17.55	20.31
Median	536.41	837.57	1,018.86	1,153.58
Standard Deviation	179.33	284.51	350.94	406.11
Kurtosis	0.88	0.87	1.33	1.83
Skewness	0.81	0.81	0.92	1.03
Range	1,013.83	1,637.72	2,104.27	2,503.70
Minimum	211.24	347.53	410.88	451.17
Maximum	1,225.07	1,985.24	2,515.16	2,954.86
Count	400	400	400	400
97.5th Percentile	984.96	1,562.88	1,935.89	2,218.85
2.5th Percentile	276.74	444.00	543.39	594.34
Confidence Level of Mean (95.0%)	17.63	27.97	34.50	39.92

3.5 Metrics for Tritium Concentration and Activity in Grid 3

The tritium plumes emanating from 200 East Area and other sources occurring within the main plume were simulated as a single unit in Grid 3. Metrics were calculated for two sub-areas based on 400 simulations of the tritium concentration. Sub-area 1 (Figure 3.15) encompassed the plume that moved southeast from 200 East Area, while sub-area 2 included the northern portion of 200 East Area and portions of the tritium plume that moved to the north. The digitized boundaries for sub-areas 1 and 2 are found in a table within Appendix A. Figure 3.15 also shows the average center of mass for each of the sub-areas and contours around the center of mass that indicate the variability in the location of the center of mass for the suite of simulations. Table 3.7 provides detailed statistics for the distribution of the center of mass locations for the two sub-areas. Figure 3.16 illustrates the probability that the tritium concentration exceeded the DWS within Grid 3, while Table 3.8 provides detailed statistics for the distribution of the area exceeding the DWS for each simulation in the two sub-areas. Sub-area 1 is bounded on the east by the Columbia River, and the southeastern tritium plume had an impact on a significant length of the shoreline. Figure 3.17 contains a histogram of the distribution of the length of shoreline above the DWS for the suite of simulations, indicating that about 10 km of river shoreline were above the DWS in FY 2001 for sub-area 1. Figures 3.18 and 3.19 present histograms that show the total activity of tritium in FY 2001 for each simulation in sub-areas 1 and 2, respectively. There are four histograms for each sub-area, showing the results for each of four different depth assumptions, with thickness varying from 5 to 20 meters. Tables 3.9 and 3.10 show the corresponding statistics for the total activity for the four thickness assumptions for the two sub-areas of Grid 3.

Figure 3.15 shows the presence of low median concentrations mapped in the area between 200 East Area and the Central Landfill and stretching to the northeast and southeast from the Central Landfill. The 20,000-pCi/L contour is not as continuous or extensive in those areas as it is in the hand-contoured maps of tritium concentration presented in the Hanford Site groundwater monitoring report for the FY 2001 data (see Figure S-3, Hartman et al. 2002). The low concentrations could lead to under estimating the

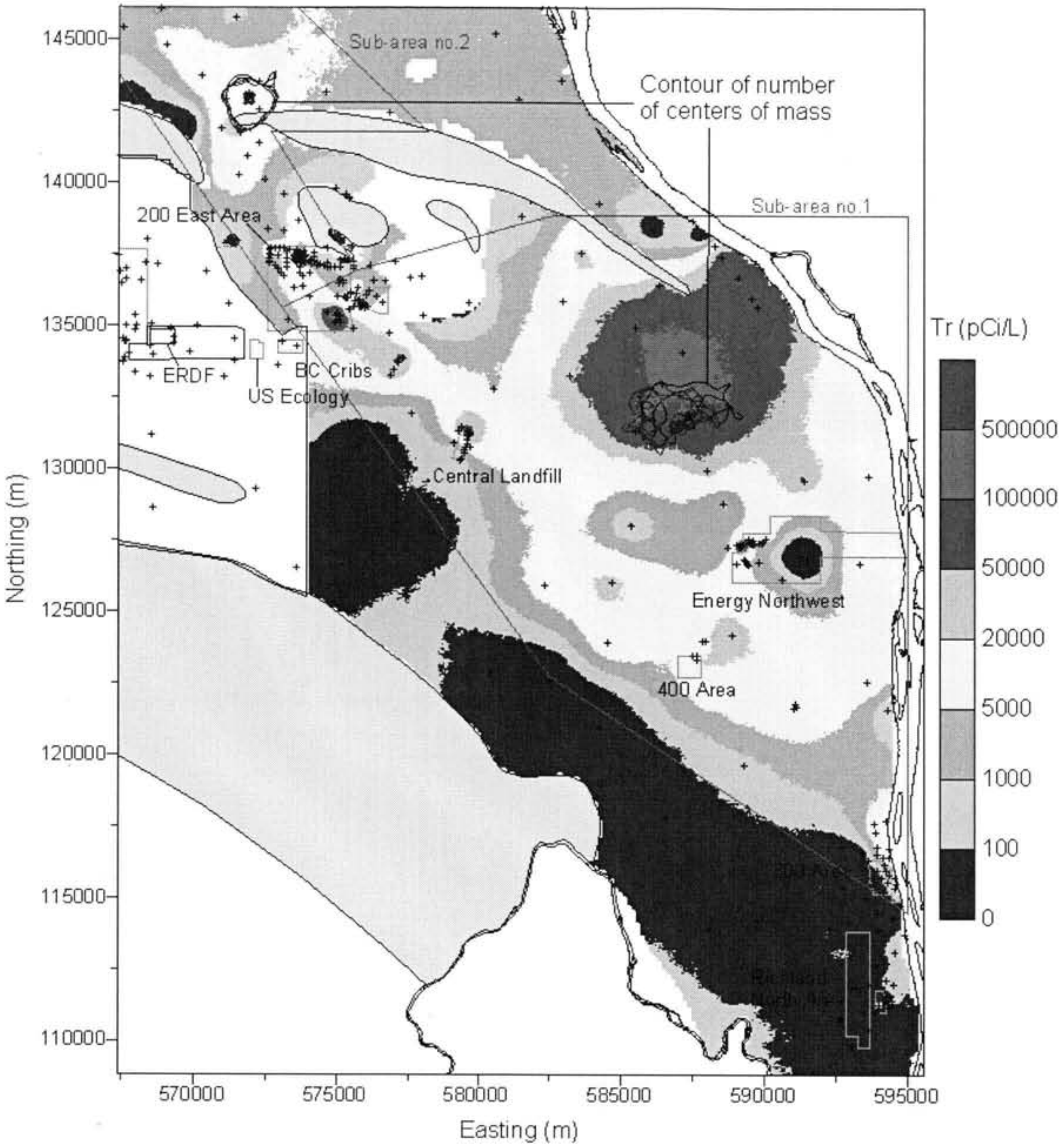

Figure 3.15. Median of Simulated FY 2001 Tritium Concentrations in Grid 3 (200 East Area Plumes). Contours of the number of times that the center of mass within the sub-areas occurred within cells of an upscaled grid are shown with the average centers of mass shown by blue stars in each sub-area.

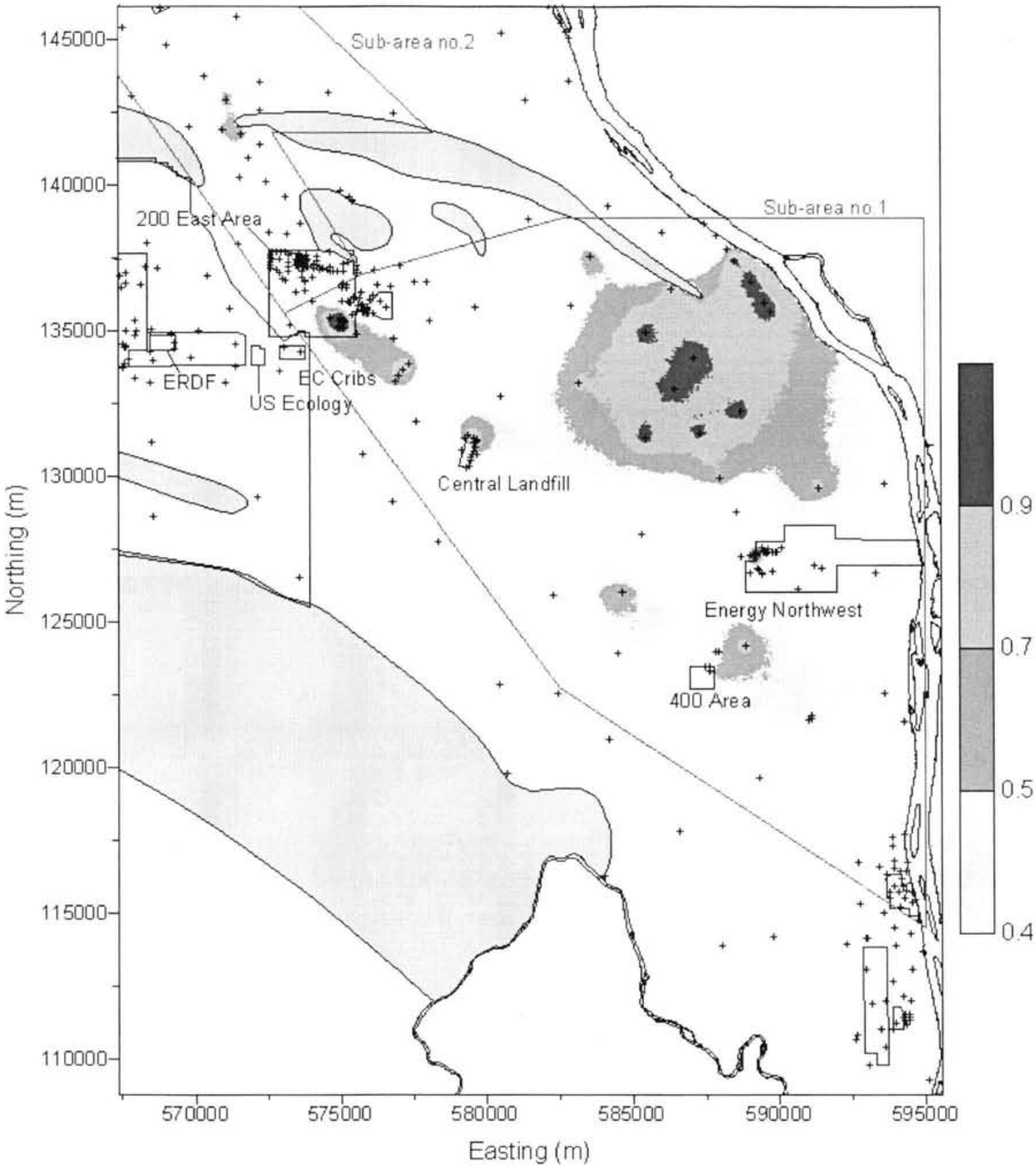

Figure 3.16. Probability of Exceeding 20,000 pCi/L Based on Simulations of FY 2001 Tritium in Grid 3 (200 East Area Plumes)

Table 3.7. Statistics of Locations of Center of Mass for Simulations of FY 2001 Tritium Calculated for a Depth of 5 m for Each Sub-Area of Grid 3 (200 East Area Plumes)

Coordinate (m)	Sub-Area 1		Sub-Area 2	
	Easting	Northing	Easting	Northing
Mean	587120.4	131577.5	571954.7	142941.6
Standard Error	59.0	62.0	39.8	37.5
Median	587055.7	131770.2	571923.2	142870.2
Standard Deviation	1180.4	1240.6	795.4	749.3
Kurtosis	-0.01	4.85	2.08	0.88
Skewness	0.34	-1.53	-0.25	0.26
Range	7598.6	10098.6	5817.5	4999.4
Minimum	584089.1	123933.2	568765.0	140385.3
Maximum	591687.7	134031.8	574582.5	145384.7
Count	400	400	400	400
97.5th Percentile	589608.7	133434.5	573526.7	144634.3
2.5th Percentile	585064.8	128621.8	570222.7	141542.2
Confidence Level of Mean (95.0%)	116.0	121.9	78.2	73.7

Table 3.8. Area Exceeding 20,000 pCi/L for FY 2001 Tritium for Each Simulation Within Two Sub-Areas of Grid 3 (200 East Area Plumes)

Area (km^2)	Sub-Area 1	Sub-Area 2	Grid 3
Mean	89.12	6.48	105.48
Standard Error	0.53	0.11	0.63
Median	88.22	6.15	105.02
Standard Deviation	10.60	2.27	12.60
Kurtosis	1.16	0.71	0.09
Skewness	0.57	0.77	0.32
Range	76.36	13.81	74.84
Minimum	60.74	1.97	74.34
Maximum	137.09	15.77	149.18
Count	400	400	400
97.5th Percentile	112.55	11.79	132.39
2.5th Percentile	70.66	2.93	83.11
Confidence Level of Mean (95.0%)	1.04	0.22	1.24

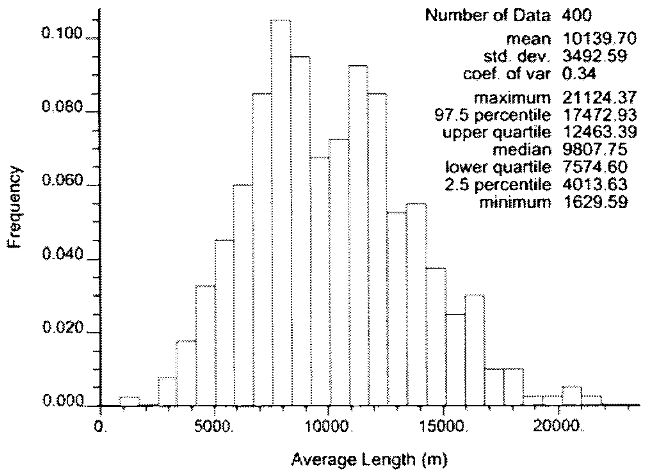

Figure 3.17. Histogram of the Average Length of Columbia River Shoreline Exceeding 20,000 pCi/L for FY 2001 Tritium in Grid 3

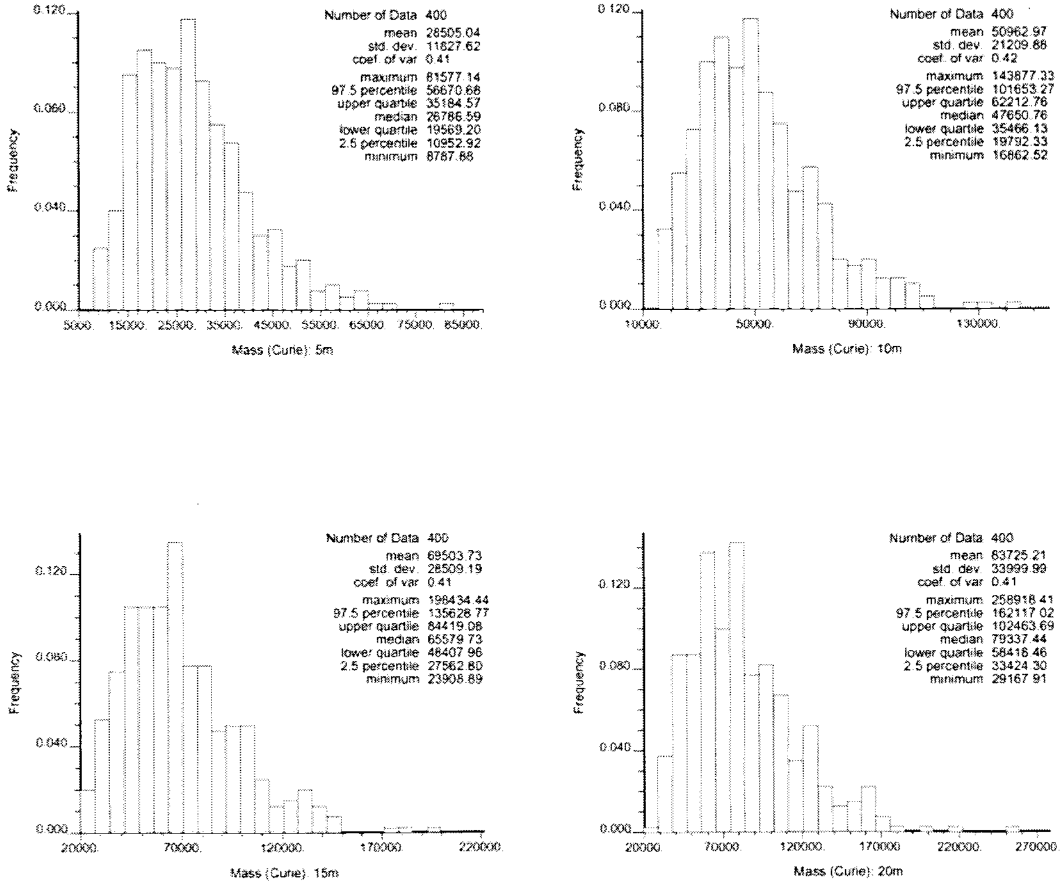

Figure 3.18. Histograms of Total Activity in Simulations of FY 2001 Tritium Within Sub-Area 1 of Grid 3 (200 East Area Plumes), Four Thickness Assumptions

Table 3.9. **Statistics of Total Activity of Simulations of FY 2001 Tritium Within Sub-Area 1 of Grid 3 (200 East Area Plumes), Four Thickness Assumptions**

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	28,505.03	50,962.96	69,503.75	83,725.17
Standard Error	592.12	1,061.82	1,427.24	1,702.13
Median	26,786.58	47,650.75	65,579.73	79,337.43
Standard Deviation	11,842.43	21,236.44	28,544.90	34,042.57
Kurtosis	1.22	1.33	1.45	1.97
Skewness	0.96	1.00	1.01	1.08
Range	72,789.27	127,014.81	174,525.53	229,750.50
Minimum	8,787.88	16,862.52	23,908.89	29,167.91
Maximum	81,577.14	143,877.33	198,434.43	258,918.41
Count	400	400	400	400
97.5th Percentile	56,805.41	102,342.08	135,976.27	162,852.93
2.5th Percentile	10,900.02	19,731.24	27,472.34	33,391.60
Confidence Level of Mean (95.0%)	1,164.07	2,087.47	2,805.86	3,346.26

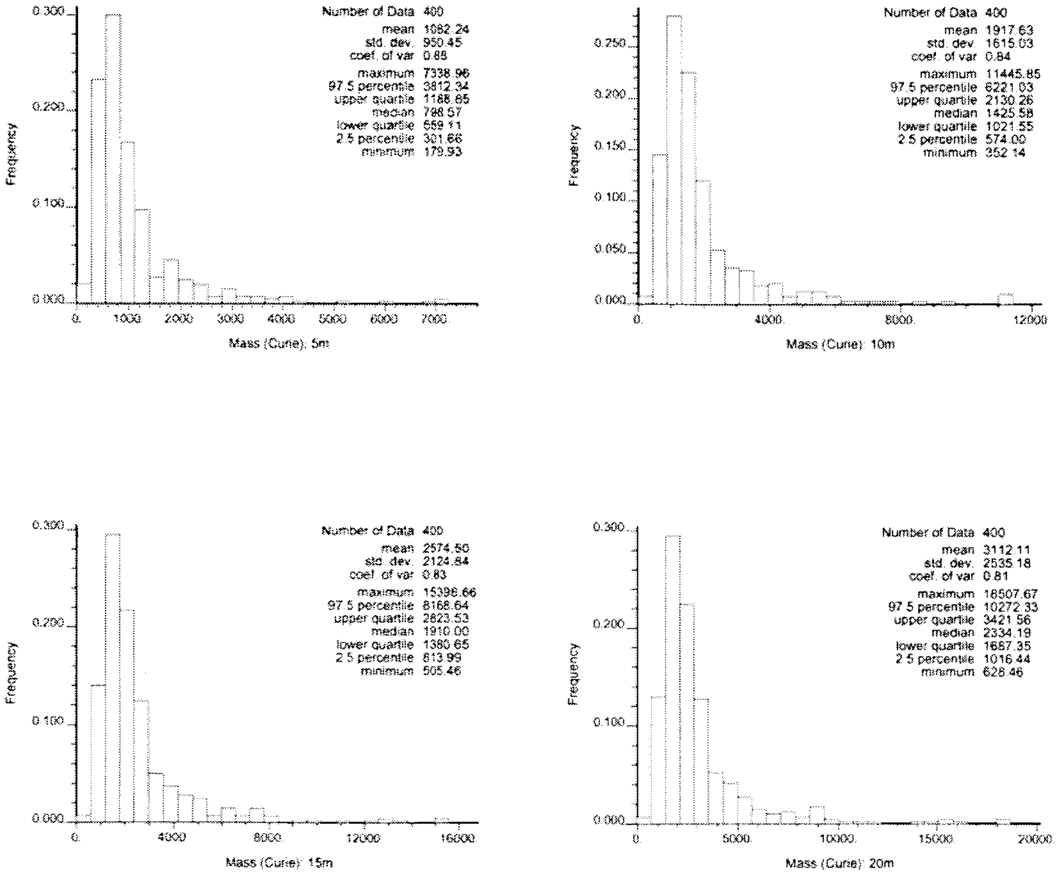

Figure 3.19. **Histograms of Total Activity in Simulations of FY 2001 Tritium Within Sub-Area 2 of Grid 3 (200 East Area Plumes), Four Thickness Assumptions**

Table 3.10. Statistics of Total Activity of Simulations of FY 2001 Tritium Within Sub-Area 2 of Grid 3 (200 East Area Plumes), Four Thickness Assumptions

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	1,082.24	1,917.64	2,574.50	3,112.11
Standard Error	47.58	80.85	106.38	126.92
Median	798.56	1,425.58	1,910.00	2,334.19
Standard Deviation	951.64	1,617.06	2,127.50	2,538.36
Kurtosis	14.50	12.82	12.06	12.04
Skewness	3.29	3.15	3.09	3.10
Range	7,159.03	11,093.71	14,893.20	17,879.21
Minimum	179.93	352.14	505.46	628.46
Maximum	7,338.96	11,445.85	15,398.66	18,507.67
Count	400	400	400	400
97.5th Percentile	3,877.40	6,370.49	8,203.01	10,638.91
2.5th Percentile	294.30	563.60	810.07	1,004.63
Confidence Level of Mean (95.0%)	93.54	158.95	209.13	249.51

metrics calculated for sub-area 1 of Grid 3 for this study (e.g., total activity in the plume and the area above the DWS). The primary reason for this discrepancy is the sparseness of data distribution in those areas, where the distance between adjacent wells can be several kilometers. In hand-contouring the data, hydrogeologists cover those gaps using their understanding of groundwater flow patterns in the region. This is more difficult to do using a geostatistical model, which is constrained by the variogram model fit to the experimental variogram values calculated from the sparse concentration data. The effects of this problem appear to be greatest for the large 200 East groundwater plume that migrates to the southeast, because of the large area and the sparse distribution of monitoring wells in the down gradient portions of that plume. Several methods are being examined to reduce the impact of this effect on history matching the geostatistical results and the results from the SAC model, as detailed in Section 4.5.

3.6 Discussion of Additional Results

Sections 3.1 through 3.5 present the history matching data generated for tritium using FY 2001 data as an example of the data generated for this project. The results provide a number of metrics that can be used to evaluate the performance of the SAC model. These include estimates of the total activity of tritium within defined areas (e.g., plumes associated with facilities), the center of mass of the tritium activity within those areas, the area above the tritium DWS within the defined boundary, and the length of the Columbia River shoreline above the DWS (where appropriate). Each of those results are based on geostatistical analysis of historical groundwater concentrations. By calculating the metrics on a suite of geostatistical simulations it was also possible to provide uncertainty intervals for each of the metrics.

History matching data for other time periods and contaminants are contained in Appendices B through H. Each appendix contains the results for a single contaminant and sampling period. Table 3.11 gives the appendices and their contents. The XY coordinates for the sub-areas for which mass calculations were made are in Appendices A through H. All coordinates are Washington State Plane Coordinates (South, UTM Zone 11), in meters.

Table 3.11. **Appendices and Content for Additional Contaminants**

Appendix	Year	Contaminant
B	1992	Tritium
C	2001	Technetium-99
D	1992	Technetium-99
E	2001	Iodine-129
F	1992	Iodine-129
G	2001	Uranium
H	1992	Uranium

The procedures used to generate the geostatistical simulations and metrics for those other contaminants are the same as those used for tritium in FY 2001 with the exception of the FY 2001 technetium-99 plume for 200 East Area. As discussed in Section 2.1, that plume was simulated using sequential indicator simulation, with calculation of the metrics performed using the same methods as those applied to all other contaminant plumes.

4.0 Parameter Uncertainties and Data Gaps

The approach taken for the current study provides quantitative methods for providing history matching data, including estimates of uncertainty in the metrics that can be used to evaluate the SAC model. However, the approach does not address all possible sources of uncertainty in those metrics. Uncertainty in several factors could lead to additional variability in the range of data presented in this study. Those factors include the true concentration for a contaminant at a given point in time, the thickness of contaminant plumes and vertical distribution of contaminants within them, the geologic structure, the porosity of the geologic units, and assumptions made in the geostatistical modeling used as the basis to calculate the metrics.

A brief discussion of each of those sources of uncertainty follows. It might be useful in the future to assess the relative importance of those additional sources of uncertainty and determine the potential effect on the uncertainty bounds provided for the metrics. The width of those uncertainty bounds could have an impact on whether the results of the SAC model are deemed to be acceptable, i.e., the SAC results fall within the range of values estimated from the historical contaminant concentration data.

4.1 Concentration Uncertainty

The contaminant concentration data used for the current study were selected and processed in the same way as the data used for the Hanford Site groundwater monitoring reports (e.g., Hartman et al. 2004). The average annual concentration was calculated for each well for each fiscal year. A number of wells in areas where concentrations do not change rapidly are not sampled every fiscal year, but are only sampled every second or third year. For that reason, if data were not available for the desired fiscal year for a well, in this case FY 2001 and FY 1992, then the average annual concentration from the most recent of the two previous fiscal years was used.

The use of an annual average masks two sources of uncertainty. One source is the measurement error associated with each concentration measurement. The second source of additional uncertainty is the variability in the suite of concentration measurements taken within a fiscal year that are used to calculate an annual average.

Although both sources of additional variability exist, it is difficult to quantify their magnitude. For most concentration measurements, the total analytical error is reported in HEIS, which should provide an estimate of the measurement error that may have been introduced into the analysis at the laboratory. However, it has recently been discovered that in some instances the laboratories reporting the total analytical error have actually been calculating the analytical error for concentrations near the minimum detection limit and then scaling that error to other concentrations[a] (so the analytical error value reported in HEIS cannot be used to estimate the uncertainty associated with an individual measurement, especially for higher concentrations.

(a) Personal communication from PE Dresel (Pacific Northwest National Laboratory) to the authors, January 2004.

The reduction in uncertainty caused by the use of an annual average cannot be assessed either, because wells have widely varying sampling schedules. During fiscal years when wells are being sampled, they are usually sampled monthly, quarterly, semi-annually, or annually. The variability between samples within a fiscal year cannot be assessed for wells that are only sampled annually or semi-annually. Although the frequency of well sampling for some wells may be determined by regulatory requirements, if there is no regulatory driver, then wells tend to be sampled more frequently when there is reason to suspect greater temporal variability. Thus, the variability found for wells measured monthly cannot be assumed to be representative of the variability that should be expected for wells that are sampled less frequently.

Given the inability to estimate the measurement error or temporal variability in concentration measurements, it does not appear to be possible to quantify the additional uncertainty in estimated contaminant concentrations resulting from measurement error or between sample variability, relative to the uncertainty estimated using data averaged over a fiscal year.

There are additional sources of uncertainty in contaminant concentrations that arise due to the varying lengths of the open intervals of the well bore from which samples are drawn and variations in hydraulic conductivity within the open interval. For example, if two wells sample areas of a plume with the same concentration and one has a relatively short open interval that only covers the high concentration zone at the top of the aquifer while the second has a longer open interval that includes deeper zones in the aquifer with high hydraulic conductivity and low concentrations, then the second well would appear to have lower concentrations than the first well due to the effects of well bore mixing, even though the mass of contaminant within a unit area of the aquifer might be identical. Given the lack of detailed data on the vertical distribution of contaminant concentrations and hydraulic conductivity in the aquifer, the uncertainty arising from varying lengths of the open interval and well bore mixing cannot be quantified at this time.

4.2 Vertical Distribution of Contaminants

As discussed in Section 2.2.1, considerable uncertainty exists in the vertical distribution of contaminants in the aquifer. This leads to uncertainty in the thickness of the plume that should be assumed in converting the simulations of contaminant concentration at the top of the aquifer to mass or activity estimates, which greatly increases the uncertainty in several of the metrics (especially the total mass or activity in a plume). The uncertainty related to the differing thickness assumptions modeled in this study can be seen for several of the FY 2001 tritium plumes (e.g., Figures 3.18 and 3.19).

If the plume is assumed to be approximately 5 meters thick, as some of the data seem to suggest, then the vertical gradient of concentrations within that interval can probably be ignored. However, there are data that suggest the plumes may be considerably thicker than 5 meters, at least locally. For thicker plumes, the vertical concentration gradient within the plume would be much more important in assessing the total mass or activity of contaminant present. There appears to be data indicating that concentration decreases rapidly with depth even in the thicker plumes, so the assumption of constant concentration with depth that was made earlier in the history matching performed for SAC Rev. 0 and in the present study should be revisited, especially for the 15- and 20-meter plume-thickness assumptions.

A study to further examine the vertical distribution of contaminants is planned for FY 2004 by the groundwater task of the characterization of systems project. The results of that study might be used to re-examine the assumptions made for this study regarding the thickness of the contaminant plumes and distribution of concentration within those plumes, and to guide the design of any future efforts to estimate the mass and activity of contaminants within the plumes.

4.3 Geologic Structure Uncertainty

Considerable uncertainty exists in the geologic structure of the Hanford Site. The identification of geologic formations from borehole data can be difficult, especially in drill cuttings, because of the variability that exists in formations at the site, the inability to observe sedimentary structures that might be diagnostic, and the tendency for Ringold Formation sediments to be eroded and then redeposited in the Hanford formation (Xie et al. 2003). Although Xie et al. (2003) found that mineralogy and geochemistry data can be useful in discriminating between Hanford and Ringold formation sediment, those data are rarely available. Together, these factors cause difficulties in identifying geologic units, and especially in distinguishing between coarse-grained units that have similarities (e.g., gravels belonging to the Hanford, Cold Creek, and Ringold units). Therefore, the identification of the geologic unit present can be highly uncertain, even at the borehole locations.

Additional uncertainty in the geologic structure exists between the boreholes where data are not available. To calculate the mass or activity of contaminant present beneath a given grid cell, it was necessary to know the geologic units that were present beneath the water table and its thicknesses. In that way, the thickness of a plume associated with a particular thickness assumption (e.g., 5, 10, 15, or 20 meters), could be partitioned between the different geologic units, and a porosity value assigned. The data on formation thicknesses used in the study were based on the geologic model incorporated in the sitewide groundwater model. That geologic model is based on interpolation of geologic formation surfaces between the boreholes using EarthVision. This provides continuous surfaces for the top and bottom of each geologic unit in the model, but one that does not take into account the uncertainty between the boreholes. Currently, the sitewide groundwater modeling group is producing a series of stochastic alternative conceptual models of the geologic structure of the aquifer using geostatistical methods. An early version of this approach can be found in Vermeul et al. (2003). That approach will be used to generate alternative simulations of the aquifer geology that honor the tops at the well bores and capture the spatial uncertainty between the boreholes. In future studies, those alternative realizations could be used to determine the sensitivity of the mass and activity estimates and other metrics of uncertainty in the geologic structure.

One major element of the geologic uncertainty described in the preceding paragraph is the spatial distribution of mud units in the Ringold Formation. As discussed in Section 2.2.2, the current study assumed that the mud units would not contribute to the mass and activity of the contaminants. Therefore, improved models of the spatial distribution of the mud units would be an important aspect of any future mass and activity simulations for history matching. An additional aspect that could be examined is the potential for contaminants in the mud units to contribute to the total contaminant load. Based on data from the literature on contaminant transport into and out of mud units, different scenarios for the role of the mud units at Hanford could be developed and a sensitivity analysis could be used to assess the potential effects of those scenarios on the uncertainty bounds for history matching metrics.

4.4 Uncertainty in Porosity Distributions

An additional element of geologic uncertainty that could contribute to increased uncertainty in history matching metrics is the porosity distribution within different units. For the current study, a single porosity value was sampled from the probability distributions given for each geologic unit in Table 2.1 and applied throughout the Hanford Site for a given simulation of concentration. This approach does not capture the spatial variability that might be expected in porosity within each of the geologic units caused by spatial variations in grain size, sorting, and cementation. Additional uncertainty could be introduced into the new model in two ways. One would be to simply draw a separate porosity value from the relevant probability distribution for each occurrence of a geologic unit. This would produce independent values of porosity for each unit and would not account for any spatial correlation that might be expected in the porosity within nearby cells. In order to account for spatial correlation, an alternative approach would be to use geostatistics to generate a series of simulations of the porosity of each geologic unit. However, this approach would be problematic because there are insufficient porosity data for inference of variogram models, so the variogram models would need to be developed from other data that are available for a large number of samples, e.g., grain size.

4.5 Uncertainty in Geostatistical Modeling

There are two major elements of uncertainty in the geostatistical modeling that have not been quantified. One is the impact that modifications in the variogram model might have on simulated concentration values, and thereby on the metrics that were developed for history matching. The fitting of variogram models to experimental variogram values is not a well-constrained process, and there is variation possible in the range, nugget, and other parameters selected in fitting the model, especially in cases where the data are few and highly clustered or spatially noisy (i.e., the concentration does not appear to vary smoothly in space). To determine the potential impact of uncertainty in variogram modeling, it would be possible to do sensitivity studies, vary model parameters and then generate alternative sets of stochastic simulations of the concentration that could be used to calculate alternative sets of metrics for a particular plume.

Also, as discussed in Section 3.5, metrics calculated from the geostatistical simulations, including the total activity in a plume and the area above the DWS, may underestimate the true values of metrics in areas with sparse data. In the current study, this situation appears to occur in the larger plumes associated with 200 East Area that have undergone rapid transport due to the presence of permeable Hanford formation gravels at the water table. In those areas, the spacing between wells is often beyond the range of the variogram model, and there are only a few high concentration data points within the plume that tend to be overshadowed by a larger number of low values located beyond the edge of the plume. Thus, high concentrations tend to be simulated within limited areas near high concentration data points within the plume, and the plume is not as well connected as it might be in a hand-drawn contour map.

Several avenues could be investigated to deal with this situation. One would be to split the plume within sub-area 1 of Grid 3 into near-field and far-field zones and model the experimental variograms separately. As mentioned in Section 3.2, there may be differences between the long- and short-range variogram structures because many local recharge areas associated with discrete waste facilities in the near-field areas create complex local groundwater flow directions that affect the short-range variogram structure, whereas farther away from the source, the contaminant distribution and variogram structure associated with it are affected only by the regional groundwater flow. This suggests that there might be longer variogram ranges in far-field areas of the plume, though it remains to be seen if there is sufficient data to calculate reliable variograms in those areas.

An additional complexity is that the direction of maximum continuity varies in the far-field flow system. For example in Figure 3.15, the direction of maximum continuity of tritium concentration data is roughly northwest-southeast between 200 East Area and the Central Landfill. However, the plume bifurcates east of that area, apparently due to the distribution of relatively low permeability sediment of the Cold Creek unit and Ringold Formation in that area. A segment of the plume continues to the south-east, past the 400 Area toward the Columbia River, while a sizeable portion of the contamination has moved toward the northeast. Thus, the maximum continuity of the concentration data changes in that area from northwest-southeast to northeast-southwest. Because of the variability in anisotropy direction, it was necessary to model the variogram with an isotropic model. It might be possible to achieve greater continuity of the contaminant plumes in areas of sparse data if variations in the anisotropy field could be captured. It might be possible to do this by using the groundwater velocity field in Grid 3 to provide an estimate of local variations in the directions of maximum continuity. This would require modification of the sequential Gaussian simulation code used to simulate concentration data.

There is a simpler approach that would allow direct comparison of the metrics generated from geostatistical simulations of concentration data and SAC model runs. This would involve sampling the concentration output from the SAC model at locations, and over the same depth intervals, where historical concentration measurements were made by the Groundwater Performance Assessment Project. The data sampled from SAC model runs would then be analyzed geostatistically, using methods developed in this report, and the same metrics would be calculated from geostatistical simulations of concentration. Both sets of geostatistical simulations would be performed using the same set of sparse locations, so differences due to the sparse distribution of data would be eliminated.

5.0 Summary and Recommendations

The approach taken in this study has developed a set of metrics that quantify the spatial distribution of four radionuclide contaminants for two points in time FY 2001 and FY 1992, based on historical groundwater concentration measurements. Approximately 24 separate geostatistical studies were completed for that effort, with metrics developed for numerous individual plume areas. That information can be used to evaluate the ability of the SAC Rev. 1 model to produce simulated concentration histories over time that match historical data. In addition, this study provides measures of the uncertainty in each of those metrics that can be used to determine if predictions from the SAC model fall within the uncertainty bands expected due to spatial uncertainty in historical contaminant concentration data. The approach developed for this study appears to represent a significant improvement over the approach used for history matching evaluation of SAC Rev. 0.

Several possible improvements or extensions of the approach appear to be worth consideration and are recommended for future study. These include:

- Extend this approach to other contaminants. This is currently underway, with extension of the approach to several chemical contaminants for the same time periods. The contaminants that will be completed in FY 2004 are chromium, nitrate, and carbon tetrachloride.

- Generate results for additional time points beyond the two points in time considered in the present study. History matching data should be generated for earlier points in time, although the areas covered might need to be restricted due to the sparse distribution of data for earlier time periods (see Figure 2.1).

- Examine the effect of vertical contaminant distribution assumptions on uncertainty bounds for history matching data. As mentioned in Section 4.2, a characterization of systems study will be conducted in FY 2004 to examine the vertical distribution of contaminants. The results of that study should be used to guide a sensitivity or uncertainty analysis of the effect on uncertainty bounds of history matching data related to uncertainty in plume thickness and the vertical distribution of contaminants within the plume. For example, one could examine the difference in uncertainty bounds caused by using an assumption of constant concentration with depth versus models that assume the highest concentration occurs at the water table and then use simple mathematical models to decrease the concentration with increasing depth in the aquifer.

- Perform an uncertainty analysis to examine the effect on uncertainty bounds for various metrics that might arise from uncertainty in the geologic structure and porosity distribution. This should be done by using the results of work being performed in FY 2004 for the sitewide groundwater modeling task to develop stochastic alternative conceptual models of the geologic structure. In addition, it might be useful to examine how sensitive the metrics are to the assumption that the mud units do not store appreciable quantities of contaminants that will later become available to the aquifer again.

- Examine the sensitivity of history matching metrics to variation in the parameters of the variogram models fit to experimental variograms. This might include examining smaller grid areas more representative of individual plumes, especially in the large plume associated with 200 East Area to examine the relationship between near source and far-field variograms.

- Produce a set of metrics based on the SAC model runs that accounts for the sparseness of concentration data available for geostatistical modeling. That set of metrics is more likely to match the metrics presented in this study. The suggested approach includes sampling the concentration fields from the SAC model runs at historical well locations and over the screened intervals that were employed in sampling groundwater. Geostatistical analysis of the sampled model runs would then be used to generate a set of metrics using the same methods described in this report. The metrics calculated from historical groundwater data and sampled SAC model runs would then be compared to evaluate the ability of the SAC model to reproduce historical groundwater concentration data.

6.0 References

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Appendix A

Sub-Area Boundary Coordinates for FY 2001 Tritium

Appendix A

Sub-Area Boundary Coordinates for FY 2001 Tritium

Table A.1. Coordinates for Sub-Area Boundaries for Grid 1 (200 West Area) of FY 2001 Tritium

Sub-Area 1		Sub-Area 2	
Easting (m)	Northing (m)	Easting (m)	Northing (m)
565400	131400	565400	139200
565400	134250	569868	139200
570515	138320	570515	138320
571060	137034	565400	134250
571364	136328	565400	139200
572138	135554		
572405	134779		
572700	134629		
572700	131400		
565400	131400		

Table A.2. Coordinates for Sub-Area Boundary for Grid 2 (100 Areas) of FY 2001 Tritium

Easting (m)	Northing (m)	Easting (m)	Northing (m)
563900	143800	581522	145250
563900	145566	581309	145590
564206	145277	581053	145975
564778	145277	580882	146188
565610	145502	580455	146531
566373	145754	579944	146444
566915	145882	579390	146318
567588	146172	578834	146360
567905	146522	578407	146444
568736	147033	578067	146871
569056	147447	577766	147469
569597	147959	577682	147893
570361	148692	577766	148408
570967	149392	577980	148789
572118	150987	578193	149304
572754	151785	578193	149815
573070	152199	578193	150410
573965	152744	577938	151051
573996	153030	577511	151436
574315	153828	577171	151775
574379	154144	576573	151863
574635	154500	576061	151733
575910	154500	575508	151436
577761	153410	575123	151093
578239	152710	574441	150326
579740	151371	573971	149728
579962	150987	573544	149216
579962	150573	573033	148789
579706	149806	572606	148236
579582	149614	572179	147809
579706	149200	571839	147382
580124	148787	571454	146871
580985	148211	571027	146486
581463	147764	570474	145891
582227	147350	569876	145506
581941	146902	569109	145250
582516	145724	568426	145208
582897	145118	567702	145208
583216	144129	567061	145036
583250	143800	566508	144994
582450	143800	566123	144823
582205	144140	565951	144182
581992	144441	565600	143800
581736	144910	563900	143800

Table A.3. Coordinates for Sub-Area Boundaries for Grid 3 (200 East Area) of FY 2001 Tritium

Sub-Area 1		Sub-Area 2	
Easting (m)	Northing (m)	Easting (m)	Northing (m)
573050	135650	573050	135650
575750	136950	575750	136950
576319	137080	574816	137442
576946	136478	574009	137599
577308	135180	573749	138015
579183	135415	573568	137809
579805	135567	573230	137858
580221	136037	573230	139004
580246	138196	573827	139939
582650	138900	572657	141966
582909	138876	572501	142068
583780	138441	571487	142019
584838	137633	571409	142279
585773	137011	571722	142460
587393	136135	573593	142538
586272	137197	574557	142563
583966	138876	576868	142538
587109	138925	577416	142093
589685	137285	577910	142122
590620	136169	573600	146150
591192	134999	567400	146150
593273	133570	567400	143800
594184	131797	568291	142460
594497	130319	569250	142044
594521	128733	570263	140693
594732	127822	570498	139782
594913	126990	570239	139758
594575	124704	573050	135650
594521	123950		
594521	121947		
594472	118956		
594262	117605		
594340	116694		
594810	114643		
582500	122750		
573050	135650		

Appendix B

Figures and Data Tables for FY 1992 Tritium

Appendix B

Figures and Data Tables for FY 1992 Tritium

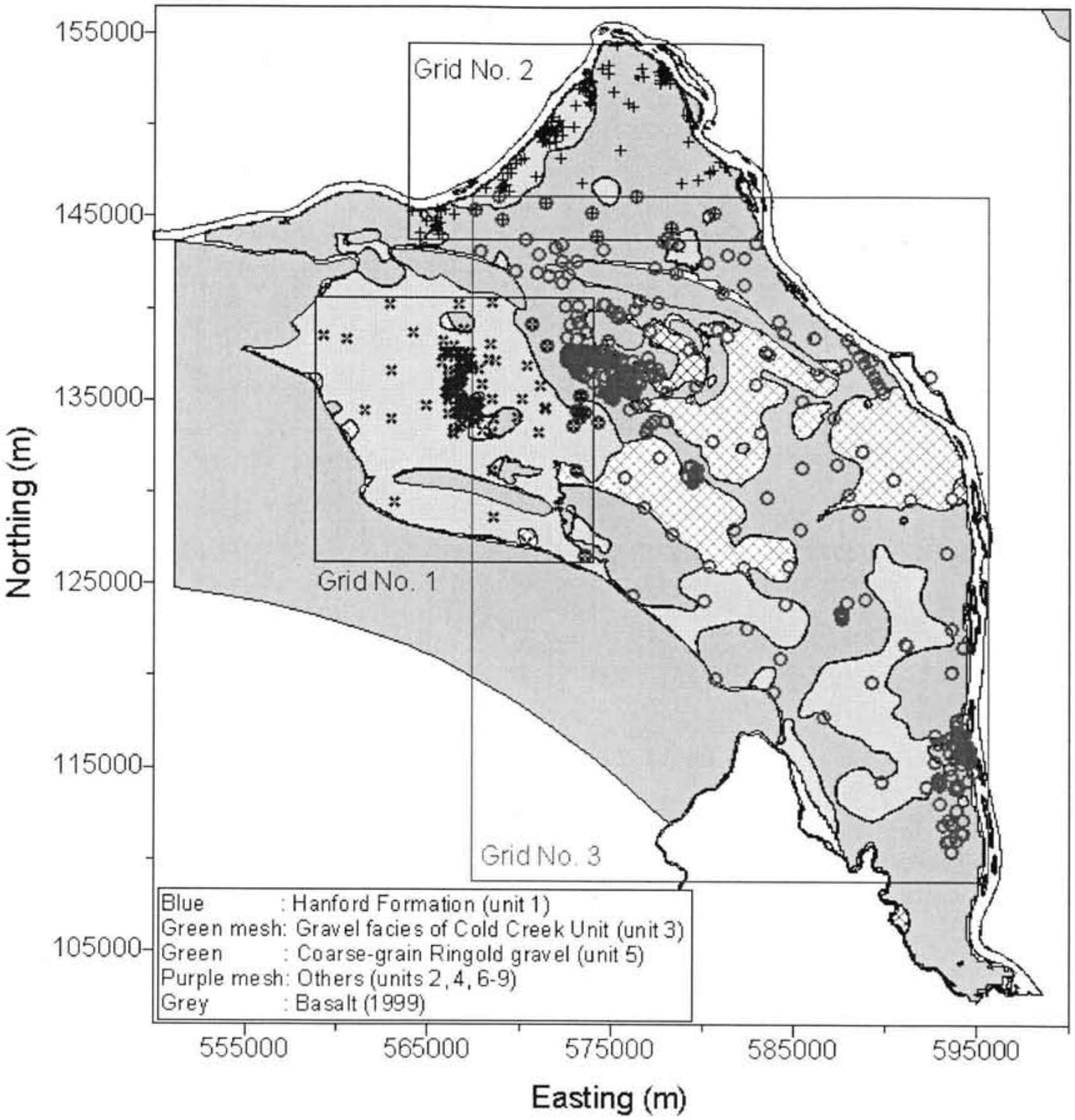

Figure B.1. Subsets of FY 1992 Tritium Data and Subcrop Formation Units at the FY 1992 Water Table

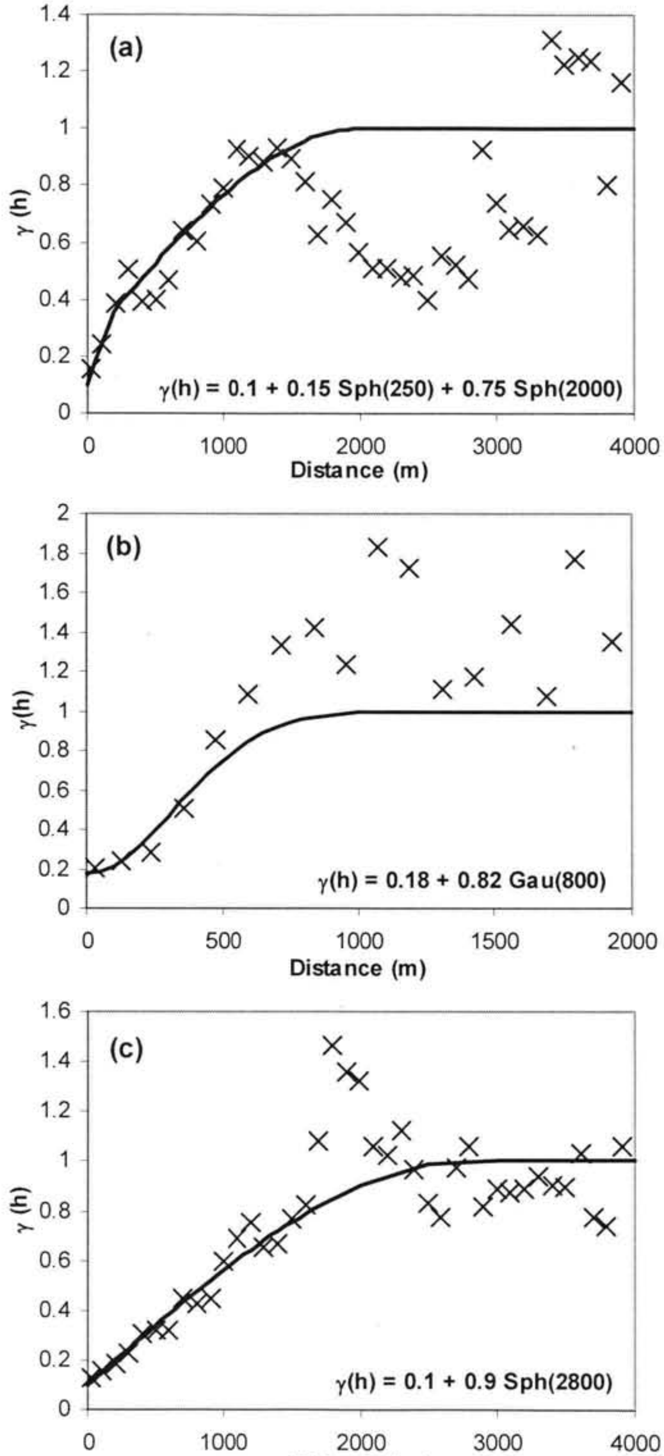

Figure B.2. Variograms and Models of Normal Scores of FY 1992 Tritium Data in Local Grid 1 (a), Grid 2 (b), and Grid 3 (c). Experimental variogram values designated by X, with the models fit to the data denoted by solid black lines.

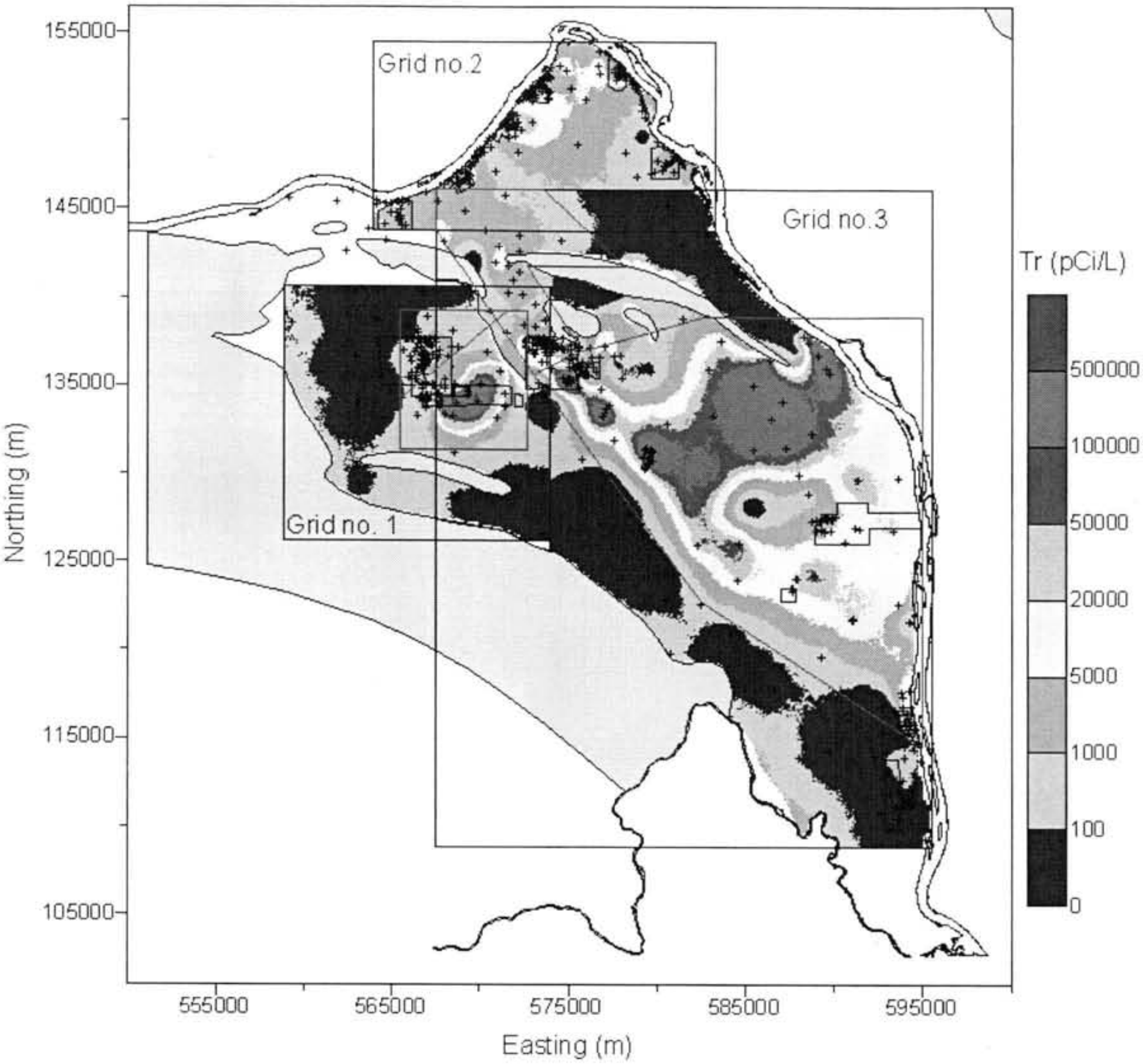

Figure B.3. Median of Simulations of FY 1992 Tritium Concentrations for Grids 1, 2, and 3

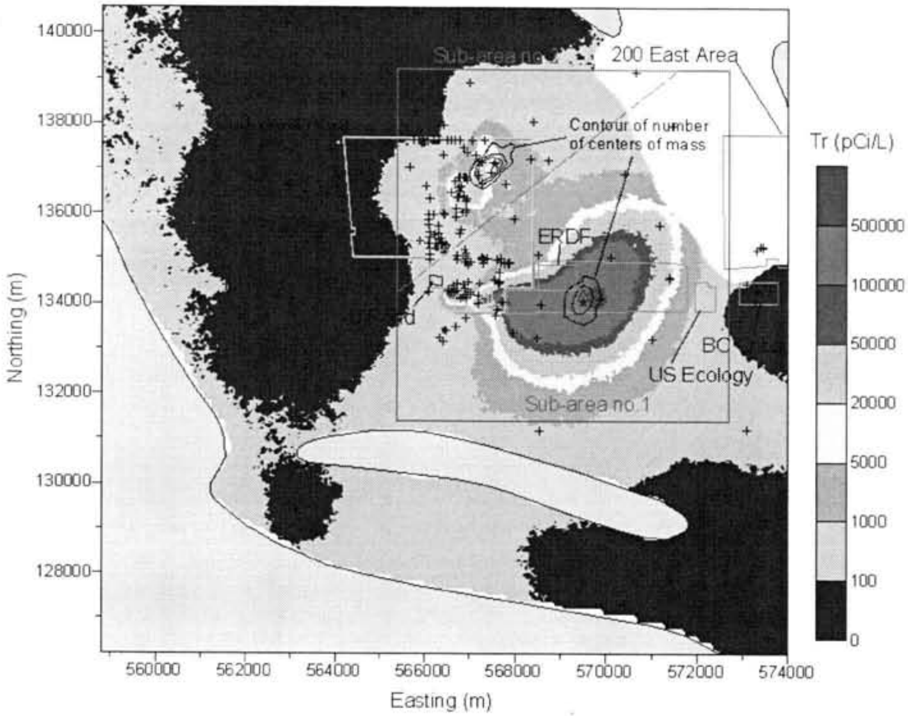

Figure B.4. Median of Simulated FY 1992 Tritium Concentrations in Grid 1 (200 West Area). Contours of the number of times that the center of mass within the sub-areas occurred within cells of an upscaled grid are shown with the average centers of mass shown by blue stars in each sub-area.

Table B.1. Coordinates for Sub-Area Boundaries for Grid 1 (200 West Area) of FY 1992 Tritium

Sub-Area 1		Sub-Area 2	
Easting (m)	Northing (m)	Easting (m)	Northing (m)
565400	131400	565400	139200
565400	134250	569786	139200
570473	138274	570473	138274
571023	136892	565400	134250
571274	136289	565400	139200
571940	135549		
572405	134779		
572700	134629		
572700	131400		
565400	131400		

Table B.2. Statistics of Centers of Mass of Individual Simulations of FY 1992 Tritium Calculated for a Depth of 5 m for Each Sub-Area of Grid 1 (200 West Area)

Coordinate (m)	Sub-Area 1		Sub-Area 2	
	Easting	Northing	Easting	Northing
Mean	569460.4	134018.9	567523.2	137113.7
Standard Error	12.5	15.4	15.3	14.3
Median	569466.3	134011.0	567458.0	137061.0
Standard Deviation	279.4	344.0	342.1	318.8
Kurtosis	1.09	0.03	3.37	0.89
Skewness	-0.32	0.02	1.42	0.88
Range	2069.4	1905.6	2403.6	1844.6
Minimum	568277.0	133041.8	566760.1	136499.3
Maximum	570346.3	134947.3	569163.7	138343.9
Count	500	500	500	500
97.5th Percentile	570007.3	134746.7	568485.9	137876.5
2.5th Percentile	568913.0	133317.2	567007.1	136620.6
Confidence Level of Mean (95.0%)	24.5	30.2	30.1	28.0

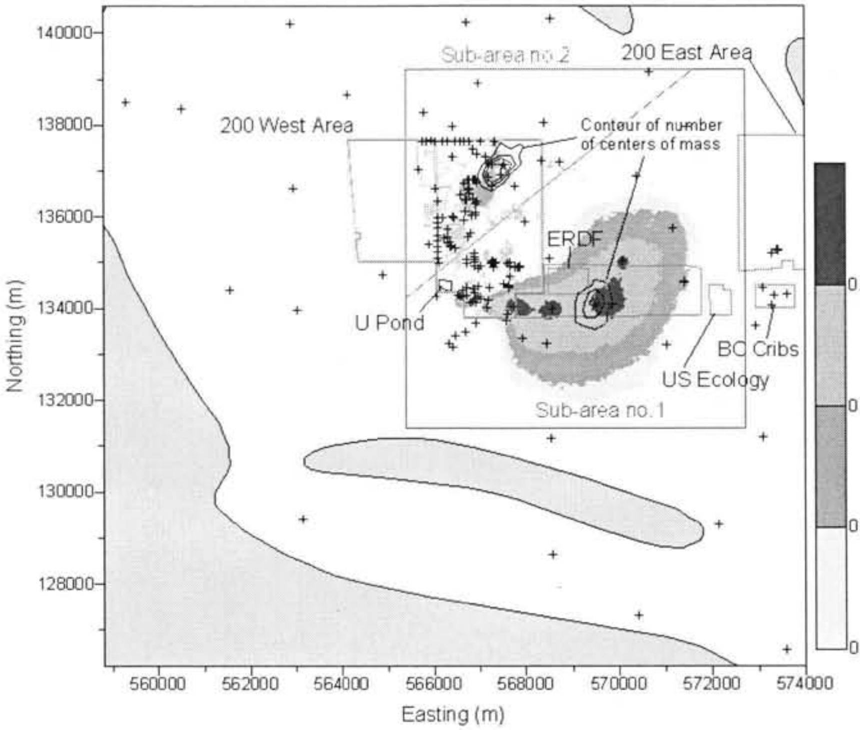

Figure B.5. Probability of Exceeding 20,000 pCi/L Based on Simulations of FY 1992 Tritium in Grid 1 (200 West Area)

Table B.3. Area Exceeding 20,000 pCi/L for FY 1992 Tritium for Each Simulation within Two Sub-Areas of Grid 1 (200 West Area)

Area (km^2)	Sub-Area 1	Sub-Area 2	Grid 1
Mean	13.16	1.83	20.13
Standard Error	0.10	0.02	0.17
Median	12.99	1.76	19.85
Standard Deviation	2.25	0.50	3.76
Kurtosis	0.02	3.21	0.30
Skewness	0.17	1.30	0.46
Range	13.86	3.43	22.48
Minimum	6.75	0.82	11.40
Maximum	20.61	4.25	33.88
Count	500	500	500
97.5th Percentile	17.76	3.13	27.98
2.5th Percentile	9.01	1.07	13.62
Confidence Level of Mean (95.0%)	0.20	0.04	0.33

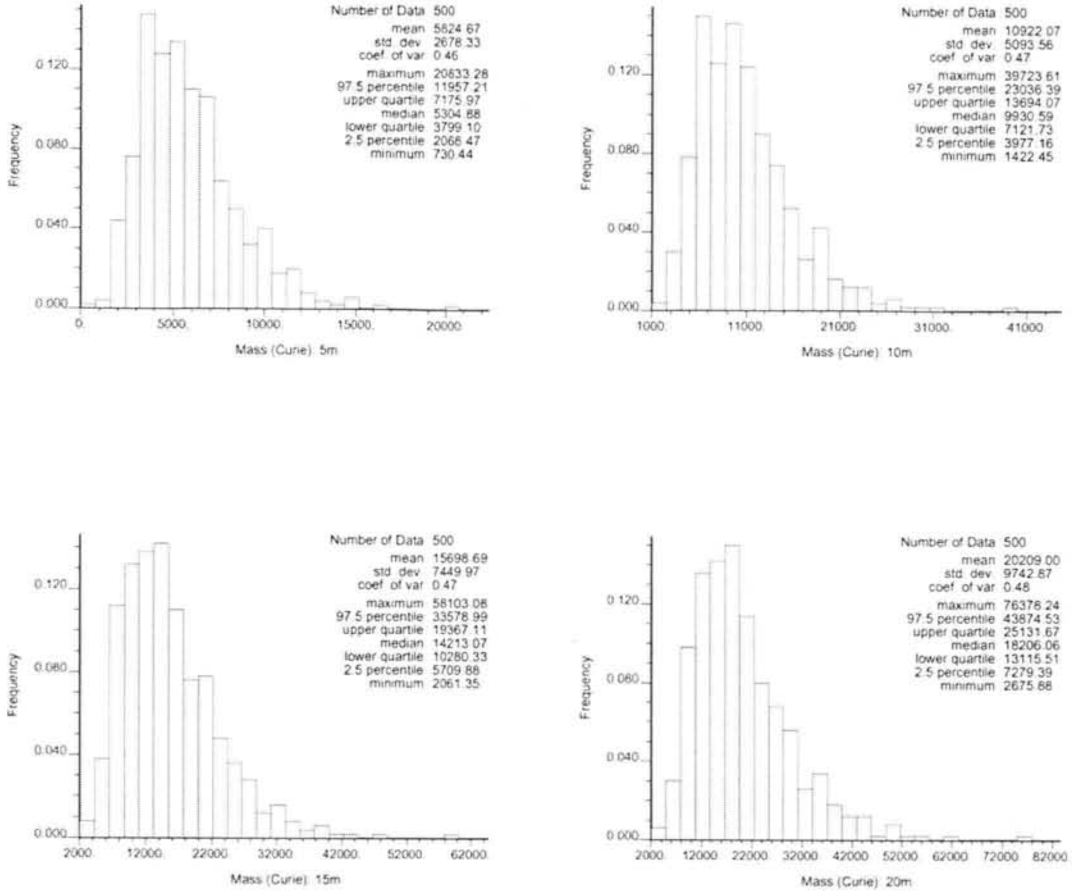

Figure B.6. **Histograms of Total Activity in Simulations of FY 1992 Tritium within Sub-Area 1 of Grid 1 (200 West Area), Four Thickness Assumptions**

Table B.4. **Statistics of Total Activity of Simulations of FY 1992 Tritium within Sub-Area 1 of Grid 1 (200 West Area), Four Thickness Assumptions**

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	5,824.67	10,922.07	15,698.69	20,208.99
Standard Error	119.90	228.02	333.51	436.15
Median	5,304.89	9,930.60	14,213.08	18,206.07
Standard Deviation	2,681.01	5,098.66	7,457.43	9,752.63
Kurtosis	2.40	2.75	2.95	3.13
Skewness	1.17	1.26	1.31	1.36
Range	20,102.83	38,301.17	56,041.73	73,702.36
Minimum	730.44	1,422.45	2,061.35	2,675.88
Maximum	20,833.28	39,723.61	58,103.08	76,378.24
Count	500	500	500	500
97.5th Percentile	11,956.96	23,036.35	33,578.76	43,873.50
2.5th Percentile	2,068.47	3,977.16	5,709.88	7,279.39
Confidence Level of Mean (95.0%)	235.57	448.00	655.25	856.92

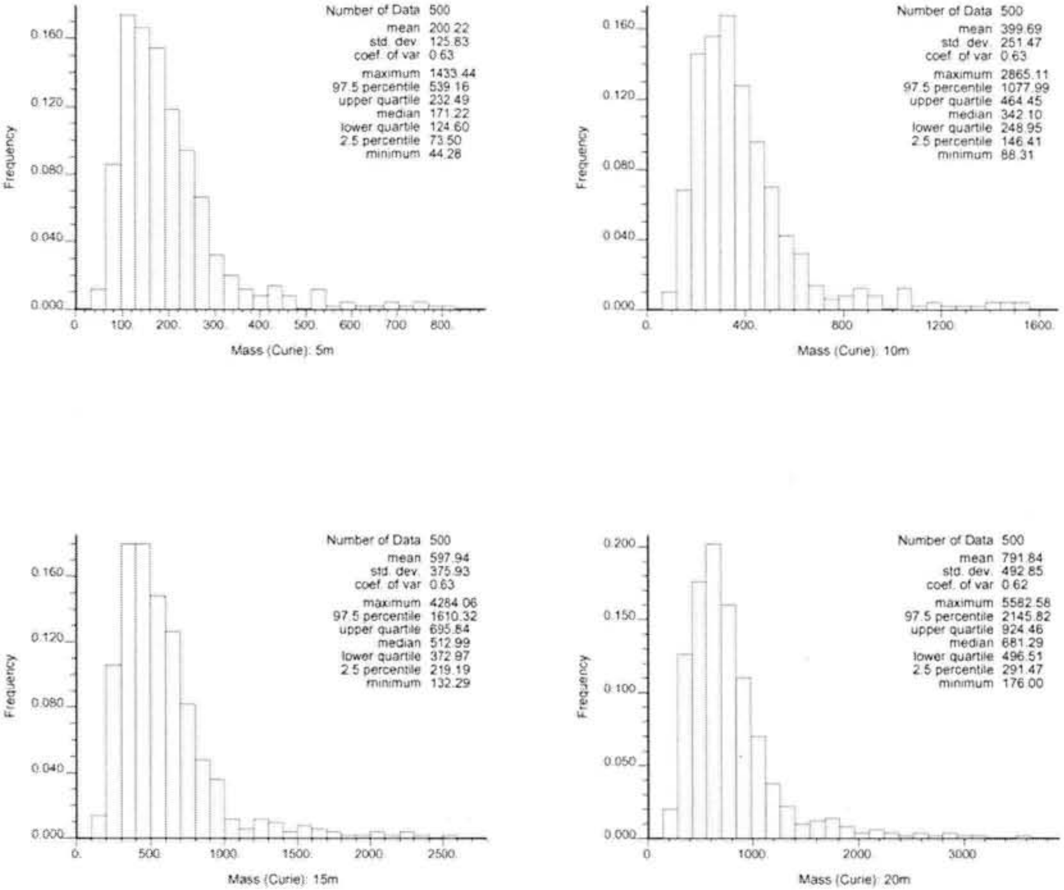

Figure B.7. **Histograms of Mass of Simulations of FY 1992 Tritium within Sub-Area 2 of Grid 1 (200 West Area), Four Depth Assumptions**

Table B.5. **Mass of Simulations of FY 1992 Tritium within Sub-Area 2 of Grid 1 (200 West Area), Four Depth Assumptions**

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	200.22	399.69	597.94	791.84
Standard Error	5.63	11.26	16.83	22.06
Median	171.22	342.11	512.99	681.29
Standard Deviation	125.96	251.72	376.31	493.34
Kurtosis	21.73	21.75	21.77	21.22
Skewness	3.44	3.44	3.44	3.40
Range	1,389.16	2,776.79	4,151.77	5,406.58
Minimum	44.28	88.31	132.29	176.00
Maximum	1,433.44	2,865.11	4,284.06	5,582.58
Count	500	500	500	500
97.5th Percentile	539.10	1,077.87	1,610.13	2,145.59
2.5th Percentile	73.50	146.41	219.19	291.47
Confidence Level of Mean (95.0%)	11.07	22.12	33.06	43.35

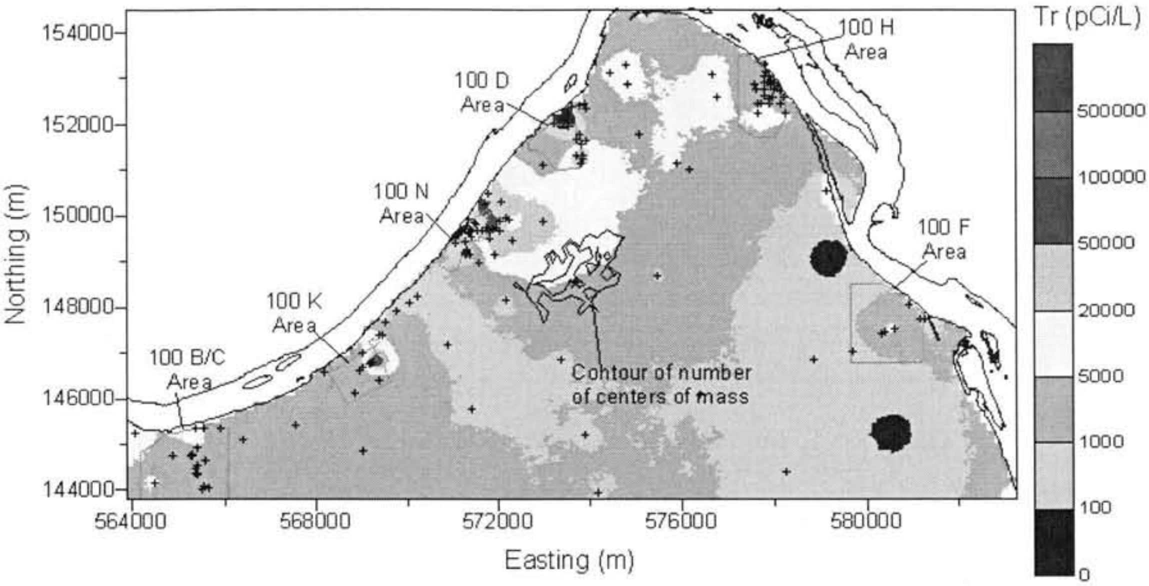

Figure B.8. Median of Simulated FY 1992 Tritium Concentrations in Grid 2 (100 Areas). Contours of the number of times that the center of mass occurred within cells of an upscaled grid are shown with the average center of mass shown by a blue star.

Table B.6. Coordinates for Sub-Area Boundary for Grid 2 (100 Areas) of FY 1992 Tritium

Easting (m)	Northing (m)	Easting (m)	Northing (m)
563900	143800	574635	154500
563900	145566	575910	154500
564206	145277	577761	153410
564778	145277	578239	152710
565610	145502	579740	151371
566373	145754	579962	150987
566915	145882	579962	150573
567588	146172	579706	149806
567905	146522	579582	149614
568736	147033	579706	149200
569056	147447	580124	148787
569597	147959	580985	148211
570361	148692	581463	147764
570967	149392	582227	147350
572118	150987	581941	146902
572754	151785	582516	145724
573070	152199	582897	145118
573965	152744	583216	144129
573996	153030	583250	143800
574315	153828	563900	143800
574379	154144		

Table B.7. Statistics of the Area Exceeding 20,000 pCi/L and Locations of Centers of Mass for Simulations of FY 1992 Tritium within Grid 2 (100 Areas)

	Area (km^2)	Center of Mass (m)	
		Easting	Northing
Mean	15.05	573710.1	148368.1
Standard Error	0.11	35.7	29.2
Median	14.69	573716.3	148370.0
Standard Deviation	2.86	944.9	773.7
Kurtosis	-0.24	0.90	-0.33
Skewness	0.35	0.00	-0.06
Range	16.38	7716.2	4549.5
Minimum	8.18	570248.0	145859.0
Maximum	24.56	577964.2	150408.5
Count	700	700	700
97.5th Percentile	21.20	575466.8	149789.9
2.5th Percentile	10.22	571800.9	146891.0
Confidence Level (95.0%)	0.21	70.1	57.4

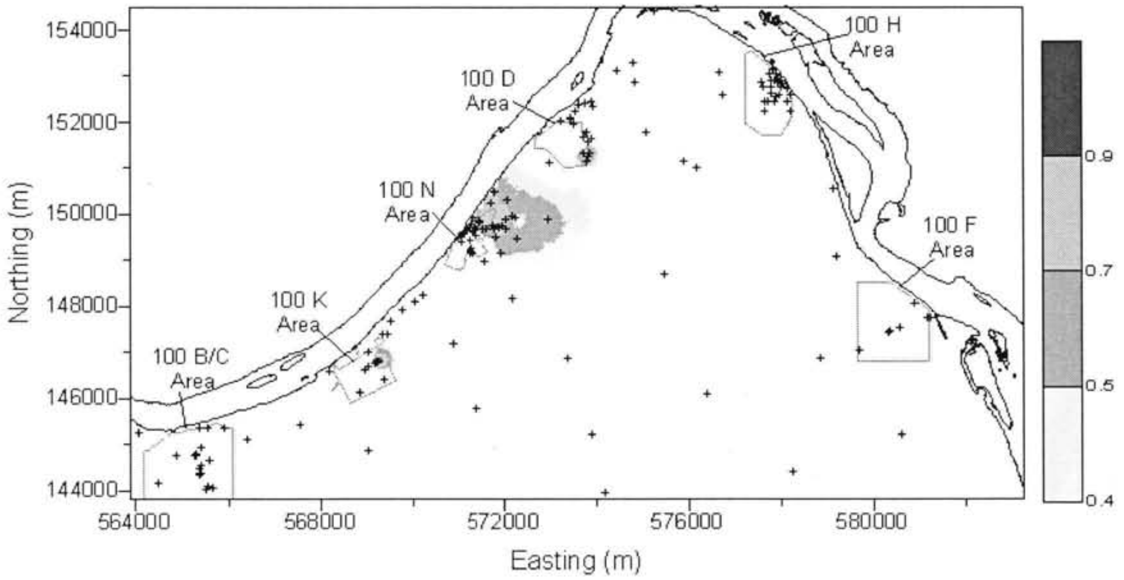

Figure B.9. Probability of Exceeding 20,000 pCi/L Based on Simulations of FY 1992 Tritium in Grid 2 (100 Areas)

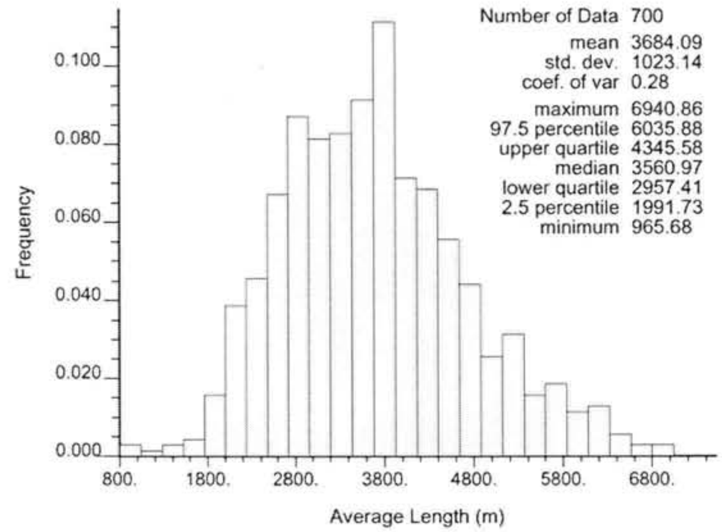

Figure B.10. Histogram of the Average Length of Columbia River Shoreline Exceeding 20,000 pCi/L for FY 1992 Tritium in Grid 2 (100 Areas)

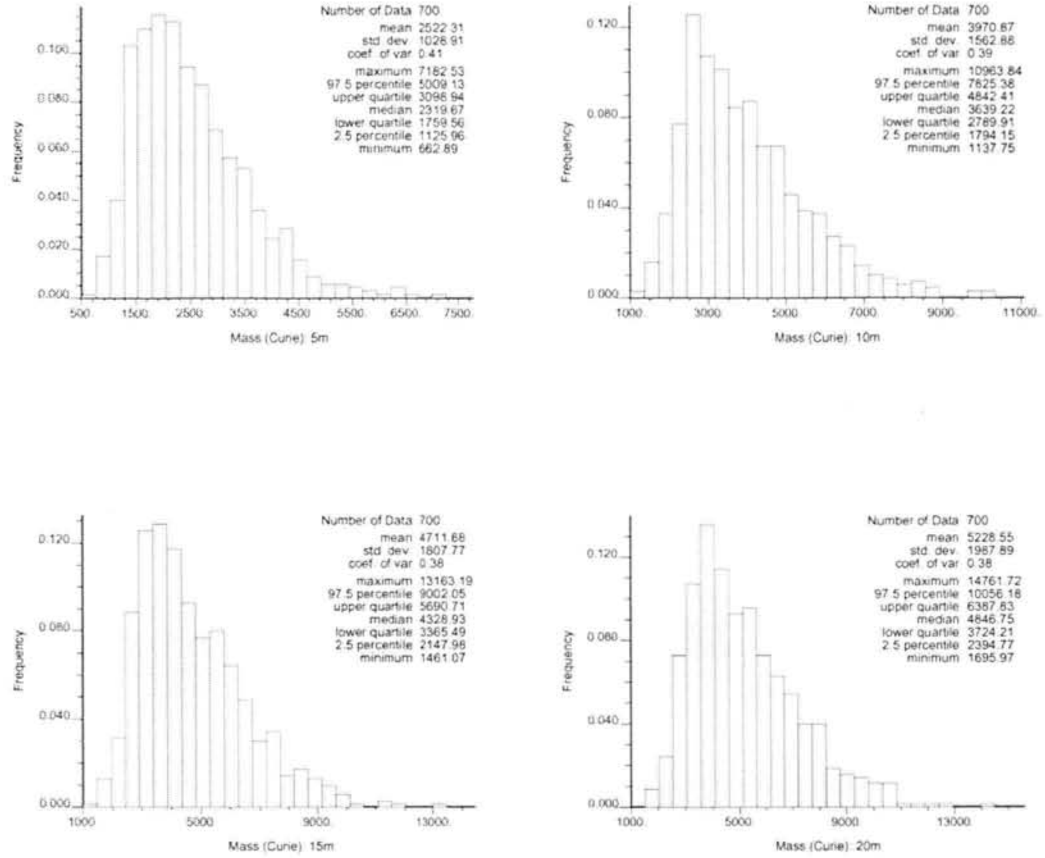

Figure B.11. Histograms of Total Activity in Simulations of FY 1992 Tritium within Grid 2 (100 Areas), Four Thickness Assumptions

Table B.8. Statistics of Total Activity of Simulations of FY 1992 Tritium within Grid 2 (100 Areas), Four Thickness Assumptions

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	2,522.31	3,970.87	4,711.68	5,228.55
Standard Error	38.92	59.11	68.38	75.19
Median	2,319.67	3,639.23	4,328.94	4,846.75
Standard Deviation	1,029.65	1,564.00	1,809.06	1,989.31
Kurtosis	1.47	1.29	1.09	1.02
Skewness	1.08	1.04	0.98	0.96
Range	6,519.65	9,826.09	11,702.11	13,065.74
Minimum	662.89	1,137.75	1,461.07	1,695.97
Maximum	7,182.53	10,963.84	13,163.19	14,761.72
Count	700	700	700	700
97.5th Percentile	5,008.89	7,825.31	9,001.98	10,055.47
2.5th Percentile	1,125.96	1,794.15	2,147.98	2,394.77
Confidence Level of Mean (95.0%)	76.41	116.06	134.25	147.62

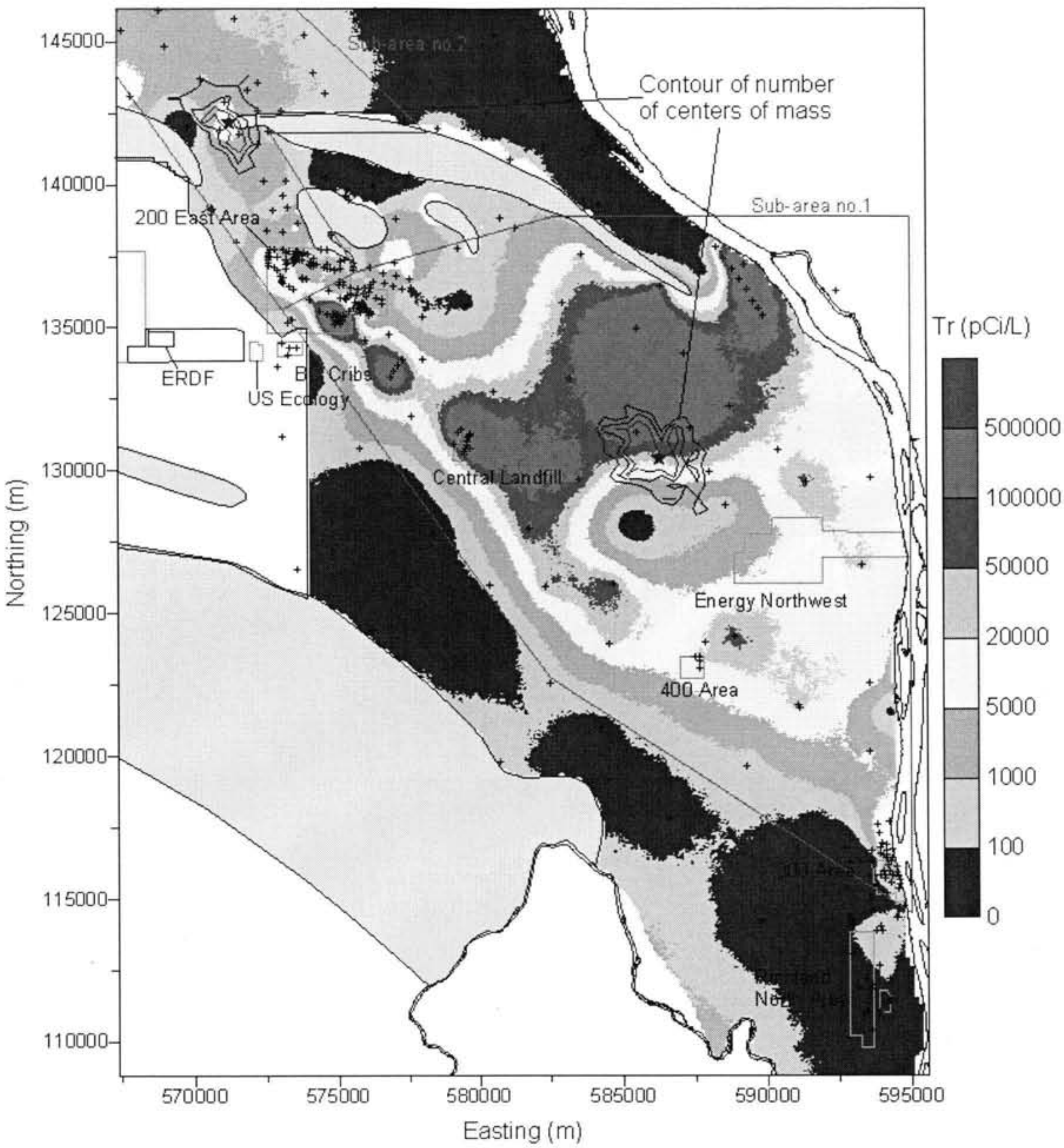

Figure B.12. Median of Simulated FY 1992 Tritium Concentrations in Grid 3 (200 East Area Plumes). Contours of the number of times that the center of mass within the sub-areas occurred within cells of an upscaled grid are shown with the average centers of mass shown by blue stars in each sub-area.

Table B.9. **Coordinates for Sub-Area Boundaries for Grid 3 (200 East Area) of FY 1992 Tritium**

Sub-Area 1		Sub-Area 2	
Easting (m)	Northing (m)	Easting (m)	Northing (m)
573050	135650	575750	136950
575750	136950	575453	137398
579634	138020	574753	137760
579609	137657	574263	137760
579790	137403	573593	139361
580020	137657	573671	139670
580074	138044	573852	139905
580045	138152	573827	139939
582650	138900	572657	141966
582909	138876	572501	142068
583780	138441	571487	142019
584838	137633	571409	142279
585773	137011	571722	142460
587393	136135	573593	142538
586272	137197	574557	142563
583966	138876	576868	142538
587109	138925	577416	142093
589685	137285	577910	142122
590620	136169	573600	146150
591192	134999	567400	146150
593273	133570	567400	143800
594184	131797	568320	142485
594497	130319	569201	142122
594521	128733	569769	141530
594732	127822	570156	140913
594913	126990	570283	140600
594575	124704	570259	140032
594521	123950	570102	139929
594521	121947	573050	135650
594472	118956	575750	136950
594262	117605		
594340	116694		
594810	114643		
582500	122750		
573050	135650		

Table B.10. Statistics of Locations of Center of Mass for Simulations of FY 1992 Tritium Calculated for a Depth of 5 m for Each Sub-Area of Grid 3 (200 East Area Plumes)

Coordinate (m)	Sub-Area 1		Sub-Area 2	
	Easting	Northing	Easting	Northing
Mean	586175.0	130186.6	571322.4	142135.7
Standard Error	49.6	49.2	36.0	42.3
Median	586114.3	130303.5	571393.6	142152.6
Standard Deviation	1052.9	1043.0	763.5	896.7
Kurtosis	-0.31	0.21	0.40	-0.16
Skewness	0.33	-0.50	-0.04	-0.17
Range	5620.3	6467.9	4578.5	4990.3
Minimum	583825.0	126248.5	569135.4	139448.3
Maximum	589445.4	132716.4	573713.9	144438.6
Count	450	450	450	450
97.5th Percentile	588325.4	131929.4	572776.1	143774.2
2.5th Percentile	584377.4	127935.5	569776.1	140339.5
Confidence Level of Mean (95.0%)	97.5	96.6	70.7	83.1

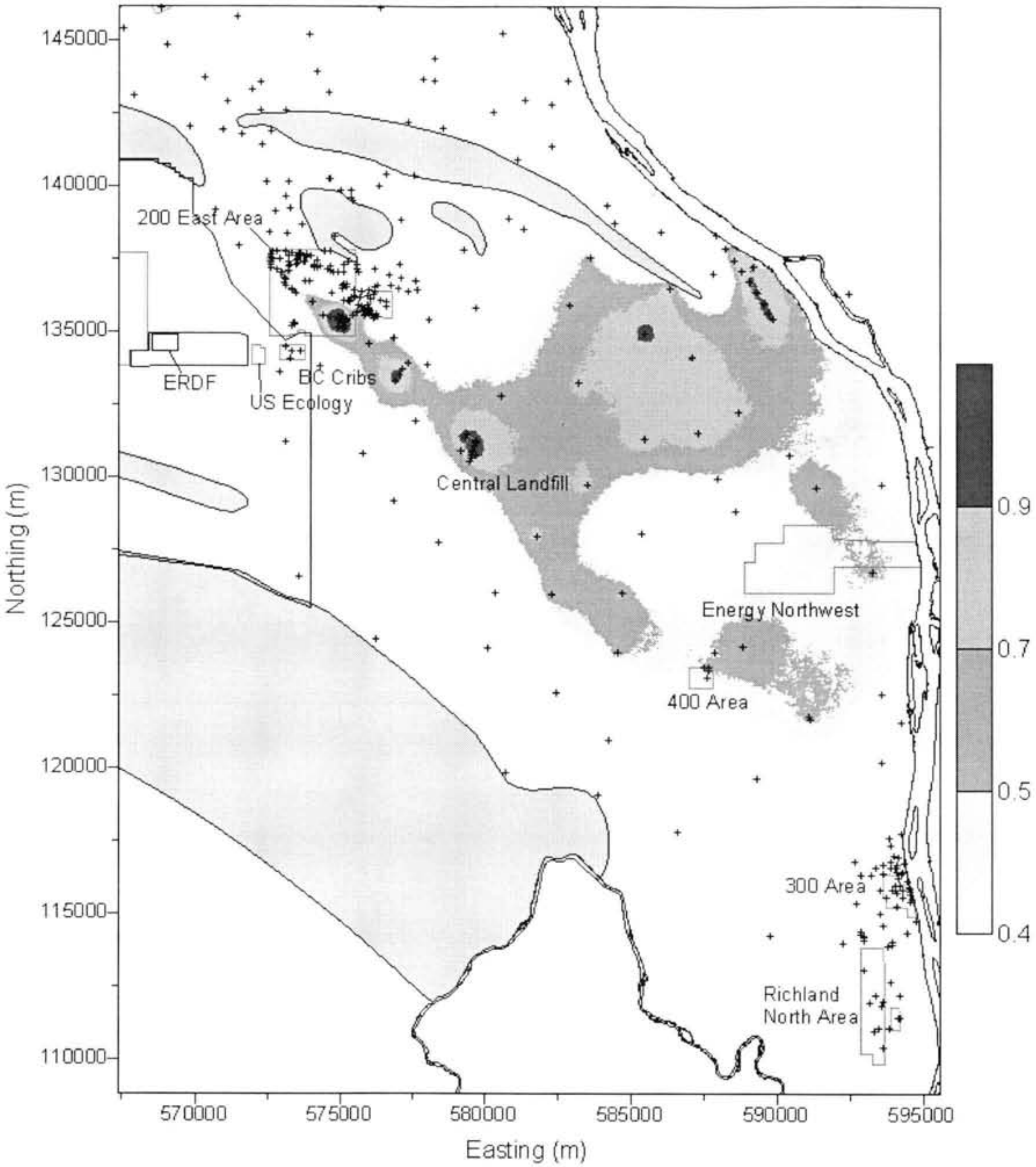

Figure B.13. Probability of Exceeding 20,000 pCi/L Based on Simulations of FY 1992 Tritium in Grid 3 (200 East Area Plumes)

Table B.11. **Area Exceeding 20,000 pCi/L for FY 1992 Tritium for Each Simulation within Two Sub-Areas of Grid 3 (200 East Area Plumes)**

Area (km^2)	Sub-Area 1	Sub-Area 2	Grid 3
Mean	117.24	6.70	133.82
Standard Error	0.60	0.09	0.63
Median	117.23	6.44	133.57
Standard Deviation	12.76	1.85	13.40
Kurtosis	0.09	0.19	0.21
Skewness	0.20	0.49	0.20
Range	78.34	11.19	85.00
Minimum	83.01	2.66	92.84
Maximum	161.35	13.85	177.84
Count	450	450	450
97.5th Percentile	143.65	10.80	162.17
2.5th Percentile	94.19	3.50	108.92
Confidence Level of Mean (95.0%)	1.18	0.17	1.24

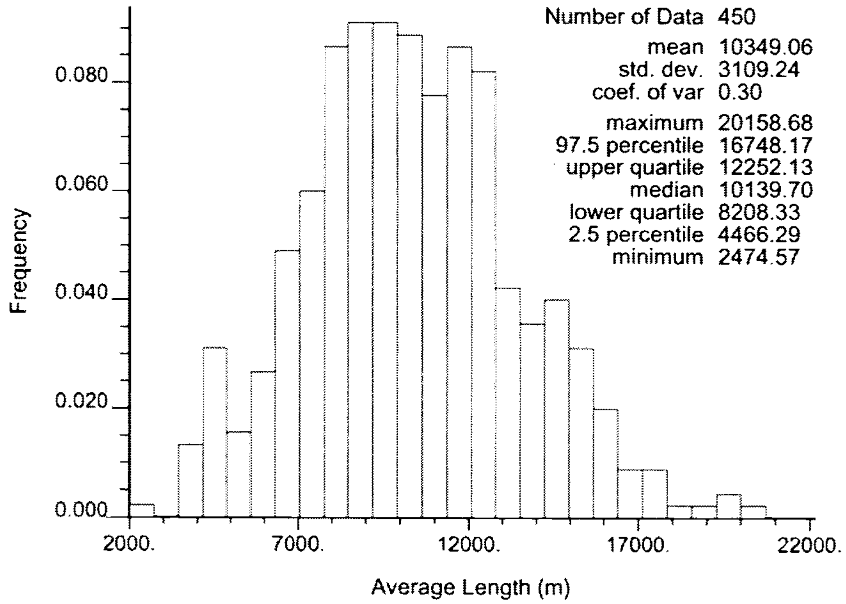

Figure B.14. **Histogram of Average Length of Columbia River Shoreline Exceeding 20,000 pCi/L for FY 1992 Tritium in Grid 3**

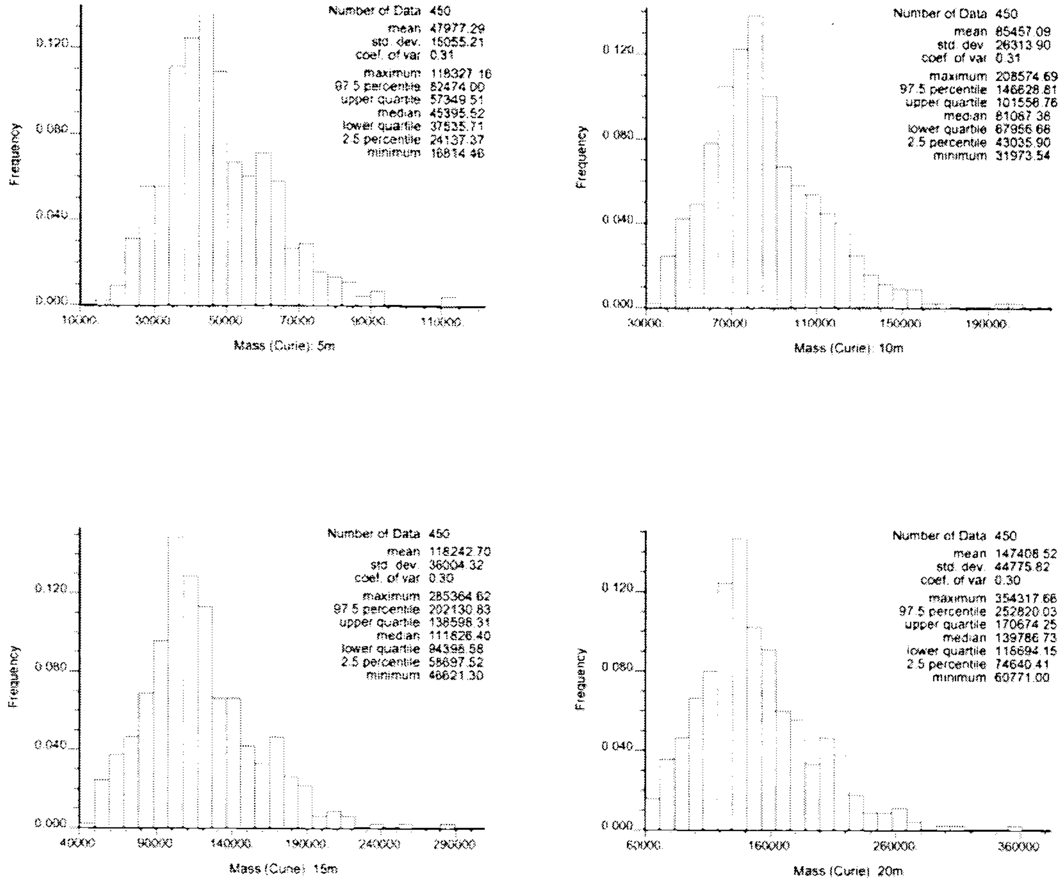

Figure B.15. Histograms of Total Activity in Simulations of FY 1992 Tritium within Sub-Area 1 of Grid 3 (200 East Area Plumes), Four Thickness Assumptions

Table B.12. Statistics of Total Activity of Simulations of FY 1992 Tritium within Sub-Area 1 of Grid 3 (200 East Area Plumes), Four Thickness Assumptions

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	47,977.31	85,457.08	11,8242.70	147,408.47
Standard Error	710.50	1,241.83	1,699.15	2,113.10
Median	45,395.52	81,087.36	111,826.39	139,786.68
Standard Deviation	15,071.96	26,343.20	36,044.39	44,825.67
Kurtosis	1.42	1.33	1.24	1.18
Skewness	0.88	0.86	0.85	0.84
Range	101,512.70	176,601.14	238,743.31	293,546.67
Minimum	16,814.46	31,973.54	46,621.30	60,771.00
Maximum	118,327.16	208,574.68	285,364.61	354,317.67
Count	450	450	450	450
97.5th Percentile	82,225.62	146,348.71	201,864.90	252,565.79
2.5th Percentile	24,226.05	43,211.51	58,750.83	74,748.07
Confidence Level of Mean (95.0%)	1,396.32	2,440.52	3,339.28	4,152.80

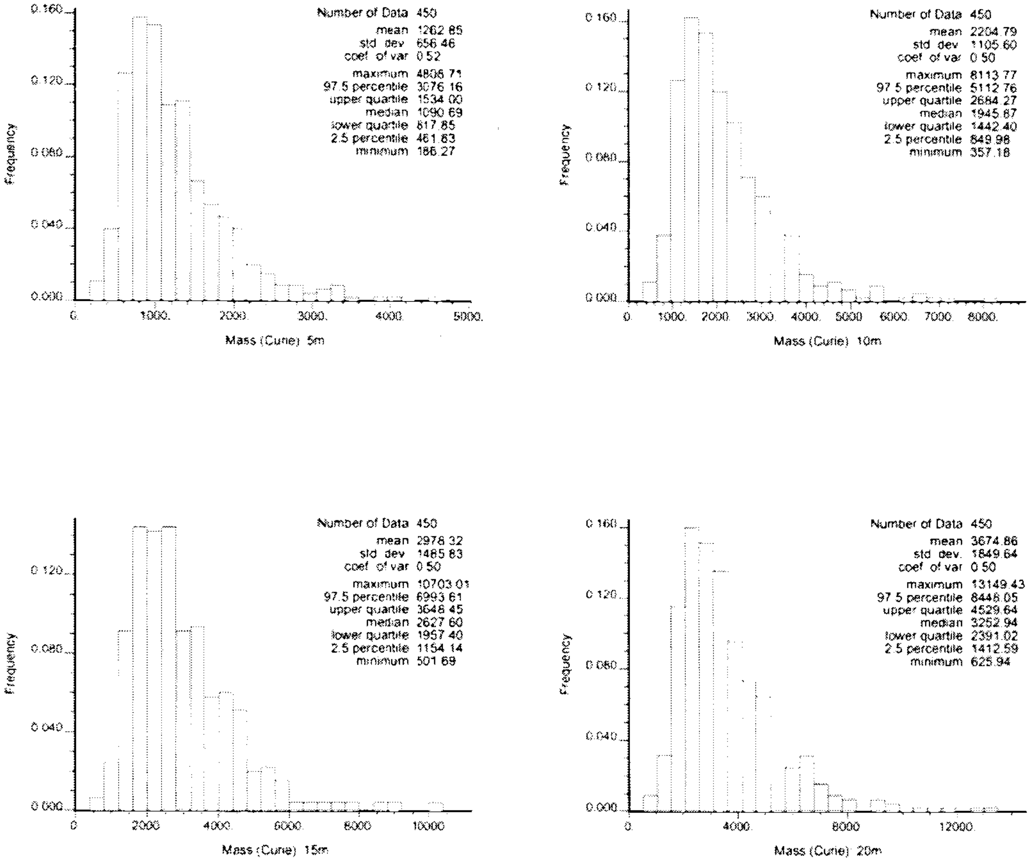

Figure B.16. Histograms of Total Activity in Simulations of FY 1992 Tritium within Sub-Area 2 of Grid 3 (200 East Area Plumes), Four Thickness Assumptions

Table B.13. Statistics of Total Activity of Simulations of FY 1992 Tritium within Sub-Area 2 of Grid 3 (200 East Area Plumes), Four Thickness Assumptions

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	1,262.85	2,204.79	2,978.32	3,674.86
Standard Error	30.98	52.18	70.12	87.29
Median	1,090.69	1,945.86	2,627.59	3,252.94
Standard Deviation	657.19	1,106.83	1,487.48	1,851.70
Kurtosis	4.29	4.14	4.15	4.20
Skewness	1.69	1.63	1.63	1.64
Range	4,622.44	7,756.59	10,201.32	12,523.50
Minimum	186.27	357.18	501.69	625.94
Maximum	4,808.71	8,113.77	10,703.01	13,149.43
Count	450	450	450	450
97.5th Percentile	3,065.12	5,067.22	6,972.57	8,292.36
2.5th Percentile	467.39	865.78	1,169.19	1,422.89
Confidence Level of Mean (95.0%)	60.88	102.54	137.81	171.55

Appendix C

Figures and Data Tables for FY 2001 Technetium-99

Appendix C

Figures and Data Tables for FY 2001 Technetium-99

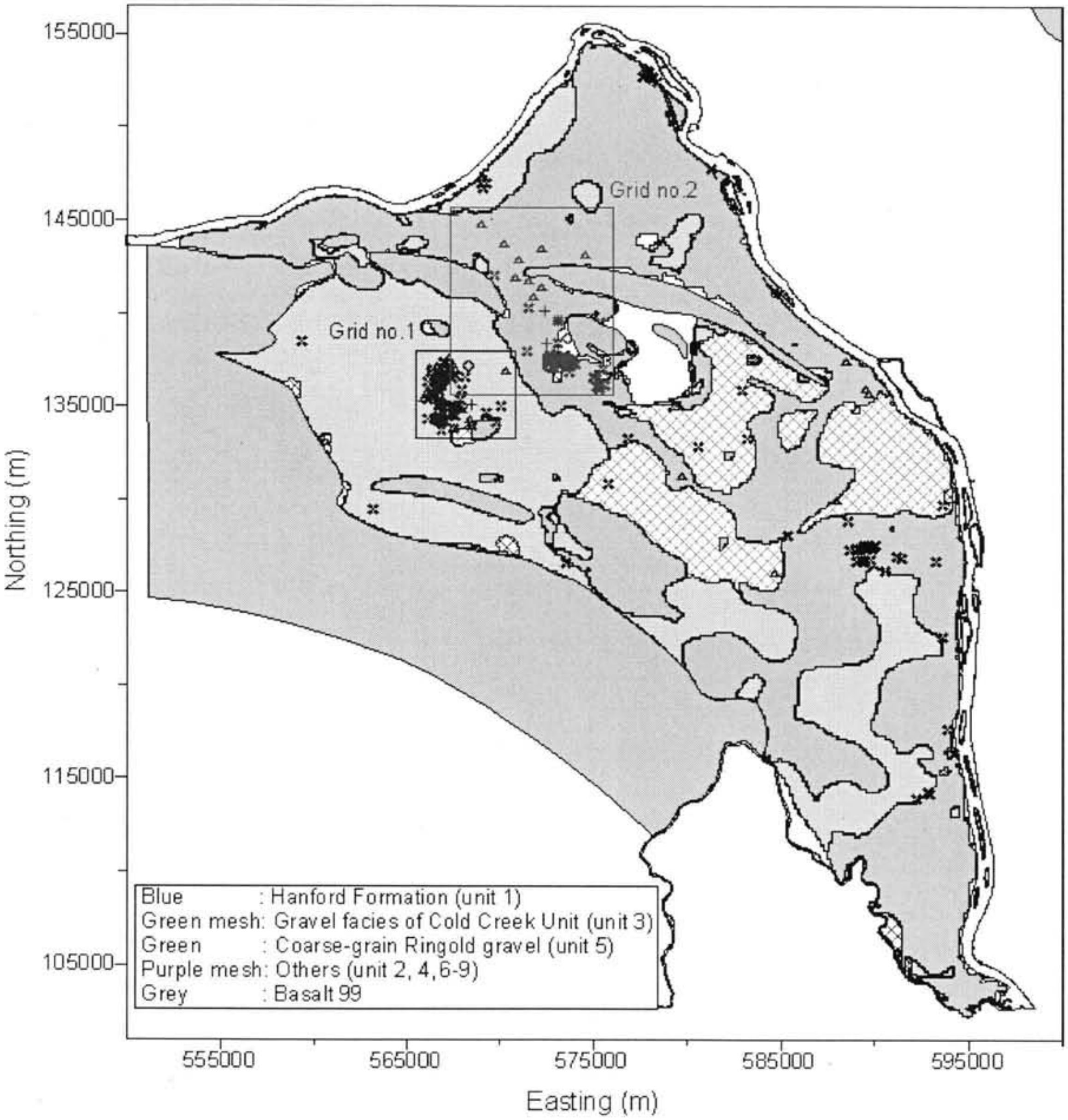

Figure C.1. Subsets of FY 2001 Technetium-99 Data and the Subcrop Formation Units at the FY 2001 Water Table

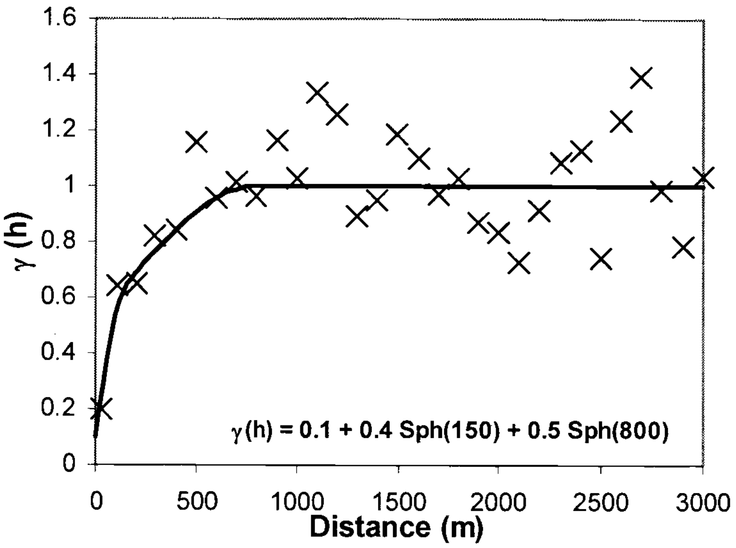

Figure C.2. Variograms and Models of Normal Scores of the FY 2001 Technetium-99 Data in Local Grid 1. Experimental variogram values designated by X, with the models fit to the data denoted by solid black lines.

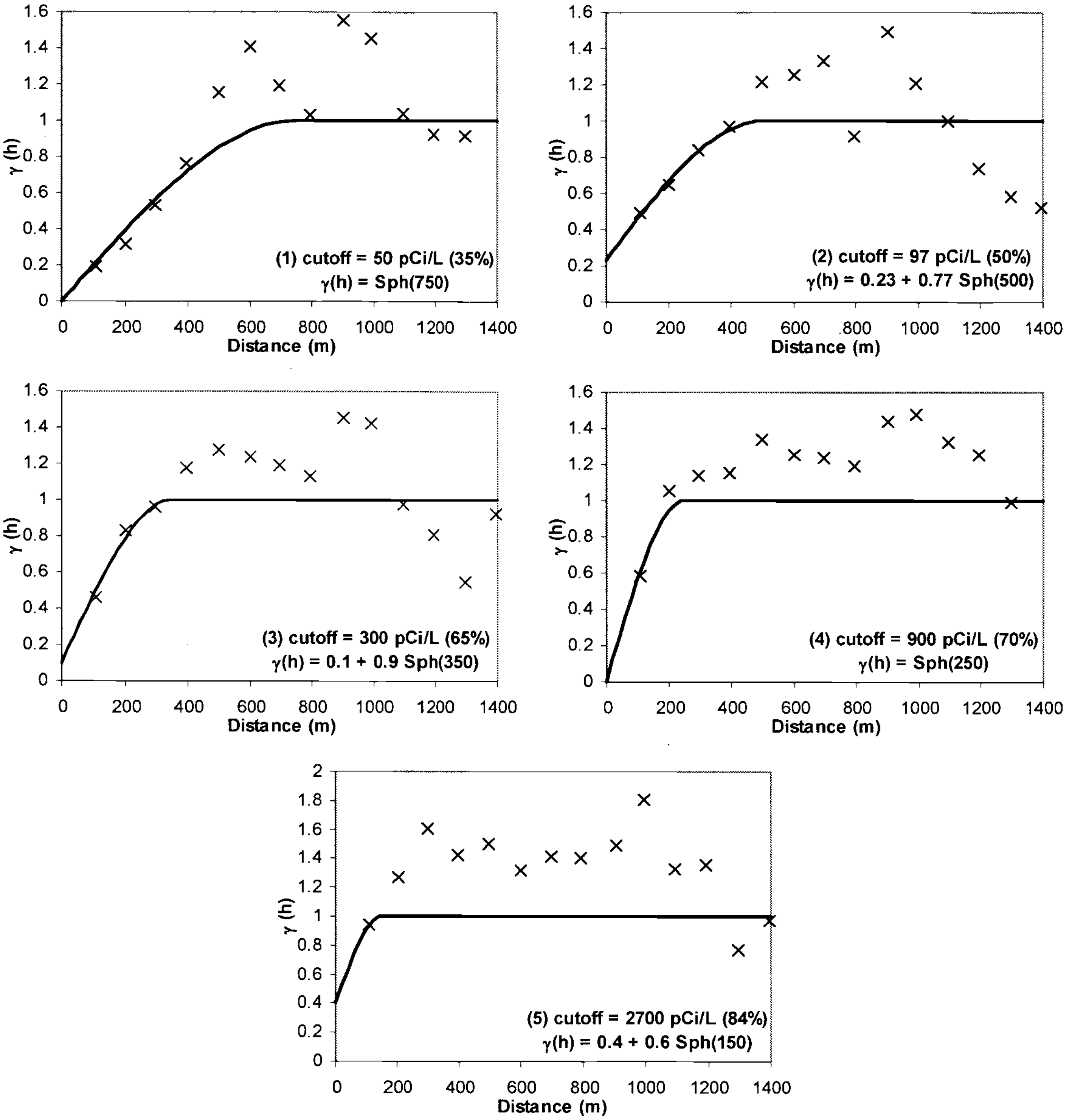

Figure C.3. Indicator Variograms and Models of the FY 2001 Technetium-99 Data in Local Grid 2. Experimental variogram values designated by X, with the models fit to the data denoted by olid black lines.

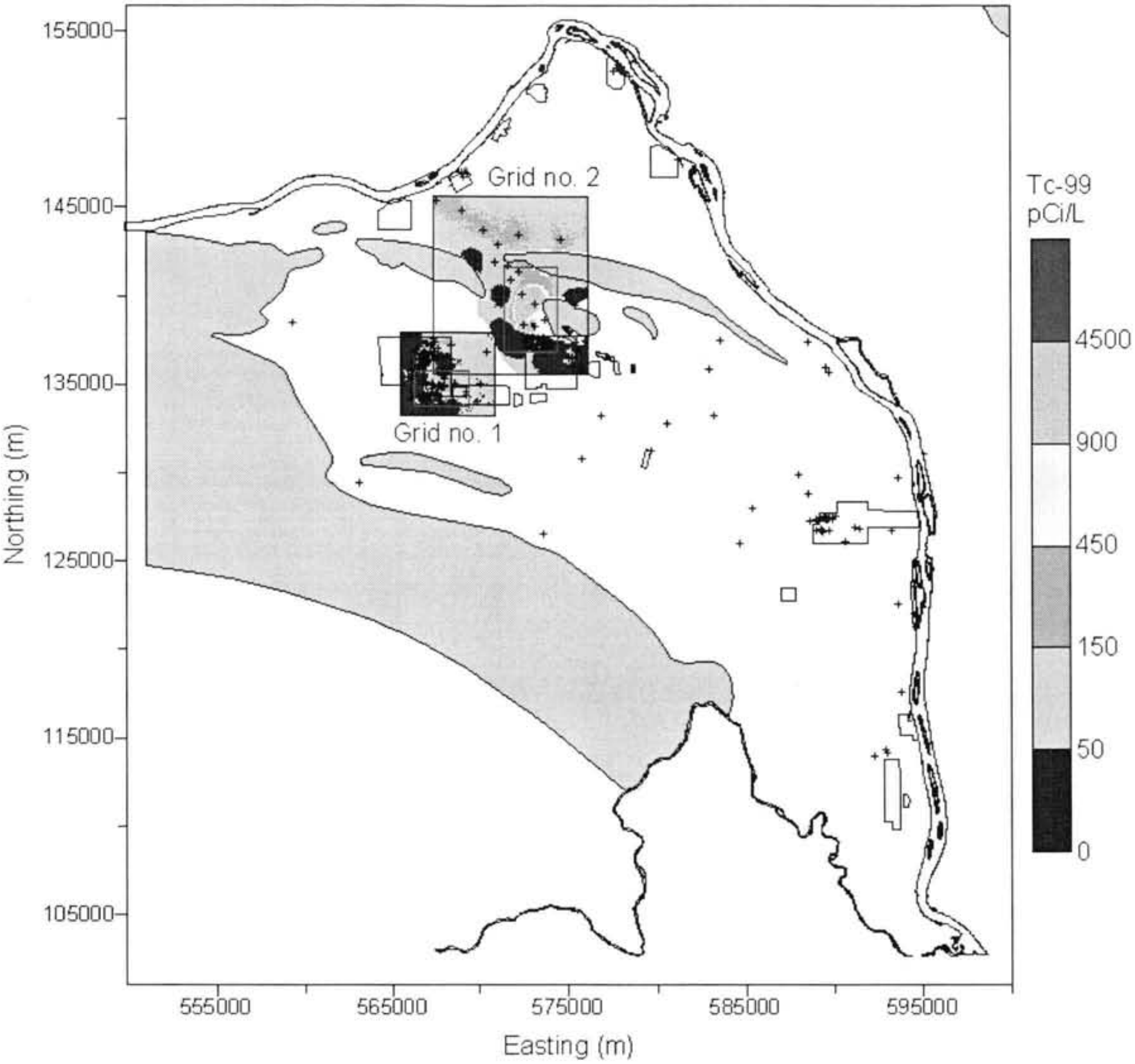

Figure C.4. Median of Simulations of FY 2001 Technetium-99 Concentrations for Grids 1 and 2

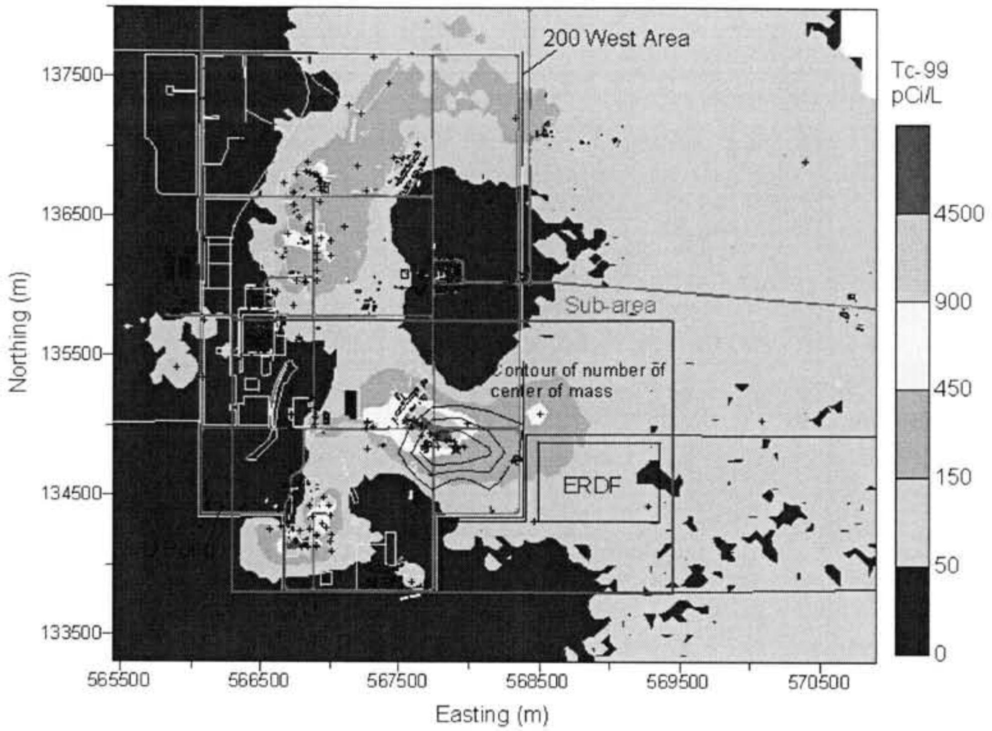

Figure C.5. Median of Simulated FY 2001 Technetium-99 Concentrations in Grid 1 (200 West Area). Contours of the number of times that the center of mass within the sub-area occurred within cells of an upscaled grid are shown with the average centers of mass shown by blue star in the sub-area.

Table C.1. Coordinates for Sub-Area Boundary for Grid 1 (200 West Area) of FY 2001 Technetium-99

Easting (m)	Northing (m)
566300	133800
569450	133800
569450	135750
566300	135750
566300	133800

Table C.2. Statistics of Centers of Mass of Individual Simulations of FY 2001 Technetium-99 Calculated for a Depth of 5 m for the Sub-Area of Grid 1 (200 West Area)

Coordinate (m)	Sub-Area	
	Easting	Northing
Mean	567987.9	134825.7
Standard Error	15.2	8.7
Median	567950.0	134826.9
Standard Deviation	263.2	151.2
Kurtosis	-0.29	-0.14
Skewness	0.40	-0.07
Range	1350.0	818.5
Minimum	567371.9	134398.8
Maximum	568721.8	135217.3
Count	300	300
97.5th Percentile	568570.4	135117.1
2.5th Percentile	567564.6	134515.1
Confidence Level of Mean (95.0%)	29.9	17.2

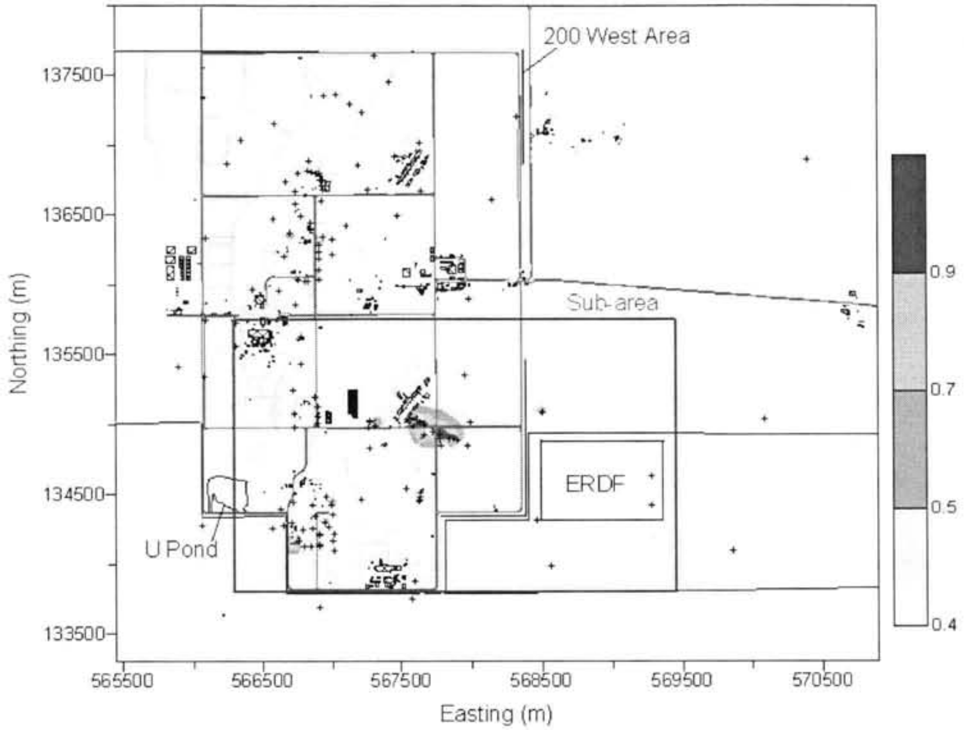

Figure C.6. Probability of Exceeding 900 pCi/L Based on Simulations of FY 2001 Technetium-99 in Grid 1 (200 West Area)

Table C.3. Area Exceeding 900 pCi/L for FY 2001 Technetium-99 for Each Simulation within Sub-Area of Grid 1 (200 West Area)

Area (km^2)	Sub-Area	Grid 1
Mean	0.71	2.71
Standard Error	0.01	0.05
Median	0.67	2.55
Standard Deviation	0.20	0.79
Kurtosis	0.16	0.31
Skewness	0.69	0.74
Range	1.07	4.05
Minimum	0.33	1.16
Maximum	1.40	5.21
Count	300	300
97.5th Percentile	1.14	4.57
2.5th Percentile	0.41	1.44
Confidence Level of Mean (95.0%)	0.02	0.09

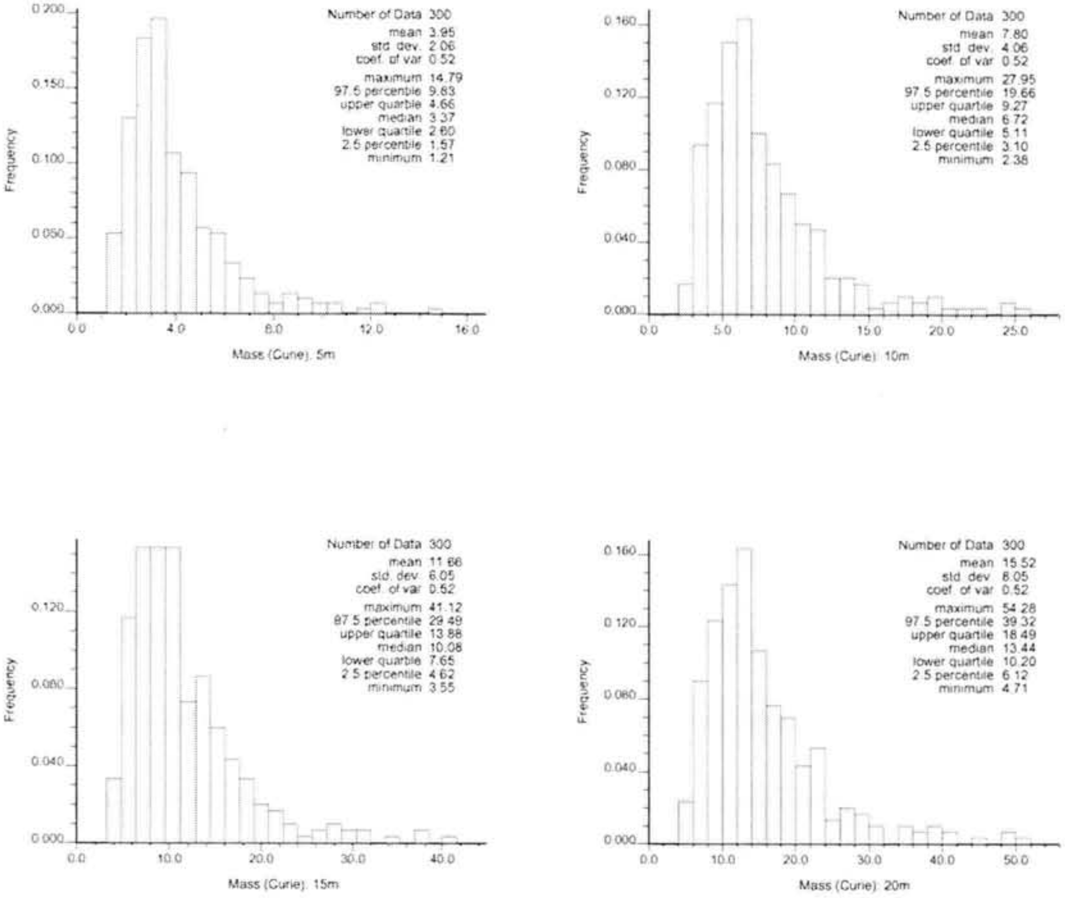

Figure C.7. Histograms of Total Activity in Simulations of FY 2001 Technetium-99 within Sub-Area of Grid 1 (200 West Area), Four Thickness Assumptions

Table C.4. Statistics of Total Activity of Simulations of FY 2001 Technetium-99 within Sub-Area of Grid 1 (200 West Area), Four Thickness Assumptions

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	3.95	7.80	11.66	15.52
Standard Error	0.12	0.23	0.35	0.47
Median	3.37	6.72	10.08	13.44
Standard Deviation	2.07	4.06	6.06	8.06
Kurtosis	4.74	4.49	4.41	4.38
Skewness	1.86	1.84	1.83	1.83
Range	13.57	25.57	37.57	49.57
Minimum	1.21	2.38	3.55	4.71
Maximum	14.79	27.95	41.12	54.28
Count	300	300	300	300
97.5th Percentile	9.83	19.66	29.49	39.32
2.5th Percentile	1.57	3.10	4.62	6.12
Confidence Level of Mean (95.0%)	0.23	0.46	0.69	0.92

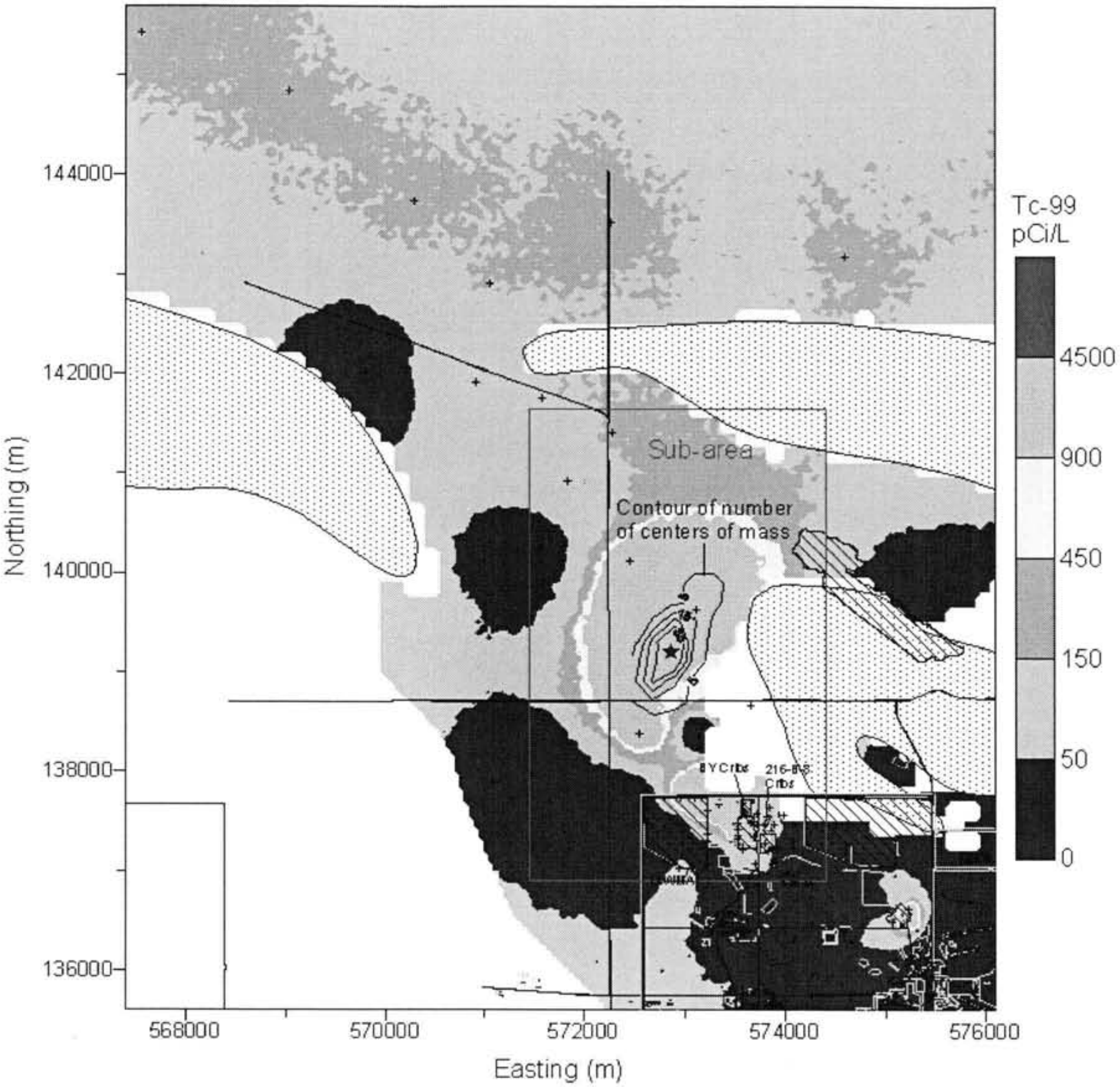

Figure C.8. Median of Simulated FY 2001 Technetium-99 Concentrations in Grid 2 (200 East Area Plume). Contours of the number of times that the center of mass within the sub-area occurred within cells of an upscaled grid are shown with the average centers of mass shown by blue star in the sub-area.

Table C.5. Coordinates for Sub-Area Boundary for Grid 2 (200 East Area) of FY 2001 Technetium-99

Easting (m)	Northing (m)
571450	141650
573143	141650
573780	141258
574149	141271
574400	141212
574400	139984
573913	139954
573706	139790
573632	139598
573617	139480
573558	139495
573499	139450
573483	139214
573364	139139
573379	139050
573217	139050
573202	138605
573350	138546
573350	138428
573215	138413
573215	137820
573676	137820
573706	137953
573795	137953
573795	137850
573928	137835
573987	137510
574400	137510
574400	136900
571450	136900
571450	141650

Table C.6. **Statistics of Centers of Mass of Individual Simulations of FY 2001 Technetium-99 Calculated for a Depth of 5 m for the Sub-Area of Grid 2 (200 East Area Plume)**

Coordinate (m)	Sub-Area	
	Easting	Northing
Mean	572769.0	139527.1
Standard Error	11.3	15.9
Median	572756.5	139521.3
Standard Deviation	226.9	318.7
Kurtosis	-0.12	0.17
Skewness	0.44	0.26
Range	1198.3	1930.8
Minimum	572294.6	138627.4
Maximum	573492.9	140558.1
Count	400	400
97.5th Percentile	573289.7	140200.6
2.5th Percentile	572373.2	138968.8
Confidence Level of Mean (95.0%)	22.3	31.3

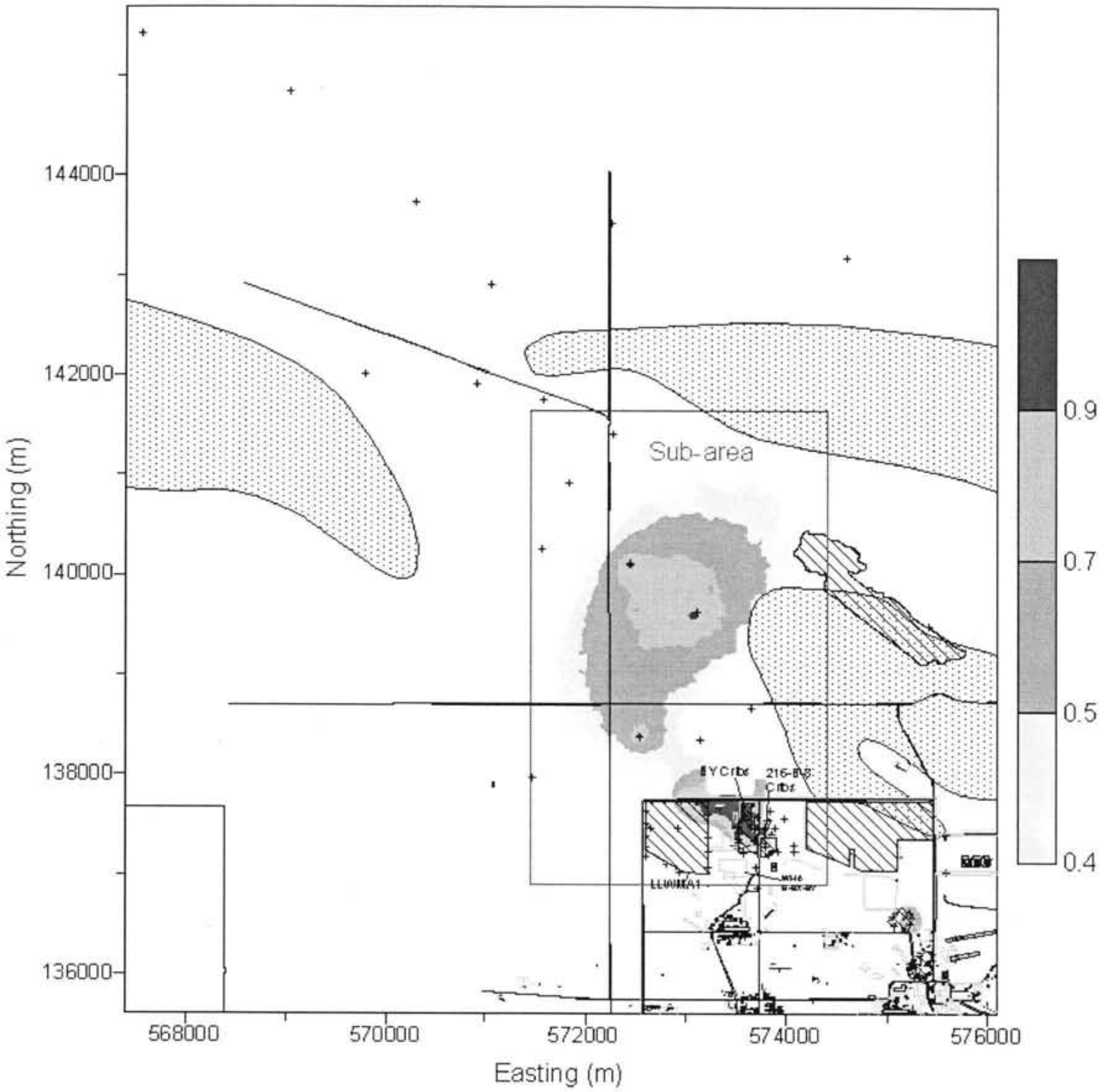

Figure C.9. Probability of Exceeding 900 pCi/L Based on Simulations of FY 2001 Technetium-99 in Grid 2 (200 East Area Plume)

Table C.7. **Area Exceeding 900 pCi/L for FY 2001 Technetium-99 for Each Simulation within Sub-Area of Grid 2 (200 East Area Plume)**

Area (km^2)	Sub-Area	Grid 2
Mean	3.89	10.59
Standard Error	0.05	0.16
Median	3.89	10.53
Standard Deviation	1.06	3.18
Kurtosis	-0.21	0.05
Skewness	0.07	0.41
Range	5.26	18.99
Minimum	1.34	3.27
Maximum	6.60	22.25
Count	400	400
97.5th Percentile	6.17	17.24
2.5th Percentile	1.81	5.09
Confidence Level of Mean (95.0%)	0.10	0.31

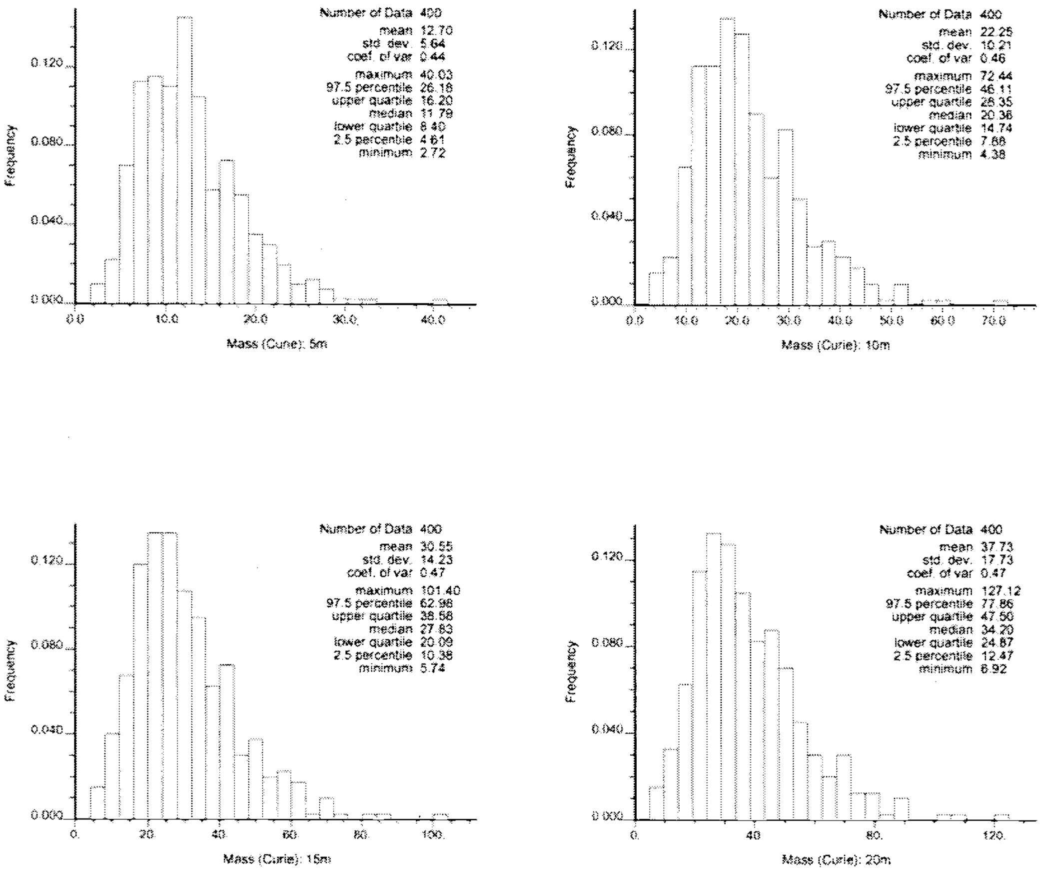

Figure C.10. Histograms of Total Activity in Simulations of FY 2001 Technetium-99 within Sub-Area of Grid 2 (200 East Area Plume), Four Thickness Assumptions

Table C.8. Statistics of Total Activity of Simulations of FY 2001 Technetium-99 within Sub-Area of Grid 2 (200 East Area Plume), Four Thickness Assumptions

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	12.70	22.25	30.55	37.73
Standard Error	0.28	0.51	0.71	0.89
Median	11.79	20.36	27.82	34.20
Standard Deviation	5.65	10.22	14.25	17.75
Kurtosis	1.50	1.76	1.94	2.09
Skewness	0.99	1.06	1.10	1.13
Range	37.31	68.06	95.66	120.19
Minimum	2.72	4.38	5.74	6.92
Maximum	40.03	72.44	101.40	127.12
Count	400	400	400	400
97.5th Percentile	26.48	46.47	63.05	78.51
2.5th Percentile	4.60	7.87	9.90	12.41
Confidence Level of Mean (95.0%)	0.56	1.00	1.40	1.74

Appendix D

Figures and Data Tables for FY 1992 Technetium-99

Appendix D

Figures and Data Tables for FY 1992 Technetium-99

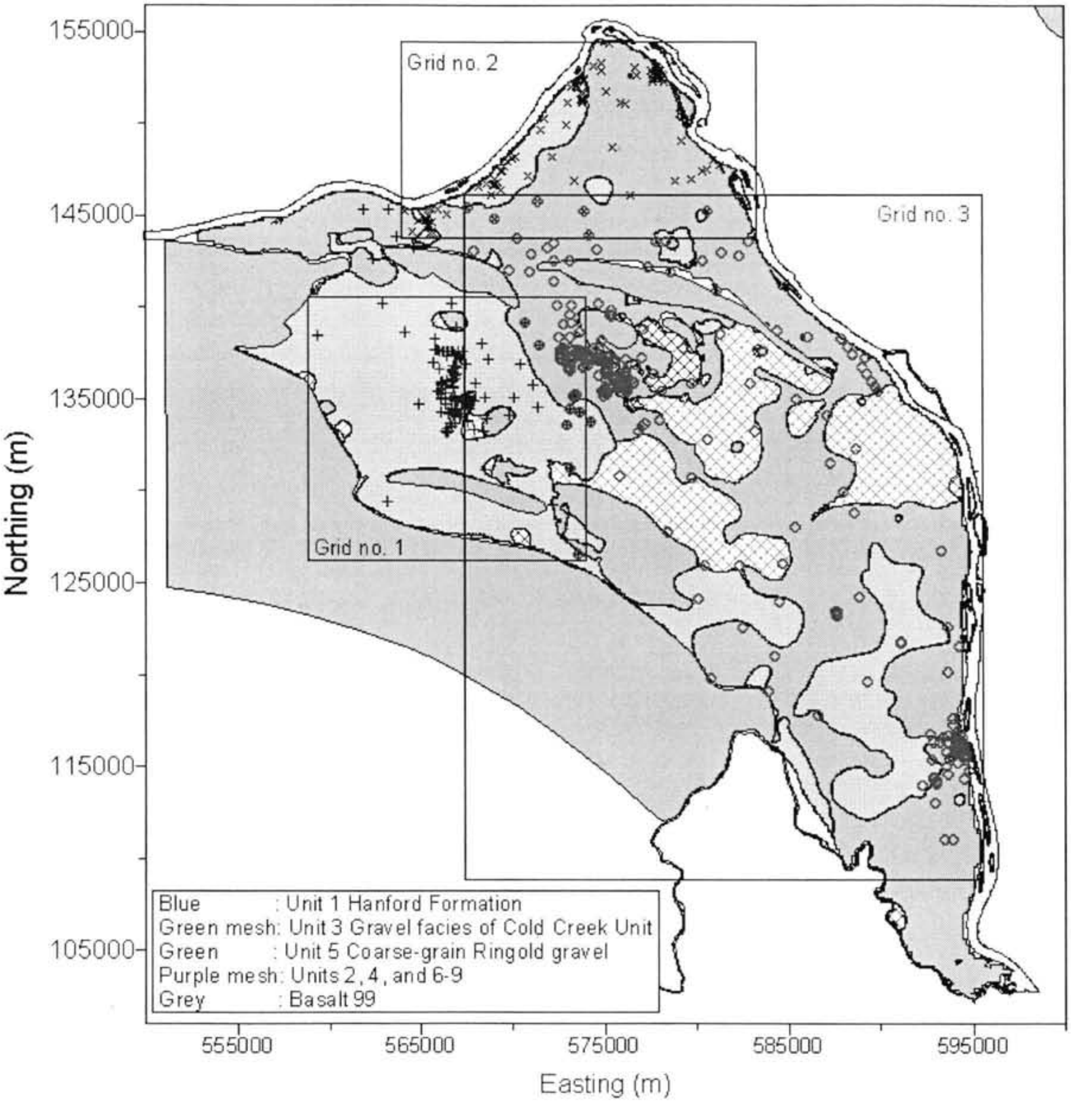

Figure D.1. Subsets of FY 1992 Technetium-99 Data and Subcrop Formation Units at the FY 1992 Water Table

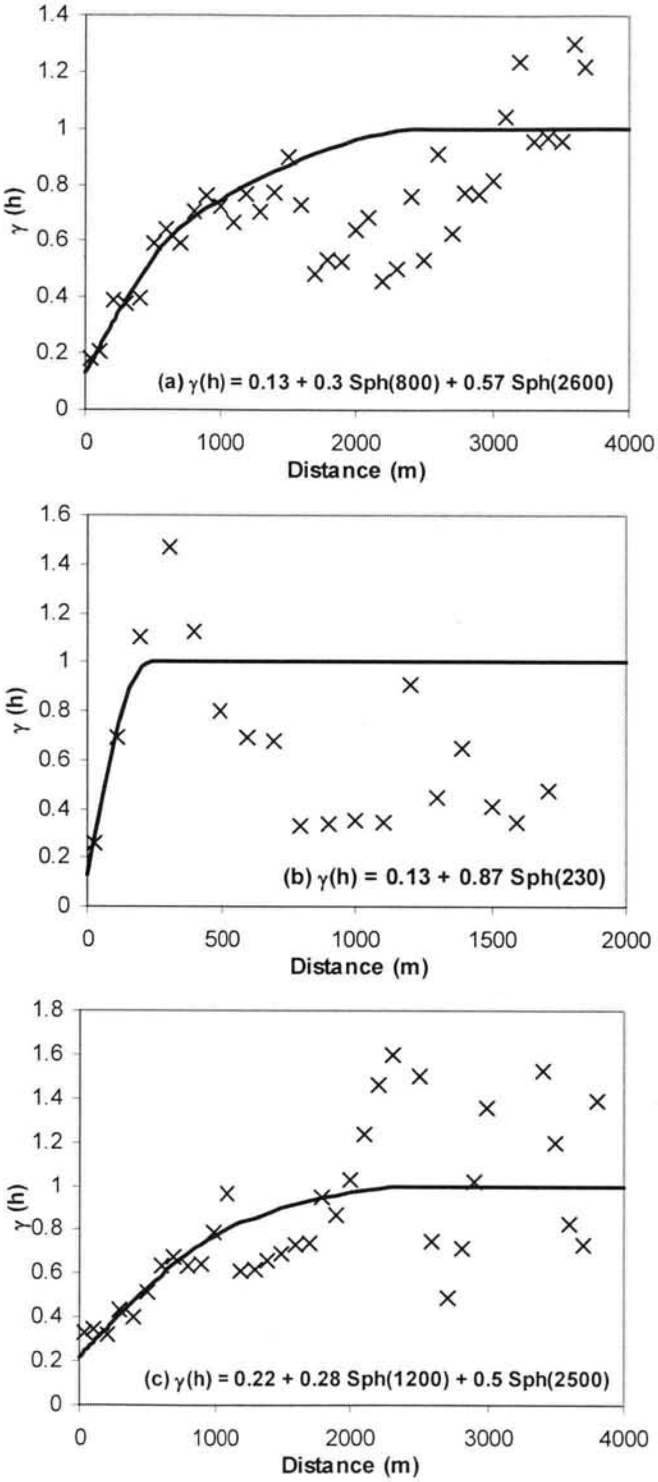

Figure D.2. Variograms and Models of Normal Scores of the FY 1992 Technetium-99 Data in Local Grid 1 (a), Grid 2 (b) and Grid 3 (c). Experimental variogram values designated by X, with the models fit to the data denoted by solid black lines.

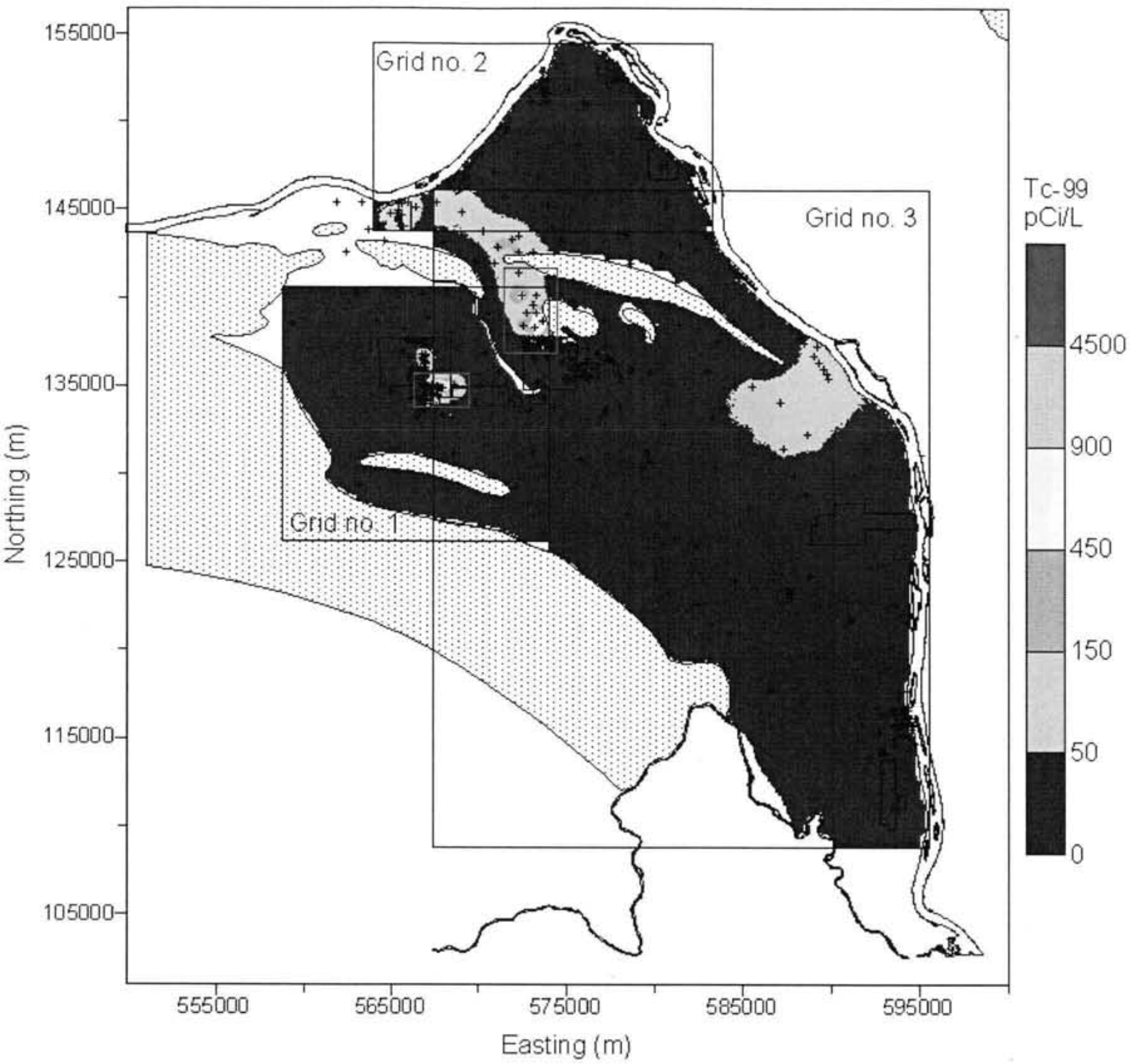

Figure D.3. Median of Simulations of FY 1992 Technetium-99 Concentrations for Grids 1, 2, and 3

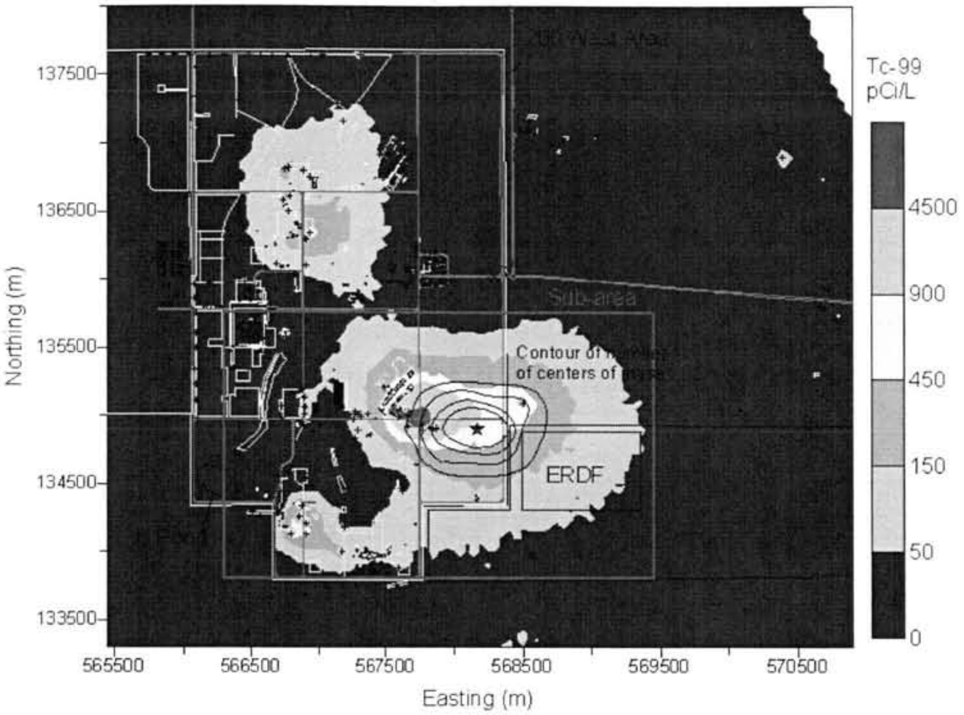

Figure D.4. Median of Simulated FY 1992 Technetium-99 Concentrations in Grid 1 (200 West Area). Contours of the number of times that the center of mass within the sub-area occurred within cells of an upscaled grid are shown with the average centers of mass shown by blue star in the sub-area.

Table D.1. Coordinates for Sub-Area Boundary for Grid 1 (200 West Area) of FY 1992 Technetium-99

Easting (m)	Northing (m)
566300	133800
569450	133800
569450	135750
566300	135750
566300	133800

Table D.2. Statistics of Centers of Mass of Individual Simulations of FY 1992 Technetium-99 Calculated for a Depth of 5 m for the Sub-Area of Grid 1 (200 West Area)

Coordinate (m)	Sub-Area	
	Easting	Northing
Mean	568227.8	134862.4
Standard Error	12.8	8.4
Median	568231.1	134854.6
Standard Deviation	270.9	179.0
Kurtosis	-0.46	-0.49
Skewness	-0.10	-0.08
Range	1361.2	870.2
Minimum	567534.6	134394.6
Maximum	568895.8	135264.8
Count	450	450
97.5th Percentile	568723.9	135191.0
2.5th Percentile	567689.8	134515.2
Confidence Level of Mean (95.0%)	25.1	16.6

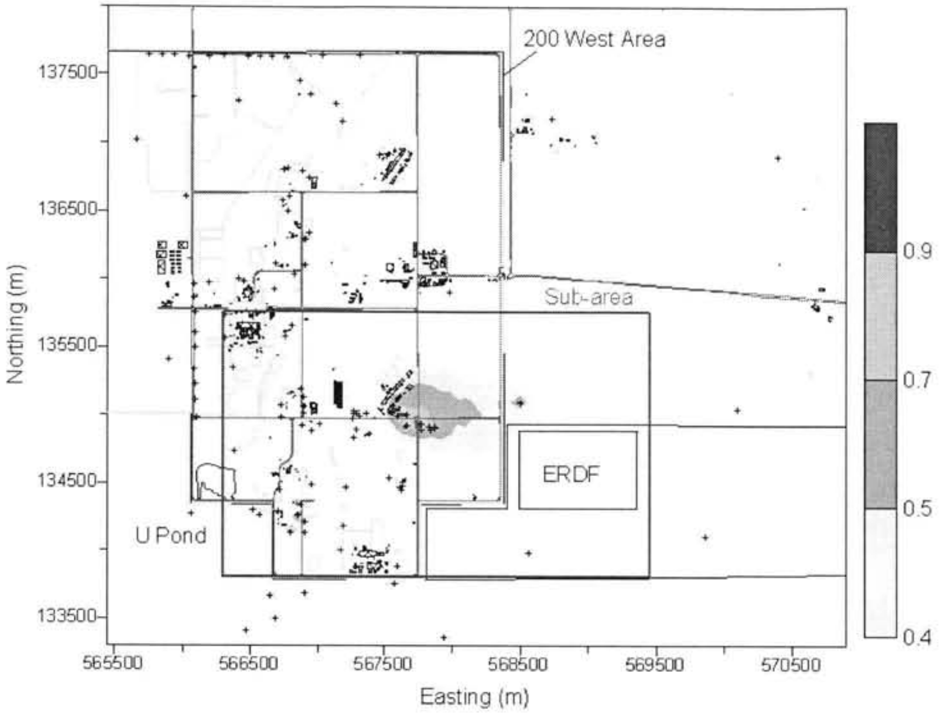

Figure D.5. **Probability of Exceeding 900 pCi/L Based on Simulations of FY 1992 Technetium-99 in Grid 1 (200 West Area)**

Table D.3. **Area Exceeding 900 pCi/L for FY 1992 Technetium-99 for Each Simulation within Sub-Area of Grid 1 (200 West Area)**

Area (km^2)	Sub-Area	Grid 1
Mean	1.01	6.55
Standard Error	0.02	0.14
Median	0.95	5.89
Standard Deviation	0.39	2.92
Kurtosis	-0.25	2.02
Skewness	0.56	1.19
Range	1.86	18.28
Minimum	0.27	1.55
Maximum	2.13	19.82
Count	450	450
97.5th Percentile	1.92	13.67
2.5th Percentile	0.41	2.64
Confidence Level of Mean (95.0%)	0.04	0.27

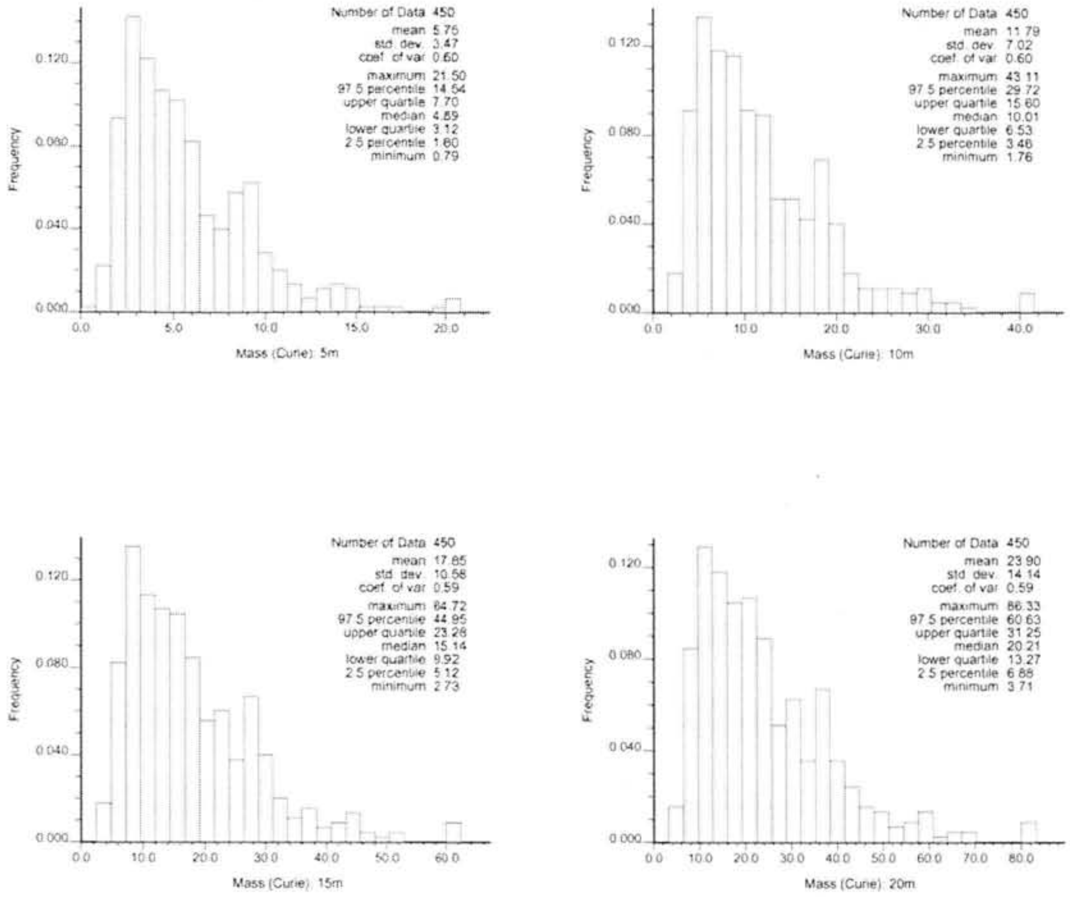

Figure D.6. **Histograms of Total Activity in Simulations of FY 1992 Technetium-99 within the Sub-Area of Grid 1 (200 West Area), Four Thickness Assumptions**

Table D.4. **Statistics of Total Activity of Simulations of FY 1992 Technetium-99 within the Sub-Area of Grid 1 (200 West Area), Four Thickness Assumptions**

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	5.75	11.79	17.85	23.90
Standard Error	0.16	0.33	0.50	0.67
Median	4.89	10.01	15.14	20.21
Standard Deviation	3.48	7.03	10.59	14.16
Kurtosis	2.34	2.45	2.51	2.54
Skewness	1.36	1.37	1.38	1.39
Range	20.71	41.34	61.99	82.63
Minimum	0.79	1.76	2.74	3.71
Maximum	21.50	43.11	64.72	86.33
Count	450	450	450	450
97.5th Percentile	14.54	29.59	44.79	60.63
2.5th Percentile	1.62	3.50	5.12	6.92
Confidence Level of Mean (95.0%)	0.32	0.65	0.98	1.31

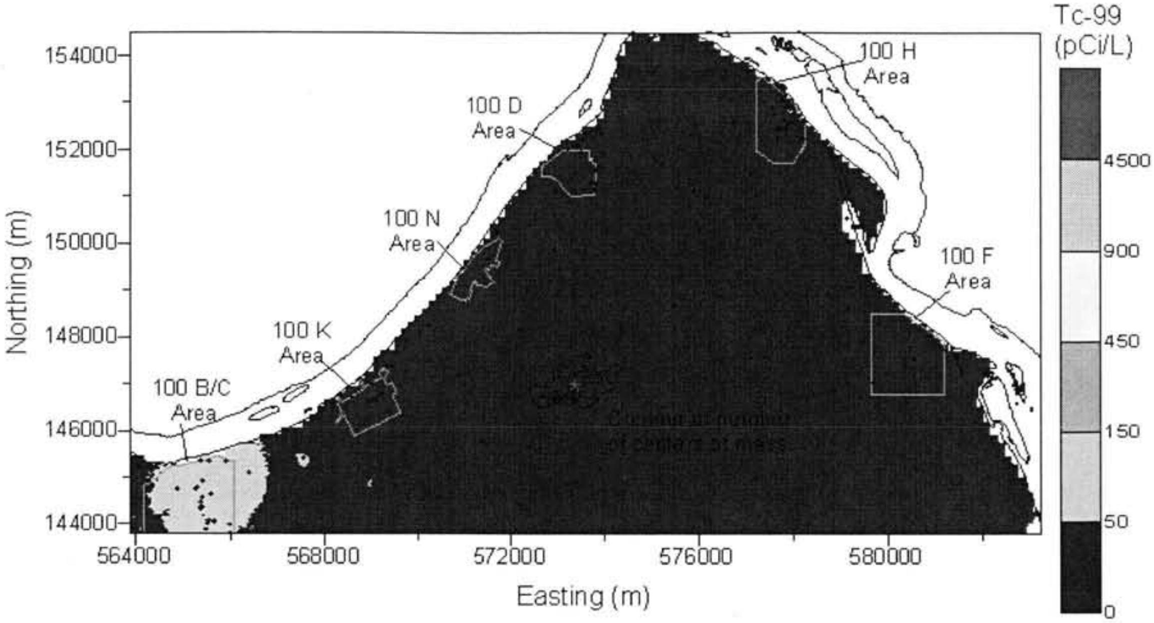

Figure D.7. **Median of Simulated FY 1992 Technetium-99 Concentrations in Grid 2 (100 Areas). Contours of the number of times that the center of mass within the grid occurred within cells of an upscaled grid are shown with the average centers of mass shown by red star in the grid. The maximum technetium-99 activity in Grid 2 for FY 1992 is only 632 pCi/L. No values over the 900 pCi/L DWS were simulated in the grid, so several of the standard metrics do not apply to this grid, including the area above the drinking water standard and the length of the Columbia River shoreline above the drinking water standard.**

Table D.5. **Coordinates for Sub-Area Boundary for Grid 2 (100 Areas) of FY 1992 Technetium-99**

Easting (m)	Northing (m)	Easting (m)	Northing (m)
563900	143800	574635	154500
563900	145566	575910	154500
564206	145277	577761	153410
564778	145277	578239	152710
565610	145502	579740	151371
566373	145754	579962	150987
566915	145882	579962	150573
567588	146172	579706	149806
567905	146522	579582	149614
568736	147033	579706	149200
569056	147447	580124	148787
569597	147959	580985	148211
570361	148692	581463	147764
570967	149392	582227	147350
572118	150987	581941	146902
572754	151785	582516	145724
573070	152199	582897	145118
573965	152744	583216	144129
573996	153030	583250	143800
574315	153828	563900	143800
574379	154144		

Table D.6. **Statistics of the Locations of Centers of Mass for Simulations of FY 1992 Technetium-99 within Grid 2 (100 Areas)**

Coordinate (m)	Easting	Northing
Mean	573369.1	146967.7
Standard Error	35.4	21.3
Median	573401.6	146950.4
Standard Deviation	613.8	369.4
Kurtosis	-0.14	0.07
Skewness	-0.24	0.14
Range	3427.1	2216.2
Minimum	571431.2	145937.8
Maximum	574858.3	148154.0
Count	300	300
97.5th Percentile	574473.9	147716.8
2.5th Percentile	572179.8	146234.4
Confidence Level (95.0%)	69.7	42.0

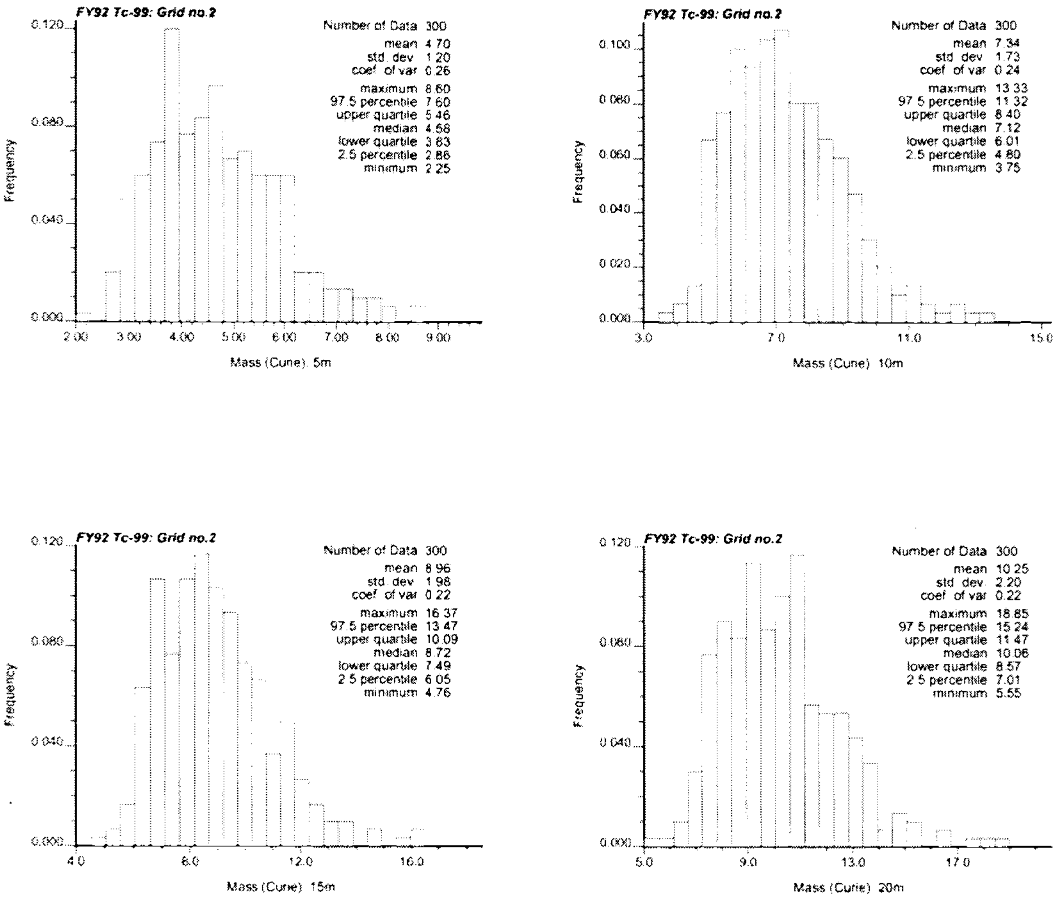

Figure D.8. **Histograms of Total Activity in Simulations of FY 1992 Technetium-99 within Grid 2 (100 Areas), Four Thickness Assumptions**

Table D.7. **Statistics of Total Activity of Simulations of FY 1992 Technetium-99 within Grid 2 (100 Areas), Four Thickness Assumptions**

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	4.70	7.34	8.96	10.25
Standard Error	0.07	0.10	0.11	0.13
Median	4.58	7.12	8.72	10.06
Standard Deviation	1.21	1.73	1.98	2.21
Kurtosis	0.16	0.48	0.86	1.05
Skewness	0.64	0.72	0.79	0.81
Range	6.35	9.58	11.61	13.30
Minimum	2.25	3.75	4.76	5.55
Maximum	8.60	13.33	16.37	18.85
Count	300	300	300	300
97.5th Percentile	7.60	11.32	13.47	15.24
2.5th Percentile	2.86	4.80	6.05	7.01
Confidence Level of Mean (95.0%)	0.14	0.20	0.23	0.25

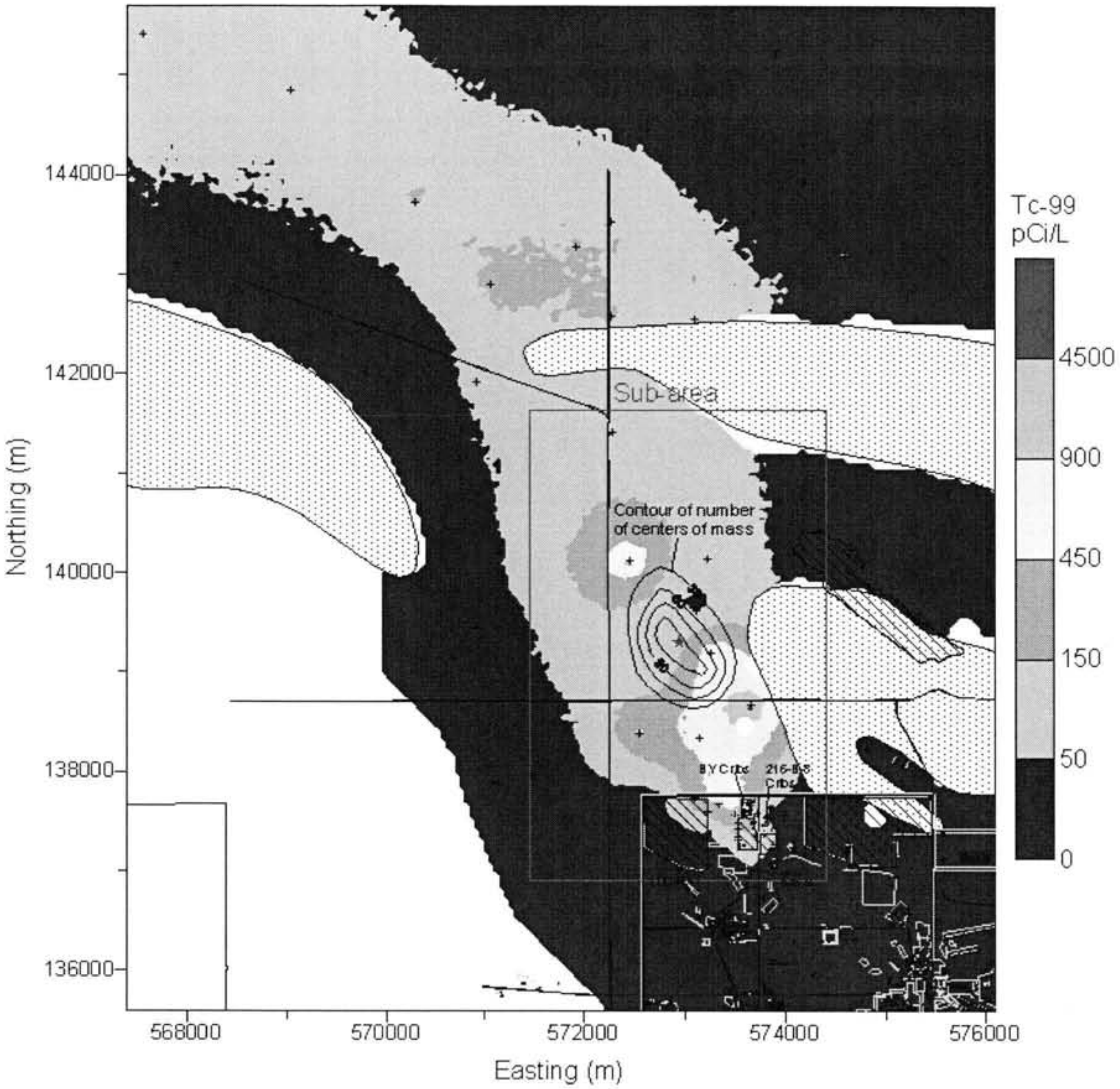

Figure D.9. Median of Simulated FY 1992 Technetium-99 Concentrations in Grid 3 (200 East Area Plume). Contours of the number of times that the center of mass within the sub-area occurred within cells of an upscaled grid are shown with the average centers of mass shown by red star in the sub-area.

Table D.8. **Coordinates for Sub-Area Boundary for Grid 3 (200 East Area) of FY 1992 Technetium-99**

Easting (m)	Northing (m)
571450	136900
574400	136900
574400	137731
574231	137856
573860	138723
573645	139197
573645	139612
573698	139739
573839	139834
573942	139879
574400	139864
574400	141205
574238	141212
574202	141256
574142	141256
574105	141205
573713	141205
573282	141568
573098	141650
571450	141650
571450	136900

Table D.9. **Statistics of Centers of Mass of Individual Simulations of FY 1992 Technetium-99 Calculated for a Depth of 5 m for Sub-Area of Grid 3 (200 East Area Plume)**

Coordinate (m)	Sub-Area	
	Easting	Northing
Mean	572723.3	139632.1
Standard Error	10.0	14.4
Median	572721.9	139628.1
Standard Deviation	243.9	351.6
Kurtosis	0.45	-0.59
Skewness	0.18	-0.01
Range	1592.2	1732.8
Minimum	572059.9	138739.3
Maximum	573652.1	140472.1
Count	600	600
97.5th Percentile	573217.1	140310.3
2.5th Percentile	572225.3	138948.4
Confidence Level of Mean (95.0%)	19.6	28.2

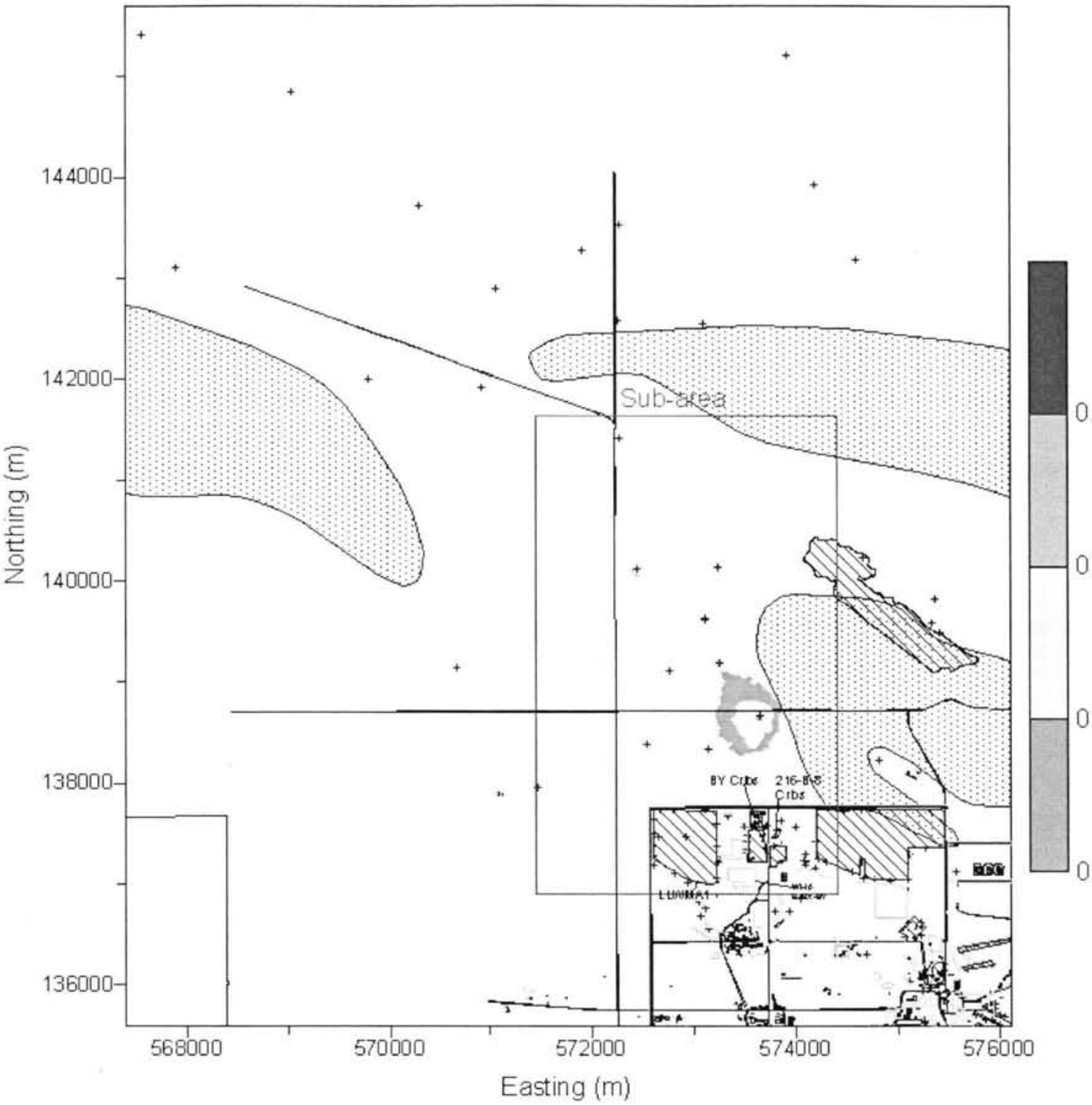

Figure D.10. Probability of Exceeding 900 pCi/L Based on Simulations of FY 1992 Technetium-99 in Grid 3 (200 East Area Plume)

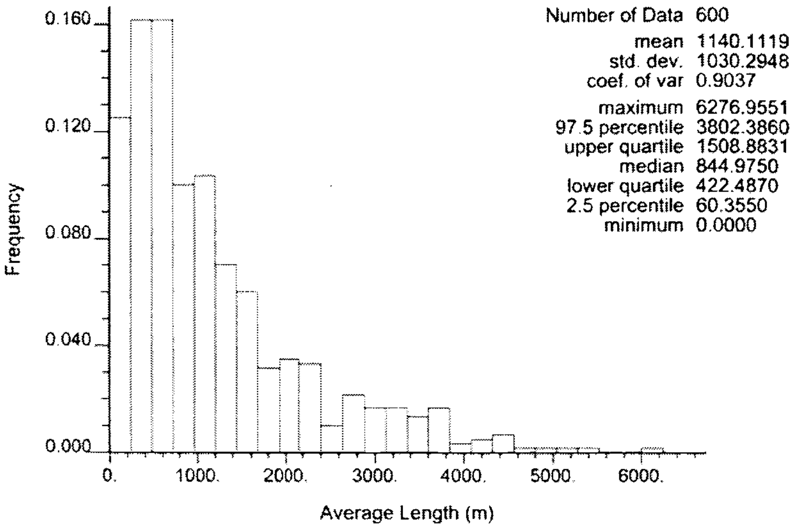

Figure D.11. Histogram of the Average Length of Columbia River Shoreline Exceeding 900 pCi/L for FY 1992 Technetium-99 in Grid 3 (200 East Area)

Table D.10. Area Exceeding 900 pCi/L for FY 1992 Technetium-99 for Each Simulation within Sub-Area of Grid 3 (200 East Area Plume)

Area (km^2)	Sub-Area	Grid 3
Mean	1.32	13.30
Standard Error	0.02	0.17
Median	1.25	12.96
Standard Deviation	0.48	4.18
Kurtosis	1.50	1.04
Skewness	0.98	0.72
Range	3.30	28.18
Minimum	0.36	4.34
Maximum	3.66	32.52
Count	600	600
97.5th Percentile	2.48	22.66
2.5th Percentile	0.61	6.86
Confidence Level of Mean (95.0%)	0.04	0.33

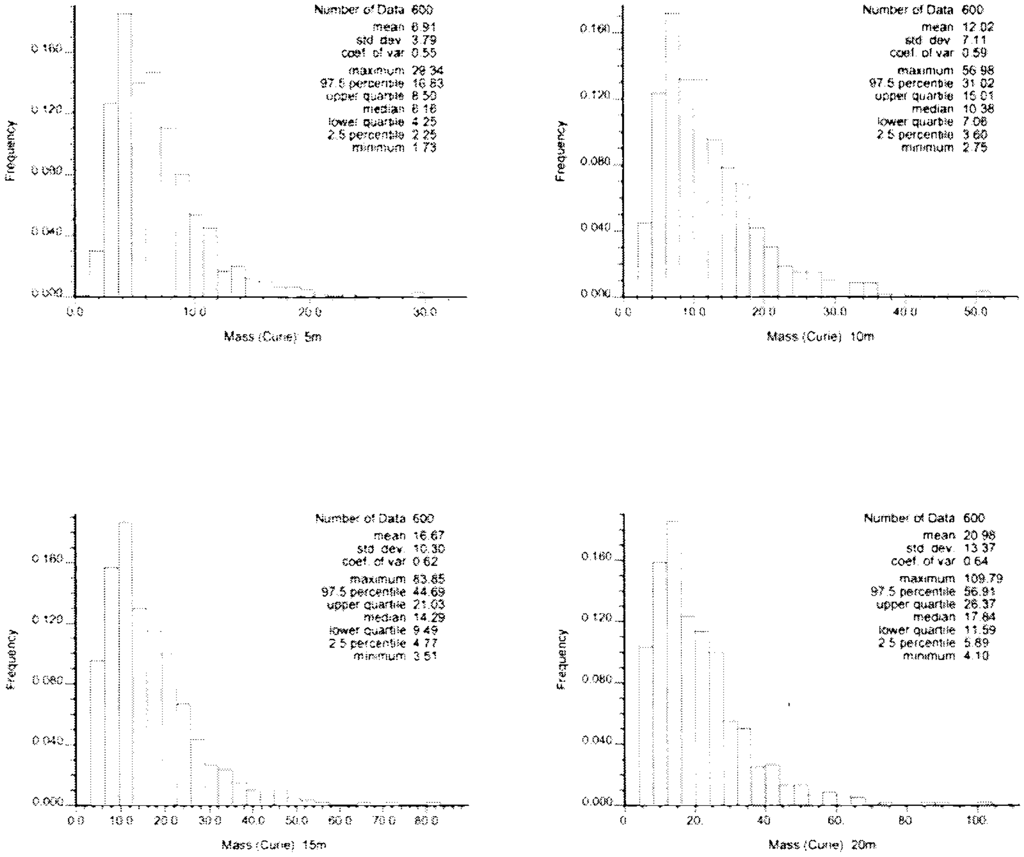

Figure D.12. **Histograms of Total Activity in Simulations of FY 1992 Technetium-99 within the Sub-Area of Grid 3 (200 East Area Plume), Four Thickness Assumptions**

Table D.11. **Statistics of Total Activity of Simulations of FY 1992 Technetium-99 within the Sub-Area of Grid 3 (200 East Area Plume), Four Thickness Assumptions**

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	6.91	12.02	16.67	20.98
Standard Error	0.15	0.29	0.42	0.55
Median	6.16	10.38	14.29	17.84
Standard Deviation	3.79	7.11	10.31	13.38
Kurtosis	4.89	5.37	5.64	5.89
Skewness	1.71	1.80	1.85	1.89
Range	27.61	54.23	80.34	105.69
Minimum	1.73	2.75	3.51	4.10
Maximum	29.34	56.98	83.85	109.79
Count	600	600	600	600
97th Percentile	17.07	32.07	45.88	57.37
2.5th Percentile	2.24	3.58	4.76	5.86
Confidence Level of Mean (95.0%)	0.30	0.57	0.83	1.07

Appendix E

Figures and Data Tables for FY 2001 Iodine-129

Appendix E

Figures and Data Tables for FY 2001 Iodine-129

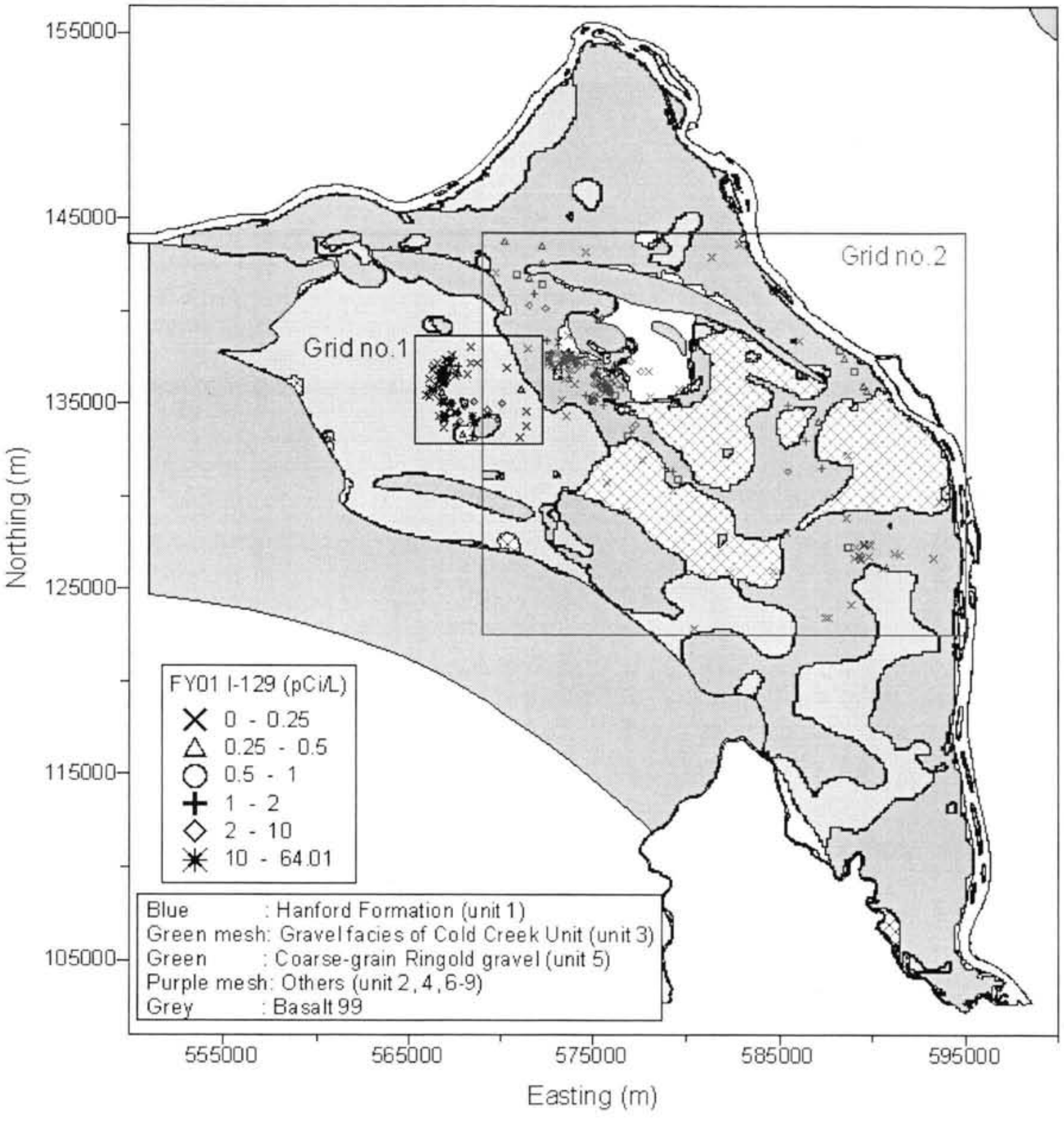

Figure E.1. Subsets of FY 2001 Iodine-129 Data and Subcrop Formation Units at the FY 2001 Water Table

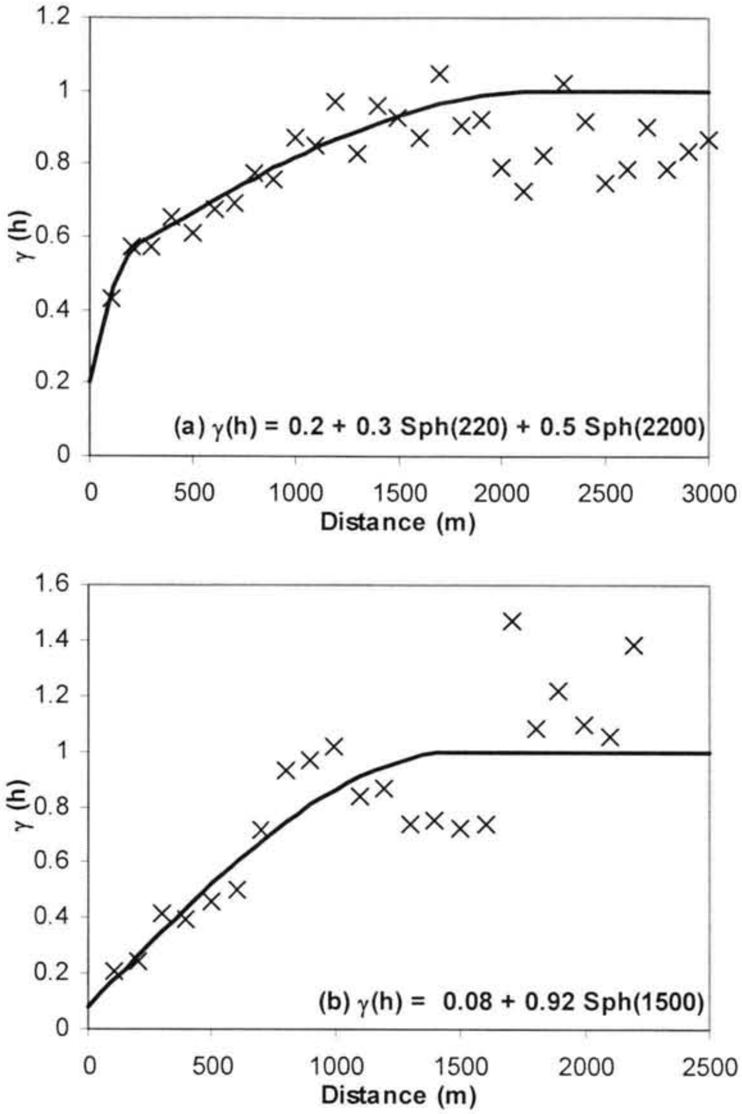

Figure E.2. Variograms and Models of Normal Scores of the FY 2001 Iodine-129 Data in Local Grid 1 (a) and Grid 2 (b). Experimental variogram values designated by X, with the models fit to the data denoted by solid black lines.

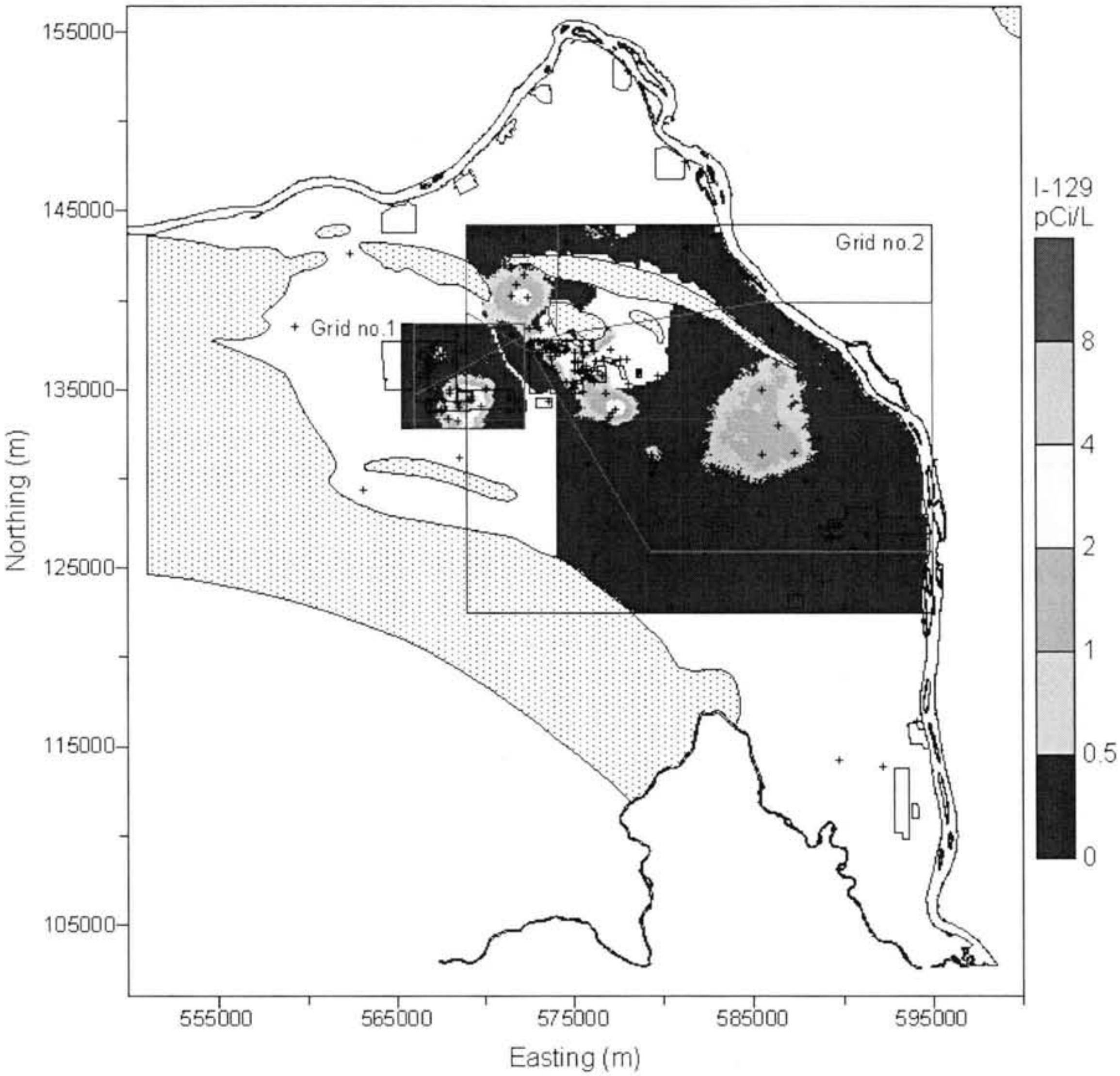

Figure E.3. Median of Simulations of FY 2001 Iodine-129 Concentrations for Grids 1 and 2

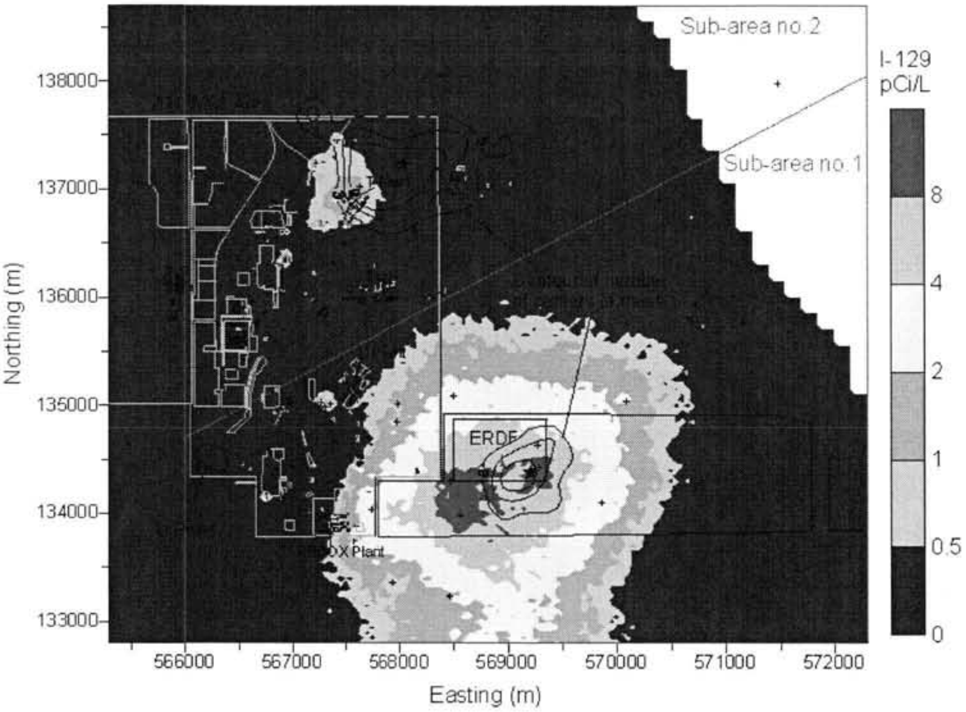

Figure E.4. Median of Simulated FY 2001 Iodine-129 Concentrations in Grid 1 (200 West Area). Contours of the number of times that the center of mass within the sub-areas occurred within cells of an upscaled grid are shown with the average centers of mass shown by black star in the sub-areas.

