Five-Year Review Report

Commencement Bay
South Tacoma Channel Superfund Sites
Tacoma, Washington

Third Five-Year Review Report for
Well 12A (OU 1/2/3)

Second Five-Year Review Report for
South Tacoma Field (OU 4)

Third Five-Year Review Report for
Tacoma Landfill (OU 5/6)

September 2008

PREPARED BY:

United States Environmental Protection Agency
Region 10
Seattle, Washington

Approved by: Date:

Daniel D. Opalski, Director
Environmental Cleanup Office
U.S. EPA, Region 10

Table of Contents

Tables

Figures

Attachments

Acronym List

ATSDR	Agency for Toxic Substances and Disease Registry
ARAR	Applicable or Relevant and Appropriate Requirements
bgs	Below ground surface
BNR	Burlington Northern Railroad
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
cfs	Cubic feet per second
COC	Contaminant of Concern
cPAH	Carcinogenic Polyaromatic Hydrocarbon
CSM	Conceptual Site Model
CY	Cubic Yards
CZA	Capture Zone Analysis
DCA	Dichloroethane
DCE	Dichloroethene
DNAPL	Dense non-aqueous phase liquid
Ecology	Washington State Department of Ecology
EOP	End of Plume
EPA	Environmental Protection Agency
ESD	Explanation of Significant Difference
FFS	Focused Feasibility Study
GAC	Granular Activated Carbon
GETS	Ground Water Extraction and Treatment System
gpm	Gallons per minute
HDPE	High Density Polyethylene
HELP	Hydrologic Evaluation of Landfill Performance
HHRA	Human Health Risk Assessment
IC	Institutional Control
ICP	Institutional Control Plan
IRIS	Integrated Risk Information System
IRM	Interim Remedial Measure
LAIP	Landfill Access Improvement Project
LEL	Lower Explosive Limit
LNAPL	Light Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Level
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
MNA	Monitored Natural Attenuation
MTCA	Model Toxics Control Act
NAPL	Non-aqueous phase liquid
NCP	National Contingency Plan
NPL	National Priority List
O&M	Operation and Maintenance
OU	Operable Unit
PAH	Polyaromatic Hydrocarbon
PCA	Tetrachloroethane
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
POC	Point of Compliance

Acronym List, Cont.

PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
ppb	Parts per billion
ppm	Parts per million
RA	Remedial Action
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
RSE	Remediation System Evaluation
SDICP	Site Development and Institutional Control Plan
SSC	State Superfund Contract
STC	South Tacoma Channel
STF	South Tacoma Field
SVE	Soil Vapor Extraction
TBC	To Be Considered
TCA	Trichloroethane
TCE	Trichloroethene
TPCHD	Tacoma Pierce County Health Department
TPH	Total Petroleum Hydrocarbon
UAO	Unilateral Administration Order
USACE	United States Army Corps of Engineers
UST	Underground Storage Tank
VOC	Volatile Organic Compound
VES	Vapor Extraction System

Executive Summary

This document presents the Five-Year Reviews for the Commencement Bay, South Tacoma Channel (STC) Superfund site in Tacoma, Washington. Although the STC was listed on the NPL as a single site due to the proximity of three different problem areas in south Tacoma, the three areas are distinctly different with separate problems, remedies, and approaches to protectiveness. The three main project areas (Well 12A, South Tacoma Field, Tacoma Landfill) are broken down into the following Operable Units (OUs) within the STC:

OU 1 – Well 12A/ground water
OU 2 – Well 12A Burlington Northern Soil Removal
OU 3 – Well 12A Soils (Vapor Extraction System)
OU 4 - South Tacoma Field (STF)
OU 5 - Tacoma Landfill/cap
OU 6 - Tacoma Landfill/ground water

The Five-Year Review groups OUs by project area, with a separate section for each project area (Well 12A, STF, Tacoma Landfill) that discusses the active OUs. Note the Burlington Northern Soil Removal and Well 12A Soils/Vapor Extraction System were designated as OUs 2 and 3 for administrative purposes, but are actually remedy components of the overall Well 12A remedy, which is designated as OU1. This Five-Year Review addresses the entire Well 12A project area including any remaining exposures from OUs 2 and 3 as OU1, and OUs 2 and 3 are not mentioned further in this document. Figure ES-1 shows the location of the three project areas within the STC Superfund site. Brief site descriptions are summarized below.