Table E.1. Coordinates for Sub-Area Boundaries for Grid 1 (200 West Area) of FY 2001 Iodine-129

Sub-Area 1		Sub-Area 2	
Easting (m)	Northing (m)	Easting (m)	Northing (m)
566000	132800	566000	134700
572300	132800	570952	137348
572300	135121	570791	137400
572146	135153	570813	137667
572146	135557	570674	137699
571261	136357	570663	138104
571261	136624	570515	138167
571113	136655	570536	138424
571102	137061	570365	138456
570963	137124	570365	138573
570952	137348	570217	138615
566000	134700	570195	138700
566000	132800	566000	138700
		566000	134700

Table E.2. Statistics of Centers of Mass of Individual Simulations of FY 2001 Iodine-129 Calculated for a Depth of 5 m for the Sub-Areas of Grid 1 (200 West Area)

Coordinate (m)	Sub-Area 1		Sub-Area 2	
	Easting	Northing	Easting	Northing
Mean	569213.8	134344.3	568037.5	137220.8
Standard Error	16.2	13.4	27.9	16.4
Median	569181.8	134340.0	567993.1	137222.7
Standard Deviation	281.2	232.5	483.3	284.6
Kurtosis	0.85	-0.10	0.27	-0.52
Skewness	0.50	0.30	0.43	-0.03
Range	1812.6	1177.7	2640.7	1453.4
Minimum	568534.8	133824.8	566905.4	136451.6
Maximum	570347.4	135002.5	569546.1	137905.0
Count	300	300	300	300
97.5th Percentile	569877.8	134866.2	569178.5	137716.8
2.5th Percentile	568689.5	133925.9	567171.7	136684.1
Confidence Level of Mean (95.0%)	31.9	26.4	54.9	32.3

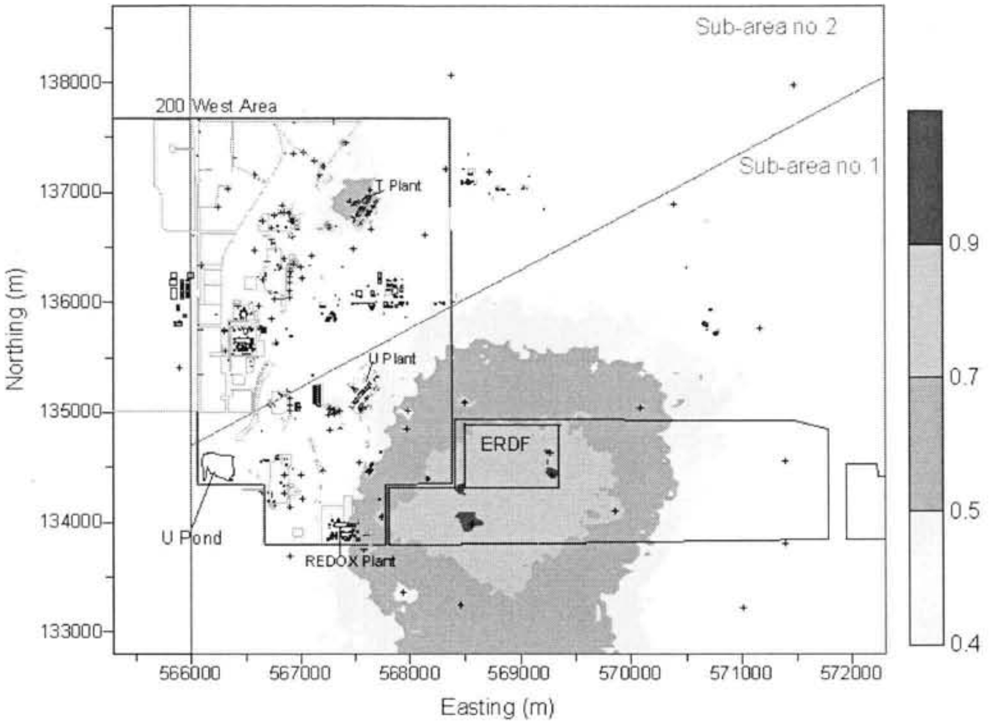

Figure E.5. Probability of Exceeding 1 pCi/L Based on Simulations of FY 2001 Iodine-129 in Grid 1 (200 West Area)

Table E.3. Area Exceeding 1 pCi/L for FY 2001 Iodine-129 for Each Simulation within Sub-Areas of Grid 1 (200 West Area)

Area (km^2)	Sub-Area 1	Sub-Area 2	Grid 1
Mean	8.08	2.32	11.17
Standard Error	0.08	0.04	0.10
Median	8.06	2.16	11.02
Standard Deviation	1.31	0.70	1.72
Kurtosis	0.22	1.14	-0.10
Skewness	0.29	1.01	0.17
Range	7.29	3.82	8.76
Minimum	4.74	1.16	7.13
Maximum	12.03	4.98	15.89
Count	300	300	300
97.5th Percentile	10.85	3.96	14.87
2.5th Percentile	5.76	1.29	7.87
Confidence Level of Mean (95.0%)	0.15	0.08	0.20

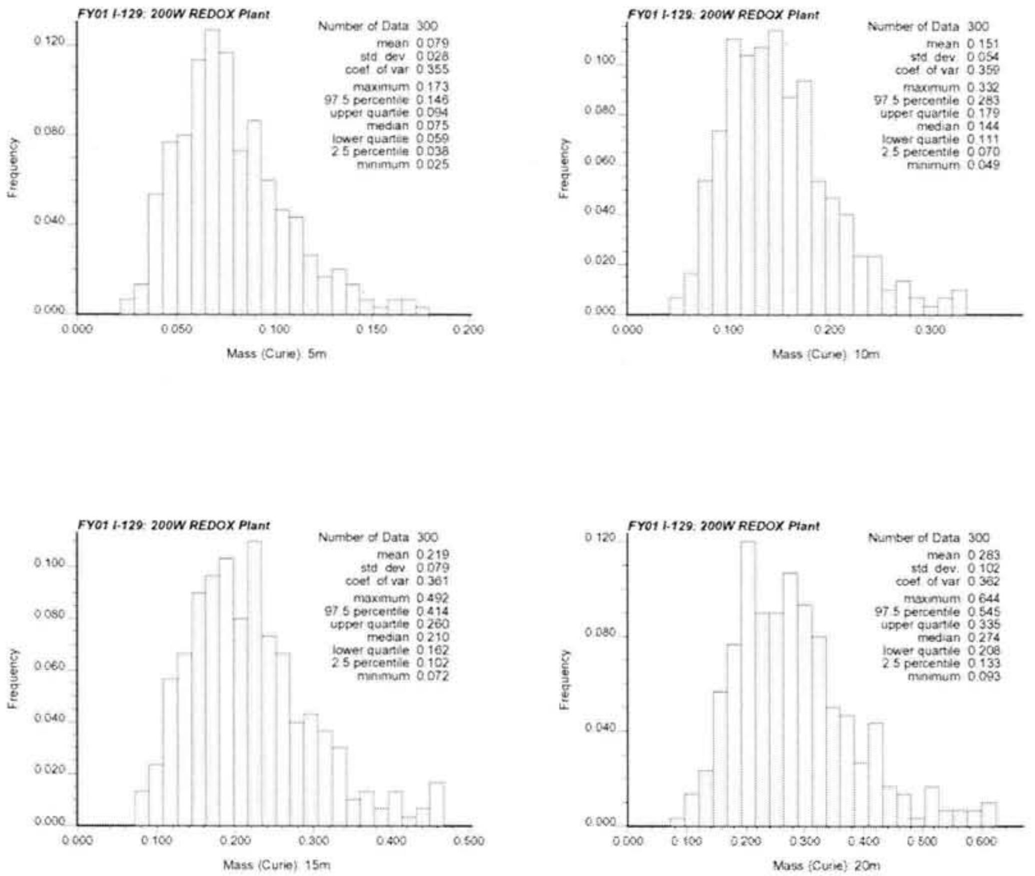

Figure E.6. Histograms of Total Activity in Simulations of FY 2001 Iodine-129 within Sub-Area 1 of Grid 1 (200 West Area), Four Thickness Assumptions

Table E.4. Statistics of Total Activity of Simulations of FY 2001 Iodine-129 within Sub-Area 1 of Grid 1 (200 West Area), Four Thickness Assumptions

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	0.0788	0.1506	0.2187	0.2833
Standard Error	0.0016	0.0031	0.0046	0.0059
Median	0.0744	0.1443	0.2096	0.2732
Standard Deviation	0.0280	0.0541	0.0790	0.1026
Kurtosis	0.6636	0.7715	0.8586	0.9137
Skewness	0.8307	0.8590	0.8854	0.9032
Range	0.1475	0.2832	0.4201	0.5507
Minimum	0.0255	0.0492	0.0718	0.0935
Maximum	0.1729	0.3324	0.4920	0.6442
Count	300	300	300	300
97.5th Percentile	0.1457	0.2828	0.4135	0.5446
2.5th Percentile	0.0376	0.0700	0.1022	0.1329
Confidence Level of Mean (95.0%)	0.0032	0.0061	0.0090	0.0117

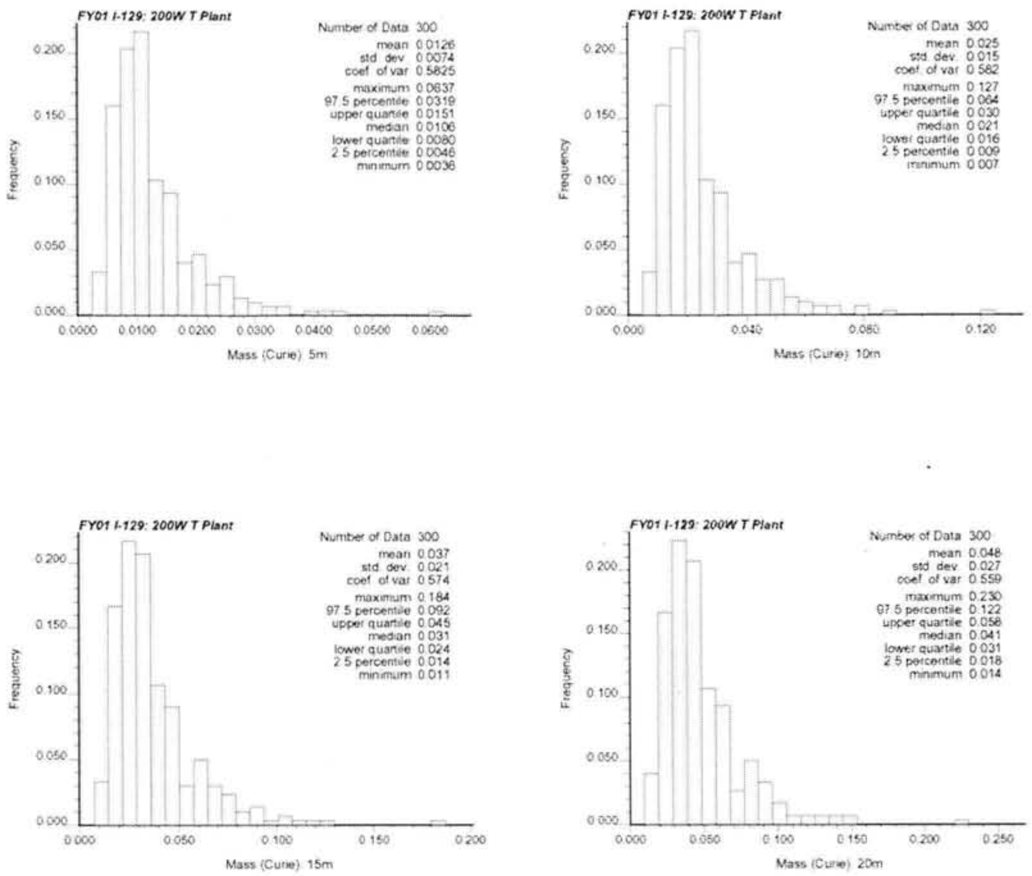

Figure E.7. Histograms of Total Activity in Simulations of FY 2001 Iodine-129 within Sub-Area 2 of Grid 1 (200 West Area), Four Thickness Assumptions

Table E.5. Statistics of Total Activity of Simulations of FY 2001 Iodine-129 within Sub-Area 2 of Grid 1 (200 West Area), Four Thickness Assumptions

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	0.0126	0.0252	0.0373	0.0483
Standard Error	0.0004	0.0008	0.0012	0.0016
Median	0.0106	0.0211	0.0312	0.0407
Standard Deviation	0.0074	0.0147	0.0214	0.0271
Kurtosis	9.5127	9.5111	9.0143	8.1742
Skewness	2.3911	2.3902	2.3233	2.2051
Range	0.0601	0.1201	0.1734	0.2162
Minimum	0.0036	0.0072	0.0107	0.0140
Maximum	0.0637	0.1272	0.1841	0.2302
Count	300	300	300	300
97.5th Percentile	0.0319	0.0637	0.0922	0.1222
2.5th Percentile	0.0046	0.0093	0.0136	0.0179
Confidence Level of Mean (95.0%)	0.0008	0.0017	0.0024	0.0031

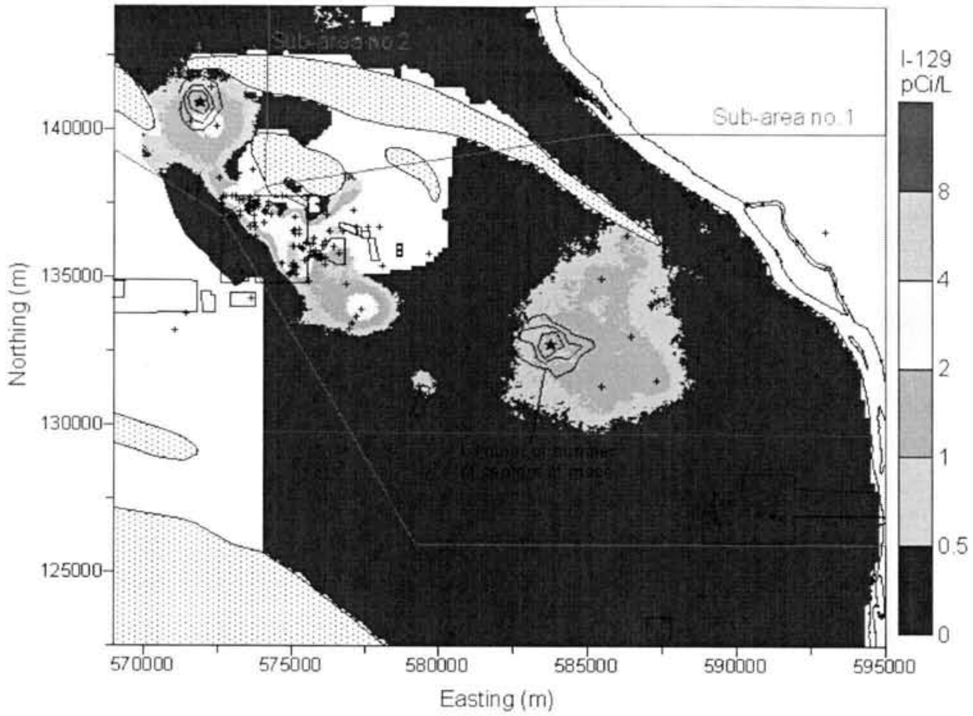

Figure E.8. **Median of Simulated FY 2001 Iodine-129 Concentrations in Grid 2 (200 East Area Plumes). Contours of the number of times that the center of mass within the sub-areas occurred within cells of an upscaled grid are shown with the average centers of mass shown by black stars in the sub-areas.**

Table E.6. Coordinates for Sub-Area Boundaries for Grid 2 (200 East Area) of FY 2001 Iodine-129

Sub-Area 1				Sub-Area 2	
Easting (m)	Northing (m)	Easting (m)	Northing (m)	Easting (m)	Northing (m)
572700	137050	580272	136063	572700	137050
573684	137815	580272	136890	573684	137815
573684	137971	580128	136953	573225	137815
573779	137971	580114	137351	573225	138979
573793	137812	580272	137415	573535	139485
573970	137826	580286	138427	573838	139938
573970	137540	580430	138477	574145	139942
574842	137540	580430	139128	574154	141260
574887	137365	581873	139332	573495	141260
575601	137365	582746	138984	573495	141425
575651	137207	583410	138730	572915	141805
575920	137207	584319	137984	572558	142015
575920	137781	585508	137161	571455	142015
576316	137826	587335	136130	571382	142253
576664	137826	587430	136257	571604	142505
576714	138079	586444	137017	572364	142505
576858	138509	585287	137889	573485	142565
577098	138572	584174	138699	573562	142655
577130	138414	583238	139571	574195	142664
577270	138427	585400	139900	574200	144200
577288	138287	585902	139900	569000	144200
577396	138287	587028	138920	569000	142212
577396	137844	588267	138129	569822	141466
576750	137225	589537	137365	570085	141226
576555	137225	590170	136637	570505	140209
576510	137066	590650	136176	570505	139775
576542	136777	591047	135511	570205	139775
576960	136447	591219	135000	570205	139924
576960	135764	591536	134652	569930	139924
577112	135714	593263	133539	569930	139006
577112	135289	593851	132554	570546	138346
577256	135289	594136	131744	572700	137050
577288	135127	594312	130903		
578287	135127	594457	130302		
578350	135289	594520	128100		
579033	135289	594805	127747		
579078	135440	594805	125950		
579526	135440	579250	125950		
579558	135574	572700	137050		
579811	135606				

Table E.7. Statistics of Centers of Mass of Individual Simulations of FY 2001 Iodine-129 Calculated for a Depth of 5 m for the Sub-Areas of Grid 2 (200 East Area Plumes)

Coordinate (m)	Sub-Area 1		Sub-Area 2	
	Easting	Northing	Easting	Northing
Mean	583567.1	132677.4	571816.0	141075.3
Standard Error	31.3	25.0	13.8	19.3
Median	583564.1	132701.4	571797.6	141082.2
Standard Deviation	700.4	558.5	309.0	430.9
Kurtosis	0.06	-0.06	-0.13	-0.02
Skewness	0.06	-0.24	0.21	0.02
Range	4406.1	3148.6	1768.9	2512.2
Minimum	581204.8	130762.6	570957.1	139849.6
Maximum	585610.9	133911.2	572726.1	142361.7
Count	500	500	500	500
97.5th Percentile	584952.5	133743.2	572458.6	141906.6
2.5th Percentile	582203.1	131489.9	571233.5	140212.6
Confidence Level of Mean (95.0%)	61.5	49.1	27.2	37.9

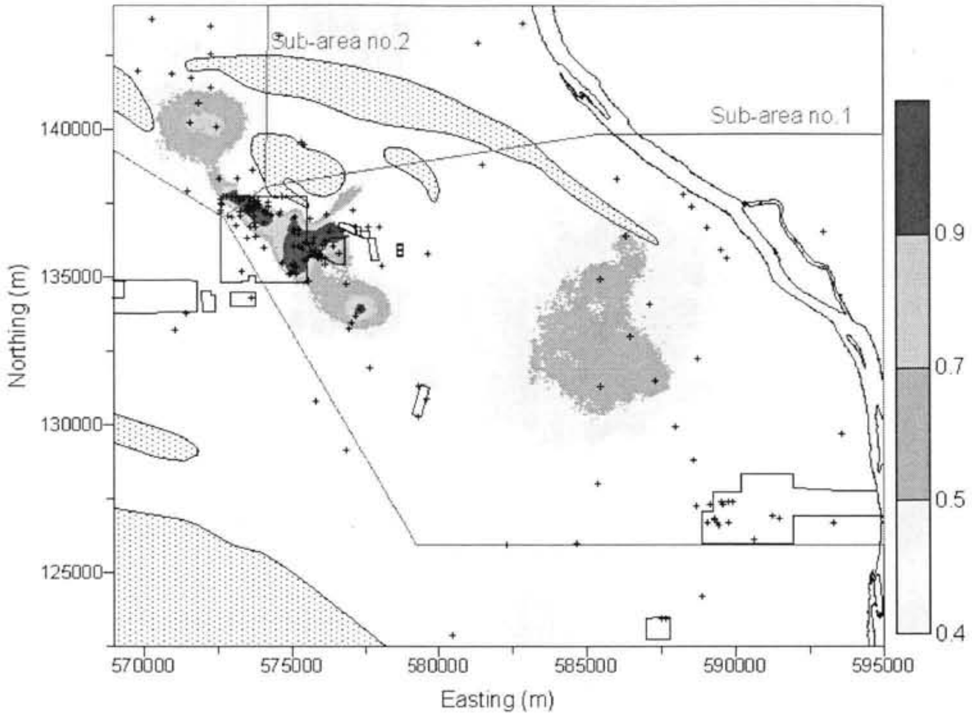

Figure E.9. Probability of Exceeding 1 pCi/L Based on Simulations of FY 2001 Iodine-129 in Grid 2 (200 East Area Plumes)

Table E.8. Area Exceeding 1 pCi/L for FY 2001 Iodine-129 for Each Simulation within Sub-Areas of Grid 2 (200 East Area Plumes)

Area (km^2)	Sub-Area 1	Sub-Area 2	Grid 2
Mean	71.30	10.83	114.32
Standard Error	0.55	0.10	0.670
Median	71.07	10.78	113.69
Standard Deviation	12.36	2.24	15.56
Kurtosis	-0.11	-0.06	-0.11
Skewness	0.11	-0.08	0.12
Range	69.70	12.65	89.93
Minimum	37.26	3.72	73.48
Maximum	106.96	16.37	163.41
Count	500	500	500
97.5th Percentile	95.46	15.41	144.13
2.5th Percentile	47.50	6.27	84.41
Confidence Level of Mean (95.0%)	1.09	0.20	1.37

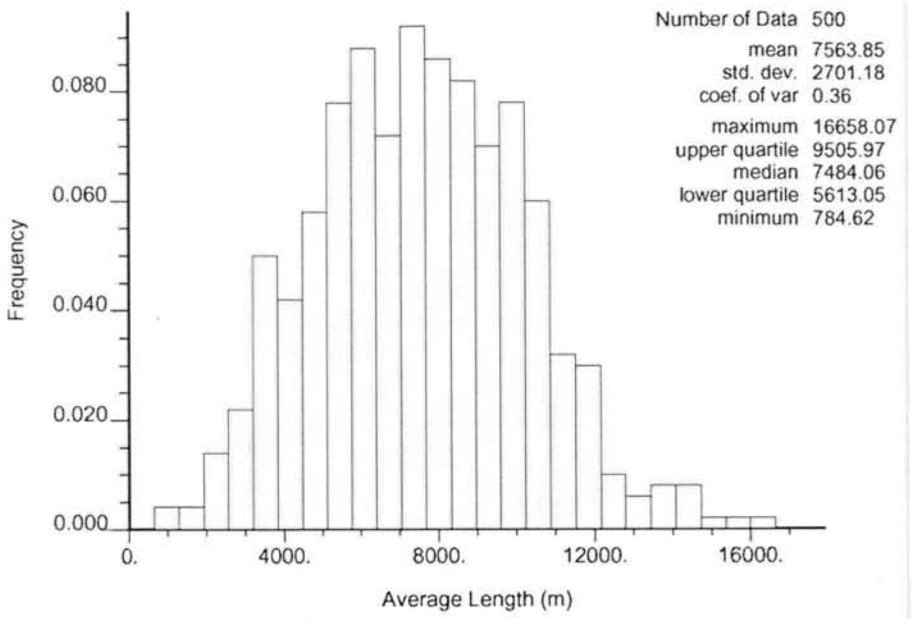

Figure E.10. Histogram of the Average Length of Columbia River Shoreline Exceeding 1 pCi/L for FY 2001 Iodine-129 in Grid 2 (200 East Area Plumes)

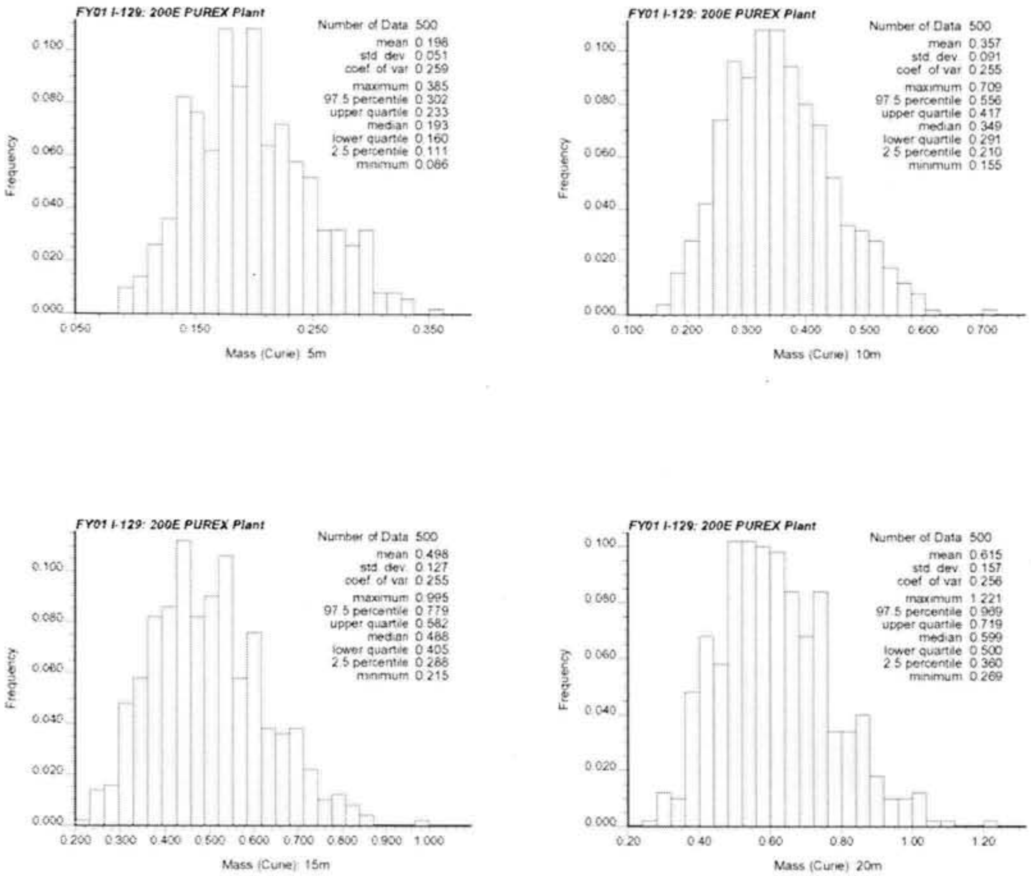

Figure E.11. Histograms of Total Activity in Simulations of FY 2001 Iodine-129 within Sub-Area 1 of Grid 2 (200 East Area), Four Thickness Assumptions

Table E.9. Statistics of Total Activity of Simulations of FY 2001 Iodine-129 within Sub-Area 1 of Grid 2 (200 East Area), Four Thickness Assumptions

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	0.1979	0.3569	0.4976	0.6145
Standard Error	0.0023	0.0041	0.0057	0.0070
Median	0.1935	0.3495	0.4885	0.5992
Standard Deviation	0.0512	0.0911	0.1269	0.1573
Kurtosis	-0.1737	-0.0172	0.0752	0.1244
Skewness	0.4051	0.4483	0.4793	0.5102
Range	0.2991	0.5547	0.7797	0.9525
Minimum	0.0863	0.1546	0.2151	0.2687
Maximum	0.3854	0.7092	0.9948	1.2212
Count	500	500	500	500
97.5th Percentile	0.3016	0.5558	0.7795	0.9685
2.5th Percentile	0.1108	0.2098	0.2876	0.3604
Confidence Level of Mean (95.0%)	0.0045	0.0080	0.0111	0.0138

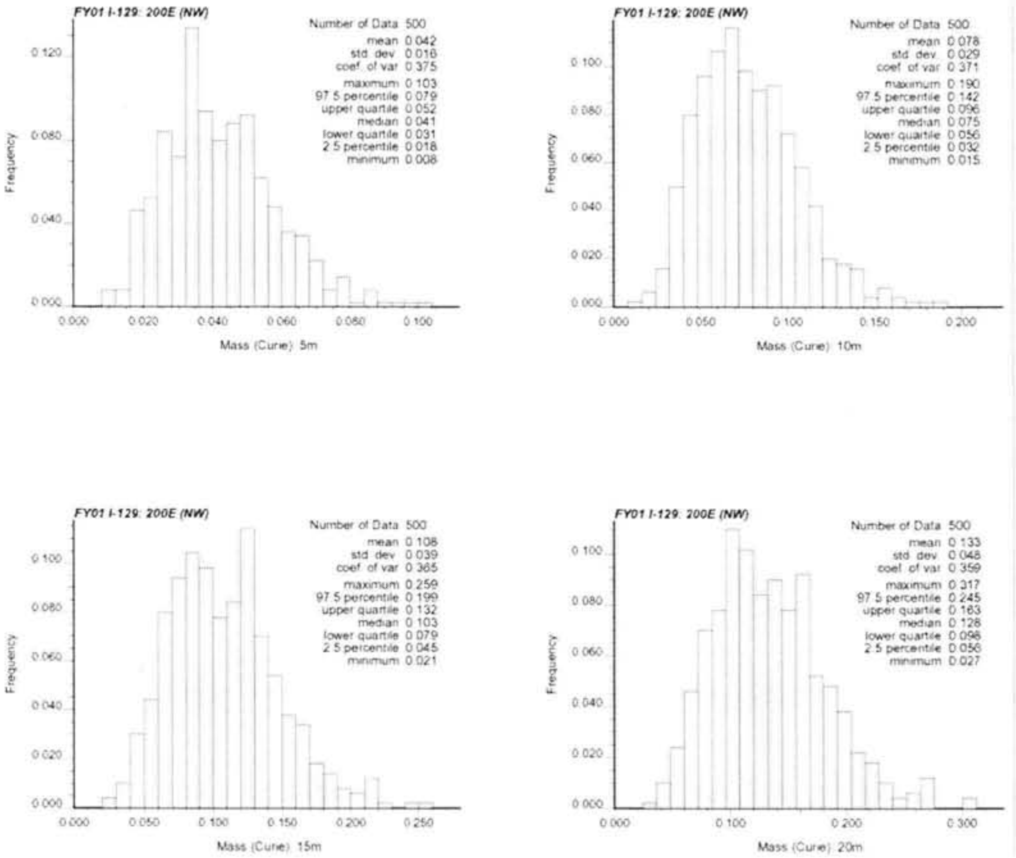

Figure E.12. Histograms of Total Activity in Simulations of FY 2001 Iodine-129 within Sub-Area 2 of Grid 2 (200 East Area), Four Thickness Assumptions

Table E.10. Statistics of Total Activity of Simulations of FY 2001 Iodine-129 within Sub-Area 2 of Grid 2 (200 East Area), Four Thickness Assumptions

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	0.0424	0.0778	0.1076	0.1333
Standard Error	0.0007	0.0013	0.0018	0.0021
Median	0.0405	0.0746	0.1030	0.1281
Standard Deviation	0.0159	0.0289	0.0393	0.0479
Kurtosis	0.4067	0.4503	0.4432	0.4278
Skewness	0.6301	0.6339	0.6221	0.6116
Range	0.0941	0.1741	0.2378	0.2908
Minimum	0.0084	0.0155	0.0214	0.0266
Maximum	0.1025	0.1896	0.2592	0.3174
Count	500	500	500	500
97.5th Percentile	0.0786	0.1422	0.1988	0.2448
2.5th Percentile	0.0176	0.0321	0.0445	0.0557
Confidence Level of Mean (95.0%)	0.0014	0.0025	0.0034	0.0042

Appendix F

Figures and Data Tables for FY 1992 Iodine-129

Appendix F

Figures and Data Tables for FY 1992 Iodine-129

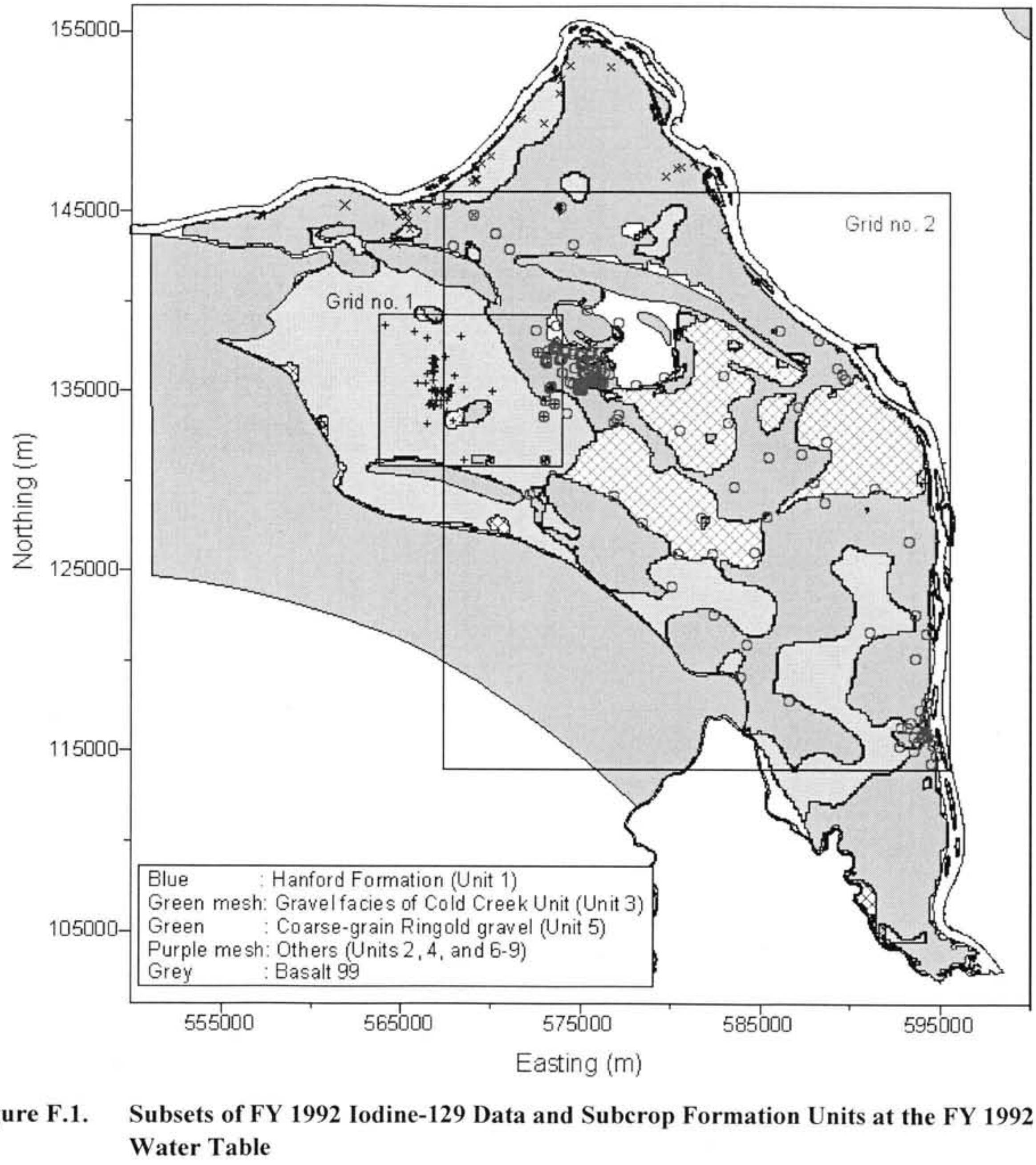

Figure F.1. Subsets of FY 1992 Iodine-129 Data and Subcrop Formation Units at the FY 1992 Water Table

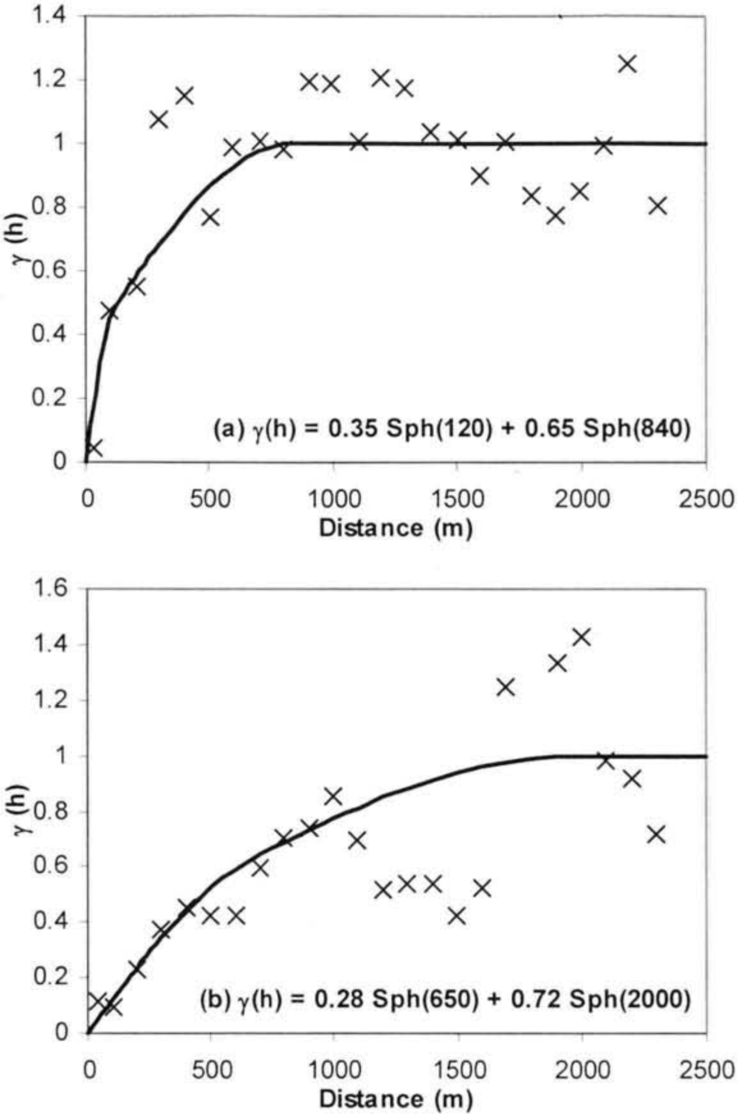

Figure F.2. Variograms and Models of Normal Scores of the FY 1992 Iodine-129 Data in Local Grid 1 (a) and Grid 2 (b). Experimental variogram values designated by x, with the models fit to the data denoted by solid black lines.

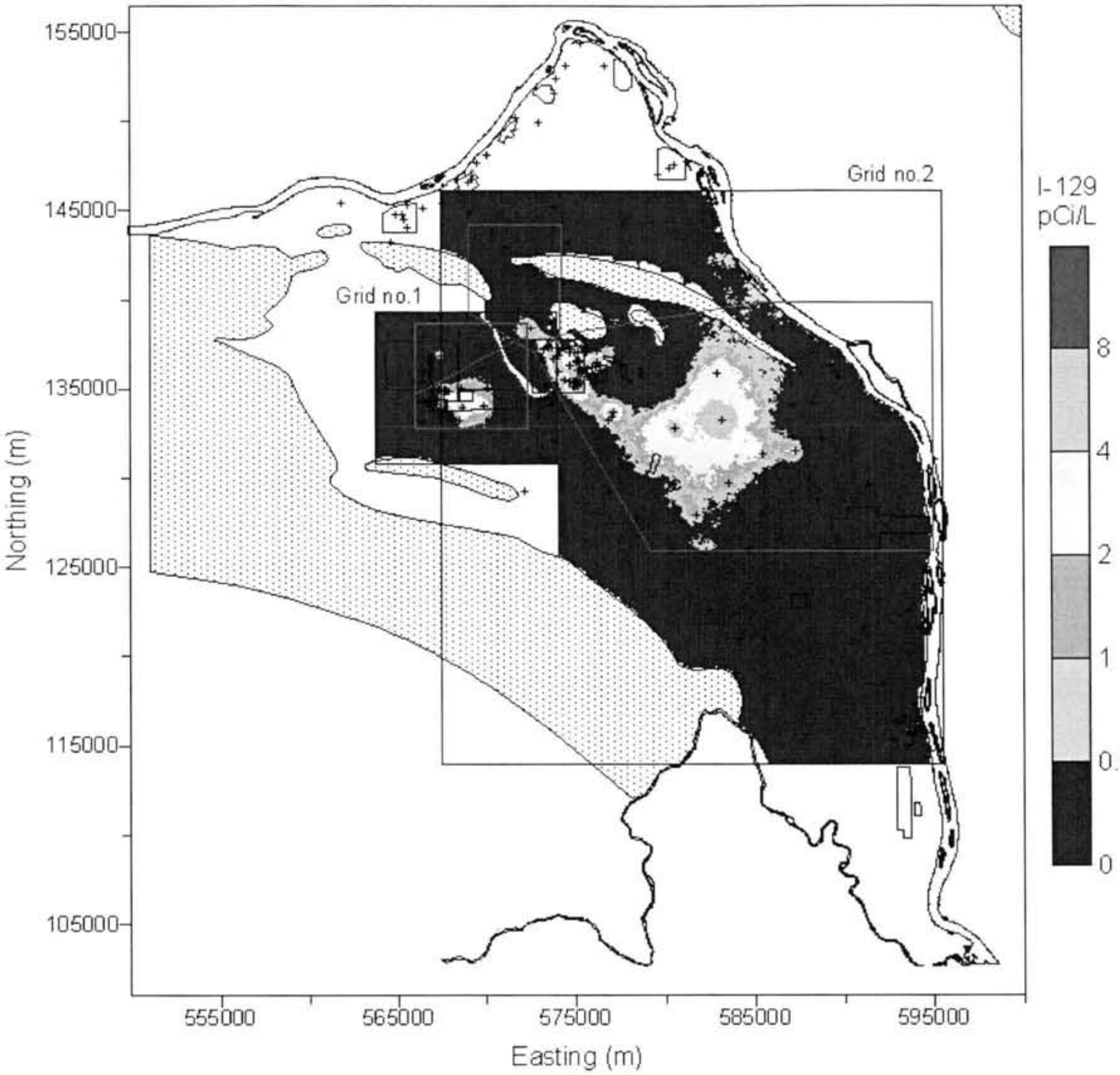

Figure F.3. Median of Simulations of FY 1992 Iodine-129 Concentrations for Grids 1 and 2. There were only 27 iodine-129 data in the 100 Areas (all lower than the drinking water standard 1 pCi/L). No spatial structure was detected in the data from that area, so the geostatistical analysis and calculation of history matching metrics were not performed.

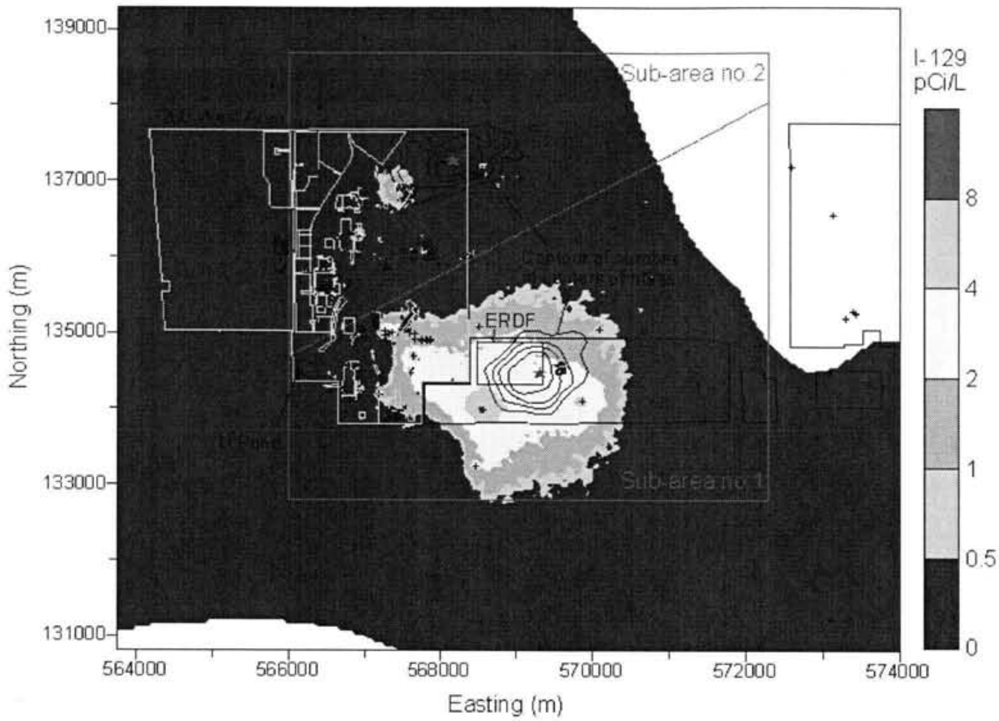

Figure F.4. Median of Simulated FY 1992 Iodine-129 Concentrations in Grid 1 (200 West Area). Contours of the number of times that the center of mass within the sub-areas occurred within cells of an upscaled grid are shown with the average centers of mass shown by red stars in the sub-areas.

Table F.1. Coordinates for Sub-Area Boundaries for Grid 1 (200 West Area) of FY 1992 Iodine-129

Sub-Area 1		Sub-Area 2	
Easting (m)	Northing (m)	Easting (m)	Northing (m)
566000	132800	566000	134700
572300	132800	570850	137280
572300	134916	570500	138209
571950	135569	570348	138514
571356	136148	570151	138700
570850	137280	566000	138700
566000	134700	566000	134700
566000	132800		

Table F.2. Statistics of Centers of Mass of Individual Simulations of FY 1992 Iodine-129 Calculated for a Depth of 5 m for Sub-Areas of Grid 1 (200 West Area)

Coordinate (m)	Sub-Area 1		Sub-Area 2	
	Easting	Northing	Easting	Northing
Mean	569301.4	134376.4	568181.8	137278.2
Standard Error	14.2	13.4	24.8	12.2
Median	569267.6	134342.5	568168.3	137287.9
Standard Deviation	302.0	283.6	526.9	259.7
Kurtosis	0.03	-0.15	0.00	-0.20
Skewness	0.38	0.39	0.23	-0.12
Range	1736.1	1623.1	3119.4	1541.5
Minimum	568543.8	133653.2	566667.1	136360.4
Maximum	570279.9	135276.3	569786.5	137901.8
Count	450	450	450	450
97.5th Percentile	569928.6	134969.3	569333.4	137778.9
2.5th Percentile	568775.8	133899.3	567167.3	136778.0
Confidence Level of Mean (95.0%)	28.0	26.3	48.8	24.1

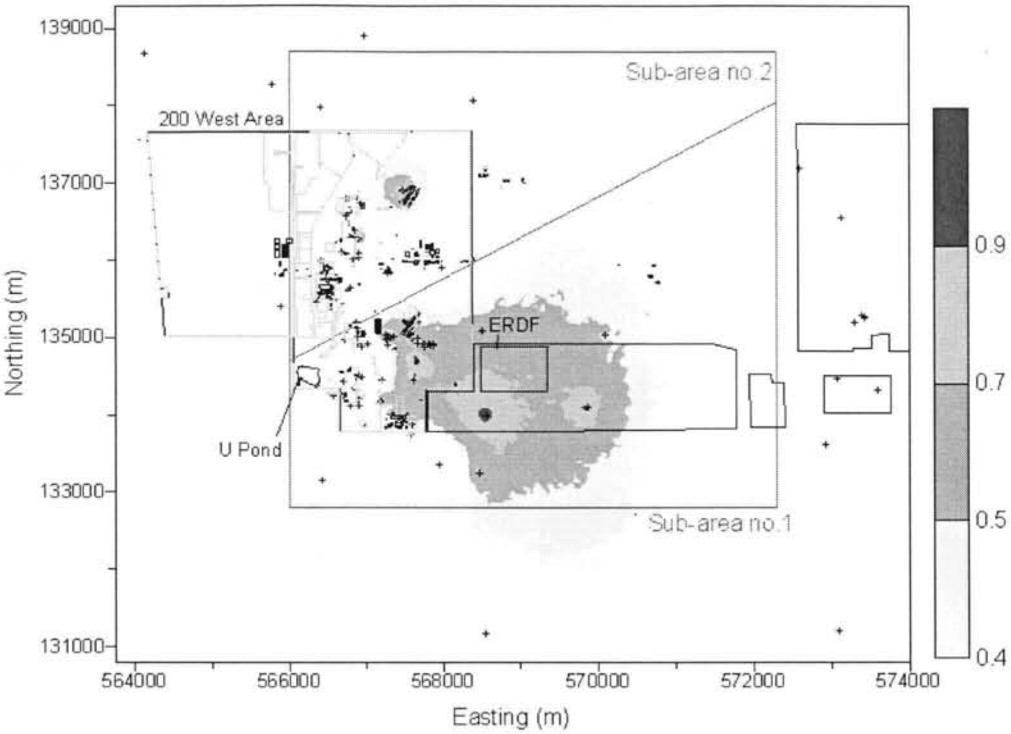

Figure F.5. Probability of Exceeding 1 pCi/L Based on Simulations of FY 1992 Iodine-129 in Grid 1 (200 West Area)

Table F.3. Area Exceeding 1 pCi/L for FY 1992 Iodine-129 for Each Simulation within Sub-Areas of Grid 1 (200 West Area)

Area (km^2)	Sub-Area 1	Sub-Area 2	Grid 1
Mean	7.23	2.89	17.08
Standard Error	0.07	0.05	0.16
Median	7.13	2.77	16.99
Standard Deviation	1.53	1.11	3.48
Kurtosis	-0.34	0.38	-0.34
Skewness	0.31	0.69	0.15
Range	8.50	5.77	19.52
Minimum	3.52	0.73	8.12
Maximum	12.01	6.50	27.63
Count	450	450	450
97.5th Percentile	10.36	5.56	24.13
2.5th Percentile	4.68	1.13	10.62
Confidence Level of Mean (95.0%)	0.14	0.10	0.32

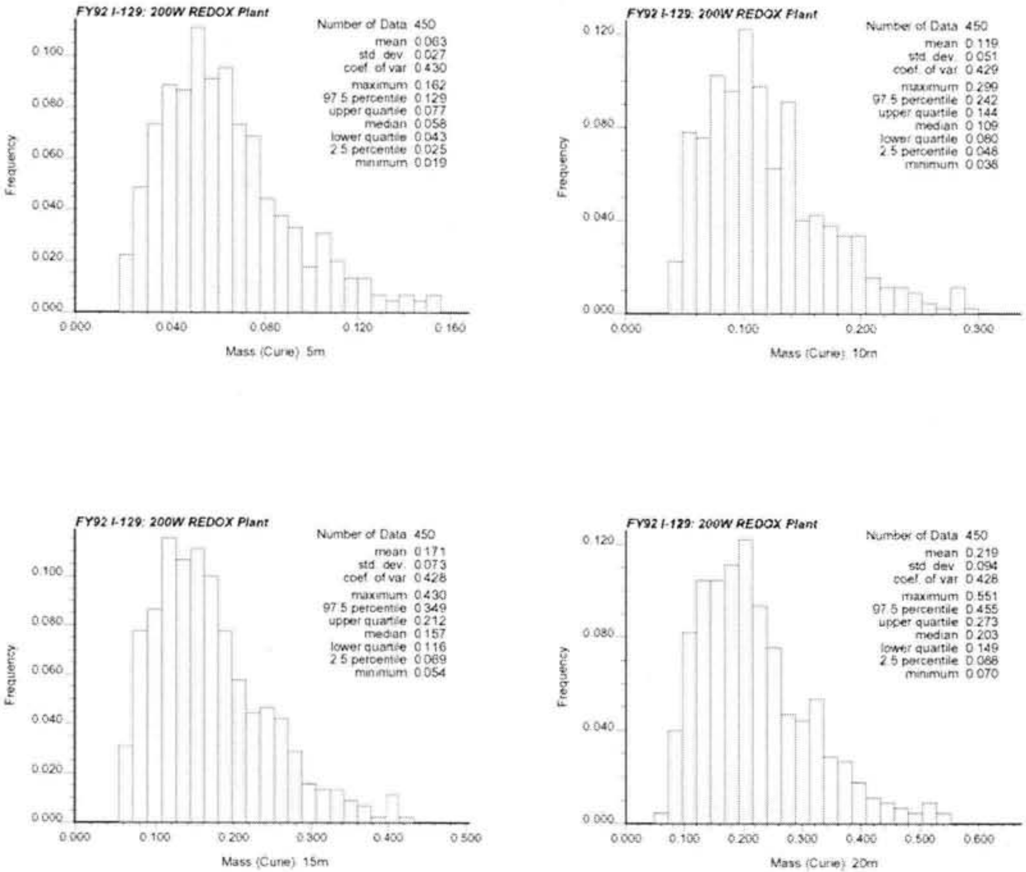

Figure F.6. Histograms of Total Activity in Simulations of FY 1992 Iodine-129 within Sub-Area 1 of Grid 1 (200 West Area), Four Thickness Assumptions

Table F.4. Statistics of Total Activity of Simulations of FY 1992 Iodine-129 within Sub-Area 1 of Grid 1 (200 West Area), Four Thickness Assumptions

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	0.0633	0.1190	0.1708	0.2195
Standard Error	0.0013	0.0024	0.0035	0.0044
Median	0.0584	0.1092	0.1574	0.2029
Standard Deviation	0.0272	0.0511	0.0732	0.0941
Kurtosis	0.6970	0.6817	0.6776	0.6956
Skewness	0.9262	0.9266	0.9253	0.9273
Range	0.1434	0.2610	0.3754	0.4814
Minimum	0.0186	0.0376	0.0545	0.0700
Maximum	0.1620	0.2986	0.4299	0.5514
Count	450	450	450	450
97.5th Percentile	0.1277	0.2419	0.3489	0.4529
2.5th Percentile	0.0253	0.0484	0.0690	0.0877
Confidence Level of Mean (95.0%)	0.0025	0.0047	0.0068	0.0087

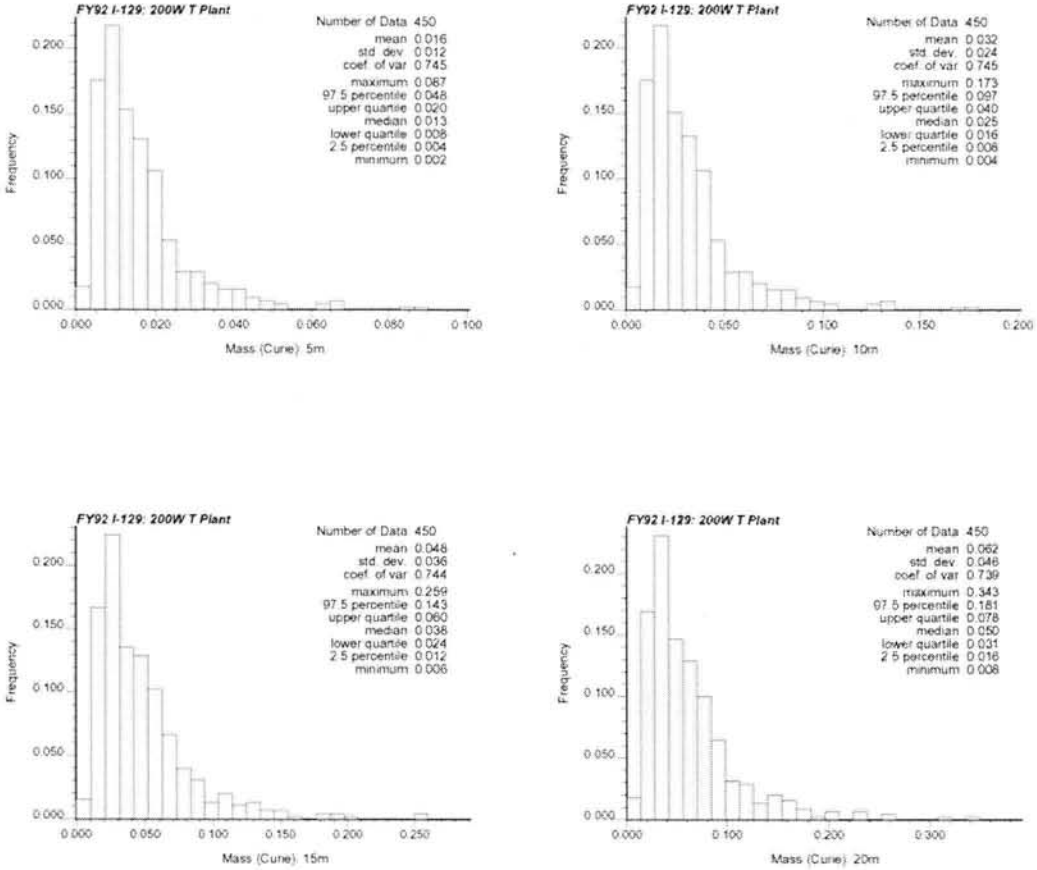

Figure F.7. Histograms of Total Activity in Simulations of FY 1992 Iodine-129 within Sub-Area 2 of Grid 1 (200 West Area), Four Thickness Assumptions

Table F.5. Statistics of Total Activity of Simulations of FY 1992 Iodine-129 within Sub-Area 2 of Grid 1 (200 West Area), Four Thickness Assumptions

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	0.0160	0.0321	0.0478	0.0619
Standard Error	0.0006	0.0011	0.0017	0.0022
Median	0.0127	0.0255	0.0381	0.0499
Standard Deviation	0.0120	0.0239	0.0356	0.0458
Kurtosis	7.0938	7.0938	7.1390	7.2792
Skewness	2.2204	2.2204	2.2226	2.2300
Range	0.0845	0.1690	0.2531	0.3344
Minimum	0.0021	0.0042	0.0063	0.0081
Maximum	0.0866	0.1732	0.2593	0.3425
Count	450	450	450	450
97.5th Percentile	0.0479	0.0959	0.1423	0.1794
2.5th Percentile	0.0040	0.0080	0.0119	0.0158
Confidence Level of Mean (95.0%)	0.0011	0.0022	0.0033	0.0042

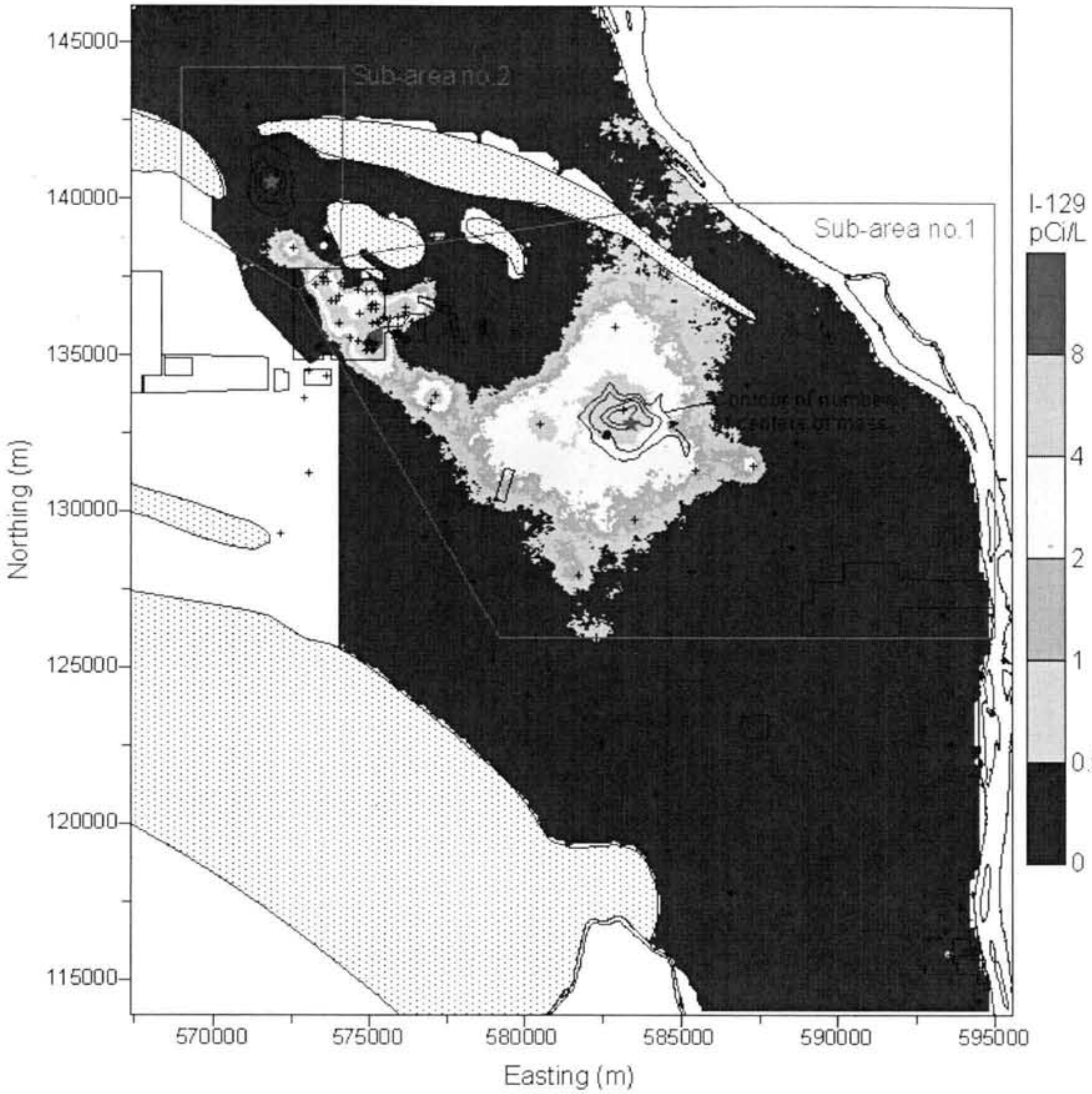

Figure F.8. Median of Simulated FY 2001 Iodine-129 Concentrations in Grid 2 (200 East Area Plumes). Contours of the number of times that the center of mass within the sub-area occurred within cells of an upscaled grid are shown with the average centers of mass shown by red stars in the sub-areas.

Table F.6. **Coordinates for Sub-Area Boundaries for Grid 2 (200 East Area) of FY 1992 Iodine-129**

Sub-Area 1				Sub-Area 2	
Easting (m)	Northing (m)	Easting (m)	Northing (m)	Easting (m)	Northing (m)
572700	137050	582746	138984	572700	137050
574100	138100	583410	138730	574100	138100
574114	138075	584319	137984	573955	138563
574285	137776	585508	137161	573675	139155
574417	137704	587335	136130	573634	139413
574665	137776	587430	136257	573698	139712
575466	137383	586444	137017	573946	139883
575565	137415	585287	137889	574145	139983
575542	137546	584174	138699	574136	141200
575163	137835	583238	139571	573698	141200
574733	138174	585400	139900	573164	141602
575113	138256	585902	139900	572536	142031
575556	137894	587028	138920	572332	142072
575764	137794	588267	138129	571627	141995
576103	137794	589537	137365	571505	142013
576424	137876	590170	136637	571387	142235
576650	138057	590650	136176	571753	142452
576790	138256	591047	135511	573512	142565
576781	138536	591219	135000	574186	142551
578192	138744	591536	134652	574200	144200
578464	138560	593263	133539	569000	144200
578870	138560	593851	132554	569000	142162
579513	138183	594136	131744	569628	141715
579553	137595	594312	130903	570279	140706
579702	137446	594457	130302	570388	140105
579861	137446	594520	128100	570125	139929
580042	137654	594805	127747	569936	140037
580033	138183	594805	125950	569936	139006
579870	138563	579250	125950	570537	138378
579531	138975	572700	137050	572700	137050
581865	139345				

Table F.7. Statistics of Centers of Mass of Individual Simulations of FY 1992 Iodine-129 Calculated for a Depth of 5 m for Sub-Areas of Grid 2 (200 East Area Plumes)

Coordinate (m)	Sub-Area 1		Sub-Area 2	
	Easting	Northing	Easting	Northing
Mean	583217.2	132781.1	571787.5	140646.9
Standard Error	44.3	35.3	21.5	34.6
Median	583138.7	132846.0	571801.2	140589.7
Standard Deviation	827.8	660.5	403.0	647.9
Kurtosis	0.67	-0.35	-0.16	-0.21
Skewness	0.44	-0.19	-0.16	0.23
Range	5607.9	3446.4	2155.3	3596.3
Minimum	581105.2	130923.3	570606.1	138927.2
Maximum	586713.2	134369.7	572761.4	142523.5
Count	350	350	350	350
97.5th Percentile	585038.8	134011.8	572543.3	141989.9
2.5th Percentile	581731.7	131396.6	570994.9	139469.1
Confidence Level of Mean (95.0%)	87.0	69.4	42.4	68.1

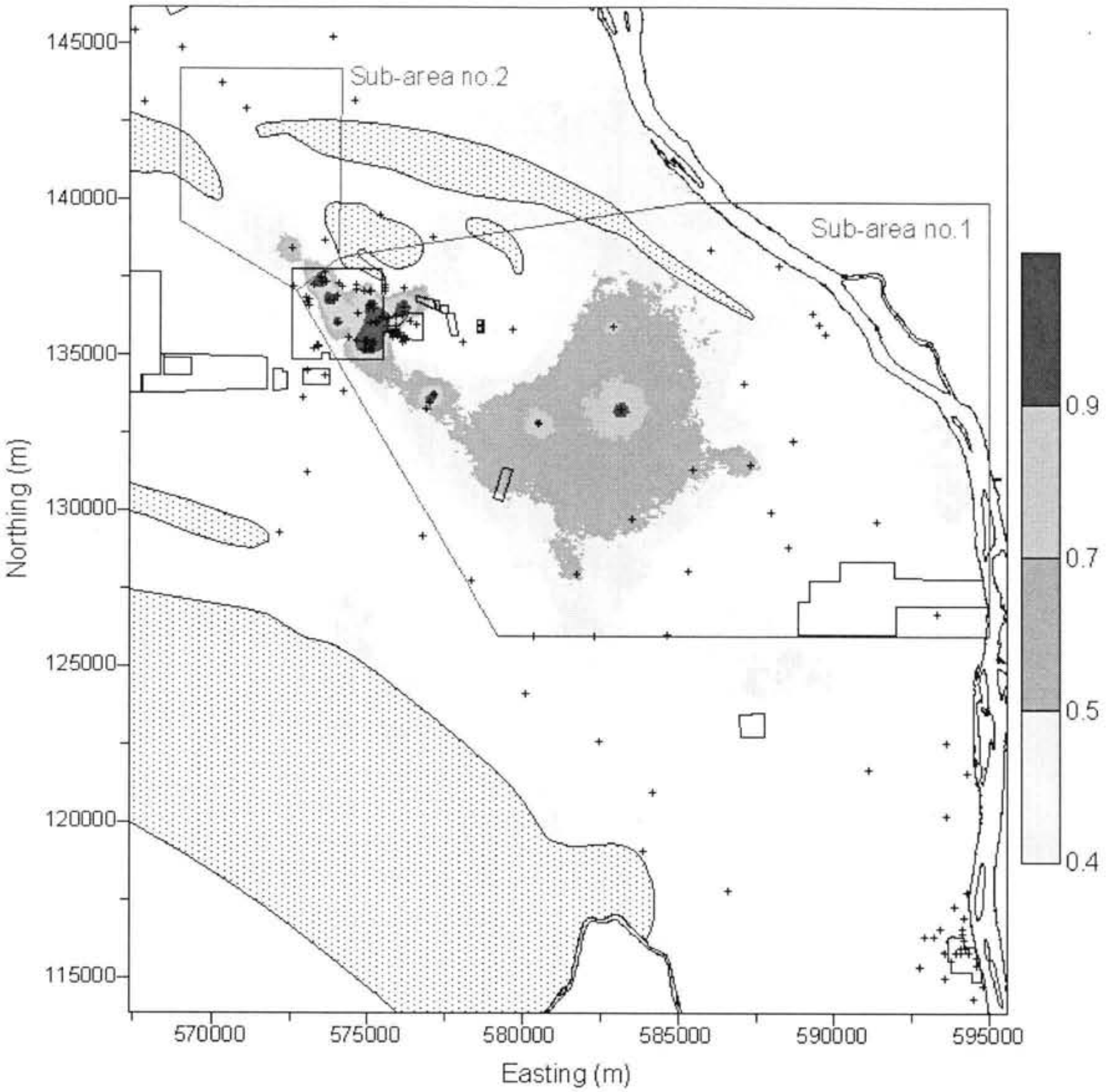

Figure F.9. Probability of Exceeding 1 pCi/L Based on Simulations of FY 1992 Iodine-129 in Grid 2 (200 East Area Plumes)

Table F.8. **Area Exceeding 1 pCi/L for FY 1992 Iodine-129 for Each Simulation within Sub-Areas of Grid 2 (200 East Area Plumes)**

Area (km^2)	Sub-Area 1	Sub-Area 2	Grid 3
Mean	88.08	7.82	165.92
Standard Error	0.65	0.19	1.06
Median	86.85	7.31	165.11
Standard Deviation	12.21	3.56	19.81
Kurtosis	-0.28	0.07	-0.23
Skewness	0.13	0.65	0.21
Range	67.47	17.66	119.97
Minimum	54.74	1.29	121.58
Maximum	122.21	18.94	241.54
Count	350	350	350
97.5th Percentile	111.62	16.11	202.97
2.5th Percentile	67.15	2.08	131.25
Confidence Level of Mean (95.0%)	1.28	0.37	2.08

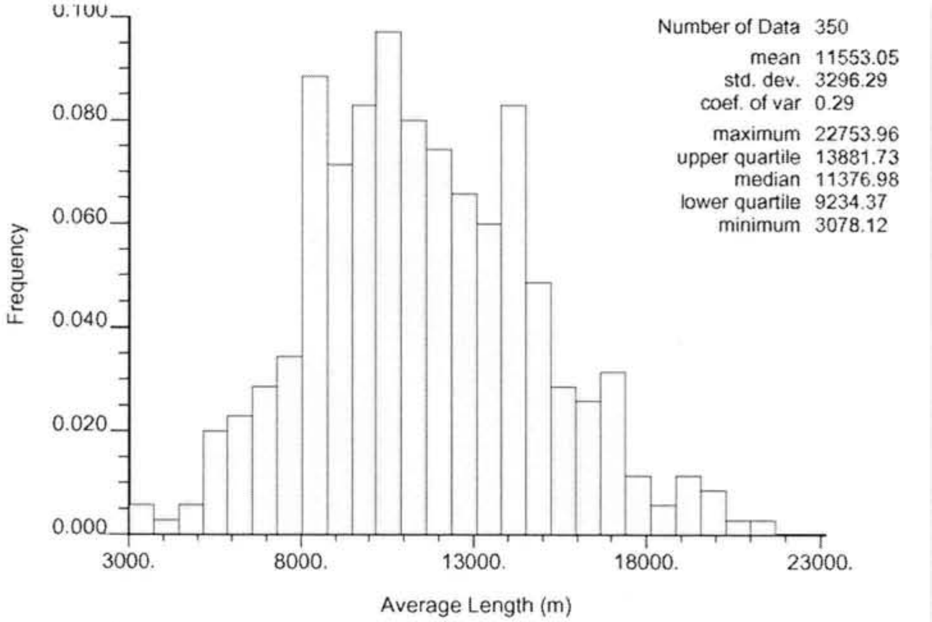

Figure F.10. **Histogram of the Average Length of Columbia River Shoreline Exceeding 1 pCi/L for FY 1992 Iodine-129 in Grid 2 (200 East Area Plumes)**

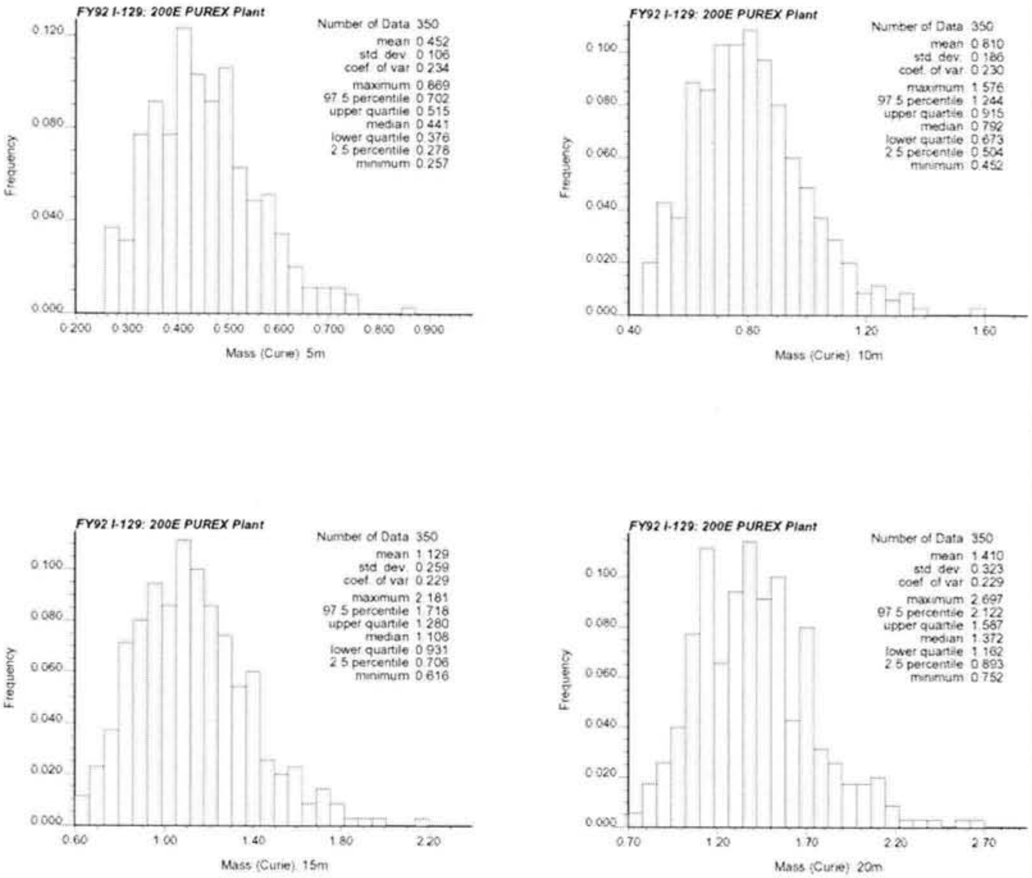

Figure F.11. **Histograms of Total Activity in Simulations of FY 1992 Iodine-129 within Sub-Area 1 of Grid 2 (200 East Area), Four Thickness Assumptions**

Table F.9. **Statistics of Total Activity of Simulations of FY 1992 Iodine-129 within Sub-Area 1 of Grid 2 (200 East Area), Four Thickness Assumptions**

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	0.4518	0.8100	1.1292	1.4100
Standard Error	0.0057	0.0100	0.0139	0.0173
Median	0.4412	0.7917	1.1084	1.3718
Standard Deviation	0.1061	0.1866	0.2592	0.3237
Kurtosis	0.3687	0.6081	0.6523	0.6701
Skewness	0.6037	0.6636	0.6745	0.6759
Range	0.6121	1.1241	1.5650	1.9441
Minimum	0.2570	0.4520	0.6157	0.7525
Maximum	0.8692	1.5761	2.1807	2.6966
Count	350	350	350	350
97.5th Percentile	0.7033	1.2459	1.7181	2.1220
2.5th Percentile	0.2777	0.5023	0.7005	0.8910
Confidence Level of Mean (95.0%)	0.0112	0.0196	0.0273	0.0340

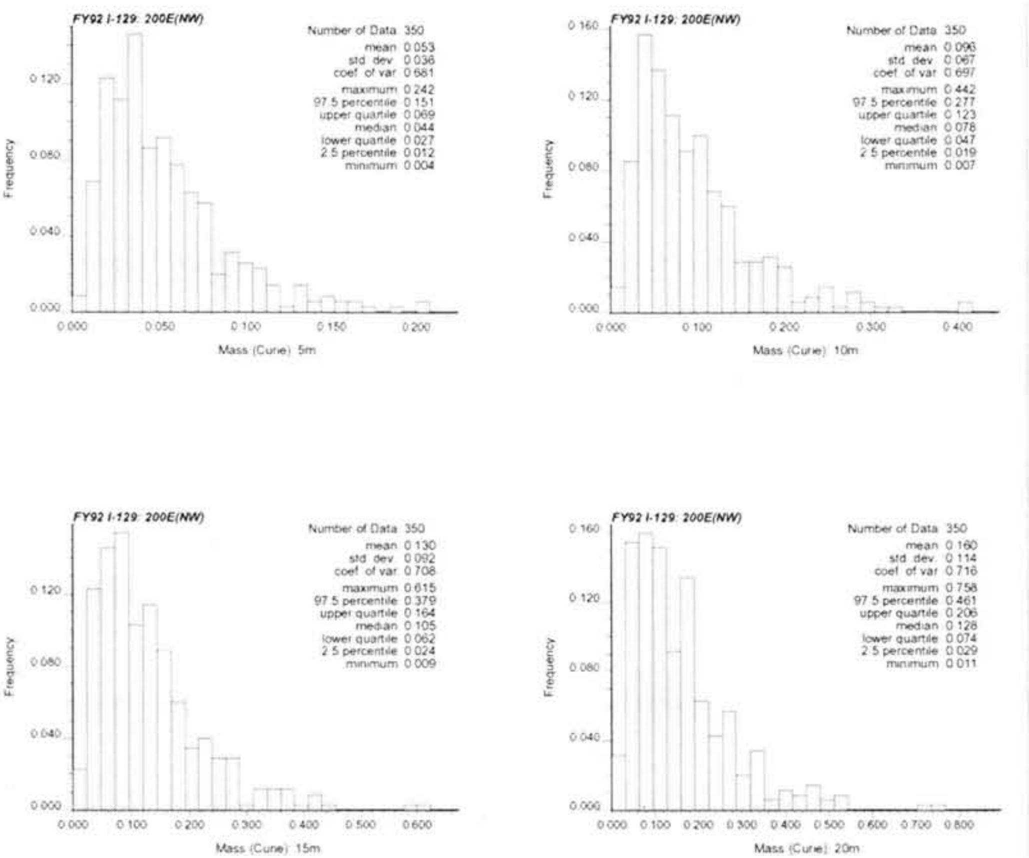

Figure F.12. Histograms of Total Activity in Simulations of FY 1992 Iodine-129 within Sub-Area 2 of Grid 2 (200 East Area), Four Thickness Assumptions

Table F.10. Statistics of Total Activity of Simulations of FY 1992 Iodine-129 within Sub-Area 2 of Grid 2 (200 East Area), Four Thickness Assumptions

Mass (Ci) in Depth	5 m	10 m	15 m	20 m
Mean	0.0534	0.0960	0.1305	0.1595
Standard Error	0.0019	0.0036	0.0049	0.0061
Median	0.0440	0.0783	0.1052	0.1285
Standard Deviation	0.0364	0.0670	0.0925	0.1144
Kurtosis	4.1850	4.2031	4.1345	4.0238
Skewness	1.6959	1.7015	1.6943	1.6849
Range	0.2373	0.4347	0.6055	0.7472
Minimum	0.0044	0.0071	0.0091	0.0110
Maximum	0.2417	0.4418	0.6147	0.7582
Count	350	350	350	350
97.5th Percentile	0.1514	0.2781	0.3790	0.4614
2.5th Percentile	0.0119	0.0188	0.0240	0.0290
Confidence Level of Mean (95.0%)	0.0038	0.0070	0.0097	0.0120

Appendix G

Figures and Data Tables for FY 2001 Uranium

Appendix G

Figures and Data Tables for FY 2001 Uranium

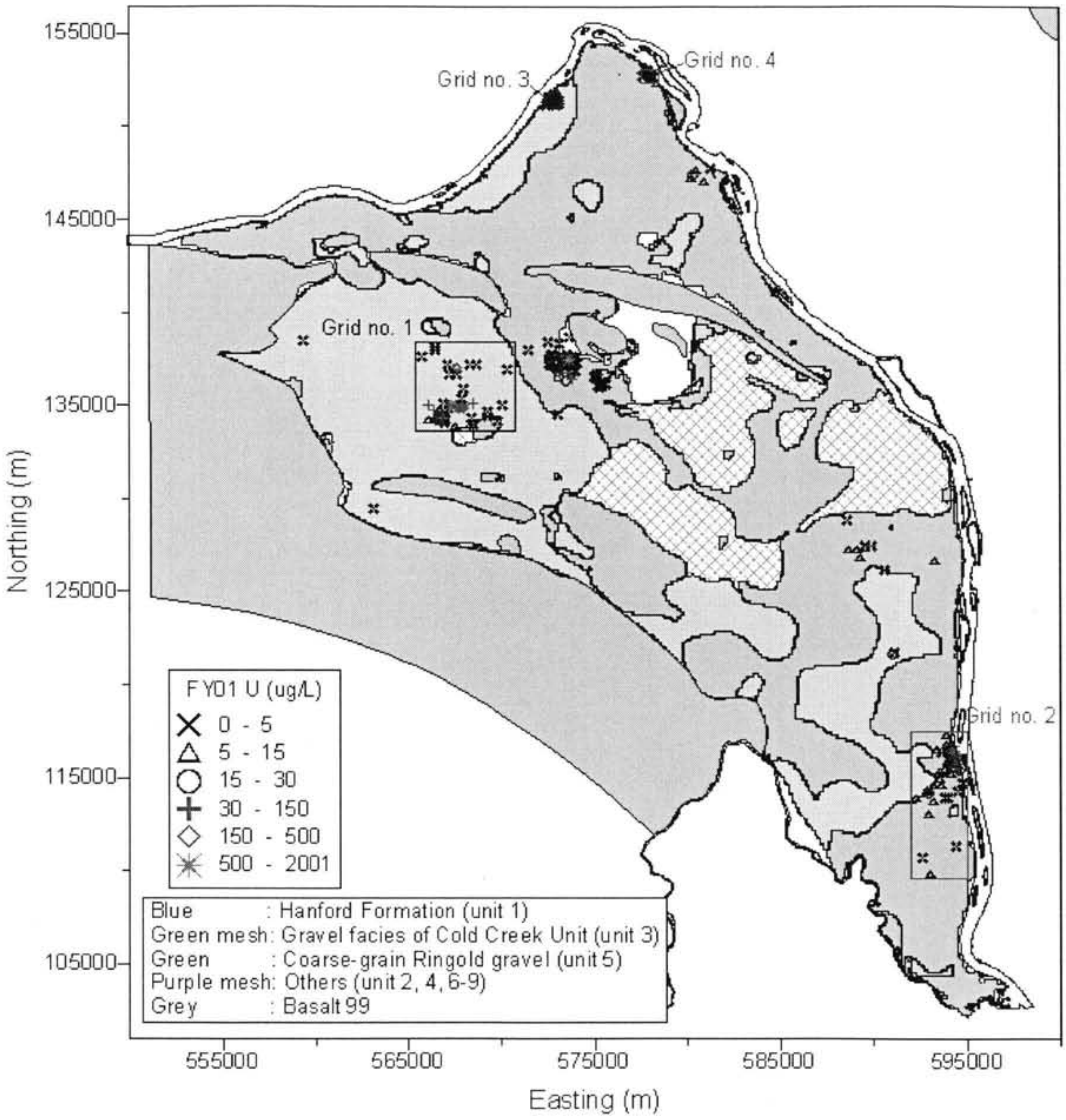

Figure G.1. Subsets of FY 2001 Uranium Data and Subcrop Formation Units at the FY 2001 Water Table. Although an area is highlighted for Grid 3, initial data analysis indicated that reliable results could not be obtained in that area.

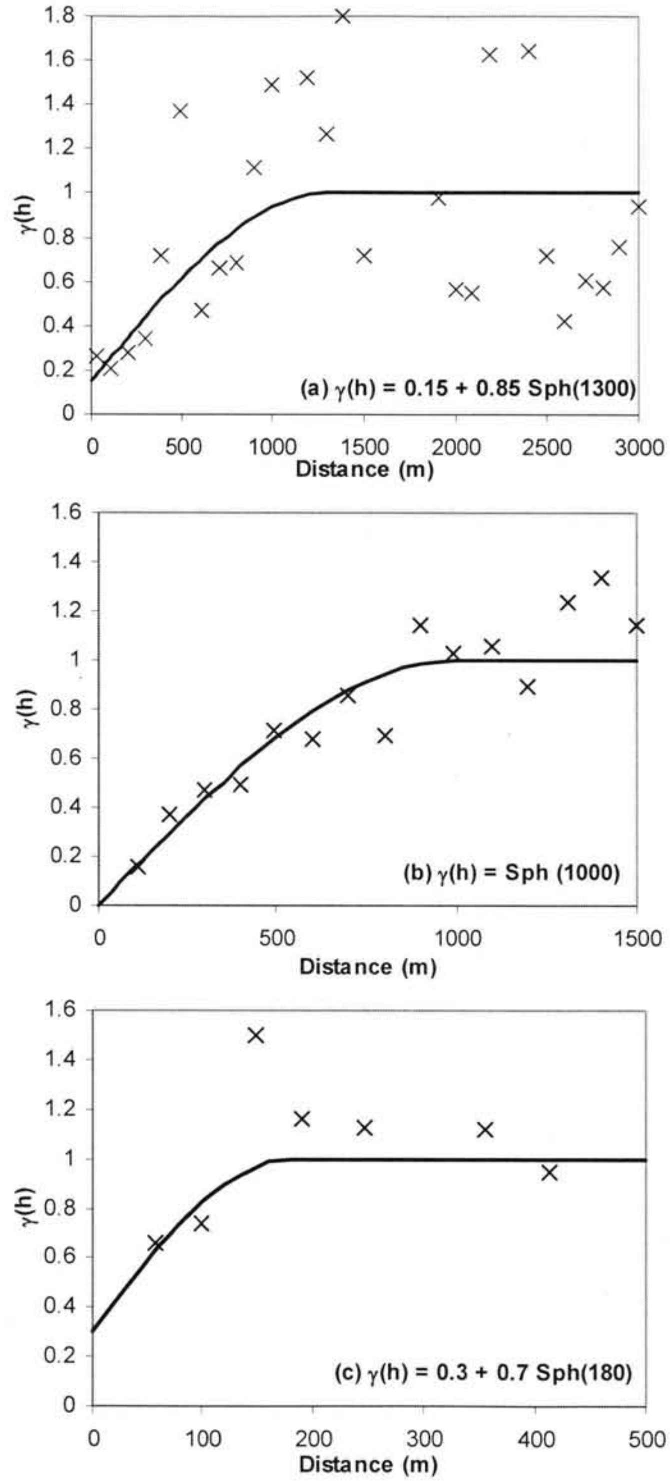

Figure G.2. Variograms and Models of Normal Scores of the FY 2001 Uranium Data in Local Grid 1 (a), Grid 2 (b), and Grid 4 (c). Experimental variogram values designated by X, with the models fit to the data denoted by the solid black lines.

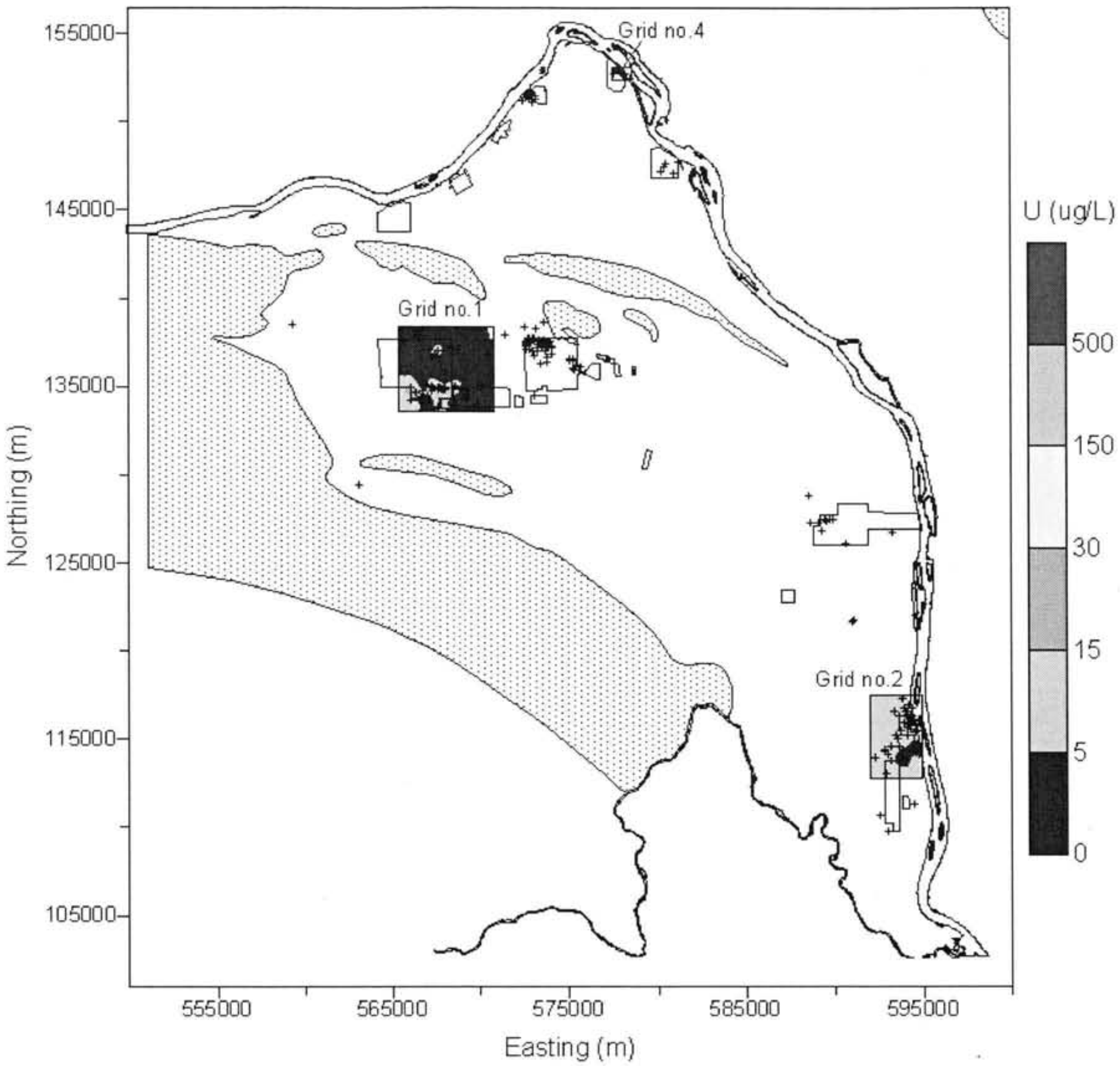

Figure G.3. **Median of Simulations of FY 2001 Uranium Concentrations for Grids 1, 2, and 4. No spatial structure was detected in the data from the 200 East Area, so the geostatistical analysis and calculation of history matching metrics were not performed.**

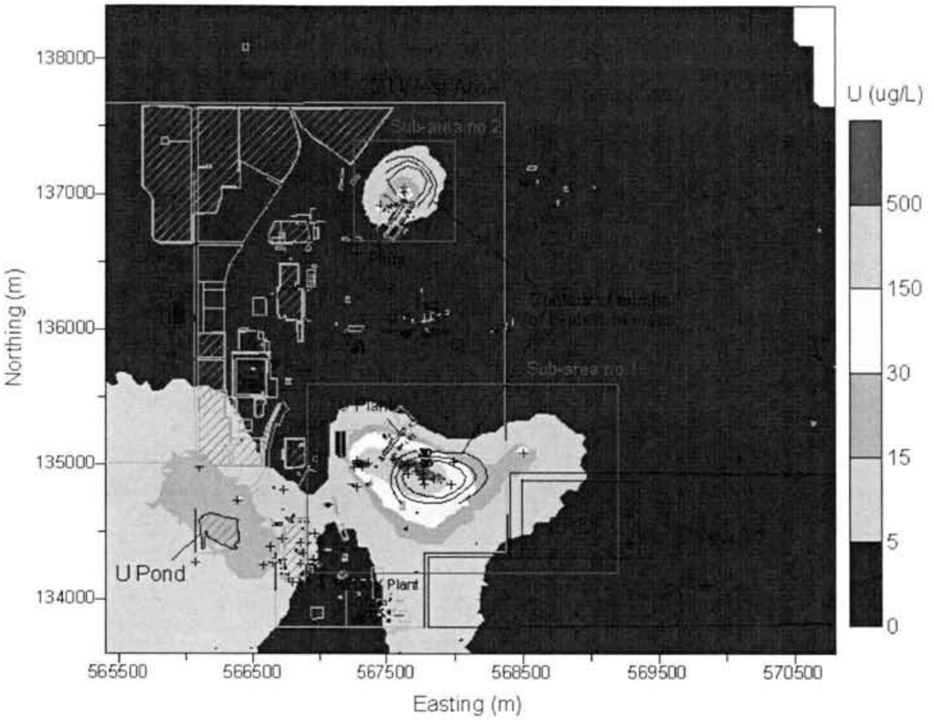

Figure G.4. Median of Simulated FY 2001 Uranium Concentrations in Grid 1 (200 West Area). Contours of the number of times that the center of mass within the sub-areas occurred within cells of an upscaled grid are shown with the average centers of mass shown by pink star in the sub-areas.

Table G.1. Coordinates for Sub-Area Boundaries for Grid 1 (200 West Area) of FY 2001 Uranium

Sub-Area 1		Sub-Area 2	
Easting (m)	Northing (m)	Easting (m)	Northing (m)
566900	134200	567250	136650
569200	134200	568000	136650
569200	135600	568000	137400
566900	135600	567250	137400
566900	134200	567250	136650

Table G.2. **Statistics of Centers of Mass of Individual Simulations of FY 2001 Uranium Calculated for a Depth of 5 m for the Sub-Areas of Grid 1 (200 West Area)**

Coordinate (m)	Sub-Area 1		Sub-Area 2	
	Easting	Northing	Easting	Northing
Mean	567883.9	134892.2	567634.4	137042.3
Standard Error	6.7	3.9	2.7	2.8
Median	567873.2	134888.5	567633.3	137038.4
Standard Deviation	171.7	98.7	69.6	70.4
Kurtosis	0.24	0.15	-0.42	-0.24
Skewness	0.54	0.21	0.17	0.26
Range	1009.9	615.3	378.0	424.0
Minimum	567470.6	134606.9	567454.3	136829.8
Maximum	568480.5	135222.2	567832.3	137253.8
Count	650	650	650	650
97.5th Percentile	568258.2	135096.0	567777.5	137187.1
2.5th Percentile	567605.6	134712.9	567506.9	136919.2
Confidence Level of Mean (95.0%)	13.2	7.6	5.4	5.4

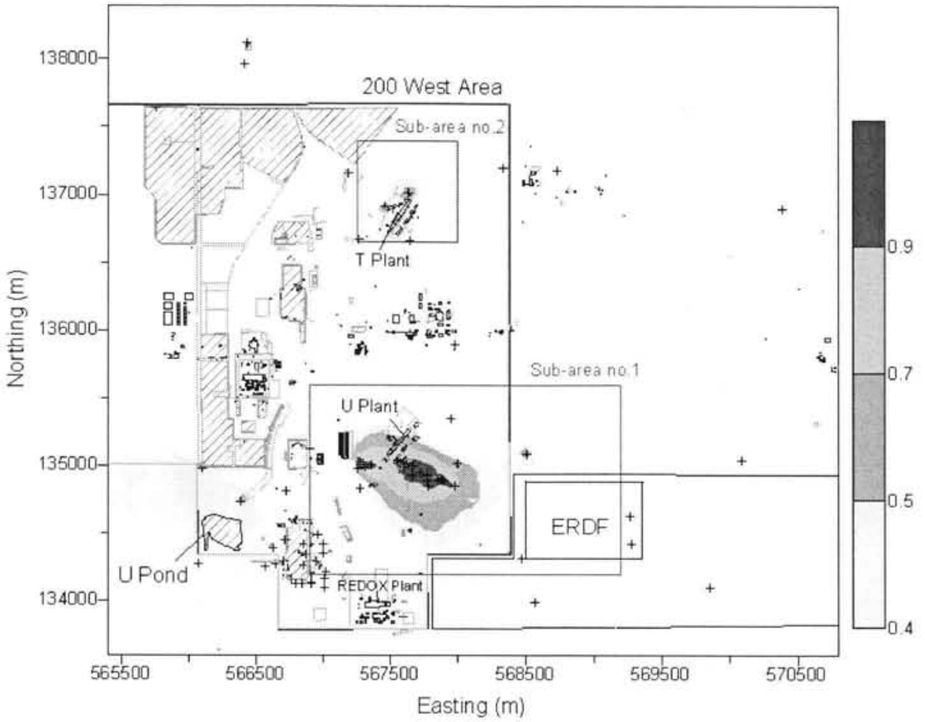

Figure G.5. **Probability of Exceeding 30 μg/L Based on Simulations of FY 2001 Uranium in Grid 1 (200 West Area)**

Table G.3. **Area Exceeding 30 μg/L for FY 2001 Uranium for Each Simulation within Sub-Areas of Grid 1 (200 West Area)**

Area (km^2)	Sub-Area 1	Sub-Area 2	Grid 1
Mean	0.834	0.104	33.19
Standard Error	0.008	0.002	0.36
Median	0.813	0.095	31.70
Standard Deviation	0.213	0.058	9.29
Kurtosis	0.316	0.340	0.30
Skewness	0.515	0.747	0.65
Range	1.310	0.330	57.70
Minimum	0.358	0.010	13.30
Maximum	1.668	0.340	71.00
Count	650	650	650
97.5th Percentile	1.290	0.228	54.25
2.5th Percentile	0.470	0.020	17.88
Confidence Level of Mean (95.0%)	0.016	0.004	0.72

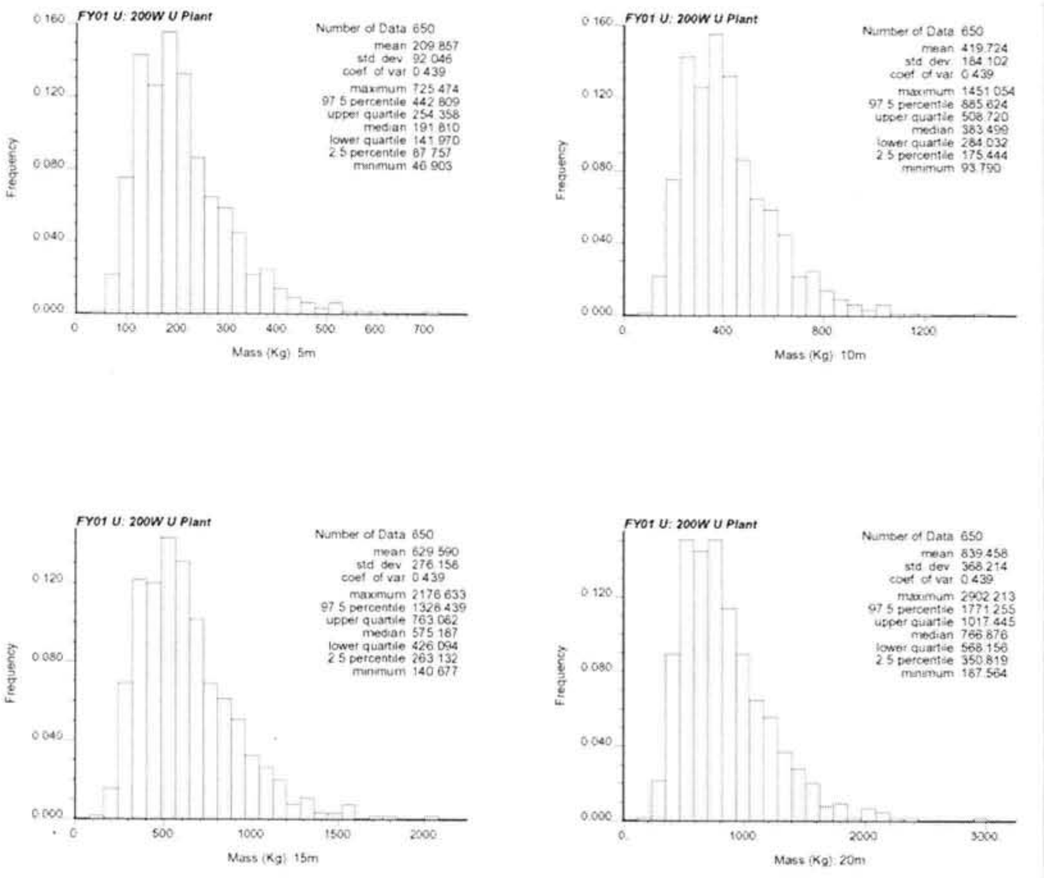

Figure G.6. Histograms of Total Activity in Simulations of FY 2001 Uranium within Sub-Area 1 of Grid 1 (200 West Area), Four Thickness Assumptions

Table G.4. Statistics of Total Activity of Simulations of FY 2001 Uranium within Sub-Area 1 of Grid 1 (200 West Area), Four Thickness Assumptions

Mass (kg) in Depth	5 m	10 m	15 m	20 m
Mean	209.86	419.72	629.59	839.46
Standard Error	3.61	7.23	10.84	14.45
Median	191.81	383.50	575.19	766.87
Standard Deviation	92.12	184.24	276.37	368.50
Kurtosis	2.63	2.63	2.62	2.62
Skewness	1.29	1.29	1.29	1.29
Range	678.57	1,357.26	2,035.96	2,714.65
Minimum	46.90	93.79	140.68	187.56
Maximum	725.47	1,451.05	2,176.63	2,902.21
Count	650	650	650	650
97.5th Percentile	442.69	885.39	1,328.09	1,770.79
2.5th Percentile	87.98	175.87	263.75	351.64
Confidence Level of Mean (95.0%)	7.09	14.19	21.29	28.38

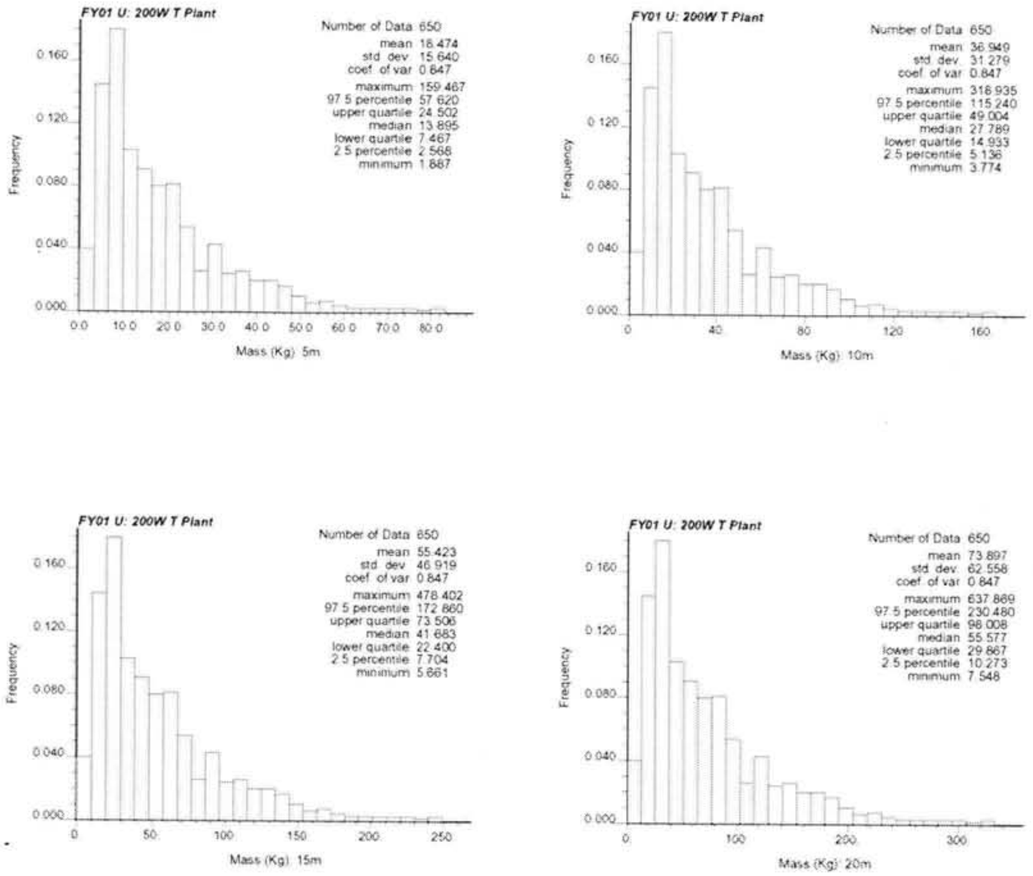

Figure G.7. Histograms of Total Mass in Simulations of FY 2001 Uranium within Sub-Area 2 of Grid 1 (200 West Area), Four Thickness Assumptions

Table G.5. Statistics of Total Mass of Simulations of FY 2001 Uranium within Sub-Area 2 of Grid 1 (200 West Area), Four Thickness Assumptions

Mass (kg) in Depth	5 m	10 m	15 m	20 m
Mean	18.47	36.95	55.42	73.90
Standard Error	0.61	1.23	1.84	2.46
Median	13.89	27.79	41.68	55.58
Standard Deviation	15.65	31.30	46.95	62.61
Kurtosis	11.87	11.87	11.87	11.87
Skewness	2.41	2.41	2.41	2.41
Range	157.58	315.16	472.74	630.32
Minimum	1.89	3.77	5.66	7.55
Maximum	159.47	318.93	478.40	637.87
Count	650	650	650	650
97.5th Percentile	57.56	115.13	172.69	230.25
2.5th Percentile	2.58	5.16	7.74	10.32
Confidence Level of Mean (95.0%)	1.21	2.41	3.62	4.82

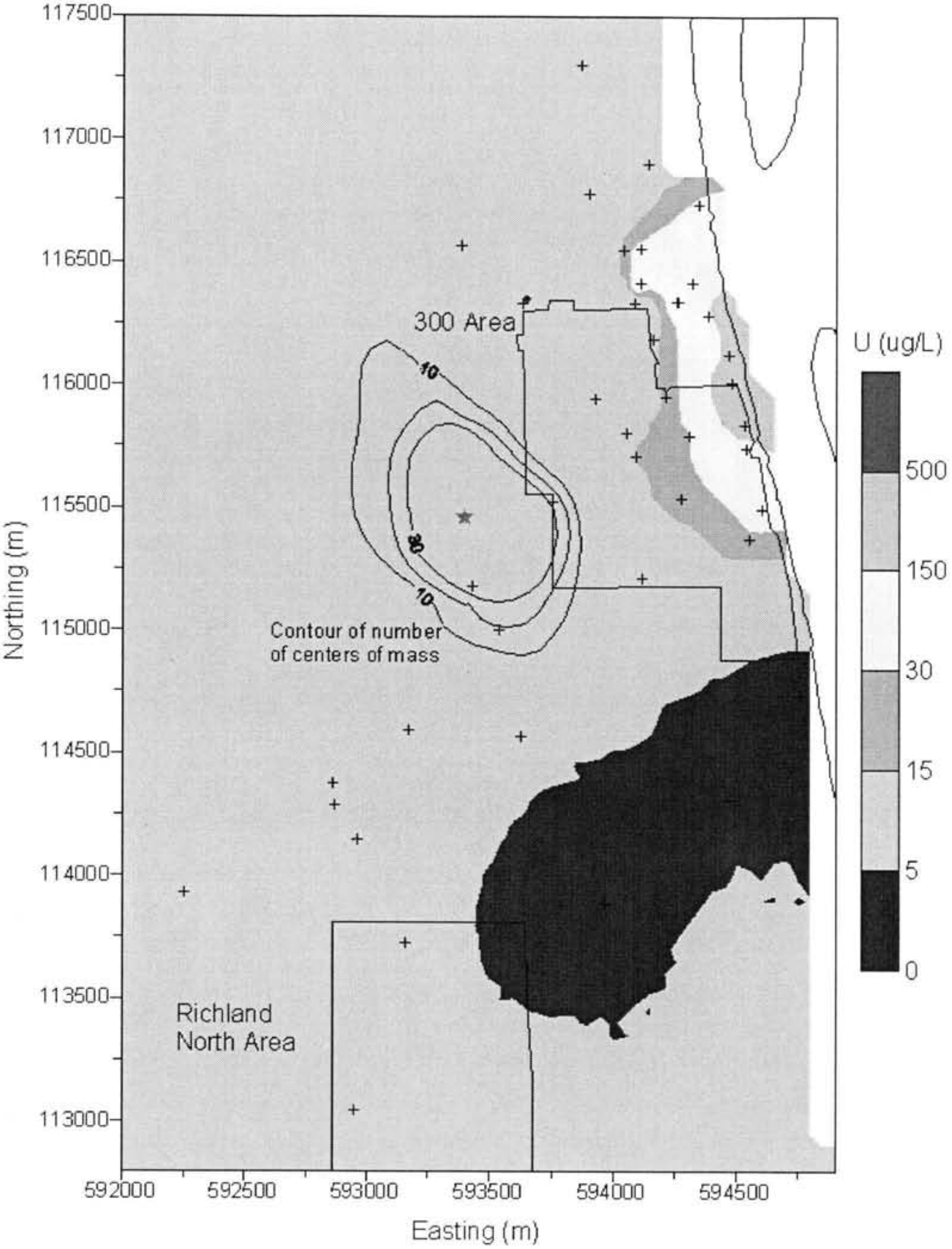

Figure G.8. Median of Simulated FY 2001 Uranium Concentrations in Grid 2 (300 Area). Contours of the number of times that the center of mass within the grid occurred within cells of an upscaled grid are shown with the average centers of mass shown by pink star in the grid.

Table G.6. **Coordinates for Sub-Area Boundary for Grid 2 (300 Area) of FY 2001 Uranium**

Easting (m)	Northing (m)
592000	117500
594196	117500
594196	116904
594254	116850
594450	116850
594450	116397
594551	116258
594551	116043
594659	115960
594659	115599
594700	115568
594700	115251
594800	115156
594800	112958
594900	112908
594900	112800
592000	112800
592000	117500

Table G.7. **Statistics of the Area Exceeding 30 μg/L and Locations of Centers of Mass for Simulations of FY 2001 Uranium within Grid 2 (300 Area)**

	Area (km^2)	Center of Mass (unit: m)	
		Easting	Northing
Mean	1.426	593475.2	115499.7
Standard Error	0.026	9.3	12.3
Median	1.261	593495.4	115492.9
Standard Deviation	0.652	237.4	313.9
Kurtosis	1.593	-0.54	0.15
Skewness	1.211	-0.33	-0.05
Range	3.928	1156.5	1784.0
Minimum	0.508	592821.6	114557.1
Maximum	4.435	593978.1	116341.1
Count	650	650	650
97.5th Percentile	3.073	593864.5	116123.8
2.5th Percentile	0.615	592975.2	114855.3
Confidence Level (95.0%)	0.050	18.3	24.2

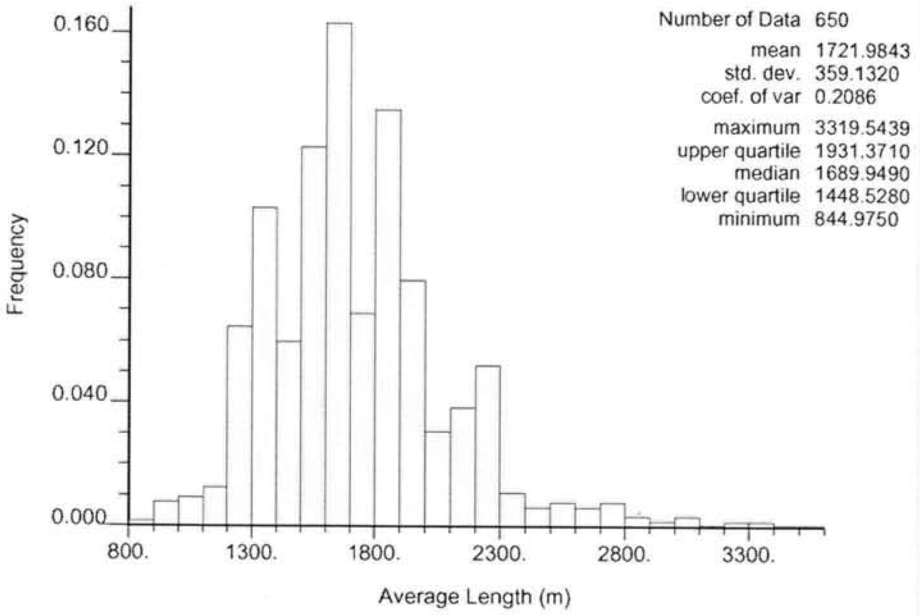

Figure G.9. Histogram of the Average Length of Columbia River Shoreline Exceeding 30 μg/L for FY 2001 Uranium in Grid 2 (300 Area)

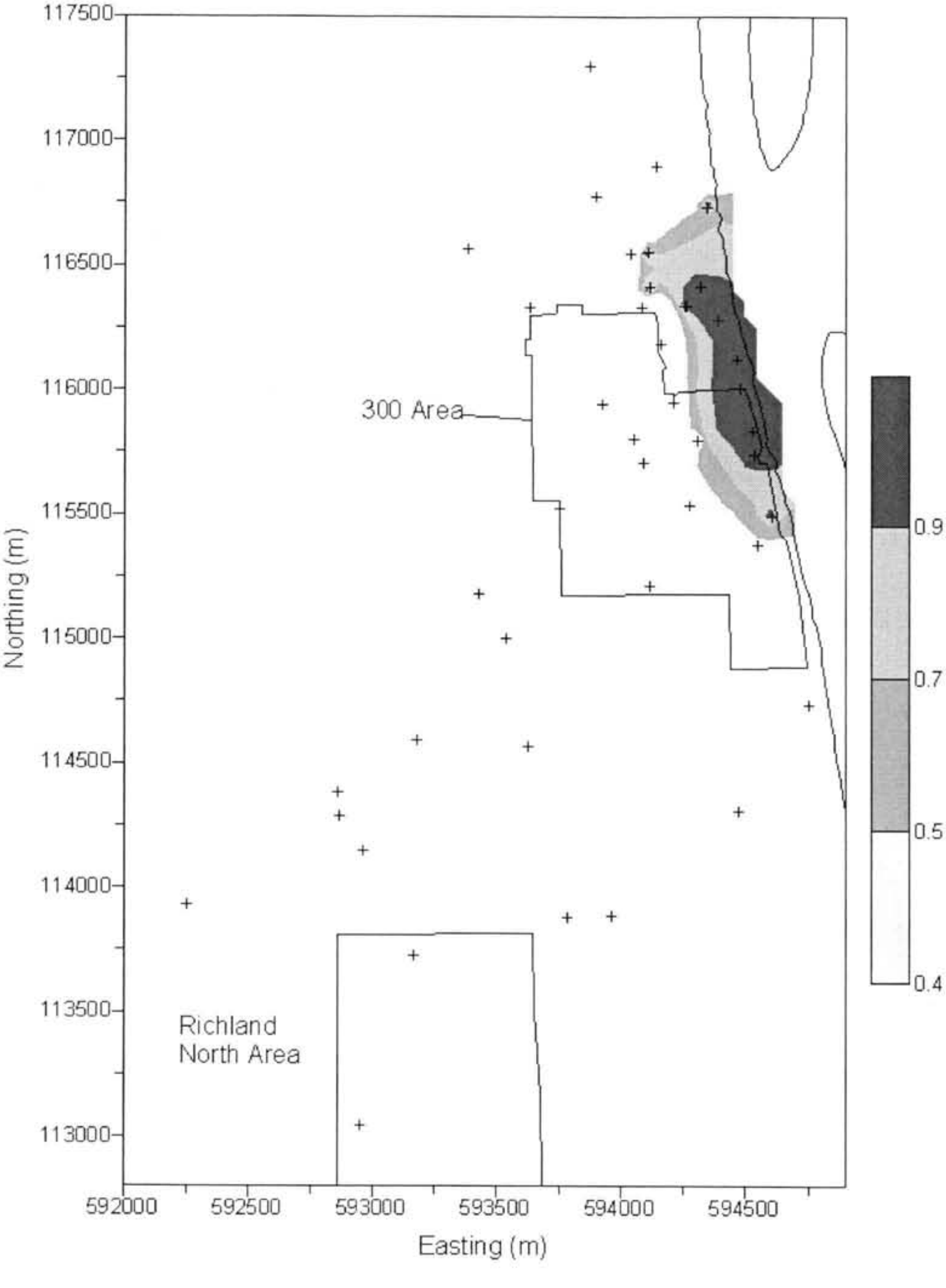

Figure G.10. Probability of Exceeding 30 μg/L Based on Simulations of FY 2001 Uranium in Grid 2 (300 Area)

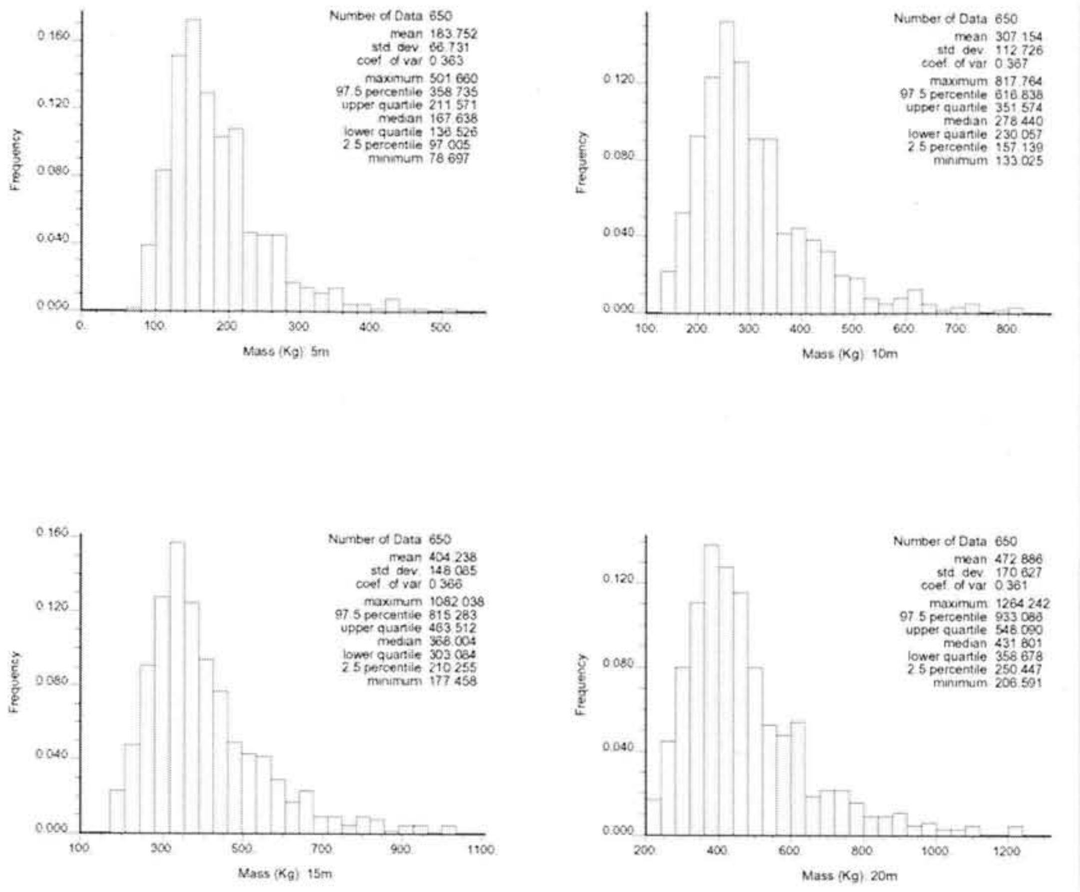

Figure G.11. Histograms of Total Mass in Simulations of FY 2001 Uranium within Grid 2 (300 Area), Four Thickness Assumptions

Table G.8. Statistics of Total Mass of Simulations of FY 2001 Uranium within Grid 2 (300 Area), Four Thickness Assumptions

Mass (kg) in Depth	5 m	10 m	15 m	20 m
Mean	183.75	307.15	404.24	472.89
Standard Error	2.62	4.42	5.81	6.70
Median	167.64	278.44	368.00	431.80
Standard Deviation	66.78	112.81	148.20	170.76
Kurtosis	2.65	2.71	2.71	2.76
Skewness	1.41	1.45	1.45	1.46
Range	422.96	684.74	904.58	1,057.65
Minimum	78.70	133.02	177.46	206.59
Maximum	501.66	817.76	1,082.04	1,264.24
Count	650	650	650	650
97.5th Percentile	358.47	615.93	814.09	928.62
2.5th Percentile	97.11	157.38	210.97	251.01
Confidence Level of Mean (95.0%)	5.14	8.69	11.41	13.15

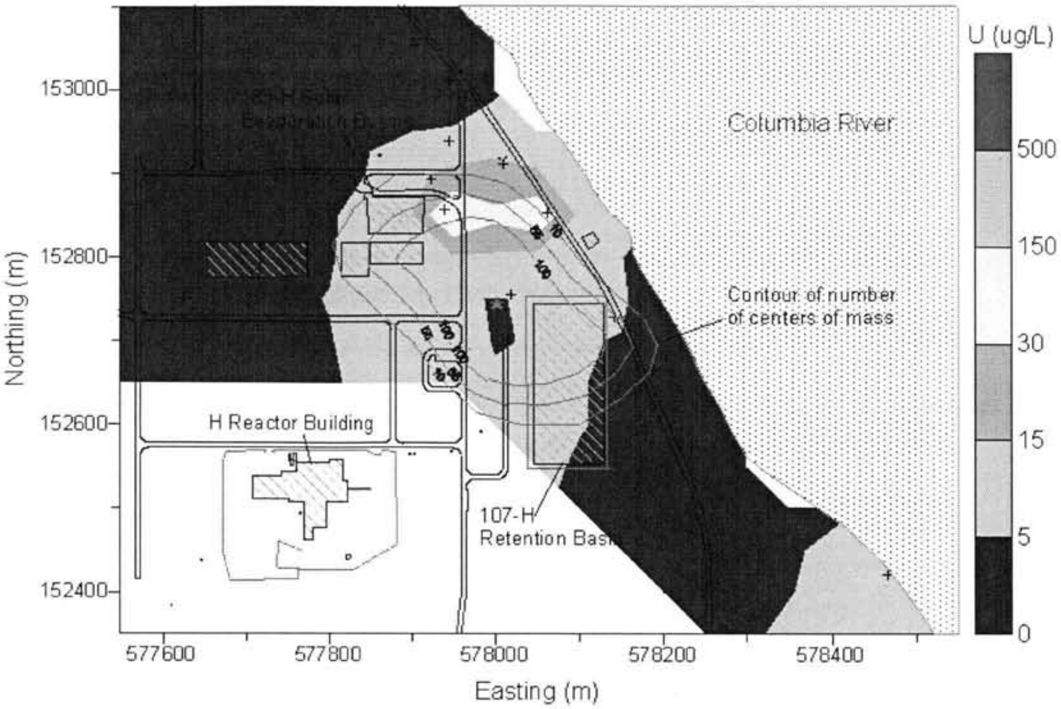

Figure G.12. Median of Simulated FY 2001 Uranium Concentrations in Grid 4 (100 H Area). Contours of the number of times that the center of mass within the grid occurred within cells of an upscaled grid are shown with the average centers of mass shown by pink star in the grid.

Table G.9. **Coordinates for Sub-Area Boundary for Grid 4 (100 H Area) of FY 2001 Uranium**

Easting (m)	Northing (m)
577550	153100
578000	153100
578000	153000
578050	152950
578150	152950
578150	152900
578200	152850
578200	152800
578250	152750
578250	152700
578300	152650
578300	152550
578350	152500
578450	152500
578500	152450
578550	152450
578550	152350
578250	152350
577950	152650
577550	152650
577550	153100

Table G.10. **Statistics of the Area Exceeding 30 μg/L and Locations of Centers of Mass for Simulations of FY 2001 Uranium within Grid 4 (100 H Area)**

	Area (km^2)	Center of Mass (unit: m)	
		Easting	Northing
Mean	0.062	578005.1	152742.3
Standard Error	0.001	2.6	2.0
Median	0.060	578004.9	152743.3
Standard Deviation	0.025	70.1	54.2
Kurtosis	0.097	-0.46	-0.16
Skewness	0.571	-0.11	0.11
Range	0.143	366.6	308.2
Minimum	0.010	577815.7	152600.3
Maximum	0.153	578182.3	152908.4
Count	700	700	700
97.5th Percentile	0.118	578134.1	152854.1
2.5th Percentile	0.023	577864.8	152637.6
Confidence Level (95.0%)	0.002	5.2	4.0

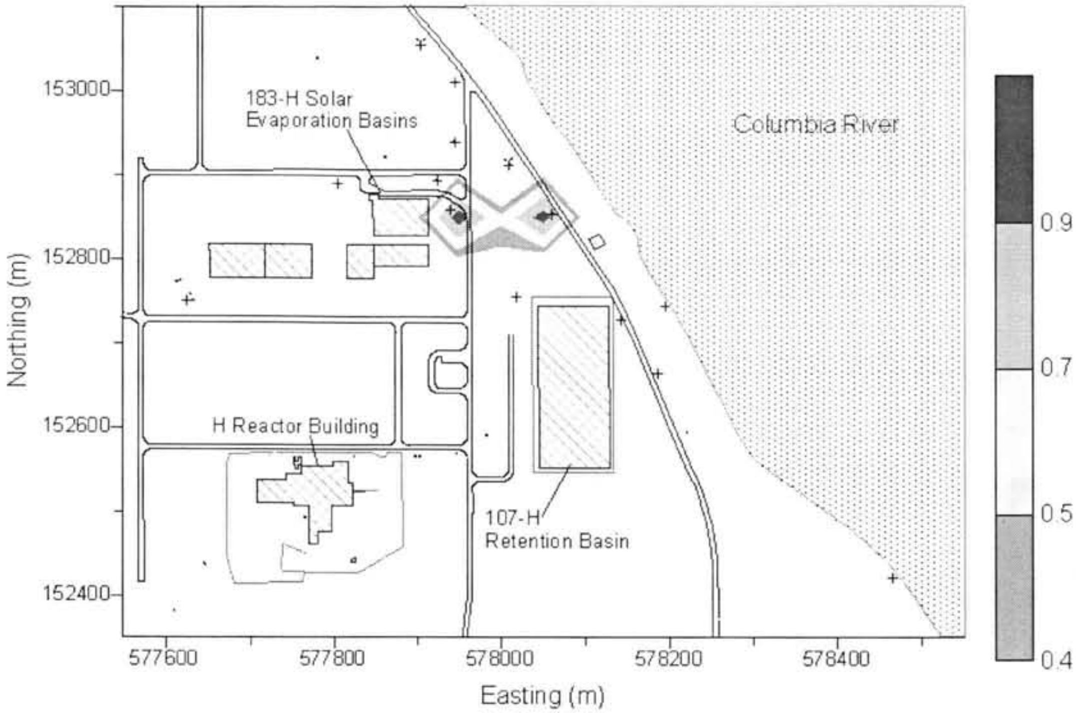

Figure G.13. Probability of Exceeding 30 μg/L Based on Simulations of FY 2001 Uranium in Grid 4 (100 H Area)

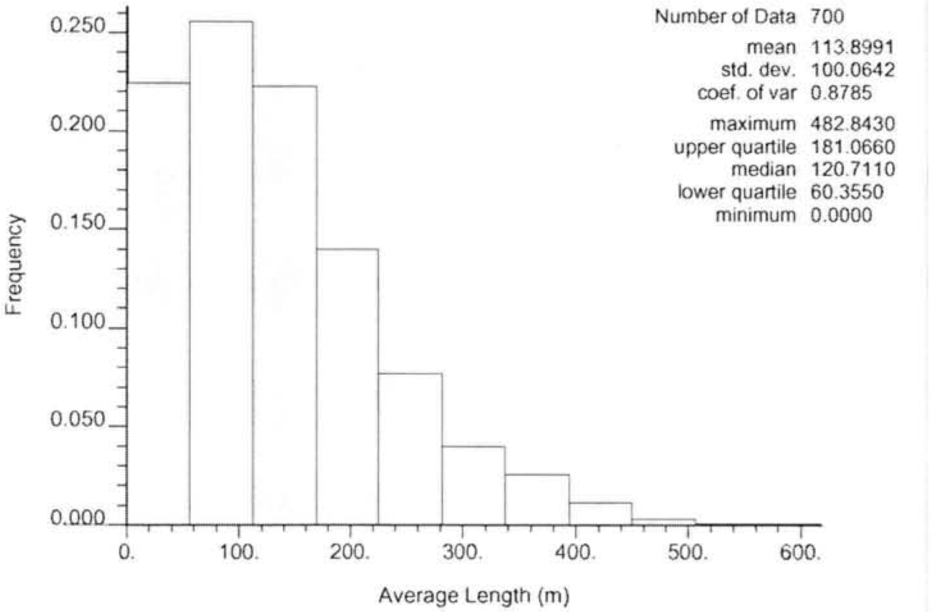

Figure G.14. Histogram of the Average Length of Columbia River Shoreline Exceeding 30 μg/L for FY 2001 Uranium in Grid 4 (100 H Area)

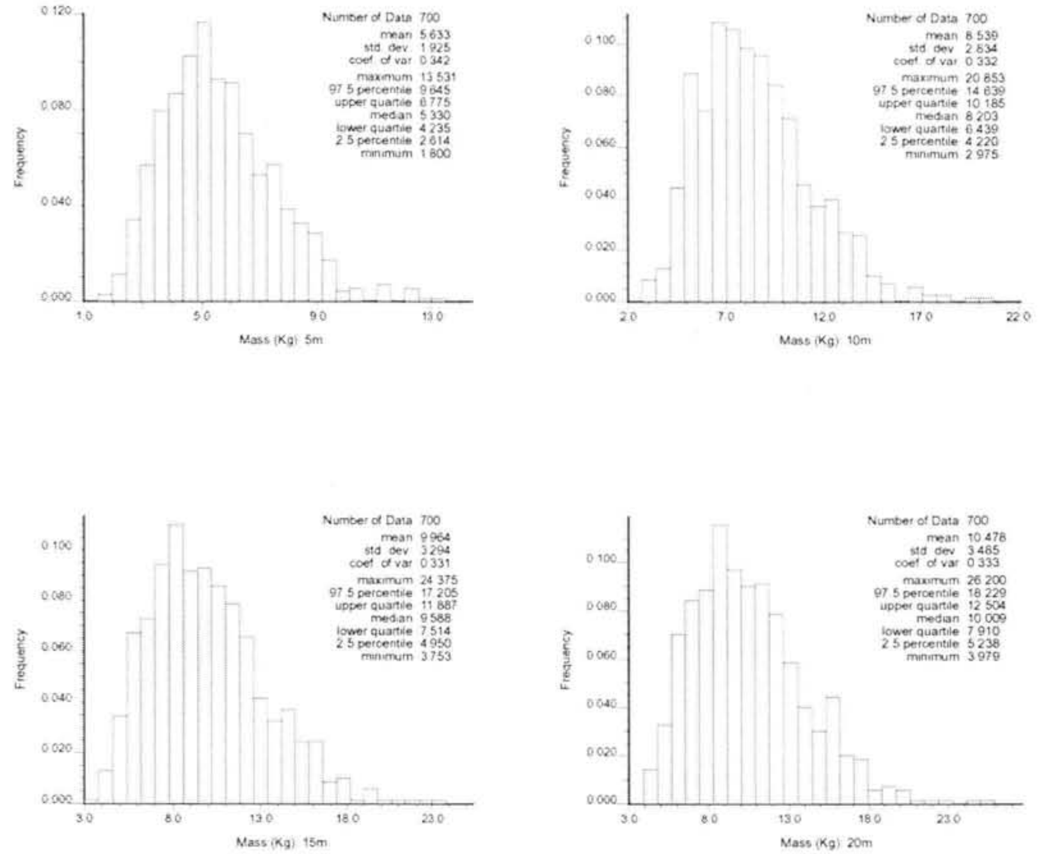

Figure G.15. Histograms of Total Mass in Simulations of FY 2001 Uranium within Grid 4 (100 H Area), Four Thickness Assumptions

Table G.11. Statistics of Total Mass of Simulations of FY 2001 Uranium within Grid 4 (100 H Area), Four Thickness Assumptions

Mass (kg) in Depth	5 m	10 m	15 m	20 m
Mean	5.633	8.539	9.964	10.478
Standard Error	0.073	0.107	0.125	0.132
Median	5.330	8.204	9.589	10.009
Standard Deviation	1.926	2.836	3.296	3.488
Kurtosis	0.759	0.744	0.641	0.713
Skewness	0.765	0.768	0.752	0.771
Range	11.731	17.879	20.622	22.221
Minimum	1.800	2.975	3.753	3.979
Maximum	13.531	20.853	24.375	26.200
Count	700	700	700	700
97.5th Percentile	9.643	14.639	17.204	18.229
2.5th Percentile	2.614	4.220	4.950	5.238
Confidence Level of Mean (95.0%)	0.143	0.210	0.245	0.259

Appendix H

Figures and Data Tables for FY 1992 Uranium

Appendix H

Figures and Data Tables for FY 1992 Uranium

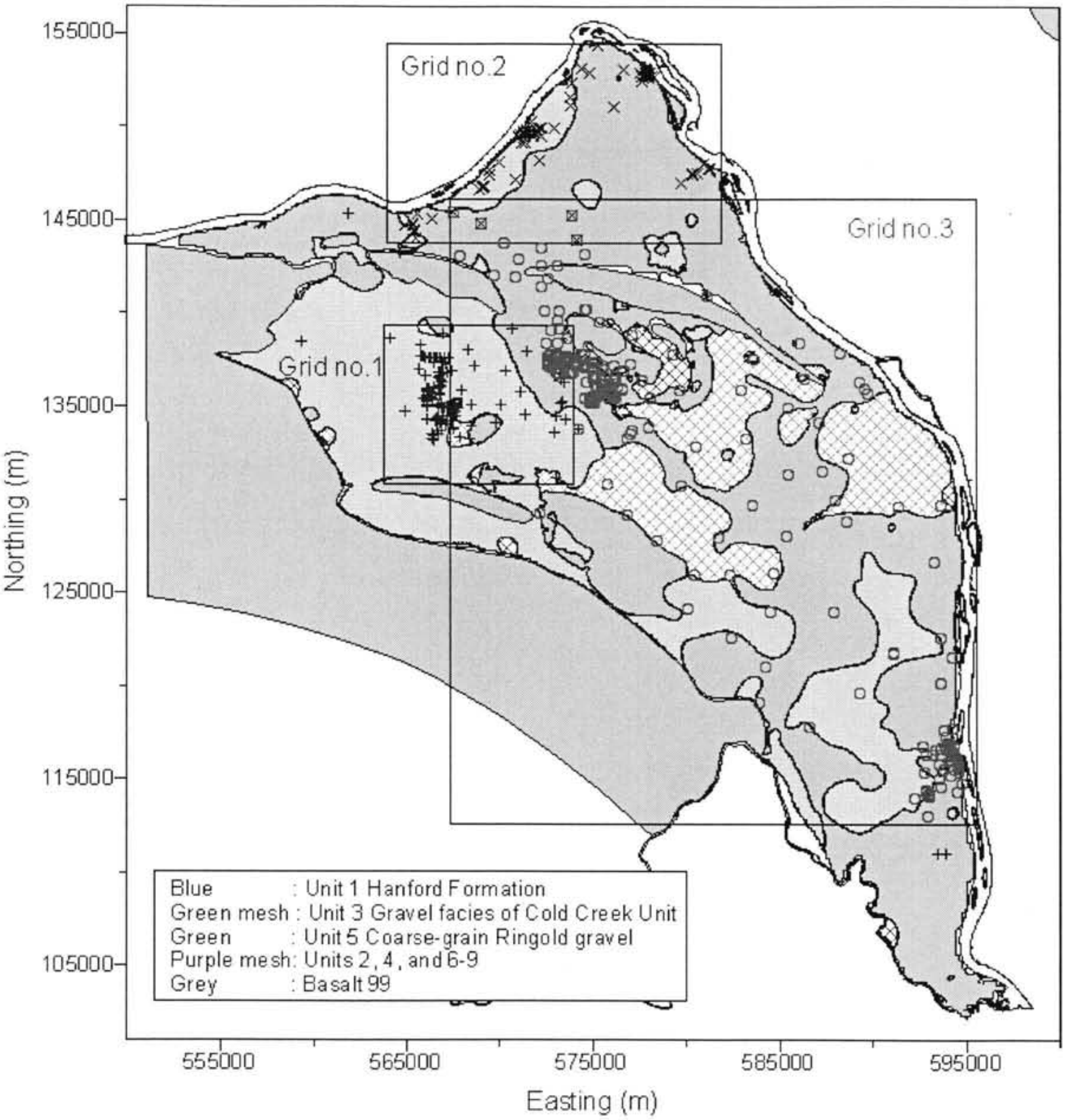

Figure H.1. Subsets of FY 1992 Uranium Data and Subcrop Formation Units at the FY 1992 Water Table

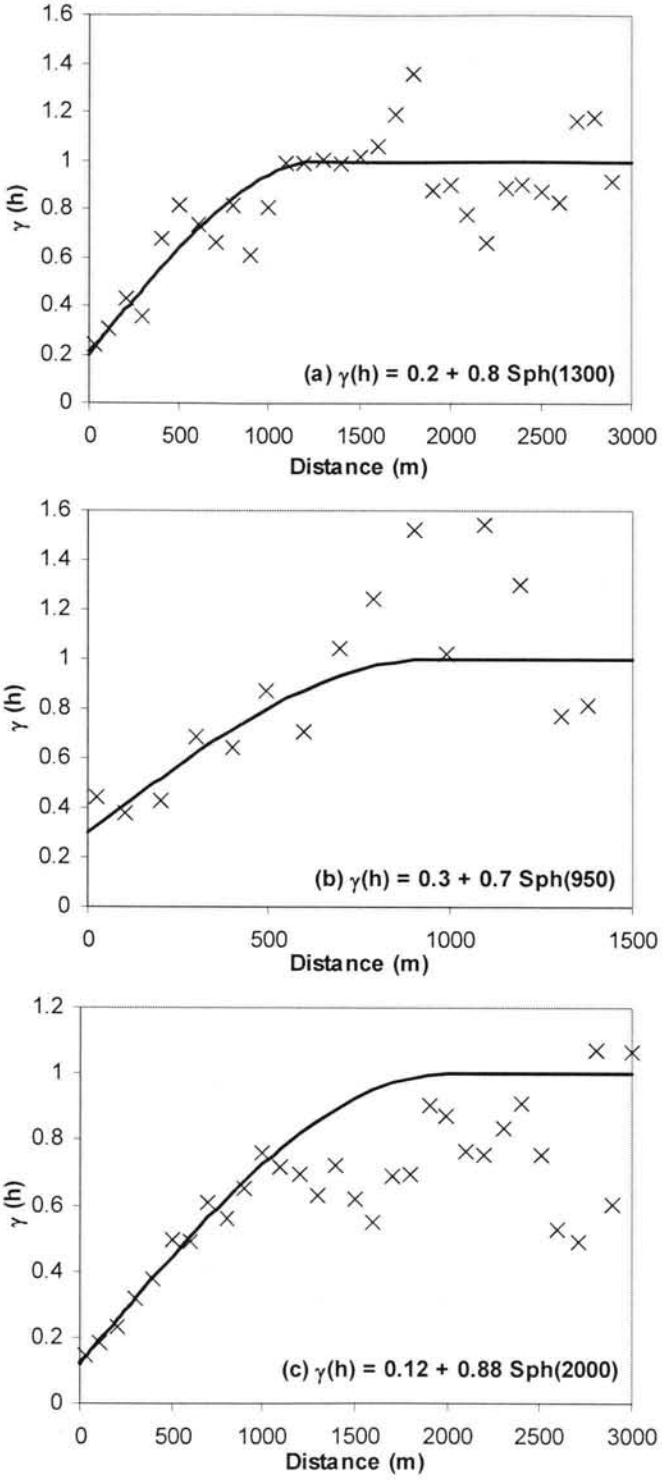

Figure H.2. Variograms and Models of Normal Scores of the FY 1992 Uranium Data in Local Grid 1 (a), Grid 2 (b), and Grid 3 (c). Experimental variogram values designated by X, with the models fit to the data denoted by the solid black lines.

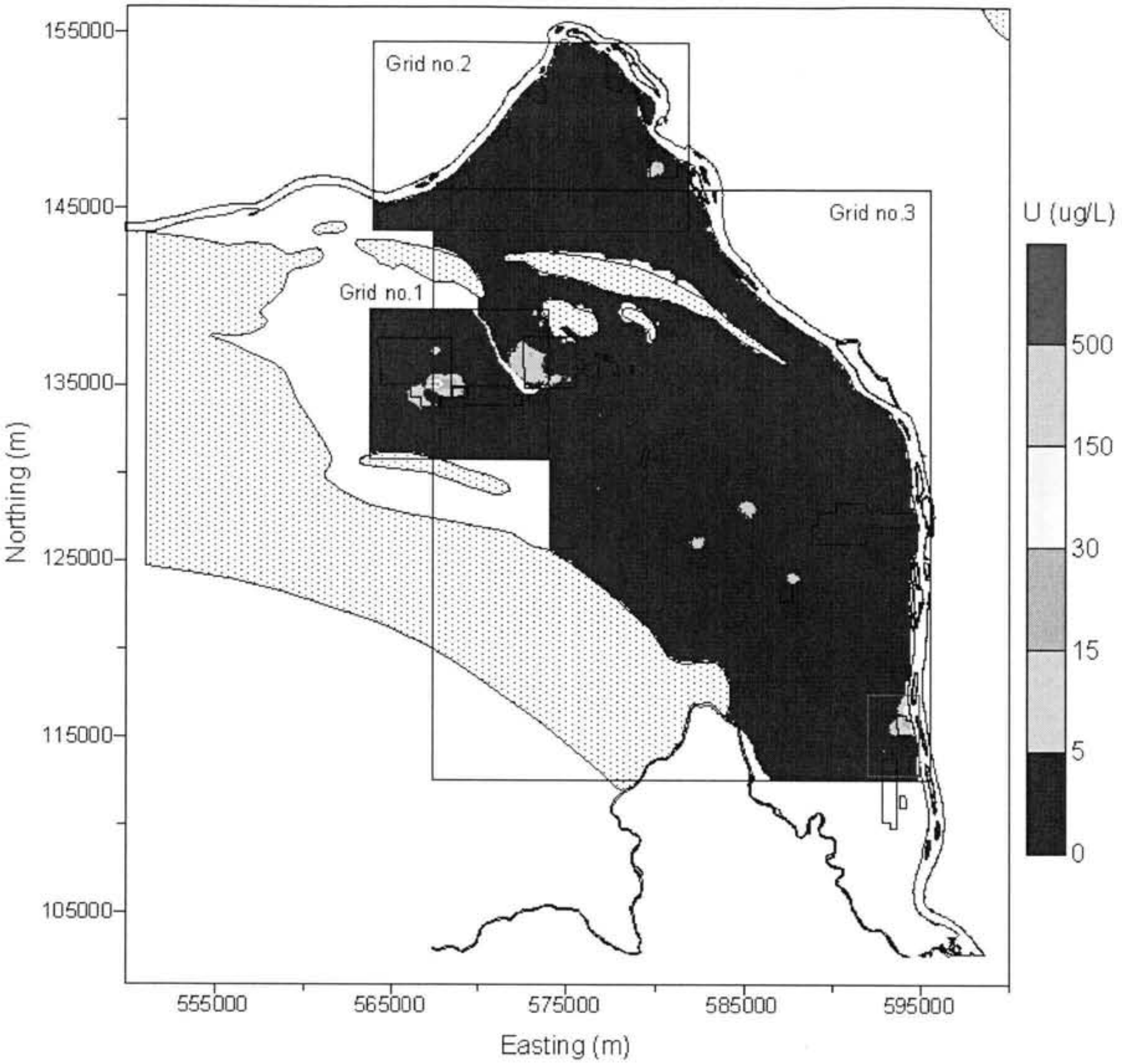

Figure H.3. Median of Simulations of FY 1992 Uranium Concentrations for Grids 1, 2, and 3

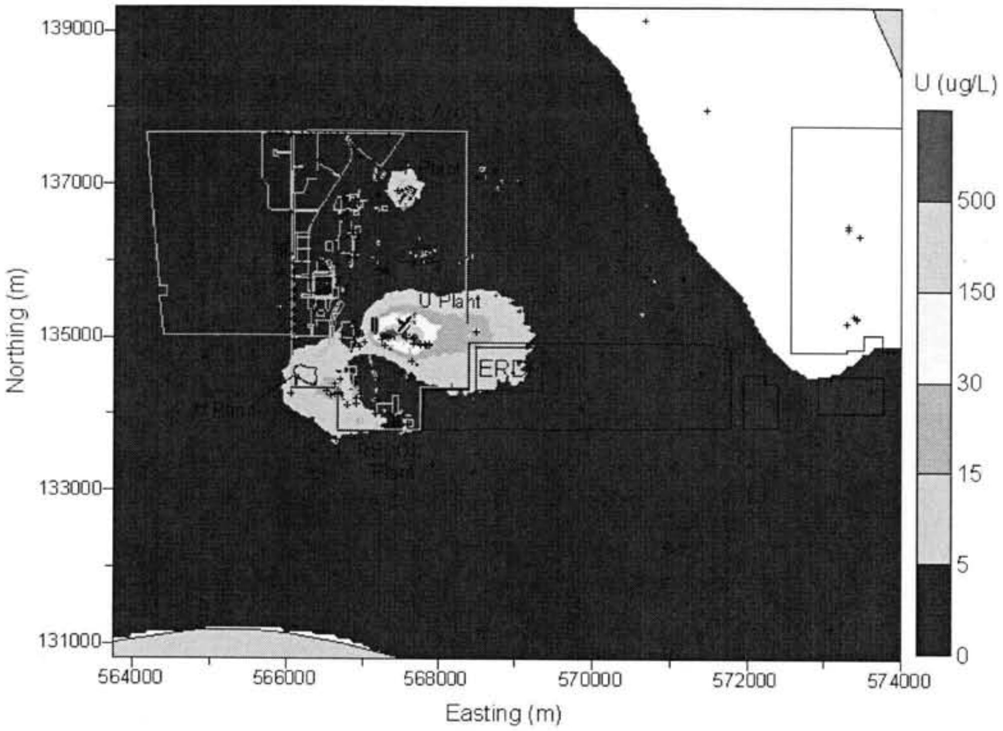

Figure H.4. Median of Simulated FY 1992 Uranium Concentrations in Grid 1 (200 West Area)

Table H.1. Coordinates for the Boundary of Grid 1 (200 West Area) of FY 1992 Uranium

Easting (m)	Northing (m)
563750	139300
569750	139300
569850	139000
570350	138450
571350	136150
571950	135550
572250	134950
572800	134500
573050	134500
573650	134900
574000	134900
574000	130800
567450	130800
566650	131100
566400	131100
566350	131150
566000	131150
565950	131200
564950	131200
564900	131150
564200	131150
564150	131100
564000	131100
563950	131050
563750	131050
563750	139300

Table H.2. **Statistics of the Area Exceeding 30 μg/L and Locations of Centers of Mass for Simulations of FY 1992 Uranium within Grid 1 (200 West Area)**

	Area (km^2)	Center of Mass (unit: m)	
		Easting	Northing
Mean	6.98	569192.6	133900.9
Standard Error	0.09	44.0	28.9
Median	6.79	569250.9	133900.8
Standard Deviation	2.18	1032.3	678.8
Kurtosis	0.38	0.24	-0.39
Skewness	0.58	-0.51	0.10
Range	12.89	6057.4	3853.1
Minimum	2.23	565613.5	132013.3
Maximum	15.11	571670.9	135866.4
Count	550	550	550
97.5th Percentile	11.67	570900.2	135201.5
2.5th Percentile	3.55	566803.9	132681.6
Confidence Level (95.0%)	0.18	86.5	56.9

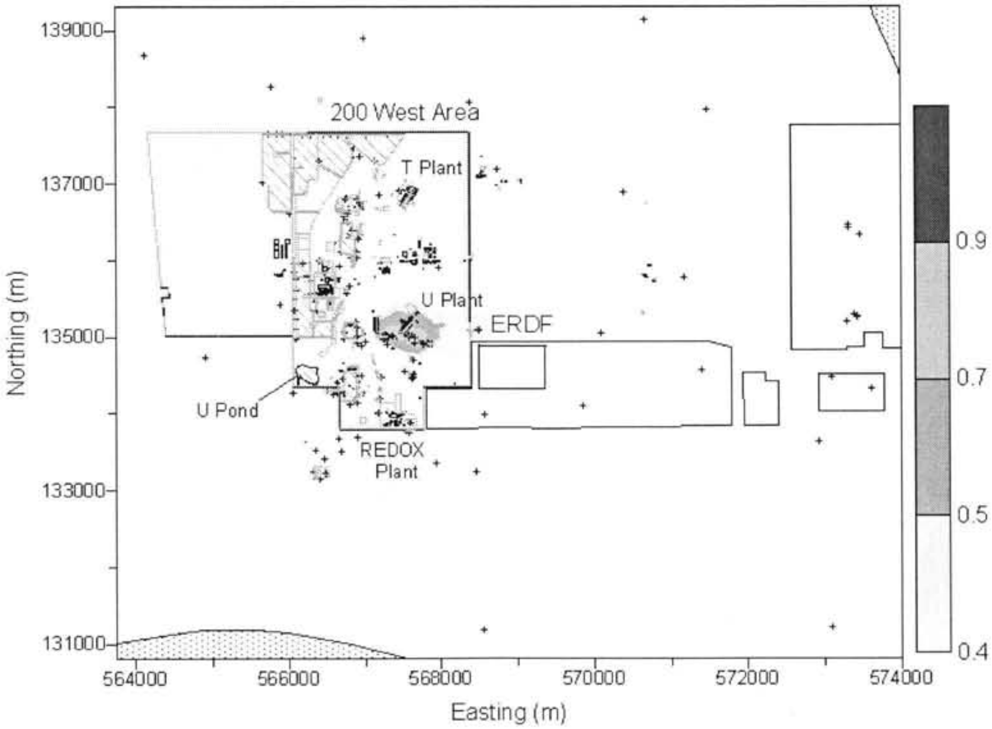

Figure H.5. **Probability of Exceeding 30 μg/L Based on Simulations of FY 1992 Uranium in Grid 1 (200 West Area)**

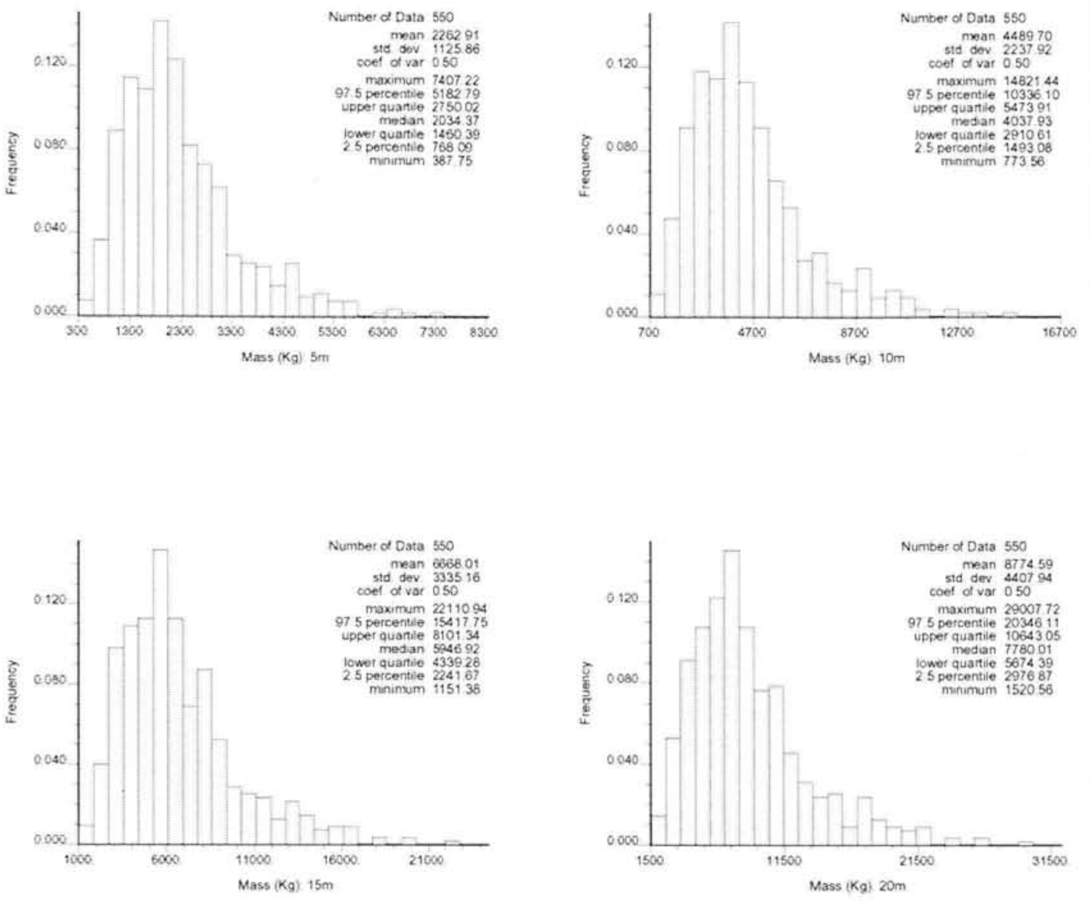

Figure H.6. Histograms of Total Mass in Simulations of FY 1992 Uranium within Grid 1 (200 West Area), Four Thickness Assumptions

Table H.3. Statistics of Total Mass of Simulations of FY 1992 Uranium within Grid 1 (200 West Area), Four Thickness Assumptions

Mass (kg) in Depth	5 m	10 m	15 m	20 m
Mean	2,262.90	4,489.69	6,668.01	8,774.60
Standard Error	48.05	95.51	142.34	188.13
Median	2,034.37	4,037.93	5,946.91	7,780.00
Standard Deviation	1,126.88	2,239.96	3,338.20	4,411.96
Kurtosis	2.08	2.10	2.10	2.09
Skewness	1.29	1.30	1.30	1.31
Range	7,019.47	14,047.89	20,959.56	27,487.17
Minimum	387.75	773.56	1,151.38	1,520.56
Maximum	7,407.22	14,821.44	22,110.94	29,007.72
Count	550	550	550	550
97.5th Percentile	5,187.91	10,338.39	15,440.26	20,406.87
2.5th Percentile	763.42	1,483.63	2,232.25	2,967.34
Confidence Level of Mean (95.0%)	94.39	187.61	279.60	369.54

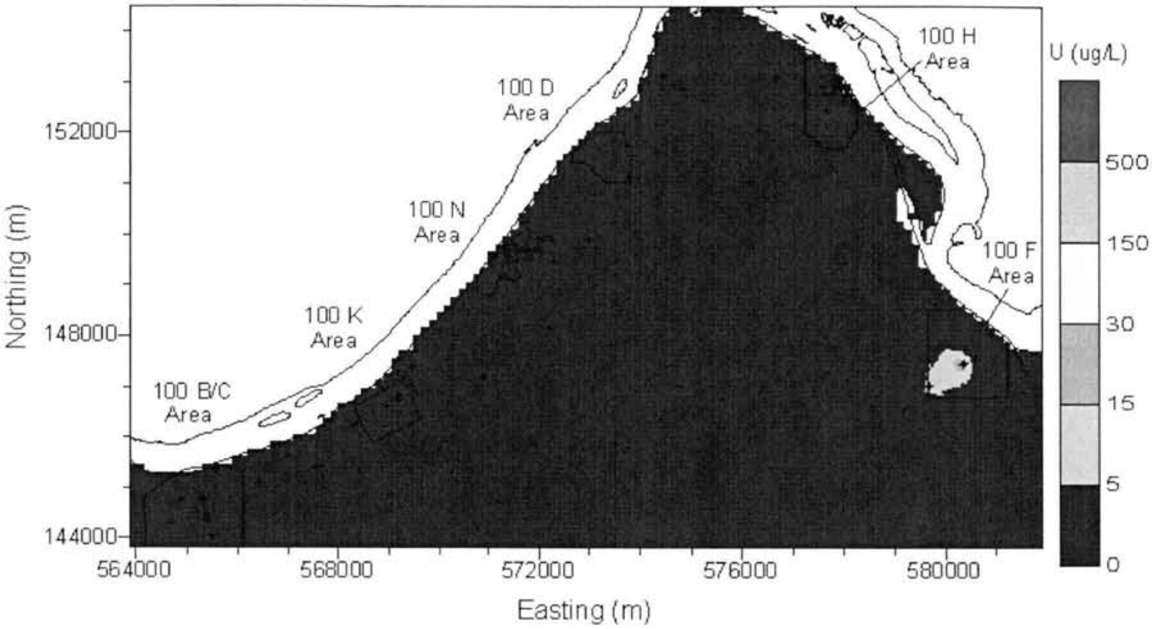

Figure H.7. Median of Simulated FY 1992 Uranium Concentrations in Grid 2 (100 Areas)

Table H.4. Coordinates for the Boundary of Grid 2 (100 Areas) of FY 1992 Uranium

Easting (m)	Northing (m)
563900	143800
563900	145566
564206	145277
564778	145277
565610	145502
566373	145754
566915	145882
567588	146172
567905	146522
568736	147033
569056	147447
569597	147959
570361	148692
570967	149392
572118	150987
572754	151785
573070	152199
573965	152744
573996	153030
574315	153828
574379	154144
574635	154500
575910	154500
577761	153410
578239	152710
579740	151371
579962	150987
579962	150573
579706	149806
579582	149614
579706	149200
580124	148787
580985	148211
581463	147764
581900	147700
581900	143800
563900	143800

Table H.5. Statistics of the Area Exceeding 30 µg/L and Locations of Centers of Mass for Simulations of FY 1992 Uranium within Grid 2 (100 Areas)

	Area (km^2)	Center of Mass (unit: m)	
		Easting	Northing
Mean	7.13	575292.6	147010.4
Standard Error	0.12	35.4	20.0
Median	6.64	575312.2	146986.3
Standard Deviation	3.06	936.3	529.9
Kurtosis	1.21	-0.17	-0.23
Skewness	0.99	-0.05	0.32
Range	19.57	5996.8	2888.2
Minimum	0.91	572180.9	145797.1
Maximum	20.48	578177.8	148685.3
Count	700	700	700
97.5th Percentile	14.27	577016.1	148183.8
2.5th Percentile	2.65	573596.9	146065.1
Confidence Level (95.0%)	0.23	69.5	39.3

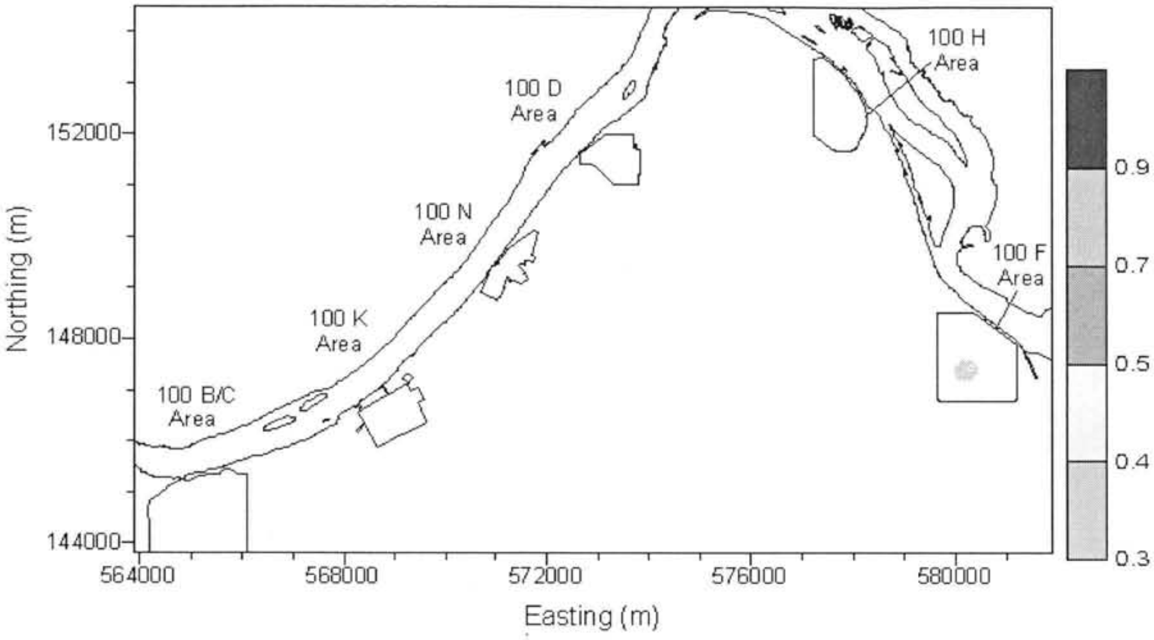

Figure H.8. Probability of Exceeding 30 μg/L Based on Simulations of FY 1992 Uranium in Grid 2 (100 Areas)

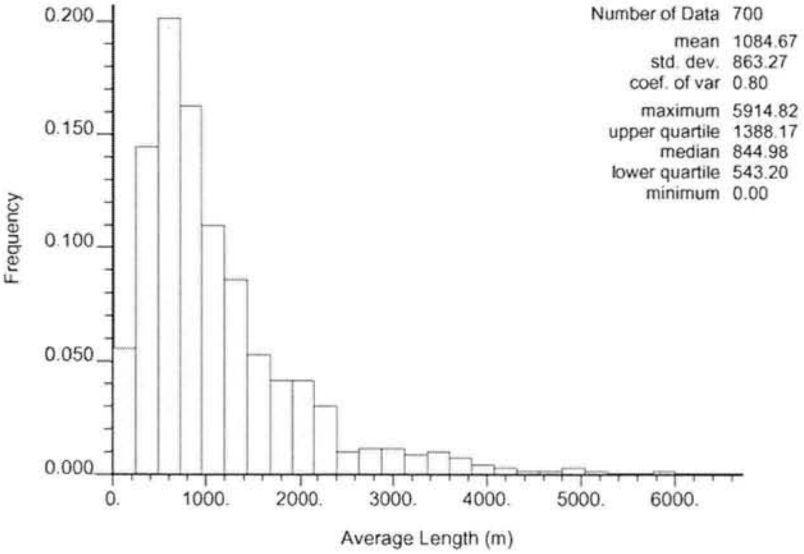

Figure H.9. Histogram of the Average Length of Columbia River Shoreline Exceeding 30 μg/L for FY 1992 Uranium in Grid 2 (100 Areas)

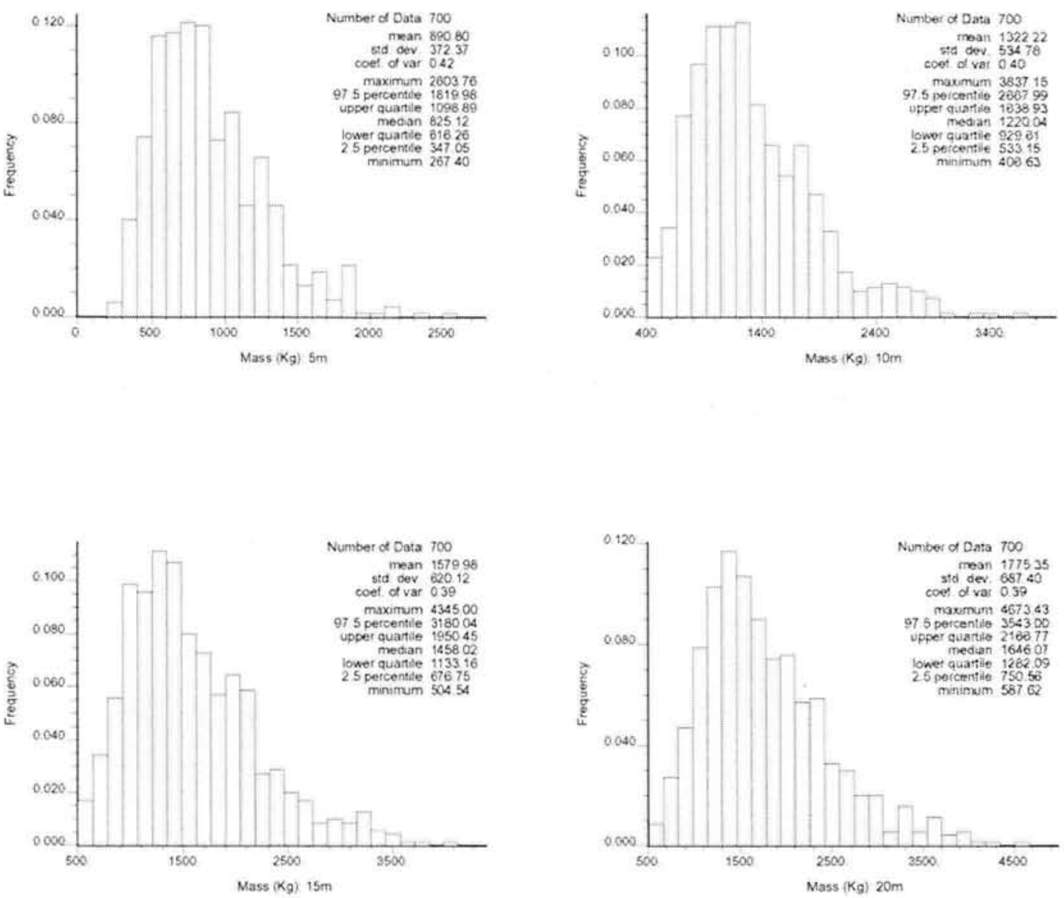

Figure H.10. Histograms of Total Mass in Simulations of FY 1992 Uranium within Grid 2 (100 Areas), Four Thickness Assumptions

Table H.6. Statistics of Total Mass of Simulations of FY 1992 Uranium within Grid 2 (100 Areas), Four Thickness Assumptions

Mass (kg) in Depth	5 m	10 m	15 m	20 m
Mean	890.80	1,322.22	1,579.98	1,775.35
Standard Error	14.08	20.23	23.45	26.00
Median	825.12	1,220.04	1,458.02	1,646.08
Standard Deviation	372.64	535.16	620.56	687.89
Kurtosis	1.10	1.22	1.05	0.96
Skewness	0.98	1.01	0.98	0.96
Range	2,336.36	3,430.52	3,840.46	4,085.82
Minimum	267.40	406.63	504.54	587.62
Maximum	2,603.76	3,837.15	4,345.00	4,673.43
Count	700	700	700	700
97.5th Percentile	1,819.97	2,667.91	3,180.04	3,542.94
2.5th Percentile	347.05	533.15	676.75	750.56
Confidence Level of Mean (95.0%)	27.65	39.71	46.05	51.05

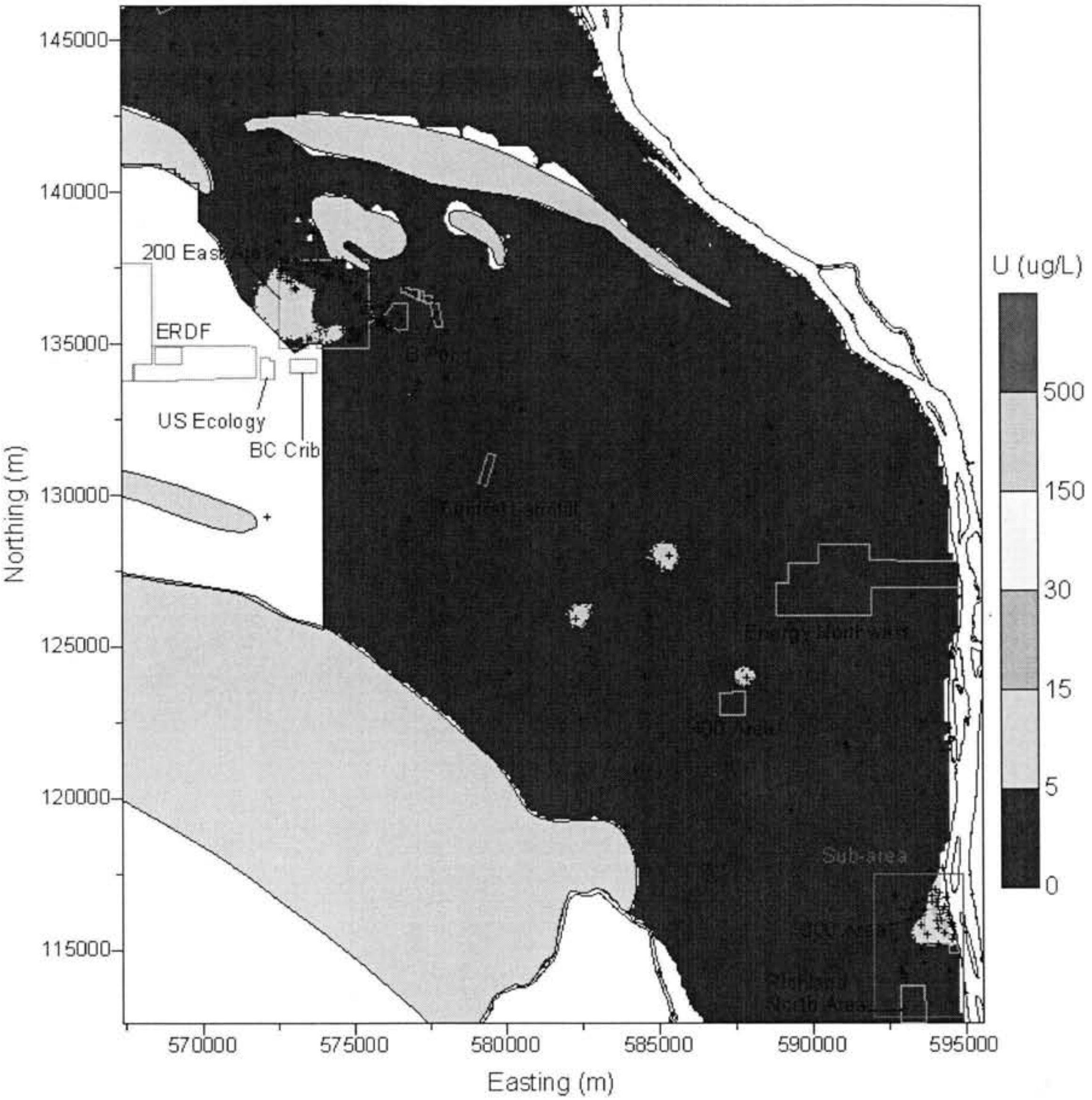

Figure H.11. Median of Simulated FY 1992 Uranium Concentrations in Grid 3

Table H.7. Coordinates for Sub-Area Boundary of Grid 3 of FY 1992 Uranium

Easting (m)	Northing (m)
592000	117500
594196	117500
594196	116904
594254	116850
594450	116850
594450	116397
594551	116258
594551	116043
594659	115960
594659	115599
594700	115568
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592000	112800
592000	117500

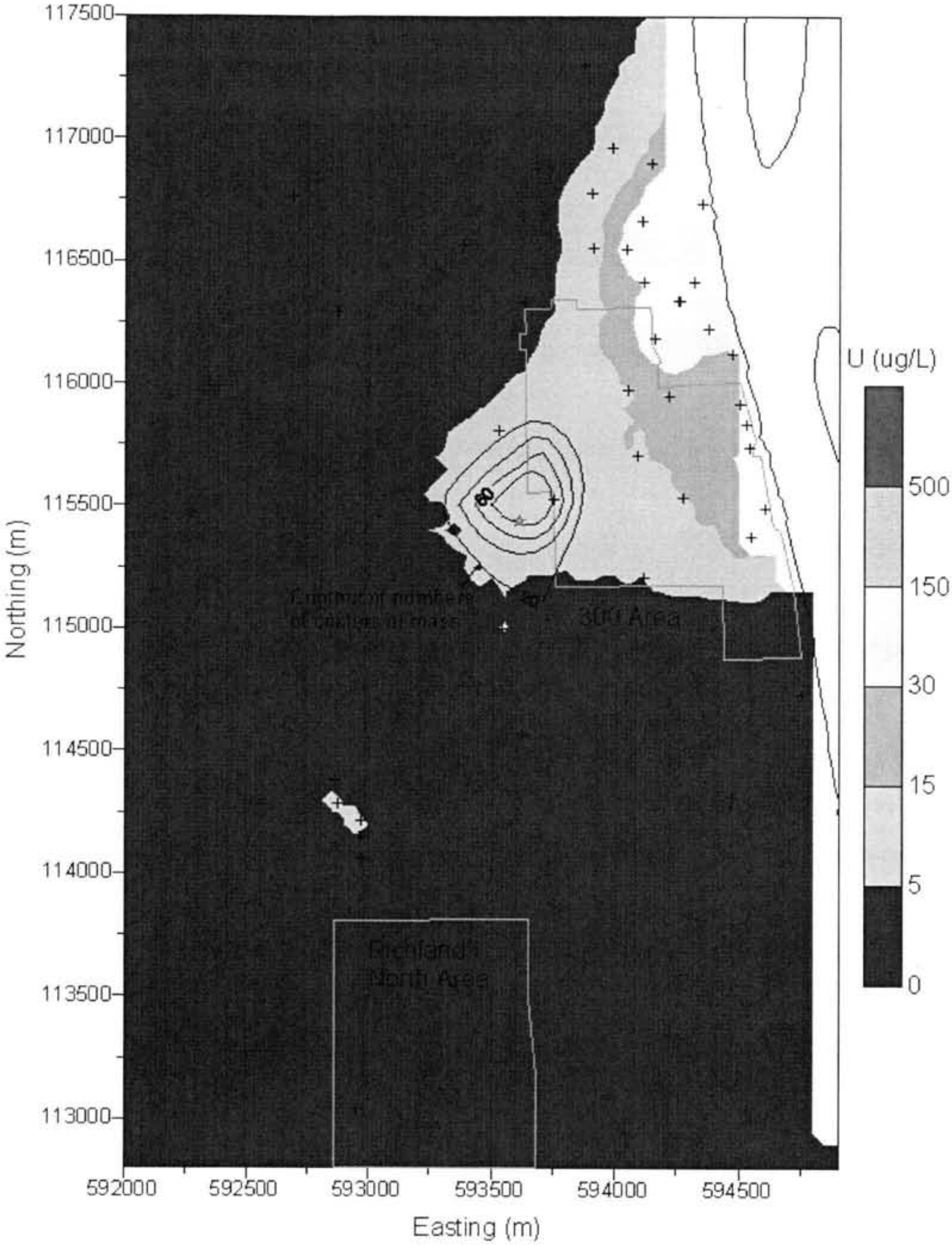

Figure H.12. Median of Simulated FY 1992 Uranium Concentrations in Sub-Area (300 Area Plume) of Grid 3. Contours of the number of times that the center of mass within the sub-area occurred within cells of an upscaled grid are shown with the average centers of mass shown by pink star in the sub-area.

Table H.8. **Statistics of Centers of Mass of Individual Simulations of FY 1992 Uranium Calculated for a Depth of 5 m for Sub-Area (300 Area Plume) of Grid 3**

Coordinate (m)	Sub-Area	
	Easting	Northing
Mean	593680.0	115464.8
Standard Error	6.5	11.5
Median	593687.9	115519.9
Standard Deviation	138.9	243.0
Kurtosis	0.62	1.90
Skewness	-0.49	-1.26
Range	900.2	1476.5
Minimum	593188.8	114557.4
Maximum	594089.0	116033.9
Count	450	450
97.5th Percentile	593932.7	115779.4
2.5th Percentile	593360.4	114807.4
Confidence Level of Mean (95.0%)	12.9	22.5

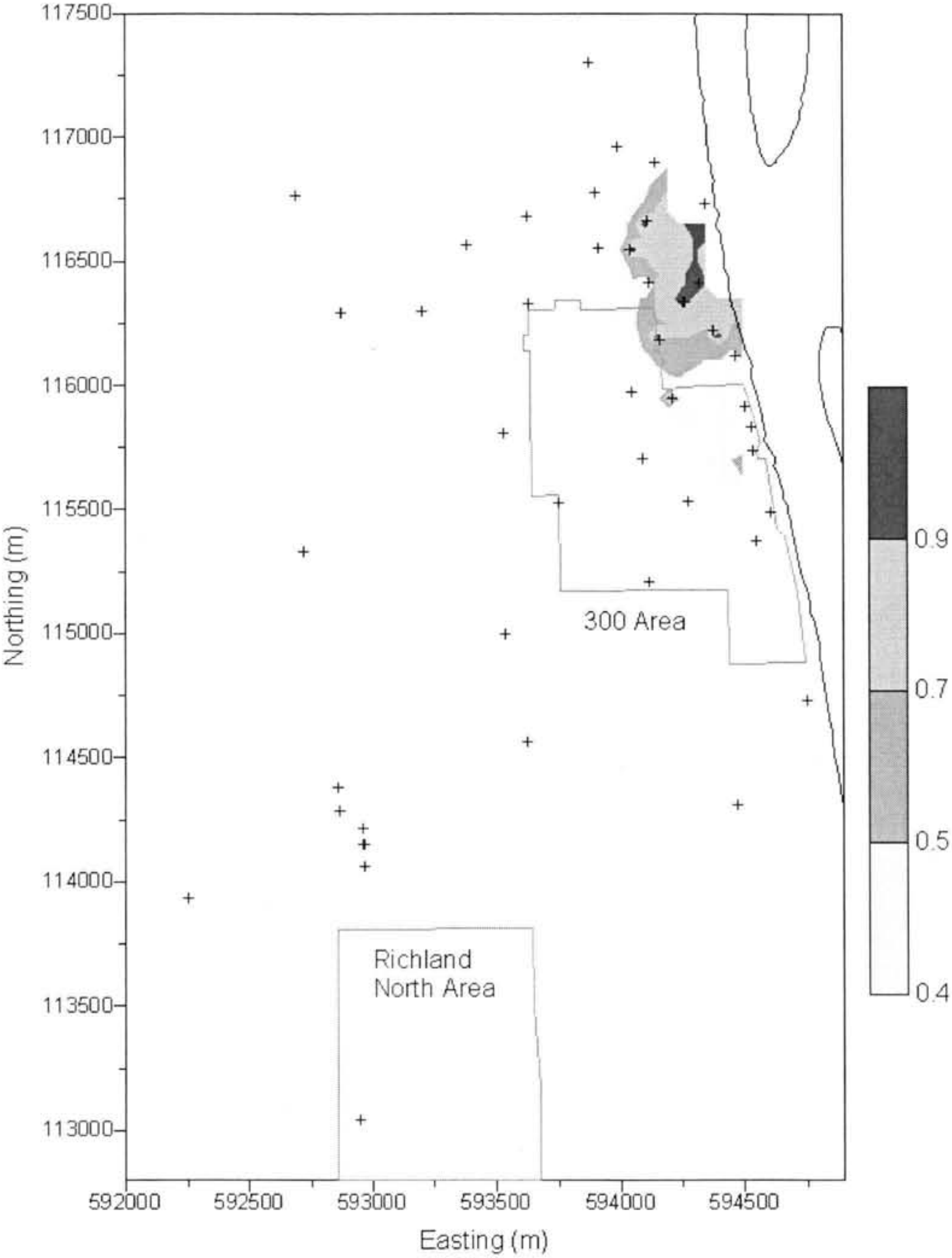

Figure H.13. Probability of Exceeding 30 µg/L Based on Simulations of FY 1992 Uranium in Sub-Area (300 Area Plume) of Grid 3

Table H.9. **Statistics of the Area Exceeding 30 μg/L for Simulations of FY 1992 Uranium within Sub-Area (300 Area Plume) of Grid 3**

Area (km^2)	Sub-Area	Grid 3
Mean	0.64	20.95
Standard Error	0.01	0.27
Median	0.60	20.46
Standard Deviation	0.19	6.61
Kurtosis	3.19	0.68
Skewness	1.37	0.66
Range	1.31	38.90
Minimum	0.26	8.02
Maximum	1.57	46.92
Count	450	600
97.5th Percentile	1.06	35.69
2.5th Percentile	0.38	9.99
Confidence Level of Mean (95.0%)	0.02	0.53

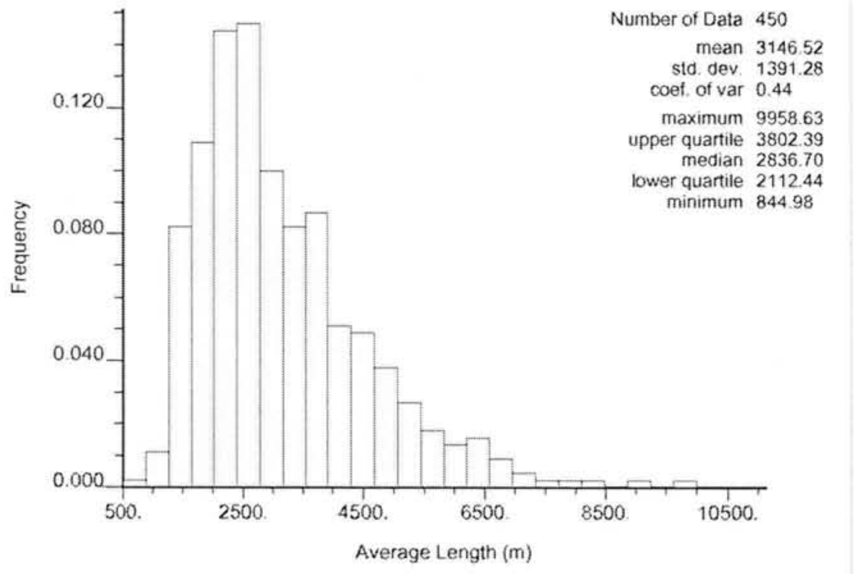

Figure H.14. Histogram of the Average Length of Columbia River Shoreline Exceeding 30 μg/L for FY 1992 Uranium in Grid 3

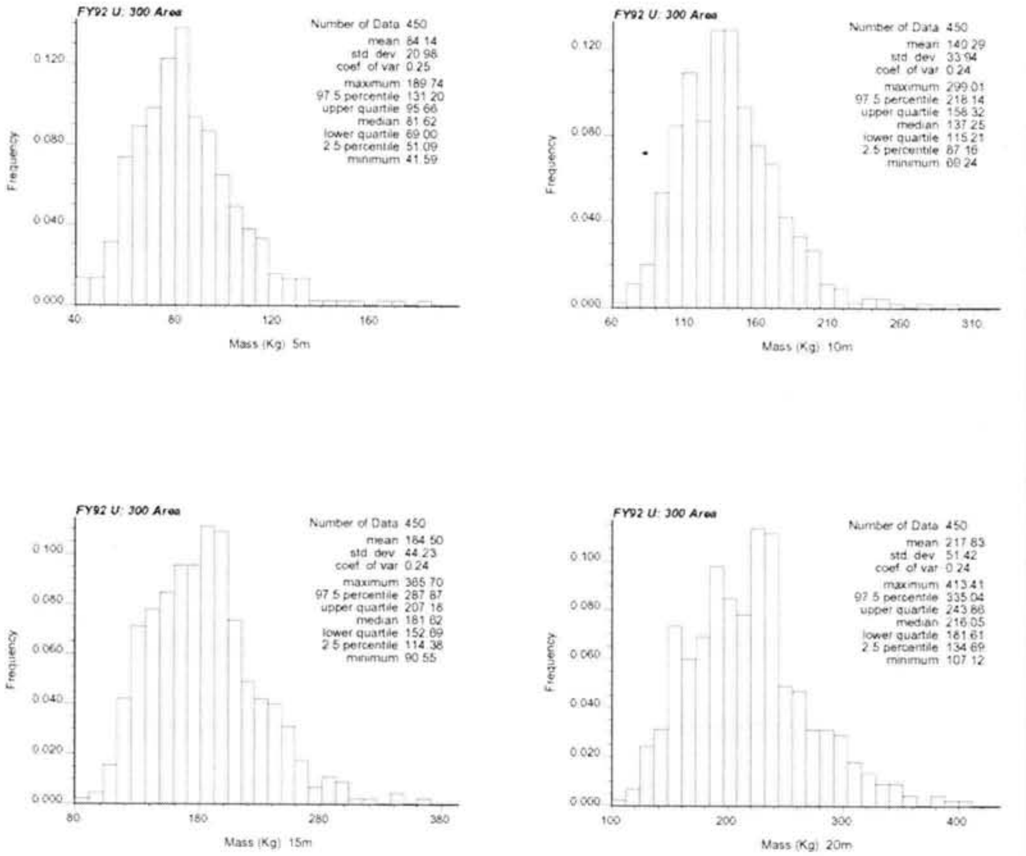

Figure H.15. Histograms of Total Mass in Simulations of FY 1992 Uranium within Sub-Area of Grid 3 (300 Area Plume), Four Thickness Assumptions

Table H.10. Statistics of Total Mass of Simulations of FY 1992 Uranium within Sub-Area of Grid 3 (300 Area Plume), Four Thickness Assumptions

Mass (kg) in Depth	5 m	10 m	15 m	20 m
Mean	84.14	140.29	184.50	217.83
Standard Error	0.99	1.60	2.09	2.43
Median	81.62	137.25	181.62	216.05
Standard Deviation	21.00	33.97	44.28	51.48
Kurtosis	2.12	1.41	0.82	0.56
Skewness	0.97	0.82	0.70	0.64
Range	148.15	229.77	275.16	306.29
Minimum	41.59	69.24	90.55	107.12
Maximum	189.74	299.01	365.70	413.41
Count	450	450	450	450
97.5th Percentile	130.79	218.10	287.49	334.90
2.5th Percentile	51.12	87.24	114.49	134.82
Confidence Level of Mean (95.0%)	1.95	3.15	4.10	4.77

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PNNL-14702, Rev. 0

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July 2004

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Prepared for
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Pacific Northwest National Laboratory
Richland, Washington 99352

Executive Summary

The U.S. Department of Energy is required to conduct a composite analysis of active and planned low-level radioactive waste disposal facilities associated with the Hanford Site. The original composite analysis was completed in 1998; however, it must be revised in 2004 to address a number of revisions to waste site information, updated performance assessments and environmental impact statements (EIS), changes in inventory estimates, and changes in the definition of offsite receptors.

This data package documents the technical basis for selecting physical and geochemical parameters and input values that will be used in vadose zone modeling for the 2004 Composite Analysis. This work was conducted as part of the Characterization of Systems Task of the Groundwater Remediation Project (formerly the Groundwater Protection Program) managed by Fluor Hanford, Inc., Richland, Washington.

This data package describes the geologic framework, the physical, hydrologic, and contaminant transport properties of the geologic materials, and deep drainage (i.e., recharge) estimates, building on the general framework developed for the initial assessment conducted using the System Assessment Capability (SAC). The general approach for this work was to update and provide incremental improvements over the previous SAC data package completed in 2001. As with the previous SAC data package, much of the data and interpreted information were extracted from existing documents and databases. Every attempt was made to provide traceability back to the original source(s) of the data or interpretations.

Kincaid et al. (2004) identified 1,046 waste sites from the Waste Information Data System (WIDS) sites and several existing and future storage sites for inclusion in the 2004 Composite Analysis, with analyses to be conducted on a site-by-site basis whenever inventory and release data permit.(a) The complexity of this assessment, together with the lack of detailed characterization data and/or understanding of some of the less dominant fine-scale fate and transport processes necessitates simplification of the site features, release events, and the contaminant fate and transport processes to those factors considered most dominant. The dominant factors affecting transport of contaminants through the vadose zone include: 1) waste inventory and release estimates, 2) estimates of deep drainage (recharge), 3) the hydrogeologic profiles and properties of the vadose zone affecting aqueous phase advection and dispersion, and 4) estimates of geochemical reactions (e.g., sorption) affecting the retardation of contaminants. The last three of these data types are addressed by this data package. The first one, waste inventory and release estimates, is addressed in the inventory and release model data packages.

The 2004 Composite Analysis will, in general, use a one-dimensional vadose zone model, configured to account for lateral spreading, and in selected cases, conditioned against multi-dimensional model results (Kincaid et al. 2004). Waste sites were grouped into a number of geographic areas assumed to

---

(a) Originally 974 of 2,730 Waste Information Data System (WIDS) sites were identified for inclusion in the 2004 Composite Analysis. Further work identified 48 more waste sites bringing the total to 1,022. Subsequent reviews identified an additional 24 sites that have been included, many of which account for offsite transfers of waste and nuclear material. This brings the total to 1,046.

have similar hydrogeologic structure and properties. Hydrogeologic units were identified and their thickness ranges specified for each of these hydrogeologic provinces. To account for uncertainty in the model parameters, a stochastic distribution was developed for each process model parameter for each hydrogeologic unit.

The vadose zone hydrostratigraphic profiles and hydrogeochemical property distributions for the 2004 Composite Analysis are represented by 26 generalized one-dimensional vertical columns representing 17 general geographic areas and 9 site-specific locations. Each hydrostratigraphic profile (template) was configured with the hydraulic and geochemical parameters necessary to simulate the flow and transport through the vadose zone using the Subsurface Transport Over Multiple Phases (STOMP) code. As many as five variations of a single hydrostratigraphic template were incorporated to more accurately represent the depth of waste release, the thickness of the vadose zone beneath the point of release, and variations in contaminant distribution coefficients (K_d values) associated with different waste chemistry designations. Each template consists of a few major hydrostratigraphic units that are horizontally layered with constant thicknesses, and are homogeneous and isotropic. Hydraulic and geochemical parameters for each hydrostratigraphic unit are represented by stochastic distributions to facilitate sensitivity and uncertainty analyses.

This data package is a compilation of the available data to support a composite analysis of Hanford's impact. As site characterization is completed at waste sites and as investigations into contaminant behavior are completed, the uncertainty in this information will be reduced and, as a result, the uncertainty in future estimates of impact will be reduced.

Acknowledgments

The authors would like to acknowledge Thomas W. Fogwell and the Groundwater Remediation Project managed by Fluor Hanford, Inc. for supporting this work. We would like to thank Raziuddin Khaleel (Fluor Federal Services), and Charles T. Kincaid, Christopher J. Murray, Stephen P. Reidel, and Robert W. Bryce for their technical reviews. The authors would also like to thank Anderson L. Ward for his technical support throughout the completion of this work, and Christopher A. Newbill for preparation of the site location map. We would also like to thank Launa F. Morasch for her technical editorial support, and Lila M. Andor and the rest of the Publication Design team for their support in producing this document.

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Figures

Tables

1.0 Introduction

A composite analysis is required by U.S. Department of Energy (DOE) Order 435.1 to ensure public safety through the management of active and planned low-level radioactive waste disposal facilities associated with the Hanford Site (DOE M 435.1-1). The original composite analysis (Kincaid et al. 1998) must be revised and submitted to DOE Headquarters (DOE-HQ) in 2004 because of revisions to waste site information in the 100, 200, and 300 Areas, updated performance assessments and environmental impact statements (EIS), changes in inventory estimates for key sites and constituents, and a change in the definition of offsite receptors.

Kincaid et al. (2004) describe the technical scope of the 2004 Composite Analysis for the Hanford Site and the approach to perform this analysis. It will be a site-wide analysis, considering final remedial actions for the Columbia River corridor and the Central Plateau and will be a companion to waste-specific and site-specific assessments. The 2004 Composite Analysis also will provide supporting information on a regional or site-wide basis for use in important Hanford assessments and decisions such as the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) 5-year review in 2005, tank closure decisions, decisions on final groundwater remedies for the 200 Areas, decisions on final groundwater remedies for the 100 Areas, and the Columbia River corridor final record of decision.

Beginning in fiscal year (FY) 2003, the DOE Richland Operations Office (DOE-RL) initiated activities, including the development of data packages, to support the 2004 Composite Analysis. This report describes the data compiled in FY 2003 to support vadose zone modeling for the 2004 Composite Analysis. This work was conducted as part of the Characterization of Systems Task of the Groundwater Remediation Project (formerly the Groundwater Protection Program) managed by Fluor Hanford, Inc., Richland, Washington.

1.1 Purpose

The purpose of this data package is to summarize the conceptual understanding of flow and transport through the vadose zone (i.e., the conceptual model), describe how this understanding will be simplified for numerical simulation as part of the 2004 Composite Analysis (i.e., implementation model), and finally to provide the input parameters needed for the vadose zone simulations.

1.2 Scope and Approach

The scope of this data package covers the geologic framework, the physical, hydrologic, and contaminant transport properties of the geologic materials in the vadose zone, and estimates of deep drainage (i.e., recharge). This data package builds on the general framework developed for the initial assessment conducted using the System Assessment Capability (SAC) as presented in:

- Preliminary System Assessment Capability Concepts for Architecture, Platform, and Data Management - Appendix C, Vadose Zone Conceptual Model (http://www.hanford.gov/cp/gpp/modeling/sacarchive/App%20C.pdf)

- Draft 2001 SAC Data Package, *Appendix C - Vadose Zone Data for Initial Assessment Performed with System Assessment Capability* (Revision 0) (http://www.hanford.gov/cp/gpp/modeling/sacarchive/dp_vadose.pdf).

The general approach for this work was to update and provide incremental improvements over the previous 2001 data package. As with the previous SAC data package, much of the data and interpreted information were extracted from existing documents and databases. Every attempt was made to provide traceability back to the original source(s) of the data or interpretations.

2.0 Background

The vadose zone is the hydrogeologic region that extends from the soil surface to the water table (DOE 1998). At the Hanford Site, the vadose zone ranges in thickness from less than 1 meter along the river in the 100 and 300 Areas to more than 100 meters on the Central Plateau in the center of the Hanford Site. At discrete locations, the vadose zone contains waste inventories from past waste disposal practices (e.g., direct liquid waste disposal to the ground via engineered facilities) and from unplanned releases (e.g., spills and tank leaks).

The geologic framework of the vadose zone is very complex with a high degree of heterogeneity and anisotropy in its physical, hydrologic, and geochemical properties. This complex hydrogeochemical framework, together with waste water and meteoric water fluxes lead to highly complex three-dimensional movement of moisture and contaminants through the vadose zone. Wilson et al. (1995) describe flow within the vadose zone as dynamic and characterized by periods of unsaturated flow at varying degrees of partial saturation punctuated by episodes of preferential, saturated flow in response to hydrologic events or releases of liquids.

This section summarizes our conceptual understanding of flow and transport through the Vadose Zone and the technical basis and approach for modeling the Vadose Zone for the Composite Analysis. Conceptual models are evolving hypotheses that identify the important features, events, and processes controlling fluid flow and contaminant transport at a specific field site and in the context of a specific problem. Looney and Falta (2000) further describe a conceptual model as answering the question "How do we believe the system actually operates?" The conceptual model is one of the key initial elements in the overall modeling process. Once the site-specific problem has been defined and the important features, events, and processes conceptualized, quantitative descriptions can be prepared and implemented. Field and laboratory data are used to provide the input data, as well as to calibrate and independently test the predictive capabilities of the model. Of particular interest to this data package are the subsurface geologic, hydraulic, and geochemical parameters and the deep drainage estimates that control flow and transport through the vadose zone.

2.1 Conceptual Model of the Hanford Site Vadose Zone

Conceptual models of the vadose zone at the Hanford Site have been developed from information on the geology, geochemistry, and hydrologic regime as well as the distribution and movement of waste in the subsurface. Most of the information has been obtained from borehole drilling through sediment sampling and analysis and geophysical logging. This has provided a considerable amount of information about the lithology and stratigraphy, but a more limited amount of hydrologic and geochemical information has been obtained. These investigations into the vadose zone have traditionally been at or near the waste disposal sites; however, a few areas that represent background conditions or provide representative test sites have also been studied. The integrated knowledge from these previous studies and ongoing work provides a reasonable conceptual understanding of the geologic, hydraulic, and geochemical controls on contaminant movement and distribution within the vadose zone of the Hanford Site (DOE 1999). Figure 2.1 illustrates some of these controls. However, there are still many outstanding issues, some of which require additional study and some of which may never be completely resolved.

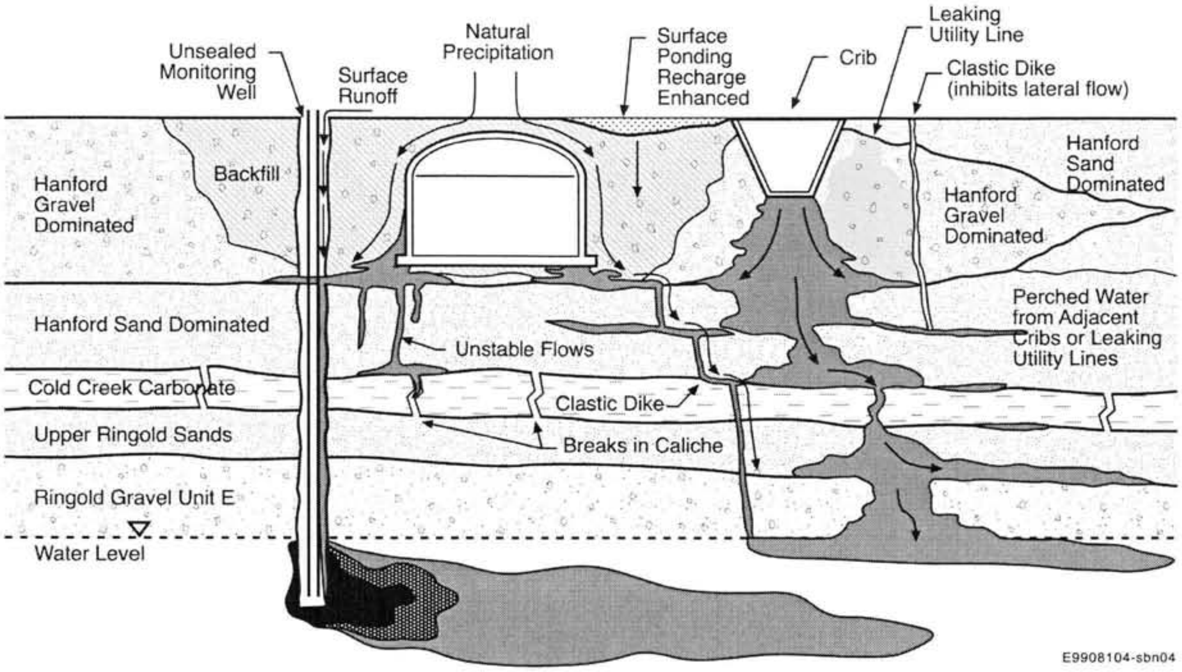

Figure 2.1. **General Vadose Zone Conceptual Model Concepts after Caggiano (1996). Note that the geologic nomenclature varies from that used today.**

The *Preliminary System Assessment Capability Concepts for Architecture, Platform and Data Management, Appendix C*[(a)] describes the conceptual models of vadose zone flow and transport and the preferred approach (and the rationale behind it) used for representing vadose zone transport in the initial assessments conducted using SAC. A common process to define the modeling requirements for a particular assessment is to break the conceptual model down into potentially relevant factors (i.e., features, events, and processes [FEPs]) and to logically screen and select the factors that should be included in the assessment (Last et al. 2004b). The process of identifying, classifying, and screening these factors is often called FEP analysis (NEA 2000) or FEP analysis methodology (Bailey and Billington 1998).

Kincaid's *Candidate Sets Report*[(b)] and Soler et al. (2001) provide comprehensive compilations of the 1) features (the structure and transport properties of the various pathways), 2) events (e.g., recharge, source releases, etc.), and 3) processes (the fate and transport processes/mechanisms, including driving forces) considered potentially relevant to contaminant flow and transport within the vadose zone beneath the Hanford Site. Last et al. (2001) developed the process relationship diagram as a tool to illustrate the interrelationships between factors and to facilitate analysis/screening of the dominant versus subordinate

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(a) *Groundwater/Vadose Zone Integration Project Preliminary System Assessment Capability Concepts for Architecture, Platform, and Data Management.* September 30, 1999. http://www.hanford.gov/cp/gpp/modeling/sacarchive/9-30rpt.pdf

(b) Kincaid CT et al. June 25 1999. *Candidate Sets Report*. http://www.hanford.gov/cp/gpp/modeling/sacarchive/candsets.pdf factors of a given conceptual model. Figure 2.2 illustrates the main features and processes potentially effecting flow and transport within the vadose zone.