Well 12A

The Well 12A subsite is OU 1 of the STC Superfund site. Well 12A is located in Tacoma, Washington approximately 6 miles south of Commencement Bay and directly west of Interstate 5 (Figure 1-1). The Well 12A OU encompasses the source of contamination at the property of the former Time Oil Company, (Figure 1-2), and the City of Tacoma's production Well 12A.

The Remedial Investigation (RI) identified the contaminants of concern (COCs) in soil and ground water as tetrachloroethane (PCA), tetrachloroethene (PCE), trichloroethene (TCE), and trans-1,2-dichloroethene (DCE). In addition, vinyl chloride and cis-1,2-DCE are currently detected in site ground water above the federal Maximum Contaminant Levels (MCLs) for drinking water. 1,4- Dioxane is also detected in ground water above EPA Region 9 Preliminary Remediation Goals (PRGs). Contamination is believed to be derived from oil processing and solvent use, including generation and handling of filter cake, at the former Time Oil Site.

The remedy for the site as set forth in the Record of Decision (ROD) included vadose zone soil treatment by a Vapor Extraction System (VES), limited soil excavation, and a Ground water Extraction and Treatment System (GETS) that uses carbon adsorption to treated extracted ground water. In addition, air strippers are used on Well 12A when pumped. The Washington Department of Ecology (Ecology) currently operates the GETS system. The City of Tacoma manages the air stripper and operations at Well 12A.

Operation and maintenance (O&M) of the GETS and Well 12A system has generally been conducted as designed with the following exceptions. The GETS extraction wells pumping rates have decreased below design rates over time and will likely continue to decrease due to aging pumps and system biofouling.

Based on the distribution of contaminants in ground water and a Capture Zone Analysis (CZA) conducted in 2005, the system is containing some of the ground water plumes, including MCL exceedences of most of the contaminants of concern and TCE concentrations in excess of 500 µg/L (ppb). TCE contamination above MCLs in ground water is not currently contained, nor is the lateral extent defined. It is not clear whether pumping Well 12A will provide capture of the dissolved phase TCE plume and provide long-term protection for additional down-gradient City of Tacoma production wells. In addition, although identified as being required in the ROD, targeted achievable Remedial Action Objectives (RAOs) for both ground water and soil have not been established to date.

South Tacoma Field

The South Tacoma Field (STF) project area is OU 4 of the STC Superfund site. STF is located in Tacoma, Pierce County, Washington, and extends from approximately South 36th Street on the north, South 56th Street on the south, Tyler Way on the west, and Adams Street on the east (Figures 2-1 and 2-2). The STF OU is approximately 260 acres. The southern half of the site contains industrial and commercial facilities; the northern and western portions are primarily open grass fields.

For management purposes the STF OU is divided into three areas, based on source of contamination and location. A summary of the COCs, matrices, remedies, and institutional controls for each area is presented below.

Table ES-1: Summary of Selected Remedy at South Tacoma Field OU 4

Site	Media	Contaminant	Selected Remedy	Institutional Control
South Tacoma Field	Soil	Metals, Carcinogenic polyaromatic hydrocarbons (cPAHs), Polychlorinated biphenyls (PCBs) Pentachlorophenol Aldrin	Soil excavation to industrial standards, consolidation, and capping. Fencing and signage to restrict access. Ground water monitoring to confirm no impacts from residual soil contamination.	Deed restriction limiting site usage to industrial.
Pioneer Builders Supply	Soil	Benzene, ethylbenzene, toluene, xylenes (BETX); Total petroleum hydrocarbons (TPH)	Ground Water Monitoring (see below)	Deed restriction limiting site water use.
	Ground Water	Volatile organic compounds (VOCs), TPH	Monitored Natural Attenuation (MNA)	Deed restriction preventing ground water use for drinking water.
Tacoma City Light Dry wells	Soil	Pesticides, PCBs, cPAHs, Pentachlorophenol, 3,3-Dichlorobenzidine, 1,4-Dichlorobenzene	Soil excavation to residential standards	NA –remedy is complete

Tacoma Landfill

The Tacoma Landfill project area consists of OUs 5 and 6. The Tacoma Landfill is located in Tacoma, Washington, approximately 6 miles south of Commencement Bay and directly west of Interstate 5 (Figure 3-1). The Tacoma Landfill has been operating as a sanitary landfill since 1960.