The following sections (taken from Preliminary System Assessment Capability Concepts for Architecture, Platform, and Data Management - Appendix C, Vadose Zone Conceptual Model)[(a)] describe

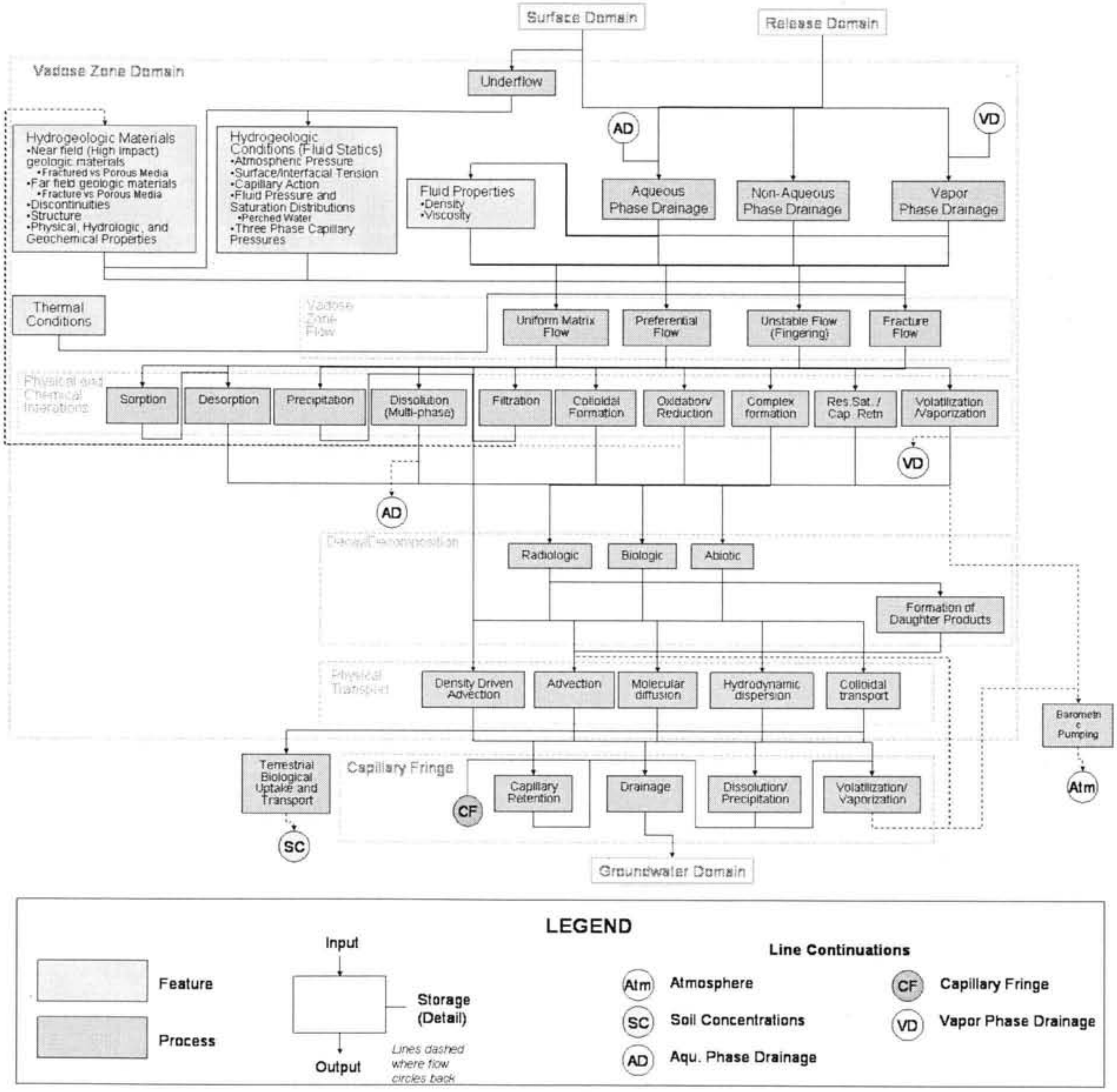

Figure 2.2. Process Relationship Diagram of Vadose Zone Flow and Transport

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(a) *Preliminary System Assessment Capability Concepts for Architecture, Platform, and Data Management - Appendix C, Vadose Zone Conceptual Model* (http://www.hanford.gov/cp/gpp/modeling/sacarchive/App%20C.pdf) these important features, events, and processes, and identifies those factors that are considered most dominant and have been selected as study sets for numerical representation (modeling) in the 2004 Composite Analysis.

2.1.1 Features

The primary features relevant to the vadose zone flow and transport include the hydrogeologic materials (and their physical, hydraulic, and geochemical properties); subsurface conditions (e.g., fluid statics and thermal conditions); and fluid properties. Other features relevant to the vadose zone conceptual model such as climate and weather statistics, terrestrial ecology, and projected land use are not specifically discussed here. Instead, the reader is referred to (Neitzel et al. 2003) for general discussions of these specific features. Some aspects of the climate and weather phenomena are discussed later as they relate to precipitation, run-off, and infiltration events.

There is a significant amount of hydrogeologic data available for the Hanford Site, primarily from borehole drilling in the vicinity of waste disposal operations. Interpretation of the geologic data are presented in numerous reports, including Delaney et al. (1991); Lindsey (1992, 1995); Lindsey et al. 1992a, b; Lindsey and Jager 1993; Hartman and Peterson (1992); Peterson et al. (1996); DOE (1993a, 1994); Thorne et al. (1993, 1994); Hartman (2000); Williams et al. (2000); Williams et al. (2002); and DOE (2002).

The thickness of the vadose zone varies from less than 1 meter along the river in the 100 and 300 Areas to more than 100 meters beneath the Central Plateau. The vadose zone lies mostly within cataclysmic flood deposits of the Hanford formation, but in places such as 200 West Area and portions of the 100 Areas it extends into the underlying Cold Creek unit, and/or the upper portions of the Ringold Formation. The physical structure (e.g., geology, hydrologic properties, and geochemical properties) of the geologic framework and its principal transport pathways is complex with a high degree of heterogeneity and anisotropy. To capture some of the site-wide variability in these features, this discussion is broken into three general physiographic areas (the 100, 200, and 300 Areas). While other selected areas away from these focus areas, such as areas representative of background conditions and areas that have the potential to become contaminated in the future, are also important to the general vadose zone technical element, they are not specifically discussed here.

2.1.1.1 100 Areas

The average thickness of the vadose zone in the reactor areas ranges from 6 meters (100-F Area) to over 30 meters (100-B/C Area) with each reactor area being slightly different. During operations, groundwater mounding reduced the thickness of the vadose zone by 6 to 9 meters directly under the retention basins or other liquid-waste disposal facilities.

Hydrogeologic Materials. The hydrogeologic framework of the vadose zone is complex; however, locally within the 100 Areas, it can be divided into two primary hydrostratigraphic units: 1) the gravel-dominated facies association of the Hanford formation and 2) the conglomeratic member of Wooded Island, Unit E, of the Ringold Formation (DOE 2002; Peterson et al. 1996; Hartman and Lindsey 1993; Lindberg 1993a, b; Lindsey and Jaeger 1993). The Ringold Formation makes up the lower portion of the vadose zone at the 100-K, 100-N, and the 100-D Areas. It is only partially present in the 100-B/C Area and not present in the 100-H and 100-F Areas. The Hanford formation extends from the surface to just above the water table when the Ringold Formation is present. The Hanford formation extends beneath the water table and makes up the unconfined aquifer in the 100-H and 100-F Areas.

The Ringold Formation Unit E is a fluvially deposited pebble-to-cobble conglomerate with a sandy matrix. It is characterized by complex interstratified beds and lenses of sand and gravel with variable degrees of cementation.

The gravel-dominated facies of the Hanford formation occasionally exhibits an open framework texture composed of uncemented, clast-supported pebble, cobble, and boulder gravel with a coarse-grained sandy matrix and minor sand and silt interbeds or stringers. The clast size decreases in the lower portion of the Hanford formation. The Hanford formation is generally less cemented and more poorly sorted than the Ringold Formation and typically contains a higher percentage of angular basaltic detritus.

Although clastic dikes have been observed in the vadose zone beneath the 100 Areas (Fecht et al. 1999), because of their limited areal distribution and lack of vertical continuity, they may not represent significant preferential pathways. However, these vertical features could represent natural cutoff walls that confine or limit plumes from spreading horizontally during wetting from a waste site; then later, under unsaturated conditions, be more conductive than the surrounding sediments (Murray et al. 2002). The contact between Ringold Unit E and the Hanford formation is important because the saturated hydraulic conductivity for the gravel-dominated sequence of the Hanford formation is one to two orders of magnitude higher than the denser and locally cemented Ringold Unit E. Since hydraulic conductivity varies with the formation, different groundwater level responses could occur where channels now filled with the Hanford formation had been scoured into the Ringold Unit E. These buried channels could become preferential pathways for contaminated groundwater during high river stages.

Hydraulic Properties and Conditions. The physical properties of the vadose zone in the 100 Areas are not well characterized. Peterson et al. (1996) reported saturated hydraulic conductivity, moisture content, specific gravity, and bulk density for samples taken from the single-pass reactor areas. No scaling of hydraulic conductivity based on particle-size distribution was done for that report. Khaleel and Relyea (1997) published moisture retention data for the 100-D, 100-F, and 100-H Areas. In the 100 N Area, Connelly et al. (1991) collected 10 surface samples for moisture retention data and DOE (1996a) collected four samples each from boreholes 199-N-108A and 199-N-109A. The measured physical properties for these samples vary widely reflecting the heterogeneity of the vadose zone. These data are recorded on the catalog of vadose zone flow parameters for the Hanford Site (Freeman et al. 2002).

The large volume of liquid discharges during operations created water table mounds 6 to 9 meters above the nominal water table under the retention basins and other liquid disposal facilities. Volumetric moisture content found in sediment under the 100-N Area liquid waste disposal facilities (DOE 1996a) appear to be high for the given sediment type and natural recharge rate. This suggests these soils are still draining.

Geochemical Properties and Conditions. Results from the geochemical characterization studies in the 100 Areas show a contaminant zoning (chromatographic) effect in the vadose zone. For radionuclides and inorganic contaminants that are not adsorbed (i.e., tritium, nitrate), the large releases of water to the vadose zone at the retention basin and liquid waste disposal facilities quickly pushed these contaminants through the vadose zone, into the unconfined aquifer, and subsequently out to the Columbia River. Crews and Tillson (1969), using iodine-131 isotopic analysis, estimated the travel time to the Columbia River from 1301-N liquid waste disposal facility to be approximately 10 days during active disposal.

Contaminants that show moderate adsorption such as strontium-90 show differential distribution (i.e., chromatographic zoning) within the vadose zone. Serne and LeGore (1996) examined characterization data from 12 boreholes within the 100-N Area and found that strontium-90 in the vadose zone is bound to sediment directly underneath the liquid waste disposal facilities in a relatively thin layer at depths that correspond to the elevated water table formed during operations. Serne and LeGore (1996) also reported the average bulk distribution coefficient (K_d) for strontium-90 to be 15 mL/g for these sediments. Contaminants with strong adsorption such as cobalt-60, cesium-137, and plutonium-239/240 remained within 1 meter of the bottom of the disposal facility. Contaminated sediment that is now part of the vadose zone should be considered a source term for further downward migration to the water table.

Further complicating the release of contaminants from the vadose zone in the 100 Areas is the seasonal and diurnal fluctuations of the Columbia River. A high river stage can cause the water table to rise into sediment containing higher concentrations of contaminants. Additionally, the chemistry changes caused by the constant re-wetting of the soil due to diurnal fluctuations could affect how the contaminants are released from the vadose zone (Petersen and Connelly 2001).

2.1.1.2 200 Areas

The 200 East and 200 West Areas are located on the Central Plateau of the Hanford Site. The vadose zone beneath the 200 Areas ranges in thickness from about 50 meters in the western portion of the 200 West Area (beneath the former U Pond) to 104 meters in the southern part of 200 East Area. The stratigraphy of the vadose zone varies significantly across the Cold Creek floodbar making up the Central Plateau. A generalized geologic cross section showing the general stratigraphy through the 200 Areas is shown in Figure 2.3.

Hydrostratigraphy. The geology and hydrology of the 200 Areas have been extensively studied because they contain major sources of groundwater contamination (Hartman 2000). The major stratigraphic units making up the vadose zone include 1) glaciofluvial deposits of the Pleistocene-Age Hanford formation, 2) fluvial and/or eolian deposits and paleosols of the Pliocene/Pleistocene-Age Cold Creek unit, and 3) the fluvial/lacustrine deposits of the Miocene/Pliocene-Age Ringold Formation.

200 West Area. The vadose zone beneath 200 West Area ranges from 50 to 80 meters thick and can be subdivided into six principal hydrostratigraphic units (Lindsey et al. 1992a; Connelly et al. 1992a; Thorne et al. 1993; Williams et al. 2002; DOE 2002). These units include two facies associations of the Hanford formation (gravel-dominated and the sand-dominated), two lithofacies of the Cold Creek unit (the fine-grained, laminated to massive facies, and the coarse to fine-grained carbonate-cemented facies)

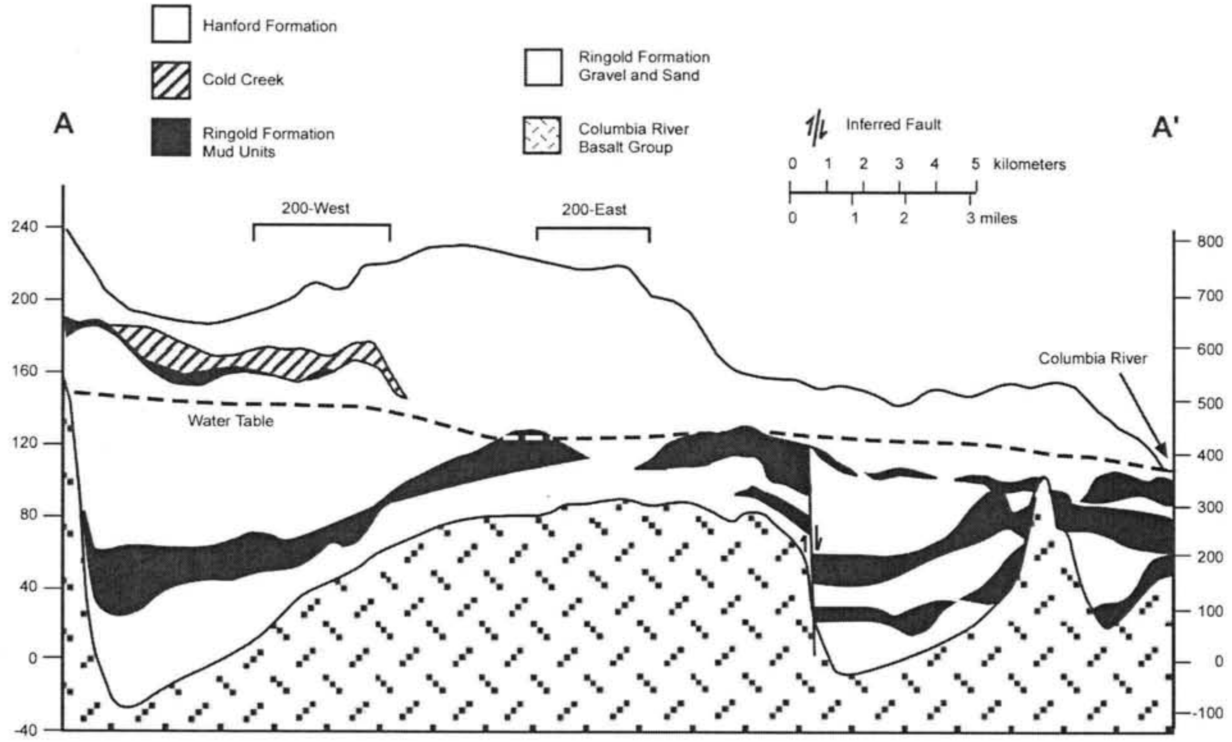

Figure 2.3. **Generalized West-to-East Geologic Cross Section Through the Hanford Site (after Hartman 2000)**

and two members of the Ringold Formation (the member of Taylor Flat and the member of Wooded Island, Unit E). Not all of these units are present everywhere within the 200 West Area, and as in any depositional system, the thickness, distribution, and continuity of these units can vary significantly from site to site.

Clastic dikes (Figure 2.4) occur as near-vertical sediment-filled structures that cut across bedding planes. Clastic dikes have been observed to form multisided polygonal cells enclosing the host sediment. Individual polygonal cells are bounded by other polygons to form what is described as a honeycomb pattern when viewed from the air (Fecht et al. 1999). Vertically oriented clay skins within clastic dikes could locally act to form an impediment to lateral flow.

Perhaps the most significant feature in the 200 West Area affecting vadose-zone transport is the fine-grained and carbonate-cemented facies of the Cold Creek unit (Rohay et al. 1994), which represents an ancient buried calcic paleosol sequence (Slate 1996, 2000). Because of the cemented nature the Cold Creek unit, it is often considered impervious; however, it is also structurally brittle and, therefore, may contain many fractures that have developed during or since soil development. The degree of cementation varies considerably within the Cold Creek unit so that contaminants could breach the unit through discontinuities in cementation or structure. The Cold Creek unit which contains many weathering products (e.g., oxides and carbonates) may also chemically react with transported wastes with which it comes in contact. Immediately overlying the carbonate-cemented facies of the Cold Creek unit is the

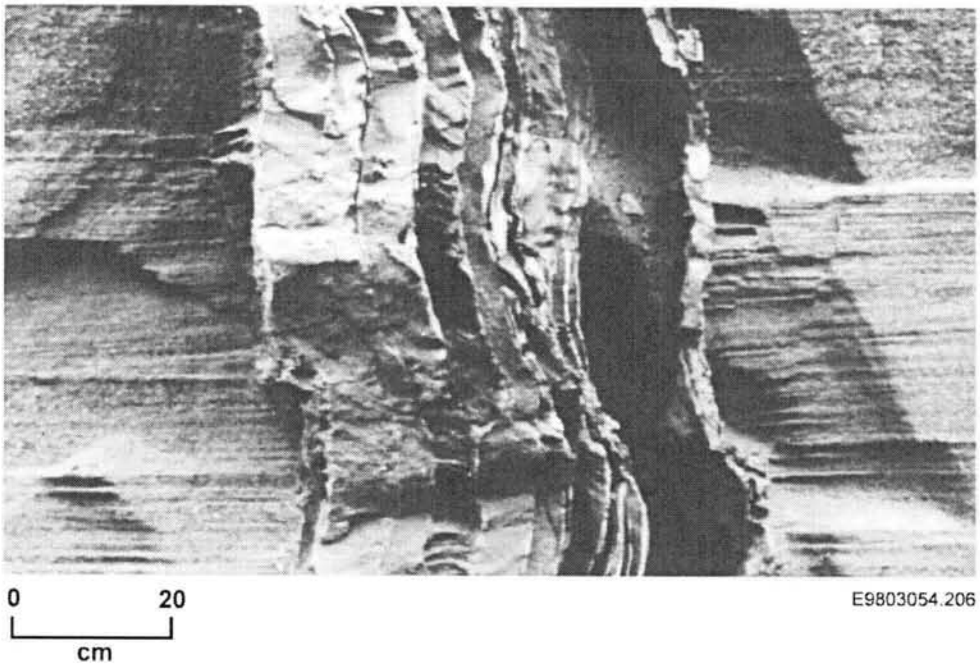

Figure 2.4. Photograph of a Typical Clastic Dike as Found at the U.S. Ecology Site in Central Hanford (after Fecht et al. 1999)

fine-grained, laminated to massive facies (formerly referred to as the "early Palouse soil") which has a relatively high moisture-retention capacity with a corresponding low permeability and would tend to retard the downward movement of moisture and contaminants.

200 East Area. The vadose zone beneath 200 East Area can be subdivided into six principal hydrostratigraphic units, including three units with in the Hanford formation, a fluvial gravel facies of the Cold Creek unit (equivalent to the Pre-Missoula Gravels), and two units belonging to the Ringold Formation (Lindsey et al. 1992b; Connelly et al. 1992b; Thorne et al. 1993; Williams et al. 2000; DOE 2002). The Hanford formation units include 1) an upper gravel-dominated facies, 2) a sand-dominated facies, and 3) a lower gravel-dominated facies. Over most of the 200 East Area the Hanford sand facies lies between the upper and lower gravel-dominated facies (Lindsey et al 1992b; Connelly et al. 1992b). Based on borehole samples, the upper and lower gravel-dominated facies appear to have similar physical and chemical properties. The Ringold Formation in the 200 East Area is, for the most part, eroded away in the northern half of 200 East Area. Here, the Hanford formation lies directly on top of basalt bedrock. With the dropping water table, basalt outcrops above the water table and, thus, is unsaturated beneath the northeastern portion of 200 East Area. Just south of 200 East Area, the water table lies within the Ringold Formation. Because the physical and chemical characteristics of the Ringold Formation, Member of Wooded Island, Unit A and Unit E gravels are similar, and because only a small portion of the vadose zone lies within Unit A, these units can be combined into a single hydrostratigraphic unit.

Clastic dikes have also been observed in the Hanford formation beneath 200 East Area. The vertically oriented clay skins within clastic dikes could locally act to form an impediment to lateral flow. This could then cause ponding (perching) of the water and eventual breakthrough to underlying strata.

Sublinear to anastamosing (braid-stream like) channel-cut scour and fill features occur within the Hanford formation and could act as preferential pathways in the horizontal direction. Other types of heterogeneity are associated with stratigraphic pinch out or offlapping/onlapping of facies.

Both the Ringold and the Hanford formations often contain relatively thin fine-grained stringers that can result in lateral spreading of moisture and slow down the vertical movement of contaminants within the vadose zone. Low-permeability layers, where they exist, often occur as single, relatively thick (meters or more) and continuous layers within the Ringold Formation. Low-permeability layers within the Hanford formation, on the other hand, occur more frequently, yet are relatively thin (0.5 meter or less) and laterally discontinuous. Low-permeability layers within the sand-dominated facies of the Hanford formation are generally thicker and more continuous than those in the gravel-dominated facies. Paleosols and some facies changes (i.e., the contact between fine grained and coarser grained facies) have been observed to be fairly continuous over the range of at least 100 meters and have been found to promote lateral spreading of crib effluent on that same scale.

Hydraulic Properties and Conditions. Accurate predictions of flow and transport in the vadose zone require a detailed characterization of the hydrologic properties and their variability, and estimates of transport parameters such as dispersivity. In particular, data that are essential for quantifying the water storage and flow properties of unsaturated soil include the soil moisture characteristics (i.e., soil moisture content versus pressure head and unsaturated hydraulic conductivity versus pressure head relationships) for sediment in various geologic units.

Data on particle-size distribution, moisture retention, and saturated hydraulic conductivity (K_s) have been cataloged for over 248 samples from throughout the Hanford Site, including 12 locations in 200 East and West Areas (Khaleel and Freeman 1995; Khaleel et al. 1995; Khaleel and Relyea 1997; and Khaleel and Heller 2003). The soil retention data were corrected for gravel content and the main drying curve. The saturated hydraulic conductivity was measured on intact, undisturbed splitspoon sleeve samples. After the data were corrected and cataloged, hydraulic parameters were determined by fitting the van Genuchten soil-moisture retention model to the data.

Macrodispersivity estimates for non-reactive species have been estimated using the Gelhar and Axness (1983) equation where the longitudinal macrodispersivity depends on the mean pressure head. Khaleel (1999) estimated a longitudinal macrodispersivity of about 100 centimeters for the sand-dominated facies of the Hanford formation in 200 East Area. The transverse dispersivities have been estimated as one-tenth of the longitudinal values (Gelhar et al. 1992).

Ward et al.[(a)] obtained dispersivity estimates via field measurements at a location close to the immobilized low-activity waste site, using potassium chloride (K_{Cl}) as a tracer. Analysis of the data provided dispersivities that ranged from 1.3 to 7.8 centimeters for travel distances ranging from 25 to 125 centimeters. Dispersivity increased with depth to about 0.75 meter, after which it essentially became constant. These estimates are for the Hanford formation, but the transport distance within the vadose

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(a) Ward AL, RE Clayton and JS Ritter. 31 December 1998. "Hanford Low-Activity Tank Waste Performance Assessment Activity: Determination of In Situ Hydraulic Parameters of the Upper Hanford Formation." In Letter to Dr. Fredrick M Mann from AL Ward dated 31 March, 1999.

zone is indeed of limited extent. Nevertheless, results based on the limited data are consistent with the concept of a scale-dependent dispersivity. Thus, although no data exist on large-scale dispersivities for the vadose zone, it is expected that they will be larger (as is suggested by the longitudinal dispersivity estimate of 100 centimeters) than those based on the small-scale tracer experiment of Ward et al.[a]

Based on a survey of literature, Gelhar (1993) examined the longitudinal vadose zone dispersivities as a function of the scale of the experiment, and found an increase of dispersivity with an increase in scale.

Geochemical Properties and Conditions. The Hanford formation sediment consists of glaciofluvial materials. The mineralogy of this sediment is highly variable depending on grain size. Gravel-dominated sediment tends to have a high degree of rock fragments (mostly basaltic, with some plutonic, metamorphic, and detrital caliche fragments) (DOE 2002). Microprobe analysis of the sand and finer-grained fraction has found it to be dominated by quartz (18 to 67.1% by weight), plagioclase (5.1 to 41.5%) and Microcline (1.8 to 30.1%) (Tallman et al. 1979; Serne et al. 1993; Xie et al. 2003). Other dominant minerals include amphiboles up to 36.6%, pyroxenes up to 27.5%, Mica (Biotite/Illite) up to 13.1%, and calcite up to 6.5% by weight. Smectite clays represent a few weight percent of the bulk sand fraction (3.3 to 5% [Serne et al. 1993]) and generally dominates in the clay fraction (Tallman et al. 1979).

Hanford formation sediment is typified as having low organic carbon content generally <0.1% by weight (Serne et al. 1993) and low-to-moderate cation exchange capacity (2.6 to 7.8 milliequivalents per 100 grams, Serne et al. 1993). The sediment has a slightly basic pH when wetted (Serne et al. 1993 found that the pH of saturation extract ranging from 7.66 to 8.17). Small amounts of detrital calcium carbonate (calcite) are common and can act as a weak buffer.

Much less mineralogy data are available for the Cold Creek unit. Tallman et al. (1979) found that the sediment they referred to as Early "Palouse" Soil are fairly similar in mineralogy (25.3 to 29.4% quartz, 15.1 to 18.2% plagioclase, 15 to 17.8% microcline, 7.9 to 10% amphiboles, 1.3 to 12.5% micas), but generally have higher in calcite (8 to 8.8%), and lack pyroxenes. Bjornstad (1990) found similar results for these fine-grained sediment, but found that the carbonate-rich facies (referred to as the Plio-Pleistocene unit) consisted predominantly of calcium carbonate and/or sedimentary rock fragments, with lesser amounts of quartz and feldspars.

Thin beds of caliche with calcite predominate and variable amounts of ferric oxide exist in the 200 West Area in the Cold Creek unit just above the Ringold Formation.

Xie et al. (2003) found significant differences in electron microprobe and petrographic results between the Hanford and Ringold Formations. The Ringold Formation sediment is generally higher in quartz but lower in plagoclase and pyroxene. Deeper within the Ringold Formation, calcic/ferric oxide cements are often present. The cementing can alter significantly the permeability of the otherwise coarse-grained Ringold sediment.

(a) Ward AL, RE Clayton and JS Ritter. 31 December 1998. "Hanford Low-Activity Tank Waste Performance Assessment Activity: Determination of In Situ Hydraulic Parameters of the Upper Hanford Formation." In Letter to Dr. Fredrick M Mann from AL Ward dated 31 March, 1999.

Empirical K_d data describing contaminant adsorption for Hanford formation, Cold Creek unit, and Ringold Formation sediments are fairly well characterized for dilute waste solutions and groundwater (Cantrell et al. 2002, 2003a). Fewer K_d data are available for high ionic strength waste solutions with slightly acidic to slightly basic pH values. A relatively small amount of K_d data exists for the combined high ionic-strength/highly-basic tank liquors for many common radionuclides. These distribution coefficient (K_d) data have been well tabulated by Cantrell et al. (2003a), Kincaid et al. (1998), Serne and Wood (1990), Kaplan and Serne (1995), and Kaplan et al. (1996, 1998). In most instances, adsorption is assumed to be the controlling geochemical process but neutralization of acid waste by the alkaline sediment and neutralization of basic tank waste can cause precipitation of some macro and many minor contaminant species within the sediment pores. Outside the zone of pH neutralization, adsorption is considered to be the dominant contaminant retardation process in the vadose zone.

The geochemical processes that affect contaminant migration and mineral alteration within the vadose zone sediment for both 200 East and 200 West Areas are quite similar. Some subtle changes should be considered as the fine-grained sediment and caliche zone above the Ringold are less prevalent in 200 East Area.

2.1.1.3 300 Area

The vadose zone beneath the 300 Area ranges in thickness from about 15 meters to less than 1 meter along the Columbia River.

Hydrostratigraphy. The geology of the vadose zone consists almost entirely of the Pleistocene Hanford formation with a thin veneer of Holocene eolian sand. Thin portions of the Ringold Formation may also extend above the water table in portions of the site. Schalla et al. (1988) described the eolian sand deposits as ranging from 0 to nearly 4.6 meters thick. Where missing, these deposits are thought to have been removed by construction activities and often replaced by or covered with construction gravel. The geologic contact with the underlying Hanford formation is quite distinct.

Schalla et al. (1988) described the Hanford formation as poorly sorted sandy gravel with some silt and local sand stringers. The upper portion was described as containing pebble to boulder gravel that grows finer with depth. The gravel fraction is described as mainly basaltic in nature with some quartz-rich and metamorphic clasts. The thickness of the Hanford formation varies from 6.4 to 24.7 meters.

Gaylord and Poeter (1991) describe the Hanford formation beneath the 300 Area as consisting predominantly of three lithofacies: gravelly sand, sandy granule to pebble-size gravel, and sandy cobble to boulder-size gravel. They further indicate that finer grained sand facies, comprising only a minor percentage of the 300 Area Hanford formation deposits, are concentrated in the southern part of the area intermixed with the coarse-grained gravel dominated deposits.

In an attempt to define the spatial distribution of hydrologic properties (primarily aimed at the unconfined aquifer) Gaylord and Poeter (1991) broke the 300 Area sediment into four general hydrofacies. These hydrofacies were defined based on grain size and sorting, recognizing the importance of the fine-grained component to hydraulic behavior.

Based on the available geologic information for the 300 Area, the hydrostratigraphy of vadose sediment can be broken into five different units: 1) backfill (or surface cover); 2) eolian sands (if still present at the waste site); 3) sand-dominated Hanford sediment; 4) gravel-dominated Hanford sediment; and 5) gravel-dominated Ringold sediment (if present above the water table). Although these sediments are primarily coarse, it must be recognized that some silt stringers and fine-grained rip up clasts (some over 1 meter in diameter) are present, particularly in the Hanford formation. The location and extent of these stringers is uncertain. It must also be recognized that sedimentary structures (e.g., stratification, grading bedding, forset bedding) impart some degree of heterogeneity and anisotropy in each of the units; however, again there is insufficient data to adequately portray these characteristics.

Hydraulic Properties and Conditions. Schalla et al. (1988) presented the results of physical (e.g., field moisture content, water retention, particle-size analysis) and bulk geochemical analyses of selected samples. The field water content ranged from <2 to nearly 5% by weight.

Geochemical Properties and Conditions. Gaylord and Poeter (1991) also provided whole rock geochemical (via x-ray fluorescence) and rare earth/trace element (inductively coupled plasma/mass spectroscopy [ICP/MS]) analyses for the Hanford and Ringold Formations. These data are similar to those for Central Plateau sediment (Xie et al. 2003). Existing sorption data are rather limited for the 300 Area (Cantrell et al. 2003b), therefore sorption parameters must be derived from an assessment of the waste chemistry and existing sorption values from other Hanford site sediments (similar to the selection process used in the Hanford composite analysis [Kincaid et al. 1998]). Without site-specific geochemical data, values for the geochemical properties (i.e., K_d values) will have to be estimated from the sediment type (e.g., grain-size data and the presence of secondary mineralization like the Fe oxide coatings often found in the Ringold Formation) and waste type. The mineralogy and contaminant adsorption properties of the Hanford formation sediment in the 300 Area are thought to be quite similar to those in the 200 Areas such that the extensive K_d data base (Cantrell et al. 2003b) should be adequate for the 2004 Composite Analysis.

2.1.2 Events

Various events to be considered in the conceptual model include those that are naturally occurring (e.g., meteoric recharge), those that are manmade (e.g., intentional or unintentional contaminant and water releases), those that occur slowly over a long period of time, and those that represent extreme or unusual occurrences (e.g., 500 year storms, volcanism). A brief synopsis of some of the important types of events that should be considered are presented in the following sections.

2.1.2.1 Recharge Events

The long-term natural driving force for flow and transport through the vadose zone is precipitation that has infiltrated below the zone of evaporation and the influence of plant roots. Such water eventually flows to the water table, carrying with it whatever dissolved species may be present. Gee et al. (1992) presented evidence from multiple experiments showing that measurable diffuse natural recharge occurs across the lower elevations of the Hanford Site, with rates ranging from near zero in undisturbed shrub-steppe plant communities to more than 100 mm per year beneath the unvegetated graveled surfaces of tank farms.

The arid climate setting, with cool wet winters and dry hot summers at the Hanford Site dictates that recharge potential is greatest in winter (Gee et al. 1992). During winter months at Hanford, precipitation is greatest and evaporation potential lowest; therefore, precipitation has the greatest chance to infiltrate into the ground. This type of recharge can occur as either diffuse or focused recharge. How much each event contributes is site- and event-dependent. Water runoff from the higher elevations occurs intermittently because of frozen ground and, while infrequent, can be extensive (e.g., Pearce et al. 1969). Cushing and Vaughan (1988) indicate runoff from higher elevations has a 3.8-year return period. Extensive water runoff does not appear prevalent at the Hanford Site between Highway 240 and the Columbia River based on the absence of geomorphic features such as erosion rills and gullies. For undisturbed (natural) sites in the 100 and 200 Areas at Hanford, there is typically gentle terrain and coarse soil that foster diffuse recharge. In contrast, at disturbed waste sites there can, at times, be localized ponding that gives rise to focused flow particularly under conditions of rapid snowmelt. Observations have revealed that local runoff does occur at waste sites when there is a heavy rain, quick snowmelt, or the ground is frozen (e.g., Gee and Hillel 1988; Jones 1989; Ward et al. 1997).

2.1.2.2 Source/Release Events

Another source of water that transports contaminants originates from industrial activities. Historically, millions of gallons of contaminated water were disposed to subsurface infiltration structures and surface ditches and ponds. Such unregulated disposal ceased several years ago. Currently, two facilities are permitted to discharge to the vadose zone: the State-Approved Liquid Disposal (SALD) Facility and the Treated Effluent Disposal Facility (TEDF). Discharges from these facilities are closely monitored and regulated. Numerous discharges of water, collectively called miscellaneous streams, are also permitted but do not need to be monitored unless they exceed certain discharge rates and annual amounts (DOE 1998). These streams include hydrotesting, maintenance, construction, cooling water and steam condensate, sanitary wastes, and storm water control. Also unregulated but possible sources of additional recharge water are roads, road shoulders, parking lots, power and fire lines, and all structures that do not have precipitation controls that fall under the miscellaneous streams permit.

Source events include accidental or intentional discharges of fluids, gases, and contaminants to the environment. Unintentional releases include spills, tank leaks, and distribution pipe leaks. The quantity, quality, duration, and phases of waste or fluid released are generally unknown. These events also include remediation activities that involve the injection of liquid, chemicals, gases, and heat.

2.1.2.3 Discharge/Exit Events

Discharge or withdrawal events include all actions to remove fluids, gases, and contaminants from the environment. These events must be characterized for quantity, quality, duration, and phases of waste or fluid removed. These events include remediation activities such as groundwater pumping, vapor extraction, and heat removal (e.g., cryogenic barriers).

2.1.2.4 Climate Events

A change to a drier and/or warmer climate could result in a sparser plant community, a change in the mix of plant and animal species, increased wind erosion and deposition (e.g., re-activated sand dunes), and changes in natural recharge. The stress of this change could allow non-native plant and animal species to supplant native species.

2.1.2.5 Volcanism

Volcanic activity has the potential to deposit significant quantities of ash. Such deposition could reduce evaporation and plant activity for years, which could increase the natural recharge rate.

2.1.2.6 Seismicity

Earthquakes and other related events, such as fault rupture, landslides, or differential settlement could potential effect the integrity of surface or subsurface structures, potentially impacting recharge and vadose zone transport.

2.1.2.7 Flooding Events

Natural flooding in the Columbia River is predicted to affect low-lying areas along the river but not the 200 Areas. Failure of the upriver dams has the potential to affect the entire Hanford Site. The probable maximum flood in the Cold Creek drainage basin could affect the southwestern portion of the 200 West Area (Skaggs and Walter 1981). Under this scenario, water from the flood would reach the Yakima River.

2.1.2.8 Human Disturbance Events

Human activities are capable of degrading surface covers over waste sites and exposing the waste to increased recharge and more direct contract with the biosphere.

2.1.3 Processes

The primary processes governing flow and transport through the vadose zone are complex and interrelated. These processes depend on the physical and chemical nature of the geologic materials that make up the vadose zone (described above) as well as the types, amounts, and compositions of the fluids that occupy the pore spaces (Looney and Falta 2000, p. 13). At a high level, one can discuss these processes in terms of the mechanisms, rates, and routes by which contaminants move (or are moved) through the vadose zone to the water table (i.e., fluid flow, physical transport, and the capillary fringe) and the fate of the contaminants (i.e., physical and chemical interactions, decay and decomposition).

2.1.3.1 Transport Mechanisms

For the majority of contaminants, movement through the vadose zone is contingent on being dissolved within flowing water (i.e., aqueous phase drainage). The flow of water through the unsaturated soils depends in complex ways on the rate of water infiltration, moisture content of the soil, textural heterogeneity, and soil hydraulic properties. Infiltrating water provides the primary driving force for downward migration of contaminants. Perched water zones and lateral spreading may develop when water moving downward through the vadose zone accumulates on top of low-permeability soil lenses, highly cemented horizons, or above the contact between a fine-grained horizon and an underlying coarse-grained horizon. Unsaturated hydraulic conductivities may vary by several orders of magnitude depending on the water content of the soils.

Some contaminants (as well as water) are volatile and move in the gas phase. The bulk of this movement is diffusional, but convective flow can occur near the soil surface and near open boreholes in response to barometric changes. Remediation activities (e.g., vapor extraction, thermal treatment) can also affect local convective gas flow.

The geothermal gradient has a small but steady impact on the movement of water upward through the vadose zone. Enfield et al. (1973) used field measurements of temperature and matric potential at a site about 1 km to the south of the 200 East Area to calculate an upward water flux of 0.04 mm per year.

2.1.3.2 Transport Rates

Fluids such as water move through the vadose zone at rates determined by the hydraulic, thermal, and vapor gradients and the relevant properties of the sediment. For many applications, common assumptions include a static air phase, isothermal conditions, and no density effects. With these assumptions, flow rates are calculated using Richards equation with gravity and capillary potential gradients. When these assumptions are not appropriate (e.g., organic liquids, vapor flow, hot saline tank waste), more sophisticated equations must be used to calculate rates.

The rate of recharge at a particular location is influenced by five main factors: climate, soil, vegetation, topography, and springs or streams. Other factors can significantly impact recharge by affecting one or more of the main factors. These other factors include soil development, animal activity, fire, water and wind erosion and deposition, plant community changes, disturbance, and human structures (e.g., roads, buildings). The rate of recharge at each waste site will depend on the design of the surface cover. Plants and animals live within the upper 1 to 2 meters of soil, and some plant roots can reach depths of 3 meters. Surface covers can be designed to protect against such intrusion by including biobarriers, which are layers that resist biotic intrusion. Coarse gravel layers have been shown to be ineffective at preventing root and insect intrusion, but they appear to deter animal intrusion. For thinner cover designs, the biobarrier may be closer to the surface and more susceptible to degradation. Intrusion of surface covers by plants and animals can create macropores that could become conduits for surface water to flow into the soil much deeper than expected. Inadvertent intrusion by humans can result in surface depressions that could become areas of focused recharge when surface runoff occurs.

Some of the liquids that were disposed or leaked to the vadose zone had properties that differed significantly from the properties of pure water. Because their properties differed from those of water, their rate and route of movement through the vadose zone may differ from those of water. The specific gravity of waste that has leaked from single-shell tanks ranged from 1.1 to 1.65, which could enhance the transport of contaminants. Increased density has been demonstrated to elongate contaminant plumes vertically and reduce lateral spreading caused by stratigraphic variations in hydraulic properties (Ward et al. 1997). The properties of these fluids will change as contaminants are diluted, sorbed, or the fluid evaporates into the sediment air space.

Organic fluids were also disposed at Hanford. The movement of these fluids through the vadose zone and groundwater aquifer is complex because it involves flow in multiple phases: the organic liquid phase, the dissolved phase in water, and the vapor phase in the vadose zone air space. The movement of organic fluids can be enhanced if their density is much higher than the density of water. That is the case for the primary organic fluid contaminant at Hanford - the dense nonaqueous phase liquid, carbon tetrachloride. Between 1955 and 1973, roughly 577 to 922 metric tons of carbon tetrachloride was disposed to three subsurface infiltration facilities at the Hanford Site (Rohay et al. 1994). The current groundwater plume containing concentrations above 0.5 mg/L covers an area of about 11 square kilometers. Soil-vapor extraction and pump-and-treat activities have been employed to prevent further movement of the plume and reduce contaminant mass. Efficiencies of the vapor extraction activities have decreased. The pump-and-treat activities may be having an impact, because the extent of the plume has not increased. The behavior of carbon tetrachloride in the subsurface and in the vadose zone is poorly understood and requires additional characterization and assessment to determine the important processes governing its fate and transport.

The rate of gas movement in the vadose zone will be affected by the magnitude of any temperature gradients. The vadose zone across the entire Hanford Site experiences temperature changes that arise from the diurnal and seasonal temperature changes at the soil surface. The magnitude of the temperature changes diminishes with depth; at 10 meters, the seasonal change appears to be less than 1°C. Near-surface temperatures appear to have a minimal effect on recharge rates if the rates exceed 10 millimeters per year, but they could be important when rates are less. In addition to the near-surface temperature changes, a steady upward geothermal gradient exists that drives gas (and water vapor) upward. The elevated temperatures of the leaked waste from the single-shell tanks and previous operational discharges could have induced local movement of both liquids and vapor.

The formation of colloids and occurrence of colloid-facilitated transport of contaminants were identified by the Expert Panel as a potentially important process for the vadose zone (DOE 1997). For most waste sites at Hanford, the low water contents and simple geochemistry are not conducive to colloid formation or colloid-facilitated transport. However, for the large-volume discharges and waste from leaking tanks, the conditions existed for both colloid formation and colloid-facilitated transport. However, insufficient data exist at the Hanford Site to adequately characterize the potential for colloidal transport under these conditions.

2.1.3.3 Transport Pathways

Because gravity is the dominant force that moves liquid downward, the predominant direction for contaminant movement is downward. Variations in the hydraulic properties and the presence of impeding features such as bedding interfaces, caliche layers and disposal facilities can locally alter and redirect the movement laterally. Various preferential pathways such as clastic dikes and fractures are capable of concentrating or contributing to phenomena such as fingering and funnel flow. Preferential flow has been documented along poorly sealed well casings at the Hanford Site (Baker et al. 1988) and transport along clastic dikes has been postulated to be potentially important (DOE 1997). Relatively simple stratigraphic layering can give rise to complex water content distributions and enhanced lateral spreading that impedes vertical migration of contaminants.

Because of the nature of some waste, local routes of contaminant movement will vary. The Vadose Zone Expert Panel (DOE 1997) stated that the likely mode of transport for leaked or disposed tank waste in the Hanford geology is along preferential, vertical, and possibly tortuous pathways. They identified possible preferential flow caused by:

- Hot (177°C) caustic tank waste leaking into the vadose zone, flashing to steam, fracturing the matrix, and enlarging pores
- Hot (177°C) caustic tank waste leaking into the vadose zone with a self-healing nature, creating geothermal convection systems that could move contaminants upward and the hot alkaline slurry reacts with Hanford sediment
- Dissolution of siliceous sediment by the hot and alkaline tank waste, which could increase porosity in some places (by dissolution) and lower porosity in others (by precipitation)

2.1.3.4 Contaminant Behavior

The fate of contaminants in the vadose zone depends on geochemical conditions, the speciation of the contaminant, residence time, and microbial activity.

Sediment has the capacity to sorb most contaminants from solution. The amount of sorption is a function of many factors, including mineral surface area and type, contaminant type (speciation) and concentration, overall solution concentration, pH, Eh, and reaction rates for the controlling adsorption or precipitation, dissolution, and hydrolysis reactions.

Some contaminants do not sorb at all (i.e., soluble anions such as nitrate, chromate, and protectonate) and are moved along with the bulk solution. The movement of contaminants through the vadose zone is affected by their sorption in the far-field and sometimes by complex dissolution/precipitation reactions between waste liquids of extreme pH and the slightly alkaline sediment in the near field. The significance of sorption is that it delays downward movement of the contaminant and allows degradation processes to occur (e.g., radioactive decay) and, for some, irreversible incorporation into the sediment. Sorption can be described using a simple linear relationship (i.e., a distribution coefficient or K_d) that is determined empirically. Values of K_d have been measured for a wide range of contaminants and waste types at the Hanford Site (Kincaid et al. 1998). The K_d approach is applicable for conditions at Hanford where the contaminant concentrations are low and the chemistry is relatively constant. However, conditions near some waste sources are so variable due to the strong influence of the waste that the K_d approach may not be applicable. Such is the case for the hot, highly concentrated tank waste in contact with Hanford sediment. The general consensus is that the presence of this waste will likely decrease the sorption of contaminants (e.g., cesium-137). The net effect will be an increase in their mobility until conditions in the sediment (e.g., lower concentrations via waste dilution) become more appropriate for the K_d approach. The complex reactions that occur between the sediment and the highly acidic and (more importantly for

Hanford) highly basic wastes are currently under study. Future SAC revisions will determine whether more complex chemical reaction processes should be considered to increase the accuracy of transport models used to estimate migration rates of key contaminants of concern.

Contaminants that exist in the gas phase (e.g., radon, carbon-14, carbon tetrachloride) are subject to atmospheric venting and remediation activities such as vapor extraction. Carbon-14 as carbon dioxide also reacts strongly with alkaline earth cations to form insoluble carbonates at neutral to basic pH values. Further it reacts with cement, a common constituent of waste form containers and structures used in many solid waste burial grounds, to form carbonate precipitates (Krupka and Serne 1996; Serne et al. 1992).

Contaminants near the soil surface are subject to animal and plant uptake. Plants and animals live within the upper 1 to 2 meters of soil, and some plant roots reach depths of 3 meters or more. Waste present within this zone is subject to ecological uptake and dispersal above ground.

Contaminants that are consumed by microbes are subject to degradation into other compounds that may or may not be considered contaminants. This degradation process depends on the presence of a microbial population that is capable of degrading the contaminant(s) in question and the availability of any additional nutrients that may be required for the microbes to be effective.

Sometimes it is the water that is consumed rather than the waste. Waste forms such as the immobilized low-activity waste undergo a corrosion process that consumes water. In a dry disposal, this consumption process will create a water vapor gradient that draws vapor toward the waste form.

2.2 Uncertainty and Unresolved Technical Issues

Unresolved technical issues and sources of uncertainty affect the ability to predict the behavior of contaminants in the vadose zone. These include property representation, scale effects, spatial and temporal resolution of data, preferential flow, funneled flow, colloid transport, density effects, and thermal effects. Many of these issues are not addressed in this data package but may be addressed in later revisions of the composite analysis after resolution of key issues by the science and technology program.

Discussions of outstanding issues are generally focused on performance/risk assessment under future conditions and future releases. However, there are also site characterization and laboratory study needs related to interpreting observations from past tank leaks, spills, and nearby intentional discharges. This information, i.e., interpretation of site characterization data, is important to estimate existing inventories for use as initial conditions and also to demonstrate the validity of our understanding and the predictive ability of the models used for flow and transport of contaminants. Interpreting the mass and distribution of contaminants is difficult because there is much about the history and character of the leaks, spills, and water losses that is difficult to characterize. The resulting uncertainty will always hamper the ability of models to predict observed distributions of contaminants in the vadose zone, even if the distributions are well known.

2.2.1 Property Representation

The physical, chemical, and hydraulic properties of the various solids, liquids, and gases in the subsurface are typically represented within numerical simulators using mathematical functions. The form of these functions, and their resulting suite of parameters, change as more process knowledge and characterization information becomes available. Good examples are the water retention and hydraulic conductivity properties of the sediments. The parameters for these functions are determined by fitting them directly to data or by inferring them from physical properties. Many functions have been proposed to represent hydraulic properties. One of the most commonly used hydraulic models is the van Genuchten-Mualem model (Kosugi et al. 2002). A standard practice is to fit the van Genuchten retention model to retention data and the saturated conductivity value and use the resulting parameters with the Mualem conductivity model to predict unsaturated conductivity values. In this standard approach, the "*m*" parameter is fixed equal to 1-1/*n* and the pore interaction term is fixed at 0.5. This approach has been shown to work for a number of soils, but examples exist to show that it is not universally applicable and that, for many soils, it becomes increasingly less applicable as the soil dries out (e.g., Stephens 1992; Khaleel et al. 1995). Predictions of dry-end conductivity can be improved by including one or more measured values of unsaturated conductivity in the fitting process and excluding the saturated conductivity value. Improvements can also be obtained by treating the "*m*" parameter as independent and fitting both "*m*" and the pore interaction term. The drawback to increasing the number of fitting parameters is the possibility of obtaining a non-unique set of parameter values during the fitting process. Some soils have unique structural features such as fractures and macropores that make them less amenable to characterization using a single function like the van Genuchten function. For such cases, Durner (1992) and others have proposed multiple functions, either linked or combined. The resulting fits to the data are better, but the number of parameters is so large that these techniques are not often used. To date, nearly all analyses at Hanford have used a single van Genuchten-Mualem function to represent hydraulic properties. Many have used the standard approach of fitting to retention and saturated conductivity data, but a portion have included an unsaturated conductivity value in the fitting process (Khaleel et al. 1995). As more knowledge is gained and the original data evaluated more fully, the parameter values can be revised such that uncertainty in the conductivity predictions can be reduced.

2.2.2 Effects of Scale

One of the greatest challenges facing the composite analysis and similar efforts is adequately understanding the effects of spatial and temporal scale related to processes, observation, modeling, and assessments. Not a lot is known about how vadose zone processes, at various spatial and temporal scales, interact, which ones are dominant, and how these interactions can be related to and interpreted from existing field and/or laboratory observations. It is also difficult to determine what must be measured and modeled to assess both risk and the ability of the models to assess the risk within useful uncertainty bounds (i.e., to determine the validity of the models).

In past assessments, the hydrogeologic units were generally assumed to be homogeneous and isotropic in character. In reality, these units display complex inter- and intra-sedimentary structures at various scales. The effects of these complex structures are generally thought to enhance lateral spreading and impede downward migration. However, some of these structures might also promote "funneled flow" and/or the development of "fingered flow." Thus, the effect of these small-scale structures needs to be more thoroughly understood and properly accounted for in the assignment of physical properties (e.g., effective permeability, porosity, moisture retention characteristics, anisotropy, dispersivity) to the larger modeled units. The effects of small-scale structures on large scale flow and transport parameters also needs to be assessed to understand the degree of uncertainty, to make appropriate choices for bounding calculations and to determine the effects of simplification on assessment predictions.

Scaling and volume averaging tools are needed that can be used to determine effective values of parameters from small scale (often disturbed) borehole samples in conjunction with soft information on the fine-scale structure of these sediments. Data are lacking for much of the vadose zone where the analysis will be focused, so scale-up and volume averaging will be required. The justification of upscaling and averaging will need to be evaluated either deterministically or by a probabilistic assessment that clearly reflects the uncertainties involved in the analysis.

2.2.3 Spatial and Temporal Resolution of Site Data

The resolution of the nature and extent of various hydrogeologic units beneath a given waste site, based on borehole samples, is generally on the order of 1.5 meters vertically and tens of meters or more horizontally, and the minimum discernable thickness of fine-grained units is thought to be about 15 centimeters. Also, the internal structure of these sedimentary units may have been lost in the drilling and sampling process. Vertical borehole data alone cannot provide the quality and quantity of data needed for accurate analysis of vadose zone transport. Thus, much of our knowledge on the internal structure and heterogeneities of these units comes from extrapolation of qualitative examination of "representative" outcrops. At the Hanford Site, only a few limited geostatistical studies have been conducted to quantitatively describe the internal structure and heterogeneities in outcrop and core samples. Thus, in many cases there is currently a lack of site specific data to support the development of detailed three dimensional geologic models for a given waste site.

2.2.4 Preferential Flow

Preferential pathways are important for contaminant transport associated with tank-farm releases and/or other low-volume discharges where mobile constituents have not yet been flushed through the vadose zone. However, it is important to differentiate between structurally controlled flow and unstable flow. Structurally controlled flow occurs when the structure of the porous medium or the presence of a buried structure (e.g., tank) routes the water along a "preferential path." Unstable flow or wetting-front instability occurs during infiltration when an instability develops at the fluid-fluid interface (e.g., water-air, dense nonaqueous phase liquid water).

2.2.4.1 Structure Controlled Flow

Preferential flow is greatest when the preferred flow path consists of a series of connected large pore spaces. Because flux is proportional to the fourth power of the pore radius, large pores transmit very large quantities of fluid, but only when the pores are filled. Thus, water content determines the effectiveness of preferred pathways to conduct water. When water contents are high (at or near saturation), preferred pathways can conduct copious quantities of water. When water contents are low (dry vadose zone), preferred pathways with large pores do not conduct water because they cannot fill with water.

Whenever there are variations in sediment properties, the potential exists for water flow to be affected. The capillary barrier effect is a good example. The arrangement of fine textured material over coarse-textured material temporarily delays the downward migration of water and allows it to be evaporated and transpired back into the atmosphere. The net effect is that deep drainage is reduced. Such textural breaks are used for surface covers, but they also occur naturally throughout the vadose zone. When such "capillary breaks" are sloped, the water that is retained above the break can move laterally. In fact, this feature has been used to improve the performance of waste disposal facilities in the vadose zone (Frind et al. 1977).

Clastic dikes and unsealed boreholes may potentially act as preferential flow paths for saturated flow by providing large connected pore spaces. These features are especially effective as preferred pathways when they cross-cut the normally horizontally layered sedimentary sequences. The actual influence of clastic dikes on flow is somewhat uncertain; whereas some portions of clastic dikes have large connected pore spaces, other portions have fine-grained clay skins that may actually limit high rates of lateral flow (Murray et al. 2002). Wood et al. (1995, 1996) and Jacobs (1999) suggested that both clastic dikes and unsealed boreholes are insufficiently large and continuous to be significant with respect to the overall contaminant mass transport through the vadose zone. A recent field study of clastic dikes suggested that dikes are not important preferential flow and transport pathways when the drainage flux was less than 100 mm/yr (Murray et al. 2003). Thus, these potential pathways are not considered dominant enough features to be incorporated into an assessment on the scale of the 2004 Composite Analysis.

2.2.4.2 Unstable Flow

Unstable flow fingering seems to develop when a saturated fine-grained textured soil overlies a coarse-grained soil. Water accumulates in and over the fine-grained unit until the thickness of the perched water provides sufficient driving force to allow the water to "drip" into the large pore spaces of the underlying coarse-grained sediment. This situation results in fingers with inner cores that are saturated surrounded by an unsaturated layer. However, fingers that are clearly caused only by the instability of a wetting front have been primarily observed in the laboratory. There is a commonly held belief that unstable flow or fingering may be an artifact of the uniform, horizontal, and homogeneous layers (e.g., glass beads) used in the laboratory experiments. The phenomena may or may not occur in natural structured geologic media. If it does, the following questions need to be addressed:

- What effect does the fine-scaled structure that typically involves alternating coarse-grained and fine-grained layers do to enhance or deter the formation of unstable flow fingers?
- How does this fine structure change the scale of fingers and relative speed up of the transport process (i.e., the effect of bypassing)?

Experiments by Yao and Hendricks (1996) found that at low infiltration rates wetting fronts stabilize because under these conditions capillarity dominates over gravity; thus, there is no mechanism to cause instability and no fingers form. They further found an increase in the number and a decrease in the size of fingers as the infiltration rate increased. Similar studies are needed to address finger formation and its scale when the fluid properties differ from these of water at ambient temperatures (e.g., high density fluids, hot liquids).

2.2.4.3 Temporal Effects

In dry environments, deep vadose zone flow (i.e., recharge to the aquifer) can be dominated by the extreme transient events (e.g., snowmelt and run-on events) if they result in saturated or nearly saturated conditions in regions with fast preferential pathways. Proper assessment of deep recharge and effects related to enhanced transport down borehole annular space or any near surface preferential pathways and/or man-made structures must be addressed at a higher resolution both spatially and temporally. How spatial and temporal variations (particularly the extreme events) interact with heterogeneity and interfaces (particularly sloping ones with breaks or holes) to change the pathway and rates, needs more investigation. The effects of geologic complexity and the spatial and temporal complexity of adjacent, interacting sources (e.g., water line leaks, fire hydrant flushing, adjacent cribs) have also not been adequately addressed.

2.2.4.4 Funneled Flow Coupled with Colloid Transport

The Tank Waste Remediation System (TWRS) Expert Panel (DOE 1997) hypothesized that structure controlled flow coupled with colloid transport was the most likely mechanism to move large quantities of contaminants (such as cesium-137). If important to the transport of key contaminants, this combination of processes needs to be investigated. Research is currently underway to investigate the impact of colloids on contaminant transport in Hanford sediment (Zhuang et al. 2003; Cherrey et al. 2003).

2.2.5 Temperature and Density Effects

Other important issues raised by the TWRS Expert Panel relate to how the hot (177°C) caustic waste from tank leaks interacts with the geohydrologic system through time to affect both the fluid movement and contaminant transport processes. Many of the heat effects related to the high temperatures of the tanks, elevated temperatures surrounding the tanks, and self-heating nature of the leaked waste have yet to be investigated and resolved.

The high heat load of the single-shell tanks coupled with vapor transfer could potentially set up a system whereby soluble briny waste, leaked from the tank, could migrate toward the heat source (e.g., center of the bottom of the tank). The possibility of a heat pipe being created needs to be investigated, as does the nature and scale of the effect. In addition, the possibility that the high heat lowered infiltration rates needs to be investigated.

Density effects have only been investigated to a limited degree (e.g., Ward et al. 1997). These studies did not fully investigate the interactions of density with temperature, unstable flow effects, structurally controlled preferential flow (e.g., clastic dikes), colloidal transport, and/or waste-soil chemical and physical effects to determine inter-relationships and importance among the processes.

2.2.6 Geochemical Processes

As discussed in detail in the *Groundwater/Vadose Zone Integration Project Specification* (DOE 1998) and *Science and Technology Summary Description* (DOE 2000), more studies are needed to improve the knowledge and databases for the vadose zone.

The vadose zone is not well characterized in a quantitative fashion. Field studies will corroborate lab tests and extend the time to study reactions from months to tens of years. Field studies will allow some key questions to be investigated such as the extent of existing physical, chemical, and mineralogic associations between contaminants and major chemical components in the waste and sediment and identification of the primary processes that produced these associations. Such "forensic" characterization will identify migration profiles (transport distances and concentrations) of key constituents and changes in the mineralogy, sorption capacity, and buffer capacity. Subsequent to characterization and analysis of the resulting data, laboratory testing to quantify the key controlling processes will begin. The goal will be to evaluate the key short- and long-term processes controlling the key risk driving contaminants. Processes to be quantified include adsorption, mineral precipitation and dissolution, biomineralization, matrix diffusion, pore plugging, and colloid formation and transport.

In the area of geochemistry, field studies are in progress on representative contaminated sites to improve the conceptual models for waste interactions and on contaminant transport processes and directed laboratory research to clarify details of the chemical processes. Another activity in which geochemists will contribute is development of a credible reactive transport model. At the present time, SAC will likely rely on the K_d construct to describe all contaminant retardation reactions/processes. More sophisticated descriptions of contaminant/sediment interactions may be required for future iterations of SAC.

Field studies to characterize the near-field geochemical environments at representative inactive liquid waste disposal sites and past leaks at single-shell tanks and complementary laboratory studies under more controlled conditions are in progress. The field studies (vadose zone geochemical and hydrologic characterization) will provide the ranges of conditions and field scale observations on contaminant distributions and migration rates versus time or volume discharge. Once the field characterization data bound the conditions and define the nature and extent of the near field, laboratory tests can be chosen to better quantify the physical and chemical processes that control the interaction of contaminants and sediment. Currently at most liquid disposal sites, information is available on the chemistry and volumes disposed, and groundwater monitoring data are available to describe existing contaminants within the upper unconfined aquifer.

These efforts are likely to focus on the "extreme-pH" chemical environments such as acidic process liquids and highly alkaline tank liquors. The latter were also high temperature fluids and both are known to have contained organic complexing agents. Our knowledge base is most sparse for these extreme-pH wastes that are far from chemical equilibrium with the sediments. During interactions of these highly reactive solutions with the sediments, large amounts of mineral dissolution and precipitation can occur. Such large changes in mass between phases can significantly influence the pore structure and hydraulics (permeability) of the vadose zone sediments. The formation and sequestration of colloids may also be most active in this dynamic zone. It is this highly interactive near-field zone that merits detailed study to improve current modeling approaches which rely on the simplistic K_d construct. More detailed discussions of the planned field characterization and focused laboratory studies can be found in DOE (1998, 2000) and individual project work plans such the ORP's RFI/CMS *Single-Shell Tank Vadose Program Work Plan* (DOE/RL 2000b) and the *Immobilized Low-Activity Waste Multi-Year Statement of Work* (LMHC 1999).

2.3 Technical Basis and Approach for Vadose Zone Modeling

Kincaid et al. (2004) describe the basis and technical approach for the 2004 Composite Analysis, indicating that the SAC (Kincaid et al. 2000; Bryce et al. 2002; Eslinger et al. 2002 a, b) would be used for the analysis. The SAC consists of a set of modules (models and data) that have been assembled since the previous 1998 Composite Analysis was performed to allow the collective impact of all the waste that will remain at the Hanford Site to be estimated. These modules include: Inventory, Release, Air Transport, Vadose Zone Transport, Groundwater Transport, Soil, River, Riparian Zone, and Risk/Impact Modules. These modules have been organized to simulate the transport and fate of contaminants through the environment. In general, inventory feeds to release, which feeds to the atmospheric, vadose zone, groundwater, and Columbia River pathways. The atmosphere, groundwater, Columbia River and riparian zone modules provide media-specific concentration estimates used in the risk and impact assessment.

Kincaid et al. (2004) identified 1,046 waste sites from the 2,730 Waste Information Data System (WIDS) sites and several existing and future storage sites for inclusion in the 2004 Composite Analysis. Analysis of liquid discharge and unplanned release sites will be conducted on a site-by-site basis whenever inventory and release data permit. This is because the superposition of liquid discharge to a single soil column results in non-representative contaminant migration and release from the vadose zone. Solid waste burial grounds will be simulated at the burial ground scale; for example, individual burial trenches would be aggregated for a single burial ground. The inventory of solid waste disposal will be increased over time until all burial grounds are closed. Vadose zone flow and transport simulations for the assessment will be based on 1) hydrogeologic profiles and properties for selected areas of the Hanford Site, 2) estimates of deep drainage rates that drive contaminant migration, 3) estimates of geochemical reactions between contaminants and the soil and sediment of the vadose zone profile, and 4) waste inventory and release projections. The first three of these data types are the focus of this data package. The fourth, waste inventory and release projections, is the subject of other data packages.

The behavior of contaminants in the vadose zone can be complex and subject to many unresolved issues and levels of uncertainty. The options for numerically simulating this behavior can be equally as complex. Table 2.1 attempts to summarize some of the important features and processes that can be incorporated into the simulations, depending on the complexity of the model. On a large scale, and for

Table 2.1. Options for the Composite Analysis (after the Preliminary Concepts Document)[(a)]

Model Type	Dimensions and Hydrogeology	Transport Processes	Scale and Temporal Factors	Degradation and Decay Processes
Simple	• 1-D • 4-6 Horizontal Layers • Homogeneous, Isotropic	• Aqueous Phase Transport • Linear Sorption Isotherm (K_d)	• Step-Wise Steady State • One Site per area per waste type	• Radioactive Decay • Biological Pseudo-Decay
Semi-Complex	• 2-D • Up to 10 Sloping Layers • Homogeneous, Isotropic	• Density and Temperature Effects • Linear Sorption Isotherms (K_d values) • Peak Arrivals	• Long Term Climate Changes • Sites on finer grid	• Radioactive Decay • Biological Decay
Complex	• 2 and 3-D • Numerous complexly formed layers • Heterogeneous and Anisotropic • Preferential Flowpaths • Chemically enhanced permeability	• Multiphase Transport • Colloidal Transport • Barometric Effects • Reactive Transport • Wind and Water Erosion	• Episodic, Seasonal Variations • Long Term Climate Changes • Scale on site-specific basis • Near and long term	• Radioactive Decay • Biological Decay • Inorganic Decay (Oxidative/ Reductive)

(a) *Groundwater/Vadose Zone Integration Project Preliminary System Assessment Capability Concepts for Architecture, Platform, and Data Management.* September 30, 1999. http://www.hanford.gov/cp/gpp/modeling/sacarchive/9-30rpt.pdf

(b) Shaded area identifies the model type options selected for the Composite Analysis.

the purposes of simulating the release of mobile contaminants from the vadose zone to the groundwater, the vadose zone can be simulated in a fairly simple manner to account for the most dominant features, events, and processes, as highlighted in Table 2.1.

2.3.1 Features

The physical structure (e.g., geology, hydrologic properties, geochemical properties) of the vadose zone and its principal transport pathways varies by location on the Hanford Site. Because the geometry and configuration of various hydrostratigraphic facies and heterogeneities are not well defined, the effects of these features will be captured via sensitivity or uncertainty analyses, within the context of larger hydrostratigraphic units. Not accounting for small-scale stratifications and variations in texture will likely lead to an under estimation of lateral spreading.

The limited quantity of site-specific data requires that values for the hydraulic properties be estimated from existing hydraulic property values provided by Freeman et al. (2002) and Freeman and Last (2003). For the 2004 Composite Analysis, the relationships between moisture content, pressure head, and unsaturated hydraulic conductivity are assumed to be nonhysteretic and representable using the van Genuchten (1980) and Mualem (1976) functions.

Predictions of unsaturated conductivity can be markedly improved by simultaneously fitting van Genuchten parameters to retention and unsaturated conductivity data (Kosugi et al. 2002). A subset of the samples tested at Hanford were analyzed for unsaturated hydraulic conductivity. Because unsaturated conductivity data were unavailable for a majority of samples, the parameter database was established using only those parameters determined using just retention data, so as to have an internally consistent set of parameters. Setting up the database in this manner allowed the generation of statistical distributions that support the Monte Carlo approach to be used for the 2004 CA. For future composite analyses, methods are being developed to incorporate and benefit from actual unsaturated conductivity data. Just as important, methods will also be developed to scale lab-derived parameters to field-scale appropriate parameters as well as develop methods to use field-derived parameters.

Again, with only limited site-specific geochemical data, values for the geochemical properties (i.e., K_d values) must be estimated from the sediment type (e.g., grain-size data and the presence of secondary mineralization like the iron oxide coatings often found in the Ringold Formation) and waste type, based on data from existing laboratory measurements (Cantrell et al. 2003a). For most circumstances, the linear sorption model approach is adequate for modeling transport, especially for the far-field and low impact sites where geochemical conditions remain fairly constant and contaminant loading of the adsorption sites is low (Cantrell et al. 2003b). However, in situations where large changes in chemical conditions occur within a small spatial zone (e.g., where highly concentrated, alkaline or acidic wastes have been discharged), a more sophisticated approach to surface adsorption modeling may be warranted. A simplified way to account for changes in mobility is to use a multitude of different K_d values to represent the sorptive capacity of the soil as the waste becomes more diluted and/or buffered by meteoric recharge and waste-sediment interactions (i.e., mimicking the decrease in competing ions along the flowpath) as was done in the previous Composite Analysis (Kincaid et al. 1998) and SAC initial assessment (Bryce et al. 2002).

2.3.2 Events

Various events could be considered in the implementation model for the composite analysis include those that are naturally occurring (e.g., meteoric recharge), those that are manmade (e.g., intentional or unintentional contaminant and water releases), those that are rather normally occurring (e.g., occur slowly over a long period of time), and those that represent extreme or unusual occurrences (e.g., 500 year storms, volcanism). Of primary importance to the composite analysis are the source release events, which discharged large volumes of waste water to the vadose zone, and the deep drainage (recharge) of meteoric water. Climate change and other disruptive events such as volcanism, flooding, or human disturbance are believed to be of rather low probability or consequence and are outside the scope of the composite analysis (Kincaid et al. 2004).

2.3.3 Processes

For the majority of contaminants, movement through the vadose zone is contingent on being dissolved within flowing water. The primary long term source of flowing water is precipitation that has infiltrated below the zone of evaporation and the influence of plant roots. Such water eventually flows to the water table, carrying with it whatever dissolved species may be present. Other important transport mechanisms such as: gaseous transport, temperature gradients, and possibly colloidal transport, are not considered significant on the scale and complexity of the composite analysis.

The rate of recharge (deep drainage) at a particular location can be influenced by climate, soil, vegetation, topography, springs and streams, animal activity, fire, water and wind erosion and deposition, plant community changes, disturbance, and human structures (e.g., roads, buildings). For most applications, flow rates through the vadose zone can be calculated using Richards equation with gravity and capillary potential gradients providing the dominant forces.

The formation of colloids and occurrence of colloid-facilitated transport of contaminants have been identified as a potentially important process for the vadose zone (DOE 1997). However, for most waste sites at Hanford, the low water content and simple geochemistry are not conducive to colloid formation or colloid-facilitated transport. Little or no data exist at the Hanford Site to adequately characterize the potential for colloidal transport.

Various preferential pathways such as clastic dikes and fractures are capable of concentrating or contributing to phenomena such as fingering and funnel flow. Because of the nature of some waste, the local routes of contaminant movement will vary. The Vadose Zone Expert Panel (DOE 1997) stated that a likely mode of transport for leaked or disposed tank waste in the Hanford geology is along preferential, vertical, and possibly tortuous pathways. However, detailed analyses of tank farm plumes as well as vadose zone transport field studies suggest that these mechanisms are not significant contributors to groundwater contamination under normal recharge environments (i.e., fluxes <100 mm/yr) (Knepp 2002; CH2M HILL Hanford Group 2002; Murray et al. 2003).

The fate of contaminants in the vadose zone depends on geochemical conditions, the speciation of the contaminant, residence time, and microbial activity. Sediment has the capacity to sorb most contaminants from solution. The amount of sorption is a function of many factors. Some contaminants do not sorb at all. Sorption can be described using a simple linear relationship (i.e., a distribution coefficient or K_d) that is determined empirically. The K_d approach is applicable for most analyses at Hanford where contaminant concentrations are low and the chemistry is relatively constant. However, conditions near some waste sources are highly variable due to strong influences from the chemical components in the wastes. The general consensus is that these wastes will likely decrease the sorption of normally sorbed contaminants (e.g., cesium-137), increasing in their mobility until concentrations in the sediments decrease to the range appropriate for the K_d approach.

Contaminants that exist in the gas phase (e.g., radon, carbon-14, carbon tetrachloride) are subject to atmospheric venting and vapor extraction. Carbon-14 as carbon dioxide also reacts strongly with alkaline earth cations to form insoluble carbonates at neutral to basic pH values, and can also react with cement (Krupka and Serne 1996; Serne et al. 1992). Contaminants near the soil surface are subject to animal and plant uptake and dispersal within the aboveground environment. Contaminants can also be consumed by microbes, degrading into other compounds that may or may not be considered contaminants. Sometimes it is the water that is consumed rather than the wastes. Waste forms such as the immobilized low-activity waste undergo a corrosion process that consumes water. In a dry disposal, this consumption process will create a water vapor gradient that draws vapor toward the waste form.

2.4 Implementation

The large scale and complexity of a cumulative effects assessment for the entire Hanford Site together with the lack of detailed characterization data and/or understanding of some of the fate and transport processes necessitates simplification of the site features, release events, and the contaminant fate and transport processes to enable timely results. Thus, the model approach shown in Table 2.1 was selected for this analysis.

Implementation of this modeling approach is schematically illustrated in Figure 2.5. The primary transport mechanism to be simulated is aqueous phase transport in the porous media of the vadose zone, with radiological decay simulated using first order decay models.

2.4.1 Hydrogeologic Profiles

The 2004 Composite Analysis will in general use a one-dimensional vadose zone model, with some analysis performed to explore the use of multidimensional models to explicitly account for structural features within the Hanford Site, and/or to condition the one-dimensional model results (Kincaid et al. 2004). To account for large scale variability in the hydrostratigraphy across the Hanford Site, the

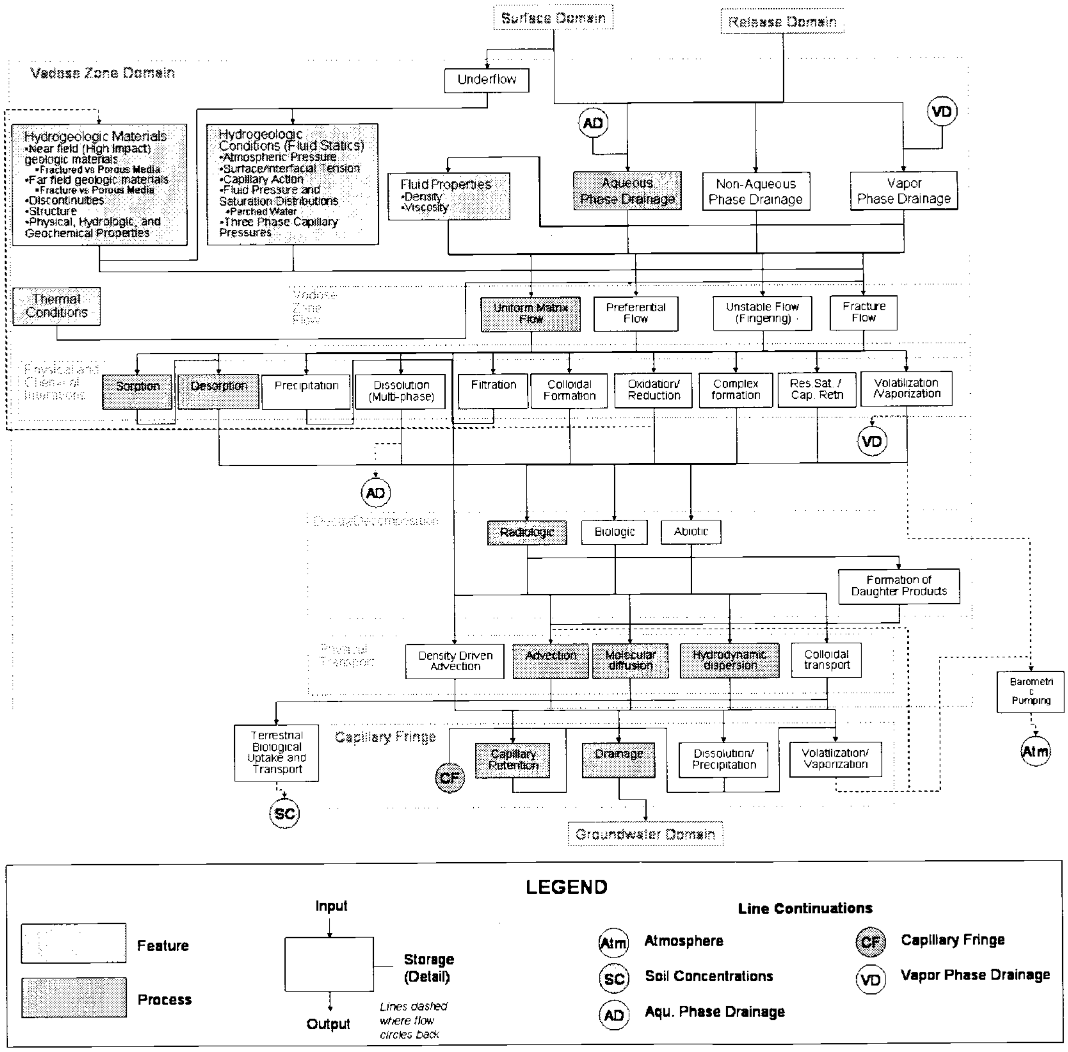

Figure 2.5. Schematic of Vadose Zone Implementation Model for the Composite Analysis

preparation of hydrogeologic profiles and hydraulic and transport property datasets for each site were grouped into a number of geographic areas assumed to have similar hydrogeologic structure and properties. Hydrogeologic units are identified and their thickness ranges specified for each of these hydrogeologic provinces. To account for finer scale variability and uncertainty in the model parameters, probability distribution functions for each process model parameter were developed for each hydrogeologic unit of the hydrogeologic province.

Kincaid et al. (2000) identified the Subsurface Transport Over Multiple Phases (STOMP) computer code (White and Oostrom 1996) as the code of choice for the Vadose Zone Flow and Transport Module for the System Assessment Capability. Properties that would be represented include unsaturated hydraulic conductivity, porosity, water retention parameters, dispersivity, and diffusion coefficient. Kincaid et al. (2004) also indicated that care would be taken to develop and apply correlated model parameters, where necessary, to appropriately model properties (for example, parameters of the van Genuchten and Mualem models - van Genuchten 1980) of unsaturated hydraulics and water retention). Data to support the vadose zone profile and property models would be assembled for each geographic area.

2.4.2 Deep Drainage Rates

Deep drainage rates (also called recharge rates) are critical to the 2004 Composite Analysis because they affect both the release of waste from the disposal zone and the transport of waste to the water table. Deep drainage rates are a function of the climate, surface soil, topography, and vegetation. Kincaid et al. (2004) indicated that estimates of deep drainage and water-table elevation for the 2004 Composite Analysis will be based on the assumption of a continuation of current climate as defined by Hanford Site weather records (Hoitink et al. 2003). Hanford weather data have been collected regularly since 1946 at the Hanford Meteorological Station, which is located between the 200 East and 200 West Areas.

For the 2004 Composite Analysis, a set of deep drainage rates will be assigned for specific intervals of time. The first interval, called the *pre-Hanford* period, is the natural environment that existed prior to the start of Hanford activities. The undisturbed soil profiles and the shrub-steppe plant community determine the rates during this interval.

The second interval is called the *operations* period, during which much of the land surface at waste sites was disturbed (e.g., trenches excavated; cribs constructed; waste disposed and buried) and maintained free of vegetation.

The third interval is the *remediation* period, during which sites will be covered with a protective surface barrier, remediated by retrieval and/or treatment, or left intact. For sites receiving a surface barrier, the remediation period begins with construction of the barrier and lasts for the period of institutional control followed by the design life of the barrier. For sites being remediated by retrieval, the remediation period encompasses the time to remove the contamination (and inventory) to a prescribed depth, place it in the Environmental Remediation Disposal Facility, and backfill with sediment. For sites being treated in place, the Remediation period encompasses the time to treat the contaminants so that they are altered or destroyed and then restore the site. For both retrieval and treatment activities, the remediation period includes the period of institutional control during which a shrub-steppe plant community is re-established. In both cases, the vadose zone simulations will continue to predict the migration and fate of residual contamination in the vadose zone below the cleanup depth.

The fourth and final interval is the *post-Hanford* period, during which long-term changes can occur after the site is no longer under active institutional control. The post-Hanford period represents the longest time interval evaluated. During this period, the design life of surface barriers is exceeded. For a period of time equivalent to the design life of the barrier, the deep drainage rate is changed in stages till it reaches the rate associated with an equivalent natural soil.

2.4.3 Geochemical Reactions

Kincaid et al. (2004) indicated that adsorption of contaminants with vadose zone sediment will be approximated using the linear sorption isotherm model. The mobility of contamination is highly dependent on its speciation and surrounding environment. It is assumed that upon introduction to the vadose zone environment, waste mobility is dominated by waste characteristics. After being in contact with vadose zone sediment and soil water for some distance, it is assumed the waste undergoes a change in its mobility based on buffering of the contaminant solution by the vadose zone hydrogeologic units. Finally, it is assumed once contaminants have migrated a short distance in the Hanford Site unconfined aquifer, another mobility state is defined by the highly buffered, neutralized, and diluted contaminant. Distribution coefficients would be defined for each contaminant in several zones; for example, upper (near field) vadose zone, lower (far field) vadose zone, and unconfined aquifer. Where indicated, K_d dependency on hydrogeologic units would be included. Broad ranges of distribution coefficient may be necessary to represent the suite of waste speciation and surrounding environment conditions that are possible. Data to support the vadose zone and aquifer geochemical reaction model would be assembled.

2.4.4 Interaction with the Inventory, Release, and Groundwater Modules

The inventory and release modeling results for the composite analysis will provide input to the vadose zone module. In addition to curie or kilogram amounts of waste and waste volume, the inventory module provides data on the location and dimensions of each storage or disposal facility. The release module, in concert with the inventory module, provides the contaminant flux to the vadose zone. Large-volume contaminant releases to sites where the vadose zone is thin, such as the cooling water discharges to retention basins in the 100 Areas, are routed directly to the Columbia River, bypassing the vadose zone.

The Vadose Zone Module will provide estimates of the mass flux of contaminant as a function of time entering the unconfined aquifer. The estimates will address releases from all operational areas for the radionuclide and chemical contaminants selected for the 2004 Composite Analysis. Released flux to the aquifer will be provided for individual waste sites and/or aggregations of waste sites where available (for example, liquid discharge sites), and for solid waste burial grounds where applicable (for example, the combination of trenches that comprise solid waste burial grounds). The vadose zone releases to the aquifer will be aggregated to groundwater model nodes in order to introduce contaminants into the aquifer model.

The Vadose Zone Module will provide estimates of mass flux of contaminants from the vadose zone to groundwater for the period of analysis.

3.0 Data Compilation

Kincaid et al. (2004) selected a reduced model approach for simulating vadose zone flow and transport for the composite analysis. In this approach, flow and transport are treated as either one-dimensional processes or as one-dimensional approximation of two-dimensional processes. Vadose zone simulations will be conducted using the STOMP computer code (White and Oostrom 1996). Needed input parameters include: 1) hydrostratigraphy; 2) physical and hydraulic properties (e.g., unsaturated hydraulic conductivity, porosity, water retention parameters, dispersivity, diffusion coefficients); 3) contaminant distribution coefficients; and 4) estimates of deep drainage rates.

Input parameters for the vadose zone model were obtained from existing geologic, soil physics, and geochemical databases. To facilitate sensitivity and uncertainty analyses, probability distribution functions were developed for each of the primary transport parameters.

3.1 HydroStratigraphy

The vadose zone stratigraphic profiles and hydrogeochemical property distributions for the composite analysis are represented by 26 generalized one-dimensional vertical columns. These 26 stratigraphic profiles represent 17 general geographic areas and 9 site-specific locations. Each hydrostratigraphic profile (template) was configured with the hydraulic and geochemical parameters necessary for STOMP to simulate the flow and transport through the vadose zone. As many as five variations of a single hydrostratigraphic template were necessary to more accurately represent the depth of waste releases and thickness of the vadose zone beneath the point of injection. Additional variations of the hydrostratigraphic templates were necessary to accommodate variations in K_d values associated with different waste chemistry designations. Thus, a series of 63 templates were ultimately identified for application in the 17 geographic areas shown in Figure 3.1. These templates consist of the one-dimensional stratigraphy, hydrologic properties, and geochemical properties as well as the waste site type (e.g., crib, tank, etc.) and waste chemistry designation. An additional template was added to identify those sites that discharged waste effluents directly to the river. A more complete discussion regarding the development of the templates is provided in Section 3.2 and Last et al. 2004.

The preferred approach for modeling contaminant transport through the vadose zone uses these templates to represent the vadose zone beneath each waste site within a given geographic area. The actual simulation of each waste site assigned to a given template is implemented at that site's centroid coordinates.

Each template consists of a few major hydrostratigraphic units that are horizontally layered with constant thicknesses and are homogeneous and isotropic (Figure 3.2). Hydrologic and geochemical parameters for each hydrostratigraphic unit are represented by stochastic distributions to facilitate sensitivity and uncertainty analyses. Once each site was assigned to a geographic area and representative stratigraphic template, site-specific parameters such as the site location (centroid), and recharge rates (based on surface cover changes) were added. Each site was then assigned a unique alphanumeric identifier (refer to Last et al. 2004).

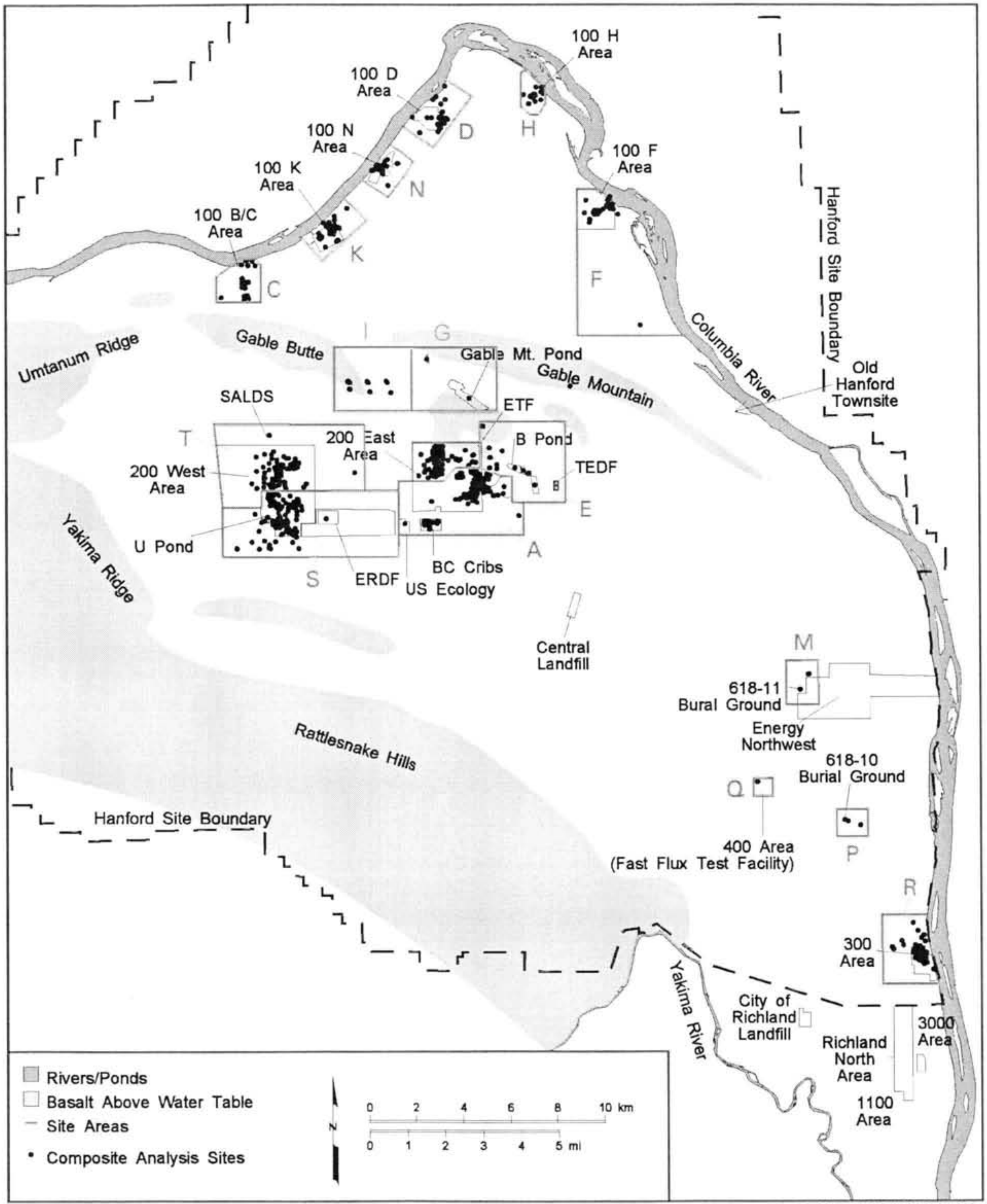

Figure 3.1. Location of Geographic Areas Represented by a Single Generalized Stratigraphic Column

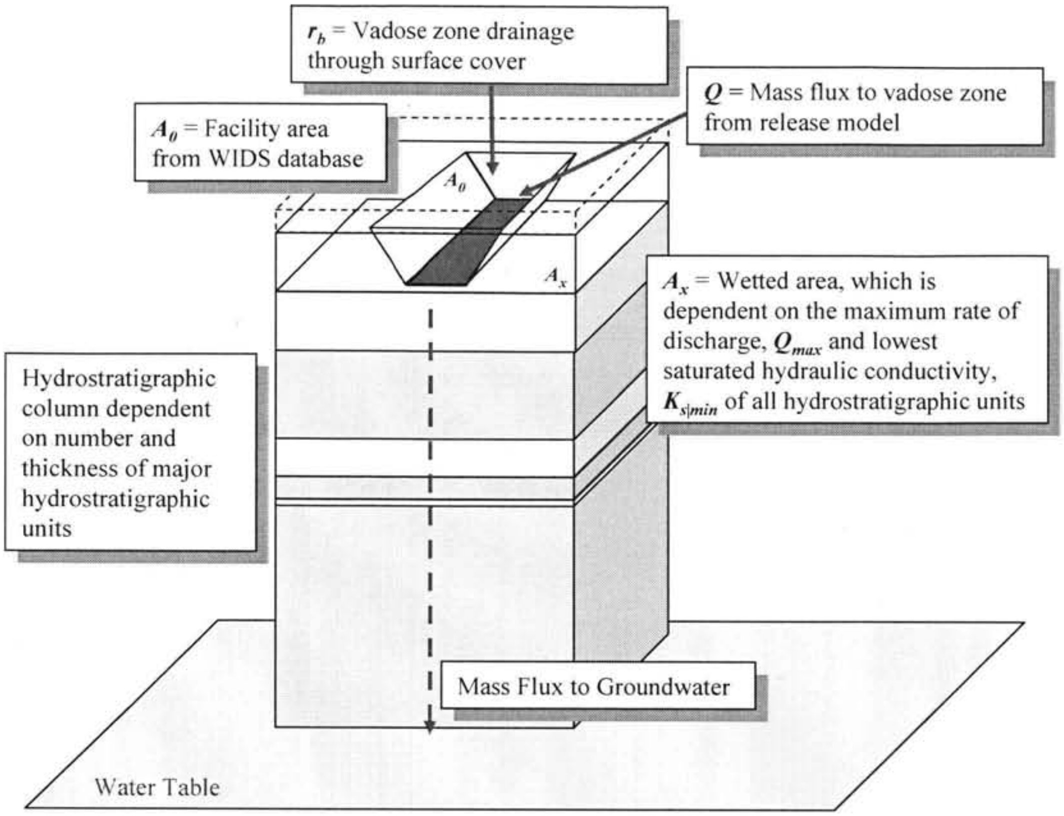

Figure 3.2. Schematic of One-Dimensional Vadose Zone Simulation

3.2 Hydrostratigraphic Templates

Sixty-three hydrostratigraphic templates were defined on the basis of 1) the types of waste sites, 2) the general hydrostratigraphy for 17 selected geographic areas (Figure 3.1), and 3) the chemical characteristics of the waste streams. To accommodate the large number of hydrostratigraphic templates, an alphanumeric code was developed to identify each unique hydrostratigraphic template. This code generally consists of a three-digit number that reflects the waste site type, a letter designating the geographic area, and a number designating the waste chemistry group for assigning K_d values. Nine site-specific hydrostratigraphic templates were created by adding additional alphanumeric characters to the geographic area designation. These codes are explained in Section 3.2.1.

3.2.1 Waste Site Type (reflecting the depth of waste injection)

Nearly all waste sites selected for simulation in the 2004 Composite Analysis have a Waste Information Data System (WIDS) site code. This code generally includes a three-digit number, with the first digit identifying the operational area where the facility is located, and the second and third digits identifying the type of facility. For example, the site code 116 indicates that the facility is in the 100 Area and that it is a liquid disposal facility (i.e., crib, pond, ditch); the site code 241 indicates that it is in the 200 Area and that it is an underground high-level waste tank. For the purposes of defining the base templates, five main categories of waste sites were distinguished: 1) surface facilities such as ponds, ditches, retention basins, buildings, unplanned releases; 2) near surface facilities such as cribs, specific retention trenches, French drains, burial grounds; 3) underground storage tanks; 4) reverse (injection) wells; and 5) river outfalls. Each of these site types (except the river outfalls) release waste to the vadose zone at increasingly deeper depths, making the hydrostratigraphic column shorter, and moving the location of high impact versus intermediate impact K_d zones deeper in the soil profile. The waste site designation scheme for implementation in the base template nomenclature is shown in Table 3.1.

3.2.2 Geographic and Site-Specific Areas Designations

Seventeen geographic areas (Figure 3.1) were identified that could each be represented by a single generalized hydrostratigraphic column. Each of the six 100 Areas were designated as separate geographic areas because each area is geographically distinct and has distinct hydrogeologic characteristics. The 200 Areas were divided into six aggregate areas based on differences in hydrogeologic characteristics. The 200 West and 200 East Areas were each divided into two geographic areas. Additional geographic areas were designated for the 200 North, Gable Mountain Pond, and the B Pond areas. A single geographic area was designated to encompass waste sites in the 300 Area. Finally, three additional geographic areas were defined for isolated sites in the 400 and 600 Areas. Table 3.2 presents the letter designations and brief descriptions of each geographic area. Nine site-specific designations were created by adding additional alphanumeric characters to two of the geographic area designations (Table 3.3).

3.2.3 Waste Chemistry Groupings (for assigning K_d ranges)

Six waste chemistry types were defined by Kincaid et al. (1998) for use in the 2004 Composite Analysis. These waste chemistry types describe chemically distinct waste streams that impact the sorption of contaminants. These same waste chemistry designations were adapted for use in the initial assessment conducted using SAC to assign K_d values to the vadose zone base templates (Bryce et al.

Table 3.1. Waste Site Type Designations Used in the Hydrostratigraphic Template Codes

Waste Site Type Designation[(a)]	Facility Types (reflecting depth of waste injection)
100, 200, 300, 400	Surface facilities (e.g., process sewers, reactor buildings, laboratory buildings, stacks, ponds, ditches, valve pits, process plants, unplanned releases [except tank leaks]).
116, 216, 217, 316, 616	Near surface, shallow liquid and/or dry waste disposal facilities (e.g., cribs, burial grounds, retention basins, trenches, French drain, storage tunnels, drain/tile fields, pipelines, sewers).
241	High level waste tanks, settling tanks, diversion boxes, catch tanks, tank leak unplanned releases.
166, 266, 276	Deep injection sites (e.g., reverse wells)
River[(b)]	River outfalls and associated pipelines

(a) First digit represents the area: 1 = 100 Area, 2 = 200 Area, 3 = 300 Area, 4 = 400 Area, 6 = 600 Area. Second and third digits indicate the facility type.

(b) River outfall discharged wastes directly to the river; thus, there is no vadose zone flow and transport component for these sites.

Table 3.2. Geographic Area Designations Used in the Hydrostratigraphic Template Codes

Designation	Geographic Area Description
A	Southern 200 East Area - encompassing the PUREX (A plant), hot semi-works (C-Plant), associated facilities (including PUREX tunnels), BC cribs, US Ecology, and the A, AN, AP, AW, AX, AY, AZ, C Tank Farms
B	Northwestern 200 East Area - encompassing the B-plant, associated waste disposal facilities, and the B, BX, BY Tank Farms
C	100-B/C Area
D	100-D/DR Area
E	East of 200 East – B Pond
F	100-F Area
G	Gable Mountain Pond Areas
H	100-H Area
I	200 North
K	100-KE/KW Area
M	600 Area near Energy Northwest and the 618-11 burial ground
N	100-N Area
P	600 Area southwest of the 400 area near the 618-10 burial ground
Q	400 Area
R	300 Area (and a few isolated facilities in and near the 400 Area)
S	Southern 200 West Area - encompassing the REDOX (S-Plant), U-plant, Z-plant associated facilities, ERDF, and the S, SX, SY, U Tank Farms
T	Northern 200 West Area - encompassing T Plant , associated facilities, and the T, TX, TY Tank Farms

Table 3.3. Site-Specific Area Designations Used in the Hydrostratigraphic Template Codes

Designation	Site-Specific Area Description
A_BC_W	Southern 200 East Area – representing the western portion of the BC cribs area
A_BC_E	Southern 200 East Area – representing the eastern portion of the BC cribs area
A_BT_N	Southern 200 East Area – representing the northern portion of the BC trench area
A_BT_S	Southern 200 East Area – representing the southern portion of the BC trench area
A_BT_W	Southern 200 East Area – representing the western portion of the BC trench area
A_ILAW_C	Southern 200 East Area – representing the central portion of the ILAW site
S_U_N	Southern 200 West Area – representing the northern portion of the 216-U-1&2 crib area
S_U_S	Southern 200 West Area – representing the southern portion of the 216-U-1&2 crib area
S_Z9	Southern 200 West Area – representing the 216-Z-9 trench area

2002). However, based on the results of a recent compilation of contaminant distribution coefficients (K_d) for Hanford sediment (Cantrell et al. 2002), the six waste stream categories used in these assessments have been reduced to four.(a)

(a) Cantrell KJ, RJ Serne, and GV Last, Pacific Northwest National Laboratory, Richland, Washington. A white paper, *Waste Stream Descriptions, Impact Zones and Associated K_d Estimates Including Rational for Selections*, dated May 16, 2003.

K_d values used in the 1998 Composite Analysis were initially tabulated for six source term categories (Kincaid et al. 1998, Table E.2) and three impact zone categories (Kincaid et al. 1998, Table E.3). In addition to the three impact zone categories (High Impact, Intermediate Impact and Groundwater), another K_d category (Intermediate Impact Zone – Gravel) was included in the SAC initial assessment to represent very coarse lithologies composed of 90% by weight gravel. K_d measurements are generally conducted on material that is <2 millimeters in size. The first three impact zone categories mentioned assume that the material is sand size and that K_d values measured using <2 millimeter-size material are applicable. For materials that contain significant amounts of gravel, K_d values will be much lower than those determined with <2 millimeter-size material because the surface area and corresponding quantity of adsorption sites is much lower. For the Intermediate Impact Zone – Gravel category it is necessary to make a correction to K_d values due to the high gravel content. For the Intermediate Impact Zone – Gravel case, it was assumed that the material was 90% gravel and the corresponding correction factor was taken to be 0.31 for relatively high K_d contaminants (cesium, strontium, and plutonium) and 0.1 for low K_d contaminants (see Kaplan and Serne 2000, Appendix A). In future versions of the composite analysis, stratigraphic correlations will be used to estimate gravel contents of sediment to make gravel corrections to the K_d values rather than using an assumed gravel content of 90% for gravel rich sediment.

To better justify the selection of the K_d values for each waste stream designation and impact zone, it was determined that quantitative values (chemical concentrations), for each waste stream category should be assigned. This provides for a systematic approach for the assignment of K_d values that is less ambiguous and more technically defensible.

Based on review of the six waste stream designations, six designations were reduced to four. The previous six waste stream designations were:

1. High Organic/Very Acidic
2. High Organic/Near Neutral
3. High Salt/Very Basic
4. Chelates/High Salt
5. Low Organic/Low Salt/Acidic
6. Low Organic/Low Salt/Near Neutral

These were simplified to the following four:

1. Very Acidic (simplified from 1 above)
2. High Salt/Very Basic (same as 3 above)
3. Chelates/High Salt (same as 4 above)
4. Low Salt/Near Neutral (same 6 above with incorporation of 2 and 5)

The reasons for these simplifications are discussed in the following paragraphs. The high organic designation can be eliminated because waste streams that were termed high organic generally refer to waste streams containing significant concentrations of tributyl phosphate, hexone, kerosene, lard oil, and/or carbon tetrachloride. Except for tributyl phosphate, these organics compounds do not complex metals and radionuclides under normal aqueous environmental conditions and as a result will not enhance their transport through chemical mechanisms. However, it is possible that if these materials occur as a free organic phase, they could significantly affect transport through multiphase flow and alteration of the hydrologic properties of the sediments.

Tributyl phosphate is a weak complexant and after any dilution will not be capable of significantly mobilizing metals and radionuclides. These organic compounds, if disposed in large quantities and high concentration, could potentially affect radionuclide and metal migration by creating a reducing zone; however, no field evidence for such an occurrence has been found. As a result of this simplification, the High Organic/Very Acidic waste stream was redesignated as the Very Acidic waste stream and the High Organic/Near Neutral waste stream was combined with the Low Salt/Near Neutral waste stream. The Low Organic/Low Salt/Acidic waste stream was combined with the Low Salt/Near Neutral waste stream because mildly acidic waste streams will generally be neutralized relatively quickly near the disposal location by calcite that occurs naturally in most Hanford sediment. Slower reactions with alumino-silicate minerals could also account for some acid neutralization.

To better justify the selection of K_d values, specific compositions have been assigned to each waste stream (high impact zone). These compositions are shown in Table 3.4. The compositions are meant to represent a major component that is generic for each waste stream category and not an actual measured component. Only major components that are expected to have a significant influence on adsorption are included. In the case of the Very Acidic waste stream, the assumed composition is largely a guess. No actual acid concentration data could be located for this waste stream. The composition of the High Salt/Very Basic waste stream provided in Table 3.4 is meant to represent a generic composite composition of Hanford fuel processing waste that has leaked from single-shell tanks or intentionally discharged to specific retention cribs. Because a large number of leaking single-shell tanks occur in the single-shell waste management areas (S-SX, B-BX-BY, T and TX-TY, and U), estimated compositions available for SX Tanks and Tank T-106 (Agnew et al. 1996) were used to guide the selected compositions. Similar to the High Salt/Very Basic waste stream, the composition selected to represent the Chelates/High Salt waste stream should be considered to be a generic composite composition and does not represent any single or specific waste stream. The concentration of ethylenediamine-tetraocietic acid (EDTA) was selected based on measured concentrations of chelating agents in actual tank waste (Campbell et al. 1998a, 1998b).

Intermediate impact zone compositions are assumed to be 10% of the concentrations assumed for the high impact zone (Table 3.4), except in the case of the Very Acidic waste stream where it is assumed that all the acid is neutralized in the High Impact zone. The un-impacted zone is assumed to have the composition of typical Hanford groundwater. Several typical compositions of Hanford groundwater (uncontaminated) are tabulated in (Cantrell et al. 2002). In general, Hanford groundwater is a calcium

Table 3.4. Waste Stream Designation and Assumed Compositions for Determination of K_d Values

Waste Stream	Composition
Very Acidic	1.0 M HNO_3
High Salt/Very Basic	2 M NaOH, 4 M $NaNO_3$, 2 M $NaNO_2$
Chelates/High Salt	1.0 M $NaNO_3$, 0.05 M EDTA, pH 12
Low Salt/Near Neutral	Same as Hanford Groundwater

bicarbonate dominated water with a pH that typically ranges from approximately 7.5 to 8.5. Other prominent major ions are sodium, chloride, sulfate, and magnesium. A total ion composition of between 4 and 10 meq/L is typical. Table 3.5 presents the waste chemistry designations used in the hydrostratigraphic templates.

3.2.4 Hydrostratigraphic Template Designations

A total of 63 hydrostratigraphic templates have been identified based on various combinations of the geographic areas, site types, and waste chemistry types. Table 3.6 provides a description of the general hydrostratigraphic templates established for each geographic area. Table 3.7 describes the site-specific templates set up for a number of key facilities within two of these general geographic areas.

Table 3.5. Waste Chemistry Designations Used in the Base Template Codes

Waste Chemistry Designation	Waste Stream Description
1	Very Acidic
2	High Salt/Very Basic
3	Chelates/High Salt
4	Low Salt/Near Neutral

Table 3.6. General Hydrostratigraphic Templates for Each Geographic Area

Template Designation	Geographic Area		Waste Site Types		Waste Chemistry Designation[d]
	Area	Designation[a]	Description	Designation[b]	
100C-4	100 B/C	C	Surface Facilities	100	4
116C-4			Near Surface Facilities	116	4
100D-4	100 D	D	Surface Facilities	100	4
116D-4			Near Surface Facilities	116	4
100F-4	100 F	F	Surface Facilities	100	4
116F-4			Near Surface Facilities	116	4
100H-4	100 H	H	Surface Facilities	100	4
116H-4			Near Surface Facilities	116	4
100K-4	100 K	K	Surface Facilities	100	4
116K-4			Near Surface Facilities	116	4
166K-4			Reverse Wells	166	4
100N-4	100 N	N	Surface Facilities	100	4
116N-4			Near Surface Facilities	116	4
200G-4	Gable Mtn.	G	Surface Facilities	200	4
200I-4	200N	I	Surface Facilities	200	4
200E-4	E 200 E (B-Pond)	E	Surface Facilities	200	4
200B-2	N 200 E (B-Plant)	B	Surface Facilities	200	2
200B-4					4
216B-3			Near Surface Facilities	216	3
216B-4					4
241B-2			Tanks	241	2
266B-4			Reverse Wells	266	4
267B-2				267[c]	2
200A-2	S 200 E (PUREX, BC Cribs)	A	Surface Facilities	200	2
200A-4					4
216A-2			Near Surface Facilities	216	2
216A-4					4
241A-2			Tanks	241	2
241A-3					3
266A-4			Reverse Wells	266	4
200S-2	S 200 W (Redox, U-Plant, Z-Plant)	S	Surface Facilities	200	2
200S-4					4

Table 3.6. (contd)

Template Designation	Geographic Area		Waste Site Types		Waste Chemistry Designation(d)
216S-1	S 200 W (Redox, U-Plant, Z-Plant)	S	Near Surface Facilities	216	1
216S-2					2
216S-4					4
241S-2			Tanks	241	2
241S-3					3
241S-4					4
266S-4			Reverse Wells	266	4
200T-2	N 200 W (T-Plant)	T	Surface Facilities	200	2
200T-4					4
216T-2			Near Surface Facilities	216	2
216T-3					3
216T-4					4
241T-2			Tanks	241	2
266T-2			Reverse Wells	266	2
266T-4					4
300R-4	300 Area (North Richland	R	Surface Facilities	300	4
316R-4			Near Surface Facilities	316	4
400Q-4	400	Q	Surface Facilities	400	4
616M-4	600	M	Near Surface Facilities	616	4
616P-4	600	P	Near Surface Facilities	616	4
River	-	-	River	-	-

(a) Assigned letter designation for geographic area.

(b) Assigned number designation for waste site type: First number designates traditional Hanford Site area (i.e., 100, 200, 300, 400, 600 Areas); last two numbers designate waste site type (00 = surface facilities, 16 = near surface facilities, 41 = tanks, 66/67 = reverse wells).

(c) Two designations are used for reverse wells that have very different depths within a single geographic area. The "67" designation distinguishes the very deep reverse wells from those at a more intermediate depth (66).

(d) Assigned number designation for waste chemistry type.

Table 3.7. Site-Specific Templates Established for a Few Key Facilities

Template Designation	Site-Specific Area		Waste Site Types		Waste Chemistry Designation(d)
	Area	Designation(a)	Description	Designation(b)	
216A_BC_W-3	S 200 E, BC Cribs, Western Portion	A_BC_W	Near Surface Facilities	216	3
216A_BC_E-3	S 200 E, BC Cribs, Eastern Portion	A_BC_E	Near Surface Facilities	216	3
216A_BT_N-3	S 200 E, BC Trenches, Northern Portion	A_BT_N	Near Surface Facilities	216	3
216A_BT_N-4					4
216A_BT_S-3	S 200 E, BC Trenches, Southern Portion	A_BT_S	Near Surface Facilities	216	3
216A_BT_W-3	S 200 E, BC Trenches, Western Portion	A_BT_W	Near Surface Facilities	216	3
216A_ILAW_C-3	S 200 E, ILAW Site, Central Portion	A_ILAW_C	Near Surface Facilities	216	3
216S_U_N-4	S 200 W, 216-U-1&2 Area, Northern Portion	S_U_N	Near Surface Facilities	216	4
216S_U_S-4	S 200 W, 216-U-1&2 Area, Northern Portion	S_U_S	Near Surface Facilities	216	4
216S_Z9-1	S 200 W, 216-U-1&2 Area, Northern Portion	S_Z9	Near Surface Facilities	216	1

(a) Assigned letter designation for geographic area.

(b) Assigned number designation for waste site type: First number designates traditional Hanford Site area (i.e., 100, 200, 300, 400, 600 Areas); last two numbers designate waste site type (00 = surface facilities, 16 = near surface facilities, 41 = tanks, 66/67 = reverse wells).

(c) Two designations are used for reverse wells that have very different depths within a single geographic area. The “67” designation distinguishes the very deep reverse wells from those at a more intermediate depth (66).

(d) Assigned number designation for waste chemistry type.

4.0 Input Parameters

This section describes the input data sets assembled for use in vadose zone modeling for the 2004 Composite Analysis.

4.1 Hydrostratigraphy

The geology of the vadose zone forms the framework through which contaminants move. The physical structure of the vadose zone, along with its hydraulic and geochemical properties, controls the migration and distribution of contaminants. Of particular interest are the interrelationships between the coarse- and fine-grained sediments within the vadose zone, and the degree of contrast in their physical and geochemical properties.

As described by Kincaid et al. 2004, the large scale and complexity of a cumulative effects assessment for the entire Hanford Site necessitates the use of a simplified modeling approach. In this approach, industrial waste sites were grouped into one of 17 geographic areas that were identified as having unique hydrostratigraphic properties. The vadose zone beneath each geographic area is represented as a single one-dimensional hydrostratigraphic column. The hydrostratigraphic information that described a geographic area was assembled into a common template for all waste sites within that area. These templates were assembled from existing information including:

- Driller's logs, geologists' logs, and geophysical logs
- Published interpretive depths to the top and bottom surfaces of hydrogeologic units
- Surface elevations (to convert hydrogeologic unit depths to elevations)
- Elevation of the 1944 water table (to define the bottom of the vadose zone prior to waste disposal)

In general, the main hydrostratigraphic units, contact depths, and thicknesses were taken from published maps and cross-sections, where available. The estimated average strata thicknesses were used to assemble the generalized columns extending from the surface to the 1944 water table (Kipp and Mudd 1973). However, because the sum of the average thicknesses did not always equal the distance from the ground surface to the water table, small adjustments were made to normalize the average strata thicknesses to equal the total thickness of the vadose zone. Table 4.1 lists the published references used to assign hydrogeologic units to each of the hydrostratigraphic templates.

Since lithofacies identification and geologic nomenclature has varied over time and by published sources, some translation was necessary to relate the major geologic units to a common classification. Table 4.2 describes the generalized hydrostratigraphic nomenclature used in this study based on that defined by DOE (2002), and Lindsey (1996). Appendix A provides the hydrostratigraphic column for each geographic area, including the layer thicknesses and their hydraulic and geochemical property designations.

Table 4.1. Sources of Hydrogeologic Data for the Seventeen Geographic Areas to be Analyzed

Geographic Area	Designation	References
100 B/C	C	Lindberg 1993a; Lindsey 1992; Peterson et al. 1996
100 D	D	Lindsey and Jaeger 1993; DOE, 1993b; Lindsey 1992; Peterson et al. 1996
100 F	F	Raidl 1994; Lindsey 1992; Peterson et al. 1996
100 H	H	Lindsey and Jaeger 1993; Liikala et al. 1988; Vermuel et al. 1995; DOE 1993b; Peterson et al. 1996
100 K	K	Lindsey 1992; Lindberg 1995; Peterson et al. 1996
100 N	N	Hartman and Lindsey 1993
Gable Mountain Pond Area	G	Lindsey et al. 1992b; DOE 1993c; DOE 1993d; Wurstner et al. 1995
200 N	I	Lindsey et al. 1992b; DOE 1993c; DOE 1993d; Wurstner et al. 1995
E 200 E (B-Pond)	E	Barnett et al. 2000; Cearlock et al. 2000; Lindsey et al. 1992b; Wurstner et al. 1995
N 200 E (B-Plant)	B	Lindsey et al. 1992b; Price and Fecht 1976a, b, c; Tallman et al. 1979; Wurstner et al. 1995; Wood et al. 2000
S 200 E (PUREX, BC cribs, BC Trenches, ILAW)	A A_BC A_BT A_ILAW	Lindsey et al. 1992b; Reidel and Horton 1999; Valenta et al. 2000; Reidel et al. 2001; Reidel and Ho 2002; Tallman et al. 1979; Wurstner et al. 1995
S 200 W (Redox, U-Plant, Z-Plant)	S S-U S-Z9	Johnson and Chou 1988; Lindsey et al. 1992a; Price and Fecht 1976d; Slate 2000; Tallman et al. 1979; Wurstner et al. 1995; Rohay et al. 1994; Connelly et al. 1992a; Last et al. 1989; Last and Rohay 1993; Swanson et al. 1999; Well logs for 299-W19-14, -15, and -16; and borehole data from wells 299-W15-8, -9, -83, -84, -86, -95, -101, and -207.
N 200 W (T-Plant)	T	Lindsey et al. 1992a; Slate 2000; Tallman et al. 1979; Wurstner et al. 1995
300 Area (North Richland)	R	Gaylord and Poeter 1991; Lindberg and Bond 1979; Schalla et al. 1988; Swanson et al. 1992
400 Area	Q	HEDL, 1975; Meier Associates Log Book Project V-749; Well logs from 499-S1-8J, and 499-S1-7B.
600 Area (618-10 Area)	P	Well Logs from 699-S6-E4A
600 Area (618-11 Area, Energy Northwest)	M	Well Logs from 699-13-3A

In the simplified modeling approach selected for the composite analysis, the number and thicknesses of the hydrostratigraphic units within each template remain fixed. However, it must be recognized that there is uncertainty associated with the configuration of the hydrostratigraphic columns. The primary sources of uncertainty relate to drilling and sampling techniques, borehole logging, elevation control, and interpretation of the stratigraphy.

Table 4.2. Hydrostratigraphic Units Used in this Study (after DOE 2002 and Lindsey 1996)

Formation/Unit	Facies/Subunit	Code	Description
Holocene	Backfill	HDb	Poorly sorted gravel, sand, and silt derived from the Hanford formation and/or Holocene deposits
	Medium-grained, Cross-Bedded, Well Sorted	HDs	Medium-grained dune sand, moderate to well sorted, and cross laminated to cross-bedded.
Hanford formation	Interbedded Sand- to Silt-dominated	HISSD	Rhythmite sequences of slackwater deposits consisting of graded beds of horizontal or climbing ripple laminated sand, to fine sand, to silt (laminated to massively bedded).
	Sand-Dominated, Silty Sand	HSD(f)	Silt to fine sand, massively bedded to horizontally laminated or cross laminated.
	Sand-Dominated, Fine Sand	HSD-Sm	Fine to coarse sand, massively bedded, with or without silt.
	Sand-Dominated, Coarse Sand	HSD-Sh(c)	Medium to coarse sand with minor amounts of pebbly sand, exhibiting horizontal to low-angle cross stratification.
	Sand-Dominated, Gravelly Sand	HSD(c)	Medium to coarse sand to pebbly sand (with up to 30 wt% very fine pebble to cobble), with high angle planar-tabular cross stratification to trough cross-stratification
	Gravel-Dominated	HGD	Silty sandy pebble to boulder gravel (with 30-60 wt% gravel), massive to cross stratified.
	Gravel-Dominated, Coarse	HGD(c)	Pebble to boulder gravel (with greater than 60 wt% gravel), to silty sandy gravel, massive to cross stratified.
Cold Creek unit	Fine-Grained, Laminated to Massive	CCUf(lam-msv)	Fine sand, silt, and/or clay, with a buff, pale to dark brown color, well sorted to very well sorted, micaceous, and having high natural-gamma activity
	Coarse to Fine-Grained, Carbonate Cemented	CCUf-c(calc)	Calcium-carbonate cemented clay, silt, sand, and/or gravel, white to light gray in color, very poor to moderately sorted, with a massive to platy structure and bioturbated with root casts (rhyzoliths).
Ringold Formation	Fluvial Sand (Member of Taylor Flat)	Rtf	Interstratified sand and silt deposits
	Fluvial Gravel (Member of Wooded Island, subunit E)	Rwi(e)	Moderate to strongly cemented well rounded gravel and sand deposits, and interstratified finer-grained deposits.

4.2 Hydraulic Properties

Hydraulic property data for the vadose zone simulations were derived from the laboratory measurements of 284 soil samples (both repacked and splitspoon samples) taken from the 100 and 200 Areas (Appendix B). These data were selected from a catalog of vadose zone hydraulic properties (Freeman et al. 2002) and a subsequent prototype database (Freeman and Last 2003). Because the hydraulic property data are rather limited in regard to the spatial location of samples and the soil types represented, individual stochastic data sets were developed to represent ten different soil classes. These ten classes build on the six soil classes originally identified by Khaleel and Freeman (1995) based on texture (i.e., particle size), International Society of Soil Science (ISSS) classification, and moisture retention curve characteristics. Four additional soil classes were incorporated to separate out the Cold Creek unit sediment, add additional detail for the Hanford formation sand-dominated sediment, and add a new class for very coarse gravel. The 10 soil hydraulic property classes and their associated hydraulic property distributions were later correlated to the hydrostratigraphic units used in the 17 geographic area templates. Table 4.3 describes the hydraulic-property soil classes to be used in the composite analysis.

The statistical distributions of van Genuchten model (van Genuchten 1980) parameters, saturated hydraulic conductivity, and bulk density data were developed from laboratory data described in a catalog of vadose zone hydraulic properties by Freeman et al. (2001, 2002), and a subsequent prototype database

Table 4.3. Description of Hydraulic-Property Soil Classes

Formation	Soil Class	Code	Description	Hydrostratigraphic Unit Code(s)
Holocene Deposits	Backfill	Bf	Sand and gravel mixed with finer fraction. Same as the SSG soil category identified by Khaleel and Freeman (1995)	HDb
Hanford formation	Silty Sand	Hss	Sand mixed with finer fraction, containing >50% fine sands, silt, and clay, with >15% silt and clay. Derived from the SS soil category identified by Khaleel and Freeman (1995)	HISSD/HSD(f)
	Fine Sand	Hfs	Sand, containing 35-70% fine sand, silt, and clay, with <15% silt and clay. Derived from the S soil category identified by Khaleel and Freeman (1995)	HSD-Sm
	Coarse Sand	Hcs	Sand, containing >60% coarse sand. Derived from the S soil category identified by Khaleel and Freeman (1995)	HSD-Sh(c)
	Gravelly Sand	Hgs	Gravelly sand. Same as the GS soil category identified by Khaleel and Freeman (1995)	HSD(c)
	Sandy Gravel	Hg	Sandy gravel for which gravel content is approximately <60%. Same as the SG1 soil category identified by Khaleel and Freeman (1995)	HGD
	Gravel	Hrg	Very high gravel content soils (>60% gravel) from the 100 areas (along the river).	HGD(c)
Cold Creek unit	Silt Dominated	PPlz	Derived from the SS soil category identified by Khaleel and Freeman (1995) but correlated to Cold Creek unit silt. Includes additional samples from borehole B8814.	CCUf(lam-msv)
	Caliche	PPlc	Derived from the SS soil category identified by Khaleel and Freeman (1995) but correlated to the Cold Creek unit carbonate.	CCUf-c(calc)
Ringold Formation	Gravel Dominated	Rg	Sandy gravel for which gravel content is approximately >60%. Same as the SG2 soil category identified by Khaleel and Freeman (1995).	Rwi(e)

(Freeman and Last 2003). Ideally, all parameters in this database should be corrected for gravel content using the same gravel-correction procedure. Some of the parameters are known to have been corrected using the Gardner method (e.g., Khaleel et al. 1997) However, it is not clear that all samples were treated in a consistent manner. Gravel percentages are included in Tables 4.4 to 4.8 to indicate which soil classes might be affected. Future revisions of this database ought to address any disparity that might exist among samples. Estimates for longitudinal dispersivity were primarily taken from Ho et al. (1999). Values for residual saturation (S_r) were calculated by dividing the raw residual water content (θ_R) by the raw saturated content (θ_S). Effective porosity is assumed to be equal to the saturated water content (θ_s).

The high, low, mean, and standard deviation values were calculated for each soil hydraulic property class. However, it should be noted that most of these soil classes do not have enough data points to qualify as a statistically significant distribution (Warrick et al. 1986). The residual water content (S_r), saturated water content (θ_s), bulk density (ρ_b), gravel content, and fitting parameter n are assumed as normal Gaussian distributions based, in part on the report of Khaleel and Freeman (1995). The saturated hydraulic conductivity (K_s) and the fitting parameter α, are treated as lognormal distributions, in accordance with Domenico and Schwartz (1990) and Carsel and Parrish (1988), respectively. In addition to the normal distribution statistics, the statistics for the log-normal parameters are also included and truncation values are calculated for all parameters. Although Carsel and Parrish (1988) have reported cross-correlations between a number of these parameters, recent examination of the Hanford Site data have not found any statistically significant correlations.(a)

In addition to statistical tables for the full suite of samples, subsets of samples were also assembled near specific sites of interest. Site-specific data sets for the 200 West Area, BC cribs and trenches, 200-UP-1 (216-U-1 and -2 cribs), and the 200-ZP-1 (216-Z-9 trench) were also assembled. The site-specific data for the 216-U-1 and -2 cribs were derived from the S-SX tank farm, 216-U-1 and -2 crib, and Environmental Restoration Disposal Facility samples. The 216-Z-9 site-specific data consists of samples from T Tank Farms, the 216-ZP-1 area, the 218-W-5 burial grounds, and project C-018-H. A composite table consisting of only 200 West Area samples was also created as part of this task. This data set provides a greater sample population that is unique to the unsaturated hydraulic properties found in the 200 West Area plateau sediments. The site-specific data for the BC cribs and trenches are derived from the closest sites to the facility, the immobilized low-activity waste (ILAW) site, the Sission and Lu Injection test site, and U.S. Ecology. A disadvantage to using only those sample sets close to the site of interest is that the population size is greatly diminished resulting in cases where the statistical distribution may not adequately represent the actual formation properties.

Methods to increase the sample size (e.g., use an inverse distance weighting)(b) or otherwise incorporate information from large data sets (e.g., Bayesian Updating)(b) yet still account for site-specific

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(a) Freeman EJ and ML Rockhold. 2003. *Estimation of Site-Specific Probability Distribution Functions for Soil Hydraulic Parameters using Bayesian Updating*. Letter Report, Pacific Northwest National Laboratory, Richland, Washington.

(b) Freeman EJ. May 14, 2003. *Revised SAC Statistical Properties Tables of Vadose Hydraulic Properties*. Letter Report, Pacific Northwest National Laboratory, Richland, Washington.

information are being examined. However, for the purposes of the 2004 Composite Analysis, the site-specific parameter distributions were based on equally weighted parameter values from samples nearest the site of interest. Tables 4.4 to 4.8 present the hydraulic property distributions for the Hanford site-wide data set as well as the site-specific data sets.

Table 4.4. Statistical Mean Values for Site-Wide Samples

Site-Wide									
Soil Class	Count	α (1/cm)	n	θ_R (cm^3/cm^3)	θ_s (cm^3/cm^3)	K_s (cm/sec)	S_r	% gravel	Bulk Density (g/cm^3)
Bf	6	3.20E-02	1.400	0.030	0.262	1.50E-02	0.10	------	1.94
Hss	38	7.71E-03	1.915	0.072	0.445	8.58E-05	0.16	0.18	1.61
Hfs	40	2.49E-02	2.107	0.049	0.397	2.87E-04	0.11	0.57	1.60
Hcs	82	5.85E-02	2.020	0.031	0.353	2.19E-03	0.08	2.55	1.66
Hgs	17	1.34E-02	2.111	0.046	0.250	4.73E-04	0.17	25.78	1.92
Hg	29	1.79E-02	1.727	0.023	0.167	3.56E-04	0.14	51.42	1.91
Hrg	40	7.40E-03	1.831	0.020	0.102	1.46E-03	0.20	67.63	1.97
PPlz	9	5.52E-03	2.101	0.034	0.420	5.57E-05	0.08	0.44	1.68
PPlc	16	1.08E-02	1.727	0.072	0.306	5.00E-04	0.21	16.73	1.71
Rg	18	7.81E-03	1.697	0.063	0.178	4.13E-04	0.23	46.08	1.90

Table 4.5. Statistical Mean Values for BC-Crib Samples

BC-Cribs									
Soil Class	Count	α (1/cm)	n	θ_R (cm^3/cm^3)	θ_s (cm^3/cm^3)	K_s (cm/sec)	S_r	% gravel	Bulk Density (g/cm^3)
Bf	6	3.20E-02	1.400	0.030	0.262	1.50E-02	0.10	------	1.94
Hfs_BC	18	2.08E-02	2.507	0.033	0.380	2.25E-03	0.09	0.38	1.65
Hcs_BC	46	7.19E-02	2.047	0.026	0.357	5.32E-03	0.07	2.68	1.67
Hgs	5	3.07E-02	1.872	0.040	0.271	3.02E-03	0.15	17.66	1.95

Table 4.6. Statistical Mean Values for U1 & U2 Samples

U1 and U2									
Soil Class	Count	α (1/cm)	n	θ_R (cm^3/cm^3)	θ_s (cm^3/cm^3)	K_s (cm/sec)	S_r	% gravel	Bulk Density (g/cm^3)
Bf	6	3.20E-02	1.400	0.030	0.262	1.50E-02	0.10	------	1.94
Hss_U	6	6.78E-03	2.347	0.066	0.437	2.49E-05	0.15	0.00	1.58
Hfs_U	4	1.25E-02	2.451	0.042	0.347	1.71E-05	0.12	0.00	1.72
Hg_U	3	1.14E-02	1.845	0.029	0.150	2.88E-04	0.20	57.10	2.09
PPlz_U	5	4.73E-03	2.020	0.035	0.398	7.27E-06	0.09	0.08	1.71
Rg_U	7	1.33E-02	1.768	0.144	0.318	7.83E-05	0.38	16.49	1.82

Table 4.7. Statistical Mean Values for 200-ZP-1 Samples

200-ZP-1									
Soil Class	Count	α (1/cm)	n	θ_R (cm^3/cm^3)	θ_s (cm^3/cm^3)	K_s (cm/sec)	S_r	% gravel	Bulk Density (g/cm^3)
Bf	6	3.20E-02	1.400	0.030	0.262	1.50E-02	0.10	------	1.94
Hss_Z	5	2.79E-03	1.840	0.047	0.351	6.55E-06	0.13	0.00	1.80
Hfs_Z	4	8.33E-03	1.903	0.042	0.366	7.88E-05	0.11	0.75	1.68
Hcs_Z	5	6.65E-02	1.692	0.021	0.292	1.49E-03	0.07	0.00	1.56
Hg_Z	9	1.86E-02	1.711	0.026	0.156	3.51E-03	0.16	53.44	1.79
PPlz_Z	4	6.69E-03	2.203	0.033	0.448	7.11E-04	0.07	1.00	1.58
PPlc_Z	15	1.09E-02	1.734	0.075	0.312	5.74E-04	0.22	15.07	1.68

4.2.1 Site-Wide Hydraulic Property Distributions

The site-wide sample distribution (Table 4.4) uses all the data in each of the soil classes to calculate the statistical mean van Genuchten parameters that were then used to generate the hydraulic properties curves shown in Figures 4.1, 4.2, and 4.3. Figure 4.1 shows that the Hanford formation silty sand and the Cold Creek unit silt attain the highest saturated water content, while the Hanford formation coarse gravels and Hanford formation sandy gravels have the lowest water content. Table 4.4 illustrates that the finer textured sediments typically have greater saturated water content, lower saturated hydraulic conductivity

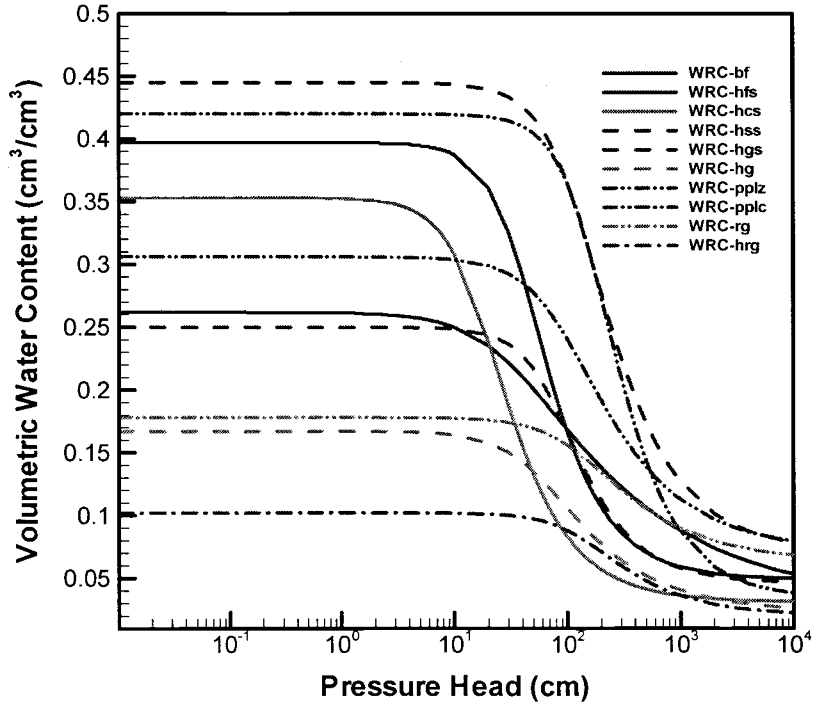

Figure 4.1. Formation Specific Water Retention Curves for the Site-Wide Distribution

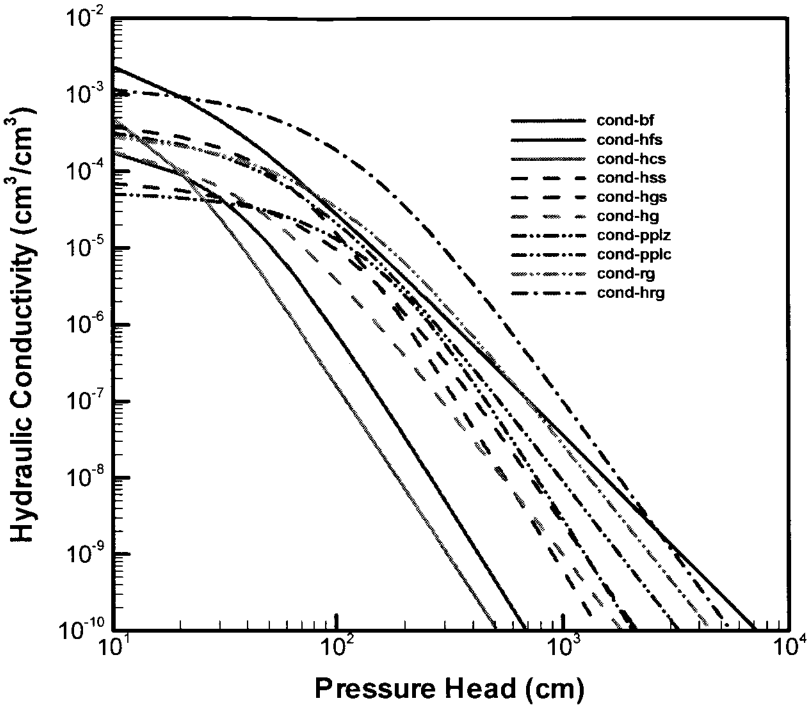

Figure 4.2. Formation Specific Hydraulic Conductivity Curves for the Site-Wide Distribution

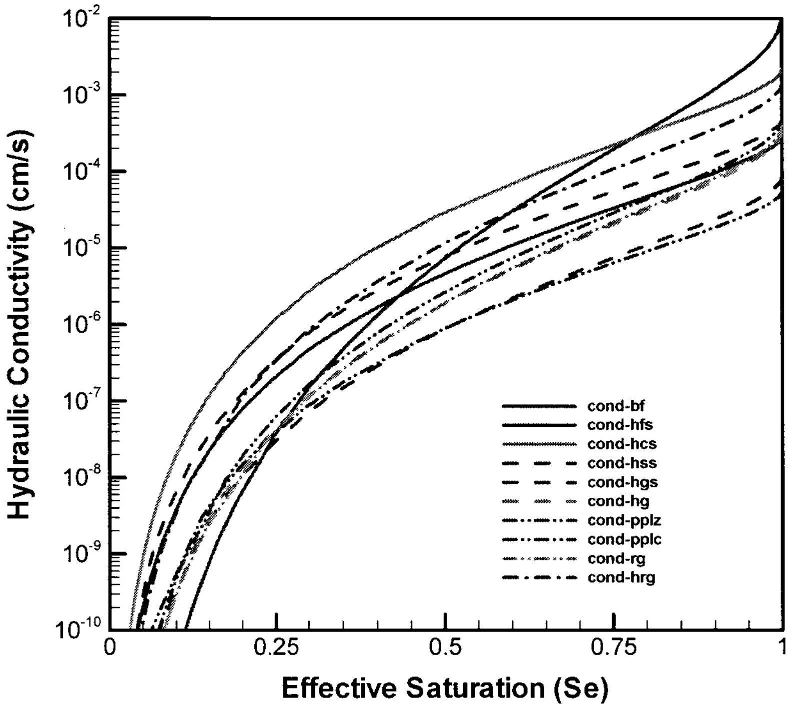

Figure 4.3. Formation Specific Hydraulic Conductivity Curves Versus Saturation for the Site-Wide Distribution

and lower bulk density. As the samples become coarser the water content declines, saturated hydraulic conductivity increases and bulk density increases. The properties in Table 4.4 and Figure 4.1 represent matrix characteristics and do not account for preferential flow through cracks (refer to et al. 2002, 2003).

Uncertainties arise from the drilling and sampling methods used to collect the samples (e.g., core-barrel, splitspoon), how the samples are handled in the lab (e.g., repacked), subjectivity in assigning the samples to various geologic formations and facies (i.e., soil classes), systematic or measurement errors associated with the laboratory analyses, and scaling issues when using small sample data to represent larger field scale processes.

The saturated hydraulic conductivity is highest for the backfill (B) and Hanford coarse gravel (Hcg) and lowest for the silty Cold Creek unit (PPlz) and Hanford formation silty sand (Hss). The hydraulic conductivity does not drop off rapidly as would be expected for the coarse textured sediment. This may indicate a higher fraction of fines than accounted for.

4.2.2 Site-Specific Hydraulic Property Distributions

When evaluating the hydraulic properties at a particular location it is valuable to only use those data that are most representative of the hydraulic properties at that site. Three sites were selected from which to generate site-specific hydraulic properties data sets: 1) the BC cribs and trenches, 2) the 216-U-1 and -2 crib area, and 3) the 216-Z-9 trench area. A fourth set of hydraulic property data was generated for all 200 West Area samples. Tables 4.5 to 4.8 list the mean hydraulic property data derived for each of these specific areas. Appendix B provides the hydraulic property distributions for the each site-wide and site-specific soil class.

4.2.3 Application to Vadose Zone Simulations

Each vadose zone hydrostratigraphic template represents a one-dimensional soil column made up of several hydrostratigraphic units. Each hydrostratigraphic unit occupies a number of model nodes depending on the thickness of the hydrostratigraphic unit. The hydraulic properties for each hydrostratigraphic unit are determined by stochastically sampling the probability distribution function for each parameter, for a given simulation (realization). All model nodes within a single hydrogeologic unit are assigned the same hydraulic properties for a single realization.

4.2.3.1 Conditioning of One-Dimensional Flow Simulations Against Detailed Site-Specific Assessments

Several studies were conducted to examine multiple hydrostratigraphic models and two-dimensional vadose zone simulations of selected waste sites where previous one-dimensional simulations failed to provide reasonable results. One of the main areas of interest was the BC cribs and trenches. Here multiple hydrostratigraphic profiles (templates) were developed to generate reasonable two-dimensional representations of the vadose zone. Multiple two-dimensional flow simulations were conducted to provide the basis with which to estimate the wetted column area needed as input for one-dimensional flow and transport simulations (Appendix C). Additional work was aimed at trying to incorporate the up scaling techniques developed through the Science and Technology Project (Zhang et al. 2002) to improve hydraulic property estimates for the BC crib and trench area.

Table 4.8. Statistical Mean Values for 200 West Area Samples

200W									
Soil Class	Count	α (1/cm)	n	θ_R (cm^3/cm^3)	θ_s (cm^3/cm^3)	K_s (cm/sec)	S_r	% gravel	Bulk Density (g/cm^3)
Bf	6	0.032	1.4	0.03	0.262	1.50E-02	0.102	------	1.94
Hss_2W	11	4.53E-03	2.116	0.057	0.398	1.91E-05	0.141	0.00	1.67
Hfs_2W	8	1.02E-02	2.177	0.042	0.356	3.67E-05	0.118	0.38	1.70
Hcs_2W	7	4.15E-02	1.759	0.026	0.318	1.09E-03	0.077	2.14	1.65
Hgs_2W	2	7.90E-03	2.223	0.030	0.273	2.35E-04	0.133	24.00	1.81
Hg_2W	12	1.65E-02	1.745	0.027	0.154	1.48E-03	0.172	54.36	1.89
PPlz	9	5.52E-03	2.101	0.034	0.420	5.57E-05	0.080	0.49	1.66
PPlc	16	1.08E-02	1.727	0.072	0.306	5.00E-04	0.214	16.73	1.71
Rg_2W	8	1.32E-02	1.753	0.126	0.297	1.06E-04	0.334	22.18	1.84

Another main area of interest was the 216-U-1 and -2 cribs. Here, another approach has been taken to model this site as two separate sites to account for the multiple release mechanisms. Field data indicate this location experienced a fast path release (perhaps due to flow through a borehole annulus or similar mechanism) that allowed a significant quantity of contamination to effectively bypass the vadose zone and travel directly to the surface aquifer. Because the mechanism for this fast path is not characterized, the 216-U-1 and -2 site was modeled with an empirical two-site arrangement wherein a duplicate site, "216-U-1 and -2-Fast" was defined that uses a special hydrostratigraphic template that immediately releases any waste it receives directly to groundwater. No waste is routed to this "fast" site by the inventory model. However, a remedial action is declared in the overall SAC model input set that declares that a fraction of the waste in the vadose zone in the year of the suspected fast path event (1988) is to be remediated from 216-U-1 and -2 site and sent to the 216-U-1 and -2-Fast site (which effectively sends it immediately to the surface aquifer). The fraction used for this remediation was determined by dividing the estimated contaminant mass in the aquifer after the fast path event (as determined by history matching data prepared by Murray et al. (2004) by the total mass in the vadose zone at 216-U-1 and -2 in 1988 (as modeled in an initial median-inputs simulation of the 216-U-1 and -2 site). Thus, the model is effectively forced to deliver the field-observed mass of contaminant directly from the vadose zone to groundwater in a single event in 1988.

Several other sites (e.g., the Integrated Disposal Facility [IDF, formerly the Immobilized Low-Level Activity Waste facility], and the tank farms) are the subject of more detailed site-specific performance assessments. Thus, efforts were made to incorporate the results of these performance assessments more directly into the composite analysis, and/or to scale the composite analysis model results so that the central tendency of the results mimics the deterministic results from these site-specific assessments. None of these more-detailed site-specific performance assessments are stochastic, so the results are used directly in SAC median-inputs runs in place of the embedded STOMP one-dimensional model results. The results are also used to calibrate the STOMP one-dimensional model at these sites so that the stochastic simulations will better mimic the expected behavior of the site-specific assessments where they run stochastically with the SAC data. This is done by comparing the release rates of the median-inputs STOMP model in SAC for these sites to the more-detailed site-specific modeling results for a range of vadose zone wetted area scaling factors, and choosing the factor that results in the best agreement for use in later stochastic simulations. This is similar to the approach used for the BC cribs and trenches in which the one-dimensional model used in SAC was calibrated against idealized two-dimensional models.

4.2.4 Transport Parameters

For the 2004 Composite Analysis, the two key parameters that will govern transport of contaminants in the subsurface are the dispersivity and the species-specific water content dependent diffusion coefficient. The product of dispersivity (λ) and pore water velocity yields the mechanical dispersion coefficient, which relates the dispersive solute flux to the solute concentration gradient. Longitudinal dispersivity (i.e., in the direction of flow) is generally larger than dispersivity in the transverse direction and it is also scale dependent (Khaleel et al. 2002). Field measurements of dispersivity are extremely rare and small-scale laboratory measurements have only marginal utility in estimating field values (Meyer et al. 2004). Estimates of longitudinal dispersivity for the composite analysis were primarily taken from Ho et al. (1999). In the absence of data, dispersivity values are often based on simple guidelines related to the size of the computational elements in numerical simulation codes.

Dispersion during transport of contaminants can potentially be enhanced when the contaminants react with either the sediments or the fluid or gas constituents. The enhanced macrodispersion phenomenon is not well understood and is therefore a current research topic (e.g., Khaleel et al. 2003). Although not entirely understood, enhanced macrodispersion has been estimated at specific sites at Hanford. For example, the modeling data package for the S-SX FIR (Khaleel et al. 2001) suggested that dispersion of cesium was enhanced by 10 to 15% for all but the plio-pleistocene layer, for which the enhancement factor was roughly a factor of 2. Enhanced macrodispersion is not addressed in the current version of the Composite Analysis but will be considered for future versions.

The diffusion coefficient is the proportionality factor in Fick's law that relates the diffusive transport flux to the gradient in solute concentration (Meyer et al. 2004). According to Meyer et al., the diffusion process results in mass transport from regions of high solute concentration to regions of lower concentration and occurs as a result of the random thermal motion (Brownian motion) of molecules and atoms. The diffusion process will be represented in the 2004 Composite Analysis. Each contaminant species will be assigned a unique free-water diffusion coefficient that applies to diffusion in dilute water solution. In the subsurface environment, porous medium and the water content will affect the diffusion process. Thus, the *effective* diffusion coefficient will be a function of the tortuosity of the porous medium and the water content. The tortuosity will be represented using the Millington and Quirk tortuosity model. Finally, reactive solutes can affect diffusion. The resulting *apparent* coefficient will be represented as a function of the water content, bulk density, and sorption coefficient as explained by Meyer et al. (2004).

4.3 Contaminant Distribution Coefficients

Geochemical properties were assigned to each hydrogeologic unit, in a manner similar to that done for the 1998 Composite Analysis (Kincaid et al. 1998). The waste characteristics were assumed to dominate the near-field mobility of the contaminants in the vadose zone. After being in contact with vadose zone sediments and soil water for some distance, the waste undergoes a change in its mobility based on buffering of the contaminant solution by the vadose zone sediments. Thus, distribution coefficients were defined separately for each contaminant in the upper vadose zone (near-field or high impact zone) and in the lower vadose zone (far-field or intermediate impact zone) (Kincaid et al. 1998).

Distribution coefficient zones were defined as either high impact or intermediate impact depending on the nature of the contamination fluid. Zones in which the organic concentration, pH, or salt concentration in the fluids may have affected the K_d values were designated high-impact. Zones in which the acidic or basic nature of the wastes was estimated to have been neutralized by the natural soil were designated intermediate impact. Kincaid et al. (1998) estimated the depths of this transition zone by examining the peak location of beta/gamma contamination (as presented by Fecht et al. 1977) for 200 Area cribs receiving very acid or high-salt/very basic waste. In general, these transition depths ranged from 10 to 40 meters. Given the limited data available on which to base further interpretations on the depths of transition, and the desire to simplify the numerical simulations, a slightly different approach was used here. Generally, the hydrogeologic unit into which waste streams were introduced was designated as high-impact regardless of waste stream characteristics. If those hydrogeologic units were thin (e.g., <1 meter), then the hydrogeologic unit immediately below that into which the waste stream was introduced was also designated high-impact. All other hydrogeologic units lower in the profile were designated intermediate impact. This approach enables us to keep the numerical simulations relatively simple by using the existing number of hydrogeologic units (i.e., we did not have to add new layers to make the K_d change where it might have occurred within a single hydrogeologic unit). At the same time, the depths of change, corresponding to the thickness of the hydrogeologic units, are still on the same scale (tens of meters) as those used by Kincaid et al. (1998). Appendix A provides the detailed hydrogeologic columns and locations of the various K_d zones, for each base template.

As described in Section 3.2.3, several K_d classes were defined for mapping distribution coefficients to high or intermediate impact zones and chemical waste type. These K_d classes were labeled using a two or three digit alpha-numeric code. The first digit represents the waste chemistry type (numbers 1 through 4) (see Table 3.5). The second digit represents the impact zone (i.e., H for high impact [i.e., near field vadose zone], I for intermediate impact [i.e., far field vadose zone], or G for the zone not impacted [i.e., very far field vadose] and groundwater). For K_d values in the intermediate impact zone, a third digit was added to identify those K_d classes that were adjusted for the gravel-dominated hydrostratigraphic units. To account for the common observation that significant gravel content decreases K_d values (Kaplan and Serne 2000), the intermediate impact zone for each K_d class in the intermediate impact zone was subdivided into gravel rich and gravel poor zones. K_d classes with a third digit of "1" pertain to gravel poor (i.e., sand-dominated) strata and K_d classes ending in a "2" pertain to gravel rich (i.e., gravel dominated) strata (See Section 3.2.3).

Kincaid et al. (2004) identified sixteen radionuclides as contaminants of concern to be addressed in the composite analysis, see Table 4.9. However, two of these radionuclides, radium-226 and protatctinium-231 are to be simulated as progeny of uranium-234 and uranium-238, and will not be directly incorporated into the flow and transport simulations for the 2004 Composite Analysis. Thus, K_d estimates were not developed for those contaminants. For all other contaminants of interest, a best estimate K_d value and range (minimum and maximum) were developed for each K_d class. A brief discussion for each contaminant is presented below. Probability distribution functions for these K_d values were generated according to the following set of rules and derived from the minimum, maximum, and best estimate K_d values.

Table 4.9. List of Contaminants of Concern to be Included in the 2004 Composite Analysis (Kincaid et al. 2003)

Contaminants of Concern	
Tritium	Carbon-14
Chlorine-36	Selenium-79
Strontium-90	Technetium-99
Iodine-129	Cesium-137
Europium-152(a)	*Radium-226*(b)
Protactinium-231(c)	Uranium-233
Uranium-234(d)	Uranium-235(e)
Uranium-238(d)	Neptunium-237

(a) Europium-152 will be simulated using median values in a deterministic simulation. Because of its relatively short decay half-life, the simulation will extend at most two or three hundred years beyond Hanford Site closure.

(b) Radium-226 will be simulated as progeny of U-234 and U-238. It will be further evaluated in the 2004 Composite Analysis because the chemical separation for uranium may have placed radium-226 in Hanford wastes at levels not in secular equilibrium with the uranium in the waste.

(c) Protactinium-231 will be simulated as progeny of U-238. It will be further evaluated in the 2004 Composite Analysis because the chemical separation for uranium may have placed protactinium-231 in Hanford wastes at levels not in secular equilibrium with the uranium in the waste.

(d) Uranium-238 and uranium-234 will be summed and shown as uranium-238 to represent both in this simulation. It is assumed that these two uranium isotopes are always in secular equilibrium.

(e) Uranium-235 is modeled separately to properly generate protactinium-231 through radioactive decay and progeny ingrowth.

Case #1: Where the minimum estimate, best estimate, and maximum estimate were all greater than zero, a lognormal distribution was assumed. The best estimate was assigned to the median value. The minimum estimate was assigned to the lower 1% tail of the distribution, and the maximum estimate was not used in defining the distribution.

Case #2: Where the minimum estimate was zero, but the best estimate and maximum estimate were greater than zero. A lognormal distribution was used, with the best estimate assigned to the median value, the lower 1% tail of the distribution assigned to the value 0.001, and the maximum estimate used to define a probability truncation limit for the upper tail of the distribution (if less than 0.99 probability, otherwise truncation was set to 0.99).

Case #3: Where the minimum and best estimates were zero, but the maximum estimate was greater than zero. A composite distribution was used. The value zero was assigned a 50%

probability. The other portion of the distribution was assigned a triangular distribution where the minimum and mode were both zero and the maximum was assigned to the upper tail estimate.

In those cases where a lognormal distribution was assumed, the lognormal distributions were truncated at the 1% and 99% levels, thereby preventing the generation of values that could fall below the minimum estimate.

Table 4.10 provides the current compilation of distribution coefficients for each waste stream category and impact zone (derived from the Contaminant Distribution Coefficient Database and Users Guide by Cantrell et al. 2002, 2003a). The hydrostratigraphic templates provided in Appendix A identify the K_d classes assigned to each hydrostratigraphic unit for each geographic and site-specific area. As with the hydraulic parameters, all model nodes within a single hydrogeologic unit are assigned the same K_d values for a given realization.

4.3.1 Tritium

The best estimates for K_d values of tritium are zero, and the ranges were selected to be zero for all source and impact zone categories. It is assumed that tritium atoms are incorporated into water molecules and, as a result, no adsorption or other significant geochemical interactions are expected.

4.3.2 Carbon-14

Under typical Hanford conditions, it is assumed that carbon-14 will occur predominately as the bicarbonate ion ($H^{14}CO_3^-$), though at high pH bicarbonate will deprotonate to carbonate ($^{14}CO_3^{2-}$) and at low pH will protonate to form $^{14}CO_2(aq)$. In general, adsorption of any anion (through surface complexation) onto Hanford sediment in the alkaline pH range is expected to be negligible because the pH point of zero charge (pzc) or pH_{pzc} for most minerals is below the typical pH of Hanford groundwater. For example, the pH_{pzc} for montmorillonite and feldspar is approximately 3 (Stumm and Morgan 1996). The pH_{pzc} for calcite (at $p_{CO2} = 10^{-3.5}$ atm) is approximately 8.2 and goes down to 6.5 at $p_{CO2} = 1$ atm. This indicates that Hanford sediments will be dominated by negatively charged sites in the alkaline pH range; conditions which are not conducive to adsorption of anions. This is clearly demonstrated with CrO_4^{2-} for example (Cantrell et al. 2002).

Although surface adsorption of $H^{14}CO_3^-$ or $^{14}CO_3^{2-}$ is not likely to be significant under Hanford conditions, two other processes could potentially remove these species from solution. These two mechanisms are isotopic exchange and precipitation. Calcite is common within Hanford sediment (often as caliche or mineral grain coatings) and is the most readily available carbonate phase within Hanford sediment available for solid surface exchange with $^{14}CO_3^{2-}$. Like ion exchange, isotopic exchange can be written as a chemical reaction (Garnier 1985):

$$^{12}C_s + {}^{14}C_m = {}^{14}C_s + {}^{12}C_m \qquad (4.1)$$

Table 4.10. K_d Ranges by Waste Chemistry/Source Category

Waste Chemistry/Source Category 1: Very Acidic

Analyte	High Impact (A) - 1H			Intermediate Impact - Sand (B1) - 1I1			Intermediate Impact - Gravel (B2) - 1I2			Groundwater (F1) - 1G		
	Kd Estimate (mL/g)			Kd Estimate (mL/g)			Kd Estimate (mL/g)			Kd Estimate (mL/g)		
	Best	Min	Max	Best	Min	Max	Best	Min	Max	Best	Min	Max
Non-Adsorbing Radionuclides												
H3	0	0	0	0	0	0	0	0	0	0	0	0
Tc99	0	0	0.1	0	0	0.1	0	0	0.01	0	0	0.1
Cl36	0	0	0	0	0	0	0	0	0	0	0	0
Moderately Adsorbing												
I129	4	0	15	0.2	0	2	0.02	0	0.2	0.2	0	2
U238	0.2	0	4	0.8	0.2	4	0.08	0.02	0.4	0.8	0.2	4
Se79	5	3	10	5	3	10	0.5	0.3	1	5	3	10
Np237	0	0	2	10	2	30	1	0.2	3	10	2	30
C14	0	0	0	unsuitable	0	100	unsuitable	0	100	unsuitable	0	100
Highly Adsorbing												
Sr90	10	5	15	22	10	50	6.8	3.1	15.5	22	10	50
Cs137	1000	200	10000	2000	200	10000	620	62	3100	2000	200	10000
Pu239	0.4	0.1	1	600	200	2000	186	62	620	600	200	2000
Eu152	20	1	100	200	10	1000	62	3.1	310	200	10	1000
Organic Contaminants												
CCl4	0.2	0.1	2	0.2	0.1	0.6	0.02	0.01	0.06	0.2	0.1	0.6
Inorganic Contaminants												
CrVI	4	2	20	0	0	0.3	0	0	0.03	0	0	0.3

Waste Chemistry/Source Category 2: Very High Salt/Very Basic

Analyte	High Impact (D) - 2H			Intermediate Impact - Sand (E1) - 2I1			Intermediate Impact - Gravel (E2) - 2I2			Groundwater (F1) - 2G		
	Kd Estimate (mL/g)			Kd Estimate (mL/g)			Kd Estimate (mL/g)			Kd Estimate (mL/g)		
	Best	Min	Max	Best	Min	Max	Best	Min	Max	Best	Min	Max
Non-Adsorbing Radionuclides												
H3	0	0	0	0	0	0	0	0	0	0	0	0
Tc99	0	0	0.1	0	0	0.1	0	0	0.01	0	0	0.1
Cl36	0	0	0	0	0	0	0	0	0	0	0	0
Moderately Adsorbing												
I129	0.02	0	0.2	0.1	0	0.2	0.01	0	0.02	0.2	0	2
U238	0.8	0.2	4	0.8	0.2	4	0.08	0.02	0.4	0.8	0.2	4
Se79	0	0	0.1	0	0	1	0	0	0.1	5	3	10
Np237	200	100	500	200	100	500	200	100	500	10	2	30
C14	unsuitable	0	100	unsuitable	0	100	unsuitable	0	100	unsuitable	0	100
Highly Adsorbing												
Sr90	22	10	50	22	10	50	6.8	3.1	15.5	22	10	50
Cs137	10	0	500	100	10	1000	31	3.1	310	2000	200	10000
Pu239	200	70	600	600	200	2000	190	62	620	600	200	2000
Eu152	200	10	1000	200	10	1000	62	3.1	310	200	10	1000
Organic Elements												
CCl4	0.2	0.1	0.6	0.2	0.1	0.6	0.02	0.01	0.06	0.2	0.1	0.6
Inorganic Elements												
CrVI	0	0	0.3	0	0	0.3	0	0	0.03	0	0	0.3

Waste Chemistry/Source Category 3: Chelates/High Salts

Analyte	High Impact (G1) - 3H			Intermediate Impact - Sand (G1) - 3I1			Intermediate Impact - Gravel (G2) - 3I2			Groundwater (C) - 3G		
	Kd Estimate (mL/g)			Kd Estimate (mL/g)			Kd Estimate (mL/g)			Kd Estimate (mL/g)		
	Best	Min	Max	Best	Min	Max	Best	Min	Max	Best	Min	Max
Highly Mobile Elements												
H3	0	0	0	0	0	0	0	0	0	0	0	0
Tc99	0	0	0.1	0	0	0.1	0	0	0.01	0	0	0.1
Cl36	0	0	0	0	0	0	0	0	0	0	0	0
Somewhat Mobile Elements												
I129	0.2	0	2	0.2	0	2	0.02	0	0.2	0.2	0	2
U238	0.2	0	4	0.8	0.2	4	0.08	0.02	0.4	0.8	0.2	4
Se79	0	0	0.1	0	0	1	0	0	0.1	5	3	10
Np237	2	1	15	5	2	30	0.5	0.2	3	10	2	30
C14	unsuitable	0	100	unsuitable	0	100	unsuitable	0	100	unsuitable	0	100
Moderately Immobile Elements												
Sr90	1	0.2	20	10	5	20	3.1	1.6	6.2	22	10	50
Cs137	10	0	500	100	10	1000	31	3.1	310	2000	200	10000
Pu239	10	1	100	600	200	2000	190	62	620	600	200	2000
Eu152	20	1	100	200	10	1000	62	3.1	310	200	10	1000
Organic Elements												
CCl4	0.2	0.1	2	0.2	0.1	0.6	0.02	0.01	0.06	0.2	0.1	0.6
Inorganic Elements												
CrVI	0	0	0.3	0	0	0.3	0	0	0.03	0	0	0.3

Waste Chemistry/Source Category 4: Low Organic/Low Salt/Near Neutral

Analyte	High Impact (F1) - 4H			Intermediate Impact - Sand (F1) - 4I1			Intermediate Impact - Gravel (F2) - 4I2			Groundwater (F1) - 4G		
	Kd Estimate (mL/g)			Kd Estimate (mL/g)			Kd Estimate (mL/g)			Kd Estimate (mL/g)		
	Best	Min	Max	Best	Min	Max	Best	Min	Max	Best	Min	Max
Highly Mobile Elements												
H3	0	0	0	0	0	0	0	0	0	0	0	0
Tc99	0	0	0.1	0	0	0.1	0	0	0.01	0	0	0.1
Cl36	0	0	0	0	0	0	0	0	0	0	0	0
Somewhat Mobile Elements												
I129	0.2	0	2	0.2	0	2	0.02	0	0.2	0.2	0	2
U238	0.8	0.2	4	0.8	0.2	4	0.08	0.02	0.4	0.8	0.2	4
Se79	5	3	10	5	3	10	0.5	0.3	1	5	3	10
Np237	10	2	30	10	2	30	1	0.2	3	10	2	30
C14	unsuitable	0	100	unsuitable	0	100	unsuitable	0	10	unsuitable	0	100
Moderately Immobile Elements												
Sr90	22	10	50	22	10	50	7	3	16	22	10	50
Cs137	2000	200	10000	2000	200	10000	620	62	3100	2000	200	10000
Pu239	600	200	2000	600	200	2000	190	62	620	600	200	2000
Eu152	200	10	1000	200	10	1000	62	3.1	310	200	10	1000
Organic Elements												
CCl4	0.2	0.1	0.6	0.2	0.1	0.6	0.02	0.01	0.06	0.2	0.1	0.6
Inorganic Elements												
CrVI	0	0	0.3	0	0	0.3	0	0	0.03	0	0	0.3

where C_s and C_m refer to the carbon content in the stationary and mobile phases, respectively. The equilibrium constant can be defined as:

$$K(^{14}C/^{12}C) = [(^{14}C/^{12}C)_s/(^{14}C/^{12}C)_m] \tag{4.2}$$

This equilibrium constant is a pure thermodynamic constant. At a given temperature, it leads to a selectivity that is based only on the mass difference. Application of this concept to selection of a K_d value for ^{14}C is problematic. Previous work using columns composed of a natural carbonate sand (aragonite and calcite) has demonstrated that the exchange process occurs at the first mono-molecular layer (Garnier 1985); however, the adsorption process was found to be complicated by kinetic and other factors. Kinetic factors that affected the results included flow rate and sediment aging. Adsorption of other ions such as HPO_4^- was also found to significantly reduce uptake of $H^{14}CO_3^-$ by the carbonate surfaces.

In addition to isotopic exchange, the migration of $H^{14}CO_3^-$ or $^{14}CO_3^{2-}$ could potentially be retarded through precipitation of sodium/calcium carbonates that could occur during exposure to high pH, high salt concentrations in high level waste within tanks or released from leaking tanks or disposed in trenches. Because of the high pH conditions within the tanks, any CO_2 within the system will be in the form of CO_3^{2-}. As a result of the extremely high sodium concentrations within the tanks, most of the CO_3^{2-} will precipitate as Na_2CO_3. Initially the $^{14}CO_3^{2-}$ within the tanks is likely to be at trace concentrations and could be below the solubility limit; however, as CO_2 from the atmosphere enters the system from openings in the tank, Na_2CO_3 will precipitate, removing $^{14}CO_3^{2-}$ in the process. If a tank leak were to occur, this process would continue within the vadose zone as CO_2 from the atmosphere diffuses through the vadose zone into the tank leak impact zone.

Because of the complex processes described above that impact the mobility of ^{14}C, a simple linear adsorption model will not adequately describe its transport from a tank leak and through groundwater. As a result of these uncertainties with regard to $H^{14}CO_3^-$ or $^{14}CO_3^{2-}$ retardation within Hanford sediments, a large range in K_d values has been selected. The best estimate was taken to be zero and the minimum and maximum were taken to be zero and 100, respectively.

4.3.3 Chlorine-36 (as chloride)

Chloride K_d value measurements are not available for Hanford sediment. This species is not expected to form complexes in Hanford groundwater, nor is it expected to undergo significant adsorption. Chloride is generally considered to exhibit conservative behavior. Measurements of chloride adsorption on clay, sandstone and granite indicated no adsorption (Stenhouse 1995). In acid soil rich in kaolinite, and iron and aluminum hydrous oxides, some chloride adsorption can occur (Higgo 1988); however, Hanford sediment does not have these characteristics. As a result the minimum, maximum, and best value for the chloride K_d value is taken to be 0.0 ml/g.

4.3.4 Selenium-79 (as selenate)

A fair number of $Se(VI)$ K_d values have been determined using natural Hanford sediment (Cantrell et al. 2002). These results indicate that at trace concentrations, adsorption of $Se(VI)$ to Hanford sediment is low to moderate with K_d values ranging from 3 to 10 mL/g. At higher $Se(VI)$ concentrations, the K_d

values are lower (0 to 3 mL/g). Acidic conditions typically increase adsorption for anions such as selenate, but this cannot be confirmed for Hanford sediments with the available data. Basic conditions significantly reduce adsorption.

4.3.5 Strontium-90

The best estimate K_d value for strontium selected for most Hanford impact zones and source categories is 22 ml/g with a range of 10 to 50. In acidic high impact zones the best estimate is reduced to 10 ml/g with a range of 5 to 15. For the chelates/high salts source category, the best estimate for the high impact zone is 0.5 ml/g with an range of 0.2 to 20 and for the intermediate impact zone the best estimate is 10 ml/g with a range of 5 to 20. It is expected that in future work will incorporate ongoing multi-component ion exchange data to provide a more scientifically defensible approach for estimating K_d values for strontium-90.

4.3.6 Technetium-99 (as pertechnetate)

The best estimates for the K_d values of pertechnetate are zero. The ranges were taken to be from zero to 0.1 ml/g for all source and impact zone categories (except gravel corrected). When comparing this range to values tabulated in Cantrell et al. (2002), the range may appear to be somewhat narrow; however, in most cases when higher K_d values were measured, the K_d values were not significantly greater than the standard deviation. As a result of this and the fact that it is known that pertechnetate is a very weak adsorbate, this narrow range for the K_d values was selected. It should be noted that in environments where reducing agents are present, significantly higher immobilization of pertechnetate could potentially occur that is not represented by this range of K_d values.

4.3.7 Iodine-129 (as iodide)

The best estimate value selected for the iodide K_d appropriate for most Hanford impact zones and source categories is 0.2 ml/g with a range of 0 to 2. For acidic high impact zones, the best estimate value selected is 4 with a range of 0 to 15. Because pH effects resulting from acidic discharges were assumed to impact only the high impact zone categories, intermediate impact zones K_d values are assumed to be the same as for groundwater. High pH and high salt appear to reduce K_d values. This would result from increasing negative charges on sediment surfaces at high pH and increased competition with other anions at high salt concentrations. As a result, for high pH and high salt in the high impact zone a range of K_d values of 0 to 0.2 was selected with a best estimate of 0.02 ml/g. For the intermediate impact zone, the best estimate is 0.1 ml/g.

4.3.8 Cesium-137

For cesium the best estimate K_d value selected for most Hanford impact zones and source categories is 2,000 ml/g with a range of 200 to 10,000. For acidic source categories and high impact zones the best estimate is reduced somewhat to 1,000 ml/g. For the high impact zones of the very high salt/very basic and chelates/high salts source categories the best estimate is 10 ml/g with a range of 0 to 500; for the intermediate impact zone the best estimate is 100 ml/g with a range of 10 to 1,000. It is expected that in future work will incorporate available multi-component ion exchange data to provide a more scientifically defensible approach for estimating K_d values for cesium-137.

4.3.9 Europium-152

K_d value data are not available for adsorption of Eu^{3+} on Hanford sediments; however, the chemistry of Eu^{3+} is very similar to Am^{3+} (Cantrell 1988; Allard 1982), so K_d data available for Am^{3+} adsorption onto Hanford sediments has been used as an analog for Eu^{3+} (Cantrell et al. 2002). Review of this data suggest a best estimate of 200 ml/g with a range of between 10 and 1,000.

4.3.10 Uranium

The best estimate K_d value for uranium selected for most Hanford impact zones and source categories is 0.8 ml/g, with a range of 0.2 to 4. For high impact zones with sources that are acidic or contain chelates, the best estimate value is reduced to 0.2 ml/g and with a range of 0 to 4. Although the K_d value for very basic conditions is taken to be the same across each impact zone, no reliable data are available at high pH (one measurement is available at pH 11, but precipitation of the uranium is believed to have occurred in this case).

4.3.11 Neptunium-237

Np(V) K_d values for Hanford sediment compiled in Cantrell et al. (2002) indicate *Np(V)* adsorption is generally moderate, with K_d values in the general range of 2 to 30 ml/g. Lower values can result at contact times of 1 day or less, and high calcium or chelate concentrations in solution. High solution pH values can result in very high K_d values; however, this may actually be due to precipitation. These results indicate that *Np(V)* migration from a tank leak should be minimal except when the tank wastes contain chelates. Moderate migration of *Np(V)* could occur in the vadose zone and groundwater under natural Hanford conditions. Because precipitation is the most likely removal mechanism for *Np(V)* retardation at high pH, the same range of high K_d values was used for the High Impact, Intermediate Impact and the Intermediate Impact – Gravel Zones of the Very High Salt/Very Basic waste category.

4.4 Hydrostratigraphic Templates

Of the more than 2,730 waste sites at Hanford and several storage sites, a subset of 1,046 sites has been selected for inclusion in the 2004 Composite Analysis. A unique alphanumeric identification tag (i.e., the site code as given in the Hanford WIDS system), was used to identify each waste site for vadose zone simulation. For example, the 241-T-106 tank was identified by its WIDS site code "241-T-106." Initially each site was assigned to a hydrostratigraphic template based on its location within one of the 16 geographic areas, its site type (surface, near surface, tank, or injection well), and its waste chemistry designation. Other waste site-specific information (location, facility dimensions, and surface cover) was assigned to define the site-specific parameters needed to perform the vadose zone simulations.

4.4.1 Assignment of Waste Chemistry Types

As described in Section 3.2.3, a waste chemistry designation was assigned to each facility to be simulated in the 2004 Composite Analysis. This assignment was based on the original waste chemistry designations used in the 1998 Composite Analysis (Kincaid et al. 1998) and translating these six waste chemistry categories to the four categories used in this study (see Section 3.2.3). In assigning waste chemistry designation to facilities not included in the 1998 Composite Analysis, the following approach was taken:

- Burial grounds, process sewers, ponds, retention basins, buildings, cooling water, stacks, steam condensate, and sand filters were assigned a "low salt, near neutral" waste type (waste type 4).
- All 241 facilities were assigned a "high salt, very basic" waste type (waste type 2). Note that some tank wastes are designated as containing "chelates and high salt" (waste type 3) (Kincaid et al. 1998). This simplifying assumption to group essentially all tank waste into just two waste types on which to assign K_d values does have obvious limitations.
- Liquid waste facilities that lacked a waste type designation, were assigned a waste type based on waste descriptions by Maxfield (1979) and/or the various Source Aggregate Area Management Study Reports (e.g., DOE 1992; DOE 1993e).
- The WIDS was consulted for all remaining facilities. If the WIDS indicated a source for the effluent discharged to a facility, the facility was given the waste type for the source. In a few instances, WIDS provided no information and a waste type 4 was assigned.
- Unplanned releases associated with a facility were assigned the waste type given to the facility.
- Unplanned releases of solids (e.g., animal waste, contaminated equipment, particulates), and atmospheric releases were assigned waste type 4.
- Unplanned releases with insufficient information were assigned a best guess of waste type 4.
- Petroleum spills are obviously high organic but they do not fit the idea of waste type 3. Therefore, petroleum spills were arbitrarily labeled waste type 4.

The waste chemistry designations for all facilities represented in the 2004 Composite Analysis are provided in a master spreadsheet of site-specific parameters and model designations (the General Operational Site Parameters List [GOSPL], see Last et al. 2004).

4.4.2 Facility Location, Dimensions, and Wetted Area

The facility location is used to assign geohydrologic properties and specify where waste that is leaving the vadose zone enters the groundwater model. The locations of most waste facilities were obtained from the WIDS. If a facility location was not in WIDS, the location was estimated using other available resources such as the *Hanford Site Waste Management Units Report* (DOE 2003), the *Hanford*

Site Atlas (BHI 1998) and Maxfield (1979). Facility locations were assumed to be the centroid of the facility (in state-plane coordinates). Long linear facilities (such as ditches) generally do not have center coordinates listed in WIDS, so their coordinates were estimated based on visual inspection of the *Hanford Site Atlas* and/or other site maps.

The facility surface area (also called the facility footprint) was used to estimate the waste release area (e.g., the bottom area of a crib) and the dimensions of the surface barrier (if any). Facility surface areas of many sites were obtained from the WIDS. If the WIDS did not contain the facility surface area, the area was estimated using the facility length and width or the facility diameter. If no data were found to estimate facility area, a default value was assigned. The default values are combinations of three "9"s for easy recognition as default values. Table 4.11 lists the default values used for the four different site types.

Table 4.11. Default Surface Areas

Facility (site) Type	Default Area (m^2)
Unplanned Release, French Drain	0.999
Storage Tank, Trench	9.99
Radioactive Process Sewer, Crib	99.9
Burial Ground	999

The wetted column area (in essence, the wetted vadose zone area) represents the maximum areal extent of the waste as it migrates to the water table. For at least some sites, the facility area in WIDS represents the fenced boundary rather than the actual waste release area, which can be significantly smaller. It is also possible that the waste at some sites could spread laterally and extend beyond the facility boundaries. Until the waste-zone area of each individual waste site is determined, we will continue to assume, as was done for the previous composite analysis, that the waste zone area equals the facility area. The result of this assumption is that, whenever the waste zone area is significantly smaller than the wetted column area, the source term will be dispersed over the larger wetted column and migrate downward more slowly. Conversely, when the waste zone area is larger than the wetted column, the source term will be dispersed over the smaller wetted column area and migrate downward more quickly.

In certain simulation cases, the volume of liquid disposed per facility area exceeds the capacity of the vadose zone to transmit it. Either the vadose zone sediments have very low conductivity values or the facility area is inordinately small (e.g., reverse wells listed as having a facility area equivalent to the borehole diameter). In the field, this situation would result in significant lateral spreading beyond the facility footprint. The impact of lateral spreading will be represented in the 2004 Composite Analysis using the K_s-dependent approach. In this approach, the wetted vadose zone area $A_x(m^2)$ is related to the facility footprint by the scaling factor λ (dimensionless), as follows:

$$A_x = \lambda A_0 = \left[\frac{|Q_{max}|}{K_{s\,min} A_0}\right] A_0;\ \lambda \geq 1 \tag{4.3}$$

where Q_{max} = the maximum artificial liquid discharge rate (m^3/s)
$K_{s\,min}$ = the minimum hydraulic conductivity (m/s) of all layers for the given site and realization
A_0 = the facility area (m^2) from the WIDS database

The major assumptions underlying Equation 4.3 are that the vadose zone layer with the lowest K_s controls flow, a unit gradient is always present across the controlling layer, and flow is steady. The scaling factor, λ, is constrained by the SAC Environmental Settings Definition keyword file to be equal to or greater than 1.0 so that the effective area is not less than the facility footprint area, unless specified for a specific site. For example, λ is usually permitted to be less than 1.0 for the underground storage tanks, for which the actual wetted area from leaks is commonly less than the facility footprint. For most sites with little or no artificial discharges, λ usually resolves to 1.0 (no scaling) and hence the assigned WIDS area is used. For large-discharge sites, λ values greater than 1.0 are common.

4.5 Recharge Estimates

This section provides recharge (deep drainage) estimates for use in the 2004 Composite Analysis. The recharge estimates were derived from a suite of available field data and computer simulation results (Fayer and Walters 1995; Murphy et al. 1996; Prych 1998; Fayer et al. 1999; Wittreich et al. 2003). The estimates do not account for overland flow from roadways or roofs, water line leaks, or any other manmade additions of water, the impacts wrought by future climate change or land use alterations, variations within soil types, or dune-sand deposition. The estimates were developed for fairly large geographic areas and may not represent the local recharge rates at specific locations.

This section provides recharge estimates for natural and distributed soils and for surface barriers for each of the four intervals: pre-Hanford, operations, remediation, and post-Hanford. The conditions during these periods include natural soil and shrub-steppe plant communities, disturbances that alter the surface soil and vegetation, emplacement of surface barriers, and long-term changes that occur as the waste sites stabilize and return to natural conditions. This section describes the probability distribution of the recharge estimates. These distributions will be used in a Monte Carlo analysis to represent the expected range of recharge rates. This section describes a method to examine the impact of surface barrier side slopes and the terrain surrounding surface barriers, both of which could significantly affect waste release and vadose zone transport. Finally, this section summarizes the recharge estimates for all conditions.

4.5.1 Natural and Disturbed Soil

Prior to the establishment of the Hanford Site in 1943, the undisturbed soil and shrub-steppe plant community generally resulted in very low recharge rates. Those low rates led to the very dry vadose zone conditions that characterized the pre-Hanford period. During the subsequent operations period, the soil and vegetation at many of the waste sites were disturbed, which increased recharge rates; similar conditions will exist during the remediation period. In addition to the recharge that occurs directly in a waste site, recharge in the immediate vicinity of the site could affect transport of contaminants to the groundwater.

Examination of the Hanford soil map produced by Hajek (1966) revealed five natural soil types prevalent in and around the waste areas. These soils are nominally 1 to 2 meters thick (at most) and easily disrupted during construction activities. Experience shows that the dominant soil condition following construction is the underlying sediment, i.e., the Hanford sands. The only other soil type that might occur in the waste areas is a silt loam. Such soil does not currently exist in these areas. However, surface barriers will eventually age to the point where they eventually resemble silt loam soil. Recharge estimates were assigned to the five undisturbed soil types and two sediment types for the following four plant community conditions:

1. *Shrub-Steppe Plant Community.* This condition is a mature plant community consisting of shrubs and bunchgrasses and associated fauna and flora. Table 4.12 lists the recharge estimates for the five soil types that dominate the areas being evaluated in the 2004 Composite Analysis. It is assumed that these soils, when undisturbed, will support a shrub-steppe plant community.

Table 4.12. Estimated Recharge Rates for Predominant Soil Types and Sediment with a Shrub-Steppe Plant Community

Soil Type	Recharge Rate Estimate (mm/yr)	Description
Ephrata stony loam (E_b)	1.5	No data; used estimate for E_l, which is a similar soil
Ephrata sandy loam (E_l)	1.5	Avg. of two estimates (1.2; 1.8) from deep (>10 m) chloride data collected from the two boreholes B17 and B18 (Prych 1998)
Burbank loamy sand (B_a)	3.0	Avg. of three estimates (0.66, 2.8, 5.5) from deep (>10 m) chloride data collected from the three boreholes B10, B12, and B20 (Prych 1998)
Rupert Sand (R_p) in 200 East	0.9	Avg. of four estimates (0.16, 0.58, 1.0, and 1.8) from deep (>10 m) chloride data collected from the four boreholes E24-161, E24-162, B8501, B8502 (Fayer et al. 1999)
Rupert Sand (R_p) outside of 200 East	4.0	Estimated from chloride data collected from a borehole near the Wye Barricade (Murphy et al. 1996)
Hanford-formation sand	4.0	No data; used estimate for Rupert sand outside the 200 East area
Warden silt loam	0.11	Highest of four values estimated from chloride data collected in silt loam soil (Prych 1998)

2. *No Plants.* This condition describes the case in which vegetation was removed and plants were prevented from re-establishing (e.g., weed control). This condition can be applied to the analysis of fire effects, although the duration without plants will be short (<1 year). Table 4.13 shows the recharge estimates for the case without vegetation.

3. *Shallow-Rooted Plants.* This condition describes the case in which a fire or Hanford operations destroys the existing shrub-steppe vegetation and the plants that re-vegetate the site are strictly shallow-rooted (e.g., cheatgrass). Very few recharge data are available for native soils and backfilled sediments with shallow rooted grasses such as cheatgrass (Fayer and Walters 1995). For the purposes of this analysis, it was estimated that a cheatgrass cover will reduce the recharge rates listed in Table 4.13 by 50%. Thus, Ephrata stony loam will have an expected mean annual recharge of 8.5 millimeters per year and a graveled surface will have a recharge rate of 44.5 millimeters per year if the surface is covered with cheatgrass.

Table 4.13. Estimated Recharge Rates for Soil Types and Sediment Without Vegetation

Soil Type	Recharge Rate Estimate (mm/yr)	Description
Ephrata stony loam (E_h)	17	Simulation estimate for period 1958 to 1992 (Fayer and Walters 1995)
Ephrata sandy loam (E_l) (E_l)	17	Simulation estimate for period 1958 to 1992 (Fayer and Walters 1995)
Burbank loamy sand (B_a) (B_a)	53	Simulation estimate for period 1957 to 1997 (Fayer et al. 1999)
Rupert Sand (R_p)	44	Simulation estimate for period 1957 to 1997 (Fayer et al. 1999)
Hanford-formation sand	55	8-yr (July 1984 to June 1993) lysimeter record for Hanford sand (Fayer and Walters 1995)
Graveled surface	89	9-yr (Feb 1990 to Feb 1999) lysimeter record for graveled surface showed 52% of precipitation received became deep drainage (Fayer et al. 1999); drainage rate scaled to precipitation rate of 172 mm/yr

4. *Young Shrub-Steppe Plant Community.* This condition describes the case in which a young shrub-steppe plant community is developing in an area that had previously been disturbed by an event such as a fire. It was estimated that recharge in such areas will be double the rates estimated for mature shrub-steppe conditions (Table 4.12).

Table 4.14 shows the estimated recharge rates for various surface conditions for the 16 geographic areas, along with a brief description of each setting and major soil type that was identified using the Hajek (1966) soil map. If a significant secondary soil type was present, that soil type and its estimated recharge rate are shown in parentheses.

Note that a recharge estimate of 1 millimeter per year was assumed for those sites that discharged directly to the river, and an estimate of 0.1 millimeter per year was assumed for those sites covered by asphalt, concrete, or building.

4.5.2 Surface Barriers

The Hanford Disposition Baseline and Kincaid et al. (2004) determined the schedule and type of engineered surface barriers to be applied to each site for the 2004 Composite Analysis. This section describes the recharge rates to be used for barriers during the institutional control period, their design life, and after their design life. A key assumption of the 2004 Composite Analysis is that deep drainage beneath barrier side slopes and the surrounding terrain does not appreciably affect contaminant release and transport. This assumption is consistent with the previous composite analysis as well as recent and ongoing assessments. To date, the assumption has not been tested. Therefore, estimates of side slope drainage are provided here for possible use in sensitivity tests.

4.5.2.1 Barrier Tops

DOE conducted a focused feasibility study of engineered surface barriers and identified four designs that met Hanford needs (DOE 1996). Table 4.15 lists the four designs and the expected design life of

Table 4.14. Estimated Recharge Rates by Soil Type/Sediment and Vegetation Condition in Each Hanford Area. Significant secondary soil types and their associated recharge estimates are shown in parentheses

Area Label	Brief Description	Major (Secondary)$^{(a)}$ Soil Type(s) and Sediments	Estimated Recharge Rate (mm/yr)			
			No Vegetation	Cheatgrass	Young Shrub-Steppe	Shrub-Steppe
C	Reactor along river	E_b (B_a)	17 (53)	8.5 (26.5)	3.0 (6.0)	1.5 (3.0)
K	Reactor along river	E_b (E_l)	17 (17)	8.5 (8.5)	3.0 (3.0)	1.5 (1.5)
N	Reactor along river	E_b	17	8.5	3.0	1.5
D	Reactor along river	E_l	17	8.5	3.0	1.5
H	Reactor along river	B_a	53	26.5	6.0	3.0
F	Reactor along river	R_p (E_l)	44 (17)	22 (8.5)	8.0 (3.0)	4.0 (1.5)
R	300 Area	R_p (E_l)	44 (17)	22 (8.5)	8.0 (3.0)	4.0 (1.5)
Q	400 Area	R_p (B_a)	44 (53)	22 (26.5)	8.0 (3.0)	4.0 (3.0)
P	618-10 Area	R_p (B_a)	44 (53)	22 (26.5)	8.0 (3.0)	4.0 (3.0)
M	618-11 Area	R_p (B_a)	44 (53)	22 (26.5)	8.0 (3.0)	4.0 (3.0)
G	200N Area	E_l (B_a)	17 (53)	8.5 (26.5)	3.0 (6.0)	1.5 (3.0)
T	Northern 200W Area	R_p (B_a)	44 (53)	22 (26.5)	8.0 (3.0)	4.0 (3.0)
S	Southern 200W Area and ERDF	R_p	44	22	8.0	4.0
A	Southern 200E Area	R_{pe} (B_a)	44 (53)	22 (26.5)	1.8 (6.0)	0.9 (3.0)
B	Northwestern 200E Area	E_l	17	8.5	3.0	1.5
E	Eastern 200E Area	B_a (R_{pe})	53 (44)	26.5 (22)	6.0 (1.8)	3.0 (0.9)
--	All Areas with soils disturbed by excavations	Hanford sand	55	27.5	8.0	4.0
--	All Areas with a surface barrier	Warden silt loam	na	na	0.22	0.11
--	All Areas with gravel surface and no plants	gravel	89	44.5	na	na

E_b = Ephrata stony loam E_l = Ephrata sandy loam B_a = Burbank loamy sand R_p = Rupert sand
R_{pe} = Rupert sand in 200 East Area.
(a) Note: Only the major soil types were used to represent each aggregate area.

each. For the 2004 Composite Analysis analyses, only the Hanford barrier and the modified RCRA C barrier are being evaluated for sites that require protection. Recharge rates for the top portion of the surface barriers were estimated from field studies of surface barrier systems at Hanford (Fayer et al. 1999; Wittreich et al. 2003) and are shown in Table 4.15.

4.5.2.2 Barrier Side Slopes

This discussion of recharge through barrier side slopes is provided only for completeness and to provide the basis for possible use in sensitivity analyses. A significant number of the surface barriers

Table 4.15. Barrier Design Life and Estimated Recharge Rates for Barrier Tops

FFS Design (DOE/RL 1996)	Design Life (yr)	Recharge Rate (mm/yr)	Source
Hanford Barrier	1,000	0.1	Based on lysimeter data and simulation results (Fayer et al. 1999; Wittreich et al. 2003)
Modified RCRA C	500	0.1	Based on lysimeter data and simulation results (Fayer et al. 1999)
Standard RCRA C (not evaluated in the 2004 Composite Analysis)	30	0.1	No data; recommendation is based on presence of Geomembrane and 2-ft thick clay admix layer
Modified RCRA D (not evaluated in the 2004 Composite Analysis)	100	0.1	Based on simulation results using parameters from Fayer et al. (1999)

being planned at Hanford will be above-grade structures that require stabilizing side slopes. Two side slope designs are currently being tested at the Prototype Surface Barrier (Wittreich 2003). One design, called "Gravel," is a sandy gravel/gravelly sand mix emplaced at a 10 horizontal (H):1 vertical (V) slope. The second design, called "Basalt," is open-work basalt riprap emplaced at a 2H:1V slope. Neither design incorporates any plant-promoting features. Since being constructed in November 1994, the sandy gravel side slope has had very few plants established and the basalt side slope has had none.

Drainage data have been collected since November 1994. During that period, records show that Hanford received higher-than-normal precipitation. Therefore, the side slope drainage data were scaled to the long-term precipitation average to yield long-term estimates of side slope recharge rates. Hoitink et al. (2003) reported an annual mean precipitation at the Hanford Meteorological Station (HMS) of 172 millimeters per year, based on HMS records from 1946 through 2002. For the 2004 Composite Analysis, we assumed the long-term precipitation average was 172 millimeters per year and scaled the drainage data accordingly. The full set of drainage data encompassed the period from November 1994 to September 2002. For the estimation process, the drainage data from the first year (up to October 1995) were not included so as to avoid any effects from the initial conditions. Drainage was not measured during the period from October 1998 to September 1999. The remaining data, which spanned a total of six years, were used to estimate recharge rates for the period immediately following barrier construction. Table 4.16 shows these estimates for the two side slope materials in the current baseline for above-grade surface barriers.

Table 4.16. Initial Side Slope Recharge Rates for Hanford Site Climate Conditions

Side Slope Type	Slope	Initial Recharge Rate (mm/yr)	Source
Gravel (mix of sand and gravel)	10H:1V	42	Based on six years of drainage data from the prototype surface barrier (Wittreich et al. 2003) scaled to average precipitation of 172 mm/yr.
Basalt (open-work riprap)	2H:1V	32	Based on six years of drainage data from the prototype surface barrier (Wittreich et al. 2003) scaled to average precipitation of 172 mm/yr.

We do not expect the initial recharge rates shown in Table 4.16 to persist forever. During the 100 years of institutional control, we expect the plant community on the side slopes to slowly develop and mature to the point where recharge rates beneath the side slopes resemble Burbank loamy sand and a shrub-steppe plant community. Therefore, we propose representing side slope recharge rates in a time-dependent fashion during the period of institutional control.

4.5.2.3 Surface Barriers Post-Hanford

No guidance is available for specifying barrier performance after the design life. In the previous composite analysis (Kincaid et al. 1998) barrier performance after the design life was simply assumed to end, after which recharge rates were set equal those of the original soil type at each location. However, there is no basis for assuming the surface barrier will disappear or evolve to resemble the local soil. What will happen is that the barrier will continue to experience soil and ecological processes that will alter the nature of the barrier and affect it's performance.

Appendix D describes processes that could potentially affect barrier performance and outlines several scenarios that could be used to simulate performance after the design life. Fayer et al. (1999) examined two key natural processes (erosion of the silt loam layer and deposition of dune sand on the barrier) that could alter barrier performance. Their results suggested that neither process would significantly alter barrier performance. Thus, after the barrier design life, the barrier would continue to function as designed; the barrier top would most likely resemble a Warden silt loam and the side slope would most likely resemble the Ephrata stony loam.

For the 2004 Composite Analysis, the approach chosen to describe barrier performance after the design life was to retain some functioning after the design life but for a limited duration equivalent to the design life. For example, the modified RCRA C barrier top would perform as designed for it's 500-year design life, after which the barrier performance would be changed linearly to the final rate (the recharge rate for the equivalent soil type, which in this case would be Warden silt loam). For simplicity and ease of implementation, the changes in performance after the design life will be represented by five equal stepwise changes in recharge during the degradation period.

4.5.3 Probability Distribution Functions

After reviewing the possible probability distributions, we chose a three-point triangular distribution to represent recharge at all sites. In this distribution, the low value is equal to the mean value minus the standard deviation and the high value is equal to twice the mean value. The number of recharge estimates is too small to calculate adequate statistics, so recharge statistics (mean and standard deviations) were estimated using statistics from winter precipitation. Data from HMS precipitation records from Hoitink et al. (2003) and current Hanford Site weather records (http://hms.rl.gov/products.htm) were used to obtain the mean value and standard deviation of the extended-winter (November through March) precipitation for the period from November 1946 to March 2003 and resulted in a mean value of 101 millimeters per year and standard deviation of 40 millimeters per year. We reasoned that winter precipitation was the primary source of recharge and that recharge would seldom, if ever, exceed winter precipitation; so all recharge values were keyed to the mean extended winter precipitation as the upper limit of recharge. Because the available data were limited, we estimated the standard deviation for all surfaces as equal to half the mean value. This appears to be a conservative estimate based on the statistic for the extended winter precipitation. As more data are collected for various surface conditions the actual standard deviations can be substituted.

4.5.4 Integrated Drainage Calculations

A key assumption of the baseline analysis of the 2004 Composite Analysis is that vadose zone waste is only affected by the recharge that occurs beneath the surface barrier tops. The implication of this assumption is that recharge occurring beneath the barrier side slopes (if present) or in the areas immediately surrounding the surface barrier will not affect the mobilization of waste beneath the surface barrier nor the transport of the waste contaminants to the water table. To test the assumption, a method was developed to integrate the drainage rates from the barrier top and side slopes (or surrounding terrain if no side slopes) into a single composite rate that could be used for sensitivity analyses in the 2004 Composite Analysis.

In the composite analysis, each waste site is characterized by two drainage estimates defined as follows:

> ***Release Model Drainage.*** This drainage rate directly affects the behavior of the release model. The assumption is that the waste form is directly beneath the intact and functional part of the surface barrier and affected only by recharge through the barrier top. Any recharge through the barrier side slopes or in the areas surrounding the barrier is assumed to have no impact on the waste form.
>
> ***Vadose Zone Model Drainage.*** This drainage rate directly impacts the transport of contaminants released by the waste form through the vadose zone and to the water table. In the baseline 2004 Composite Analysis, the vadose zone drainage rate is equivalent to the barrier top drainage rate. However, for sensitivity tests of this assumption, the vadose zone drainage rate could be assigned a value that is a composite of recharge through the barrier and recharge through a portion of the barrier side slopes or surrounding terrain.

The impact of higher drainage rates around a surface barrier is a function of individual site characteristics such as barrier geometry and dimensions, distance to the water table, geology, physical-hydraulic-chemical properties, and contaminant depth and characteristics. Given the diversity of site characteristics and the one-dimensional conceptual model used in the 2004 Composite Analysis, the analysis was simplified for the purpose of demonstrating sensitivity without having to represent the unique features of every site. For this purpose, the recharge rates were integrated by weighting the recharge contributions from the barrier and the contributing portion of the side slope based on their respective areas referenced to the total area. Some of the recharge beneath the side slope will affect contaminant transport beneath the barrier and some will move away from the barrier and have negligible impact on contaminants. This partitioning was represented by assuming that half the side slope area would contribute to contaminant transport. The resulting integrated vadose zone drainage rate (r_b) is computed as follows:

$$r_b = \left(r_{bt} A_{bt} + r_{bs} 0.5 A_{bs}\right) / A_b \tag{4.4}$$

where r_{bt} = drainage rate of the barrier top
r_{bs} = drainage rate of the barrier side slope
A_{bt} = area of the barrier top
A_{bs} = area of the barrier side slope
A_b = total area of the barrier and contributing side slope; sum of A_{bt} and $0.5*A_{bs}$

The following example illustrates how the integrated recharge rate from a modified RCRA C barrier with side slopes might affect the overall vadose zone drainage rate.

Modified RCRA C Barrier

- shape = square, 316 m on a side, yielding area A_{bt} = 10 ha
- height = 5 m above the surrounding terrain
- surface barrier drainage rate r_{bt} = 0.1 mm/yr

Gravel Side Slope

- slope = 5H:1V
- slope length = 25 m
- contributing area, 0.5 * A_{bs} = 1.71 ha (equal to one-half of the side slope area)
- drainage rate r_{bs} = 3.0 mm/yr (assumed mature shrub-steppe plant community)

Using Equation 4.4 and the values provided above, the integrated vadose zone drainage rate is

$$r_b = [0.1 \text{ x } 10 + 3.0 \text{ x } 1.71]/11.7 = 0.52 \text{ mm/yr} \tag{4.5}$$

If the waste site requires the barrier area to be doubled to 20 hectares, the contributing side slope area would be 2.35 hectares and the integrated vadose zone drainage rate would be

$$r_b = [0.1 \text{ x } 20 + 3.0 \text{ x } 2.36]/22.4 = 0.41 \text{ mm/yr} \tag{4.6}$$

The integrated drainage rate for the 10-hectare waste site is 5 times larger than the barrier top drainage rate. For the 20-hectare site, the integrated drainage rate drops to 0.41 millimeter per year, but it is still 4 times larger than the barrier top drainage rate. These examples show that, for surface barriers in the range from 2 to 20 hectares (typical of what might be expected for the Hanford Site), side slope drainage can significantly increase the vadose zone drainage rate. To further dramatize the significance, consider the case where the side slope drainage rate is equal to the rate currently measured beneath the gravel side slope at the prototype barrier. If plants never establish on the side slope and the rate remains at 42 millimeters per year, the integrated vadose drainage rate would be 6.2 millimeters per year for the 10-hectare barrier and 4.5 millimeters per year for the 20-hectare barrier. To further illustrate the effect of barrier dimensions on drainage, if the barrier were reduced to 1 ha with a corresponding side slope area of 0.62 hectare, the integrated drainage rate would be increased to 16.2 millimeters per year.

The impact of the side slopes on integrated drainage rates decreases as the size of the barrier increases. Plans for surface barriers typically assume that the barrier top will extend 10 meters beyond the edge of the waste to provide more protection. The extent of such overbuilding is colloquially referred to as the barrier overhang distance. The overhang will increase the functional area of the surface barrier and somewhat decrease the impact of any side slope. For the 2004 Composite Analysis, however, we assumed no overhang.

If surface barriers are built at or near ground level to eliminate side slopes, they will still be prone to the influence of drainage rates in the surrounding soils. The analysis of impacts from such drainage can be evaluated using a similar methodology to that used in evaluating side slope impacts.

4.5.5 Recharge Classes

To facilitate the assignment of recharge rates for individual waste sites, four sets of recharge classes were developed: 1) rates for baseline soil conditions with shrub-steppe plant community; 2) rates for disturbed conditions or for sensitivity tests (e.g., native soils or backfilled soils; with or without vegetation; asphalt, concrete, or gravel covers); 3) rates for surface barrier components; and 4) integrated rates for surface barriers with side slopes. In all cases, the waste site drainage rates described by Equation 4.4 were assumed to be directly equivalent to recharge rates (i.e., all drainage subsequently becomes recharge). Each recharge class was identified with a unique code based on either the primary native soil and vegetation type or the type and size of the surface barrier. Tables 4.17 through 4.21 provide the estimated recharge rates for each class.

Table 4.17. Estimated Recharge Rates for Baseline Soil Conditions

Recharge Class Code	Description	Best Estimate (mm/yr)	Estimated Standard Deviation (mm/yr)	Minimum (mm/yr)	Maximum (mm/yr)
E_b-s	Ephrata stony loam (E_b) - with shrub-steppe (*s*) plant community	1.5	0.75	0.75	3.0
E_l-s	Ephrata sandy loam (E_l) - with shrub-steppe (*s*) plant community	1.5	0.75	0.75	3.0
B_a-s	Burbank loamy sand (B_a) - with shrub-steppe (*s*) plant community	3.0	1.5	1.5	6.0
R_{pe}-s	Rupert sand (R_p) in 200 East (*e*) - with shrub-steppe (*s*) plant community	0.9	0.45	0.45	1.8
R_p-s	Rupert sand (R_p) outside 200 East - with shrub-steppe (*s*) plant community	4.0	2.0	2.0	8.0
W_a-s	Warden silt loam (W_a) – with shrub-steppe (*s*) plant community	0.11	0.06	0.06	0.22

Table 4.18. Estimated Recharge Rates for Disturbed Conditions and Sensitivity Tests

Recharge Class Code	Description	Best Estimate (mm/yr)	Estimated Standard Deviation (mm/yr)	Minimum (mm/yr)	Maximum (mm/yr)(a)
E_b-ds	Ephrata stony loam (E_b), disturbed (*d*) - with young shrub-steppe (*s*) vegetation	3.0	1.5	1.5	6.0
E_b-dg	Ephrata stony loam (E_b), disturbed (*d*) - with cheatgrass (*g*) vegetation	9	4.5	4.5	18
E_b -dn	Ephrata stony loam (E_b), disturbed (*d*) - with no (*n*) vegetation	17	8.5	8.5	34
E_l-ds	Ephrata sandy loam (E_l), disturbed (*d*) - with young shrub-steppe (*s*) vegetation	3.0	1.5	1.5	6.0
E_l-dg	Ephrata sandy loam (E_l), disturbed (*d*) - with cheatgrass (*g*) vegetation	9	4.5	4.5	18
E_l-dn	Ephrata sandy loam (E_l), disturbed (*d*) - with no (*n*) vegetation	17	8.5	8.5	34
B_a-ds	Burbank loamy sand (B_a), disturbed (*d*) - with young shrub-steppe (*s*) plant community	6.0	3.0	3.0	12
B_a-dg	Burbank loamy sand (B_a), disturbed (*d*) - with cheatgrass (*g*) plant community	26	13.0	13.0	52
B_a-dn	Burbank loamy sand (B_a), disturbed (*d*) - with no (*n*) vegetation	53	26.5	26.5	101
R_{pe}-ds	Rupert sand (R_p) in 200 East, disturbed (*d*) - with young shrub-steppe (*s*) plant community	1.8	0.9	0.9	3.6
R_{pe}-dg	Rupert sand (R_p) in 200 East, disturbed (*d*) - with cheatgrass (*g*) plant community	22	11	11	44
R_{pe}-dn	Rupert sand (R_p) in 200 East, disturbed (*d*) - with no (*n*) vegetation	44	22	22	88
R_p-ds	Rupert sand (R_p) outside 200 East, disturbed (*d*) - with young shrub-steppe (*s*) plant community	8.0	4.0	4.0	16.0
R_p-dg	Rupert sand (R_p) outside 200 East, disturbed (*d*) - with cheatgrass (*g*) plant community	22	11	11	44
R_p-dn	Rupert sand (R_p) outside 200 East, disturbed (*d*) - with no (*n*) vegetation	44	22	22	88
H_s-dn	Hanford Sand (H_s), disturbed (*d*) - with no (*n*) vegetation	55	27.5	27.5	101
G-dn	Gravel surface (*G*), disturbed - with no (*n*) vegetation	89	44.5	44.5	101
ABC	Soil Surface covered by Asphalt, Building, or Concrete	0.1	0.05	0.05	0.2

(a) Note: the maximum recharge was truncated at the mean extended winter precipitation value of 101 mm/yr.

Table 4.19. Estimated Recharge Rates for Surface Barrier Components

Recharge Class Code	Description	Best Estimate (mm/yr)	Estimated Standard Deviation (mm/yr)	Minimum (mm/yr)	Maximum (mm/yr)
RCRA C	Modified RCRA C – barrier top during design life	0.1	0.05	0.05	0.20
Hanford	Hanford Barrier- barrier top during design life	0.1	0.05	0.05	0.20
W_a-s	Warden Silt Loam (W_a) - with shrub-steppe (s) plant community (Could be used to represent final degradation of barrier top)	0.11	0.06	0.06	0.22
G_r-s	Gravel side slope – with shrub-steppe (s) plant community (Could be used to represent final degradation of gravel side slope)	3.0	1.5	1.5	6.0
G_r-n	Gravel side slope – no vegetation (n)	42	21	21	84

Table 4.20. Estimated Recharge Rates for Surface Barriers with Side Slopes and $r_{bs} = 3.0$ mm/yr

Barrier Type	Recharge Class Code	Cover Area, A_{bt} (m^2)	Best Estimate (mm/yr)	Minimum (mm/yr)	Maximum (mm/yr)
Modified RCRA C or Hanford	-I8	$128 \leq A_{bt} < 256$	2.81	1.40	5.62
	-I9	$256 \leq A_{bt} < 512$	2.68	1.34	5.36
	-I10	$512 \leq A_{bt} < 1024$	2.49	1.24	4.97
	-I11	$1024 \leq A_{bt} < 2048$	2.23	1.12	4.47
	-I12	$2048 \leq A_{bt} < 4096$	1.93	0.97	3.86
	-I13	$4096 \leq A_{bt} < 8192$	1.61	0.81	3.22
	-I14	$8192 \leq A_{bt} < 16384$	1.30	0.65	2.60
	-I15	$16384 \leq A_{bt} < 32768$	1.02	0.51	2.05
	-I16	$32768 \leq A_{bt} < 65536$	0.79	0.40	1.59
	-I17	$65536 \leq A_{bt} < 131072$	0.61	0.31	1.22
	-I18	$131072 \leq A_{bt} < 262144$	0.47	0.24	0.95
	-I19	$262144 \leq A_{bt} < 524288$	0.37	0.18	0.74
	-I20	$524288 \leq A_{bt} < 1048576$	0.29	0.15	0.59
	-I21	$1048576 \leq A_{bt} < 2097152$	0.24	0.12	0.48
	-I22	$2097152 \leq A_{bt} < 4194304$	0.20	0.10	0.40

Table 4.21. Estimated Recharge Rates for Surface Barriers with Side Slopes and $r_{bs} = 42.0$ mm/yr

Barrier Type	Recharge Class Code	Cover Area, A_{bt} (m^2)	Best Estimate (mm/yr)	Minimum (mm/yr)	Maximum (mm/yr)
Modified RCRA C or Hanford	-I8	$128 \le A_{bt} < 256$	39.2	19.6	78.5
	-I9	$256 \le A_{bt} < 512$	37.3	18.7	74.7
	-I10	$512 \le A_{bt} < 1024$	34.6	17.3	69.2
	-I11	$1024 \le A_{bt} < 2048$	30.9	15.5	61.8
	-I12	$2048 \le A_{bt} < 4096$	26.6	13.3	53.1
	-I13	$4096 \le A_{bt} < 8192$	21.9	11.0	43.8
	-I14	$8192 \le A_{bt} < 16384$	17.4	8.7	34.9
	-I15	$16384 \le A_{bt} < 32768$	13.4	6.7	26.9
	-I16	$32768 \le A_{bt} < 65536$	10.1	5.1	20.2
	-I17	$65536 \le A_{bt} < 131072$	7.5	3.7	15.0
	-I18	$131072 \le A_{bt} < 262144$	5.5	2.7	11.0
	-I19	$262144 \le A_{bt} < 524288$	4.0	2.0	8.0
	-I20	$524288 \le A_{bt} < 1048576$	2.9	1.4	5.8
	-I21	$1048576 \le A_{bt} < 2097152$	2.1	1.0	4.2
	-I22	$2097152 \le A_{bt} < 4194304$	1.5	0.8	3.0

5.0 Conclusions and Recommendations

The 2004 Composite Analysis will include one-dimensional stochastic simulations of flow and transport through the vadose zone for 1,022 of the 1,046 waste sites selected for inclusion in the 2004 Composite Analysis. The remaining 24 sites are just place holders to account for offsite transfers and nuclear materials and thus are not directly simulated. Data and interpreted information needed to define the input parameters for the vadose zone simulations have been extracted from existing documents and databases.

This report describes the assumptions and rationale for 1) defining the hydrostratigraphy, hydraulic properties, and distribution coefficients for each site to be simulated; and 2) defining the recharge estimates for each site. To simplify the preparation of input files for the large number of sites, and to improve the computational efficiencies, the Hanford Site was subdivided into 17 geographically similar areas that could each be represented by a single generalized hydrostratigraphic column. The hydrostratigraphic columns for each of the 17 geographic areas were further modified to account for differences in the depth of waste releases, and differences in solid/liquid distribution coefficients (K_d values) affected by different waste chemistries. This resulted in 63 base templates, each with their own unique hydrogeologic stratigraphy, hydraulic parameter distributions, and K_d distributions. Flow and transport parameters are to be stochastically sampled for each hydrogeologic unit for each realization. Thus, each model node within a given hydrogeologic unit has the same set of parameters for a given realization.

Recharge estimates are provided for four different conditions: pre-Hanford, operations, remediation, and post-Hanford. The conditions during these periods include natural soil with shrub-steppe plant communities, disturbed soil and vegetation, surface barriers, and degraded surface barriers as the waste sites stabilize and return to natural conditions. Probability distributions have been provided for each recharge estimate to facilitate Monte Carlo analysis in representing the expected range of recharge rates.

There are many issues and sources of uncertainty that can affect the ability to predict the behavior of contaminants in the vadose zone. These include scale effects, spatial resolution of data, preferential flow, funneled flow, colloid transport, density effects, and thermal effects. Fogwell et al. 2003 has identified a number of data gaps related to key technical issues and parameter uncertainties. This includes a number of site characterization and laboratory study needs related to interpreting observations from past tank leaks, spills, and deliberate discharges. Adequate site characterization is important to estimate existing inventories, initial conditions, and also to demonstrate the validity of our understanding and the predictive ability of the models used for flow and transport. Estimating inventories and contaminant distributions is difficult because there is much about the history and character of the leaks, spills, and water losses that is difficult to characterize with a reasonable level of uncertainty. This level of uncertainty will always hamper the ability of models to predict observed distributions of contaminants in the vadose zone, even if the distributions were well known.

Recommendations to reduce uncertainty and improve the site-wide data sets presented in this document include the following:

- Increase the number of hydrostratigraphic profiles to better represent the site-specific conditions beneath the waste sites. A first step might be to further differentiate the 200 Areas into 24 zones (representative of the regional closure zones) rather than the 6 general geographic areas currently used. Additional site-specific hydrostratigraphic profiles (or even two or three dimensional representations), should also be developed for those sites found to be high risk drivers and with correspondingly high uncertainty.

- Improve our quantitative representation (i.e., through geostatistics) of the geologic structure and heterogeneities associated with the various hydrogeologic facies.

- Improve defensibility and traceability of assigning physical and hydrologic properties to the hydrostratigraphic units. This could entail improving our understanding and semi-quantification of the relationship/correlation between geologic facies and hydraulic properties.

- Improve the hydraulic property database to include all the available data. These data include measured values of unsaturated conductivity, parameter estimates from resulting outflow experiments, and data and parameters resulting from field-scale tests.

- Address the impacts of gravel on hydraulic and sorption behavior of all samples, in a systematic and consistent manner.

- Improve the physical and hydraulic property distribution estimates. This could entail improving the number of sample analyses we have for each of the hydraulic property classes, improving these data via pedotransfer functions tied to particle-size data, using Bayesian updating to improve site-specific property distributions, and incorporating concepts for scaling up sample analytical data to the field and model cell scale.

- Improve contaminant distribution coefficient estimates by correcting for gravel content based on particle-size data of the geologic facies and addressing scale-up issues from sample derived K_d values to field and model cell scales.

- Improve our recharge estimates, particularly for coarse surface soil and side slope material.

- Improve our technical basis and modeling parameters to investigate the effect of side-slope design on deep infiltration rates.

- Improve the technical basis and modeling parameters for barrier performance after the design life.

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Appendix A

Hydrostratigraphic Templates

VZ Base Templates A

South 200 East Area (A Plant, C Plant, U. S. Ecology) Stratigraphic Columns

Notes/Assumptions:

1) Topography ranges from 735 ft MSL in southwest corner of 200 East Area to 645 ft MSL in the 241-C area (USGS Gable Butte 7.5 min. Quadrangle Map)
   Will assume an average elevation of 690 ft MSL.
2) The pre-Hanford Water Table (January 1944) is estimated to range from an elevation of 116 m (380 ft) in the eastern part of 200 East to 119 m (390 ft) in the western part (BNWL-B-360).
   Will assume an average water table elevation of 117 m (385 ft) MSL.
3) A thin blanket of eolian sand and silt covers the surface of the site where not disturbed.
   However, this material was generally removed during excavation and construction of the waste disposal sites and then incorporated into backfill materials
   The depth of the sites and thus, the backfull over these sites range from 0 m for ponds and unplanned releases, to an average of about 4.5 m for cribs and burial grounds, and upto 16.4 m for tanks.
4) Injection well 216-C-2 is screened from 15-40 ft. Well 299-E24-11 is 60 ft deep (Hanford Wells). Assume average depth of 50 ft..

Template 200A-x for surface disposal sites (e.g. Ponds)

										200A-2		200A-4	
Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**		K_d Class		K_d Class	
		0	690	Surface	NA	NA	NA	NA					
15	15	15	675	Eolian	Sand and Silt	S	Hss	HI		2H		4H	
15	15	30	660	Hanford Gravel	Slightly Silty pebbly very coarse to coarse sand	SG1	Hg	II		2I2		4I2	
200	203	233	457	South 200 East Sand	Slightly silty medium to coarse sand to coarse to fine sand	S	Hfs	II		2I1		4I1	
62	62	295	395	Hanford Gravel	Pebbly very coarse to coarse sand to medium to fine pebble	SG1	Hg	II		2I2		4I2	
10	10	305	385	Ringold Unit E	Silty sandy medium to fine pebble to sandy very coarse to fine pebble	SG2	Rg	II		2I2		4I2	
		305	385	Water Table	NA	NA	NA	NA		NA		NA	

Template 216A-x for shallow disposal sites (e.g. Cribs, Burial Grounds)

										216A-2	216A-3	216A-4	
Average Thickness (ft)	Adjusted Average Thickness (ft)	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**		K_d Class	K_d Class	K_d Class	
		0	690	Surface	NA	NA	NA	NA		NA	NA	NA	
15	15	15	675	Backfill	Backfill	B	B	HI		2H	3H	4H	
15	15	30	660	Hanford Gravel	Slightly Silty pebbly very coarse to coarse sand	SG1	Hg	HI		2H	3H	4H	
200	203	233	457	South 200 East Sand	Slightly silty medium to coarse sand to coarse to fine sand	S	Hfs	II		2I1	3I1	4I1	
62	62	295	395	Hanford Gravel	Pebbly very coarse to coarse sand to medium to fine pebble	SG1	Hg	II		2I2	3I2	4I2	
10	10	305	385	Ringold Unit E	Silty sandy medium to fine pebble to sandy very coarse to fine pebble	SG2	Rg	II		2I2	3I2	4I2	
		305	385	Water Table	NA			NA		NA	NA	NA	

Template 241A-3 for tanks

										241A-2	241A-3		
Average Thickness (ft)	Adjusted Average Thickness (ft)	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**		Kd Class	Kd Class		
		0	690	Surface	NA	NA	NA	NA		NA	NA		
50	50	50	640	Backfill	Backfill	B	B	HI		2H	3H		
180	183	233	457	South 200 East Sand	Slightly silty medium to coarse sand to coarse to fine sand	S	Hfs	HI		2H	3H		
62	62	295	395	Hanford Gravel	Pebbly very coarse to coarse sand to medium to fine pebble	SG1	Hg	II		2I2	3I2		
10	10	305	385	Ringold Unit E	Silty sandy medium to fine pebble to sandy very coarse to fine pebble	SG2	Rg	II		2I2	3I2		
		305	385	Water Table	NA	NA	NA	NA		2I2	3I2		
										NA	NA		

Template 266A-6 for deep injection sites (e.g. reverse wells 216-C-2)

												266A-4	
Average Thickness (ft)	Adjusted Average Thickness (ft)	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**				Kd Class	
		0	690	Surface	NA	NA	NA	NA				NA	
15	15	15	675	Eolian	Sand and silt	S	Hfs	II				4I1	
15	35	50	640	Hanford Gravel	Slightly Silty pebbly very coarse to coarse sand	SG1	Hg	HI				4H	
200	183	233	457	South 200 East Sand	Slightly silty medium to coarse sand to coarse to fine sand	S	Hfs	HI				4H	
62	62	295	395	Hanford Gravel	Pebbly very coarse to coarse sand to medium to fine pebble	SG1	Hg	II				4I2	
10	10	305	385	Ringold Unit E	Silty sandy medium to fine pebble to sandy very coarse to fine pebble	SG2	Rg	II				4I2	
		305	385	Water Table	NA	NA	NA	NA				NA	

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

BLUE = Injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone

VZ Base Templates - A_BC Cribs

BC-Cribs (216-B-14 through -19), South 200 East Area Stratigraphic Columns

Notes/Assumptions:

1) Topography ranges from 229m (751 ft) MSL northeast of the cribs to 227m (745') ft MSL southeast of the cribs (as taken from the Hanford Site Atlas).
2) The pre-Hanford Water Table (January 1944) is estimated to have been at an elevation of 387 ft (118 m) MSL (based on Kipp and Mud, 1974 - BNWL-B-360).
3) The site depth to the crib bottom is reported to be 13 ft (4 m) based on Maxfield, 1979 - RHO-CD-673. Thus, the backfill is assumed to be 13 ft deep.
4) However, the site was interim stabilized in 1981 by covering with a minium of 2 ft (0.61m) of clean soil and revegetated (WIDS).

Template 216A_BC_E-X for the Eastern corner of the BC crib area based on 299-E13-1 (N 134404.512, E 573655.723). **216A_BC_E-3**

Estimated Thickness (ft)***	Adjusted Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Class
		0	742	Surface	NA	NA	NA	NA
13	13	13	729	Backfill	Backfill	B	B	3H
9	9	22	720	Hanford Sand - horizontally bedded coarse sand (Sh[c])	Pebbly very coarse to medium sand to coarse to medium sand	S	Hcs_BC	3H
221	221	243	499	Handford Sand - horizontally bedded fine sand (Sh[f])	Coarse to fine sand to slightly silty coarse to fine sand	S	Hfs_BC	3I1
83	112	355	387	Ringold Unit E	Silty sandy coarse to fine pebble to slightly silty pebbly very coarse to medium sand	SG2	Rg	3I2
		355	387	Water Table	NA			NA

Template 216A_BC_W-X for the Western corner of the BC crib area based on 299-E13-6 (N 134341.797, E 573564.077). **216A_BC_W-3**

Estimated Thickness (ft)***	Adjusted Thickness (ft)	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Class
		0	742	Surface	NA	NA	NA	NA
13	13	13	729	Backfill	Backfill	B	B	3H
10	10	23	719	Hanford Sand - horizontally bedded coarse sand (Sh[c])	Pebbly very coarse to medium sand to coarse to medium sand	S	Hcs_BC	3H
215	215	238	504	Handford Sand - horizontally bedded fine sand (Sh[f])	Coarse to fine sand to slightly silty coarse to fine sand	S	Hfs_BC	3I1
98	117	355	387	Ringold Unit E	Silty sandy coarse to fine pebble to slightly silty pebbly very coarse to medium sand	SG2	Rg	3I2
		355	387	Water Table	NA			NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

*** Based on Fecht, Last, and Marratt, 1979 - RHO-LD-72.

BLUE = Injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates - A_BC Trenches

BC-Trenches (216-B-20 through -31, -52 through -54, and -58), South 200 East Area Stratigraphic Columns

Notes/Assumptions:

1) Topography ranges from 228.5 m (750 ft) MSL near the 216-B-58 trench to 225 m (738') ft MSL south of the 216-B-28 trench (as taken from the Hanford Site Atlas). Note however, that the site was interim stabilized in 1981 by covering with a minium of 2 ft

2) The pre-Hanford Water Table (January 1944) is estimated to have been at an elevation of 387 ft (118 m) MSL (based on Kipp and Mud, 1974 - BNWL-B-360).

3) The site depth to the trench bottom is reported to be 8 to 10 ft-min. (2.4-3 m) based on Maxfield, 1979 - RHO-CD-673. Thus, the backfill is assumed to be 10 ft deep.

Template 216A_BCT_W-X for the Western corner of the BC crib area based on 299-E13-6 (N 134341.797, E 573564.077).

								216A_BCT_W-3	
Estimated Thickness (ft)***	**Adjusted Thickness (ft)†**	**Depth (ft)**	**Elevation (ft)**	**Geologic Unit**	**Description**	**Hydraulic Property Type ***	**SAC Soil Type**	**Kd Class**	
		0	742	Surface	NA	NA	NA	NA	
13	13	13	729	Backfill	Backfill	B	B	3H	
10	10	23	719	Hanford Sand - horizontally bedded coarse sand (Sh[c])	Pebbly very coarse to medium sand to coarse to medium sand	S	Hcs_BC	3H	
215	215	238	504	Handford Sand - horizontally bedded fine sand (Sh[f])	Coarse to fine sand to slightly silty coarse to fine sand	S	Hfs_BC	3I1	
98	117	355	387	Ringold Unit E	Silty sandy coarse to fine pebble to slightly silty pebbly very coarse to medium sand	SG2	Rg	3I2	
		355	387	Water Table	NA			NA	

Template 216A_BCT_N-X for the northwestern corner of the BC trench area based on 299-E13-14 (N 134474.132, E 573087.497).

								216A_BCT_N-3	216A_BCT_N-4
Estimated Thickness (ft)***	**Adjusted Thickness (ft)**	**Depth (ft)**	**Elevation (ft)**	**Geologic Unit**	**Description**	**Hydraulic Property Type ***	**SAC Soil Type**	**Kd Class**	**Kd Class**
		0	745	Surface	NA	NA	NA	NA	NA
10	10	10	735	Backfill	Backfill	B	B	3H	4H
17	17	27	718	Hanford Sand - horizontally bedded coarse sand (Sh[c])	Pebbly very coarse to medium sand to coarse to medium sand	S	Hcs_BC	3H	4H
188	188	215	530	Handford Sand - horizontally bedded fine sand (Sh[f])	Coarse to fine sand to slightly silty coarse to fine sand	S	Hfs_BC	3I1	4I1
58	58	273	472	Hanford Sand - horizontally bedded coarse sand (Sh[c])	Slightly pebbly very coarse to medium sandy coarse to fine pebble	S	Hcs_BC	3I1	4I1
22	22	295	450	Handford Sand - horizontally bedded fine sand (Sh[f])	Coarse to fine sand to slightly silty coarse to fine sand	S	Hfs_BC	3I1	4I1
43	114	387	358	Ringold Unit E	Silty sandy coarse to fine pebble to slightly silty pebbly very coarse to medium sand	SG2	Rg	4I2	4I2
		358	387	Water Table	NA			NA	NA

Template 216A_BCT_S-X for the southwestern portion of the BC trench area based on 299-E13-12 (N 134146.593, E 573188.669).

								216A_BCT_S-3	216A_BCT_S-4
Estimated Thickness (ft)***	**Adjusted Thickness (ft)**	**Depth (ft)**	**Elevation (ft)**	**Geologic Unit**	**Description**	**Hydraulic Property Type ***	**SAC Soil Type**	**Kd Class**	**Kd Class**
		0	731	Surface	NA	NA	NA	NA	NA
10	10	10	721	Backfill	Backfill	B	B	3H	4H
187	187	197	534	Handford Sand - horizontally bedded fine sand (Sh[f])	Coarse to fine sand to slightly silty coarse to fine sand	S	Hfs_BC	3I1	4I1
87	87	284	447	Hanford Sand - horizontally bedded coarse sand (Sh[c])	Slightly pebbly very coarse to medium sandy coarse to fine pebble	S	Hcs_BC	3I1	4I1
5	5	289	442	Handford Sand - horizontally bedded fine sand (Sh[f])	Coarse to fine sand to slightly silty coarse to fine sand	S	Hfs_BC	3I1	4I1
35	98	387	344	Ringold Unit E	Silty sandy coarse to fine pebble to slightly silty pebbly very coarse to medium sand	SG2	Rg	3I2	4I2
		344	387	Water Table	NA			NA	NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

*** Based on Fecht, Last, and Marratt, 1979 - RHO-LD-72.

BLUE = Injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates - A_ILAW
South 200 East Area (ILAW) Stratigraphic Columns

Notes/Assumptions:

1) Thicknesses, elevation, and water table are averages from wells 299-W17-21, 299-E17-23, and 199-E17-25 for the south template, averages from wells 299-
2) A thin blanket of eolian sand and silt covers the surface of the site where not disturbed. This is ignored because ILAW activities will remove this unit prior to
3) All data from PNNL-11957, PNNL-13652, and PNNL-14029
4) Coordinates are for well 299-E17-21 (south template), 299-E24-7 (central template), and 299-E24-21 (north template)

Template 216A_ILAW_S-X for the southern portion of the ILAW site. Nearsu Easting = 574,107 m, Northing = 134,893 m **200A_ILAW_S-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
			736	Surface	NA	NA	NA	NA	
50	**50**	**0**	**736**	**Backfill**	**Sand and gravel**	**B**	**B**	**HI**	**4H**
187	187	50	686	Hanford formation, sand-dominated	Sand (S2)	S	Hfs	HI	4H
11	11	237	499	Hanford formation, gravel-dominated	Gravelly sand to sandy gravel (G3)	SG1	Hg	II	4I2
11	11	248	488	Hanford formation, sand-dominated	Sand (S3)	S	Hfs	II	4I1
75	75	259	477	Hanford formation, gravel-dominated	Gravel to sandy gravel (G4)	SG2	Rg	II	4I2
		334	402	Water Table	NA	NA	NA	NA	NA

Template 216A-ILAW_C-X for the central portion of the ILAW site. Nearsurfa Easting = 574,407 m, Northing = 135,560 m **200A_ILAW_C-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	Hydraulic Property Type *	Kd Zone**	Kd Class
			718	Surface	NA	NA	NA	NA	
50	**50**	**0**	**718**	**Backfill**	**Sand and Gravel**	**B**	**B**	**HI**	**4H**
164	164	50	668	Hanford formation, sand dominated	Sand (S2)	S	Hfs	HI	4H
20	20	214	504	Hanford formation, gravel dominated	Gravelly sand to sandy gravel (G3)	SG1	Hg	II	4I2
33	33	234	484	Hanford formation, sand dominated	Sand (S3)	S	Hfs	II	4I1
51	51	267	451	Hanford formation, gravel dominated	Gravel to sandy gravel (G4)	SG2	Rg	II	4I2
		318	400	Water Table	NA	NA	NA	NA	NA

Template 216A-ILAW_N-X, for the northern portion of the ILAW Site. Surfac Easting = 574,636 m, Northing = 135,698 m **200A_ILAW_N-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	Hydraulic Property Type *	Kd Zone**	Kd Class
			714	Surface	NA	NA	NA	NA	
50	**50**	**0**	**714**	**Backfill**	**Sand and Gravel**	**B**	**B**	**HI**	**4H**
168	168	50	664	Hanford formation, sand dominated	Sand (S2)	S	Hfs	HI	4H
14	14	218	496	Hanford formation, gravel dominated	Gravelly sand to sandy gravel (G3)	SG1	Hg	II	4I2
38	38	232	482	Hanford formation, sand dominated	Sand (S3)	S	Hfs	II	4I1
48	48	270	444	Hanford formation, gravel dominated	Gravel to sandy gravel (G4)	SG2	Rg	II	4I2
		318	396	Water Table	NA	NA	NA	NA	NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

*** Based on Fecht, Last, and Marratt, 1979 - RHO-LD-72.

BLUE = Injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates B

North 200 East Area (B Plant facilities and burial grounds) Stratigraphic Columns

Notes/Assumptions:

1) Topography ranges from 700 ft MSL east of B Plant to 590 ft MSL in the northeast corner of 200 East Area (USGS Gable Butte 7.5 min. Quadrangle Map).
   Will assume an average elevation of 645 ft MSL.
2) The pre-Hanford Water Table (January 1944) is estimated to range from an elevation of 116 m (380 ft) in the eastern part of 200 East to 119 m (390 ft) in the western part (BNWL-B-360).
   Will assume an average water table elevation of 117 m (385 ft) MSL.
3) A thin blanket of eolian sand and silt covers the surface of the site where not disturbed.
   However, this material was generally removed during excavation and construction of the waste disposal sites and then incorporated into backfill materials.
   The depth of the sites and thus, the backfull over these sites range from 0 m for ponds and unplanned releases, to an average of about 4.5 m for cribs and burial grounds, and up to 16.4 m for tanks.
4) Five reverse wells are located in this area ranging in depth from 15 - 92 m. Assume average depth of 50m (164ft), with an average preforated interval of 11.5 m (38 ft).
5) Injection well 216-B-4 is 108' deep; 216-B-5 is perfed 252-302'; 216-B-6 is perfed 73-75'

Template 200B-X for surface disposal sites (e.g. Buildings, Ponds, Ditches, Unplanned Releases)

									200B-2	200B-3	200B-4
Average Thickness (ft)	**Adjusted Average Thickness (ft)†**	**Depth (ft)**	**Elevation (ft)**	**Geologic Unit**	**Description**	**Hydraulic Property Type ***	**SAC Soil Type**	**K_d Zone****	**K_d Class**	**K_d Class**	**K_d Class**
		0	645	Surface	NA	NA	NA	NA	NA	NA	NA
2	2	2	643	Eolian	Sand and silt	S	Hss	HI	2H	3H	4H
60	64	66	579	Hanford Gravel	Silty sandy medium to fine pebble to slightly silty pebbly very coarse to coarse sand	SG1	Hg	HI	2H	3H	4H
173	183	249	396	North 200 East Hanford Sand	Coarse to medium sand to slightly pebbly slightly silty coarse to medium sand	S	Hcs	II	2I1	3I1	4I1
10	11	260	385	Undifferenciated Hanford/Plio-Pleistocene	Pebbly very coarse to coarse sand to sandy medium to fine pebble	SG1	Hg	II	2I2	3I2	4I2
		260	385	Water Table	NA	NA	NA	NA	NA	NA	NA

Template 216B-X for shallow disposal sites (e.g. Cribs, Burial Grounds)

									216B-2	216B-3	216B-4
Average Thickness (ft)	**Adjusted Average Thickness (ft)†**	**Depth (ft)**	**Elevation (ft)**	**Geologic Unit**	**Description**	**Hydraulic Property Type ***	**SAC Soil Type**	**K_d Zone****	**K_d Class**	**K_d Class**	**K_d Class**
		0	645	Surface	NA	NA	NA	NA	NA	NA	NA
15	*15*	*15*	*630*	*Backfill*	*Backfill*	B	B	NA	2H	3H	4H
47	51	*66*	*579*	Hanford Gravel	Silty sandy medium to fine pebble to slightly silty pebbly very coarse to coarse sand	SG1	Hg	HI	2H	3H	4H
173	183	249	*396*	North 200 East Hanford Sand	Coarse to medium sand to slightly pebbly slighly silty coarse to medium sand	S	Hcs	II	2I1	3I1	4I1
10	11	260	*385*	Undifferenciated Hanford/Plio-Pleistocene	Pebbly very coarse to coarse sand to sandy medium to fine pebble	SG1	Hg	II	2I2	3I2	4I2
20	20	260	*385*	Water Table	NA	NA	NA	NA	NA	NA	NA

Template 241B-X for tanks

									241B-2		
Average Thickness (ft)	**Adjusted Average Thickness (ft)†**	**Depth (ft)**	**Elevation (ft)**	**Geologic Unit**	**Description**	**Hydraulic Property Type ***	**SAC Soil Type**	**K_d Zone****	**K_d Class**		
		0	645	Surface	NA	NA	NA	NA	NA		
50	50	50	595	*Backfill*	*Backfill*	B	B	NA	2H		
12	16	66	579	Hanford Gravel	Silty sandy medium to fine pebble to slightly silty pebbly very coarse to coarse sand	SG1	Hg	HI	2H		
173	183	249	396	North 200 East Hanford Sand	Coarse to medium sand to slightly pebbly slightly silty coarse to medium sand	S	Hcs	II	2I1		
10	11	260	385	Undifferenciated Hanford/Plio-Pleistocene	Pebbly very coarse to coarse sand to sandy medium to fine pebble	SG1	Hg	II	2I2		
		260	385	Water Table	NA	NA	NA	NA	NA		

Template 266B-X for deep injection sites (e.g. reverse wells - except 216-B-5 (a).

											266B-4
Average Thickness (ft)	**Adjusted Average Thickness (ft)†**	**Depth (ft)**	**Elevation (ft)**	**Geologic Unit**	**Description**	**Hydraulic Property Type ***	**SAC Soil Type**	**K_d Zone****			**K_d Class**
		0	645	Surface	NA	NA	NA	NA			NA
2	2	2	643	Eolian	Sand and silt	S	Hss	NA			4I1
60	64	66	579	Hanford Gravel	Silty sandy medium to fine pebble to slightly silty pebbly very coarse to coarse sand	SG1	Hg	NA			4I2
	60	126	519	North 200 East Hanford Sand	Coarse to medium sand to slightly pebbly slightly silty coarse to medium sand	S	Hcs	NA			4I1
	98	164	481			S	Hcs	NA			4H
173	183	249	396			S	Hcs	II			4H
10	11	260	385	Undifferenciated Hanford/Plio-Pleistocene	Pebbly very coarse to coarse sand to sandy medium to fine pebble	SG1	Hg	*HI*			4I2
		260	385	Water Table	NA	NA	NA	*NA*			NA

(a) Injection well 216-B-4 is 108' deep; 216-B-5 is perfed 252-302'; 216-B-6 is perfed 73-75'

Template 267B-X for very deep injection sites (i.e., the 216-B-5 reverse well (a))

									267B-2		
Average Thickness (ft)	**Adjusted Average Thickness (ft)†**	**Depth (ft)**	**Elevation (ft)**	**Geologic Unit**	**Description**	**Hydraulic Property Type ***	**SAC Soil Type**	**K_d Zone****	**K_d Class**		
		0	645	Surface	NA	NA	NA	NA	NA		
2	2	2	643	Eolian	Sand and silt	S	Hss	NA	2I1		
60	64	66	579	Hanford Gravel	Silty sandy medium to fine pebble to slightly silty pebbly very coarse to coarse sand	SG1	Hg	NA	2I2		
	183	249	396	North 200 East Hanford Sand	Coarse to medium sand to slightly pebbly slightly silty coarse to medium sand	S	Hcs	NA	2I1		
10	3	252	393	Undifferenciated Hanford/Plio-Pleistocene	Pebbly very coarse to coarse sand to sandy medium to fine pebble	S	Hcs	NA	2H		
10	8	260	385			SG1	Hg	*HI*	2H		
		260	385	Water Table	NA	NA	NA	*NA*	NA		

* After Khaleel and Freeman (1995)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

BLUE = Injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates C

100-B/C Stratigraphic Columns

Notes/Assumptions:

1) Elevation ranges from 500 ft AMSL in the south to about 400 ft AMSL to the north along the rivers edge (USGS Vernita Bridge and Riverland 7.5 min. Quad Maps).
   Average elevation near retention basins ~440 ft and increases to the south (up to 460 ft) away from the river.
2) The water table ranges from an elevation of 122 m (400.3 ft) to 123 m (403.5 ft) (Hartman and Dresel 1998).
   Assume an average water table elevation of 122.5 m (402 ft) AMSL
3) A thin (≤1m) blanket of eolian or fluvial sand or silt may cover the surface of the site where not disturbed. Some backfill may also be present but it is not documented in existing reports.
4) No reverse wells are located in this aggregate area.

Template 100C-X - For surface disposal sites (i.e. reactors) **100C-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	**460**	**Surface**	**NA**	**NA**	**NA**	**HI**	**4H**
	30	30	430	Hanford fm gravel	Silty sandy pebble to boulder gravel with lenses of gravelly medium to coarse sand. (DOE 1993)	SG1	Hg	HI	4H
	28	58	402			SG1	Hg	II	4I2
		58	402	Water Table	NA	NA	NA	NA	NA

Template 116C-X - For shallow disposal sites (i.e. cribs, trenches, burial grounds, sand filter) **116C-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	460	Surface	NA	NA	NA	NA	NA
	15	15	445	Backfill		B	B	HI	4H
	30	45	415	Hanford fm gravel	Silty sandy pebble to boulder gravel with lenses of gravelly medium to coarse sand. (DOE 1993)	SG1	Hg	HI	4H
	13	58	402			SG1	Hg	II	4I2
		58	402	Water Table	NA	NA	NA	NA	NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

BLUE = injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates D

100-D/DR Stratigraphic Columns

Notes/Assumptions:

1) Surface elevation ranges from 470 ft MSL along the southern boundary to about 390 ft MSL to the northwest along rivers edge (USGS Coyote Rapids 7.5 min. Quad Map).
   Will assume an average elevation of 460 ft MSL.
2) Water table ranges from an elevation of 116.5 m (382 ft) along the eastern boundary to 119 m (390.5 ft) to the northwest (DOE 1993, Hartman and Dresel 1998).
   Will assume an average water table elevation of 118 m (387 ft) MSL.
3) A thin (≤1m) blanket of eolian or fluvial sand or silt may cover the surface of the site where not disturbed. Some backfill may also be present but it is not well documented in existing reports.
4) No reverse wells are located in the 100-D/DR aggregate area.

Template 100D-X - For surface disposal sites (i.e. reactors) **100D-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	460	**Surface**	**NA**	**NA**	**NA**	**NA**	**NA**
	30	30	430	Hanford fm gravel	Sandy gravel and gravelly sand, with local sandy and silty interbeds (Peterson et. al., 1996)	SG1	Hg	HI	4H
	23	53	407			SG1	Hg	II	4I2
	20	73	387	Ringold Unit E	Silty sandy gravel	SG2	Rg	II	4I2
		73	387	Water Table		NA	NA	NA	NA

Template 116D-X - For shallow disposal sites (i.e. cribs, trenches, burial grounds, sand filter) **116D-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	460	Surface	NA	NA	NA	NA	NA
	15	17	443	Backfill		B	B	HI	4H
	30	47	413	Hanford fm gravel	Sandy gravel and gravelly sand, with local sandy and silty interbeds (Peterson et. al., 1996)	SG1	Hg	HI	4H
	6	53	407			SG1	Hg	II	4I2
	20	73	387	Ringold Unit E	Silty sandy gravel	SG2	Rg	II	4I2
		73	387	Water Table		NA	NA	NA	NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

BLUE = injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates E

East 200 East Area (B-Pond) Stratigraphic Columns

Notes/Assumptions:

1) Topography ranges from460 to 650 ft (137 to 198 m) MSL (USGS Gable Butte 7.5 min. Quadrangle Map).
   Will assume an average elevation of 169 m (555 ft) MSL.
2) The pre-Hanford Water Table (January 1944) is estimated to range from an elevation of 113 m (370 ft) to 116 m (380 ft) MSL (BNWL-B-360).
   Will assume an average water table elevation of 115 m (375 ft) MSL.
3) A thin blanket of eolian sand and silt covers the surface of the site where not disturbed.
   However, this material was generally removed during excavation and construction of the waste disposal sites and then incorporated into backfill materials.
4) The depth of the sites and thus, the backfull over these sites range from 0 m for ponds and unplanned releases, to an average of about 4.5 m for cribs and burial grounds, and upto 16.4 m for tanks.

Template 200E-X for surface disposal sites (e.g. Ponds) **200E-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	555	Surface	NA	NA	NA	HI	4H
3	3	3	552	Eolian	Sand and silt	S	Hss	HI	4H
12	11	14	541	Hanford Gravel	Silty sandy gravel to sandy gravel to gravelly sand	SG1	Hg	HI	4I2
62	58	72	483	Hanford sand	Slightly pebbly, slightly silty coarse to medium sand to coarse to fine sand	S	Hcs	II	4I1
85	79	151	404	Hanford gravel	Sandy gravel to silty sandy gravel	SG1	Hg	II	4I2
30	28	179	376	Ringold Lower Mud	silt, sandy silt	SS	PPlz	II	4I1
		180	375	Water Table	NA	NA	NA	NA	NA

BLUE = injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates F

100-F Stratigraphic Columns

Notes/Assumptions:

1) Surface elevation ranges from 420 ft MSL within the north-central 100-F Area to about 380 ft MSL to the northeast along rivers edge (USGS Locke Island 7.5 min. Quad Map).
   Will assume an average elevation of 410 ft MSL.
2) Water table ranges from an elevation of 113.5 m (372 ft) in the southeast to 115 m (377 ft) to the north (Hartman and Dresel 1998).
   Will assume an average water table elevation of 114 m (374 ft) MSL.
3) A thin (≤1m) blanket of eolian or fluvial sand or silt may cover the surface of the site where not disturbed. Some backfill may also be present but it is not well documented in existing reports.
4) No reverse wells are located in the 100-F aggregate area.

Template 100F-X for surface disposal sites (i.e. reactors) **100F-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	**410**	**Surface**	**NA**	**NA**	**NA**	**NA**	**NA**
	30	30	380	Hanford Gravel	Sandy gravel to silty sandy gravel (Peterson et al. 1996). Gravel-dominated with subordinate sand-dominated facies (Raidl 1994).	SG1	Hg	HI	4H
	6	36	374			SG1	Hg	II	4I2
		36	374	Water Table	NA	NA	NA	NA	NA

Template 116F-X for shallow disposal sites (e.g. cribs, trenches, burial grounds, sand filter) **116F-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	410	Surface	NA	NA	NA	NA	NA
	15	15	395	Backfill		B	B	HI	4H
	21	36	374	Hanford fm gravel	Sandy gravel to silty sandy gravel (Peterson et al. 1996). Gravel-dominated with subordinate sand-dominated facies (Raidl 1994).	SG1	Hg	HI	4H
		36	374	Water Table	NA	NA	NA	NA	NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

BLUE = injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates G

200 North Area and Gable Mountain Pond (Aggregate Area G) Stratigraphic Columns

Notes/Assumptions:

1) Topography ranges from 435 ft MSL at Gable Mountain Pond to 584 ft MSL in the 200 North Area (DOE/RL-92-17).
   Will assume an average elevation of 510 ft MSL.
2) The pre-Hanford Water Table (January 1944) is estimated to range from an elevation of 116 m (380 ft) to 119 m (390 ft) (BNWL-B-360).

   Will assume an average water table elevation of 117 m (385 ft) MSL.
3) A thin blanket of eolian sand and silt covers the surface of the site where not disturbed.
   However, this material was generally removed during excavation and construction of the waste disposal sites and then incorporated into backfill materials.
   The depth of the sites and thus, the backfull over these sites range from 0 m for ponds and unplanned releases, to an average of about 4.5 m for cribs and burial grounds.
4) There are no tanks or reverse wells in this aggregate area.

Template 200G-X for surface disposal sites (e.g. Ponds, trenches, buildings) **200G-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	510	Surface	NA	NA	NA	NA	NA
3	3	3	507	Eolian	Sand and silt	S	Hss	HI	4H
122	121	124	386	Undifferenciated Hanford formation	coarse gravel and sand to silty sandy gravel	SG1	Hg	HI	4H
		125	385	Water Table	NA	NA	NA	NA	NA

Template 216G-X for shallow disposal sites (e.g. Cribs) **216G-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	510	Surface	NA	NA	NA	NA	NA
15	15	15	495	Backfill	Backfill	B	B	HI	4H
110	109	124	386	Undifferenciated Hanford formation	Coarse gravel and sand to silty sandy gravel	SG1	Hg	HI	4H
		125	385	Water Table	NA	NA	NA	NA	NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

BLUE = Injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates H

100-H Stratigraphic Columns

Notes/Assumptions:

1) Surface elevation ranges from 425 ft MSL in the center of the 100-H Area to about 380 ft MSL along rivers edge to the northeast (USDOE, Hanford Site Topography - Locke Island, Bechtel Job #22192; USGS Locke Island 7.5 min. Quad Map).
   Will assume an average elevation of 415 ft MSL.
2) Water table ranges from an elevation of 116 m (380 ft) to the south to 117 m (384 ft) to the northeast (Hartman and Dresel 1998).
   Will assume an average water table elevation of 116.5 m (382 ft) MSL.
3) A thin (≤1m) blanket of eolian or fluvial sand or silt may cover the surface of the site where not disturbed. Locally, up to 15 ft of backfill may also be present (Peterson et al. 1996) but it is not well documented in existing reports.
4) There are no reverse (injection wells) in the 100-H Aggregate Area.

Template 100H-X for surface disposal sites (i.e., retention basins) **100H-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	415	**Surface**	**NA**	**NA**	**NA**	**NA**	**NA**
	30	30	385	Hanford fm gravel	Sandy gravel with subordinate gravelly sand (Peterson et. al. 1996)	SG1	Hg	HI	4H
	3	33	382			SG1	Hg	II	4I2
		33	382	Water Table	NA	NA	NA	NA	NA

Template 116H-X for shallow disposal sites (e.g. cribs, trenches, burial grounds) **116H-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	415	Surface	NA	NA	NA	NA	NA
	15	15	400	Backfill		B	B	HI	4H
	18	33	382	Hanford fm gravel	Sandy gravel with subordinate gravelly sand (Peterson et. al. 1996)	SG1	Hg	HI	4H
		33	382	Water Table	NA	NA	NA	NA	NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

BLUE = injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates I

200 North Area (Aggregate Area I) Stratigraphic Columns

Notes/Assumptions:

1) Topography ranges from 580 ft MSL near 216-N-3 in the NW portion of this geographic area, to 540 ft MSL beneath the old 216-N-6 Pond in the SE portion of the area (Gable Butte Quadrangle, 7.5 Minute Series, 1986).
   Will assume an average elevation of 565 ft MSL.
2) The pre-Hanford Water Table (January 1944) is estimated at an elevation of 395 ft (BNWL-B-360).

   Will assume an average water table elevation of 395 ft MSL.
3) Stratigraphy based on asbuilt drawings of 699-55-60A,B, and -51-63. A thin blanket of top soil (eolian sand and silt) covers the surface of However, this material was generally removed during excavation and construction of the waste disposal sites and then incorporated into backfill materials.
   The depth of the sites and thus, the backfull over these sites range from 0 m for ponds and unplanned releases, to an average of about 4.5 m for cribs and burial grounds.
4) There are no tanks or reverse wells in this aggregate area.

Template 200G-X for surface disposal sites (e.g. Ponds, trenches, buildings)

									200I-4
Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	565	Surface	NA	NA	NA	NA	NA
3	3	3	562	Eolian	Sand and silt	S	Hss	HI	4H
122	172	175	390	Undifferenciated Hanford formation	Gravel and sand to boulders	SG1	Hg	HI	4H
		175	390	Water Table	NA	NA	NA	NA	NA

STOMP Node Ranges			200I-4
# Nodes	Node Index Start	Node Index End	
6	345	350	Hss(4H),1,1,1,1,345,350,
344	1	344	Hg(4H),1,1,1,1,1,344,

Template 216G-X for shallow disposal sites (e.g. Cribs)

									216I-4
Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	565	Surface	NA	NA	NA	NA	NA
15	15	15	550	Backfill	Backfill	B	B	HI	4H
110	160	175	390	Undifferenciated Hanford formation	Gravel and sand to boulders	SG1	Hg	HI	4H
		175	390	Water Table	NA	NA	NA	NA	NA

STOMP Node Ranges			216I-4
# Nodes	Node Index Start	Node Index End	
30	321	350	B(4H),1,1,1,1,321,350,
320	1	320	Hg(4H),1,1,1,1,1,320,

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

BLUE = Injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates K
100-K Stratigraphic Columns

Notes/Assumptions:

1) Surface elevation ranges from 515 ft MSL in adjacent waste sites south of K Area to about 390 ft MSL to the northwest along rivers edge (USGS Coyote Rapids 7.5 min. Quad Map).
   Will assume an average elevation of 480 ft MSL, except injection wells which have projected surface elevation of 465 ft MSL.

2) Water table ranges from an elevation of 121 m (397 ft) to the northeast to 121.5 m (399 ft) to the south (Hartman and Dresel 1998).
   Will assume an average water-table elevation of 121.5 m (399 ft) MSL.
3) A thin (<1m) layer of eolian or fluvial sand or silt may cover the surface of the site where not disturbed (Lindberg 1995).
4) Two injection wells (116-KE-3 and 116-KE-2) extend 10 ft into water table, and approximately 10 ft of the perforated casings extend above

Template 100K-X for surface disposal sites (i.e. ponds and reactors) **100K-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**	K_d Class
		0	480	**Surface**	NA	**NA**	**NA**	**NA**	**NA**
	30	30	450	Hanford fm gravel	Sandy gravel to silty sandy gravel intercalated with gravelly sand to sand (Lindberg 1995, Peterson et. al. 1996)	SG1	Hg	HI	4H
	15	45	435			SG1	Hg	II	4I2
	36	81	399	Ringold Unit E	Fluvial sandy gravel to silty sandy gravel (Lindberg 1995)	SG2	Rg	II	4I2
		81	399	Water Table	NA	NA	NA	NA	NA

Template 116K-X for shallow disposal sites (e.g. cribs, trenches, burial grounds) **116K-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**	K_d Class
		0	480	**Surface**	NA	**NA**	**NA**	**NA**	**NA**
	15	15	465	Backfill	Loose sandy gravel to silty sandy gravel	B	B	HI	4H
	30	45	435	Hanford fm gravel	Sandy gravel to silty sandy gravel intercalated with gravelly sand to sand (Lindberg 1995, Peterson et. al. 1996)	SG1	Hg	HI	4H
	36	81	399	Ringold Unit E	Fluvial sandy gravel to silty sandy gravel (Lindberg 1995)	SG2	Rg	II	4I2
		81	399	Water Table	NA	NA	NA	NA	NA

Template 166K-X for deep disposal sites (e.g. reverse wells) **166K-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**	K_d Class
		0	465	**Surface**	NA	**NA**	**NA**	**NA**	**NA**
	20	20	445	Backfill	Loose sandy gravel to silty sandy gravel	B	B	II	4I2
	20	40	425	Hanford fm gravel	Sandy gravel to silty sandy gravel intercalated with gravelly sand to sand (Lindberg 1995, Peterson et. al. 1996)	SG1	Hg	II	4I2
	16	56	409	Ringold Unit E	Fluvial sandy gravel to silty sandy gravel (Lindberg 1995)	SG2	Rg	II	4I2
	10	66	399		Lowermost 10 feet of reverse wells are open to the vadose zone	SG2	Rg	HI	4H
		66	399	Water Table	NA	NA	NA	NA	NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

BLUE = injection/release point

Red indicates changes based on e-mails from Cantrel to Last (12/19/01) and Freeman to Last (12/27/01)

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates M

600 Area (M) Stratigraphic Columns (618-11)

Notes/Assumptions:

1) Assume an average elevation of 450 ft (137.2 m) MSL. (USGS Topo - Richland, Wash, 15 min. Quad. 1951)
2) Assume an average water table elevation of 389 ft (118.5m) MSL. (Groundwater Monitoring Report, 2002, PNNL-14187).
3) Lithofacies taken from Well Logs (699-13-3A). In Hanford Well Log Library Sigma V.

Template 600M-X for surface disposal sites (e.g. Trenches, ponds, unplanned releases) **600M-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	445	Surface	NA	NA	NA	NA	NA
	6	6	439	Hanford Hfs	Silty Silty Sand	S	Hcs	HI	4H
	12	18	427	Hanford Hg	Sandy Gravel	SG1	Hg	II	4I2
	22	40	405	Hanford Hgs	Gravelly Sand	GS	Hgs	II	4I1
	10	50	395	Hanford Hg	Gravel	SG1	Hg	II	4I2
	8	58	387	Ringold Rg	Gravelly Sand (Ringold Formation)	SG2	Rg	II	4I2
		58	387	Water Table	NA	NA	NA	NA	NA

Template 616M-X for shallow disposal (e.g. cribs, burial grounds) **616M-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	380	Surface	NA	NA	NA	NA	NA
	15	15	430	Backfill		B	B	HI	4H
	3	18	427	Hanford Hg	Sandy Gravel	SG1	Hg	II	4I2
	22	40	405	Hanford Hgs	Gravelly Sand	GS	Hgs	II	4I1
	10	50	395	Hanford Hg	Gravel	SG1	Hg	II	4I2
	8	58	387	Ringold Rg	Gravelly Sand (Ringold Formation)	SG2	Rg	II	4I2
		58	387	Water Table	NA	NA	NA	NA	NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000).

** HI = high impact, II = Intermediate Impact, (After Composite Analysis)

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates N

100-N Stratigraphic Columns

Notes/Assumptions:

1) Surface elevation ranges from 460 ft MSL in the center of the 100-N Area to about 390 ft MSL along the rivers edge to the northwest (USGS Coyote Rapids 7.5 min. Quad Map).
   Will assume an average elevation of 455 ft MSL.
2) Water table ranges from an elevation of 119 m (390 ft) to the east to 120.5 m (395 ft) to the west (Hartman and Dresel 1998).
   Will assume an average water table elevation of 119.5 m (392 ft) MSL.
3) A thin (≤1m) blanket of eolian or fluvial sand or silt may cover the surface of the site where not disturbed. Locally, backfill may also be present but it is not well documented in existing reports.
4) There are no reverse (injection wells) in the 100-N Aggregate Area.

Template 100N-X for surface disposal sites (i.e., ponds and reactor) **100N-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	455	**Surface**	**NA**	**NA**	**NA**	**NA**	**NA**
	30	30	425	Hanford fm gravel	Glaciofluvial sandy pebble to boulder gravel (Hartman and Lindsey 1993)	SG1	Hg	HI	4H
	10	40	415			SG1	Hg	II	4I2
	23	63	392	Ringold Unit E	Fluvial, sandy pebble to cobble gravel (Hartman and Lindsey 1993)	SG2	Rg	II	4I2
		63	392	Water Table	NA	NA	NA	NA	NA

Template 116N-X for shallow disposal sites (e.g. cribs and trenches) **116N-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	Hydraulic Property Type *	Kd Zone**	Kd Class
		0	455	Surface	NA	NA	NA	NA	NA
	15	15	440	Backfill		B	B	HI	4H
	25	40	415	Hanford fm gravel	Glaciofluvial sandy pebble to boulder gravel (Hartman and Lindsey 1993)	SG1	Hg	HI	4H
	23	63	392	Ringold Unit E	Fluvial, sandy pebble to cobble gravel (Hartman and Lindsey 1993)	SG2	Rg	II	4I2
		63	392	Water Table	NA	NA	NA	NA	NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

BLUE = injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates P

600 Area (P) Stratigraphic Columns (316-4, 618-10)

Notes/Assumptions:

1) Assume an average elevation of 440 ft (134.1 m) MSL. (USGS Topo - Richland, Wash, 15 min. Quad. 1951)
2) Assume an average water table elevation of 375.7 ft (114.5m) MSL. (Groundwater Monitoring Report, 2002, PNNL-14187).
3) Lithofacies taken from Well Logs (699-S6-E4A). In Hanford Well Log Library Sigma V.

Template 600P-X for surface disposal sites (e.g. Trenches, ponds, unplanned releases) **600P-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	445	Surface	NA	NA	NA	NA	NA
	35	35	410	Hanford Hcs	Grey to Black Basaltic Sand	S	Hcs	HI	4H
	35	70	375	Hanford Hg	Gravel with sand and small amount of clay	SG1	Hg	II	4I2
		70	375	Water Table	NA	NA	NA	NA	NA

Template 616P-X for shallow disposal (e.g. cribs, burial grounds) **616P-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	380	Surface	NA	NA	NA	NA	NA
	15	15	430	Backfill		B	B	HI	4H
	20	35	410	Hanford Hcs	Grey to Black Basaltic Sand	S	Hcs	HI	4H
	35	70	375	Hanford Hg	Gravel with sand and small amount of clay	SG1	Hg	II	4I2
		70	375	Water Table	NA	NA	NA	NA	NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000).

** HI = high impact, II = Intermediate Impact, (After Composite Analysis)

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates Q

400 Area (Q) Stratigraphic Columns

Notes/Assumptions:

1) Assume an average elevation of 540 ft (164.6m) MSL. (USGS Topo - Richland, Wash, 15 min. Quad. 1951)
2) Assume an average water table elevation of 392 ft (119.5m) MSL. (Groundwater Monitoring Report, 2001, PNNL-13788).
3) Lithofacies taken from Summary Report, FFTF Well No. 4 (499-S1-8J) in Project Inspection Log Book Project V-749, Meier Associates, Inc. and well logs for 499-S1-7B. In Hanford Well Log Library Sigma V.

Template 400Q-X for surface disposal sites (e.g. Trenches, ponds, unplanned releases) **400Q-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	540	Surface	NA	NA	NA	NA	NA
	54	54	486	Hanford Hfs	Fine sand to silty medium sand, with occational lenses of coarse sand.	S	Hfs	HI	4H
	70	124	416	Hanford Hss	Silty fine to medium sand.	S	Hss	II	4I1
	24	148	392	Hanford Hcs	Interbedded gravelly sand, and silty sand, and silty gravel.	S	Hcs	II	4I1
		148	392	Water Table	NA	NA	NA	NA	NA

Template 416Q-X for shallow disposal (e.g. cribs, burial grounds) **416Q-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	380	Surface	NA	NA	NA	NA	NA
	15	15	525	Backfill		B	B	HI	4H
	39	54	486	Hanford Hfs	Fine sand to silty medium sand, with occational lenses of coarse sand.	S	Hfs	HI	4H
	70	124	416	Hanford Hss	Silty fine to medium sand.	S	Hss	II	4I1
	24	148	392	Hanford Hcs	Interbedded gravelly sand, and silty sand, and silty gravel.	S	Hcs	II	4I1
		148	392	Water Table	NA	NA	NA	NA	NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000).

** HI = high impact, II = Intermediate Impact, (After Composite Analysis)

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates R

300 Area (R) Stratigraphic Columns

Notes/Assumptions:

1) Assume an average elevation of 380 ft (115.8m) MSL. (Schalla et. al, 1988)
2) Assume an average water table elevation of 347 ft (106m) MSL. (Groundwater Monitoring Report, 1999).
   Waterlevels flucutate daily, weekly and seasonally up to a meter depending on postion relative to the river
   Water levels have been increasing recently due to irrigation west of 300 Area
3) Lithofacies after Lindsey, 89, 91 and Gaylord Lindsey, 90; Lithofacies are highly varible in thickness and extent because of the fluvial nature of depostion

Template 300R-X for surface disposal sites (e.g. Trenches, ponds, unplanned releases) **300R-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	380	Surface	NA	NA	NA	NA	NA
2	2	2	378	Eolian	Sand and silt (absent for trenches and ponds)	S	Hss	HI	4H
37	37	39	341	Hanford Hg	Gravel (Cobble/boulder to gravel/pebble lithofacies after Lindsey, 89, 91 and Gaylord Lindsey, 90)	SG1	Hg	HI	4H
71	71	110	270	Ringold Rg	Fluvial gravel lithofacies; sandy granule- to pebble-sized gravel	SG2	Rg	II	4I2
61	61	171	209	Ringold Rm	massive to laminated silt; sand comprises up to 10%	SS	PPlz	II	4I2
70		171	209	Water Table	NA	NA	NA	NA	NA

Template 316R-X for surface disposal sites (e.g. Trenches, ponds, unplanned releases) **316R-4**

Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Zone**	Kd Class
		0	380	Surface	NA	NA	NA	NA	NA
15	15	15	365	Backfill		B	B	HI	4H
37	24	39	341	Hanford Hg	Gravel (Cobble/boulder to gravel/pebble lithofacies after Lindsey, 89, 91 and Gaylord Lindsey, 90)	SG1	Hg	HI	4H
71	71	110	270	Ringold Rg	Fluvial gravel lithofacies; sandy granule- to pebble-sized gravel	SG2	Rg	II	4I2
61	61	171	209	Ringold Rm	massive to laminated silt; sand comprises up to 10%	SS	PPlz	II	4I2
70		171	209	Water Table	NA	NA	NA	NA	NA

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates S

South 200 West Area (S, U [except U-1&2], Z Areas [except 216-Z-9]and ERDF) Stratigraphic Columns

Notes/Assumptions:

1) Topography ranges from 730 ft MSL east of ERDF to 625 ft MSL southwest of the S-16 Pond (USGS Gable Butte and Riverland 7.5 min. Quad Maps).
   Will assume an average elevation of 680 ft MSL.
2) The pre-Hanford Water Table (January 1944) is estimated to range from an elevation of 122 m (400 ft) east of ERDF to 127 m (417 ft) west of the S-16 Pond (DOE-EIS-0113, page 4.21).
   Will assume an average water table elevation of 124 m (407 ft) MSL.
3) A thin blanket of eolian sand and silt covers the surface of the site where not disturbed.
   However, this material was generally removed during excavation and construction of the waste disposal sites and then incorporated into backfill materials.
   The depth of the sites and thus, the backfull over these sites range from 0-2.6 m for ponds and unplanned releases, to an average of about 4.5 to 5.7 m for cribs and burial grounds, and 13.7 to 16.4 m for tanks.
4) Only two reverse wells are located in this area ranging in depth from 23 - 46 m.
5) Injection well 216-Z-10 is screened from 118-150 ft. 216-U-4 is screened from 50-75 ft.

Template 200S-X for surface disposal sites (e.g. Ponds)

									200S-1	200S-2	200S-3	200S-4
Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**	K_d Class	K_d Class	K_d Class	K_d Class
		0	**680**	Surface	NA	NA	NA	NA	NA	NA	NA	NA
2.5	5	5	675	Eolian	Sand and silt	S	Hss	HI	1H	2H	3H	4H
60	65	70	610	Hanford Gravel	Pebbly very coarse to medium sand to silty sandy medium to fine pebble	SG1	Hg_2W	II	1I2	2I2	3I2	4I2
30	30	100	580	Hanford Sand	Slightly silty coarse to very fine sand	S	Hfs_2W	II	1I1	2I1	3I1	4I1
30	30	130	550	Hanford Silty Sand	Slightly silty medium to very fine sand to silty medium to very fine sand	S	Hss_2W	II	1I1	2I1	3I1	4I1
15	20	150	530	Old Hanford/Plio-pleistocene ("Early Palouse")	Silty fine to very fine sand	SS	PPlz	II	1I1	2I1	3I1	4I1
20	20	170	510	Plio-Pleistocene Caliche	Pebbly silty coarse to very fine sand to silty medium to very fine sand	SS	PPlc	II	1I1	2I1	3I1	4I1
	102	272	408	Ringold (Unit E)	Silty Sandy Medium to fine pebble to sandy very coarse to fine pebble (semi-indurated)	SG2	Rg_2W	II	1I2	2I2	3I2	4I2
		273	407	Water Table	NA	NA	NA	NA		NA	NA	NA

Template 216S-X for shallow disposal sites (e.g. Cribs, Burial Grounds)

									216S-1	216S-2	216S-3	216S-4
Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**	K_d Class	K_d Class	K_d Class	K_d Class
		0	680	Surface	NA	NA	NA	NA	NA	NA	NA	NA
15	**15**	**15**	**665**	Backfill	Backfill	B	B	II	1I2	2I2	3I2	4I2
60	65	70	610	Hanford Gravel	Pebbly very coarse to medium sand to silty sandy medium to fine pebble	SG1	Hg_2W	HI	1H	2H	3H	4H
30	30	100	580	Hanford Sand	Slightly silty coarse to very fine sand	S	Hfs_2W	II	1I1	2I1	3I1	4I1
30	30	130	550	Hanford Silty Sand	Slightly silty medium to very fine sand to silty medium to very fine sand	S	Hss_2W	II	1I1	2I1	3I1	4I1
15	20	150	530	Old Hanford/Plio-pleistocene ("Early Palouse")	Silty fine to very fine sand	SS	PPlz	II	1I1	2I1	3I1	4I1
20	20	170	510	Plio-Pleistocene Caliche	Pebbly silty coarse to very fine sand to silty medium to very fine sand	SS	PPlc	II	1I1	2I1	3I1	4I1
	102	272	408	Ringold (Unit E)	Silty Sandy Medium to fine pebble to sandy very coarse to fine pebble (semi-indurated)	SG2	Rg_2W	II	1I2	2I2	3I2	4I2
		273	407	Water Table	NA	NA	NA	NA	NA	NA	NA	NA

Template 217S-x for shallow disposal sites (e.g. Cribs, Tilefields) receiving NAPL CCl4

									217S-1			
Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**	K_d Class			
		0	680	Surface	NA	NA	NA	NA	NA			
15	15	**15**	**665**	Backfill	Backfill	B	B	HI	1H			
60	65	70	610	Hanford Gravel	Pebbly very coarse to medium sand to silty sandy medium to fine pebble	SG1	Hg_2W	HI	1H			
30	30	100	580	Hanford Sand	Slightly silty coarse to very fine sand	S	Hfs_2W	II	1I1			
30	30	130	550	Hanford Silty Sand	Slightly silty medium to very fine sand to silty medium to very fine sand	S	Hss_2W	II	1I1			
15	20	150	530	Old Hanford/Plio-pleistocene ("Early Palouse")	Silty fine to very fine sand	SS	PPlz	*II*	1I1			
20	20	170	510	Plio-Pleistocene Caliche	Pebbly silty coarse to very fine sand to silty medium to very fine sand	SS	PPlc	*II*	1I1			
	102	272	408	Ringold (Unit E)	Silty Sandy Medium to fine pebble to sandy very coarse to fine pebble (semi-indurated)	SG2	Rg_2W	*II*	1I2			
		273	407	Water Table	NA	NA	NA	NA	NA			

Template 241S-X for intermediate depth disposal sites (e.g. high-level waste tanks)

										241S-2	241S-3	241S-4
Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**		K_d Class	K_d Class	K_d Class
		0	680	Surface	NA	NA	NA	NA		NA	NA	NA
50	50	**50**	**630**	Backfill	Backfill	B	B	HI		2H	3H	4H
60	65	70	610	Hanford Gravel	Pebbly very coarse to medium sand to silty sandy medium to fine pebble	SG1	Hg_2W	HI		2H	3H	4H
30	30	100	580	Hanford Sand	Slightly silty coarse to very fine sand	S	Hfs_2W	II		2I1	3I1	4I1
30	30	130	550	Hanford Silty Sand	Slightly silty medium to very fine sand to silty medium to very fine sand	S	Hss_2W	II		2I1	3I1	4I1
15	20	150	530	Old Hanford/Plio-pleistocene ("Early Palouse")	Silty fine to very fine sand	SS	PPlz	II		2I1	3I1	4I1
20	20	170	510	Plio-Pleistocene Caliche	Pebbly silty coarse to very fine sand to silty medium to very fine sand	SS	PPlc	II		2I1	3I1	4I1
	102	272	408	Ringold (Unit E)	Silty Sandy Medium to fine pebble to sandy very coarse to fine pebble (semi-indurated)	SG2	Rg_2W	II		2I2	3I2	4I2
		273	407	Water Table	NA	NA	NA			NA	NA	NA

Template 266S-X for deep injection sites (e.g. reverse wells [e.g. 216-Z-10 (a)])

												266S-4
Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**				K_d Class
		0	680	Surface	NA	NA	NA	NA				NA
2.5	5	5	675	Eolian	Sand and silt	Hs	Hss	II				4I1
60	65	70	610	Hanford Gravel	Pebbly very coarse to medium sand to silty sandy medium to fine pebble	Hg	Hg_2W	II				4I2
30	30	100	580	Hanford Sand	Slightly silty coarse to very fine sand	S	Hfs_2W	II				4I1
30	30	130	550	Hanford Silty Sand	Slightly silty medium to very fine sand to silty medium to very fine sand	S	Hss_2W	II				4I1
15	20	**150**	**530**	Old Hanford/Plio-pleistocene ("Early Palouse")	Silty fine to very fine sand	PP	PPlz	HI				4H
20	20	170	510	Plio-Pleistocene Caliche	Pebbly silty coarse to very fine sand to silty medium to very fine sand	PP	PPlc	HI				4H
	102	272	408	Ringold (Unit E)	Silty Sandy Medium to fine pebble to sandy very coarse to fine pebble (semi-indurated)	Rg	Rg_2W	II				4I2
		273	407	Water Table	NA	NA	NA	NA				NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

BLUE = Injection/release point

Formulas for Depth (ft) corrected by WE Nichols (04/16/02)

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates - U Cribs
U Cribs (216-U-1, -2 and -16)

Notes/Assumptions:

1) Surface elevation ranges from 211.0 m (692.3 ft) near 216-U-16 to 212.5 m (697.2 ft) MSL near the 216-U-1 and -2 Cribs (as taken from the Hanford Site Atlas).
2) Ground surface and water-table elevations from PNNL HYDRODAT database.
3) The pre-Hanford Water Table (January 1944) is estimated to have been at an elevation of 405 MSL (based on Kipp and Mud, 1974 - BNWL-B-360).
4) The site depth to bottom of the 216-U-1 and -2 Cribs is reported to be 24 ft-min. (7.3 m) based on Maxfield, 1979 - RHO-CD-673. No bottom is reported for the 216-U-16 Crib. Thus, the backfill is assumed to be 24 deep for all three cribs.

Template 216S_U_N-x for the area N-NE of the 216-U-1&2 Cribs, based on well 299-W19-16 (N 135029.21, E 567270.68) located 24 m (80 ft) north of 216-U-1 Crib. **216S_U_N-4**

Estimated Thickness (ft)***	Adjusted Thickness (ft)†	Bottom Depth (ft)	Bottom Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Class
		0	695.157	Surface	NA	NA	NA	NA
24	24	24	671	Backfill	Backfill	B	B	4H
67	67	91	604	Hanford H1	Interbedded layers of fine to coarse sand and sandy gravel	S	Hcs_2W	4H
55	55	146	549	Hanford H2	Interbedded layers of silty to fine, medium, and coarse sand	S	Hfs_U	4I1
19	19	165	530	CCU-upper	Silt and fine sand	SS	PPlz_U	4I1
2	2	167	528	CCU-lower	Calcium-carbonate cemented sand, silt and clay (caliche)	SS	PPlc	4I1
83	83	250	445	Ringold Unit E	Sandy gravel	SG2	Rg_U	4I2
		250.59	444.57	Water Table	NA			NA

Template 216S_U_C-x for the central area between 216-U-1/2 Cribs and 216-U-16 Crib based on well 299-W19-15 (N 134975.78, E 567254.25), located about 26 m (85 ft) south of 216-U-1/2 Cribs and 56 m (185 ft) north of 216-U-16 Crib. **216S_U_C-4**

Estimated Thickness (ft)***	Adjusted Thickness (ft)†	Bottom Depth (ft)	Bottom Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Class
		0	693.501	Surface	NA	NA	NA	NA
105	105	105	589	Hanford H1	Interbedded layers of fine to coarse sand and sandy gravel	NA	Hcs_2W	4I1
43	43	148	546	Hanford H2	Interbedded layers of silty to fine, medium, and coarse sand	S	Hfs_U	4H
16	16	164	530	CCU-upper	Silt and fine sand	SS	PPlz_U	4H
3	3	167	527	CCU-lower	Calcium-carbonate cemented sand, silt and clay (caliche)	SS	PPlc	4I1
9	9	176	518	Upper Ringold	Medium to coarse sand	S	Hcs	4I1
44	44	220	474	Ringold Unit E	Sandy gravel	SG2	Rg_U	4I2
30	30	250	444	Ringold Unit E	Medium to coarse sand	S	Hcs	4I1
		249.55	443.95	Water Table	NA			NA

Template 216S_U_S-x for the southern portion of the 216-U-1& 2 crib area, based on well 299-W19-14 (N 134831.14, E 567267.99), located 9 m (30 ft) from SE edge of 216-U-16 Crib.

216S_U_S-4

Estimated Thickness (ft)***	Adjusted Thickness (ft)†	Bottom Depth (ft)	Bottom Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	Kd Class
		0	693.44	Surface	NA	NA	NA	NA
24	24	24	669	Backfill	Backfill	B	B	4H
86	86	110	583	Hanford H1	Interbedded layers of fine to coarse sand and sandy gravel	S	Hcs_2W	4H
42	42	152	541	Hanford H2	Interbedded layers of silty to fine, medium, and coarse sand	S	Hfs_U	4I1
14	14	166	527	CCU-upper	Silt and fine sand	SS	PPlz_U	4I1
4	4	170	523	CCU-lower	Calcium-carbonate cemented sand, silt and clay (caliche)	SS	PPlc	4I1
78	78	248	445	Ringold Unit E	Sandy gravel	SG2	Rg_U	4I2
		248.02	445.42	Water Table	NA			NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

*** Based on Fecht, Last, and Marratt, 1979 - RHO-LD-72.

BLUE = Injection/release point

GREEN = Modifications by Nichols to support air phase modeling

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates - S_Z9

216-Z-9 Trench

Notes/Assumptions:

1) Land surface elevations range from 201.1 m (660 ft) near well 299-W15-39 to 209.4 m (687 ft) near well 299-W15-18. Will assume an average elevation of 205.2 m (673 ft) MSL.
2) The pre-Hanford Water Table (January 1944) is estimated to range from an elevation of 122 m (400 ft) east of ERDF to 127 m (417 ft) west of the S-16 Pond (DOE-EIS-0113, page 4.21). The lowest measured water-level was 440.6 ft in 299-W15-5 on April 18, 1

   Will assume a minimum water table elevation of 124 m (407 ft) MSL.
3) A thin blanket of eolian sand and silt covers the surface of the site where not disturbed. However, this material was generally removed during excavation and construction of the waste disposal sites and then incorporated into backfill materials.
4) The depth of the 216-Z-9 Trench is about 6.1 m (20 ft). Note that it has a concrete cover. A building also partially overlies the site.

Template 217S_Z9-X for the 216-Z-9 Trench **217S_Z9-1**

Geologic Unit	Description	Depth to Top Contact (ft)	Elevation of Top Contact (ft)	Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth to Bottom Contact (ft)	Elevation of Bottom Contact (ft)	VZ Hydraulic Property Type *	SAC Soil Type	K_d Zone**	K_d Class
Surface	Concrete	0	**0**			**0**	**673**	NA	NA	NA	NA
Backfill	Gravelly Medium Sand	0	673	15.5	20	20	653	B	B	HI	1H
Hanford Gravel (H1)	Sandy Gravel	20	653	29.2	24	44	629	SG1	Hg_Z	HI	1H
Hanford Sand (H2)	Coarse to Medium Sand	44	629	39.2	39	83	590	S	Hfs_Z	II	1I1
Hanford Interbedded sand and mud (H4)	Slightly Muddy Medium to Fine Sand to Sandy Mud	83	590	23.4	23	106	567	S	Hss_Z	II	1I1
CCU Silt	Sandy Mud	106	567	8.7	9	115	558	SS	PPlz_Z	II	1I1
CCU Carbonate	Calcareous Gravelly, Muddy, Sand	115	558	4.0	4	119	554	SS	PPlc_Z	II	1I1
Ringold (Unit E)	Semi-indurated Muddy Sandy Gravel	119	554	146.1	147	266	407	SG2	Rg_2W	II	1I2
Ringold (Unit E) - Saturated	Semi-indurated Muddy Sandy Gravel	266	407	127.0	163	429	244			GW	
Ringold Lower Mud	Muddy Medium to Fine Sand	429	244	54.0	54	483	190			GW	
Ringold Unit A	Sandy Gravel	483	190	45.0	45	528	145			GW	
Elephant Mountain Basalt	Basalt	528	145								

☐	Hand Entered Unsaturated Zone Geologic Data Taken from 8 wells near Z-9 (Wells 299-W15-8, -9, -83, -84, -86, -95, -101, -217).
☐	Hand Entered Unsaturated Property Class Designations taken from SAC Rev. 0 Inputs.
☐	Hand Entered Saturated Zone Geologic Data Taken from 299-W15-5.
▨	Calculated Values

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

VZ Base Templates T
North 200 West Area (T Areas) Stratigraphic Columns

Notes/Assumptions:

1) Topography ranges from 790 ft MSL in the NW corner of the 216-W-5 burial ground to about 665 ft MSL east of the TX Tankfarm (USGS Gable Butte and Riverland 7.5 min. Quad Maps).
   Will assume an average elevation of 690 ft MSL.
2) The pre-Hanford Water Table (January 1944) is estimated to range from an elevation of 122 m (400 ft) east of 200 W to 127 m (417 ft) on the west side of the 218-W-5 Burial Ground (Kipp and Mud, 1974; DOE-EIS-0113, page 4.21).
   Will assume an average water table elevation of 124 m (407 ft) MSL.
3) A thin blanket of eolian sand and silt covers the surface of the site where not disturbed.
   However, this material was generally removed during excavation and construction of the waste disposal sites and then incorporated into backfill materials.
   The depth of the sites and thus, the backfull over these sites range from 0 m for ponds and most unplanned releases, to an average of about 8 m for cribs and burial grounds, and upto 15 m for tanks.
4) Only two reverse wells are located in this area ranging in depth from 22 - 62 m.
5) Injection well 216-T-2 is 75 ft deep. 216-T-3 is reported as 206 ft. Screened interval is unknown -- will assume 25 ft screened interval.

Template 200T-X for surface disposal sites (e.g. Ponds)

									200T-2		200T-4
Average Thickness (ft)	**Adjusted Average Thickness (ft)†**	**Depth (ft)**	**Elevation (ft)**	**Geologic Unit**	**Description**	**Hydraulic Property Type ***	**SAC Soil Type**	**K_d Zone****	**K_d Class**		**K_d Class**
		0	690	Surface	NA	NA	NA	NA	NA		NA
2.5	2	2	688	Eolian	Sand and silt	S	Hss	HI	2H		4H
90	90	92	598	Hanford Gravel	Silty sandy medium to fine pebble to slightly silty pebbly very coarse to coarse sand	SG1	Hg_2W	HI	2H		4H
35	35	127	563	Hanford Gravelly Sand	Pebbly very coarse to medium sand to slightly silty very coarse to medium sand	GS	Hgs_2W	II	2I1		4I1
10	10	137	553	Old Hanford/Plio-pleistocene ("Early Palouse")	Silty fine to very fine sand to slightly silty fine to very fine sand	SS	PPlz	II	2I1		4I1
18	18	155	535	Plio-Pleistocene Caliche	Pebbly silty coarse to fine sand to silty medium to very fine sand with caliche	SS	PPlc	II	2I1		4I1
25	25	180	510	Upper Ringold	silty fine to very fine sand to silty medium to very fine sand (semi-indurated)	S	PPlz	II	2I1		4I1
	103	283	407	Ringold Unit E	Silty Sandy Medium to fine pebble to sandy very coarse to fine pebble (semi-indurated)	SG2	Rg_2W	II	2I2		4I2
		283	407	Water Table	NA	NA	NA	NA	NA		NA

Template 216T-X for shallow disposal sites (e.g. Cribs, Burial Grounds)

									216T-2	216T-3	216T-4
Average Thickness (ft)	**Adjusted Average Thickness (ft)†**	**Depth (ft)**	**Elevation (ft)**	**Geologic Unit**	**Description**	**Hydraulic Property Type ***	**SAC Soil Type**	**K_d Zone****	**K_d Class**	**K_d Class**	**K_d Class**
		0	690	Surface	NA	NA	NA	NA	NA	NA	NA
17	17	17	673	Backfill		B	B	HI	2H	3H	4H
90	75	92	598	Hanford Gravel	Silty sandy medium to fine pebble to slightly silty pebbly very coarse to coarse sand.	SG1	Hg_2W	HI	2H	3H	4H
35	35	127	563	Hanford Gravelly Sand	Pebbly very coarse to medium sand to slightly silty very coarse to medium sand	GS	Hgs_2W	II	2I1	3I1	4I1
10	10	137	553	Old Hanford/Plio-pleistocene ("Early Palouse")	Silty fine to very fine sand to slightly silty fine to very fine sand	SS	PPlz	II	2I1	3I1	4I1
18	18	155	535	Plio-Pleistocene Caliche	Pebbly silty coarse to fine sand to silty medium to very fine sand with caliche	SS	PPlc	II	2I1	3I1	4I1
25	25	180	510	Upper Ringold	silty fine to very fine sand to silty medium to very fine sand (semi-indurated)	S	PPlz	II	2I1	3I1	4I1
	103	283	407	Ringold Unit E	Silty Sandy Medium to fine pebble to sandy very coarse to fine pebble (semi-indurated)	SG2	Rg_2W	II	2I2	3I2	4I2
		283	407	Water Table	NA	NA	NA	NA	NA	NA	NA

Template 241T-X for tanks

									241T-2		
Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**	K_d Class		
		0	690	Surface	NA	NA	NA	NA	NA		
48	48	48	642	Backfill		B	B	HI	2H		
90	44	92	598	Hanford Gravel	Silty sandy medium to fine pebble to slightly silty pebbly very coarse to coarse sand	SG1	Hg_2W	HI	2H		
35	35	127	563	Hanford Gravelly Sand	Pebbly very coarse to medium sand to slightly silty very coarse to medium sand	GS	Hgs_2W	II	2I1		
10	10	137	553	Old Hanford/Plio-pleistocene ("Early Palouse")	Silty fine to very fine sand to slightly silty fine to very fine sand	SS	PPlz	II	2I1		
18	18	155	535	Plio-Pleistocene Caliche	Pebbly silty coarse to fine sand to silty medium to very fine sand with caliche	SS	PPlc	II	2I1		
25	25	180	510	Upper Ringold	silty fine to very fine sand to silty medium to very fine sand (semi-indurated)	S	PPlz	II	2I1		
	103	283	407	Ringold Unit E	Silty Sandy Medium to fine pebble to sandy very coarse to fine pebble (semi-indurated)	SG2	Rg_2W	II	2I2		
		283	407	Water Table	NA	NA	NA	NA	NA		

Template 266T-X for deep injection sites (e.g. reverse wells [e.g. 216-T-2 & -3 (a)])

									266T-2		266T-4
Average Thickness (ft)	Adjusted Average Thickness (ft)†	Depth (ft)	Elevation (ft)	Geologic Unit	Description	Hydraulic Property Type *	SAC Soil Type	K_d Zone**	K_d Class		K_d Class
		0	690	Surface	NA	NA	NA	NA	NA		NA
2.5	2	2	688	Eolian	Sand and silt	S	Hss	II	2I1		4I1
90	90	92	598	Hanford Gravel	Silty sandy medium to fine pebble to slightly silty pebbly very coarse to coarse sand	SG1	Hg_2W	II	2I2		4I2
35	35	127	563	Hanford Gravelly Sand	Pebbly very coarse to medium sand to slightly silty very coarse to medium sand	GS	Hgs_2W	II	2I1		4I1
10	10	137	553	Old Hanford/Plio-pleistocene ("Early Palouse")	Silty fine to very fine sand to slightly silty fine to very fine sand	SS	PPlz	II	2I1		4I1
18	18	155	535	Plio-Pleistocene Caliche	Pebbly silty coarse to fine sand to silty medium to very fine sand with caliche	SS	PPlc	II	2I1		4I1
25	25	180	510	Upper Ringold	silty fine to very fine sand to silty medium to very fine sand (semi-indurated)	S	PPlz	HI	2H		4H
	103	283	407	Ringold Unit E	Silty Sandy Medium to fine pebble to sandy very coarse to fine pebble (semi-indurated)	SG2	Rg_2W	HI	2I2		4I2
		283	407	Water Table	NA	NA	NA	NA	NA		NA

* After Khaleel and Freeman (1995), per white paper by Khaleel (September 2000)

** HI=high impact, II=Intermediate Impact (After Composite Analysis)

BLUE = Injection/release point

† Average thickness adjusted to normalize the average strata thicknesses to equal the total thickness of the vadose zone.

Appendix B

Hydraulic Property Distributions

Hydraulic Property Distributions - Revised (4/22/03)

(After Freeman's May 14, 2003 White Paper "Revised SAC Statistical Properties Tables of Vadose Hydraulic Properties"; Khaleel's Sept. 2000 White Paper, and

Table 1. Approximation for the distribution function for **soil type "B" (backfill)** based on **Khaleel and Freeman (1995) soil category SSG** (sand and gravel mixed with finer

B	Number of samples	Raw				Transform†	Transformed (normal distribution)				Beta Distribution		Observed Data	
Parameter		Low	High	Mean	Standard Deviation		Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
$\square_S$	6	0.187	0.375	0.262	0.072	NO					-	-	0.149	0.942
$\square_R$	6	0	0.064	0.03	0.029	NO					-	-	0.150	0.879
s_r	7	0	0.213	0.102	0.0895	NO							0.128	0.893
$\square$ (1/cm)	6	0.003	0.103	0.032	0.036	LN	-5.843	-2.276	-3.957	1.166	-	-	0.056	0.926
n	6	1.256	1.629	1.4	0.131	NO					-	-	0.136	0.960
K_s (cm/s)	6	0.0000276	0.068	0.015	0.027	LR	-10.854	2.995	-5.262	5.499	-	-		
Longitudinal Dispersivity[1] (m)	NA	2.70E-02	0.178	0.09	NA	UN	-	-	-	-	-	-		
% Gravel														
Bulk Density[2]	NA	-	-	1.94	-	CO	-	-	-	-	-	-		

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT])

Table 2. Approximation for the distribution function for **soil type "Hss"** (Hanford silty fine sand) based on **Khaleel and Freeman (1995) soil category SS** (sand mixed with finer

Hss	Number of samples	Raw				Transform†	Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter		Low	High	Mean	Standard Deviation		Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
$\square_S$	38	0.321	0.587	0.445	0.060	NO							0.019	0.991
$\square_R$	38	0.019	0.181	0.072	0.033	NO							0.053	1.000
s_r	38	0.047	0.339	0.159	0.059	NO					5.9070	31.3000	0.030	0.999
$\square$ (1/cm)	38	0.001	0.387	0.008	0.076	LN	-0.949	-7.131	-4.866	1.212			0.031	0.999
n	38	1.262	3.265	1.915	0.461	NO							0.078	0.998
K_s (cm/s)	30	3.20E-07	8.88E-04	8.58E-05	2.66E-04	LN	-7.027	-14.955	-9.363	1.885			0.002	0.892
Longitudinal Dispersivity[1] (m)	NA	0.0279	0.0341	0.031	NA	UN	-	-	-	-	-	-		
% Gravel	38	0	2	0.18	0.51									
Bulk Density[3] (g/cm^3)	35	1.28	2.13	1.61	0.17	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm].

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]).

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 3. Approximation for the distribution function for **soil type "Hss_2W"** (Hanford silty fine sand - 200 West Area) based on **Khaleel and Freeman (1995) soil category SS**

Hss_2W	Number of samples	Raw				Transform†	Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter		Low	High	Mean	Standard Deviation		Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
$\square_S$	11	0.321	0.566	0.398	0.076	NO							0.155	0.987
$\square_R$	11	0.019	0.102	0.057	0.027	NO							0.077	0.952
s_r	11	0.054	0.211	0.141	0.052	NO					6.2710	38.2750	0.046	0.914
$\square$ (1/cm)	11	0.001	0.017	0.005	0.004	LN	-4.080	-7.131	-5.397	0.804			0.015	0.949
n	11	1.527	3.265	2.116	0.528	NO							0.132	0.985
K_s (cm/s)	5	4.90E-06	1.27E-04	1.91E-05	5.10E-05	LN	-8.971	-12.226	-10.865	1.312			0.150	0.926
Longitudinal Dispersivity[1] (m)	NA	0.0279	0.0341	0.031	NA	UN	-	-	-	-	-	-		
% Gravel	11	0.000	0.000	0.000	0.000									
Bulk Density[3] (g/cm^3)	10	1.400	1.900	1.668	0.167	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm].

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]).

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 4. Approximation for the distribution function for **soil type "Hss_U"** (Hanford silty fine sand - 200-UP-1) based on **Khaleel and Freeman (1995) soil category SS** (sand

Hss_U	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
□S	6	0.353	0.566	0.437	0.078	NO							0.140	0.952
□R	6	0.019	0.102	0.066	0.033	NO							0.074	0.866
s_r	6	0.054	0.211	0.147	0.064	NO					4.4347	25.6347	0.071	0.841
□ (1/cm)	6	0.003	0.017	0.007	0.005	LN	-4.080	-5.843	-4.994	0.596			0.077	0.937
n	6	1.527	3.265	2.347	0.597	NO							0.085	0.938
K$_s$ (cm/s)	2	4.90E-06	1.27E-04	2.49E-05	8.63E-05	LN	-8.971	-12.226	-10.599	2.302			0.240	0.760
Longitudinal Dispersivity^1 (m)	NA	0.0279	0.0341	0.031	NA	UN	-	-	-	-	-	-		
% Gravel	6	0	0	0	0									
Bulk Density^3 (g/cm^3)	6	1.4	1.72	1.58	0.13	NO	-	-	-	-	-	-		
Particle Density^3 (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm].

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]).

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 5. Approximation for the distribution function for **soil type "Hss_Z"** (Hanford silty fine sand - 200-ZP-1) based on **Khaleel and Freeman (1995) soil category SS** (sand

Hss_Z	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
□S	5	0.3208	0.4134	0.35058	0.0401409	NO							0.229	0.941
□R	5	0.03	0.06	0.047	0.01548031	NO							0.136	0.799
s_r	5	0.09349845	0.17837508	0.13273273	0.0378506	NO					10.5323	68.8176	0.150	0.886
□ (1/cm)	5	0.0008	0.0064	0.00279414	0.00211376	LN	-5.05146	-7.1309	-5.88023	0.79664			0.058	0.851
n	5	1.63766	2.2593	1.839872	0.27356881	NO							0.230	0.937
K$_s$ (cm/s)	1	6.55E-06	6.55E-06	6.55E-06	0.00E+00	LN	-11.936	-11.936	-11.936	1			0.000	1.000
Longitudinal Dispersivity^1 (m)	NA	0.0279	0.0341	0.031	NA	UN	-	-	-	-	-	-		
% Gravel	5	0	0	0	0									
Bulk Density^3 (g/cm^3)	4	1.61	1.9	1.8	0.12987173	NO	-	-	-	-	-	-		
Particle Density^3 (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm].

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]).

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

[3] Revised by Nichols (unacceptable to truncate both the lower 50% and the upper 50%)

Table 6. Approximation for the distribution function for **soil type "Hfs"** (Hanford fine sand) based on **Khaleel and Freeman (1995) soil category S** (sand). As modified by

Hfs	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
□S	40	0.266	0.657	0.397	0.076	NO							0.042	1.000
□R	40	0.000	0.426	0.049	0.076	NO							0.261	1.000
s_r	40	0.000	0.648	0.110	0.122	NO					0.6183	4.9937	0.183	1.000
□ (1/cm)	40	0.002	0.742	0.025	0.135	LN	-0.299	-6.032	-3.694	1.337			0.040	0.994
n	40	1.193	4.914	2.107	0.859	NO							0.143	0.999
K$_s$ (cm/s)	40	6.72E-08	4.42E-02	2.87E-04	7.84E-03	LN	-3.119	-16.516	-8.158	2.975			0.002	0.955
Longitudinal Dispersivity^1 (m)	NA	0.183	0.223	0.203	NA	UN	-	-	-	-	-	-		
% Gravel	40	0	10	0.57	1.63									
Bulk Density^3 (g/cm^3)	30	1.33	2.16	1.60	0.18	NO	-	-	-	-	-	-		
Particle Density^3 (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT])

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 7. Approximation for the distribution function for **soil type "Hfs_BC"** (Hanford fine sand - BC Cribs and Trenches) based on **Khaleel and Freeman (1995) soil category**

Hfs_BC	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
□S	18	0.323	0.444	0.380	0.040	NO							0.081	0.945
□R	18	0.016	0.061	0.033	0.011	NO							0.065	0.992
s_r	18	0.045	0.184	0.089	0.035	NO					5.8391	59.8393	0.102	0.997
□ (1/cm)	18	0.005	0.201	0.021	0.045	LN	-1.604	-5.279	-3.874	0.889			0.057	0.995
n	18	1.542	4.914	2.507	1.036	NO							0.176	0.990
K_s (cm/s)	18	1.40E-04	4.42E-02	2.25E-03	1.09E-02	LN	-3.119	-8.874	-6.097	1.563			0.038	0.972
Longitudinal Dispersivity[1] (m)	NA	0.183	0.223	0.203	NA	UN	-	-	-	-	-	-		
% Gravel	18	0	2	0.38	0.57									
Bulk Density[3] (g/cm^3)	8	1.52	1.79	1.65	0.10	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT])

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 8. Approximation for the distribution function for **soil type "Hfs_2W"** (Hanford fine sand-200 West Area) based on **Khaleel and Freeman (1995) soil category S** (sand).

Hfs_2W	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
□S	8	0.325	0.433	0.356	0.035	NO							0.188	0.986
□R	8	0.027	0.058	0.042	0.014	NO							0.143	0.869
s_r	8	0.074	0.167	0.118	0.040	NO					7.3390	55.0938	0.142	0.889
□ (1/cm)	8	0.004	0.026	0.010	0.008	LN	-3.646	-5.613	-4.584	0.704			0.072	0.909
n	8	1.574	3.294	2.177	0.546	NO							0.135	0.980
K_s (cm/s)	8	6.72E-08	4.62E-04	3.67E-05	1.76E-04	LN	-7.680	-16.516	-10.212	2.808			0.012	0.816
Longitudinal Dispersivity[1] (m)	NA	0.183	0.223	0.203	NA	UN	-	-	-	-	-	-		
% Gravel	8	0	2	0.38	0.74									
Bulk Density[3] (g/cm^3)	7	1.58	1.82	1.70	0.10	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT])

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 9. Approximation for the distribution function for **soil type "Hfs_U"** (Hanford fine sand - 200-UP-1) based on **Khaleel and Freeman (1995) soil category S** (sand). As

Hfs_U	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
□S	4	0.325	0.374	0.347	0.021	NO							0.150	0.902
□R	4	0.028	0.057	0.042	0.015	NO							0.173	0.837
s_r	4	0.074	0.163	0.122	0.047	NO					5.9087	42.5209	0.153	0.809
□ (1/cm)	4	0.004	0.026	0.013	0.010	LN	-3.646	-5.613	-4.380	0.888			0.082	0.796
n	4	1.673	3.294	2.451	0.663	NO							0.120	0.898
K_s (cm/s)	4	6.72E-08	4.62E-04	1.71E-05	2.15E-04	LN	-7.680	-16.516	-10.975	3.841			0.075	0.805
Longitudinal Dispersivity[1] (m)	NA	0.183	0.223	0.203	NA	UN	-	-	-	-	-	-		
% Gravel	4	0	0	0	0									
Bulk Density[3] (g/cm^3)	4	1.58	1.82	1.72	0.12	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT])

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 10. Approximation for the distribution function for **soil type "Hfs_Z"** (Hanford fine sand - 200-ZP-1) based on **Khaleel and Freeman (1995) soil category S** (sand). As

Hfs_Z	Number of samples	Raw				Transform†	Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter		Low	High	Mean	Standard Deviation		Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
s	4	0.326	0.433	0.366	0.047	NO							0.199	0.925
R	4	0.027	0.058	0.042	0.015	NO							0.169	0.850
S_r	4	0.082	0.167	0.113	0.040	NO					6.9964	54.8679	0.218	0.911
(1/cm)	4	0.004	0.013	0.008	0.004	LN	-4.358	-5.521	-4.788	0.508			0.074	0.802
n	4	1.574	2.086	1.903	0.238	NO							0.083	0.779
K_s (cm/s)	4	1.38E-05	3.70E-04	7.88E-05	1.61E-04	LN	-7.902	-11.191	-9.449	1.446			0.114	0.858
Longitudinal Dispersivity[1] (m)	NA	0.183	0.223	0.203	NA	UN	-	-	-	-	-	-		
% Gravel	4	0	2	0.75	0.95742711	NO								
Bulk Density[3] (g/cm^3)	4	1.59	1.76	1.68	0.08544004	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT])

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 11. Approximation for the distribution function for **soil type "Hcs"** (Hanford coarse sand) based on **Khaleel and Freeman (1995) soil category S** (sand). As modified by

Hcs	Number of samples	Raw				Transform†	Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter		Low	High	Mean	Standard Deviation		Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
s	82	0.197	0.651	0.353	0.077	NO							0.022	1.000
R	82	0.000	0.370	0.031	0.041	NO							0.225	1.000
S_r	82	0.000	0.569	0.084	0.069	NO					1.2795	13.8715	0.111	1.000
(1/cm)	82	0.002	0.861	0.059	0.133	LN	-0.149	-6.119	-2.838	1.052			0.001	0.995
n	82	1.266	5.000	2.020	0.680	NO							0.134	1.000
K_s (cm/s)	81	2.100E-05	5.800E-02	2.188E-03	1.197E-02	LN	-2.847	-10.771	-6.125	1.741			0.004	0.970
Longitudinal Dispersivity[1] (m)	NA	1.83E-01	0.223	0.203	NA	UN	-	-	-	-	-	-		
% Gravel	82	0.00	31.90	2.55	4.56									
Bulk Density[3] (g/cm^3)	69	1.51	2.02	1.66	0.10	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT])

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 12. Approximation for the distribution function for **soil type "Hcs_BC"** (Hanford coarse sand - BC crib and trench area) based on **Khaleel and Freeman (1995) soil**

Hcs_BC	Number of samples	Raw				Transform†	Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter		Low	High	Mean	Standard Deviation		Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
s	46	0.245	0.453	0.357	0.052	NO							0.016	0.968
R	46	0.000	0.045	0.026	0.011	NO							0.007	0.964
S_r	46	0.000	0.129	0.074	0.031	NO					5.1305	64.6175	0.009	0.964
(1/cm)	46	0.013	0.861	0.072	0.146	LN	-0.149	-4.343	-2.632	0.800			0.016	0.999
n	46	1.337	4.170	2.047	0.581	NO							0.111	1.000
K_s (cm/s)	46	5.16E-04	4.93E-02	5.32E-03	1.18E-02	LN	-3.010	-7.569	-5.235	1.173			0.023	0.971
Longitudinal Dispersivity[1] (m)	NA	1.83E-01	0.223	0.203	NA	UN	-	-	-	-	-	-		
% Gravel	46	0	31.9	2.68	5.34									
Bulk Density[3] (g/cm^3)	37	1.51	1.92	1.67	0.10	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT])

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 13. Approximation for the distribution function for **soil type "Hcs_2W"** (Hanford coarse sand - 200 West Area) based on **Khaleel and Freeman (1995) soil category S**

Hcs_2W	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
s	7	0.208	0.427	0.318	0.085	NO							0.098	0.900
R	7	0.000	0.050	0.026	0.016	NO							0.048	0.936
S_r	7	0.000	0.117	0.077	0.039	NO					3.4657	41.3731	0.025	0.843
(1/cm)	7	0.007	0.131	0.041	0.042	LN	-2.034	-4.978	-3.183	0.970			0.032	0.882
n	7	1.311	2.096	1.759	0.301	NO							0.068	0.868
K_s (cm/s)	7	1.80E-04	5.80E-02	1.09E-03	2.16E-02	LN	-2.847	-8.623	-6.822	2.002			0.184	0.976
Longitudinal Dispersivity[1] (m)	NA	1.83E-01	0.223	0.203	NA	UN	-	-	-	-	-	-		
% Gravel	7	0.000	15.000	2.143	5.669									
Bulk Density[3] (g/cm^3)	5	1.490	1.860	1.650	0.143	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT])

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 14. Approximation for the distribution function for **soil type "Hcs_Z"** (Hanford coarse sand - 200-ZP-1) based on **Khaleel and Freeman (1995) soil category S** (sand).

Hcs_Z	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
s	5	0.208	0.392	0.292	0.083	NO							0.157	0.886
R	5	0.000	0.040	0.021	0.014	NO							0.065	0.903
S_r	5	0.000	0.110	0.069	0.043	NO					2.3367	31.3462	0.054	0.824
(1/cm)	5	0.041	0.131	0.067	0.037	LN	-2.034	-3.199	-2.710	0.496			0.162	0.914
n	5	1.311	2.067	1.692	0.319	NO							0.116	0.880
K_s (cm/s)	5	1.80E-04	5.80E-02	1.49E-03	2.55E-02	LN	-2.847	-8.623	-6.512	2.361			0.186	0.940
Longitudinal Dispersivity[1] (m)	NA	1.83E-01	0.223	0.203	NA	UN	-	-	-	-	-	-		
% Gravel	5	0	0	0	0									
Bulk Density[3] (g/cm^3)	3	1.49	1.65	1.56	0.08	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT])

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 15. Approximation for the distribution function for **soil type "Hgs"** (Hanford gravelly sand) based on **Khaleel and Freeman (1995) soil category GS.**

Hgs	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
s	17	0.180	0.436	0.250	0.071	NO	-	-	-	-	-	-	0.164	0.995
R	17	0.010	0.248	0.046	0.055	NO	-	-	-	-	-	-	0.258	1.000
S_r	17	0.030	0.569	0.165	0.122	NO					1.3622	6.8814	0.134	1.000
(1/cm)	17	0.004	0.090	0.013	0.023	LN	-2.411	-5.655	-4.313	1.033	-	-	0.330	1.000
n	17	1.529	4.148	2.111	0.681	NO					-	-	0.197	0.999
K_s (cm/s)	17	2.00E-06	9.00E-02	4.73E-04	2.16E-02	LR	-2.408	-13.122	-7.657	2.626	-	-	0	1
Longitudinal Dispersivity[1] (m)	NA	4.68E-02	0.134	0.088	NA	UN	-	-	-	-	-	-		
% Gravel	17	10	40.00	25.78	9.65	NO								
Bulk Density[2]	15	1.68	2.16	1.92	0.16	NO	-	-	-	-	-	-		

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]). Same as SG1.

Table 16. Approximation for the distribution function for **soil type "Hgs_2W"** (Hanford gravelly sand - 200 West Area) based on **Khaleel and Freeman (1995) soil category**

Hgs_2W	Number of samples	Raw				Transform†	Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter		Low	High	Mean	Standard Deviation		Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
S	2	0.208	0.337	0.273	0.091	NO	-	-	-	-	-	-	0.240	0.760
R	2	0.010	0.049	0.030	0.028	NO	-	-	-	-	-	-	0.240	0.760
s$_r$	2	0.030	0.237	0.133	0.147	BE					0.5829	3.7866	0.049	0.103
(1/cm)	2	0.004	0.016	0.008	0.008	LN	-4.160	-5.521	-4.841	0.962	-	-	0.317	0.826
n	2	2.023	2.423	2.223	0.283	NO	-	-	-	-	-	-	0.240	0.760
K$_s$ (cm/s)	2	5.43E-05	1.02E-03	2.35E-04	6.83E-04	LR	-6.888	-9.821	-8.354	2.074	-	-	0	1
Longitudinal Dispersivity[1] (m)	NA	4.68E-02	0.134	0.088	NA	UN	-	-	-	-	-	-		
% Gravel	2	17.00	31.00	24.00	9.90	NO								
Bulk Density[2]	2	1.73	1.89	1.81	0.11	NO	-	-	-	-	-	-		

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]). Same as SG1.

Table 17. Approximation for the distribution function for **soil type "Hg"** (Hanford sandy gravel) based on **Khaleel and Freeman (1995) soil category SG1** (sandy gravel with

Hg	Number of samples	Raw				Transform†	Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter		Low	High	Mean	Standard Deviation		Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
S	29	0.072	0.307	0.167	0.047	NO	-	-	-	-	-	-	0.022	0.999
R	29	0.000	0.062	0.023	0.014	NO	-	-	-	-	-	-	0.046	0.997
s$_r$	29	0.000	0.387	0.143	0.084	NO					2.3024	13.8393	0.046	0.998
(1/cm)	29	0.002	0.919	0.018	0.190	LN	-0.084	-6.075	-4.024	1.481	-	-	0.083	0.996
n	29	1.347	2.947	1.727	0.360	NO					-	-	0.146	1.000
K$_s$ (cm/s)	28	1.90E-07	3.70E-02	3.56E-04	8.72E-03	LN	-3.297	-15.476	-7.941	3.228	-	-	0.010	0.925
Longitudinal Dispersivity[1] (m)	NA	0.027	0.178	0.09	NA	UN	-	-	-	-	-	-		
% Gravel	29	22	80	51.42	12.81	NO								
Bulk Density[2]	26	1.6	2.3	1.91	0.21	NO	-	-	-	-	-	-		

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]. Same as SSG

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]). Same as SG-1.

Table 18. Approximation for the distribution function for **soil type "Hg_2W"** (Hanford sandy gravel -200 West Area) based on **Khaleel and Freeman (1995) soil category SG1**

Hg_2W	Number of samples	Raw				Transform†	Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter		Low	High	Mean	Standard Deviation		Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
S	12	0.072	0.217	0.154	0.040	NO	-	-	-	-	-	-	0.020	0.940
R	12	0.000	0.062	0.027	0.017	NO	-	-	-	-	-	-	0.054	0.980
s$_r$	12	0.000	0.387	0.172	0.106	BE					2.0011	9.6331	0	0.087
(1/cm)	12	0.002	0.276	0.016	0.077	LN	-1.288	-6.075	-4.106	1.318	-	-	0.068	0.984
n	12	1.347	2.269	1.745	0.324	NO					-	-	0.109	0.948
K$_s$ (cm/s)	12	3.30E-06	3.70E-02	1.48E-03	1.21E-02	LN	-3.297	-12.622	-6.515	2.829	-	-	0.015	0.872
Longitudinal Dispersivity[1] (m)	NA	0.027	0.178	0.09	NA	UN	-	-	-	-	-	-		
% Gravel	12	39.000	80.000	54.358	12.380	NO								
Bulk Density[2]	9	1.630	2.300	1.891	0.225	NO	-	-	-	-	-	-		

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]. Same as SSG

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]). Same as SG-1.

Table 19. Approximation for the distribution function for **soil type "Hg_U"** (Hanford sandy gravel - 200-UP-1) based on **Khaleel and Freeman (1995) soil category SG1** (sandy

Hg_U	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
s	3	0.124	0.194	0.150	0.039	NO	-	-	-	-	-	-	0.249	0.875
R	3	0.028	0.030	0.029	0.001	NO	-	-	-	-	-	-	0.136	0.805
s_r	3	0.144	0.239	0.204	0.052	BE					12.0545	46.9891	0	0.087
(1/cm)	3	0.006	0.033	0.011	0.015	LN	-3.417	-5.083	-4.473	0.918	-	-	0.253	0.875
n	3	1.660	2.205	1.845	0.312	NO					-	-	0.277	0.876
K_s (cm/s)	3	3.300E-06	5.590E-03	2.884E-04	2.924E-03	LN	-5.187	-12.622	-8.151	3.940	-	-	0.128	0.774
Longitudinal Dispersivity[1] (m)	NA	0.027	0.178	0.09	NA	UN	-	-	-	-	-	-		
% Gravel	3	43.3	65	57.10	11.99	NO								
Bulk Density[2]	3	1.8	2.3	2.09	0.26	NO	-	-	-	-	-	-		

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]. Same as SSG

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]). Same as SG-1.

Table 20. Approximation for the distribution function for **soil type "Hg_Z"** (Hanford sandy gravel - 200-ZP-1) based on **Khaleel and Freeman (1995) soil category SG1** (sandy

Hg_Z	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
s	9	0.072	0.217	0.156	0.043	NO	-	-	-	-	-	-	0.025	0.922
R	9	0.000	0.062	0.026	0.020	NO	-	-	-	-	-	-	0.090	0.964
s_r	9	0.000	0.387	0.161	0.120	NO					1.3637	7.0918	0.089	0.970
(1/cm)	9	0.002	0.276	0.019	0.088	LN	-1.288	-6.075	-3.983	1.453	-	-	0.075	0.968
n	9	1.347	2.269	1.711	0.339	NO					-	-	0.141	0.950
K_s (cm/s)	8	2.83E-05	3.70E-02	3.51E-03	1.37E-02	LN	-3.297	-10.473	-5.651	2.359	-	-	0.020	0.841
Longitudinal Dispersivity[1] (m)	NA	0.027	0.178	0.09	NA	UN	-	-	-	-	-	-		
% Gravel	9	39	80	53.44	13.08	NO								
Bulk Density[2]	6	1.63	1.92	1.79	0.13	NO	-	-	-	-	-	-		

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]. Same as SSG

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]). Same as SG-1.

Table 21. Approximation for the distribution function for **soil type "Hrg"** (Hanford River Gravel) based on **Khaleel and Freeman (1995) soil category SG2** (sandy gravel with

Hrg		Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	Number of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
s	40	0.051	0.191	0.102	0.031	NO					-	-	0.048	0.998
R	40	0.007	0.036	0.020	0.007	NO					-	-	0.045	0.987
s_r	40	0.082	0.359	0.197	0.066	BE					6.8937	28.1745	0	0.079
(1/cm)	40	0.002	0.048	0.007	0.010	LN	-3.047	-6.119	-4.907	0.763	-	-	0.056	0.993
n	40	1.449	2.315	1.831	0.197	NO					-	-	0.026	0.993
K_s (cm/s)	40	3.70E-05	3.90E-01	1.46E-03	6.26E-02	LN	-0.942	-10.205	-6.532	2.062	-	-	0.037	0.997
Longitudinal Dispersivity[1] (m)	NA	0.027	0.178	0.09	NA	UN	-	-	-	-	-	-		
% Gravel	40	50	85	67.63	8.83	NO								
Bulk Density[2]	40	1.56	2.42	1.97	0.16	NO	-	-	-	-	-	-		

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]. Same as SSG.

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]). Same as SG-1.

Table 22. Approximation for the distribution function for **soil type "PPlz"** (Plio-Pleistocene-silt) based on **Khaleel and Freeman (1995) soil category SS** (sand mixed with finer

PPlz	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
□s	9	0.293	0.533	0.420	0.092	NO							0.082	0.891
□R	9	0.010	0.060	0.034	0.016	NO							0.073	0.946
s_r	9	0.020	0.113	0.080	0.029	NO					6.8296	78.7949	0.020	0.870
□ (1/cm)	9	0.001	0.019	0.006	0.005	LN	-3.988	-6.522	-5.200	0.702			0.030	0.958
n	9	1.522	2.815	2.101	0.464	NO							0.106	0.938
K_s (cm/s)	9	4.12E-07	1.36E-01	5.57E-05	4.53E-02	LN	-1.995	-14.702	-9.795	3.805			0.099	0.980
Longitudinal Dispersivity[1] (m)	NA	0.0279	0.0341	0.031	NA	UN	-	-	-	-	-	-		
% Gravel	9	0	4	0.44	1.33									
Bulk Density[3] (g/cm^3)	9	1.55	1.8	1.68	0.08	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm].

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]).

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 23. Approximation for the distribution function for **soil type "PPlz_U"** (Plio-Pleistocene-silt - 200-UP-1) based on **Khaleel and Freeman (1995) soil category SS** (sand

PPlz_U	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
□s	5	0.293	0.525	0.398	0.103	NO							0.152	0.890
□R	5	0.020	0.050	0.035	0.013	NO							0.122	0.884
s_r	5	0.068	0.098	0.086	0.013	NO					37.9068	405.1820	0.097	0.825
□ (1/cm)	5	0.001	0.019	0.005	0.007	LN	-3.988	-6.522	-5.355	0.923			0.103	0.931
n	5	1.522	2.743	2.020	0.500	NO							0.159	0.926
K_s (cm/s)	5	4.12E-07	6.74E-04	7.27E-06	3.00E-04	LN	-7.302	-14.702	-11.831	2.818			0.154	0.946
Longitudinal Dispersivity[1] (m)	NA	0.0279	0.0341	0.031	NA	UN	-	-	-	-	-	-		
% Gravel	5	0	0.4	0.08	0.18									
Bulk Density[3] (g/cm^3)	5	1.55	1.8	1.71	0.10	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm].

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]).

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 24. Approximation for the distribution function for **soil type "PPlz_Z"** (Plio-Pleistocene-silt - 200-ZP-1) based on **Khaleel and Freeman (1995) soil category SS** (sand

PPlz_Z	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
□s	4	0.373	0.533	0.448	0.081	NO							0.177	0.855
□R	4	0.010	0.060	0.033	0.022	NO							0.155	0.893
s_r	4	0.020	0.113	0.073	0.044	NO					2.4964	31.9252	0.114	0.821
□ (1/cm)	4	0.005	0.010	0.007	0.002	LN	-4.605	-5.279	-5.007	0.295			0.179	0.913
n	4	1.702	2.815	2.203	0.465	NO							0.141	0.906
K_s (cm/s)	4	6.70E-05	1.36E-01	7.11E-04	6.79E-02	LN	-1.995	-9.611	-7.249	3.532			0.252	0.932
Longitudinal Dispersivity[1] (m)	NA	0.0279	0.0341	0.031	NA	UN	-	-	-	-	-	-		
% Gravel	4	0	4	1	2									
Bulk Density[3] (g/cm^3)	3	1.49	1.66	1.58	0.09	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm].

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]).

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 25. Approximation for the distribution function for **soil type "PPlc"** (Plio-Pleistocene-carbonate) based on **Khaleel and Freeman (1995) soil category SS** (sand mixed

PPlc	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
θ_s	16	0.193	0.631	0.306	0.111	NO							0.155	0.998
θ_R	16	0.019	0.241	0.072	0.057	NO							0.175	0.999
s_r	16	0.097	0.445	0.214	0.096	NO					3.6651	13.4934	0.113	0.992
α (1/cm)	16	0.003	0.073	0.011	0.017	LN	-2.620	-5.843	-4.525	0.847			0.060	0.988
n	16	1.262	2.537	1.727	0.332	NO							0.081	0.993
K_s (cm/s)	16	2.60E-07	6.80E-02	5.00E-04	1.73E-02	LN	-2.688	-15.163	-7.600	3.280			0.011	0.933
Longitudinal Dispersivity[1] (m)	NA	0.0279	0.0341	0.031	NA	UN	-	-	-	-	-	-		
% Gravel	15	0	59	16.73	19.21	NO								
Bulk Density[3] (g/cm^3)	16	1.48	2.13	1.71	0.18	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm].

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]).

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 26. Approximation for the distribution function for **soil type "PPlc_Z"** (Plio-Pleistocene-carbonate - 200-ZP-1) based on **Khaleel and Freeman (1995) soil category SS**

PPlc_Z	Number	Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
θ_s	15	0.193	0.631	0.312	0.112	NO							0.146	0.998
θ_R	15	0.019	0.241	0.075	0.057	NO							0.164	0.998
s_r	15	0.097	0.445	0.220	0.096	NO					3.8823	13.7626	0.100	0.990
α (1/cm)	15	0.003	0.073	0.011	0.018	LN	-2.620	-5.843	-4.518	0.876			0.065	0.985
n	15	1.262	2.537	1.734	0.343	NO							0.084	0.990
K_s (cm/s)	15	0.00000026	0.068	0.00057392	0.01771766	LN	-2.688	-15.163	-7.463	3.348			0.011	0.923
Longitudinal Dispersivity[1] (m)	NA	0.0279	0.0341	0.031	NA	UN	-	-	-	-	-	-		
% Gravel	14	0.00	59.00	15.07	18.79	NO								
Bulk Density[3] (g/cm^3)	14	1.48	1.94	1.68	0.16	NO	-	-	-	-	-	-		
Particle Density[3] (g/cm^3)						NO								

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm].

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]).

[3] Taken from Freeman's e-mail to George Last, dated 12/27/01 (finetex1a.doc and HStex1.doc).

Table 27. Approximation for the distribution function for **soil type "Rg"** (Ringold sandy gravel) based on **Khaleel and Freeman (1995) soil category SG2** (sandy gravel with

Rg		Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	Number of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
θ_s	18	0.056	0.433	0.178	0.139	NO					-	-	0.189	0.967
θ_R	18	0.000	0.780	0.063	0.180	NO					-	-	0.363	1.000
s_r	18	0.000	1.952	0.230	0.437	NO					2.1112	14.3331	0.299	1.000
α (1/cm)	18	0.003	0.059	0.008	0.014	LN	-2.827	-5.952	-4.853	0.893	-	-	0.109	0.988
n	18	1.297	2.357	1.697	0.231	NO					-	-	0.042	0.998
K_s (cm/s)	18	6.20E-06	1.30E-01	4.13E-04	3.04E-02	LN	-2.040	-11.991	-7.791	2.572	-	-	0.051	0.987
Longitudinal Dispersivity[1] (m)	NA	0.027	0.178	0.09	NA	UN	-	-	-	-	-	-		
% Gravel	18	0	82	46.08	30.71	NO								
Bulk Density[2]	18	1.63	2.17	1.90	0.15	NO	-	-	-	-	-	-		

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]. Same as SSG.

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]). Same as SG-1.

Table 28. Approximation for the distribution function for **soil type "Rg_2W"** (Ringold sandy gravel - 200 West Area) based on **Khaleel and Freeman (1995) soil category SG2**

Rg_2W		Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	Number of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
$_s$	8	0.08	0.43	0.30	0.13	NO					-	-	0.051	0.852
$_R$	8	0.00	0.78	0.13	0.27	NO					-	-	0.318	0.993
S_r	8	0.00	1.95	0.33	0.66	BE					1.7377	15.2226	0	0.079
(1/cm)	8	0.00	0.06	0.01	0.02	LN	-2.827	-5.547	-4.329	0.879	-	-	0.083	0.956
n	8	1.30	2.36	1.75	0.30	NO					-	-	0.063	0.978
K_s (cm/s)	8	7.80E-06	8.70E-03	1.06E-04	3.02E-03	LN	-4.744	-11.761	-9.155	2.564	-	-	0.155	0.957
Longitudinal Dispersivity[1] (m)	NA	0.027	0.178	0.09	NA	UN	-	-	-	-	-	-		
% Gravel	8	0	70	22.175	28.788	NO								
Bulk Density[2]	8	1.630	2.118	1.838	0.167	NO	-	-	-	-	-	-		

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]. Same as SSG.

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]). Same as SG-1.

Table 29. Approximation for the distribution function for **soil type "Rg_U"** (Ringold sandy gravel - 200-UP-1) based on **Khaleel and Freeman (1995) soil category SG2** (sandy

Rg_U		Raw					Transformed (normal distribution)				Beta Distribution		Truncation Limits	
Parameter	Number of samples	Low	High	Mean	Standard Deviation	Transform†	Upper Limit	Lower Limit	Mean	Standard Deviation	A	B	Lower	Upper
$_s$	7	0.083	0.433	0.318	0.125	NO					-	-	0.030	0.821
$_R$	7	0.009	0.780	0.144	0.282	NO					-	-	0.316	0.988
S_r	7	0.060	1.952	0.381	0.695	BE					3.2853	24.1993	0	0.079
(1/cm)	7	0.004	0.059	0.013	0.019	LN	-2.827	-5.547	-4.320	0.949	-	-	0.098	0.942
n	7	1.297	2.357	1.768	0.319	NO					-	-	0.070	0.967
K_s (cm/s)	6	8.90E-06	1.75E-03	7.83E-05	6.87E-04	LN	-6.348	-11.629	-9.455	1.961	-	-	0.134	0.943
Longitudinal Dispersivity[1] (m)	NA	0.027	0.178	0.09	NA	UN	-	-	-	-	-	-		
% Gravel	7	0	70.00	16.49	25.78	NO								
Bulk Density[2]	7	1.63	2.12	1.82	0.17	NO	-	-	-	-	-	-		

†NO = Normal (no transformation required); LN = Lognormal; LR = Log ratio; SN = Hyperbolic arcsine; UN = Uniform, CO = Constant, BE = Beta

[1] Taken from Ho, et. al., 1999 [Stochastic Parameter Development for PORFLOW Simulations of the Hanford AX Tank Farm]. Same as SSG.

[2] Taken from Khaleel, et. al. 2000 (Modeling Data Package for S-SX Field Investigation Report (FIR) [DRAFT]). Same as SG-1.

Appendix C

Resolution of Discrepancies in the System Assessment Capability Vadose Zone Model for the BC Cribs and Trenches

Appendix C

Resolution of Discrepancies in the System Assessment Capability Vadose Zone Model for the BC Cribs and Trenches

W. E. Nichols

The System Assessment Capability (SAC) Initial Assessment (Bryce et al. 2002) exhibited large, early releases of technetium-99. In all cases, the releases from the vadose zone to groundwater were nearly instant, following disposal to ground by only a year or two. To date, no groundwater monitoring data show evidence of any technetium-99 plume from the area of these sites consistent with such large releases.

Because of the large predicted impact of technetium-99 from the BC cribs and trenches and inconsistency between predictions and groundwater monitoring data, resolution of the vadose zone model at these sites is required.

C.1 Approach

The SAC vadose zone modeling uses a one-dimensional approach for computational speed. It is recognized that the multidimensional aspects of the vadose zone are highly important, but multidimensional modeling of the hundreds of waste disposal sites addressed in the SAC in a stochastic framework is computationally untenable. For vadose zone sites with liquid discharges, this is compensated by applying a K_s-dependent wetted area adjustment, wherein the area of the vadose zone area represented in the one-dimensional model is scaled so that a unit gradient is attained in the layer with the lowest saturated hydraulic conductivity for the period with the highest liquid discharge rate.

However, for the BC cribs and trenches, the Ks-depended wetted area adjustment method does not yield an area larger than the site area, so the SAC model defaults to using the Waste Information Data System (WIDS) area. This is equivalent to declaring there is no lateral movement of liquid associated with the liquid discharges at these sites.

I propose that lateral spreading would still occur for the short-duration (less than one year) discharges that occurred at the BC cribs and trenches, and that two-dimensional modeling of each crib and trench for median input values can be used to quantify the extent of lateral spreading. Lateral spreading of fluid will tend to delay arrival of technetium-99 at the aquifer. If enough delay occurs, then the disposal inventory could still be consistent with the groundwater monitoring data that does not indicate a substantial technetium-99 plume in the vicinity of the BC cribs and trenches before calendar year 2000.

C.2 Multidimensional Modeling of BC Trenches

The BC trenches and their respective areas and discharge volumes are listed in Table C.1. The BC trenches are long relative to their width and were, therefore, idealized as a two-dimensional feature symmetric about the length axis of the trench. An idealized two-dimensional model was constructed that assumes the trench is infinite in length, and that lateral spreading is strictly perpendicular to the trench length axis.

The SAC one-dimensional model for each BC trench with a substantial inventory of technetium-99 (trenches below 216-B-34 in Table C.1 did not have a large disposal of technetium-99) was expanded into a two-dimensional axial-symmetric model (half the trench represented, with results scalable to represent the whole trench). The vertical resolution (580 0.15-meter grid cells) was retained, and the x-axis was resolve into 96, 0.15-meter grid cells. This yielded a model grid of 55,680 grid nodes. The liquid and analyte discharges were converted to density-type sources and assigned to the topmost nodes in the grid index range from 1 to 10 (inner 1.5 meters), representing half the source term (again, consistent with the axial-symmetric treatment).

Hanford soils are anisotropic, considered about 10 times more conductive in the horizontal dimension than in the vertical. To consider this feature, each trench was modeled twice, once with isotropic properties and once with 10:1 anisotropy in saturated hydraulic conductivity.

Table C.1. BC Trenches (data from Maxfield 1979)

WIDS Identification	Area (square meters)	Discharge Volume (liters)
216-B-20	152.4×3.0 = 457.2	4.68×10^6
216-B-21	152.4×3.0 = 457.2	4.67×10^6
216-B-22	152.4×3.0 = 457.2	4.74×10^6
216-B-23	152.4×3.0 = 457.2	4.52×10^6
216-B-24	152.4×3.0 = 457.2	4.7×10^6
216-B-25	152.4×3.0 = 457.2	3.76×10^6
216-B-26	152.4×3.0 = 457.2	5.88×10^6
216-B-27	152.4×3.0 = 457.2	4.42×10^6
216-B-28	152.4×3.0 = 457.2	5.05×10^6
216-B-29	152.4×3.0 = 457.2	4.84×10^6
216-B-30	152.4×3.0 = 457.2	4.78×10^6
216-B-31	152.4×3.0 = 457.2	4.74×10^6
216-B-32	152.4×3.0 = 457.2	4.77×10^6
216-B-33	152.4×3.0 = 457.2	4.74×10^6
216-B-34	152.4×3.0 = 457.2	4.87×10^6
216-B-52	176.8×3.0 = 530.4	8.53×10^6
216-B-53A	18.3×3.0 = 54.9	5.49×10^5
216-B-53B	45.7×3.0 = 137.2	1.51×10^4
216-B-54	61.0×3.0 = 182.9	9.99×10^5
216-B-58	61.0×3.0 = 182.9	4.13×10^5
WIDS – Waste Information Data System		

Once the release histories for the multidimensional model runs were available, the one-dimensional model was rerun with several AreaX (area scaling parameter) values. By trial-and-error, an AreaX scaling factor that would cause the one-dimensional model to produce releases similar to the two-dimensional model (with explicit treatment of lateral flow) was determined. For all BC trenches, the value AreaX = 3.0 provided the best match for isotropic conductivity and AreaX = 6.5 provided the best match for anisotropic (10:1 ratio) conductivity.

Figures C.1 through C.15 provide the modeling results for the BC trenches with substantial technetium-99 inventory (216-B-20 through 216-B-34, inclusive). Each figure depicts the release from the VADER vadose zone release model (i.e., the "input signal"), the release from the various Subsurface Transport Over Multiple Phases (STOMP) one-dimensional models (with variable AreaX factor values), and from the STOMP two-dimensional models (with isotropic and anisotropic conductivity).

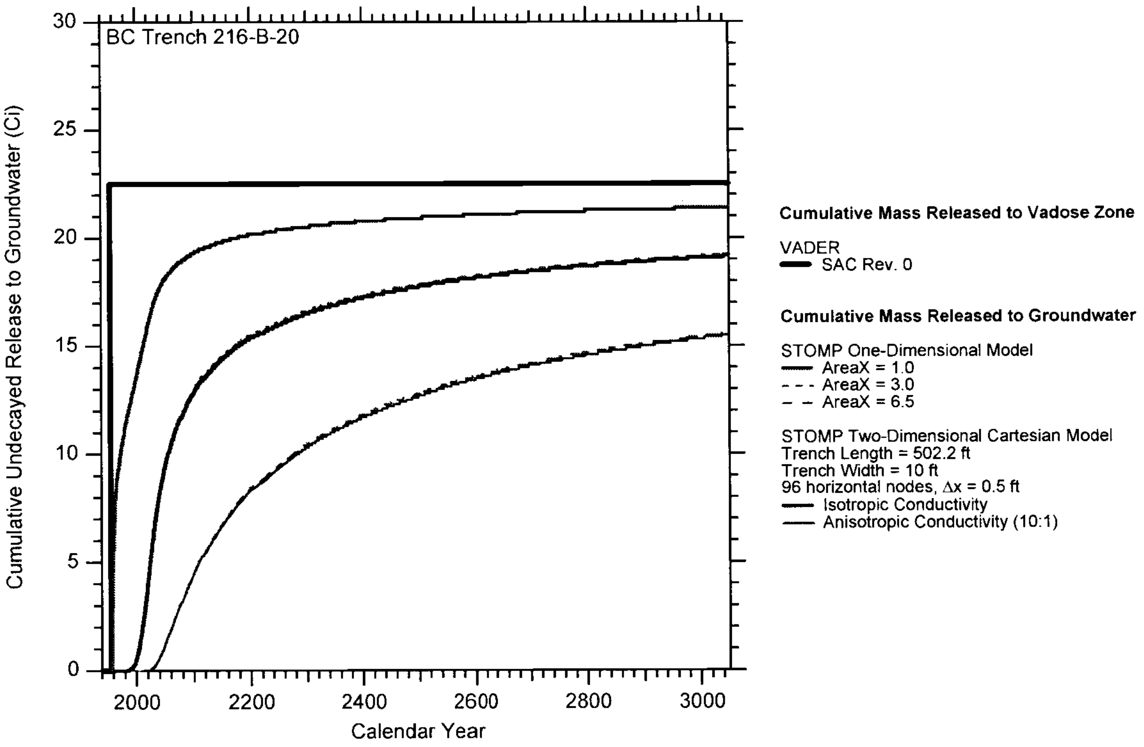

Figure C.1. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-20

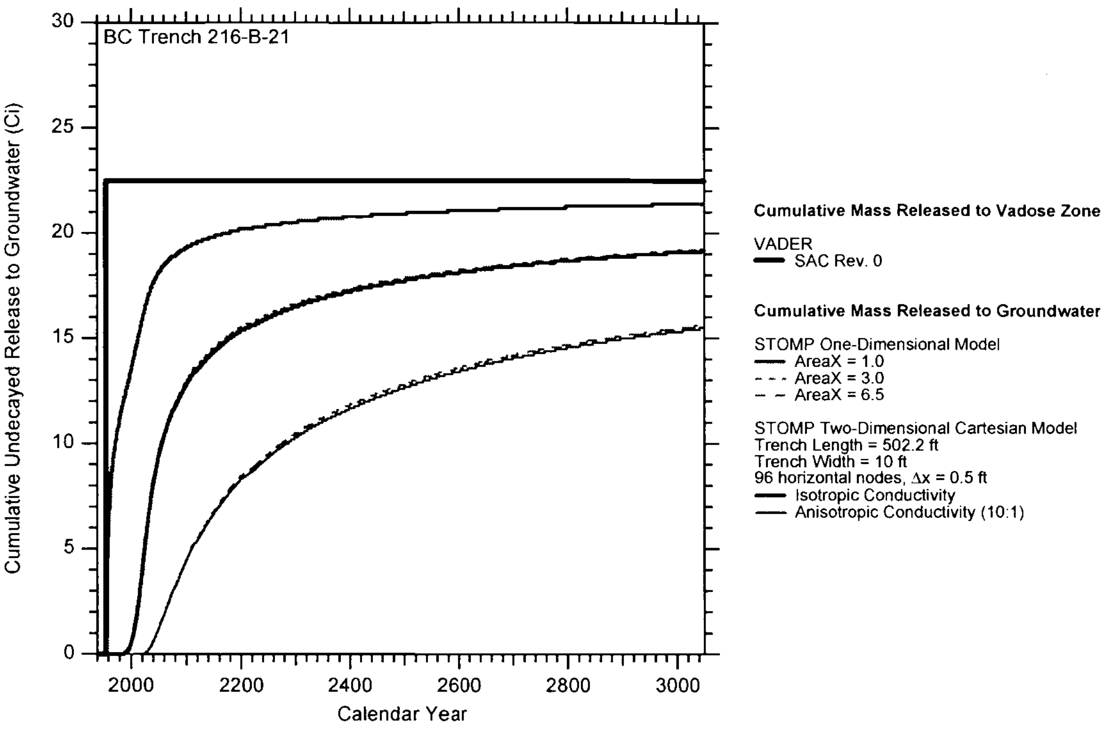

Figure C.2. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-21

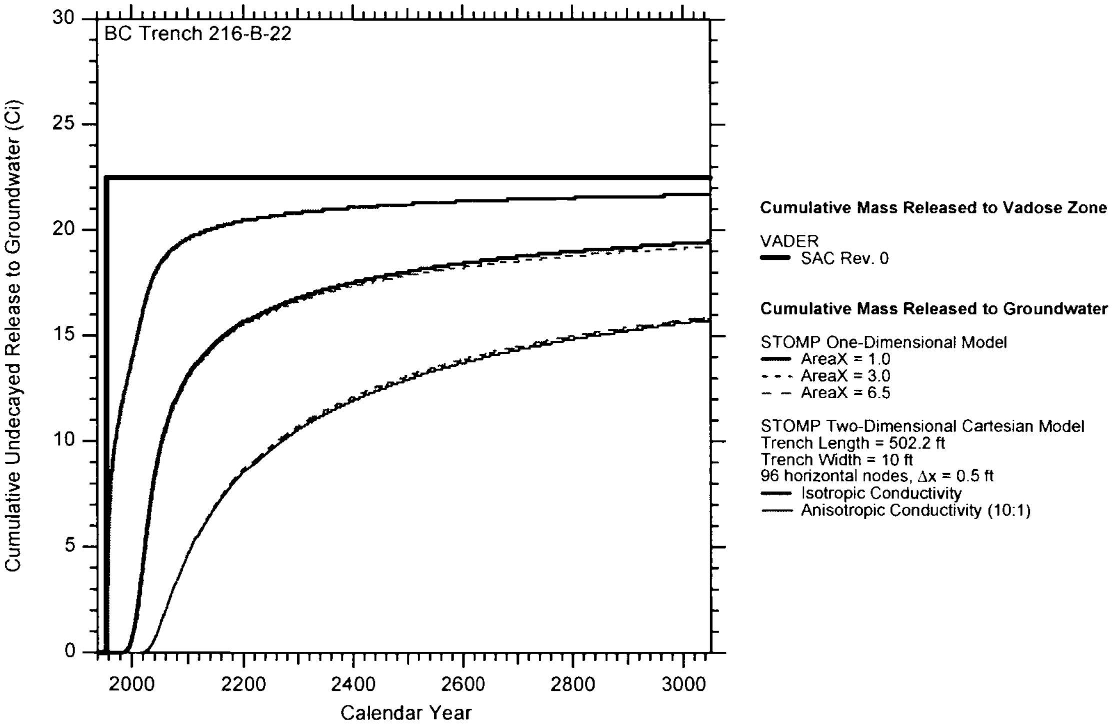

Figure C.3. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-22

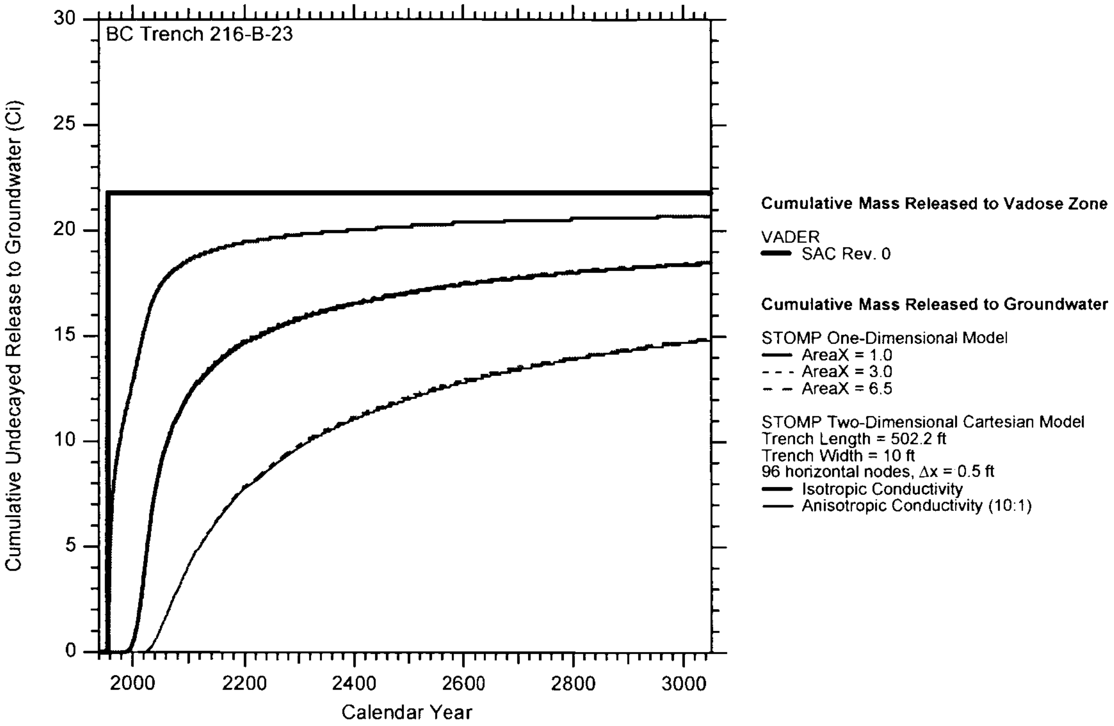

Figure C.4. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-23

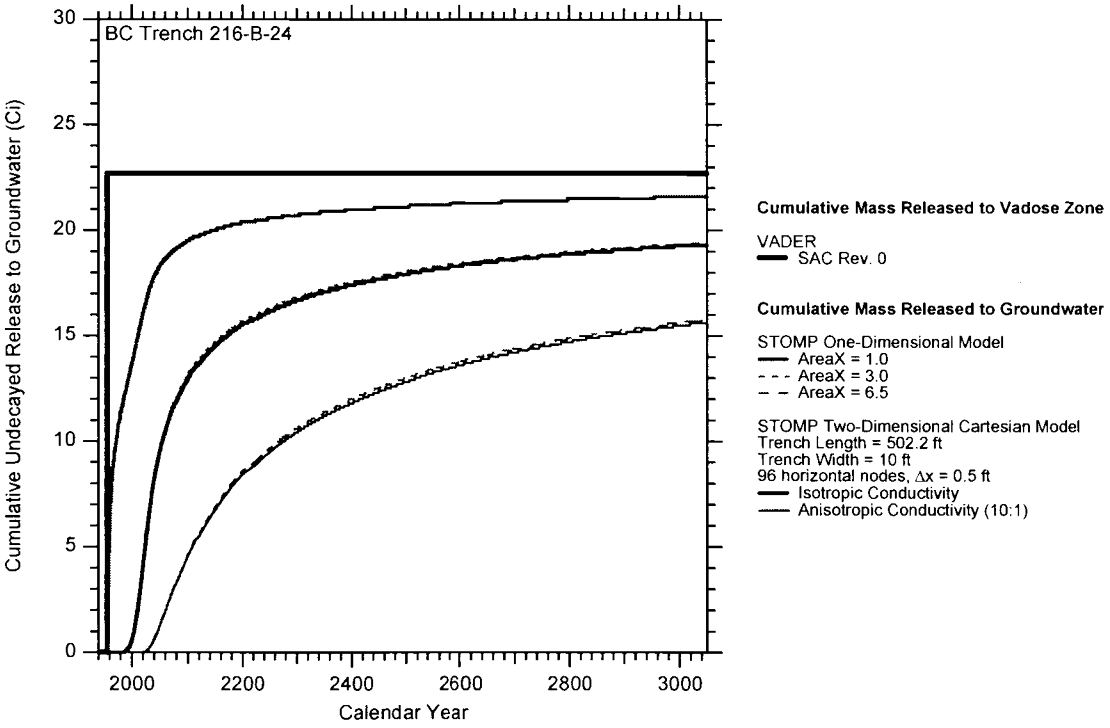

Figure C.5. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-24

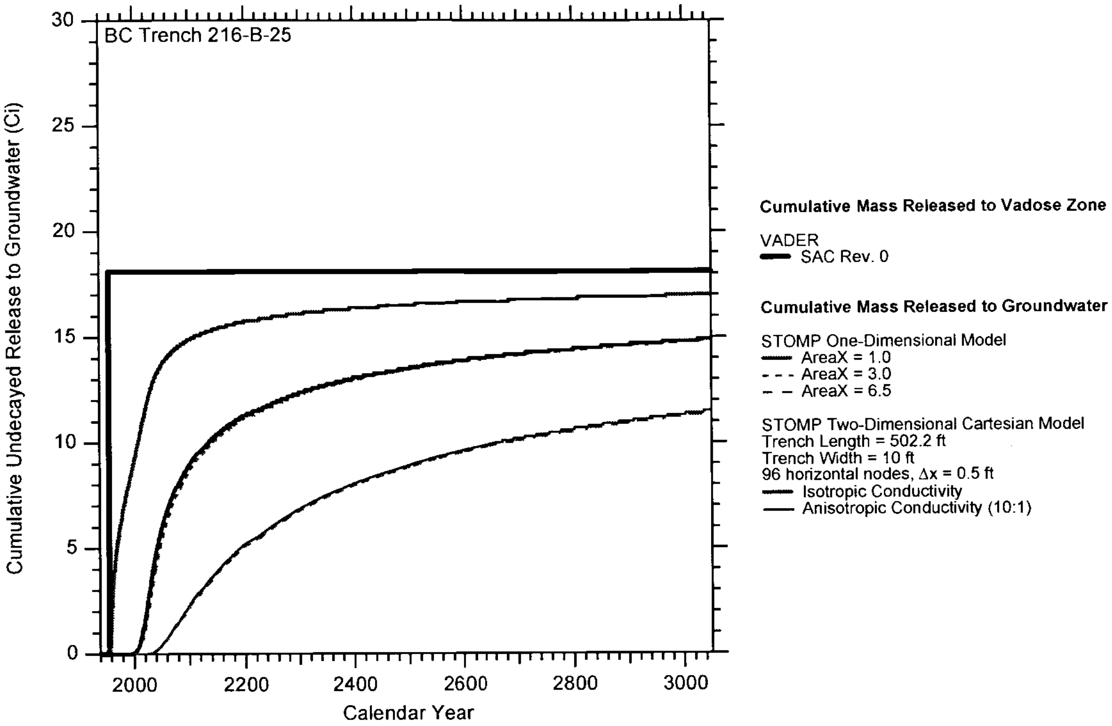

Figure C.6. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-25

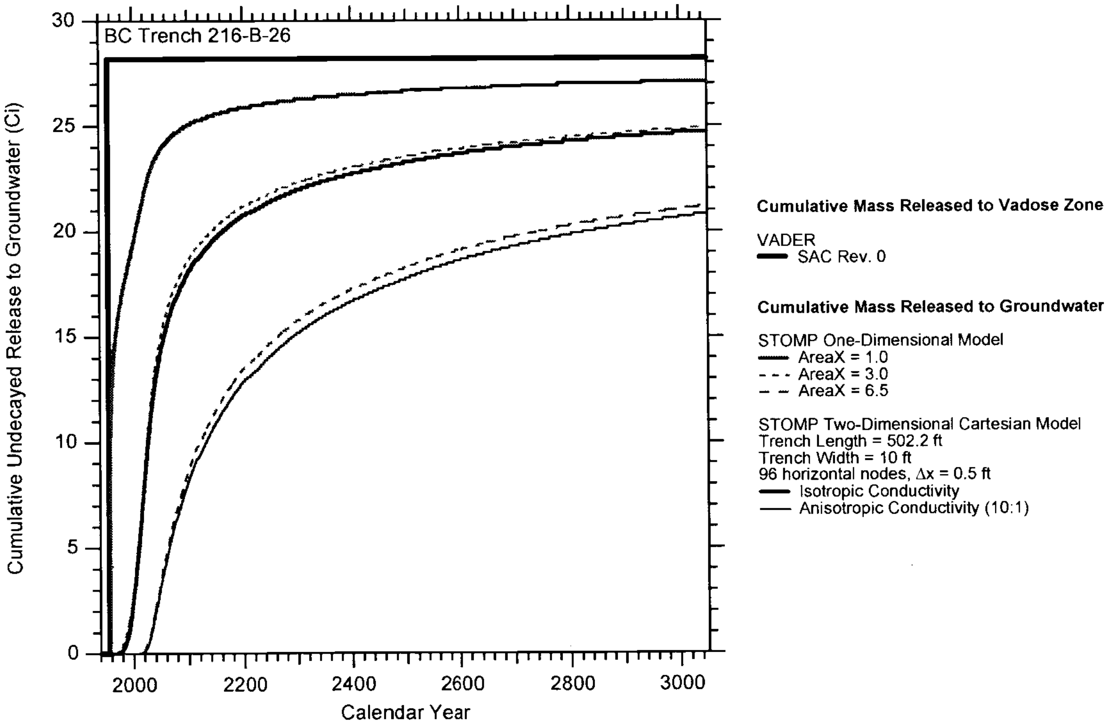

Figure C.7. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-26

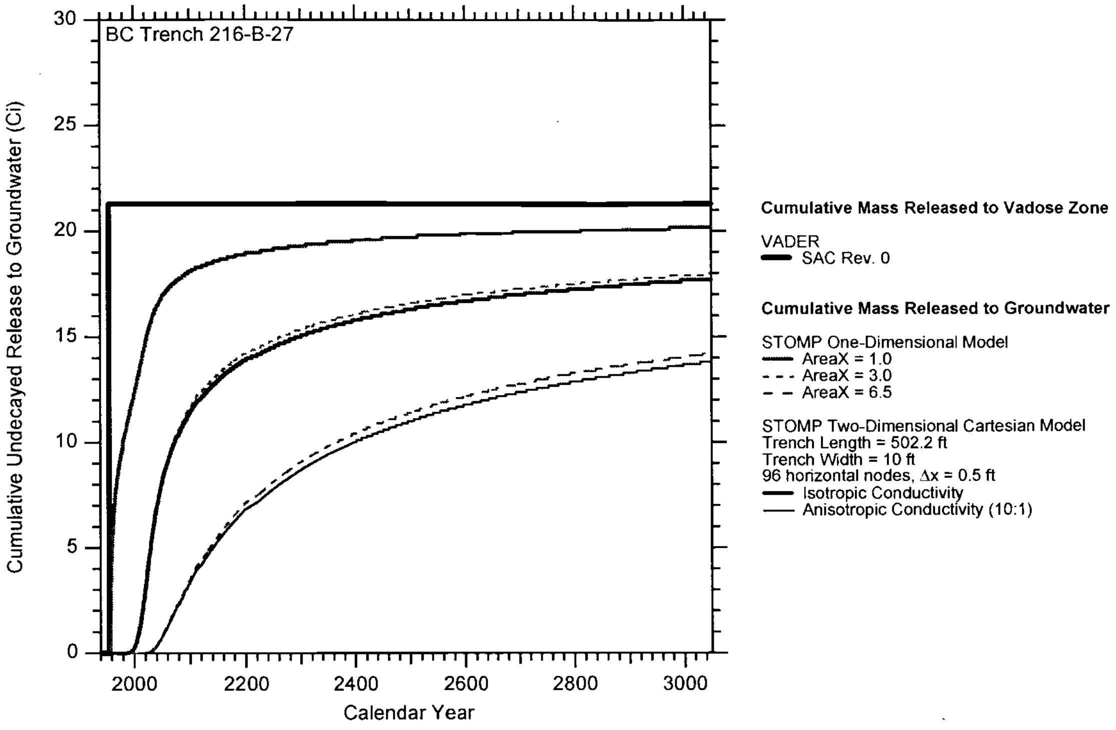

Figure C.8. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-27

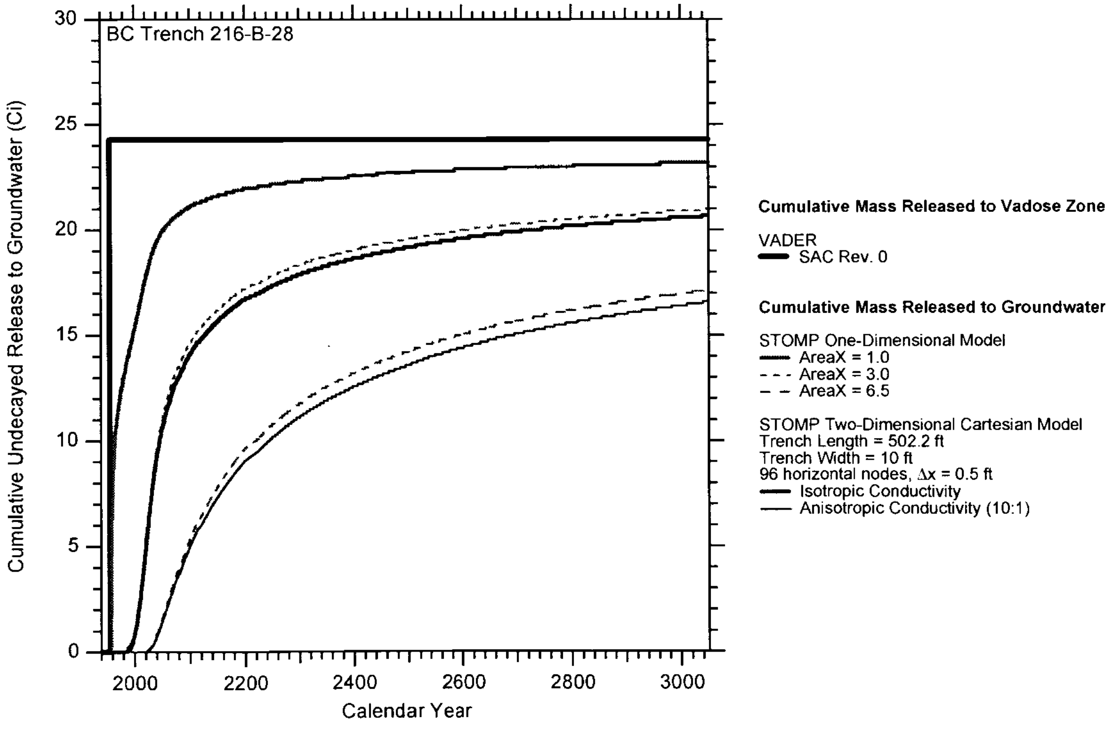

Figure C.9. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-28

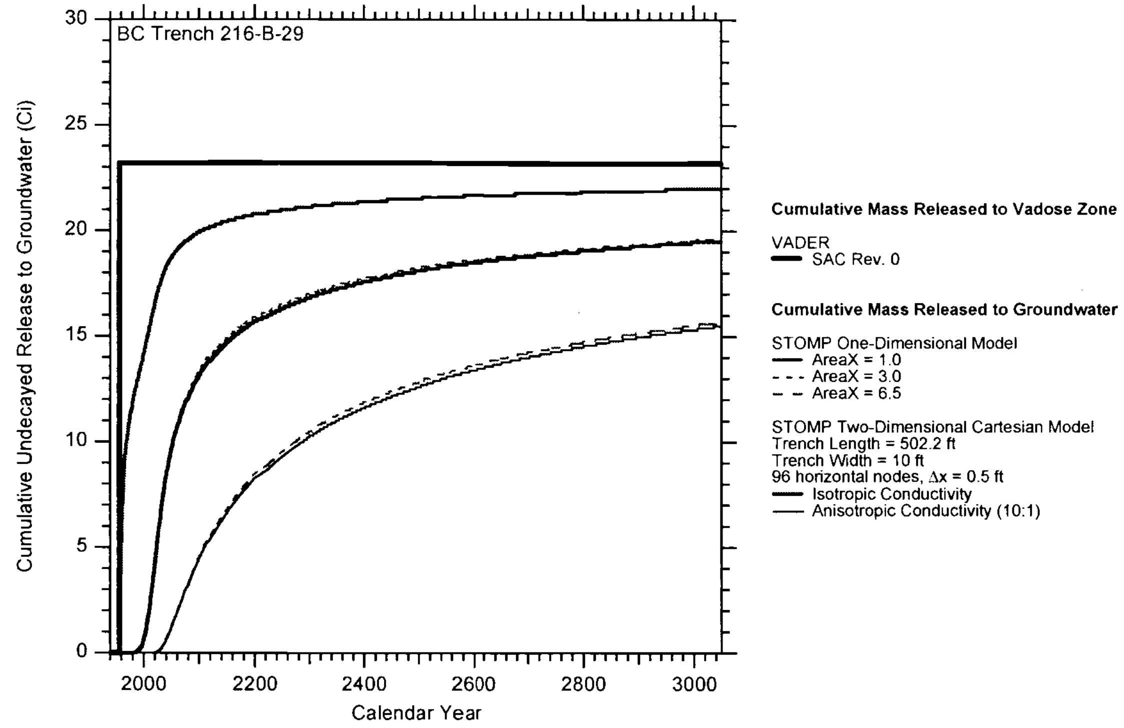

Figure C.10. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-29

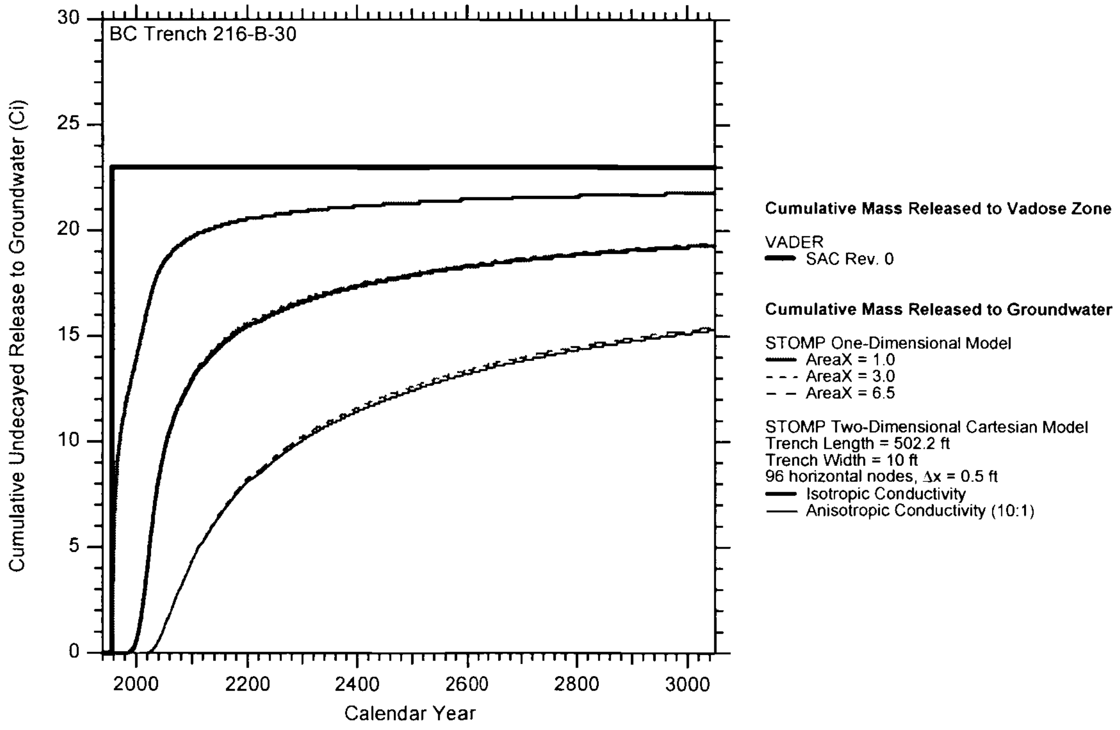

Figure C.11. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-30

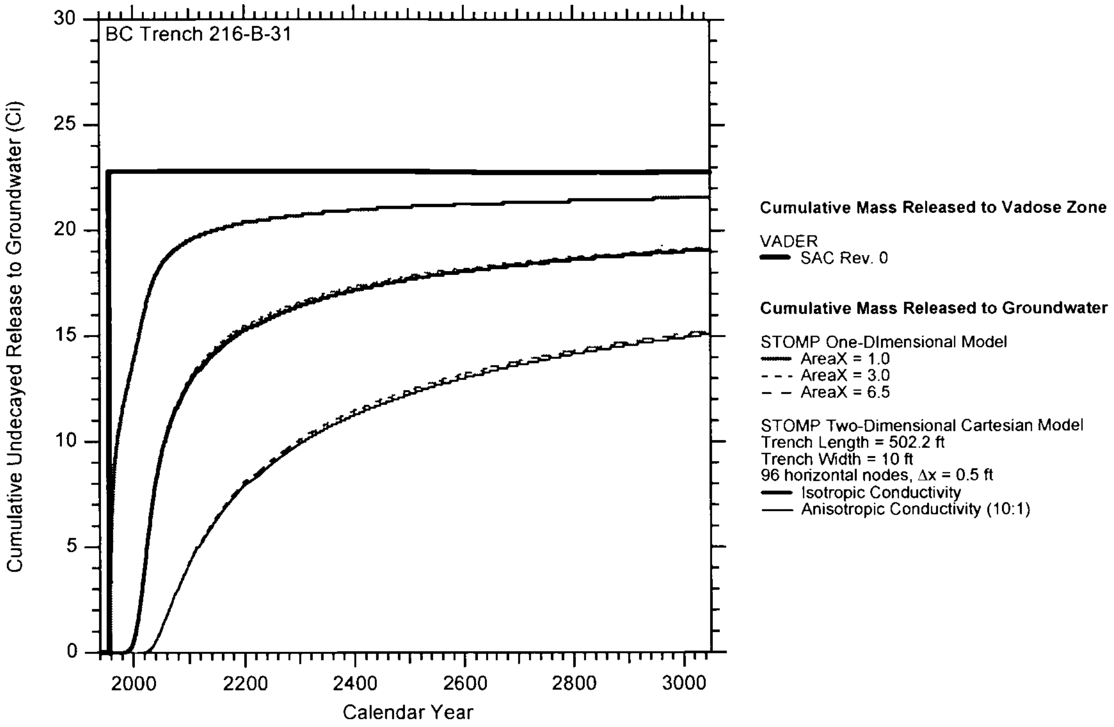

Figure C.12. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-31

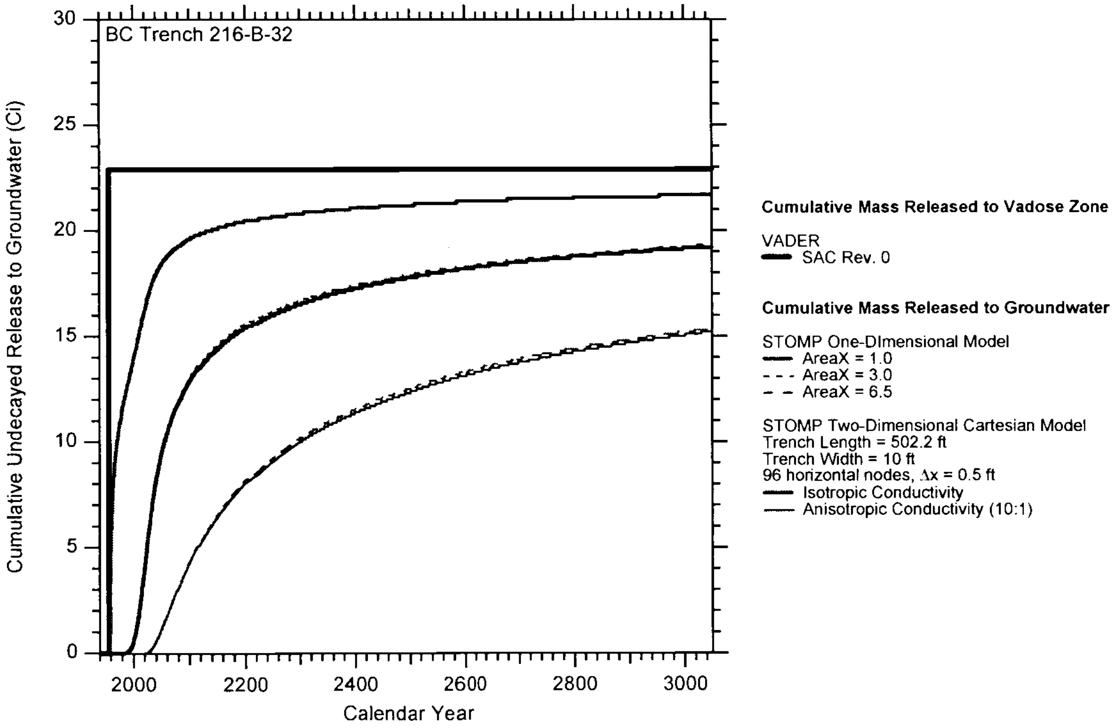

Figure C.13. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-32

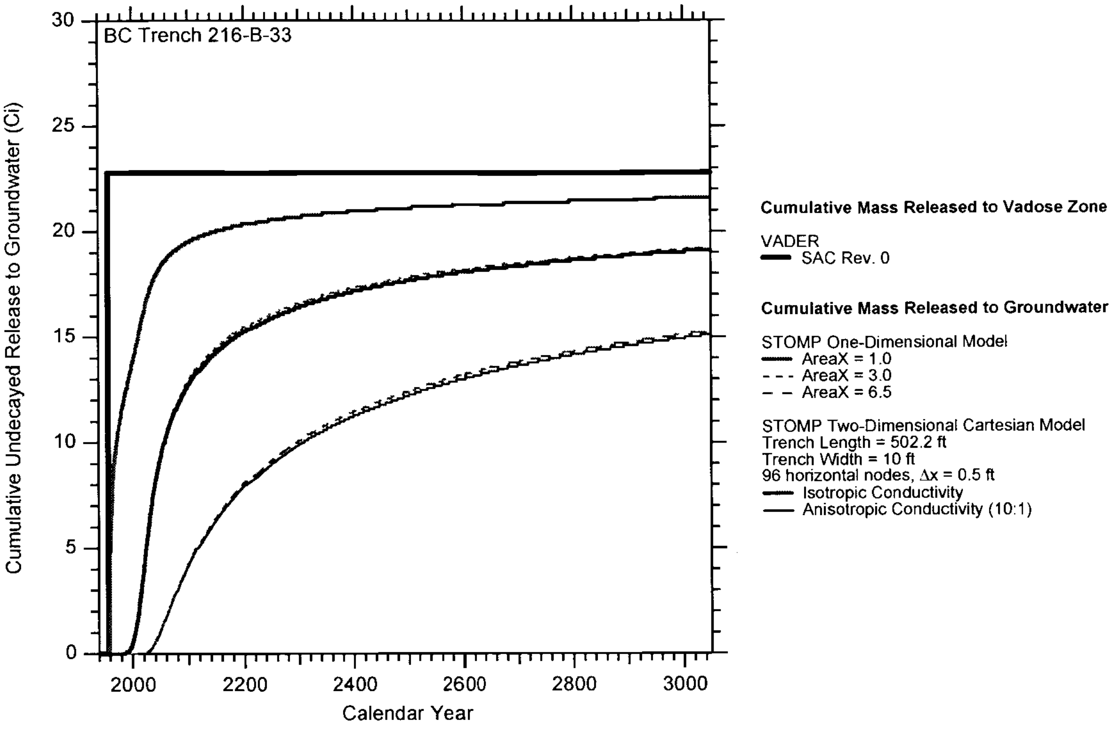

Figure C.14. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-33

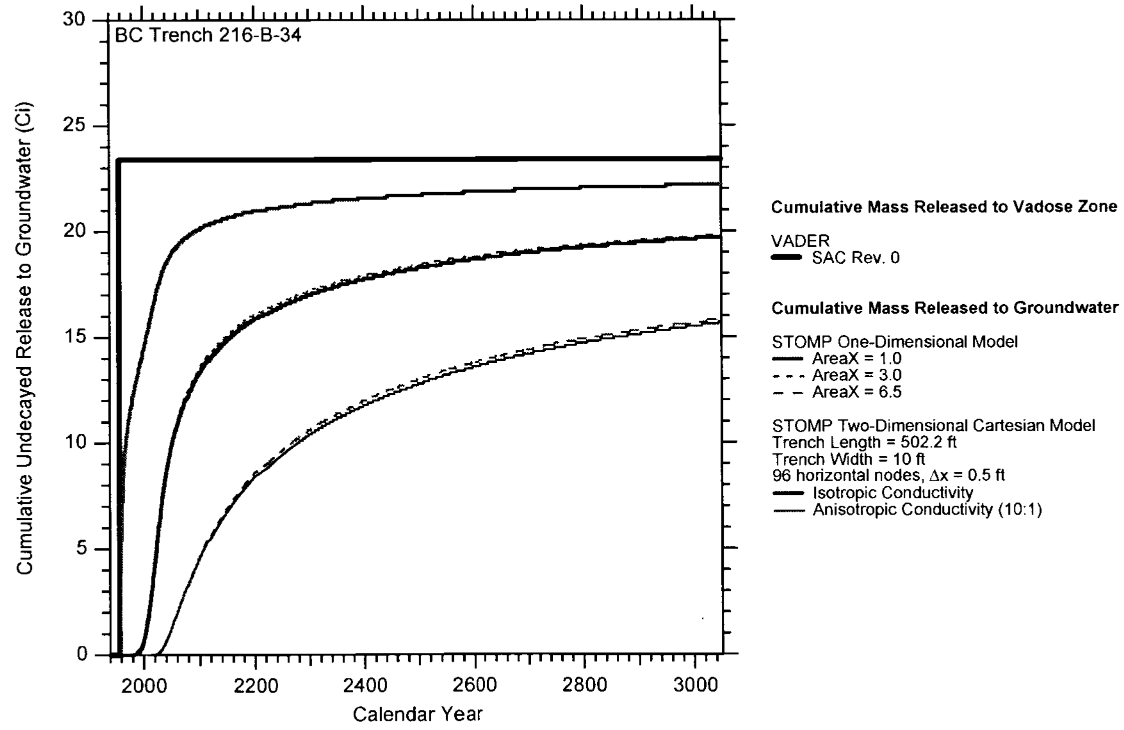

Figure C.15. Vadose Zone Cumulative Release to Groundwater Modeled for Trench 216-B-34

C.3 Multidimensional Modeling of BC Cribs

The BC cribs and their respective areas and discharge volumes are listed in Table C.2. The BC cribs are essentially square and were idealized as a two-dimensional circular feature symmetric about the diameter. An idealized two-dimensional cylindrical model was constructed that assumes lateral spreading will be strictly radial outward.

The SAC one-dimensional model for each BC crib was expanded into a two-dimensional axial-symmetric cylindrical model (a 180-degree arc, or half the crib, represented with results scalable to represent the whole crib). The vertical resolution (580, 0.15-meter-grid cells) was retained, and the x-axis was resolved several ways. Ideally, the model should be resolved to the same degree horizontally (0.15 meter) as vertical to avoid numerical dispersion, but for the high volume (relative to disposal area) the number of nodes necessary to accomplish this leads to a model too large to solve practically with available computer systems. Instead, several successively finer resolutions were simulated for the first crib (216-B-14) to demonstrate convergence in the release history with finer resolution. It is notable that lower resolution leads to greater lateral flow (due to numerical dispersion in the horizontal dimension), which in turn leads to lower release predictions. This indicates the need to use full resolution in two-dimensional models if release is not to be systematically under-predicted in SAC analyses.

Liquid and analyte discharges were converted to density-type sources and assigned to the topmost nodes in the grid index range covering the inner 13.7 meters (the radius of a circle with the same area as a typical BC crib), representing half the source term (again, consistent with the axial-symmetric treatment). Note that the area given in Table C.2 does not match the area declared in WIDS and the SAC database; often the WIDS area is larger than the true footprint.

Hanford soil is anisotropic, considered about 10 times more conductive in the horizontal dimension than in the vertical. To consider this feature, each crib was modeled twice, once with isotropic properties and once with 10:1 anisotropy in saturated hydraulic conductivity.

Once the release histories for the multidimensional model runs were available, the one-dimensional model was rerun with several AreaX (area scaling parameter) values. By trial-and-error, an AreaX scaling factor that would cause the one-dimensional model to produce releases similar to the

Table C.2. BC Cribs (data from Maxfield 1979)

WIDS Identification	Area (square feet)	Discharge Volume (liters)
216-B-14	40×40 = 1600	8.71×10^6
216-B-15	40×40 = 1600	6.32×10^6
216-B-16	40×50 = 2000	5.6×10^6
216-B-17	40×40 = 1600	3.41×10^6
216-B-18	40×40 = 1600	8.52×10^6
216-B-19	40×40 = 1600	6.4×10^6
WIDS = Waste Information Data System		

two-dimensional model (with explicit treatment of lateral flow) was determined. For all BC cribs, the value AreaX = 1.5 provided the best match for isotropic conductivity and AreaX = 3.0 provided the best match for anisotropic (10:1 ratio) conductivity.

Figures C.16 through C.24 shows simulated vadose zone release to groundwater results for BC crib 216-B-14 for various horizontal resolutions of the two-dimensional cylindrical model for the early years 1944 to 2000 for both isotropic and anisotropic (10:1) conductivity. Note that increasing release with increasing resolution, showing the need for a highly resolved two-dimensional model to preclude substantially under predicting release. The highest model resolution simulated was 580 vertical (0.15 meter) by 192 horizontal (0.43 meter) nodes, for a total model grid of 111,360 nodes. Ideally, the horizontal should be resolved to 0.15-meter nodes also, but this would yield a model domain of more than 300,000 nodes, too large to simulate with available equipment in a reasonable time. As it was, the final resolution (111,360 nodes) could only be simulated on the analysis stations (paper.pnl.gov or plastic.pnl.gov) and not on any RANSAC compute node due to the memory demands of such a large domain. Hence, the release for the highest resolution should be seen as close, but not quite as high as the release that would be predicted for the fully resolved (0.15-meter grid) model if it were run.

Also displayed in Figure C.16 are the release results for the one-dimensional model for AreaX = 1.0 (SAC Rev. 0 default) and for AreaX = 1.5, which approximates the isotropic release history, and AreaX = 3.0, which approximates the anisotropic (10:1) release history. The one-dimensional model is shown to slightly under predict annual releases from the crib in early years (up to about 1980) and slightly over predict annual releases thereafter.

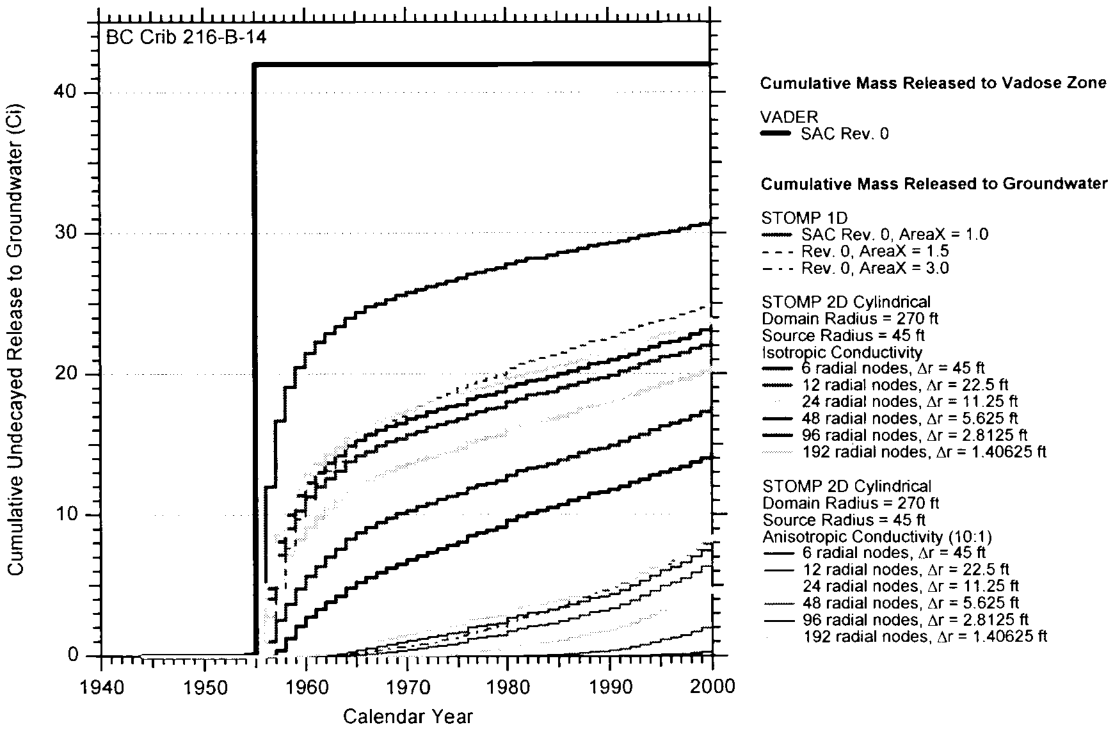

Figure C.16. **Vadose Zone Cumulative Release to Groundwater Modeled for Crib 216-B-14 (1944 to 2000)**

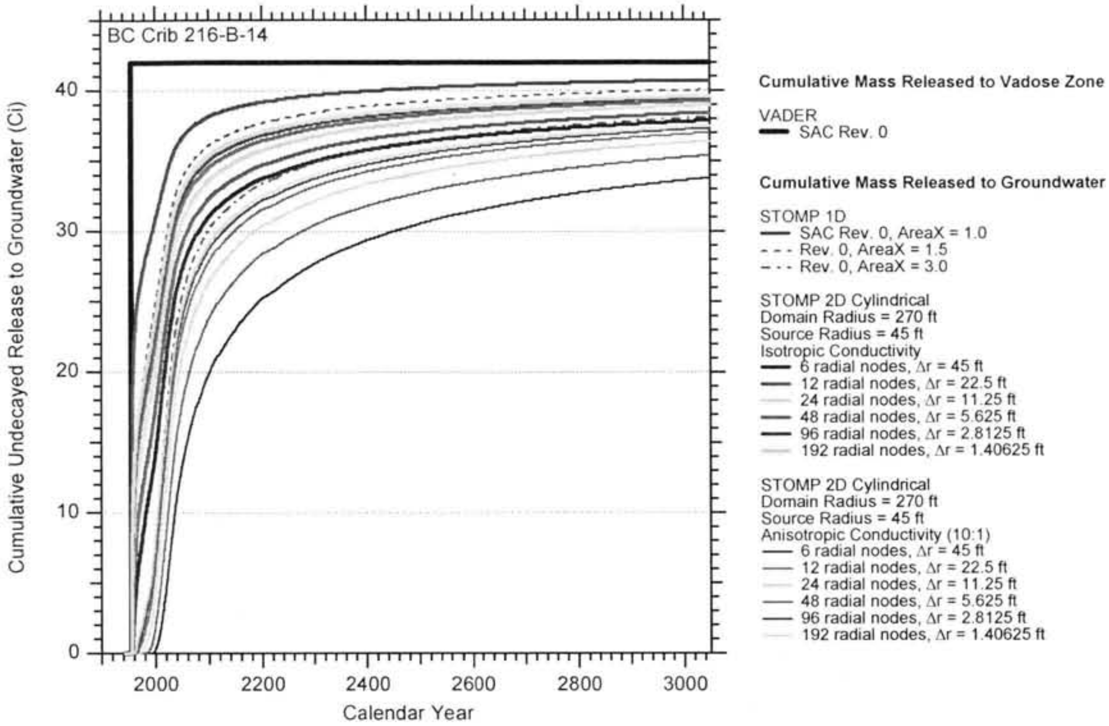

Figure C.17. Vadose Zone Cumulative Release to Groundwater Modeled for Crib 216-B-14

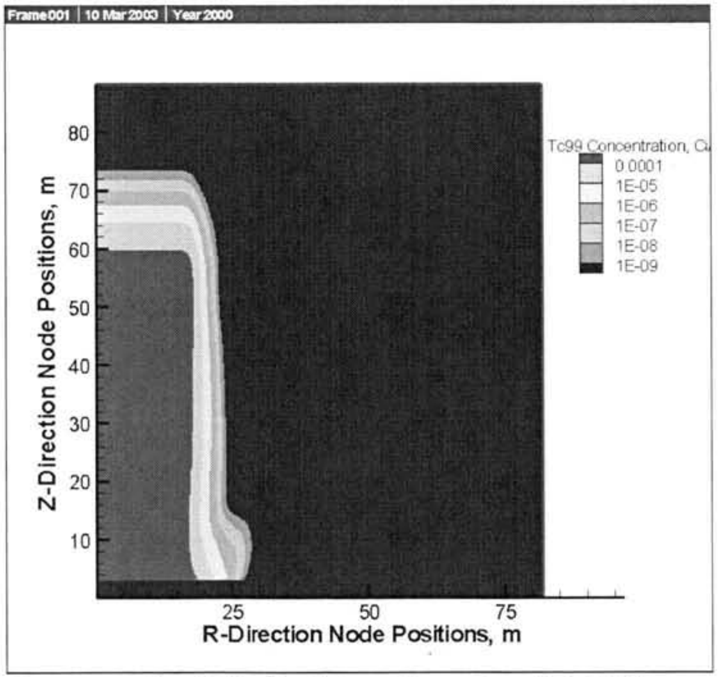

Figure C.18. Tc-99 Concentration (Ci/m^3) of Two-Dimensional Axial-Symmetric (192 radial nodes) Isotropic Model of Crib 216-B-14 (center of crib is the left-hand side and the water table is the bottom of the domain)

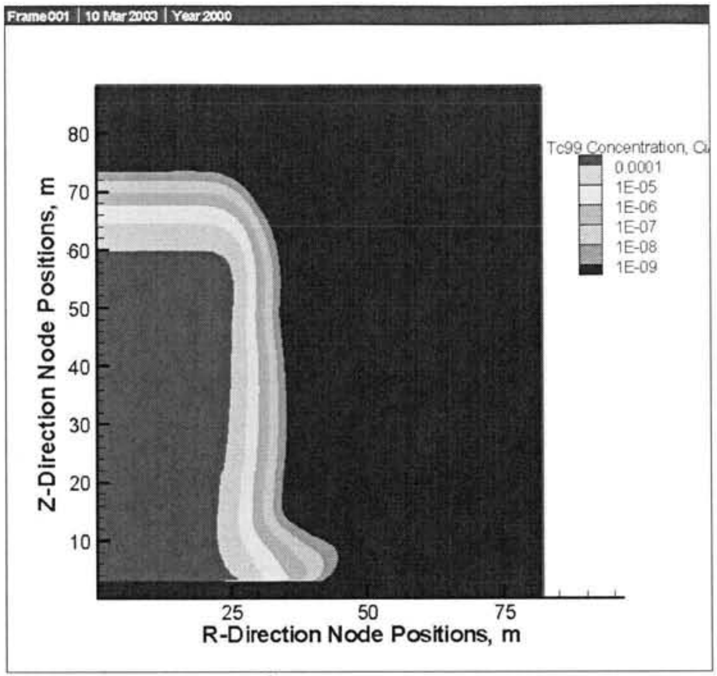

Figure C.19. Tc-99 Concentration (Ci/m^3) of Two-Dimensional Axial-Symmetric (192 radial nodes) Anisotropic (10:1 conductivity ratio) Model of Crib 216-B-14 (center of crib is the left-hand side and the water table is the bottom of the domain).

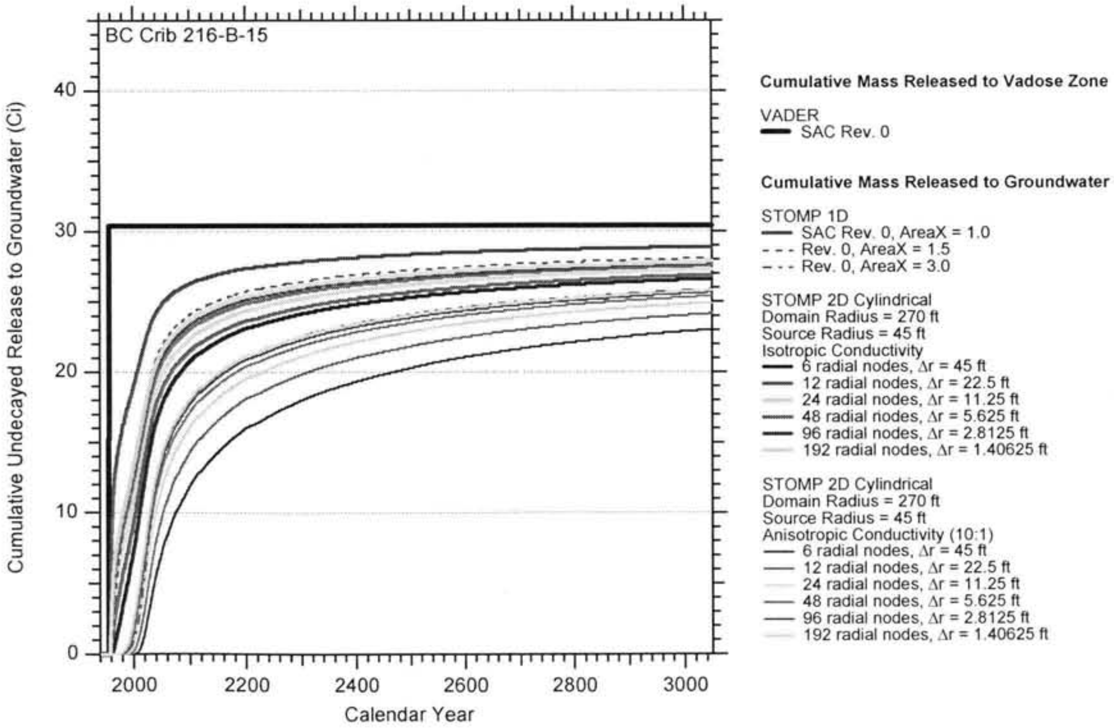

Figure C.20. Vadose Zone Cumulative Release to Groundwater Modeled for Crib 216-B-15

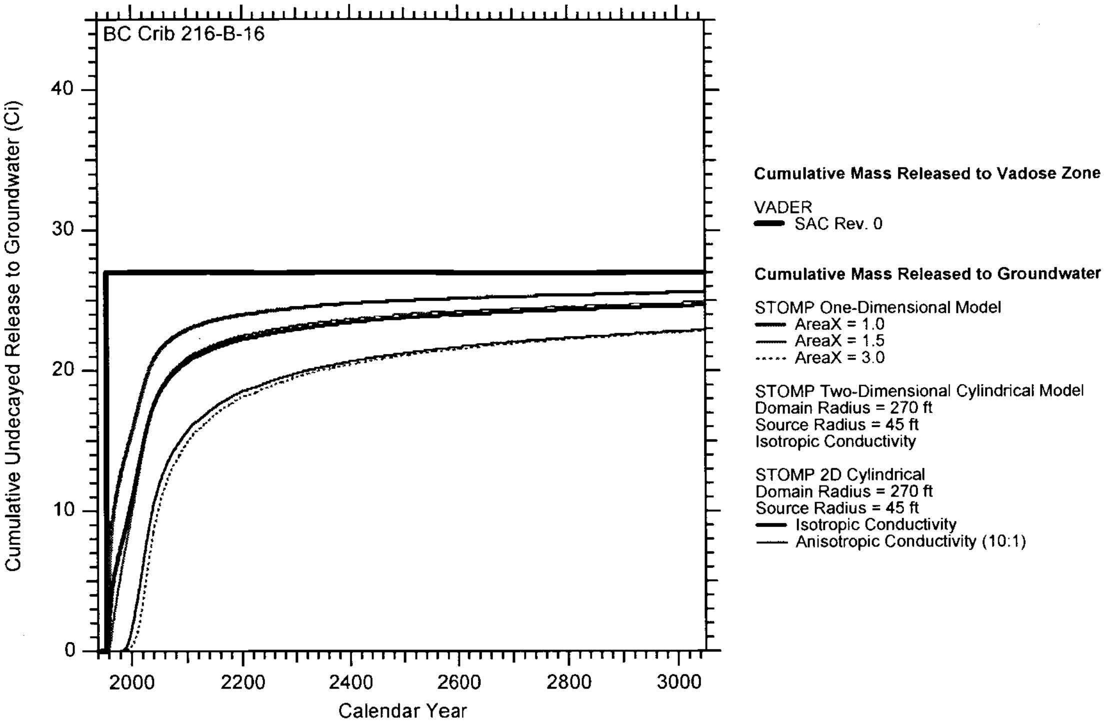

Figure C.21. Vadose Zone Cumulative Release to Groundwater Modeled for Crib 216-B-16

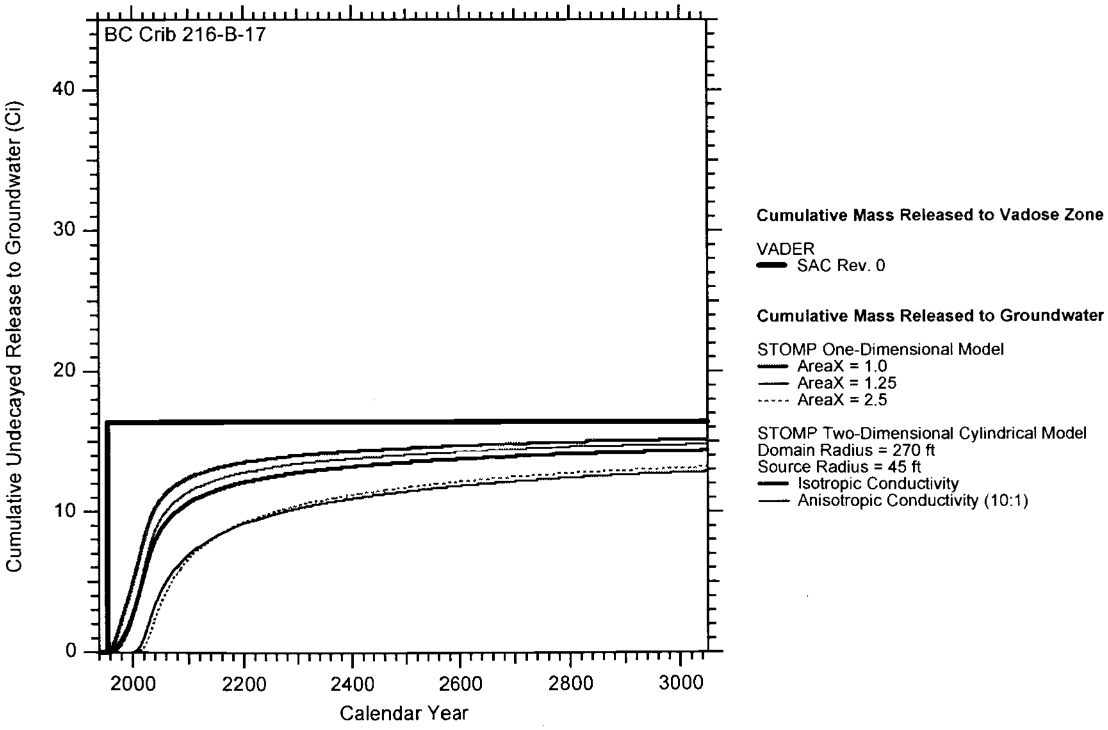

Figure C.22. Vadose Zone Cumulative Release to Groundwater Modeled for Crib 216-B-17

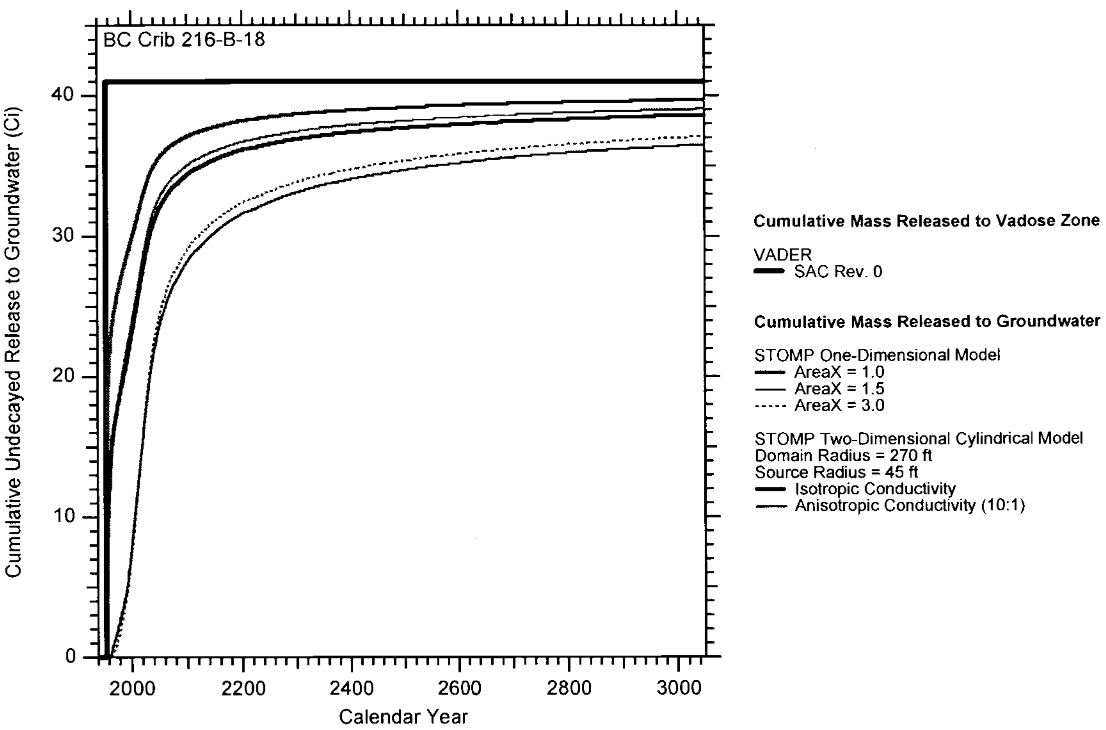

Figure C.23. Vadose Zone Cumulative Release to Groundwater Modeled for Crib 216-B-18

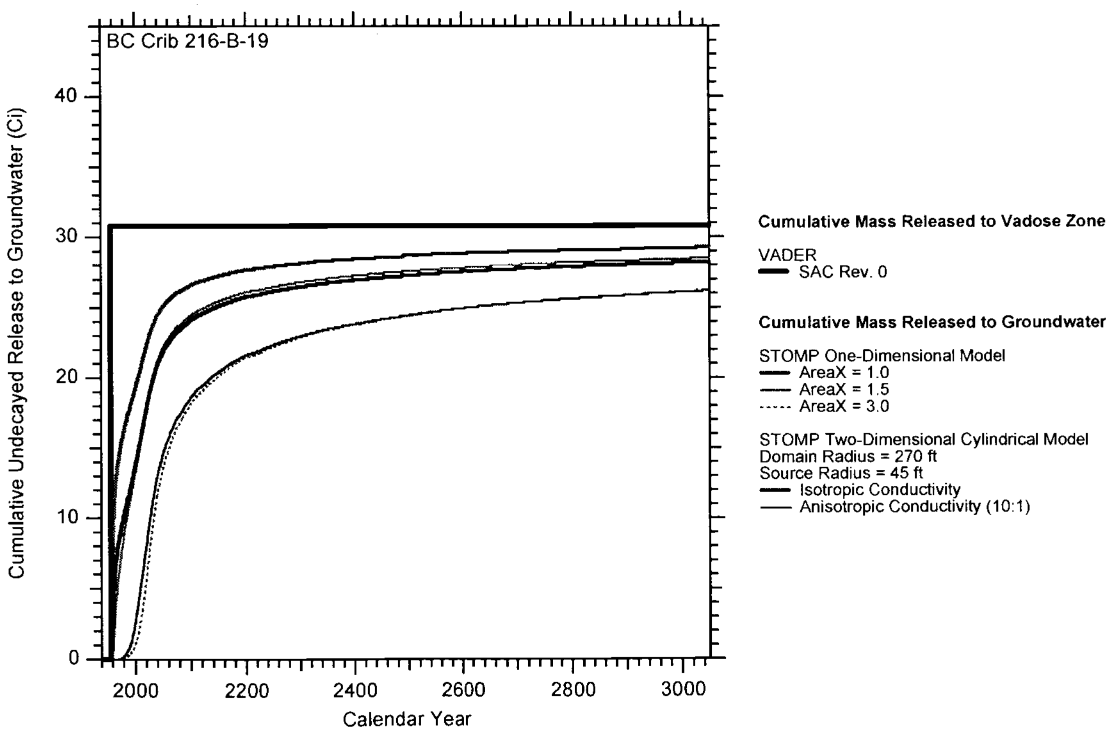

Figure C.24. Vadose Zone Cumulative Release to Groundwater Modeled for Crib 216-B-19

C.4 Computer Simulation Time

An important implication of two-dimensional simulation in the SAC context is the simulation time required to solve for vadose zone transport of analytes. As a stochastic simulator, SAC will invoke a STOMP model of a vadose zone site for a number of cases equal to the number of realizations times the number of analytes. Ideally, locations with liquid discharges (such as the BC cribs and trenches) would be modeled as two-dimensional features. However, if the computer time required to perform the number of two-dimensional cases required is too great, a problem of feasibility arises.

The times required to solve the various one- and two-dimensional simulations of the crib 216-B-14 provides a basis for consideration. Table C.3 provides the timing results. Note all time are for simulations on a Pentium 4 processor, except the highest resolution grid which had to be run on a SAC analysis node due to the high RAM requirements of this resolution grid. The highest resolution two-dimensional model, with 111,360 nodes, was too large to run on any RANSAC compute node as it required more RAM than any of the compute nodes are equipped with. The high memory demand of this size model has important implications for inclusion in SAC of a two-dimensional model of the BC cribs. Moreover, this model still wasn't sufficiently resolved (that would require a model with more than 300,000 nodes).

C.5 Summary

Based on the simulation times in Table C.3 and the simulation results shown earlier, several points can be made with respect to SAC Rev. 1 implementation:

1. If a two-dimensional capability is desired, the SPLIB solver is substantially faster for grid domains over 20,000 nodes and should be made standard for STOMP in SAC.

Table C.3. Computer Simulation Time for Various One- and Two-Dimensional STOMP Models of 216-B-14 Crib (Pentium 4, 2.2-GHz processor running under Linux)

Number of Nodes in Direction			Total Number of Nodes	Solution Time(s)	
r	θ	Z		Banded Matrix Solver	SPLIB Solver
1	1	580	580	137	129
6	1	580	3,480	960	955
12	1	580	6,960	2,081	2,055
24	1	580	13,920	4,910	4,501
48	1	580	27,840	21,835	9,522
96	1	580	55,680		20,588
192	1	580	111,360		55,748[(a)]

(a) Simulated on Pentium III, 1.3-GHz processor instead because RAM was insufficient on any RANSAC compute node for this large of grid domain.

2. If a two-dimensional model were to be used directly in SAC, the time required to solve the vadose zone segment of SAC would increase starkly. For crib 216-B-14, more than 15 hours were required at a grid resolution that was nearly sufficient. In a production run with 25 realizations and 10 analytes, this would imply 3,750 hours of computer time for just one crib, or 22,500 hours for the six BC cribs. Spread over 132 compute nodes (assuming these were equipped with enough RAM to carry the problem), it would take 170 hours, or about one week, just to solve for the six BC cribs. Worse, these time estimates were based on runs on 2.2-GHz processors; 128 of the 132 compute nodes on RANSAC are 1.0-GHz processors (about three times slower). And this only for the BC cribs; there are many other liquid-discharge sites that make good candidates for two-dimensional simulation in SAC. It is clear that direct two-dimensional treatment of liquid discharge waste sites remains impractical, requiring at least RAM upgrades to the entire SAC cluster and unacceptably long simulation times to solve.

3. However, the results also demonstrate that the one-dimensional model can be made to approximate the direct two-dimensional model by selecting an appropriate value of the vadose zone wetted area based on detailed two-dimensional modeling.

It is recommended that for the BC cribs and trenches the one-dimensional model continue to be used in SAC Rev. 1, but with vadose zone wetted area scaling factors derived from the simulations performed in this report.

C.6 Projected Impact on Initial Assessment

To demonstrate the change from following these calibration factors, the total technetium-99 release from all BC cribs and trenches was simulated both using the SAC Rev. 0 approach (effectively AreaX = 1.0) and with the vadose zone wetted area scaling parameters derived in this study. The results are shown in Figure C.25. Note the difference predicted by year 2000; 449 curies released to the aquifer in the initial assessment model (one-dimensional model, AreaX = 1.0) compared to only 18.2 curies released in the one-dimensional model with scaling factors drawn from the detailed two-dimensional models. Based on the more detailed modeling, the absence of a detected technetium plume in groundwater monitoring data for this area, the much lower release is considered much more realistic.

C.7 References

Bryce RW, CT Kincaid, PW Eslinger, and LF Morasch (eds.). 2002. *An Initial Assessment of Hanford Impact Performed with the System Assessment Capability.* PNNL-14027, Pacific Northwest National Laboratory, Richland, Washington.

Maxfield HL. 1979. *Handbook – 200 Areas Waste Sites.* RHO-CD-673, Volumes I and II, Rockwell Hanford Company, Richland, Washington.

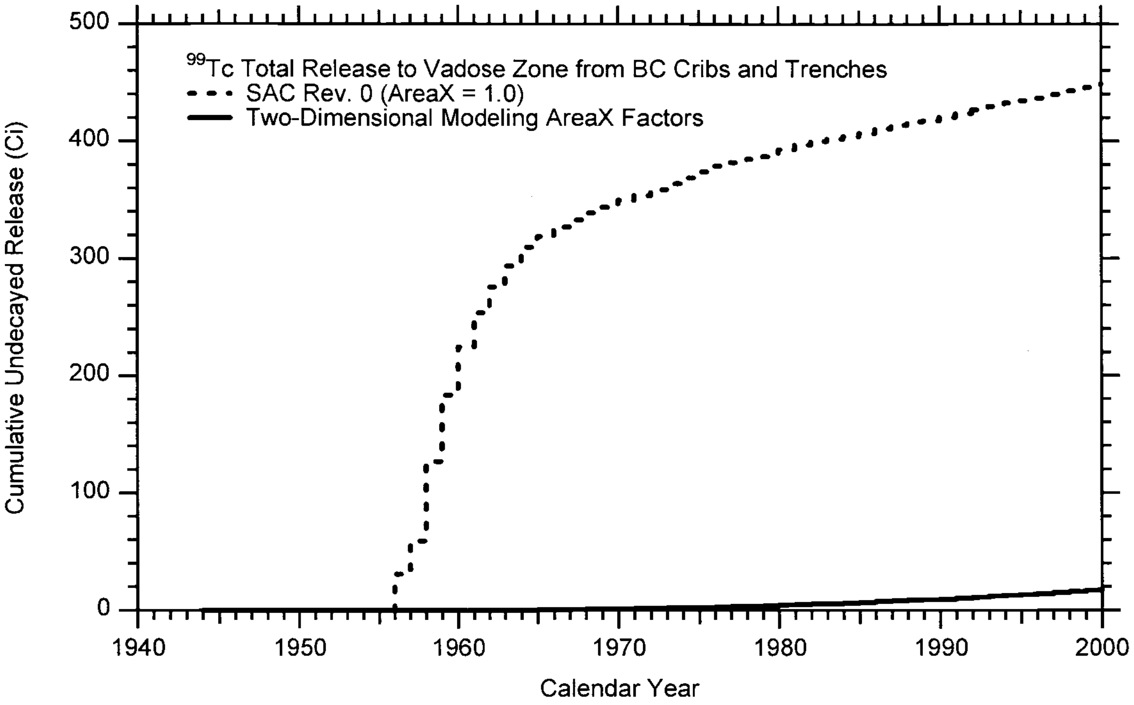

Figure C.25. Total Annual Release from all BC Cribs and Trenches Simulated in SAC Rev. 0 Initial Assessment and with Vadose Zone Wetted Area Scaling Parameters Conditioned to Direct Two-Dimensional Simulations

Appendix D

Surface Barrier Degradation

Appendix D

Surface Barrier Degradation

G. W. Gee and A. L. Ward

Surface barriers, consisting of vegetated soil and assorted sublayers, will be constructed and placed over as many as 200 waste sites at Hanford. These surface barriers, if effective, will isolate the general public from buried waste and limit surface erosion and minimize water and biotic intrusion into the waste. Over time, it is assumed that numerous forces, including wind, water, fire, drought, and seismic activity will act to degrade the barrier surface. This appendix describes key potential failure mechanisms and outlines several scenarios that could be used to simulate barrier degradation in long term assessments. The most probable failure mechanism is wind erosion resulting in sand dune formation, which can change surface texture and vegetation and result in increased recharge rates. In terms of recharge control, a surface barrier at Hanford may change from a very low recharge rate (<0.1 millimeter per year) to something more representative of a stabilized sand dune at the Hanford Site (e.g., 4 millimeters per year or greater).

D.1 Introduction

In the mid 1980s the U.S. Department of Energy initiated a Barrier Development Program at the Hanford Site (see Attachment 1). The purpose of the program was to develop a long-term barrier, capable of isolating waste for more than 1,000 years. The barrier development program included 12 elements designed to address all aspects of barrier design and construction:

- biointrusion
- water intrusion
- wind and water erosion
- physical stability
- material quality and quantity
- monitoring
- modeling
- prototype design and construction
- natural analogs
- climate change
- regulatory issues
- technical exchange

Field tests were initiated to test selected aspects of the long-term barrier and culminated in the design and construction of a prototype surface barrier (PSB), placed over the B-57 crib in the 200 BP-1 Operable Unit, adjacent to the BY Tank Farm in the 200 East Area at the Hanford Site. Over 130 reports and papers have been published to date, documenting various aspects of the PSB, construction, and performance (see Attachment 1). Figure D.1 shows the general features of PSB designed for long-term (1,000 year) protection.

Testing of PSB has successfully demonstrated that above-grade vegetated covers at Hanford act as a sponge, storing incident precipitation during wet (winter) periods and subsequently losing water by evapotranspiration (ET) during dry (summer) periods, thus minimizing water intrusion into underlying

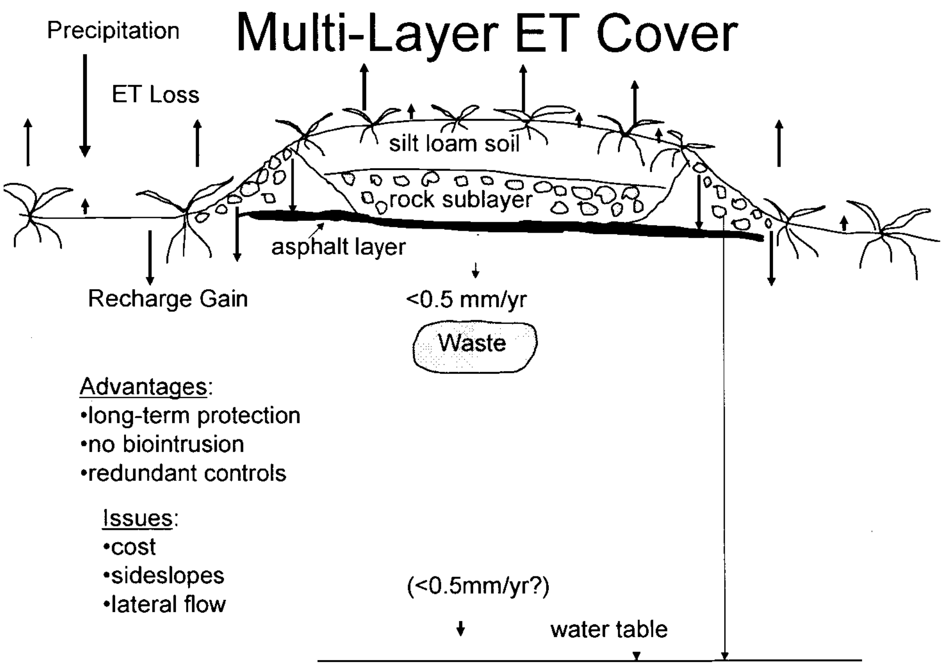

Figure D.1. **Hanford Prototype Surface Barrier (PSB) Designed for Long-Term (1,000 year) Protection of Hanford Waste Sites**

waste. In contrast, the side slopes, built to engineering specifications (DOE 1994), are designed to stabilize the barrier against wind and water erosion. Because they are coarse and mostly barren they allow significant water to infiltrate into subsurface sediments surrounding the waste (Ward and Gee 1997; Gee et al. 2002; Wittreich et al. 2003). The results from the PSB studies indicate that the complete barrier system, soil cover and side slopes, must be understood to evaluate total barrier performance. In the final design of long-term barriers there may be tradeoffs between erosion control and water intrusion protection, as illustrated by the side slope drainage measurements which have shown that coarse side slopes, used for erosion protection, can drain up to 20% or more of the annual precipitation (Wittreich et al. 2003).