During the RI, ground water contamination was detected at the perimeter of the landfill and extended in a south westerly direction toward Leach Creek. Landfill gases were also found to be migrating from the landfill to residences and businesses adjacent to the site. COCs in ground water at the site include VOCs and heavy metals. Vinyl chloride was the most pervasive compound found in ground water during the RI. Landfill gases were found to contain a variety of VOCs as well as methane.

The remedy for the site included constraining further site operations, capping the landfill, constructing a gas extraction system, constructing a GETS, conducted monitoring of ground water, surface water, and soil gas, and providing an alternate water supply to residences affected by ground water contamination from the landfill. In addition, a closure plan for the landfill was developed and institutional controls were established to protect human health and the environment.

Operation and maintenance of the landfill cover, gas extraction system, and GETS have generally been conducted as designed. Four new gas monitoring probes and one new gas extraction well were installed near the northern landfill boundary to monitor landfill gas migration onto the adjacent Home Depot property. The gas data indicate methane concentrations have decreased since the new extraction well was installed. It has been noted that several gas monitoring probes around the site have become damaged due to settlement or deterioration and are being considered for replacement or repair.

The ROD required treatment to reduce contaminant levels in the ground water to or below cleanup standards with treatment performance levels for indicator chemicals based on federal MCLs and discharge to surface water. Extraction was required until water quality at the edge of the filled area met or exceeded MCLs, or previously established and approved health-based standards. In addition, consideration of potential impacts to public and private water supplies and to adjacent Leach Creek were required in the decision to shut off the system.

Based on existing ground water data, the GETS is controlling ground water contamination from the landfill; however, the pumping efficiency is declining from system aging and biofouling. Surface water quality at the edge of the filled area has been below the MCLs for several years. However, vinyl chloride and 1,2-dichloroethane (1,2-DCA) concentrations in ground water continue to remain above surface water quality criteria near Leach Creek where data indicate residual ground water plumes may be discharging to the creek. Concentrations of these constituents are not detected in the closest surface water samples; however, the reporting limits for both vinyl chloride and 1,2-DCA from the 1988 ROD are above the more conservative surface water criteria from 2006 which are protective of human health from fish and water consumption. It may also be that current sample types and sampling locations are not appropriate to evaluate the extent of the plume above this newer standard. In addition, a residential well on the other side of the creek from the vinyl chloride plume (EW-12) has had exceedences of the early warning value for vinyl chloride. MCL exceedences for arsenic have also been detected in other residential wells; however, only one of these (EW-10) is currently thought to be used for drinking water.

Summaries of issues and recommendations for each site are presented at the beginning of each chapter. Protectiveness statements are as follows:

Well 12A: The remedy at Well 12A is not protective because of the following issues:

- A potential threat is present from direct contact with remaining contaminated soils;
- Migration of the contaminated groundwater above the MCLs is not being controlled;
- Potential exposure to indoor air is likely. This exposure pathway requires evaluation to determine if the remedy effectively minimizes risk of this exposure pathway.
- An ICP that considers remedy protectiveness of pathways of concern should be developed to prevent exposure to soil and ground water contaminated above levels of concern.
- An effluent discharge permit is required to establish discharge criteria and point of compliance requirements by which system O&M can be measured and potential exposure pathways from discharge can be controlled; and
- Drums are present on-site which contain investigative derived wastes.