D.2 Alternative Designs

In addition to PSB (Figure D.1), other barrier designs have been proposed for Hanford (DOE 1997). Only PSB has been tested in full-scale prototype. However, some alternative covers have been tested in small lysimeters (Fayer et al. 1999). These include the so-called modified RCRA C cover. The modified RCRA C cover incorporates the low permeability (asphalt layer) layer of PSB but does not use the biointrusion layer; thus, the total thickness is less than PSB and construction costs are correspondingly reduced. Monofill ET covers have also been proposed for use at Hanford. Figure D.2 shows the general features of a monofill ET cover, which consists simply of a soil layer placed above the waste and vegetated with native plants. Side slope issues that exist for all above-grade surface barriers will affect both the modified RCRA C and the monofill ET cover. An alternative cover that has not been considered yet but has great potential for Hanford is what can be called the Shallow Liner ET Cover (Figure D.3).

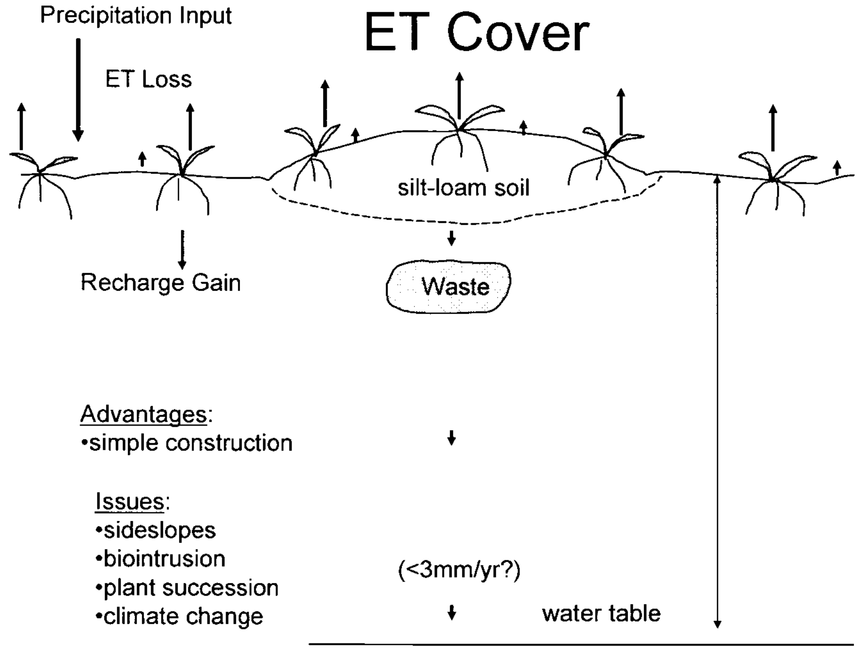

Figure D.2. Simple Evapotranspiration (ET) Cover, with Silt Loam Soil (for optimal water storage) and Native Vegetation (shrub steppe) to Enhance Surface Water Loss

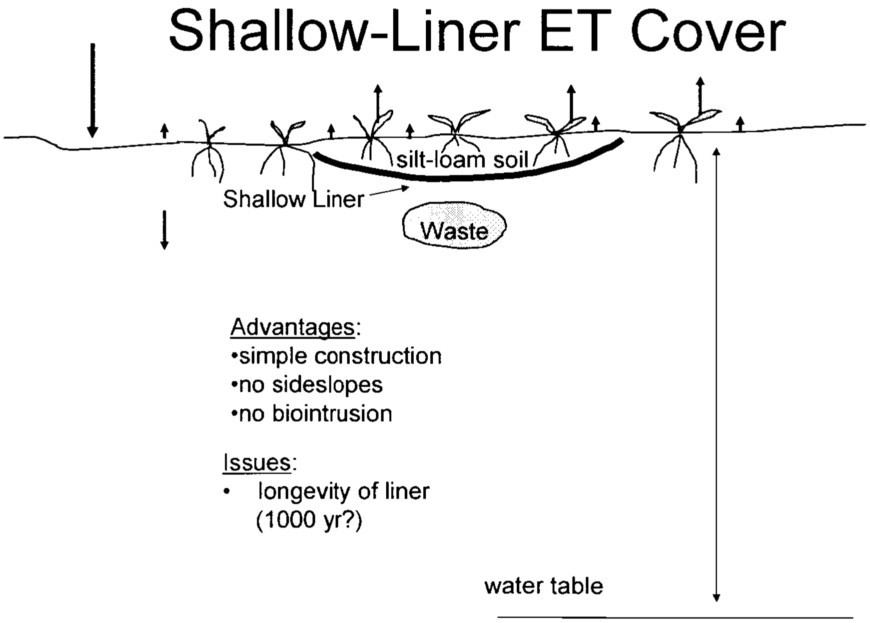

Figure D.3. Shallow Liner Evapotranspiration (ET) Cover. Includes a low permeability (Geomembrane) below a silt loam surface to provide redundant drainage control, minimize biointrusion and eliminate side slopes.

This design eliminates side slopes and biointrusion and because these are two mechanisms that can aid to the degradation of surface covers, such design features should be seriously considered for placement at Hanford waste sites.

No systematic study of all surface barrier degradation mechanisms has been made to date. For example, the impact of side slopes on net water infiltration into the waste has not been addressed in current designs of above grade surface barriers, nor previously factored into discussions of barrier degradation. The interaction of side slope recharge, erosion control, depositional processes and impacts from fire, disease, etc. have not been systematically incorporated into a final design. In the following sections we attempt to describe the most reasonable and expected degradation (or failure) mechanisms for surface barriers at Hanford, including effect of wind erosion, biointrusion protection, and the impact of side slopes on degradation on final barrier performance. We offer some alternative designs for improved side slope performance, and provide several timelines for expected barrier degradation including estimates of overall net infiltration or recharge associated with final barrier performance as a consequence of a specific design.

D.3 Barrier Degradation Assumptions

In recent numerical assessments, (such as the initial assessment performed with the System Assessment Capability (SAC) (Bryce et al. 2002) it was assumed that there were two kinds of barriers: 1) a long-term (1,000 year) barrier used primarily for tank farms and transuranic waste sites and 2) a 500-year barrier used for solid waste landfills and other low-level waste sites at Hanford. There have been no specific degradation mechanisms specified but for the initial assessment performed with SAC, the following assumptions were made about performance and recharge rates.

D.3.1 The 1,000-Year Barrier

This barrier was assumed to perform optimally (0.1 millimeter per year) for 1,000 years. After 1,000 years, the barrier was assumed to degrade (by a combination of unspecified failure mechanisms) to a pre-operations recharge level specified by the soil type that existed prior to the waste-site construction. The degradation was assumed to take place in 5 equal steps of 200 years over the next 1,000 years. For example, if the pre-operations recharge level was 2 millimeters per year, the following scenario was assumed:

- Year 0 to 1000 - recharge = 0.1 millimeter per year
- Year 1001 to 1200 - recharge = 0.4 millimeter per year
- Year 1201 to 1400 - recharge = 0.8 millimeter per year
- Year 1401 to 1600 - recharge = 1.2 millimeters per year
- Year 1601 to 1800 - recharge = 1.6 millimeters per year
- Year 1801 to 2000 - recharge = 2.0 millimeters per year

D.3.2 The 500-Year Barrier

This barrier was assumed to perform optimally (0.1 millimeter per year) for 500 years. After 500 years, the barrier was assumed to degrade (by a combination of unspecified failure mechanisms) to a pre-operations recharge level specified by the soil type that existed prior to the waste-site construction. The degradation was assumed to take place in 5 equal steps of 100 years over the next 500 years. For example, if the pre-operations recharge level was 2 millimeters per year, the following scenario was assumed:

- Year 0 to 500 - recharge = 0.1 millimeter per year
- Year 501 to 600 - recharge = 0.4 millimeter per year
- Year 601 to 700 - recharge = 0.8 millimeter per year
- Year 701 to 800 - recharge = 1.2 millimeters per year
- Year 801 to 900 - recharge = 1.6 millimeters per year
- Year 901 to 1000 - recharge = 2.0 millimeters per year

These degradation assumptions were made purely to simplify the modeling and do not represent any actual degradation responses. They are considered conservative assumptions, in that degradation processes are generally slow, though some catastrophic events such as floods, drought, and related climate change events can cause rapid alteration of the landscape. In fact, extreme dynamics are responsible for much of the geologic setting for Hanford (Baker et al. 1991; Bjornstad and Teel 1993; Gaylord and Stetler 1994; Peterson et al. 1993). Prediction of the exact timing of degradation is virtually impossible, so the stepwise degradation assumptions are as reasonable as any other alternatives.

Other recent assessments (such as the ILAW performance assessment [reference]) have assumed that the barrier disappears at the end of its design life.

D.4 Potential Degradation Mechanisms

This section describes degradation mechanisms that could affect surface barriers placed over Hanford waste sites.

D.4.1 Wind Deposition

The most likely mechanism for long-term degradation of a barrier at Hanford is wind induced sand-dune formation (sand deposition). Studies by Gaylord et al. (1993); Gaylord and Stetler (1994) demonstrate that most of the surficial soil at Hanford is eolian (wind blown) in nature, with about half of the Hanford Site exposed to or covered by stabilized or active dunes. Active and stabilized dunes have their highest densities in areas to the south and east of the 200 Areas, while some stabilized dunes are located in the 200 East Area. All soil in the 200 Areas is covered with a mantle of windblown sand material (Gaylord and Stetler 1994). For long-term considerations, all surface covers are assumed to be affected in some way by wind action. When vegetated, the soil surface is generally stabilized against wind erosion. However, there are local changes to microrelief because of wind action that can affect water storage and other surface properties. Coppice dunes are found extensively at the Hanford Site.

These miniature dunes consist of fine sands deposited around shrubs, creating small mounds (hummocks) elevated 0.5 meter or more above surroundings. The intermound (or swale) is a depression that is often sparsely vegetated and has different water-storage capacity than that found on the hummock. At one coppice dune site near the Yakima Barricade, west of the 200 Areas at Hanford, Link et al. (1994) found that water storage was strongly associated with vegetation patterns and that actual water storage was inversely correlated with vegetation, suggesting the greater the plant density the lower the available water in the soil profile, consistent with our ET cover concepts. An irrigation treatment demonstrated that all of the rainfall and irrigation water was consumed (transpired) by plants at this coppice dune site. Soil texture was coarser in the top 0.5 meter of the hummock than in the swale but vegetation density was greatest on the hummock. It is entirely possible that as coarser soils accumulate, that water storage capacities will actually decrease, with corresponding decreases in vegetation density and conversion from deep-rooted vegetation to shallow rooted vegetation. Coppice dunes are complex systems and illustrate the dynamic nature of the soil surface in the Hanford environment. It is most likely that changes similar to coppice dune features will develop on even the most stable cover under the present Hanford climatic regime. Initially, this change may not directly impact barrier drainage rates, but features like coppice dunes are a precursor to larger accumulation of sands over time and the subsequent change from shrub vegetation to sparse grasses as observed on a significant portion of the Hanford Site (Gaylord and Stetler 1994). Based on these observations, it is likely that engineered surface barriers will change from well-contoured surfaces to surfaces with significant microrelief (hummocks and swales) and finally to more extensive stabilized dunes in the next 1,000 years or more.

A possible scenario for wind action on the surface barrier is as follows:

1. Year 1 (barrier placement) to year 500. Barrier performance as specified (<0.1 millimeter per year)

2. Year 501 to year 1000. Development of stabilized dunes – linearly degrades to 4 millimeters per year of average recharge. This rate is based on recharge estimates of stabilized dunes obtained from chloride mass balance data of Murphy et al. (1996).

3. Year 1001 and beyond. Surface barrier is assumed to behave like a stabilized sand dune. (Recharge assumed to be 4 millimeters per year). It should be noted that the chloride mass balance method apparently predicts recharge reliably in the very low (<1 millimeter per year) range but there is less certainty when the recharge is above a few mm/yr (Prych 1995; Tyler et al. 1999), so a sand-dune recharge rate of 4 millimeters per year may not be conservative and likely will have to be updated in the future, as more reliable results are obtained.

D.4.2 Water Erosion

Studies conducted at PSB have demonstrated that little if any runoff or surface erosion has occurred over the 9 years of monitoring of the surface barrier (Gee et al. 2002; Wittreich et al. 2003). The low grade on slopes for the soil cover plus the well-established vegetation has minimized any water erosion on PSB. There is no evidence that water erosion would cause any significant barrier degradation at the Hanford site. Runoff occurs primarily in winter or early spring when soils are frozen and when snowmelt occurs rapidly due to warm (e.g., Chinook) winds (Skaggs and Walters 1981; Gee and Hillel 1988). For soil on gentle slopes with well established vegetation, runoff is accompanied by little or no sediment loss.

The lack of evidence for water erosion allows us to assume that there will be no changes in recharge rate due to any plausible water erosion scenario.

D.4.3 Biotic Intrusion

There is ample evidence that biotic (plant and animal) intrusion has occurred at waste sites at Hanford in the past (Dabrowski 1973; O'Farrell and Gilbert 1975, Landeen and Mitchell 1982; Marshall 1987). Deep-rooted tumbleweed (*Salsoa kali)* has a tap root that can penetrate to depths of 5 meters or more in the sandy soil and backfill sediment at Hanford. Dabrowski (1973) describes waste sites near the Columbia River in the 100 Areas where tumbleweeds intruded in to wastes containing cesium-137 and strontium-90. Uptake of strontium-90 caused the plants to become radioactive. The radioactive tumbleweeds created problems, because as they aged, some were blown off the waste site, thus becoming an undesirable biotic vector. Ants and burrowing insects, small (pocket mice and gophers) and large mammals (badgers) also have been observed to intrude into waste and bring contaminants to the surface where they have been scattered to locations some distance from the waste sites (O'Farrell and Gilbert 1975; Cline et al. 1980; Landeen and Mitchell 1982, Kennedy et al. 1985). A waste site, called the BC cribs, located to the south of the 200 East Area, has documented widespread surface contamination, attributed to biotic intrusion. In the 1950s, a badger hole was found at one of the BC cribs, which contained near-surface contamination (strontium-90 and cesium-137). The badger likely foraged for mice in contaminated soil. Jackrabbits then used the burrow and became contaminated (O'Farrell and Gilbert 1975). Coyotes and raptors subsequently ate the jackrabbits and spread the contamination over a wide area (more than several hundred hectares). Similar situations have been observed at the Idaho National Laboratory, near Arco, Idaho (Arthur and Markum 1983; Arthur et al. 1987).

While such intrusion is possible, particularly at waste sites with surface spills or with otherwise near-surface contamination, a properly designed surface cover will limit biotic intrusion. Features to prevent biotic intrusion were incorporated into the design of the Hanford surface barrier. These features included a sublayer of coarse rock designed to discourage digging (see Cline and Rogers 1982) and an asphalt layer that is impervious to water, small mammals and burrowing insects (Myers and Duranceau 1993; Wing and Gee 1994). An asphalt layer is placed below the rock layer, providing a redundancy that limits not only biotic intrusion (including both plant root and animal intrusion into underlying wastes) but prevents water intrusion as well. For ET cover systems with no rock or asphalt sublayers, the possibility of biointrusion remains. However, in the final barrier design for all waste sites at Hanford, we assume that some kind of biotic intrusion protection will exist and that borrowing animals will be confined to the near surface (top meter of soil) and their presence does not create pathways for water intrusion. This assumption is supported by the work of Landeen (1994) who demonstrated that pocket mice burrows acted much like vent tubes, allowing for advective drying of the near surface soils thus reducing the actual water content in the profile during the summer months and subsequently increasing the actual storage capacity of the soil. Based on past biointrusion studies we conclude that biotic transport can be minimized with a properly designed surface barrier and that water intrusion will not be enhanced. The most probable scenario for biotic intrusion then is to assume that it is minimal and that water intrusion is not affected by biotic vectors, so the recharge impact is zero from biotic intrusion.

D.4.4 Fire, Plant Succession and Associated Wind Erosion

A concern about relying on ET for water removal is the dynamic nature of the vegetation. At Hanford, a key component of any reliable surface barrier will be a vegetated surface. Periodic fires can remove the vegetation in dramatic and often catastrophic fashion. Wildfires have occurred periodically at Hanford. Two of them, one in 1984 and one in 2000, each burned over 64,749 hectares leaving large portions of the landscape temporarily barren (Link et al. 1990; Gee et al. 1992a). The 2000 fire occurred in late June, when understory vegetation (primarily cheatgrass) had senesced (died) and was tinder dry. The fire, started by an auto accident on Highway 24, quickly spread to the Hanford Site, jumping Highways 24 and 240 and burning most of Rattlesnake Mountain and part of Benton City, in addition to spreading onto and around the 200 Areas. The removal of almost all vegetation from the western perimeter of the 200 West Area on to the top of Rattlesnake Mountain left the land surface in that area vulnerable to wind erosion, which did occur. The surface soil in this area has a fine sand texture, which is highly susceptible to wind erosion. It was enough of a problem that tank farm operations were periodically curtailed because of blowing dust. Subsequently, a windbreak, consisting of a double row of 1,500 trees (Australian willow), was placed along the western boarder of the 200 West Area to protect buildings, vehicles, and personnel from sand blasting and dust inhalation. Irrigation of the windbreak was initiated in the summer of 2001 and is continuing because trees do not survive in the Hanford environment without supplemental irrigation (Gee et al. 2002).

In addition to the tree placement and irrigation, other measures, including straw mulching were implemented to lessen the impact of bare surface exposures or wind erosion. By the spring of 2003, the surface has stabilized by natural revegetation, so that little erosion, if any, has occurred for the past two years. This is consistent with the observations made by Link et al. (1990), who demonstrated that after the 1984 fire that plants on the Fitzner/Eberhartdt Arid Land Ecology (ALE) Reserve recovered sufficiently to actively remove stored water from the soil profile in a fashion similar to pre-fire conditions. The effectiveness of the plant water uptake was such that after two years there were no marked differences between unburned and burned sites. The data of Link et al. (1990) clearly demonstrate that for silt loam soil, the effect of fire is temporary and recovery is rapid. For most, if not all of the Hanford Site, it would be expected that the no significant impact should occur, particularly when the soil is fine-textured with significantly large storage capacities. Wind erosion occurs from silt loam soil, only if it is very dry and highly disturbed. Vegetation tends to anchor the finer (silt loams) soil so that is it far less susceptible to wind erosion than coarse soil (e.g., fine sands). Based on these observations, we conclude that fire may have a temporary impact on surface barriers, but with fine soil (silt loam) dominating the surfaces, that recovery of vegetation is rapid and the impacts from fire can be considered negligible.

D.4.5 Drought and Plant Succession

Another concern with surface barriers is the potential for extended drought followed by elevated precipitation (wet climate) conditions. In such a scenario, the excess (or elevated) precipitation would either be incident on the soil surface and runoff or be infiltrated into the soil. For coarse soils the lack of vegetation would allow drainage while for fine soil drainage would be contained in the soil for subsequent use by plants (ET). Drought in the current shrub-steppe environment often leads to fire, so much of the discussion on fire and plant succession hold for this case of drought. There are no data to show performance of a cover under an extreme drought or extended period (multiple years) of dryness. Clearly vegetation would be affected. While much of the shrub-steppe has been altered by fire, the most dramatic thing is the potential conversion of the shrub-steppe vegetation, where deep-rooted shrubs dominate the vegetation type, to cool-season, shallow-rooted grasses (e.g., *bromus tectorum* or cheatgrass), thus, reducing the water storage capacity of the soil by virtue of the change in both rooting depth and plant phenology (life cycle), such that less water can be lost from the soil by transpiration over time. The famous ecologist, Leopold (1966), described the process of converting the western U.S. native shrub-steppe vegetation to cheatgrass prairie through a succession of fires. Invasion of cheatgrass perpetuates itself. After senescence, cheatgrass stalks and heads acts like dry tinder. When a fire starts (via lightning strike or man) the fuel is the dead cheatgrass, which burns rapidly, destroying the shrubs. Regeneration of the shrubs requires a seed source and the seeds in turn must compete with cheatgrass for a limited water supply in fall and winter. The cheatgrass acts much like winter wheat, germinating in the fall, going dormant in winter, then sprouting in full vigor in early spring. It generally out-competes its rivals for water so that many shrub seedlings do not survive, and the cheatgrass becomes the dominant plant species in a fire-swept steppe country. The process repeats itself until the cheatgrass dominates the entire landscape. It is entirely possible that over time much of the Hanford Site landscape could become cheatgrass dominated. The impact on coarse soil sites would be dramatic since water storage will change and more drainage and recharge will result. Increased recharge has been observed at Hanford where the coarse soil shrub-steppe landscape has been converted from shrub-steppe to grassland (Prych 1995; Fayer and Walter 1995). A fire-affected site near the 300 Area, with a fine sand over coarse (Burbank loamy sand) soil, transitioned from shrub-steppe to grassland (bluegrass and cheatgrass). The estimated recharge rate was 25 millimeters per year, as obtained from neutron-probe monitoring (Fayer and Walter 1995) while at this same site (Prych 1995) used chlorine-36 analysis to estimate a recharge rate of about 5 millimeters per year. This compares to shrub-steppe recharge rate estimates that are generally much less than 1 millimeter per year (Prych 1995; Murphy et al. 1996).

In contrast, where soil is fine textured (e.g., silt loams), there appears to be little impact on the recharge with this vegetation change, since the soil water storage is sufficient to contain the water, hold it near the surface long enough that both soil evaporation and plant transpiration act to remove it. Studies at the Field Lysimeter Test Facility near the Hanford Meteorological Station have demonstrated that 1-meter-thick silt loam soil, void of any vegetation, is entirely capable of losing all of the annual precipitation via evaporation. Data collected for over a period of 12 years (Fayer et al. 1999) indicated that there has been no drainage from bare, silt loam soil data, suggesting that fire and subsequent vegetation changes, will have little or no effect on the drainage from a silt-loam surface-barrier. Based on these observations we assume that fire will not adversely impact the barrier performance but may impact the surroundings by increasing the recharge in surrounding areas where there are coarse soils dominated by cheatgrass or similar shallow-rooted plants.

D.4.6 Other Mechanisms

Other mechanisms for barrier degradation include subsidence, human intrusion and climate change. These mechanisms were considered in the Hanford barrier development program.

D.4.6.1 Subsidence

Subsidence or surface collapse is associated with consolidation of waste (e.g., collapse of waste containers, general settlement of surficial materials after backfilling operations or response to seismic events). While subsidence can affect the integrity of a capillary barrier and the impermeable asphalt by differential settlement, the assumption was made that stabilization of the waste with grout injection, dynamic compaction, or other means could minimize effects of consolidation at most waste sites. The PSB has been studied for nearly 10 years and tested for consolidation and surface stability. Civil surveys indicate that the surfaces have remained stable for the first decade after construction (Wittreich et al. 2003) with little indication of settlement even on the 2:1 rock side slopes. Based on these findings, it is assumed that stable surfaces can be achieved and that subsidence will not be a major degradation mechanism for most of the Hanford waste sites. Where there are buried objects such as empty metal tanks, wooden boxes, and building with large void spaces, special consideration will have to be given to address consolidation effects on barrier performance. In principle, technologies such as dynamic compaction and grout injection can be used to minimize subsidence effects.

D.4.6.2 Inadvertent Human Intrusion

Inadvertent human intrusion is a possible scenario but warning markers identifying no-dig zones at the wastes sites have been proposed for the Hanford waste sites (Adams and Wing 1986) and if such markers were used it would lessen the chance for inadvertent intrusion. It could be envisioned that after loss of institutional control, that deliberate removal of an entire surface barrier is possible since the surface cover is always exposed and vulnerable. However, the likelihood of such a scenario of cover removal appears remote, particularly if the warning and marker systems are used.

D.4.6.3 Climate Change

Climate change, on the other hand, is entirely possible and was considered in the barrier development program. One scenario would be for Hanford to experience a wetter, cooler climate, which could increase the chance for water storage to be exceeded. Paleoclimate studies suggest that if the past were a indicator of the future that change to a wetter and cooler environment would produce at most a 30% increase in the precipitation over the long-term (Wing et al. 1995). In the design of PSB, a doubling of precipitation was assumed to be the upper limit of precipitation for 1,000-year performance (Myers and Duranceau 1994). Studies of PSB indicated that applications of 1,000-year-storm events and precipitation elevated to 3 times the annual average value caused less than 0.2 millimeter of drainage in 3 years of testing at rates of 480 millimeters per year or three times the annual average rate (Gee et al. 2002a; Wittreich et al. 2003). Based on these observations, we assume that the human intrusion and climate change scenarios will not significantly impact the recharge rates for surface barriers at Hanford.

D.5 Side Slope Impacts on Degradation

Side slopes can have a huge impact on surface barrier performance. As demonstrated by the Hanford surface barrier tests, sparsely covered gravel and rock side slopes, while effective in eliminating wind and water erosion, add drainage water to the areas surrounding the soil cover. Side slope drainage can be as much as 20% or more of the annual precipitation (Gee et al. 2002a; Wittreich et al. 2003). While advective drying reduces the drainage rates, particularly on steep rock side slopes, they still contribute a large portion of the total recharge, particularly when the waste areas are small and the ratio of the side slope area to the total area is large. For sites with dimensions less than 100 meters on a side the side slope area can be 40% or more of the total area when the side slopes have 5:1 (horizontal:vertical) dimensions or less. The contribution of the total recharge then becomes dramatically weighed toward the recharge rate of the side slopes.

For many of the proposed waste sites in the 200 Areas at Hanford, which have deep underlying water tables, the added water from the side slopes can percolate into the subsurface and carry contaminants to groundwater. Degradation of stabilized, armored side slopes is not expected under any of the probable scenarios, except in the case of sand-dune formation. Under such a scenario, the side slope drainage would be reduced to the drainage rate of the sand dune material and attendant vegetative cover. Improvements over present side slope design might include terracing and additions of fine materials trenched into the side slopes to improve water holding capacity and provide adequate rooting media for native plants. If such schemes were employed it is possible that recharge rates could be reduced to values comparable to the soil cover but such schemes have not yet been demonstrated.

D.6 Timelines for Barrier Degradation

Timelines for drainage from 500-year and 1,000-year barriers are listed in Table D.1. The tables assume that sand dune formation is responsible for barrier degradation and increases the recharge over time. It is assumed that the dune develops sooner on the 500-year barrier but ends at the final recharge rate at the same time as the 1,000-year barrier. This assumption is tied solely to differences in climate effects that cause the sand dune formation (for the 500-year barrier scenario the sand dune forms sooner and expresses its full impact sooner than on the 1,000-year barrier). The final rate for both barriers in 2,000 years is assumed to be 4 millimeters per year, a rate observed by Murphy et al. (1996) on a stabilized sand dune at Hanford. This rate may not be conservative because it was estimated from chloride mass balance techniques, which become insensitive at rates much above a few millimeters per year (Tyler et al. 1999). Also, higher recharge rates have been observed on stabilized soil that are vegetated (Fayer and Walters 1995). Selected barrier performance is illustrated in Table D.2, where the final drainage rates for various covers are listed along with the probabilities of a number of degradation factors.

D.7 Summary and Conclusions

Wind and water erosion, biointrusion, fire, drought, subsidence, human intrusion, and climate change were considered as possible barrier degradation mechanisms. In addition, side slope water intrusion was considered in light of its potential effects on overall barrier performance. The most plausible degradation mechanism for the Hanford Site is wind erosion, causing sand dune formation. Timelines of degradation were developed which assumed that the final barrier will be covered with a dune that drains at the rate of 4 millimeters per year. It is possible that higher rates may develop on barriers covered with sand dunes but such rates have yet to be documented.

Table D.1. **Drainage Rates for 500-Year and 1,000-Year Surface Barriers (assumes an initial recharge rate of 0.1 mm/yr and a final recharge rate of 4 mm/yr after 2000 years)**

Time (yrs)	500-Year Barrier (mm/yr)	1,000-Year Barrier (mm/yr)
Present	0.1	0.1
+500	0.1	0.1
+600	0.4	0.1
+700	0.8	0.1
+800	1.2	0.1
+900	1.6	0.1
+1000	2.0	0.1
+1200	2.4	1.5
+1400	2.8	2.5
+1600	3.2	3.0
+1800	3.6	3.5
+2000	4.0	4.0

Table D.2. Degradation Factor Probabilities for Selected Landfill Covers at the Hanford Site

Factors	Multilayer Hanford	Modified RCRA C	Monofill ET	Shallow Liner ET
Wind deposition	H	H	H	H
Water erosion	L	L	M	L
Biointrusion	L	L	H	L
Human intrusion	L	M	H	L
Subsidence	L	L	M	L
Fire	L	L	M	L
Drought	L	L	M	L
Side slope impact	H	H	H	L
Climate change	M	M	H	M
Final Recharge (mm/yr)	4	4	>4	<4
H = High. L = Low. M = Medium.				

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Geographic and Operational Site Parameters List (GOSPL) for the 2004 Composite Analysis

G. V. Last
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July 2004

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Richland, Washington 99352

Executive Summary

A composite analysis is required by U.S. Department of Energy (DOE) Order 435.1 to ensure public safety through the management of active and planned low-level radioactive waste disposal facilities associated with the Hanford Site. Kincaid et al. (2004) indicated that the System Assessment Capability (SAC) (Kincaid et al. 2000; Bryce et al. 2002; Eslinger 2002a, 2002b) would be used to analyze over a thousand different waste sites.

A master spreadsheet termed the Geographic and Operational Site Parameters List (GOSPL) was assembled to facilitate the generation of keyword input files containing general information on each waste site, its operational/disposal history, and its environmental settings (past, current, and future). This report briefly describes each of the key data fields, including the source(s) of data, and provides the resulting inputs to be used for the 2004 Composite Analysis.

Contents

Figures

Tables

1.0 Introduction

A composite analysis is required by U.S. Department of Energy (DOE) Order 435.1 to ensure public safety through the management of active and planned low-level radioactive waste disposal facilities associated with the Hanford Site. The original composite analysis detailed in Kincaid et al. (1998) must be revised and submitted to DOE Headquarters (DOE-HQ) because of revisions to waste site information in the 100, 200, and 300 Areas; updated performance assessments and environmental impact statements (EIS); changes in inventory estimates for key sites and constituents; and a change in the definition of offsite receptors.

Kincaid et al. (2004) describe the technical scope of the 2004 Composite Analysis for the Hanford Site and the approach to perform this analysis. It will be a site-wide analysis, considering final remedial actions for the Columbia River corridor and the Central Plateau, and will support waste-specific and site-specific assessments throughout the Hanford Site. The 2004 Composite Analysis also will provide supporting information on a regional or site-wide basis for use in important Hanford assessments and decisions such as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 5-year review in 2005, tank closure decisions, decisions on final groundwater remedies for the 200 Areas, decisions on final groundwater remedies for the 100 Areas, and the Columbia River corridor final record of decision.

Kincaid et al. (2004) identified 1,046 waste sites from the 2,730 Waste Information Data System (WIDS) sites and several existing and future storage sites for inclusion in the 2004 Composite Analysis.(a) Each of these sites will be modeled as an individual release or storage site whenever inventory and release data permit. Beginning in fiscal year (FY) 2003, the DOE Richland Operations Office (DOE-RL) initiated activities to develop the input data needed to support the 2004 Composite Analysis. This report describes the compilation of site-specific parameters for incorporation into the Geographic and Operational Site Parameters List (GOSPL) to support the 2004 Composite Analysis. This work was conducted as part of the Characterization of Systems Task of the Groundwater Remediation Project (formerly the Groundwater Protection Program) managed by Fluor Hanford, Inc., Richland, Washington.

2.0 Background

Kincaid et al. (2004) indicated that the System Assessment Capability (SAC) (Kincaid et al. 2000; Bryce et al. 2002; Eslinger 2002a, 2002b) would be used for the analysis. The SAC is a set of models and data that have been assembled since the previous 1998 Composite Analysis (Kincaid et al. 1998) was

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(a) Originally 974 of 2,730 Waste Information Data System (WIDS) sites were identified for inclusion in the 2004 Composite Analysis. Further work identified 48 more waste sites bringing the total to 1,022. Subsequent reviews identified an additional 24 sites that have been included, many of which account for offsite transfers of waste and nuclear material. This brings the total to 1,046.

performed to estimate the collective impact of all the waste that will remain at the Hanford Site. Computer codes that have been well tested at the Hanford Site have been used when possible and new software has been written when necessary to simulate the features and processes that affect the release of contaminants into the environment, transport of contaminants through the environment, and the impact those contaminants have on living systems, cultures, and the local economy. The various SAC components have been organized to simulate the transport and fate of contaminants from their presence in Hanford waste sites, through their release into the vadose zone, to their movement in the groundwater, and into the Columbia River. Components of SAC such as the groundwater model, the ecological impact component, and the human health component were originally developed and tested for previous Hanford assessments.

The elements of the SAC computational tool include:

- Inventory Module – develops an inventory of specific waste disposal and storage locations for the period 1944 to Hanford Site closure based on disposal records, process knowledge, the results of tank and field samples, and planned disposals and remedial actions. The year 2035 is used as the Hanford Site closure date for the 2004 Composite Analysis because it has been identified as the time of site closure for the majority of facilities (e.g., tanks, solid waste burial grounds, chemical separations plants). However, the commercial waste site (US Ecology) is assumed to close in 2056 and the graphite cores of the production reactors are moved to the Central Plateau in 2056. Future runs will use the closure date predicted at the time of the run. This module also identifies the material scheduled for disposal in offsite repositories, including high-level waste, transuranic waste, and spent fuel.

- Release Module – simulates the annual release of contaminants to the vadose zone from the variety of waste types in the modeled waste sites. This module also simulates future remediation actions that move waste to the Environmental Restoration Disposal Facility (ERDF) and other permanent disposal locations.

- Air Transport Module – simulates the transport of contaminants through the air pathway from release points to points of deposition.

- Vadose Zone Transport Module – simulates fluid flow and contaminant transport in the vadose zone, which is the unsaturated sediment between the land surface and the unconfined aquifer. The module also simulates the release of volatile contaminants out of the vadose zone into the air pathway.

- Groundwater Transport Module – simulates fluid flow and contaminant transport in the unconfined aquifer that underlies the Hanford Site using the transient inverse calibrated three-dimensional Site-wide groundwater model.

- Soil Module – simulates the buildup of contaminants in the plant root-zone soil layer due to air deposition and irrigation. Solutions are available for the cases of no irrigation, irrigation with groundwater, and irrigation with river water.

- River Module – simulates river flow and contaminant/sediment transport in the Hanford Reach from Vernita Bridge downstream to the city of Richland. This module simulates background concentrations and background plus the Hanford Site concentrations to enable an assessment of the Hanford Site incremental impact to the Columbia River and its ecosystem.

- Riparian Zone Module – uses river and groundwater information to simulate the concentration of contaminants in seep or spring water and in the wet soil near the edge of the Columbia River.

- Risk/Impact Modules – performs risk/impact analysis in four topical areas: human health, ecological health, economic impact, and cultural impact with the latter two being new impact metrics for Hanford assessments. The ecological and human health risk modules will be applied in the 2004 Composite Analysis. The remaining two modules of risk/impact will be applied in a supplemental analysis to inform the public and regulators regarding issues related to the composite analysis (for example, the economic and cultural impacts of chemical hazards).

Each module was assembled so that it could be tested and evaluated independently of the other modules. The inventory, release, environmental pathways, and risk/impact modules were then linked to test the overall performance of the system.

A conceptual illustration of SAC (Figure 2.1) portrays a linear flow of information. In general, inventory feeds release mechanisms, which feed to the atmospheric, vadose zone, groundwater, and Columbia River pathways. At times, release occurs directly to the groundwater through reverse wells and to the Columbia River from the single-pass reactors. During chemical separation plant operation, release also occurred to the atmosphere. The atmosphere, groundwater, Columbia River, riparian zone and soil technical modules provide media-specific concentration estimates used in the risk and impact assessment.

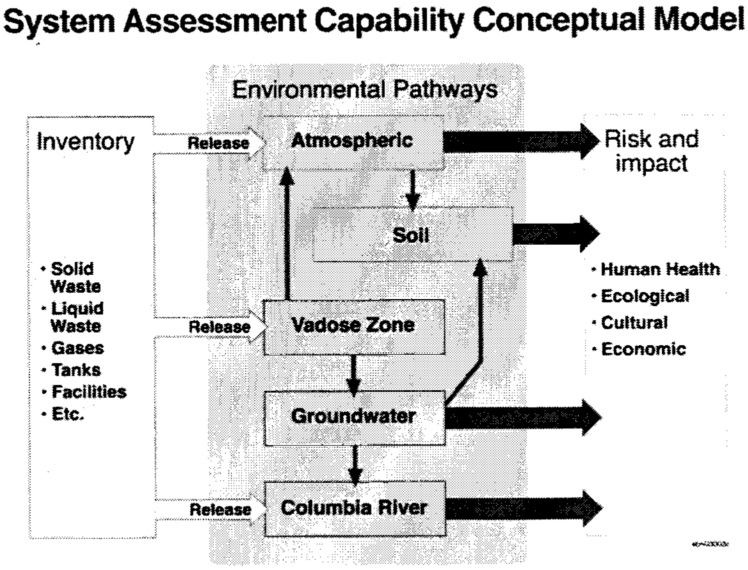

Figure 2.1. Conceptual Model of the System Assessment Capability

Background information for the development of the initial SAC is presented in *Groundwater/Vadose Zone Integration Project: Preliminary System Assessment Capability Concepts for Architecture,* *Platform and Data Management.*[a] This document includes a description of alternate architectures for SAC as well as conceptual models for each technical element of the capability. Design of the initial SAC tool is summarized in Kincaid et al. (2000). Results of an initial assessment performed with the SAC are provided in Bryce et al. (2002).

A description of the software is provided in Eslinger et al. (2002a, 2002b). The system of codes includes existing computer programs, new computer programs, electronic data libraries, and data formatting processors (or data translators). The relationships among code modules that make up the SAC Systems Code are illustrated in Figure 2.2. Major modules appearing on the left side of the diagram perform inventory and transport calculations providing estimates of the concentrations of analytes in various media. Modules shown on the right perform calculations related to the impact from the contaminated media. Impacts include potential effects on humans, the ecology of the area, the economy of the region, and the proximity of contaminants to social and cultural resources.

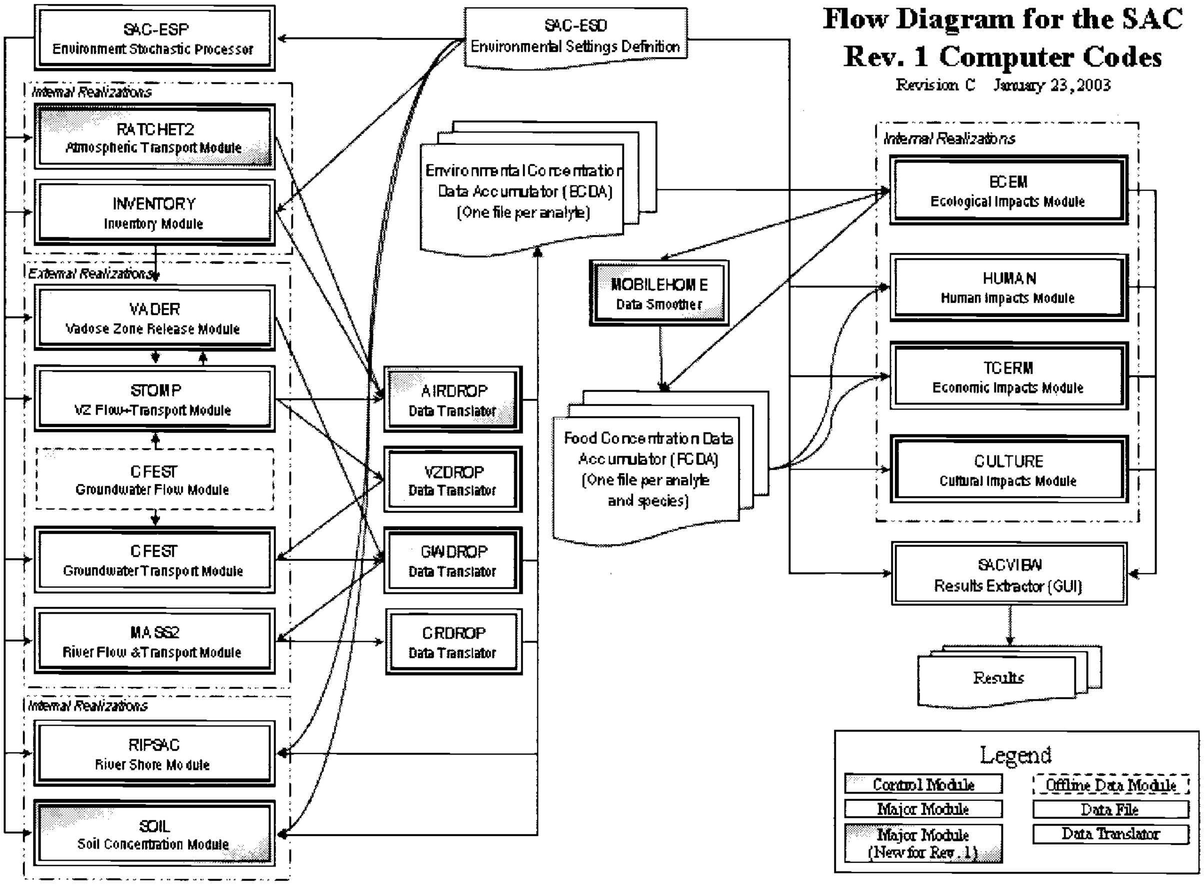

Figure 2.2. Information Flow in SAC Rev. 1 Software Design

(a) Groundwater/Vadose Zone Integration Project: Preliminary System Assessment Capability Concepts for Architecture, Platform and Data Management. (http://www.hanford.gov/cp/gpp/modeling/sacarchive/9-30rep.pdf)

As can be seen in Figure 2.2, the SAC Rev. 1 Systems Code consists of a number of components that can be executed separately. A number of pieces of information, such as the site identification, coordinates, release model, hydrogeologic column (template), remediation action, infiltration class, and the start time and stop time of a simulated problem, are needed for the system components. The environmental settings definition (ESD) keyword file was designed to contain this common information. Generally, if information is needed by one or more modules of the suite of codes, it is entered in the ESD keyword file. A number of the ESD keywords are generated from general information on the waste site, its operational/ disposal history, and its environmental settings (past, current, and future). To facilitate the generation of these ESD keyword input files, a database termed the Geographic and Operational Site Parameters List (GOSPL) was assembled.

One of the challenges associated with performing an assessment is appropriately presenting how well the results predict what might actually occur. This is because the attributes of the site that effect transport of contaminants, the impact of contaminants on living systems, and the future conditions used in the assessment, as well as many other factors upon which the predictions depend, are not completely understood. SAC was developed to allow the performance of a probabilistic risk assessment so an indication of the effect of parameter uncertainty on results could be examined. In general, other sources of uncertainty, such as conceptual model uncertainty, will not be handled within the calculations but will be discussed in the interpretation of the results of this analysis.

For the 2004 Composite Analysis, SAC has been modified to enable the import of results from detailed assessments of individual waste sites by other Hanford Site programs/projects. Such results come from selected tank waste analyses (e.g., the Integrated Disposal Facility [IDF] Performance Assessment [Mann 2003]). Information on 1) release to vadose zone or 2) release to water table will be imported into the SAC deterministic analysis. The 2004 Composite Analysis will treat best estimate simulations by other Hanford Site programs as "median" simulations and incorporate them into an overall "median-input" deterministic simulation. For most waste sites simulated by others, the SAC modules will be adjusted to achieve comparable results.

To perform a stochastic analysis, best-estimate data (geologic profile, hydraulic properties, geochemical properties, recharge sequence, etc.) used by other Hanford Site programs to perform assessments will be interpreted as "median" values for distributions where the data range is defined by the Hanford-wide data set previously compiled for SAC. A simplified model (such as, release and one-dimensional vadose zone or release and two-dimensional vadose zone) will be calibrated to reproduce key aspects of the median simulation provided by the detailed assessment. This simplified but calibrated model will be used to generate the stochastic realizations. Where available, comparison will be made between the range of SAC stochastic responses and the range of deterministic sensitivity cases provided by the other Hanford Site program.

Significant differences may exist between the SAC representation of uncertainty and the representation of sensitivity created by other assessments. This is especially true when the site-specific assessment is using sensitivity analyses to explore alternate conceptual models of waste form release (for example, tank residuals modeled with a solubility model, diffusion model, advection-desorption model, linear release-time-model) or barrier performance (for example, alternate surface barriers and engineered containment systems surrounding a glass waste form).

3.0 Geographic and Operational Site Parameter List Definitions

Of the more than 2,730 waste sites at Hanford and several storage sites, a subset of 1,046 sites was selected for inclusion in the 2004 Composite Analysis (Kincaid et al. 2004). A number of pieces of information are needed for the assessment, such as the site location, the release model, the hydrostratigraphic column (template), and the remedial action and infiltration assumptions. If this type of information is needed by one or more module of the suite of codes used by SAC, for a particular site, then the data are assembled for entry in the ESD keyword file. Of the 1,046 sites to be included in the 2004 Composite Analysis, 24 sites are primarily just place holders used to account for offsite transfers and nuclear material that are not directly simulated in any of the SAC codes. Thus, data have been assembled to enable the simulation of each of the 1,022 remaining sites, individually, using their site-specific parameters, and environmental settings. A master spreadsheet termed the Geographic and Operational Site Parameters List (or GOSPL) was developed for the initial assessments conducted using the SAC to define the site-specific location and facility design parameters as well as the key model assumptions for each assessment. GOSPL has continued to evolve as the site information and assessment basis has changed. It can generally be subdivided into three main sections: Site-Specific Parameters, Model-Specific Instructions, and Remediation/Infiltration Assumptions. Brief descriptions of each key data field, including the source(s) of data are provided below. Note that other subordinate data fields that are not directly used by the current SAC modules are not described here. This version of GOSPL (containing the 1,022 sites to be individually simulated for the 2004 Composite Analysis) is provided in the appendix.

3.1 Site-Specific Parameters

Key site-specific geographic parameters used in the SAC include such input as the site identifiers (e.g., Site Code), general site design and operational history information, site geographic information (e.g., location), and facility dimensions. Much of this information is taken from WIDS. Please refer to the WIDS home page on the Hanford Intranet at http://apweb02.rl.gov/rapidweb/phmc/cp/wids/index.cfm?PageNum=1, and in particular the WIDS Data Field Definitions and Criteria http://apweb02.rl.gov/rapidweb/phmc/cp/wids/docs/5/docs/datacrit1.pdf.

3.1.1 Site Identifiers

There are three fields used to identify each specific site to be represented in the composite analysis: the WIDS Site Identification Number, the Site Code, and the Site Names.

3.1.1.1 WIDS Site Identification Number (SiteId) – Site Table

The WIDS SiteId (e.g., 575) provides a numeric identification number to uniquely identify each site record within WIDS. The primary data source for this information is the WIDS database, either directly or indirectly via the *Hanford Site Waste Management Units Report* (DOE 2003) or the QMAP geospatial map portal (http://www7.rl.gov/cfroot/knowledgenet/qmap/index.cfm). Future sites or facilities not contained in the WIDS database were assigned a SiteId equal to or greater than 9,900.

3.1.1.2 WIDS Site Code (SiteCode) – Site Table

The SiteCode (e.g., 216-Z-9) is a unique alphanumeric identification tag (code) assigned to a site when it is entered into WIDS. The codes have been assigned in accordance with the facility naming conventions in use at the time the site was entered into the database or as modified during database reengineering. The site codes generally consist of a prefix indicating the designed area in which the site is located and its facility type (such as 100-D-, 216-B-, 618-), followed by a sequential number.

The primary data source for the SiteCode is the WIDS database. Planned or proposed future waste sites or facilities not contained in the WIDS database were assigned their own unique identifier by SAC project staff.

3.1.1.3 WIDS Site Names (SiteNames) – Site Table

The SiteNames field (e.g., 216-Z-9, 216-Z-9 Cavern, 234-5 Recuplex Cavern, 216-Z-10, 216-Z-9 Crib, 216-Z-9 Covered Trench) provides the common or working names by which the site is known, including all aliases for a site. The primary data source for this information is from WIDS and was obtained either directly from the WIDS database, or indirectly via the *Hanford Site Waste Management Units Report* (DOE 2003) or the QMAP geospatial map portal. The purpose of this field is to provide a cross reference to previously used site codes and names used in reference documents.

3.1.2 General Site Design and Operational History Information

General information on the design and operational history of the site is captured via four fields: site type, waste type, and start and end dates.

3.1.2.1 Site Type (SiteType) – Site Table

The SiteType (e.g., Trench) describes the structural design of the site. Generally, the site types are defined by the general function of the site (e.g., ground disposal) and its design (e.g., trench). The primary data source for this information is WIDS, and was obtained either directly from the WIDS database, or indirectly via the *Hanford Site Waste Management Units Report* (DOE 2003) or the QMAP geospatial map portal. The purpose of this field is to help describe the manner in which the sites were used to store or dispose of waste.

3.1.2.2 Waste/Material Type (Type) – Waste Table

The waste/material type describes the type of waste at the site in terms of its source, its appearance, its use before becoming a waste, or other general category (e.g., steam condensate, process effluent, bismuth phosphate metal waste). The primary source of this data is WIDS. If the information was missing from WIDS, then it may be that the type of waste was unknown or the information has not been entered. The purpose of this information is to allow grouping of sites into similar waste chemistry groups to aid selection and assignment of linear sorption coefficients.

3.1.2.3 Operational Start Date (StartDate) – Site Table

The start date is the year the site started receiving waste. The primary source of this data is WIDS. If the information was missing from WIDS, then a start date was estimated from other nearby sites receiving similar waste types or servicing the same major process facilities.

3.1.2.4 Operational End Date (EndDate) – Site Table

The end date is the year the site stopped receiving waste. The primary source of this data is WIDS. If the information was missing from WIDS, then an end date was estimated from other nearby sites receiving similar waste types or servicing the same major process facilities.

3.1.3 Geographic Information

The basic geographic information captured for each site includes the site location and the type of feature used to represent the site within the Hanford Geographic Information System (HGIS) and *Hanford Site Atlas* (BHI 1998).

3.1.3.1 Site Location (Center X Coordinate, Center Y Coordinate) – GisSite Table

The X and Y coordinates for the site location are defined in terms of the Washington State Plane Easting and Northing coordinates (respectively), Southern Section, North American Datum 1983, in meters. The coordinate information represents the centroid of the site for sites mapped as a polygon. For sites mapped as a point (e.g., injection/reverse well), it represents the site itself. The primary data source for this information is WIDS, either directly from the WIDS database, or indirectly via the *Hanford Site Waste Management Units Report* (DOE 2003) or the QMAP geospatial map portal. However, coordinates are not recorded in WIDS for sites that are mapped as a line (e.g., sewers). So, for sites mapped as a line, and for sites where coordinate information is not available in WIDS, the centroid coordinates were estimated from HGIS documentation (i.e., the *Hanford Site Atlas* [BHI 1998]).

More detailed coordinate information was provided for large high volume liquid waste sites (e.g., ponds, ditches, cribs, and trenches) that might spatially overlap a number of different groundwater nodes. Rather than representing the centroid of the site, this information provides a number of key X,Y coordinate points that represent the perimeter of the site. Two fields are provided for this input, the number of coordinate points used to define the perimeter of the site, and the actual string of X, Y coordinates.

Number of X, Y Coordinate Points. This field provides the number of distinct X, Y coordinate points included in the X, Y coordinate string defined below.

X, Y Coordinate String. This field provides a string of paired X, Y coordinates used to define the perimeter of the site. The primary source of this information is estimates of selected key points used to represent the gross perimeter of the site as derived from the QMAP geospatial map portal (http://www7.rl.gov/cfroot/knowledgenet/qmap/index.cfm) or from HGIS documentation (i.e., the *Hanford Site Atlas* [BHI 1998]).

3.1.3.2 GIS Feature Type (GISFeatureType) – GisSite Table

The Geographic Information System (GIS) feature type describes the spatial representation of the site features in the HGIS. This includes sites mapped as a polygon, point, or line.

3.1.4 Facility Dimensions

Facility dimensions are captured via five fields generally taken from the WIDS database. These data fields include: Site Length, Site Width, Site Depth (or Height), Site Diameter, and Site Area. In general, dimensions are provided in length and width fields or in the diameter field, but not both.

3.1.4.1 Site Length (LengthMtrs) – Dimensions Table

The site length is the longest dimension of a rectangular or nearly rectangular site. The primary source of this data is the WIDS database. If the data were not directly available from WIDS, then the site length was estimated from the QMAP geospatial map portal or HGIS documentation (i.e., the *Hanford Site Atlas* [BHI 1998]). If the value is blank, then it may be that the site length is unknown, or the information has not been entered (i.e., was not readily available for entry in the WIDS database).

3.1.4.2 Site Width (WidthMtrs) – Dimensions Table

The site width is the shortest dimension of a rectangular or nearly rectangular site. The primary source of this data is the WIDS database. If the data were not directly available from WIDS, then the site width was estimated from the QMAP geospatial map portal or HGIS documentation (i.e., the *Hanford Site Atlas* [BHI 1998]). If the value is blank, then it may be that the site width is unknown, or the information has not been entered (i.e., was not readily available for entry in the WIDS database).

3.1.4.3 Site Depth/Height (DepthHeightMtrs) – Dimensions Table

The site depth/height is the maximum depth of the site (in meters) below the ground surface or the maximum height of the unit above the ground surface. This includes the overburden depth. The primary source of this data is the WIDS database. If the value is blank, then it may be that the depth/height is unknown, or the information has not been entered (i.e., was not readily available for entry in the WIDS database).

3.1.4.4 Site Diameter (DiameterMtrs) – Dimensions Table

The site diameter is the distance (in meters) through the center of a circular or cylindrical (or nearly circular or cylindrical) site. The primary source of this data is the WIDS database. If the field is blank then it may be that the site diameter is unknown, there is no diameter (e.g., the site is rectangular), or the information has not been entered.

3.1.4.5 Site Area (AreaSqMtrs) – Dimensions Table

The site area is the surface extent of the site, measured in square meters. The primary source of this data is the WIDS database. If the data were not directly available from WIDS, then the site area was calculated from other site dimensions (i.e., site width and site length, or site diameter). If site dimension information was unavailable, then the area was estimated from the QMAP geospatial map portal or HGIS documentation (i.e., the *Hanford Site Atlas* [BHI 1998]). If data could not be found with which to estimate the site area, then the site was assigned a default value. Table 3.1 lists the default site area values used for different site types.

Table 3.1. Default Site Areas

Site Type	Default Area (m^2)
Unplanned Release, French Drain	0.999
Storage Tank, Trench	9.99
Radioactive Process Sewer, Crib	99.9
Burial Ground	999

The site area is used to represent the footprint of the release area (e.g., the bottom area of a crib). However, a comparison of facility dimension information in WIDS with that by Maxfield (1979) suggests that the site area as recorded in WIDS is quite a bit bigger than the actual bottom area of the waste sites. It is believed that the site area represents the maximum surface extent of the facility, or perhaps even the fenced boundaries of the radiation zone surrounding the site. Thus, site area, as recorded in WIDS, may over estimate the actual footprint of the release area.

3.2 Model-Specific Instructions

This portion of GOSPL provides key model instructions for various components of the SAC system. This includes information regarding the release models and the vadose zone hydrogeologic templates.

3.2.1 Selected for Simulation in the 2004 Composite Analysis

This field identifies those sites that have been selected for simulation in the 2004 Composite Analysis. This field designates those sites selected for the 2004 Composite Analysis with a "1," while those that will not be simulated are designated with a "0" or left blank.

3.2.2 Release Model Designation

The Release Models field is used to identify the type of release model that will be used in the SAC simulations. The designation for each site is based in part on the site type (see Section 3.1.2.1), the physical state of the waste (as taken from the PhysicalState field in the Waste Table of WIDS), and the material type (see Section 3.1.2.2). Table 3.2 lists the release model designations generally assigned by site type. Note that the release models assigned to each site are subjective in nature, based on best professional judgment, and may account for a combination of physiochemical processes (i.e., multiple release models).

Table 3.2. Summary of Release Model Assignments to Waste Source Types (after Riley and LoPresti 2004)

Release Model	Site (waste source) Type	Exceptions
Atmosphere	Stacks	
Liquid	Single-shell tanks,[a] unplanned releases,[b] trenches, cribs, drain/tile fields, radioactive process sewers, French drains, retention basins, ponds, ditches, sumps, injection/reverse wells, storage tanks, diversion boxes, catch tanks, valve pits, settling tanks, receiving vaults, and neutralization tanks	Receiving vault 241-WR_Vault will be modeled using the cement model.
Soil-Debris	Unplanned releases,[b] sand filters, burial grounds, laboratories, storage, stacks,[c] landfills, surplus production sites (i.e., the soil below and surrounding a site), storage tunnels	The GTF Landfill contains grouted waste, so the cement model should be applied. Site 116-C-2C will be modeled as a liquid release.
Cement	Process unit/plants, control structures, cemented waste in burial grounds	
Salt-cake	Single-shell tanks,[a] double-shell tanks[d]	
Reactor Block[e]	Decommissioned surplus production reactor cores	
Glass[f]	Vitrified ILAW waste from single-shell tanks	
River	Process sewer, outfall	

(a) Releases from single-shell tanks will be modeled using a combination of liquid, salt-cake, and/or diffusion (cement) models. Releases include past tank leaks, liquid released during retrieval and contaminant release from dissolution of residual solids following waste retrieval completion.
(b) Modeled as initial liquid release, release from surface contaminated soil or a combination of both.
(c) Modeled as initial atmospheric release, then as soil-debris following its operational period.
(d) Double-shell tanks are assumed not to leak prior to and during retrieval. Release of contaminants from residual solids modeled using salt-cake and/or diffusion (cement) model.
(e) B reactor release occurs entirely in the 100 Area. Following a specified period of time (75 years). The remaining inventories for all other reactors are moved to a 200 Area burial ground where release continues using the reactor block model.
(f) An empirical model that approximates the results from the ILAW STORM model, allowing SAC (VADER) to generate stochastic results through variation of recharge rate.
GTF = Grout Treatment Facility.
ILAW = Immobilized low-activity waste.
STORM = Subsurface Transport Over Reactive Multiphases.
VADER = Vadose Zone Environmental Release.

3.2.3 Vadose Zone Model Hydrostratigraphy

Each site contained in GOSPL was assigned to a general vadose zone hydrostratigraphic profile based on its location within one of 26 geographic areas (representing 17 general geographic areas and 9 site-specific locations), its site type (surface, near surface, tank, or injection well), and its waste chemistry designation. Each hydrostratigraphic profile (template) identifies the hydraulic and geochemical parameters necessary for STOMP to simulate the flow and transport through the vadose zone. As many as five variations of a single hydrostratigraphic template were incorporated to more accurately represent the depth of waste releases and the thickness of the vadose zone beneath the point of release. Additional variations of the hydrostratigraphic templates were necessary to accommodate variations in K_d values associated with different waste chemistry designations. Thus, a series of 63 base templates were ultimately identified using a unique alphanumeric code consisting of a three-digit number that reflects the waste site type, a letter designating the geographic area, and a number designating the waste chemistry group for assigning K_d values. Nine site-specific hydrostratigraphic templates were created by adding additional alphanumeric characters to the geographic area designation. These codes are explained below. A more complete discussion regarding the development of the vadose zone templates is provided by Last et al. (2004).

3.2.3.1 VZ (Vadose Zone) Template Site Type (reflecting the depth of waste injection)

The VZ Template Site Type Code (e.g., 216) generally consists of a three-digit number, with the first digit indicating the operational area in which the facility is located, and the second and third digits signifying the relative depth of waste release based on its facility type (such as 100-, 241-, 616-). This code is primarily derived from the WIDS SiteCode (see Section 3.1.1.2), the WIDS SiteType (see Section 3.1.2.1), the WIDS DepthHeightMtrs (see Section 3.1.4.3), and the WIDS Site Description (SiteDesc), which are used to classify the sites into six main categories reflecting the relative depth of waste release as defined in Table 3.3. This code identifies variants to the geographic area hydrostratigraphic columns to account for the thickness of the soil column beneath different waste release depths.

Table 3.3. Site Type Codes Used in the Hydrostratigraphic Templates

Site Type Code[(a)]	Relative Depth of Waste Release	Representative WIDS SiteTypes
100, 200, 300, 400	Ground Surface (generally less that 3 m deep).	Surface and/or near surface facilities (e.g., process sewers, reactor buildings, laboratory buildings, storage, stacks, ponds, ditches, valve pits, process unit/plants, unplanned releases except tank leaks).
116, 216, 316, 616	Shallow Subsurface (generally 3-7 m below ground surface)	Shallow liquid and/or dry waste disposal facilities (e.g., cribs, burial grounds, retention basins, trenches, French drains, storage tunnels, drain/tile fields, pipelines, sewers).
241	Intermediate Subsurface (generally 9 to 17 m below ground surface)	High level waste tanks, settling tanks, diversion boxes, catch tanks, tank leak unplanned releases.
166, 266	Deep Subsurface (generally greater than 18 m below ground surface)	Deep injection sites (e.g., reverse wells)
276	Very Deep Subsurface (generally near or into the water table)	Very deep injection sites (e.g., very deep reverse wells)
River[(b)]	River Level	River outfalls and associated pipelines

(a) First digit represents the area: 1 = 100 Area, 2 = 200 Area, 3 = 300 Area, 4 = 400 Area, 6 = 600 Area. Second and third digits indicate the general facility type and relative release depth.
(b) River outfall discharged waste directly to the river, thus there is no vadose zone flow and transport component for these sites.
WIDS = Waste Information Data System.

3.2.3.2 Geographic Area

Sixteen geographic areas were identified that could each be represented by a single generalized hydrostratigraphic column (Figure 3.1). Each of the six 100 Areas were designated as separate geographic areas because each area is geographically distinct and have distinct hydrogeologic characteristics. The 200 Areas were divided into six aggregate areas based on differences in hydrogeologic characteristics. The 200 West and 200 East Areas were each divided into two geographic areas. Additional geographic areas were designated for the 200 North Area, Gable Mountain Pond area, and the B-Pond area. A single geographic area was designated to encompass waste sites in the 300 Area. Finally, three additional geographic areas were defined for isolated sites in the 400 and 600 Areas. Table 3.4 presents the letter designations and brief descriptions of each geographic area. Nine site-specific designations were created by adding additional alphanumeric characters to two of the geographic area designations (Table 3.5).

3.2.3.3 Waste Chemistry Group (for assigning K_d ranges)

Six waste chemistry types were defined by Kincaid et al. (1998) for use in the first composite analysis published in 1998. These waste chemistry types describe chemically distinct waste streams that impact the sorption of contaminants. These same waste chemistry designations were adapted for use in the initial assessment conducted using SAC to assign K_d values to the vadose zone base templates (Bryce et al. 2002). However, based on the results of a recent compilation of contaminant distribution coefficients (K_d) for Hanford sediments (Cantrell et al. 2003a, 2003b), the six waste stream categories used in these assessments were reduced to four (Table 3.6).[(a)] Refer to the vadose zone data package (Last et al. 2004) for additional information regarding the assignment of these waste chemistry designations.

3.2.3.4 VZ Base Templates

A total of 61 base templates were identified based on various combinations of the site types, geographic areas, and waste chemistry types. This field is calculated by combining the information from the VZ Template Site Type, Geographic Area, and Waste Chemistry data fields, unless the VZ Template Site Type is "River," in which case this field is calculated as "River." However, if the Site Type is blank or the site is not on the list of sites for the composite analysis (i.e., the On Composite Analysis List field is "0"), then this field is left blank. The general Excel formula used to calculate this field is as follows:

$$= IF(A = 1, IF(B = "River", "River", IF(B = "", "", B \,\&\, C\&"-"\&D)), "") \tag{1}$$

where A = On CA List
B = Site Type
C = Geographic Area
D = Waste Chemistry Group.

(a) Cantrell KJ, RJ Serne, and GV Last. *Waste Stream Descriptions, Impact Zones and Associated K_d Estimates Including Rational for Selections* (Revision May 16, 2003).

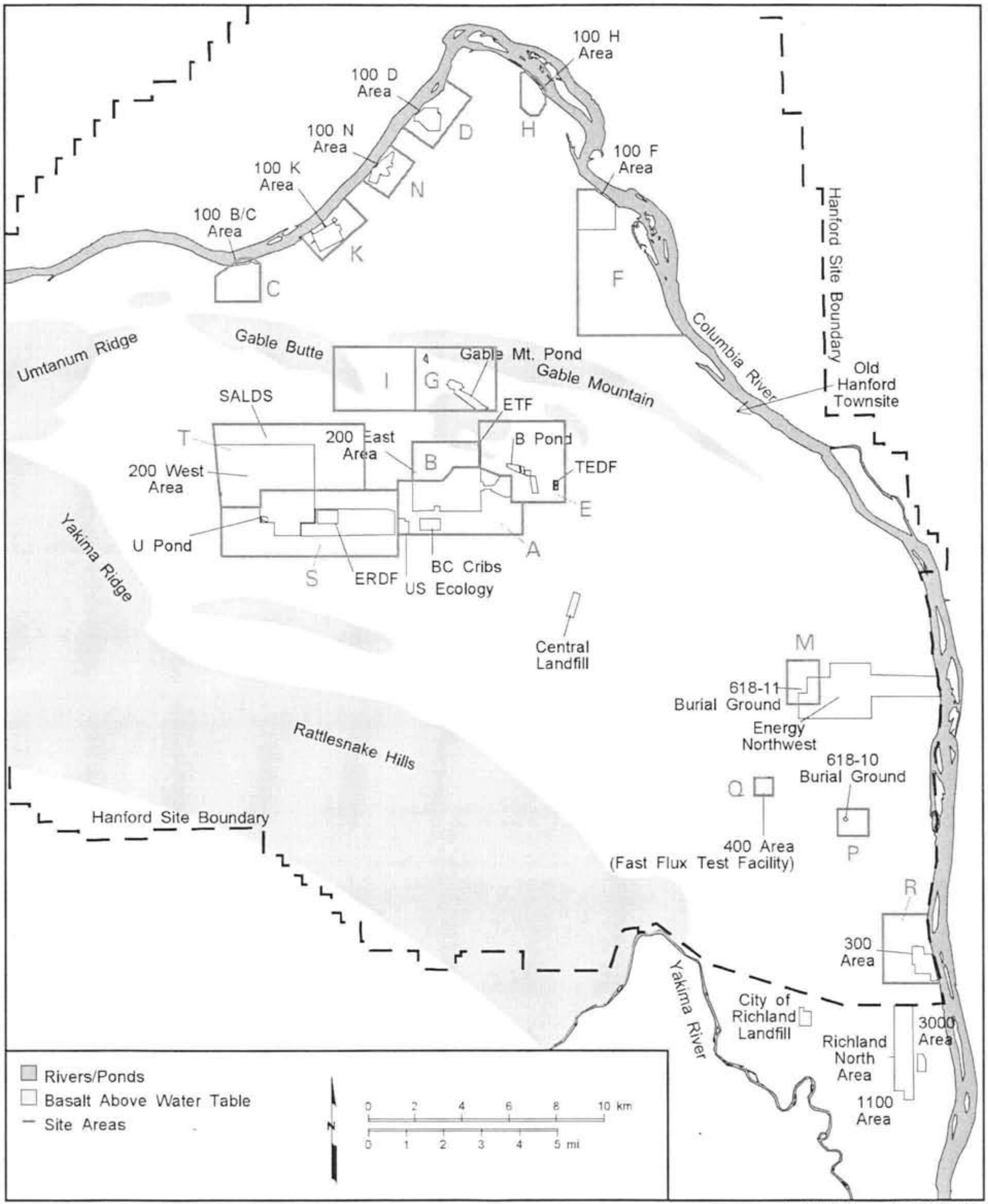

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Figure 3.1. Geographic Areas Used to Define Different Hydrostratigraphic Profiles

Table 3.4. Geographic Area Designations Used in the Hydrostratigraphic Template Codes

Designation	Geographic Area Description
A	Southern 200 East Area – encompassing the PUREX (A Plant), Hot Semi-Works (C-Plant), associated facilities (including PUREX tunnels), US Ecology, and the A, AN, AP, AW, AX, AY, AZ, C Tank Farms
B	Northwestern 200 East Area – encompassing the B-Plant Area, associated waste disposal facilities, and the B, BX, BY Tank Farms
C	100-B/C Area
D	100-D/DR Area
E	East of 200 East – B-Pond Area
F	100-F Area
G	Gable Mountain Pond Area
I	200 North Area
H	100-H Area
K	100-KE/KW Area
M	600 Area near Energy Northwest and the 618-11 burial ground
N	100-N Area
P	600 Area southwest of the 400 Area near the 618-10 burial ground
Q	400 Area
R	300 Area (and a few isolated facilities in and near the 400 Area)
S	Southern 200 West Area – encompassing the REDOX (S-Plant), U-Plant, Z-Plant associated facilities, ERDF, and the S, SX, SY, U Tank Farms
T	Northern 200 West Area - encompassing T Plant , associated facilities, and the T, TX, TY Tank Farms

ERDF = Environmental Restoration Disposal Facility.
PUREX = Plutonium-Uranium Extraction (Plant).
REDOX = Reduction Oxidation (Plant).

Table 3.5. Site-Specific Area Designations Used in the Hydrostratigraphic Template Codes

Designation	Site-Specific Area Description
A_BC_W	Southern 200 East Area – representing the western portion of the BC cribs area
A_BC_E	Southern 200 East Area – representing the eastern portion of the BC cribs area
A_BT_N	Southern 200 East Area – representing the northern portion of the BC trench area
A_BT_S	Southern 200 East Area – representing the southern portion of the BC trench area
A_BT_W	Southern 200 East Area – representing the western portion of the BC trench area
A_ILAW_C	Southern 200 East Area – representing the central portion of the ILAW/IDF site
S_U_N	Southern 200 West Area – representing the northern portion of the 216-U-1&2 crib area
S_U_S	Southern 200 West Area – representing the southern portion of the 216-U-1&2 crib area
S_Z9	Southern 200 West Area – representing the 216-Z-9 trench area

IDF = Integrated Disposal Facility.
ILAW = Immobilized low-activity waste.

Table 3.6. Waste Chemistry Groups Used in the Base Template Codes

Waste Chemistry Designation	Waste Stream Description
1	Very Acidic
2	High Salt/Very Basic
3	Chelates/High Salt
4	Low Salt/Near Neutral

Table 3.7 provides a description of the general hydrostratigraphic templates established for each geographic area. Table 3.8 describes the site-specific templates set up for a number of key facilities within two of these general geographic areas.

Table 3.7. General Hydrostratigraphic Templates for Each Geographic Area

VZ Base Template Designation	Geographic Area		Waste Site Types		Waste Chemistry Designation(d)
	Area	Designation(a)	Description	Designation(b)	
100C-4	100 B/C	C	Surface Facilities	100	4
116C-4			Near Surface Facilities	116	4
100D-4	100 D	D	Surface Facilities	100	4
116D-4			Near Surface Facilities	116	4
100F-4	100 F	F	Surface Facilities	100	4
116F-4			Near Surface Facilities	116	4
100H-4	100 H	H	Surface Facilities	100	4
116H-4			Near Surface Facilities	116	4
100K-4	100 K	K	Surface Facilities	100	4
116K-4			Near Surface Facilities	116	4
166K-4			Reverse Wells	166	4
100N-4	100 N	N	Surface Facilities	100	4
116N-4			Near Surface Facilities	116	4
200G-4	Gable Mtn. Pond	G	Surface Facilities	200	4
200I-4	200 North	I	Surface Facilities	200	4
200E-4	E 200 E (B-Pond)	E	Surface Facilities	200	4
200B-2	N 200 E (B-Plant)	B	Surface Facilities	200	2
200B-4					4
216B-3			Near Surface Facilities	216	3
216B-4					4
241B-2			Tanks	241	2
266B-4			Reverse Wells	266	4
267B-2				267(c)	2

Table 3.7. (contd)

VZ Base Template Designation	Geographic Area		Waste Site Types		Waste Chemistry Designation(d)
	Area	Designation(a)	Description	Designation(b)	
200A-2	S 200 E (PUREX, BC Cribs)	A	Surface Facilities	200	2
200A-4					4
216A-2			Near Surface Facilities	216	2
216A-4					4
241A-2			Tanks	241	2
241A-3					3
266A-4			Reverse Wells	266	4
200S-2	S 200 W (REDOX, U-Plant, Z-Plant)	S	Surface Facilities	200	2
200S-4					4
216S-1	S 200 W (REDOX, U-Plant, Z-Plant)	S	Near Surface Facilities	216	1
216S-2					2
216S-4					4
241S-2			Tanks	241	2
241S-3					3
241S-4					4
266S-4			Reverse Wells	266	4
200T-2	N 200 W (T-Plant)	T	Surface Facilities	200	2
200T-4					4
216T-2			Near Surface Facilities	216	2
216T-3					3
216T-4					4
241T-2			Tanks	241	2
266T-2			Reverse Wells	266	2
266T-4					4
300R-4	300 Area (North Richland	R	Surface Facilities	300	4
316R-4			Near Surface Facilities	316	4
400Q-4	400	Q	Surface Facilities	400	4
616M-4	600	M	Near Surface Facilities	616	4
616P-4	600	P	Near Surface Facilities	616	4
River	-	-	River	-	-

(a) Assigned letter designation for geographic area.
(b) Assigned number designation for waste site type: first number designates traditional Hanford Site area (i.e., 100, 200, 300, 400, 600 Areas); last two numbers designate waste site type (00 = surface facilities, 16 = near surface facilities, 41 = tanks, 66/67 = reverse wells)
(c) Two designations are used for reverse wells that have very different depths within a single geographic area. The "67" designation distinguishes the very deep reverse wells from those at a more intermediate depth (66).
(d) Assigned number designation for waste chemistry type (see Table 3.6).
PUREX = Plutonium-Uranium Extraction (Plant).
REDOX = Reduction Oxidation (Plant).

Table 3.8. Site-Specific Templates Established for a Few Key Facilities

Template Designation	Site-Specific Area		Waste Site Types		Waste Chemistry Designation[d]
	Area	Designation[a]	Description	Designation[b]	
216A_BC_W-3	S 200 E, BC Cribs, Western Portion	A_BC_W	Near Surface Facilities	216	3
216A_BC_E-3	S 200 E, BC Cribs, Eastern Portion	A_BC_E	Near Surface Facilities	216	3
216A_BT_N-3	S 200 E, BC Trenches, Northern Portion	A_BT_N	Near Surface Facilities	216	3
216A_BT_N-4					4
216A_BT_S-3	S 200 E, BC Trenches, Southern Portion	A_BT_S	Near Surface Facilities	216	3
216A_BT_W-3	S 200 E, BC Trenches, Western Portion	A_BT_W	Near Surface Facilities	216	3
216A_ILAW_C-3	S 200 E, ILAW Site, Central Portion	A_ILAW_C	Near Surface Facilities	216	3
216S_U_N-4	S 200 W, 216-U-1&2 Area, Northern Portion	S_U_N	Near Surface Facilities	216	4
216S_U_S-4	S 200 W, 216-U-1&2 Area, Northern Portion	S_U_S	Near Surface Facilities	216	4
216S_Z9-1	S 200 W, 216-U-1&2 Area, Northern Portion	S_Z9	Near Surface Facilities	216	1

(a) Assigned letter designation for geographic area.
(b) Assigned number designation for waste site type: first number designates traditional Hanford Site area (i.e., 100, 200, 300, 400, 600 Areas); last two numbers designate waste site type (00 = surface facilities, 16 = near surface facilities, 41 = tanks, 66/67 = reverse wells)
(c) Two designations are used for reverse wells that have very different depths within a single geographic area. The "67" designation distinguishes the very deep reverse wells from those at a more intermediate depth (66).
(d) Assigned number designation for waste chemistry type (see Table 3.6).
ILAW = Immobilized low-activity waste.

3.2.3.5 Site Template

The Site Template uniquely identifies the site for the set of geographic and operational parameters to be used for the vadose zone simulations. For the 2004 Composite Analysis, this field is identical to that of the WIDS Site Code (see Section 3.1.1.2). However, this field has been used to aggregate multiple sites to a single template.

3.3 Remediation/Recharge Assumptions

This portion of GOSPL provides key assumptions regarding the surface soil conditions and deep drainage (recharge) at each waste site. These soil conditions and recharge estimates were derived from a suite of available field data and computer simulation results and assembled into a suite of recharge classes that describe the probability distribution function for recharge at the site. Recharge classes are defined for a number of different time intervals: Pre-Hanford, Operations, Post-Remediation, and Post-Hanford. Each recharge class was identified with a unique code based on either the primary native soil and vegetation type or the type and size of the surface barrier. Refer to the vadose zone data package (Last et al. 2004) for details.

3.3.1 Pre-Hanford Recharge Class

This field defines the recharge class to be applied to the simulations for the time period prior to the establishment of the Hanford Site in 1943. The source of this information is the vadose zone data package (Last et al. 2004), which generally assumed a natural soil cover with undisturbed shrub-steppe plant community and based on the Hanford soil map produced by Hajek (1966). Table 3.9 lists the Pre-Hanford Recharge Classes used for the 2004 Composite Analysis.

Table 3.9. Pre-Hanford Recharge Classes for the 2004 Composite Analysis

Recharge Class Code	Description	Best Estimate (mm/yr)	Estimated Standard Deviation (mm/yr)	Minimum (mm/yr)	Maximum (mm/yr)
Eb-s	Ephrata stony loam (Eb) - with shrub-steppe (s) plant community	1.5	0.75	0.75	3.0
El-s	Ephrata sandy loam (El) - with shrub-steppe (s) plant community	1.5	0.75	0.75	3.0
Ba-s	Burbank loamy sand (Ba) - with shrub-steppe (s) plant community	3.0	1.5	1.5	6.0
Rpe-s	Rupert sand (Rp) in 200 East (e) - with shrub-steppe (s) plant community	0.9	0.45	0.45	1.8
Rp-s	Rupert sand (Rp) outside 200 East - with shrub-steppe (s) plant community	4.0	2.0	2.0	8.0
River	Assumes discharge directly to the river, no release or vadose zone modeling is required, so recharge rates are not applicable.	NA	NA	NA	NA
NA = Not applicable.					

3.3.2 Operational Recharge Class

This field defines the recharge classes to be used for simulations for the time period during and after site operations, prior to any site remediation. Once again, the source of this information comes directly from the vadose zone data package (Last et al. 2004). This generally assumes that the site is covered by native soils or backfilled soils with or without vegetation; asphalt, buildings, concrete, or gravel covers. Table 3.10 lists the Operational Recharge Classes used for the 2004 Composite Analysis.

Table 3.10. Operational Recharge Classes for the 2004 Composite Analysis

Recharge Class Code	Description	Best Estimate (mm/yr)	Estimated Standard Deviation (mm/yr)	Minimum (mm/yr)	Maximum (mm/yr)[(a)]
Eb-dn	Ephrata stony loam (Eb), disturbed (d) – with no (n) vegetation	17	8.5	8.5	34
El-dn	Ephrata sandy loam (El), disturbed (d) – with no (n) vegetation	17	8.5	8.5	34
Ba-dg	Burbank loamy sand (Ba), disturbed (d) – with cheatgrass (g) plant community	26	13.0	13.0	52
Ba-dn	Burbank loamy sand (Ba), disturbed (d) – with no (n) vegetation	53	26.5	26.5	101
Rpe-dn	Rupert sand (Rp) in 200 East, disturbed (d) – with no (n) vegetation	44	22	22	88
Rp-dn	Rupert sand (Rp) outside 200 East, disturbed (d) – with no (n) vegetation	44	22	22	88
G-dn	Gravel surface (G), disturbed – with no (n) vegetation	89	44.5	44.5	101
ABC	Soil Surface covered by Asphalt, Building, or Concrete	0.1	0.05	0.05	0.2
River	Assumes discharge directly to the river, no release or vadose zone modeling is required, so recharge rates are not applicable.	NA	NA	NA	NA

(a) Note: the maximum recharge was truncated at the mean extended winter precipitation value of 101 mm/yr.
NA = Not applicable.

3.3.3 Interim Remedial Actions (IRA-1 and IRA-2)

Interim remedial actions (IRA) have been identified or proposed for some sites. Currently, GOSPL is configured to handle two different interim remedial action events (IRA-1 and IRA-2). For these particular sites, three additional fields have been defined (Year Interim Remedial Action Complete, Interim Remedial Action Type, and Interim Barrier/Soil Cover Type) for each remedial action event defined. The primary source of this information was from Maxfield (1979) or the WIDS database (via the *Hanford Site Waste Management Units Report* [DOE 2003]). An example for the BC cribs and trenches is shown in Table 3.11, with the fields in that table as defined below.

3.3.3.1 Year Interim Remedial Action Complete (year IRA-1 complete; year IRA-2 complete)

This field defines the year that the interim remedial action was completed.

Table 3.11. Example of Interim Remedial Actions Defined for the 2004 Composite Analysis

WIDS Site Code	IRA-1			IRA-2		
	Year Complete	Type	Barrier/Soil Type	Year Complete	Type	Barrier/Soil Type
216-B-14	1981	ABAR	Rp-ds			
216-B-20	1969	ABAR	G-dn	1982	ABAR	Rpe-ds

ABAR = Aggregate barrier.
IRA = Interim remedial actions.
WIDS = Waste Information Data System.

3.3.3.2 Interim Remedial Action Type (IRA-1 type, IRA-2 type)

This field defines the type of interim remedial action that was taken at the site. For the 2004 Composite Analysis, this includes: (1) remove, treat, and dispose (RTD) or (2) surface stabilization (e.g., aggregate barrier [ABAR], isolated barrier [IBAR]).

3.3.3.3 Interim Barrier/Soil Type (recharge class) (IRA-1 barrier/soil type; IRA-2 barrier/soil type)

This field, when populated, defines the recharge class to be applied to the site during the period after interim remediation and prior to any other interim remediation or final site remediation. For the 2004 Composite Analysis only three IRA recharge classes have been identified, G-dn (as described in Table 3.10) and Rp-ds and Rpe-ds (as described in Table 3.12).

3.3.4 Remediation

Some form of remediation (or no action) was identified for each site. A number of data fields were used to define the recharge classes to be used during the period following remediation and prior to the long-term post-remediation/closure design-life. The primary source of this information comes from the Hanford Disposition Baseline and Kincaid et al. (2004). These sources determined the schedule and type of remediation (e.g., engineered surface barriers) to be applied to each site for the 2004 Composite Analysis. The vadose zone data package (Last et al. 2004) describes the assumptions regarding the recharge rates to be used for barriers during the institutional control period, their design life, and after their design life. A key assumption of the 2004 Composite Analysis is that deep drainage beneath barrier side slopes and the surrounding terrain does not appreciably affect contaminant release from immediately below the barrier, nor transport in the vadose zone to the water table. This assumption is consistent with the previous composite analysis as well as recent and ongoing assessments.

3.3.4.1 Year Remedial Action Complete

This field defines the planned (or actual) year that remediation will be (or was) completed at the site. This assumes that all remedial action for that particular site is completed within a given year. For those sites slated for no further action, a value of "NA" was used, indicating that the recharge class would not change from its pre-remediation time period.

3.3.4.2 Remediation Type

This field identifies the type of remedial action planned (or completed) for the site, including: no action; decontamination and decommissioning (D&D); remove, treat, and dispose (RTD); isolated barriers (IBAR), or aggregate barriers (ABAR). This field identifies a number of different aggregate barriers defined by a unique alphanumeric code, with the same code assigned to all sites to be covered by the same aggregate barrier.

3.3.4.3 Barrier Type

This field identifies the type of barrier planned (or completed) for the site. If the remediation type is anything other than an IBAR or ABAR, then this field is blank. Otherwise this field contains either Resource Conservation and Recovery Act (RCRA) C or Hanford to designate the two types of surface barriers currently planned for Hanford waste sites.

3.3.4.4 Barrier Infiltration Class

This field assigns an infiltration (recharge) class to those sites that are to receive a surface barrier. If the remediation type (Section 3.3.6.2) is anything other than an IBAR or ABAR, then this field is blank. Otherwise this field is calculated from a lookup table of barrier infiltration classes based on the estimated barrier top-to-side slope ratio. It was developed to help address the possible effects of side slopes on barrier recharge rates. However, for the 2004 Composite Analysis it is assumed that deep drainage beneath the barrier side slopes and the surrounding terrain does not appreciably affect contaminant release and transport (Last et al. 2004). Thus far, for the baseline case of the 2004 Composite Analysis, the actual values in this field are of no consequence. These infiltration assignments that account for side slope influence may be used in a sensitivity case.

3.3.4.5 Post Remediation Recharge Classes

This field provides the recharge class to be used for the post-remediation time period (i.e., following site remediation and prior to any soil/barrier evolution/degradation). This field is calculated by combining the information from the Barrier Type and Barrier Infiltration Class, if the Barrier Type is not blank, or by modifying the information in the Pre-Operations Recharge Class to replace the suffix with "-ds" (to reflect disturbed shrub-steppe vegetation). If the VZ Template Site Type is "River," then this field is calculated as "River." The general Excel formula used to calculate this field is as follows:

$$= IF(A = "", IF(B = "River", "River", REPLACE(C, SEARCH("-", C, 1), 2, "-ds")), D\&"-"\&A) \qquad (2)$$

where A = Barrier Infiltration Class
B = Vadose Zone Template Type
C = Pre-Operations Infiltration Class
D = Barrier Type.

Table 3.12 lists the post-remediation recharge classes for the composite analysis. Note that for this composite analysis all sizes of RCRA C and Hanford Barriers have the same estimated recharge rates (i.e., there are no side-slope effects). Refer to the vadose zone data package (Last et al. 2004) for further discussion.

Table 3.12. Post-Remediation Recharge Classes

Recharge Class Code	Description	Best Estimate (mm/yr)	Estimated Standard Deviation (mm/yr)	Minimum (mm/yr)	Maximum (mm/yr)
RCRA C-Ixx	Modified RCRA C – barrier top during design life	0.1	0.05	0.05	0.20
Hanford-Ixx	Hanford Barrier – barrier top during design life	0.1	0.05	0.05	0.20
Ba-ds	Burbank loamy sand (Ba), disturbed (d) – with young shrub-steppe (s) plant community	6.0	3.0	3.0	12
Eb-ds	Ephrata stony loam (Eb), disturbed (d) - with young shrub-steppe (s) vegetation	3.0	1.5	1.5	6.0
El-ds	Ephrata sandy loam (El), disturbed (d) – with young shrub-steppe (s) vegetation	3.0	1.5	1.5	6.0
Rp-ds	Rupert sand (Rp) outside 200 East, disturbed (d) – with young shrub-steppe (s) plant community	8.0	4.0	4.0	16.0
Rpe-ds	Rupert sand (Rp) in 200 East, disturbed (d) – with young shrub-steppe (s) plant community	1.8	0.9	0.9	3.6
River	Assumes discharge directly to the river, no release or vadose zone modeling is required, so recharge rates are not applicable.	NA	NA	NA	NA

NA = Not applicable.

3.3.4.6 Post-Remediation/Barrier Design Life

This field defines the design life of the post-remediation period (i.e., that period after remediation is complete and prior to any significant degradation of the surface soils (e.g., barrier) or succession of plant communities). Table 3.13 lists the Post-Remediation/Barrier Design Life.

Table 3.13. Post-Remediation/Barrier Design Life

Post-Remediation Soil Conditions (recharge classes)	Design Life (years)
Native soil with young shrub-steppe plant community (Ba-ds, Eb-ds, El-ds, Rp-ds, Rpe-ds)	30
RCRA C surface barrier	500
Hanford surface barrier	1,000
River	NA

NA = Not applicable.
RCRA = Resource Conservation and Recovery Act.

3.3.4.7 Barrier End Date

This field defines the date at which the post-remediation recharge period ends and the final long-term recharge period begins. This field is calculated by adding the Design Life to the Year Remedial Action Complete. However, if the Release Model Designation is "River," then this field is calculated as "NA," or if the Year Remedial Action Complete field is "NA," then this field is calculated as "2010." The general Excel formula used to calculate this field is as follows:

$$= IF(A = "River", "NA", IF(B = "NA", 2010, B + C)) \qquad (3)$$

where A = Release Model Designation
B = Year Remedial Action Complete
C = Post-remediation/Barrier Design Life.

3.3.4.8 Final Long-Term Recharge Class

This field defines the final long-term recharge class to be used for the final simulation period. This field is calculated as being equal to the Pre-Operational Infiltration Class.

4.0 Conclusions and Recommendations

A composite analysis is required by U.S. Department of Energy (DOE) Order 435.1 to ensure public safety through the management of active and planned low-level radioactive waste disposal facilities associated with the Hanford Site. Kincaid et al. (2004) indicated that the System Assessment Capability (SAC) (Kincaid et al. 2000; Bryce et al. 2002; Eslinger 2002a, 2002b) would be used for the analysis. They also identified 1,046 waste sites from the 2,730 WIDS sites and several existing and future storage sites for inclusion in the 2004 Composite Analysis. Each of these sites will be handled as an individual release or storage site whenever inventory and release data permit.

A number of pieces of information, such as the site identification, coordinates, release model, hydrogeologic column (template), remediation action, infiltration class, and the start time and stop time of a simulated problem, are needed for the numerical assessment. The ESD keyword file was designed to contain this common information. Generally, if information is needed by one or more module of the suite of codes used by SAC, it is entered in the ESD keyword file. A number of the ESD keywords are generated from general information on the waste site, its operational/disposal history, and its environmental settings (past, current, and future). To facilitate the generation of these ESD keyword input files, a master spreadsheet termed the Geographic and Operational Site Parameters List (GOSPL) was assembled. It can generally be subdivided into three main sections: Site-Specific Parameters, Model-Specific Instructions, and Remediation/Infiltration Assumptions. This report briefly describes each of the key data fields, including the source(s) of data, and provides the inputs to be used for the 2004 Composite Analysis.

This master spreadsheet was originally developed for the initial assessments conducted using the SAC to lock down the site-specific location and facility design parameters as well as the key model assumptions for each assessment. GOSPL has continued to evolve as the site information and/or assessment basis has changed. It is recommended that a complete restructuring of GOSPL be developed to interactively retrieve data directly from the record databases (e.g., WIDS) and to streamline the selection of sites and model assumptions.

5.0 References

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Appendix

Geographic and Operational Site Parameters for Waste Sites To Be Simulated in the 2004 Composite Analysis

-	S	C	C	N C	C S	G	L	W	D	D	A	W	W	R	V	S	P	O	O	O
r	Radioactive Process Sewer	########	########			line	1438.0	1.4			1973.655		NA	River	River	100-B-15	River	1944	River	1972
	Burial Grounc	565290.00	144369.00			point					999.000		4	Soil-Debris	116C-4	100-B-3	Eb-s	1952	Eb-dn	1952
	Trench	565437.00	144568.00			point	30.5	3.0	3.0		92.903		4	Liquid	116C-4	100-B-5	Eb-s	1954	Eb-dn	1956
	Radioactive Process Sewer	565342.19	144504.94			line/poly					99.900		4	Liquid	100C-4	100-B-8	Eb-s	1944	Eb-dn	1968
	French Drair	565392.50	143951.97			point				0.6	0.292		4	Liquid	100C-4	100-C-3	Eb-s	1960	Eb-dn	1960
	Radioactive Process Sewer	565387.81	143991.48			line/poly					99.900		4	Liquid	100C-4	100-C-6	Eb-s	1952	Eb-dn	1969
	Trench	565538.56	145293.56			polygon	112.8	15.2	4.6		1718.706		4	Liquid	116C-4	116-B-1	Eb-s	1950	Eb-dn	1968
	Trench	565413.19	144511.23			point	22.9	3.0	4.6		69.677		4	Liquid	116C-4	116-B-2	Eb-s	1946	Eb-dn	1946
	Crib	565356.00	144527.48			polygon	3.0	3.0	6.1		23.226		4	Liquid	116C-4	116-B-3	Eb-s	1951	Eb-dn	1952
	French Drair	565368.75	144508.84			polygon			4.572	1.2	6.039		4	Liquid	116C-4	116-B-4	Eb-s	1957	Eb-dn	1968
	Crib	565289.63	144761.75			polygon	27.0	2.4	3.53568		65.902		4	Liquid	116C-4	116-B-5	Eb-s	1950	Eb-dn	1968
	Crib	565387.56	144370.98			point	3.7	2.4	4.6		23.226		4	Liquid	116C-4	116-B-6A	Eb-s	1951	Eb-dn	1968
	Crib	565401.00	144344.00			point	3.7	2.4	4.6		7.897		4	Liquid	116C-4	116-B-6B	Eb-s	1950	Eb-dn	1953
r	Outfall	565257.44	145324.63			polygon	8.2	4.3	6.4		36.697		NA	River	River	116-B-7	River	1944	River	1972
	Trench	565849.06	145284.91	5	(565695.044,145310.112), (565702.596,145264.803), (565974.449,145297.527), (565971.932,145345.353), (565695.044,145310.112)	polygon	152.4	15.2	6.096		2322.576		4	Liquid	116C-4	116-C-1	Eb-s	1952	Eb-dn	1968
	Crib	565501.75	144030.41			polygon	6.8	4.7	7.9		83.613		4	Liquid	116C-4	116-C-2A	Eb-s	1952	Eb-dn	1969
	Sand Filter	565478.13	144022.31			polygon	12.6	5.5	5.5		34.188		4	Liquid	116C-4	116-C-2C	Eb-s	1952	Eb-dn	1969
	Burial Grounc	564387.31	143945.20			polygon	304.8	97.8	6.1		2982.188		4	Soil-Debris	116C-4	118-B-1	Eb-s	1944	Eb-dn	1973
	Burial Grounc	565474.00	144578.42			polygon	18.3	9.1	3.0		167.225		4	Soil-Debris	116C-4	118-B-2	Eb-s	1952	Eb-dn	1956
	Burial Grounc	565549.69	144596.83			polygon	106.7	83.8	6.096		8941.918		4	Soil-Debris	116C-4	118-B-3	Eb-s	1956	Eb-dn	1960
	Burial Grounc	565365.56	144619.52			polygon	15.2	9.1	4.6		139.355		4	Soil-Debris	116C-4	118-B-4	Eb-s	1956	Eb-dn	1958
	Burial Grounc	565391.44	144417.39			polygon	15.2	15.2	6.1		232.258		4	Soil-Debris	116C-4	118-B-5	Eb-s	1953	Eb-dn	1953
	Burial Grounc	565355.63	144637.66			polygon	4.6	3.0	6.096		13.935		4	Soil-Debris	116C-4	118-B-6	Eb-s	1950	Eb-dn	1953
	Burial Ground	565412.00	144348.20			point	2.1	2.4	2.4		5.950		4	Soil-Debris	116C-4	118-B-7	Eb-s	1951	Eb-dn	1968
	Reactor	565288.19	144512.22			polygon					3948.379		4	Reactor Block/Soil-Debris	100C-4	118-B-8	Eb-s	1944	ABC	1968
	Storage	565293.19	144630.98			polygon	7.3	3.7	3.048		26.756		4	Soil-Debris	100C-4	118-B-9	Eb-s	1950	Eb-dn	1955
	Burial Grounc	565575.44	143911.34			polygon	155.4	121.9	6.1		18952.220		4	Soil-Debris	116C-4	118-C-1	Eb-s	1953	Eb-dn	1969
	Reactor	565374.25	144004.13			polygon					6038.698		4	Reactor Block/Soil-Debris	100C-4	118-C-3	Eb-s	1952	ABC	1969
	Storage	565397.94	143898.48			polygon	12.2	7.6	1.2		92.888		4	Soil-Debris	100C-4	118-C-4	Eb-s	1950	Eb-dn	1969
r	Outfall	565719.81	145480.98			point	16.0	8.2			131.179		NA	River	River	132-C-2	River	1944	River	1969
	Burial Grounc	565368.94	143846.78			point	6.1	6.1			37.210		4	Soil-Debris	116C-4	600-33	Eb-s	1963	Eb-dn	1963
	French Drair	573751.19	151234.19			point					0.999		4	Liquid	116D-4	100-D-23	El-s	1959	El-dn	1967
	French Drair	573745.56	151540.80			point					0.999		4	Liquid	116D-4	100-D-24	El-s	1959	El-dn	1967
	Unplanned Release	573832.38	152132.50			polygon	69.0	11.0			740.075		4	Liquid	116D-4	100-D-29	El-s	1951	El-dn	1951
	Burial Grounc	573818.56	151513.86			polygon					999.000		4	Soil-Debris	116D-4	100-D-3	El-s	1953	El-dn	1955
	Burial Grounc	573857.38	151432.53			polygon	15.2	15.2			231.040		4	Soil-Debris	116D-4	100-D-32	El-s	1956	El-dn	1955
	Burial Grounc	574039.06	151546.05			polygon			6.1	12.2	116.900		4	Soil-Debris	116D-4	100-D-40	El-s	1953	El-dn	1955
	Burial Grounc	573848.81	151522.88			polygon	28.0	13.0			276.548		4	Soil-Debris	116D-4	100-D-42	El-s	1955	El-dn	1955
	Burial Grounc	573852.00	151507.50			polygon	21.3	7.6	4.6		162.580		4	Soil-Debris	116D-4	100-D-43	El-s	1953	El-dn	1955
	Burial Grounc	573821.56	151500.77			polygon	24.7	7.3	5.2		180.604		4	Soil-Debris	116D-4	100-D-45	El-s	1953	El-dn	1955
	Burial Grounc	574000.13	151493.63			polygon	57.0	69.5			3961.014		4	Soil-Debris	116D-4	100-D-47	El-s	1953	El-dn	1955
	Radioactive Process	########	########			line					99.900		4	Liquid	100D-4	100-D-49	El-s	1950	El-dn	1967
	Process Unit/Plant	573753.00	151209.64			polygon	20.7	11.9			246.480		4	Cement	100D-4	100-D-53	El-s	1960	El-dn	1960
	French Drain	########	########			point			0.3	0.5	0.159		4	Liquid	116D-4	100-D-59	El-s	1969	El-dn	1969
r	Radioactive Process	########	########			line	400	3.8			1528.000		NA	River	River	100-D-60	River	1949	River	1969
r	Outfall	572625.00	151569.45			polygon					9.990		NA	River	River	100-D-8	River	1949	River	1968
	Trench	573861.25	151588.91			polygon	39.6	3.0	6.4		120.774		4	Liquid	116D-4	116-D-1A	El-s	1947	El-dn	1952
	Trench	573841.31	151613.67			polygon	30.5	3.0	6.4		92.903		4	Liquid	116D-4	116-D-1B	El-s	1953	El-dn	1967
	Crib	573819.38	151536.27			polygon	3.0	3.0	6.1		120.774		4	Liquid	116D-4	116-D-2	El-s	1950	El-dn	1956
r	Outfall	573502.19	152319.13			polygon	18.3	7.3			133.7803781		NA	River	River	116-D-5	River	1969	River	1969
	Storage	573695.50	151280.61			polygon					0.999		4	Soil-Debris	100D-4	116-D-8	El-s	1946	El-dn	1975
	Trench	574013.56	152328.47	6	(574063.679,152347.690), (573952.812,152348.922), (573954.044,152291.024), (574003.318,152251.605), (574063.679,152251.605), (574063.679,152347.690)	polygon	137.2	4.6	6.1		4856.228		4	Liquid	116D-4	116-DR-1%2	El-s	1950	El-dn	1967
	Trench	573829.56	151207.05			polygon	18.3	12.2	3.0		222.967		4	Liquid	116D-4	116-DR-3	El-s	1955	El-dn	1955
	Crib	573824.25	151227.66			point	3.0	3.0	6.1		9.290		4	Liquid	116D-4	116-DR-4	El-s	1950	El-dn	1956
r	Outfall	573625.56	152441.50			polygon	8.2	4.3			35.11734925		NA	River	River	116-DR-5	River	1969	River	1969
	Trench	573854.38	151290.83			polygon	15.2	3.0	5.0		46.452		4	Liquid	116D-4	116-DR-6	El-s	1953	El-dn	1965
	Crib	573820.75	151127.88			polygon	3.0	3.0	5.2		9.290		4	Liquid	116D-4	116-DR-8	El-s	1960	El-dn	1964
	Burial Grounc	573708.88	150968.16			polygon	137.2	114.3	6.1		15677.388		4	Soil-Debris	116D-4	118-D-1	El-s	1944	El-dn	1967
	Burial Grounc	572949.06	150919.08			polygon	304.8	109.7	6.1		33445.095		4	Soil-Debris	116D-4	118-D-2	El-s	1949	El-dn	1970

	Laboratory	573748.63	151234.59			polygon					790.000		4	Liquid	100D-4	122-DR-1	El-s	1972	ABC	1986
	Stack	573757.75	151240.20			polygon	61.0			5.1	20.400		4	Soil-Debris	100D-4	132-DR-2	El-s	1950	ABC	1986
	French Drair	580490.19	147590.94			point				0.9	0.657		4	Liquid	116F-4	100-F-10	Rp-s	1944	Rp-dn	1965
	French Drair	580460.44	147630.00			point				0.9	0.657		4	Liquid	116F-4	100-F-12	Rp-s	1944	Rp-dn	1965
	Radioactive Process	########	########			line	2214.7				99.900		4	Liquid	100F-4	100-F-19	Rp-s	1945	Rp-dn	1965
	French Drair	580871.00	147790.78			point					0.999		4	Liquid	116F-4	100-F-23	Rp-s	1944	Rp-dn	1965
	French Drair	580864.81	147825.23			point					0.999	Animal Waste	4	Liquid	116F-4	100-F-24	Rp-s	1977	Rp-dn	1977
	French Drair	580925.06	148040.36			point				1.5	1.824		4	Liquid	116F-4	100-F-25	Rp-s	1956	Rp-dn	1975
	Radioactive Process	########	########			line					99.900		4	Liquid	100F-4	100-F-29	Rp-s	1945	Rp-dn	1976
	Unplanned Release	580913.94	148056.19			polygon	49.0	19.0			889.310		4	Liquid	100F-4	100-F-33	Rp-s	1952	Rp-dn	1971
	Laboratory	580600.56	147613.91				45.87	9.75	17.68		447.233		4	Soil-Debris/Liquid	100F-4	100-F-36	Rp-s	1944	ABC	1973
	French Drain	580712.81	147677.92								0.999		4	Liquid	100F-4	100-F-37	Rp-s	1969	Rp-dn	1969
	Unplanned Release	580702.44	147672.64								0.999		4	Soil-Debris	100F-4	100-F-38	Rp-s	1969	Rp-dn	1969
r	Radioactive Process Sewer	########	########				91.0	2.1			194.740		4	River	River	100-F-39	River	1944	River	1969
	French Drair	580490.19	147597.64			point				0.9	0.657		4	Liquid	116F-4	100-F-9	Rp-s	1944	Rp-dn	1965
	Trench	579989.19	148050.38			polygon	1744.0	6.1	3.0		10638.400		4	Liquid	116F-4	116-F-1	Rp-s	1953	Rp-dn	1965
	French Drair	580453.38	147500.50			point			6.096	0.9	0.999		4	Liquid	116F-4	116-F-10	Rp-s	1948	Rp-dn	1965
	French Drair	580450.88	147576.00			point			0.9144	0.9	0.83612736		4	Liquid	116F-4	116-F-11	Rp-s	1953	Rp-dn	1965
r	Outfall	580963.44	148143.98				30.5	4.6			4.570		4	River/Liquid	River	116-F-16	River	1969	River	1969
	Trench	581147.88	147681.13			polygon	158.8	6.1	3.4		968.050		4	Liquid	116F-4	116-F-2	Rp-s	1950	Rp-dn	1965
	Trench	580440.50	147530.73			polygon	30.5	6.1	3.4		303.514		4	Liquid	116F-4	116-F-3	Rp-s	1947	Rp-dn	1951
	Crib	580387.63	147524.25			polygon	1.8	1.8	3.0		9.290		4	Liquid	116F-4	116-F-4	Rp-s	1950	Rp-dn	1952
	Crib	580378.81	147504.56			polygon	3.0	3.0	2.7		9.290		4	Liquid	116F-4	116-F-5	Rp-s	1954	Rp-dn	1964
	Trench	580482.50	147456.89			polygon	91.4	30.5	3.0		2787.091		4	Liquid	116F-4	116-F-6	Rp-s	1952	Rp-dn	1965
	French Drair	580355.13	147450.84			point	6.1	6.1	5.1816		0.999		4	Liquid	116F-4	116-F-7	Rp-s	1960	Rp-dn	1965
r	Outfall	580963.81	148107.72			polygon	8.2	4.3			36.23218573		NA	River	River	116-F-8	River	1969	River	1969
	Trench	581095.56	147874.61			polygon	154.5	3.0	3.0		696.773		4	Liquid	116F-4	116-F-9	Rp-s	1963	Rp-dn	1976
	Burial Grounc	580146.06	147239.50			polygon	182.9	152.4	6.1		2787.091		4	Soil-Debris	116F-4	118-F-1	Rp-s	1954	Rp-dn	1965
	Burial Grounc	579919.44	147512.48			polygon	112.2	99.4	6.1		11148.365		4	Soil-Debris	116F-4	118-F-2	Rp-s	1945	Rp-dn	1965
	Burial Grounc	580328.44	147495.78			polygon	53.3	15.2	4.6		812.902		4	Soil-Debris	116F-4	118-F-3	Rp-s	1952	Rp-dn	1952
	Crib	580303.13	147533.02			point	3.0	3.0	4.6		9.290		4	Liquid/Soil-Debris	116F-4	118-F-4	Rp-s	1949	Rp-dn	1949
	Burial Grounc	581341.81	147459.33			polygon	152.4	45.7	4.6		6967.728		4	Soil-Debris	116F-4	118-F-5	Rp-s	1954	Rp-dn	1975
	Burial Grounc	580130.38	147112.30			polygon	121.9	61.0	5.5		7432.243		4	Soil-Debris	116F-4	118-F-6	Rp-s	1965	Rp-dn	1973
	Storage	580444.50	147501.94				4.88	2.44	2.44		11.907		4	Soil-Debris	100F-4	118-F-7	Rp-s	1945	ABC	1965
	Reactor	580432.69	147600.23			polygon					4112.500		4	Reactor Block/Soil-Debris	100F-4	118-F-8	Rp-s	1944	ABC	1965
	Burial Grounc	580353.31	147622.63			polygon	18.3	12.2	8.2		222.967		4	Soil-Debris	116F-4	132-F-5	Rp-s	1960	Rp-dn	1965
	Laboratory	580881.63	147843.22			polygon					431.070		4	Soil-Debris	100F-4	141-C	Rp-s	1945	ABC	1976
	Crib	582272.88	142762.97			point	2.4	2.4			5.946	Low-level plutonium waste	4	Liquid	116F-4	600-111	Rp-s	1949	Rp-dn	1951
	Unplanned Releas(	580915.00	147862.00			point	12.2	12.2			148.645		4	Liquid	100F-4	UPR-100-F-1	Rp-s	1971	Rp-dn	1971
	Unplanned Releas(	580920.50	148035.77			point	3.0	3.0			9.290		4	Soil-Debris	100F-4	UPR-100-F-3	Rp-s	1977	Rp-dn	1977
	French Drair	577771.88	152560.84			polygon				1.2	1.167		4	Liquid	116H-4	100-H-10	Ba-s	1950	Ba-dn	1965
	French Drair	577798.38	152505.78			polygon				0.8	0.456		4	Liquid	116H-4	100-H-12	Ba-s	1950	Ba-dn	1965
	French Drair	577827.50	152514.66			polygon				1.2	1.167		4	Liquid	116H-4	100-H-13	Ba-s	1950	Ba-dn	1965
	Unplanned Releas(	577790.06	152471.44			polygon	16.0	14.0			251.077		4	Liquid	100H-4	100-H-14	Ba-s	1950	G-dn	1965
	Unplanned Release	577771.94	152556.05			point					0.999		4	Soil-Debris	100H-4	100-H-31	Ba-s	1969	Ba-dn	1969
	Retention Basin	577879.38	152851.34				39.01	16.46	5.03		2452.640		4	Liquid	116H-4	100-H-33	Ba-s	1949	Ba-dn	1985
r	Radioactive Process Sewer	########	########				152.4	3.0			463.296		4	River	River	100-H-34	River	1944	River	1969
	Burial Grounc	578178.69	152578.89			poly	100.0	15.8	4.6		1584.554		4	Soil-Debris	116H-4	100-H-5	Ba-s	1953	Ba-dn	1965
	French Drair	577821.81	152540.80			polygon				0.8	0.456		4	Liquid	116H-4	100-H-7	Ba-s	1950	Ba-dn	1965
	French Drair	577825.63	152554.09			polygon				0.9	0.657		4	Liquid	116H-4	100-H-8	Ba-s	1950	Ba-dn	1965
	French Drair	577799.44	152560.42			polygon				0.6	0.292		4	Liquid	116H-4	100-H-9	Ba-s	1950	Ba-dn	1965
	Trench	578088.69	152305.02			line	246.0	20.1	4.6		4948.202		4	Liquid	116H-4	116-H-1	Ba-s	1952	Ba-dn	1965
	Trench	577734.44	152407.89			point	9.1	3.0	1.8		27.871		4	Liquid	116H-4	116-H-2	Ba-s	1953	Ba-dn	1965
	French Drair	577859.13	152493.09			point			4.572	0.9	0.657		4	Liquid	116H-4	116-H-3	Ba-s	1950	Ba-dn	1965
	Crib	577712.81	152482.69			point	3.0	3.0	3.0		9.290		4	Liquid	116H-4	116-H-4	Ba-s	1950	Ba-dn	1952
r	Outfall	578113.44	152821.30			polygon	8.2	4.3			35.11734925		NA	River	River	116-H-5	River	1969	River	1969
	Retention Basir	577879.38	152851.34			poly	39.0	16.5	5.0		2452.640		4	Liquid	116H-4	116-H-6	Ba-s	1973	Ba-dn	1985
	Retention Basir	578086.50	152649.38			poly	194.5	86.0	7.3		16714.743		4	Liquid	116H-4	116-H-7	Ba-s	1949	Ba-dn	1965
	Crib	577628.50	152452.95			point	6.1	6.1	4.6		37.161		4	Liquid	116H-4	116-H-9	Ba-s	1960	Ba-dn	1965
	Burial Grounc	577566.13	152136.95			polygon	213.4	106.7	6.096		24387.04809		4	Soil-Debris	116H-4	118-H-1	Ba-s	1949	Ba-dn	1965
	Burial Grounc	577338.50	152527.95			polygon	42.7	15.2			650.321		4	Soil-Debris	116H-4	118-H-2	Ba-s	1955	Ba-dn	1965
	Burial Grounc	577840.38	152238.63			polygon	103.0	80.0	6.1		8210.000		4	Soil-Debris	116H-4	118-H-3	Ba-s	1953	Ba-dn	1957
	Burial Grounc	577676.75	152487.30			polygon	45.7	9.1	3.0		418.064		4	Soil-Debris	116H-4	118-H-4	Ba-s	1953	Ba-dn	1953
	Burial Grounc	577751.31	152428.33			polygon	9.1	0.6	3.0		5.574		4	Soil-Debris	116H-4	118-H-5	Ba-s	1953	Ba-dn	1960
	Reactor	577773.06	152521.80			polygon					5759.989		4	Reactor Block/Soil-Debris	100H-4	118-H-6	Ba-s	1949	ABC	1965
	French Drain	568684.75	146464.55			polygon				0.5	0.164		4	Liquid	116K-4	100-K-1	Eb-s	1955	Eb-dn	1971
	French Drain	569341.50	146320.75							1.52	1.815		4	Liquid	116K-4	100-K-14	Eb-s	1969	Eb-dn	1969
	Burial Grounc	569264.94	147015.03			polygon	53.3	18.3	4.6		975.482		4	Soil-Debris	116K-4	100-K-2	Eb-s	1955	Eb-dn	1971
	French Drain	569192.06	146651.28						1.22	0.46	0.166		4	Liquid	116K-4	100-K-36	Eb-s	1963	Eb-dn	1963

	S	C	C	N C	C S	G	L	W	D	D	A	W	W	R	V	S	P	O	O	C	F C	F	F C	F C	F	F C
	Radioactive Process	########	########			*line*	1902.9		4.6		*99.900*		4	Liquid	100K-4	100-K-56	Eb-s	1955	Eb-dn	1971						
	Ditch	########	########			line	570.0	1.5	1.2		*868.680*		4	Liquid	100K-4	100-K-57	Eb-s	1967	Eb-dn	1971						
	Process Unit/Plant	569234.56	146730.44							3.1	*7.306*		4	Cement	100K-4	100-K-6	Eb-s	*1969*	Eb-dn	*1969*						
	Process Unit/Plant	568697.19	146487.72						9.8		*99.900*		4	Cement	100K-4	100-K-61	Eb-s	1960	Eb-dn	1971						
	Process Unit/Plant	569239.06	146767.63						9.8		*99.900*		4	Cement	100K-4	100-K-62	Eb-s	1960	Eb-dn	1971						
	Unplanned Release	569254.06	147388.81				19.4	16.4			*318.160*		4	Soil-Debris	100K-4	100-K-78	Eb-s	*1969*	Eb-dn	*1969*						
r	Radioactive Process Sewer	########	########								*99.900*		4	River	River	100-K-80	River	*1969*	River	*1969*						
	Crib	569261.06	147222.53			polygon	121.9	121.9	6.1		*14864.486*		4	Liquid	116K-4	116-K-1	Eb-s	1955	Eb-dn	1956						
	Trench	569797.50	147715.88	8	(569351.648,147244.796), (569750.756,147732.450), (570149.832,148265.777), (570247.303,148206.928), (569993.512,147837.276), (569634.895,147384.867), (569437.889,147180.810), (569351.648,147244.796)	polygon	1249.7	17.2	5.3		21520.989		4	Liquid	116K-4	116-K-2	Eb-s	1955	Eb-dn	1971						
r	Outfall	568911.56	146964.88			polygon	10.7	10.1	7.0104		107.3030112		NA	River	River	116-K-3	River	*1969*	River	*1969*						
	Crib	569249.88	146744.31			point			7.8	12.2	*116.746*		4	Liquid	116K-4	116-KE-1	Eb-s	1955	Eb-dn	1971						
	Crib	569082.06	146636.06			polygon	4.9	4.9			24.248		4	Liquid	116K-4	116-KE-2	Eb-s	1955	Eb-dn	1971						
	Injection/Reverse Wel	569133.69	146750.81			point				6.1	24.248		4	Liquid	166K-4	116-KE-3	Eb-s	1955	Eb-dn	1971						
	Retention Basin	569096.75	146960.16			polygon			3.9	76.2	27870.912		4	Liquid	116K-4	116-KE-4	Eb-s	1955	Eb-dn	1971						
	Process Unit/Plant	569165.19	146871.94								*99.900*		4	Soil-Debris	100K-4	116-KE-5	Eb-s	1955	ABC	1971						
	Process Unit/Plant	569132.38	146663.73								*99.900*		4	Cement	100K-4	116-KE-6D	Eb-s	1984	ABC	*1984*						
	Crib	568718.06	146478.16			point			7.8	12.2	*116.745*		4	Liquid	116K-4	116-KW-1	Eb-s	1955	Eb-dn	1971						
	Injection/Reverse Wel	568591.56	146470.45			point				6.1	5.388		4	Liquid	166K-4	116-KW-2	Eb-s	1955	Eb-dn	1970						
	Retention Basin	568593.13	146668.14			polygon			3.9	76.2	13759.312		4	Liquid	116K-4	116-KW-3	Eb-s	1954	Eb-dn	1970						
	Process Unit/Plant	568649.06	146576.28								*99.900*		4	Cement	100K-4	116-KW-4	Eb-s	1955	ABC	1970						
	Burial Ground	569452.31	146895.86			polygon	365.8	182.9	6.1		66890.189		4	Soil-Debris	116K-4	118-K-1	Eb-s	1953	Eb-dn	1975						
	Reactor	569184.31	146717.02			polygon					5343.500		4	Reactor Block/Soil-Debris	100K-4	118-KE-1	Eb-s	1955	ABC	1971						
	Storage	569267.75	146808.50			polygon	12.2	7.6			92.903		4	Soil-Debris	100K-4	118-KE-2	Eb-s	1955	Eb-dn	1971						
	Reactor	568644.25	146433.25			polygon					4567.700		4	Reactor Block/Soil-Debris	100K-4	118-KW-1	Eb-s	1955	ABC	1970						
	Storage	568726.44	146529.14			polygon	12.2	7.6			92.903		4	Soil-Debris	100K-4	118-KW-2	Eb-s	1955	Eb-dn	1971						
	French Drain	569419.31	146363.73						0.9	0.9	0.650		4	Liquid	116K-4	120-KE-2	Eb-s	1955	Eb-dn	1971						
	Trench	569407.94	146376.88			polygon	12.2	0.9			*11.148*		4	Liquid	116K-4	120-KE-3	Eb-s	1955	Eb-dn	1971						
	French Drain	568877.88	146083.83						0.9	0.9	0.650		4	Liquid	116K-4	120-KW-2	Eb-s	1955	Eb-dn	1970						
	Unplanned Release	569152.19	146725.72			point					*0.999*		4	Liquid	100K-4	UPR-100-K-1	Eb-s	1955	ABC	2000						
	Pond	570914.38	149306.38			polygon	30.5	12.2			371.612		4	Liquid	100N-4	100-N-1	Eb-s	1965	Eb-dn	1993						
	Unplanned Release	571082.25	149472.34			point					*0.999*		4	Liquid	100N-4	100-N-29	Eb-s	1971	G-dn	1971						
	French Drain	571315.56	149303.56			point				1.7	*2.141*		4	Liquid	116N-4	100-N-54	Eb-s	1964	Eb-dn	1987						
	French Drain	571293.56	149367.50							1.2	1.169		4	Liquid	116N-4	100-N-55	Eb-s	*1997*	Eb-dn	1997						
	Unplanned Release	571322.13	149546.72				0.76	1.37			*1.041*		4	Liquid	100N-4	100-N-59	Eb-s	1995	Eb-dn	1995						
	French Drain	########	########								*0.999*		4	Liquid	116N-4	100-N-60	Eb-s	1964	Eb-dn	1987						
	Radioactive Process	########	########								*99.900*		4	Liquid	100N-4	100-N-62	Eb-s	1963	Eb-dn	1987						
	Radioactive Process	########	########								*99.900*		4	Liquid	100N-4	100-N-63	Eb-s	1963	Eb-dn	1987						
	Radioactive Process	########	########								*99.900*		4	Liquid	100N-4	100-N-64	Eb-s	1963	Eb-dn	1987						
	Reactor	571201.44	149489.48			polygon	137.8	141.7	21.3		*19526.361*		4	Reactor Block/Soil-Debris	100N-4	100-N-66	Eb-s	1963	ABC	1987						
	Crib	571534.19	149782.05	9	(571737.021,150105.953), (571315.717,149782.670), (571425.048,149735.544), (571408.083,149706.327), (571498.565,149662.028), (571552.288,149745.912), (571716.286,149705.384), (571822.790,150070.137), (571737.021,150105.953)	polygon	38.1	88.4	3.7		13759.312		4	Liquid	116N-4	116-N-1	Eb-s	1963	Eb-dn	1985						
	Crib	571954.88	149610.30	5	(571833.948,149629.040), (571955.532,149681.350)	polygon	76.2	73.2			5574.182		4	Liquid	116N-4	116-N-3	Eb-s	1983	Eb-dn	1991						

Retention Basir	571105.50	149501.52			polygon	39.6	24.4			809.371		4	Liquid	116N-4	116-N-4	Eb-s	1963	Eb-dn	1973
Pond	571326.56	149166.67			polygon					2694.188		4	Liquid	100N-4	120-N-1	Eb-s	1977	Eb-dn	1991
Surface Impoundment	571292.75	149210.33				42.67	21.34	4.57		910.578		4	Liquid	116N-4	120-N-2	Eb-s	1986	ABC	1988
French Drain	571136.13	149352.11				10.2	2.8	2.4		28.560		4	Liquid	116N-4	120-N-3	Eb-s	1963	Eb-dn	1988
French Drain	571276.38	149242.17						1.2	0.9	0.650		4	Liquid	116N-4	120-N-7	Eb-s	1963	Eb-dn	1987
Pond	571551.81	148677.50			polygon					*20000.00C*		4	Liquid	100N-4	130-N-1	Eb-s	1983	Eb-dn	*1983*
r Outfall	570870.75	149317.84			polygon	30.5	24.4			743.224		NA	River	River	1908-NE	River	*1969*	River	*1969*
Unplanned Releas	571079.31	149536.08			point					1858.061		4	Liquid	100N-4	UPR-100-N-1	Eb-s	1974	Eb-dn	1974
Unplanned Releas	571142.88	149537.78			point	3.0	3.0			9.290		4	Liquid	100N-4	UPR-100-N-10	Eb-s	1975	Eb-dn	1975
Unplanned Releas	571142.88	149537.78			point	0.6	0.9	18.3		*0.557*		4	Liquid	100N-4	UPR-100-N-12	Eb-s	1979	Eb-dn	1979
Unplanned Releas	571411.69	149614.75			point					*0.999*		4	Liquid	100N-4	UPR-100-N-25	Eb-s	1971	Eb-dn	1971
Unplanned Releas	571068.31	149543.88			polygon	15.2	15.2			232.258		4	Liquid	100N-4	UPR-100-N-30	Eb-s	1971	Eb-dn	1971
Unplanned Releas	571410.94	149699.39			point					*0.999*		4	Liquid	100N-4	UPR-100-N-31	Eb-s	1971	Eb-dn	1971
Unplanned Releas	571182.19	149521.22			point					*0.999*		4	Liquid	100N-4	UPR-100-N-35	Eb-s	1986	Eb-dn	1986
Unplanned Releas	571397.13	149628.16			point			18.3		*0.999*		4	Liquid	100N-4	UPR-100-N-5	Eb-s	1972	Eb-dn	1972
Unplanned Releas	########	########			line					*0.999*		4	Liquid	100N-4	UPR-100-N-7	Eb-s	*1985*	Eb-dn	1985
Unplanned Releas	571398.63	149671.23			point					2.323		4	Liquid	100N-4	UPR-100-N-8	Eb-s	1975	Eb-dn	1975
Pond	574970.88	139650.36	8	(576090.770,139387.189), (575744.373,139040.792), (574283.012,139787.710), (574185.588,140350.604), (574748.483,140458.853), (574889.206,140047.507), (575127.354,139820.184), (576090.770,139387.189)	polygon	1423.7	243.8	1.5		*347160.080*		4	Liquid	200G-4	216-A-25	El-s	1957	El-dn	1987
Pond	573191.88	141319.23			polygon	85.0	85.0			*7231.666*		4	Liquid	200G-4	216-N-8	El-s	*1944*	El-dn	*1952*
Storage	579282.19	140170.25			polygon	12.2	3.7	2.4		44.615		4	Soil-Debris	200G-4	600-108	El-s	1944	ABC	*2020*
Storage	569874.00	140328.19			polygon					555.000		4	Soil-Debris	200I-4	212-N	El-s	1945	ABC	*1945*
Storage	570678.50	140330.02			polygon					555.000		4	Soil-Debris	200I-4	212-P	El-s	1945	ABC	*1945*
Storage	571483.38	140331.81			polygon					555.000		4	Soil-Debris	200I-4	212-R	El-s	1945	ABC	1952
Pond	569885.63	140044.59			point	152.4	30.5	1.8		*4645.152*		4	Liquid	200I-4	216-N-1	El-s	1944	El-dn	1952
Trench	569829.13	140379.89			point	15.2	3.0	2.1		*46.452*		4	Liquid	200I-4	216-N-2	El-s	1947	El-dn	1947
Trench	569818.31	140371.34			polygon	15.2	6.1	1.8		*92.903*		4	Liquid	200I-4	216-N-3	El-s	1952	El-dn	1952
Pond	570754.44	139933.16			polygon	152.4	61.0	0.9		*9290.304*		4	Liquid	200I-4	216-N-4	El-s	1944	El-dn	1952
Trench	570635.19	140373.53			polygon	24.4	4.6	1.8		*111.484*		4	Liquid	200I-4	216-N-5	El-s	1952	El-dn	1952
Pond	571642.56	139894.81			polygon	152.4	45.7			*6967.728*		4	Liquid	200I-4	216-N-6	El-s	1944	El-dn	1952
Trench	571433.69	140383.53			polygon	24.4	4.6	1.8		*111.484*		4	Liquid	200I-4	216-N-7	El-s	1952	El-dn	1952
Trench	########	########				*20.0*	*2.0*			*40.000*		4	Liquid	216A-4	200-E-102	Rpe-s	1958	Rp-dn	1958
Unplanned Release	575195.94	135518.42			polygon					17326.417	Soil	4	Soil-Debris/Liquid	200A-4	200-E-103	Rpe-s	*1969*	G-dn	*1969*
Receiving Vaul	########	########								100000.000		4	Glass	216A-4	200-E-106	Rpe-s	*2010*	Rp-dn	*2035*
Unplanned Release	575311.06	135601.03			polygon	114.6	34.8			3982.350		4	Soil-Debris/Liquid	200A-4	200-E-107	Rpe-s	*1969*	Rp-dn	*1969*
Unplanned Release	575262.51	136631.02				9.14	9.14			83.540		4	Soil-Debris	200A-4	200-E-115	Rpe-s	*1969*	Rp-dn	*1969*
Unplanned Releas	575178.35	135870.38				64	4.6			294.400		4	Soil-Debris	200A-4	200-E-124	Rpe-s	*1969*	Rp-dn	*1969*
Unplanned Release	575211.66	136108.92				6.84	4.43			30.301		4	Soil-Debris	200A-4	200-E-125	Rpe-s	*1969*	Rp-dn	*1969*
Process Unit/Plan	575113.52	135641.83			polygon	306.0	30.0	12.0		*9180.00C*		4	Cement/Liquic	200A-4	200-E-136	Ba-s	1956	ABC	1990
French Drair	574450.19	136348.50			point				1.2	*1.167*		4	Liquid	216A-4	200-E-4	Rpe-s	1958	Rp-dn	1959
Unplanned Release	574622.25	136331.13			polygon	150.0	150.0			22500.000		4	Soil-Debris/Liquid	200A-4	200-E-41	Rpe-s	*1969*	Rp-dn	*1969*
Unplanned Release	575401.94	135508.25			polygon	94.0	95.0	0.0		26000.000		4	Atmosphere/Soil-Debris	200A-4	200-E-42	Ba-s	1985	Ba-dg	1994
Unplanned Releas	575254.12	135762.75			polygon					*9.990*		4	Soil-Debris	200A-4	200-E-44	Rpe-s	*1969*	Rp-dn	*1969*
Unplanned Release	575137.25	135585.36			point					*9.990*		4	Liquid	200A-4	200-E-54	Rpe-s	1991	Rp-dn	*1991*
Unplanned Release	574609.38	136349.23			point					*9.990*		4	Liquid	200A-4	200-E-56	Rpe-s	1949	Rp-dn	1957
Unplanned Release	574657.31	136337.25			point					0.999		4	Liquid	200A-4	200-E-57	Rpe-s	1957	Rp-dn	1957
Injection/Reverse Well	575022.18	135683.83			point				0.6	0.292	Stormwater Runoff	4	Liquid	216A-4	200-E-61	Rpe-s	1955	Rp-dn	2001
Injection/Reverse Well	575099.00	135796.00			point					*0.999*	Steam Condensate	4	Liquid	216A-4	200-E-62	Rpe-s	*1955*	Rp-dn	1996
Injection/Reverse Well	575075.00	135714.00			point				1.2	1.169	Steam Condensate	4	Liquid	216A-4	200-E-63	Rpe-s	*1955*	Rp-dn	1996

Injection/Reverse Well	575275.00	135620.00			point				1.2	1.131	Steam Condensate	4	Liquid	216A-4	200-E-65	Ba-s	1955	Ba-dn	1996			
Injection/Reverse Well	575141.88	135614.28			point					9.990	Steam Condensate	4	Liquid	216A-4	200-E-67	Ba-s	1996	Ba-dn	1996			
Injection/Reverse Well	575205.00	135555.00			point				1.2	1.131	Steam Condensate	4	Liquid	216A-4	200-E-68	Ba-s	1955	Ba-dn	1996			
Injection/Reverse Well	574933.00	135719.00			point				1.3	1.327	Steam Condensate	4	Liquid	216A-4	200-E-69	Rpe-s	1955	Rp-dn	1997			
Injection/Reverse Well	575272.00	135601.00			point				0.9	0.636	Steam Condensate	4	Liquid	216A-4	200-E-70	Ba-s	1955	Ba-dn	1997			
Injection/Reverse Well	575252.00	135602.00			point			0.9	0.6	0.292	Steam Condensate	4	Liquid	216A-4	200-E-71	Ba-s	1955	Ba-dn	1997			
Injection/Reverse Well	575104.00	135513.00			point				0.9	0.636	Steam Condensate	4	Liquid	216A-4	200-E-72	Ba-s	1955	Ba-dn	1997			
Injection/Reverse Well	575185.00	135607.00			point				0.9	0.636	Steam Condensate	4	Liquid	216A-4	200-E-73	Ba-s	1955	Ba-dn	1996			
Injection/Reverse Well	575244.00	135552.00			point				0.9	0.636	Steam Condensate	4	Liquid	216A-4	200-E-74	Ba-s	1955	Ba-dn	1997			
Injection/Reverse Well	574936.00	135614.00			point				0.9	0.636	Steam Condensate	4	Liquid	216A-4	200-E-75	Ba-s	1955	Ba-dn	1997			
Injection/Reverse Well	575284.00	135903.00			point				1.5	1.767	Steam Condensate	4	Liquid	216A-4	200-E-76	Rpe-s	1955	Rp-dn	1997			
Injection/Reverse Well	575274.00	135645.00			point				1.2	1.131	Steam Condensate	4	Liquid	216A-4	200-E-77	Rpe-s	1955	Rp-dn	1997			
Injection/Reverse Well	575110.00	135736.00			point					0.999	Steam Condensate	4	Liquid	200A-4	200-E-78	Rpe-s	1955	Rp-dn	1996			
Injection/Reverse Well	575284.00	135658.00			point				0.9	0.636	Steam Condensate	4	Liquid	216A-4	200-E-79	Rpe-s	1955	Rp-dn	1997			
Injection/Reverse Well	575222.00	135656.00			point					0.999	Steam Condensate	4	Liquid	216A-4	200-E-80	Rpe-s	1955	Rp-dn	1996			
Injection/Reverse Well	575007.00	135717.00			point					0.999	Steam Condensate	4	Liquid	216A-4	200-E-81	Rpe-s	1955	Rp-dn	1996	1997	Surface Stabilization	G-dn
Injection/Reverse Well	575052.75	135814.66			point			1.52	1.37	1.478	Steam Condensate	4	Liquid	216A-4	200-E-82	Rpe-s	1997	Rp-dn	1997			
Injection/Reverse Well	574959.00	135624.00			point				0.90	0.636	Steam Condensate	4	Liquid	216A-4	200-E-84	Ba-s	1955	Ba-dn	1996			
Injection/Reverse Well	#######	#######			point					0.999	Water	4	Liquid	216A-4	200-E-85	Ba-s	1969	Ba-dn	1969			
Process Unit/Plan	574591.78	136348.45			polygon	42.67	24.38			1040.514	Chemicals/Equipmen	4	Cement/Liquic	200A-4	201-C	Rpe-s	1949	ABC	1967			
Storage	575159.13	135629.47			point					9.990	Equipment	4	Soil-Debris	200A-4	202-A-WS-1	Rpe-s	1956	ABC	1956			
Retention Basir	575568.25	136023.98			polygon	16.8	3.0	2.1		51.097		4	Liquid	200A-4	207-A-NORTH	Rpe-s	1977	Rp-dn	1989			
Retention Basir	575568.38	135975.22			polygon	16.8	3.0	2.1		51.097		4	Liquid	200A-4	207-A-SOUTH	Rpe-s	1977	Rp-dn	1989			
French Drair	574467.06	136308.94			polygon				1.2	1.167		4	Liquid	216A-4	209-E-WS-2	Rpe-s	1960	Rp-dn	1989			
Pond	573374.56	135269.52			point	147.8	3.0			450.580		4	Liquid	200A-4	2101-M-POND	Rpe-s	1953	Rp-dn	1995			
Crib	575521.69	136081.78			polygon	9.1	9.1	4.6		83.613		4	Liquid	216A-4	216-A-1	Rpe-s	1955	Rp-dn	1955			
Crib	574978.25	135439.94	5	(574956.625,135 499.088), (574992.676,135 499.088), (574992.676,135 343.254), (574956.625,135 343.254),	polygon	83.8	13.7			1149.675		4	Liquid	216A-4	216-A-10	Rpe-s	1956	Rp-dn	1987			

French Drain	575064.13	135527.72			point			13.4	1.0	*0.795*	Drainage from the 216-A-10 Process Condensate Sampler Pit #4. The waste is acidic.	4	Liquid	216A-4	216-A-15	Rpe-s	1955	Rp-dn	1972						
French Drair	575432.38	136039.22			point			5.1816	1.1	*0.894*	Low in salt, neutral to basi	4	Liquid	216A-4	216-A-16	Rpe-s	1956	Rp-dn	1969						
French Drair	575429.38	136036.16			point	1.8			1.1	*0.894*	Low in salt, neutral to basi	4	Liquid	216A-4	216-A-17	Rpe-s	1956	Rp-dn	1969						
Trench	575580.19	136235.69			polygon	24.4	24.4			594.579		4	Liquid	216A-4	216-A-18	Rpe-s	1955	Rp-dn	1956						
Trench	575665.31	136277.81			polygon	7.6	7.6	4.6		58.064		4	Liquid	216A-4	216-A-19	Rpe-s	1955	Rp-dn	1956						
Crib	575180.13	135528.66			polygon	6.1	6.1	8.2		37.161		4	Liquid	216A-4	216-A-2	Rpe-s	1956	Rp-dn	1963						
Trench	575707.00	136248.50			polygon	7.6	7.6	4.6		58.064		4	Liquid	216A-4	216-A-20	Rpe-s	1955	Rp-dn	1955						
Crib	575214.56	135462.39			polygon	18.3	4.9			*89.187*		4	Liquid	216A-4	216-A-21	Rpe-s	1957	Rp-dn	1965						
Crib	575093.06	135778.17			point			3.0	4.9	18.674		4	Liquid	216A-4	216-A-22	Rpe-s	1956	Rp-dn	1969						
French Drair	575426.63	136025.23			point			1.8288	1.1	0.893727244	Low in salt, neutral to basi	4	Liquid	216A-4	216-A-23A	Rpe-s	1957	Rp-dn	1969						
French Drair	575423.56	136025.22			point			1.8288	1.1	0.893727244	Low in salt, neutral to basi	4	Liquid	216A-4	216-A-23B	Rpe-s	1957	Rp-dn	1969						
Crib	575832.88	136395.78			polygon	426.7	6.1			2601.285		4	Liquid	216A-4	216-A-24	Rpe-s	1958	Rp-dn	1966						
French Drair	575200.69	135533.89			point			4.6	0.9	1.167		4	Liquid	216A-4	216-A-26	Rpe-s	1965	Rp-dn	1991						
French Drair	575200.69	135538.45			point			4.6	1.2	1.167		4	Liquid	216A-4	216-A-26A	Rpe-s	1959	Rp-dn	1965						
Crib	575197.38	135400.69			polygon	61.0	3.0			185.806		4	Liquid	216A-4	216-A-27	Rpe-s	1965	Rp-dn	1970						
Crib	575082.63	135778.98			point			3.4	6.1	29.190		4	Liquid	216A-4	216-A-28	Rpe-s	1958	Rp-dn	1967						
Ditch	575657.69	135885.03			polygon	1219.2	1.8			26304.567		4	Liquid	216A-4	216-A-29	Rpe-s	1955	Rp-dn	1991						
Crib	575099.50	135819.53			polygon	6.1	6.1	4.9		37.161		4	Liquid	216A-4	216-A-3	Rpe-s	1956	Rp-dn	1981						
Crib	575980.88	135507.75	5	(575756.467, 135597.169), (576270.785, 135293.759), (576315.186, 135373.928), (575798.401,135661.305), (575756.467,135597.169)	polygon	426.7	3.0			1300.643		4	Liquid	216A-4	216-A-30	Rpe-s	1961	Rp-dn	1992						
Crib	575166.38	135483.80			polygon	21.3	3.0			65.032		4	Liquid	216A-4	216-A-31	Rpe-s	1964	Rp-dn	1966						
Crib	575325.56	135730.81			polygon	21.3	2.4	3.7		52.026		4	Liquid	216A-4	216-A-32	Rpe-s	1959	Rp-dn	1972						
French Drair	575169.50	135558.78			point			3.7	1.8	2.626		4	Liquid	216A-4	216-A-33	Rpe-s	1955	Rp-dn	1964						
Ditch	575647.94	136210.16			polygon	85.3				607.028		4	Liquid	216A-4	216-A-34	Rpe-s	1955	Rp-dn	1957						
French Drair	574958.50	135613.69			point				1.8	404.686		4	Liquid	216A-4	216-A-35	Rpe-s	1963	Rp-dn	1966						
Crib	575106.50	135396.03			polygon	30.5	3.4			809.371		4	Liquid	216A-4	216-A-36A	Rpe-s	1965	Rp-dn	1966						
Crib	575105.06	135294.92	4	(575095.000,135220.000), (575120.000,135220.000), (575120.000,135420.000), (575095.000,135420.000)	polygon	152.4	3.4			510.967		4	Liquid	216A-4	216-A-36B	Rpe-s	1966	Rp-dn	1987						
Crib	575842.13	135678.91			polygon	213.4	3.0			1011.714		4	Liquid	216A-4	216-A-37-1	Rpe-s	1977	Rp-dn	1989						
Crib	576170.38	135525.66			polygon	426.7	3.0			*1300.643*		4	Liquid	216A-4	216-A-37-2	Rpe-s	1983	Rp-dn	1995						
Crib	575431.50	136253.80			polygon	28.0	22.0			*616.000*		4	Liquid	216A-4	216-A-39	Rpe-s	1966	Rp-dn	1966						
Crib	575216.81	135528.66			polygon	6.1	6.1	7.9		37.161		4	Liquid	216A-4	216-A-4	Rpe-s	1955	Rp-dn	1958						
Retention Basir	575172.13	136187.17			polygon	121.9	6.1	3.7		743.224		4	Liquid	216A-4	216-A-40	Rpe-s	1968	Rp-dn	1979						
Crib	575237.44	136108.48			polygon	3.0	3.0			40.599		4	Liquid	216A-4	216-A-41	Rpe-s	1968	Rp-dn	1974						
Retention Basin	575681.63	135694.72			polygon	104.2	9.1	6.1		953.185		4	Liquid	216A-4	216-A-42	Rpe-s	1978	Rp-dn	1997						
Crib	574908.25	135161.34			polygon	94.5	18.3			1727.997		4	Liquid	216A-4	216-A-45	Rpe-s	1987	Rp-dn	1991						
Crib	575047.50	135492.72			polygon	10.7	10.7	8.8		*113.806*		4	Liquid	216A-4	216-A-5	Rpe-s	1955	Rp-dn	1966						
Crib	575591.44	135648.02	5	(575544.670,135616.334), (575598.686,135644.659), (575615.484,135616.663), (575561.797,135588.338), (575544.670,135616.334)	polygon	30.5	30.5			929.030		4	Liquid	216A-4	216-A-6	Rpe-s	1955	Rp-dn	1970						
Crib	575506.19	136043.55			polygon	3.0	3.0	4.9		9.290		4	Liquid	216A-4	216-A-7	Rpe-s	1955	Rp-dn	1966						
Crib	575779.69	136194.02			polygon	259.1	6.1			1579.352		4	Liquid	216A-4	216-A-8	Rpe-s	1955	Rp-dn	1991						
Crib	575108.94	136024.95			polygon	128.0	6.1			780.386		4	Liquid	216A-4	216-A-9	Rpe-s	1956	Rp-dn	1969						
Crib	573649.25	134404.89			point	24.4	24.4	4.0		*594.579*		3	Liquid	216A_BC_E-3	216-B-14	Rpe-s	1956	Rp-dn	1956	1981	ABAR	Rp-			
Crib	573607.13	134432.20			point	24.4	24.4	4.0		*594.579*		3	Liquid	216A_BC_E-3	216-B-15	Rpe-s	1956	Rp-dn	1957	1981	ABAR	Rp-			
Crib	573624.94	134365.50			point	24.4	24.4	4.0		*594.579*		3	Liquid	216A_BC_E-3	216-B-16	Rpe-s	1956	Rp-dn	1956	1981	ABAR	Rp-			
Crib	573582.81	134389.77			point	24.4	24.4	4.0		*594.579*		3	Liquid	216A_BC_W-3	216-B-17	Rpe-s	1956	Rp-dn	1956	1981	ABAR	Rp-			
Crib	573600.69	134323.06			point	24.4	24.4	4.0		*594.579*		3	Liquid	216A_BC_W-3	216-B-18	Rpe-s	1956	Rp-dn	1956	1981	ABAR	Rp-			
Crib	573558.56	134347.33			point	24.4	24.4	4.0		*594.579*		3	Liquid	216A_BC_W-3	216-B-19	Rpe-s	1957	Rp-dn	1957	1981	ABAR	Rp-			
Trench	573413.99	134373.12			line	152.4	3.0	3.0		*464.515*		3	Liquid	216A_BCT_W-	216-B-20	Rpe-s	1956	Rp-dn	1956	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573378.94	134373.12			line	152.4	3.0	3.0		*464.515*		3	Liquid	216A_BCT_W-	216-B-21	Rpe-s	1956	Rp-dn	1956	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573343.73	134373.12			line	152.4	3.0	3.0		*464.515*		3	Liquid	216A_BCT_W-	216-B-22	Rpe-s	1956	Rp-dn	1956	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573283.23	134234.44			line	152.4	3.0	3.0		*464.515*		3	Liquid	216A_BCT_S-3	216-B-23	Rpe-s	1956	Rp-dn	1956	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573283.23	134203.96			line	152.4	3.0	3.0		*464.515*		3	Liquid	216A_BCT_S-3	216-B-24	Rpe-s	1956	Rp-dn	1956	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573283.23	134173.48			line	152.4	3.0	3.0		*464.515*		3	Liquid	216A_BCT_S-3	216-B-25	Rpe-s	1956	Rp-dn	1956	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573283.23	134143.00			line	152.4	3.0	3.0		*464.515*		3	Liquid	216A_BCT_S-3	216-B-26	Rpe-s	1956	G-dn	1957	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573283.23	134112.52			line	152.4	3.0	3.0		*464.515*		3	Liquid	216A_BCT_S-3	216-B-27	Rpe-s	1957	Rp-dn	1957	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573283.23	134082.04			line	152.4	3.0	3.0		*464.515*		3	Liquid	216A_BCT_S-3	216-B-28	Rpe-s	1957	Rp-dn	1957	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573083.28	134439.27			line	152.4	3.0			*464.515*		3	Liquid	216A_BCT_N-3	216-B-29	Rpe-s	1957	Rp-dn	1957	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573083.28	134401.17			line	152.4	3.0			*464.515*		3	Liquid	216A_BCT_N-3	216-B-30	Rpe-s	1957	Rp-dn	1957	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573083.28	134363.07			line	152.4	3.0			*464.515*		3	Liquid	216A_BCT_N-3	216-B-31	Rpe-s	1957	Rp-dn	1957	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573083.28	134324.97			line	152.4	3.0			*464.515*		3	Liquid	216A_BCT_N-3	216-B-32	Rpe-s	1957	Rp-dn	1957	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573083.28	134286.87			line	152.4	3.0			*464.515*		3	Liquid	216A_BCT_N-3	216-B-33	Rpe-s	1957	Rp-dn	1957	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573083.28	134248.77			line	152.4	3.0			*464.515*		3	Liquid	216A_BCT_S-3	216-B-34	Rpe-s	1957	Rp-dn	1957	1969	ABAR	G-dn	1982	ABAR	Rpe-
Trench	573293.59	134269.49			line	176.8	3.0			*538.836*		3	Liquid	216A_BCT_S-3	216-B-52	Rpe-s	1957	Rp-dn	1958	1969	ABAR	G-dn	1982	ABAR	Rpe-

Crib	574533.50	136299.98			polygon	15.2	3.0	3.0		*46.452*		4	Liquid	216A-4	216-C-3	Rpe-s	1953	Rp-dn	1954
Crib	574521.69	136304.64			polygon	6.1	3.0	4.9		*18.581*		4	Liquid	216A-4	216-C-4	Rpe-s	1955	Rp-dn	1965
Crib	574542.69	136292.39			point	6.1	3.0	4.9		*18.581*		4	Liquid	216A-4	216-C-5	Rpe-s	1955	Rp-dn	1955
Crib	574632.19	136288.22			polygon	6.1	3.0	4.9		*18.581*		4	Liquid	216A-4	216-C-6	Rpe-s	1955	Rp-dn	1964
Crib	574447.00	136281.13			polygon	6.1	6.1	3.7		*37.161*		4	Liquid	216A-4	216-C-7	Rpe-s	1961	Rp-dn	1983
French Drain	575210.25	136475.59			point			4.8768	2.4	*4.670*	Ion exchange waste from 271-CR	4	Liquid	216A-4	216-C-8	Rpe-s	1962	Rp-dn	1965
Pond	574585.38	136478.14			polygon	243.8	30.5	7.6		7432.243		4	Liquid	216A-4	216-C-9	Rpe-s	1953	Rp-dn	1983
Burial Grounc	574657.56	136464.67			polygon	86.3	86.3			16982.676		4	Soil-Debris	216A-4	218-C-9	Rpe-s	1985	Rp-dn	1989
Burial Grounc	574754.69	135574.91			polygon	148.1	88.4			*7440.512*		4	Soil-Debris	216A-4	218-E-1	Rpe-s	1945	Rp-dn	1953
Storage Tunne	575259.13	135486.86			polygon	109.1	5.8	6.9		*631.926*		4	Cement/Soil-Debris	216A-4	218-E-14	Rpe-s	1960	Rp-dn	1964
Storage Tunne	575277.31	135225.56			polygon	514.5	10.4	6.7		*5331.891*		4	Cement/Soil-Debris	216A-4	218-E-15	Rpe-s	1967	Rp-dn	1996
Burial Grounc	574600.00	135400.00								100000.000		4	Glass	216A_ILAW_C-	218-E-ILAW	Rpe-s	*2010*	Rp-dn	*2035*
Burial Grounc	574800.00	135200.00				174.0	70.0			*12180.00*		4	Glass	216A-4	218-E-Melter	Rpe-s	*2010*	Rp-dn	*2035*
Burial Ground	574382.72	135354.65			polygon	205.0	218.5	12.2		44791.848		4	Glass/Soil Debris	216A_ILAW_C-4	218-E-RCRA	Rpe-s	*2008*	Rp-dn	*2035*
Burial Ground	574547.36	135354.65			polygon	205.0	218.5	12.2		44791.848		4	Soil-Debris	216A_ILAW_C-4	218-E-LLW	Rpe-s	*2008*	Rp-dn	*2035*
Burial Grounc	574600.00	135400.00								10000.000		4	Reactor Block/Soil-Debris	216A_ILAW_C-	218-E-Cores	Rpe-s	*2065*	Rp-dn	*2065*
Single-Shell Tanl	575322.38	136043.30			polygon			15.24	22.9	*410.433*		2	Liquid/Salt Cake	241A-2	241-A-101	Rpe-s	1956	G-dn	1980
Single-Shell Tanl	575353.50	136043.38			polygon			15.24	22.9	*410.433*		2	Liquid/Salt Cake	241A-2	241-A-102	Rpe-s	1956	G-dn	1980
Single-Shell Tanl	575384.56	136043.47			polygon			15.24	22.9	*410.433*		2	Liquid/Salt Cake	241A-2	241-A-103	Rpe-s	1956	G-dn	1980
Single-Shell Tanl	575322.31	136074.38			polygon			15.24	22.9	*410.433*		2	Liquid/Salt Cake	241A-2	241-A-104	Rpe-s	1958	G-dn	1975
Single-Shell Tanl	575353.38	136074.45			polygon			15.24	22.9	*410.433*		2	Liquid/Salt Cake	241A-2	241-A-105	Rpe-s	1962	G-dn	*2024*
Single-Shell Tanl	575384.50	136074.55			polygon			15.24	22.9	*410.433*		2	Liquid/Salt Cake	241A-2	241-A-106	Rpe-s	1957	G-dn	1980
Process Unit/Plant	575424.80	136030.79			Polygon	6.10	4.88			29.729	Equipment	2	Cement/Liquid	200A-2	241-A-431	Rpe-s	1955	ABC	1969
Double-Shell Tank	575412.25	136389.28			polygon			16.764	22.9	*410.433*	Non-complexed waste from PUREX, dilute non-complexed waste, low-level waste from B Plant, decontamination waste from N Reactor, and dilute non-complexed salt well waste	2	Salt Cake	241A-2	241-AN-101	Rpe-s	1981	G-dn	*2024*
Double-Shell Tank	575379.63	136389.19			polygon			16.764	22.9	*410.433*	Non-complexed waste from Tank 241-SY-102, complexant concentrate waste, low-level waste from PUREX, complexant concentrate waste from Tank 241-AW-101	3	Salt Cake	241A-3	241-AN-102	Rpe-s	1981	G-dn	*2024*
Double-Shell Tank	575347.00	136389.06			polygon			16.764	22.9	*410.433*	Non-complexed waste from Tank 241-SY-102, low-level waste from B Plant and dilute non-complexed waste from the 200-East Area single shell tanks, double-shell slurry feed waste	2	Salt Cake	241A-2	241-AN-103	Rpe-s	1981	G-dn	*2024*
Double-Shell Tank	575412.13	136421.86			polygon			16.764	22.9	*410.433*	Non-complexed waste, double-shell slurry feed waste, low-level waste from PUREX.	2	Salt Cake	241A-2	241-AN-104	Rpe-s	1981	G-dn	*2024*
Double-Shell Tank	575379.56	136421.77			polygon			16.764	22.9	*410.433*	Non-complexed waste, double-shell slurry feed waste	2	Salt Cake	241A-2	241-AN-105	Rpe-s	1981	G-dn	*2024*
Double-Shell Tank	575346.94	136421.67			polygon			16.764	22.9	*410.433*	Non-complexed waste, concentrated customer waste, Hanford facility waste, phosphate waste	2	Salt Cake	241A-2	241-AN-106	Rpe-s	1981	G-dn	*2024*
Double-Shell Tank	575346.81	136454.28			polygon			16.764	22.9	*410.433*	Non-complexed waste, complexant concentrate waste.	3	Salt Cake	241A-3	241-AN-107	Rpe-s	1981	G-dn	*2024*
Double-Shell Tank	575537.38	135879.66			polygon			16.764	22.9	*410.433*	Non-complexed waste, dilute non-complexed waste	2	Salt Cake	241A-2	241-AP-101	Rpe-s	1986	G-dn	*2024*
Double-Shell Tank	575577.63	135879.77			polygon			16.764	22.9	*410.433*	Hanford facility waste, waste from PUREX, dilute non-complexed waste	2	Salt Cake	241A-2	241-AP-102	Rpe-s	1986	G-dn	*2024*
Double-Shell Tank	575537.50	135847.05			polygon			16.764	22.9	*410.433*	Non-complexed waste, waste from PUREX, dilute non-complexed waste	2	Salt Cake	241A-2	241-AP-103	Rpe-s	1986	G-dn	*2024*
Double-Shell Tank	575577.69	135847.16			polygon			16.764	22.9	*410.433*	Hanford Facility waste, decontamination waste from N Reactor, dilute non-complexed waste	2	Salt Cake	241A-2	241-AP-104	Rpe-s	1986	G-dn	*2024*
Double-Shell Tank	575537.63	135796.45			polygon			16.764	22.9	*410.433*	Non-complexed waste, double-shell slurry feed waste.	2	Salt Cake	241A-2	241-AP-105	Rpe-s	1986	G-dn	*2024*
Double-Shell Tank	575577.88	135796.58			polygon			16.764	22.9	*410.433*	Hanford Facility waste, non-complexed waste, dilute non-complexed waste.	2	Salt Cake	241A-2	241-AP-106	Rpe-s	1986	G-dn	*2024*
Double-Shell Tank	575537.75	135763.84			polygon			16.764	22.9	*410.433*	Double-shell slurry feed waste, non-complexed waste, waste form PUREX, dilute non-complexed wast	2	Salt Cake	241A-2	241-AP-107	Rpe-s	1986	G-dn	*2024*
Double-Shell Tank	575577.94	135763.97			polygon			16.764	22.9	*410.433*	Dilute non-complexed waste	2	Salt Cake	241A-2	241-AP-108	Rpe-s	1986	G-dn	*2024*

	S	C	C	N C	O S	G	L	W	D	D	A	W	W	R	V	S	P	O	O	O	C		C	C		C
	Double-Shell Tanl	575371.38	135858.16			polygon			16.764	22.9	*410.433*		2	Salt Cake	241A-2	241-AW-104	Rpe-s	1980	G-dn	*2024*						
	Double-Shell Tanl	575338.88	135825.45			polygon			16.764	22.9	*410.433*		2	Salt Cake	241A-2	241-AW-105	Rpe-s	1980	G-dn	*2024*						
	Double-Shell Tanl	575371.50	135825.55			polygon			16.764	22.9	*410.433*		2	Salt Cake	241A-2	241-AW-106	Rpe-s	1980	G-dn	*2024*						
	Single-Shell Tank	575422.19	136203.86			polygon			15.24	22.9	*410.433*	Double shell slurry feed is waste concentrated just before reacting the sodium aluminate saturatior	2	Liquid/Salt Cake	241A-2	241-AX-101	Rpe-s	1965	G-dn	1980						
	Single-Shell Tank	575422.31	136172.78			polygon			15.24	22.9	*410.433*	Concentrated complexant from the evaporation of dilute complexed waste	3	Liquid/Salt Cake	241A-3	241-AX-102	Rpe-s	1966	G-dn	1980						
	Single-Shell Tank	575394.75	136203.78			polygon			15.24	22.9	*410.433*	Concentrated complexant from the evaporation of dilute complexed waste	3	Liquid/Salt Cake	241A-3	241-AX-103	Rpe-s	1965	G-dn	1980						
	Single-Shell Tanl	575394.88	136172.70			polygon			15.24	22.9	*410.433*	Non-complexed waste	2	Liquid/Salt Cake	241A-2	241-AX-104	Rpe-s	1966	G-dn	1976						
	Double-Shell Tank	575312.19	136204.31			polygon			16.764	22.9	*410.433*	Dilute complexed waste - including organic complexants: ethylenediaminetetra-acetic acid, citric acid, and hydroxyethyl-ethylenediaminetriacetic aci	3	Salt Cake	241A-3	241-AY-101	Rpe-s	1971	G-dn	*2024*						
	Double-Shell Tank	575312.31	136171.70			polygon			16.764	22.9	*410.433*	Neutralized high-level waste and double-shell slurry fee	2	Salt Cake	241A-2	241-AY-102	Rpe-s	1972	G-dn	*2024*						
	Double-Shell Tank	575412.44	136310.17			polygon			16.764	22.9	*410.433*	Complexed waste, double-shell slurry feed waste, non-complexed waste, water, evaporator waste, residual liquor, and complexant concentrate waste	3	Salt Cake	241A-3	241-AZ-101	Rpe-s	1976	G-dn	*2024*						
	Double-Shell Tank	575379.81	136310.09			polygon			16.764	22.9	*410.433*	Waste from PUREX, non-complexed waste, complexant concentrate waste, complexed waste, residual liquor waste	3	Salt Cake	241A-3	241-AZ-102	Rpe-s	1976	G-dn	*2024*						
	Single-Shell Tank	575161.44	136504.28			polygon			11.7348	22.9	*410.433*	Bismuth phosphate metal waste, tributyl phosphate waste, and PUREX coating waste.	2	Liquid/Salt Cake	241A-2	241-C-101	Rpe-s	1946	G-dn	1970						
	Single-Shell Tank	575182.94	136525.89			polygon			9.525	22.9	*410.433*	Bismuth phosphate metal waste, tributyl phosphate waste, PUREX coating waste, high-level waste, PUREX organic wash waste, supernatant containing organic wash wastes and coating wastes	2	Liquid/Salt Cake	241A-2	241-C-102	Rpe-s	1946	G-dn	1976						
	Single-Shell Tank	575204.44	136547.50			polygon			11.7348	22.9	*410.433*	PUREX coating waste, tributyl phosphate waste, coating waste, PUREX high-level waste, B Plant high-level waste, B Plant waste fractionization low-level waste, PUREX sludge supernatant, PUREX low-level waste, waste fractionization PUREX sludge, PUREX organ	2	Liquid/Salt Cake	241A-2	241-C-103	Rpe-s	1946	G-dn	1979						
	Single-Shell Tank	575139.81	136525.77			polygon			11.7348	22.9	*410.433*	Metal waste, strontium-leached sluicing solids, and fissile material (including uranium-223) from PUREX thorium campaigns	2	Liquid/Salt Cake	241A-2	241-C-104	Rpe-s	1946	G-dn	1980						
	Single-Shell Tank	575161.31	136547.38			polygon			11.7348	22.9	*410.433*	PUREX sludge supernatant enroute to B Plant, and metal waste	2	Liquid/Salt Cake	241A-2	241-C-105	Rpe-s	1946	G-dn	1979						
	Single-Shell Tank	575182.81	136568.98			polygon			11.7348	22.9	*410.433*	Metal waste, and PUREX Plant fission product waste	2	Liquid/Salt Cake	241A-2	241-C-106	Rpe-s	1947	G-dn	1979						
	Single-Shell Tank	575118.25	136547.25			polygon			11.7348	22.9	*410.433*	Bismuth Phosphate First Cycle Waste, insoluble strontium leached, sluicing solids.	2	Liquid/Salt Cake	241A-2	241-C-107	Rpe-s	1946	G-dn	1978						
	Single-Shell Tank	575139.69	136568.86			polygon			11.7348	22.9	*410.433*	Used as a primary settling tank for "In-Farm Scavenged Uranium". On the ferrocyanide watch list	3	Liquid/Salt Cake	241A-3	241-C-108	Rpe-s	1947	G-dn	1977						
	Single-Shell Tank	575161.19	136590.47			polygon			11.7348	22.9	*410.433*	Used as a primary settling tank for "In-Farm Scavenged Uranium".On the ferrocyanide watch list	3	Liquid/Salt Cake	241A-3	241-C-109	Rpe-s	1948	G-dn	1978						
	Single-Shell Tank	575096.63	136568.73			polygon			11.7348	22.9	*410.433*	Bismuth phosphate first cycle waste and B Plant decontamination waste. Used as a primary settling tank for "In-Farm Scavenged Uranium".	3	Liquid/Salt Cake	241A-3	241-C-110	Rpe-s	1946	G-dn	1976						
	Single-Shell Tank	575118.13	136590.34			polygon			11.7348	22.9	*410.433*	Bismuth phosphate first cycle waste and B Plant decontamination waste.	3	Liquid/Salt Cake	241A-3	241-C-111	Rpe-s	1946	G-dn	1978						

S	C	C	N	O	G	L	W	D	D	A	W	W	R	V	S	P	O	O	O
Single-Shell Tank	575139.63	136611.95			polygon			11.7348	22.9	410.433	Bismuth phosphate first cycle waste and B Plant decontamination waste. Used as a primary settling tank for "In-Farm Scavenged Uranium".	3	Liquid/Salt Cake	241A-3	241-C-112	Rpe-s	1946	G-dn	1976
Single-Shell Tanl	575188.13	136606.70			polygon			11.545824	6.1	29.186	Receiving metal waste	2	Liquid/Salt Cake	241A-2	241-C-201	Rpe-s	1947	G-dn	1977
Single-Shell Tanl	575177.31	136617.45			polygon			11.545824	6.1	29.186	Receiving metal waste	2	Liquid/Salt Cake	241A-2	241-C-202	Rpe-s	1947	G-dn	1977
Single-Shell Tanl	575166.50	136628.20			polygon			11.545824	6.1	29.186	Receiving metal waste	2	Liquid/Salt Cake	241A-2	241-C-203	Rpe-s	1947	G-dn	1976
Single-Shell Tanl	575155.69	136638.94			polygon			11.548872	6.1	29.186	Receiving metal waste	2	Liquid/Salt Cake	241A-2	241-C-204	Rpe-s	1948	G-dn	1977
Process Unit/Plant	575229.55	136571.17			Polygon	9.75	7.92	7.62		77.295	Process Effluent	4	Liquid/Cement	200A-4	241-C-801	Rpe-s	1962	ABC	1976
French Drair	574572.88	136394.56			point					0.999		4	Liquid	216A-4	2704-C-WS-1	Rpe-s	1958	Rp-dn	1998
Process Unit/Plant	########	########			line	62.0	3.0			186.000		4	Cement	**200A-4**	291-C	**Rpe-s**	1949	**ABC**	1987
Stack	576400.00	135600.00			point				4.3	14.522		4	Atmosphere	200A-4	291-WTP	Rpe-s	2010	ABC	2035
Stack	575230.00	136100.00								13.000		4	Soil-Debris	200A-4	296-A-13	Rpe-s	1955	Rp-dn	1988
Injection/Reverse Wel	574830.13	135418.84			point			18.3	0.2	0.018		4	Liquid	266A-4	299-E24-111	Rpe-s	1980	Rp-dn	1981
Process Unit/Plant	575778.82	135834.13			polygon					99.900	Process Effluent	4	Cement/Liquid/Soil	200A-4	GTF	Rpe-s	1969	Rp-dn	1969
Burial Grounc	576440.19	135888.02			polygon	38.1	15.2	10.4		580.644		4	Soil-Debris/Cement	216A-4	GTFL	Rpe-s	1986	Rp-dn	1991
Process Unit/Plant	572854.06	136354.66			point					99.900		4	Cement	200A-4	HWVP	Rpe-s	1969	Rp-dn	1969
Unplanned Release	575196.38	135977.20			point					0.999	Soil	4	Soil-Debris	200A-4	UPR-200-E-10	Rpe-s	1969	Rp-dn	1969
Unplanned Release	575101.69	136557.81			point					0.999		4	Liquid	200A-4	UPR-200-E-107	Rpe-s	1952	G-dn	1952
Unplanned Release	575200.69	135584.84			point					0.999		4	Liquid	200A-4	UPR-200-E-114	Rpe-s	1952	Rp-dn	1954
Unplanned Release	575414.63	136173.56			point					0.999		2	Liquid	200A-2	UPR-200-E-115	Rpe-s	1974	Rp-dn	1974
Unplanned Release	575241.56	135518.59			point					0.999		4	Liquid	200A-4	UPR-200-E-117	Rpe-s	1972	Rp-dn	1972
Unplanned Release	575401.88	136167.75			point					0.999	Process Effluent	2	Soil-Debris/Liquid	200A-2	UPR-200-E-119	Rpe-s	1969	Rp-dn	1969
Unplanned Release	575185.00	135993.50			point					0.999	Water	4	Liquid	200A-4	UPR-200-E-12	Rpe-s	1957	Rp-dn	1957
Unplanned Release	574440.88	136294.16			point					0.999		4	Liquid	200A-4	UPR-200-E-141	Rpe-s	1984	Rp-dn	1984
Unplanned Release	575491.00	136125.00			line	12.2	1.8			22.297		4	Liquid	200A-4	UPR-200-E-145	Rpe-s	1993	Rp-dn	1993
Unplanned Release	575093.06	135778.17			point					0.999	Process Effluent	4	Liquid	200A-4	UPR-200-E-17	Rpe-s	1959	Rp-dn	1959
Unplanned Release	575568.50	135640.06			point					0.999		4	Liquid	200A-4	UPR-200-E-21	Rpe-s	1959	Rp-dn	1959
Unplanned Release	575202.94	135599.42			point					0.999		2	Liquid	200A-2	UPR-200-E-26	Rpe-s	1960	Rp-dn	1960
Unplanned Release	575568.50	135640.06			point					0.999	Process Effluent	4	Liquid	200A-4	UPR-200-E-29	Rpe-s	1961	Rp-dn	1961
Unplanned Release	575129.50	136053.91			point					0.999	Chemicals	4	Liquid	200A-4	UPR-200-E-33	Rpe-s	1964	Rp-dn	1964
Unplanned Release	574530.00	136421.16			point	274.3	137.2			37625.732	Process Effluent	4	Liquid	200A-4	UPR-200-E-36	Rpe-s	1967	Rp-dn	1967
Unplanned Release	575247.25	135610.08			point	7.9	7.9			60.387		4	Liquid	200A-4	UPR-200-E-39	Rpe-s	1968	Rp-dn	1968
Unplanned Release	575246.94	135608.09			point					4.645		4	Liquid	200A-4	UPR-200-E-40	Rpe-s	1968	Rp-dn	1968
Unplanned Release	575267.88	135955.77			point					0.999		2	Liquid	200A-2	UPR-200-E-42	Rpe-s	1972	Rp-dn	1972
Unplanned Release	575699.31	136431.48			polygon	30.5	30.5			929.030	Process Effluent	2	Liquid	200A-2	UPR-200-E-56	Rpe-s	1979	Rp-dn	1979
Unplanned Release	575121.25	136467.73			point	12.2	1.8			22.297		2	Liquid	200A-2	UPR-200-E-81	Rpe-s	1969	Rp-dn	1969
Unplanned Release	575032.63	136543.67			point					0.999		2	Liquid	200A-2	UPR-200-E-82	Rpe-s	1969	Rp-dn	1969
Unplanned Release	575034.25	136505.58			point	6.1	6.1	6.1		37.161		2	Liquid	200A-2	UPR-200-E-86	Rpe-s	1971	Rp-dn	1971
Unplanned Release	575223.69	136368.94			point					0.999	Soil	2	Soil-Debris	200A-2	UPR-200-E-99	Rpe-s	1969	Rp-dn	1969
Process Unit/Plant	575088.69	135746.95			point	3.66	3.05	2.44		11.148		4	Cement/Liquic	200A-4	205-A	Rpe-s	1956	ABC	1976
Unplanned Release	577060.44	134662.27			polygon					0.999	Uranium nitrate hexahydrate solution	4	Liquid	200A-4	UPR-600-12	Rpe-s	1954	Rp-dn	1954
Burial Grounc	572200.00	134320.00								409300.000		4	Soil-Debris	216A-4	US_Ecology	Rpe-s	1965	Rp-dn	2050
Unplanned Release	570082.88	136496.39			Point					9.990	Chemical Release	4	Liquid	200T-4	600-256	Rpe-s	1995	Rp-dn	1995
Burial Ground	########	########								*211676.580*		4	*Soil-Debris/Cement*	*216T-4*	*CS-Resin*	*Rp-s*	*2010*	*Rp-dn*	*2035*
Storage	########	########								*100000.000*		4	*Soil-Debris/Glass*	*200A-4*	*HLW-store*	*Rpe-s*	*2010*	*Rp-dn*	*2035*
Burial Ground	########	########								*211676.580*		4	*Soil-Debris/Cement*	*216T-4*	*ILAW-HLW-solid*	*Rp-s*	*2010*	*Rp-dn*	*2035*
Retention Basin	########	########								*2155.351*		4	*Liquid*	*200T-4*	*ILAW-liquid*	*Rp-s*	*2010*	*Rp-dn*	*2035*
Burial Ground	########	########								*211676.580*		4	*Soil-Debris/Cement*	*216T-4*	*TC-Resin*	*Rp-s*	*2010*	*Rp-dn*	*2035*
Process Unit/Plant	575814.71	137537.73			polygon					99.900		4	Cement	200B-4	200_ETF	Ba-s	1995	Ba-dn	1995
French Drain	573714.00	136369.00						0.3	0.6	0.292	Steam Condensate	4	Liquid	200B-4	200-E-100	Rpe-s	1945	Rp-dn	1998
Unplanned Release	573560.58	136366.12				3.05	3.05			9.303		4	Soil-Debris	200B-4	200-E-117	Rpe-s	1969	Rp-dn	1969
Unplanned Release	573751.71	137592.63				200	24.38			4876.000		4	Soil-Debris	200B-4	200-E-121	El-s	1969	El-dn	1969
Storage	573551.63	136317.22				44	20			880.000		4	Soil-Debris	200B-4	200-E-122	Rpe-s	1969	Rp-dn	1969
Unplanned Release	########	########				7.1	4.5			31.950		4	Soil-Debris	200B-4	200-E-123	Ba-s	1969	Ba-dn	1969
Radioactive Process Sewer	575095.51	136952.84				4836	1			4836.000		4	Liquid	216B-4	200-E-126	Ba-s	1945	Ba-dn	1995
Radioactive Process Sewer	575535.49	138462.92				3804	1			3804.000		4	Liquid	216B-4	200-E-127	Ba-s	1969	Ba-dn	1969
Unplanned Release	574077.56	137018.16							0.15	0.018		4	Soil-Debris	200B-4	200-E-128	Ba-s	1969	Ba-dn	1969
Unplanned Release	573638.29	136770.90				6.1	3.66			22.326		4	Soil-Debris	200B-4	200-E-129	Rpe-s	1969	Rp-dn	1969
Unplanned Release	573521.51	136667.80			polygon					0.999		4	Soil-Debris	200B-4	200-E-130	Rpe-s	1969	G-dn	1969
Stack	########	########			point			61	4.3	14.522		4	Soil-Debris	200B-4	200-E-137	El-s	1944	ABC	1998

Sand Filter	573630.38	136389.02			polygon	33.5	15.2	4.9		*510.967*		4	Liquid/Soil-Debris	216B-4	200-E-30	El-s	1948	El-dn	1997
French Drain	573650	136388			Polygon			0.9144	1.8288	2.627		4	Liquid	200B-4	200-E-55	Rpe-s	*1969*	Rp-dn	*1969*
Storage Tank	573569.38	137517.95			point	12.8			0.30	0.071		4	Liquid	200B-4	200-E-60	El-s	1977	G-dn	1977
Injection/Reverse Well	573643.00	136368.00			point					*0.999*	Steam Condensate	4	Liquid	216B-4	200-E-88	Rpe-s	1945	Rpe-dn	1997
Injection/Reverse Well	573557.00	136368.00			point				0.9	0.636	Steam Condensate	4	Liquid	216B-4	200-E-89	Rpe-s	1945	Rpe-dn	1997
Injection/Reverse Well	573412.00	136368.00			point				1.0	0.785	Steam Condensate	4	Liquid	216B-4	200-E-90	Rpe-s	1945	Rpe-dn	1997
Injection/Reverse Well	573358.38	136368.30			point				0.6	0.283	Steam Condensate	4	Liquid	216B-4	200-E-91	Rpe-s	1945	Rpe-dn	1997
Injection/Reverse Well	573330.19	136401.39			point				0.8	0.442	Steam Condensate	4	Liquid	216B-4	200-E-92	Rpe-s	1945	Rpe-dn	1997
Injection/Reverse Well	573556.50	136375.53			point				0.9	0.636	Steam Condensate	4	Liquid	216B-4	200-E-93	Rpe-s	1945	Rpe-dn	1997
Injection/Reverse Well	573277.50	136377.50			point					*0.999*	Steam Condensate	4	Liquid	216B-4	200-E-94	Rpe-s	1945	Rpe-dn	1997
French Drain	573433.30	136280.10			polygon				0.4	0.126	Steam Condensate	4	Liquid	216B-4	200-E-95	Rpe-s	1945	Rpe-dn	1997
French Drain	573388.70	136446.23			polygon				0.4	0.126	Steam Condensate	4	Liquid	216B-4	200-E-97	Rpe-s	1945	Rpe-dn	1997
French Drain	573467.20	136477.60			polygon					*0.999*	Water	4	Liquid	216B-4	200-E-98	Rpe-s	1945	Rpe-dn	1997
French Drain	573715.00	136369.00			polygon					*0.999*	Steam Condensate	4	Liquid	200B-4	200-E-99	Rpe-s	1945	Rpe-dn	1998
Retention Basir	573876.81	137079.11			polygon	75.0	37.5	2.0		2811.060		4	Liquid	200B-4	207-B	El-s	1945	El-dn	1997
Crib	573473.44	136339.66			point	4.3	4.3			809.371		4	Liquid	216B-4	216-B-10A	El-s	1949	El-dn	1952
Crib	573450.56	136339.58			point	4.3	4.3			*18.209*		4	Liquid	216B-4	216-B-10B	El-s	1949	El-dn	1973
French Drain	573851.00	137419.30			point	9.1			2.4	*4.670*	Low in salt and neutral to basic.	4	Liquid	216B-4	216-B-11A%B	El-s	1951	El-dn	1954
Crib	573128.00	136600.14			polygon	48.8	15.2			743.224		4	Liquid	216B-4	216-B-12	El-s	1952	El-dn	1973
French Drair	573571.50	136392.30			point			5.5	1.2	*1.167*		4	Liquid	216B-4	216-B-13	El-s	1945	El-dn	1976
Ditch	574584.40	137061.50			line	1066.8	4.6			4877.410		4	Liquid	200B-4	216-B-2-1	El-s	1945	El-dn	1963
Ditch	574416.80	137088.90			line	1097.3	4.6			5016.764		4	Liquid	200B-4	216-B-2-2	El-s	1963	El-dn	1970
Ditch	574515.80	137011.90			line	1219.2	6.1			7432.243		4	Liquid	200B-4	216-B-2-3	El-s	1970	El-dn	1987
Trench	573441.10	137274.20			line	76.8	3.0			*234.116*		2	Liquid	216B-2	216-B-35	El-s	1954	El-dn	1954
Trench	573441.10	137289.50			line	76.8	3.0			*234.116*		2	Liquid	216B-2	216-B-36	El-s	1954	El-dn	1954
Trench	573441.10	137316.90			line	76.8	3.0			*234.116*		2	Liquid	216B-2	216-B-37	El-s	1954	El-dn	1954
Trench	573441.10	137344.30			line	76.8	3.0			*234.116*		2	Liquid	216B-2	216-B-38	El-s	1954	El-dn	1954
Trench	573441.10	137377.80			line	76.8	3.0			*234.116*		2	Liquid	216B-2	216-B-39	El-s	1953	El-dn	1954
Injection/Reverse Wel	573554.06	136391.08			point	33.5		33.0	0.2	*0.033*		4	Liquid	266B-4	216-B-4	El-s	1945	El-dn	1949
Trench	573440.00	137403.00			line	76.8	3.0			*234.116*		2	Liquid	216B-2	216-B-40	El-s	1954	El-dn	1954
Trench	573440.00	137430.00			line	76.8	3.0			*234.116*		2	Liquid	216B-2	216-B-41	El-s	1954	El-dn	1954
Trench	573345.00	137060.00			line	76.8	3.0			*234.116*		2	Liquid	216B-2	216-B-42	El-s	1955	El-dn	1955
Crib	573624.94	137614.02			point	22.9	22.9	4.3		*522.580*		3	Liquid	216B-3	216-B-43	El-s	1954	El-dn	1954
Crib	573624.88	137639.92			point	22.9	22.9	4.3		*522.580*		3	Liquid	216B-3	216-B-44	El-s	1954	El-dn	1955
Crib	573624.81	137665.83			point	22.9	22.9	4.3		*522.580*		3	Liquid	216B-3	216-B-45	El-s	1955	El-dn	1955
Crib	573624.75	137691.64			point	22.9	22.9	4.3		*522.580*		3	Liquid	216B-3	216-B-46	El-s	1955	El-dn	1955
Crib	573582.31	137613.89			point	22.9	22.9	4.3		*522.580*		3	Liquid	216B-3	216-B-47	El-s	1955	El-dn	1955
Crib	573582.19	137639.80			point	22.9	22.9	4.3		*522.580*		3	Liquid	216B-3	216-B-48	El-s	1955	El-dn	1955
Crib	573582.19	137665.63			point	22.9	22.9	4.3		*522.580*		3	Liquid	216B-3	216-B-49	El-s	1955	El-dn	1955
Injection/Reverse Wel	573781.06	136732.14			point	92.0		92.0	0.2	*0.033*		2	Liquid	267B-2	216-B-5	El-s	1945	El-dn	1947
Crib	573582.13	137691.50			point	22.9	22.9	4.3		*522.580*		4	Liquid	216B-4	216-B-50	El-s	1965	El-dn	1974
French Drain	573866.31	137611.94			point			4.3	1.5	*1.824*	High salt, neutral to basic scavenged tributyl phosphate waste	3	Liquid	216B-3	216-B-51	El-s	1956	El-dn	1958
Crib	573091.50	136495.38			polygon	228.6	3.0			*696.773*		3	Liquid	216B-3	216-B-55	El-s	1967	El-dn	1991
Crib	573498.50	137578.55			polygon	105.0	64.0	15		*6720.000*	Waste storage tank condensate from the In Tank Solidification (ITS) #2 Unit	4	Liquid	216B-4	216-B-57	El-s	1968	El-dn	1973
Trench	573833.00	136617.61			polygon	121.9	6.1	3.7		*743.224*		4	Liquid	216B-4	216-B-59	El-s	1967	El-dn	1974
Retention Basir	573828.00	136645.86			polygon	40.0	30.0	3.0		*1200.000*		4	Liquid	216B-4	216-B-59B	El-s	1974	El-dn	1997
Injection/Reverse Wel	573472.63	136403.03			point	48.8		23.0	0.2	*0.018*		4	Liquid	266B-4	216-B-6	El-s	1945	El-dn	1949
Crib	573380.00	136480.00			line	4.9		12.2	2.4	*4.670*		4	Liquid	216B-4	216-B-60	El-s	1967	El-dn	1967
Crib	573074.88	136814.70			polygon	152.4	3.0			*464.515*		4	Liquid	216B-4	216-B-62	El-s	1973	El-dn	1991

Ditch	574235.00	137190.00	7	(573934.599,137130.037), (573987.626,137040.299), (574148.745,137138.194), (574825.853,136909.773), (574870.721,137066.813), (574128.350,137285.037), (573934.599,137130.037)	line	426.7	1.2			520.257		4	Liquid	216B-4	216-B-63	El-s	1970	El-dn	1992
Crib	573799.00	137392.94			point	3.7	3.7	1.2		13.378		2	Liquid	216B-2	216-B-7A%B	El-s	1946	El-dn	1967
Crib	573807.88	137504.94			polygon	3.7	3.7	2.1		13.378		2	Liquid	216B-2	216-B-8	El-s	1948	El-dn	1953
Crib	573852.25	136850.03			polygon	59.1	19.5			1618.743		2	Liquid	216B-2	216-B-9	El-s	1948	El-dn	1951
Settling Tank	573608.00	137594.50			polygon	12.6	1.9	2.8		24.305	Radioactive waste from the 241-BY Tank Farm and the TBP Waste Line; includes nitrate, sodium, aluminum, carbonate and hydroxide	2	Liquid	216B-2	216-BY-201	El-s	1950	El-dn	1977
Burial Grounc	572944.81	137267.61			polygon	716.3	617.2	4.9		442102.342		4	Soil-Debris	216B-4	218-E-10	El-s	1960	El-dn	2018
Burial Grounc	574938.06	136803.19			polygon	362.1	12.2			4414.753		4	Soil-Debris	216B-4	218-E-12A	El-s	1953	El-dn	1967
Burial Grounc	574796.31	137446.50			polygon	1258.8	698.0	4.9		878649.081		4	Soil Debris/RXCOMP	216B-4	218-E-12B	El-s	1967	El-dn	2018
Burial Grounc	573510.50	137077.88			polygon	164.9	134.4			22164.901		4	Soil-Debris	216B-4	218-E-2	El-s	1945	El-dn	1953
Burial Grounc	573544.63	136989.91			polygon	97.5	14.0			1367.533		4	Soil-Debris	216B-4	218-E-2A	El-s	1945	El-dn	1950
Burial Grounc	573497.00	136890.73			polygon	237.7	61.0			14492.875		4	Soil-Debris	216B-4	218-E-4	El-s	1955	El-dn	1956
Burial Grounc	573417.13	137079.63			polygon	102.0	63.1			6432.746		4	Soil-Debris	216B-4	218-E-5	El-s	1954	El-dn	1956
Burial Grounc	573355.94	137087.56			polygon	36.6	30.5			1114.837		4	Soil-Debris	216B-4	218-E-5A	El-s	1956	El-dn	1959
Burial Grounc	573500.44	136362.23			point					27.000		4	Soil-Debris	216B-4	218-E-7	El-s	1945	El-dn	1952
Burial Grounc	575115.75	137224.70			polygon	121.9	35.1			4273.540		4	Soil-Debris	216B-4	218-E-8	El-s	1958	El-dn	1959
Burial Grounc	573584.25	137078.23			polygon	130.1	30.5			3966.960		4	Soil-Debris	216B-4	218-E-9	El-s	1953	El-dn	1958
Process Unit/Plant	573270.00	136630.00								5590.000		4	Cement	200B-4	221-B	El-s	1945	ABC	1985
Settling Tank	573581.88	136464.95			point			4.3	2.4	4.670		4	Liquid	216B-4	221-B_SDT	El-s	1945	El-dn	1985
Storage	573604.25	136464.91			point	5.39	3.96	6.71		21.377		4	Soil-Debris	200B-4	221-B-WS-2	Rp-s	1945	ABC	1945
Process Unit/Plant	573411.44	136393.42			polygon	60.0	18.3	21.3		1098.114		4	Cement	200B-4	224-B	El-s	1945	ABC	1976
Single-Shell Tanl	573871.94	137268.00			polygon			9.0678	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-B-101	El-s	1945	G-dn	1974
Single-Shell Tanl	573871.81	137298.48			polygon			9	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-B-102	El-s	1945	G-dn	1978
Single-Shell Tanl	573871.75	137328.95			polygon			9	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-B-103	El-s	1945	G-dn	1977
Single-Shell Tanl	573841.44	137267.94			polygon			9	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-B-104	El-s	1946	G-dn	1972
Single-Shell Tanl	573841.38	137298.39			polygon			9	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-B-105	El-s	1947	G-dn	1972
Single-Shell Tanl	573841.31	137328.86			polygon			9	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-B-106	El-s	1947	G-dn	1977
Single-Shell Tanl	573811.00	137267.84			polygon			9	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-B-107	El-s	1945	G-dn	1969
Single-Shell Tanl	573810.88	137298.33			polygon			9	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-B-108	El-s	1945	G-dn	1977
Single-Shell Tanl	573810.81	137328.78			polygon			9	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-B-109	El-s	1946	G-dn	1977
Single-Shell Tanl	573780.50	137267.75			polygon			9	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-B-110	El-s	1945	G-dn	1971
Single-Shell Tanl	573780.44	137298.23			polygon			9	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-B-111	El-s	1945	G-dn	1976
Single-Shell Tanl	573780.31	137328.72			polygon			9	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-B-112	El-s	1946	G-dn	1977
Single-Shell Tanl	573818.44	137359.42			polygon			11.5	6.1	29.186		2	Liquid/Salt Cake	241B-2	241-B-201	El-s	1952	G-dn	1971
Single-Shell Tanl	573803.06	137359.42			polygon			11.5	6.1	29.186		2	Liquid/Salt Cake	241B-2	241-B-202	El-s	1951	G-dn	1977
Single-Shell Tanl	573787.88	137359.34			polygon			11.5	6.1	29.186		2	Liquid/Salt Cake	241B-2	241-B-203	El-s	1951	G-dn	1977
Single-Shell Tanl	573772.56	137359.42			polygon			11.5	6.1	29.186		2	Liquid/Salt Cake	241B-2	241-B-204	El-s	1951	G-dn	1977
Settling Tank	573770.44	136707.73			point	5.8			6.1	29.186		2	Liquid	241B-2	241-B-361	El-s	1945	G-dn	1947
Single-Shell Tanl	573659.25	137316.91			polygon			9.5	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BX-101	El-s	1948	G-dn	1975
Single-Shell Tanl	573659.13	137347.39			polygon			9.5	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BX-102	El-s	1948	G-dn	1971
Single-Shell Tanl	573659.06	137377.88			polygon			9.5	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BX-103	El-s	1948	G-dn	1977
Single-Shell Tanl	573628.75	137316.86			polygon			9.5	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BX-104	El-s	1949	G-dn	1980
Single-Shell Tanl	573628.69	137347.30			polygon			9.5	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BX-105	El-s	1949	G-dn	1980
Single-Shell Tanl	573628.56	137377.78			polygon			9.5	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BX-106	El-s	1949	G-dn	1977
Single-Shell Tanl	573598.31	137316.77			polygon			9.5	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BX-107	El-s	1948	G-dn	1977
Single-Shell Tanl	573598.19	137347.25			polygon			9.5	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BX-108	El-s	1949	G-dn	1974
Single-Shell Tanl	573598.13	137377.69			polygon			9.5	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BX-109	El-s	1950	G-dn	1974
Single-Shell Tanl	573567.81	137316.67			polygon			9.5	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BX-110	El-s	1949	G-dn	1977
Single-Shell Tanl	573567.75	137347.16			polygon			9.5	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BX-111	El-s	1950	G-dn	1977
Single-Shell Tanl	573567.63	137377.63			polygon			9.5	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BX-112	El-s	1950	G-dn	1977
Single-Shell Tanl	573659.69	137468.67			polygon			11.2776	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BY-101	El-s	1950	G-dn	1971
Single-Shell Tanl	573659.63	137499.77			polygon			11.2776	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BY-102	El-s	1950	G-dn	1977
Single-Shell Tanl	573659.56	137530.86			polygon			11.2776	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BY-103	El-s	1950	G-dn	1973
Single-Shell Tanl	573628.63	137468.61			polygon			11.2776	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BY-104	El-s	1950	G-dn	1977
Single-Shell Tanl	573628.56	137499.67			polygon			11.2776	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BY-105	El-s	1951	G-dn	1974
Single-Shell Tanl	573628.50	137530.77			polygon			11.2776	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BY-106	El-s	1953	G-dn	1977
Single-Shell Tanl	573597.56	137468.52			polygon			11.2776	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BY-107	El-s	1950	G-dn	1974
Single-Shell Tanl	573597.50	137499.58			polygon			11.2776	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BY-108	El-s	1951	G-dn	1972
Single-Shell Tanl	573597.38	137530.67			polygon			11.2776	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BY-109	El-s	1953	G-dn	1979
Single-Shell Tanl	573566.50	137468.42			polygon			11.2776	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BY-110	El-s	1951	G-dn	1977
Single-Shell Tanl	573566.38	137499.52			polygon			11.2776	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BY-111	El-s	1952	G-dn	1977
Single-Shell Tanl	573566.31	137530.58			polygon			11.2776	22.9	410.433		2	Liquid/Salt Cake	241B-2	241-BY-112	El-s	1951	G-dn	1976
Process Unit/Plant	573422.75	136465.22			point				0.8	0.493		4	Cement/Liquid/Soi	200B-4	B_PLANT_FILTE	El-s	1945	ABC	1985
Unplanned Releas	573499.94	136443.34			point					0.999		4	Liquid	200B-4	UPR-200-E-1	El-s	1946	El-dn	1946
Unplanned Releas	573605.25	137461.55			point					27.871		2	Liquid	200B-2	UPR-200-E-105	El-s	1952	El-dn	1952
Unplanned Releas	575144.94	137245.00			point					0.999	Chemicals	4	Soil-Debris	200B-4	UPR-200-E-106	El-s	1969	El-dn	1969
Unplanned Releas	573758.25	137256.25			point					0.999		4	Liquid	200B-4	UPR-200-E-108	El-s	1953	El-dn	1953
Unplanned Releas	573819.06	137309.78			point					27.871		2	Liquid	200B-2	UPR-200-E-109	El-s	1969	El-dn	1969
Unplanned Releas	573566.25	137519.02			point					0.999		2	Liquid	200B-2	UPR-200-E-110	El-s	1955	El-dn	1955
Unplanned Releas	573219.25	137005.14			Polygon,	15.2				0.999	Process Effluent	4	Liquid	200B-4	UPR-200-E-112	El-s	1969	El-dn	1969
Unplanned Releas	573597.56	137499.63			point					0.999		2	Liquid	200B-2	UPR-200-E-116	El-s	1955	El-dn	1955
Unplanned Releas	573597.94	137347.28			point					0.999		2	Liquid	200B-2	UPR-200-E-133	El-s	1955	El-dn	1955
Unplanned Releas	573535.44	136479.58			point					0.999	Chemicals	4	Soil-Debris	200B-4	UPR-200-E-140	El-s	1969	El-dn	1969
Unplanned Releas	573501.56	136446.05			point					0.999		2	Liquid	200B-2	UPR-200-E-3	El-s	1951	El-dn	1951

Unplanned Release	573371.94	136439.94			point	30.5	30.5			929.030	Chemicals	4	Soil-Debris	200B-4	UPR-200-E-55	El-s	1969	El-dn	1969
Unplanned Release	573765.94	137225.80			point					0.999	Process Effluent	2	Liquid	200B-2	UPR-200-E-6	El-s	1954	G-dn	1954
Unplanned Release	573682.44	136647.95			point					2.787		2	Liquid	200B-2	UPR-200-E-7	El-s	1954	El-dn	1954
Unplanned Release	573763.56	137188.27			point					0.999		2	Liquid	200B-2	UPR-200-E-73	El-s	1954	El-dn	1954
Unplanned Release	573750.19	137197.64			point					4.645	Process Effluent	2	Soil-Debris/Liquid	200B-2	UPR-200-E-74	El-s	1954	El-dn	1954
Unplanned Release	573765.94	137225.80			point	30.5	15.2			464.515	Process Effluent	2	Liquid	200B-2	UPR-200-E-75	El-s	1954	El-dn	1954
Unplanned Release	573798.63	136448.77			point					0.999		2	Liquid	200B-2	UPR-200-E-77	El-s	1946	El-dn	1946
Unplanned Release	573675.19	136951.19			point					18.000		2	Liquid	200B-2	UPR-200-E-78	El-s	1955	El-dn	1955
Unplanned Release	573857.50	137180.38			point	61.0	7.6			464.515		2	Liquid	200B-2	UPR-200-E-79	El-s	1953	El-dn	1953
Unplanned Release	573594.44	136441.86			point	152.4	30.5			4645.152		4	Liquid	200B-4	UPR-200-E-80	El-s	1946	El-dn	1946
Unplanned Release	573232.88	136266.20			point					0.999		2	Liquid	200B-2	UPR-200-E-84	El-s	1953	El-dn	1953
Unplanned Release	573488.25	136443.84			point	15.2	15.2	4.6		232.256		4	Liquid	200B-4	UPR-200-E-85	El-s	1972	El-dn	1972
Unplanned Release	573439.19	136379.17			point	4.5	4.6			20.555		4	Liquid	200B-4	UPR-200-E-87	El-s	1945	El-dn	1953
Unplanned Release	573608.25	137603.31			point					925.278		2	Liquid	200B-2	UPR-200-E-9	El-s	1955	El-dn	1955
Surface Impoundment	575845.36	137131.37			polygon	102.7176	69.1896			7106.990		4	Liquid	200E-4	200-E-17	Ba-s	1994	Ba-dn	1994
Pond	576898.69	136687.00	6	(576573.279,136897.929), (577146.946,136803.501), (577194.931,136563.456), (577135.474,136424.325), (576559.956,136677.447), (576573.279,136897.929)	polygon					161874.258		4	Liquid	200E-4	216-B-3	Ba-s	1945	Ba-dn	1994
Ditch	576130.00	136830.00			line	975.4	1.8			1783.738		4	Liquid	200E-4	216-B-3-1	Ba-s	1945	Ba-dn	1964
Ditch	576130.00	136660.00			line	1127.8	4.6	2.4		5156.119		4	Liquid	200E-4	216-B-3-2	Ba-s	1964	Ba-dn	1970
Ditch	575824.88	136691.31			polygon	1127.8			6.1	6879.656		4	Liquid	200E-4	216-B-3-3	Ba-s	1970	Ba-dn	1994
Pond	577255.75	136578.52	6	(577152.719,136803.501), (577348.999,136745.772), (577348.999,136347.439), (577143.097,136447.503), (577195.054,136562.962), (577152.719,136803.501)	polygon					40468.564		4	Liquid	200E-4	216-B-3A_RAD	Ba-s	1983	Ba-dn	1998
Pond	577486.94	136462.98	5	(577352.848,136580.281), (577599.160,136574.508), (577603.00,136343.590), (577352.848,136351.288), (577352.848,136580.281)	polygon					40468.564		4	Liquid	200E-4	216-B-3B_RAD	Ba-s	1983	Ba-dn	1985
Pond	577755.25	135957.48	5	(577579.917,136337.817), (577835.850,136337.817), (577972.477,135570.016), (577681.905,135564.243), (577579.917,136337.817)	polygon					165921.114		4	Liquid	200E-4	216-B-3C_RAD	Ba-s	1985	Ba-dn	1997
Surface Impoundment	576365.10	137417.77			polygon	121.92	60.96			7432.244	Water	4	Liquid	200E-4	600-214	Ba-s	1990	ABC	1990
Landfill (Lined	568866.06	134533.88			polygon	432.8	228.6			98941.738		4	Soil-Debris	216S-4	600-148	Rp-s	1996	Rp-dn	2014
Pond	567112.06	135927.22			polygon	182.9	15.2	6.1		2787.091		4	Liquid	200S-4	200-W-PP	Rp-s	1984	Rp-dn	1995
Storage	########	########								0.999		4	Soil-Debris	200S-4	200-W-104	Rp-s	1969	ABC	1969
Unplanned Release	567305.88	133933.69			polygon	12.2	2.4			29.729	Chemical Release	4	Soil-Debris	200S-4	200-W-15	Rp-s	1969	Rp-dn	1969
Unplanned Release	567287.94	134069.08				84.0	68.0			5712.000		4	Liquid	200S-4	200-W-22	Rp-s	1952	Rp-dn	1983
Radioactive Process	567616.20	134858.80			line	646.0	8.0			5168.000		4	Liquid	200S-4	200-W-42	Rp-s	1952	Rp-dn	1988
Sand Filter	567481.80	133973.40				26.0	26.0	4.0		676.000		4	Liquid/Soil-Debris	216S-4	200-W-43	Rp-s	1952	Rp-dn	1967
Sand Filter	567688.13	135206.73			polygon	29.3	29.3	6.7		856.194		4	Liquid/Soil-Debris	216S-4	200-W-44	Rp-s	1945	Rp-dn	1991
Laboratory	567419.14	133881.97				99.9	48.7			4865.590		4	Soil-Debris	200S-4	200-W-69	Rp-s	1951	ABC	2024
Unplanned Release	########	########			point					0.999		4	Liquid	200S-4	200-W-72	Rp-s	2000	ABC	2000
Storage	########	########								9.990		4	Soil and Liquid	200S-4	200-W-76	Rp-s	1951	ABC	1951