The following actions need to be taken to ensure protectiveness:

- Institutional controls should be developed and implemented to prevent direct contact to remaining soil contamination;
- Additional information on the evaluation of source strength and current extent of current ground water plume should be collected. Once this information is obtained, an evaluation of the remaining source area, impact on ability to achieve various targeted achievable RAOs for groundwater, and potential remedy modifications shall be conducted via a focused feasibility study which will screen remedial options in light of improving effectiveness of the remedy. ICs should also be put into place preventing drinking water use;
- Evaluation of the indoor air pathway should be conducted and, if unacceptable risks are found, they should be remedied;
- A discharge permit should be developed and finalized with the City of Tacoma; and
- Drums should be removed from the site.

South Tacoma Field: The remedy at South Tacoma Field is not protective because of the following issues:

- In the short term there is an immediate threat to transients using open, unused areas of the site based on the potential for direct contact with remaining contaminated soils that exceed the standard for unrestricted use on some portions of the site. The pending commercial/industrial development will significantly reduce the amount of open space currently attractive to transients.

- The MNA groundwater remedy at Pioneer Building Supply has not met the cleanup goal within the time specified in the ROD. It may be that residual, subsurface soil contamination is contributing to the groundwater plume; it may also be that recent paving of large areas in this vicinity is affecting attenuation. If residual soil contamination is present, ICs may be required to prevent contact with these soils (e.g. excavation in future construction); and

- Migration of the contaminated groundwater above the cleanup levels at Pioneer Building Supply

may not be controlled.

The following actions need to be taken to ensure protectiveness:

- Work with BNR to determine actions regarding transients living on open, unused areas of the site, including access controls along public right-of-ways;

- Develop and implement a revised groundwater monitoring program. Use new groundwater and soil data to assess time frame needed for MNA, or modifications to the remedy. Modifications to the remedy may include ICs for residual soil contamination, if present; and

- Evaluate new groundwater data at Pioneer Building Supply to determine if migration of groundwater plumes is controlled.

Tacoma Landfill: A protectiveness determination of the remedy at the Tacoma Landfill cannot be made at this time until further information is obtained. An evaluation of impacts from the remaining ground water plumes to Leach Creek and migration west of the creek is required. Surface water and GETS effluent discharge data need to be evaluated against more current surface water criteria and reporting limits should be lowered as applicable. Concentrations of COCs in two residential wells not connected to municipal water supply exceed the performance criteria. Pending a site visit to determine status of these wells, additional actions may be required at these homes. Finally, additional evaluations on the effects of elevated arsenic concentrations on human health and the ground water to indoor air pathway are required. It is expected that these actions will take one year to complete, at which time a protectiveness determination can be made (between August and December 2009). Details of project completion dates are presented in Table 3-3.

In addition to Five Year Review protectiveness determinations, EPA has also developed other environmental and site status indicators to measure and report progress and conditions of Superfund sites. These include Sitewide Human Health Exposure and Groundwater Migration Environmental Indicators and the Cross-Program Revitalization Measures, which are evaluated by Project Area and Sitewide. Based on the findings of this Five Year Review, EPA has made updated determinations for those indicators as follows:

Human Exposure Environmental Indicator: Status for the STC Site is "Not Controlled" because Institutional Controls have not been developed and implemented in the Well 12A project area, site access and ICs need to be improved and/or implemented to prevent human exposure to remaining soil, and groundwater contamination. In addition, evaluation of indoor air is pending for Well 12A.

Groundwater Migration Environmental Indicator: Status for the STC Site is "Not Controlled" because the most recent data available for the Well 12A project area indicates TCE contamination is not contained. In addition, current monitoring data are insufficient to determine whether groundwater migration is under control at South Tacoma Field, pending the revision and implementation of the ground water monitoring program to fully represent down gradient conditions.

Cross Program Revitalization Measure Status: Parts of the Site are "protective for people under current conditions" and in use; however, based on the findings of this review additional Institutional Controls and data are needed to make the Well 12A and STF operable units protective for people and all ICs need to be in place and cleanup goals met for soils before the site can be designated ready for anticipated use.

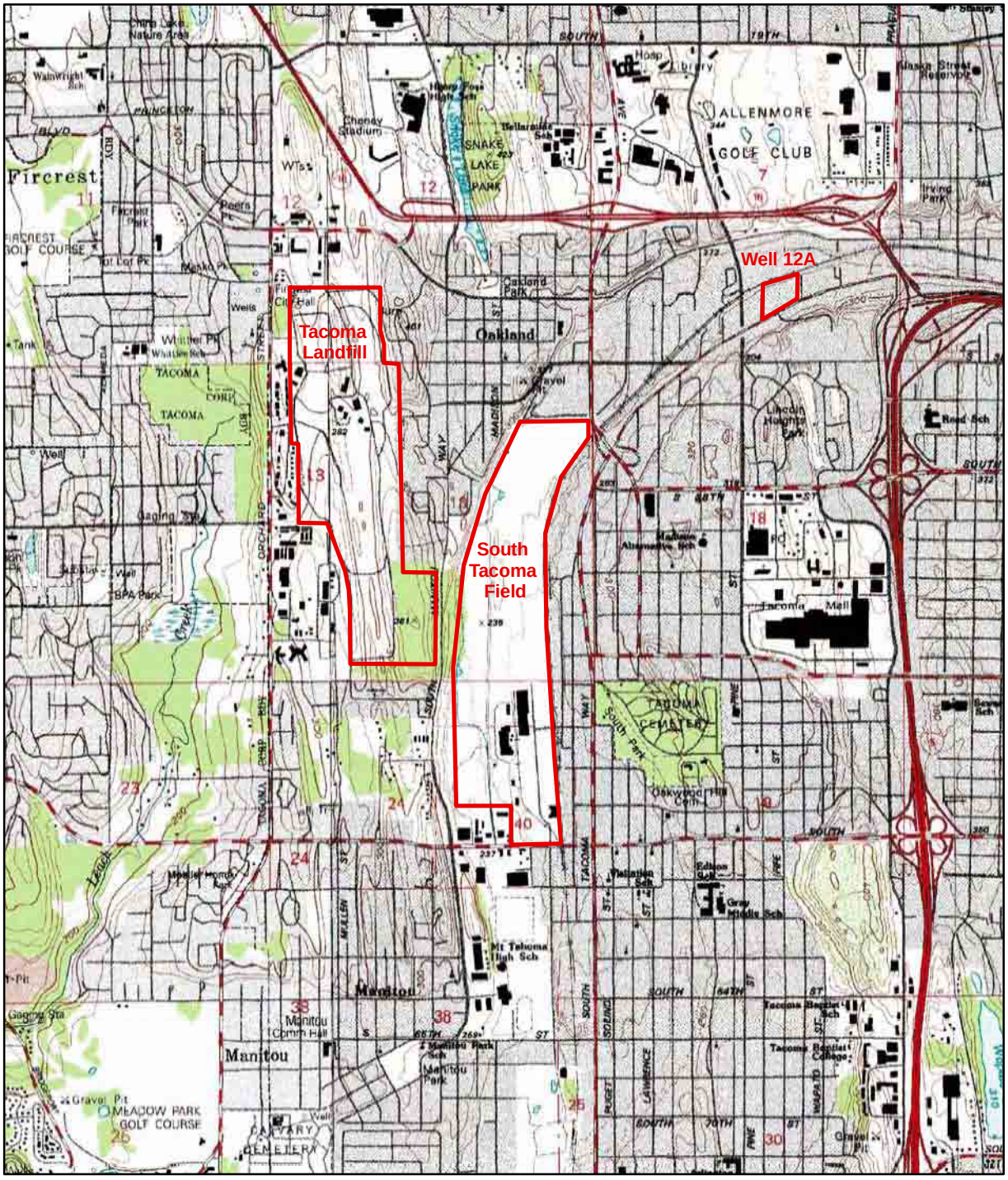


Figure ES-1
South Tacoma Channel Superfund Site
Operable Units

Source:
USGS Topographic Map, Tacoma South, WA, 1997
USGS Topographic Map, Steilacoom, WA, 1997