Unplanned Release	567478.27	135251.17			Polygon	36.58	9.14			334.451		*4*	Soil-Debris	200S-4	200-W-87	Rp-s	*1969*	Rp-dn	*1969*
Process Unit/Plant	567379.13	133972.78			polygon	142.3	49.1	25.0		*6985.101*		4	Cement	200S-4	202-S	Rp-s	1952	ABC	1967
Process Unit/Plant	567287.97	134069.07			Polygon	84.00	68.00			*5712.000*		4	Cement	200S-4	203-S_%_205-S	Rp-s	1953	ABC	1965
Retention Basin	566978.44	133891.94			polygon	39.6	39.6			1570.061		4	Liquid	200S-4	207-S	Rp-s	1951	Rp-dn	1954
Retention Basin	566973.25	135044.02			polygon	75.0	37.5	2.0		2832.800		4	Liquid	200S-4	207-U	Rp-s	1952	Rp-dn	1994
Retention Basin	566574.69	135522.58			polygon	15.2	12.2	3.0		*185.806*		4	Liquid	200S-4	207-Z	Rp-s	1949	Rp-dn	1959
Crib	566979.94	134260.22			polygon	27.4	12.2	10.7		*334.451*		4	Liquid	216S-4	216-S-1%2	Rp-s	1952	Rp-dn	1956
Ditch	566690.80	133566.16			line	685.8	1.8			1255.010		4	Liquid	200S-4	216-S-10D	Rp-s	1951	Rp-dn	1991
Pond	566402.75	133308.63			polygon					20234.282		4	Liquid	200S-4	216-S-10P	Rp-s	1952	Rp-dn	1984
Pond	566473.19	133269.56	7	(566461.594,133334.641), (566446.744,133160.691), (566532.447,133142.871), (566558.327,133197.602), (566547.720,133338.036), (566501.899,133350.339), (566461.594,133334.641)	polygon	152.4	61.0	3.0		6082.827		4	Liquid	200S-4	216-S-11	Rp-s	1954	Rp-dn	1965
Trench	567531.25	134120.33			point	27.4	6.1	3.0		*167.225*		4	Liquid	200S-4	216-S-12	Rp-s	1954	Rp-dn	1954
Crib	567154.81	134011.14			polygon	12.2	12.2	9.9		*148.645*		4	Liquid	216S-4	216-S-13	Rp-s	1952	Rp-dn	1972
Trench	567430.19	133541.11			polygon	30.5	2.4			*74.322*		4	Liquid	216S-4	216-S-14	Rp-s	1951	Rp-dn	1952
Pond	566909.50	134468.58			point	10.7	1.5	1.5		*16.258*		4	Liquid	200S-4	216-S-15	Rp-s	1951	Rp-dn	1952
Ditch	565674.00	133546.61			polygon	914.4	1.2			*1114.837*		4	Liquid	200S-4	216-S-16D	Rp-s	1957	Rp-dn	1975
Pond	565032.75	133253.53	7	(565058.497,133309.553), (565317.076,133306.932), (565371.238,133047.916), (565179.051,133041.364), (565023.990,133123.044), (564992.104,133225.253), (565058.497,133309.553)	polygon					125452.550		4	Liquid	200S-4	216-S-16P	Rp-s	1957	Rp-dn	1975
Pond	565991.31	133248.41	7	(566301.270,133508.444), (566102.383,133472.774), (565840.262,133318.745), (565795.945,133185.793), (566273.167,133132.828), (566326.672,133258.754), (566301.270,133508.444)	polygon	292.0	292.0	3.0		84983.990		4	Liquid	200S-4	216-S-17	Rp-s	1951	Rp-dn	1954
Trench	567065.88	134407.92			polygon	38.1	4.6	1.8		*174.193*		4	Liquid	200S-4	216-S-18	Rp-s	1954	Rp-dn	1954
Pond	567692.44	133274.69	6	(567602.379,133290.572), (567724.693,133292.947), (567782.881,133169.445), (567708.068,133114.820), (567597.629,133167.070), (567602.379,133290.572)	polygon					14164.000		4	Liquid	200S-4	216-S-19	Rp-s	1952	Rp-dn	1984
Crib	567553.69	133916.75			polygon	27.4	12.2	9.1		*334.451*		4	Liquid	216S-4	216-S-20	Rp-s	1952	Rp-dn	1972
Crib	566611.38	134409.23			polygon	15.2	15.2	6.7		*232.258*		4	Liquid	216S-4	216-S-21	Rp-s	1954	Rp-dn	1970
Crib	567608.44	133989.03			polygon	30.5	1.1	3.0		*32.516*		4	Liquid	216S-4	216-S-22	Rp-s	1957	Rp-dn	1967
Crib	567113.63	134692.27			polygon	109.7	3.0	8.5		*334.451*		4	Liquid	216S-4	216-S-23	Rp-s	1969	Rp-dn	1972
Crib	566569.69	134287.22			polygon	175.3	3.0			534.192		4	Liquid	216S-4	216-S-25	Rp-s	1973	Rp-dn	1992
Crib	567594.94	133759.81			polygon	128.0	3.0			*390.193*		4	Liquid	216S-4	216-S-26	Rp-s	1984	Rp-dn	1995
Crib	566893.44	134438.06			polygon	30.5	3.0	1.8		92.903		4	Liquid	216S-4	216-S-3	Rp-s	1953	Rp-dn	1956
French Drain	566549.25	134456.61			polygon		0.8	6.1	0.8	*0.456*		4	Liquid	216S-4	216-S-4	Rp-s	1953	Rp-dn	1956

S	C	C	N	C S	G	L	W	D	D	A	W	W	R	V	S	P	O	O	O
Crib	566430.38	133440.17	5	(566390.601,133480.147), (566473.862,133481.228), (566474.403,133403.914), (566388.979,133404.455), (566390.601,133480.147)	polygon	64.0	64.0	4.6		*4097.024*		4	Liquid	216S-4	216-S-5	Rp-s	1954	Rp-dn	1957
Crib	566216.75	133595.77	5	(566173.257,133639.100), (566271.656,133640.182), (566268.953,133556.380), (566171.094,133555.299), (566173.257,133639.100)	polygon	64.0	64.0	4.6		*4097.024*		4	Liquid	216S-4	216-S-6	Rp-s	1954	Rp-dn	1972
Crib	567168.25	134176.48			polygon	30.5	15.2	6.6		*464.515*		4	Liquid	216S-4	216-S-7	Rp-s	1956	Rp-dn	1965
Trench	566925.56	134222.89			polygon	30.5	18.3	7.6		*557.416*		4	Liquid	216S-4	216-S-8	Rp-s	1951	Rp-dn	1952
Crib	567175.94	134481.03			polygon	91.4	9.1			*836.127*		4	Liquid	216S-4	216-S-9	Rp-s	1965	Rp-dn	1969
Crib	566704.13	134161.38			polygon	19.0	8.0			152.000		**2**	Liquid	**216S-2**	216-SX-2	Rp-s	1952	Rp-dn	1965
Crib	567243.19	135001.94			polygon	23.8	8.5			*202.900*		4	Liquid	216S_U_N-4	216-U-1%2	Rp-s	1951	Rp-dn	1967
Pond	566346.75	134604.44	5	(566061.531,134750.348), (566425.386,134667.838), (566414.565,134324.272), (566059.217,134329.059), (566061.531,134750.348)	polygon					121405.693		4	Liquid	200S-4	216-U-10	Rp-s	1944	Rp-dn	1985
Ditch	565805.94	134729.88			line	1374.6	1.5	1.8		*2094.964*		**4**	Liquid	**200S-4**	216-U-11	Rp-s	1944	Rp-dn	1957
Crib	567592.31	134501.55			polygon	30.5	3.0	4.6		*92.903*		4	Liquid	216S-4	216-U-12	Rp-s	1960	Rp-dn	1988
Trench	566722.63	135067.77			polygon	61.0	6.1	5.5		*371.612*		4	Liquid	216S-4	216-U-13	Rp-s	1952	Rp-dn	1956
Ditch	567033.24	135347.11	7	(566420.112,134593.888), (566572.078,134673.933), (566649.051,134840.067), (566681.123,134822.748), (566611.206,134629.032), (566429.036,134554.625), (566420.112,134593.888)	line	1731.3	2.4			4224.270		4	Liquid	200S-4	216-U-14	Rp-s	1944	Rp-dn	1995
Trench	567410.56	135115.97			polygon	6.1	6.1	4.6		*37.161*		4	Liquid	216S-4	216-U-15	Rp-s	1957	Rp-dn	1957
Crib	567235.63	134861.31			polygon	79.9	58.2			*4649.054*		4	Liquid	216S_U_S-4	216-U-16	Rp-s	1984	Rp-dn	1987
Crib	567839.38	134903.33			polygon	45.7	3.0			*139.355*		4	Liquid	216S-4	216-U-17	Rp-s	1988	Rp-dn	1994
French Drain	566844.75	134927.89			polygon			3.6576	1.8	*2.627*	Received nitrate containing condensate from the 241-U-110-Tank.	4	Liquid	216S-4	216-U-3	Rp-s	*1946*	Rp-dn	*1975*
Injection/Reverse Wel	567579.38	135109.22			point			22.9	0.1	*0.005*		4	Liquid	266S-4	216-U-4	Rp-s	1947	Rp-dn	1955
French Drair	567580.25	135111.05			point			2.7432	1.3	*1.318*		4	Liquid	216S-4	216-U-4A	Rp-s	1955	Rp-dn	1970
French Drair	567615.25	135121.19			point			3.048	0.9	*0.657*		4	Liquid	216S-4	216-U-4B	Rp-s	1960	Rp-dn	1970
Trench	567672.94	135359.31			polygon	12.2	12.2	3.0		*148.645*		4	Liquid	216S-4	216-U-5	Rp-s	1952	Rp-dn	1952
Trench	567624.19	135369.78			polygon	22.9	3.0			*69.677*		4	Liquid	216S-4	216-U-6	Rp-s	1952	Rp-dn	1952
French Drair	567611.44	135203.77			point			5.1816	0.8	*0.456*		4	Liquid	216S-4	216-U-7	Rp-s	1952	Rp-dn	1957
Crib	567615.94	134697.39			polygon	48.8	15.2			*743.224*		4	Liquid	216S-4	216-U-8	Rp-s	1952	Rp-dn	1960
Ditch	565976.21	134005.69			line	1066.8	1.8			1952.240		**4**	Liquid	**200S-4**	216-U-9	Rp-s	1952	Rp-dn	1975
Crib	566547.38	135469.17			polygon	4.3	4.3	6.4		*18.209*		4	Liquid	216S-4	216-Z-1%2	Rp-s	1949	Rp-dn	1969
Injection/Reverse Wel	566566.50	135897.34			point			45.7	0.2	*0.018*		4	Liquid	266S-4	216-Z-10	Rp-s	1945	Rp-dn	1945
Ditch	566628.01	135126.86		(566720,135460), (566660,135280), (566610,135090)	line	797.1	1.2	0.6		*971.766*		**4**	Liquid	**200S-4**	216-Z-11	Rp-s	1959	Rp-dn	1971
Crib	566365.06	135422.84			polygon	91.4	6.1	5.8		*557.416*		4	Liquid	216S-4	216-Z-12	Rp-s	1959	Rp-dn	1973
French Drair	566498.13	135582.03			point			4.6	0.9	*0.657*		*4*	Liquid	216S-4	216-Z-13	Rp-s	1949	Rp-dn	1995
French Drair	566479.81	135583.50			point			4.6	0.9	*0.657*		4	Liquid	216S-4	216-Z-14	Rp-s	1949	Rp-dn	*1995*
French Drair	566483.38	135625.27			point			6.7	0.9	*0.657*		4	Liquid	216S-4	216-Z-15	Rp-s	1949	Rp-dn	*1995*
Crib	566430.06	135991.34			polygon	54.9	3.0	4.9		*167.225*		4	Liquid	216S-4	216-Z-16	Rp-s	1968	Rp-dn	1977
Trench	566603.44	135862.59			polygon	61.0	7.9	2.4		*483.096*		4	Liquid	216S-4	216-Z-17	Rp-s	1967	Rp-dn	1968
Crib	566440.06	135286.48			polygon	63.1	3.0	5.5		*192.309*		1	Liquid/Soil-Debris	216S-1	216-Z-18	Rp-s	1969	Rp-dn	1973
Ditch	566598.90	135099.69		(566720,135460), (566640,135290), (566590,135090)	line	842.8	1.2	0.6		*1027.508*		**4**	Liquid	**200S-4**	216-Z-19	Rp-s	1971	Rp-dn	1981
Tilefield	566549.00	135418.91			polygon	84.0	35.0	5.8		*2940.000*		1	Liquid/Soil-Debris	216S-1	216-Z-1A	Rp-s	1949	Rp-dn	1969

Ditch	566644.14	135258.09		(566560,135900) , (566600,135900) , (566610,135880) , (566610,135700) , (566700,135610)	line	1295.4	1.2	0.6		*1579.352*		**4**	Liquid	**200S-4**	216-Z-1D	Rp-s	1944	Rp-dn	1959						
Crib	566607.75	135230.80	8	(566577.112,135351.828), (566560.895,135246.419), (566544.678,134964.247), (566599.815,134957.760), (566604.680,135072.899), (566629.006,135269.122), (566625.762,135355.071), (566577.112,135351.828)	line	463.0	3.0			*1411.197*		4	Liquid	216S-4	216-Z-20	Rp-s	1981	Rp-dn	1995						
Pond	566842.06	135523.36			polygon	41.6	41.6			1728.060		4	Liquid	200S-4	216-Z-21	Rp-s	1980	Rp-dn	1995						
Crib	566576.81	135459.19			polygon	20.1	8.4	7.6	1.2	169.320		1	Liquid	216S-1	216-Z-3	Rp-s	1952	Rp-dn	1959						
Trench	566586.31	135920.70			polygon	3.0	3.0	4.6		*9.290*		4	Liquid	216S-4	216-Z-4	Rp-s	1945	Rp-dn	1945						
Crib	566555.19	135949.22			polygon	4.3	4.3	5.5		*18.209*		4	Liquid	216S-4	216-Z-5	Rp-s	1945	Rp-dn	1947						
Crib	566579.06	135875.77			polygon	15.8	2.6	2.4		*41.063*		4	Liquid	216S-4	216-Z-6	Rp-s	1945	Rp-dn	1945						
Crib	566700.56	135926.88			polygon	64.0	13.4	2.1		*858.424*		1	Liquid	216S-1	216-Z-7	Rp-s	1947	Rp-dn	1967						
French Drair	566654.19	135652.75			point			4.572	0.9	*0.657*		4	Liquid	216S-4	216-Z-8	Rp-s	1955	Rp-dn	1962						
Trench	566758.00	135610.58			polygon	36.6	27.4	6.4		*1003.353*		1	Liquid/Soil-Debris	216S_Z9-1	216-Z-9	Rp-s	1955	Rp-dn	1962	1978	RTD		1978	RTD	
Burial Grounc	566458.06	135086.13			polygon	774.1	299.5			231885.890		4	Soil-Debris/Cement	216S-4	218-W-4C	Rp-s	1974	Rp-dn	*2010*						
Process Unit/Plant	567558.63	135170.69			polygon	246.9	20.1	23.5		*4966.597*		4	Cement	200S-4	221-U	Rp-s	1952	ABC	1958						
Storage	567408.31	133903.72			polygon	5.8	4.9	2.62128		27.840		4	Soil-Debris	200S-4	222-SD	Rp-s	1951	ABC	*2024*						
Process Unit/Plant	567549.91	135056.69				60.0	18.3			1097.530		4	Cement	200S-4	224-U	Rp-s	1952	ABC	1991						
Process Unit/Plant	566483.40	135886.49			polygon	83.8	58.7			4916.960		4	Cement	**200S-4**	231-Z	**Rp-s**	1945	**ABC**	*2024*						
Process Unit/Plant	566447.49	135568.51			polygon	17.4	11.3	5.8		*195.934*		**4**	Cement	**200S-4**	232-Z	**Rp-s**	1959	**ABC**	1976						
Process Unit/Plant	567343.87	134010.74			polygon	26.2	11.3	9.8		*295.649*		**4**	Cement	**200S-4**	233-S	**Rp-s**	1952	**ABC**	1967						
Process Unit/Plant	566472.83	135657.23			polygon	150.0	53.5			8025.000		4	Cement	200S-4	234-5Z	Rp-s	1949	ABC	*2024*						
Single-Shell Tanl	566835.13	134503.05			polygon			13.185648	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-S-101	Rp-s	1953	G-dn	1980						
Single-Shell Tanl	566804.06	134502.97			polygon			13.185648	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-S-102	Rp-s	1953	G-dn	1980						
Single-Shell Tanl	566772.94	134502.89			polygon			13.185648	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-S-103	Rp-s	1953	G-dn	1980						
Single-Shell Tanl	566835.19	134471.95			polygon			13.185648	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-S-104	Rp-s	1953	G-dn	1968						
Single-Shell Tanl	566804.13	134471.89			polygon			13.185648	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-S-105	Rp-s	1953	G-dn	1976						
Single-Shell Tanl	566773.06	134471.81			polygon			13.185648	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-S-106	Rp-s	1953	G-dn	1976						
Single-Shell Tanl	566835.31	134440.88			polygon			13.185648	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-S-107	Rp-s	1952	G-dn	1980						
Single-Shell Tanl	566804.19	134440.80			polygon			13.185648	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-S-108	Rp-s	1952	G-dn	1979						
Single-Shell Tanl	566773.13	134440.72			polygon			13.185648	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-S-109	Rp-s	1952	G-dn	1979						
Single-Shell Tanl	566835.38	134409.78			polygon			13.185648	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-S-110	Rp-s	1952	G-dn	1976						
Single-Shell Tanl	566804.31	134409.72			polygon			13.185648	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-S-111	Rp-s	1952	G-dn	1972						
Single-Shell Tanl	566773.19	134409.64			polygon			13.185648	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-S-112	Rp-s	1952	G-dn	1974						
Single-Shell Tank	566835.63	134297.64			polygon			15.3924	22.9	*410.433*	REDOX high-level waste and ion exchange waste, evaporator bottoms, partial neutralization feed, and complexed waste.	3	Liquid/Salt Cake	241S-3	241-SX-101	Rp-s	1954	G-dn	1980						
Single-Shell Tank	566804.56	134297.56			polygon			15.3924	22.9	*410.433*	REDOX high-level waste, carbonate waste, concrete, ion exchange waste, evaporator bottoms, and partial neutralization feec	2	Liquid/Salt Cake	241S-2	241-SX-102	Rp-s	1954	G-dn	1980						
Single-Shell Tank	566773.50	134297.48			polygon			15.3924	22.9	*410.433*	REDOX high-level waste, concrete, coating waste, evaporator bottoms, organic wash waste, and partial neutralization feec	2	Liquid/Salt Cake	241S-2	241-SX-103	Rp-s	1954	G-dn	1980						
Single-Shell Tank	566835.75	134266.56			polygon			15.3924	22.9	*410.433*	REDOX high-level waste and ion exchange waste, double-shell slurry feed, and evaporator bottoms.	2	Liquid/Salt Cake	241S-2	241-SX-104	Rp-s	1955	G-dn	1980						
Single-Shell Tank	566804.63	134266.48			polygon			15.3924	22.9	*410.433*	REDOX high-level waste and ion exchange waste, double-shell slurry feed, evaporator bottoms, and partial neutralization feec	2	Liquid/Salt Cake	241S-2	241-SX-105	Rp-s	1955	G-dn	1980						
Single-Shell Tank	566773.56	134266.41			polygon			15.3924	22.9	*410.433*	Hanford laboratory waste, Pacific Northwest Laboratory waste, REDOX and waste fractionization ion exchange waste, evaporator bottoms, B Plant low level waste, PUREX low level waste, coating waste, and	2	Liquid/Salt Cake	241S-2	241-SX-106	Rp-s	1954	G-dn	1980						

Single-Shell Tank	566773.63	134235.33			polygon			15.3924	22.9	*410.433*	REDOX high-level waste and supernatant containing REDOX high-level waste	2	Liquid/Salt Cake	241S-2	241-SX-109	Rp-s	1955	G-dn	1965
Single-Shell Tank	566835.88	134204.39			polygon			15.3924	22.9	*410.433*	REDOX high-level waste, concrete, Pacific Northwest Laboratory waste, B Plant low-level waste, ion exchange waste, evaporator bottoms, and 224-U waste	2	Liquid/Salt Cake	241S-2	241-SX-110	Rp-s	1960	G-dn	1976
Single-Shell Tank	566804.81	134204.31			polygon			15.3924	22.9	*410.433*	REDOX high-level waste and supernatant containing REDOX high-level waste and REDOX ion exchange	2	Liquid/Salt Cake	241S-2	241-SX-111	Rp-s	1956	G-dn	1974
Single-Shell Tank	566773.69	134204.23			polygon			15.3924	22.9	*410.433*	REDOX high-level waste and supernatant containing REDOX high-level waste	2	Liquid/Salt Cake	241S-2	241-SX-112	Rp-s	1956	G-dn	1969
Single-Shell Tank	566835.94	134173.31			polygon			15.3924	22.9	*410.433*	REDOX high-level waste. Diatomaceous earth.	2	Liquid/Salt Cake	241S-2	241-SX-113	Rp-s	1958	G-dn	1962
Single-Shell Tank	566804.88	134173.23			polygon			15.3924	22.9	*410.433*	REDOX high-level waste and ion exchange waste, an evaporator bottoms	2	Liquid/Salt Cake	241S-2	241-SX-114	Rp-s	1957	G-dn	1972
Single-Shell Tank	566773.81	134173.16			polygon			15.3924	22.9	*410.433*	REDOX high-level waste and supernatant containing REDOX high-level waste	2	Liquid/Salt Cake	241S-2	241-SX-115	Rp-s	1958	G-dn	1965
Process Unit/Plant	566731.86	134270.81			polygon	11.0	7.3	2.1		*80.300*		**4**	Cement	**200S-4**	241-SX-401	**Rp-s**	1954	**ABC**	1975
Process Unit/Plant	566731.88	134244.87			polygon	11.0	7.3	2.1		*80.300*		**4**	Cement	**200S-4**	241-SX-402	**Rp-s**	1954	**ABC**	1975
Double-Shell Tank	566899.00	134557.75			polygon			16.383	22.9	*410.433*	Double-shell slurry, and radioactive mixed waste	2	Salt Cake	241S-2	241-SY-101	Rp-s	1977	G-dn	*2024*
Double-Shell Tank	566866.38	134557.67			polygon			16.383	22.9	*410.433*	Supernatant containing partial neutralization feed, double-shell slurry feed, double-shell slurry, and noncomplexed wastes	2	Salt Cake	241S-2	241-SY-102	Rp-s	1977	G-dn	*2024*
Double-Shell Tank	566899.06	134525.14			polygon			16.383	22.9	*410.433*	Supernatant containing complexed waste and double-shell slurr	3	Salt Cake	241S-3	241-SY-103	Rp-s	1977	G-dn	*2024*
Single-Shell Tank	566842.00	135103.88			polygon			11.7348	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-U-101	Rp-s	1946	G-dn	1959
Single-Shell Tank	566811.56	135103.80			polygon			11.7348	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-U-102	Rp-s	1946	G-dn	1976
Single-Shell Tank	566781.06	135103.72			polygon			11.7348	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-U-103	Rp-s	1947	G-dn	1978
Single-Shell Tank	566842.13	135073.41			polygon			11.7348	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-U-104	Rp-s	1947	G-dn	1961
Single-Shell Tank	566811.63	135073.33			polygon			11.7348	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-U-105	Rp-s	1947	G-dn	1978
Single-Shell Tank	566781.13	135073.25			polygon			11.7348	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-U-106	Rp-s	1948	G-dn	1977
Single-Shell Tank	566842.19	135042.92			polygon			11.7348	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-U-107	Rp-s	1948	G-dn	1980
Single-Shell Tank	566811.69	135042.84			polygon			11.7348	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-U-108	Rp-s	1949	G-dn	1979
Single-Shell Tank	566781.25	135042.77			polygon			11.7348	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-U-109	Rp-s	1949	G-dn	1980
Single-Shell Tank	566842.25	135012.45			polygon			11.7348	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-U-110	Rp-s	1946	G-dn	1975
Single-Shell Tank	566811.75	135012.38			polygon			11.7348	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-U-111	Rp-s	1947	G-dn	1980
Single-Shell Tank	566781.31	135012.30			polygon			11.7348	22.9	*410.433*		2	Liquid/Salt Cake	241S-2	241-U-112	Rp-s	1947	G-dn	1975
Single-Shell Tank	566752.25	135050.31			polygon			11.548872	6.1	*29.186*		2	Liquid/Salt Cake	241S-2	241-U-201	Rp-s	1956	G-dn	1977
Single-Shell Tank	566752.31	135035.09			polygon			11.548872	6.1	*29.186*		2	Liquid/Salt Cake	241S-2	241-U-202	Rp-s	1956	G-dn	1978
Single-Shell Tank	566752.31	135019.84			polygon			11.5	6.1	*29.186*		2	Liquid/Salt Cake	241S-2	241-U-203	Rp-s	1956	G-dn	1977
Single-Shell Tank	566752.38	135004.61			polygon			11.5	6.1	*29.186*		2	Liquid/Salt Cake	241S-2	241-U-204	Rp-s	1954	G-dn	1978
Settling Tank	567297.13	135008.25			point			7.6	6.1	*29.186*		2	Liquid	241S-2	241-U-361	Rp-s	1951	G-dn	1957
Receiving Vault	567691.31	135305.16			polygon	39.0	20.1	13.7		*784.845*		2	Liquid	241S-2	241-WR-VAULT	Rp-s	1952	G-dn	1976
Settling Tank	566547.75	135514.86			point	8.5	4.6	6.4		*39.019*		**4**	Liquid	**241S-4**	241-Z-361	Rp-s	1949	G-dn	1976
Settling Tank	566638.94	135652.72			point	12.2			2.4	*4.670*		**4**	Liquid	**241S-4**	241-Z-8	Rp-s	1955	G-dn	1962
Process Unit/Plant	567536.33	134034.35			polygon	4.3	3.8	2.4		16.260		4	Cement	200S-4	2711-S	Rp-s	1952	ABC	*1952*
Process Unit/Plant	567466.28	133965.99			polygon	4.3	3.8	2.4		16.260		4	Cement	200S-4	2718-S	Rp-s	1952	ABC	*1952*
Process Unit/Plant	567283.91	134011.97			polygon	17.7	13.1	10.7		*231.785*		4	Cement	200S-4	276-S	Rp-s	1952	ABC	1967
Process Unit/Plant	567470.94	135066.92			polygon	20.1	16.5	2.4		330.800		4	Cement	200S-4	276-U	Rp-s	1952	ABC	1957
Process Unit/Plant	567261.67	133946.03			polygon	2.4	2.4	2.1		*5.954*		**4**	Cement	200S-4	2904-SA	Rp-s	1956	ABC	1976
Stack	567531.56	134029.64			polygon	61.0			4.3	14.301		4	Atmosphere	200S-4	291-S-1	Rp-s	1952	ABC	*2014*
Process Unit/Plant	567675.67	135181.27			Polygon	5.79	5.49	4.27		31.866		4	Cement	200S-4	291-U	Rp-s	1945	ABC	*1945*
Stack	567659.06	135173.77			Polygon			60.96	4.27	14.301		4	Atmosphere	200S-4	291-U-1	Rp-s	1945	Rp-dn	*1945*
Process Unit/Plant	567531.78	134003.61			Polygon	8.23	4.27			35.117		4	Cement	200S-4	292-S	Rp-s	1952	ABC	1967
Process Unit/Plant	567521.27	133989.41			Polygon	8.84	4.88			43.107		4	Cement	200S-4	293-S	Rp-s	1958	ABC	1967
Stack	567432.44	133963.16			point	19.5			0.4	0.100		**4**	Atmosphere	**200S-4**	296-S-1	Rp-s	1950	ABC	1976
Stack	567288.88	134014.39			point	1.1	1.1			1.124		**4**	Atmosphere	**200S-4**	296-S-12	Rp-s	*1952*	ABC	*2014*
Stack	567463.56	133879.77			point					1.124		**4**	Atmosphere	**200S-4**	296-S-13	Rp-s	*1952*	ABC	*2014*
Stack	567474.31	133926.13			point					1.124		**4**	Atmosphere	**200S-4**	296-S-16	Rp-s	*1952*	ABC	*2014*
Stack	567451.00	133838.22			point					1.124		**4**	Atmosphere	**200S-4**	296-S-21	Rp-s	*1952*	ABC	*2014*
Stack	567523.69	135197.77			point	3.0			7.3	42.028		**4**	Atmosphere	**200S-4**	296-U-10	Rp-s	*1952*	ABC	1976
Unplanned Release	566773.44	134281.44			point					*0.999*	Soil	4	Soil-Debris/Liquid+AH1090	200S-4	UPR-200-W-10	Rp-s	1952	Rp-dn	1952
Unplanned Release	567558.63	135170.69			line	27.4	19.8			543.483	Reclaimed acid	4	Liquid	200S-4	UPR-200-W-101	Rp-s	1957	Rp-dn	1957
Unplanned Release	566532.31	135576.33			point	7.6	1.8	2.1		13.935	Process Effluent	4	Liquid	200S-4	UPR-200-W-103	Rp-s	1971	Rp-dn	1971

S	C	C	N C	C S	G	L	W	D	D	A	W	W	R	V	S	P	O	O	O	C		C	C		C
Unplanned Release	566978.75	133894.73			polygon	39.6	39.6			1570.061		4	Liquid	200S-4	UPR-200-W-13	Rp-s	1952	Rp-dn	1952						
Unplanned Releas	566553.13	135896.63			point					*0.999*		**4**	Liquid	**200S-4**	UPR-200-W-130	Rp-s	1967	Rp-dn	1967						
Unplanned Releas	566836.13	135155.08			point					52.955		2	Liquid	200S-2	UPR-200-W-132	Rp-s	1956	Rp-dn	1956						
Unplanned Releas	567603.00	135235.05			point					0.456		4	Liquid	200S-4	UPR-200-W-138	Rp-s	1953	Rp-dn	1953						
Unplanned Release	565976.21	134005.69			line	1066.8	1.8			1952.240		4	Liquid	200S-4	UPR-200-W-139	Rp-s	1953	Rp-dn	1954						
Unplanned Releas	566975.50	133893.39			polygon	39.6	39.6			1570.061		4	Liquid	200S-4	UPR-200-W-15	Rp-s	1952	Rp-dn	1952						
Unplanned Releas	566382.94	135563.72			point					*0.999*		4	Liquid	200S-4	UPR-200-W-159	Rp-s	1985	Rp-dn	1985						
Unplanned Release	567615.44	134842.23			line					4046.856		4	Liquid	200S-4	UPR-200-W-163	Rp-s	*1952*	Rp-dn	*1995*						
Unplanned Releas	567223.06	134406.94			polygon					283.280	Soil	4	Soil-Debris/Liquid	200S-4	UPR-200-W-164	Rp-s	*1952*	Rp-dn	*1967*						
Unplanned Releas	567280.38	134983.83			point					4.645		2	Liquid	200S-2	UPR-200-W-19	Rp-s	1953	Rp-dn	*1953*						
Unplanned Releas	566913.50	134314.91			point					92.903		2	Liquid	200S-2	UPR-200-W-20	Rp-s	1953	Rp-dn	1953						
Unplanned Releas	566801.44	135162.55			point	305.0	150.0			45750.000		2	Liquid	200S-2	UPR-200-W-24	Rp-s	1953	Rp-dn	1953						
Unplanned Releas	567239.88	134136.16			point					*0.999*		4	Liquid	200S-4	UPR-200-W-32	Rp-s	1954	Rp-dn	1954						
Unplanned Releas	567584.94	135060.77			point	4.5	3.0			13.500		2	Liquid	200S-2	UPR-200-W-33	Rp-s	1955	Rp-dn	1955						
Unplanned Release	567230.56	134152.64			point					*0.999*		4	Liquid	200S-4	UPR-200-W-35	Rp-s	1955	Rp-dn	*1955*						
Unplanned Releas	567555.13	135016.72			point	15.2	3.0			46.452		4	Liquid	200S-4	UPR-200-W-39	Rp-s	1954	Rp-dn	1954						
Unplanned Releas	566871.88	134153.03			polygon					464.515		2	Liquid	200S-2	UPR-200-W-49	Rp-s	1958	Rp-dn	1958						
Unplanned Release	566864.88	134257.25			polygon	17.1	7.2	5.5		122.260		2	Soil-Debris/Liquid	200S-2	UPR-200-W-51	Rp-s	1958	Rp-dn	1958						
Unplanned Releas	566944.94	133852.20			point					*0.999*	Process Effluent	**2**	Soil-Debris/Liquid	**200S-2**	UPR-200-W-52	Rp-s	1958	Rp-dn	1958						
Unplanned Releas	567546.38	135081.89			point					*0.999*	Chemicals	**4**	**Soil-Debri**	200S-4	UPR-200-W-55	Rp-s	*1969*	Rp-dn	*1969*						
Unplanned Release	565030.88	133276.78			polygon					125452.550		4	Liquid	200S-4	UPR-200-W-59	Rp-s	1965	Rp-dn	1965						
Unplanned Release	566917.44	134990.81			point					*0.999*	Process Effluent	2	Soil-Debris	200S-2	UPR-200-W-6	Rp-s	1950	Rp-dn	1950						
Unplanned Releas	567307.25	133965.67			point					18.581		4	Liquid	200S-4	UPR-200-W-61	Rp-s	1966	Rp-dn	1966						
Unplanned Releas	566091.88	134371.38			point	30.48				*99.900*	Chemicals	**4**	Liquid	200S-4	UPR-200-W-68	Rp-s	*1969*	Rp-dn	*1969*						
Unplanned Releas	567276.56	134087.48			point					*0.999*	Chemicals	**4**	Liquid	200S-4	UPR-200-W-69	Rp-s	*1969*	Rp-dn	*1969*						
Unplanned Release	########	########			line					*99.900*	Chemicals	**2**	**Liquid**	200S-2	UPR-200-W-71	Rp-s	1974	Rp-dn	1974						
Unplanned Releas	566604.06	135530.73			point					0.010		4	Liquid	200S-4	UPR-200-W-74	Rp-s	1976	Rp-dn	1976						
Unplanned Releas	566522.25	135524.03			point	21.3	21.3			455.225	Chemicals	**2**	**Soil-Debri**	200S-2	UPR-200-W-75	Rp-s	*1969*	Rp-dn	*1969*						
Unplanned Releas	567478.44	134999.56			point					3.716	Chemicals	**4**	**Soil-Debri**	200S-4	UPR-200-W-78	Rp-s	*1969*	Rp-dn	*1969*						
Unplanned Releas	566523.13	135529.55			polygon	3.048	3.048			9.290	Process Effluent	**4**	**Liqui**	200S-4	UPR-200-W-79	Rp-s	1978	Rp-dn	*1978*						
Unplanned Release	567819.00	135066.20			polygon	129.5	30.5			3948.379		4	Soil-Debris/Liquid+AH738	200S-4	UPR-200-W-8	Rp-s	1950	Rp-dn	*1950*						
Unplanned Releas	566901.31	134342.63			point					*0.999*		2	Liquid	200S-2	UPR-200-W-82	Rp-s	1980	Rp-dn	1980						
Unplanned Release	567272.00	134087.47			point					*0.999*	Chemicals	**4**	**Soil-Debris**	200S-4	UPR-200-W-83	Rp-s	*1969*	Rp-dn	*1969*						
Unplanned Release	567474.13	133924.58			point					2.787	Chemicals	**4**	Liquid	200S-4	UPR-200-W-87	Rp-s	*1969*	Rp-dn	*1969*						
Unplanned Release	566539.00	135574.03			point					6.503	Chemicals	**4**	**Soil-Debris**	200S-4	UPR-200-W-90	Rp-s	*1969*	Rp-dn	*1969*						
Unplanned Releas	566978.38	133891.88			polygon	39.6	39.6			1570.061		4	Liquid	200S-4	UPR-200-W-95	Rp-s	1951	Rp-dn	1954						
Unplanned Releas	567328.50	134015.98			point					125.419		4	Liquid	200S-4	UPR-200-W-96	Rp-s	1969	Rp-dn	1969						
Drain/Tile Fiel	566437.63	138090.11			line	61.0	35.4			2155.351		4	Liquid	216T-4	600-211	Rp-s	1995	Rp-dn	*2028*						
Process Unit/Plan	########	########								*999.00*	Process Effluent	4	Liquid	200T-4	200-W-20	Rp-s	*1969*	Rp-dn	*1969*						
Laboratory	567654.94	136838.41			polygon	15.2	7.0			106.838	Building , equipment, underground lines	4	Soil-Debris	200T-4	200-W-40	Rp-s	1944	G-dn	*1990*						
Sand Filter	567690.60	136911.80				33.5	15.2	4.9		510.967		4	Liquid/Soil-Debris	216T-4	200-W-45	Rp-s	1949	Rp-dn	1979						
Crib	566741.30	136656.90				3.7	3.7	7.9		13.378	Process Effluent	4	Liquid	216T-4	200-W-52	Rp-s	1948	Rp-dn	1955						
Unplanned Release	566908.42	134952.81			polygon	100.00	18.00			1800.000	Soil	4	Soil-Debris	200T-4	200-W-67	Rp-s	1998	Rp-dn	*1998*						
Unplanned Release	567467.19	136676.91			point			1.8		*0.999*		4	Liquid	200T-4	200-W-9	Rp-s	1994	G-dn	1994						
Unplanned Release	566419.25	136621.70			polygon	6.10	3.05			18.581	Soil	4	Soil-Debris	200T-4	200-W-90	Rp-s	*1969*	Rp-dn	*1969*						
Retention Basin	566969.06	136705.03			polygon	75.0	37.5			2811.060		4	Liquid	200T-4	207-T	Rp-s	1944	Rp-dn	1995						
Process Unit/Plant	565897.25	135829.48			polygon	12.5	5.8			72.371		4	Liquid	200T-4	213-W	Rp-s	1988	Rp-dn	*1988*						
Ditch	567551.31	137102.70			polygon	556.3	0.9	3.0		2162.783		4	Liquid	216T-4	216-T-1	Rp-s	1944	Rp-dn	1995						
Trench	567353.81	136843.33			point	15.2	3.0	1.8		46.452		4	Liquid	216T-4	216-T-10	Rp-s	1951	Rp-dn	1957	1972	RTD	1972		RTD	
Trench	567359.81	136841.92			point	15.2	3.0	1.8		46.452		4	Liquid	216T-4	216-T-11	Rp-s	1951	Rp-dn	1957	1972	RTD	1972		RTD	
Trench	566992.63	136737.05			polygon	4.6	3.0	2.4		13.935		4	Liquid	216T-4	216-T-12	Rp-s	1954	Rp-dn	1954						

Trench	566948.13	136839.00			polygon	83.8	3.0			255.483		2	Liquid	216T-2	216-T-14	Rp-s	1954	Rp-dn	1954						
Trench	566975.63	136836.05			polygon	83.8	3.0			255.483		2	Liquid	216T-2	216-T-15	Rp-s	1954	Rp-dn	1954						
Trench	567003.00	136836.09			polygon	83.8	3.0			255.483		2	Liquid	216T-2	216-T-16	Rp-s	1954	Rp-dn	1954						
Trench	567018.25	136836.16			polygon	83.8	3.0			255.483		2	Liquid	216T-2	216-T-17	Rp-s	1954	Rp-dn	1954						
Crib	566949.38	136460.19			polygon	9.1	9.1	4.6		83.613		2	Liquid	216T-2	216-T-18	Rp-s	1953	Rp-dn	1953						
Crib	566849.44	135974.00			polygon	118.9	25.9			3079.736		4	Liquid	216T-4	216-T-19	Rp-s	1951	Rp-dn	1980						
Injection/Reverse Wel	567588.88	136781.89			point			22.9	0.2	0.018		4	Liquid	266T-4	216-T-2	Rp-s	1945	Rp-dn	1950						
Trench	567119.19	136074.44			point	3.0	3.0			9.290		4	Liquid	216T-4	216-T-20	Rp-s	1952	Rp-dn	1952						
Trench	566555.31	136118.70			line	73.2	3.0	3.0		222.967		2	Liquid	216T-2	216-T-21	Rp-s	1954	Rp-dn	1954						
Trench	566555.25	136146.13			line	73.2	3.0	3.0		222.967		2	Liquid	216T-2	216-T-22	Rp-s	1954	Rp-dn	1954						
Trench	566555.19	136173.56			line	73.2	3.0	3.0		222.967		2	Liquid	216T-2	216-T-23	Rp-s	1954	Rp-dn	1954						
Trench	566555.00	136201.03			line	73.2	3.0	3.0		222.967		2	Liquid	216T-2	216-T-24	Rp-s	1954	Rp-dn	1954						
Trench	566545.88	136228.47			line	54.9	3.0	3.0		167.225		2	Liquid	216T-2	216-T-25	Rp-s	1954	Rp-dn	1954						
Crib	566932.06	136398.72			polygon	9.1	9.1	4.6		83.613		3	Liquid	216T-3	216-T-26	Rp-s	1955	Rp-dn	1956						
Crib	566932.50	136372.83			polygon	9.1	9.1	4.6		83.613		4	Liquid	216T-4	216-T-27	Rp-s	1965	Rp-dn	1965						
Crib	566932.50	136347.16			polygon	9.1	9.1	4.6		83.613		4	Liquid	216T-4	216-T-28	Rp-s	1960	Rp-dn	1966						
French Drain	567705.25	136913.95			point	1.1			0.2	0.018		4	Liquid	216T-4	216-T-29	Rp-s	1949	Rp-dn	1964						
Injection/Reverse Well	567260.94	136670.61			point			62.8	0.3	0.050		2	Liquid	266T-2	216-T-3	Rp-s	1945	Rp-dn	1946						
French Drair	566868.44	136144.98			point				0.9	0.657		4	Liquid	216T-4	216-T-31	Rp-s	1954	Rp-dn	1962						
Crib	566719.31	136696.13			polygon	20.7	4.3	7.9		88.444		2	Liquid	216T-2	216-T-32	Rp-s	1946	Rp-dn	1952						
Crib	567461.50	136898.14			polygon	9.1	1.5	3.3		13.935		4	Liquid	216T-4	216-T-33	Rp-s	1963	Rp-dn	1963						
Crib	567265.25	137110.86			polygon	61.0	9.1	4.6		557.418		4	Liquid	216T-4	216-T-34	Rp-s	1966	Rp-dn	1967						
Crib	567168.44	137107.81			polygon	137.2	3.0	4.6		418.064		4	Liquid	216T-4	216-T-35	Rp-s	1967	Rp-dn	1968						
Crib	566702.00	136595.95			polygon	48.8	3.0	4.6		148.645		4	Liquid	216T-4	216-T-36	Rp-s	1967	Rp-dn	1973						
Ditch	566762.14	136960.00			line	259.1	2.4			631.741		4	Liquid	200T-4	216-T-4-1D	Rp-s	1944	Rp-dn	1972						
Ditch	566758.43	137042.02			line	533.4	2.4	1.2		1300.643		4	Liquid	200T-4	216-T-4-2	Rp-s	1972	Rp-dn	1995						
Pond	566533.00	137099.09	9	(566438.727,137406.606), (566430.678,137198.667), (566453.819,137063.507), (566555.441,137029.298), (566653.038,137043.384), (566712.401,137160.098), (566542.361,137285.867), (566522.238,137418.680), (566438.727,137406.606)	point	548.6	182.9			100335.286		4	Liquid	200T-4	216-T-4A	Rp-s	1944	Rp-dn	1972						
Pond	566522.63	137271.25			point					6100.000		4	Liquid	200T-4	216-T-4B	Rp-s	1972	Rp-dn	1995						
Trench	566666.50	136727.09			polygon	15.2	3.0	3.7		46.452		2	Liquid	216T-2	216-T-5	Rp-s	1955	Rp-dn	1955						
Crib	567188.31	136663.17			polygon	39.5	16.9	7.6		667.260		2	Liquid	216T-2	216-T-6	Rp-s	1946	Rp-dn	1951						
Crib	566685.00	136659.56			polygon	94.5	25.6			2419.195		2	Liquid	216T-2	216-T-7	Rp-s	1948	Rp-dn	1955						
Crib	567650.75	136726.91			polygon	35.2	11.1			390.960		4	Liquid	216T-4	216-T-8	Rp-s	1950	Rp-dn	1951						
Trench	567348.25	136844.84			point	15.2	3.0	1.8		46.452		4	Liquid	216T-4	216-T-9	Rp-s	1965	Rp-dn	1969	1972	RTD		1972	RTD	

Burial Ground	566205.13	136221.53	polygon	158.8	139.6			22168.338		4	Soil-Debris	216T-4	218-W-1	Rp-s	1944	Rp-dn	1953
Burial Ground	566204.94	136318.61	polygon	152.4	61.0	4.6		9290.304		4	Soil-Debris	216T-4	218-W-11	Rp-s	1960	Rp-dn	1960
Burial Ground	567059.81	137184.27	polygon	184.4	139.3			25686.297		4	Soil-Debris	216T-4	218-W-1A	Rp-s	1944	Rp-dn	1960
Burial Ground	566205.44	136061.98	polygon	179.5	158.8			28509.064		4	Soil-Debris	216T-4	218-W-2	Rp-s	1953	Rp-dn	1956
Burial Ground	566424.88	136890.80	polygon	535.9	340.0			182213.800		4	Soil-Debris	216T-4	218-W-2A	Rp-s	1954	Rp-dn	1985
Burial Grounc	566165.63	136744.98	polygon	218.2	155.4			33924.475		4	Soil-Debris	216T-4	218-W-3	Rp-s	1957	Rp-dn	1961
Burial Ground	566226.44	137282.42	polygon	746.8	283.5			211676.580		4	Soil-Debris	216T-4	218-W-3A	Rp-s	1970	Rp-dn	2014
Burial Ground	566616.44	137391.28	polygon	500.0	453.0			226500.000		4	Soil-Debris/Cement	216T-4	218-W-3AE	Rp-s	1981	Rp-dn	2014
Burial Ground	566227.81	136490.94	polygon	274.3	267.9			73495.595		4	Soil-Debris	216T-4	218-W-4A	Rp-s	1961	Rp-dn	1968
Burial Ground	566190.56	135880.45	polygon	189.0	158.5			29951.940		4	Soil-Debris/Cement	216T-4	218-W-4B	Rp-s	1967	Rp-dn	1990
Burial Ground	565869.69	137164.56	polygon	1012.7	360.1			364625.560		4	Soil-Debris	216T-4	218-W-5	Rp-s	1986	Rp-dn	2014
Process Unit/Plant	567568.28	136849.69	polygon	254.0	21.0			5334.000		4	Cement	200T-4	221-T	Rp-s	1944	Rp-dn	1990
Storage Tank	567558.13	136822.95	point			4.3		*9.990*		4	Liquid	200T-4	221-T-11-R	Rp-s	1944	Rp-dn	*2015*
Process Unit/Plant	567555.79	136724.80		60.0	18.3	18.3		1098.114		4	Cement	200T-4	224-T	Rp-s	1944	Rp-dn	*2015*
Single-Shell Tanl	566837.88	136764.75	polygon			11.6	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-T-101	Rp-s	1944	G-dn	1979
Single-Shell Tanl	566807.44	136764.67	polygon			11.6	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-T-102	Rp-s	1945	G-dn	1976
Single-Shell Tanl	566776.94	136764.59	polygon			11.7	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-T-103	Rp-s	1945	G-dn	1974
Single-Shell Tanl	566837.94	136734.27	polygon			11.7	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-T-104	Rp-s	1946	G-dn	1974
Single-Shell Tanl	566807.50	136734.19	polygon			11.7	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-T-105	Rp-s	1946	G-dn	1976
Single-Shell Tanl	**566777.00**	**136734.13**	**polygor**			**11.8**	**22.9**	410.433		2	Liquid/Salt Cake	241T-2	**241-T-106**	Rp-s	1947	G-dn	1973
Single-Shell Tanl	566838.06	136703.80	polygon			11.7	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-T-107	Rp-s	1944	G-dn	1976
Single-Shell Tanl	566807.56	136703.72	polygon			11.7	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-T-108	Rp-s	1945	G-dn	1974
Single-Shell Tanl	566777.06	136703.70	polygon			11.9	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-T-109	Rp-s	1945	G-dn	1974
Single-Shell Tanl	566838.13	136673.33	polygon			11.6	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-T-110	Rp-s	1944	G-dn	1976
Single-Shell Tanl	566807.63	136673.25	polygon			11.6	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-T-111	Rp-s	1945	G-dn	1974
Single-Shell Tanl	566777.19	136673.17	polygon			11.7	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-T-112	Rp-s	1946	G-dn	1976
Single-Shell Tanl	566746.63	136711.19	polygon			11.5	6.1	29.186		2	Liquid/Salt Cake	241T-2	241-T-201	Rp-s	1952	G-dn	1976
Single-Shell Tanl	566746.63	136695.95	polygon			11.4	6.1	29.186		2	Liquid/Salt Cake	241T-2	241-T-202	Rp-s	1952	G-dn	1976
Single-Shell Tanl	566746.69	136680.72	polygon			11.5	6.1	29.186		2	Liquid/Salt Cake	241T-2	241-T-203	Rp-s	1952	G-dn	1976
Single-Shell Tanl	566746.69	136665.47	polygon			11.5	6.1	29.186		2	Liquid/Salt Cake	241T-2	241-T-204	Rp-s	1952	G-dn	1976
Settling Tank	567280.00	136665.17	polygon			7.6	6.1	29.186		4	Liquid/Salt Cake	216T-4	241-T-361	Rp-s	1946	G-dn	1951
Single-Shell Tanl	566805.13	136155.92	polygon			14.3	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-101	Rp-s	1949	G-dn	1980
Single-Shell Tanl	566774.56	136155.86	polygon			14.7	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-102	Rp-s	1950	G-dn	1975
Single-Shell Tanl	566742.94	136155.78	polygon			14.7	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-103	Rp-s	1950	G-dn	1980
Single-Shell Tanl	566711.88	136155.69	polygon			14.6	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-104	Rp-s	1950	G-dn	1977
Single-Shell Tanl	566805.06	136187.02	polygon			14.7	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-105	Rp-s	1952	G-dn	1976
Single-Shell Tanl	566774.50	136186.94	polygon			14.7	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-106	Rp-s	1952	G-dn	1977
Single-Shell Tanl	566742.88	136186.86	polygon			14.8	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-107	Rp-s	1952	G-dn	1977
Single-Shell Tanl	566711.81	136186.78	polygon			14.7	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-108	Rp-s	1952	G-dn	1977
Single-Shell Tanl	566804.94	136218.09	polygon			14.3	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-109	Rp-s	1949	G-dn	1977
Single-Shell Tanl	566774.44	136218.02	polygon			14.5	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-110	Rp-s	1949	G-dn	1977
Single-Shell Tanl	566742.81	136217.94	polygon			14.4	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-111	Rp-s	1950	G-dn	1977
Single-Shell Tanl	566711.69	136217.86	polygon			14.4	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-112	Rp-s	1950	G-dn	1976
Single-Shell Tanl	566804.88	136249.17	polygon			14.2	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-113	Rp-s	1952	G-dn	1976
Single-Shell Tanl	566774.38	136249.11	polygon			14.2	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-114	Rp-s	1952	G-dn	1975
Single-Shell Tanl	566742.69	136249.03	polygon			14.2	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-115	Rp-s	1952	G-dn	1977
Single-Shell Tanl	566804.81	136280.27	polygon			14.0	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-116	Rp-s	1952	G-dn	1976
Single-Shell Tanl	566774.25	136280.19	polygon			14.3	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-117	Rp-s	1952	G-dn	1976
Single-Shell Tanl	566742.63	136280.11	polygon			14.3	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TX-118	Rp-s	1952	G-dn	1980
Diversion Box	567598.75	136835.38	polygon	11.0	3.0	5.5		33.445		2	Liquid	241T-2	241-TX-154	Rp-s	1949	G-dn	*2015*
Single-Shell Tanl	566773.31	136446.58	polygon			13.6	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TY-101	Rp-s	1953	G-dn	1973
Single-Shell Tanl	566742.25	136446.50	polygon			13.6	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TY-102	Rp-s	1953	G-dn	1979
Single-Shell Tanl	566773.38	136415.50	polygon			13.6	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TY-103	Rp-s	1953	G-dn	1976
Single-Shell Tanl	566742.31	136415.42	polygon			13.6	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TY-104	Rp-s	1953	G-dn	1974
Single-Shell Tanl	566773.44	136384.41	polygon			13.6	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TY-105	Rp-s	1953	G-dn	1960
Single-Shell Tanl	566742.38	136384.33	polygon			14.0	22.9	410.433		2	Liquid/Salt Cake	241T-2	241-TY-106	Rp-s	1953	G-dn	1959
Storage	565673.50	136024.50	polygon					56345.000		4	Soil-Debris	200T-4	RMWSF	Rp-s	1988	Rp-dn	*2028*
Storage	567548.81	136719.16	polygon	60.0	18.3			1098.114	Barrels/Drums/Buckets/Cans	4	Soil-Debris	200T-4	TRUSAF	Rp-s	1985	Rp-dn	*1985*
Unplanned Release	566744.06	136186.31	point	30.5	38.1			1161.288		2	Liquid	200T-2	UPR-200-W-100	Rp-s	1954	Rp-dn	1954

S					G	L	W	D	D	A	W	W	R	V	S			
Unplanned Releas	566804.88	136246.78			point					0.999		2	Liquid	200T-2	UPR-200-W-129	Rp-s	1971	Rp-dn 1971
Unplanned Release	567101.50	136094.02			point					0.999		4	Liquid	200T-4	UPR-200-W-131	Rp-s	1953	Rp-dn 1953
Unplanned Release	566241.19	136258.17			point					0.999	Barrels/Drums/Buckets/Cans	4	**Soil-Debris**	200T-4	UPR-200-W-134	Rp-s	1975	Rp-dn 1975
Unplanned Release	567119.19	136074.44			point	12.2				0.999		2	Liquid	200T-2	UPR-200-W-135	Rp-s	1954	Rp-dn 1954
Unplanned Release	566938.25	136540.31			point					0.999		4	Liquid	200T-4	UPR-200-W-14	Rp-s	1952	Rp-dn 1952
Unplanned Releas	566773.38	136415.56			point					0.999		2	Liquid	200T-2	UPR-200-W-150	Rp-s	1973	Rp-dn 1973
Unplanned Releas	567520.00	136745.00			point			3.4		0.999		4	Liquid	200T-4	UPR-200-W-2	Rp-s	1947	Rp-dn 1947
Unplanned Release	567577.75	136822.78			point	48.8	27.4			1337.804		2	Liquid	200T-2	UPR-200-W-21	Rp-s	1953	Rp-dn 1953
Unplanned Release	567064.19	136107.53			point	30.5	9.1			278.709		2	Liquid	200T-2	UPR-200-W-28	Rp-s	1954	Rp-dn 1954
Unplanned Release	566907.88	136595.58			polygon	30.5	22.9			696.773		2	Liquid	200T-2	UPR-200-W-29	Rp-s	1954	G-dn 1954
Unplanned Release	567603.00	136840.58			point					371.612		2	Liquid	200T-2	UPR-200-W-38	Rp-s	1955	Rp-dn 1955
Unplanned Release	########	########				7.6	6.1			46.452	Soil	4	Soil-Debris	200T-4	UPR-200-W-44	Rp-s	1954	Rp-dn 1954
Unplanned Release	567064.31	136088.02			point					0.999		2	Liquid	200T-2	UPR-200-W-5	Rp-s	1950	Rp-dn 1950
Unplanned Release	567513.06	136923.69			point					0.999		4	Liquid	200T-4	UPR-200-W-85	Rp-s	1982	ABC 1982
Unplanned Release	568024.44	136021.83			point					0.999		4	Liquid	200T-4	UPR-200-W-88	Rp-s	1984	ABC 1984
Unplanned Release	566902.81	136595.44			point			0.9		0.999		2	Liquid	200T-2	UPR-200-W-97	Rp-s	1966	G-dn 1966
Unplanned Release	567510.69	136736.73			point					0.999		2	Liquid	200T-2	UPR-200-W-98	Rp-s	1945	Rp-dn 1945
Process Unit/Plant	565882.69	136553.25			polygon	73.2	61.0			4459.346	Barrels/Drums/Buckets/Cans	4	Cement	200T-4	WRAP	Rp-s	1969	Rp-dn 1969
Radioactive Process	594156.94	115933.27			line	853.4	0.3			256.032		4	Liquid	300R-4	300_RLWS	Rp-s	1979	Rp-dn 1998
Radioactive Process	########	########			line	1247.2	0.3			374.172		4	Liquid	300R-4	300_RRLWS	Rp-s	1954	Rp-dn 1975
Process Unit/Plant	593295.31	116400.06			polygon	103.63	85.34			8844.370	Soil/Equipment	4	Cement	300R-4	300_VTS	Rp-s	1983	Rp-dn 1986
French Drain	594334.75	115664.34			polygon				1.37	1.473	Water	4	Liquid	316R-4	300-121	Rp-s	1969	Rp-dn 1969
French Drain	593961.75	116052.34			point				0.69	0.369	Steam Condensate	4	Liquid	316R-4	300-123	Rp-s	1969	Rp-dn 1969
Unplanned Releas	593775.44	116075.94			point					0.999	Soil	4	Soil-Debris	300R-4	300-16	Rp-s	1992	G-dn 1998
Trench	594192.19	115607.46			point	22.9	15.2			348.386		4	Liquid	316R-4	300-2	Rp-s	1965	Rp-dn 1966
Radioactive Process	########	########				274.3	0.3			82.296		4	Liquid	300R-4	300-214	Rp-s	1953	Rp-dn 2011
Trench	########	########				243.8	0.5			121.920		4	Liquid	316R-4	300-224	Rp-s	1960	Rp-dn 1988
Unplanned Releas	593739.56	116114.23			polygon					2571.830		4	Soil-Debris	300R-4	300-24	Rp-s	1945	Rp-dn 1995
Process Unit/Plant	593802.69	116064.16			polygon					99.900	Chemicals	4	Cement	300R-4	300-249	Rp-s	1969	Rp-dn 1969
Laboratory	594247.44	115784.75			point	71.5	61.9	13.7		4422.510		4	Soil-Debris	300R-4	300-25	Rp-s	1966	Rp-dn 2004
Unplanned Releas	########	########				30.0	25.0			450.000		4	Liquid/Soil-Debris	300R-4	300-251	Rp-s	1943	Rp-dn 1995
Unplanned Releas	########	########				23.0	20.0			460.000		4	Liquid	300R-4	300-255	Rp-s	1960	Rp-dn 1969
Unplanned Releas	########	########								0.999		4	Liquid	300R-4	300-262	Rp-s	1943	Rp-dn 1975
Laboratory	########	########				70.0	40.0			2800.000		4	Soil-Debris	300R-4	300-264	Rp-s	1953	Rp-dn 2004
Radioactive Process	########	########				350.0	1.0			350.000		4	Liquid	300R-4	300-265	Rp-s	1971	Rp-dn 2004
Unplanned Release	########	########								0.999	Soil	4	Liquid	300R-4	300-270	Rp-s	1969	G-dn 1969
Unplanned Releas	593926.19	116092.34			line	168.0	6.5			1055.000		4	Soil-Debris	300R-4	300-28	Rp-s	1990	ABC 1998
Unplanned Releas	593978.44	116125.02			polygon	115.8	48.8			5648.505		4	Soil-Debris	300R-4	300-33	Rp-s	1956	Rp-dn 1990
Storage	########	########				27.4	10.1	10.4		275.922	Equipment	4	Soil-Debris	300R-4	300-39	Rp-s	1969	ABC 1969
Unplanned Releas	593785.50	116261.41			polygon	19.5	21.3			415.000		4	Liquid/Soil-Debris	300R-4	300-4	Rp-s	1949	Rp-dn 1990
Unplanned Releas	593900.69	116121.05			point					0.030		4	Liquid	300R-4	300-40	Rp-s	1980	G-dn 1995
Unplanned Releas	593833.13	116062.49			polygon	14.7	8.7			126.813		4	Liquid	300R-4	300-48	Rp-s	1949	Rp-dn 1970
French Drain	593706.75	116107.03			polygon	1.2192	1.2192			1.486	Stormwater Runoff	4	Liquid	300R-4	300-80	Rp-s	1969	ABC 1969

Storage	594001.50	116273.07			Polygon	13.65504	10.60704	0.1270102		144.840	Barrels/Drums/Buckets/Cans	4	Soil and Liquid	300R-4	303-M-SA	Rp-s	1983	ABC	1987
Process Unit/Plant	594012.88	116273.00			Polygon					*99.900*	Chemicals	4	Cement	300R-4	303-M-UOF	Rp-s	1983	ABC	1987
Storage	593723.38	116159.29			Polygon	36.8808	11.5824	5.4864		427.168	Chemicals	4	Soil and Liquid	300R-4	305-B_SF	Rp-s	1978	ABC	*1978*
Retention Basir	594163.31	115909.95			polygon	8.5	5.2	2.7		44.222		4	Liquid	300R-4	307_RB	Rp-s	1953	Rp-dn	*2005*
Process Unit/Plant	594148.88	115693.64			Point	4.2672	4.2672	4.8768		18.209	Chemicals	4	Cement/Liquid	316R-4	309-WS-1	Rp-s	1961	ABC	1969
Process Unit/Plant	594127.63	115705.52			Point	7.9735681	4.8249841	4.8768		38.462	Equipment	4	Cement	316R-4	309-WS-2	Rp-s	1960	ABC	1969
Storage	593877.56	116107.71			Polygon					*99.900*	Barrels/Drums/Buckets/Cans	4	Soil and Liquid	300R-4	313_ESSP	Rp-s	*1969*	ABC	*1969*
Pond	594283.63	116106.10	6	(594161.253,116208.892), (594299.780,116227.251), (594438.307,116170.505), (594454.997,116015.288), (594191.295,116006.943), (594161.253,116208.892)	polygon	182.9	114.3			32000.000		4	Liquid	300R-4	316-1	Rp-s	1943	Rp-dn	1975
Pond	594238.69	116566.36	7	(594331.491,116724.613), (594131.211,116642.832), (594126.204,116492.622), (594166.260,116389.144), (594379.892,116392.482), (594379.892,116554.375), (594331.491,116724.613)	polygon	189.0	182.9			40000.000		4	Liquid	300R-4	316-2	Rp-s	1949	Rp-dn	1974
Trench	594273.63	115861.58			polygon	182.9	3.0	6.1		557.418		4	Liquid	316R-4	316-3	Rp-s	1953	Rp-dn	1963
Crib	590974.44	121671.41			point	7.9	7.9			62.802		4	Liquid	616P-4	316-4	Rp-s	1948	Rp-dn	1956
Trench	594083.81	116715.63	5	(594114.705,116392.304), (594105.094,116887.288), (593992.961,116887.288), (593992.961,116392.304), (594114.705,116392.304)	polygon	467.9	3.0	3.7		1426.062		4	Liquid	316R-4	316-5	Rp-s	1975	Rp-dn	1994
Process Unit/Plant	593983.22	115804.51			Polygon					*99.900*	Chemicals	4	Cement/Liquid	300R-4	325_WTF	Rp-s	*1969*	ABC	*1969*
Drain/Tile Fielc	594641.25	115364.73			polygon					831.109		4	Liquid	316R-4	331_LSLDF	Rp-s	1970	Rp-dn	1974
Trench	594592.13	115395.33			point			2.1		*99.900*	Animal Waste	4	Liquid	316R-4	331_LSLT2	Rp-s	1966	Rp-dn	1974
Storage	594003.44	116284.65			Polygon					*99.900*	Barrels/Drums/Buckets/Cans	4	Liquid	300R-4	333_ESHWSA	Rp-s	1964	ABC	*1964*
Storage	593907.44	116149.45			Polygon					*99.900*	Chemicals	4	Soil-Debris	300R-4	3712_USSA	Rp-s	1961	ABC	*1961*
Unplanned Releas	594171.31	115927.14			point				3.7	*0.999*		4	Liquid	300R-4	UPR-300-1	Rp-s	1969	Rp-dn	1969
Unplanned Releas	593949.25	115795.88			point					*0.999*		4	Liquid	300R-4	UPR-300-10	Rp-s	1977	Rp-dn	1977
Unplanned Releas	594171.00	115929.57			point	0.6	0.9	7.6		0.557		4	Liquid	300R-4	UPR-300-11	Rp-s	1977	Rp-dn	1977
Unplanned Releas	594024.81	115789.26			polygon	12.2	0.3			3.716		4	Liquid	300R-4	UPR-300-12	Rp-s	1979	Rp-dn	1979
Unplanned Releas	594176.50	115935.44			polygon					240.686		4	Liquid	300R-4	UPR-300-2	Rp-s	1954	Rp-dn	*1977*
Unplanned Releas	594290.13	116037.09			point					*0.999*		4	Liquid	300R-4	UPR-300-32	Rp-s	1974	Rp-dn	1974
Unplanned Releas	594290.13	116037.09			point					*0.999*		4	Liquid	300R-4	UPR-300-34	Rp-s	1973	Rp-dn	1973

Unplanned Releas	593891.69	116112.02	polygon				25.948		4	Liquid	300R-4	UPR-300-40	Rp-s	1974	Rp-dn	1974
Unplanned Releas	593895.88	116107.51	point				*0.999*		4	Liquid	300R-4	UPR-300-45	Rp-s	1985	Rp-dn	1985
Unplanned Releas	594000.00	115760.00	point				*0.999*		4	Liquid	300R-4	UPR-300-48	Rp-s	*1991*	Rp-dn	1991
Unplanned Releas	594161.88	115662.42	point	1.2	6.1	0.5	7.432		4	Liquid	300R-4	UPR-300-5	Rp-s	1973	Rp-dn	1973
Unplanned Releas	594152.06	116283.70	point				*0.999*		4	Soil-Debris	300R-4	UPR-300-FF-1	Rp-s	*1945*	Rp-dn	*1990*
Storage	587150.38	123340.51	polygon	12.2	12.2		148.645	Dangerous and mixed alkali metal wastes including mixe sodium waste	4	Soil-Debris	400Q-4	4843	Rp-s	1986	Rp-dn	1997
Process Unit/Plant	593723.23	117350.94	polygon	143.3	91.4		16187.430		*4*	Cement	300R-4	600-117	~~Rp-s~~	1994	ABC	*2020*
French Drain	589348.04	127925.03				4.6	*0.999*		4	Liquid	616M-4	600-58	Rp-s	1988	Rp-dn	*2020*
Storage	589323.19	127908.42	polygon	6.1	4.6		27.877		4	Soil-Debris	600M-4	600-59	Rp-s	1976	Rp-dn	*1976*
Laboratory	591500.00	121500.00		25.0	25.0		625.000		4	Soil-Debris	600P-4	600-259	Rp-s	1984	Rp-dn	1994
Burial Grounc	594020.94	116233.76	polygon	97.5	45.7		3299.915993		4	Soil-Debris	316R-4	618-1	Rp-s	1945	Rp-dn	1951
Burial Grounc	590834.00	121723.23	polygon	152.4	152.4		23225.761		4	Soil-Debris	616P-4	618-10	Rp-s	1954	Rp-dn	1963
Burial Grounc	588977.31	127263.38	polygon	304.8	114.3		34838.641		4	Soil-Debris/Cement	616M-4	618-11	Rp-s	1962	Rp-dn	1967
Burial Grounc	592879.63	116237.92	polygon	38.1	15.2	7.62	580.644		4	Soil and Liquic	316R-4	618-13	Rp-s	1950	Rp-dn	1950
Burial Grounc	594020.63	116360.76	polygon	106.7	65.5		6990.954		4	Soil-Debris	316R-4	618-2	Rp-s	1951	Rp-dn	1954
Burial Grounc	593961.75	116367.56	polygon	121.9	51.2	4.572	6243.084		4	Soil-Debris	316R-4	618-3	Rp-s	1954	Rp-dn	1955
Burial Grounc	593929.31	117011.69	polygon	178.7	68.1		12172.846		4	Soil-Debris	316R-4	618-4	Rp-s	1955	Rp-dn	1961
Burial Grounc	594184.06	116830.02	polygon	96.0	56.0		5376.000		*4*	Soil-Debris	316R-4	618-5	Rp-s	1945	Rp-dn	1962
Burial Grounc	593222.88	116585.24	polygon	216.1	202.4		43736.522		4	Soil-Debris	316R-4	618-7	Rp-s	1960	Rp-dn	1973
Burial Grounc	593820.06	116409.59	polygon	182.9	30.5		5574.183		4	Soil-Debris	316R-4	618-8	Rp-s	1954	Rp-dn	1954
Burial Ground	592821.50	116325.00	polygon	56.4	12.2	4.572	687.483		*4*	Soil-Debris	316R-4	618-9	Rp-s	1950	Rp-dn	1956
											1022	1022				

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Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

A composite analysis is required by U.S. Department of Energy (DOE) Order 435.1 to ensure public safety through the management of active and planned low-level radioactive waste disposal facilities associated with the Hanford Site. The original composite analysis performed in 1998 must be revised because of updated waste site information, updated performance assessments and environmental impact statements, changes in inventory estimates for key sites and constituents, and a change in the definition of offsite receptors.

Beginning in fiscal year 2003, the DOE Richland Operations Office initiated activities, including the development of data packages, to support the composite analysis. This report presents data and interpreted information that supports the groundwater module for the composite analysis. The objective of the groundwater module is to predict movement of radioactive and chemical contaminants through the aquifer to the Columbia River or other potential discharge locations. Future contaminant concentrations in groundwater also need to be known for any location where groundwater may be acquired from water-supply wells. For the composite analysis, this includes all areas outside of the "Core Zone" surrounding the 200 Areas. The Core Zone is assumed to remain under institutional control for the foreseeable future and it is assumed that water supply wells in this zone will be prohibited.

The groundwater module will provide estimates of contaminant concentrations over the time period of the analysis within the unconfined aquifer underlying the Hanford Site outside of the Core Zone. These concentrations will provide the basis for the estimated impact to human health and supplemental ecosystem risk. The groundwater module will also provide predictions of contaminant mass and volumetric flux to the Columbia River over time for the period of analysis. The groundwater prediction for the composite analysis will be for radionuclide contaminants. Chemical contaminants will be simulated as an additional effort to provide perspective to stakeholders, regulators, and Tribal Nations.

This report presents data and information that supports the groundwater module. The conceptual model of groundwater flow and transport at the Hanford Site is described and specific information applied in the numerical implementation module is provided.

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1.0 Introduction

This report presents data and interpreted information that supports the groundwater module of the System Assessment Capability (SAC) as applied to the Hanford Site Composite Analysis.

The composite analysis is an assessment of the cumulative impact from all sources of radioactive contamination, including present and future low-level waste disposal facilities, on the radiation dose to future members of the public (Kincaid et al. 2004). At the Hanford Site, a composite analysis is required for continued disposal of radioactive waste at several existing and planned facilities that are critical for site cleanup.

The SAC is an integrated assessment tool that includes several linked computer models designed to simulate the movement of contaminants from waste sites through the vadose zone, groundwater, and Columbia River to receptors. It also incorporates modules that calculate the risks to human health and the environment. Background information on the development of the SAC is presented in *Preliminary System Assessment Capability Concepts for Architecture, Platform and Data Management* and Kincaid et al. (2000). A discussion of an initial assessment performed with the SAC is presented in Bryce et al. (2002).

1.1 Purpose

The objective of the groundwater module is to predict movement of radioactive and chemical contaminants through the aquifer to the Columbia River or other potential discharge locations. Future contaminant concentrations in groundwater also need to be known for any location where groundwater may be acquired from water-supply wells. For the composite analysis, this includes all areas outside of the "Core Zone" surrounding the 200 Areas (Figure 1.1). The Core Zone is assumed to remain under institutional control for the foreseeable future, and it is assumed that water supply wells in this zone will be prohibited (Kincaid et al. 2004).

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1.2 Scope

The scope of the groundwater module is limited to the unconfined aquifer system within sediments overlying the Columbia River Basalts. The unconfined aquifer system includes some aquifer sediment that is locally confined beneath relatively extensive Ringold Formation mud units. However, the permeable Ringold sediment is interconnected on a site-wide scale. Confined aquifers within the

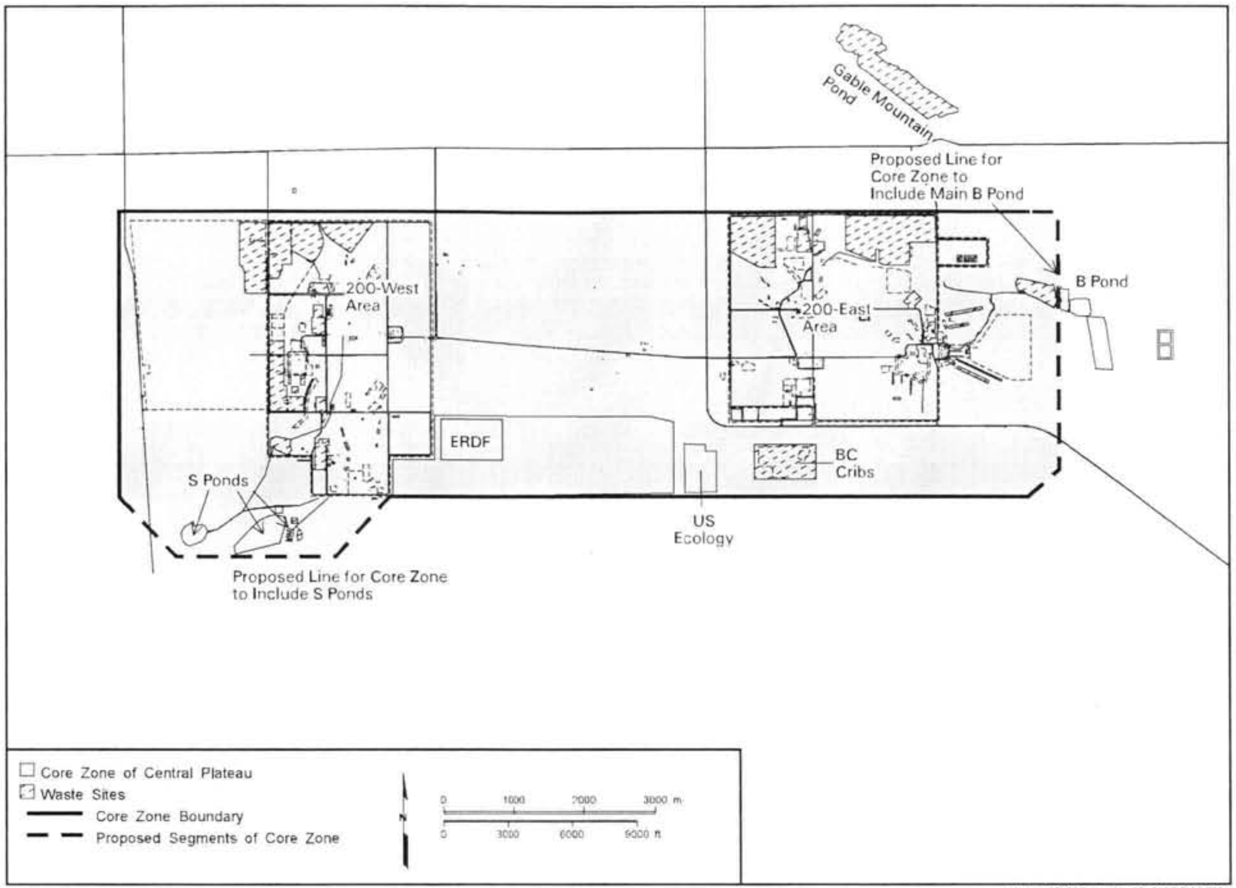

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Figure 1.1. Location of the Core Zone

Columbia River Basalt are not included in the scope of composite analysis simulations. However, potential impacts from groundwater contaminants within the basalt-confined aquifers have been considered in other studies (Spane and Webber 1995; Thorne 1998; Newcomer et al. 2002). Although some Hanford Site contaminants have been found within the basalt-confined aquifers, the concentrations are much lower than those found in the overlying sedimentary aquifer. Therefore, the maximum impact is predicted without including the small mass of contaminants in the basalt-confined aquifer system. Groundwater simulations will extend through the year 3035, thereby including the 1,000 years following an assumed Hanford Site closure date of 2035 as required by U.S. Department of Energy (DOE) Order 435.1 (Kincaid et al. 2004).

1.3 Requirements/Assessment Basis

The objectives, requirements, assessment basis, and scope of the composite analysis are presented in Kincaid et al. (2004). They also describe the modified data quality objectives process applied to the composite analysis.

2.0 Background

Data presented in this report supports a conceptual model of groundwater flow. The conceptual model is a working description of the characteristics and processes that describe the dynamics of the physical and chemical hydrogeologic system. The conceptual model must be consistent with available data and understanding. Assumptions are made to define the conceptual model where information is lacking. However, assumptions must also be consistent with available data and understanding of the groundwater flow system.

2.1 Implementation Model

An "implementation model" was developed based on the conceptual model and incorporated simplifications where needed and appropriate. For example, groundwater-river interactions have been implemented in the model using a specified-head boundary where head in the Columbia River does not change over time. The simplification of the boundary condition would be part of the description of the implementation model. However, the actual groundwater-river interactions, which are affected by both annual and daily fluctuations of river stage, are described in the conceptual model. This simplification is appropriate because only long-term transport to the river is being evaluated in the composite analysis and the effect of short-term river-stage fluctuations is expected to be small. Assumptions, parameters, and even processes in an implementation model may conflict with the available information regarding local details. This is part of the spatial and temporal aggregation process associated with choosing the appropriate simplifications needed to model complex systems (Cole et al. 2001a).

The groundwater flow model used to simulate contaminant transport for the composite analysis is based on the three-dimensional model presented in Cole et al. (2001b). This Hanford site-wide groundwater model has evolved over the past 30 years. A two-dimensional model was initially developed in the 1970s. In the 1980s, work began on building two- and three-dimensional models using the Coupled Fluid, Energy, and Solute Transport (CFEST) code (Gupta 1997). Historical development and earlier calibrations of the CFEST model are described in Chapter 5 of Evans et al. (1989) and in Wurstner et al. (1995). The CFEST code was also used to implement the groundwater flow and transport model used for the composite analysis.

For the composite analysis, the model grid used to simulate transport was refined to reduce errors caused by "numerical dispersion" and permit the use of lower values for hydrodynamic dispersion parameters. The model was calibrated to transient head conditions using an automated inverse modeling technique as described in Cole et al. (2001b). Calibration of the model matched model-predicted hydraulic heads to historical observations of hydraulic head from 1944 through 1996. The transient calibration process included the discharge of large volumes of wastewater to a variety of waste facilities during this period, which caused changes in hydraulic head over parts of the Hanford Site. This artificial recharge to the aquifer raised the water table and created groundwater mounds near discharge facilities. In 1988, the change in Hanford's mission from weapons production to environmental restoration resulted in a reduction in wastewater discharges and significant declines in hydraulic heads.

2.2 Uncertainty

Uncertainties in the conceptual model arise from a lack of information concerning features and events, or a lack of understanding of the processes controlling groundwater flow and transport. It is important to understand these uncertainties and their potential impact on model results. Additional uncertainty arises from simplifications in developing the implementation model. Cole et al. (2001a) provides a detailed discussion of sources of uncertainty in the Hanford site-wide groundwater model. Specific sources of uncertainty pertaining to various components of the groundwater model are discussed in Chapter 5.

2.3 Continuing Model Improvements

Improvements continue to be made in the site-wide groundwater model. These improvements are aimed at quantifying uncertainty within the model and improving model accuracy as recommended by an outside review panel in 1998 (Cole et al. 2001a). The review panel recommended that the concept of uncertainty be acknowledged and that a new modeling framework be established that is stochastic rather than purely deterministic. The panel also requested an assessment of the relative importance of uncertainties due to alternative model structures and constructs of processes (e.g., different zonation, different boundary conditions, large-scale features, stresses, chemical reactions) and due to variations in parameter values. Based on the panel's recommendations, a strategy was devised for assessing model uncertainty through the development and calibration of alternative conceptual models, where the calibration is based on the transient changes in hydraulic heads since the start of Hanford operations. Cole et al. (2001a) presents the proposed strategy for assessing model uncertainty. The model used for the composite analysis is a revision of the "baseline" model resulting from transient calibration. Additional "alternative" conceptual models have been developed that consider hydraulic interactions with the underlying basalt-confined aquifers (Vermeul et al. 2001) and that also include a geologically based zonation of hydraulic properties within the Hanford formation (Unit 1) and the middle Ringold Formation (Unit 5) (Vermeul et al. 2003).

2.4 Interaction with Other SAC Modules

The vadose zone module of SAC provides contaminant flux out of the vadose zone as input to the groundwater module. Water fluxes from large volume waste sites to the water table are also calculated in the vadose zone module. This helps account for the time delay between disposal to the ground and recharge of the aquifer. The input volumes from this artificial recharge are added to natural recharge to define the specified flux boundary at the top of the groundwater model.

Contaminant flux out of the groundwater module is used as input to the Columbia River module and concentrations in groundwater at specified locations are used in the risk module. The groundwater module will provide predictions of contaminant mass and volumetric flux to the Columbia River over time for the period of analysis. The groundwater module will also provide estimates of contaminant concentrations over the time period of the analysis within the unconfined aquifer. These concentrations are used in the Human Health Risk Assessment and Supplemental Ecological Risk Assessment modules.

3.0 Model Input Parameter Requirements

The groundwater flow and transport model required the following types of data and information:

- **Model structure (geometry)** – Three-dimensional model layers representing major hydrogeologic units.
- **Hydraulic property distributions** – Estimates of horizontal and vertical hydraulic conductivity, specific storage, and specific yield for each of the hydrogeologic units.
- **Boundary conditions** – Definitions of each model boundary as specified head, specified flux, head-dependent flux, or no flow. This includes the top and bottom surfaces of the model domain as well as the lateral boundaries.
- **Transport properties** – Distributions of effective porosity, dispersivity, radioactive decay coefficients, and retardation factors for sorbed contaminants.
- **Initial conditions** – Distributions of hydraulic head and contaminant concentrations at the start of the simulation period.
- **Inputs and withdrawals** – Inputs and withdrawals of water volume and contaminant mass (or activity) at specific locations and times during the simulation period. This includes pumping from wells, natural and artificial recharge to the aquifer, and contaminant inputs. Some of the water volume inputs are included in boundary conditions.

4.0 Data Gathering Methods

Data and information supporting the groundwater conceptual model are available in several different documents and electronic databases. Where possible, applicable documents and files containing the data and information are described and referenced rather than listing all information in this data package. Table 4.1 lists pertinent data files. The files are available on the CD distributed with this report. Documents supporting the conceptual model are cited throughout Chapter 5 and are listed in Chapter 9. All elevations in the data tables are based on the NAVD88 sea-level datum. All lateral locations are based on the NAD83 datum and expressed in state plane coordinates (m) for FIPSZONE 4602. Some older documents (pre-1995) may use a different reference datum.

A distinction is made between data and interpreted information as recommended by the Groundwater Modeling Project Peer Review Panel (DOE 1999). For example, measured contaminant concentrations in groundwater samples are data, but plume maps or grids of interpolated contaminant concentrations in the aquifer are interpreted information.

Table 4.1. Summary of Groundwater Data and Information Supporting the Composite Analysis Groundwater Model (files are on the CD distributed with this report)

Description	Value or File Name	File Type
Elevation of the bottom of the model domain	bndbot_CA.dat	ascii grid file
Interpreted elevation for the top of each hydrogeologic unit at wells	geo_CA.xls	EXCEL file
Elevation grids for the top of each hydrogeologic unit applied in the model	u*_top_elev.dat	ascii grid file
Grid node and element locations	elem_nod_CA.xls	EXCEL file
Fluxes at constant flux boundaries	Table 5-1	table in text
Specified-head condition for Columbia River	col_river_CA.dat	text file
Specified-head condition for Yakima River	yak_river_CA.dat	text file
Natural recharge from precipitation	n_rech79_CA.dat	ascii grid file
Artificial recharge/discharge	a_rech_CA.xls	EXCEL file
Hydraulic conductivity for each model node	nod_K_CA.dat	text file
Specific storage applied to model units	Table 5.2	table in text
Specific yield applied to model units	Table 5.2	table in text
Anisotropy (Kz/Kx) applied to model units	Table 5.2	table in text
Porosity – Hanford Gravels (Unit 1)[(a)]	0.25	
Porosity – Ringold Gravels (Units 5, 7, 9)[(a)]	0.1	
Longitudinal dispersivity	Table 5.3	table in text
Transverse dispersivity	Table 5.3	table in text
Radionuclide half-life/specific activity	Table 5.4	table in text
Distribution coefficients for sorbed contaminants (linear sorption isotherm)	Table 5.5	table in text
(a) Total and effective porosity assumed to be equal.		

5.0 Data and Information for the Groundwater Module

This section describes the conceptual model of groundwater flow and transport at the Hanford Site. Supporting data and interpreted information are presented or referenced. It also provides specific information that defines the implementation model. The three-dimensional Hanford site-wide groundwater flow model described in Cole et al. (2001b) was used as a basis for the SAC simulations. However, to support the required transport simulations, a refined model grid was used.

5.1 Groundwater Flow System

Both local and regional groundwater flow systems exist beneath the Hanford Site. The regional aquifer system is composed of saturated transmissive units within the Columbia River Basalt Group and extends from western Idaho through eastern Washington and northeastern Oregon (Figure 5.1). Basalt-confined aquifers within the regional groundwater flow system beneath the Hanford Site are grouped into three separate hydrogeologic units corresponding to three distinct basalt formations (DOE 1989; Cole 2001b). From lowest to highest in elevation, these are the Grande Ronde, the Wanapum, and the Saddle Mountains (Figure 5.1). The basalt-confined aquifers are composed of the brecciated tops of individual basalt flows and sedimentary interbeds between basalt flows. Sediments within the basalts are collectively referred to as the Ellensburg Formation. These aquifers are confined by the relatively impermeable interiors of basalt flows. The local flow system exists within fluvial, lacustrine, and glaciofluvial sediment that have been deposited on top of the Columbia River Basalts within the Pasco Basin. Figure 5.2 shows a cross section of the basalt formations and sediment accumulated within the Pasco Basin. The local aquifer system provides a pathway for transport of contaminants released from past, present, and future site activities. This uppermost saturated zone is termed the unconfined aquifer system, although locally confined conditions may exist in certain areas.

The regional basalt-confined aquifers were excluded from the implementation model because they are generally isolated from contaminants by low-permeability basalt confining layers. Although there is some hydraulic communication between the basalt-confined and unconfined sedimentary flow systems and Hanford Site contaminants have been found within the basalt-confined aquifers, the concentrations are much lower than those found in the overlying sedimentary aquifer (Hartman 2003). The potential for contaminant transport through the confined aquifer has been evaluated by Thorne (1998) and found to present a small risk compared to the potential for contaminant transport in the local unconfined aquifer system. Additional information on the basalt-confined regional aquifer system and communication between the aquifer systems is available in Spane and Vermeul (1994), Spane and Webber (1995), Graham et al. (1984), and Gephardt et al. (1979).

Only the local Pasco Basin unconfined aquifer system that lies west and south of the Columbia River and east and north of the Yakima River were included in the composite analysis groundwater model. The unconfined aquifer system also extends beneath these rivers and exists on both sides of the rivers. However, the model implementation assumes no communication under the rivers. For the Columbia River,

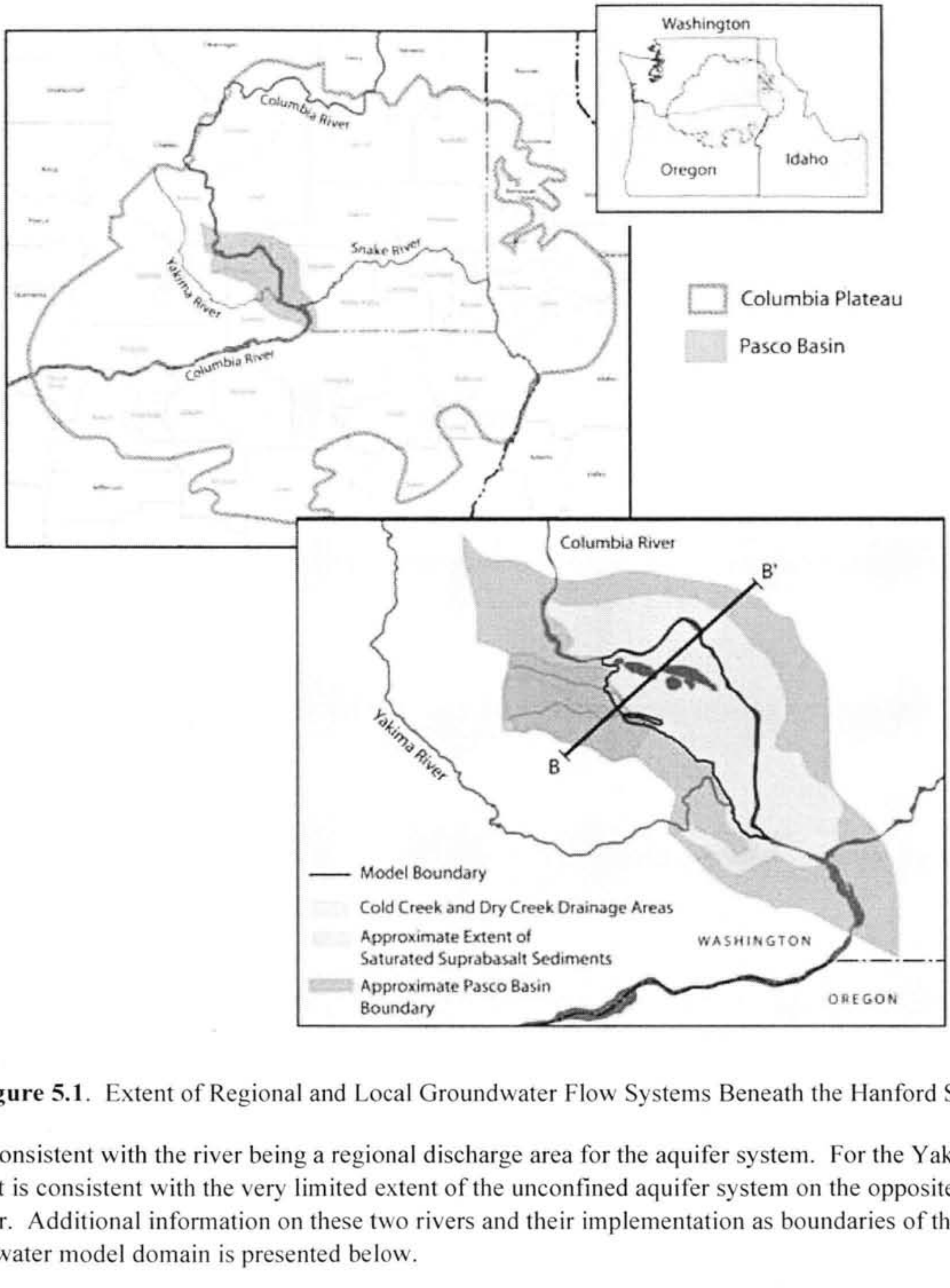

Figure 5.1. Extent of Regional and Local Groundwater Flow Systems Beneath the Hanford Site

this is consistent with the river being a regional discharge area for the aquifer system. For the Yakima River, it is consistent with the very limited extent of the unconfined aquifer system on the opposite side of the river. Additional information on these two rivers and their implementation as boundaries of the groundwater model domain is presented below.

Limiting the groundwater implementation model to the supra-basalt sediment introduces uncertainty because interaction with deeper basalt-confined aquifers is ignored. The nature and significance of this information is being evaluated through the development and calibration of alternative conceptual models as part of a separate groundwater model development task (Vermeul et al. 2001, 2003).

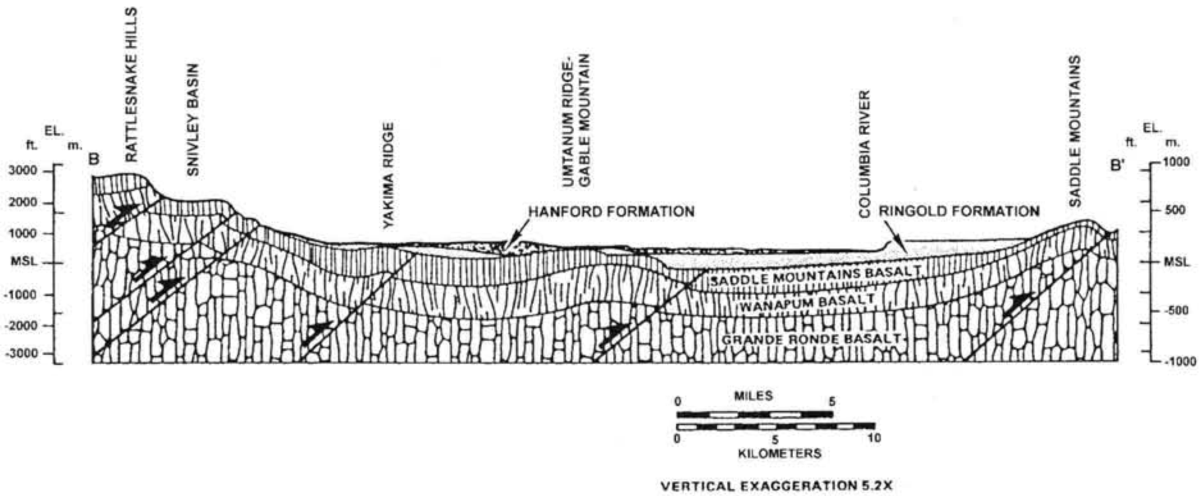

Figure 5.2. Schematic Cross Section of the Pasco Basin (see Figure 5.1 for location)

5.2 Hydrogeologic Units of the Unconfined Aquifer System

Distinct hydrogeologic units within the sediment overlying the basalt bedrock can be correlated between boreholes over distances of several kilometers. The hydrogeologic structure of the groundwater model was designed to reflect differences in hydraulic properties of sediment such as effective porosity and hydraulic conductivity. These properties are related to sediment texture, which is a function of grain-size distribution, sorting, and consolidation/cementation. In developing the three-dimensional model, an effort was made to identify major textural units that influence groundwater flow directions and contaminant transport on a site-wide scale. Delineation of textural units was based primarily on the stratigraphy and sediment facies described by Lindsey (1995).

For the implementation model, sediment overlying the basalt bedrock was grouped into nine major hydrogeologic units. Seven of these units are found below the water table and compose the modeled aquifer system. Units 2 and 3 are above the water table in this implementation of the model. The nine hydrogeologic model units are:

- **Unit 1** – Hanford formation and the underlying, texturally similar, coarse-grained multilithic facies of the Cold Creek Unit (pre-Missoula gravels).
- **Unit 2** – Fluvial/eolian facies of the Cold Creek Unit.
- **Unit 3** – Calcic paleosol sequence of the Cold Creek Units.
- **Unit 4** – Silt and clay facies of the Upper Ringold Unit.
- **Unit 5** – Lindsey's (1995) Ringold gravel units E and C, also includes sand facies of the Upper Ringold Unit where it directly overlies the other E and C gravel units.

- **Unit 6** – Fine-grained overbank and paleosol deposits that vertically separate Lindsey's (1995) unit B from overlying unit C in the eastern part of the Hanford Site.

- **Unit 7** – Lindsey's (1995) Ringold gravel units B and D.

- **Unit 8** – Lower Ringold mud unit (Lindsey 1995).

- **Unit 9** – Lindsey's (1995) Ringold unit A, a gravel and sand facies that is dominated by sand in the western part of the Pasco Basin.

Cross sections of the model units are shown in Figure 5.3. Cross section locations are shown on Figure 5.4. Figure 5.4 also shows the units present at the top of the groundwater model, which is slightly higher than the maximum historical water table at each location. Figure 5.5 shows the units present at the water table for 1944 (pre-Hanford) conditions.

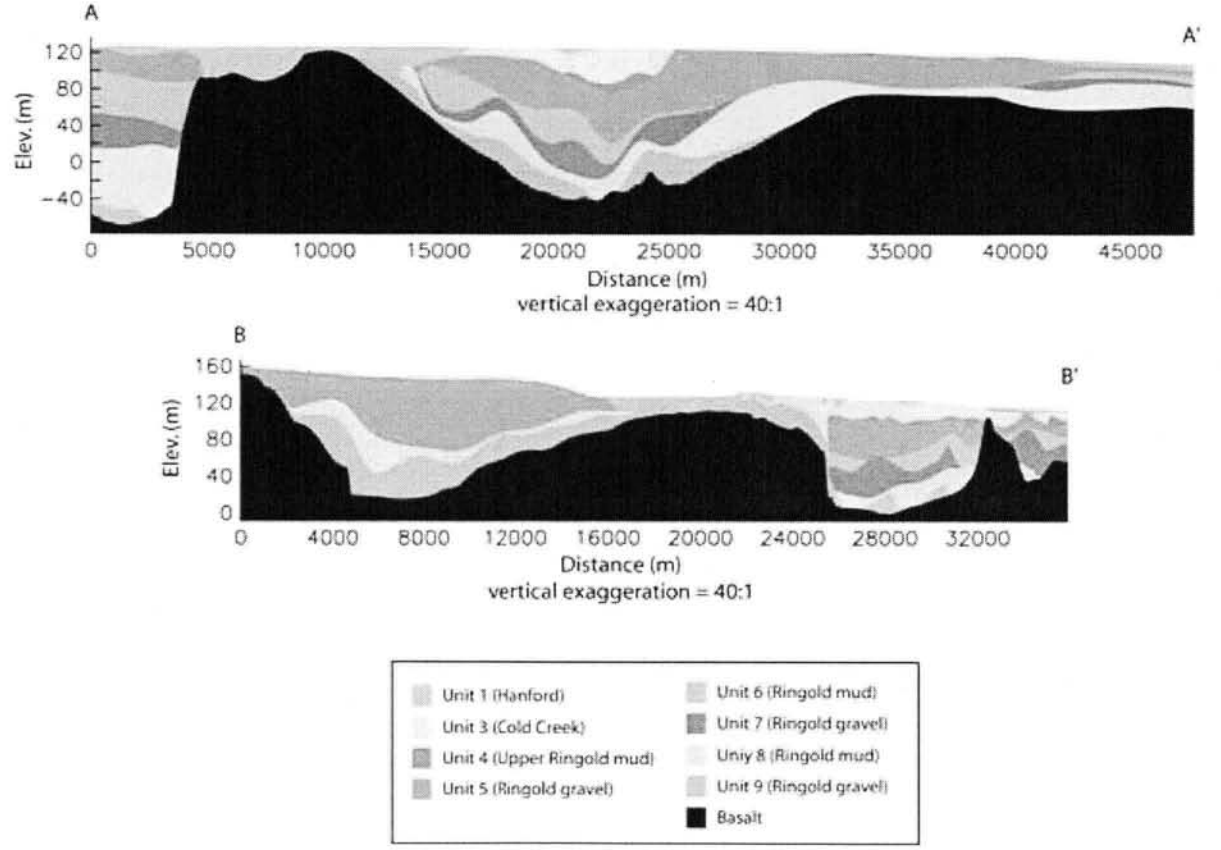

Figure 5.3. Cross-Sections Showing Distributions of Hydrogeologic Units Below the Maximum Water Table Elevation Along A-A' and B-B' (see Figure 5.4 for transect locations)

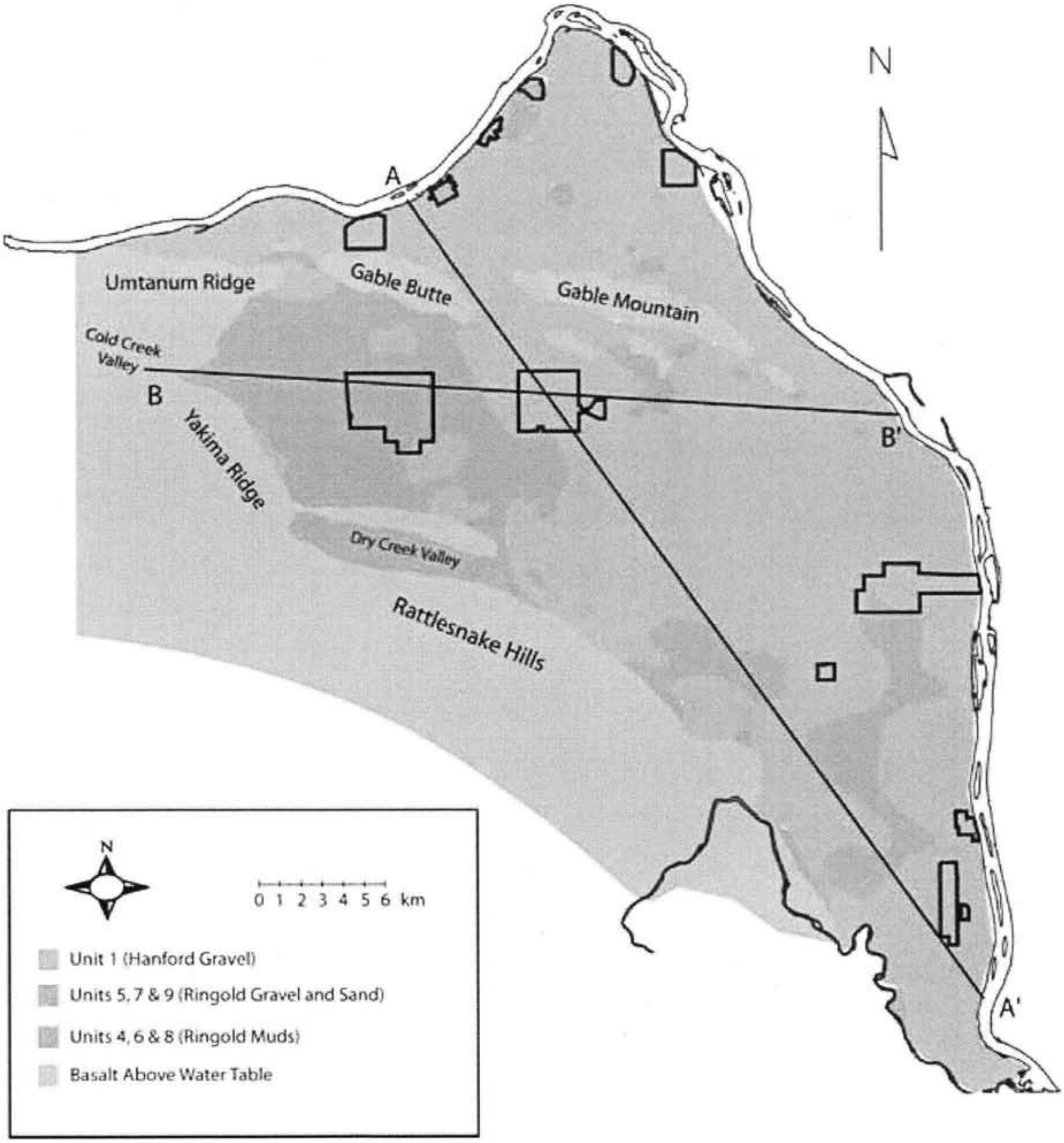

Figure 5.4. Distribution of Hydrogeologic Units at the Top of the Model (maximum water table)

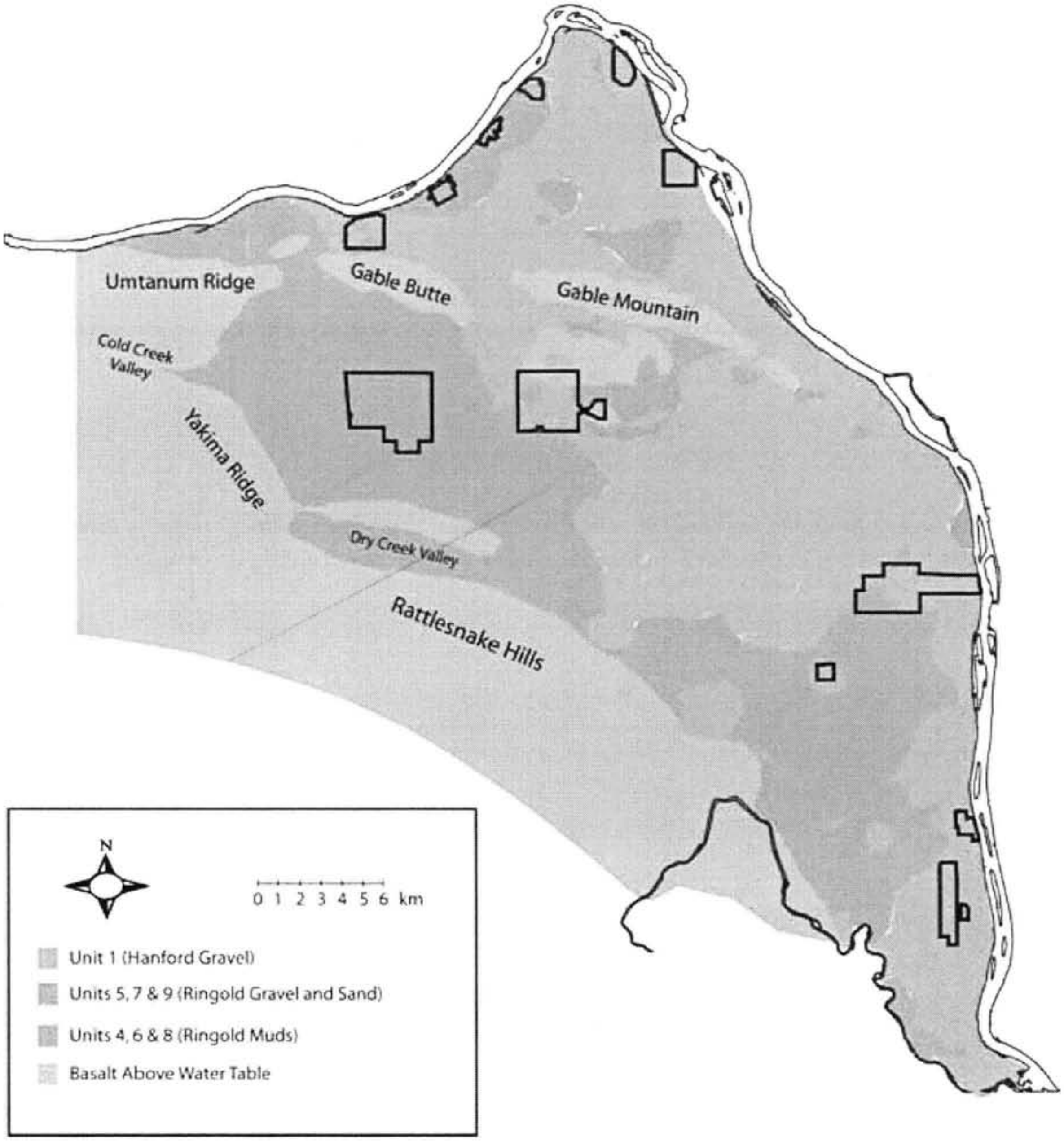

Figure 5.5. Distribution of Hydrogeologic Units Present at the Water Table for 1944 (pre-Hanford) Conditions

In subsequent model implementations (Vermeul et al. 2003), the coarse-grained multilithic facies of the Cold Creek Unit (pre-Missoula gravels) were included in model unit 3 and are found below the water table. This later implementation was still undergoing calibration refinement at the time of the SAC simulations. Information on the geologic setting and additional details on the grouping of sediment for the model units is provided in Cole et al. (2001a). Classification of Ringold Formation sediment into different facies associations based on geologic characteristics and depositional environment is discussed in Lindsey (1995). The depositional environment, facies classifications, and depositional environments of post-Ringold sediment including the Cold Creek Unit and the Hanford formation are discussed in DOE (2002).

Unit top elevations and thicknesses, as well as the elevation for the top of basalt, which forms the base of the groundwater flow model, are primarily based on data from boreholes. The unit geometry information is in the form of unit elevation grids, which are based on "unit picks" for each well used in the interpretation. The unit picks are listed in the file geo_CA.xls, which is on the CD provided with this report. Files containing grids that define elevations for the top and bottom of each of the model units are also provided. Borehole data that are the basis for the unit picks include descriptions of borehole samples (cuttings), particle size analyses of samples, and geophysical logs. Figure 5.6 shows the distribution of wells used for defining model unit geometries.

Sources of uncertainty arising from the borehole data used for defining unit picks include the following:

- Differences in drilling techniques
- Differences in procedures for describing sediments
- Differences in knowledge or training of person making the descriptions
- Losses of coarse-grained particle fraction caused by drilling
- Vertical density of samples
- Quality of geophysical logs

In addition, there is uncertainty in the spatial geometry and continuity of model units that arises from the spatial distribution of borehole data and the lack of knowledge concerning unit configuration below the surface. Differences in hydraulic properties caused by differences in texture, sorting, cementation, and compaction also occur within major units defined for the model. These differences are another source of model uncertainty.

5.3 Boundary Conditions

The conceptual model of groundwater flow beneath the Hanford Site includes several important flow-system boundaries. These include the top and bottom surfaces of the model domain as well as the lateral boundaries. The flow system is bounded by the Columbia River on the north and east and by the Yakima River and basalt ridges on the south and west, respectively. It is bounded below by the Columbia River Basalt formations. Groundwater recharge and discharge takes place at the river boundaries, at the top of the model, and at the bottom of the model. There are also boundaries within the model where basalt

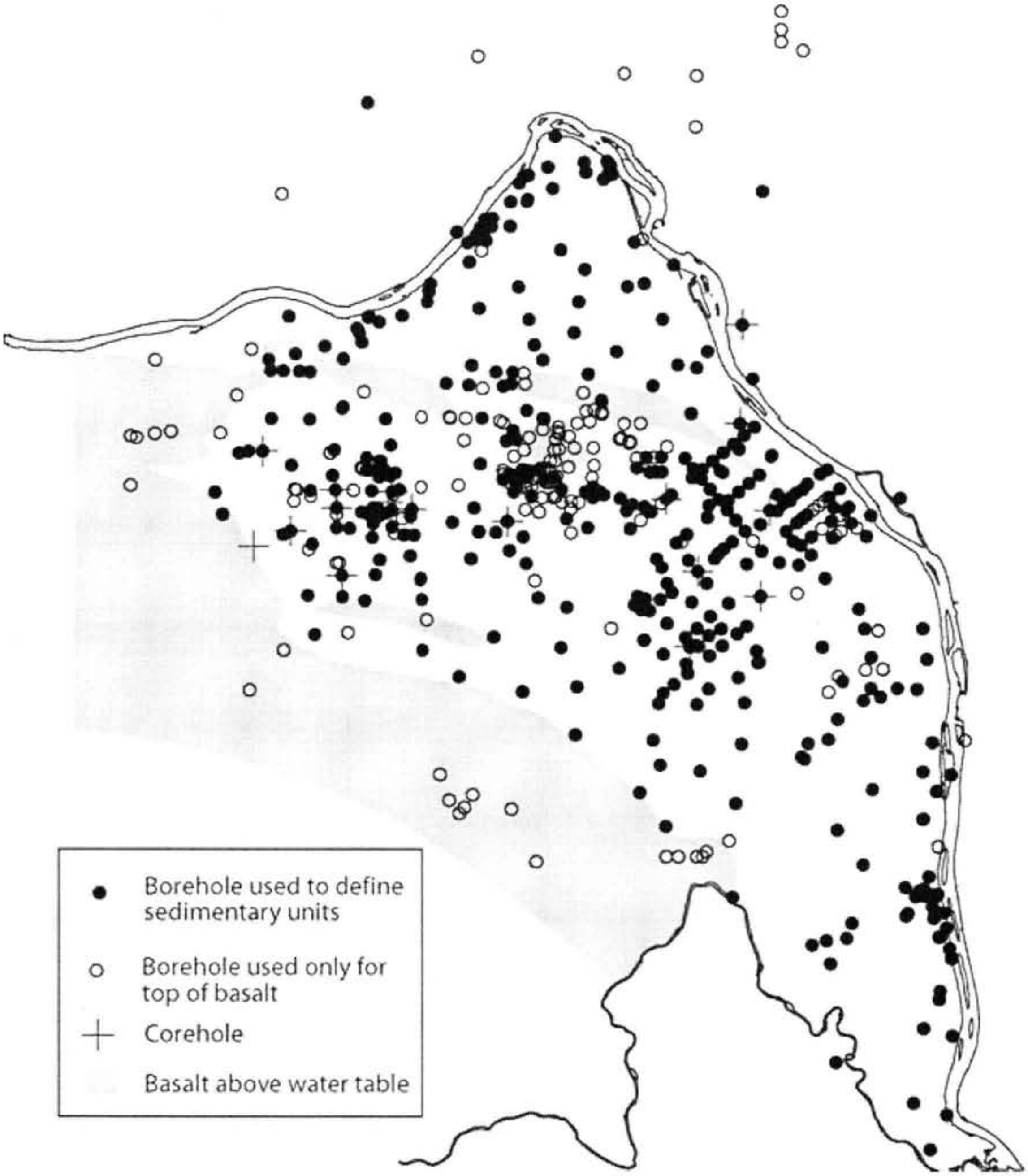

Figure 5.6. Distribution of Boreholes Used to Determine Hydrogeologic Structure for the Composite Analysis Groundwater Model

subcrops above the water table. However, the implementation model assumes that no flow takes place at the bottom of the model or at the boundaries formed by basalt subcrops within the model domain.

For each boundary in the implementation model, a spatial geometry is needed as well as a definition as being a specified head, specified flux, head-dependent flux, or no flow boundary. Parameters defining the flux at boundaries are also needed. The lateral boundary conditions implemented in the groundwater model are illustrated in Figure 5.7 together with the model grid used for the SAC simulations.

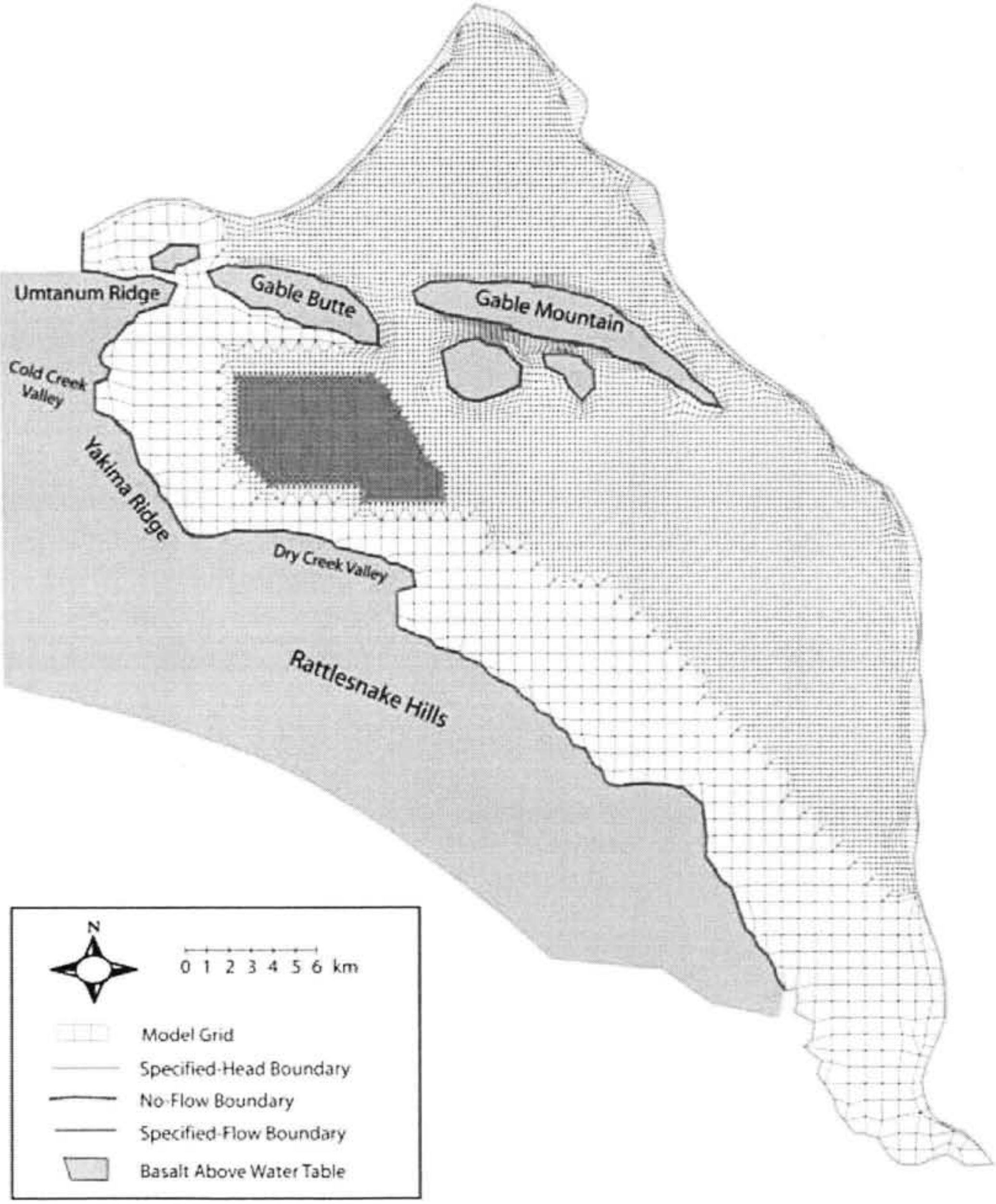

Figure 5.7. Groundwater Model Grid and Lateral Boundary Conditions

5.3.1 Columbia River Boundary

The Columbia River is assumed to represent a point of regional discharge for the unconfined aquifer system. Interpreted water-table elevation contours (Figure 5.8) support this assumption. The amount of groundwater discharging to the river is a function of the local hydraulic gradient between the groundwater elevation adjacent to the river and the river-stage elevation. This hydraulic gradient is highly variable because the river stage is affected by releases from upstream dams. For the section of river below the 300 Area, it is also affected by releases from McNary Dam, below the Hanford Site, because the McNary pool backs up into this area. All available data indicate that groundwater from the shallow flow system discharges to the Columbia River from both banks. The width of the river varies from approximately 300 to 1,000 meters at the Hanford Site. Transects of the river bottom elevation have been measured about every kilometer. The maximum depth of the Columbia River in the area adjacent to the Hanford Site is about 11 meters.

The flow rate of the Columbia River in the Hanford Reach fluctuates significantly and is controlled primarily by releases from dams. There are both seasonal and daily fluctuations in flow, which also cause fluctuations in river stage. Seasonal flows typically peak from April through June, during spring runoff from snowmelt, and are lowest from September through October. The seasonal change in average water level is up to about 2 meters. Daily fluctuations in discharge are caused by releases from dams based on demand for power production. Because of these changes in flow, the river stage varies significantly over a short time period. Vertical fluctuations of more than 1.5 meters during a 24-hour period are common along the Hanford Reach (Dirkes and Hanf 1996).

For the composite analysis implementation model, short-term fluctuations of river stage are not considered. These fluctuations are not expected to have a significant effect on model predictions. Near the river, daily fluctuations may be important because of bank storage effects. River water moving into and out of the aquifer would dilute the concentration of contaminants in the groundwater and may cause contaminants to move some distance downstream parallel to the river before leaving the aquifer. Sampling tubes have recently been installed at multiple depths along the 100 Area shoreline to increase the understanding of the groundwater/river interface (Peterson et al. 1998; Hartman and Peterson 2003). These tubes monitor conditions within or very close to the interface between groundwater and river water. Effects of river stage changes on groundwater near the river have been simulated by using a cross-sectional pathline model near the 100-N Area (Peterson and Connelly 2001). This work showed a delay in contaminants reaching the river because each particle takes a circuitous route rather than moving directly to the riverbank. Movement of water in and out of the aquifer can also increase the release of sorbed contaminants in sediment near the Columbia River as river water moves in and out of the contaminated material. However, these effects are only significant locally, close to the river, and are not expected to have an effect on the long-term predictions of contaminant transport from the Central Plateau to the Columbia River.

The implementation model represents the Columbia River as a prescribed-head boundary. Flow from the aquifer to the river is controlled by the relative heads between the river and aquifer and the hydraulic conductivity of the sediments in contact with the river. To approximate the river boundary conditions, water-surface elevations for the Hanford Reach of the Columbia River were generated using the Modular Aquatic Simulation System 1D (MASS1). The MASS1 simulations are described in detail in Appendix C

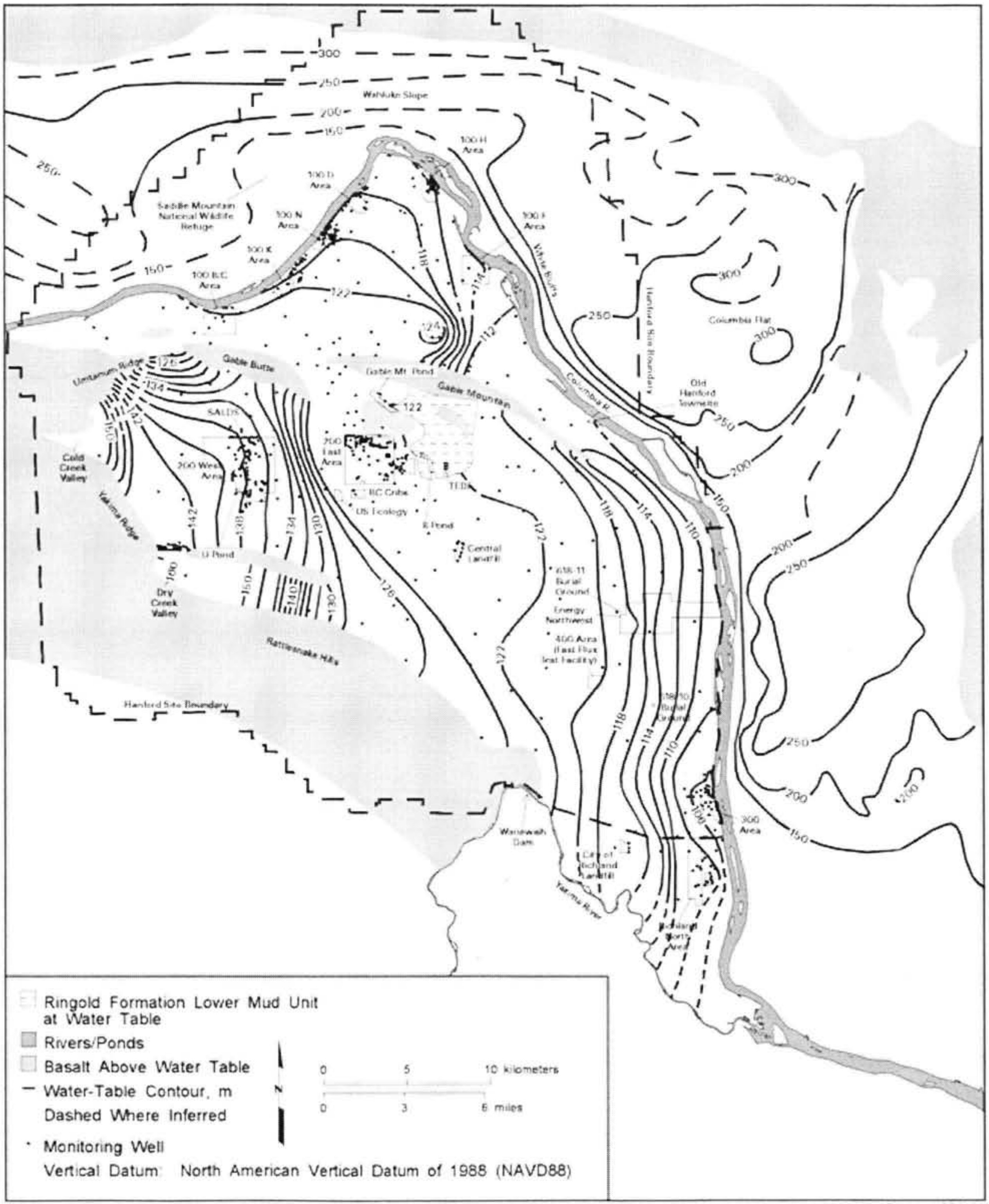

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Figure 5.8. Hanford Site and Outlying Areas Water Table Map, March/April 2000 (Hartman et al. 2001)

of Cole et al. (2001b). The geometry and prescribed-head boundary condition of the Columbia River boundary as applied in the composite analysis model is contained in the file col_river_CA.dat, which is on the CD provided with this report.

5.3.2 Yakima River Boundary

The Yakima River follows the southwestern boundary of the Hanford Site for about 2 kilometers (Figure 5.8), then flows southwest of Richland, partially defining the southern extent of the groundwater model domain. Surface runoff from approximately one-third of the Hanford Site is drained by the Yakima River system. The Yakima River carries much less flow than the Columbia River. The average flow, based on nearly 60 years of records, is about 104 m^3/s, compared to 3,360 m^3/s for the Columbia River.

River stage of the Yakima is generally higher than the water table of the adjacent unconfined aquifer (Figure 5.8). Therefore, the Yakima River represents a potential source of recharge to the aquifer in the southwestern portion of the Hanford Site. As part of a study of groundwater chemistry of the Pasco Basin (Ebbert et al. 1991), the U.S. Geological Survey found evidence that the Yakima River recharges into the unconfined aquifer adjacent to the Hanford Site. This conclusion was based on a comparison between the chemical composition of river water, groundwater from a well completed in the Saddle Mountains Basalt, and groundwater from an offsite well completed in the unconfined aquifer (Ringold Formation) near the river. The recharge rate from the river is controlled by the hydraulic conductivity of sediment adjacent to the river and the head difference between the river and aquifer. The rate of recharge at this boundary is uncertain because of a lack of wells and a corresponding lack of information concerning hydraulic properties and water-level elevations near the river.

To help define aquifer interaction with the Yakima River, river-stage elevation and water levels in an adjacent well were monitored at a location just below Horn Rapids Dam. As reported in Thorne et al. (1993), water levels in the unconfined aquifer at this well showed very little response to changes in river stage. However, the water level of the unconfined aquifer does respond to the filling of a canal (the Horn Rapids Ditch) between the well and the river. The observed response indicates that at this location the Yakima River is isolated from the aquifer by relatively low-permeability sediment. The section of the Yakima River below Horn Rapids Dam flows through flood plain sediment that mainly consists of fine-grained overbank and oxbow lake deposits. The adjacent canal is within the more permeable sediment lying above the water table.

The implementation model represents the Yakima River as a prescribed-head boundary. Flow to the aquifer is controlled by the relative heads between the river and aquifer and the hydraulic conductivity of the sediment in contact with the river. To approximate the river boundary conditions, water-surface elevations for the lower reach of the Yakima River were generated using the MASS1 (Cole et al. 2001b). Results of the MASS1 modeling provided the historical Yakima River stages that were averaged for the model boundary. Seasonal river-stage fluctuations are not expected to significantly affect model predictions. The geometry and prescribed-head boundary condition of the Yakima River boundary as applied in the composite analysis model is contained in the file yak_river_CA.dat, which is on the CD provided with this report.

Flooding of the Yakima River also presents a potential for recharge events to the unconfined aquifer. There have been fewer than 20 major floods on the Yakima River since 1862 (DOE 1988). The development of irrigation reservoirs within the Yakima River Basin has considerably reduced the flood potential of the river. The southern border of the Hanford Site could be susceptible to a 100-year flood on the Yakima River. However, because these events would be infrequent and not greatly influence average patterns of groundwater flow and transport, the potential impact of increased recharge from Yakima flood events has not been considered in the implementation model.

5.3.3 Natural Surface Recharge at Upper Boundary

Natural recharge from precipitation falling on the Hanford Site is highly variable both spatially and temporally, ranging from near zero to more than 100 mm/yr depending on climate, vegetation, and soil texture (Gee et al. 1992; Fayer and Walters 1995). Areas with shrubs and fine-textured soil like silt loams tend to have low recharge rates, while areas with little vegetation and coarse-textured soil, such as dune sands, tend to have high recharge rates. Recharge is also generally higher near the basalt ridges because of greater precipitation and runoff.

Fayer and Walters (1995) developed estimates of natural recharge for 1992 conditions. Distributions of soil and vegetation types were mapped first. A recharge rate was then assigned to each combination on the basis of data from lysimeters, tracer studies, neutron probe measurements, and computer modeling. Estimated recharge rates for 1992 were found to range from 2.6 to 127 mm/yr, and the total volume of natural recharge from precipitation over the Hanford Site was estimated to be 2.35×10^4 m^3/d. This value is of the same order of magnitude as the artificial recharge to the 200-Area waste disposal facilities during 1992 and approximately six times less than peak discharges to these facilities during the 1960s. Uncertainty in the recharge estimates results from gaps in data and incomplete consideration and understanding of processes involved. These uncertainties are discussed in Fayer and Walters (1995) and Cole et al. 2001a.

To support the Hanford site-wide groundwater model, recharge was also calculated for 1979 vegetation/land-use patterns (Fayer et al. 1996). The 1992 estimates were affected by vegetation changes resulting from a fire in the southern part of the Hanford Site. Anthropomorphic alteration of soil and vegetation (e.g., gravel-covered tank farms; subsoil sand brought to the surface in many waste disposal areas) was not accounted for because it is not expected to remain over the time scale of the model simulations. A map of recharge based on 1979 conditions is shown in Figure 5.9. The recharge estimates applied in the model were scaled to 171% of the values shown in Figure 5.9 based on model calibration (Cole et al. 2001b). Natural recharge applied to the model was assumed to be constant over time. The recharge information is contained in the file called n_rech_CA.dat, which is on the CD provided with this report. This file represents a regular grid with a 50-meter by 50-meter spacing. The recharge values are in millimeters per year.

The estimated recharge rates applied in the composite analysis model do not reflect historical 1979 recharge rates. Rather, they reflect the distribution of recharge estimated using the current climate, the Hajek (1966) soil map, and the 1979 vegetation/land-use patterns. Exactly when these estimated rates apply to the water table depends on the propagation of the diffused pressure wave through the unsaturated zone, which varies as a function of precipitation intensity and duration, atmospheric conditions, initial

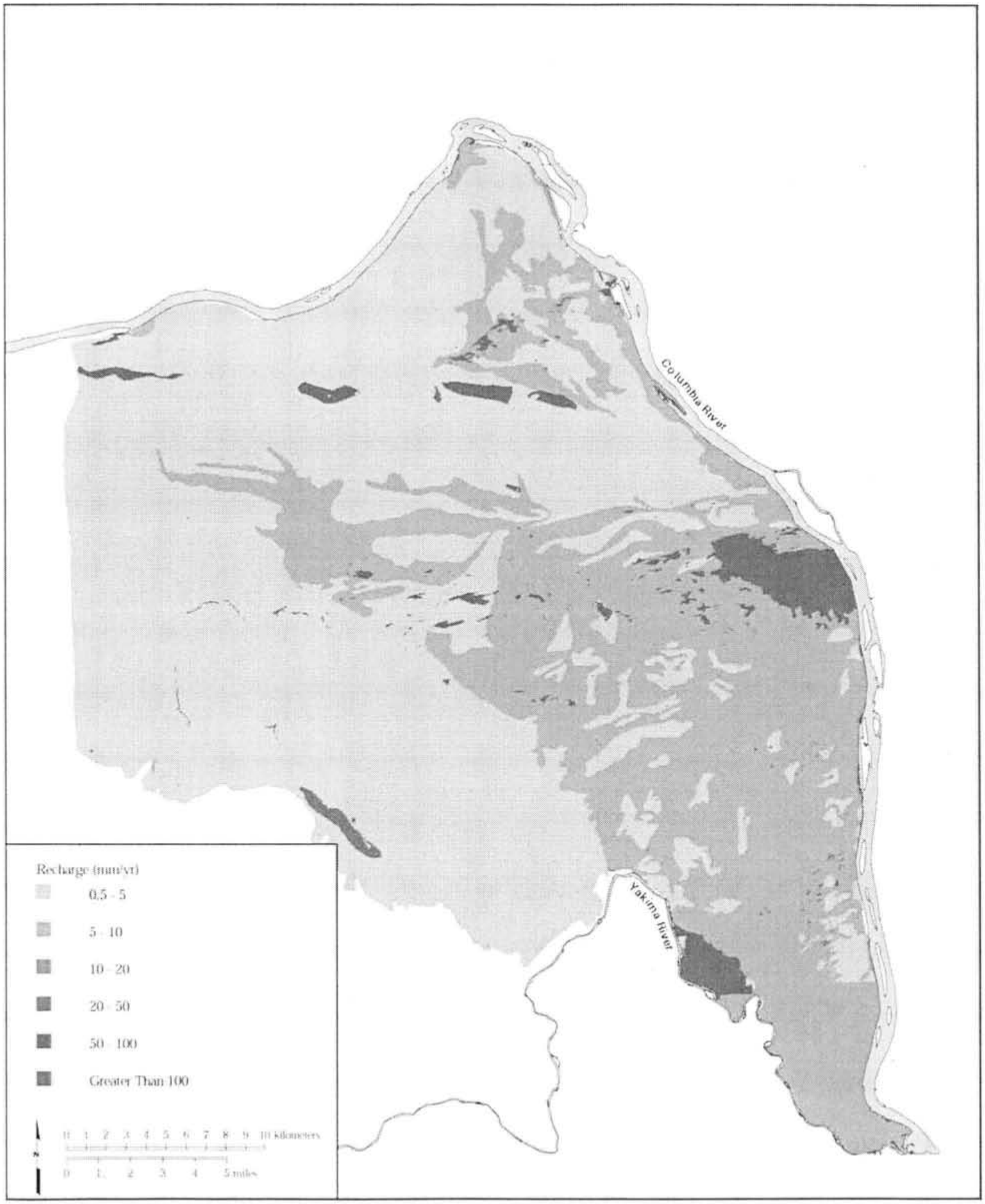

Figure 5.9. Estimates of Natural Recharge Based on 1979 Vegetation and Land-Use Patterns Without Considering Anthropomorphic Alternation

water content, type of topsoil, geostratigraphy, and vadose zone thickness across the site. At this point, very little is known quantitatively about most of these characteristics and the complex relationships between them across the site.

5.3.4 Recharge Along Western Model Boundary and Basalt Subcrops

Two main sources of natural recharge occur along the western model boundary. These are infiltration from stream flow or runoff that originates outside the domain and flows into the model domain, and lateral subsurface flow from outside the model domain. Springs contribute to both these sources. Cushing and Vaughan (1988) indicated that there may be more than 100 springs and spring locations in the higher elevations to the west of Hanford, but only two (Snively and Rattlesnake) appeared to be significant. Flow from both of these springs is thought to originate from basalt-confined aquifers. Studies of Rattlesnake Springs indicate that baseflow is 864 m^3/d and can range up to 1,340 m^3/d in winter. Baseflow for Snively Springs was estimated to be 432 m^3/d.

To approximate the groundwater flux entering the model domain, both prescribed head and prescribed flux boundary conditions were defined in the implementation model. Prescribed-head boundary conditions were used in previous steady-state calibration of the model (Cole et al. 1997) to estimate boundary fluxes entering into the aquifer system from the Cold Creek and Dry Creek Valleys as well as along the Rattlesnake Hills. These calculated fluxes provided the initial estimates of boundary fluxes used in the transient inverse calibration. The boundary recharge fluxes are summarized in Table 5.1 and compared with the volume of natural recharge from the surface. The boundary fluxes and natural surface recharge were scaled as parameters in the inversing process together with the hydraulic properties of conductive hydrogeologic units to achieve the best match to observed hydraulic head data over the transient calibration period. The inverse calibration process and results are described in more detail in Cole et al. (2001b). The recharge from the Dry Creek Valley boundary was insensitive in the inversing and was, therefore, fixed at the initial value.

Table 5.1. Fluxes from Four Recharge Sources Resulting from Transient Calibration (Cole et al. 2001b)

Recharge Area	Initial Values	Transient Calibration[(a)]
Cold Creek Valley	2,881 m^3/d	6,021 m^3/d
Dry Creek Valley	1,207 m^3/d	1,207 m^3/d
Rattlesnake Hills	3,104 m^3/d	13,566 m^3/d
Surface natural recharge	8.47 x 10^6 m^3/yr	1.45 x 10^7 m^3/yr
(a) Values applied in composite analysis groundwater model.		

Lateral perimeter boundary segments not identified as constant-head boundaries in Figure 5.6 were defined as no-flow boundaries in the model. Except the short segment between Umtanum Ridge and the Columbia River, these boundaries represent basalt rising above the water table. For the segment between Umtanum Ridge and the Columbia River, flow is assumed to be predominantly toward the river and little flow is expected across the boundary. Inflow from precipitation on Rattlesnake Mountain is accounted for by the Rattlesnake Hills constant-flux boundary (Figure 5.7). No-flow boundaries also occur within the model domain where basalt subcrops above the water table.

There is uncertainty in the boundary fluxes because they were not measured independently. There is an ongoing effort to independently estimate the runoff and potential underflow for these boundaries (Waichler et al. 2004). Also, the applied recharge is constant over time, whereas actual recharge events are episodic. Potential runoff from elevated basalt areas along part of the western boundary and within the model domain, such as Gable Mountain, was not accounted for in the current model. However, it is known that some runoff does occur.

5.3.5 Artificial Recharge at Upper Boundary

Artificial recharge from wastewater disposal is important information for groundwater modeling at Hanford because the volumes of artificial recharge since 1944 have been significantly greater than the volume of recharge from natural sources. Over the past 50 years, the large volume of wastewater discharged to disposal facilities at the Hanford Site has significantly affected groundwater flow and contaminant transport in the unconfined aquifer. As shown in Figure 5.10, the annual volume of artificial recharge has decreased significantly since 1985.

Artificial recharge information for the groundwater flow model is contained in the EXCEL file a_rech_CA.xls, which is on the CD provided with this report. This file lists the estimated volume of artificial recharge over time for each wastewater discharge site. The values are based on data presented in quarterly discharge reports for Hanford facilities. The file also includes net recharge at the North Richland well field where water is pumped from the Columbia River into recharge basins and then a smaller volume is extracted from nearby wells.

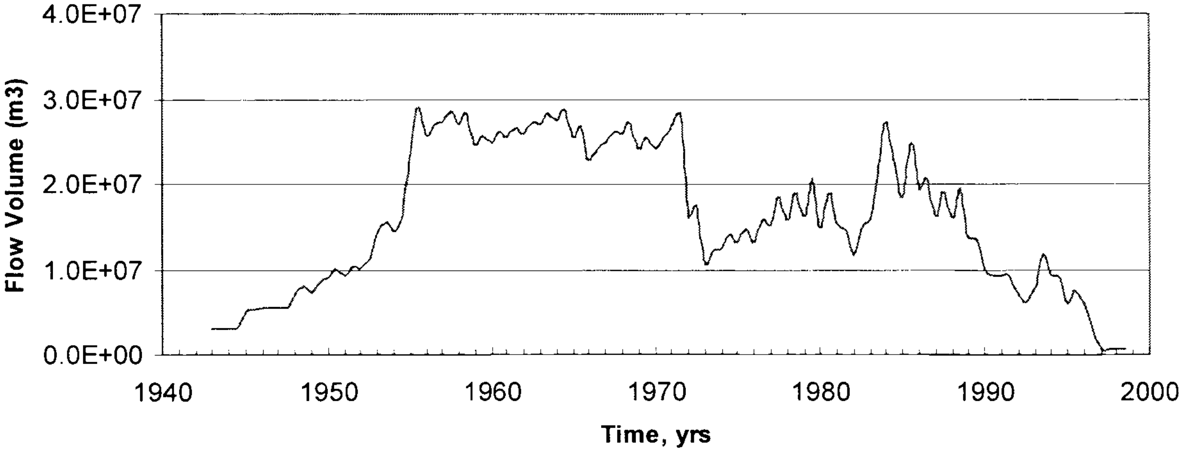

Figure 5.10. Artificial Discharges to the Unconfined Aquifer from 1943 to 1998

Uncertainties in the volume and timing of artificial recharge arise from uncertainty in the available discharge records and from simplification concerning delivery of water from the discharge point to the aquifer. The artificial recharge sources included in the current composite analysis model are based on information reported in a series of internal reports on effluent discharges and solid waste management issued by the Hanford Operations Contractor. Because of incomplete records, only about 80% of the sources are known with some accuracy. It is also possible that a significant volume of artificial recharge occurred through leaks in the water distribution system, but has not been accounted for in the model. The model also does not account for evaporation from surface ponds and ditches. Uncertainties also exist in the spatial location and timing of recharge arrival at the water table. The flux of artificial recharge to groundwater model nodes beneath each disposal facility is calculated in the composite analysis vadose zone module using a simple one-dimensional unsaturated flow model (Last et al. 2004).

Future land use on the Hanford Site is another source of uncertainty in predicted future artificial recharge. Previous analyses of post-Hanford Site unconfined aquifer conditions have considered land uses such as large-scale irrigation on the Hanford Site that could significantly alter the long-term behavior of the unconfined aquifer beneath the Hanford Site. The potential for large-scale agricultural irrigation on the Hanford Site in the future was examined for the composite analysis. Consultations with staff from the Agricultural Research Service at the Agricultural Experiment Station in Prosser, Washington, resulted in the conclusion that the prospect of large-scale irrigation occurring on the Hanford Site is unlikely because of limitations on regional water resources (Kincaid et al. 1998).

5.3.6 Lower Model Boundary

Interflow (recharge and discharge) between the basalt-confined aquifer system and the unconfined aquifer system is known to occur (Graham et al. 1984; DOE 1988; Jensen 1987). However, it is postulated to be small relative to the large volume of artificial recharge during the Hanford Site operational period. Lower artificial recharge volumes during the past decade and predicted for future Hanford Site conditions make interflow with the underlying basalt aquifers a more significant component of groundwater flow in the future.

The composite analysis groundwater model assumes that the lower boundary of the sedimentary aquifer system is the top of the underlying basalt bedrock and that the basalt is impermeable. Hydraulic interaction between the unconfined aquifer system and the underlying basalt-confined aquifers is being investigated as an alternative conceptual model (Vermeul et al. 2001). For additional information on mechanisms of potential interaction between the aquifers and volumes estimated through calibration of an alternative conceptual model, see Vermeul et al. (2001).

The geometry of the lower impermeable boundary applied in the composite analysis model is defined by the grid file "bnd_bot_CA.dat" and can be found on the CD provided with this report.

5.3.7 Discharge from Onsite Wells

Wells used for water supply on the Hanford Site and the adjacent Arid Lands Ecology Reserve are described in Poston et al. (2000). Within the Hanford Site boundary, only the Fast Flux Test Facility water supply wells are accounted for in the composite analysis groundwater model. The volume of withdrawal at the other Hanford Site wells is too low to affect model results. Other water-supply wells located south of the Hanford Site, but within the model domain were also accounted for in the flow model. Extraction volumes for wells are listed as negative values in the file "a_rech_CA.xls," which lists the artificial recharge applied in the model.

5.4 Hydraulic Property Parameters

Hydraulic properties needed for the groundwater model include spatial distributions of hydraulic conductivity, specific storage, and specific yield for each of the hydrogeologic units. In addition, the distribution of vertical anisotropy of hydraulic conductivity was needed. Ranges and values for these parameters applied to each of the hydrogeologic units in the composite analysis groundwater model are listed in Table 5.2. Ranges given for hydraulic conductivity reflect the spatial variability resulting from calibration of the groundwater flow model (see Cole et al. 2001b for details) rather than probability distributions. Single values were applied for the other parameters.

Table 5.2. Ranges of Hydraulic Property Values Applied to Each Composite Analysis Model Unit

Unit	Minimum Kx (m/d)	Maximum Kx (m/d)	Specific Yield	Storage Coefficient	Anisotropy (Kz/Kx)
1	1.6	29843	0.07	1E-06	0.1
2	NA	NA	NA	NA	NA
3	14.2	190.5	0.1	1E-06	0.1
4	0.005	0.005	0.05	1E-06	0.1
5	0.09	3817	0.212	1E-06	0.1
6	0.01	0.10	0.05	1E-06	0.1
7	0.008	85.7	0.1	1E-06	0.1
8	0.00005	0.00005	0.05	1E-06	0.1
9	0.008	210.8	0.1	1E-06	0.1

Hydraulic conductivity and specific yield values applied in the implementation model resulted from a three-dimensional transient inverse calibration of the flow model described in Cole et al. (2001b). This calibration was recommended by an external peer review panel and was performed using UCODE, a universal inverse modeling code developed jointly by the U.S. Geological Survey and the International Groundwater Modeling Center of the Colorado School of Mines. See Cole et al. (2001b) for additional details on the calibration procedure and information on UCODE and its application to the inverse transient calibration.

The calibration period was 1943 through 1996. During this period of time, large volumes of wastewater were discharged to a variety of waste facilities resulting in large water-table changes over much of the Hanford Site. The discharges created significant groundwater mounds (in excess of 20 meters) under waste management facilities in the central part of the site. Since 1988, the mission of the Hanford Site has changed from producing weapons to restoring the environment, and wastewater discharges have declined significantly, which has caused significant water-table declines. The transient inverse calibration was implemented with the CFEST code, which is the forward model whose parameters are estimated by UCODE. The transient inverse calibration uses over 76,000 water-level measurements taken in about 1,200 wells at the Hanford Site since the mid-1940s. The initial baseline transient inverse calibration effort (Cole et al. 2001b) significantly improved the capability of the baseline model over the prior model to simulate historical trends in water-table changes over the entire site for the entire 1943-1996 period of calibration, most notably the historical trends of water-table changes and mound building observed near major discharge facilities in the 200 West Area.

Figure 5.11 shows the hydraulic conductivity distribution that resulted from the calibration process for sediment at the top of the model. The top of the model represents the maximum water table at each location over the calibration period. Figures 5.12 and 5.13 show cross sections through the model that compare unit definition with the calculated hydraulic conductivities. Cross section locations are shown on Figure 5.11. Files containing the hydraulic conductivity values for each model node (node_K_CA.dat) and the grid node and element locations (elem_nod_CA.dat.) are on the CD provided with this report.

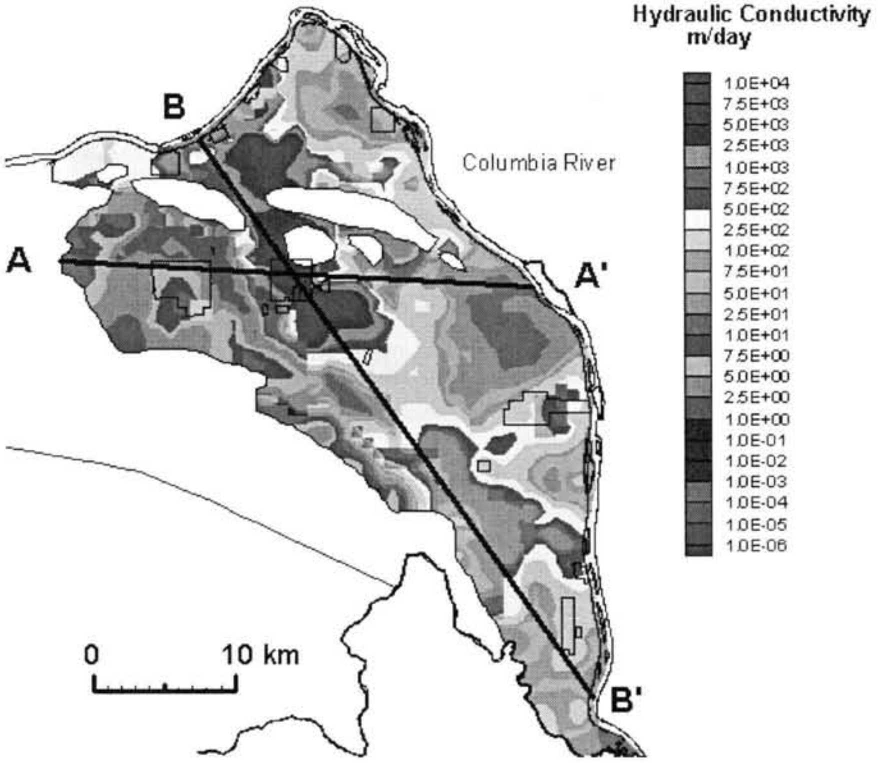

Figure 5.11. Hydraulic Conductivity Distribution for Units at Top of Model (maximum water table)

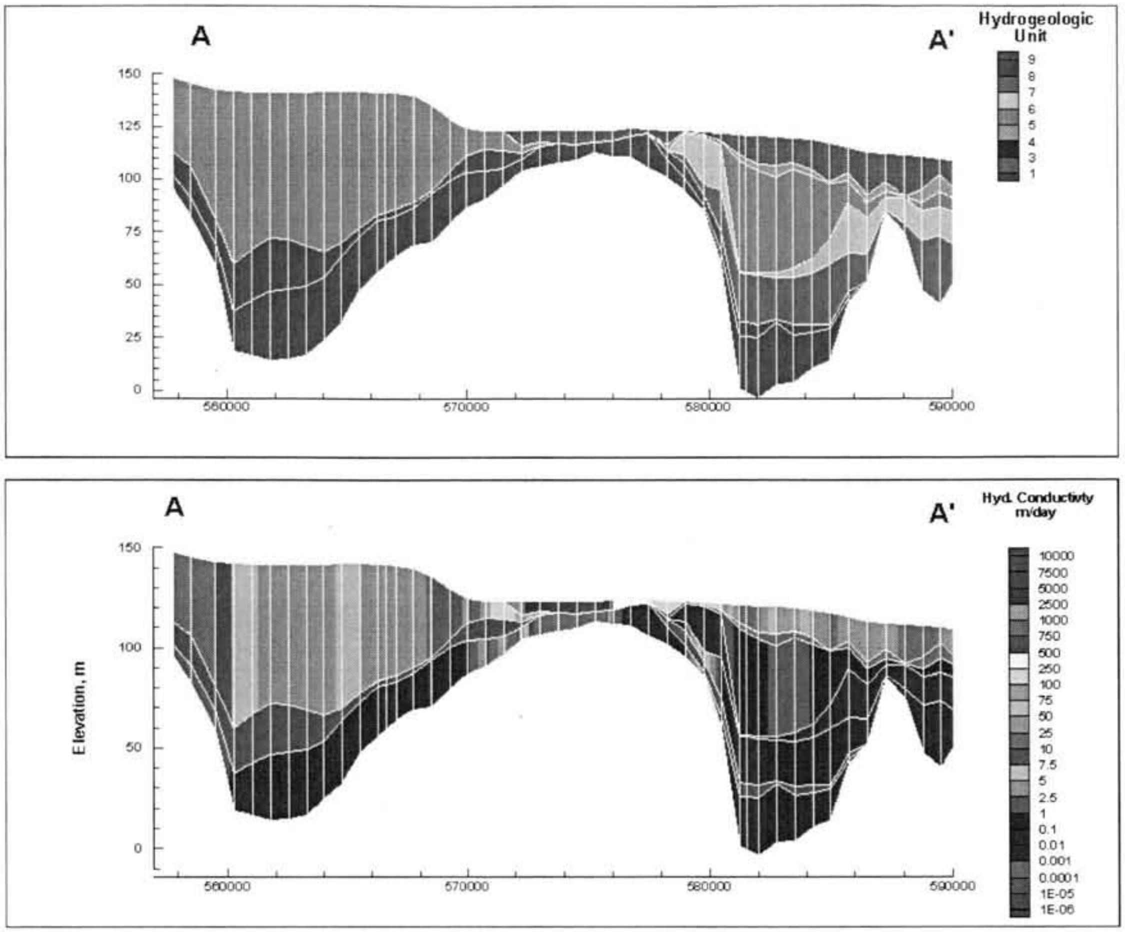

Figure 5.12. Cross Section of Model Along A-A' Showing Distribution of Hydrogeologic Units (top) and Hydraulic Conductivity (bottom)

Values for specific storage and anisotropy were set as constants for each of the model units as specified in Table 5.2. These values were based on data on aquifer tests and on knowledge of sediment characteristics. Because the aquifer is predominantly unconfined, errors in the specific storage values applied in the model are not expected to have a significant effect on predicted hydraulic head or contaminant transport. Errors in the estimated vertical anisotropy may affect the vertical flow of groundwater within the model.

Hydraulic property data from aquifer tests are available for wells within the model domain. These data are useful for qualitative comparison with hydraulic property values resulting from model calibration. The aquifer test data are described in Thorne and Newcomer (1992), Thorne et al. (1993, 1994), Wurstner et al. (1995), and Cole et al. (2001a). A database for aquifer hydraulic properties derived from aquifer tests is under development (Thorne and Newcomer 2002).

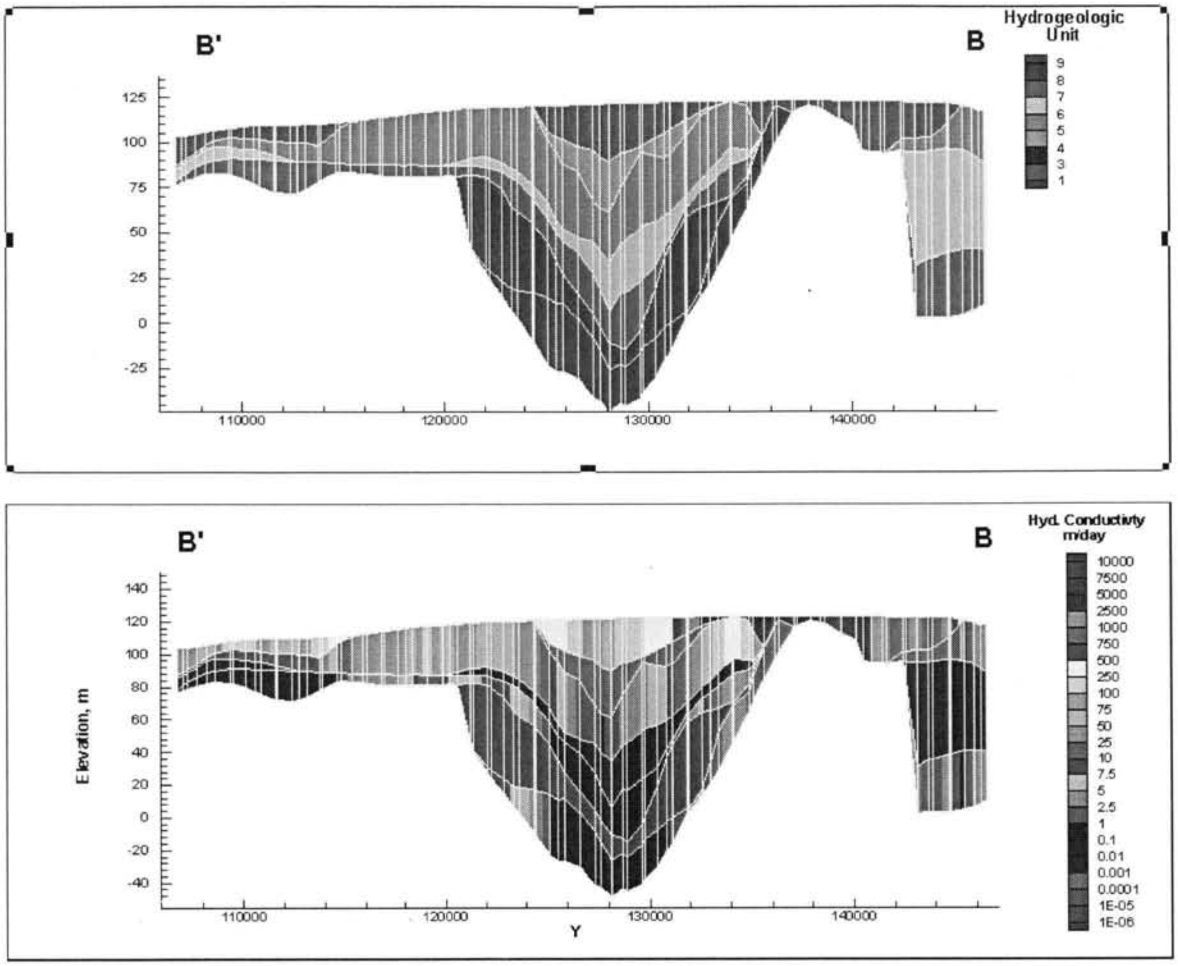

Figure 5.13. Cross Section of Model Along B-B' Showing Distribution of Hydrogeologic Units (top) and Hydraulic Conductivity (bottom)

5.5 Contaminant Transport Parameters

Contaminant transport through groundwater was modeled based on the discharge velocity field calculated by the groundwater flow model and specified transport properties. The initial conditions assumed that concentrations of modeled contaminants were negligible in 1944, prior to the start of Hanford Site operations. Transport properties used in the model include the following:

- Porosity
- Dispersivity
- Radioactive decay coefficients (or half-lives)
- Retardation factors for sorbed contaminants

Porosity (equivalent to effective porosity) was assumed to be 0.25 for the Hanford formation and Cold Creek gravel unit sediment. For the Ringold gravels, a porosity of 0.1 was assumed. These values are in the ranges from measurements for Ringold and Hanford formation gravel sediment (Wurstner et al. 1995) and are also reasonable based on values from the literature (Freeze and Cherry 1979).

Values for longitudinal dispersivity, I_L, and transverse dispersivity, I_T, used in the groundwater transport model are listed in Table 5.3. Dispersivity is a scale dependent parameter and can only be determined from inverse modeling of tracer tests on the scale of interest. Because very few such large-scale tracer tests have been conducted and none have been conducted at the Hanford Site, the dispersivity values used in the groundwater transport model were not based on Hanford Site data. However, I_L for the Hanford formation and Cold Creek gravel unit is in the range of 60 to 120 meters determined by Van der Kamp et al. (1994) for a plume that moved 7.7 kilometers at an average pore velocity of 380 meters per year. By comparison, the distance moved by the tritium plume from 200 East Area to the Columbia River was about 14 kilometers at a velocity of about 800 meters per year (Freshley and Graham 1988).

Table 5.3. Dispersivity Values Used in the Composite Analysis Groundwater Transport Model

Sediment Type	I_L (m)	I_T (m)
Hanford/Pre-Missoula Gravels (unit 1)	62.5	12.5
Ringold Gravels (units 5, 7, and 9)	30	6

Dispersivity values used in the Hanford site-wide groundwater model also satisfy the following constraints:

- The grid Peclet number, P_e=(grid spacing)/I_L must be less than 4 for acceptable solutions in finite element simulations (Campbell et al. 1981). The 30-meter longitudinal dispersivity value meets this criterion for the 83-meter grid spacing, which is used where most contaminant transport from the 200 West Area occurs. The 62.5-meter longitudinal dispersivity value meets this criterion for the 250- by 250-meter grid spacing, which is used where most contaminant transport from the 200 East Area occurs. A larger value was not selected because large values of I_L are not conservative in transport calculations.

- At the grid scale, the flow system is homogeneous. Heterogeneities at scales less than 150 meters are uncharacterized and the maximum selected I_L of 62.5 m is less than this distance.

- The ratio of $I_L/I_T = 5$ is within the suggested range of 1 to 24 cited by Walton (1985) and 5 to 20 indicated by Freeze and Cherry (1979).

The U.S. Environmental Protection Agency (Mills et al. 1995) indicates that "A rough estimate of longitudinal dispersivity in saturated porous media may be made by setting I_L equal to 10% of the mean travel distance." The distance from the closest source in the 200 East Area to the Columbia River is about 17 kilometers. Using the 10% rule-of-thumb would suggest a value of 1,700 meters for I_L for this simulation. However, this is much larger than the scale of uncharacterized heterogeneity within the model. Also, large values of dispersivity are not conservative in that they tend to reduce maximum contaminant concentrations too much at smaller distances. Using the 62.5-meter value for I_L, estimates of concentration at 625 meters from the source should be accurate and for greater distances, they should be conservative. This is also the smallest value that could be used with the grid spacing selected and meet the condition for the Peclet number described above.

Decay of radioactive constituents is controlled by the specific activity, which is related to the half-life of the radioactive isotope. Consistent values are used in all of the SAC modules and are listed in Table 5.4.

Retardation of sorbed contaminants was calculated based on a linear isotherm model. The distribution coefficients (K_d) assigned to each contaminant are listed in Table 5.5. These values were consistently used in all SAC modules. The K_d was treated as a stochastic parameter for the non-zero K_d contaminants in the assessment. Therefore, the minimum, maximum, and type of population distribution for each parameter is also listed. The K_d values used for groundwater transport assume low ionic strength and near neutral acidity with low organic content.

Table 5.4. Half-Lives and Specific Activities for Radioactive Contaminants

Contaminant	Half-Life (Y)	Specific Activity (Ci/g)
Tritium	12.3	9.681E+3
Tc-99	2.13E+5	1.697E-2
I-129	1.70E+7	1.632E-4
U-238	4.51E+09	3.363E-7
Sr-90	28.9	1.366E+2
Cs-137	30.2	8.706E+1
Pu-239/240	2.44E+04	6.209E-2

Table 5.5. Distribution Coefficients and Effective Retardation Factors

Waste Chemistry/Source Category 6: Low Organic/Low Salt/Near Neutral - Groundwater				
	Best	Min	Max	
Element	K_d (mL/g)	K_d (mL/g)	K_d (mL/g)	Probability Distribution
Tritium	0	0	0	NA
Technetium	0	0	0.1	Ln normal
Iodine	0.2	0	2	Ln normal
Uranium	0.8	0.2	4	Ln normal
Strontium	22	10	50	Ln normal
Cesium	2,000	200	10,000	Ln normal
Plutonium	600	200	2,000	Ln normal
Carbon Tetrachloride	0.2	0.1	0.6	Ln normal
Chromium	0	0	0.3	Ln normal
Ln normal = Natural log (base-e) normal distribution.				

5.6 Contaminant Data for Groundwater

A large amount of historical data is available on the concentration of contaminants in groundwater at the Hanford Site. These data are mostly contained in the Hanford Environmental Information System database. Data have been assessed and presented in annual reports for the past several years. The most recent annual report summarizing the groundwater data sampling conducted in 2002 is Hartman et al. (2003). Background information on the methods used in groundwater monitoring effort is given in Hartman (2000). Additional data have been collected on samples from sampling tubes installed at the bank of the Columbia River in recent years. These data and information on the sampling tubes are presented in Peterson et al. (1998) and Hartman and Peterson (2003).

Groundwater contaminant data were not used directly in the composite analysis groundwater model. However, they were used for a general understanding of the groundwater flow system. They are also used in "history matching" to evaluate groundwater transport model results.

For history matching of the composite analysis model results, the contaminant observations have been analyzed geostatistically. This analysis is presented by Murray et al. (2004). The purpose of that analysis was to generate maps and statistics that quantify the contamination in the groundwater, based on the historical groundwater concentration data for multiple points in time. The maps and statistics could then be used for verification of the composite analysis model results. The results generated from the study include several quantitative summaries of contaminant distribution, e.g., the location of the center of mass of contaminant plumes and the total mass of contaminants in the plume, and are collectively referred to as history matching data. A primary goal of the history matching study was to use geostatistical and Monte Carlo methods that allow one to provide an estimate of the uncertainty in the history matching data generated by the study. The scope of the analysis was restricted to four radioactive contaminants with a wide distribution at the site: tritium, technetium-99, iodine-129, and uranium. All four are current contaminants of concern at the site that will be examined in detail by the composite analysis (Kincaid et al. 2004, Table A.4). Results were generated for two time periods, fiscal years 2001 and 1992. In order to support the geographic scope of the composite analysis, the geostatistical analysis covered the entire Hanford Site, including the 200 West and 200 East Areas in the Central Plateau, and the 100 Areas and 300 Area in the Columbia River corridor. History matching data are currently being generated for several chemical contaminants of concern. Those contaminants are nitrate, carbon tetrachloride, and chromium.

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216-U-1%2-Fast	3.68E-08	3.67E-08	3.67E-08	3.67E-08	3.68E-08	3.67E-08	3.67E-08	8.12E+00	8.14E+00	8.12E+00	8.12E+00	8.12E+00	8.14E+00	8.12E+00	8.12E+00	8.12E+00
100-B-5	6.14E-07	6.12E-07	6.12E-07	6.12E-07	6.14E-07	6.12E-07	6.12E-07	6.12E-07	6.14E-07	6.12E-07	2.37E+04	2.41E+04	2.42E+04	4.32E+02	4.13E+01	2.20E+01
100-D-3	2.90E-08	2.90E-08	2.90E-08	2.90E-08	2.90E-08	2.90E-08	2.90E-08	2.90E-08	2.90E-08	2.90E-08	2.90E-08	5.23E-07	1.22E-05	7.56E-05	3.35E-04	1.19E-03
100-D-32	5.10E-09	5.09E-09	5.09E-09	5.09E-09	5.10E-09	5.09E-09	5.09E-09	5.09E-09	5.10E-09	5.09E-09	5.09E-09	5.09E-09	5.10E-09	5.09E-09	1.24E-07	2.66E-06
100-D-40	3.57E-09	3.56E-09	3.56E-09	3.56E-09	3.57E-09	3.56E-09	3.56E-09	3.56E-09	3.57E-09	3.56E-09	3.56E-09	6.40E-08	1.44E-06	8.85E-06	3.91E-05	1.40E-04
100-D-47	1.21E-07	1.21E-07	1.21E-07	1.21E-07	1.21E-07	1.21E-07	1.21E-07	1.21E-07	1.21E-07	1.21E-07	1.21E-07	2.17E-06	4.86E-05	2.99E-04	1.32E-03	4.72E-03
100-F-25	2.26E-13	2.26E-13	2.26E-13	2.26E-13	2.26E-13	2.26E-13	2.26E-13	2.26E-13	2.26E-13	2.26E-13	2.26E-13	2.26E-13	2.27E+01	2.60E+01	2.60E+01	2.59E+01
100-H-10	5.73E-13	5.71E-13	5.71E-13	5.71E-13	5.73E-13	2.38E+01	2.51E+01	2.50E+01	2.51E+01	2.51E+01	2.51E+01	2.50E+01	2.51E+01	2.51E+01	2.51E+01	2.50E+01
100-H-5	2.71E-14	2.71E-14	2.71E-14	2.71E-14	2.71E-14	2.71E-14	2.71E-14	2.71E-14	2.71E-14	1.11E-02	1.39E+00	1.27E+01	3.68E+01	5.93E+01	7.14E+01	7.63E+01
100-H-7	1.53E-18	1.52E-18	1.52E-18	1.52E-18	1.53E-18	2.46E+01	2.50E+01	2.50E+01	2.51E+01	2.50E+01	2.50E+01	2.50E+01	2.51E+01	2.50E+01	2.50E+01	2.50E+01
100-H-8	3.38E-18	3.37E-18	3.37E-18	3.37E-18	3.38E-18	2.44E+01	2.50E+01	2.50E+01	2.51E+01	2.50E+01	2.50E+01	2.50E+01	2.51E+01	2.50E+01	2.50E+01	2.50E+01
100-H-9	1.55E-19	1.55E-19	1.55E-19	1.55E-19	1.55E-19	2.47E+01	2.50E+01	2.49E+01	2.51E+01	2.50E+01	2.50E+01	2.49E+01	2.51E+01	2.50E+01	2.50E+01	2.49E+01
100-K-2	5.24E-08	5.23E-08	5.23E-08	5.23E-08	5.24E-08	5.23E-08	5.23E-08	5.23E-08	5.24E-08	5.23E-08	5.23E-08	5.23E-08	5.24E-08	1.15E-06	2.10E-05	1.27E-04
100-K-5	1.70E-10	1.70E-10	1.70E-10	1.70E-10	1.70E-10	1.70E-10	1.70E-10	1.70E-10	1.70E-10	1.70E-10	1.70E-10	1.70E-10	1.26E+01	1.82E+01	1.82E+01	1.82E+01
100-N-60	2.02E-06	2.01E-06	2.01E-06	2.01E-06	2.02E-06	2.01E-06	2.01E-06	2.01E-06	2.02E-06	2.01E-06	2.01E-06	2.01E-06	2.02E-06	2.01E-06	2.01E-06	2.01E-06
100-N-66	9.69E-11	9.93E-11	9.93E-11	9.93E-11	9.96E-11	9.93E-11	9.93E-11	9.93E-11	9.96E-11	9.93E-11	9.93E-11	9.93E-11	9.96E-11	9.93E-11	9.93E-11	9.93E-11
116-B-1	1.89E-07	1.88E-07	1.88E-07	1.88E-07	5.36E+03	3.32E+03	8.45E+02	2.33E+05	4.49E+05	9.34E+04	6.28E+03	9.30E+02	4.50E+02	3.01E+02	2.30E+02	1.74E+02
116-B-2	1.33E-10	1.33E-10	3.86E+03	1.05E+02	1.09E+01	5.64E+00	3.98E+00	2.52E+00	2.51E+00	1.76E+00	1.71E+00	1.71E+00	1.37E+00	1.31E+00	1.31E+00	1.31E+00
116-B-3	4.43E-09	4.42E-09	4.42E-09	4.42E-09	4.43E-09	4.42E-09	4.42E-09	4.42E-09	7.59E-06	4.83E-03	2.38E-02	1.63E-01	1.88E-01	3.64E-01	3.64E-01	3.76E-01
116-B-4	2.01E-13	2.01E-13	2.01E-13	2.01E-13	2.01E-13	2.01E-13	2.01E-13	2.01E-13	2.01E-13	2.01E-13	2.01E-13	2.01E-13	2.01E-13	1.67E+01	2.51E+01	2.50E+01
116-B-5	2.79E-09	2.78E-09	2.78E-09	2.78E-09	2.79E-09	2.78E-09	4.24E+02	5.26E+02	5.28E+02	5.27E+02	5.27E+02	5.26E+02	5.28E+02	5.27E+02	5.27E+02	5.26E+02
116-B-6B	1.88E-11	1.88E-11	1.88E-11	1.88E-11	1.88E-11	1.88E-11	4.19E-09	2.83E-04	1.54E-01	9.21E-01	9.47E-01	6.63E-01	4.22E-01	3.92E-01	2.43E-01	2.43E-01
116-C-1	5.33E-08	5.31E-08	5.31E-08	5.31E-08	5.33E-08	5.31E-08	5.31E-08	5.31E-08	5.33E-08	3.92E+05	1.03E+06	1.22E+06	6.87E+05	1.06E+06	5.71E+05	2.31E+05
116-C-2A	1.90E-10	1.90E-10	1.90E-10	1.90E-10	1.90E-10	1.90E-10	1.90E-10	1.90E-10	3.00E+02	4.18E+02	4.18E+02	4.17E+02	4.19E+02	4.18E+02	4.18E+02	4.17E+02
116-C-2C	2.22E-11	2.21E-11	2.21E-11	2.21E-11	2.22E-11	2.21E-11	2.21E-11	2.21E-11	3.60E+02	4.18E+02	4.18E+02	4.16E+02	4.19E+02	4.18E+02	4.18E+02	4.16E+02
116-D-1A	1.32E-06	1.31E-06	1.31E-06	1.31E-06	1.76E-01	1.56E+01	3.23E+01	3.49E+01	3.52E+01	2.33E+01	1.45E+01	8.33E+00	7.67E+00	4.52E+00	4.52E+00	4.07E+00
116-D-1B	5.19E-10	5.18E-10	5.18E-10	5.18E-10	5.19E-10	5.18E-10	5.18E-10	5.18E-10	5.19E-10	3.76E+02	5.34E+02	5.33E+02	5.36E+02	5.34E+02	5.34E+02	5.33E+02
116-DR-1%2	2.61E-06	2.60E-06	2.60E-06	2.60E-06	2.61E-06	2.60E-06	2.59E+04	1.11E+06	7.42E+05	6.87E+04	1.01E+04	3.41E+03	1.43E+03	1.25E+03	6.26E+02	6.26E+02
116-DR-3	2.29E-11	2.28E-11	2.28E-11	2.28E-11	2.29E-11	2.28E-11	2.28E-11	2.28E-11	2.29E-11	2.28E-11	2.28E-11	3.52E+03	3.11E+02	5.27E+01	2.39E+01	1.62E+01
116-F-1	4.32E-10	4.31E-10	4.31E-10	4.31E-10	4.32E-10	4.31E-10	4.31E-10	4.31E-10	4.32E-10	3.46E+02	6.22E+03	7.97E+03	8.12E+03	8.11E+03	8.12E+03	8.10E+03
116-F-10	3.87E-16	3.86E-16	3.86E-16	3.86E-16	2.04E+01	2.22E+01	2.22E+01	2.22E+01	2.23E+01	2.22E+01	2.22E+01	2.22E+01	2.23E+01	2.22E+01	2.22E+01	2.22E+01
116-F-11	4.32E-17	4.31E-17	4.31E-17	4.31E-17	4.32E-17	4.31E-17	4.31E-17	4.31E-17	4.32E-17	1.39E+01	1.54E+01	1.54E+01	1.55E+01	1.54E+01	1.54E+01	1.54E+01
116-F-2	1.27E-12	1.27E-12	1.27E-12	1.27E-12	5.01E+03	2.97E+03	1.10E+03	1.53E+05	4.72E+05	1.61E+05	6.95E+03	1.30E+03	7.06E+02	4.80E+02	3.56E+02	3.17E+02
116-F-3	1.46E-12	1.46E-12	1.46E-12	1.16E+03	1.62E+03	1.61E+03	1.61E+03	1.61E+03	2.22E+02	7.26E+01	4.19E+01	2.38E+01	2.38E+01	1.60E+01	1.60E+01	1.60E+01
116-F-4	9.47E-14	9.45E-14	9.45E-14	9.45E-14	9.47E-14	9.45E-14	1.05E-03	5.16E-02	4.23E-01	7.06E-01	6.57E-01	5.37E-01	5.24E-01	4.30E-01	4.30E-01	4.21E-01
116-F-6	5.93E-11	5.91E-11	5.91E-11	5.91E-11	5.93E-11	5.91E-11	5.91E-11	5.91E-11	3.38E-03	7.14E-02	2.79E-01	6.93E-01	1.75E+00	4.61E+00	1.22E+01	2.88E+01
116-H-1	4.66E-14	4.65E-14	4.65E-14	4.65E-14	4.66E-14	4.65E-14	2.76E+04	5.06E+05	7.83E+05	2.38E+05	7.05E+03	1.18E+03	7.11E+02	5.58E+02	4.97E+02	4.78E+02
116-H-2	8.15E-11	8.13E-11	8.13E-11	8.13E-11	8.15E-11	8.13E-11	8.13E-11	8.13E-11	8.15E-11	4.57E+04	4.62E+04	4.61E+04	4.64E+04	4.62E+04	4.62E+04	4.61E+04
116-H-3	4.59E-19	4.58E-19	4.58E-19	4.58E-19	4.59E-19	4.58E-19	2.44E+01	2.50E+01	2.51E+01	2.50E+01	2.50E+01	2.50E+01	2.51E+01	2.50E+01	2.50E+01	2.50E+01
116-H-7	2.29E-12	2.28E-12	2.28E-12	2.28E-12	2.29E-12	1.68E+03	7.61E+03	8.00E+03	8.04E+03	8.02E+03	8.02E+03	8.01E+03	8.04E+03	8.02E+03	8.02E+03	8.01E+03
116-K-2	1.84E-08	1.84E-08	1.84E-08	1.84E-08	1.84E-08	1.84E-08	1.84E-08	1.84E-08	1.84E-08	1.84E-08	1.84E-08	1.84E-08	1.88E+07	2.05E+07	2.04E+07	1.89E+07

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	**1944**	**1945**	**1946**	**1947**	**1948**	**1949**	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**
116-KE-1	4.78E-09	4.76E-09	4.76E-09	4.76E-09	4.78E-09	4.76E-09	4.76E-09	4.76E-09	4.78E-09	4.76E-09	4.76E-09	3.95E-07	4.78E+00	3.57E+01	4.76E+01	4.87E+01
116-KE-2	4.61E-15	4.60E-15	4.60E-15	4.60E-15	4.61E-15	4.60E-15	4.60E-15	4.60E-15	4.61E-15	4.60E-15	4.60E-15	1.28E+02	1.77E+02	1.76E+02	1.76E+02	1.76E+02
116-KE-3	5.65E-11	5.64E-11	5.64E-11	5.64E-11	5.65E-11	5.64E-11	5.64E-11	5.64E-11	5.65E-11	5.64E-11	1.51E-02	1.63E+01	1.67E+01	1.67E+01	1.69E+01	1.74E+01
116-KW-2	6.24E-11	6.22E-11	6.22E-11	6.22E-11	6.24E-11	6.22E-11	6.22E-11	6.22E-11	6.24E-11	6.22E-11	1.51E-02	1.63E+01	1.67E+01	1.67E+01	1.68E+01	1.68E+01
116-N-1	3.76E-10	3.75E-10	3.75E-10	3.75E-10	3.76E-10	3.75E-10	3.75E-10	3.75E-10	3.76E-10	3.75E-10	3.75E-10	3.75E-10	3.76E-10	3.75E-10	3.75E-10	3.75E-10
116-N-3	4.72E-10	4.71E-10	4.71E-10	4.71E-10	4.72E-10	4.71E-10	4.71E-10	4.71E-10	4.72E-10	4.71E-10	4.71E-10	4.71E-10	4.72E-10	4.71E-10	4.71E-10	4.71E-10
116-N-4	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07
118-B-6	8.36E-11	8.34E-11	8.34E-11	8.34E-11	8.36E-11	8.34E-11	8.34E-11	7.04E-10	3.20E-07	2.85E-06	1.49E-05	5.76E-05	1.88E-04	5.39E-04	1.42E-03	3.54E-03
118-B-7	5.02E-11	5.00E-11	5.00E-11	5.00E-11	5.02E-11	5.00E-11	5.00E-11	5.00E-11	3.81E-10	1.29E-07	1.17E-06	6.11E-06	2.43E-05	7.89E-05	2.27E-04	6.02E-04
118-B-8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-C-1	8.41E-08	8.39E-08	8.39E-08	8.39E-08	8.41E-08	8.39E-08	8.39E-08	8.39E-08	8.41E-08	8.39E-08	2.04E-06	4.10E-04	3.79E-03	1.98E-02	7.73E-02	2.50E-01
118-C-3	2.15E-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-C-4	8.99E-15	8.86E-15	8.86E-15	8.86E-15	8.88E-15	8.86E-15	7.93E-13	1.11E-08	2.81E-06	3.06E-05	1.95E-04	9.28E-04	3.74E-03	1.30E-02	4.07E-02	1.12E-01
118-D-2	1.47E-06	1.46E-06	1.46E-06	1.46E-06	1.47E-06	1.46E-06	1.46E-06	1.74E-05	4.09E-04	2.53E-03	1.12E-02	3.99E-02	1.25E-01	3.49E-01	9.15E-01	2.30E+00
118-D-3	5.29E-07	5.27E-07	5.27E-07	5.27E-07	5.29E-07	5.27E-07	5.27E-07	5.27E-07	5.29E-07	5.27E-07	5.27E-07	5.27E-07	5.29E-07	5.27E-07	1.28E-05	2.68E-04
118-D-4	3.41E-07	3.40E-07	3.40E-07	3.40E-07	3.41E-07	3.40E-07	3.40E-07	3.40E-07	3.41E-07	3.40E-07	3.40E-07	6.10E-06	1.37E-04	8.44E-04	3.73E-03	1.33E-02
118-DR-2	1.96E-11	2.01E-11	2.01E-11	2.01E-11	2.01E-11	2.00E-11	1.98E-11	8.87E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-F-1	6.20E-11	6.18E-11	6.18E-11	6.18E-11	6.20E-11	6.18E-11	6.18E-11	6.18E-11	6.20E-11	6.18E-11	2.45E-07	5.88E-04	2.87E-02	1.90E-01	8.08E-01	2.74E+00
118-F-4	3.84E-13	3.83E-13	3.83E-13	3.83E-13	3.84E-13	8.09E-10	2.13E-06	9.09E-05	6.18E-04	2.63E-03	9.01E-03	2.67E-02	6.86E-02	1.39E-01	2.20E-01	2.84E-01
118-F-8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-H-1	7.43E-13	7.41E-13	7.41E-13	7.41E-13	7.43E-13	1.71E-01	2.14E+01	1.96E+02	5.67E+02	9.15E+02	1.10E+03	1.18E+03	1.21E+03	1.21E+03	1.22E+03	1.22E+03
118-H-6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-K-1	8.79E-06	8.76E-06	8.76E-06	8.76E-06	8.79E-06	8.76E-06	8.76E-06	8.76E-06	8.79E-06	8.76E-06	8.76E-06	3.39E-05	1.51E-03	9.15E-03	4.04E-02	1.45E-01
118-KE-1	7.98E-12	7.96E-12	1.13E-11	2.72E-11	2.72E-11	2.72E-11	2.72E-11	2.72E-11	2.72E-11	2.72E-11	2.71E-11	2.67E-11	1.22E-11	0.00E+00	0.00E+00	0.00E+00
118-KW-1	6.43E-12	6.46E-12	2.32E-11	2.32E-11	2.33E-11	2.32E-11	2.32E-11	2.32E-11	2.33E-11	2.32E-11	2.32E-11	2.28E-11	1.04E-11	0.00E+00	0.00E+00	0.00E+00
118-KW-2	1.62E-13	1.61E-13	1.61E-13	1.61E-13	1.62E-13	1.61E-13	1.61E-13	1.61E-13	1.62E-13	1.61E-13	1.61E-13	1.61E-13	1.10E-09	2.41E-07	3.09E-06	2.23E-05
200-E-100	4.35E-06	1.52E+00	4.39E+00	4.38E+00	4.40E+00	4.39E+00	4.39E+00	4.38E+00	4.40E+00	4.39E+00	4.39E+00	4.38E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00
200-E-102	1.57E-04	1.56E-04	1.56E-04	1.56E-04	1.57E-04	1.56E-04	1.56E-04	1.56E-04	1.57E-04	1.56E-04	1.56E-04	1.56E-04	1.57E-04	1.56E-04	7.76E+02	4.24E+02
200-E-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-25	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08
200-E-28	2.70E-10	2.69E-10	2.69E-10	2.69E-10	2.70E-10	2.69E-10	2.69E-10	2.69E-10	2.70E-10	2.69E-10	2.69E-10	2.69E-10	2.70E-10	2.69E-10	2.69E-10	2.69E-10
200-E-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-54	4.57E-07	4.56E-07	4.56E-07	4.56E-07	4.57E-07	4.56E-07	4.56E-07	4.56E-07	4.57E-07	4.56E-07	4.56E-07	4.56E-07	4.57E-07	4.56E-07	4.56E-07	4.56E-07
200-E-55	1.73E-06	1.73E-06	1.73E-06	1.73E-06	1.42E-01	4.33E+00	4.38E+00	4.38E+00	4.39E+00	4.38E+00	4.38E+00	4.38E+00	4.38E+00	4.37E+00	4.37E+00	4.37E+00
200-E-56	3.14E-07	3.13E-07	3.13E-07	3.13E-07	3.14E-07	3.13E-07	3.13E-07	3.13E-07	3.14E-07	3.13E-07	3.13E-07	3.13E-07	3.14E-07	3.13E-07	3.13E-07	3.13E-07
200-E-57	4.44E-06	4.42E-06	4.42E-06	4.42E-06	4.44E-06	4.42E-06	4.42E-06	4.42E-06	4.44E-06	4.42E-06	4.42E-06	4.42E-06	4.44E-06	3.32E+00	4.92E+01	1.23E+01
200-E-60	4.09E-13	4.08E-13	4.08E-13	4.08E-13	4.09E-13	4.08E-13	4.08E-13	4.08E-13	4.09E-13	4.08E-13	4.08E-13	4.08E-13	4.09E-13	4.08E-13	4.08E-13	4.08E-13
200-E-61	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-62	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	**1944**	**1945**	**1946**	**1947**	**1948**	**1949**	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**
200-E-64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-65	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07
200-E-67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-68	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07
200-E-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-70	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05
200-E-71	2.64E-05	2.63E-05	2.63E-05	2.63E-05	2.64E-05	2.63E-05	2.63E-05	2.63E-05	2.64E-05	2.63E-05	2.63E-05	2.63E-05	2.64E-05	2.63E-05	2.63E-05	2.63E-05
200-E-72	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05
200-E-73	5.86E-07	5.84E-07	5.84E-07	5.84E-07	5.86E-07	5.84E-07	5.84E-07	5.84E-07	5.86E-07	5.84E-07	5.84E-07	5.84E-07	5.86E-07	5.84E-07	5.84E-07	5.84E-07
200-E-74	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05
200-E-75	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05
200-E-76	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-77	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-80	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-81	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-84	9.44E-07	9.42E-07	9.42E-07	9.42E-07	9.44E-07	9.42E-07	9.42E-07	9.42E-07	9.44E-07	9.42E-07	9.42E-07	9.42E-07	9.44E-07	9.42E-07	9.42E-07	9.42E-07
200-E-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-88	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04
200-E-89	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03
200-E-90	8.26E-04	8.23E-04	8.23E-04	8.23E-04	8.26E-04	8.23E-04	8.23E-04	8.23E-04	8.26E-04	8.23E-04	8.23E-04	8.23E-04	8.26E-04	8.23E-04	8.23E-04	8.23E-04
200-E-91	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05
200-E-92	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03
200-E-93	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03
200-E-94	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04
200-E-95	1.35E-05	2.65E+00	4.38E+00	4.37E+00	4.40E+00	4.38E+00	4.38E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00
200-E-97	1.10E-05	2.71E+00	4.39E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00
200-E-98	1.33E-04	1.32E-04	1.32E-04	3.25E+00	3.70E+00	3.69E+00	3.69E+00	3.69E+00	3.70E+00	3.69E+00	3.69E+00	3.68E+00	3.70E+00	3.69E+00	3.69E+00	3.68E+00
200-E-99	8.07E-06	8.05E-06	6.74E-01	4.42E+00	4.42E+00	4.42E+00	4.42E+00	4.41E+00	4.43E+00	4.42E+00	4.42E+00	4.41E+00	4.43E+00	4.42E+00	4.42E+00	4.42E+00
200-W-22	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06
200-W-42	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05
200-W-52	1.13E-08	1.12E-08	1.12E-08	1.12E-08	2.66E+03	1.19E+04	1.19E+04	1.19E+04	1.20E+04	1.19E+04	1.19E+04	1.19E+04	3.15E+03	1.35E+03	7.15E+02	4.87E+02
200-W-9	1.66E-11	1.65E-11	1.65E-11	1.65E-11	1.66E-11	1.65E-11	1.65E-11	1.65E-11	1.66E-11	1.65E-11	1.65E-11	1.65E-11	1.66E-11	1.65E-11	1.65E-11	1.65E-11
2101-M-POND	2.04E-02	2.03E-02	2.03E-02	2.03E-02	2.04E-02	2.03E-02	2.03E-02	2.03E-02	2.04E-02	7.59E+02	2.60E+04	2.59E+04	2.60E+04	2.60E+04	2.60E+04	2.59E+04
216-A-10	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.10E+05	6.03E+04	1.47E+04	7.61E+03
216-A-11	4.19E-07	4.17E-07	4.17E-07	4.17E-07	4.19E-07	4.17E-07	4.17E-07	4.17E-07	4.19E-07	4.17E-07	4.17E-07	4.17E-07	4.19E-07	4.09E+00	5.90E+00	5.89E+00
216-A-12	7.14E-09	7.12E-09	7.12E-09	7.12E-09	7.14E-09	7.12E-09	7.12E-09	7.12E-09	7.14E-09	7.12E-09	7.12E-09	7.12E-09	3.66E+00	5.57E+00	5.57E+00	5.56E+00
216-A-13	1.87E-06	1.86E-06	1.86E-06	1.86E-06	1.87E-06	1.86E-06	1.86E-06	1.86E-06	1.87E-06	1.86E-06	1.86E-06	1.86E-06	1.87E-06	1.86E-06	1.86E-06	1.86E-06
216-A-14	6.90E-07	6.88E-07	6.88E-07	6.88E-07	6.90E-07	6.88E-07	6.88E-07	6.88E-07	6.90E-07	6.88E-07	6.88E-07	6.88E-07	6.90E-07	6.88E-07	6.88E-07	6.88E-07

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
216-A-15	2.51E-08	2.51E-08	2.51E-08	2.51E-08	2.51E-08	2.51E-08	2.51E-08	2.51E-08	2.51E-08	2.51E-08	2.51E-08	3.88E+02	5.58E+02	5.56E+02	5.56E+02	5.55E+02
216-A-16	5.19E-08	5.18E-08	5.18E-08	5.18E-08	5.19E-08	5.18E-08	5.18E-08	5.18E-08	5.19E-08	5.18E-08	5.18E-08	5.18E-08	5.19E-08	1.90E+00	8.75E+00	8.74E+00
216-A-17	2.43E-06	2.42E-06	2.42E-06	2.42E-06	2.43E-06	2.42E-06	2.42E-06	2.42E-06	2.43E-06	2.42E-06	2.42E-06	2.42E-06	2.43E-06	2.42E-06	2.42E-06	4.04E+00
216-A-2	9.87E-05	9.84E-05	9.84E-05	9.84E-05	9.87E-05	9.84E-05	9.84E-05	9.84E-05	9.87E-05	9.84E-05	9.84E-05	9.84E-05	9.87E-05	9.84E-05	9.84E-05	9.84E-05
216-A-20	1.47E-05	1.46E-05	1.46E-05	1.46E-05	1.47E-05	1.46E-05	1.46E-05	1.46E-05	1.47E-05	1.46E-05	1.46E-05	1.46E-05	3.62E+02	1.20E+02	6.36E+01	4.33E+01
216-A-21	2.57E-04	2.56E-04	2.56E-04	2.56E-04	2.57E-04	2.56E-04	2.56E-04	2.56E-04	2.57E-04	2.56E-04	2.56E-04	2.56E-04	2.57E-04	2.56E-04	2.56E-04	5.90E+03
216-A-22	2.07E-04	2.06E-04	2.06E-04	2.06E-04	2.07E-04	2.06E-04	2.06E-04	2.06E-04	2.07E-04	2.06E-04	2.06E-04	2.06E-04	2.07E-04	2.06E-04	2.06E-04	2.06E-04
216-A-23A	3.23E-05	3.22E-05	3.22E-05	3.22E-05	3.23E-05	3.22E-05	3.22E-05	3.22E-05	3.23E-05	3.22E-05	3.22E-05	3.22E-05	3.23E-05	3.22E-05	3.22E-05	3.22E-05
216-A-23B	3.55E-05	3.54E-05	3.54E-05	3.54E-05	3.55E-05	3.54E-05	3.54E-05	3.54E-05	3.55E-05	3.54E-05	3.54E-05	3.54E-05	3.55E-05	3.54E-05	3.54E-05	3.54E-05
216-A-24	6.98E-02	6.96E-02	6.96E-02	6.96E-02	6.98E-02	6.96E-02	6.96E-02	6.96E-02	6.98E-02	6.96E-02	6.96E-02	6.96E-02	6.98E-02	6.96E-02	1.90E+05	3.80E+05
216-A-25	2.33E-11	1.98E-11	1.98E-11	1.98E-11	1.98E-11	1.98E-11	1.98E-11	1.98E-11	1.98E-11	1.98E-11	1.98E-11	1.98E-11	1.98E-11	6.35E-09	3.60E+06	8.20E+06
216-A-26	2.14E-06	2.13E-06	2.13E-06	2.13E-06	2.14E-06	2.13E-06	2.13E-06	2.13E-06	2.14E-06	2.13E-06	2.13E-06	2.13E-06	2.14E-06	2.13E-06	2.13E-06	2.13E-06
216-A-26A	2.18E-06	2.17E-06	2.17E-06	2.17E-06	2.18E-06	2.17E-06	2.17E-06	2.17E-06	2.18E-06	2.17E-06	2.17E-06	2.17E-06	2.18E-06	2.17E-06	2.17E-06	2.17E-06
216-A-27	6.62E-04	6.60E-04	6.60E-04	6.60E-04	6.62E-04	6.60E-04	6.60E-04	6.60E-04	6.62E-04	6.60E-04	6.60E-04	6.60E-04	6.62E-04	6.60E-04	6.60E-04	6.60E-04
216-A-28	1.27E-03	1.26E-03	1.26E-03	1.26E-03	1.27E-03	1.26E-03	1.26E-03	1.26E-03	1.27E-03	1.26E-03	1.26E-03	1.26E-03	1.27E-03	1.26E-03	1.26E-03	1.26E-03
216-A-3	1.88E-06	1.87E-06	1.87E-06	1.87E-06	1.88E-06	1.87E-06	1.87E-06	1.87E-06	1.88E-06	1.87E-06	1.87E-06	1.87E-06	1.88E-06	1.87E-06	1.87E-06	1.94E+02
216-A-30	1.78E-01	1.77E-01	1.77E-01	1.77E-01	1.78E-01	1.77E-01	1.77E-01	1.77E-01	1.78E-01	1.77E-01	1.77E-01	1.77E-01	1.78E-01	1.77E-01	1.77E-01	1.77E-01
216-A-31	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-35	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-36A	1.28E-02	1.27E-02	1.27E-02	1.27E-02	1.28E-02	1.27E-02	1.27E-02	1.27E-02	1.28E-02	1.27E-02	1.27E-02	1.27E-02	1.28E-02	1.27E-02	1.27E-02	1.27E-02
216-A-36B	1.14E-02	1.13E-02	1.13E-02	1.13E-02	1.14E-02	1.13E-02	1.13E-02	1.13E-02	1.14E-02	1.13E-02	1.13E-02	1.13E-02	1.14E-02	1.13E-02	1.13E-02	1.13E-02
216-A-37-1	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05
216-A-37-2	4.32E-03	4.31E-03	4.31E-03	4.31E-03	4.32E-03	4.31E-03	4.31E-03	4.31E-03	4.32E-03	4.31E-03	4.31E-03	4.31E-03	4.32E-03	4.31E-03	4.31E-03	4.31E-03
216-A-39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-4	4.77E-04	4.76E-04	4.76E-04	4.76E-04	4.77E-04	4.76E-04	4.76E-04	4.76E-04	4.77E-04	4.76E-04	4.76E-04	4.76E-04	1.24E+03	1.36E+03	2.75E+03	4.45E+02
216-A-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-45	4.36E-03	4.35E-03	4.35E-03	4.35E-03	4.36E-03	4.35E-03	4.35E-03	4.35E-03	4.36E-03	4.35E-03	4.35E-03	4.35E-03	4.36E-03	4.35E-03	4.35E-03	4.35E-03
216-A-5	9.88E-03	9.86E-03	9.86E-03	9.86E-03	9.88E-03	9.86E-03	9.86E-03	9.86E-03	9.88E-03	9.86E-03	9.86E-03	9.86E-03	1.43E+05	1.39E+05	2.49E+05	3.30E+05
216-A-6	7.10E-03	7.09E-03	7.09E-03	7.09E-03	7.10E-03	7.09E-03	7.09E-03	7.09E-03	7.10E-03	7.09E-03	7.09E-03	7.09E-03	1.30E+05	4.18E+05	7.68E+05	6.34E+05
216-A-7	2.42E-05	2.41E-05	2.41E-05	2.41E-05	2.42E-05	2.41E-05	2.41E-05	2.41E-05	2.42E-05	2.41E-05	2.41E-05	2.41E-05	2.42E-05	2.41E-05	9.74E+00	9.72E+00
216-A-8	6.79E-05	6.77E-05	6.77E-05	6.77E-05	6.79E-05	6.77E-05	6.77E-05	6.77E-05	6.79E-05	6.77E-05	6.77E-05	6.77E-05	4.33E+05	2.44E+05	1.29E+05	4.70E+04
216-A-9	5.64E-03	5.63E-03	5.63E-03	5.63E-03	5.64E-03	5.63E-03	5.63E-03	5.63E-03	5.64E-03	5.63E-03	5.63E-03	5.63E-03	4.91E+05	2.72E+05	8.74E+04	3.17E+04
216-B-10A	8.67E-03	8.65E-03	8.65E-03	8.65E-03	8.67E-03	8.65E-03	8.65E-03	2.72E+03	2.76E+03	1.04E+03	5.63E+02	3.42E+02	2.67E+02	2.00E+02	1.74E+02	1.19E+02
216-B-10B	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05
216-B-11A%B	1.51E-03	1.51E-03	1.51E-03	1.51E-03	1.51E-03	1.51E-03	1.51E-03	1.51E-03	1.18E+04	8.27E+03	7.34E+03	1.33E+03	2.20E+02	1.13E+02	7.37E+01	4.62E+01
216-B-12	4.51E-04	4.50E-04	4.50E-04	4.50E-04	4.51E-04	4.50E-04	4.50E-04	4.50E-04	1.74E+03	8.88E+04	1.03E+05	7.96E+04	7.89E+04	1.15E+04	2.35E+03	1.20E+03
216-B-13	1.32E-05	1.32E-05	1.32E-05	1.32E-05	1.32E-05	1.32E-05	1.32E-05	1.32E-05	9.19E-03	6.17E-01	6.89E-01	6.89E-01	6.91E-01	6.89E-01	6.89E-01	6.89E-01
216-B-14	5.34E-04	5.33E-04	5.33E-04	5.33E-04	5.34E-04	5.33E-04	5.33E-04	5.33E-04	5.34E-04	5.33E-04	5.33E-04	5.33E-04	5.34E-04	5.33E-04	5.33E-04	5.33E-04
216-B-15	8.07E-04	8.05E-04	8.05E-04	8.05E-04	8.07E-04	8.05E-04	8.05E-04	8.05E-04	8.07E-04	8.05E-04	8.05E-04	8.05E-04	8.07E-04	8.05E-04	8.05E-04	8.05E-04

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
216-B-16	4.95E-02	4.93E-02	4.93E-02	4.93E-02	4.95E-02	4.93E-02	4.93E-02	4.93E-02	4.95E-02	4.93E-02	4.93E-02	4.93E-02	4.95E-02	4.93E-02	4.93E-02	4.93E-02
216-B-17	1.93E-03	1.92E-03	1.92E-03	1.92E-03	1.93E-03	1.92E-03	1.92E-03	1.92E-03	1.93E-03	1.92E-03	1.92E-03	1.92E-03	1.93E-03	1.92E-03	1.92E-03	1.92E-03
216-B-18	3.59E-02	3.58E-02	3.58E-02	3.58E-02	3.59E-02	3.58E-02	3.58E-02	3.58E-02	3.59E-02	3.58E-02	3.58E-02	3.58E-02	3.59E-02	3.58E-02	3.58E-02	3.58E-02
216-B-19	3.56E-02	3.55E-02	3.55E-02	3.55E-02	3.56E-02	3.55E-02	3.55E-02	3.55E-02	3.56E-02	3.55E-02	3.55E-02	3.55E-02	3.56E-02	3.55E-02	3.55E-02	3.55E-02
216-B-20	7.54E-03	7.52E-03	7.52E-03	7.52E-03	7.54E-03	7.52E-03	7.52E-03	7.52E-03	7.54E-03	7.52E-03	7.52E-03	7.52E-03	7.54E-03	7.52E-03	7.52E-03	7.52E-03
216-B-21	7.66E-03	7.64E-03	7.64E-03	7.64E-03	7.66E-03	7.64E-03	7.64E-03	7.64E-03	7.66E-03	7.64E-03	7.64E-03	7.64E-03	7.66E-03	7.64E-03	7.64E-03	7.64E-03
216-B-22	9.63E-03	9.61E-03	9.61E-03	9.61E-03	9.63E-03	9.61E-03	9.61E-03	9.61E-03	9.63E-03	9.61E-03	9.61E-03	9.61E-03	9.63E-03	9.61E-03	9.61E-03	9.61E-03
216-B-23	6.86E-04	6.84E-04	6.84E-04	6.84E-04	6.86E-04	6.84E-04	6.84E-04	6.84E-04	6.86E-04	6.84E-04	6.84E-04	6.84E-04	6.86E-04	6.84E-04	6.84E-04	6.84E-04
216-B-24	3.05E-04	3.04E-04	3.04E-04	3.04E-04	3.05E-04	3.04E-04	3.04E-04	3.04E-04	3.05E-04	3.04E-04	3.04E-04	3.04E-04	3.05E-04	3.04E-04	3.04E-04	3.04E-04
216-B-25	2.38E-03	2.37E-03	2.37E-03	2.37E-03	2.38E-03	2.37E-03	2.37E-03	2.37E-03	2.38E-03	2.37E-03	2.37E-03	2.37E-03	2.38E-03	2.37E-03	2.37E-03	2.37E-03
216-B-26	5.65E-04	5.63E-04	5.63E-04	5.63E-04	5.65E-04	5.63E-04	5.63E-04	5.63E-04	5.65E-04	5.63E-04	5.63E-04	5.63E-04	5.65E-04	5.63E-04	5.63E-04	5.63E-04
216-B-27	8.58E-05	8.56E-05	8.56E-05	8.56E-05	8.58E-05	8.56E-05	8.56E-05	8.56E-05	8.58E-05	8.56E-05	8.56E-05	8.56E-05	8.58E-05	8.56E-05	8.56E-05	8.56E-05
216-B-28	8.38E-05	8.36E-05	8.36E-05	8.36E-05	8.38E-05	8.36E-05	8.36E-05	8.36E-05	8.38E-05	8.36E-05	8.36E-05	8.36E-05	8.38E-05	8.36E-05	8.36E-05	8.36E-05
216-B-29	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03
216-B-3	3.39E-07	3.38E-07	3.38E-07	3.38E-07	3.35E+04	1.09E+06	1.73E+06	3.26E+06	2.72E+06	1.48E+06	1.07E+06	8.26E+05	5.71E+06	1.09E+07	7.19E+06	4.68E+06
216-B-30	2.27E-03	2.26E-03	2.26E-03	2.26E-03	2.27E-03	2.26E-03	2.26E-03	2.26E-03	2.27E-03	2.26E-03	2.26E-03	2.26E-03	2.27E-03	2.26E-03	2.26E-03	2.26E-03
216-B-31	1.43E-03	1.42E-03	1.42E-03	1.42E-03	1.43E-03	1.42E-03	1.42E-03	1.42E-03	1.43E-03	1.42E-03	1.42E-03	1.42E-03	1.43E-03	1.42E-03	1.42E-03	1.42E-03
216-B-32	3.38E-05	3.37E-05	3.37E-05	3.37E-05	3.38E-05	3.37E-05	3.37E-05	3.37E-05	3.38E-05	3.37E-05	3.37E-05	3.37E-05	3.38E-05	3.37E-05	3.37E-05	3.37E-05
216-B-33	4.55E-04	4.54E-04	4.54E-04	4.54E-04	4.55E-04	4.54E-04	4.54E-04	4.54E-04	4.55E-04	4.54E-04	4.54E-04	4.54E-04	4.55E-04	4.54E-04	4.54E-04	4.54E-04
216-B-34	1.51E-03	1.50E-03	1.50E-03	1.50E-03	1.51E-03	1.50E-03	1.50E-03	1.50E-03	1.51E-03	1.50E-03	1.50E-03	1.50E-03	1.51E-03	1.50E-03	1.50E-03	1.50E-03
216-B-35	3.97E-03	3.96E-03	3.96E-03	3.96E-03	3.97E-03	3.96E-03	3.96E-03	3.96E-03	3.97E-03	3.96E-03	3.96E-03	3.34E+00	2.13E+02	1.21E+02	7.90E+01	5.88E+01
216-B-36	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	7.96E+02	2.54E+02	1.31E+02	9.05E+01	5.86E+01
216-B-37	1.09E-03	1.08E-03	1.08E-03	1.08E-03	1.09E-03	1.08E-03	1.08E-03	1.08E-03	1.09E-03	1.08E-03	1.69E+03	1.34E+03	3.06E+02	1.65E+02	1.05E+02	6.91E+01
216-B-38	2.27E-03	2.26E-03	2.26E-03	2.26E-03	2.27E-03	2.26E-03	2.26E-03	2.26E-03	2.27E-03	2.26E-03	2.26E-03	3.25E+02	2.40E+02	1.27E+02	8.00E+01	6.19E+01
216-B-39	2.80E-04	2.79E-04	2.79E-04	2.79E-04	2.80E-04	2.79E-04	2.79E-04	2.79E-04	2.80E-04	2.79E-04	2.79E-04	4.30E+02	2.38E+02	1.27E+02	8.56E+01	6.21E+01
216-B-4	2.35E-05	2.34E-05	2.34E-05	2.34E-05	2.35E-05	2.34E-05	2.34E-05	2.34E-05	2.35E-05	2.34E-05	2.34E-05	2.34E-05	2.35E-05	2.34E-05	2.34E-05	2.34E-05
216-B-40	2.96E-06	2.95E-06	2.95E-06	2.95E-06	2.96E-06	2.95E-06	2.95E-06	2.95E-06	2.96E-06	2.95E-06	2.95E-06	5.25E+02	2.46E+02	1.27E+02	8.10E+01	5.93E+01
216-B-41	9.09E-07	9.07E-07	9.07E-07	9.07E-07	9.09E-07	9.07E-07	9.07E-07	9.07E-07	9.09E-07	9.07E-07	9.07E-07	3.43E+02	2.37E+02	1.23E+02	8.25E+01	6.36E+01
216-B-42	3.74E-06	3.73E-06	3.73E-06	3.73E-06	3.74E-06	3.73E-06	3.73E-06	3.73E-06	3.74E-06	3.73E-06	3.73E-06	3.95E+02	2.40E+02	1.27E+02	7.92E+01	6.09E+01
216-B-43	3.96E-03	3.95E-03	3.95E-03	3.95E-03	3.96E-03	3.95E-03	3.95E-03	3.95E-03	3.96E-03	3.95E-03	3.95E-03	3.95E-03	2.59E+02	2.69E+02	1.76E+02	1.27E+02
216-B-44	2.78E-03	2.77E-03	2.77E-03	2.77E-03	2.78E-03	2.77E-03	2.77E-03	2.77E-03	2.78E-03	2.77E-03	2.77E-03	1.33E+03	1.55E+03	5.87E+02	3.39E+02	2.00E+02
216-B-45	3.96E-09	3.95E-09	3.95E-09	3.95E-09	3.96E-09	3.95E-09	3.95E-09	3.95E-09	3.96E-09	3.95E-09	3.95E-09	3.95E-09	2.31E+03	6.03E+02	3.03E+02	1.83E+02
216-B-46	1.25E-06	1.24E-06	1.24E-06	1.24E-06	1.25E-06	1.24E-06	1.24E-06	1.24E-06	1.25E-06	1.24E-06	1.24E-06	1.28E+03	2.69E+03	6.24E+02	3.30E+02	2.27E+02
216-B-47	6.03E-07	6.01E-07	6.01E-07	6.01E-07	6.03E-07	6.01E-07	6.01E-07	6.01E-07	6.03E-07	6.01E-07	6.01E-07	6.01E-07	1.19E+03	5.43E+02	2.82E+02	1.94E+02
216-B-48	3.75E-08	3.74E-08	3.74E-08	3.74E-08	3.75E-08	3.74E-08	3.74E-08	3.74E-08	3.75E-08	3.74E-08	3.74E-08	3.74E-08	1.57E+03	5.51E+02	2.92E+02	1.84E+02
216-B-49	8.29E-07	8.26E-07	8.26E-07	8.26E-07	8.29E-07	8.26E-07	8.26E-07	8.26E-07	8.29E-07	8.26E-07	8.26E-07	1.27E+03	2.70E+03	6.49E+02	3.25E+02	1.93E+02
216-B-5	7.80E-06	9.13E+03	1.37E+04	9.16E+03	7.86E+01	2.80E+00	1.29E+00	8.13E-01	4.84E-01	4.07E-01	2.42E-01	2.42E-01	1.84E-01	1.10E-01	1.10E-01	1.10E-01
216-B-50	3.12E-08	3.11E-08	3.11E-08	3.11E-08	3.12E-08	3.11E-08	3.11E-08	3.11E-08	3.12E-08	3.11E-08	3.11E-08	3.11E-08	3.12E-08	3.11E-08	3.11E-08	3.11E-08
216-B-51	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08
216-B-52	9.12E-05	9.10E-05	9.10E-05	9.10E-05	9.12E-05	9.10E-05	9.10E-05	9.10E-05	9.12E-05	9.10E-05	9.10E-05	9.10E-05	9.12E-05	9.10E-05	9.10E-05	9.10E-05
216-B-53A	3.75E-05	3.74E-05	3.74E-05	3.74E-05	3.75E-05	3.74E-05	3.74E-05	3.74E-05	3.75E-05	3.74E-05	3.74E-05	3.74E-05	3.75E-05	3.74E-05	3.74E-05	3.74E-05

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
216-B-53B	3.31E-04	3.30E-04	3.30E-04	3.30E-04	3.31E-04	3.30E-04	3.30E-04	3.30E-04	3.31E-04	3.30E-04	3.30E-04	3.30E-04	3.31E-04	3.30E-04	3.30E-04	3.30E-04
216-B-54	4.62E-04	4.61E-04	4.61E-04	4.61E-04	4.62E-04	4.61E-04	4.61E-04	4.61E-04	4.62E-04	4.61E-04	4.61E-04	4.61E-04	4.62E-04	4.61E-04	4.61E-04	4.61E-04
216-B-55	1.61E-07	1.60E-07	1.60E-07	1.60E-07	1.61E-07	1.60E-07	1.60E-07	1.60E-07	1.61E-07	1.60E-07	1.60E-07	1.60E-07	1.61E-07	1.60E-07	1.60E-07	1.60E-07
216-B-57	1.16E-05	1.15E-05	1.15E-05	1.15E-05	1.16E-05	1.15E-05	1.15E-05	1.15E-05	1.16E-05	1.15E-05	1.15E-05	1.15E-05	1.16E-05	1.15E-05	1.15E-05	1.15E-05
216-B-58	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04
216-B-59	9.48E-07	9.45E-07	9.45E-07	9.45E-07	9.48E-07	9.45E-07	9.45E-07	9.45E-07	9.48E-07	9.45E-07	9.45E-07	9.45E-07	9.48E-07	9.45E-07	9.45E-07	9.45E-07
216-B-6	4.20E-03	1.89E+02	1.21E+03	1.29E+03	1.29E+03	1.29E+03	3.21E+02	1.18E+02	5.21E+01	4.50E+01	2.07E+01	2.07E+01	1.81E+01	1.00E+01	1.00E+01	1.00E+01
216-B-60	1.12E-07	1.11E-07	1.11E-07	1.11E-07	1.12E-07	1.11E-07	1.11E-07	1.11E-07	1.12E-07	1.11E-07	1.11E-07	1.11E-07	1.12E-07	1.11E-07	1.11E-07	1.11E-07
216-B-62	2.57E-06	2.56E-06	2.56E-06	2.56E-06	2.57E-06	2.56E-06	2.56E-06	2.56E-06	2.57E-06	2.56E-06	2.56E-06	2.56E-06	2.57E-06	2.56E-06	2.56E-06	2.56E-06
216-B-63	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03
216-B-7A%B	9.28E-05	9.25E-05	5.85E+02	4.22E+03	8.99E+03	4.86E+03	6.09E+03	6.77E+03	1.99E+03	7.27E+03	1.63E+03	4.26E+02	1.66E+02	8.74E+01	5.49E+01	3.84E+01
216-B-8	2.45E-06	2.45E-06	2.45E-06	2.45E-06	4.87E+03	6.75E+03	8.72E+03	7.04E+03	4.55E+03	2.18E+03	5.96E+02	1.39E+02	6.78E+01	4.42E+01	3.26E+01	2.34E+01
216-B-9	2.47E-03	2.47E-03	2.47E-03	2.47E-03	2.47E-03	2.31E+03	1.20E+04	8.71E+03	3.87E+03	1.99E+03	1.02E+03	7.94E+02	5.09E+02	5.07E+02	2.83E+02	2.63E+02
216-BY-201	1.26E-09	1.26E-09	1.26E-09	1.26E-09	1.26E-09	1.26E-09	1.26E-09	1.26E-09	1.26E-09	1.26E-09	1.26E-09	2.84E+01	7.17E+00	1.61E+00	7.68E-01	5.22E-01
216-C-1	1.10E-04	1.10E-04	1.10E-04	1.10E-04	1.10E-04	1.10E-04	1.10E-04	1.10E-04	1.10E-04	6.95E+03	4.55E+03	5.40E+03	4.06E+03	1.17E+03	2.95E+02	1.45E+02
216-C-10	2.31E-08	2.30E-08	2.30E-08	2.30E-08	2.31E-08	2.30E-08	2.30E-08	2.30E-08	2.31E-08	2.30E-08	2.30E-08	2.30E-08	2.31E-08	2.30E-08	2.30E-08	2.30E-08
216-C-2	8.49E-05	8.46E-05	8.46E-05	8.46E-05	8.49E-05	8.46E-05	8.46E-05	8.46E-05	8.49E-05	8.46E-05	8.46E-05	8.46E-05	8.49E-05	8.46E-05	8.46E-05	8.46E-05
216-C-3	7.15E-05	7.13E-05	7.13E-05	7.13E-05	7.15E-05	7.13E-05	7.13E-05	7.13E-05	7.15E-05	2.80E+03	1.19E+03	3.77E+02	1.38E+02	6.89E+01	5.08E+01	3.26E+01
216-C-4	1.61E-04	1.60E-04	1.60E-04	1.60E-04	1.61E-04	1.60E-04	1.60E-04	1.60E-04	1.61E-04	1.60E-04	1.60E-04	1.60E-04	1.61E-04	1.60E-04	1.60E-04	1.60E-04
216-C-6	6.59E-07	6.57E-07	6.57E-07	6.57E-07	6.59E-07	6.57E-07	6.57E-07	6.57E-07	6.59E-07	6.57E-07	6.57E-07	6.57E-07	6.59E-07	6.57E-07	6.57E-07	6.57E-07
216-C-8	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04
216-C-9	2.90E-01	2.90E-01	2.90E-01	2.90E-01	2.90E-01	2.90E-01	2.90E-01	2.90E-01	2.90E-01	2.90E-01	1.73E+04	9.43E+04	9.47E+04	9.44E+04	5.14E+04	2.79E+04
216-N-2	1.37E-09	1.36E-09	1.36E-09	5.78E+03	1.16E+03	2.57E+02	1.16E+02	7.71E+01	6.23E+01	4.02E+01	3.52E+01	3.52E+01	2.11E+01	2.06E+01	2.06E+01	2.06E+01
216-N-3	1.52E-05	1.51E-05	1.51E-05	1.51E-05	1.52E-05	1.51E-05	1.51E-05	1.51E-05	5.51E+03	1.18E+03	1.98E+02	1.03E+02	6.74E+01	5.28E+01	3.52E+01	3.16E+01
216-N-4	1.72E-11	5.84E+04	1.32E+05	1.04E+05	1.22E+05	1.17E+05	1.37E+05	1.65E+05	7.25E+04	1.67E+04	6.58E+03	2.89E+03	2.55E+03	1.20E+03	1.20E+03	9.89E+02
216-N-5	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	5.51E+03	1.18E+03	1.98E+02	1.03E+02	6.74E+01	5.28E+01	3.52E+01	3.16E+01
216-N-6	1.46E-11	6.33E+04	1.33E+05	1.04E+05	1.22E+05	1.17E+05	1.37E+05	1.65E+05	7.12E+04	1.51E+04	5.77E+03	2.50E+03	2.20E+03	1.03E+03	1.03E+03	8.49E+02
216-N-7	1.52E-05	1.52E-05	1.52E-05	1.52E-05	1.52E-05	1.52E-05	1.52E-05	1.52E-05	5.51E+03	1.18E+03	1.98E+02	1.03E+02	6.74E+01	5.28E+01	3.52E+01	3.16E+01
216-S-1%2	1.68E-05	1.67E-05	1.67E-05	1.67E-05	1.68E-05	1.67E-05	1.67E-05	1.67E-05	1.68E-05	1.67E-05	5.07E+03	4.94E+04	3.32E+04	1.34E+04	7.72E+03	5.47E+03
216-S-10P	6.76E-07	6.75E-07	6.75E-07	6.75E-07	6.76E-07	6.75E-07	6.75E-07	6.75E-07	6.76E-07	6.75E-07	6.75E-07	6.75E-07	6.30E+04	1.97E+05	1.95E+05	1.92E+05
216-S-12	7.64E-07	7.61E-07	7.61E-07	7.61E-07	7.64E-07	7.61E-07	7.61E-07	7.61E-07	7.64E-07	7.61E-07	7.61E-07	7.61E-07	7.64E-07	7.61E-07	7.61E-07	7.61E-07
216-S-13	5.38E-06	5.37E-06	5.37E-06	5.37E-06	5.38E-06	5.37E-06	5.37E-06	5.37E-06	5.38E-06	9.37E+01	7.08E+02	6.23E+02	4.09E+02	2.82E+02	1.69E+02	1.19E+02
216-S-15	3.37E-07	3.36E-07	3.36E-07	3.36E-07	3.37E-07	3.36E-07	3.36E-07	3.36E-07	3.37E-07	3.36E-07	3.36E-07	3.36E-07	3.37E-07	3.36E-07	3.36E-07	3.36E-07
216-S-16P	1.66E-01	1.65E-01	1.65E-01	1.65E-01	1.66E-01	1.65E-01	1.65E-01	1.65E-01	1.66E-01	1.65E-01	1.65E-01	1.65E-01	1.66E-01	1.65E-01	1.65E-01	1.65E-01
216-S-17	2.34E-01	2.33E-01	2.33E-01	2.33E-01	2.34E-01	2.33E-01	2.33E-01	2.33E-01	2.34E-01	2.33E-01	1.07E+06	9.63E+05	6.03E+05	4.07E+05	3.12E+05	2.61E+05
216-S-19	1.73E-07	1.72E-07	1.72E-07	1.72E-07	1.73E-07	1.72E-07	1.72E-07	1.72E-07	1.73E-07	1.72E-07	1.72E-07	1.72E-07	1.73E-07	1.72E-07	1.72E-07	1.72E-07
216-S-20	2.40E-03	2.39E-03	2.39E-03	2.39E-03	2.40E-03	2.39E-03	2.39E-03	2.39E-03	2.40E-03	2.39E-03	2.39E-03	2.39E-03	2.40E-03	5.22E+03	8.40E+03	6.83E+03
216-S-21	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	4.46E+03
216-S-22	1.79E-06	1.78E-06	1.78E-06	1.78E-06	1.79E-06	1.78E-06	1.78E-06	1.78E-06	1.79E-06	1.78E-06	1.78E-06	1.78E-06	1.79E-06	1.78E-06	1.78E-06	1.78E-06
216-S-23	7.61E-04	7.58E-04	7.58E-04	7.58E-04	7.61E-04	7.58E-04	7.58E-04	7.58E-04	7.61E-04	7.58E-04	7.58E-04	7.58E-04	7.61E-04	7.58E-04	7.58E-04	7.58E-04
216-S-25	6.27E-05	6.25E-05	6.25E-05	6.25E-05	6.27E-05	6.25E-05	6.25E-05	6.25E-05	6.27E-05	6.25E-05	6.25E-05	6.25E-05	6.27E-05	6.25E-05	6.25E-05	6.25E-05

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
216-S-26	4.08E-08	4.07E-08	4.07E-08	4.07E-08	4.08E-08	4.07E-08	4.07E-08	4.07E-08	4.08E-08	4.07E-08	4.07E-08	4.07E-08	4.08E-08	4.07E-08	4.07E-08	4.07E-08
216-S-3	6.34E-06	6.33E-06	6.33E-06	6.33E-06	6.34E-06	6.33E-06	6.33E-06	6.33E-06	6.34E-06	6.33E-06	6.33E-06	9.47E+01	7.49E+02	4.78E+02	3.42E+02	2.53E+02
216-S-4	1.50E-10	1.49E-10	1.49E-10	1.49E-10	1.50E-10	1.49E-10	1.49E-10	1.49E-10	1.50E-10	1.49E-10	1.49E-10	8.73E+01	2.64E+02	1.56E+02	8.20E+01	5.47E+01
216-S-5	9.62E-02	9.60E-02	9.60E-02	9.60E-02	9.62E-02	9.60E-02	9.60E-02	9.60E-02	9.62E-02	9.60E-02	9.60E-02	9.60E-02	2.00E+04	7.17E+05	5.21E+05	3.45E+05
216-S-6	3.16E-04	3.15E-04	3.15E-04	3.15E-04	3.16E-04	3.15E-04	3.15E-04	3.15E-04	3.16E-04	3.15E-04	3.15E-04	3.15E-04	1.37E+05	5.98E+05	2.97E+05	2.29E+05
216-S-7	3.01E-05	3.00E-05	3.00E-05	3.00E-05	3.01E-05	3.00E-05	3.00E-05	3.00E-05	3.01E-05	3.00E-05	3.00E-05	3.00E-05	3.01E-05	3.00E-05	3.70E+04	4.39E+04
216-S-9	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05
216-SX-2	1.67E-07	1.66E-07	1.66E-07	1.66E-07	1.67E-07	1.66E-07	1.66E-07	1.66E-07	1.67E-07	5.24E-07	5.03E+03	5.91E+03	5.93E+03	5.92E+03	5.92E+03	5.91E+03
216-T-1	3.99E-12	3.98E-12	7.61E-09	2.82E-06	6.45E-05	7.37E-04	5.91E-03	3.72E-02	2.07E-01	1.03E+00	4.87E+00	2.13E+01	7.79E+01	1.89E+02	2.97E+02	3.52E+02
216-T-12	2.27E-08	2.26E-08	2.26E-08	2.26E-08	2.27E-08	2.26E-08	2.26E-08	2.26E-08	2.27E-08	2.26E-08	1.12E+03	1.74E+03	4.39E+02	2.40E+02	1.70E+02	1.09E+02
216-T-14	6.09E-05	6.07E-05	6.07E-05	6.07E-05	6.09E-05	6.07E-05	6.07E-05	6.07E-05	6.09E-05	6.07E-05	6.07E-05	6.07E-05	6.09E-05	7.02E-01	1.27E+01	4.00E+01
216-T-15	8.46E-05	8.43E-05	8.43E-05	8.43E-05	8.46E-05	8.43E-05	8.43E-05	8.43E-05	8.46E-05	8.43E-05	8.43E-05	8.43E-05	8.03E-04	2.97E+00	1.56E+01	5.28E+01
216-T-16	2.74E-05	2.74E-05	2.74E-05	2.74E-05	2.74E-05	2.74E-05	2.74E-05	2.74E-05	2.74E-05	2.74E-05	2.74E-05	2.74E-05	3.79E-04	2.09E+00	1.00E+01	4.89E+01
216-T-17	6.28E-09	6.26E-09	6.26E-09	6.26E-09	6.28E-09	6.26E-09	6.26E-09	6.26E-09	6.28E-09	6.26E-09	6.26E-09	6.26E-09	6.28E-09	1.38E-06	1.66E-02	1.10E+00
216-T-18	1.33E-10	1.32E-10	1.32E-10	1.32E-10	1.33E-10	1.32E-10	1.32E-10	1.32E-10	1.33E-10	1.32E-10	3.65E+02	1.20E+02	6.77E+01	4.56E+01	3.61E+01	2.47E+01
216-T-19	3.25E-06	3.25E-06	3.25E-06	3.25E-06	3.25E-06	3.25E-06	3.25E-06	3.25E-06	3.25E-06	3.25E-06	3.97E+00	4.08E+03	8.09E+03	7.07E+03	4.96E+03	3.47E+03
216-T-2	2.35E-04	1.98E+02	1.11E+03	1.11E+03	1.11E+03	1.11E+03	6.06E+02	2.33E+02	1.14E+02	6.67E+01	4.15E+01	3.45E+01	2.67E+01	1.85E+01	1.85E+01	1.80E+01
216-T-20	2.47E-10	2.46E-10	2.46E-10	2.46E-10	2.47E-10	2.46E-10	2.46E-10	2.46E-10	2.47E-10	2.46E-10	2.46E-10	2.46E-10	1.93E-08	5.67E-08	1.42E-04	2.25E-04
216-T-21	7.06E-06	7.04E-06	7.04E-06	7.04E-06	7.06E-06	7.04E-06	7.04E-06	7.04E-06	7.06E-06	7.04E-06	7.04E-06	7.04E-06	7.06E-06	7.04E-06	7.04E-06	4.26E-04
216-T-22	3.06E-07	3.05E-07	3.05E-07	3.05E-07	3.06E-07	3.05E-07	3.05E-07	3.05E-07	3.06E-07	3.05E-07	3.05E-07	2.74E+01	2.57E+02	1.72E+02	1.16E+02	9.49E+01
216-T-23	5.02E-08	5.00E-08	5.00E-08	5.00E-08	5.02E-08	5.00E-08	5.00E-08	5.00E-08	5.02E-08	5.00E-08	5.00E-08	1.08E+01	2.35E+02	1.72E+02	1.13E+02	8.83E+01
216-T-24	2.34E-05	2.33E-05	2.33E-05	2.33E-05	2.34E-05	2.33E-05	2.33E-05	2.33E-05	2.34E-05	2.33E-05	2.33E-05	2.14E+01	2.68E+02	1.70E+02	1.17E+02	9.20E+01
216-T-25	1.36E-08	1.36E-08	1.36E-08	1.36E-08	1.36E-08	1.36E-08	1.36E-08	1.36E-08	1.36E-08	1.36E-08	6.68E+02	1.04E+03	2.63E+02	1.44E+02	1.02E+02	6.50E+01
216-T-26	3.17E-08	3.16E-08	3.16E-08	3.16E-08	3.17E-08	3.16E-08	3.16E-08	3.16E-08	3.17E-08	3.16E-08	3.16E-08	1.70E+03	4.18E+03	1.72E+03	6.93E+02	4.18E+02
216-T-27	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08
216-T-28	1.29E-07	1.29E-07	1.29E-07	1.29E-07	1.29E-07	1.29E-07	1.29E-07	1.29E-07	1.29E-07	1.29E-07	1.29E-07	1.29E-07	1.29E-07	1.29E-07	1.29E-07	1.29E-07
216-T-29	9.91E-12	9.88E-12	9.88E-12	9.88E-12	9.91E-12	3.60E-01	4.83E+00	4.91E+00	4.93E+00	4.92E+00	4.92E+00	4.91E+00	4.93E+00	4.92E+00	4.92E+00	4.91E+00
216-T-3	4.38E-03	1.62E+03	6.31E+03	1.45E+03	4.58E+02	2.26E+02	1.66E+02	1.06E+02	1.02E+02	5.80E+01	5.80E+01	5.80E+01	4.02E+01	3.22E+01	3.22E+01	3.22E+01
216-T-32	2.84E-06	2.83E-06	2.83E-06	2.83E-06	4.14E+03	5.17E+03	5.62E+03	7.33E+03	3.46E+03	1.44E+03	6.46E+02	3.86E+02	2.83E+02	1.73E+02	1.65E+02	1.25E+02
216-T-33	4.77E-09	4.75E-09	4.75E-09	4.75E-09	4.77E-09	4.75E-09	4.75E-09	4.75E-09	4.77E-09	4.75E-09	4.75E-09	4.75E-09	4.77E-09	4.75E-09	4.75E-09	4.75E-09
216-T-34	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08
216-T-35	9.55E-11	9.53E-11	9.53E-11	9.53E-11	9.55E-11	9.53E-11	9.53E-11	9.53E-11	9.55E-11	9.53E-11	9.53E-11	9.53E-11	9.55E-11	9.53E-11	9.53E-11	9.53E-11
216-T-36	1.61E-09	1.60E-09	1.60E-09	1.60E-09	1.61E-09	1.60E-09	1.60E-09	1.60E-09	1.61E-09	1.60E-09	1.60E-09	1.60E-09	1.61E-09	1.60E-09	1.60E-09	1.60E-09
216-T-4A	2.07E-10	2.07E-10	2.07E-10	2.07E-10	2.08E-10	2.07E-10	2.07E-10	2.07E-10	2.08E-10	2.07E-10	2.07E-10	2.07E-10	5.75E+05	7.53E+05	1.92E+05	1.06E+05
216-T-5	1.31E-08	1.30E-08	1.30E-08	1.30E-08	1.31E-08	1.30E-08	1.30E-08	1.30E-08	1.31E-08	1.30E-08	1.30E-08	7.02E+02	1.10E+03	2.75E+02	1.51E+02	1.07E+02
216-T-6	2.09E-09	2.08E-09	2.08E-09	2.33E+04	9.84E+03	2.42E+03	1.34E+03	9.53E+02	6.09E+02	5.87E+02	3.75E+02	3.75E+02	3.59E+02	2.33E+02	2.33E+02	2.33E+02
216-T-7	7.39E-06	7.37E-06	7.37E-06	7.37E-06	7.39E-06	7.37E-06	7.37E-06	3.07E+03	7.96E+03	1.21E+04	2.27E+04	3.08E+04	1.12E+04	4.25E+03	2.25E+03	1.69E+03
216-T-8	1.58E-06	1.58E-06	1.58E-06	1.58E-06	1.58E-06	1.58E-06	1.58E-06	1.58E-06	1.58E-06	1.58E-06	1.58E-06	1.58E-06	1.58E-06	1.58E-06	2.34E-04	2.46E-04
216-TY-201	2.10E-08	2.09E-08	2.09E-08	2.09E-08	2.10E-08	2.09E-08	2.09E-08	2.09E-08	2.10E-08	2.09E-08	2.08E+00	6.22E+00	6.25E+00	6.24E+00	6.24E+00	6.22E+00
216-U-1%2	3.56E-06	3.55E-06	3.55E-06	3.55E-06	3.56E-06	3.55E-06	3.55E-06	3.55E-06	3.56E-06	3.55E-06	3.55E-06	3.55E-06	3.56E-06	3.55E-06	3.55E-06	3.55E-06
216-U-10	3.30E-09	3.30E-09	3.30E-09	3.30E-09	3.31E-09	3.30E-09	3.30E-09	3.30E-09	3.31E-09	4.49E+04	1.07E+07	1.11E+07	1.15E+07	1.11E+07	1.05E+07	7.97E+06

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	**1944**	**1945**	**1946**	**1947**	**1948**	**1949**	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**
216-U-12	2.89E-05	2.88E-05	2.88E-05	2.88E-05	2.89E-05	2.88E-05	2.88E-05	2.88E-05	2.89E-05	2.88E-05	2.88E-05	2.88E-05	2.89E-05	2.88E-05	2.88E-05	2.88E-05
216-U-13	5.00E-06	4.99E-06	4.99E-06	4.99E-06	5.00E-06	4.99E-06	4.99E-06	4.99E-06	5.00E-06	4.99E-06	4.99E-06	4.99E-06	5.00E-06	4.99E-06	4.99E-06	4.99E-06
216-U-14	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10
216-U-15	3.00E-06	2.99E-06	2.99E-06	2.99E-06	3.00E-06	2.99E-06	2.99E-06	2.99E-06	3.00E-06	2.99E-06	2.99E-06	2.99E-06	3.00E-06	2.99E-06	2.99E-06	2.99E-06
216-U-16	7.18E-02	7.16E-02	7.16E-02	7.16E-02	7.18E-02	7.16E-02	7.16E-02	7.16E-02	7.18E-02	7.16E-02	7.16E-02	7.16E-02	7.18E-02	7.16E-02	7.16E-02	7.16E-02
216-U-17	9.95E-09	9.93E-09	9.93E-09	9.93E-09	9.95E-09	9.93E-09	9.93E-09	9.93E-09	9.95E-09	9.93E-09	9.93E-09	9.93E-09	9.95E-09	9.93E-09	9.93E-09	9.93E-09
216-U-3	3.34E-05	3.33E-05	3.33E-05	3.33E-05	3.34E-05	3.33E-05	3.33E-05	3.33E-05	3.34E-05	3.33E-05	3.33E-05	3.33E-05	5.77E+00	6.50E+01	7.74E+01	6.46E+01
216-U-4	9.97E-08	9.94E-08	9.94E-08	9.94E-08	9.97E-08	9.94E-08	9.94E-08	9.94E-08	6.92E-05	2.07E-02	2.41E+00	1.97E+01	2.91E+01	2.65E+01	1.98E+01	1.89E+01
216-U-4A	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08
216-U-4B	6.63E-11	6.62E-11	6.62E-11	6.62E-11	6.63E-11	6.62E-11	6.62E-11	6.62E-11	6.63E-11	6.62E-11	6.62E-11	6.62E-11	6.63E-11	6.62E-11	6.62E-11	6.62E-11
216-U-7	1.71E-09	1.71E-09	1.71E-09	1.71E-09	1.71E-09	1.71E-09	1.71E-09	1.71E-09	1.71E-09	1.71E-09	1.71E-09	4.89E-07	8.82E-01	1.18E+00	9.15E-01	5.98E-01
216-U-8	1.24E-05	1.23E-05	1.23E-05	1.23E-05	1.24E-05	1.23E-05	1.23E-05	1.23E-05	1.24E-05	1.23E-05	4.06E+03	7.31E+04	7.88E+04	5.19E+04	2.88E+04	2.12E+04
216-W-LWC	4.17E-07	4.16E-07	4.16E-07	4.16E-07	4.17E-07	4.16E-07	4.16E-07	4.16E-07	4.17E-07	4.16E-07	4.16E-07	4.16E-07	4.17E-07	4.16E-07	4.16E-07	4.16E-07
216-Z-1%2	4.08E-08	4.07E-08	4.07E-08	4.07E-08	4.08E-08	4.07E-08	4.07E-08	3.90E+03	8.36E+03	4.66E+03	2.76E+03	1.87E+03	1.36E+03	1.04E+03	8.26E+02	6.79E+02
216-Z-10	1.17E-05	1.17E-05	3.30E+02	1.34E+02	7.68E+01	5.37E+01	3.70E+01	3.17E+01	2.26E+01	2.25E+01	1.80E+01	1.36E+01	1.36E+01	1.36E+01	1.25E+01	8.11E+00
216-Z-12	5.57E-06	5.55E-06	5.55E-06	5.55E-06	5.57E-06	5.55E-06	5.55E-06	5.55E-06	5.57E-06	5.55E-06	5.55E-06	5.55E-06	5.57E-06	5.55E-06	5.55E-06	5.55E-06
216-Z-3	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	3.62E-04	2.82E+04	3.24E+04	3.49E+04	2.43E+04
216-Z-4	2.01E-08	2.00E-08	2.00E-08	2.00E-08	2.01E-08	2.00E-08	2.00E-08	2.00E-08	2.01E-08	2.00E-08	2.00E-08	9.76E-07	1.54E-06	1.53E-06	1.53E-06	1.53E-06
216-Z-5	4.17E-05	4.16E-05	4.16E-05	2.52E+03	5.10E+03	3.07E+03	2.20E+03	1.78E+03	1.18E+03	1.18E+03	8.33E+02	7.54E+02	7.56E+02	6.05E+02	4.72E+02	4.72E+02
216-Z-6	7.81E-06	7.79E-06	7.79E-06	7.79E-06	7.81E-06	7.79E-06	7.79E-06	7.79E-06	7.81E-06	5.44E-04	7.94E-04	7.94E-04	7.96E-04	1.62E-01	1.74E-01	1.74E-01
216-Z-7	8.69E-08	8.67E-08	8.67E-08	8.67E-08	8.69E-08	1.01E+04	1.31E+04	1.31E+04	9.98E+03	5.96E+03	3.53E+03	2.46E+03	1.73E+03	1.25E+03	9.95E+02	8.43E+02
218-E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-E-Cores	4.10E-03	4.02E-03	3.95E-03	3.89E-03	3.84E-03	3.77E-03	3.71E-03	3.65E-03	3.60E-03	3.54E-03	3.48E-03	3.43E-03	3.38E-03	3.32E-03	3.26E-03	3.21E-03
218-E-LLW	1.84E-02	1.80E-02	1.77E-02	1.74E-02	1.72E-02	1.69E-02	1.66E-02	1.64E-02	1.61E-02	1.58E-02	1.56E-02	1.53E-02	1.51E-02	1.49E-02	1.46E-02	1.44E-02
218-W-3A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-3AE	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-4B	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-4C	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-104	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05
241-A-105	1.29E-05	1.28E-05	1.28E-05	1.28E-05	1.29E-05	1.28E-05	1.28E-05	1.28E-05	1.29E-05	1.28E-05	1.28E-05	1.28E-05	1.29E-05	1.28E-05	1.28E-05	1.28E-05
241-A-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
241-AN-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-108	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AY-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AY-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AZ-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AZ-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-B-101	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08
241-B-102	4.45E-08	4.44E-08	4.44E-08	4.44E-08	4.45E-08	4.44E-08	4.44E-08	4.44E-08	4.45E-08	4.44E-08	4.44E-08	4.44E-08	4.45E-08	4.44E-08	4.44E-08	4.44E-08
241-B-103	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08
241-B-104	5.93E-08	5.92E-08	5.92E-08	5.92E-08	5.93E-08	5.92E-08	5.92E-08	5.92E-08	5.93E-08	5.92E-08	5.92E-08	5.92E-08	5.93E-08	5.92E-08	5.92E-08	5.92E-08
241-B-105	4.22E-05	4.21E-05	4.21E-05	4.21E-05	4.22E-05	4.21E-05	4.21E-05	4.21E-05	4.22E-05	4.21E-05	4.21E-05	4.21E-05	4.22E-05	4.21E-05	4.21E-05	4.21E-05
241-B-106	3.40E-08	3.39E-08	3.39E-08	3.39E-08	3.40E-08	3.39E-08	3.39E-08	3.39E-08	3.40E-08	3.39E-08	3.39E-08	3.39E-08	3.40E-08	3.39E-08	3.39E-08	3.39E-08
241-B-107	9.09E-08	9.06E-08	9.06E-08	9.06E-08	9.09E-08	9.06E-08	9.06E-08	9.06E-08	9.09E-08	9.06E-08	9.06E-08	9.06E-08	9.09E-08	9.06E-08	9.06E-08	9.06E-08
241-B-108	4.46E-08	4.45E-08	4.45E-08	4.45E-08	4.46E-08	4.45E-08	4.45E-08	4.45E-08	4.46E-08	4.45E-08	4.45E-08	4.45E-08	4.46E-08	4.45E-08	4.45E-08	4.45E-08
241-B-109	5.93E-08	5.92E-08	5.92E-08	5.92E-08	5.93E-08	5.92E-08	5.92E-08	5.92E-08	5.93E-08	5.92E-08	5.92E-08	5.92E-08	5.93E-08	5.92E-08	5.92E-08	5.92E-08
241-B-110	2.50E-11	2.49E-11	2.49E-11	2.49E-11	2.50E-11	2.49E-11	2.49E-11	2.49E-11	2.50E-11	2.49E-11	2.49E-11	2.49E-11	2.50E-11	2.49E-11	2.49E-11	2.49E-11
241-B-111	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08
241-B-112	5.94E-08	5.92E-08	5.92E-08	5.92E-08	5.94E-08	5.92E-08	5.92E-08	5.92E-08	5.94E-08	5.92E-08	5.92E-08	5.92E-08	5.94E-08	5.92E-08	5.92E-08	5.92E-08
241-B-201	2.91E-09	2.90E-09	2.90E-09	2.90E-09	2.91E-09	2.90E-09	2.90E-09	2.90E-09	2.91E-09	2.90E-09	2.90E-09	2.90E-09	2.91E-09	2.90E-09	2.90E-09	2.90E-09
241-B-202	2.96E-09	2.95E-09	2.95E-09	2.95E-09	2.96E-09	2.95E-09	2.95E-09	2.95E-09	2.96E-09	2.95E-09	2.95E-09	2.95E-09	2.96E-09	2.95E-09	2.95E-09	2.95E-09
241-B-203	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08
241-B-204	7.72E-09	7.70E-09	7.70E-09	7.70E-09	7.72E-09	7.70E-09	7.70E-09	7.70E-09	7.72E-09	7.70E-09	7.70E-09	7.70E-09	7.72E-09	7.70E-09	7.70E-09	7.70E-09
241-BX-101	3.85E-06	3.84E-06	3.84E-06	3.84E-06	3.85E-06	3.84E-06	3.84E-06	3.84E-06	3.85E-06	3.84E-06	3.84E-06	3.84E-06	3.85E-06	3.84E-06	3.84E-06	3.84E-06
241-BX-102	3.03E-05	3.03E-05	3.03E-05	3.03E-05	3.03E-05	3.03E-05	3.03E-05	2.32E+02	7.26E+01	1.09E+01	5.33E+00	3.33E+00	2.42E+00	1.86E+00	1.49E+00	1.23E+00

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
241-BX-103	3.64E-08	3.63E-08	3.63E-08	3.63E-08	3.64E-08	3.63E-08	3.63E-08	3.63E-08	3.64E-08	3.63E-08	3.63E-08	3.63E-08	3.64E-08	3.63E-08	3.63E-08	3.63E-08
241-BX-104	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08
241-BX-105	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08
241-BX-106	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08
241-BX-107	3.64E-08	3.63E-08	3.63E-08	3.63E-08	3.64E-08	3.63E-08	3.63E-08	3.63E-08	3.64E-08	3.63E-08	3.63E-08	3.63E-08	3.64E-08	3.63E-08	3.63E-08	3.63E-08
241-BX-108	5.23E-08	5.21E-08	5.21E-08	5.21E-08	5.23E-08	5.21E-08	5.21E-08	5.21E-08	5.23E-08	5.21E-08	5.21E-08	5.21E-08	5.23E-08	5.21E-08	5.21E-08	5.21E-08
241-BX-109	6.48E-08	6.47E-08	6.47E-08	6.47E-08	6.48E-08	6.47E-08	6.47E-08	6.47E-08	6.48E-08	6.47E-08	6.47E-08	6.47E-08	6.48E-08	6.47E-08	6.47E-08	6.47E-08
241-BX-110	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08
241-BX-111	2.40E-05	2.39E-05	2.39E-05	2.39E-05	2.40E-05	2.39E-05	2.39E-05	2.39E-05	2.40E-05	2.39E-05	2.39E-05	2.39E-05	2.40E-05	2.39E-05	2.39E-05	2.39E-05
241-BX-112	6.49E-08	6.47E-08	6.47E-08	6.47E-08	6.49E-08	6.47E-08	6.47E-08	6.47E-08	6.49E-08	6.47E-08	6.47E-08	6.47E-08	6.49E-08	6.47E-08	6.47E-08	6.47E-08
241-BY-101	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08
241-BY-102	6.49E-08	6.47E-08	6.47E-08	6.47E-08	6.49E-08	6.47E-08	6.47E-08	6.47E-08	6.49E-08	6.47E-08	6.47E-08	6.47E-08	6.49E-08	6.47E-08	6.47E-08	6.47E-08
241-BY-103	7.54E-08	7.52E-08	7.52E-08	7.52E-08	7.54E-08	7.52E-08	7.52E-08	7.52E-08	7.54E-08	7.52E-08	7.52E-08	7.52E-08	7.54E-08	7.52E-08	7.52E-08	7.52E-08
241-BY-104	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08
241-BY-105	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08
241-BY-106	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	5.70E-08	5.70E-08
241-BY-107	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08
241-BY-108	8.61E-08	8.59E-08	8.59E-08	8.59E-08	8.61E-08	8.59E-08	8.59E-08	8.59E-08	8.61E-08	8.59E-08	8.59E-08	8.59E-08	8.61E-08	8.59E-08	8.59E-08	8.59E-08
241-BY-109	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	5.70E-08	5.70E-08
241-BY-110	4.16E-08	4.15E-08	4.15E-08	4.15E-08	4.16E-08	4.15E-08	4.15E-08	4.15E-08	4.16E-08	4.15E-08	4.15E-08	4.15E-08	4.16E-08	4.15E-08	4.15E-08	4.15E-08
241-BY-111	4.33E-08	4.32E-08	4.32E-08	4.32E-08	4.33E-08	4.32E-08	4.32E-08	4.32E-08	4.33E-08	4.32E-08	4.32E-08	4.32E-08	4.33E-08	4.32E-08	4.32E-08	4.32E-08
241-BY-112	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08
241-C-101	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-102	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-103	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-104	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-105	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04
241-C-106	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04
241-C-107	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-108	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04
241-C-109	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04
241-C-110	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-111	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-112	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-201	7.42E-06	7.40E-06	7.40E-06	7.40E-06	7.42E-06	7.40E-06	7.40E-06	7.40E-06	7.42E-06	7.40E-06	7.40E-06	7.40E-06	7.42E-06	7.40E-06	7.40E-06	7.40E-06
241-C-202	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06
241-C-203	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06
241-C-204	7.46E-06	7.44E-06	7.44E-06	7.44E-06	7.46E-06	7.44E-06	7.44E-06	7.44E-06	7.46E-06	7.44E-06	7.44E-06	7.44E-06	7.46E-06	7.44E-06	7.44E-06	7.44E-06
241-S-101	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08
241-S-102	1.79E-08	1.78E-08	1.78E-08	1.78E-08	1.79E-08	1.78E-08	1.78E-08	1.78E-08	1.79E-08	1.78E-08	1.78E-08	1.78E-08	1.79E-08	1.78E-08	1.78E-08	1.78E-08
241-S-103	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
241-S-104	4.46E-09	4.44E-09	4.44E-09	4.44E-09	4.46E-09	4.44E-09	4.44E-09	4.44E-09	4.46E-09	4.44E-09	4.44E-09	4.44E-09	4.46E-09	4.44E-09	4.44E-09	4.44E-09
241-S-105	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08
241-S-106	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08
241-S-107	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08
241-S-108	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08
241-S-109	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08
241-S-110	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08
241-S-111	1.59E-08	1.58E-08	1.58E-08	1.58E-08	1.59E-08	1.58E-08	1.58E-08	1.58E-08	1.59E-08	1.58E-08	1.58E-08	1.58E-08	1.59E-08	1.58E-08	1.58E-08	1.58E-08
241-S-112	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08
241-SX-101	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08
241-SX-102	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08
241-SX-103	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08
241-SX-104	1.64E-08	1.63E-08	1.63E-08	1.63E-08	1.64E-08	1.63E-08	1.63E-08	1.63E-08	1.64E-08	1.63E-08	1.63E-08	1.63E-08	1.64E-08	1.63E-08	1.63E-08	1.63E-08
241-SX-105	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08
241-SX-106	2.08E-08	2.07E-08	2.07E-08	2.07E-08	2.08E-08	2.07E-08	2.07E-08	2.07E-08	2.08E-08	2.07E-08	2.07E-08	2.07E-08	2.08E-08	2.07E-08	2.07E-08	2.07E-08
241-SX-107	5.58E-09	5.56E-09	5.56E-09	5.56E-09	5.58E-09	5.56E-09	5.56E-09	5.56E-09	5.58E-09	5.56E-09	5.56E-09	5.56E-09	5.58E-09	5.56E-09	5.56E-09	5.56E-09
241-SX-108	7.70E-10	7.68E-10	7.68E-10	7.68E-10	7.70E-10	7.68E-10	7.68E-10	7.68E-10	7.70E-10	7.68E-10	7.68E-10	7.68E-10	7.70E-10	7.68E-10	7.68E-10	7.68E-10
241-SX-109	1.28E-09	1.27E-09	1.27E-09	1.27E-09	1.28E-09	1.27E-09	1.27E-09	1.27E-09	1.28E-09	1.27E-09	1.27E-09	1.27E-09	1.28E-09	1.27E-09	1.27E-09	1.27E-09
241-SX-110	4.66E-11	4.65E-11	4.65E-11	4.65E-11	4.66E-11	4.65E-11	4.65E-11	4.65E-11	4.66E-11	4.65E-11	4.65E-11	4.65E-11	4.66E-11	4.65E-11	4.65E-11	4.65E-11
241-SX-111	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09
241-SX-112	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08
241-SX-113	1.28E-08	1.27E-08	1.27E-08	1.27E-08	1.28E-08	1.27E-08	1.27E-08	1.27E-08	1.28E-08	1.27E-08	1.27E-08	1.27E-08	1.28E-08	1.27E-08	1.27E-08	1.27E-08
241-SX-114	3.15E-11	3.14E-11	3.14E-11	3.14E-11	3.15E-11	3.14E-11	3.14E-11	3.14E-11	3.15E-11	3.14E-11	3.14E-11	3.14E-11	3.15E-11	3.14E-11	3.14E-11	3.14E-11
241-SX-115	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08
241-SY-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-SY-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-SY-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-T-101	5.36E-16	5.35E-16	5.35E-16	5.35E-16	5.36E-16	5.35E-16	5.35E-16	5.35E-16	5.36E-16	5.35E-16	5.35E-16	5.35E-16	5.36E-16	5.35E-16	5.35E-16	5.35E-16
241-T-102	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.00E-09	5.00E-09	5.00E-09
241-T-103	3.76E-09	3.75E-09	3.75E-09	3.75E-09	3.76E-09	3.75E-09	3.75E-09	3.75E-09	3.76E-09	3.75E-09	3.75E-09	3.75E-09	3.76E-09	3.75E-09	3.75E-09	3.75E-09
241-T-104	5.36E-09	5.34E-09	5.34E-09	5.34E-09	5.36E-09	5.34E-09	5.34E-09	5.34E-09	5.36E-09	5.34E-09	5.34E-09	5.34E-09	5.36E-09	5.34E-09	5.34E-09	5.34E-09
241-T-105	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.34E-09	5.34E-09
241-T-106	7.06E-06	7.04E-06	7.04E-06	7.04E-06	7.06E-06	7.04E-06	7.04E-06	7.04E-06	7.06E-06	7.04E-06	7.04E-06	7.04E-06	7.06E-06	7.04E-06	7.04E-06	7.04E-06
241-T-107	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16
241-T-108	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.00E-09	5.00E-09	5.00E-09
241-T-109	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.00E-09	5.00E-09	5.00E-09
241-T-110	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16
241-T-111	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.00E-09	5.00E-09	5.00E-09
241-T-112	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.34E-09	5.34E-09
241-T-201	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10
241-T-202	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
241-T-203	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10
241-T-204	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10
241-TX-101	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09
241-TX-102	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09
241-TX-103	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09
241-TX-104	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09
241-TX-105	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TX-106	4.25E-10	4.24E-10	4.24E-10	4.24E-10	4.25E-10	4.24E-10	4.24E-10	4.24E-10	4.25E-10	4.24E-10	4.24E-10	4.24E-10	4.25E-10	4.24E-10	4.24E-10	4.24E-10
241-TX-107	2.76E-11	2.75E-11	2.75E-11	2.75E-11	2.76E-11	2.75E-11	2.75E-11	2.75E-11	2.76E-11	2.75E-11	2.75E-11	2.75E-11	2.76E-11	2.75E-11	2.75E-11	2.75E-11
241-TX-108	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TX-109	4.79E-09	4.77E-09	4.77E-09	4.77E-09	4.79E-09	4.77E-09	4.77E-09	4.77E-09	4.79E-09	4.77E-09	4.77E-09	4.77E-09	4.79E-09	4.77E-09	4.77E-09	4.77E-09
241-TX-110	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09
241-TX-111	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09
241-TX-112	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09
241-TX-113	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TX-114	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TX-115	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TX-116	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TX-117	4.17E-09	4.15E-09	4.15E-09	4.15E-09	4.17E-09	4.15E-09	4.15E-09	4.15E-09	4.17E-09	4.15E-09	4.15E-09	4.15E-09	4.17E-09	4.15E-09	4.15E-09	4.15E-09
241-TX-118	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TY-101	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12
241-TY-102	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12
241-TY-103	2.54E-09	2.53E-09	2.53E-09	2.53E-09	2.54E-09	2.53E-09	2.53E-09	2.53E-09	2.54E-09	2.53E-09	2.53E-09	2.53E-09	2.54E-09	2.53E-09	2.53E-09	2.53E-09
241-TY-104	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12
241-TY-105	5.05E-06	5.04E-06	5.04E-06	5.04E-06	5.05E-06	5.04E-06	5.04E-06	5.04E-06	5.05E-06	5.04E-06	5.04E-06	5.04E-06	5.05E-06	5.04E-06	3.33E-01	2.37E+01
241-TY-106	3.07E-08	3.06E-08	3.06E-08	3.06E-08	3.07E-08	3.06E-08	3.06E-08	3.06E-08	3.07E-08	3.06E-08	3.06E-08	3.06E-08	3.07E-08	3.06E-08	3.06E-08	2.23E-01
241-U-101	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08
241-U-102	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08
241-U-103	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08
241-U-104	9.82E-09	9.79E-09	9.79E-09	9.79E-09	9.82E-09	9.79E-09	9.79E-09	9.79E-09	9.82E-09	9.79E-09	9.79E-09	9.79E-09	9.82E-09	9.79E-09	9.79E-09	9.79E-09
241-U-105	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08
241-U-106	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08
241-U-107	1.67E-08	1.66E-08	1.66E-08	1.66E-08	1.67E-08	1.66E-08	1.66E-08	1.66E-08	1.67E-08	1.66E-08	1.66E-08	1.66E-08	1.67E-08	1.66E-08	1.66E-08	1.66E-08
241-U-108	1.89E-08	1.88E-08	1.88E-08	1.88E-08	1.89E-08	1.88E-08	1.88E-08	1.88E-08	1.89E-08	1.88E-08	1.88E-08	1.88E-08	1.89E-08	1.88E-08	1.88E-08	1.88E-08
241-U-109	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08
241-U-110	4.53E-09	4.52E-09	4.52E-09	4.52E-09	4.53E-09	4.52E-09	4.52E-09	4.52E-09	4.53E-09	4.52E-09	4.52E-09	4.52E-09	4.53E-09	4.52E-09	4.52E-09	4.52E-09
241-U-111	1.74E-08	1.73E-08	1.73E-08	1.73E-08	1.74E-08	1.73E-08	1.73E-08	1.73E-08	1.74E-08	1.73E-08	1.73E-08	1.73E-08	1.74E-08	1.73E-08	1.73E-08	1.73E-08
241-U-112	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08
241-U-201	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09
241-U-202	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09
241-U-203	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	**1944**	**1945**	**1946**	**1947**	**1948**	**1949**	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**
241-U-204	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09
300-224	3.39E-07	3.38E-07	3.38E-07	3.38E-07	3.39E-07	3.38E-07	3.38E-07	3.38E-07	3.39E-07	3.38E-07	3.38E-07	3.38E-07	3.39E-07	3.38E-07	3.38E-07	3.38E-07
316-1	3.06E-12	1.55E+06	2.39E+06	2.38E+06	2.39E+06	1.30E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06
316-2	2.19E-06	2.19E-06	2.19E-06	2.19E-06	2.19E-06	6.15E+05	1.20E+06	1.20E+06	1.21E+06	1.20E+06	1.20E+06	1.20E+06	1.21E+06	1.20E+06	1.20E+06	1.20E+06
316-3	2.34E-11	2.34E-11	2.34E-11	2.34E-11	2.34E-11	2.34E-11	2.34E-11	2.34E-11	2.34E-11	5.99E+04	9.10E+04	9.08E+04	9.13E+04	9.10E+04	9.10E+04	9.08E+04
316-5	3.08E-10	3.07E-10	3.07E-10	3.07E-10	3.08E-10	3.07E-10	3.07E-10	3.07E-10	3.08E-10	3.07E-10	3.07E-10	3.07E-10	3.08E-10	3.07E-10	3.07E-10	3.07E-10
600-148	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
600-211	4.24E-09	4.23E-09	4.23E-09	4.23E-09	4.24E-09	4.23E-09	4.23E-09	4.23E-09	4.24E-09	4.23E-09	4.23E-09	4.23E-09	4.24E-09	4.23E-09	4.23E-09	4.23E-09
618-11	5.63E-11	5.60E-11	5.60E-11	5.60E-11	1.03E-10	3.27E-10	3.27E-10	3.27E-10	3.27E-10	3.27E-10	3.27E-10	3.27E-10	3.27E-10	3.27E-10	3.27E-10	3.27E-10
GTF	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GTFL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILAW-liquid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RMWSF	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-100-N-1	9.22E-12	9.45E-12	9.45E-12	9.45E-12	9.47E-12	9.45E-12	9.45E-12	9.45E-12	9.47E-12	9.45E-12	9.45E-12	9.45E-12	9.47E-12	9.45E-12	9.45E-12	9.45E-12
UPR-100-N-25	4.96E-15	5.08E-15	5.08E-15	5.08E-15	5.10E-15	5.08E-15	5.08E-15	5.08E-15	5.10E-15	5.08E-15	5.08E-15	5.08E-15	5.10E-15	5.08E-15	5.08E-15	5.08E-15
UPR-100-N-30	1.69E-13	1.68E-13	1.68E-13	1.68E-13	1.68E-13	3.46E-13	1.18E-12	1.18E-12	1.19E-12	1.18E-12	1.18E-12	1.18E-12	1.19E-12	1.18E-12	1.18E-12	1.18E-12
UPR-100-N-5	2.86E-15	2.85E-15	2.85E-15	2.85E-15	2.86E-15	5.87E-15	2.01E-14	2.01E-14	2.02E-14	2.01E-14	2.01E-14	2.01E-14	2.02E-14	2.01E-14	2.01E-14	2.01E-14
UPR-200-E-1	4.80E-09	4.79E-09	4.79E-09	4.79E-09	4.80E-09	4.79E-09	2.01E-07	3.35E-03	1.09E-02	3.42E-02	7.20E-02	7.20E-02	7.20E-02	7.15E-02	7.15E-02	7.15E-02
UPR-200-E-105	8.33E-04	8.31E-04	8.31E-04	8.31E-04	8.33E-04	8.31E-04	8.31E-04	8.31E-04	8.33E-04	8.31E-04	8.31E-04	4.72E+00	9.11E+00	6.65E+00	5.12E+00	4.54E+00
UPR-200-E-107	4.33E-05	4.32E-05	4.32E-05	4.32E-05	4.33E-05	4.32E-05	4.32E-05	4.32E-05	4.33E-05	4.32E-05	4.32E-05	4.32E-05	4.33E-05	4.32E-05	4.32E-05	4.32E-05
UPR-200-E-108	6.35E-09	6.33E-09	6.33E-09	6.33E-09	6.35E-09	6.33E-09	6.33E-09	6.33E-09	6.35E-09	6.33E-09	6.33E-09	6.33E-09	6.35E-09	6.33E-09	6.33E-09	6.33E-09
UPR-200-E-109	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07
UPR-200-E-110	4.60E-11	4.59E-11	4.59E-11	4.59E-11	4.60E-11	4.59E-11	4.59E-11	4.59E-11	4.60E-11	4.59E-11	4.59E-11	1.35E+01	8.46E+00	2.03E+00	1.01E+00	5.70E-01
UPR-200-E-114	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-115	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-116	1.39E-08	1.38E-08	1.38E-08	1.38E-08	1.39E-08	1.38E-08	1.38E-08	1.38E-08	1.39E-08	1.38E-08	1.38E-08	1.38E-08	1.39E-08	1.38E-08	1.38E-08	1.38E-08
UPR-200-E-117	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-119	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-133	7.12E-08	7.10E-08	7.10E-08	7.10E-08	7.12E-08	7.10E-08	7.10E-08	7.10E-08	7.12E-08	7.10E-08	7.10E-08	7.10E-08	7.12E-08	7.10E-08	7.10E-08	7.10E-08
UPR-200-E-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-145	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-21	5.31E-05	5.29E-05	5.29E-05	5.29E-05	5.31E-05	5.29E-05	5.29E-05	5.29E-05	5.31E-05	5.29E-05	5.29E-05	5.29E-05	5.31E-05	5.29E-05	5.29E-05	5.29E-05
UPR-200-E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-3	3.73E-07	3.72E-07	3.72E-07	3.72E-07	3.73E-07	3.72E-07	3.72E-07	3.72E-07	3.73E-07	3.72E-07	3.72E-07	3.72E-07	3.73E-07	3.72E-07	3.72E-07	3.72E-07
UPR-200-E-38	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12
UPR-200-E-42	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-6	6.25E-10	6.23E-10	6.23E-10	6.23E-10	6.25E-10	6.23E-10	6.23E-10	6.23E-10	6.25E-10	6.23E-10	6.23E-10	6.23E-10	6.25E-10	6.23E-10	6.23E-10	6.23E-10
UPR-200-E-7	8.42E-07	8.39E-07	8.39E-07	8.39E-07	8.42E-07	8.39E-07	8.39E-07	8.39E-07	8.42E-07	8.39E-07	8.39E-07	6.20E+00	2.85E+00	1.50E+00	9.17E-01	7.13E-01
UPR-200-E-73	9.41E-08	9.39E-08	9.39E-08	9.39E-08	9.41E-08	9.39E-08	9.39E-08	9.39E-08	9.41E-08	9.39E-08	9.39E-08	9.39E-08	9.41E-08	9.39E-08	9.39E-08	9.39E-08
UPR-200-E-74	2.67E-08	2.66E-08	2.66E-08	2.66E-08	2.67E-08	2.66E-08	2.66E-08	2.66E-08	2.67E-08	2.66E-08	2.66E-08	2.66E-08	2.67E-08	2.66E-08	2.66E-08	2.66E-08
UPR-200-E-75	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	**1944**	**1945**	**1946**	**1947**	**1948**	**1949**	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**
UPR-200-E-77	7.43E-09	7.41E-09	7.41E-09	7.41E-09	7.43E-09	7.41E-09	7.41E-09	7.41E-09	7.43E-09	7.41E-09	7.41E-09	7.41E-09	7.43E-09	7.41E-09	7.41E-09	7.41E-09
UPR-200-E-78	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07
UPR-200-E-79	9.98E-07	9.95E-07	9.95E-07	9.95E-07	9.98E-07	9.95E-07	9.95E-07	9.95E-07	9.98E-07	9.95E-07	9.95E-07	9.95E-07	9.98E-07	9.95E-07	9.95E-07	9.95E-07
UPR-200-E-80	3.67E-05	3.66E-05	3.66E-05	3.66E-05	3.67E-05	3.66E-05	3.66E-05	3.66E-05	3.67E-05	3.66E-05	3.66E-05	3.66E-05	3.67E-05	3.66E-05	3.66E-05	3.66E-05
UPR-200-E-81	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03
UPR-200-E-82	5.17E-07	5.16E-07	5.16E-07	5.16E-07	5.17E-07	5.16E-07	5.16E-07	5.16E-07	5.17E-07	5.16E-07	5.16E-07	5.16E-07	5.17E-07	5.16E-07	5.16E-07	5.16E-07
UPR-200-E-84	4.10E-08	4.09E-08	4.09E-08	4.09E-08	4.10E-08	4.09E-08	4.09E-08	4.09E-08	4.10E-08	4.09E-08	1.75E+00	1.03E+00	5.45E-01	3.44E-01	2.68E-01	1.92E-01
UPR-200-E-85	6.90E-09	6.88E-09	6.88E-09	6.88E-09	6.90E-09	6.88E-09	6.88E-09	6.88E-09	6.90E-09	6.88E-09	6.88E-09	6.88E-09	6.90E-09	6.88E-09	6.88E-09	6.88E-09
UPR-200-E-86	1.79E-03	1.78E-03	1.78E-03	1.78E-03	1.79E-03	1.78E-03	1.78E-03	1.78E-03	1.79E-03	1.78E-03	1.78E-03	1.78E-03	1.79E-03	1.78E-03	1.78E-03	1.78E-03
UPR-200-E-87	9.16E-06	9.14E-06	9.14E-06	9.14E-06	9.16E-06	9.14E-06	9.14E-06	9.14E-06	9.16E-06	9.14E-06	9.14E-06	9.14E-06	9.16E-06	9.14E-06	9.14E-06	9.14E-06
UPR-200-E-9	1.27E-05	1.26E-05	1.26E-05	1.26E-05	1.27E-05	1.26E-05	1.26E-05	1.26E-05	1.27E-05	1.26E-05	1.26E-05	1.26E-05	1.27E-05	1.26E-05	1.26E-05	1.26E-05
UPR-200-W-10	3.40E-09	3.39E-09	3.39E-09	3.39E-09	3.40E-09	3.39E-09	3.39E-09	3.39E-09	3.40E-09	3.39E-09	3.39E-09	3.39E-09	3.40E-09	3.39E-09	3.39E-09	3.39E-09
UPR-200-W-100	3.98E-06	3.97E-06	3.97E-06	3.97E-06	3.98E-06	3.97E-06	3.97E-06	3.97E-06	3.98E-06	3.97E-06	3.97E-06	3.97E-06	3.98E-06	3.97E-06	3.97E-06	3.97E-06
UPR-200-W-101	6.98E-08	6.96E-08	6.96E-08	6.96E-08	6.98E-08	6.96E-08	6.96E-08	6.96E-08	6.98E-08	6.96E-08	6.96E-08	6.96E-08	6.98E-08	6.96E-08	6.96E-08	6.96E-08
UPR-200-W-102	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07
UPR-200-W-107	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	7.69E-01
UPR-200-W-115	3.11E-07	3.10E-07	3.10E-07	3.10E-07	3.11E-07	3.10E-07	3.10E-07	3.10E-07	3.11E-07	3.10E-07	3.10E-07	3.10E-07	3.11E-07	3.10E-07	3.10E-07	3.10E-07
UPR-200-W-12	5.28E-09	5.27E-09	5.27E-09	5.27E-09	5.28E-09	5.27E-09	5.27E-09	5.27E-09	5.28E-09	5.27E-09	5.27E-09	5.27E-09	5.28E-09	5.27E-09	5.27E-09	5.27E-09
UPR-200-W-127	3.73E-10	3.72E-10	3.72E-10	3.72E-10	3.73E-10	3.72E-10	3.72E-10	3.72E-10	3.73E-10	3.72E-10	3.72E-10	3.72E-10	3.73E-10	3.72E-10	3.72E-10	3.72E-10
UPR-200-W-128	2.60E-06	2.59E-06	2.59E-06	2.59E-06	2.60E-06	2.59E-06	2.59E-06	2.59E-06	2.60E-06	2.59E-06	2.59E-06	2.59E-06	2.60E-06	2.59E-06	2.59E-06	2.59E-06
UPR-200-W-129	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09
UPR-200-W-13	2.24E-07	2.23E-07	2.23E-07	2.23E-07	2.24E-07	2.23E-07	2.23E-07	2.23E-07	2.24E-07	2.23E-07	2.23E-07	2.23E-07	2.24E-07	2.23E-07	2.23E-07	2.23E-07
UPR-200-W-131	3.34E-09	3.33E-09	3.33E-09	3.33E-09	3.34E-09	3.33E-09	3.33E-09	3.33E-09	3.34E-09	3.33E-09	3.33E-09	3.33E-09	3.34E-09	3.33E-09	3.33E-09	3.33E-09
UPR-200-W-132	1.11E-08	1.10E-08	1.10E-08	1.10E-08	1.11E-08	1.10E-08	1.10E-08	1.10E-08	1.11E-08	1.10E-08	1.10E-08	1.10E-08	1.11E-08	1.10E-08	1.10E-08	1.10E-08
UPR-200-W-135	3.28E-10	3.27E-10	3.27E-10	3.27E-10	3.28E-10	3.27E-10	3.27E-10	3.27E-10	3.28E-10	3.27E-10	3.27E-10	3.27E-10	3.28E-10	9.92E-08	9.16E-04	2.53E-02
UPR-200-W-138	8.63E-11	8.61E-11	8.61E-11	8.61E-11	8.63E-11	8.61E-11	8.61E-11	8.61E-11	8.63E-11	8.61E-11	8.61E-11	8.61E-11	8.63E-11	8.61E-11	8.61E-11	8.61E-11
UPR-200-W-139	2.04E-07	2.03E-07	2.03E-07	2.03E-07	2.04E-07	2.03E-07	2.03E-07	2.03E-07	2.04E-07	2.03E-07	2.03E-07	2.03E-07	2.04E-07	2.03E-07	2.03E-07	2.03E-07
UPR-200-W-14	1.34E-08	1.33E-08	1.33E-08	1.33E-08	1.34E-08	1.33E-08	1.33E-08	1.33E-08	1.34E-08	1.33E-08	1.33E-08	1.33E-08	1.34E-08	1.33E-08	1.33E-08	1.33E-08
UPR-200-W-15	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07
UPR-200-W-163	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05
UPR-200-W-19	7.05E-10	7.03E-10	7.03E-10	7.03E-10	7.05E-10	7.03E-10	7.03E-10	7.03E-10	7.05E-10	7.03E-10	7.03E-10	7.03E-10	7.05E-10	7.03E-10	7.03E-10	7.03E-10
UPR-200-W-2	5.98E-11	5.96E-11	5.96E-11	5.96E-11	5.98E-11	5.96E-11	5.96E-11	5.96E-11	5.98E-11	5.96E-11	5.96E-11	5.96E-11	5.98E-11	2.94E-09	5.35E-09	5.35E-09
UPR-200-W-20	9.44E-09	9.41E-09	9.41E-09	9.41E-09	9.44E-09	9.41E-09	9.41E-09	9.41E-09	9.44E-09	9.41E-09	9.41E-09	9.41E-09	9.44E-09	9.41E-09	9.41E-09	9.41E-09
UPR-200-W-21	4.37E-06	4.36E-06	4.36E-06	4.36E-06	4.37E-06	4.36E-06	4.36E-06	4.36E-06	4.37E-06	4.36E-06	4.36E-06	4.36E-06	4.37E-06	4.36E-06	4.36E-06	4.36E-06
UPR-200-W-24	4.66E-06	4.65E-06	4.65E-06	4.65E-06	4.66E-06	4.65E-06	4.65E-06	4.65E-06	4.66E-06	4.65E-06	4.65E-06	4.65E-06	4.66E-06	4.65E-06	4.65E-06	4.65E-06
UPR-200-W-28	8.72E-07	8.70E-07	8.70E-07	8.70E-07	8.72E-07	8.70E-07	8.70E-07	8.70E-07	8.72E-07	8.70E-07	8.70E-07	8.70E-07	8.72E-07	8.70E-07	8.70E-07	8.70E-07
UPR-200-W-29	4.30E-08	4.29E-08	4.29E-08	4.29E-08	4.30E-08	4.29E-08	4.29E-08	4.29E-08	4.30E-08	4.29E-08	4.29E-08	4.29E-08	4.30E-08	4.29E-08	4.29E-08	4.29E-08
UPR-200-W-32	1.05E-08	1.05E-08	1.05E-08	1.05E-08	1.05E-08	1.05E-08	1.05E-08	1.05E-08	1.05E-08	1.05E-08	1.05E-08	1.05E-08	1.05E-08	1.05E-08	1.18E-06	4.08E-06
UPR-200-W-33	1.85E-09	1.84E-09	1.84E-09	1.84E-09	1.85E-09	1.84E-09	1.84E-09	1.84E-09	1.85E-09	1.84E-09	1.84E-09	1.84E-09	1.85E-09	1.84E-09	1.84E-09	1.84E-09
UPR-200-W-35	1.13E-10	1.13E-10	1.13E-10	1.13E-10	1.13E-10	1.13E-10	1.13E-10	1.13E-10	1.13E-10	1.13E-10	1.13E-10	1.13E-10	1.13E-10	1.13E-10	1.13E-10	1.13E-10
UPR-200-W-38	2.09E-06	2.08E-06	2.08E-06	2.08E-06	2.09E-06	2.08E-06	2.08E-06	2.08E-06	2.09E-06	2.08E-06	2.08E-06	2.08E-06	2.09E-06	2.08E-06	2.08E-06	2.08E-06

	ANNUAL DISCHARGE VOLUMES IN M^3															
Site	**1944**	**1945**	**1946**	**1947**	**1948**	**1949**	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**
UPR-200-W-39	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07
UPR-200-W-49	5.16E-08	5.14E-08	5.14E-08	5.14E-08	5.16E-08	5.14E-08	5.14E-08	5.14E-08	5.16E-08	5.14E-08	5.14E-08	5.14E-08	5.16E-08	5.14E-08	5.14E-08	5.14E-08
UPR-200-W-5	3.45E-10	3.45E-10	3.45E-10	3.45E-10	3.45E-10	3.45E-10	3.45E-10	3.45E-10	3.45E-10	3.45E-10	3.45E-10	1.51E-08	5.70E-08	5.69E-08	4.54E-05	5.87E-05
UPR-200-W-51	1.24E-08	1.23E-08	1.23E-08	1.23E-08	1.24E-08	1.23E-08	1.23E-08	1.23E-08	1.24E-08	1.23E-08	1.23E-08	1.23E-08	1.24E-08	1.23E-08	1.23E-08	1.23E-08
UPR-200-W-59	1.24E-05	1.23E-05	1.23E-05	1.23E-05	1.24E-05	1.23E-05	1.23E-05	1.23E-05	1.24E-05	1.23E-05	1.23E-05	1.23E-05	1.24E-05	1.23E-05	1.23E-05	1.23E-05
UPR-200-W-6	7.67E-09	7.65E-09	7.65E-09	7.65E-09	7.67E-09	7.65E-09	7.65E-09	7.65E-09	7.67E-09	7.65E-09	7.65E-09	7.65E-09	7.67E-09	7.65E-09	7.65E-09	7.65E-09
UPR-200-W-61	3.21E-09	3.20E-09	3.20E-09	3.20E-09	3.21E-09	3.20E-09	3.20E-09	3.20E-09	3.21E-09	3.20E-09	3.20E-09	3.20E-09	3.21E-09	3.20E-09	3.20E-09	3.20E-09
UPR-200-W-82	1.39E-10	1.38E-10	1.38E-10	1.38E-10	1.39E-10	1.38E-10	1.38E-10	1.38E-10	1.39E-10	1.38E-10	1.38E-10	1.38E-10	1.39E-10	1.38E-10	1.38E-10	1.38E-10
UPR-200-W-87	3.64E-10	3.63E-10	3.63E-10	3.63E-10	3.64E-10	3.63E-10	3.63E-10	3.63E-10	3.64E-10	3.63E-10	3.63E-10	3.63E-10	3.64E-10	3.63E-10	3.63E-10	3.63E-10
UPR-200-W-95	1.61E-05	1.60E-05	1.60E-05	1.60E-05	1.61E-05	1.60E-05	1.60E-05	1.60E-05	1.61E-05	1.60E-05	1.60E-05	1.60E-05	1.61E-05	1.60E-05	1.60E-05	1.60E-05
UPR-200-W-96	4.74E-08	4.72E-08	4.72E-08	4.72E-08	4.74E-08	4.72E-08	4.72E-08	4.72E-08	4.74E-08	4.72E-08	4.72E-08	4.72E-08	4.74E-08	4.72E-08	4.72E-08	4.72E-08
UPR-200-W-97	3.95E-10	3.93E-10	3.93E-10	3.93E-10	3.95E-10	3.93E-10	3.93E-10	3.93E-10	3.95E-10	3.93E-10	3.93E-10	3.93E-10	3.95E-10	3.93E-10	3.93E-10	3.93E-10
UPR-200-W-98	7.10E-10	7.08E-10	7.08E-10	7.08E-10	7.10E-10	7.08E-10	7.08E-10	7.08E-10	7.10E-10	7.08E-10	7.08E-10	3.45E-08	5.43E-08	5.41E-08	5.41E-08	5.41E-08
UPR-300-4	7.22E-10	7.20E-10	7.20E-10	7.20E-10	7.22E-10	8.35E-08	4.06E-06	7.14E-05	1.10E-03	1.38E-02	1.49E-01	1.29E+00	1.35E+01	3.99E+01	8.22E+01	8.63E+01
US_Ecology	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
216-U-1%2-Fast	8.14E+00	8.12E+00	8.12E+00	8.12E+00	8.14E+00	8.12E+00	8.12E+00	8.12E+00	8.14E+00	8.12E+00	8.12E+00	8.12E+00	8.14E+00	8.12E+00	8.12E+00	8.12E+00
100-B-5	1.47E+01	1.18E+01	8.37E+00	7.83E+00	7.29E+00	5.73E+00	5.73E+00	5.73E+00	5.39E+00	4.78E+00	4.78E+00	4.78E+00	4.79E+00	4.78E+00	4.60E+00	4.45E+00
100-D-3	3.73E-03	1.04E-02	2.73E-02	6.87E-02	1.71E-01	4.15E-01	9.83E-01	2.17E+00	4.22E+00	6.86E+00	9.49E+00	1.16E+01	1.31E+01	1.40E+01	1.46E+01	1.49E+01
100-D-32	1.69E-05	7.49E-05	2.69E-04	8.35E-04	2.37E-03	6.21E-03	1.57E-02	3.87E-02	9.52E-02	2.26E-01	5.00E-01	9.70E-01	1.59E+00	2.20E+00	2.69E+00	3.02E+00
100-D-40	4.37E-04	1.22E-03	3.20E-03	8.04E-03	2.00E-02	4.85E-02	1.15E-01	2.53E-01	4.94E-01	8.03E-01	1.11E+00	1.36E+00	1.53E+00	1.64E+00	1.70E+00	1.74E+00
100-D-47	1.48E-02	4.13E-02	1.08E-01	2.72E-01	6.76E-01	1.64E+00	3.89E+00	8.57E+00	1.67E+01	2.72E+01	3.76E+01	4.59E+01	5.18E+01	5.53E+01	5.76E+01	5.90E+01
100-F-25	2.60E+01	2.60E+01	2.60E+01	2.59E+01	2.60E+01	2.60E+01	2.60E+01	2.59E+01	2.60E+01	2.60E+01	2.60E+01	2.59E+01	2.60E+01	2.60E+01	2.60E+01	2.59E+01
100-H-10	2.51E+01	2.51E+01	2.51E+01	2.50E+01	2.51E+01	2.50E+01	9.34E-01	1.39E-01	8.54E-02	7.18E-02	6.58E-02	6.34E-02	6.21E-02	6.19E-02	6.13E-02	6.11E-02
100-H-5	7.83E+01	7.87E+01	7.89E+01	7.90E+01	7.93E+01	7.91E+01	7.91E+01	7.91E+01	7.93E+01	7.91E+01	7.91E+01	7.91E+01	7.93E+01	7.91E+01	7.91E+01	7.91E+01
100-H-7	2.51E+01	2.50E+01	2.50E+01	2.50E+01	2.51E+01	2.50E+01	3.79E-01	4.94E-02	2.99E-02	2.50E-02	2.28E-02	2.20E-02	2.15E-02	2.14E-02	2.12E-02	2.11E-02
100-H-8	2.51E+01	2.50E+01	2.50E+01	2.50E+01	2.51E+01	2.50E+01	5.31E-01	7.17E-02	4.36E-02	3.65E-02	3.34E-02	3.21E-02	3.14E-02	3.14E-02	3.10E-02	3.09E-02
100-H-9	2.51E+01	2.50E+01	2.50E+01	2.49E+01	2.51E+01	2.50E+01	2.44E-01	2.69E-02	1.84E-02	1.62E-02	1.50E-02	1.49E-02	1.46E-02	1.46E-02	1.46E-02	1.45E-02
100-K-2	5.72E-04	2.06E-03	6.48E-03	1.85E-02	5.06E-02	1.32E-01	3.37E-01	8.15E-01	1.80E+00	3.41E+00	5.57E+00	7.90E+00	1.01E+01	1.17E+01	1.29E+01	1.37E+01
100-K-5	1.83E+01	1.82E+01	1.82E+01	1.82E+01	1.83E+01	1.82E+01	1.82E+01	1.82E+01	1.83E+01	1.82E+01	1.82E+01	1.82E+01	1.83E+01	1.82E+01	2.89E+00	9.68E-01
100-N-60	2.02E-06	2.01E-06	2.01E-06	1.24E-05	1.98E-02	2.39E-01	2.96E-01	2.99E-01	3.00E-01	2.99E-01	2.99E-01	2.99E-01	3.00E-01	2.99E-01	2.99E-01	2.99E-01
100-N-66	9.96E-11	9.93E-11	9.90E-11	9.81E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
116-B-1	1.47E+02	1.47E+02	1.12E+02	1.06E+02	1.06E+02	1.06E+02	9.49E+01	8.81E+01	8.83E+01	8.81E+01	8.81E+01	8.81E+01	8.68E+01	8.22E+01	8.22E+01	8.22E+01
116-B-2	1.28E+00	1.14E+00	1.14E+00	1.14E+00	1.15E+00	1.14E+00	1.14E+00	1.13E+00	1.10E+00	1.09E+00	1.09E+00	1.09E+00	1.10E+00	1.09E+00	1.09E+00	1.09E+00
116-B-3	4.07E-01	4.06E-01	4.06E-01	4.04E-01	3.85E-01	3.84E-01	3.84E-01	3.84E-01	3.85E-01	3.84E-01	3.72E-01	3.69E-01	3.70E-01	3.69E-01	3.69E-01	3.69E-01
116-B-4	2.52E+01	2.51E+01	2.51E+01	2.50E+01	2.52E+01	2.51E+01	2.51E+01	2.50E+01	2.51E+01	4.02E+00	1.34E+00	6.05E-01	5.27E-01	2.61E-01	2.61E-01	2.39E-01
116-B-5	5.28E+02	5.27E+02	5.27E+02	5.26E+02	5.28E+02	5.27E+02	5.27E+02	5.26E+02	5.27E+02	5.48E+01	1.60E+01	7.34E+00	4.65E+00	3.47E+00	2.94E+00	1.95E+00
116-B-6B	2.28E-01	1.67E-01	1.67E-01	1.67E-01	1.67E-01	1.35E-01	1.34E-01	1.34E-01	1.34E-01	1.34E-01	1.34E-01	1.27E-01	1.23E-01	1.23E-01	1.23E-01	1.23E-01
116-C-1	5.29E+05	1.57E+05	4.14E+05	1.56E+05	3.02E+05	4.16E+05	4.82E+04	7.33E+04	7.64E+04	7.60E+04	1.02E+04	3.27E+03	1.38E+03	1.21E+03	6.16E+02	6.16E+02
116-C-2A	4.19E+02	4.18E+02	4.18E+02	4.17E+02	4.19E+02	4.18E+02	4.18E+02	4.17E+02	4.19E+02	4.17E+02	6.01E+01	1.85E+01	9.62E+00	4.99E+00	4.60E+00	3.13E+00
116-C-2C	4.19E+02	4.18E+02	4.18E+02	4.16E+02	4.19E+02	4.18E+02	4.18E+02	4.16E+02	4.19E+02	4.17E+02	3.22E+01	8.76E+00	4.01E+00	2.39E+00	1.87E+00	1.50E+00
116-D-1A	2.92E+00	2.91E+00	2.91E+00	2.85E+00	2.21E+00	2.21E+00	2.21E+00	2.21E+00	2.21E+00	2.21E+00	2.00E+00	1.95E+00	1.96E+00	1.95E+00	1.95E+00	1.95E+00
116-D-1B	5.36E+02	5.34E+02	5.34E+02	5.33E+02	5.36E+02	5.34E+02	5.34E+02	5.33E+02	8.07E+01	2.51E+01	1.17E+01	7.10E+00	5.48E+00	4.42E+00	3.00E+00	3.00E+00
116-DR-1%2	5.38E+02	3.57E+02	3.57E+02	3.57E+02	3.39E+02	2.50E+02	2.50E+02	2.50E+02	2.51E+02	2.50E+02	2.50E+02	2.15E+02	2.13E+02	2.13E+02	2.13E+02	2.13E+02
116-DR-3	1.10E+01	9.43E+00	6.71E+00	6.71E+00	6.15E+00	4.67E+00	4.67E+00	4.67E+00	4.68E+00	4.11E+00	3.80E+00	3.80E+00	3.81E+00	3.80E+00	3.80E+00	3.80E+00
116-F-1	8.13E+03	8.11E+03	8.12E+03	8.10E+03	8.13E+03	8.10E+03	3.29E+03	1.68E+03	9.81E+02	9.01E+02	5.96E+02	5.96E+02	5.69E+02	4.73E+02	4.73E+02	4.73E+02
116-F-10	2.23E+01	2.22E+01	2.22E+01	2.22E+01	2.23E+01	2.22E+01	1.06E+00	2.95E-01	1.43E-01	1.19E-01	6.81E-02	6.53E-02	6.42E-02	4.69E-02	4.69E-02	4.69E-02
116-F-11	1.55E+01	1.54E+01	1.54E+01	1.54E+01	1.55E+01	1.54E+01	8.23E-01	2.35E-01	1.11E-01	9.57E-02	5.28E-02	5.25E-02	5.05E-02	3.77E-02	3.77E-02	3.77E-02
116-F-2	2.96E+02	2.49E+02	2.49E+02	2.49E+02	2.34E+02	2.25E+02	2.25E+02	2.25E+02	2.26E+02	2.25E+02	2.20E+02	2.20E+02	2.20E+02	2.20E+02	2.20E+02	2.20E+02
116-F-3	1.34E+01	1.31E+01	1.31E+01	1.31E+01	1.29E+01	1.23E+01	1.23E+01	1.23E+01	1.23E+01	1.23E+01	1.23E+01	1.22E+01	1.22E+01	1.21E+01	1.21E+01	1.21E+01
116-F-4	3.86E-01	3.85E-01	3.85E-01	3.85E-01	3.72E-01	3.71E-01	3.71E-01	3.71E-01	3.72E-01	3.71E-01	3.69E-01	3.68E-01	3.69E-01	3.68E-01	3.68E-01	3.68E-01
116-F-6	5.44E+01	7.97E+01	9.75E+01	1.08E+02	1.13E+02	1.16E+02	1.16E+02	1.15E+02	1.14E+02	1.13E+02	1.12E+02	1.12E+02	1.12E+02	1.12E+02	1.12E+02	1.12E+02
116-H-1	4.72E+02	4.57E+02	4.57E+02	4.57E+02	4.56E+02	4.54E+02	4.54E+02	4.54E+02	4.55E+02	4.54E+02	4.53E+02	4.53E+02	4.54E+02	4.53E+02	4.53E+02	4.53E+02
116-H-2	4.64E+04	4.62E+04	4.62E+04	4.61E+04	4.64E+04	4.62E+04	4.50E+02	5.00E+01	3.39E+01	2.94E+01	2.80E+01	2.74E+01	2.72E+01	2.69E+01	2.69E+01	2.69E+01
116-H-3	2.51E+01	2.50E+01	2.50E+01	2.50E+01	2.51E+01	2.50E+01	5.24E-01	6.52E-02	4.22E-02	3.49E-02	3.20E-02	3.13E-02	3.08E-02	3.03E-02	3.03E-02	3.02E-02
116-H-7	8.04E+03	8.02E+03	8.02E+03	8.01E+03	8.04E+03	8.01E+03	3.07E+03	1.62E+03	1.10E+03	1.04E+03	8.80E+02	8.80E+02	8.74E+02	8.42E+02	8.42E+02	8.42E+02
116-K-2	2.01E+07	1.85E+07	1.82E+07	1.82E+07	1.79E+07	1.85E+07	1.81E+07	1.84E+07	1.84E+07	1.80E+07	5.05E+05	4.77E+04	2.47E+04	1.66E+04	1.13E+04	9.69E+03

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
116-KE-1	4.89E+01	4.88E+01	4.88E+01	4.87E+01	4.89E+01	4.88E+01	4.88E+01	4.87E+01	4.89E+01	4.88E+01	4.88E+01	4.87E+01	3.04E+01	1.78E+01	9.83E+00	8.96E+00
116-KE-2	1.77E+02	1.76E+02	1.76E+02	1.76E+02	1.77E+02	1.76E+02	1.76E+02	1.76E+02	1.77E+02	1.76E+02	1.76E+02	1.76E+02	2.50E+01	7.74E+00	3.46E+00	2.22E+00
116-KE-3	1.93E+01	2.41E+01	3.58E+01	6.22E+01	1.21E+02	2.42E+02	4.74E+02	8.53E+02	1.37E+03	1.92E+03	2.42E+03	2.82E+03	3.14E+03	3.32E+03	3.49E+03	3.52E+03
116-KW-2	1.73E+01	1.84E+01	2.11E+01	2.71E+01	4.06E+01	6.82E+01	1.21E+02	2.08E+02	3.25E+02	4.51E+02	5.66E+02	6.52E+02	7.16E+02	7.72E+02	7.80E+02	8.18E+02
116-N-1	3.76E-10	3.75E-10	3.75E-10	3.43E+06	3.65E+06	3.64E+06	3.64E+06	3.63E+06	3.65E+06	3.64E+06	3.64E+06	3.63E+06	3.65E+06	3.64E+06	3.64E+06	3.63E+06
116-N-3	4.72E-10	4.71E-10	4.71E-10	4.71E-10	4.72E-10	4.71E-10	4.71E-10	4.71E-10	4.72E-10	4.71E-10	4.71E-10	4.71E-10	4.72E-10	4.71E-10	4.71E-10	4.71E-10
116-N-4	2.06E-07	2.06E-07	2.06E-07	8.23E+05	1.68E+04	1.39E+03	6.93E+02	4.43E+02	3.47E+02	2.89E+02	2.53E+02	2.07E+02	2.08E+02	2.02E+02	1.70E+02	1.70E+02
118-B-6	8.44E-03	1.87E-02	3.76E-02	6.63E-02	1.02E-01	1.35E-01	1.63E-01	1.82E-01	1.95E-01	2.03E-01	2.07E-01	2.10E-01	2.13E-01	2.13E-01	2.14E-01	2.15E-01
118-B-7	1.52E-03	3.61E-03	8.05E-03	1.63E-02	2.90E-02	4.43E-02	5.92E-02	7.12E-02	7.99E-02	8.52E-02	8.86E-02	9.07E-02	9.23E-02	9.28E-02	9.34E-02	9.37E-02
118-B-8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-C-1	7.25E-01	1.91E+00	4.78E+00	1.13E+01	2.53E+01	5.10E+01	9.02E+01	1.38E+02	1.85E+02	2.22E+02	2.48E+02	2.65E+02	2.76E+02	2.82E+02	2.86E+02	2.89E+02
118-C-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-C-4	2.62E-01	5.00E-01	7.79E-01	1.03E+00	1.20E+00	1.31E+00	1.37E+00	1.40E+00	1.42E+00	1.42E+00	1.43E+00	1.43E+00	1.44E+00	1.43E+00	1.43E+00	1.43E+00
118-D-2	5.72E+00	1.39E+01	3.29E+01	7.25E+01	1.41E+02	2.29E+02	3.17E+02	3.88E+02	4.38E+02	4.68E+02	4.87E+02	4.98E+02	5.07E+02	5.10E+02	5.13E+02	5.15E+02
118-D-3	1.69E-03	7.52E-03	2.70E-02	8.38E-02	2.38E-01	6.23E-01	1.57E+00	3.88E+00	9.55E+00	2.26E+01	5.02E+01	9.74E+01	1.60E+02	2.21E+02	2.70E+02	3.03E+02
118-D-4	4.16E-02	1.16E-01	3.05E-01	7.66E-01	1.91E+00	4.63E+00	1.10E+01	2.42E+01	4.71E+01	7.65E+01	1.06E+02	1.29E+02	1.46E+02	1.56E+02	1.62E+02	1.66E+02
118-DR-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-F-1	8.20E+00	2.08E+01	4.22E+01	6.66E+01	8.62E+01	9.79E+01	1.04E+02	1.08E+02	1.10E+02	1.10E+02	1.11E+02	1.11E+02	1.11E+02	1.11E+02	1.11E+02	1.11E+02
118-F-4	3.25E-01	3.45E-01	3.56E-01	3.62E-01	3.66E-01	3.66E-01	3.67E-01	3.67E-01	3.69E-01	3.68E-01	3.68E-01	3.68E-01	3.69E-01	3.68E-01	3.68E-01	3.68E-01
118-F-8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-H-1	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03
118-H-6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-K-1	4.58E-01	1.31E+00	3.53E+00	9.19E+00	2.35E+01	5.67E+01	1.24E+02	2.34E+02	3.83E+02	5.42E+02	6.87E+02	8.01E+02	8.86E+02	9.39E+02	9.75E+02	9.98E+02
118-KE-1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-KW-1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-KW-2	1.21E-04	5.34E-04	2.07E-03	7.34E-03	2.45E-02	7.27E-02	1.82E-01	3.68E-01	6.14E-01	8.59E-01	1.06E+00	1.21E+00	1.31E+00	1.36E+00	1.39E+00	1.41E+00
200-E-100	4.40E+00	4.39E+00	4.38E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00	4.40E+00	4.38E+00	4.38E+00	4.38E+00	4.39E+00	4.39E+00	4.39E+00	4.38E+00
200-E-102	1.02E+02	5.30E+01	3.14E+01	2.49E+01	1.81E+01	1.74E+01	1.05E+01	1.05E+01	1.05E+01	8.39E+00	6.22E+00	6.22E+00	6.24E+00	6.22E+00	5.99E+00	3.82E+00
200-E-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-25	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	1.19E-08	2.47E+00	3.66E+00	3.66E+00	3.65E+00
200-E-28	2.70E-10	2.69E-10	2.69E-10	2.69E-10	2.70E-10	2.69E-10	2.69E-10	2.69E-10	2.70E-10	2.69E-10	2.69E-10	2.69E-10	2.70E-10	2.69E-10	2.69E-10	2.69E-10
200-E-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-54	4.57E-07	4.56E-07	4.56E-07	4.56E-07	4.57E-07	4.56E-07	4.56E-07	4.56E-07	4.57E-07	4.56E-07	4.56E-07	4.56E-07	4.57E-07	4.56E-07	4.56E-07	4.56E-07
200-E-55	4.39E+00	4.38E+00	4.38E+00	4.37E+00	4.38E+00	4.37E+00	4.37E+00	4.37E+00	4.39E+00	4.40E+00	4.47E+00	4.48E+00	4.49E+00	4.48E+00	4.49E+00	4.49E+00
200-E-56	8.41E+00	7.11E+00	5.08E+00	3.89E+00	3.12E+00	2.78E+00	2.28E+00	1.91E+00	1.92E+00	1.66E+00	1.29E+00	1.29E+00	1.29E+00	1.29E+00	1.02E+00	8.69E-01
200-E-57	6.49E+00	4.45E+00	2.84E+00	2.70E+00	1.78E+00	1.63E+00	1.63E+00	1.12E+00	9.91E-01	9.88E-01	9.88E-01	9.23E-01	6.12E-01	6.10E-01	6.10E-01	6.10E-01
200-E-60	4.09E-13	4.08E-13	4.08E-13	4.08E-13	4.09E-13	4.08E-13	4.08E-13	4.08E-13	4.09E-13	4.08E-13	4.08E-13	4.08E-13	4.09E-13	4.08E-13	4.08E-13	4.08E-13
200-E-61	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-62	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
200-E-64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-65	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07
200-E-67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-68	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07
200-E-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-70	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05
200-E-71	2.64E-05	2.63E-05	2.63E-05	2.63E-05	2.64E-05	2.63E-05	2.63E-05	2.63E-05	2.64E-05	2.63E-05	2.63E-05	2.63E-05	2.64E-05	2.63E-05	2.63E-05	2.63E-05
200-E-72	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05
200-E-73	5.86E-07	5.84E-07	5.84E-07	5.84E-07	5.86E-07	5.84E-07	5.84E-07	5.84E-07	5.86E-07	5.84E-07	5.84E-07	5.84E-07	5.86E-07	5.84E-07	5.84E-07	5.84E-07
200-E-74	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05
200-E-75	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05
200-E-76	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-77	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-80	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-81	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-84	9.44E-07	9.42E-07	9.42E-07	9.42E-07	9.44E-07	9.42E-07	9.42E-07	9.42E-07	9.44E-07	9.42E-07	9.42E-07	9.42E-07	9.44E-07	9.42E-07	9.42E-07	9.42E-07
200-E-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-88	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04
200-E-89	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03
200-E-90	8.26E-04	8.23E-04	8.23E-04	8.23E-04	8.26E-04	8.23E-04	8.23E-04	8.23E-04	8.26E-04	8.23E-04	8.23E-04	8.23E-04	8.26E-04	8.23E-04	8.23E-04	8.23E-04
200-E-91	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05
200-E-92	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03
200-E-93	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03
200-E-94	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04
200-E-95	4.40E+00	4.39E+00	4.39E+00	4.37E+00	4.39E+00	4.38E+00	4.39E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00	4.40E+00	4.38E+00	4.38E+00	4.37E+00
200-E-97	4.39E+00	4.38E+00	4.39E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00	4.40E+00	4.39E+00	4.38E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00
200-E-98	3.70E+00	3.69E+00	3.69E+00	3.69E+00	3.70E+00	3.69E+00	3.69E+00	3.69E+00	3.70E+00	3.69E+00	3.69E+00	3.69E+00	3.70E+00	3.69E+00	3.69E+00	3.69E+00
200-E-99	4.43E+00	4.42E+00	4.42E+00	4.42E+00	4.43E+00	4.42E+00	4.42E+00	4.42E+00	4.43E+00	4.42E+00	4.42E+00	4.42E+00	4.42E+00	4.42E+00	4.42E+00	4.42E+00
200-W-22	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06
200-W-42	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05
200-W-52	3.60E+02	3.17E+02	1.91E+02	1.91E+02	1.92E+02	1.34E+02	1.07E+02	1.07E+02	1.07E+02	1.07E+02	9.37E+01	6.30E+01	6.32E+01	6.30E+01	6.30E+01	6.30E+01
200-W-9	1.66E-11	1.65E-11	1.65E-11	1.65E-11	1.66E-11	1.65E-11	1.65E-11	1.65E-11	1.66E-11	1.65E-11	1.65E-11	1.65E-11	1.66E-11	1.65E-11	1.65E-11	1.65E-11
2101-M-POND	2.60E+04	2.60E+04	2.60E+04	2.59E+04	2.60E+04	2.60E+04	2.60E+04	2.59E+04	2.60E+04	2.60E+04	2.60E+04	2.59E+04	2.60E+04	2.60E+04	2.60E+04	2.59E+04
216-A-10	4.89E+03	3.70E+03	3.12E+05	3.08E+05	3.76E+05	4.23E+05	2.90E+05	3.10E+05	2.61E+05	1.32E+05	6.61E+04	6.22E+04	4.42E+04	2.19E+04	1.21E+04	7.48E+03
216-A-11	5.91E+00	5.90E+00	5.90E+00	5.89E+00	5.91E+00	5.90E+00	5.90E+00	5.89E+00	5.91E+00	5.90E+00	5.90E+00	5.89E+00	5.90E+00	2.46E+00	1.10E+00	6.65E-01
216-A-12	5.58E+00	5.57E+00	5.57E+00	5.56E+00	5.58E+00	5.57E+00	5.57E+00	5.56E+00	5.58E+00	5.57E+00	5.57E+00	5.56E+00	5.57E+00	2.30E+00	1.11E+00	5.29E-01
216-A-13	1.08E-02	1.44E+00	1.46E+00	1.29E+00	8.89E-01	5.62E-01	4.39E-01	3.29E-01	2.86E-01	1.93E-01	1.93E-01	1.89E-01	1.13E-01	1.13E-01	1.13E-01	1.13E-01
216-A-14	6.90E-07	6.88E-07	6.88E-07	6.88E-07	6.90E-07	6.88E-07	6.88E-07	6.88E-07	6.90E-07	6.88E-07	6.88E-07	6.88E-07	6.90E-07	6.88E-07	6.88E-07	6.88E-07

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
216-A-15	5.58E+02	5.56E+02	5.56E+02	5.55E+02	5.58E+02	5.56E+02	5.56E+02	5.55E+02	5.58E+02	5.56E+02	5.56E+02	5.55E+02	5.58E+02	9.02E+01	1.61E+01	8.27E+00
216-A-16	8.77E+00	8.75E+00	8.75E+00	8.74E+00	8.77E+00	8.75E+00	8.75E+00	8.74E+00	8.77E+00	8.74E+00	4.40E+00	2.22E+00	1.28E+00	8.07E-01	6.50E-01	5.15E-01
216-A-17	4.33E+00	4.32E+00	4.32E+00	4.32E+00	4.33E+00	4.32E+00	4.32E+00	4.32E+00	4.33E+00	4.32E+00	2.87E+00	1.73E+00	1.01E+00	9.07E-01	4.90E-01	4.76E-01
216-A-2	9.87E-05	9.84E-05	9.84E-05	3.49E-03	1.34E+01	1.83E+01	1.38E+01	1.12E+01	1.01E+01	7.79E+00	7.05E+00	7.05E+00	5.18E+00	4.82E+00	4.82E+00	4.82E+00
216-A-20	3.10E+01	2.40E+01	1.90E+01	1.90E+01	1.22E+01	1.16E+01	1.16E+01	1.16E+01	7.46E+00	7.20E+00	7.20E+00	7.20E+00	7.22E+00	7.20E+00	4.68E+00	4.64E+00
216-A-21	3.01E+03	7.41E+03	1.92E+04	1.29E+04	1.52E+04	9.00E+03	2.51E+03	6.51E+02	3.27E+02	2.16E+02	1.63E+02	1.16E+02	9.36E+01	9.34E+01	6.01E+01	5.44E+01
216-A-22	2.07E-04	2.06E-04	2.06E-04	2.06E-04	2.07E-04	2.06E-04	2.06E-04	2.06E-04	2.07E-04	2.06E-04	2.06E-04	2.06E-04	2.07E-04	2.06E-04	2.06E-04	2.06E-04
216-A-23A	3.23E-05	3.22E-05	3.22E-05	3.22E-05	3.23E-05	3.22E-05	3.22E-05	3.22E-05	3.23E-05	3.22E-05	3.22E-05	3.22E-05	3.23E-05	3.22E-05	3.22E-05	3.22E-05
216-A-23B	3.55E-05	3.54E-05	3.54E-05	3.54E-05	3.55E-05	3.54E-05	3.54E-05	3.54E-05	3.55E-05	3.54E-05	3.54E-05	3.54E-05	3.55E-05	3.54E-05	3.54E-05	3.54E-05
216-A-24	6.72E+04	2.11E+04	1.85E+04	1.93E+04	1.78E+04	1.45E+04	1.26E+04	1.22E+04	1.63E+04	9.83E+03	6.24E+03	4.64E+03	3.16E+03	2.37E+03	1.91E+03	1.58E+03
216-A-25	7.85E+06	9.85E+06	1.24E+07	1.25E+07	1.09E+07	1.08E+07	8.92E+06	9.94E+06	1.33E+07	8.72E+06	1.03E+07	1.60E+07	1.27E+07	2.03E+06	2.10E+06	3.92E+06
216-A-26	2.14E-06	2.13E-06	2.13E-06	2.13E-06	2.14E-06	2.13E-06	2.13E-06	2.13E-06	2.14E-06	2.13E-06	2.13E-06	2.13E-06	2.14E-06	2.13E-06	2.13E-06	2.13E-06
216-A-26A	2.18E-06	2.17E-06	2.17E-06	2.17E-06	2.18E-06	2.17E-06	2.17E-06	2.17E-06	2.18E-06	2.17E-06	2.17E-06	2.17E-06	2.18E-06	2.17E-06	2.17E-06	2.17E-06
216-A-27	6.62E-04	6.60E-04	6.60E-04	6.60E-04	6.62E-04	2.61E+03	8.00E+03	4.61E+03	2.41E+03	1.56E+03	1.20E+03	6.70E+02	3.82E+02	2.07E+02	1.88E+02	9.93E+01
216-A-28	1.27E-03	1.26E-03	1.26E-03	1.26E-03	1.27E-03	1.26E-03	1.26E-03	1.26E-03	1.27E-03	1.26E-03	1.26E-03	1.26E-03	1.27E-03	1.26E-03	1.26E-03	1.26E-03
216-A-3	5.46E+02	3.71E+02	2.52E+02	2.26E+02	4.74E+02	2.68E+02	1.05E+02	6.08E+01	4.04E+01	2.90E+01	2.22E+01	1.76E+01	1.45E+01	1.21E+01	1.03E+01	8.94E+00
216-A-30	1.78E-01	1.77E-01	1.77E-01	3.99E+05	4.31E+05	4.73E+05	3.57E+05	2.43E+05	1.89E+05	1.55E+05	1.45E+05	1.96E+05	2.28E+05	1.66E+05	1.13E+05	7.55E+04
216-A-31	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-35	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-36A	1.28E-02	1.27E-02	1.27E-02	1.27E-02	1.28E-02	1.27E-02	1.27E-02	1.27E-02	1.28E-02	1.27E-02	1.27E-02	1.27E-02	1.28E-02	1.27E-02	1.27E-02	1.27E-02
216-A-36B	1.14E-02	1.13E-02	1.13E-02	1.13E-02	1.14E-02	1.13E-02	1.13E-02	1.13E-02	1.14E-02	1.13E-02	1.13E-02	3.48E+03	2.18E+04	1.74E+04	9.98E+03	6.11E+03
216-A-37-1	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05	2.41E-05
216-A-37-2	4.32E-03	4.31E-03	4.31E-03	4.31E-03	4.32E-03	4.31E-03	4.31E-03	4.31E-03	4.32E-03	4.31E-03	4.31E-03	4.31E-03	4.32E-03	4.31E-03	4.31E-03	4.31E-03
216-A-39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-4	9.30E+01	4.75E+01	2.91E+01	2.20E+01	1.70E+01	1.49E+01	1.00E+01	1.00E+01	1.00E+01	6.55E+00	5.96E+00	5.96E+00	5.98E+00	5.96E+00	4.39E+00	3.67E+00
216-A-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-45	4.36E-03	4.35E-03	4.35E-03	4.35E-03	4.36E-03	4.35E-03	4.35E-03	4.35E-03	4.36E-03	4.35E-03	4.35E-03	4.35E-03	4.36E-03	4.35E-03	4.35E-03	4.35E-03
216-A-5	4.07E+05	2.44E+05	5.94E+04	1.29E+04	6.66E+03	4.45E+03	3.50E+03	2.49E+03	1.94E+03	1.55E+03	1.39E+03	1.20E+03	1.18E+03	9.57E+02	9.57E+02	9.57E+02
216-A-6	5.80E+05	1.17E+05	2.81E+04	1.49E+04	9.75E+03	7.02E+03	3.18E+04	1.74E+05	1.57E+05	1.29E+05	5.88E+04	2.58E+04	1.52E+04	8.56E+03	7.85E+03	4.53E+03
216-A-7	6.43E+00	4.70E+00	3.72E+00	3.04E+00	2.56E+00	2.19E+00	9.99E+01	8.59E+01	2.16E+01	1.18E+01	7.92E+00	4.99E+00	4.60E+00	3.27E+00	2.68E+00	2.68E+00
216-A-8	1.73E+04	9.66E+03	6.29E+03	4.50E+03	3.43E+03	2.72E+03	2.33E+03	1.30E+04	5.54E+04	2.81E+04	2.17E+04	1.69E+04	1.58E+04	1.33E+04	1.13E+04	1.05E+04
216-A-9	1.77E+04	1.12E+04	7.83E+03	5.82E+03	4.54E+03	3.65E+03	3.02E+03	2.67E+03	2.21E+03	1.88E+03	1.60E+03	1.46E+03	1.26E+03	1.24E+03	9.72E+02	9.72E+02
216-B-10A	1.19E+02	1.16E+02	7.00E+01	7.00E+01	7.02E+01	7.00E+01	6.61E+01	4.17E+01	4.18E+01	4.17E+01	4.17E+01	4.17E+01	4.18E+01	4.17E+01	2.93E+01	2.58E+01
216-B-10B	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05	2.05E-05
216-B-11A%B	4.19E+01	3.00E+01	2.40E+01	2.40E+01	2.04E+01	1.40E+01	1.40E+01	1.40E+01	1.40E+01	1.16E+01	8.29E+00	8.29E+00	8.31E+00	8.29E+00	8.29E+00	8.29E+00
216-B-12	7.26E+02	4.93E+02	3.62E+02	2.79E+02	2.25E+02	1.85E+02	1.56E+02	1.39E+02	1.03E+04	2.00E+04	2.23E+04	3.17E+04	3.02E+04	2.34E+04	6.90E+03	1.63E+03
216-B-13	6.91E-01	6.89E-01	6.89E-01	6.89E-01	6.91E-01	6.89E-01	6.89E-01	6.89E-01	6.91E-01	6.89E-01	6.89E-01	6.89E-01	6.91E-01	6.89E-01	6.89E-01	6.89E-01
216-B-14	5.34E-04	5.33E-04	5.33E-04	5.33E-04	5.34E-04	5.33E-04	2.39E-02	8.12E-02	1.23E+01	1.54E+01	5.16E+01	1.23E+02	1.23E+02	1.23E+02	1.97E+02	2.38E+02
216-B-15	8.07E-04	8.05E-04	8.05E-04	8.05E-04	8.07E-04	8.05E-04	8.05E-04	8.05E-04	8.07E-04	8.05E-04	8.05E-04	8.05E-04	1.11E-01	1.24E-01	1.18E+01	1.32E+01

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
216-B-16	4.95E-02	4.93E-02	4.93E-02	4.93E-02	4.95E-02	4.93E-02	4.93E-02	4.93E-02	4.95E-02	4.93E-02	4.93E-02	4.93E-02	4.95E-02	4.93E-02	4.93E-02	1.79E+00
216-B-17	1.93E-03	1.92E-03	1.92E-03	1.92E-03	1.93E-03	1.92E-03	1.92E-03	1.92E-03	1.93E-03	1.92E-03	1.92E-03	1.92E-03	1.93E-03	1.92E-03	1.92E-03	1.92E-03
216-B-18	3.59E-02	3.58E-02	3.58E-02	3.58E-02	3.59E-02	3.58E-02	3.58E-02	3.58E-02	5.43E+00	6.27E+00	5.74E+01	8.36E+01	8.38E+01	1.03E+02	2.14E+02	2.14E+02
216-B-19	3.56E-02	3.55E-02	3.55E-02	3.55E-02	3.56E-02	3.55E-02	3.55E-02	3.55E-02	3.56E-02	3.55E-02	3.55E-02	3.55E-02	3.56E-02	3.55E-02	4.58E+00	5.67E+00
216-B-20	7.54E-03	7.52E-03	7.52E-03	7.52E-03	7.54E-03	7.52E-03	7.52E-03	7.52E-03	7.54E-03	7.52E-03	7.52E-03	7.52E-03	7.54E-03	7.52E-03	1.23E+00	2.15E+00
216-B-21	7.66E-03	7.64E-03	7.64E-03	7.64E-03	7.66E-03	7.64E-03	7.64E-03	7.64E-03	7.66E-03	7.64E-03	7.64E-03	7.64E-03	7.66E-03	7.64E-03	1.25E+00	2.19E+00
216-B-22	9.63E-03	9.61E-03	9.61E-03	9.61E-03	9.63E-03	9.61E-03	9.61E-03	9.61E-03	9.63E-03	9.61E-03	9.61E-03	9.61E-03	9.63E-03	9.61E-03	1.57E+00	2.75E+00
216-B-23	6.86E-04	6.84E-04	6.84E-04	6.84E-04	6.86E-04	6.84E-04	6.84E-04	6.84E-04	6.86E-04	6.84E-04	6.84E-04	6.84E-04	6.86E-04	6.84E-04	6.84E-04	6.84E-04
216-B-24	3.05E-04	3.04E-04	3.04E-04	3.04E-04	3.05E-04	3.04E-04	3.04E-04	3.04E-04	3.05E-04	3.04E-04	3.04E-04	3.04E-04	3.05E-04	3.04E-04	3.04E-04	5.52E-01
216-B-25	2.38E-03	2.37E-03	2.37E-03	2.37E-03	2.38E-03	2.37E-03	2.37E-03	2.37E-03	2.38E-03	2.37E-03	2.37E-03	2.37E-03	2.38E-03	2.37E-03	2.37E-03	2.84E+00
216-B-26	5.65E-04	5.63E-04	5.63E-04	5.63E-04	5.65E-04	5.63E-04	5.63E-04	5.63E-04	5.65E-04	5.63E-04	5.63E-04	5.63E-04	5.65E-04	2.07E+00	5.17E+01	1.71E+02
216-B-27	8.58E-05	8.56E-05	8.56E-05	8.56E-05	8.58E-05	8.56E-05	8.56E-05	8.56E-05	8.58E-05	8.56E-05	8.56E-05	8.56E-05	8.58E-05	8.56E-05	8.56E-05	8.56E-05
216-B-28	8.38E-05	8.36E-05	8.36E-05	8.36E-05	8.38E-05	8.36E-05	8.36E-05	8.36E-05	8.38E-05	8.36E-05	8.36E-05	8.36E-05	8.38E-05	8.36E-05	8.36E-05	3.71E-01
216-B-29	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03
216-B-3	4.52E+06	3.92E+06	2.54E+06	1.65E+06	2.31E+06	1.96E+06	1.02E+06	1.22E+06	4.62E+06	4.19E+06	3.37E+06	3.50E+06	3.90E+06	3.91E+06	3.66E+06	3.51E+06
216-B-30	2.27E-03	2.26E-03	2.26E-03	2.26E-03	2.27E-03	2.26E-03	2.26E-03	2.26E-03	2.27E-03	2.26E-03	2.26E-03	2.26E-03	2.27E-03	2.26E-03	2.26E-03	2.26E-03
216-B-31	1.43E-03	1.42E-03	1.42E-03	1.42E-03	1.43E-03	1.42E-03	1.42E-03	1.42E-03	1.43E-03	1.42E-03	1.42E-03	1.42E-03	1.43E-03	1.42E-03	1.42E-03	1.42E-03
216-B-32	3.38E-05	3.37E-05	3.37E-05	3.37E-05	3.38E-05	3.37E-05	3.37E-05	3.37E-05	3.38E-05	3.37E-05	3.37E-05	3.37E-05	3.38E-05	3.37E-05	3.37E-05	3.37E-05
216-B-33	4.55E-04	4.54E-04	4.54E-04	4.54E-04	4.55E-04	4.54E-04	4.54E-04	4.54E-04	4.55E-04	4.54E-04	4.54E-04	4.54E-04	4.55E-04	4.54E-04	4.54E-04	4.54E-04
216-B-34	1.51E-03	1.50E-03	1.50E-03	1.50E-03	1.51E-03	1.50E-03	1.50E-03	1.50E-03	1.51E-03	1.50E-03	1.50E-03	1.50E-03	1.51E-03	1.50E-03	1.50E-03	1.50E-03
216-B-35	4.68E+01	3.63E+01	3.01E+01	3.01E+01	2.12E+01	1.91E+01	1.91E+01	1.91E+01	1.48E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.08E+01	7.68E+00
216-B-36	5.28E+01	3.56E+01	3.56E+01	2.95E+01	2.16E+01	2.15E+01	2.15E+01	2.00E+01	1.31E+01	1.31E+01	1.31E+01	1.31E+01	1.31E+01	1.31E+01	9.03E+00	8.14E+00
216-B-37	5.83E+01	4.70E+01	3.29E+01	3.29E+01	3.30E+01	1.96E+01	1.90E+01	1.90E+01	1.90E+01	1.90E+01	1.33E+01	1.12E+01	1.12E+01	1.12E+01	1.12E+01	1.12E+01
216-B-38	4.63E+01	4.09E+01	2.87E+01	2.87E+01	2.74E+01	1.77E+01	1.77E+01	1.77E+01	1.77E+01	1.53E+01	1.09E+01	1.09E+01	1.10E+01	1.09E+01	1.09E+01	1.09E+01
216-B-39	4.68E+01	3.83E+01	3.73E+01	2.34E+01	2.35E+01	2.34E+01	2.16E+01	1.43E+01	1.44E+01	1.43E+01	1.43E+01	1.43E+01	1.22E+01	8.90E+00	8.90E+00	8.90E+00
216-B-4	2.35E-05	2.34E-05	2.34E-05	2.34E-05	1.30E-04	1.49E-04	1.49E-04	2.60E-03	3.75E-03	3.74E-03	3.74E-03	3.74E-03	3.75E-03	3.74E-03	3.74E-03	3.74E-03
216-B-40	5.06E+01	3.72E+01	3.11E+01	3.11E+01	2.33E+01	1.90E+01	1.90E+01	1.90E+01	1.84E+01	1.17E+01	1.17E+01	1.17E+01	1.17E+01	1.17E+01	1.17E+01	1.06E+01
216-B-41	4.28E+01	4.01E+01	3.19E+01	2.50E+01	2.51E+01	2.48E+01	1.54E+01	1.54E+01	1.55E+01	1.54E+01	1.54E+01	1.12E+01	9.66E+00	9.64E+00	9.64E+00	9.64E+00
216-B-42	4.72E+01	3.96E+01	2.92E+01	2.92E+01	2.60E+01	1.80E+01	1.80E+01	1.80E+01	1.80E+01	1.39E+01	1.11E+01	1.11E+01	1.12E+01	1.11E+01	1.11E+01	1.11E+01
216-B-43	1.09E+02	7.26E+01	7.26E+01	5.77E+01	4.73E+01	4.72E+01	4.72E+01	3.12E+01	3.02E+01	3.02E+01	3.02E+01	3.02E+01	2.51E+01	1.94E+01	1.94E+01	1.94E+01
216-B-44	1.64E+02	1.14E+02	1.14E+02	6.92E+01	6.54E+01	6.52E+01	6.10E+01	3.79E+01	3.80E+01	3.79E+01	3.79E+01	3.79E+01	3.02E+01	2.26E+01	2.26E+01	2.26E+01
216-B-45	1.47E+02	1.10E+02	9.91E+01	6.56E+01	6.58E+01	6.56E+01	4.32E+01	3.94E+01	3.95E+01	3.94E+01	3.94E+01	2.74E+01	2.40E+01	2.39E+01	2.39E+01	2.39E+01
216-B-46	1.35E+02	1.35E+02	7.90E+01	7.90E+01	7.92E+01	4.91E+01	4.65E+01	4.65E+01	4.66E+01	4.09E+01	2.78E+01	2.78E+01	2.78E+01	2.78E+01	2.78E+01	2.78E+01
216-B-47	1.30E+02	1.11E+02	8.04E+01	8.04E+01	5.93E+01	4.92E+01	4.92E+01	4.92E+01	3.71E+01	3.02E+01	3.02E+01	3.02E+01	3.02E+01	3.02E+01	2.36E+01	1.88E+01
216-B-48	1.47E+02	1.01E+02	1.01E+02	6.16E+01	6.18E+01	6.16E+01	4.77E+01	3.74E+01	3.75E+01	3.74E+01	3.74E+01	3.12E+01	2.31E+01	2.30E+01	2.30E+01	2.30E+01
216-B-49	1.54E+02	1.13E+02	1.05E+02	6.66E+01	6.68E+01	6.66E+01	4.72E+01	3.95E+01	3.96E+01	3.95E+01	3.95E+01	3.15E+01	2.39E+01	2.38E+01	2.38E+01	2.38E+01
216-B-5	1.02E-01	4.27E-02	4.27E-02	4.27E-02	4.28E-02	4.27E-02	4.27E-02	2.37E-02	1.35E-02	1.35E-02	1.35E-02	1.35E-02	1.35E-02	1.35E-02	1.35E-02	1.35E-02
216-B-50	3.12E-08	3.11E-08	3.11E-08	3.11E-08	3.12E-08	3.78E+02	5.37E+03	8.32E+03	7.51E+03	8.73E+03	8.58E+03	6.50E+03	3.79E+03	1.98E+03	1.00E+03	5.22E+02
216-B-51	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	1.57E-08	4.98E-07	9.84E-07	9.84E-07	9.84E-07
216-B-52	9.12E-05	9.10E-05	9.10E-05	9.10E-05	9.12E-05	9.10E-05	9.10E-05	9.10E-05	9.12E-05	2.84E+00	9.24E+01	2.34E+02	2.97E+02	3.19E+02	3.08E+02	3.02E+02
216-B-53A	3.75E-05	3.74E-05	3.74E-05	3.74E-05	3.75E-05	3.74E-05	3.74E-05	3.74E-05	3.75E-05	3.74E-05	3.74E-05	3.74E-05	3.75E-05	3.74E-05	3.74E-05	3.74E-05

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
216-B-53B	3.31E-04	3.30E-04	3.30E-04	3.30E-04	3.31E-04	3.30E-04	3.30E-04	3.30E-04	3.31E-04	3.30E-04	3.30E-04	3.30E-04	3.31E-04	3.30E-04	3.30E-04	3.30E-04
216-B-54	4.62E-04	4.61E-04	4.61E-04	4.61E-04	4.62E-04	4.61E-04	4.61E-04	4.61E-04	4.62E-04	4.61E-04	4.61E-04	4.61E-04	4.62E-04	4.61E-04	4.61E-04	4.61E-04
216-B-55	1.61E-07	1.60E-07	1.60E-07	1.60E-07	1.61E-07	1.60E-07	1.60E-07	1.60E-07	2.04E+04	8.20E+04	8.83E+04	1.50E+05	1.48E+05	8.89E+04	8.11E+04	6.76E+04
216-B-57	1.16E-05	1.15E-05	1.15E-05	1.15E-05	1.16E-05	1.15E-05	1.15E-05	1.15E-05	1.16E-05	1.15E-05	3.98E+03	1.73E+04	1.41E+04	1.19E+04	7.15E+03	4.74E+03
216-B-58	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04
216-B-59	9.48E-07	9.45E-07	9.45E-07	9.45E-07	9.48E-07	9.45E-07	9.45E-07	9.45E-07	9.48E-07	9.45E-07	9.45E-07	9.45E-07	9.48E-07	9.45E-07	9.45E-07	9.45E-07
216-B-6	9.83E+00	5.07E+00	5.07E+00	5.07E+00	5.08E+00	5.07E+00	5.07E+00	3.30E+00	2.63E+00	2.63E+00	2.63E+00	2.63E+00	2.63E+00	2.63E+00	2.63E+00	2.63E+00
216-B-60	1.12E-07	1.11E-07	1.11E-07	1.11E-07	1.12E-07	1.11E-07	1.11E-07	1.11E-07	1.12E-07	1.11E-07	2.59E+00	2.35E+00	1.55E+00	1.14E+00	9.21E-01	6.80E-01
216-B-62	2.57E-06	2.56E-06	2.56E-06	2.56E-06	2.57E-06	2.56E-06	2.56E-06	2.56E-06	2.57E-06	2.56E-06	2.56E-06	2.56E-06	2.57E-06	1.30E+04	2.68E+04	3.69E+04
216-B-63	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	1.89E-03	3.33E+05	4.51E+05	3.13E+05
216-B-7A%B	2.88E+01	2.26E+01	1.84E+01	1.54E+01	1.31E+01	1.13E+01	1.27E+02	4.98E+02	1.98E+02	9.78E+01	6.12E+01	3.86E+01	3.49E+01	2.13E+01	1.97E+01	1.97E+01
216-B-8	1.85E+01	1.85E+01	1.21E+01	1.06E+01	1.07E+01	1.06E+01	8.21E+00	6.23E+00	6.25E+00	6.23E+00	6.23E+00	6.23E+00	5.86E+00	3.77E+00	3.77E+00	3.77E+00
216-B-9	2.64E+02	2.48E+02	1.42E+02	1.42E+02	1.42E+02	1.42E+02	1.42E+02	1.15E+02	8.01E+01	7.99E+01	7.99E+01	7.99E+01	8.01E+01	7.99E+01	7.99E+01	7.99E+01
216-BY-201	3.11E-01	3.02E-01	1.70E-01	1.70E-01	1.71E-01	1.11E-01	9.59E-02	9.59E-02	9.62E-02	9.59E-02	5.90E-02	5.56E-02	5.57E-02	5.56E-02	5.56E-02	5.56E-02
216-C-1	1.00E+02	6.12E+01	5.81E+01	3.73E+01	3.74E+01	3.25E+01	2.26E+01	2.26E+01	2.27E+01	2.16E+01	1.39E+01	1.39E+01	1.40E+01	1.39E+01	1.39E+01	1.39E+01
216-C-10	2.31E-08	2.30E-08	2.30E-08	2.30E-08	2.31E-08	1.09E+01	4.71E+02	1.80E+02	6.31E+01	3.29E+01	1.73E+01	1.56E+01	8.13E+00	8.11E+00	7.16E+00	4.28E+00
216-C-2	8.49E-05	8.46E-05	8.46E-05	8.46E-05	8.49E-05	8.46E-05	8.46E-05	8.46E-05	8.49E-05	8.46E-05	8.46E-05	8.46E-05	8.49E-05	8.46E-05	8.46E-05	8.46E-05
216-C-3	3.08E+01	1.77E+01	1.77E+01	1.77E+01	1.20E+01	9.96E+00	9.96E+00	9.96E+00	9.99E+00	7.18E+00	5.84E+00	5.84E+00	5.85E+00	5.84E+00	5.84E+00	5.84E+00
216-C-4	1.61E-04	1.60E-04	1.60E-04	1.60E-04	1.61E-04	6.96E+00	2.70E+01	1.74E+01	1.23E+01	8.96E+00	6.93E+00	5.91E+00	5.17E+00	3.80E+00	3.80E+00	3.80E+00
216-C-6	6.59E-07	6.57E-07	6.57E-07	6.26E+01	1.92E+02	8.13E+01	3.76E+01	2.31E+01	1.47E+01	1.12E+01	8.28E+00	8.28E+00	4.84E+00	4.73E+00	4.73E+00	4.49E+00
216-C-8	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04
216-C-9	2.18E+04	2.06E+04	5.47E+04	9.43E+04	9.49E+04	9.47E+04	9.46E+04	5.01E+04	2.78E+04	1.88E+04	1.36E+04	9.86E+03	7.26E+03	5.48E+03	4.28E+03	3.45E+03
216-N-2	1.50E+01	1.26E+01	1.26E+01	1.26E+01	1.27E+01	1.26E+01	1.14E+01	8.49E+00	8.52E+00	8.49E+00	8.49E+00	8.49E+00	8.52E+00	8.49E+00	8.49E+00	8.49E+00
216-N-3	2.95E+01	1.92E+01	1.92E+01	1.92E+01	1.79E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.12E+01	8.22E+00	8.24E+00	8.22E+00	8.22E+00	8.22E+00
216-N-4	5.55E+02	5.53E+02	5.53E+02	5.00E+02	2.46E+02	2.45E+02	2.45E+02	2.45E+02	2.46E+02	2.45E+02	1.06E+02	9.69E+01	9.72E+01	9.69E+01	9.69E+01	9.69E+01
216-N-5	2.95E+01	1.92E+01	1.92E+01	1.92E+01	1.79E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.12E+01	8.22E+00	8.24E+00	8.22E+00	8.22E+00	8.22E+00
216-N-6	4.75E+02	4.74E+02	4.74E+02	4.28E+02	2.10E+02	2.10E+02	2.10E+02	2.10E+02	2.10E+02	2.10E+02	9.06E+01	8.28E+01	8.30E+01	8.28E+01	8.28E+01	8.28E+01
216-N-7	2.95E+01	1.92E+01	1.92E+01	1.92E+01	1.79E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.12E+01	8.22E+00	8.24E+00	8.22E+00	8.22E+00	8.22E+00
216-S-1%2	4.04E+03	3.16E+03	2.61E+03	2.53E+03	1.66E+03	1.66E+03	1.66E+03	1.48E+03	1.05E+03	1.05E+03	1.05E+03	1.05E+03	1.05E+03	8.19E+02	6.75E+02	6.75E+02
216-S-10P	1.93E+05	1.93E+05	1.92E+05	1.93E+05	1.93E+05	1.92E+05	1.93E+05	1.23E+05	8.78E+04	8.94E+04	8.14E+04	7.49E+04	1.47E+05	2.00E+05	2.00E+05	2.00E+05
216-S-12	7.64E-07	7.61E-07	7.61E-07	7.61E-07	7.64E-07	7.61E-07	7.61E-07	7.61E-07	7.64E-07	7.40E-05	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04
216-S-13	9.73E+01	7.48E+01	6.40E+01	5.33E+01	4.79E+01	3.63E+02	3.88E+02	2.36E+02	1.63E+02	1.17E+02	8.45E+01	7.31E+01	6.11E+01	4.45E+01	4.45E+01	4.45E+01
216-S-15	3.37E-07	3.36E-07	3.36E-07	3.36E-07	3.37E-07	3.36E-07	3.36E-07	2.36E-05	5.30E-05	5.28E-05	5.28E-05	5.28E-05	5.30E-05	5.28E-05	5.28E-05	6.79E-03
216-S-16P	1.66E-01	2.67E+06	4.07E+06	4.54E+06	5.86E+06	5.02E+06	3.23E+06	2.00E+06	1.53E+06	1.06E+06	8.21E+05	8.55E+05	9.80E+05	8.94E+05	7.70E+05	5.75E+05
216-S-17	2.06E+05	1.63E+05	1.63E+05	1.35E+05	9.98E+04	9.95E+04	9.95E+04	9.95E+04	7.15E+04	6.11E+04	6.11E+04	6.11E+04	6.13E+04	6.11E+04	6.11E+04	4.58E+04
216-S-19	1.73E-07	1.72E-07	1.72E-07	1.72E-07	1.73E-07	1.72E-07	1.72E-07	1.72E-07	1.73E-07	1.72E-07	3.83E-04	1.99E+02	5.77E+03	7.03E+03	7.05E+03	7.01E+03
216-S-20	6.10E+03	6.48E+03	8.25E+03	1.14E+04	1.11E+04	8.95E+03	6.94E+03	5.41E+03	4.33E+03	3.52E+03	2.94E+03	2.51E+03	2.25E+03	1.95E+03	1.68E+03	1.47E+03
216-S-21	5.54E+03	5.21E+03	4.79E+03	4.60E+03	5.24E+03	8.81E+03	1.31E+04	1.00E+04	5.67E+03	3.64E+03	2.16E+03	1.51E+03	1.10E+03	9.32E+02	7.31E+02	7.08E+02
216-S-22	1.79E-06	1.78E-06	1.78E-06	1.78E-06	1.79E-06	4.97E-04	6.53E-04	6.53E-04	2.53E-01	2.59E-01	2.59E-01	2.59E-01	1.44E+00	1.91E+00	1.91E+00	1.91E+00
216-S-23	7.61E-04	7.58E-04	7.58E-04	7.58E-04	7.61E-04	7.58E-04	7.58E-04	7.58E-04	7.61E-04	7.58E-04	7.58E-04	4.06E+03	6.69E+03	4.51E+03	2.84E+03	1.98E+03
216-S-25	6.27E-05	6.25E-05	6.25E-05	6.25E-05	6.27E-05	6.25E-05	6.25E-05	6.25E-05	6.27E-05	6.25E-05	6.25E-05	6.25E-05	6.27E-05	6.25E-05	6.25E-05	6.25E-05

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
216-S-26	4.08E-08	4.07E-08	4.07E-08	4.07E-08	4.08E-08	4.07E-08	4.07E-08	4.07E-08	4.08E-08	4.07E-08	4.07E-08	4.07E-08	4.08E-08	4.07E-08	4.07E-08	4.07E-08
216-S-3	2.18E+02	1.57E+02	1.57E+02	1.11E+02	1.03E+02	1.02E+02	9.18E+01	6.51E+01	6.52E+01	6.51E+01	6.51E+01	6.51E+01	4.25E+01	4.14E+01	4.14E+01	4.14E+01
216-S-4	3.51E+01	2.98E+01	2.09E+01	2.09E+01	1.50E+01	1.25E+01	1.25E+01	1.25E+01	8.98E+00	7.52E+00	7.52E+00	7.52E+00	7.54E+00	7.52E+00	5.46E+00	4.65E+00
216-S-5	2.43E+05	2.05E+05	1.38E+05	1.38E+05	1.03E+05	8.70E+04	8.70E+04	8.48E+04	5.46E+04	5.44E+04	5.44E+04	5.44E+04	5.46E+04	4.20E+04	3.45E+04	3.45E+04
216-S-6	2.11E+05	2.03E+05	1.87E+05	1.91E+05	2.06E+05	2.26E+05	2.31E+05	2.18E+05	1.72E+05	1.31E+05	1.09E+05	8.32E+04	7.36E+04	7.52E+04	7.60E+04	6.54E+04
216-S-7	3.65E+04	3.28E+04	3.27E+04	3.58E+04	4.18E+04	3.22E+04	1.81E+04	1.19E+04	7.36E+03	6.79E+03	4.04E+03	4.04E+03	3.57E+03	2.33E+03	2.33E+03	2.33E+03
216-S-9	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.96E-05	2.67E+03	1.02E+04	8.59E+03	4.63E+03	3.09E+03	1.96E+03	1.82E+03	1.12E+03	1.12E+03
216-SX-2	5.93E+03	5.92E+03	5.92E+03	5.91E+03	5.93E+03	5.92E+03	3.88E+03	1.56E+03	9.34E+02	6.79E+02	4.52E+02	4.25E+02	2.83E+02	2.82E+02	2.60E+02	1.75E+02
216-T-1	3.65E+02	3.53E+02	3.31E+02	3.04E+02	4.12E+03	2.49E+04	2.49E+04	2.48E+04	2.50E+04	2.49E+04	3.68E+04	1.39E+04	4.32E+03	3.31E+03	3.17E+03	3.15E+03
216-T-12	1.06E+02	6.87E+01	6.50E+01	6.50E+01	4.43E+01	4.03E+01	4.03E+01	4.03E+01	3.68E+01	2.56E+01	2.56E+01	2.56E+01	2.57E+01	2.56E+01	2.56E+01	2.27E+01
216-T-14	5.20E+01	4.99E+01	4.89E+01	4.89E+01	3.94E+01	3.31E+01	3.31E+01	3.31E+01	3.28E+01	2.16E+01	2.16E+01	2.16E+01	2.17E+01	2.16E+01	2.16E+01	2.05E+01
216-T-15	5.72E+01	5.23E+01	5.22E+01	5.10E+01	3.52E+01	3.51E+01	3.51E+01	3.51E+01	2.63E+01	2.28E+01	2.28E+01	2.28E+01	2.29E+01	2.28E+01	2.14E+01	1.56E+01
216-T-16	5.17E+01	5.17E+01	5.17E+01	4.89E+01	3.55E+01	3.54E+01	3.54E+01	3.54E+01	2.46E+01	2.30E+01	2.30E+01	2.30E+01	2.31E+01	2.30E+01	1.98E+01	1.57E+01
216-T-17	5.84E+00	6.22E+00	2.65E+01	2.65E+01	2.66E+01	2.72E+01	2.73E+01	2.73E+01	2.74E+01	2.73E+01	2.05E+01	1.96E+01	1.97E+01	1.96E+01	1.96E+01	1.96E+01
216-T-18	2.26E+01	2.02E+01	1.40E+01	1.40E+01	1.40E+01	1.18E+01	8.79E+00	8.79E+00	8.82E+00	8.79E+00	8.79E+00	6.89E+00	5.80E+00	5.79E+00	5.79E+00	5.79E+00
216-T-19	2.53E+03	1.93E+03	1.53E+03	1.26E+03	1.05E+03	9.32E+02	5.46E+03	6.75E+04	6.59E+04	6.76E+04	3.71E+04	4.30E+04	3.89E+04	2.42E+04	1.98E+04	1.57E+04
216-T-2	1.01E+01	1.01E+01	1.01E+01	1.01E+01	1.01E+01	6.15E+00	5.76E+00	5.76E+00	5.77E+00	5.76E+00	5.76E+00	5.76E+00	5.48E+00	4.14E+00	4.14E+00	4.14E+00
216-T-20	2.26E-04	3.94E-02	3.96E-02	3.96E-02	5.06E-02	3.45E-01	3.45E-01	3.45E-01	3.46E-01	3.45E-01	3.60E-01	5.03E-01	5.04E-01	5.03E-01	5.03E-01	5.03E-01
216-T-21	1.61E-03	1.60E-03	3.90E-01	5.04E-01	5.05E-01	5.04E-01	6.74E+00	7.18E+00	7.20E+00	7.18E+00	7.18E+00	8.07E+00	1.23E+01	1.23E+01	1.23E+01	1.23E+01
216-T-22	6.11E+01	6.08E+01	4.66E+01	3.86E+01	3.87E+01	3.72E+01	2.46E+01	2.46E+01	2.47E+01	2.46E+01	2.46E+01	1.80E+01	1.62E+01	1.62E+01	1.62E+01	1.62E+01
216-T-23	6.70E+01	5.97E+01	4.28E+01	4.28E+01	4.08E+01	2.74E+01	2.74E+01	2.74E+01	2.74E+01	2.36E+01	1.79E+01	1.79E+01	1.79E+01	1.79E+01	1.79E+01	1.79E+01
216-T-24	6.28E+01	5.93E+01	4.81E+01	3.78E+01	3.79E+01	3.78E+01	2.48E+01	2.42E+01	2.42E+01	2.42E+01	2.42E+01	1.93E+01	1.60E+01	1.60E+01	1.60E+01	1.60E+01
216-T-25	6.32E+01	4.11E+01	3.89E+01	3.89E+01	2.65E+01	2.41E+01	2.41E+01	2.41E+01	2.20E+01	1.53E+01	1.53E+01	1.53E+01	1.53E+01	1.53E+01	1.53E+01	1.36E+01
216-T-26	2.69E+02	2.03E+02	1.54E+02	1.53E+02	9.03E+01	9.01E+01	9.01E+01	8.28E+01	5.40E+01	5.39E+01	5.39E+01	5.39E+01	5.40E+01	4.46E+01	3.39E+01	3.39E+01
216-T-27	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.61E+03	2.50E+03	6.30E+02	3.47E+02	2.44E+02	1.56E+02	1.51E+02	9.92E+01	9.35E+01	9.35E+01	6.36E+01
216-T-28	1.29E-07	1.29E-07	1.29E-07	1.15E+03	1.46E+04	1.35E+04	4.79E+03	1.72E+03	9.85E+02	6.37E+02	5.42E+02	3.56E+02	3.06E+02	3.05E+02	2.02E+02	1.75E+02
216-T-29	4.93E+00	4.91E+00	4.92E+00	4.91E+00	1.97E+00	7.96E-01	4.27E-01	2.32E-01	2.11E-01	1.14E-01	1.14E-01	1.01E-01	6.24E-02	6.23E-02	6.23E-02	6.13E-02
216-T-3	3.23E+01	2.39E+01	1.82E+01	1.82E+01	1.83E+01	1.82E+01	1.82E+01	1.82E+01	1.83E+01	1.23E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01
216-T-32	9.71E+01	9.68E+01	9.43E+01	5.80E+01	5.81E+01	5.80E+01	5.80E+01	5.80E+01	4.09E+01	3.62E+01	3.62E+01	3.62E+01	3.63E+01	3.62E+01	3.62E+01	3.62E+01
216-T-33	4.77E-09	4.75E-09	4.75E-09	4.30E+02	6.75E+02	1.69E+02	9.26E+01	6.54E+01	4.20E+01	4.05E+01	2.65E+01	2.50E+01	2.51E+01	1.70E+01	1.55E+01	1.55E+01
216-T-34	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.01E-08	3.13E+03	5.79E+03	2.30E+03	1.12E+03	7.12E+02	4.63E+02	3.64E+02	2.71E+02	2.71E+02	1.67E+02
216-T-35	9.55E-11	9.53E-11	9.53E-11	9.53E-11	9.55E-11	9.53E-11	9.53E-11	1.80E+02	2.35E+03	6.51E+02	3.54E+02	2.51E+02	1.70E+02	1.50E+02	1.08E+02	1.08E+02
216-T-36	1.61E-09	1.60E-09	1.60E-09	1.60E-09	1.61E-09	1.60E-09	1.60E-09	1.60E-09	1.61E-09	1.60E-09	8.24E-08	5.45E-03	1.34E-01	5.21E+00	7.73E+00	2.07E+01
216-T-4A	1.37E+05	9.28E+05	9.66E+05	9.64E+05	9.68E+05	9.66E+05	9.66E+05	8.32E+05	7.77E+05	7.35E+05	5.95E+05	5.04E+05	4.79E+05	3.99E+05	3.17E+05	2.73E+05
216-T-5	6.85E+01	6.62E+01	4.32E+01	4.08E+01	4.09E+01	2.78E+01	2.53E+01	2.53E+01	2.54E+01	2.30E+01	1.61E+01	1.61E+01	1.61E+01	1.61E+01	1.61E+01	1.61E+01
216-T-6	2.33E+02	1.75E+02	1.48E+02	1.48E+02	1.48E+02	1.48E+02	1.48E+02	1.48E+02	9.99E+01	9.96E+01	9.96E+01	9.96E+01	9.99E+01	9.96E+01	9.96E+01	9.96E+01
216-T-7	1.09E+03	1.07E+03	6.13E+02	6.13E+02	6.14E+02	4.55E+02	3.55E+02	3.55E+02	3.56E+02	3.55E+02	2.91E+02	2.16E+02	2.16E+02	2.16E+02	2.16E+02	2.16E+02
216-T-8	2.46E-04	4.29E-02	7.02E-02	7.02E-02	7.04E-02	7.02E-02	1.39E+00	2.94E+00	2.94E+00	2.94E+00	2.94E+00	2.94E+00	2.94E+00	2.94E+00	9.73E+00	1.21E+01
216-TY-201	6.25E+00	6.24E+00	6.24E+00	6.22E+00	6.25E+00	6.24E+00	6.23E+00	2.96E+00	1.46E+00	9.40E-01	4.97E-01	4.97E-01	3.03E-01	2.72E-01	2.72E-01	1.94E-01
216-U-1%2	3.56E-06	3.55E-06	3.55E-06	3.55E-06	3.56E-06	3.55E-06	3.55E-06	3.55E-06	3.56E-06	3.55E-06	3.55E-06	3.55E-06	3.56E-06	3.55E-06	3.55E-06	3.55E-06
216-U-10	3.48E+06	2.15E+06	2.79E+06	2.27E+06	2.06E+06	2.22E+06	2.23E+06	2.27E+06	2.51E+06	3.25E+06	2.84E+06	2.54E+06	2.22E+06	2.24E+06	2.04E+06	3.60E+06

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
216-U-12	2.89E-05	2.88E-05	1.34E+03	1.42E+04	1.63E+04	1.42E+04	1.14E+04	1.05E+04	9.68E+03	8.50E+03	6.56E+03	5.41E+03	5.02E+03	4.32E+03	3.30E+03	2.48E+03
216-U-13	5.00E-06	4.99E-06	4.99E-06	4.99E-06	5.00E-06	4.99E-06	4.99E-06	4.99E-06	5.00E-06	4.99E-06	4.99E-06	4.99E-06	5.00E-06	4.99E-06	6.58E-04	9.96E-04
216-U-14	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10
216-U-15	3.00E-06	2.99E-06	2.99E-06	2.99E-06	3.00E-06	2.99E-06	2.99E-06	3.84E-04	5.82E-04	5.80E-04	5.80E-04	5.80E-04	6.52E-02	8.92E-02	8.92E-02	8.92E-02
216-U-16	7.18E-02	7.16E-02	7.16E-02	7.16E-02	7.18E-02	7.16E-02	7.16E-02	7.16E-02	7.18E-02	7.16E-02	7.16E-02	7.16E-02	7.18E-02	7.16E-02	7.16E-02	7.16E-02
216-U-17	9.95E-09	9.93E-09	9.93E-09	9.93E-09	9.95E-09	9.93E-09	9.93E-09	9.93E-09	9.95E-09	9.93E-09	9.93E-09	9.93E-09	9.95E-09	9.93E-09	9.93E-09	9.93E-09
216-U-3	4.85E+01	4.30E+01	3.08E+01	3.08E+01	2.76E+01	1.92E+01	1.92E+01	1.92E+01	1.92E+01	1.39E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01
216-U-4	1.26E+01	1.25E+01	1.12E+01	7.62E+00	7.64E+00	7.62E+00	7.33E+00	4.50E+00	4.51E+00	4.50E+00	4.50E+00	4.50E+00	4.51E+00	3.01E+00	2.66E+00	2.66E+00
216-U-4A	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	1.31E-08	8.12E+01	1.29E+02	9.78E+01	5.51E+01	3.13E+01	2.02E+01	1.56E+01	9.73E+00
216-U-4B	6.63E-11	6.62E-11	6.62E-11	6.62E-11	6.63E-11	6.62E-11	2.90E+00	7.12E+00	6.58E+00	3.52E+00	2.07E+00	1.37E+00	1.06E+00	6.77E-01	6.48E-01	4.99E-01
216-U-7	4.29E-01	2.87E-01	2.51E-01	1.69E-01	1.70E-01	1.42E-01	9.94E-02	9.94E-02	9.97E-02	9.94E-02	5.94E-02	5.92E-02	5.93E-02	5.92E-02	5.92E-02	5.92E-02
216-U-8	1.47E+04	1.10E+04	9.00E+03	6.68E+03	6.35E+03	4.44E+03	4.44E+03	3.91E+03	2.86E+03	2.85E+03	2.85E+03	2.67E+03	1.80E+03	1.80E+03	1.80E+03	1.80E+03
216-W-LWC	4.17E-07	4.16E-07	4.16E-07	4.16E-07	4.17E-07	4.16E-07	4.16E-07	4.16E-07	4.17E-07	4.16E-07	4.16E-07	4.16E-07	4.17E-07	4.16E-07	4.16E-07	4.16E-07
216-Z-1%2	5.72E+02	4.89E+02	4.26E+02	3.75E+02	3.35E+02	3.00E+02	2.79E+02	2.50E+02	2.33E+02	2.14E+02	1.94E+02	1.79E+02	1.64E+02	1.54E+02	1.42E+02	1.40E+02
216-Z-10	8.13E+00	8.11E+00	8.11E+00	8.11E+00	8.13E+00	5.59E+00	4.78E+00	4.78E+00	4.80E+00	4.78E+00	4.78E+00	4.78E+00	4.80E+00	4.78E+00	4.65E+00	3.19E+00
216-Z-12	5.57E-06	3.34E+04	3.19E+04	2.45E+04	2.14E+04	1.90E+04	1.70E+04	1.50E+04	1.24E+04	1.05E+04	8.01E+03	6.85E+03	6.01E+03	7.50E+03	7.57E+03	6.12E+03
216-Z-3	1.11E+04	6.86E+03	4.76E+03	3.81E+03	2.47E+03	2.42E+03	1.83E+03	1.50E+03	1.50E+03	1.41E+03	9.17E+02	9.17E+02	9.20E+02	9.17E+02	9.17E+02	5.96E+02
216-Z-4	4.73E-04	6.48E-04	6.48E-04	6.48E-04	6.50E-04	6.48E-04	6.48E-04	6.26E-03	3.94E-02	3.93E-02	3.93E-02	3.93E-02	3.94E-02	3.93E-02	3.93E-02	3.93E-02
216-Z-5	4.73E+02	4.72E+02	3.67E+02	2.97E+02	2.97E+02	2.97E+02	2.97E+02	2.97E+02	2.97E+02	2.76E+02	1.94E+02	1.94E+02	1.95E+02	1.94E+02	1.94E+02	1.94E+02
216-Z-6	1.74E-01	1.74E-01	4.01E-01	1.48E+00	1.49E+00	1.48E+00	1.48E+00	1.48E+00	1.49E+00	1.48E+00	1.48E+00	1.80E+00	2.09E+00	2.09E+00	2.09E+00	2.09E+00
216-Z-7	7.37E+02	6.54E+02	5.89E+02	5.34E+02	4.86E+02	4.51E+02	4.11E+02	3.69E+02	4.31E+02	7.27E+02	7.84E+02	8.12E+02	7.92E+02	5.82E+02	5.82E+02	5.82E+02
218-E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-E-Cores	3.17E-03	3.11E-03	3.06E-03	3.01E-03	2.97E-03	2.91E-03	2.86E-03	2.81E-03	2.78E-03	2.72E-03	2.68E-03	2.63E-03	2.59E-03	2.54E-03	2.50E-03	2.46E-03
218-E-LLW	1.42E-02	1.39E-02	1.37E-02	1.35E-02	1.33E-02	1.30E-02	1.28E-02	1.26E-02	1.24E-02	1.22E-02	1.20E-02	1.18E-02	1.16E-02	1.14E-02	1.12E-02	1.10E-02
218-W-3A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-3AE	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-4B	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-4C	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-104	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05
241-A-105	1.29E-05	1.28E-05	1.28E-05	1.28E-05	1.29E-05	4.23E+02	3.08E+02	7.29E+01	3.85E+01	2.47E+01	1.77E+01	1.35E+01	1.08E+01	8.85E+00	7.46E+00	6.41E+00
241-A-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
241-AN-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-108	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AY-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AY-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AZ-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AZ-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-B-101	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	3.29E-06	1.03E-03
241-B-102	4.45E-08	4.44E-08	4.44E-08	4.44E-08	4.45E-08	4.44E-08	4.44E-08	4.44E-08	4.45E-08	4.44E-08	4.44E-08	4.44E-08	4.45E-08	4.44E-08	3.29E-06	1.03E-03
241-B-103	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	3.29E-06	1.03E-03
241-B-104	5.93E-08	5.92E-08	5.92E-08	5.92E-08	5.93E-08	5.92E-08	5.92E-08	5.92E-08	5.93E-08	5.92E-08	5.92E-08	5.92E-08	5.93E-08	5.92E-08	5.92E-08	7.16E-07
241-B-105	4.22E-05	4.21E-05	4.21E-05	4.21E-05	4.22E-05	4.21E-05	4.21E-05	4.21E-05	4.22E-05	4.21E-05	4.21E-05	7.60E-03	2.09E+00	2.21E+00	1.73E+00	1.44E+00
241-B-106	3.40E-08	3.39E-08	3.39E-08	3.39E-08	3.40E-08	3.39E-08	3.39E-08	3.39E-08	3.40E-08	3.39E-08	3.39E-08	3.39E-08	3.40E-08	3.39E-08	3.39E-08	3.39E-08
241-B-107	9.09E-08	9.06E-08	9.06E-08	9.06E-08	9.09E-08	9.06E-08	2.38E+01	9.39E+00	4.87E+00	3.18E+00	2.36E+00	1.86E+00	1.54E+00	1.31E+00	1.15E+00	1.04E+00
241-B-108	4.46E-08	4.45E-08	4.45E-08	4.45E-08	4.46E-08	4.45E-08	4.45E-08	4.45E-08	4.46E-08	4.45E-08	4.45E-08	4.45E-08	4.46E-08	4.45E-08	3.30E-06	1.03E-03
241-B-109	5.93E-08	5.92E-08	5.92E-08	5.92E-08	5.93E-08	5.92E-08	5.92E-08	5.92E-08	5.93E-08	5.92E-08	5.92E-08	5.92E-08	5.93E-08	5.92E-08	5.92E-08	7.16E-07
241-B-110	2.50E-11	2.49E-11	2.49E-11	2.49E-11	2.50E-11	2.49E-11	2.49E-11	2.49E-11	2.50E-11	2.49E-11	2.55E+01	4.20E+01	1.06E+01	5.50E+00	3.61E+00	2.62E+00
241-B-111	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	4.44E-08	4.44E-08	4.46E-08	4.44E-08	3.29E-06	1.03E-03
241-B-112	5.94E-08	5.92E-08	5.92E-08	5.92E-08	5.94E-08	5.92E-08	5.92E-08	5.92E-08	5.94E-08	5.92E-08	5.92E-08	5.92E-08	5.94E-08	5.92E-08	5.92E-08	7.17E-07
241-B-201	2.91E-09	2.90E-09	2.90E-09	2.90E-09	2.91E-09	2.90E-09	2.10E+00	6.66E-01	3.56E-01	2.33E-01	1.71E-01	1.34E-01	1.10E-01	9.35E-02	8.20E-02	7.39E-02
241-B-202	2.96E-09	2.95E-09	2.95E-09	2.95E-09	2.96E-09	2.95E-09	2.95E-09	2.95E-09	2.96E-09	2.95E-09	2.95E-09	2.95E-09	2.96E-09	2.95E-09	2.95E-09	2.95E-09
241-B-203	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	6.68E-05	6.41E-02	1.43E-01	1.24E-01	1.04E-01	8.87E-02	7.86E-02	7.15E-02
241-B-204	7.72E-09	7.70E-09	7.70E-09	7.70E-09	7.72E-09	7.70E-09	7.70E-09	1.86E-04	2.30E-01	2.09E-01	1.53E-01	1.22E-01	1.02E-01	8.78E-02	7.80E-02	7.12E-02
241-BX-101	3.85E-06	3.84E-06	3.84E-06	3.84E-06	3.85E-06	3.84E-06	3.84E-06	3.84E-06	3.85E-06	3.84E-06	3.84E-06	3.84E-06	3.85E-06	3.84E-06	3.84E-06	3.84E-06
241-BX-102	1.05E+00	9.00E-01	7.91E-01	7.07E-01	6.47E-01	6.06E-01	5.93E-01	6.10E-01	6.56E-01	7.10E-01	7.62E-01	7.97E-01	8.20E-01	8.28E-01	8.32E-01	8.34E-01

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
241-BX-103	3.64E-08	3.63E-08	3.63E-08	3.63E-08	3.64E-08	3.63E-08	3.63E-08	3.63E-08	3.64E-08	3.63E-08	3.63E-08	3.63E-08	3.64E-08	3.63E-08	3.63E-08	3.63E-08
241-BX-104	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08
241-BX-105	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08
241-BX-106	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08
241-BX-107	3.64E-08	3.63E-08	3.63E-08	3.63E-08	3.64E-08	3.63E-08	3.63E-08	3.63E-08	3.64E-08	3.63E-08	3.63E-08	3.63E-08	3.64E-08	3.63E-08	3.63E-08	3.63E-08
241-BX-108	5.23E-08	5.21E-08	5.21E-08	5.21E-08	5.23E-08	5.21E-08	5.21E-08	5.21E-08	5.23E-08	5.21E-08	5.21E-08	5.21E-08	5.23E-08	5.21E-08	5.21E-08	5.21E-08
241-BX-109	6.48E-08	6.47E-08	6.47E-08	6.47E-08	6.48E-08	6.47E-08	6.47E-08	6.47E-08	6.48E-08	6.47E-08	6.47E-08	6.47E-08	6.48E-08	6.47E-08	6.47E-08	6.47E-08
241-BX-110	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08	5.22E-08	5.21E-08	5.21E-08	5.21E-08
241-BX-111	2.40E-05	2.39E-05	2.39E-05	2.39E-05	2.40E-05	2.39E-05	2.39E-05	2.39E-05	9.39E-03	1.10E+00	1.97E+00	1.77E+00	1.50E+00	1.29E+00	1.14E+00	1.04E+00
241-BX-112	6.49E-08	6.47E-08	6.47E-08	6.47E-08	6.49E-08	6.47E-08	6.47E-08	6.47E-08	6.49E-08	6.47E-08	6.47E-08	6.47E-08	6.49E-08	6.47E-08	6.47E-08	6.47E-08
241-BY-101	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08
241-BY-102	6.49E-08	6.47E-08	6.47E-08	6.47E-08	6.49E-08	6.47E-08	6.47E-08	6.47E-08	6.49E-08	6.47E-08	6.47E-08	6.47E-08	6.49E-08	6.47E-08	6.47E-08	6.47E-08
241-BY-103	7.54E-08	7.52E-08	7.52E-08	7.52E-08	7.54E-08	7.52E-08	7.52E-08	7.52E-08	7.54E-08	7.52E-08	7.52E-08	7.52E-08	7.54E-08	7.52E-08	7.52E-08	3.30E+00
241-BY-104	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08
241-BY-105	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08
241-BY-106	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	5.70E-08	5.70E-08
241-BY-107	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08	6.48E-08	6.46E-08	6.46E-08	6.46E-08
241-BY-108	8.61E-08	8.59E-08	8.59E-08	8.59E-08	8.61E-08	8.59E-08	8.59E-08	8.59E-08	8.61E-08	8.59E-08	8.59E-08	8.59E-08	8.61E-08	8.59E-08	1.84E+00	4.60E+00
241-BY-109	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	5.70E-08	5.70E-08
241-BY-110	4.16E-08	4.15E-08	4.15E-08	4.15E-08	4.16E-08	4.15E-08	4.15E-08	4.15E-08	4.16E-08	4.15E-08	4.15E-08	4.15E-08	4.16E-08	4.15E-08	4.15E-08	4.15E-08
241-BY-111	4.33E-08	4.32E-08	4.32E-08	4.32E-08	4.33E-08	4.32E-08	4.32E-08	4.32E-08	4.33E-08	4.32E-08	4.32E-08	4.32E-08	4.33E-08	4.32E-08	4.32E-08	4.32E-08
241-BY-112	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08
241-C-101	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-102	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-103	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-104	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-105	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04
241-C-106	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04
241-C-107	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-108	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04
241-C-109	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04
241-C-110	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-111	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-112	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-201	7.42E-06	7.40E-06	7.40E-06	7.40E-06	7.42E-06	7.40E-06	7.40E-06	7.40E-06	7.42E-06	7.40E-06	7.40E-06	7.40E-06	7.42E-06	7.40E-06	7.40E-06	7.40E-06
241-C-202	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06
241-C-203	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06
241-C-204	7.46E-06	7.44E-06	7.44E-06	7.44E-06	7.46E-06	7.44E-06	7.44E-06	7.44E-06	7.46E-06	7.44E-06	7.44E-06	7.44E-06	7.46E-06	7.44E-06	7.44E-06	7.44E-06
241-S-101	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08
241-S-102	1.79E-08	1.78E-08	1.78E-08	1.78E-08	1.79E-08	1.78E-08	1.78E-08	1.78E-08	1.79E-08	1.78E-08	1.78E-08	1.78E-08	1.79E-08	1.78E-08	1.78E-08	1.78E-08
241-S-103	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
241-S-104	4.46E-09	4.44E-09	4.44E-09	4.44E-09	4.46E-09	4.44E-09	4.44E-09	4.44E-09	4.46E-09	4.44E-09	4.44E-09	4.44E-09	4.46E-09	4.44E-09	3.99E-06	3.51E-04
241-S-105	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08
241-S-106	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08
241-S-107	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08
241-S-108	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08
241-S-109	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08
241-S-110	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08
241-S-111	1.59E-08	1.58E-08	1.58E-08	1.58E-08	1.59E-08	1.58E-08	1.58E-08	1.58E-08	1.59E-08	1.58E-08	1.58E-08	1.58E-08	1.59E-08	1.58E-08	1.58E-08	1.58E-08
241-S-112	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08
241-SX-101	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08
241-SX-102	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08
241-SX-103	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08
241-SX-104	1.64E-08	1.63E-08	1.63E-08	1.63E-08	1.64E-08	1.63E-08	1.63E-08	1.63E-08	1.64E-08	1.63E-08	1.63E-08	1.63E-08	1.64E-08	1.63E-08	1.63E-08	1.63E-08
241-SX-105	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08
241-SX-106	2.08E-08	2.07E-08	2.07E-08	2.07E-08	2.08E-08	2.07E-08	2.07E-08	2.07E-08	2.08E-08	2.07E-08	2.07E-08	2.07E-08	2.08E-08	2.07E-08	2.07E-08	2.07E-08
241-SX-107	5.58E-09	5.56E-09	5.56E-09	5.56E-09	5.58E-09	5.56E-09	5.56E-09	5.56E-09	5.58E-09	5.56E-09	5.56E-09	5.56E-09	5.58E-09	5.56E-09	3.33E-06	1.54E-04
241-SX-108	7.70E-10	7.68E-10	7.68E-10	7.68E-10	7.70E-10	7.68E-10	7.68E-10	7.68E-10	7.70E-10	7.68E-10	7.68E-10	7.68E-10	7.70E-10	7.68E-10	7.68E-10	9.82E-08
241-SX-109	1.28E-09	1.27E-09	1.27E-09	1.27E-09	1.28E-09	1.27E-09	1.27E-09	1.27E-09	1.28E-09	1.27E-09	1.27E-09	1.27E-09	1.28E-09	1.27E-09	1.27E-09	1.27E-09
241-SX-110	4.66E-11	4.65E-11	4.65E-11	4.65E-11	4.66E-11	4.65E-11	4.65E-11	4.65E-11	4.66E-11	4.65E-11	4.65E-11	4.65E-11	4.66E-11	4.65E-11	4.65E-11	4.65E-11
241-SX-111	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09
241-SX-112	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08
241-SX-113	1.28E-08	1.27E-08	1.27E-08	1.27E-08	1.28E-08	1.27E-08	1.27E-08	1.27E-08	1.28E-08	1.27E-08	1.27E-08	1.27E-08	1.28E-08	5.93E-06	1.36E-04	2.19E-03
241-SX-114	3.15E-11	3.14E-11	3.14E-11	3.14E-11	3.15E-11	3.14E-11	3.14E-11	3.14E-11	3.15E-11	3.14E-11	3.14E-11	3.14E-11	3.15E-11	3.14E-11	3.14E-11	3.14E-11
241-SX-115	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08	1.23E-08
241-SY-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-SY-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-SY-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-T-101	5.36E-16	5.35E-16	5.35E-16	5.35E-16	5.36E-16	5.35E-16	5.35E-16	5.35E-16	5.36E-16	3.52E-11	2.20E-01	7.53E+00	7.76E+00	5.38E+00	3.84E+00	2.85E+00
241-T-102	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.00E-09	5.00E-09	5.00E-09
241-T-103	3.76E-09	3.75E-09	3.75E-09	3.75E-09	3.76E-09	3.75E-09	3.75E-09	3.75E-09	3.76E-09	3.75E-09	3.75E-09	3.75E-09	3.76E-09	3.75E-09	3.75E-09	3.75E-09
241-T-104	5.36E-09	5.34E-09	5.34E-09	5.34E-09	5.36E-09	5.34E-09	5.34E-09	5.34E-09	5.36E-09	5.34E-09	5.34E-09	5.34E-09	5.36E-09	5.34E-09	5.34E-09	5.34E-09
241-T-105	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.34E-09	5.34E-09
241-T-106	7.06E-06	7.04E-06	7.04E-06	7.04E-06	7.06E-06	7.04E-06	7.04E-06	7.04E-06	7.06E-06	7.04E-06	7.04E-06	7.04E-06	7.06E-06	7.04E-06	8.72E+01	9.48E+01
241-T-107	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16
241-T-108	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.00E-09	5.00E-09	5.00E-09
241-T-109	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.00E-09	5.00E-09	5.00E-09
241-T-110	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16
241-T-111	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.00E-09	5.00E-09	5.00E-09
241-T-112	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.34E-09	5.34E-09
241-T-201	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10
241-T-202	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
241-T-203	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10
241-T-204	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10
241-TX-101	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09
241-TX-102	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09
241-TX-103	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09
241-TX-104	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09
241-TX-105	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TX-106	4.25E-10	4.24E-10	4.24E-10	4.24E-10	4.25E-10	4.24E-10	4.24E-10	4.24E-10	4.25E-10	4.24E-10	4.24E-10	4.24E-10	4.25E-10	4.24E-10	4.24E-10	4.24E-10
241-TX-107	2.76E-11	2.75E-11	2.75E-11	2.75E-11	2.76E-11	2.75E-11	2.75E-11	2.75E-11	2.76E-11	2.75E-11	2.75E-11	2.75E-11	2.76E-11	2.75E-11	2.75E-11	2.75E-11
241-TX-108	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TX-109	4.79E-09	4.77E-09	4.77E-09	4.77E-09	4.79E-09	4.77E-09	4.77E-09	4.77E-09	4.79E-09	4.77E-09	4.77E-09	4.77E-09	4.79E-09	4.77E-09	4.77E-09	4.77E-09
241-TX-110	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09
241-TX-111	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09
241-TX-112	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09
241-TX-113	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TX-114	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TX-115	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TX-116	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TX-117	4.17E-09	4.15E-09	4.15E-09	4.15E-09	4.17E-09	4.15E-09	4.15E-09	4.15E-09	4.17E-09	4.15E-09	4.15E-09	4.15E-09	4.17E-09	4.15E-09	4.15E-09	4.15E-09
241-TX-118	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09
241-TY-101	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12
241-TY-102	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12
241-TY-103	2.54E-09	2.53E-09	2.53E-09	2.53E-09	2.54E-09	2.53E-09	2.53E-09	2.53E-09	2.54E-09	2.53E-09	2.53E-09	2.53E-09	2.54E-09	2.53E-09	2.53E-09	2.53E-09
241-TY-104	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12
241-TY-105	1.59E+01	1.10E+01	8.26E+00	6.52E+00	5.35E+00	4.48E+00	3.84E+00	3.35E+00	2.98E+00	2.66E+00	2.41E+00	2.21E+00	2.05E+00	1.91E+00	1.80E+00	1.72E+00
241-TY-106	1.35E+01	9.01E+00	6.06E+00	4.59E+00	3.65E+00	2.99E+00	2.53E+00	2.18E+00	1.92E+00	1.70E+00	1.53E+00	1.40E+00	1.29E+00	1.20E+00	1.12E+00	1.07E+00
241-U-101	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08
241-U-102	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08
241-U-103	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08
241-U-104	9.82E-09	9.79E-09	9.79E-09	9.79E-09	9.82E-09	9.79E-09	1.52E-06	2.85E-04	1.20E-02	3.13E-01	2.94E+00	7.43E+00	9.26E+00	9.22E+00	8.79E+00	8.33E+00
241-U-105	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08
241-U-106	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08
241-U-107	1.67E-08	1.66E-08	1.66E-08	1.66E-08	1.67E-08	1.66E-08	1.66E-08	1.66E-08	1.67E-08	1.66E-08	1.66E-08	1.66E-08	1.67E-08	1.66E-08	1.66E-08	1.66E-08
241-U-108	1.89E-08	1.88E-08	1.88E-08	1.88E-08	1.89E-08	1.88E-08	1.88E-08	1.88E-08	1.89E-08	1.88E-08	1.88E-08	1.88E-08	1.89E-08	1.88E-08	1.88E-08	1.88E-08
241-U-109	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08
241-U-110	4.53E-09	4.52E-09	4.52E-09	4.52E-09	4.53E-09	4.52E-09	4.52E-09	4.52E-09	4.53E-09	4.52E-09	4.52E-09	4.52E-09	4.53E-09	4.52E-09	4.52E-09	4.52E-09
241-U-111	1.74E-08	1.73E-08	1.73E-08	1.73E-08	1.74E-08	1.73E-08	1.73E-08	1.73E-08	1.74E-08	1.73E-08	1.73E-08	1.73E-08	1.74E-08	1.73E-08	1.73E-08	1.73E-08
241-U-112	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	4.16E-08	4.16E-08	4.17E-08	4.16E-08	3.70E-05	3.01E-03
241-U-201	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09
241-U-202	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09
241-U-203	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
241-U-204	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09
300-224	2.69E+02	1.20E+03	1.20E+03	1.20E+03	1.21E+03	1.20E+03	1.20E+03	1.20E+03	1.21E+03	1.20E+03	1.20E+03	1.20E+03	1.21E+03	1.20E+03	1.20E+03	1.20E+03
316-1	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06	1.20E+06
316-2	1.21E+06	1.20E+06	1.20E+06	1.20E+06	1.21E+06	1.20E+06	1.20E+06	1.20E+06	1.21E+06	1.20E+06	1.20E+06	1.20E+06	1.21E+06	1.20E+06	1.20E+06	1.20E+06
316-3	9.13E+04	9.10E+04	9.10E+04	9.08E+04	1.70E+04	3.58E+03	1.96E+03	1.35E+03	8.14E+02	8.07E+02	4.78E+02	4.78E+02	4.80E+02	3.13E+02	2.95E+02	2.95E+02
316-5	3.08E-10	3.07E-10	3.07E-10	3.07E-10	3.08E-10	3.07E-10	3.07E-10	3.07E-10	3.08E-10	3.07E-10	3.07E-10	3.07E-10	3.08E-10	3.07E-10	3.07E-10	6.47E+05
600-148	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
600-211	4.24E-09	4.23E-09	4.23E-09	4.23E-09	4.24E-09	4.23E-09	4.23E-09	4.23E-09	4.24E-09	4.23E-09	4.23E-09	4.23E-09	4.24E-09	4.23E-09	4.23E-09	4.23E-09
618-11	3.27E-10	3.27E-10	3.05E-09	4.28E-05	1.38E-02	1.81E-01	1.53E+00	1.05E+01	6.45E+01	2.78E+02	6.99E+02	1.08E+03	1.28E+03	1.35E+03	1.38E+03	1.39E+03
GTF	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GTFL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILAW-liquid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RMWSF	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-100-N-1	9.47E-12	9.45E-12	9.45E-12	9.45E-12	9.47E-12	9.45E-12	9.45E-12	9.45E-12	9.47E-12	9.45E-12	9.45E-12	9.45E-12	9.47E-12	9.43E-12	3.35E-08	8.55E-04
UPR-100-N-25	5.10E-15	5.08E-15	5.08E-15	5.08E-15	5.10E-15	5.08E-15	5.08E-15	5.08E-15	5.10E-15	5.08E-15	5.07E-15	2.12E-14	1.32E-09	1.47E-07	1.43E-06	9.66E-01
UPR-100-N-30	1.19E-12	1.18E-12	1.18E-12	1.18E-12	1.19E-12	1.18E-12	1.18E-12	1.18E-12	1.19E-12	1.18E-12	1.18E-12	4.94E-12	3.08E-07	3.34E-05	9.76E-05	1.80E-03
UPR-100-N-5	2.02E-14	2.01E-14	2.01E-14	2.01E-14	2.02E-14	2.01E-14	2.01E-14	2.01E-14	2.02E-14	2.01E-14	2.01E-14	2.01E-14	3.34E+02	6.10E+00	4.71E-01	2.29E-01
UPR-200-E-1	6.82E-02	4.83E-02	4.83E-02	4.83E-02	4.85E-02	4.83E-02	4.83E-02	3.74E-02	3.14E-02	3.14E-02	3.14E-02	3.14E-02	3.14E-02	3.14E-02	3.14E-02	3.14E-02
UPR-200-E-105	3.26E+00	3.09E+00	2.90E+00	2.04E+00	2.05E+00	2.04E+00	1.95E+00	1.33E+00	1.33E+00	1.33E+00	1.33E+00	1.33E+00	1.32E+00	8.72E-01	8.72E-01	8.72E-01
UPR-200-E-107	4.33E-05	4.32E-05	4.32E-05	4.32E-05	4.33E-05	4.32E-05	4.32E-05	4.32E-05	4.33E-05	4.32E-05	4.32E-05	4.32E-05	4.33E-05	4.32E-05	4.32E-05	4.32E-05
UPR-200-E-108	6.35E-09	6.33E-09	6.33E-09	6.33E-09	6.35E-09	6.33E-09	6.33E-09	6.33E-09	6.35E-09	6.33E-09	6.33E-09	6.33E-09	6.35E-09	6.33E-09	6.33E-09	6.33E-09
UPR-200-E-109	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07
UPR-200-E-110	5.00E-01	3.01E-01	3.01E-01	2.29E-01	1.70E-01	1.70E-01	1.70E-01	1.27E-01	9.80E-02	9.77E-02	9.77E-02	9.77E-02	9.80E-02	7.15E-02	5.80E-02	5.80E-02
UPR-200-E-114	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-115	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-116	1.39E-08	1.38E-08	1.38E-08	1.38E-08	1.39E-08	1.38E-08	1.38E-08	1.38E-08	1.39E-08	1.38E-08	1.38E-08	1.38E-08	1.39E-08	1.38E-08	1.38E-08	1.38E-08
UPR-200-E-117	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-119	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-133	7.12E-08	7.10E-08	7.10E-08	7.10E-08	7.12E-08	7.10E-08	7.10E-08	7.10E-08	7.12E-08	7.10E-08	7.10E-08	7.10E-08	7.12E-08	7.10E-08	1.37E-01	4.58E+00
UPR-200-E-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-145	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-21	5.31E-05	5.29E-05	5.29E-05	5.29E-05	5.31E-05	5.29E-05	5.29E-05	5.29E-05	5.31E-05	5.29E-05	5.29E-05	5.29E-05	5.31E-05	5.29E-05	6.76E-04	7.08E-03
UPR-200-E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-3	3.73E-07	3.72E-07	3.72E-07	3.72E-07	3.73E-07	3.72E-07	3.72E-07	3.72E-07	3.73E-07	3.72E-07	3.72E-07	3.72E-07	3.73E-07	3.72E-07	9.39E-06	2.18E-05
UPR-200-E-38	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	2.14E-12	8.90E+00	5.95E+00	1.35E+00	6.90E-01	4.70E-01	2.81E-01	2.73E-01	1.59E-01
UPR-200-E-42	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-6	6.25E-10	6.23E-10	6.23E-10	6.23E-10	6.25E-10	6.23E-10	6.23E-10	6.23E-10	6.25E-10	6.23E-10	6.23E-10	6.23E-10	6.25E-10	6.23E-10	6.23E-10	6.23E-10
UPR-200-E-7	5.49E-01	4.69E-01	3.34E-01	3.34E-01	3.16E-01	2.04E-01	2.04E-01	2.04E-01	2.04E-01	1.79E-01	1.25E-01	1.25E-01	1.25E-01	1.25E-01	1.25E-01	1.25E-01
UPR-200-E-73	9.41E-08	9.39E-08	9.39E-08	9.39E-08	9.41E-08	9.39E-08	9.39E-08	9.39E-08	9.41E-08	9.39E-08	9.39E-08	9.39E-08	9.41E-08	9.39E-08	9.39E-08	9.39E-08
UPR-200-E-74	2.67E-08	2.66E-08	2.66E-08	2.66E-08	2.67E-08	2.66E-08	2.66E-08	2.66E-08	2.67E-08	2.66E-08	2.66E-08	2.66E-08	2.67E-08	2.66E-08	2.66E-08	2.66E-08
UPR-200-E-75	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
UPR-200-E-77	7.43E-09	7.41E-09	7.41E-09	7.41E-09	7.43E-09	7.41E-09	7.41E-09	7.41E-09	7.43E-09	2.14E-07	3.48E-07	3.48E-07	3.49E-07	3.48E-07	3.48E-07	3.48E-07
UPR-200-E-78	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07	1.65E-07
UPR-200-E-79	9.98E-07	9.95E-07	9.95E-07	9.95E-07	9.98E-07	9.95E-07	9.95E-07	9.95E-07	1.17E-05	4.88E-05	4.88E-05	4.88E-05	4.89E-05	4.88E-05	4.88E-05	6.57E-03
UPR-200-E-80	3.67E-05	3.66E-05	3.66E-05	3.66E-05	3.67E-05	3.66E-05	3.66E-05	3.66E-05	3.67E-05	1.06E-03	1.72E-03	1.72E-03	1.72E-03	1.72E-03	1.72E-03	1.72E-03
UPR-200-E-81	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	1.64E-03	5.10E+00	8.98E+00
UPR-200-E-82	5.17E-07	5.16E-07	5.16E-07	5.16E-07	5.17E-07	5.16E-07	5.16E-07	5.16E-07	5.17E-07	5.16E-07	5.16E-07	5.16E-07	5.17E-07	5.16E-07	5.16E-07	5.16E-07
UPR-200-E-84	1.81E-01	1.18E-01	1.18E-01	1.18E-01	7.80E-02	7.28E-02	7.28E-02	7.28E-02	7.29E-02	4.50E-02	4.50E-02	4.50E-02	4.51E-02	4.50E-02	4.50E-02	4.50E-02
UPR-200-E-85	6.90E-09	6.88E-09	6.88E-09	6.88E-09	6.90E-09	6.88E-09	6.88E-09	6.88E-09	6.90E-09	6.88E-09	6.88E-09	6.88E-09	6.90E-09	6.88E-09	6.88E-09	6.88E-09
UPR-200-E-86	1.79E-03	1.78E-03	1.78E-03	1.78E-03	1.79E-03	1.78E-03	1.78E-03	1.78E-03	1.79E-03	1.78E-03	1.78E-03	1.78E-03	1.79E-03	1.78E-03	1.78E-03	1.78E-03
UPR-200-E-87	9.16E-06	9.14E-06	9.14E-06	9.14E-06	9.16E-06	9.14E-06	9.14E-06	9.14E-06	9.16E-06	9.14E-06	9.14E-06	9.14E-06	2.17E-04	5.00E-04	5.00E-04	5.00E-04
UPR-200-E-9	1.27E-05	1.26E-05	1.26E-05	1.26E-05	1.27E-05	1.26E-05	1.26E-05	1.26E-05	1.27E-05	1.26E-05	1.26E-05	1.26E-05	1.27E-05	1.26E-05	1.26E-05	1.26E-05
UPR-200-W-10	3.40E-09	3.39E-09	3.39E-09	3.39E-09	3.40E-09	3.39E-09	3.39E-09	2.38E-07	5.34E-07	5.33E-07	5.33E-07	5.33E-07	5.34E-07	5.33E-07	5.33E-07	1.01E-04
UPR-200-W-100	3.98E-06	3.97E-06	3.97E-06	3.97E-06	3.98E-06	3.97E-06	3.97E-06	3.97E-06	3.98E-06	3.86E-04	6.66E-04	6.66E-04	6.68E-04	6.66E-04	6.66E-04	6.66E-04
UPR-200-W-101	6.98E-08	6.96E-08	6.96E-08	6.96E-08	6.98E-08	6.96E-08	6.96E-08	6.96E-08	6.98E-08	6.96E-08	6.96E-08	6.96E-08	7.56E-06	1.30E-05	1.30E-05	1.30E-05
UPR-200-W-102	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07
UPR-200-W-107	8.71E+03	2.18E+04	2.01E+04	1.83E+04	1.37E+04	1.37E+04	1.05E+04	8.80E+03	8.82E+03	8.80E+03	6.57E+03	5.61E+03	5.62E+03	5.61E+03	5.61E+03	5.61E+03
UPR-200-W-115	3.11E-07	3.10E-07	3.10E-07	3.10E-07	3.11E-07	3.10E-07	3.10E-07	3.10E-07	3.11E-07	3.10E-07	3.10E-07	3.10E-07	3.11E-07	3.10E-07	3.10E-07	3.10E-07
UPR-200-W-12	5.28E-09	5.27E-09	5.27E-09	5.27E-09	5.28E-09	5.27E-09	3.55E-07	7.92E-07	7.95E-07	7.92E-07	7.92E-07	7.92E-07	7.95E-07	7.92E-07	1.29E-04	1.37E-04
UPR-200-W-127	3.73E-10	3.72E-10	3.72E-10	3.72E-10	3.73E-10	3.72E-10	3.72E-10	3.72E-10	3.73E-10	3.72E-10	3.72E-10	3.72E-10	3.73E-10	3.72E-10	3.72E-10	3.72E-10
UPR-200-W-128	2.60E-06	2.59E-06	2.59E-06	2.59E-06	2.60E-06	2.59E-06	2.59E-06	2.59E-06	2.60E-06	2.59E-06	2.59E-06	2.59E-06	2.60E-06	8.89E-04	3.39E-01	9.18E-01
UPR-200-W-129	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09
UPR-200-W-13	2.24E-07	2.23E-07	2.23E-07	2.23E-07	2.24E-07	2.23E-07	2.23E-07	1.57E-05	3.51E-05	3.50E-05	3.50E-05	3.50E-05	3.51E-05	3.50E-05	3.50E-05	2.44E-02
UPR-200-W-131	3.34E-09	3.33E-09	3.33E-09	3.33E-09	3.34E-09	3.33E-09	3.33E-09	3.33E-09	3.11E-07	5.37E-07	5.37E-07	5.37E-07	5.38E-07	5.37E-07	5.37E-07	1.53E-05
UPR-200-W-132	1.11E-08	1.10E-08	1.10E-08	1.10E-08	1.11E-08	1.10E-08	1.10E-08	1.10E-08	1.11E-08	1.10E-08	1.10E-08	9.05E-07	2.03E-06	2.03E-06	2.03E-06	2.03E-06
UPR-200-W-135	7.60E-02	8.52E-02	1.57E-01	1.57E-01	1.58E-01	1.32E-01	1.26E-01	1.26E-01	1.27E-01	1.26E-01	9.17E-02	8.45E-02	8.47E-02	8.45E-02	8.45E-02	8.45E-02
UPR-200-W-138	8.63E-11	8.61E-11	8.61E-11	8.61E-11	8.63E-11	8.61E-11	8.61E-11	8.61E-11	8.04E-09	1.39E-08	1.39E-08	1.39E-08	1.39E-08	1.39E-08	1.39E-08	1.18E-06
UPR-200-W-139	2.04E-07	2.03E-07	2.03E-07	2.03E-07	2.04E-07	2.03E-07	2.03E-07	2.03E-07	1.90E-05	3.28E-05	3.28E-05	3.28E-05	3.29E-05	3.28E-05	3.28E-05	4.21E-03
UPR-200-W-14	1.34E-08	1.33E-08	1.33E-08	1.33E-08	1.34E-08	1.33E-08	1.33E-08	9.36E-07	2.10E-06	2.09E-06	2.09E-06	2.09E-06	2.10E-06	2.09E-06	2.09E-06	2.67E-04
UPR-200-W-15	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	1.56E-05	3.51E-05	3.50E-05	3.50E-05	3.50E-05	3.51E-05	3.50E-05	3.50E-05	2.44E-02
UPR-200-W-163	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05
UPR-200-W-19	7.05E-10	7.03E-10	7.03E-10	7.03E-10	7.05E-10	7.03E-10	7.03E-10	7.03E-10	6.56E-08	1.13E-07	1.13E-07	1.13E-07	1.14E-07	1.13E-07	1.13E-07	1.13E-05
UPR-200-W-2	5.36E-09	5.35E-09	2.78E-06	4.67E-06	4.68E-06	4.67E-06	4.67E-06	4.67E-06	4.68E-06	4.67E-06	4.95E-04	5.24E-04	5.26E-04	5.24E-04	5.24E-04	5.24E-04
UPR-200-W-20	9.44E-09	9.41E-09	9.41E-09	9.41E-09	9.44E-09	9.41E-09	9.41E-09	9.41E-09	8.79E-07	1.52E-06	1.52E-06	1.52E-06	1.52E-06	1.52E-06	1.52E-06	1.98E-04
UPR-200-W-21	4.37E-06	4.36E-06	4.36E-06	4.36E-06	4.37E-06	4.36E-06	4.36E-06	4.36E-06	4.07E-04	7.02E-04	7.02E-04	7.02E-04	7.04E-04	7.02E-04	7.02E-04	2.01E-02
UPR-200-W-24	4.66E-06	4.65E-06	4.65E-06	4.65E-06	4.66E-06	4.65E-06	4.65E-06	4.65E-06	4.34E-04	7.48E-04	7.48E-04	7.48E-04	7.50E-04	7.48E-04	7.48E-04	9.79E-02
UPR-200-W-28	8.72E-07	8.70E-07	8.70E-07	8.70E-07	8.72E-07	8.70E-07	8.70E-07	8.70E-07	8.72E-07	8.46E-05	1.46E-04	1.46E-04	1.46E-04	1.46E-04	1.46E-04	1.46E-04
UPR-200-W-29	4.30E-08	4.29E-08	4.29E-08	4.29E-08	6.84E-06	9.83E-06	9.83E-06	9.83E-06	9.85E-06	1.02E-02	1.41E-02	1.41E-02	1.41E-02	1.41E-02	1.41E-02	1.41E-02
UPR-200-W-32	2.98E-03	6.76E-03	6.76E-03	5.30E-02	8.31E-02	8.29E-02	8.29E-02	9.13E-02	1.07E-01	1.06E-01	1.06E-01	1.06E-01	1.07E-01	1.06E-01	7.85E-02	7.83E-02
UPR-200-W-33	1.85E-09	1.84E-09	1.84E-09	1.84E-09	1.85E-09	1.84E-09	1.84E-09	1.84E-09	1.85E-09	1.84E-09	1.46E-07	3.26E-07	3.27E-07	3.26E-07	3.26E-07	3.26E-07
UPR-200-W-35	2.29E-08	3.17E-08	8.09E-05	1.75E-04	1.75E-04	1.75E-04	1.81E-02	1.83E-02	1.84E-02	1.83E-02	1.83E-02	5.28E-02	6.27E-02	6.25E-02	6.25E-02	6.25E-02
UPR-200-W-38	2.09E-06	2.08E-06	2.08E-06	2.08E-06	2.09E-06	2.08E-06	2.08E-06	2.08E-06	2.09E-06	2.08E-06	1.65E-04	3.69E-04	3.70E-04	3.69E-04	3.69E-04	3.69E-04

Site	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
UPR-200-W-39	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.84E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05
UPR-200-W-49	5.16E-08	5.14E-08	5.14E-08	5.14E-08	5.16E-08	5.14E-08	5.14E-08	5.14E-08	5.16E-08	5.14E-08	5.14E-08	5.14E-08	5.16E-08	5.78E-06	9.98E-06	9.98E-06
UPR-200-W-5	5.88E-05	5.87E-05	5.55E-03	5.94E-03	5.95E-03	5.94E-03	5.94E-03	1.10E-02	3.53E-02	3.52E-02	3.52E-02	3.52E-02	3.53E-02	3.52E-02	3.52E-02	3.52E-02
UPR-200-W-51	1.24E-08	1.23E-08	1.23E-08	1.23E-08	1.24E-08	1.23E-08	1.23E-08	1.23E-08	1.24E-08	1.23E-08	1.23E-08	1.23E-08	1.24E-08	1.39E-06	2.39E-06	2.39E-06
UPR-200-W-59	1.24E-05	1.23E-05	1.23E-05	1.23E-05	1.24E-05	1.23E-05	1.23E-05	1.23E-05	1.24E-05	1.23E-05	1.23E-05	1.23E-05	1.24E-05	1.23E-05	1.23E-05	1.23E-05
UPR-200-W-6	7.67E-09	7.65E-09	7.65E-09	7.65E-09	7.67E-09	6.27E-07	1.08E-06	1.08E-06	1.08E-06	1.08E-06	1.08E-06	1.08E-06	2.84E-05	1.85E-04	1.85E-04	1.85E-04
UPR-200-W-61	3.21E-09	3.20E-09	3.20E-09	3.20E-09	3.21E-09	3.20E-09	3.20E-09	3.20E-09	3.21E-09	3.20E-09	3.20E-09	3.20E-09	3.21E-09	3.20E-09	3.20E-09	3.20E-09
UPR-200-W-82	1.39E-10	1.38E-10	1.38E-10	1.38E-10	1.39E-10	1.38E-10	1.38E-10	1.38E-10	1.39E-10	1.38E-10	1.38E-10	1.38E-10	1.39E-10	1.38E-10	1.38E-10	1.38E-10
UPR-200-W-87	3.64E-10	3.63E-10	3.63E-10	3.63E-10	3.64E-10	3.63E-10	3.63E-10	3.63E-10	3.64E-10	3.63E-10	3.63E-10	3.63E-10	3.64E-10	3.63E-10	3.63E-10	3.63E-10
UPR-200-W-95	1.61E-05	1.60E-05	1.60E-05	1.60E-05	1.61E-05	1.60E-05	1.60E-05	1.60E-05	1.61E-05	1.60E-05	1.60E-05	1.60E-05	1.98E-03	2.99E-03	2.99E-03	2.99E-03
UPR-200-W-96	4.74E-08	4.72E-08	4.72E-08	4.72E-08	4.74E-08	4.72E-08	4.72E-08	4.72E-08	4.74E-08	4.72E-08	4.72E-08	4.72E-08	4.74E-08	4.72E-08	4.72E-08	4.72E-08
UPR-200-W-97	3.95E-10	3.93E-10	3.93E-10	3.93E-10	3.95E-10	3.93E-10	3.93E-10	3.93E-10	3.95E-10	3.93E-10	3.93E-10	3.93E-10	3.95E-10	3.93E-10	3.93E-10	3.93E-10
UPR-200-W-98	1.13E-05	1.55E-05	1.55E-05	1.55E-05	1.55E-05	1.55E-05	1.55E-05	2.01E-04	1.29E-03	1.29E-03	1.29E-03	1.29E-03	1.29E-03	1.29E-03	1.29E-03	1.29E-03
UPR-300-4	9.54E+01	9.51E+01	9.07E+01	7.60E+01	7.62E+01	7.60E+01	7.58E+01	5.56E+01	5.58E+01	5.56E+01	5.56E+01	5.56E+01	5.58E+01	4.74E+01	4.36E+01	4.36E+01
US_Ecology	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
216-U-1%2-Fast	8.14E+00	8.12E+00	8.12E+00	8.12E+00	8.14E+00	8.12E+00	8.12E+00	8.12E+00	8.14E+00	8.12E+00	8.12E+00	8.12E+00	8.14E+00	8.12E+00	8.12E+00	8.12E+00
100-B-5	4.46E+00	4.45E+00	4.45E+00	4.45E+00	4.46E+00	4.45E+00	4.45E+00	4.38E+00	4.37E+00	4.36E+00	4.36E+00	4.36E+00	4.37E+00	4.36E+00	4.36E+00	4.36E+00
100-D-3	1.52E+01	1.52E+01	1.53E+01	1.54E+01	1.55E+01	1.54E+01	1.55E+01	1.55E+01	1.55E+01	1.55E+01	1.55E+01	1.55E+01	1.55E+01	1.55E+01	1.55E+01	1.55E+01
100-D-32	3.25E+00	3.37E+00	3.45E+00	3.50E+00	3.54E+00	3.55E+00	3.56E+00	3.57E+00	3.58E+00	3.58E+00	3.58E+00	3.58E+00	3.59E+00	3.58E+00	3.58E+00	3.58E+00
100-D-40	1.77E+00	1.78E+00	1.79E+00	1.80E+00	1.81E+00	1.81E+00	1.81E+00	1.81E+00	1.82E+00	1.81E+00	1.81E+00	1.81E+00	1.82E+00	1.81E+00	1.81E+00	1.81E+00
100-D-47	6.00E+01	6.03E+01	6.07E+01	6.09E+01	6.12E+01	6.11E+01	6.12E+01	6.12E+01	6.14E+01	6.13E+01	6.13E+01	6.13E+01	6.15E+01	6.13E+01	6.13E+01	6.13E+01
100-F-25	1.77E+00	5.31E-01	2.48E-01	1.83E-01	1.34E-01	1.28E-01	9.16E-02	9.16E-02	9.18E-02	8.52E-02	7.77E-02	7.77E-02	7.80E-02	7.77E-02	7.77E-02	7.44E-02
100-H-10	6.13E-02	6.11E-02	6.10E-02	6.10E-02	6.11E-02	6.10E-02	6.10E-02	6.10E-02	6.11E-02	6.10E-02	6.10E-02	6.10E-02	6.11E-02	6.10E-02	6.10E-02	6.10E-02
100-H-5	7.93E+01	7.91E+01	7.91E+01	7.91E+01	7.93E+01	7.91E+01	7.91E+01	7.91E+01	7.93E+01	7.91E+01	7.91E+01	7.91E+01	7.93E+01	7.91E+01	7.91E+01	7.91E+01
100-H-7	2.12E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02
100-H-8	3.10E-02	3.09E-02	3.09E-02	3.08E-02	3.09E-02	3.08E-02	3.08E-02	3.08E-02	3.09E-02	3.08E-02	3.08E-02	3.08E-02	3.09E-02	3.08E-02	3.08E-02	3.08E-02
100-H-9	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02
100-K-2	1.43E+01	1.46E+01	1.48E+01	1.49E+01	1.50E+01	1.50E+01	1.51E+01	1.51E+01	1.51E+01	1.51E+01	1.51E+01	1.51E+01	1.52E+01	1.51E+01	1.51E+01	1.51E+01
100-K-5	3.72E-01	3.26E-01	1.70E-01	1.70E-01	1.28E-01	9.18E-02	9.18E-02	9.18E-02	7.62E-02	6.08E-02	6.08E-02	6.08E-02	6.09E-02	6.08E-02	5.57E-02	4.99E-02
100-N-60	3.00E-01	2.99E-01	2.99E-01	2.99E-01	3.00E-01	2.99E-01	2.99E-01	2.99E-01	3.00E-01	2.99E-01	2.99E-01	2.99E-01	1.81E-01	1.05E-01	5.87E-02	5.37E-02
100-N-66	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
116-B-1	8.25E+01	8.22E+01	8.22E+01	8.22E+01	8.25E+01	8.22E+01	8.13E+01	8.09E+01	8.11E+01	8.09E+01	8.09E+01	8.09E+01	8.11E+01	8.09E+01	8.09E+01	8.09E+01
116-B-2	1.10E+00	1.09E+00	1.09E+00	1.08E+00	1.09E+00	1.08E+00	1.08E+00	1.08E+00	1.09E+00	1.08E+00	1.08E+00	1.08E+00	1.09E+00	1.08E+00	1.08E+00	1.08E+00
116-B-3	3.70E-01	3.69E-01	3.69E-01	3.67E-01	3.66E-01	3.65E-01	3.65E-01	3.65E-01	3.66E-01	3.65E-01	3.65E-01	3.65E-01	3.66E-01	3.65E-01	3.65E-01	3.65E-01
116-B-4	1.55E-01	1.55E-01	1.55E-01	1.55E-01	1.14E-01	1.13E-01	1.13E-01	1.13E-01	1.14E-01	1.13E-01	1.05E-01	9.96E-02	9.99E-02	9.96E-02	9.96E-02	9.96E-02
116-B-5	1.96E+00	1.95E+00	1.44E+00	1.33E+00	1.33E+00	1.33E+00	1.33E+00	1.21E+00	1.11E+00	1.10E+00	1.10E+00	1.10E+00	1.11E+00	1.10E+00	1.10E+00	1.07E+00
116-B-6B	1.23E-01	1.23E-01	1.23E-01	1.23E-01	1.23E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01
116-C-1	5.33E+02	3.61E+02	3.61E+02	3.61E+02	3.44E+02	2.61E+02	2.61E+02	2.61E+02	2.62E+02	2.61E+02	2.61E+02	2.30E+02	2.29E+02	2.28E+02	2.28E+02	2.28E+02
116-C-2A	2.59E+00	2.59E+00	2.21E+00	1.74E+00	1.74E+00	1.74E+00	1.74E+00	1.57E+00	1.42E+00	1.41E+00	1.41E+00	1.41E+00	1.42E+00	1.41E+00	1.40E+00	1.33E+00
116-C-2C	1.04E+00	1.04E+00	1.04E+00	7.05E-01	7.01E-01	6.99E-01	6.99E-01	6.99E-01	6.03E-01	5.75E-01	5.75E-01	5.75E-01	5.76E-01	5.75E-01	5.75E-01	5.75E-01
116-D-1A	1.96E+00	1.95E+00	1.95E+00	1.93E+00	1.89E+00	1.89E+00	1.89E+00	1.89E+00	1.89E+00	1.89E+00	1.89E+00	1.89E+00	1.89E+00	1.89E+00	1.89E+00	1.89E+00
116-D-1B	3.01E+00	2.03E+00	1.98E+00	1.98E+00	1.98E+00	1.98E+00	1.69E+00	1.58E+00	1.59E+00	1.58E+00	1.58E+00	1.58E+00	1.59E+00	1.58E+00	1.48E+00	1.47E+00
116-DR-1%2	2.13E+02	2.13E+02	2.13E+02	2.13E+02	2.07E+02	2.03E+02	2.03E+02	2.03E+02	2.03E+02	2.03E+02	2.03E+02	2.03E+02	2.03E+02	2.03E+02	2.03E+02	2.03E+02
116-DR-3	3.61E+00	3.52E+00	3.52E+00	3.52E+00	3.53E+00	3.52E+00	3.52E+00	3.52E+00	3.53E+00	3.52E+00	3.50E+00	3.45E+00	3.46E+00	3.45E+00	3.45E+00	3.45E+00
116-F-1	4.74E+02	4.35E+02	4.35E+02	4.35E+02	4.36E+02	4.35E+02	4.35E+02	4.29E+02	4.28E+02	4.27E+02	4.27E+02	4.27E+02	4.28E+02	4.27E+02	4.27E+02	4.27E+02
116-F-10	4.70E-02	4.28E-02	4.14E-02	4.14E-02	4.15E-02	4.14E-02	4.14E-02	4.10E-02	4.03E-02	4.02E-02	4.02E-02	4.02E-02	4.03E-02	4.02E-02	4.02E-02	4.02E-02
116-F-11	3.78E-02	3.38E-02	3.32E-02	3.32E-02	3.33E-02	3.32E-02	3.32E-02	3.27E-02	3.23E-02	3.22E-02	3.22E-02	3.22E-02	3.23E-02	3.22E-02	3.22E-02	3.22E-02
116-F-2	2.20E+02	2.20E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02
116-F-3	1.22E+01	1.21E+01	1.21E+01	1.21E+01	1.22E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01
116-F-4	3.69E-01	3.68E-01	3.68E-01	3.68E-01	3.68E-01	3.67E-01	3.67E-01	3.67E-01	3.68E-01	3.67E-01	3.67E-01	3.67E-01	3.68E-01	3.67E-01	3.67E-01	3.67E-01
116-F-6	1.12E+02	1.11E+02	1.11E+02	1.11E+02	1.12E+02	1.11E+02	1.11E+02	1.11E+02	1.12E+02	1.11E+02	1.11E+02	1.11E+02	1.12E+02	1.11E+02	1.11E+02	1.11E+02
116-H-1	4.54E+02	4.53E+02	4.53E+02	4.53E+02	4.54E+02	4.53E+02	4.53E+02	4.53E+02	4.54E+02	4.53E+02	4.53E+02	4.53E+02	4.54E+02	4.53E+02	4.53E+02	4.53E+02
116-H-2	2.69E+01	2.68E+01	2.68E+01	2.68E+01	2.69E+01	2.68E+01	2.68E+01	2.68E+01	2.68E+01	2.68E+01	2.68E+01	2.68E+01	2.68E+01	2.68E+01	2.68E+01	2.68E+01
116-H-3	3.02E-02	3.01E-02	3.01E-02	3.01E-02	3.02E-02	3.01E-02	3.01E-02	3.01E-02	3.01E-02	3.01E-02	3.01E-02	3.01E-02	3.01E-02	3.01E-02	3.01E-02	3.01E-02
116-H-7	8.44E+02	8.36E+02	8.36E+02	8.36E+02	8.38E+02	8.36E+02	8.36E+02	8.35E+02	8.37E+02	8.35E+02	8.35E+02	8.35E+02	8.37E+02	8.35E+02	8.35E+02	8.35E+02
116-K-2	7.19E+03	7.17E+03	6.01E+03	5.04E+03	5.06E+03	5.04E+03	4.78E+03	4.10E+03	4.11E+03	4.10E+03	4.10E+03	4.10E+03	4.11E+03	3.81E+03	3.77E+03	3.77E+03

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
116-KE-1	5.03E+00	5.02E+00	4.47E+00	3.04E+00	3.05E+00	3.04E+00	2.96E+00	2.19E+00	2.20E+00	2.19E+00	2.19E+00	2.19E+00	2.20E+00	1.95E+00	1.89E+00	1.89E+00
116-KE-2	1.58E+00	1.36E+00	8.30E-01	8.30E-01	8.32E-01	6.13E-01	5.26E-01	5.26E-01	5.28E-01	5.26E-01	4.85E-01	4.13E-01	4.14E-01	4.13E-01	4.13E-01	4.13E-01
116-KE-3	3.64E+03	3.63E+03	3.65E+03	3.70E+03	3.71E+03	3.70E+03	3.70E+03	3.72E+03	3.73E+03	3.72E+03	3.72E+03	3.72E+03	3.73E+03	3.73E+03	3.73E+03	3.73E+03
116-KW-2	8.21E+02	8.25E+02	8.40E+02	8.40E+02	8.43E+02	8.41E+02	8.49E+02	8.49E+02	8.51E+02	8.49E+02	8.49E+02	8.49E+02	8.54E+02	8.52E+02	8.52E+02	8.52E+02
116-N-1	3.65E+06	3.64E+06	3.64E+06	3.63E+06	3.65E+06	3.64E+06	3.64E+06	3.63E+06	3.65E+06	3.63E+06	1.56E+05	1.91E+04	8.75E+03	5.22E+03	4.51E+03	3.11E+03
116-N-3	4.72E-10	4.71E-10	4.71E-10	4.71E-10	4.72E-10	4.71E-10	4.71E-10	8.05E+05	8.47E+05	8.44E+05	8.44E+05	8.42E+05	8.47E+05	8.44E+05	8.44E+05	8.42E+05
116-N-4	1.70E+02	1.70E+02	1.67E+02	1.56E+02	1.56E+02	1.56E+02	1.56E+02	1.56E+02	1.56E+02	1.56E+02	1.53E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02
118-B-6	2.16E-01	2.15E-01	2.15E-01	2.15E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01
118-B-7	9.41E-02	9.40E-02	9.41E-02	9.42E-02	9.45E-02	9.42E-02	9.42E-02	9.43E-02	9.45E-02	9.43E-02	9.43E-02	9.43E-02	9.45E-02	9.43E-02	9.43E-02	9.43E-02
118-B-8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-C-1	2.91E+02	2.92E+02	2.92E+02	2.93E+02	2.94E+02	2.93E+02	2.93E+02	2.93E+02	2.94E+02	2.93E+02	2.93E+02	2.93E+02	2.94E+02	2.93E+02	2.93E+02	2.94E+02
118-C-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-C-4	1.44E+00	1.43E+00	1.43E+00	1.43E+00	1.44E+00	1.43E+00	1.43E+00	1.43E+00	1.44E+00	1.43E+00	1.43E+00	1.43E+00	1.44E+00	1.43E+00	1.43E+00	1.43E+00
118-D-2	5.17E+02	5.17E+02	5.17E+02	5.17E+02	5.19E+02	5.18E+02	5.18E+02	5.18E+02	5.19E+02	5.18E+02	5.18E+02	5.18E+02	5.19E+02	5.18E+02	5.18E+02	5.18E+02
118-D-3	3.26E+02	3.38E+02	3.46E+02	3.51E+02	3.55E+02	3.56E+02	3.57E+02	3.58E+02	3.60E+02	3.59E+02	3.59E+02	3.59E+02	3.61E+02	3.60E+02	3.60E+02	3.60E+02
118-D-4	1.69E+02	1.70E+02	1.71E+02	1.72E+02	1.72E+02	1.72E+02	1.72E+02	1.73E+02	1.73E+02	1.73E+02	1.73E+02	1.73E+02	1.73E+02	1.73E+02	1.73E+02	1.73E+02
118-DR-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-F-1	1.12E+02	1.11E+02	1.11E+02	1.11E+02	1.12E+02	1.11E+02	1.11E+02	1.11E+02	1.12E+02	1.11E+02	1.11E+02	1.11E+02	1.12E+02	1.11E+02	1.11E+02	1.11E+02
118-F-4	3.69E-01	3.68E-01	3.68E-01	3.68E-01	3.69E-01	3.68E-01	3.68E-01	3.68E-01	3.69E-01	3.68E-01	3.68E-01	3.68E-01	3.69E-01	3.68E-01	3.68E-01	3.68E-01
118-F-8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-H-1	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03
118-H-6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-K-1	1.01E+03	1.02E+03	1.03E+03	1.03E+03	1.03E+03	1.03E+03	1.03E+03	1.03E+03	1.04E+03	1.04E+03	1.04E+03	1.04E+03	1.04E+03	1.04E+03	1.04E+03	1.04E+03
118-KE-1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-KW-1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-KW-2	1.43E+00	1.43E+00	1.43E+00	1.43E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00
200-E-100	4.40E+00	4.39E+00	4.39E+00	4.38E+00	4.40E+00	4.38E+00	4.39E+00	4.38E+00	4.40E+00	4.39E+00	4.39E+00	4.38E+00	4.39E+00	4.39E+00	4.39E+00	4.38E+00
200-E-102	3.84E+00	3.82E+00	3.82E+00	3.82E+00	3.84E+00	3.82E+00	3.82E+00	2.56E+00	2.56E+00	2.56E+00	2.56E+00	2.56E+00	2.56E+00	2.56E+00	2.56E+00	2.56E+00
200-E-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-25	3.67E+00	3.66E+00	3.66E+00	3.65E+00	3.67E+00	3.66E+00	3.66E+00	3.65E+00	3.67E+00	3.66E+00	3.66E+00	3.65E+00	3.67E+00	3.66E+00	3.66E+00	2.92E+00
200-E-28	2.70E-10	2.69E-10	2.69E-10	2.69E-10	2.70E-10	2.69E-10	2.69E-10	2.69E-10	2.70E-10	2.69E-10	2.69E-10	2.69E-10	2.70E-10	2.69E-10	2.64E+02	1.65E+02
200-E-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-54	4.57E-07	4.56E-07	4.56E-07	4.56E-07	4.57E-07	4.56E-07	4.56E-07	4.56E-07	4.57E-07	4.56E-07	4.56E-07	4.56E-07	4.57E-07	4.56E-07	4.56E-07	2.08E-01
200-E-55	4.50E+00	4.49E+00	4.49E+00	4.49E+00	4.50E+00	4.49E+00	4.49E+00	4.49E+00	4.50E+00	4.49E+00	4.49E+00	4.49E+00	4.50E+00	4.49E+00	4.49E+00	4.49E+00
200-E-56	8.72E-01	8.69E-01	8.69E-01	8.69E-01	8.72E-01	7.49E-01	6.16E-01	6.16E-01	6.17E-01	6.16E-01	6.16E-01	6.16E-01	6.17E-01	6.16E-01	6.16E-01	6.16E-01
200-E-57	6.12E-01	6.10E-01	5.57E-01	3.97E-01	3.98E-01	3.97E-01	3.97E-01	3.97E-01	3.98E-01	3.97E-01	3.97E-01	3.97E-01	3.98E-01	3.17E-01	3.04E-01	3.04E-01
200-E-60	4.09E-13	4.08E-13	2.25E+00	6.76E-01	3.54E-01	2.19E-01	1.76E-01	1.31E-01	1.24E-01	8.58E-02	8.58E-02	8.58E-02	6.79E-02	6.27E-02	6.27E-02	6.27E-02
200-E-61	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-62	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
200-E-64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-65	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07
200-E-67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-68	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07
200-E-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-70	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05
200-E-71	2.64E-05	2.63E-05	2.63E-05	2.63E-05	2.64E-05	2.63E-05	2.63E-05	2.63E-05	2.64E-05	2.63E-05	2.63E-05	2.63E-05	2.64E-05	2.63E-05	2.63E-05	2.63E-05
200-E-72	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05
200-E-73	5.86E-07	5.84E-07	5.84E-07	5.84E-07	5.86E-07	5.84E-07	5.84E-07	5.84E-07	5.86E-07	5.84E-07	5.84E-07	5.84E-07	5.86E-07	5.84E-07	5.84E-07	5.84E-07
200-E-74	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05
200-E-75	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05
200-E-76	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-77	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-80	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-81	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-84	9.44E-07	9.42E-07	9.42E-07	9.42E-07	9.44E-07	9.42E-07	9.42E-07	9.42E-07	9.44E-07	9.42E-07	9.42E-07	9.42E-07	9.44E-07	9.42E-07	9.42E-07	9.42E-07
200-E-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-88	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	1.47E-01	1.00E+01	1.17E+02
200-E-89	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	1.01E-03	2.13E-01	1.12E+01	9.51E+01
200-E-90	8.26E-04	8.23E-04	8.23E-04	8.23E-04	8.26E-04	8.23E-04	8.23E-04	8.23E-04	8.26E-04	8.23E-04	8.23E-04	8.23E-04	8.26E-04	1.78E-01	1.04E+01	1.03E+02
200-E-91	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	2.29E-05	8.17E-03	1.33E+00	2.30E+01	7.51E+01
200-E-92	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	3.72E-01	1.47E+01	8.41E+01
200-E-93	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	2.19E-01	1.14E+01	9.42E+01
200-E-94	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	6.53E-04	6.53E-04	6.53E-04	6.55E-04	1.47E-01	1.00E+01	1.17E+02
200-E-95	4.40E+00	4.38E+00	4.38E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00
200-E-97	4.39E+00	4.38E+00	4.38E+00	4.37E+00	4.40E+00	4.38E+00	4.38E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00	4.40E+00	4.39E+00	4.39E+00	4.37E+00
200-E-98	3.70E+00	3.69E+00	3.69E+00	3.69E+00	3.70E+00	3.69E+00	3.69E+00	3.69E+00	3.70E+00	3.69E+00	3.69E+00	3.69E+00	3.70E+00	3.69E+00	3.69E+00	3.69E+00
200-E-99	4.43E+00	4.42E+00	4.42E+00	4.42E+00	4.42E+00	4.42E+00	4.42E+00	4.42E+00	4.43E+00	4.42E+00	4.42E+00	4.41E+00	4.43E+00	4.42E+00	4.42E+00	4.41E+00
200-W-22	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	9.29E-05	7.01E-04
200-W-42	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05
200-W-52	6.32E+01	6.30E+01	5.79E+01	4.12E+01	4.13E+01	4.12E+01	4.12E+01	4.12E+01	4.13E+01	4.12E+01	4.12E+01	4.12E+01	4.13E+01	4.12E+01	4.01E+01	3.39E+01
200-W-9	1.66E-11	1.65E-11	1.65E-11	1.65E-11	1.66E-11	1.65E-11	1.65E-11	1.65E-11	1.66E-11	1.65E-11	1.65E-11	1.65E-11	1.66E-11	1.65E-11	1.65E-11	1.65E-11
2101-M-POND	2.60E+04	2.60E+04	2.60E+04	2.59E+04	2.60E+04	2.60E+04	2.60E+04	2.59E+04	2.60E+04	2.60E+04	2.60E+04	2.59E+04	2.60E+04	2.60E+04	2.60E+04	2.59E+04
216-A-10	5.11E+03	3.98E+03	2.88E+03	2.25E+03	1.86E+03	1.63E+03	1.39E+03	1.20E+03	6.52E+04	1.03E+05	8.04E+04	3.69E+04	1.51E+04	8.53E+03	5.92E+03	3.53E+03
216-A-11	3.42E-01	3.41E-01	1.85E-01	1.78E-01	1.78E-01	1.11E-01	9.66E-02	9.66E-02	9.69E-02	9.23E-02	5.49E-02	5.49E-02	5.51E-02	5.49E-02	5.49E-02	5.49E-02
216-A-12	4.43E-01	2.59E-01	2.59E-01	1.71E-01	1.34E-01	1.34E-01	1.34E-01	8.59E-02	7.30E-02	7.28E-02	7.28E-02	7.28E-02	7.30E-02	4.50E-02	4.21E-02	4.21E-02
216-A-13	1.07E-01	6.77E-02	6.77E-02	6.77E-02	6.79E-02	6.77E-02	6.77E-02	6.77E-02	4.89E-02	4.34E-02	4.34E-02	4.34E-02	4.35E-02	4.34E-02	4.34E-02	4.34E-02
216-A-14	6.90E-07	6.88E-07	6.88E-07	6.88E-07	6.90E-07	6.88E-07	6.88E-07	6.88E-07	1.02E-04	1.19E-04	1.19E-04	1.19E-04	1.19E-04	1.19E-04	9.82E-03	1.21E-02

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
216-A-15	5.16E+00	3.96E+00	3.11E+00	2.66E+00	1.89E+00	1.88E+00	1.84E+00	1.14E+00	1.15E+00	1.14E+00	1.14E+00	1.11E+00	7.14E-01	7.12E-01	7.12E-01	7.12E-01
216-A-16	3.43E-01	3.42E-01	3.42E-01	1.92E-01	1.88E-01	1.87E-01	1.87E-01	1.87E-01	1.26E-01	1.08E-01	1.08E-01	1.08E-01	1.08E-01	1.08E-01	1.08E-01	1.08E-01
216-A-17	4.55E-01	2.55E-01	2.55E-01	2.55E-01	2.56E-01	1.65E-01	1.42E-01	1.42E-01	1.43E-01	1.42E-01	1.42E-01	1.22E-01	8.47E-02	8.45E-02	8.45E-02	8.45E-02
216-A-2	4.08E+00	3.28E+00	3.28E+00	3.28E+00	3.29E+00	3.28E+00	3.28E+00	2.38E+00	2.34E+00	2.33E+00	2.33E+00	2.33E+00	2.34E+00	2.33E+00	2.33E+00	2.33E+00
216-A-20	4.65E+00	4.64E+00	4.64E+00	4.64E+00	4.65E+00	4.64E+00	4.59E+00	3.29E+00	3.30E+00	3.29E+00	3.29E+00	3.29E+00	3.30E+00	3.29E+00	3.29E+00	3.29E+00
216-A-21	5.46E+01	5.44E+01	4.10E+01	3.25E+01	3.26E+01	3.25E+01	3.25E+01	3.25E+01	2.95E+01	2.04E+01	2.04E+01	2.04E+01	2.05E+01	2.04E+01	2.04E+01	2.04E+01
216-A-22	2.07E-04	2.06E-04	2.06E-04	2.06E-04	2.07E-04	2.06E-04	2.06E-04	2.06E-04	2.07E-04	2.06E-04	2.06E-04	2.06E-04	2.07E-04	2.06E-04	2.06E-04	2.06E-04
216-A-23A	3.23E-05	3.22E-05	3.22E-05	3.63E-03	7.07E-03	5.79E-02	7.67E-02	7.67E-02	8.63E-02	8.82E-02	8.82E-02	8.82E-02	8.01E-02	6.87E-02	6.87E-02	6.87E-02
216-A-23B	3.55E-05	3.54E-05	3.54E-05	3.99E-03	7.77E-03	5.89E-02	7.78E-02	7.78E-02	8.65E-02	8.83E-02	8.83E-02	8.83E-02	8.00E-02	6.86E-02	6.86E-02	6.86E-02
216-A-24	1.34E+03	1.16E+03	1.01E+03	8.79E+02	7.89E+02	6.68E+02	6.49E+02	5.35E+02	5.36E+02	4.96E+02	4.18E+02	4.18E+02	4.19E+02	4.01E+02	3.23E+02	3.23E+02
216-A-25	3.85E+06	8.85E+06	1.10E+07	1.13E+07	8.91E+06	5.15E+06	5.79E+06	1.35E+07	2.24E+07	1.79E+07	8.82E+05	7.48E+04	3.61E+04	2.44E+04	1.99E+04	1.76E+04
216-A-26	2.14E-06	2.13E-06	2.13E-06	2.13E-06	2.14E-06	2.13E-06	2.13E-06	2.13E-06	2.14E-06	2.13E-06	2.13E-06	2.13E-06	2.14E-06	2.13E-06	2.13E-06	2.13E-06
216-A-26A	2.18E-06	2.17E-06	2.17E-06	2.17E-06	2.18E-06	2.17E-06	2.17E-06	2.17E-06	2.18E-06	2.17E-06	2.17E-06	2.17E-06	2.18E-06	2.17E-06	2.17E-06	2.17E-06
216-A-27	9.96E+01	8.77E+01	5.28E+01	5.28E+01	5.30E+01	5.19E+01	2.93E+01	2.93E+01	2.93E+01	2.93E+01	2.93E+01	2.93E+01	2.06E+01	1.72E+01	1.72E+01	1.72E+01
216-A-28	1.27E-03	1.26E-03	1.26E-03	1.26E-03	1.27E-03	1.26E-03	1.26E-03	1.26E-03	1.27E-03	1.26E-03	1.26E-03	1.26E-03	1.27E-03	1.26E-03	1.26E-03	1.26E-03
216-A-3	8.12E+00	7.14E+00	6.27E+00	6.99E+00	2.39E+01	4.15E+01	3.73E+01	3.02E+01	2.17E+01	2.05E+01	1.35E+01	1.35E+01	1.21E+01	8.32E+00	8.32E+00	8.32E+00
216-A-30	5.72E+04	4.07E+04	6.31E+04	1.26E+05	1.36E+05	1.19E+05	1.39E+05	1.84E+05	3.16E+05	5.71E+05	5.52E+05	4.41E+05	3.20E+05	2.96E+05	2.80E+05	2.18E+05
216-A-31	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-35	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-36A	1.28E-02	1.27E-02	1.27E-02	1.27E-02	1.28E-02	1.27E-02	1.27E-02	1.27E-02	1.28E-02	1.27E-02	1.27E-02	1.27E-02	1.28E-02	1.27E-02	1.27E-02	1.27E-02
216-A-36B	4.19E+03	3.07E+03	2.38E+03	1.91E+03	1.59E+03	1.34E+03	1.18E+03	1.00E+03	8.73E+02	7.51E+02	6.91E+02	6.12E+02	6.03E+02	5.11E+02	5.11E+02	5.11E+02
216-A-37-1	2.41E-05	3.15E+03	2.00E+04	1.96E+04	2.86E+04	1.37E+04	1.34E+04	1.45E+04	4.91E+04	4.94E+04	5.03E+04	2.43E+04	4.66E+04	1.78E+04	5.69E+03	2.66E+03
216-A-37-2	4.32E-03	4.31E-03	4.31E-03	4.31E-03	4.32E-03	4.31E-03	4.31E-03	4.31E-03	3.87E+04	2.31E+05	2.55E+05	1.97E+05	1.28E+05	1.69E+05	1.15E+05	9.23E+04
216-A-39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-4	3.68E+00	3.67E+00	3.67E+00	3.67E+00	3.68E+00	3.67E+00	2.51E+00	2.44E+00	2.45E+00	2.44E+00	2.44E+00	2.44E+00	2.45E+00	2.44E+00	2.44E+00	2.44E+00
216-A-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-45	4.36E-03	4.35E-03	4.35E-03	4.35E-03	4.36E-03	4.35E-03	4.35E-03	4.35E-03	4.36E-03	4.35E-03	4.35E-03	9.35E+03	4.92E+04	1.86E+04	6.64E+03	3.61E+03
216-A-5	7.90E+02	7.14E+02	7.14E+02	7.14E+02	7.16E+02	5.84E+02	4.97E+02	4.97E+02	4.98E+02	4.97E+02	4.97E+02	4.97E+02	4.98E+02	3.58E+02	3.50E+02	3.50E+02
216-A-6	4.54E+03	3.87E+03	2.54E+03	2.54E+03	2.55E+03	2.36E+03	1.47E+03	1.47E+03	1.47E+03	1.47E+03	1.47E+03	1.47E+03	9.31E+02	8.93E+02	8.93E+02	8.93E+02
216-A-7	2.24E+00	1.58E+00	1.58E+00	1.58E+00	1.59E+00	1.29E+00	9.65E-01	9.65E-01	9.67E-01	9.65E-01	9.65E-01	9.65E-01	9.41E-01	6.31E-01	6.31E-01	6.31E-01
216-A-8	9.66E+03	7.64E+03	5.84E+03	4.51E+03	3.57E+03	2.89E+03	2.39E+03	2.10E+03	1.79E+03	1.51E+03	1.29E+03	1.15E+03	9.74E+02	9.45E+02	7.71E+02	7.71E+02
216-A-9	9.75E+02	8.27E+02	7.34E+02	7.34E+02	7.36E+02	7.34E+02	6.55E+02	5.62E+02	5.63E+02	5.62E+02	5.62E+02	5.62E+02	5.63E+02	5.62E+02	4.90E+02	4.65E+02
216-B-10A	2.59E+01	2.58E+01	2.58E+01	2.58E+01	2.59E+01	2.58E+01	2.58E+01	2.58E+01	2.59E+01	2.00E+01	1.79E+01	1.79E+01	1.79E+01	1.79E+01	1.79E+01	1.79E+01
216-B-10B	2.05E-05	2.05E-05	3.46E-03	5.56E-03	5.84E-01	6.86E-01	6.87E-01	1.21E+00	1.21E+00	1.21E+00	1.21E+00	9.89E-01	9.12E-01	9.09E-01	9.09E-01	9.09E-01
216-B-11A%B	8.31E+00	5.18E+00	5.14E+00	5.14E+00	5.15E+00	5.14E+00	5.14E+00	5.14E+00	5.15E+00	5.14E+00	5.14E+00	5.14E+00	3.97E+00	3.74E+00	3.74E+00	3.74E+00
216-B-12	7.90E+02	5.13E+02	3.87E+02	2.67E+02	2.20E+02	2.20E+02	1.35E+02	1.27E+02	1.27E+02	1.27E+02	8.96E+01	7.41E+01	7.43E+01	7.41E+01	7.41E+01	7.41E+01
216-B-13	6.91E-01	6.56E-01	5.54E-01	4.66E-01	3.28E-01	3.20E-01	2.03E-01	2.03E-01	2.04E-01	1.22E-01	1.21E-01	1.21E-01	1.21E-01	1.03E-01	7.16E-02	7.16E-02
216-B-14	2.39E+02	2.38E+02	2.38E+02	2.40E+02	2.56E+02	2.63E+02	2.70E+02	2.70E+02	2.69E+02	2.66E+02	2.62E+02	2.61E+02	2.61E+02	2.49E+02	2.49E+02	2.49E+02
216-B-15	1.33E+01	5.21E+01	7.76E+01	7.76E+01	7.78E+01	9.24E+01	1.37E+02	1.80E+02	2.09E+02	2.27E+02	2.39E+02	2.45E+02	2.46E+02	2.44E+02	2.44E+02	2.44E+02

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
216-B-16	8.46E+00	8.44E+00	8.44E+00	2.04E+01	2.23E+01	2.83E+01	5.29E+01	9.54E+01	1.40E+02	1.73E+02	2.07E+02	2.22E+02	2.23E+02	2.38E+02	2.38E+02	2.38E+02
216-B-17	1.93E-03	1.92E-03	1.92E-03	1.92E-03	1.93E-03	1.92E-03	1.92E-03	1.92E-03	8.30E-02	3.53E-01	8.12E+00	1.18E+01	1.31E+01	8.13E+01	8.13E+01	8.13E+01
216-B-18	2.15E+02	2.14E+02	2.14E+02	2.44E+02	2.48E+02	2.57E+02	2.66E+02	2.68E+02	2.67E+02	2.65E+02	2.62E+02	2.60E+02	2.61E+02	2.49E+02	2.49E+02	2.49E+02
216-B-19	5.68E+00	4.28E+01	5.31E+01	5.31E+01	5.32E+01	6.35E+01	1.00E+02	1.45E+02	1.83E+02	2.08E+02	2.28E+02	2.38E+02	2.38E+02	2.42E+02	2.42E+02	2.42E+02
216-B-20	3.04E+00	5.17E+01	5.17E+01	5.17E+01	5.25E+01	7.68E+01	9.76E+01	1.60E+02	2.22E+02	2.66E+02	2.96E+02	3.16E+02	3.27E+02	3.26E+02	3.03E+02	3.03E+02
216-B-21	3.08E+00	5.19E+01	5.19E+01	5.19E+01	5.28E+01	7.71E+01	9.79E+01	1.60E+02	2.22E+02	2.66E+02	2.96E+02	3.16E+02	3.26E+02	3.25E+02	3.02E+02	3.02E+02
216-B-22	3.72E+00	5.70E+01	5.70E+01	5.70E+01	5.78E+01	8.39E+01	1.06E+02	1.69E+02	2.28E+02	2.70E+02	2.98E+02	3.17E+02	3.27E+02	3.26E+02	3.03E+02	3.03E+02
216-B-23	6.86E-04	1.35E+00	1.63E+01	4.73E+01	1.14E+02	1.18E+02	1.67E+02	2.39E+02	2.92E+02	3.24E+02	3.45E+02	3.49E+02	3.51E+02	3.50E+02	3.08E+02	3.08E+02
216-B-24	1.04E+01	3.24E+01	9.30E+01	1.17E+02	1.84E+02	1.84E+02	2.09E+02	2.55E+02	2.93E+02	3.20E+02	3.38E+02	3.44E+02	3.47E+02	3.46E+02	3.06E+02	3.06E+02
216-B-25	1.10E+01	6.44E+01	7.75E+01	1.72E+02	1.72E+02	1.76E+02	2.11E+02	2.55E+02	2.91E+02	3.17E+02	3.35E+02	3.42E+02	3.46E+02	3.44E+02	3.06E+02	3.06E+02
216-B-26	2.85E+02	3.10E+02	3.62E+02	3.68E+02	3.69E+02	3.76E+02	3.79E+02	3.81E+02	3.82E+02	3.80E+02	3.79E+02	3.67E+02	3.62E+02	3.60E+02	3.10E+02	3.10E+02
216-B-27	8.58E-05	8.56E-05	7.47E-02	4.22E+00	3.45E+01	5.42E+01	1.05E+02	2.06E+02	2.82E+02	3.24E+02	3.47E+02	3.51E+02	3.53E+02	3.51E+02	3.08E+02	3.08E+02
216-B-28	8.53E+00	2.86E+01	8.78E+01	1.12E+02	1.82E+02	1.81E+02	2.08E+02	2.55E+02	2.93E+02	3.20E+02	3.39E+02	3.44E+02	3.47E+02	3.46E+02	3.06E+02	3.06E+02
216-B-29	1.17E-03	8.71E-02	3.93E+00	1.85E+01	5.89E+01	6.19E+01	1.01E+02	1.83E+02	2.53E+02	2.99E+02	3.28E+02	3.41E+02	3.48E+02	3.46E+02	3.12E+02	3.12E+02
216-B-3	3.29E+06	3.10E+06	3.60E+06	3.48E+06	3.46E+06	4.99E+06	5.05E+06	5.95E+06	5.44E+06	4.87E+06	1.96E+07	2.16E+07	2.60E+07	1.53E+07	9.83E+06	8.71E+06
216-B-30	2.27E-03	2.26E-03	5.22E-01	1.06E+01	4.51E+01	6.10E+01	8.91E+01	1.73E+02	2.48E+02	2.97E+02	3.28E+02	3.41E+02	3.48E+02	3.47E+02	3.13E+02	3.13E+02
216-B-31	1.43E-03	1.13E-01	4.46E+00	2.05E+01	6.13E+01	6.49E+01	1.05E+02	1.87E+02	2.55E+02	3.00E+02	3.29E+02	3.41E+02	3.48E+02	3.46E+02	3.12E+02	3.12E+02
216-B-32	3.38E-05	5.48E-03	2.45E+00	2.08E+01	3.75E+01	4.98E+01	8.60E+01	1.71E+02	2.46E+02	2.95E+02	3.26E+02	3.40E+02	3.47E+02	3.46E+02	3.12E+02	3.12E+02
216-B-33	4.55E-04	1.79E-02	2.09E+00	1.07E+01	4.92E+01	5.07E+01	8.39E+01	1.68E+02	2.45E+02	2.95E+02	3.26E+02	3.40E+02	3.47E+02	3.46E+02	3.12E+02	3.12E+02
216-B-34	1.05E-01	4.86E+00	3.66E+01	9.48E+01	1.24E+02	1.53E+02	1.94E+02	2.51E+02	2.97E+02	3.26E+02	3.45E+02	3.48E+02	3.51E+02	3.49E+02	3.07E+02	3.07E+02
216-B-35	7.70E+00	7.68E+00	7.68E+00	7.68E+00	7.70E+00	7.68E+00	7.68E+00	7.68E+00	5.76E+00	5.26E+00	5.26E+00	5.26E+00	5.28E+00	5.26E+00	5.26E+00	5.26E+00
216-B-36	8.17E+00	8.14E+00	8.14E+00	8.14E+00	8.17E+00	8.14E+00	8.14E+00	7.42E+00	5.46E+00	5.45E+00	5.45E+00	5.45E+00	5.46E+00	5.45E+00	5.45E+00	5.45E+00
216-B-37	1.12E+01	1.12E+01	7.46E+00	6.95E+00	6.97E+00	6.95E+00	6.95E+00	6.95E+00	6.97E+00	6.95E+00	6.95E+00	6.95E+00	6.97E+00	6.76E+00	5.29E+00	5.29E+00
216-B-38	1.02E+01	7.00E+00	7.00E+00	7.00E+00	7.02E+00	7.00E+00	7.00E+00	7.00E+00	7.02E+00	7.00E+00	7.00E+00	6.13E+00	5.12E+00	5.11E+00	5.11E+00	5.11E+00
216-B-39	8.92E+00	8.90E+00	8.90E+00	8.90E+00	8.92E+00	6.80E+00	5.86E+00	5.86E+00	5.87E+00	5.86E+00	5.86E+00	5.86E+00	5.87E+00	5.86E+00	5.86E+00	5.86E+00
216-B-4	1.14E-02	4.37E-02	4.37E-02	4.37E-02	4.38E-02	4.37E-02	4.37E-02	4.37E-02	4.38E-02	4.37E-02	4.37E-02	4.37E-02	4.38E-02	4.37E-02	4.37E-02	1.10E-01
216-B-40	7.42E+00	7.40E+00	7.40E+00	7.40E+00	7.42E+00	7.40E+00	7.40E+00	7.40E+00	7.42E+00	7.39E+00	5.17E+00	5.17E+00	5.19E+00	5.17E+00	5.17E+00	5.17E+00
216-B-41	9.66E+00	9.64E+00	9.64E+00	6.98E+00	6.30E+00	6.28E+00	6.28E+00	6.28E+00	6.30E+00	6.28E+00	6.28E+00	6.28E+00	6.30E+00	6.28E+00	6.28E+00	5.16E+00
216-B-42	8.89E+00	7.10E+00	7.10E+00	7.10E+00	7.12E+00	7.10E+00	7.10E+00	7.10E+00	7.12E+00	7.10E+00	7.08E+00	5.11E+00	5.12E+00	5.11E+00	5.11E+00	5.11E+00
216-B-43	1.94E+01	1.94E+01	1.94E+01	1.94E+01	1.77E+01	1.30E+01	1.30E+01	1.30E+01	1.30E+01	1.30E+01	1.30E+01	1.30E+01	1.30E+01	1.30E+01	1.30E+01	1.30E+01
216-B-44	2.27E+01	2.26E+01	2.26E+01	2.26E+01	2.23E+01	1.43E+01	1.43E+01	1.43E+01	1.43E+01	1.43E+01	1.43E+01	1.43E+01	1.43E+01	1.43E+01	1.43E+01	1.43E+01
216-B-45	2.40E+01	2.39E+01	2.25E+01	1.52E+01	1.52E+01	1.52E+01	1.52E+01	1.52E+01	1.52E+01	1.52E+01	1.52E+01	1.52E+01	1.52E+01	1.52E+01	1.26E+01	1.17E+01
216-B-46	2.39E+01	1.72E+01	1.72E+01	1.72E+01	1.72E+01	1.72E+01	1.72E+01	1.72E+01	1.72E+01	1.72E+01	1.72E+01	1.22E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01
216-B-47	1.89E+01	1.88E+01	1.88E+01	1.88E+01	1.89E+01	1.88E+01	1.88E+01	1.58E+01	1.26E+01	1.25E+01	1.25E+01	1.25E+01	1.26E+01	1.25E+01	1.25E+01	1.25E+01
216-B-48	2.31E+01	2.30E+01	2.30E+01	1.70E+01	1.48E+01	1.48E+01	1.48E+01	1.48E+01	1.48E+01	1.48E+01	1.48E+01	1.48E+01	1.48E+01	1.48E+01	1.42E+01	1.16E+01
216-B-49	2.39E+01	2.38E+01	2.38E+01	1.76E+01	1.51E+01	1.51E+01	1.51E+01	1.51E+01	1.51E+01	1.51E+01	1.51E+01	1.51E+01	1.51E+01	1.51E+01	1.51E+01	1.18E+01
216-B-5	1.35E-02	1.08E-02	1.07E-02	1.07E-02	1.07E-02	1.07E-02	1.07E-02	1.07E-02	1.07E-02	1.07E-02	1.07E-02	1.07E-02	1.07E-02	1.07E-02	1.07E-02	1.55E-02
216-B-50	3.30E+02	1.96E+02	1.81E+02	1.06E+02	1.06E+02	9.30E+01	6.02E+01	6.02E+01	6.04E+01	5.78E+01	3.48E+01	3.48E+01	3.49E+01	3.48E+01	3.48E+01	3.48E+01
216-B-51	9.87E-07	9.84E-07	3.61E-04	6.10E-04	6.11E-04	6.10E-04	6.10E-04	6.10E-04	6.11E-04	6.10E-04	6.10E-04	1.07E-03	1.01E-02	1.01E-02	1.01E-02	1.01E-02
216-B-52	3.03E+02	3.02E+02	3.02E+02	3.02E+02	3.03E+02	3.05E+02	3.08E+02	3.21E+02	3.41E+02	3.61E+02	3.77E+02	3.85E+02	3.90E+02	3.89E+02	3.50E+02	3.50E+02
216-B-53A	3.75E-05	3.74E-05	3.74E-05	3.74E-05	3.75E-05	3.74E-05	3.74E-05	3.74E-05	3.75E-05	2.73E-01	4.56E+00	1.36E+01	2.57E+01	3.10E+01	3.66E+01	3.66E+01

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
216-B-53B	3.31E-04	3.30E-04	3.30E-04	3.30E-04	3.31E-04	3.30E-04	3.30E-04	3.30E-04	3.31E-04	3.30E-04	3.30E-04	3.30E-04	3.31E-04	3.30E-04	3.30E-04	3.30E-04
216-B-54	4.62E-04	4.61E-04	4.61E-04	4.61E-04	4.62E-04	4.61E-04	4.61E-04	4.61E-04	4.62E-04	4.61E-04	4.61E-04	4.61E-04	4.62E-04	3.97E-02	3.35E+00	3.01E+01
216-B-55	5.76E+04	6.25E+04	6.65E+04	6.93E+04	4.31E+04	4.09E+04	2.35E+04	3.58E+04	3.47E+04	1.40E+04	6.76E+03	3.48E+03	2.19E+03	1.62E+03	1.41E+03	1.01E+03
216-B-57	2.87E+03	2.64E+03	1.53E+03	1.53E+03	1.34E+03	8.54E+02	8.54E+02	8.54E+02	8.21E+02	4.83E+02	4.83E+02	4.83E+02	4.84E+02	4.83E+02	4.83E+02	4.04E+02
216-B-58	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04	1.89E-04
216-B-59	9.48E-07	9.45E-07	9.45E-07	9.45E-07	9.48E-07	2.82E-05	7.39E-05	7.39E-05	7.41E-05	7.39E-05	8.53E-02	1.52E-01	1.53E-01	1.52E-01	1.52E-01	1.52E-01
216-B-6	2.33E+00	1.45E+00	1.45E+00	1.45E+00	1.45E+00	1.45E+00	1.45E+00	1.45E+00	1.45E+00	1.45E+00	1.45E+00	1.45E+00	1.45E+00	1.45E+00	1.43E+00	1.15E+00
216-B-60	6.07E-01	5.74E-01	3.89E-01	3.89E-01	3.90E-01	3.58E-01	2.47E-01	2.47E-01	2.48E-01	2.47E-01	2.47E-01	2.19E-01	1.59E-01	1.59E-01	1.59E-01	1.59E-01
216-B-62	2.57E+04	3.07E+04	2.90E+04	2.66E+04	1.66E+04	1.78E+04	1.27E+04	2.29E+04	8.49E+03	4.54E+03	3.93E+03	1.51E+03	6.79E+02	3.12E+02	2.78E+02	1.39E+02
216-B-63	3.65E+05	3.58E+05	3.16E+05	3.80E+05	4.10E+05	3.56E+05	3.41E+05	3.20E+05	3.11E+05	3.08E+05	3.90E+05	4.32E+05	3.42E+05	3.34E+05	3.23E+05	2.68E+05
216-B-7A%B	1.16E+01	1.13E+01	1.13E+01	1.13E+01	8.68E+00	6.53E+00	6.53E+00	6.53E+00	6.54E+00	6.53E+00	6.53E+00	4.08E+00	3.93E+00	3.92E+00	3.92E+00	3.92E+00
216-B-8	3.78E+00	3.77E+00	3.77E+00	3.77E+00	3.78E+00	3.77E+00	3.02E+00	2.46E+00	2.47E+00	2.46E+00	2.46E+00	2.46E+00	2.47E+00	2.46E+00	2.46E+00	2.46E+00
216-B-9	5.13E+01	4.82E+01	4.82E+01	4.82E+01	4.83E+01	4.82E+01	4.82E+01	4.82E+01	4.83E+01	4.82E+01	4.82E+01	4.82E+01	4.70E+01	3.62E+01	3.62E+01	3.62E+01
216-BY-201	5.57E-02	4.28E-02	3.38E-02	3.38E-02	3.38E-02	3.38E-02	3.38E-02	3.38E-02	3.38E-02	3.38E-02	3.38E-02	3.38E-02	2.82E-02	2.42E-02	2.42E-02	2.42E-02
216-C-1	9.98E+00	8.97E+00	8.97E+00	8.97E+00	9.00E+00	8.97E+00	8.97E+00	8.97E+00	9.00E+00	8.12E+00	6.41E+00	6.41E+00	6.42E+00	6.41E+00	6.41E+00	6.41E+00
216-C-10	4.29E+00	4.28E+00	4.20E+00	2.36E+00	2.36E+00	2.36E+00	2.36E+00	2.36E+00	2.36E+00	1.65E+00	1.39E+00	1.39E+00	1.39E+00	1.39E+00	1.39E+00	1.39E+00
216-C-2	8.49E-05	8.46E-05	8.46E-05	8.46E-05	8.49E-05	7.90E-02	1.58E+01	9.28E+01	1.22E+02	1.24E+02	1.24E+02	1.24E+02	1.25E+02	1.24E+02	1.24E+02	1.22E+02
216-C-3	5.72E+00	3.70E+00	3.70E+00	3.70E+00	3.71E+00	3.70E+00	3.70E+00	3.70E+00	3.71E+00	3.70E+00	3.70E+00	3.70E+00	3.15E+00	2.84E+00	2.84E+00	2.84E+00
216-C-4	2.59E+00	2.43E+00	2.43E+00	2.43E+00	2.44E+00	1.84E+00	1.58E+00	1.58E+00	1.59E+00	1.58E+00	1.58E+00	1.58E+00	1.59E+00	1.17E+00	1.12E+00	1.12E+00
216-C-6	2.77E+00	2.76E+00	2.76E+00	2.76E+00	2.77E+00	2.39E+00	1.69E+00	1.69E+00	1.69E+00	1.69E+00	1.69E+00	1.69E+00	1.69E+00	1.69E+00	1.35E+00	1.20E+00
216-C-8	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.87E-04	1.04E-02	3.23E-02	3.23E-02	3.23E-02	3.24E-02	3.23E-02	3.23E-02	3.23E-02
216-C-9	2.85E+03	2.41E+03	2.07E+03	1.82E+03	1.62E+03	1.46E+03	1.33E+03	1.23E+03	1.16E+03	1.09E+03	1.04E+03	1.00E+03	9.73E+02	9.65E+02	9.23E+02	9.23E+02
216-N-2	7.19E+00	6.61E+00	6.61E+00	6.61E+00	6.63E+00	6.61E+00	6.61E+00	6.61E+00	6.63E+00	6.61E+00	6.61E+00	6.61E+00	6.63E+00	6.61E+00	6.46E+00	6.12E+00
216-N-3	8.24E+00	8.22E+00	8.22E+00	7.74E+00	6.40E+00	6.38E+00	6.38E+00	6.38E+00	6.40E+00	6.38E+00	6.38E+00	6.38E+00	6.40E+00	6.38E+00	6.38E+00	6.38E+00
216-N-4	9.72E+01	9.69E+01	9.69E+01	5.80E+01	3.05E+01	3.04E+01	3.04E+01	3.04E+01	3.05E+01	3.04E+01	3.04E+01	3.04E+01	3.05E+01	3.04E+01	3.04E+01	3.04E+01
216-N-5	8.24E+00	8.22E+00	8.22E+00	7.74E+00	6.40E+00	6.38E+00	6.38E+00	6.38E+00	6.40E+00	6.38E+00	6.38E+00	6.38E+00	6.40E+00	6.38E+00	6.38E+00	6.38E+00
216-N-6	8.30E+01	8.28E+01	8.28E+01	4.96E+01	2.61E+01	2.60E+01	2.60E+01	2.60E+01	2.61E+01	2.60E+01	2.60E+01	2.60E+01	2.61E+01	2.60E+01	2.60E+01	2.60E+01
216-N-7	8.24E+00	8.22E+00	8.22E+00	7.74E+00	6.40E+00	6.38E+00	6.38E+00	6.38E+00	6.40E+00	6.38E+00	6.38E+00	6.38E+00	6.40E+00	6.38E+00	6.38E+00	6.38E+00
216-S-1%2	6.77E+02	6.75E+02	6.75E+02	6.75E+02	6.77E+02	6.56E+02	4.62E+02	4.62E+02	4.63E+02	4.62E+02	4.62E+02	4.62E+02	4.63E+02	4.62E+02	4.62E+02	4.62E+02
216-S-10P	2.01E+05	2.00E+05	2.00E+05	2.00E+05	1.91E+05	1.95E+05	2.00E+05	2.00E+05	2.01E+05	2.03E+05	2.01E+05	1.99E+05	2.08E+05	2.04E+05	2.01E+05	1.54E+05
216-S-12	3.59E-03	2.35E-02	2.35E-02	2.35E-02	2.36E-02	2.35E-02	2.35E-02	2.35E-02	2.36E-02	2.35E-02	2.35E-02	2.35E-02	2.86E-01	3.62E-01	3.62E-01	3.62E-01
216-S-13	2.78E+01	2.69E+01	2.69E+01	2.69E+01	2.70E+01	1.91E+01	1.64E+01	1.64E+01	1.65E+01	1.64E+01	1.64E+01	1.64E+01	1.65E+01	1.12E+01	1.07E+01	1.07E+01
216-S-15	7.22E-03	7.20E-03	7.20E-03	7.20E-03	7.22E-03	7.20E-03	7.20E-03	7.20E-03	7.22E-03	7.20E-03	5.61E-02	1.12E-01	1.12E-01	1.12E-01	1.12E-01	1.12E-01
216-S-16P	5.47E+05	3.76E+05	3.76E+05	3.29E+05	2.36E+05	2.36E+05	2.36E+05	2.20E+05	1.45E+05	1.45E+05	1.45E+05	1.45E+05	1.45E+05	1.45E+05	9.36E+04	9.03E+04
216-S-17	3.90E+04	3.89E+04	3.89E+04	3.89E+04	3.90E+04	3.89E+04	3.89E+04	3.89E+04	3.90E+04	3.76E+04	2.78E+04	2.78E+04	2.79E+04	2.78E+04	2.78E+04	2.78E+04
216-S-19	6.98E+03	6.95E+03	6.97E+03	7.02E+03	7.06E+03	8.71E+03	1.62E+04	2.71E+04	2.58E+04	2.49E+04	2.20E+04	1.59E+04	1.22E+04	1.01E+04	7.77E+03	6.87E+03
216-S-20	1.29E+03	1.20E+03	1.09E+03	1.08E+03	9.68E+02	9.65E+02	9.65E+02	8.79E+02	8.43E+02	8.41E+02	8.41E+02	8.41E+02	7.39E+02	6.66E+02	6.66E+02	6.66E+02
216-S-21	4.96E+02	4.95E+02	4.95E+02	3.77E+02	3.26E+02	3.26E+02	3.26E+02	3.26E+02	2.59E+02	2.12E+02	2.12E+02	2.12E+02	2.13E+02	2.12E+02	2.12E+02	2.12E+02
216-S-22	1.92E+00	1.91E+00	2.04E+00	2.30E+00	2.31E+00	2.30E+00	2.30E+00	2.30E+00	2.31E+00	2.30E+00	2.30E+00	2.30E+00	1.99E+00	1.87E+00	1.87E+00	1.87E+00
216-S-23	1.41E+03	1.10E+03	8.33E+02	8.33E+02	5.78E+02	4.91E+02	4.91E+02	4.91E+02	3.78E+02	2.92E+02	2.92E+02	2.92E+02	2.93E+02	2.92E+02	2.57E+02	1.80E+02
216-S-25	2.99E+04	3.59E+04	2.71E+04	2.14E+04	2.08E+04	2.18E+04	1.58E+04	1.15E+04	8.71E+03	6.87E+03	5.67E+03	4.84E+03	4.26E+03	3.85E+03	3.57E+03	3.38E+03

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
216-S-26	4.08E-08	4.07E-08	4.07E-08	4.07E-08	4.08E-08	4.07E-08	4.07E-08	4.07E-08	4.08E-08	4.07E-08	3.06E+03	3.87E+04	2.88E+04	2.07E+04	1.50E+04	1.15E+04
216-S-3	4.15E+01	4.14E+01	4.14E+01	4.14E+01	2.81E+01	2.76E+01	2.76E+01	2.76E+01	2.77E+01	2.76E+01	2.76E+01	2.76E+01	2.77E+01	2.76E+01	2.76E+01	2.76E+01
216-S-4	4.67E+00	4.65E+00	4.65E+00	4.65E+00	4.67E+00	4.65E+00	4.65E+00	3.53E+00	3.11E+00	3.10E+00	3.10E+00	3.10E+00	3.11E+00	3.10E+00	3.10E+00	3.10E+00
216-S-5	3.46E+04	3.45E+04	3.45E+04	3.45E+04	3.46E+04	2.92E+04	2.31E+04	2.31E+04	2.31E+04	2.31E+04	2.31E+04	2.31E+04	2.31E+04	2.31E+04	2.31E+04	2.31E+04
216-S-6	6.37E+04	4.62E+04	4.62E+04	4.22E+04	3.01E+04	3.00E+04	3.00E+04	2.96E+04	1.88E+04	1.88E+04	1.88E+04	1.88E+04	1.88E+04	1.88E+04	1.38E+04	1.19E+04
216-S-7	2.24E+03	1.36E+03	1.36E+03	1.36E+03	1.36E+03	1.36E+03	1.36E+03	9.25E+02	8.25E+02	8.23E+02	8.23E+02	8.23E+02	8.25E+02	8.23E+02	8.23E+02	8.23E+02
216-S-9	9.99E+02	6.72E+02	6.72E+02	6.72E+02	6.49E+02	4.06E+02	4.06E+02	4.06E+02	4.07E+02	4.06E+02	4.06E+02	2.82E+02	2.54E+02	2.53E+02	2.53E+02	2.53E+02
216-SX-2	1.76E+02	1.75E+02	1.75E+02	1.24E+02	1.09E+02	1.09E+02	1.09E+02	1.09E+02	1.09E+02	1.04E+02	7.05E+01	7.05E+01	7.07E+01	7.05E+01	7.05E+01	7.05E+01
216-T-1	3.16E+03	3.15E+03	3.17E+03	3.18E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.21E+03	3.20E+03	3.20E+03	3.19E+03	3.19E+03	3.43E+03	5.25E+03	4.90E+03
216-T-12	1.74E+01	1.74E+01	1.74E+01	1.74E+01	1.74E+01	1.74E+01	1.74E+01	1.74E+01	1.74E+01	1.73E+01	1.36E+01	1.36E+01	1.36E+01	1.36E+01	1.36E+01	1.36E+01
216-T-14	1.50E+01	1.49E+01	1.49E+01	1.49E+01	1.50E+01	1.49E+01	1.49E+01	1.49E+01	1.50E+01	1.49E+01	1.22E+01	1.18E+01	1.19E+01	1.18E+01	1.18E+01	1.18E+01
216-T-15	1.56E+01	1.56E+01	1.56E+01	1.56E+01	1.56E+01	1.56E+01	1.56E+01	1.56E+01	1.41E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01
216-T-16	1.58E+01	1.57E+01	1.57E+01	1.57E+01	1.58E+01	1.57E+01	1.57E+01	1.57E+01	1.29E+01	1.20E+01	1.20E+01	1.20E+01	1.21E+01	1.20E+01	1.20E+01	1.20E+01
216-T-17	1.97E+01	1.64E+01	1.41E+01	1.41E+01	1.41E+01	1.41E+01	1.41E+01	1.41E+01	1.41E+01	1.41E+01	1.41E+01	1.41E+01	1.27E+01	1.17E+01	1.17E+01	1.17E+01
216-T-18	5.80E+00	5.79E+00	5.79E+00	5.79E+00	4.30E+00	4.22E+00	4.22E+00	4.22E+00	4.23E+00	4.22E+00	4.22E+00	4.22E+00	4.23E+00	4.22E+00	4.22E+00	4.22E+00
216-T-19	9.96E+03	6.04E+03	4.05E+03	2.54E+03	2.37E+03	1.41E+03	1.41E+03	1.27E+03	8.26E+02	8.23E+02	8.23E+02	8.11E+02	4.92E+02	4.91E+02	4.91E+02	4.91E+02
216-T-2	4.15E+00	4.14E+00	4.14E+00	4.14E+00	4.15E+00	4.14E+00	4.14E+00	4.14E+00	4.49E+00	4.71E+00	4.71E+00	4.71E+00	4.72E+00	4.71E+00	4.71E+00	4.71E+00
216-T-20	5.04E-01	5.03E-01	5.03E-01	4.92E-01	4.44E-01	4.43E-01	4.43E-01	4.43E-01	4.44E-01	4.43E-01	4.43E-01	4.43E-01	4.44E-01	4.43E-01	4.43E-01	4.43E-01
216-T-21	1.23E+01	1.23E+01	1.23E+01	1.23E+01	1.16E+01	1.10E+01	1.10E+01	1.10E+01	1.11E+01	1.10E+01	1.10E+01	1.10E+01	1.11E+01	1.10E+01	1.10E+01	1.10E+01
216-T-22	1.62E+01	1.62E+01	1.62E+01	1.25E+01	1.17E+01	1.16E+01	1.16E+01	1.16E+01	1.17E+01	1.16E+01	1.16E+01	1.16E+01	1.17E+01	1.16E+01	1.16E+01	1.03E+01
216-T-23	1.63E+01	1.25E+01	1.25E+01	1.25E+01	1.26E+01	1.25E+01	1.25E+01	1.25E+01	1.26E+01	1.25E+01	1.25E+01	1.10E+01	1.02E+01	1.02E+01	1.02E+01	1.02E+01
216-T-24	1.60E+01	1.60E+01	1.60E+01	1.35E+01	1.16E+01	1.16E+01	1.16E+01	1.16E+01	1.16E+01	1.16E+01	1.16E+01	1.16E+01	1.16E+01	1.16E+01	1.16E+01	1.08E+01
216-T-25	1.04E+01	1.04E+01	1.04E+01	1.04E+01	1.04E+01	1.04E+01	1.04E+01	1.04E+01	1.04E+01	1.04E+01	8.13E+00	8.13E+00	8.15E+00	8.13E+00	8.13E+00	8.13E+00
216-T-26	3.40E+01	3.39E+01	3.39E+01	3.39E+01	3.40E+01	3.39E+01	2.51E+01	2.36E+01	2.37E+01	2.36E+01	2.36E+01	2.36E+01	2.37E+01	2.36E+01	2.36E+01	2.36E+01
216-T-27	5.81E+01	5.79E+01	5.79E+01	5.28E+01	3.69E+01	3.68E+01	3.68E+01	3.68E+01	3.69E+01	3.68E+01	3.26E+01	2.50E+01	2.51E+01	2.50E+01	2.50E+01	2.50E+01
216-T-28	1.76E+02	1.75E+02	1.54E+02	1.04E+02	1.04E+02	1.04E+02	1.04E+02	1.04E+02	1.04E+02	8.29E+01	6.59E+01	6.59E+01	6.61E+01	6.59E+01	6.59E+01	6.59E+01
216-T-29	3.56E-02	3.56E-02	3.56E-02	3.56E-02	3.56E-02	3.56E-02	2.55E-02	2.17E-02	2.18E-02	2.17E-02	2.17E-02	2.17E-02	2.18E-02	2.17E-02	2.17E-02	2.04E-02
216-T-3	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.29E+01	1.38E+01	1.38E+01	1.38E+01	1.38E+01	1.38E+01	1.38E+01	1.38E+01	1.38E+01	1.38E+01	1.38E+01	1.38E+01
216-T-32	2.63E+01	2.47E+01	2.47E+01	2.47E+01	2.48E+01	2.47E+01	2.47E+01	2.47E+01	2.48E+01	2.47E+01	2.47E+01	2.47E+01	2.03E+01	2.02E+01	2.02E+01	2.02E+01
216-T-33	1.55E+01	1.41E+01	9.85E+00	9.85E+00	9.87E+00	9.85E+00	9.85E+00	9.85E+00	8.77E+00	6.70E+00	6.70E+00	6.70E+00	6.71E+00	6.70E+00	6.70E+00	6.70E+00
216-T-34	1.60E+02	1.60E+02	1.56E+02	9.64E+01	9.67E+01	9.64E+01	9.64E+01	9.64E+01	8.74E+01	6.10E+01	6.10E+01	6.10E+01	6.12E+01	6.10E+01	6.10E+01	6.10E+01
216-T-35	8.29E+01	6.77E+01	6.77E+01	6.77E+01	5.34E+01	4.29E+01	4.29E+01	4.29E+01	4.30E+01	4.29E+01	3.54E+01	2.84E+01	2.85E+01	2.84E+01	2.84E+01	2.84E+01
216-T-36	2.07E+01	2.04E+01	2.00E+01	2.00E+01	2.00E+01	1.88E+01	1.39E+01	1.39E+01	1.39E+01	1.39E+01	1.39E+01	1.39E+01	9.86E+00	9.51E+00	9.51E+00	9.51E+00
216-T-4A	2.22E+05	1.61E+05	1.15E+05	8.39E+04	6.37E+04	4.99E+04	4.04E+04	3.38E+04	2.91E+04	2.56E+04	2.31E+04	2.15E+04	2.05E+04	1.97E+04	1.94E+04	1.92E+04
216-T-5	1.43E+01	1.09E+01	1.09E+01	1.09E+01	1.10E+01	1.09E+01	1.09E+01	1.09E+01	1.10E+01	1.09E+01	1.09E+01	8.60E+00	8.63E+00	8.60E+00	8.60E+00	8.60E+00
216-T-6	9.99E+01	9.96E+01	7.64E+01	7.62E+01	7.64E+01	7.62E+01	7.62E+01	7.62E+01	7.64E+01	7.62E+01	7.62E+01	7.62E+01	7.64E+01	7.62E+01	7.62E+01	7.62E+01
216-T-7	2.16E+02	2.16E+02	1.62E+02	1.43E+02	1.44E+02	1.43E+02	1.43E+02	1.43E+02	1.44E+02	1.43E+02	1.43E+02	1.43E+02	1.44E+02	1.39E+02	1.16E+02	1.16E+02
216-T-8	1.22E+01	1.21E+01	1.21E+01	1.21E+01	1.22E+01	1.21E+01	1.21E+01	1.21E+01	1.22E+01	1.27E+01	1.58E+01	1.58E+01	1.58E+01	1.58E+01	1.58E+01	1.58E+01
216-TY-201	1.54E-01	1.54E-01	1.54E-01	1.54E-01	1.00E-01	9.08E-02	9.08E-02	9.08E-02	9.10E-02	9.08E-02	9.08E-02	6.96E-02	5.84E-02	5.82E-02	5.82E-02	5.82E-02
216-U-1%2	3.56E-06	3.55E-06	3.55E-06	3.55E-06	3.56E-06	3.55E-06	7.66E-04	7.04E-03	3.53E-02	7.74E-02	4.06E-01	4.30E+00	1.20E+02	7.14E+02	1.67E+03	1.76E+03
216-U-10	5.12E+06	5.84E+06	5.35E+06	5.24E+06	4.26E+06	3.52E+06	2.79E+06	1.95E+06	1.46E+06	1.13E+06	8.54E+05	6.52E+05	5.23E+05	4.55E+05	3.73E+05	3.26E+05

Site	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
216-U-12	1.90E+03	1.50E+03	1.22E+03	1.01E+03	8.63E+02	7.68E+02	6.67E+02	5.86E+02	5.22E+02	4.60E+02	5.61E+02	1.91E+03	2.87E+03	2.38E+03	1.88E+03	1.35E+03
216-U-13	9.99E-04	9.96E-04	9.96E-04	9.96E-04	9.99E-04	9.96E-04	9.96E-04	5.75E-02	1.48E-01	1.47E-01	1.47E-01	1.47E-01	1.48E-01	1.47E-01	1.47E-01	1.47E-01
216-U-14	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	1.51E-10	5.60E-10	2.86E+04	4.27E+05	3.29E+05	3.31E+05	3.13E+05	2.75E+05
216-U-15	8.95E-02	8.92E-02	8.92E-02	2.09E-01	9.17E-01	9.14E-01	9.14E-01	9.14E-01	9.17E-01	9.14E-01	9.14E-01	9.14E-01	9.17E-01	9.14E-01	9.14E-01	1.36E+00
216-U-16	7.18E-02	7.16E-02	7.16E-02	7.16E-02	7.18E-02	7.16E-02	7.16E-02	7.16E-02	7.18E-02	7.16E-02	7.16E-02	7.16E-02	7.18E-02	7.16E-02	7.16E-02	7.16E-02
216-U-17	9.95E-09	9.93E-09	9.93E-09	9.93E-09	9.95E-09	9.93E-09	9.93E-09	9.93E-09	9.95E-09	9.93E-09	9.93E-09	9.93E-09	9.95E-09	9.93E-09	9.93E-09	9.93E-09
216-U-3	8.06E+00	7.72E+00	7.72E+00	7.72E+00	7.74E+00	7.72E+00	7.72E+00	7.72E+00	7.74E+00	7.72E+00	6.18E+00	5.55E+00	5.56E+00	5.55E+00	5.55E+00	5.55E+00
216-U-4	2.67E+00	2.66E+00	2.66E+00	2.66E+00	2.67E+00	2.66E+00	2.37E+00	1.92E+00	1.93E+00	1.92E+00	1.92E+00	1.92E+00	1.93E+00	1.92E+00	1.92E+00	1.92E+00
216-U-4A	9.55E+00	7.09E+00	5.75E+00	5.75E+00	5.40E+00	3.47E+00	3.47E+00	3.47E+00	3.48E+00	3.47E+00	2.23E+00	2.13E+00	2.14E+00	2.13E+00	2.13E+00	2.13E+00
216-U-4B	3.94E-01	3.92E-01	3.82E-01	2.38E-01	2.38E-01	2.38E-01	2.38E-01	2.38E-01	1.66E-01	1.46E-01	1.46E-01	1.46E-01	1.47E-01	1.46E-01	1.46E-01	1.46E-01
216-U-7	5.00E-02	3.65E-02	3.65E-02	3.65E-02	3.66E-02	3.65E-02	3.65E-02	3.65E-02	3.66E-02	3.65E-02	3.04E-02	2.50E-02	2.51E-02	2.50E-02	2.50E-02	2.50E-02
216-U-8	1.80E+03	1.80E+03	1.18E+03	1.14E+03	1.14E+03	1.14E+03	1.14E+03	1.14E+03	1.14E+03	1.14E+03	1.14E+03	9.38E+02	7.95E+02	7.93E+02	7.93E+02	7.93E+02
216-W-LWC	4.17E-07	4.16E-07	4.16E-07	4.16E-07	4.17E-07	4.16E-07	4.16E-07	3.13E+05	1.60E+05	8.18E+04	6.32E+04	5.57E+04	4.88E+04	3.51E+04	2.49E+04	2.44E+04
216-Z-1%2	1.22E+02	1.22E+02	1.22E+02	1.09E+02	1.04E+02	1.04E+02	1.04E+02	1.04E+02	9.65E+01	9.09E+01	9.09E+01	9.09E+01	9.11E+01	9.09E+01	9.09E+01	9.09E+01
216-Z-10	3.20E+00	3.19E+00	3.19E+00	3.19E+00	3.20E+00	3.19E+00	3.19E+00	3.19E+00	3.20E+00	3.19E+00	3.19E+00	3.19E+00	3.20E+00	3.13E+00	3.09E+00	3.09E+00
216-Z-12	4.27E+03	4.02E+03	2.60E+03	2.60E+03	2.32E+03	1.59E+03	1.59E+03	1.59E+03	1.53E+03	9.64E+02	9.64E+02	9.64E+02	9.66E+02	9.64E+02	9.64E+02	6.77E+02
216-Z-3	5.71E+02	5.69E+02	5.69E+02	5.69E+02	5.71E+02	5.69E+02	5.53E+02	3.72E+02	3.73E+02	3.72E+02	3.72E+02	3.72E+02	3.73E+02	3.72E+02	3.72E+02	3.72E+02
216-Z-4	3.94E-02	3.93E-02	3.93E-02	1.88E-01	2.32E-01	2.32E-01	2.32E-01	2.32E-01	2.32E-01	2.32E-01	2.32E-01	2.32E-01	2.32E-01	2.32E-01	2.32E-01	2.32E-01
216-Z-5	1.95E+02	1.94E+02	1.94E+02	1.94E+02	1.89E+02	1.41E+02	1.41E+02	1.41E+02	1.41E+02	1.41E+02	1.41E+02	1.41E+02	1.41E+02	1.41E+02	1.41E+02	1.41E+02
216-Z-6	2.09E+00	2.09E+00	2.09E+00	2.09E+00	2.09E+00	2.09E+00	2.09E+00	2.09E+00	1.98E+00	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.90E+00
216-Z-7	4.33E+02	3.66E+02	3.66E+02	3.66E+02	3.67E+02	2.82E+02	2.26E+02	2.26E+02	2.27E+02	2.26E+02	2.26E+02	2.26E+02	2.27E+02	1.51E+02	1.47E+02	1.47E+02
218-E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-E-Cores	2.42E-03	2.37E-03	2.33E-03	2.29E-03	2.26E-03	2.21E-03	2.18E-03	2.14E-03	2.11E-03	2.06E-03	2.03E-03	1.99E-03	1.96E-03	1.92E-03	1.89E-03	1.85E-03
218-E-LLW	1.08E-02	1.06E-02	1.05E-02	1.03E-02	1.01E-02	9.92E-03	9.75E-03	9.58E-03	9.44E-03	9.25E-03	9.08E-03	8.92E-03	8.79E-03	8.61E-03	8.46E-03	8.31E-03
218-W-3A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-3AE	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-4B	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-4C	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-104	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05
241-A-105	5.60E+00	4.93E+00	4.40E+00	3.97E+00	3.61E+00	3.29E+00	3.03E+00	2.81E+00	2.63E+00	2.47E+00	2.35E+00	2.27E+00	2.24E+00	2.26E+00	2.34E+00	2.45E+00
241-A-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
241-AN-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-108	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AY-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AY-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AZ-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AZ-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-B-101	7.80E-02	4.74E-01	7.59E-01	8.24E-01	8.36E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-B-102	7.80E-02	4.73E-01	7.59E-01	8.24E-01	8.36E-01	8.34E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-B-103	7.80E-02	4.73E-01	7.59E-01	8.24E-01	8.36E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-B-104	1.29E-03	7.90E-02	4.73E-01	7.58E-01	8.26E-01	8.33E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-B-105	1.24E+00	1.10E+00	1.00E+00	9.35E-01	8.94E-01	8.65E-01	8.50E-01	8.42E-01	8.40E-01	8.36E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-B-106	3.08E-06	9.71E-04	2.50E-02	4.83E-01	7.95E-01	8.31E-01	8.34E-01	8.34E-01	8.37E-01	8.34E-01	8.34E-01	8.34E-01	8.37E-01	8.34E-01	8.34E-01	8.34E-01
241-B-107	9.66E-01	9.12E-01	8.78E-01	8.58E-01	8.48E-01	8.40E-01	8.37E-01	8.36E-01	8.38E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-B-108	7.81E-02	4.74E-01	7.60E-01	8.25E-01	8.37E-01	8.35E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.36E-01	8.36E-01
241-B-109	1.29E-03	7.90E-02	4.73E-01	7.58E-01	8.26E-01	8.33E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-B-110	2.04E+00	1.65E+00	1.39E+00	1.21E+00	1.09E+00	9.95E-01	9.33E-01	8.92E-01	8.68E-01	8.51E-01	8.42E-01	8.38E-01	8.38E-01	8.35E-01	8.35E-01	8.35E-01
241-B-111	7.80E-02	4.74E-01	7.59E-01	8.24E-01	8.36E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-B-112	1.29E-03	7.91E-02	4.74E-01	7.59E-01	8.27E-01	8.34E-01	8.35E-01	8.36E-01	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.36E-01	8.36E-01
241-B-201	6.85E-02	6.45E-02	6.21E-02	6.07E-02	6.00E-02	5.95E-02	5.93E-02	5.92E-02	5.93E-02	5.92E-02	5.92E-02	5.92E-02	5.93E-02	5.92E-02	5.92E-02	5.92E-02
241-B-202	2.96E-09	2.95E-09	2.95E-09	2.95E-09	2.26E-07	6.90E-05	1.78E-03	3.43E-02	5.65E-02	5.90E-02	5.93E-02	5.93E-02	5.94E-02	5.93E-02	5.93E-02	5.93E-02
241-B-203	6.68E-02	6.34E-02	6.14E-02	6.03E-02	5.98E-02	5.94E-02	5.92E-02	5.92E-02	5.93E-02	5.91E-02	5.91E-02	5.91E-02	5.93E-02	5.91E-02	5.91E-02	5.91E-02
241-B-204	6.67E-02	6.34E-02	6.15E-02	6.04E-02	5.99E-02	5.94E-02	5.93E-02	5.92E-02	5.93E-02	5.92E-02	5.92E-02	5.92E-02	5.93E-02	5.92E-02	5.92E-02	5.92E-02
241-BX-101	4.55E-01	2.14E+00	1.86E+00	1.53E+00	1.31E+00	1.15E+00	1.03E+00	9.55E-01	9.06E-01	8.71E-01	8.53E-01	8.43E-01	8.41E-01	8.36E-01	8.36E-01	8.35E-01
241-BX-102	8.37E-01	8.35E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.36E-01	8.36E-01

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
241-BX-103	3.64E-08	3.11E-06	9.72E-04	2.47E-02	4.86E-01	7.93E-01	8.31E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-BX-104	5.22E-08	5.21E-08	3.39E-06	1.03E-03	7.80E-02	4.73E-01	7.59E-01	8.24E-01	8.36E-01	8.34E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-BX-105	5.22E-08	5.21E-08	3.39E-06	1.03E-03	7.80E-02	4.74E-01	7.59E-01	8.24E-01	8.36E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-BX-106	5.22E-08	5.21E-08	3.39E-06	1.03E-03	7.81E-02	4.74E-01	7.60E-01	8.25E-01	8.36E-01	8.35E-01	8.35E-01	8.35E-01	8.38E-01	8.35E-01	8.35E-01	8.35E-01
241-BX-107	3.64E-08	3.11E-06	9.72E-04	2.47E-02	4.86E-01	7.94E-01	8.31E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-BX-108	5.23E-08	5.21E-08	3.39E-06	1.03E-03	7.81E-02	4.74E-01	7.60E-01	8.25E-01	8.36E-01	8.35E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.36E-01	8.36E-01
241-BX-109	6.48E-08	6.47E-08	6.47E-08	8.05E-07	1.29E-03	7.90E-02	4.73E-01	7.58E-01	8.26E-01	8.33E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-BX-110	5.22E-08	5.21E-08	3.39E-06	1.03E-03	7.80E-02	4.73E-01	7.59E-01	8.24E-01	8.36E-01	8.34E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-BX-111	9.66E-01	9.14E-01	8.81E-01	8.60E-01	8.51E-01	8.42E-01	8.38E-01	8.36E-01	8.38E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-BX-112	6.49E-08	6.47E-08	6.47E-08	8.06E-07	1.29E-03	7.91E-02	4.74E-01	7.59E-01	8.27E-01	8.34E-01	8.35E-01	8.35E-01	8.38E-01	8.35E-01	8.35E-01	8.35E-01
241-BY-101	6.48E-08	6.46E-08	6.46E-08	8.05E-07	1.29E-03	7.89E-02	4.73E-01	7.58E-01	8.25E-01	8.33E-01	8.34E-01	8.34E-01	8.36E-01	8.34E-01	8.34E-01	8.34E-01
241-BY-102	6.49E-08	6.47E-08	6.47E-08	8.06E-07	1.29E-03	7.91E-02	4.74E-01	7.59E-01	8.27E-01	8.34E-01	8.35E-01	8.35E-01	8.38E-01	8.35E-01	8.35E-01	8.35E-01
241-BY-103	4.57E+00	3.01E+00	2.27E+00	1.80E+00	1.50E+00	1.29E+00	1.14E+00	1.03E+00	9.62E-01	9.10E-01	8.78E-01	8.58E-01	8.49E-01	8.40E-01	8.37E-01	8.36E-01
241-BY-104	6.48E-08	6.46E-08	6.46E-08	8.05E-07	1.29E-03	7.89E-02	4.73E-01	7.58E-01	8.25E-01	8.33E-01	8.34E-01	8.34E-01	8.36E-01	8.34E-01	8.34E-01	8.34E-01
241-BY-105	4.17E-08	4.16E-08	4.16E-08	4.16E-08	3.18E-06	9.73E-04	2.51E-02	4.84E-01	7.96E-01	8.32E-01	8.35E-01	8.35E-01	8.38E-01	8.35E-01	8.35E-01	8.35E-01
241-BY-106	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	3.47E-06	1.03E-03	7.80E-02	4.73E-01	7.59E-01	8.24E-01	8.36E-01	8.35E-01	8.35E-01	8.35E-01
241-BY-107	6.48E-08	6.46E-08	6.46E-08	8.05E-07	1.29E-03	7.89E-02	4.73E-01	7.58E-01	8.25E-01	8.33E-01	8.34E-01	8.34E-01	8.36E-01	8.34E-01	8.34E-01	8.34E-01
241-BY-108	3.01E+00	2.24E+00	1.77E+00	1.47E+00	1.26E+00	1.11E+00	1.01E+00	9.38E-01	8.96E-01	8.66E-01	8.50E-01	8.42E-01	8.41E-01	8.37E-01	8.36E-01	8.36E-01
241-BY-109	5.71E-08	5.70E-08	5.70E-08	5.70E-08	5.71E-08	5.70E-08	3.47E-06	1.03E-03	7.80E-02	4.74E-01	7.59E-01	8.24E-01	8.36E-01	8.35E-01	8.35E-01	8.35E-01
241-BY-110	4.16E-08	4.15E-08	4.15E-08	4.15E-08	3.18E-06	9.72E-04	2.50E-02	4.83E-01	7.95E-01	8.31E-01	8.34E-01	8.34E-01	8.37E-01	8.34E-01	8.34E-01	8.34E-01
241-BY-111	4.33E-08	4.32E-08	4.32E-08	4.32E-08	4.33E-08	3.21E-06	9.73E-04	2.47E-02	4.86E-01	7.93E-01	8.31E-01	8.34E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-BY-112	4.17E-08	4.16E-08	4.16E-08	4.16E-08	3.18E-06	9.72E-04	2.50E-02	4.84E-01	7.96E-01	8.31E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01
241-C-101	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-102	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-103	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-104	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-105	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04	1.88E-04
241-C-106	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04
241-C-107	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-108	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04
241-C-109	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04
241-C-110	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-111	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-112	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04
241-C-201	7.42E-06	7.40E-06	7.40E-06	7.40E-06	7.42E-06	7.40E-06	7.40E-06	7.40E-06	7.42E-06	7.40E-06	7.40E-06	7.40E-06	7.42E-06	7.40E-06	7.40E-06	7.40E-06
241-C-202	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06
241-C-203	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	7.39E-06
241-C-204	7.46E-06	7.44E-06	7.44E-06	7.44E-06	7.46E-06	7.44E-06	7.44E-06	7.44E-06	7.46E-06	7.44E-06	7.44E-06	7.44E-06	7.46E-06	7.44E-06	7.44E-06	7.44E-06
241-S-101	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08
241-S-102	1.79E-08	1.78E-08	1.78E-08	1.78E-08	1.79E-08	1.78E-08	1.78E-08	1.78E-08	1.79E-08	1.78E-08	1.78E-08	1.78E-08	1.79E-08	1.78E-08	1.78E-08	1.78E-08
241-S-103	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
241-S-104	1.90E-02	4.84E-01	2.79E+00	4.73E+00	5.05E+00	4.81E+00	4.52E+00	4.24E+00	4.02E+00	3.80E+00	3.62E+00	3.47E+00	3.35E+00	3.24E+00	3.14E+00	3.07E+00
241-S-105	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08	1.78E-08	1.77E-08	1.77E-08	1.77E-08
241-S-106	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08
241-S-107	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08
241-S-108	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08	1.62E-08	1.61E-08	1.61E-08	1.61E-08
241-S-109	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08	1.62E-08
241-S-110	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08	1.67E-08
241-S-111	1.59E-08	1.58E-08	1.58E-08	1.58E-08	1.59E-08	1.58E-08	1.58E-08	1.58E-08	1.59E-08	1.58E-08	1.58E-08	1.58E-08	1.59E-08	1.58E-08	1.58E-08	1.58E-08
241-S-112	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08	1.63E-08
241-SX-101	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08
241-SX-102	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08
241-SX-103	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08
241-SX-104	1.64E-08	1.63E-08	1.63E-08	1.63E-08	1.64E-08	1.63E-08	1.63E-08	1.63E-08	1.64E-08	1.63E-08	1.63E-08	1.63E-08	1.64E-08	1.63E-08	1.63E-08	1.63E-08
241-SX-105	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08
241-SX-106	2.08E-08	2.07E-08	2.07E-08	2.07E-08	2.08E-08	2.07E-08	2.07E-08	2.07E-08	2.08E-08	2.07E-08	2.07E-08	2.07E-08	2.08E-08	2.07E-08	2.07E-08	2.07E-08
241-SX-107	4.80E-03	9.71E-02	7.95E-01	2.00E+00	2.55E+00	2.58E+00	2.48E+00	2.37E+00	2.27E+00	2.17E+00	2.09E+00	2.02E+00	1.97E+00	1.92E+00	1.88E+00	1.85E+00
241-SX-108	1.48E-04	7.04E-03	2.20E-01	2.27E+00	5.77E+00	6.99E+00	6.90E+00	6.52E+00	6.16E+00	5.80E+00	5.50E+00	5.25E+00	5.04E+00	4.85E+00	4.69E+00	4.56E+00
241-SX-109	1.28E-09	1.27E-09	1.27E-09	1.27E-09	1.28E-09	1.27E-09	1.27E-09	1.27E-09	1.28E-09	1.27E-09	1.27E-09	1.27E-09	1.28E-09	1.27E-09	7.02E-07	6.92E-06
241-SX-110	4.66E-11	4.65E-11	4.65E-11	4.65E-11	4.66E-11	4.65E-11	4.65E-11	4.65E-11	4.66E-11	4.65E-11	4.65E-11	4.65E-11	4.66E-11	4.65E-11	4.65E-11	4.65E-11
241-SX-111	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	2.24E-09	1.22E-06
241-SX-112	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08
241-SX-113	3.07E-02	2.64E-01	9.86E-01	1.70E+00	2.00E+00	2.04E+00	2.01E+00	1.96E+00	1.92E+00	1.88E+00	1.85E+00	1.83E+00	1.81E+00	1.79E+00	1.78E+00	1.78E+00
241-SX-114	3.15E-11	3.14E-11	3.14E-11	3.14E-11	3.15E-11	3.14E-11	3.14E-11	3.14E-11	3.15E-11	3.14E-11	3.14E-11	3.14E-11	3.15E-11	3.14E-11	3.14E-11	3.14E-11
241-SX-115	8.56E-06	4.64E-04	1.39E-02	2.92E-01	2.62E+00	6.88E+00	8.92E+00	9.10E+00	8.78E+00	8.35E+00	7.97E+00	7.65E+00	7.38E+00	7.13E+00	6.93E+00	6.76E+00
241-SY-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-SY-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-SY-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-T-101	2.19E+00	1.70E+00	1.35E+00	1.07E+00	8.63E-01	6.91E-01	5.54E-01	4.43E-01	3.53E-01	2.78E-01	2.16E-01	1.67E-01	1.27E-01	9.44E-02	6.93E-02	4.98E-02
241-T-102	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.58E-08	1.63E-06	9.16E-06	5.34E-05	3.12E-04	1.83E-03	1.02E-02	5.01E-02	1.76E-01	3.96E-01	6.01E-01
241-T-103	3.76E-09	3.75E-09	3.75E-09	2.35E-06	1.95E-04	8.63E-03	1.77E-01	9.01E-01	1.51E+00	1.59E+00	1.49E+00	1.38E+00	1.28E+00	1.18E+00	1.11E+00	1.05E+00
241-T-104	5.36E-09	5.34E-09	5.34E-09	5.34E-09	5.36E-09	5.34E-09	5.87E-08	1.70E-06	9.74E-06	5.53E-05	3.22E-04	1.86E-03	1.05E-02	5.06E-02	1.77E-01	3.96E-01
241-T-105	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.86E-08	1.70E-06	9.73E-06	5.53E-05	3.22E-04	1.85E-03	1.05E-02	5.06E-02	1.77E-01	3.96E-01
241-T-106	5.32E+01	3.57E+01	2.70E+01	2.15E+01	1.77E+01	1.50E+01	1.29E+01	1.14E+01	1.01E+01	9.13E+00	8.34E+00	7.69E+00	7.18E+00	6.72E+00	6.37E+00	6.08E+00
241-T-107	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16
241-T-108	5.01E-09	5.00E-09	5.00E-09	5.00E-09	5.01E-09	5.58E-08	1.63E-06	9.17E-06	5.34E-05	3.12E-04	1.83E-03	1.02E-02	5.01E-02	1.76E-01	3.96E-01	6.01E-01
241-T-109	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.58E-08	1.63E-06	9.18E-06	5.35E-05	3.12E-04	1.83E-03	1.02E-02	5.01E-02	1.76E-01	3.96E-01	6.02E-01
241-T-110	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16
241-T-111	5.02E-09	5.00E-09	5.00E-09	5.00E-09	5.02E-09	5.58E-08	1.63E-06	9.18E-06	5.35E-05	3.12E-04	1.83E-03	1.02E-02	5.01E-02	1.76E-01	3.96E-01	6.02E-01
241-T-112	5.35E-09	5.34E-09	5.34E-09	5.34E-09	5.35E-09	5.34E-09	5.86E-08	1.70E-06	9.73E-06	5.53E-05	3.22E-04	1.85E-03	1.05E-02	5.05E-02	1.77E-01	3.96E-01
241-T-201	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	3.97E-09	1.10E-07	6.22E-07	3.54E-06
241-T-202	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	3.97E-09	1.10E-07	6.22E-07	3.54E-06

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
241-T-203	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	3.97E-09	1.09E-07	6.21E-07	3.54E-06
241-T-204	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	2.95E-10	2.94E-10	2.94E-10	2.94E-10	3.97E-09	1.09E-07	6.21E-07	3.54E-06
241-TX-101	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	5.78E-08	1.65E-06	9.18E-06	5.35E-05	3.12E-04	1.83E-03	1.02E-02
241-TX-102	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	6.04E-08	1.71E-06	9.74E-06	5.53E-05	3.22E-04	1.85E-03
241-TX-103	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	6.05E-08	1.71E-06	9.75E-06	5.53E-05	3.22E-04	1.86E-03
241-TX-104	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	5.08E-09	5.08E-09	5.10E-09	5.08E-09	6.05E-08	1.71E-06	9.75E-06	5.53E-05	3.22E-04	1.86E-03
241-TX-105	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	5.61E-08	1.55E-06	8.78E-06	5.00E-05
241-TX-106	4.25E-10	4.24E-10	4.24E-10	4.24E-10	4.25E-10	4.24E-10	4.24E-10	4.24E-10	4.25E-10	4.24E-10	4.24E-10	4.24E-10	2.21E-07	1.55E-06	8.79E-06	5.01E-05
241-TX-107	2.76E-11	2.75E-11	2.75E-11	1.96E-08	9.49E-03	1.54E+00	3.90E+00	3.57E+00	2.97E+00	2.50E+00	2.14E+00	1.88E+00	1.67E+00	1.50E+00	1.36E+00	1.25E+00
241-TX-108	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	5.61E-08	1.55E-06	8.78E-06	5.00E-05
241-TX-109	4.79E-09	4.77E-09	4.77E-09	4.77E-09	4.79E-09	4.77E-09	4.77E-09	4.77E-09	4.79E-09	5.77E-08	1.64E-06	9.18E-06	5.35E-05	3.12E-04	1.83E-03	1.02E-02
241-TX-110	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	4.78E-09	4.78E-09	4.78E-09	4.79E-09	5.78E-08	1.65E-06	9.19E-06	5.35E-05	3.12E-04	1.83E-03	1.02E-02
241-TX-111	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	6.04E-08	1.71E-06	9.74E-06	5.53E-05	3.22E-04	1.85E-03
241-TX-112	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	5.08E-09	5.08E-09	5.09E-09	5.08E-09	6.04E-08	1.71E-06	9.73E-06	5.52E-05	3.21E-04	1.85E-03
241-TX-113	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	5.61E-08	1.55E-06	8.78E-06	5.00E-05
241-TX-114	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	5.61E-08	1.55E-06	8.78E-06	5.00E-05
241-TX-115	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	5.61E-08	1.55E-06	8.79E-06	5.00E-05
241-TX-116	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	5.61E-08	1.55E-06	8.79E-06	5.00E-05
241-TX-117	4.17E-09	4.15E-09	4.15E-09	4.15E-09	4.17E-09	4.15E-09	4.15E-09	4.15E-09	4.17E-09	4.15E-09	4.15E-09	4.15E-09	5.60E-08	1.55E-06	8.77E-06	5.00E-05
241-TX-118	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	4.17E-09	4.16E-09	4.16E-09	4.16E-09	5.61E-08	1.55E-06	8.78E-06	5.00E-05
241-TY-101	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12	6.95E-10	2.64E-07	1.65E-06	9.19E-06
241-TY-102	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12	8.38E-12	8.36E-12	8.36E-12	8.36E-12	6.95E-10	2.64E-07	1.65E-06	9.19E-06
241-TY-103	2.54E-09	2.53E-09	2.53E-09	2.53E-09	1.14E-06	2.49E-05	4.05E-04	5.36E-03	5.39E-02	2.80E-01	6.66E-01	9.14E-01	9.84E-01	9.73E-01	9.44E-01	9.15E-01
241-TY-104	1.27E-12	1.27E-12	1.27E-12	1.27E-12	1.27E-12	5.46E-10	1.90E-07	9.76E-07	4.78E-06	2.48E-05	1.38E-04	7.83E-04	4.55E-03	2.39E-02	1.00E-01	2.81E-01
241-TY-105	1.66E+00	1.61E+00	1.58E+00	1.56E+00	1.56E+00	1.55E+00	1.55E+00	1.55E+00	1.55E+00	1.55E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00
241-TY-106	1.02E+00	9.80E-01	9.51E-01	9.29E-01	9.15E-01	9.00E-01	8.92E-01	8.86E-01	8.84E-01	8.80E-01	8.78E-01	8.77E-01	8.79E-01	8.76E-01	8.76E-01	8.76E-01
241-U-101	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.07E-08	2.69E-07	8.86E-06	5.37E-05
241-U-102	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.13E-08	2.77E-07	9.12E-06	5.53E-05
241-U-103	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	2.59E-07	8.22E-06
241-U-104	7.93E+00	7.54E+00	7.22E+00	6.96E+00	6.75E+00	6.54E+00	6.39E+00	6.26E+00	6.18E+00	6.08E+00	6.02E+00	5.97E+00	5.95E+00	5.91E+00	5.89E+00	5.88E+00
241-U-105	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	2.57E-07	8.14E-06
241-U-106	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	1.77E-08	2.44E-07
241-U-107	1.67E-08	1.66E-08	1.66E-08	1.66E-08	1.67E-08	1.66E-08	1.66E-08	1.66E-08	1.67E-08	1.66E-08	1.66E-08	1.66E-08	1.67E-08	1.66E-08	1.66E-08	2.29E-07
241-U-108	1.89E-08	1.88E-08	1.88E-08	1.88E-08	1.89E-08	1.88E-08	1.88E-08	1.88E-08	1.89E-08	1.88E-08	1.88E-08	1.88E-08	1.89E-08	1.88E-08	1.88E-08	1.88E-08
241-U-109	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08	1.91E-08
241-U-110	4.53E-09	4.52E-09	4.52E-09	4.52E-09	6.22E-06	8.47E-04	5.53E-02	8.06E-01	2.10E+00	2.42E+00	2.29E+00	2.10E+00	1.92E+00	1.77E+00	1.64E+00	1.53E+00
241-U-111	1.74E-08	1.73E-08	1.73E-08	1.73E-08	1.74E-08	1.73E-08	1.73E-08	1.73E-08	1.74E-08	1.73E-08	1.73E-08	1.73E-08	1.74E-08	1.73E-08	2.52E-07	7.98E-06
241-U-112	1.41E-01	1.16E+00	2.22E+00	2.38E+00	2.24E+00	2.05E+00	1.89E+00	1.75E+00	1.64E+00	1.53E+00	1.44E+00	1.37E+00	1.30E+00	1.25E+00	1.20E+00	1.16E+00
241-U-201	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09
241-U-202	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09
241-U-203	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	1.72E-09

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
241-U-204	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09
300-224	1.21E+03	1.20E+03	1.20E+03	1.20E+03	1.21E+03	1.20E+03	1.20E+03	1.20E+03	1.21E+03	1.20E+03	1.20E+03	1.20E+03	1.21E+03	3.55E+02	1.56E+02	6.83E+01
316-1	4.29E+05	1.08E+05	5.72E+04	3.64E+04	2.21E+04	1.92E+04	1.31E+04	9.52E+03	9.55E+03	7.87E+03	4.22E+03	4.22E+03	4.23E+03	4.22E+03	3.32E+03	1.55E+03
316-2	3.11E+05	6.97E+04	3.83E+04	2.66E+04	1.55E+04	1.54E+04	9.92E+03	9.05E+03	9.08E+03	6.74E+03	5.59E+03	5.59E+03	5.61E+03	5.59E+03	4.06E+03	3.84E+03
316-3	2.95E+02	2.73E+02	2.00E+02	2.00E+02	2.01E+02	2.00E+02	2.00E+02	2.00E+02	1.91E+02	1.59E+02	1.59E+02	1.59E+02	1.59E+02	1.59E+02	1.59E+02	1.59E+02
316-5	3.36E+06	3.46E+06	3.46E+06	3.45E+06	3.46E+06	3.46E+06	3.46E+06	3.45E+06	3.46E+06	3.46E+06	6.70E+05	1.26E+05	6.65E+04	4.58E+04	2.95E+04	2.70E+04
600-148	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
600-211	4.24E-09	4.23E-09	4.23E-09	4.23E-09	4.24E-09	4.23E-09	4.23E-09	4.23E-09	4.24E-09	4.23E-09	4.23E-09	4.23E-09	4.24E-09	4.23E-09	4.23E-09	4.23E-09
618-11	1.39E+03	1.39E+03	1.39E+03	1.39E+03	1.40E+03	1.39E+03	1.39E+03	1.39E+03	1.40E+03	1.39E+03	1.39E+03	1.39E+03	1.40E+03	1.39E+03	1.39E+03	1.39E+03
GTF	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GTFL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILAW-liquid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RMWSF	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-100-N-1	6.64E-02	1.32E+00	4.81E+00	9.87E+00	1.18E+01	2.20E+01	2.20E+01	2.20E+01	2.64E+01	2.76E+01	2.76E+01	2.76E+01	2.77E+01	2.84E+01	2.87E+01	2.87E+01
UPR-100-N-25	5.92E-01	1.34E-01	6.77E-02	4.63E-02	3.07E-02	2.87E-02	2.09E-02	2.09E-02	2.05E-02	1.70E-02	1.70E-02	1.70E-02	1.70E-02	1.64E-02	1.58E-02	1.58E-02
UPR-100-N-30	5.58E-02	6.03E-01	1.26E+00	2.27E+00	2.39E+00	3.37E+00	3.37E+00	3.37E+00	3.55E+00	3.61E+00	3.61E+00	3.61E+00	3.62E+00	3.61E+00	3.62E+00	3.62E+00
UPR-100-N-5	1.44E-01	1.17E-01	9.60E-02	8.80E-02	7.33E-02	7.31E-02	7.29E-02	6.43E-02	6.45E-02	6.43E-02	6.43E-02	6.42E-02	6.20E-02	6.18E-02	6.18E-02	6.18E-02
UPR-200-E-1	3.14E-02	2.28E-02	2.17E-02	2.17E-02	2.18E-02	2.17E-02	2.17E-02	2.17E-02	2.18E-02	2.17E-02	2.17E-02	2.17E-02	2.18E-02	2.17E-02	2.17E-02	2.10E-02
UPR-200-E-105	8.74E-01	8.72E-01	8.72E-01	8.72E-01	8.74E-01	8.72E-01	6.36E-01	6.10E-01	6.11E-01	6.10E-01	6.10E-01	6.10E-01	6.11E-01	6.10E-01	6.10E-01	6.10E-01
UPR-200-E-107	4.33E-05	4.32E-05	4.32E-05	4.32E-05	4.33E-05	4.32E-05	4.32E-05	4.32E-05	4.33E-05	4.32E-05	4.32E-05	4.32E-05	4.33E-05	4.32E-05	4.32E-05	4.32E-05
UPR-200-E-108	2.32E-07	3.79E-07	3.79E-07	3.79E-07	3.80E-07	3.79E-07	3.79E-07	3.79E-07	3.80E-07	3.79E-07	3.79E-07	2.02E-05	2.61E-05	2.60E-05	2.60E-05	2.60E-05
UPR-200-E-109	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07
UPR-200-E-110	5.82E-02	5.80E-02	5.80E-02	5.80E-02	5.82E-02	5.80E-02	4.20E-02	3.69E-02	3.70E-02	3.69E-02	3.69E-02	3.69E-02	3.70E-02	3.69E-02	3.69E-02	3.69E-02
UPR-200-E-114	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-115	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-116	1.39E-08	1.38E-08	1.38E-08	1.38E-08	1.39E-08	1.38E-08	1.38E-08	1.38E-08	1.39E-08	1.38E-08	1.38E-08	1.38E-08	1.39E-08	1.38E-08	3.63E-07	1.23E-06
UPR-200-E-117	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-119	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-133	1.17E+00	5.96E-01	3.84E-01	2.66E-01	2.29E-01	1.71E-01	1.35E-01	1.35E-01	1.14E-01	8.06E-02	8.06E-02	8.06E-02	8.08E-02	6.26E-02	4.86E-02	4.86E-02
UPR-200-E-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-145	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-21	7.09E-03	7.08E-03	7.08E-03	7.08E-03	1.00E-02	4.56E-02	4.56E-02	4.56E-02	4.58E-02	4.56E-02	4.56E-02	4.56E-02	4.58E-02	4.56E-02	4.99E-02	5.16E-02
UPR-200-E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-3	2.19E-05	2.18E-05	2.18E-05	2.18E-05	2.19E-05	2.18E-05	2.18E-05	2.18E-05	2.19E-05	5.51E-04	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03
UPR-200-E-38	1.59E-01	1.59E-01	9.73E-02	9.11E-02	9.14E-02	9.11E-02	8.44E-02	5.34E-02	5.36E-02	5.34E-02	5.34E-02	5.34E-02	5.36E-02	5.18E-02	3.32E-02	3.32E-02
UPR-200-E-42	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-6	6.25E-10	6.23E-10	6.23E-10	6.23E-10	3.65E-05	7.72E-03	2.98E-02	6.25E-02	7.15E-02	7.91E-02	7.91E-02	8.11E-02	8.15E-02	8.13E-02	8.13E-02	8.14E-02
UPR-200-E-7	1.22E-01	7.94E-02	7.94E-02	7.94E-02	7.97E-02	7.94E-02	7.94E-02	7.94E-02	7.97E-02	7.94E-02	7.94E-02	7.52E-02	5.85E-02	5.83E-02	5.83E-02	5.83E-02
UPR-200-E-73	9.41E-08	9.39E-08	9.39E-08	9.39E-08	9.41E-08	3.45E-06	6.53E-06	6.53E-06	6.55E-06	6.53E-06	6.53E-06	6.53E-06	6.55E-06	6.53E-06	6.53E-06	6.53E-06
UPR-200-E-74	2.67E-08	1.01E-06	1.64E-06	1.64E-06	1.65E-06	1.64E-06	1.64E-06	1.64E-06	1.65E-06	1.64E-06	1.64E-06	1.64E-06	4.95E-05	6.32E-05	6.32E-05	6.32E-05
UPR-200-E-75	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	4.17E-03	7.85E-03	7.83E-03	7.83E-03	7.83E-03	7.85E-03	7.83E-03	7.83E-03	7.83E-03

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
UPR-200-E-77	3.49E-07	3.48E-07	3.48E-07	3.48E-07	1.35E-04	1.73E-04	1.73E-04	1.73E-04	1.74E-04	1.73E-04	1.73E-04	1.73E-04	1.74E-04	1.73E-04	1.73E-04	1.73E-04
UPR-200-E-78	1.65E-07	1.65E-07	4.70E-06	1.09E-05	1.10E-05	1.09E-05	1.09E-05	1.09E-05	1.10E-05	1.09E-05	1.09E-05	1.09E-05	1.10E-05	8.36E-05	1.67E-04	1.67E-04
UPR-200-E-79	4.50E-02	4.49E-02	4.49E-02	4.49E-02	4.50E-02	4.49E-02	4.49E-02	4.49E-02	4.50E-02	4.49E-02	4.49E-02	8.09E-01	1.04E+00	1.03E+00	1.03E+00	1.03E+00
UPR-200-E-80	1.72E-03	1.72E-03	1.72E-03	1.72E-03	6.48E-01	8.34E-01	8.34E-01	8.34E-01	8.37E-01	8.34E-01	8.34E-01	8.34E-01	8.37E-01	8.34E-01	8.34E-01	8.34E-01
UPR-200-E-81	7.32E+00	6.28E+00	4.97E+00	4.84E+00	3.63E+00	3.62E+00	3.62E+00	2.58E+00	2.56E+00	2.56E+00	2.56E+00	2.33E+00	1.80E+00	1.80E+00	1.80E+00	1.80E+00
UPR-200-E-82	5.17E-07	5.16E-07	5.16E-07	5.16E-07	5.17E-07	5.16E-07	5.16E-07	7.92E-05	2.03E+00	1.09E+00	7.10E-01	5.00E-01	4.25E-01	3.17E-01	3.17E-01	2.08E-01
UPR-200-E-84	3.43E-02	2.88E-02	2.88E-02	2.88E-02	2.89E-02	2.88E-02	2.88E-02	2.88E-02	2.89E-02	2.88E-02	2.88E-02	2.38E-02	2.13E-02	2.12E-02	2.12E-02	2.12E-02
UPR-200-E-85	6.90E-09	6.88E-09	6.88E-09	6.88E-09	6.90E-09	6.88E-09	6.88E-09	6.88E-09	6.90E-09	6.88E-09	6.88E-09	6.88E-09	6.90E-09	6.88E-09	6.88E-09	6.88E-09
UPR-200-E-86	1.79E-03	1.78E-03	1.78E-03	1.78E-03	1.79E-03	1.78E-03	1.78E-03	1.78E-03	1.79E-03	1.78E-03	1.78E-03	1.78E-03	1.79E-03	1.78E-03	1.78E-03	1.78E-03
UPR-200-E-87	5.02E-04	5.00E-04	5.00E-04	5.00E-04	5.02E-04	5.00E-04	5.00E-04	1.79E-02	3.79E-02	3.78E-02	3.78E-02	3.78E-02	3.79E-02	3.78E-02	3.78E-02	3.78E-02
UPR-200-E-9	1.27E-05	1.26E-05	3.60E-04	8.37E-04	8.39E-04	8.37E-04	8.37E-04	8.37E-04	8.39E-04	8.37E-04	8.37E-04	8.37E-04	8.39E-04	6.33E-03	1.26E-02	1.26E-02
UPR-200-W-10	1.07E-04	1.07E-04	1.07E-04	1.07E-04	1.07E-04	1.07E-04	1.07E-04	1.07E-04	1.07E-04	1.07E-04	1.26E-03	2.57E-03	2.58E-03	2.57E-03	2.57E-03	2.57E-03
UPR-200-W-100	1.90E-02	1.24E-01	1.24E-01	1.24E-01	1.25E-01	1.24E-01	1.24E-01	1.24E-01	1.25E-01	1.24E-01	1.24E-01	1.24E-01	1.56E+00	1.97E+00	1.97E+00	1.97E+00
UPR-200-W-101	1.31E-05	1.30E-05	1.30E-05	1.22E-03	8.34E-03	8.32E-03	8.32E-03	8.32E-03	8.34E-03	8.32E-03	8.32E-03	8.32E-03	8.34E-03	8.32E-03	8.32E-03	3.61E-02
UPR-200-W-102	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.74E-05	3.90E-05	3.89E-05	3.89E-05	3.89E-05
UPR-200-W-107	4.11E+03	3.64E+03	3.64E+03	3.64E+03	3.65E+03	3.64E+03	3.64E+03	3.64E+03	3.65E+03	2.67E+03	2.54E+03	2.54E+03	2.55E+03	2.54E+03	2.54E+03	2.54E+03
UPR-200-W-115	3.11E-07	3.10E-07	3.10E-07	3.10E-07	3.11E-07	3.10E-07	3.10E-07	3.10E-07	3.11E-07	3.10E-07	3.10E-07	3.10E-07	3.11E-07	3.10E-07	3.10E-07	3.10E-07
UPR-200-W-12	1.37E-04	1.37E-04	1.37E-04	1.37E-04	1.37E-04	1.37E-04	1.37E-04	1.37E-04	1.37E-04	1.81E-03	3.74E-03	3.74E-03	3.75E-03	3.74E-03	3.74E-03	3.74E-03
UPR-200-W-127	3.73E-10	3.72E-10	3.72E-10	3.72E-10	3.73E-10	3.72E-10	3.72E-10	3.72E-10	3.73E-10	3.72E-10	3.72E-10	3.72E-10	3.73E-10	3.72E-10	3.72E-10	3.72E-10
UPR-200-W-128	1.07E+00	8.74E-01	8.59E-01	5.78E-01	5.79E-01	5.78E-01	4.04E-01	3.70E-01	3.71E-01	3.70E-01	3.68E-01	2.38E-01	2.39E-01	2.38E-01	2.38E-01	2.38E-01
UPR-200-W-129	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.13E-09	2.69E-07	6.03E-07	6.05E-07	6.03E-07	6.03E-07	6.03E-07
UPR-200-W-13	2.59E-02	2.59E-02	2.59E-02	2.59E-02	2.59E-02	2.59E-02	2.59E-02	2.59E-02	2.59E-02	2.59E-02	4.16E-01	8.63E-01	8.66E-01	8.63E-01	8.63E-01	8.63E-01
UPR-200-W-131	1.02E-04	1.02E-04	1.02E-04	1.02E-04	1.02E-04	1.02E-04	1.02E-04	1.02E-04	1.02E-04	1.02E-04	1.02E-04	1.67E-03	2.13E-03	2.13E-03	2.13E-03	2.13E-03
UPR-200-W-132	2.03E-06	2.03E-06	2.03E-06	9.81E-04	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	1.04E-03	3.91E-03	7.20E-03
UPR-200-W-135	8.47E-02	7.49E-02	5.85E-02	5.85E-02	5.86E-02	5.85E-02	5.85E-02	5.85E-02	5.86E-02	5.85E-02	5.85E-02	5.85E-02	5.67E-02	4.76E-02	4.76E-02	4.76E-02
UPR-200-W-138	8.07E-06	8.05E-06	8.05E-06	8.05E-06	8.07E-06	8.05E-06	8.05E-06	8.05E-06	8.07E-06	8.05E-06	8.05E-06	1.69E-04	2.17E-04	2.16E-04	2.16E-04	2.16E-04
UPR-200-W-139	2.89E-02	2.88E-02	2.88E-02	2.88E-02	2.89E-02	2.88E-02	2.88E-02	2.88E-02	2.89E-02	2.88E-02	2.88E-02	6.18E-01	7.93E-01	7.90E-01	7.90E-01	7.90E-01
UPR-200-W-14	2.84E-04	2.84E-04	2.84E-04	2.84E-04	2.84E-04	2.84E-04	2.84E-04	2.84E-04	2.84E-04	2.84E-04	2.51E-03	5.06E-03	5.08E-03	5.06E-03	5.06E-03	5.06E-03
UPR-200-W-15	2.59E-02	2.58E-02	2.58E-02	2.58E-02	2.59E-02	2.58E-02	2.58E-02	2.58E-02	2.59E-02	2.58E-02	4.16E-01	8.63E-01	8.65E-01	8.63E-01	8.63E-01	8.63E-01
UPR-200-W-163	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05
UPR-200-W-19	7.73E-05	7.71E-05	7.71E-05	7.71E-05	7.73E-05	7.71E-05	7.71E-05	7.71E-05	7.73E-05	7.71E-05	7.71E-05	1.64E-03	2.10E-03	2.09E-03	2.09E-03	2.09E-03
UPR-200-W-2	5.26E-04	5.24E-04	5.24E-04	5.24E-04	5.26E-04	5.44E-03	1.11E-02	1.11E-02	1.11E-02	1.11E-02	1.11E-02	1.11E-02	1.11E-02	1.11E-02	1.11E-02	1.11E-02
UPR-200-W-20	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03	2.92E-02	3.74E-02	3.73E-02	3.73E-02	3.73E-02
UPR-200-W-21	1.35E-01	1.34E-01	1.34E-01	1.34E-01	1.35E-01	1.34E-01	1.34E-01	1.34E-01	1.35E-01	1.34E-01	1.34E-01	2.21E+00	2.82E+00	2.81E+00	2.81E+00	2.81E+00
UPR-200-W-24	6.71E-01	6.70E-01	6.70E-01	6.70E-01	6.71E-01	6.70E-01	6.70E-01	6.70E-01	6.71E-01	6.70E-01	6.70E-01	1.44E+01	1.84E+01	1.84E+01	1.84E+01	1.84E+01
UPR-200-W-28	4.26E-03	2.80E-02	2.80E-02	2.80E-02	2.80E-02	2.80E-02	2.80E-02	2.80E-02	2.80E-02	2.80E-02	2.80E-02	2.80E-02	3.53E-01	4.46E-01	4.46E-01	4.46E-01
UPR-200-W-29	5.51E-01	3.64E+00	3.64E+00	3.64E+00	3.65E+00	3.64E+00	3.64E+00	3.64E+00	3.65E+00	3.64E+00	3.64E+00	3.64E+00	2.13E+01	2.64E+01	2.64E+01	2.64E+01
UPR-200-W-32	7.85E-02	7.83E-02	7.83E-02	7.83E-02	7.85E-02	7.83E-02	7.83E-02	6.84E-02	5.58E-02	5.56E-02	5.56E-02	5.56E-02	5.58E-02	5.56E-02	5.56E-02	5.56E-02
UPR-200-W-33	3.27E-07	3.26E-07	2.08E-04	2.20E-04	2.21E-04	2.20E-04	2.20E-04	2.20E-04	2.21E-04	2.20E-04	2.20E-04	2.20E-04	2.21E-04	1.19E-03	2.30E-03	2.30E-03
UPR-200-W-35	6.27E-02	6.25E-02	6.25E-02	6.18E-02	6.19E-02	6.18E-02	6.18E-02	6.18E-02	6.19E-02	6.18E-02	6.18E-02	6.18E-02	6.19E-02	6.18E-02	5.96E-02	5.30E-02
UPR-200-W-38	3.70E-04	3.69E-04	5.65E-02	5.99E-02	6.01E-02	5.99E-02	5.99E-02	5.99E-02	6.01E-02	5.99E-02	5.99E-02	5.99E-02	6.01E-02	3.14E-01	6.04E-01	6.04E-01

Site	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
UPR-200-W-39	9.14E-04	5.99E-03	5.99E-03	5.99E-03	6.01E-03	5.99E-03	5.99E-03	5.99E-03	6.01E-03	5.99E-03	5.99E-03	5.99E-03	7.42E-02	9.38E-02	9.38E-02	9.38E-02
UPR-200-W-49	1.00E-05	9.98E-06	9.98E-06	9.98E-06	1.05E-03	7.01E-03	7.01E-03	7.01E-03	7.03E-03	7.01E-03	7.01E-03	7.01E-03	7.03E-03	7.01E-03	7.01E-03	7.01E-03
UPR-200-W-5	4.16E-02	4.68E-02	4.68E-02	4.68E-02	4.70E-02	4.68E-02	4.68E-02	4.68E-02	4.70E-02	4.68E-02	4.68E-02	4.68E-02	4.70E-02	4.56E-02	4.47E-02	4.47E-02
UPR-200-W-51	2.40E-06	2.39E-06	2.39E-06	2.39E-06	2.66E-04	1.78E-03	1.78E-03	1.78E-03	1.78E-03	1.78E-03	1.78E-03	1.78E-03	1.78E-03	1.78E-03	1.78E-03	1.78E-03
UPR-200-W-59	1.24E-05	1.23E-05	1.23E-05	1.23E-05	1.72E-03	2.97E-03	2.97E-03	2.97E-03	2.97E-03	2.97E-03	2.97E-03	2.69E-01	1.84E+00	1.84E+00	1.84E+00	1.84E+00
UPR-200-W-6	1.86E-04	1.85E-04	1.85E-04	1.85E-04	1.86E-04	1.85E-04	1.85E-04	1.85E-04	4.55E-03	5.81E-03	5.81E-03	5.81E-03	5.83E-03	5.81E-03	5.81E-03	5.81E-03
UPR-200-W-61	3.21E-09	3.20E-09	3.20E-09	3.20E-09	3.21E-09	4.57E-07	7.90E-07	7.90E-07	7.92E-07	7.90E-07	7.90E-07	7.90E-07	4.58E-05	3.05E-04	3.05E-04	3.05E-04
UPR-200-W-82	1.39E-10	1.38E-10	1.38E-10	1.38E-10	1.39E-10	1.38E-10	1.38E-10	1.38E-10	1.39E-10	1.38E-10	1.38E-10	1.38E-10	1.39E-10	1.38E-10	1.38E-10	1.38E-10
UPR-200-W-87	3.64E-10	3.63E-10	3.63E-10	3.63E-10	3.64E-10	3.63E-10	3.63E-10	3.63E-10	3.64E-10	3.63E-10	3.63E-10	3.63E-10	3.64E-10	3.63E-10	3.63E-10	3.63E-10
UPR-200-W-95	2.99E-03	2.99E-03	2.99E-03	2.99E-03	2.99E-03	1.89E-01	4.80E-01	4.80E-01	4.81E-01	4.80E-01	4.80E-01	4.80E-01	4.81E-01	4.80E-01	4.80E-01	4.80E-01
UPR-200-W-96	4.74E-08	4.72E-08	4.72E-08	4.72E-08	4.74E-08	4.72E-08	4.72E-08	4.72E-08	7.29E-06	1.26E-05	1.26E-05	1.26E-05	1.26E-05	1.26E-05	1.26E-05	6.34E-05
UPR-200-W-97	9.98E-08	1.43E-07	1.43E-07	1.43E-07	1.44E-07	7.16E-05	9.81E-05	9.81E-05	9.84E-05	9.81E-05	9.81E-05	9.81E-05	1.75E-03	1.13E-02	1.13E-02	1.13E-02
UPR-200-W-98	1.29E-03	1.29E-03	1.29E-03	1.26E-02	1.60E-02	1.60E-02	1.60E-02	1.60E-02	1.60E-02	1.60E-02	1.60E-02	1.60E-02	1.60E-02	1.60E-02	1.60E-02	1.60E-02
UPR-300-4	4.37E+01	4.36E+01	4.36E+01	4.36E+01	4.37E+01	4.36E+01	4.26E+01	3.87E+01	3.88E+01	3.87E+01	3.87E+01	3.87E+01	3.88E+01	3.87E+01	3.87E+01	3.87E+01
US_Ecology	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
216-U-1%2-Fast	8.14E+00	8.12E+00	8.12E+00	8.12E+00	8.14E+00	8.12E+00	8.12E+00	8.12E+00	0.00E+00	0.00E+00	0.00E+00
100-B-5	4.37E+00	4.36E+00	4.36E+00	4.36E+00	4.37E+00	4.35E+00	4.35E+00	4.35E+00	4.36E+00	4.35E+00	4.35E+00
100-D-3	1.55E+01	1.55E+01	1.55E+01	1.55E+01	1.55E+01	1.55E+01	1.55E+01	1.55E+01	1.55E+01	1.55E+01	1.54E+01
100-D-32	3.59E+00	3.59E+00	3.59E+00	3.59E+00	3.60E+00	3.59E+00	3.59E+00	3.59E+00	3.60E+00	3.59E+00	3.58E+00
100-D-40	1.82E+00	1.81E+00	1.81E+00	1.81E+00	1.82E+00	1.81E+00	1.81E+00	1.81E+00	1.82E+00	1.81E+00	1.81E+00
100-D-47	6.15E+01	6.13E+01	6.13E+01	6.13E+01	6.15E+01	6.13E+01	6.13E+01	6.13E+01	6.15E+01	6.13E+01	6.11E+01
100-F-25	7.45E-02	7.43E-02	7.43E-02	7.43E-02	7.45E-02	7.43E-02	7.43E-02	7.41E-02	7.39E-02	7.37E-02	7.04E-02
100-H-10	6.11E-02	6.10E-02	6.10E-02	6.10E-02	6.11E-02	6.10E-02	6.10E-02	6.10E-02	6.11E-02	6.09E-02	4.87E-02
100-H-5	7.93E+01	7.91E+01	7.91E+01	7.91E+01	7.93E+01	7.91E+01	7.91E+01	7.91E+01	7.93E+01	7.48E+01	4.40E+01
100-H-7	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02	2.11E-02
100-H-8	3.09E-02	3.08E-02	3.08E-02	3.08E-02	3.09E-02	3.08E-02	3.08E-02	3.08E-02	3.09E-02	3.08E-02	3.08E-02
100-H-9	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02	1.45E-02
100-K-2	1.52E+01	1.51E+01	1.51E+01	1.51E+01	1.52E+01	1.51E+01	1.51E+01	1.51E+01	1.52E+01	1.51E+01	1.51E+01
100-K-5	5.01E-02	4.99E-02	4.99E-02	4.99E-02	5.01E-02	4.99E-02	4.99E-02	4.97E-02	4.73E-02	4.72E-02	3.49E-02
100-N-60	3.18E-02	3.17E-02	2.88E-02	2.13E-02	2.13E-02	2.13E-02	2.11E-02	1.95E-02	1.70E-02	1.70E-02	1.13E-02
100-N-66	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
116-B-1	8.11E+01	8.09E+01	8.09E+01	8.09E+01	8.11E+01	8.08E+01	8.08E+01	8.07E+01	8.07E+01	7.83E+01	4.59E+01
116-B-2	1.09E+00	1.08E+00	1.08E+00	1.08E+00	1.09E+00	1.08E+00	1.08E+00	1.08E+00	1.08E+00	1.05E+00	6.16E-01
116-B-3	3.66E-01	3.65E-01	3.64E-01	3.64E-01	3.65E-01	3.64E-01	3.64E-01	3.64E-01	3.64E-01	3.53E-01	2.07E-01
116-B-4	9.99E-02	9.96E-02	9.96E-02	9.95E-02	9.87E-02	9.79E-02	9.66E-02	9.48E-02	8.96E-02	8.11E-02	3.02E-02
116-B-5	1.05E+00	1.05E+00	1.05E+00	1.05E+00	1.05E+00	1.04E+00	1.03E+00	1.01E+00	9.59E-01	8.68E-01	3.23E-01
116-B-6B	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.16E-01	6.80E-02
116-C-1	2.29E+02	2.28E+02	2.28E+02	2.28E+02	2.28E+02	2.25E+02	2.21E+02	2.17E+02	2.05E+02	1.85E+02	6.90E+01
116-C-2A	1.33E+00	1.33E+00	1.33E+00	1.33E+00	1.33E+00	1.33E+00	1.33E+00	1.32E+00	1.31E+00	1.27E+00	7.41E-01
116-C-2C	5.45E-01	5.43E-01	5.43E-01	5.43E-01	5.45E-01	5.43E-01	5.43E-01	5.41E-01	5.37E-01	5.20E-01	3.04E-01
116-D-1A	1.89E+00	1.89E+00	1.88E+00	1.88E+00	1.89E+00	1.88E+00	1.88E+00	1.88E+00	1.88E+00	1.88E+00	1.82E+00
116-D-1B	1.47E+00	1.47E+00	1.47E+00	1.47E+00	1.47E+00	1.47E+00	1.47E+00	1.47E+00	1.46E+00	1.45E+00	1.40E+00
116-DR-1%2	2.03E+02	2.03E+02	2.02E+02	2.01E+02	2.02E+02	2.01E+02	2.01E+02	2.01E+02	2.02E+02	2.00E+02	1.49E+02
116-DR-3	3.46E+00	3.45E+00	3.45E+00	3.45E+00	3.46E+00	3.45E+00	3.45E+00	3.45E+00	3.45E+00	3.44E+00	3.15E+00
116-F-1	4.27E+02	4.25E+02	4.25E+02	4.25E+02	4.27E+02	4.25E+02	4.25E+02	4.25E+02	4.26E+02	4.25E+02	3.27E+02
116-F-10	4.03E-02	4.01E-02	4.00E-02	4.00E-02	4.01E-02	4.00E-02	4.00E-02	4.00E-02	4.01E-02	4.00E-02	3.07E-02
116-F-11	3.23E-02	3.21E-02	3.21E-02	3.21E-02	3.22E-02	3.21E-02	3.21E-02	3.21E-02	3.21E-02	3.21E-02	2.47E-02
116-F-2	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	1.92E+02
116-F-3	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	1.21E+01	9.31E+00
116-F-4	3.68E-01	3.67E-01	3.67E-01	3.67E-01	3.68E-01	3.67E-01	3.67E-01	3.67E-01	3.68E-01	3.67E-01	3.41E-01
116-F-6	1.12E+02	1.11E+02	1.11E+02	1.11E+02	1.12E+02	1.11E+02	1.11E+02	1.11E+02	1.12E+02	1.11E+02	8.56E+01
116-H-1	4.54E+02	4.53E+02	4.53E+02	4.53E+02	4.54E+02	4.53E+02	4.53E+02	4.53E+02	4.54E+02	4.29E+02	1.89E+02
116-H-2	2.68E+01	2.68E+01	2.68E+01	2.68E+01	2.68E+01	2.68E+01	2.68E+01	2.68E+01	2.68E+01	2.53E+01	1.49E+01
116-H-3	3.01E-02	3.01E-02	3.01E-02	3.01E-02	3.01E-02	3.01E-02	3.01E-02	3.01E-02	3.01E-02	2.84E-02	1.67E-02
116-H-7	8.37E+02	8.35E+02	8.35E+02	8.35E+02	8.37E+02	8.35E+02	8.35E+02	8.35E+02	8.37E+02	7.90E+02	4.65E+02
116-K-2	3.78E+03	3.77E+03	3.77E+03	3.77E+03	3.78E+03	3.77E+03	3.77E+03	3.74E+03	3.72E+03	3.71E+03	2.96E+03

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
116-KE-1	1.90E+00	1.89E+00	1.89E+00	1.89E+00	1.90E+00	1.89E+00	1.88E+00	1.86E+00	1.82E+00	1.82E+00	1.36E+00
116-KE-2	4.14E-01	4.13E-01	4.04E-01	3.87E-01	3.88E-01	3.87E-01	3.87E-01	3.87E-01	3.77E-01	3.76E-01	3.03E-01
116-KE-3	3.74E+03	3.73E+03	3.73E+03	3.73E+03	3.74E+03	3.73E+03	3.73E+03	3.73E+03	3.74E+03	3.73E+03	2.12E+03
116-KW-2	8.54E+02	8.52E+02	8.52E+02	8.52E+02	8.54E+02	8.52E+02	8.52E+02	8.52E+02	8.55E+02	8.52E+02	4.85E+02
116-N-1	3.12E+03	2.45E+03	2.21E+03	2.21E+03	2.21E+03	1.93E+03	1.91E+03	1.91E+03	1.75E+03	1.75E+03	1.42E+03
116-N-3	2.87E+04	3.34E+03	1.52E+03	9.11E+02	7.87E+02	5.40E+02	5.40E+02	4.95E+02	3.92E+02	3.91E+02	2.64E+02
116-N-4	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.51E+02	1.39E+02
118-B-6	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.16E-01	2.15E-01
118-B-7	9.45E-02	9.43E-02	9.43E-02	9.43E-02	9.45E-02	9.43E-02	9.43E-02	9.43E-02	9.45E-02	9.43E-02	9.40E-02
118-B-8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-C-1	2.94E+02	2.94E+02	2.94E+02	2.94E+02	2.94E+02	2.94E+02	2.94E+02	2.94E+02	2.94E+02	2.94E+02	2.93E+02
118-C-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-C-4	1.44E+00	1.43E+00	1.43E+00	1.43E+00	1.44E+00	1.43E+00	1.43E+00	1.43E+00	1.44E+00	1.43E+00	1.43E+00
118-D-2	5.19E+02	5.18E+02	5.18E+02	5.18E+02	5.19E+02	5.18E+02	5.18E+02	5.18E+02	5.19E+02	5.18E+02	5.17E+02
118-D-3	3.61E+02	3.60E+02	3.60E+02	3.60E+02	3.61E+02	3.60E+02	3.60E+02	3.60E+02	3.61E+02	3.60E+02	3.59E+02
118-D-4	1.73E+02	1.73E+02	1.73E+02	1.73E+02	1.73E+02	1.73E+02	1.73E+02	1.73E+02	1.73E+02	1.73E+02	1.72E+02
118-DR-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-F-1	1.12E+02	1.11E+02	1.11E+02	1.11E+02	1.12E+02	1.11E+02	1.11E+02	1.11E+02	1.12E+02	1.11E+02	1.11E+02
118-F-4	3.69E-01	3.68E-01	3.68E-01	3.68E-01	3.69E-01	3.68E-01	3.68E-01	3.68E-01	3.69E-01	3.68E-01	3.67E-01
118-F-8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-H-1	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03	1.22E+03
118-H-6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-K-1	1.04E+03	1.04E+03	1.04E+03	1.04E+03	1.04E+03	1.04E+03	1.04E+03	1.04E+03	1.04E+03	1.04E+03	1.03E+03
118-KE-1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-KW-1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
118-KW-2	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.43E+00
200-E-100	4.40E+00	4.39E+00	4.39E+00	4.38E+00	4.40E+00	4.39E+00	4.39E+00	1.46E+00	3.14E-01	1.68E-01	1.12E-01
200-E-102	2.56E+00	2.56E+00	2.56E+00	2.29E+00	2.26E+00	2.25E+00	2.25E+00	2.25E+00	1.93E+00	1.93E+00	1.90E+00
200-E-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-25	1.01E+00	4.34E-01	2.02E-01	1.79E-01	8.82E-02	8.79E-02	8.16E-02	6.57E-02	4.26E-02	4.25E-02	3.69E-02
200-E-28	3.92E+01	2.02E+01	1.09E+01	9.57E+00	6.05E+00	6.03E+00	4.92E+00	4.40E+00	3.07E+00	3.06E+00	2.43E+00
200-E-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-54	9.00E+01	2.23E+01	1.19E+01	8.27E+00	5.26E+00	4.97E+00	3.50E+00	3.50E+00	2.29E+00	2.28E+00	2.19E+00
200-E-55	4.50E+00	4.49E+00	4.49E+00	4.49E+00	4.50E+00	4.37E+00	3.25E+00	2.23E+00	1.28E+00	1.13E+00	6.99E-01
200-E-56	5.48E-01	5.22E-01	5.22E-01	5.22E-01	5.24E-01	5.22E-01	5.22E-01	5.22E-01	4.63E-01	4.62E-01	3.94E-01
200-E-57	3.04E-01	3.04E-01	3.04E-01	3.04E-01	3.04E-01	3.04E-01	3.04E-01	3.04E-01	2.55E-01	2.55E-01	2.09E-01
200-E-60	6.28E-02	5.63E-02	5.36E-02	5.36E-02	5.37E-02	5.36E-02	5.36E-02	5.36E-02	5.09E-02	5.08E-02	4.82E-02
200-E-61	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-62	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
200-E-64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-65	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	5.19E-05	1.16E-04
200-E-67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-68	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	4.15E-07	4.15E-07	4.15E-07	4.16E-07	5.19E-05	1.16E-04
200-E-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-70	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	5.70E-04	9.32E-03
200-E-71	2.64E-05	2.63E-05	2.63E-05	2.63E-05	2.64E-05	2.63E-05	2.63E-05	2.63E-05	2.64E-05	4.42E-04	7.22E-03
200-E-72	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	5.70E-04	9.32E-03
200-E-73	5.86E-07	5.84E-07	5.84E-07	5.84E-07	5.86E-07	5.84E-07	5.84E-07	5.84E-07	5.86E-07	7.30E-05	1.63E-04
200-E-74	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	5.70E-04	9.32E-03
200-E-75	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	3.40E-05	3.40E-05	3.40E-05	3.41E-05	5.70E-04	9.32E-03
200-E-76	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-77	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-80	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-81	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-84	9.44E-07	9.42E-07	9.42E-07	9.42E-07	9.44E-07	9.42E-07	9.42E-07	9.42E-07	9.44E-07	1.18E-04	2.63E-04
200-E-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
200-E-88	3.08E+02	4.04E+02	4.29E+02	4.34E+02	4.36E+02	4.35E+02	4.35E+02	4.35E+02	4.36E+02	4.35E+02	3.68E+02
200-E-89	2.09E+02	2.57E+02	2.69E+02	2.71E+02	2.73E+02	2.72E+02	2.72E+02	2.72E+02	2.73E+02	2.72E+02	2.30E+02
200-E-90	2.44E+02	3.09E+02	3.25E+02	3.28E+02	3.30E+02	3.29E+02	3.29E+02	3.29E+02	3.30E+02	3.29E+02	2.78E+02
200-E-91	1.07E+02	1.16E+02	1.18E+02	1.18E+02	1.18E+02	1.18E+02	1.18E+02	1.18E+02	1.18E+02	1.18E+02	9.97E+01
200-E-92	1.53E+02	1.77E+02	1.82E+02	1.83E+02	1.84E+02	1.84E+02	1.84E+02	1.84E+02	1.84E+02	1.84E+02	1.55E+02
200-E-93	2.05E+02	2.51E+02	2.62E+02	2.65E+02	2.66E+02	2.65E+02	2.65E+02	2.65E+02	2.66E+02	2.65E+02	2.24E+02
200-E-94	3.08E+02	4.04E+02	4.29E+02	4.34E+02	4.36E+02	4.35E+02	4.35E+02	4.35E+02	4.36E+02	4.35E+02	3.68E+02
200-E-95	4.40E+00	4.39E+00	4.38E+00	9.51E-01	1.90E-01	9.13E-02	6.19E-02	4.70E-02	2.87E-02	2.86E-02	2.02E-02
200-E-97	4.40E+00	4.39E+00	4.39E+00	4.37E+00	4.40E+00	4.38E+00	9.54E-01	1.79E-01	8.59E-02	5.46E-02	3.99E-02
200-E-98	3.70E+00	3.69E+00	3.69E+00	3.69E+00	3.70E+00	2.95E+00	1.66E+00	1.03E+00	6.17E-01	4.03E-01	3.45E-01
200-E-99	4.43E+00	4.42E+00	4.42E+00	4.42E+00	4.43E+00	4.42E+00	4.42E+00	2.60E+00	1.17E+00	6.89E-01	4.26E-01
200-W-22	7.03E-04	7.01E-04	3.65E-03	3.29E-02	3.30E-02	3.29E-02	3.29E-02	3.29E-02	2.43E+00	2.43E+00	2.41E+00
200-W-42	2.03E-05	2.03E-05	2.03E-05	9.30E-04	7.04E-03	7.03E-03	7.03E-03	7.04E-03	8.92E-02	8.90E-02	8.82E-02
200-W-52	3.40E+01	3.39E+01	3.39E+01	3.39E+01	3.40E+01	3.39E+01	3.39E+01	3.39E+01	2.99E+01	2.98E+01	2.98E+01
200-W-9	1.66E-11	1.65E-11	1.65E-11	1.65E-11	1.66E-11	1.65E-11	1.62E-08	3.15E-08	1.07E-05	3.52E-03	4.71E-03
2101-M-POND	2.60E+04	2.60E+04	2.59E+04	2.24E+04	1.00E+04	2.85E+03	1.60E+03	1.17E+03	7.59E+02	5.93E+02	4.86E+02
216-A-10	3.50E+03	2.02E+03	2.02E+03	2.02E+03	1.30E+03	1.24E+03	1.24E+03	1.24E+03	7.60E+02	7.58E+02	7.16E+02
216-A-11	5.45E-02	3.74E-02	3.74E-02	3.74E-02	3.75E-02	3.74E-02	3.74E-02	3.74E-02	2.66E-02	2.66E-02	2.47E-02
216-A-12	4.22E-02	4.21E-02	4.21E-02	4.21E-02	4.22E-02	4.17E-02	3.73E-02	3.73E-02	2.73E-02	2.72E-02	2.56E-02
216-A-13	4.35E-02	4.34E-02	4.34E-02	3.89E-02	3.73E-02	3.72E-02	3.72E-02	3.72E-02	3.07E-02	3.07E-02	2.60E-02
216-A-14	1.21E-02	1.21E-02	1.21E-02	1.21E-02	1.21E-02	1.21E-02	1.21E-02	1.25E-02	2.13E-02	2.13E-02	1.76E-02

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
216-A-15	7.14E-01	7.12E-01	7.12E-01	6.21E-01	5.67E-01	5.65E-01	5.65E-01	5.65E-01	4.43E-01	4.42E-01	4.34E-01
216-A-16	7.50E-02	7.38E-02	7.38E-02	7.38E-02	7.40E-02	7.38E-02	7.38E-02	7.38E-02	5.55E-02	5.53E-02	5.11E-02
216-A-17	8.47E-02	8.45E-02	8.45E-02	8.45E-02	8.47E-02	7.76E-02	7.42E-02	7.42E-02	5.59E-02	5.58E-02	5.12E-02
216-A-2	2.29E+00	1.98E+00	1.98E+00	1.98E+00	1.98E+00	1.98E+00	1.98E+00	1.98E+00	1.75E+00	1.75E+00	1.52E+00
216-A-20	3.30E+00	3.29E+00	3.29E+00	3.29E+00	3.15E+00	3.05E+00	3.05E+00	3.05E+00	2.69E+00	2.69E+00	2.46E+00
216-A-21	2.05E+01	2.04E+01	1.77E+01	1.66E+01	1.66E+01	1.66E+01	1.66E+01	1.66E+01	1.35E+01	1.35E+01	1.21E+01
216-A-22	2.07E-04	2.06E-04	2.06E-04	2.06E-04	2.07E-04	2.06E-04	2.06E-04	2.06E-04	3.79E-02	4.93E-02	4.06E-02
216-A-23A	6.89E-02	6.87E-02	6.87E-02	5.96E-02	5.82E-02	5.81E-02	5.81E-02	5.81E-02	4.94E-02	4.92E-02	4.68E-02
216-A-23B	6.88E-02	6.86E-02	6.86E-02	5.95E-02	5.81E-02	5.80E-02	5.80E-02	5.80E-02	4.93E-02	4.91E-02	4.67E-02
216-A-24	3.24E+02	3.23E+02	3.23E+02	3.23E+02	2.88E+02	2.84E+02	2.84E+02	2.84E+02	2.50E+02	2.50E+02	2.12E+02
216-A-25	1.67E+04	1.62E+04	1.59E+04	1.55E+04	1.56E+04	1.55E+04	1.54E+04	1.54E+04	1.54E+04	1.53E+04	1.27E+04
216-A-26	2.14E-06	2.13E-06	2.13E-06	2.13E-06	2.14E-06	3.46E-04	1.79E-02	4.71E-02	1.39E-01	1.38E-01	1.34E-01
216-A-26A	2.18E-06	2.17E-06	2.17E-06	2.17E-06	2.18E-06	2.17E-06	2.17E-06	2.17E-06	3.98E-04	5.19E-04	4.30E-04
216-A-27	1.73E+01	1.72E+01	1.72E+01	1.72E+01	1.73E+01	1.68E+01	1.54E+01	1.54E+01	1.14E+01	1.14E+01	1.09E+01
216-A-28	1.27E-03	1.26E-03	1.26E-03	1.26E-03	1.27E-03	1.26E-03	1.26E-03	1.26E-03	2.34E-01	3.04E-01	2.43E-01
216-A-3	8.04E+00	5.06E+00	5.06E+00	5.06E+00	5.08E+00	5.06E+00	5.06E+00	4.81E+00	3.37E+00	3.36E+00	3.13E+00
216-A-30	1.39E+05	8.76E+04	5.02E+04	4.59E+04	2.55E+04	2.54E+04	2.39E+04	1.98E+04	1.32E+04	1.32E+04	1.19E+04
216-A-31	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-35	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-36A	1.28E-02	1.27E-02	1.27E-02	1.27E-02	1.28E-02	1.27E-02	1.27E-02	1.27E-02	2.33E+00	3.04E+00	2.51E+00
216-A-36B	4.65E+02	4.43E+02	4.43E+02	4.43E+02	4.44E+02	4.28E+02	4.18E+02	4.18E+02	3.73E+02	3.72E+02	3.66E+02
216-A-37-1	1.31E+03	1.16E+03	5.87E+02	5.87E+02	5.17E+02	3.33E+02	3.33E+02	3.33E+02	1.93E+02	1.92E+02	1.85E+02
216-A-37-2	3.05E+04	8.34E+03	4.21E+03	2.80E+03	2.11E+03	1.51E+03	1.24E+03	1.24E+03	7.32E+02	7.30E+02	7.30E+02
216-A-39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-4	2.45E+00	2.32E+00	2.08E+00	2.08E+00	2.08E+00	2.08E+00	2.08E+00	2.08E+00	1.79E+00	1.79E+00	1.79E+00
216-A-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-A-45	1.93E+03	1.74E+03	9.26E+02	9.26E+02	8.20E+02	5.41E+02	5.41E+02	5.41E+02	3.19E+02	3.18E+02	3.09E+02
216-A-5	3.51E+02	3.50E+02	3.50E+02	3.50E+02	3.51E+02	3.50E+02	3.50E+02	3.50E+02	2.73E+02	2.72E+02	2.72E+02
216-A-6	8.96E+02	8.93E+02	8.93E+02	8.93E+02	8.96E+02	8.32E+02	7.89E+02	7.89E+02	6.01E+02	6.00E+02	5.47E+02
216-A-7	6.33E-01	6.31E-01	6.31E-01	6.31E-01	6.33E-01	6.31E-01	6.31E-01	6.31E-01	4.86E-01	4.85E-01	4.40E-01
216-A-8	7.28E+02	6.11E+02	6.11E+02	6.11E+02	6.05E+02	5.35E+02	5.35E+02	5.35E+02	4.65E+02	4.64E+02	4.47E+02
216-A-9	4.66E+02	4.65E+02	4.65E+02	4.65E+02	4.66E+02	4.65E+02	4.65E+02	4.65E+02	4.20E+02	4.19E+02	3.78E+02
216-B-10A	1.79E+01	1.79E+01	1.79E+01	1.79E+01	1.79E+01	1.79E+01	1.79E+01	1.79E+01	1.45E+01	1.45E+01	1.45E+01
216-B-10B	9.12E-01	8.29E-01	6.65E-01	6.65E-01	6.66E-01	6.65E-01	6.65E-01	6.65E-01	4.78E-01	4.77E-01	3.38E-01
216-B-11A%B	3.75E+00	3.74E+00	3.74E+00	3.74E+00	3.75E+00	3.74E+00	3.74E+00	3.74E+00	3.07E+00	3.07E+00	2.72E+00
216-B-12	6.42E+01	4.82E+01	4.82E+01	4.82E+01	4.83E+01	4.82E+01	4.82E+01	4.82E+01	3.23E+01	3.22E+01	2.49E+01
216-B-13	7.17E-02	7.16E-02	7.16E-02	7.16E-02	6.54E-02	5.71E-02	5.71E-02	5.71E-02	4.12E-02	4.11E-02	3.64E-02
216-B-14	2.49E+02	2.18E+02	2.18E+02	2.18E+02	2.19E+02	2.18E+02	2.18E+02	2.13E+02	1.79E+02	1.79E+02	1.49E+02
216-B-15	2.44E+02	2.17E+02	2.17E+02	2.17E+02	2.18E+02	2.17E+02	2.17E+02	2.12E+02	1.79E+02	1.79E+02	1.49E+02

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
216-B-16	2.38E+02	2.16E+02	2.16E+02	2.16E+02	2.17E+02	2.16E+02	2.16E+02	2.12E+02	1.79E+02	1.79E+02	1.49E+02
216-B-17	8.37E+01	1.61E+02	1.61E+02	1.61E+02	1.62E+02	1.61E+02	1.62E+02	1.73E+02	1.70E+02	1.69E+02	1.68E+02
216-B-18	2.48E+02	2.18E+02	2.18E+02	2.18E+02	2.19E+02	2.18E+02	2.18E+02	2.13E+02	1.80E+02	1.79E+02	1.78E+02
216-B-19	2.42E+02	2.17E+02	2.17E+02	2.17E+02	2.18E+02	2.17E+02	2.17E+02	2.12E+02	1.79E+02	1.79E+02	1.78E+02
216-B-20	3.04E+02	3.01E+02	2.37E+02	2.37E+02	2.38E+02	2.37E+02	2.37E+02	2.37E+02	1.82E+02	1.81E+02	1.54E+02
216-B-21	3.03E+02	3.01E+02	2.36E+02	2.36E+02	2.37E+02	2.36E+02	2.36E+02	2.36E+02	1.81E+02	1.81E+02	1.54E+02
216-B-22	3.04E+02	3.01E+02	2.37E+02	2.37E+02	2.38E+02	2.37E+02	2.37E+02	2.37E+02	1.82E+02	1.81E+02	1.54E+02
216-B-23	3.09E+02	3.06E+02	2.33E+02	2.33E+02	2.33E+02	2.33E+02	2.33E+02	2.33E+02	1.76E+02	1.75E+02	1.74E+02
216-B-24	3.07E+02	3.04E+02	2.32E+02	2.32E+02	2.33E+02	2.32E+02	2.32E+02	2.32E+02	1.75E+02	1.75E+02	1.74E+02
216-B-25	3.06E+02	3.04E+02	2.32E+02	2.32E+02	2.33E+02	2.32E+02	2.32E+02	2.32E+02	1.75E+02	1.75E+02	1.74E+02
216-B-26	3.11E+02	3.08E+02	2.33E+02	2.33E+02	2.34E+02	2.33E+02	2.33E+02	2.33E+02	1.76E+02	1.75E+02	1.74E+02
216-B-27	3.09E+02	3.06E+02	2.32E+02	2.32E+02	2.33E+02	2.32E+02	2.32E+02	2.32E+02	1.75E+02	1.75E+02	1.74E+02
216-B-28	3.07E+02	3.04E+02	2.32E+02	2.32E+02	2.33E+02	2.32E+02	2.32E+02	2.32E+02	1.75E+02	1.75E+02	1.74E+02
216-B-29	3.13E+02	3.10E+02	2.40E+02	2.40E+02	2.41E+02	2.40E+02	2.40E+02	2.40E+02	1.83E+02	1.82E+02	1.61E+02
216-B-3	5.89E+06	4.77E+06	5.86E+06	5.46E+06	5.34E+06	3.21E+06	1.40E+06	8.33E+05	4.44E+05	3.93E+05	2.35E+05
216-B-30	3.14E+02	3.11E+02	2.40E+02	2.40E+02	2.41E+02	2.40E+02	2.40E+02	2.40E+02	1.83E+02	1.82E+02	1.61E+02
216-B-31	3.13E+02	3.10E+02	2.40E+02	2.40E+02	2.41E+02	2.40E+02	2.40E+02	2.40E+02	1.83E+02	1.82E+02	1.61E+02
216-B-32	3.13E+02	3.10E+02	2.40E+02	2.40E+02	2.41E+02	2.40E+02	2.40E+02	2.40E+02	1.83E+02	1.82E+02	1.61E+02
216-B-33	3.13E+02	3.10E+02	2.40E+02	2.40E+02	2.41E+02	2.40E+02	2.40E+02	2.40E+02	1.83E+02	1.82E+02	1.61E+02
216-B-34	3.08E+02	3.05E+02	2.32E+02	2.32E+02	2.33E+02	2.32E+02	2.32E+02	2.32E+02	1.75E+02	1.75E+02	1.74E+02
216-B-35	5.28E+00	5.26E+00	5.26E+00	5.26E+00	5.28E+00	5.26E+00	5.14E+00	5.05E+00	4.29E+00	4.28E+00	3.72E+00
216-B-36	5.46E+00	5.45E+00	5.45E+00	5.45E+00	5.46E+00	5.45E+00	5.18E+00	5.17E+00	4.35E+00	4.34E+00	3.77E+00
216-B-37	5.30E+00	5.29E+00	5.29E+00	5.29E+00	5.30E+00	5.29E+00	5.29E+00	5.29E+00	4.41E+00	4.40E+00	3.82E+00
216-B-38	5.12E+00	5.11E+00	5.11E+00	5.11E+00	5.12E+00	5.11E+00	5.11E+00	5.11E+00	4.32E+00	4.31E+00	3.75E+00
216-B-39	5.87E+00	5.86E+00	5.36E+00	5.06E+00	5.08E+00	5.06E+00	5.06E+00	5.06E+00	4.30E+00	4.28E+00	3.72E+00
216-B-4	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01	8.46E-01	8.44E-01	4.01E-01
216-B-40	5.19E+00	5.17E+00	5.17E+00	5.17E+00	5.19E+00	5.17E+00	5.17E+00	5.17E+00	4.36E+00	4.34E+00	3.78E+00
216-B-41	5.04E+00	5.02E+00	5.02E+00	5.02E+00	5.04E+00	5.02E+00	5.02E+00	5.02E+00	4.27E+00	4.26E+00	3.70E+00
216-B-42	5.12E+00	5.11E+00	5.11E+00	5.11E+00	5.12E+00	5.11E+00	5.11E+00	5.11E+00	4.22E+00	4.21E+00	3.77E+00
216-B-43	1.30E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	9.34E+00	9.31E+00	8.86E+00
216-B-44	1.43E+01	1.35E+01	1.19E+01	1.19E+01	1.20E+01	1.19E+01	1.19E+01	1.19E+01	9.77E+00	9.75E+00	8.00E+00
216-B-45	1.17E+01	1.17E+01	1.17E+01	1.17E+01	1.17E+01	1.17E+01	1.17E+01	1.17E+01	9.57E+00	9.54E+00	8.55E+00
216-B-46	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	9.71E+00	9.69E+00	8.68E+00
216-B-47	1.26E+01	1.25E+01	1.25E+01	1.25E+01	1.26E+01	1.17E+01	1.16E+01	1.16E+01	9.54E+00	9.51E+00	8.77E+00
216-B-48	1.16E+01	1.16E+01	1.16E+01	1.16E+01	1.16E+01	1.16E+01	1.16E+01	1.16E+01	9.53E+00	9.50E+00	8.97E+00
216-B-49	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	9.64E+00	9.61E+00	8.57E+00
216-B-5	2.33E-02	2.32E-02	2.32E-02	2.32E-02	2.33E-02	2.32E-02	2.32E-02	2.32E-02	5.33E-01	4.35E-01	0.00E+00
216-B-50	2.44E+01	2.19E+01	2.19E+01	2.19E+01	2.20E+01	2.19E+01	2.19E+01	2.19E+01	1.44E+01	1.43E+01	1.08E+01
216-B-51	1.01E-02	1.01E-02	1.01E-02	1.01E-02	1.01E-02	1.01E-02	1.01E-02	1.01E-02	2.40E-02	2.39E-02	1.66E-02
216-B-52	3.51E+02	3.48E+02	2.68E+02	2.68E+02	2.68E+02	2.68E+02	2.68E+02	2.68E+02	2.03E+02	2.02E+02	2.01E+02
216-B-53A	3.47E+01	3.38E+01	3.38E+01	3.38E+01	3.09E+01	2.87E+01	2.87E+01	2.87E+01	2.21E+01	2.20E+01	1.83E+01

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
216-B-53B	3.31E-04	3.30E-04	3.30E-04	3.30E-04	1.11E-01	2.24E+00	9.84E+00	1.41E+01	3.18E+01	3.82E+01	3.21E+01
216-B-54	6.11E+01	8.26E+01	9.16E+01	9.94E+01	9.97E+01	9.63E+01	9.30E+01	9.30E+01	7.74E+01	7.72E+01	5.48E+01
216-B-55	7.51E+02	5.02E+02	4.71E+02	3.00E+02	3.00E+02	2.76E+02	2.17E+02	2.17E+02	1.51E+02	1.50E+02	1.34E+02
216-B-57	3.86E+02	3.85E+02	3.67E+02	3.34E+02	3.08E+02	2.85E+02	2.68E+02	2.61E+02	2.35E+02	2.28E+02	1.98E+02
216-B-58	1.89E-04	1.89E-04	1.89E-04	9.48E-01	9.41E+00	2.06E+01	4.34E+01	4.36E+01	6.29E+01	6.27E+01	3.58E+01
216-B-59	1.53E-01	1.52E-01	7.10E-01	1.06E+00	1.06E+00	1.06E+00	1.06E+00	1.06E+00	6.71E+00	6.69E+00	4.23E+00
216-B-6	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.34E+00	1.34E+00	6.29E-01
216-B-60	1.59E-01	1.59E-01	1.59E-01	1.59E-01	1.48E-01	1.36E-01	1.36E-01	1.36E-01	1.05E-01	1.05E-01	8.52E-02
216-B-62	1.39E+02	1.16E+02	6.99E+01	6.99E+01	7.01E+01	6.67E+01	5.18E+01	5.18E+01	3.45E+01	3.44E+01	3.33E+01
216-B-63	3.48E+05	3.10E+05	1.50E+05	8.19E+04	6.17E+04	4.00E+04	3.91E+04	3.09E+04	2.09E+04	2.08E+04	1.48E+04
216-B-7A%B	3.93E+00	3.92E+00	3.92E+00	3.92E+00	3.92E+00	3.40E+00	3.40E+00	3.40E+00	2.53E+00	2.52E+00	1.96E+00
216-B-8	2.47E+00	2.46E+00	2.46E+00	2.46E+00	2.43E+00	2.26E+00	2.26E+00	2.26E+00	1.90E+00	1.89E+00	1.65E+00
216-B-9	3.63E+01	3.62E+01	3.62E+01	3.62E+01	3.63E+01	3.62E+01	3.62E+01	3.62E+01	3.04E+01	3.03E+01	2.63E+01
216-BY-201	2.43E-02	2.42E-02	2.42E-02	2.42E-02	2.43E-02	2.42E-02	2.42E-02	2.42E-02	1.93E-02	1.92E-02	1.73E-02
216-C-1	6.42E+00	6.41E+00	6.41E+00	6.41E+00	6.42E+00	6.41E+00	6.41E+00	6.40E+00	5.47E+00	5.46E+00	4.58E+00
216-C-10	1.39E+00	1.39E+00	1.31E+00	1.10E+00	1.10E+00	1.10E+00	1.10E+00	1.10E+00	8.76E-01	8.73E-01	8.06E-01
216-C-2	1.22E+02	1.12E+02	1.12E+02	1.07E+02	9.17E+01	9.15E+01	9.15E+01	9.15E+01	7.37E+01	7.35E+01	5.97E+01
216-C-3	2.85E+00	2.84E+00	2.84E+00	2.84E+00	2.85E+00	2.84E+00	2.84E+00	2.84E+00	2.54E+00	2.53E+00	2.30E+00
216-C-4	1.13E+00	1.12E+00	1.12E+00	1.12E+00	1.13E+00	1.12E+00	1.12E+00	1.12E+00	9.10E-01	9.08E-01	8.25E-01
216-C-6	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00	1.20E+00	9.44E-01	9.42E-01	9.29E-01
216-C-8	4.28E-02	1.51E-01	1.51E-01	1.51E-01	1.52E-01	1.51E-01	1.51E-01	1.51E-01	2.09E-01	2.08E-01	1.39E-01
216-C-9	9.02E+02	8.29E+02	8.29E+02	8.29E+02	8.28E+02	7.51E+02	7.51E+02	7.51E+02	6.40E+02	6.38E+02	5.93E+02
216-N-2	6.13E+00	6.12E+00	6.12E+00	6.12E+00	6.13E+00	6.12E+00	6.12E+00	6.12E+00	5.93E+00	5.91E+00	3.73E+00
216-N-3	6.40E+00	6.01E+00	5.93E+00	5.93E+00	5.95E+00	5.93E+00	5.93E+00	5.93E+00	5.69E+00	5.68E+00	3.58E+00
216-N-4	3.05E+01	2.17E+01	1.48E+01	1.48E+01	1.49E+01	1.48E+01	1.48E+01	1.48E+01	5.24E+00	5.22E+00	3.30E+00
216-N-5	6.40E+00	6.01E+00	5.93E+00	5.93E+00	5.95E+00	5.93E+00	5.93E+00	5.93E+00	5.69E+00	5.68E+00	3.58E+00
216-N-6	2.61E+01	1.86E+01	1.27E+01	1.27E+01	1.27E+01	1.27E+01	1.27E+01	1.27E+01	4.48E+00	4.46E+00	2.82E+00
216-N-7	6.40E+00	6.01E+00	5.93E+00	5.93E+00	5.95E+00	5.93E+00	5.93E+00	5.93E+00	5.69E+00	5.68E+00	3.58E+00
216-S-1%2	4.63E+02	4.62E+02	4.46E+02	4.08E+02	4.09E+02	4.08E+02	4.08E+02	4.08E+02	3.50E+02	3.49E+02	2.99E+02
216-S-10P	8.76E+04	5.37E+04	3.13E+04	2.87E+04	1.65E+04	1.65E+04	1.55E+04	1.30E+04	8.91E+03	8.89E+03	8.08E+03
216-S-12	3.63E-01	3.62E-01	3.62E-01	3.62E-01	3.63E-01	3.62E-01	3.62E-01	3.62E-01	2.91E+00	2.90E+00	2.56E+00
216-S-13	1.08E+01	1.07E+01	1.07E+01	1.07E+01	1.08E+01	1.07E+01	1.07E+01	1.07E+01	7.93E+00	7.91E+00	6.80E+00
216-S-15	1.12E-01	1.12E-01	1.12E-01	1.12E-01	1.12E-01	1.12E-01	1.12E-01	1.12E-01	3.79E-01	3.78E-01	3.25E-01
216-S-16P	9.05E+04	9.03E+04	9.03E+04	9.03E+04	9.05E+04	9.03E+04	9.03E+04	8.87E+04	6.42E+04	6.41E+04	5.54E+04
216-S-17	2.79E+04	2.78E+04	2.78E+04	2.78E+04	2.79E+04	2.78E+04	2.78E+04	2.78E+04	2.27E+04	2.27E+04	2.01E+04
216-S-19	6.75E+03	4.55E+03	4.55E+03	4.55E+03	4.50E+03	3.51E+03	3.51E+03	3.51E+03	2.62E+03	2.61E+03	2.32E+03
216-S-20	6.68E+02	6.66E+02	6.66E+02	6.66E+02	5.94E+02	5.88E+02	5.88E+02	5.88E+02	4.80E+02	4.79E+02	4.79E+02
216-S-21	1.58E+02	1.55E+02	1.55E+02	1.55E+02	1.55E+02	1.55E+02	1.55E+02	1.55E+02	1.17E+02	1.16E+02	1.01E+02
216-S-22	1.87E+00	1.87E+00	1.87E+00	1.87E+00	1.87E+00	1.87E+00	1.87E+00	1.87E+00	1.61E+00	1.61E+00	1.37E+00
216-S-23	1.81E+02	1.80E+02	1.80E+02	1.80E+02	1.81E+02	1.80E+02	1.80E+02	1.80E+02	1.32E+02	1.31E+02	1.12E+02
216-S-25	3.27E+03	3.18E+03	3.14E+03	2.99E+03	2.96E+03	2.57E+03	2.57E+03	2.56E+03	2.11E+03	2.10E+03	1.98E+03

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
216-S-26	8.80E+03	1.24E+04	1.19E+04	9.69E+03	7.57E+03	6.03E+03	4.32E+03	4.20E+03	3.04E+03	2.90E+03	1.97E+03
216-S-3	2.29E+01	2.28E+01	2.28E+01	2.28E+01	2.28E+01	2.28E+01	2.28E+01	2.28E+01	1.97E+01	1.97E+01	1.73E+01
216-S-4	3.11E+00	3.10E+00	3.10E+00	3.10E+00	3.05E+00	2.84E+00	2.84E+00	2.84E+00	2.45E+00	2.44E+00	2.07E+00
216-S-5	2.31E+04	2.24E+04	1.97E+04	1.97E+04	1.98E+04	1.97E+04	1.97E+04	1.97E+04	1.67E+04	1.67E+04	1.46E+04
216-S-6	1.19E+04	1.19E+04	1.19E+04	1.19E+04	1.19E+04	1.19E+04	1.19E+04	1.18E+04	8.63E+03	8.60E+03	7.36E+03
216-S-7	7.45E+02	6.17E+02	6.17E+02	6.17E+02	6.19E+02	6.17E+02	6.17E+02	6.17E+02	4.75E+02	4.74E+02	4.18E+02
216-S-9	2.54E+02	2.53E+02	2.53E+02	2.53E+02	2.40E+02	2.18E+02	2.18E+02	2.18E+02	1.67E+02	1.67E+02	1.48E+02
216-SX-2	7.07E+01	7.05E+01	7.05E+01	6.90E+01	6.06E+01	6.04E+01	6.04E+01	6.04E+01	4.83E+01	4.81E+01	4.19E+01
216-T-1	3.95E+03	3.41E+03	3.21E+03	2.87E+03	2.18E+03	1.62E+03	1.07E+03	1.02E+03	6.82E+02	6.44E+02	3.94E+02
216-T-12	1.36E+01	1.36E+01	1.36E+01	1.36E+01	1.36E+01	1.36E+01	1.36E+01	1.36E+01	1.23E+01	1.22E+01	1.22E+01
216-T-14	1.19E+01	1.18E+01	1.18E+01	1.18E+01	1.19E+01	1.18E+01	1.18E+01	1.18E+01	1.08E+01	1.08E+01	1.08E+01
216-T-15	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.20E+01	1.19E+01	1.08E+01	1.08E+01	1.08E+01
216-T-16	1.21E+01	1.20E+01	1.20E+01	1.20E+01	1.21E+01	1.20E+01	1.20E+01	1.18E+01	1.08E+01	1.08E+01	1.08E+01
216-T-17	1.17E+01	1.17E+01	1.17E+01	1.17E+01	1.17E+01	1.17E+01	1.17E+01	1.17E+01	1.08E+01	1.07E+01	1.07E+01
216-T-18	4.23E+00	3.81E+00	3.79E+00	3.79E+00	3.80E+00	3.79E+00	3.79E+00	3.79E+00	3.49E+00	3.48E+00	2.99E+00
216-T-19	4.92E+02	4.91E+02	3.88E+02	3.49E+02	3.50E+02	3.49E+02	3.49E+02	3.49E+02	2.55E+02	2.54E+02	2.43E+02
216-T-2	4.72E+00	4.71E+00	4.71E+00	4.71E+00	4.72E+00	4.71E+00	4.71E+00	4.71E+00	5.79E+00	5.77E+00	4.59E+00
216-T-20	4.44E-01	4.16E-01	4.11E-01	4.11E-01	4.12E-01	4.11E-01	4.11E-01	4.11E-01	3.88E-01	3.87E-01	3.32E-01
216-T-21	1.11E+01	1.05E+01	1.02E+01	1.02E+01	1.02E+01	1.02E+01	1.02E+01	1.02E+01	9.38E+00	9.35E+00	9.35E+00
216-T-22	1.01E+01	1.01E+01	1.01E+01	1.01E+01	1.01E+01	1.01E+01	1.01E+01	1.01E+01	9.33E+00	9.30E+00	9.29E+00
216-T-23	1.02E+01	1.02E+01	1.02E+01	1.02E+01	1.02E+01	1.02E+01	1.02E+01	1.02E+01	9.36E+00	9.33E+00	9.33E+00
216-T-24	1.01E+01	1.01E+01	1.01E+01	1.01E+01	1.01E+01	1.01E+01	1.01E+01	1.01E+01	9.33E+00	9.31E+00	9.30E+00
216-T-25	8.15E+00	8.13E+00	8.13E+00	8.13E+00	8.15E+00	8.13E+00	8.13E+00	8.13E+00	7.39E+00	7.37E+00	7.36E+00
216-T-26	2.37E+01	2.36E+01	2.36E+01	2.14E+01	2.14E+01	2.13E+01	2.13E+01	2.13E+01	1.90E+01	1.89E+01	1.64E+01
216-T-27	2.51E+01	2.50E+01	2.50E+01	2.50E+01	2.51E+01	2.27E+01	2.27E+01	2.27E+01	1.92E+01	1.91E+01	1.86E+01
216-T-28	6.61E+01	6.59E+01	6.59E+01	6.16E+01	5.63E+01	5.61E+01	5.61E+01	5.61E+01	4.60E+01	4.59E+01	4.55E+01
216-T-29	1.65E-02	1.64E-02	1.64E-02	1.64E-02	1.65E-02	1.64E-02	1.64E-02	1.64E-02	1.33E-02	1.33E-02	1.31E-02
216-T-3	1.38E+01	1.38E+01	1.38E+01	1.38E+01	1.38E+01	1.39E+01	1.42E+01	1.42E+01	1.83E+01	1.83E+01	1.70E+01
216-T-32	2.03E+01	2.02E+01	2.02E+01	2.02E+01	2.03E+01	2.02E+01	2.02E+01	2.02E+01	1.85E+01	1.85E+01	1.85E+01
216-T-33	6.71E+00	6.70E+00	6.69E+00	5.81E+00	5.83E+00	5.81E+00	5.81E+00	5.81E+00	5.02E+00	5.01E+00	4.88E+00
216-T-34	6.12E+01	5.38E+01	4.79E+01	4.79E+01	4.81E+01	4.79E+01	4.79E+01	4.79E+01	3.92E+01	3.91E+01	3.87E+01
216-T-35	2.85E+01	2.84E+01	2.84E+01	2.66E+01	2.43E+01	2.42E+01	2.42E+01	2.42E+01	2.01E+01	2.01E+01	1.97E+01
216-T-36	9.54E+00	9.51E+00	9.51E+00	9.51E+00	9.54E+00	9.07E+00	8.67E+00	8.67E+00	7.16E+00	7.14E+00	7.09E+00
216-T-4A	1.91E+04	1.90E+04	1.90E+04	1.90E+04	1.90E+04	1.89E+04	1.88E+04	1.85E+04	1.73E+04	1.64E+04	1.37E+04
216-T-5	8.63E+00	8.60E+00	8.60E+00	8.60E+00	8.63E+00	8.60E+00	8.60E+00	8.60E+00	7.79E+00	7.77E+00	7.76E+00
216-T-6	7.64E+01	7.07E+01	7.05E+01	7.05E+01	7.07E+01	7.05E+01	7.05E+01	7.05E+01	6.70E+01	6.68E+01	6.67E+01
216-T-7	1.17E+02	1.16E+02	1.16E+02	1.16E+02	1.17E+02	1.16E+02	1.16E+02	1.16E+02	1.04E+02	1.03E+02	1.03E+02
216-T-8	1.58E+01	1.58E+01	1.58E+01	1.58E+01	1.58E+01	1.58E+01	1.58E+01	1.58E+01	1.59E+01	1.59E+01	1.59E+01
216-TY-201	5.84E-02	5.82E-02	5.82E-02	5.82E-02	5.84E-02	5.82E-02	5.48E-02	5.42E-02	4.36E-02	4.34E-02	4.28E-02
216-U-1%2	2.51E+03	2.50E+03	2.50E+03	2.08E+03	1.92E+03	1.92E+03	1.92E+03	1.92E+03	1.25E+03	1.25E+03	1.23E+03
216-U-10	2.77E+05	2.44E+05	2.30E+05	2.54E+05	3.06E+05	3.65E+05	3.69E+05	3.77E+05	3.41E+05	3.28E+05	2.53E+05

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
216-U-12	1.28E+03	8.66E+02	8.66E+02	7.79E+02	5.56E+02	5.54E+02	5.54E+02	5.54E+02	3.91E+02	3.90E+02	3.63E+02
216-U-13	1.48E-01	1.47E-01	1.47E-01	1.47E-01	1.48E-01	1.54E-01	1.76E-01	1.76E-01	2.25E+00	2.24E+00	1.99E+00
216-U-14	2.99E+05	2.80E+05	2.23E+05	1.47E+05	1.02E+05	6.31E+04	5.96E+04	4.65E+04	3.22E+04	3.03E+04	2.00E+04
216-U-15	1.50E+00	1.49E+00	1.49E+00	1.49E+00	1.50E+00	1.49E+00	1.49E+00	1.49E+00	1.61E+00	1.61E+00	1.41E+00
216-U-16	5.21E+01	6.55E+01	6.55E+01	1.84E+03	3.84E+03	3.83E+03	3.83E+03	3.83E+03	9.37E+03	9.35E+03	8.43E+03
216-U-17	2.98E-05	4.50E+02	1.60E+03	7.12E+02	4.38E+02	3.07E+02	2.48E+02	2.01E+02	1.50E+02	1.31E+02	1.05E+02
216-U-3	5.56E+00	5.55E+00	5.55E+00	5.55E+00	5.56E+00	5.55E+00	5.55E+00	5.55E+00	4.57E+00	4.55E+00	3.98E+00
216-U-4	1.93E+00	1.92E+00	1.92E+00	1.92E+00	1.90E+00	1.83E+00	1.83E+00	1.83E+00	2.19E+00	2.19E+00	1.99E+00
216-U-4A	2.14E+00	2.09E+00	1.60E+00	1.60E+00	1.61E+00	1.60E+00	1.60E+00	1.60E+00	1.22E+00	1.21E+00	1.20E+00
216-U-4B	1.10E-01	1.05E-01	1.05E-01	1.05E-01	1.05E-01	1.05E-01	1.05E-01	1.05E-01	7.78E-02	7.76E-02	6.79E-02
216-U-7	2.51E-02	2.50E-02	2.50E-02	2.50E-02	2.51E-02	2.50E-02	2.50E-02	2.50E-02	1.98E-02	1.97E-02	1.87E-02
216-U-8	7.95E+02	7.93E+02	7.93E+02	7.93E+02	7.95E+02	7.93E+02	7.93E+02	7.93E+02	6.27E+02	6.25E+02	5.42E+02
216-W-LWC	2.26E+04	1.81E+04	1.85E+04	1.69E+04	1.23E+04	1.17E+04	8.22E+03	8.22E+03	5.30E+03	5.29E+03	5.01E+03
216-Z-1%2	8.40E+01	8.33E+01	8.33E+01	8.33E+01	8.35E+01	8.33E+01	8.33E+01	8.33E+01	7.82E+01	7.80E+01	7.01E+01
216-Z-10	3.10E+00	3.09E+00	3.09E+00	3.09E+00	3.10E+00	3.09E+00	3.09E+00	3.09E+00	4.05E+00	4.04E+00	3.59E+00
216-Z-12	6.12E+02	6.10E+02	6.10E+02	6.10E+02	6.12E+02	6.10E+02	6.10E+02	6.10E+02	4.36E+02	4.34E+02	3.82E+02
216-Z-3	3.73E+02	3.72E+02	3.55E+02	3.19E+02	3.20E+02	3.19E+02	3.19E+02	3.19E+02	2.68E+02	2.67E+02	2.34E+02
216-Z-4	2.32E-01	2.32E-01	2.32E-01	2.32E-01	2.72E-01	2.87E-01	2.87E-01	2.87E-01	3.56E-01	3.55E-01	3.15E-01
216-Z-5	1.41E+02	1.41E+02	1.41E+02	1.41E+02	1.41E+02	1.38E+02	1.35E+02	1.35E+02	1.21E+02	1.20E+02	1.09E+02
216-Z-6	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.75E+00	1.75E+00	1.71E+00
216-Z-7	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.47E+02	1.06E+02	1.05E+02	9.35E+01
218-E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-E-Cores	1.83E-03	1.79E-03	1.76E-03	1.72E-03	1.70E-03	1.66E-03	1.63E-03	1.60E-03	1.58E-03	1.54E-03	1.51E-03
218-E-LLW	8.18E-03	8.01E-03	7.87E-03	7.72E-03	7.60E-03	7.45E-03	7.31E-03	7.18E-03	7.06E-03	6.92E-03	6.77E-03
218-W-3A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-3AE	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-4B	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-4C	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
218-W-5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-A-104	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	1.23E-05	9.81E-04	1.66E-01
241-A-105	2.57E+00	2.65E+00	2.72E+00	2.76E+00	2.79E+00	2.79E+00	2.79E+00	2.80E+00	2.81E+00	2.80E+00	2.79E+00
241-A-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
241-AN-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AP-108	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AW-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AX-104	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AY-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AY-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AZ-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AZ-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-B-101	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-B-102	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.32E-01
241-B-103	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-B-104	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.32E-01
241-B-105	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-B-106	8.37E-01	8.34E-01	8.34E-01	8.34E-01	8.37E-01	8.34E-01	8.34E-01	8.34E-01	8.37E-01	8.34E-01	8.32E-01
241-B-107	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-B-108	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.33E-01
241-B-109	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-B-110	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.32E-01
241-B-111	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-B-112	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.33E-01
241-B-201	5.93E-02	5.92E-02	5.92E-02	5.92E-02	5.93E-02	5.92E-02	5.92E-02	5.92E-02	5.93E-02	5.92E-02	5.90E-02
241-B-202	5.94E-02	5.93E-02	5.93E-02	5.93E-02	5.94E-02	5.93E-02	5.93E-02	5.93E-02	5.94E-02	5.93E-02	5.91E-02
241-B-203	5.93E-02	5.91E-02	5.91E-02	5.91E-02	5.93E-02	5.91E-02	5.91E-02	5.91E-02	5.93E-02	5.91E-02	5.90E-02
241-B-204	5.93E-02	5.92E-02	5.92E-02	5.92E-02	5.93E-02	5.92E-02	5.92E-02	5.92E-02	5.93E-02	5.92E-02	5.90E-02
241-BX-101	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-BX-102	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.33E-01

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
241-BX-103	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-BX-104	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.32E-01
241-BX-105	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-BX-106	8.38E-01	8.35E-01	8.35E-01	8.35E-01	8.38E-01	8.35E-01	8.35E-01	8.35E-01	8.38E-01	8.35E-01	8.33E-01
241-BX-107	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-BX-108	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.33E-01
241-BX-109	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-BX-110	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.32E-01
241-BX-111	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-BX-112	8.38E-01	8.35E-01	8.35E-01	8.35E-01	8.38E-01	8.35E-01	8.35E-01	8.35E-01	8.38E-01	8.35E-01	8.33E-01
241-BY-101	8.36E-01	8.34E-01	8.34E-01	8.34E-01	8.36E-01	8.34E-01	8.34E-01	8.34E-01	8.36E-01	8.34E-01	8.32E-01
241-BY-102	8.38E-01	8.35E-01	8.35E-01	8.35E-01	8.38E-01	8.35E-01	8.35E-01	8.35E-01	8.38E-01	8.35E-01	8.33E-01
241-BY-103	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.32E-01
241-BY-104	8.36E-01	8.34E-01	8.34E-01	8.34E-01	8.36E-01	8.34E-01	8.34E-01	8.34E-01	8.36E-01	8.34E-01	8.32E-01
241-BY-105	8.38E-01	8.35E-01	8.35E-01	8.35E-01	8.38E-01	8.35E-01	8.35E-01	8.35E-01	8.38E-01	8.35E-01	8.33E-01
241-BY-106	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.32E-01
241-BY-107	8.36E-01	8.34E-01	8.34E-01	8.34E-01	8.36E-01	8.34E-01	8.34E-01	8.34E-01	8.36E-01	8.34E-01	8.32E-01
241-BY-108	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.36E-01	8.36E-01	8.38E-01	8.36E-01	8.33E-01
241-BY-109	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-BY-110	8.37E-01	8.34E-01	8.34E-01	8.34E-01	8.37E-01	8.34E-01	8.34E-01	8.34E-01	8.37E-01	8.34E-01	8.32E-01
241-BY-111	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.32E-01
241-BY-112	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.35E-01	8.35E-01	8.37E-01	8.35E-01	8.33E-01
241-C-101	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	2.28E-03	1.98E-01	6.22E-01	8.00E-01	8.32E-01
241-C-102	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	2.28E-03	1.98E-01	6.23E-01	8.00E-01	8.33E-01
241-C-103	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	2.28E-03	1.98E-01	6.23E-01	8.00E-01	8.32E-01
241-C-104	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	2.27E-03	1.98E-01	6.22E-01	8.00E-01	8.32E-01
241-C-105	1.88E-04	1.88E-04	4.12E-02	4.11E-01	7.43E-01	8.25E-01	8.38E-01	8.40E-01	8.43E-01	8.40E-01	8.38E-01
241-C-106	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.81E-03	1.98E-01	6.23E-01	7.99E-01
241-C-107	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	2.27E-03	1.98E-01	6.22E-01	7.99E-01	8.32E-01
241-C-108	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.04E-04	1.81E-03	1.98E-01	6.23E-01	7.98E-01
241-C-109	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	2.32E-03	1.99E-01	6.22E-01
241-C-110	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	2.27E-03	1.98E-01	6.22E-01	7.99E-01	8.32E-01
241-C-111	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	2.28E-03	1.98E-01	6.22E-01	8.00E-01	8.32E-01
241-C-112	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	1.17E-04	2.28E-03	1.98E-01	6.23E-01	8.00E-01	8.33E-01
241-C-201	7.42E-06	7.40E-06	7.40E-06	7.40E-06	7.42E-06	7.40E-06	7.40E-06	1.28E-04	1.41E-02	4.42E-02	5.67E-02
241-C-202	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	1.28E-04	1.41E-02	4.42E-02	5.67E-02
241-C-203	7.41E-06	7.39E-06	7.39E-06	7.39E-06	7.41E-06	7.39E-06	7.39E-06	1.28E-04	1.41E-02	4.42E-02	5.66E-02
241-C-204	7.46E-06	7.44E-06	7.44E-06	7.44E-06	7.46E-06	7.44E-06	7.44E-06	7.44E-06	1.64E-04	1.41E-02	4.40E-02
241-S-101	1.78E-08	1.77E-08	1.77E-08	1.77E-08	2.69E-07	8.47E-06	5.19E-05	3.10E-04	1.89E-03	1.08E-02	5.29E-02
241-S-102	1.79E-08	1.78E-08	1.78E-08	1.78E-08	2.70E-07	8.50E-06	5.21E-05	3.11E-04	1.90E-03	1.08E-02	5.32E-02
241-S-103	1.77E-08	1.77E-08	1.77E-08	1.77E-08	2.68E-07	8.44E-06	5.17E-05	3.09E-04	1.89E-03	1.08E-02	5.27E-02

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
241-S-104	3.02E+00	2.96E+00	2.92E+00	2.89E+00	2.88E+00	2.85E+00	2.84E+00	2.83E+00	2.83E+00	2.82E+00	2.81E+00
241-S-105	1.78E-08	1.77E-08	1.77E-08	1.77E-08	2.69E-07	8.47E-06	5.19E-05	3.10E-04	1.89E-03	1.08E-02	5.29E-02
241-S-106	1.77E-08	1.77E-08	1.77E-08	1.77E-08	2.68E-07	8.44E-06	5.17E-05	3.09E-04	1.89E-03	1.08E-02	5.27E-02
241-S-107	1.62E-08	1.61E-08	1.61E-08	2.37E-07	7.96E-06	4.92E-05	3.00E-04	1.79E-03	1.05E-02	5.25E-02	1.90E-01
241-S-108	1.62E-08	1.61E-08	1.61E-08	2.37E-07	7.96E-06	4.92E-05	3.00E-04	1.79E-03	1.05E-02	5.25E-02	1.90E-01
241-S-109	1.62E-08	1.62E-08	1.62E-08	2.38E-07	7.98E-06	4.93E-05	3.01E-04	1.80E-03	1.06E-02	5.27E-02	1.91E-01
241-S-110	1.67E-08	1.67E-08	1.67E-08	2.45E-07	8.22E-06	5.08E-05	3.10E-04	1.85E-03	1.09E-02	5.42E-02	1.96E-01
241-S-111	1.59E-08	1.58E-08	1.58E-08	2.33E-07	7.80E-06	4.82E-05	2.94E-04	1.76E-03	1.03E-02	5.15E-02	1.86E-01
241-S-112	1.63E-08	1.63E-08	1.63E-08	2.40E-07	8.04E-06	4.97E-05	3.03E-04	1.81E-03	1.06E-02	5.31E-02	1.93E-01
241-SX-101	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	3.12E-07	9.88E-06	5.94E-05	3.63E-04	2.16E-03	1.21E-02
241-SX-102	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	2.94E-07	9.33E-06	5.60E-05	3.43E-04	2.04E-03	1.14E-02
241-SX-103	1.98E-08	1.98E-08	1.98E-08	1.98E-08	1.98E-08	2.94E-07	9.33E-06	5.60E-05	3.43E-04	2.04E-03	1.14E-02
241-SX-104	1.64E-08	1.63E-08	1.63E-08	1.63E-08	1.64E-08	1.63E-08	2.69E-07	8.15E-06	5.13E-05	3.12E-04	1.86E-03
241-SX-105	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	1.65E-08	2.71E-07	8.23E-06	5.18E-05	3.15E-04	1.88E-03
241-SX-106	2.08E-08	2.07E-08	2.07E-08	2.07E-08	2.08E-08	3.08E-07	9.77E-06	5.87E-05	3.59E-04	2.13E-03	1.20E-02
241-SX-107	1.83E+00	1.80E+00	1.79E+00	1.78E+00	1.78E+00	1.77E+00	1.76E+00	1.76E+00	1.76E+00	1.76E+00	1.75E+00
241-SX-108	4.47E+00	4.37E+00	4.30E+00	4.24E+00	4.21E+00	4.17E+00	4.14E+00	4.13E+00	4.13E+00	4.11E+00	4.09E+00
241-SX-109	4.74E-05	3.04E-04	1.91E-03	1.12E-02	5.71E-02	2.05E-01	4.65E-01	7.06E-01	8.45E-01	9.02E-01	9.22E-01
241-SX-110	4.66E-11	4.65E-11	4.65E-11	4.65E-11	4.66E-11	4.65E-11	4.65E-11	4.65E-11	4.66E-11	4.65E-11	4.63E-11
241-SX-111	9.75E-06	6.00E-05	3.65E-04	2.16E-03	1.25E-02	6.08E-02	2.12E-01	4.70E-01	7.08E-01	8.40E-01	8.96E-01
241-SX-112	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	1.56E-08	2.45E-07	8.02E-06	4.94E-05	2.96E-04
241-SX-113	1.78E+00	1.77E+00	1.76E+00	1.76E+00	1.77E+00	1.76E+00	1.76E+00	1.76E+00	1.76E+00	1.76E+00	1.75E+00
241-SX-114	3.15E-11	3.14E-11	3.14E-11	3.14E-11	3.15E-11	3.14E-11	3.14E-11	3.14E-11	1.23E-06	8.54E-06	5.13E-05
241-SX-115	6.65E+00	6.52E+00	6.44E+00	6.37E+00	6.34E+00	6.28E+00	6.25E+00	6.23E+00	6.24E+00	6.21E+00	6.19E+00
241-SY-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-SY-102	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-SY-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-T-101	3.52E-02	2.42E-02	1.64E-02	1.09E-02	7.09E-03	4.51E-03	2.83E-03	1.75E-03	1.07E-03	6.41E-04	3.80E-04
241-T-102	7.23E-01	7.74E-01	7.95E-01	8.04E-01	8.09E-01	8.08E-01	8.08E-01	8.08E-01	8.11E-01	8.09E-01	8.06E-01
241-T-103	9.97E-01	9.52E-01	9.18E-01	8.91E-01	8.72E-01	8.53E-01	8.40E-01	8.31E-01	8.26E-01	8.19E-01	8.14E-01
241-T-104	6.04E-01	7.22E-01	7.75E-01	7.97E-01	8.07E-01	8.08E-01	8.09E-01	8.10E-01	8.12E-01	8.10E-01	8.08E-01
241-T-105	6.03E-01	7.21E-01	7.75E-01	7.96E-01	8.06E-01	8.07E-01	8.09E-01	8.09E-01	8.11E-01	8.09E-01	8.07E-01
241-T-106	5.86E+00	5.65E+00	5.51E+00	5.39E+00	5.32E+00	5.24E+00	5.20E+00	5.16E+00	5.15E+00	5.13E+00	5.10E+00
241-T-107	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.00E-16
241-T-108	7.24E-01	7.75E-01	7.96E-01	8.04E-01	8.09E-01	8.08E-01	8.09E-01	8.09E-01	8.11E-01	8.09E-01	8.07E-01
241-T-109	7.24E-01	7.75E-01	7.97E-01	8.05E-01	8.10E-01	8.09E-01	8.09E-01	8.10E-01	8.12E-01	8.10E-01	8.07E-01
241-T-110	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.01E-16	4.01E-16	4.02E-16	4.01E-16	4.00E-16
241-T-111	7.24E-01	7.75E-01	7.97E-01	8.05E-01	8.10E-01	8.09E-01	8.09E-01	8.10E-01	8.12E-01	8.10E-01	8.08E-01
241-T-112	6.03E-01	7.21E-01	7.75E-01	7.96E-01	8.06E-01	8.07E-01	8.08E-01	8.09E-01	8.11E-01	8.09E-01	8.07E-01
241-T-201	2.13E-05	1.25E-04	7.11E-04	3.46E-03	1.24E-02	2.81E-02	4.27E-02	5.12E-02	5.51E-02	5.64E-02	5.68E-02
241-T-202	2.13E-05	1.25E-04	7.11E-04	3.46E-03	1.24E-02	2.81E-02	4.27E-02	5.12E-02	5.51E-02	5.64E-02	5.68E-02

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
241-T-203	2.12E-05	1.25E-04	7.10E-04	3.46E-03	1.24E-02	2.80E-02	4.26E-02	5.11E-02	5.50E-02	5.63E-02	5.67E-02
241-T-204	2.12E-05	1.25E-04	7.10E-04	3.46E-03	1.24E-02	2.80E-02	4.26E-02	5.11E-02	5.50E-02	5.63E-02	5.67E-02
241-TX-101	5.01E-02	1.76E-01	3.96E-01	6.02E-01	7.24E-01	7.75E-01	7.96E-01	8.04E-01	8.10E-01	8.09E-01	8.07E-01
241-TX-102	1.05E-02	5.06E-02	1.77E-01	3.96E-01	6.03E-01	7.21E-01	7.75E-01	7.96E-01	8.06E-01	8.07E-01	8.06E-01
241-TX-103	1.05E-02	5.06E-02	1.77E-01	3.96E-01	6.04E-01	7.22E-01	7.75E-01	7.96E-01	8.07E-01	8.08E-01	8.07E-01
241-TX-104	1.05E-02	5.06E-02	1.77E-01	3.96E-01	6.04E-01	7.22E-01	7.75E-01	7.96E-01	8.07E-01	8.08E-01	8.07E-01
241-TX-105	3.00E-04	1.77E-03	1.00E-02	4.89E-02	1.76E-01	3.97E-01	6.03E-01	7.23E-01	7.78E-01	7.97E-01	8.03E-01
241-TX-106	3.01E-04	1.77E-03	1.01E-02	4.89E-02	1.76E-01	3.96E-01	6.03E-01	7.22E-01	7.77E-01	7.96E-01	8.01E-01
241-TX-107	1.16E+00	1.08E+00	1.02E+00	9.75E-01	9.37E-01	9.03E-01	8.78E-01	8.58E-01	8.46E-01	8.33E-01	8.23E-01
241-TX-108	3.00E-04	1.77E-03	1.00E-02	4.89E-02	1.76E-01	3.96E-01	6.03E-01	7.22E-01	7.77E-01	7.96E-01	8.02E-01
241-TX-109	5.01E-02	1.76E-01	3.96E-01	6.01E-01	7.24E-01	7.75E-01	7.96E-01	8.04E-01	8.09E-01	8.08E-01	8.07E-01
241-TX-110	5.01E-02	1.76E-01	3.96E-01	6.02E-01	7.24E-01	7.76E-01	7.97E-01	8.05E-01	8.10E-01	8.09E-01	8.07E-01
241-TX-111	1.05E-02	5.06E-02	1.77E-01	3.96E-01	6.03E-01	7.21E-01	7.75E-01	7.96E-01	8.06E-01	8.07E-01	8.06E-01
241-TX-112	1.05E-02	5.05E-02	1.76E-01	3.95E-01	6.03E-01	7.21E-01	7.74E-01	7.95E-01	8.06E-01	8.07E-01	8.06E-01
241-TX-113	3.00E-04	1.77E-03	1.00E-02	4.89E-02	1.76E-01	3.96E-01	6.03E-01	7.23E-01	7.78E-01	7.97E-01	8.02E-01
241-TX-114	3.00E-04	1.77E-03	1.00E-02	4.89E-02	1.76E-01	3.96E-01	6.03E-01	7.22E-01	7.78E-01	7.96E-01	8.02E-01
241-TX-115	3.00E-04	1.77E-03	1.00E-02	4.89E-02	1.76E-01	3.97E-01	6.03E-01	7.23E-01	7.78E-01	7.97E-01	8.03E-01
241-TX-116	3.00E-04	1.77E-03	1.00E-02	4.89E-02	1.76E-01	3.97E-01	6.03E-01	7.23E-01	7.78E-01	7.97E-01	8.03E-01
241-TX-117	3.00E-04	1.77E-03	1.00E-02	4.89E-02	1.75E-01	3.96E-01	6.02E-01	7.22E-01	7.77E-01	7.96E-01	8.02E-01
241-TX-118	3.00E-04	1.77E-03	1.00E-02	4.89E-02	1.76E-01	3.96E-01	6.03E-01	7.22E-01	7.77E-01	7.96E-01	8.02E-01
241-TY-101	5.34E-05	3.12E-04	1.83E-03	1.02E-02	5.01E-02	1.76E-01	3.96E-01	6.01E-01	7.23E-01	7.74E-01	7.93E-01
241-TY-102	5.34E-05	3.12E-04	1.83E-03	1.02E-02	5.01E-02	1.76E-01	3.96E-01	6.01E-01	7.23E-01	7.74E-01	7.93E-01
241-TY-103	8.92E-01	8.68E-01	8.52E-01	8.40E-01	8.33E-01	8.24E-01	8.19E-01	8.16E-01	8.16E-01	8.12E-01	8.09E-01
241-TY-104	5.11E-01	6.73E-01	7.54E-01	7.88E-01	8.03E-01	8.06E-01	8.08E-01	8.09E-01	8.11E-01	8.09E-01	8.07E-01
241-TY-105	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.57E+00	1.56E+00	1.56E+00	1.56E+00	1.57E+00	1.56E+00	1.56E+00
241-TY-106	8.78E-01	8.76E-01	8.76E-01	8.76E-01	8.78E-01	8.76E-01	8.76E-01	8.76E-01	8.78E-01	8.76E-01	8.73E-01
241-U-101	3.29E-04	1.96E-03	1.11E-02	5.43E-02	1.97E-01	4.50E-01	6.94E-01	8.39E-01	9.06E-01	9.29E-01	9.36E-01
241-U-102	3.39E-04	2.01E-03	1.14E-02	5.59E-02	2.02E-01	4.64E-01	7.15E-01	8.63E-01	9.33E-01	9.56E-01	9.64E-01
241-U-103	5.22E-05	3.18E-04	1.92E-03	1.10E-02	5.58E-02	2.03E-01	4.71E-01	7.27E-01	8.81E-01	9.46E-01	9.69E-01
241-U-104	5.89E+00	5.86E+00	5.86E+00	5.86E+00	5.87E+00	5.85E+00	5.85E+00	5.85E+00	5.87E+00	5.85E+00	5.84E+00
241-U-105	5.17E-05	3.15E-04	1.90E-03	1.09E-02	5.53E-02	2.01E-01	4.66E-01	7.20E-01	8.73E-01	9.37E-01	9.60E-01
241-U-106	8.39E-06	5.21E-05	3.18E-04	1.90E-03	1.12E-02	5.56E-02	2.03E-01	4.70E-01	7.30E-01	8.79E-01	9.43E-01
241-U-107	7.89E-06	4.90E-05	2.99E-04	1.79E-03	1.05E-02	5.23E-02	1.91E-01	4.42E-01	6.86E-01	8.26E-01	8.87E-01
241-U-108	2.67E-07	8.59E-06	5.29E-05	3.16E-04	1.93E-03	1.10E-02	5.44E-02	1.96E-01	4.56E-01	7.01E-01	8.45E-01
241-U-109	2.71E-07	8.71E-06	5.36E-05	3.20E-04	1.95E-03	1.11E-02	5.52E-02	1.99E-01	4.62E-01	7.10E-01	8.56E-01
241-U-110	1.43E+00	1.35E+00	1.28E+00	1.22E+00	1.17E+00	1.12E+00	1.08E+00	1.05E+00	1.03E+00	1.00E+00	9.81E-01
241-U-111	5.07E-05	3.09E-04	1.87E-03	1.07E-02	5.42E-02	1.97E-01	4.57E-01	7.07E-01	8.56E-01	9.19E-01	9.42E-01
241-U-112	1.13E+00	1.09E+00	1.07E+00	1.05E+00	1.04E+00	1.02E+00	1.01E+00	1.00E+00	1.00E+00	9.95E-01	9.89E-01
241-U-201	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	1.75E-09	2.74E-08	8.98E-07	5.53E-06	3.32E-05
241-U-202	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	2.70E-08	8.84E-07	5.44E-06	3.27E-05
241-U-203	1.73E-09	1.72E-09	1.72E-09	1.72E-09	1.73E-09	1.72E-09	1.72E-09	2.70E-08	8.84E-07	5.44E-06	3.27E-05

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
241-U-204	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.00E-09	2.97E-08	9.41E-07	5.66E-06	3.46E-05	2.06E-04	1.15E-03
300-224	6.13E+01	3.25E+01	3.25E+01	2.49E+01	1.69E+01	1.68E+01	1.68E+01	1.63E+01	1.03E+01	1.03E+01	9.79E+00
316-1	1.55E+03	1.55E+03	1.55E+03	1.55E+03	1.55E+03	1.55E+03	1.15E+03	1.10E+03	8.99E+02	7.87E+02	5.38E+02
316-2	3.85E+03	3.84E+03	3.84E+03	3.84E+03	3.85E+03	3.64E+03	3.55E+03	3.46E+03	3.31E+03	3.19E+03	2.72E+03
316-3	1.59E+02	1.59E+02	1.59E+02	1.52E+02	1.50E+02	1.49E+02	1.49E+02	1.49E+02	1.44E+02	1.43E+02	1.33E+02
316-5	1.80E+04	1.80E+04	1.61E+04	1.21E+04	1.22E+04	1.21E+04	1.13E+04	1.00E+04	8.98E+03	8.20E+03	6.55E+03
600-148	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
600-211	4.24E-09	4.23E-09	4.23E-09	4.23E-09	4.24E-09	9.82E+03	1.02E+05	4.19E+04	1.46E+04	7.95E+03	4.98E+03
618-11	1.40E+03	1.39E+03	1.39E+03	1.39E+03	1.40E+03	1.39E+03	1.39E+03	1.39E+03	1.40E+03	1.39E+03	1.39E+03
GTF	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GTFL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILAW-liquid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RMWSF	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-100-N-1	2.88E+01	2.87E+01	2.87E+01	2.87E+01	2.88E+01	2.88E+01	2.88E+01	2.88E+01	2.89E+01	2.88E+01	2.73E+01
UPR-100-N-25	1.58E-02	1.58E-02	1.58E-02	1.58E-02	1.57E-02	1.56E-02	1.56E-02	1.56E-02	1.55E-02	1.55E-02	1.45E-02
UPR-100-N-30	3.63E+00	3.62E+00	3.62E+00	3.62E+00	3.63E+00	3.61E+00	3.61E+00	3.61E+00	3.62E+00	3.61E+00	2.95E+00
UPR-100-N-5	6.20E-02	6.18E-02	6.18E-02	6.16E-02	6.15E-02	6.14E-02	6.14E-02	6.14E-02	6.14E-02	6.13E-02	5.58E-02
UPR-200-E-1	1.89E-02	1.88E-02	1.88E-02	1.88E-02	1.89E-02	1.88E-02	1.88E-02	1.88E-02	1.67E-02	1.67E-02	1.02E-02
UPR-200-E-105	6.11E-01	6.10E-01	6.10E-01	5.99E-01	5.57E-01	5.56E-01	5.56E-01	5.56E-01	4.80E-01	4.78E-01	2.56E-01
UPR-200-E-107	4.33E-05	4.32E-05	4.32E-05	4.32E-05	4.33E-05	4.32E-05	4.32E-05	4.32E-05	7.23E-03	9.62E-03	7.47E-03
UPR-200-E-108	2.61E-05	2.60E-05	2.60E-05	2.60E-05	2.61E-05	2.60E-05	2.60E-05	2.60E-05	1.93E-03	1.93E-03	1.27E-03
UPR-200-E-109	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	5.74E-06	1.20E-05	7.67E-06
UPR-200-E-110	3.70E-02	3.69E-02	3.69E-02	3.51E-02	3.25E-02	3.24E-02	3.24E-02	3.24E-02	2.63E-02	2.63E-02	2.26E-02
UPR-200-E-114	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-115	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-116	1.24E-06	1.23E-06	1.23E-06	1.23E-06	1.24E-06	1.23E-06	1.23E-06	1.25E-06	3.38E-05	3.37E-05	2.08E-05
UPR-200-E-117	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-119	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-133	4.87E-02	4.86E-02	4.86E-02	4.86E-02	4.59E-02	3.97E-02	3.97E-02	3.97E-02	2.92E-02	2.92E-02	2.81E-02
UPR-200-E-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-145	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-21	5.18E-02	5.16E-02	5.16E-02	5.16E-02	5.18E-02	5.16E-02	5.16E-02	5.16E-02	4.69E-02	4.67E-02	4.26E-02
UPR-200-E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-3	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	8.45E-03	8.43E-03	5.91E-03
UPR-200-E-38	3.33E-02	3.32E-02	3.32E-02	3.32E-02	3.33E-02	3.32E-02	3.32E-02	3.32E-02	2.24E-02	2.24E-02	1.92E-02
UPR-200-E-42	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
UPR-200-E-6	8.17E-02	8.14E-02	8.14E-02	8.14E-02	8.17E-02	8.15E-02	8.15E-02	8.15E-02	8.17E-02	8.15E-02	7.04E-02
UPR-200-E-7	5.85E-02	5.83E-02	5.83E-02	5.83E-02	5.85E-02	5.83E-02	5.83E-02	5.83E-02	4.72E-02	4.71E-02	2.55E-02
UPR-200-E-73	6.55E-06	6.53E-06	9.34E-06	1.13E-05	1.13E-05	1.13E-05	1.13E-05	1.13E-05	4.26E-04	4.25E-04	2.95E-04
UPR-200-E-74	6.34E-05	6.32E-05	6.32E-05	6.32E-05	6.34E-05	6.32E-05	6.32E-05	6.32E-05	5.89E-03	5.87E-03	3.97E-03
UPR-200-E-75	7.85E-03	7.83E-03	7.83E-03	7.83E-03	7.85E-03	9.24E-03	9.71E-03	9.71E-03	2.71E-01	2.70E-01	1.76E-01

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
UPR-200-E-77	1.74E-04	1.73E-04	1.73E-04	1.73E-04	1.74E-04	1.98E-04	2.08E-04	2.08E-04	3.19E-03	3.18E-03	2.11E-03
UPR-200-E-78	1.67E-04	1.67E-04	1.67E-04	1.67E-04	1.67E-04	1.67E-04	1.67E-04	1.67E-04	1.54E-02	1.54E-02	1.08E-02
UPR-200-E-79	1.04E+00	1.03E+00	1.03E+00	1.03E+00	1.04E+00	1.03E+00	1.03E+00	1.03E+00	4.86E+00	4.85E+00	3.20E+00
UPR-200-E-80	8.37E-01	8.34E-01	8.34E-01	8.34E-01	8.37E-01	9.55E-01	1.00E+00	1.00E+00	1.51E+01	1.51E+01	1.00E+01
UPR-200-E-81	1.80E+00	1.80E+00	1.71E+00	1.47E+00	1.48E+00	1.47E+00	1.47E+00	1.47E+00	1.22E+00	1.22E+00	1.04E+00
UPR-200-E-82	2.07E-01	2.07E-01	1.72E-01	1.34E-01	1.34E-01	1.34E-01	1.34E-01	1.33E-01	9.57E-02	9.54E-02	9.37E-02
UPR-200-E-84	2.13E-02	2.12E-02	2.12E-02	2.12E-02	2.13E-02	2.12E-02	2.12E-02	2.12E-02	1.74E-02	1.73E-02	9.80E-03
UPR-200-E-85	6.90E-09	6.88E-09	6.88E-09	6.88E-09	6.90E-09	6.88E-09	6.88E-09	6.88E-09	3.79E-07	7.62E-07	4.19E-07
UPR-200-E-86	1.79E-03	1.78E-03	1.78E-03	1.78E-03	1.79E-03	1.78E-03	1.78E-03	1.78E-03	3.32E-01	4.31E-01	3.41E-01
UPR-200-E-87	3.79E-02	3.78E-02	3.78E-02	3.78E-02	3.79E-02	3.78E-02	3.78E-02	3.78E-02	1.91E-01	1.90E-01	1.34E-01
UPR-200-E-9	1.27E-02	1.26E-02	1.26E-02	1.26E-02	1.27E-02	1.26E-02	1.26E-02	1.26E-02	1.00E+00	9.99E-01	7.05E-01
UPR-200-W-10	2.58E-03	2.57E-03	2.57E-03	2.57E-03	2.58E-03	2.57E-03	2.57E-03	2.57E-03	2.00E-02	1.99E-02	1.76E-02
UPR-200-W-100	1.97E+00	1.97E+00	1.97E+00	1.97E+00	1.97E+00	1.97E+00	1.97E+00	1.97E+00	1.90E+01	1.89E+01	1.65E+01
UPR-200-W-101	4.43E-02	4.42E-02	4.42E-02	4.42E-02	4.43E-02	4.42E-02	4.42E-02	4.42E-02	1.21E+00	1.21E+00	1.05E+00
UPR-200-W-102	3.90E-05	3.89E-05	3.89E-05	1.08E-04	1.13E-04	1.13E-04	1.13E-04	1.13E-04	2.02E-03	2.01E-03	2.01E-03
UPR-200-W-107	2.55E+03	2.54E+03	2.54E+03	2.54E+03	2.55E+03	2.54E+03	2.48E+03	2.44E+03	2.05E+03	2.04E+03	1.80E+03
UPR-200-W-115	3.11E-07	3.10E-07	3.10E-07	3.10E-07	3.11E-07	3.10E-07	3.10E-07	3.10E-07	9.90E-05	1.16E-04	1.16E-04
UPR-200-W-12	3.75E-03	3.74E-03	3.74E-03	3.74E-03	3.75E-03	3.74E-03	3.74E-03	3.74E-03	2.29E-02	2.29E-02	2.00E-02
UPR-200-W-127	3.73E-10	3.72E-10	3.72E-10	3.72E-10	3.73E-10	3.72E-10	3.72E-10	3.72E-10	1.19E-07	1.40E-07	1.39E-07
UPR-200-W-128	2.39E-01	2.38E-01	1.93E-01	1.82E-01	1.82E-01	1.82E-01	1.82E-01	1.82E-01	1.40E-01	1.39E-01	1.38E-01
UPR-200-W-129	6.05E-07	6.03E-07	2.71E-06	2.83E-06	2.84E-06	2.83E-06	2.83E-06	2.83E-06	1.01E-04	1.01E-04	8.74E-05
UPR-200-W-13	8.66E-01	8.63E-01	8.63E-01	8.63E-01	8.66E-01	8.63E-01	8.63E-01	8.63E-01	1.73E+01	1.73E+01	1.53E+01
UPR-200-W-131	2.13E-03	2.13E-03	2.13E-03	2.13E-03	2.13E-03	2.13E-03	2.13E-03	2.13E-03	1.84E-02	1.83E-02	1.57E-02
UPR-200-W-132	7.22E-03	7.20E-03	7.20E-03	7.20E-03	7.22E-03	7.20E-03	7.20E-03	7.20E-03	1.94E-01	1.94E-01	1.68E-01
UPR-200-W-135	4.77E-02	4.76E-02	4.76E-02	4.76E-02	4.77E-02	4.76E-02	4.76E-02	4.76E-02	4.23E-02	4.22E-02	3.65E-02
UPR-200-W-138	2.17E-04	2.16E-04	2.16E-04	2.16E-04	2.17E-04	2.16E-04	2.16E-04	2.16E-04	4.47E-03	4.46E-03	3.86E-03
UPR-200-W-139	7.93E-01	7.90E-01	7.90E-01	7.90E-01	7.93E-01	7.90E-01	7.90E-01	7.90E-01	1.83E+01	1.82E+01	1.62E+01
UPR-200-W-14	5.08E-03	5.06E-03	5.06E-03	5.06E-03	5.08E-03	5.06E-03	5.06E-03	5.06E-03	2.40E-02	2.39E-02	2.39E-02
UPR-200-W-15	8.65E-01	8.63E-01	8.63E-01	8.63E-01	8.65E-01	8.63E-01	8.63E-01	8.63E-01	1.73E+01	1.73E+01	1.53E+01
UPR-200-W-163	1.37E-05	1.37E-05	1.37E-05	6.27E-04	4.76E-03	4.74E-03	4.74E-03	4.75E-03	6.00E-02	5.99E-02	5.93E-02
UPR-200-W-19	2.10E-03	2.09E-03	2.09E-03	2.09E-03	2.10E-03	2.09E-03	2.09E-03	2.09E-03	4.55E-02	4.54E-02	4.50E-02
UPR-200-W-2	1.11E-02	1.11E-02	1.11E-02	1.11E-02	1.11E-02	1.11E-02	1.13E-02	1.22E-02	3.00E-02	2.99E-02	2.60E-02
UPR-200-W-20	3.74E-02	3.73E-02	3.73E-02	3.73E-02	3.74E-02	3.73E-02	3.73E-02	3.73E-02	8.64E-01	8.62E-01	7.62E-01
UPR-200-W-21	2.82E+00	2.81E+00	2.81E+00	2.81E+00	2.82E+00	2.81E+00	2.81E+00	2.81E+00	2.45E+01	2.44E+01	2.10E+01
UPR-200-W-24	1.84E+01	1.84E+01	1.84E+01	1.84E+01	1.84E+01	1.84E+01	1.84E+01	1.84E+01	4.27E+02	4.25E+02	3.96E+02
UPR-200-W-28	4.48E-01	4.46E-01	4.46E-01	4.46E-01	4.48E-01	4.46E-01	4.46E-01	4.46E-01	4.47E+00	4.46E+00	3.88E+00
UPR-200-W-29	2.64E+01	2.64E+01	2.64E+01	2.64E+01	2.64E+01	2.64E+01	2.64E+01	2.64E+01	4.93E+01	4.92E+01	4.78E+01
UPR-200-W-32	5.58E-02	5.56E-02	5.56E-02	5.56E-02	5.58E-02	5.54E-02	5.30E-02	5.30E-02	4.51E-02	4.49E-02	3.89E-02
UPR-200-W-33	2.30E-03	2.30E-03	2.30E-03	2.30E-03	2.30E-03	2.30E-03	2.30E-03	2.30E-03	6.60E-02	6.58E-02	5.70E-02
UPR-200-W-35	5.31E-02	5.30E-02	5.30E-02	5.30E-02	5.31E-02	5.30E-02	5.30E-02	5.30E-02	4.54E-02	4.53E-02	3.91E-02
UPR-200-W-38	6.06E-01	6.04E-01	6.04E-01	6.04E-01	6.06E-01	6.04E-01	6.04E-01	6.04E-01	5.62E+00	5.60E+00	5.58E+00

Site	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
UPR-200-W-39	9.40E-02	9.38E-02	9.38E-02	9.38E-02	9.40E-02	9.38E-02	9.38E-02	9.38E-02	8.19E-01	8.17E-01	7.09E-01
UPR-200-W-49	2.14E-02	2.55E-02	2.55E-02	2.55E-02	2.55E-02	2.55E-02	2.55E-02	2.55E-02	5.44E-01	5.43E-01	4.76E-01
UPR-200-W-5	4.49E-02	4.47E-02	4.47E-02	4.47E-02	4.49E-02	4.47E-02	4.47E-02	4.47E-02	4.18E-02	4.17E-02	3.58E-02
UPR-200-W-51	5.42E-03	6.46E-03	6.46E-03	6.46E-03	6.47E-03	6.46E-03	6.46E-03	6.46E-03	1.39E-01	1.38E-01	1.26E-01
UPR-200-W-59	1.84E+00	1.84E+00	1.84E+00	1.84E+00	1.84E+00	1.84E+00	1.84E+00	1.94E+00	3.28E+01	3.27E+01	2.88E+01
UPR-200-W-6	5.83E-03	5.81E-03	5.81E-03	5.81E-03	5.83E-03	5.81E-03	5.81E-03	5.81E-03	2.59E-02	2.58E-02	2.28E-02
UPR-200-W-61	3.06E-04	3.05E-04	3.05E-04	3.05E-04	3.06E-04	3.05E-04	3.05E-04	3.05E-04	2.91E-02	2.90E-02	2.58E-02
UPR-200-W-82	1.39E-10	1.38E-10	1.38E-10	1.38E-10	1.39E-10	1.38E-10	1.38E-10	1.38E-10	4.43E-08	5.19E-08	5.16E-08
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UPR-200-W-97	1.13E-02	1.13E-02	1.13E-02	1.13E-02	1.13E-02	1.13E-02	1.13E-02	1.13E-02	5.68E-02	5.67E-02	5.44E-02
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