I. Well 12A, Operable Unit No. 1

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: Well 12A OU 1 for Commencement Bay, South Tacoma Channel Superfund Site		
EPA ID *(from WasteLAN)*: WAD980726301		
Region: 10	**State:** WA	**City/County:** Tacoma/Pierce
SITE STATUS		
NPL status: ☒ Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction ☒ Operating ☐ Complete		
Multiple OUs? ☒ YES ☐ NO (see South Tacoma Field and Tacoma Landfill)	**Site Construction completion date:** 9 /29/ 1999	
Has site been put into reuse? ☒ YES ☐ NO		
REVIEW STATUS		
Lead agency: ☒ EPA ☐ State ☐ Tribe ☐ Other Federal Agency		
Author name: Kym Takasaki		
Author title: Environmental Scientist	**Author affiliation:** U.S. Army Corps of Engineers, Seattle District	
Review period: 1/2008 to 5/2008		
Date(s) of site inspection: 3/ 3 /2008		
Type of review: ☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion)		
Review number: ☐ 1 (first) ☐ 2 (second) ☒ 3 (third) ☐ Other (specify)		
Triggering action: ☐ Actual RA On-site Construction at OU #___ ☐ Actual RA Start at OU# NA ☐ Construction Completion ☒ Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date *(from WasteLAN)*: 5/14/2003		
Due date *(five years after triggering action date)*: 5/14/2008		

Well 12A, Five-Year Review Summary Form, Cont.

ISSUES
1. Current ground water data and pumping data needed to assess current site conditions needed; 2. Indoor air pathway evaluation needed; 3. Lack of targeted achievable RAOs for site, including cleanup endpoints and approach for system performance monitoring; 4. Uncertainties in CSM, including remaining source materials in soil and extent of groundwater plume that may impact ability to achieve various RAOs; 5. Achievability of targeted RAOs require evaluation – potential ROD modification or enhancements to existing remedy may be required; 6. ICs are not in place that prevent exposure to contaminated soil and ground water; 7. Ground water monitoring program that measures changes in the plume needed; 8. Discharge permit, including discharge criteria and point of compliance, needed; 9. Drums on site that may contain waste derived from site investigations; and 10. O&M not transferred to Ecology via new SSC
RECOMMENDATIONS AND FOLLOWUP ACTIONS
1. Use new 2008 ground water data and pumping rates for extraction wells to establish current site conditions and capture zones; 2. Conduct modeling to evaluate if indoor air pathway is complete; 3. Identify potential viable RAOs and back calculate flux changes in source needed to achieve them; 4. Compare potential RAOs to data needs to determine if additional soil or groundwater data needed; 5a. Conduct focused feasibility study to evaluate benefits of additional remedial actions on ability towards achieving various RAOs. This evaluation should also include enhancements of existing remedy, to include changes in existing extraction system and options for targeted source area remediation; 5b. Generate decision document, as needed to document revised RAOs and or remedy modifications; 6. Develop and implement ICs to prevent exposure to contaminated soil and ground water; 7. Establish a new ground water monitoring program, including pumping rates for extraction well, and well performance monitoring (dissolved oxygen, redox, biological characteristics, etc.); 8. Establish discharge permit, including discharge criteria and point of compliance 9. Remove drums from site; and 10. Complete the SSC that will turn all site responsibilities over to Ecology.

Well 12A, Five-Year Review Summary Form, Cont.

PROTECTIVENESS STATEMENT
The remedy at Well 12A is not protective because of the following issues: • A potential threat is present from direct contact with remaining contaminated soils; • Migration of the contaminated groundwater above the MCLs is not being controlled; • Potential exposure to indoor air is likely. This exposure pathway requires evaluation to determine if the remedy effectively minimizes risk of this exposure pathway. • An ICP that considers remedy protectiveness of pathways of concern should be developed to prevent exposure to soil and ground water contaminated above levels of concern; • An effluent discharge permit is required to establish discharge criteria and point of compliance requirements by which system O&M can be measured and potential exposure pathways from discharge can be controlled; and • Drums are present on site, which contain investigative derived wastes. The following actions need to be taken to ensure protectiveness: • Institutional controls should be developed and implemented to prevent direct contact to remaining soil contamination; • Additional information on the evaluation of source strength and current extent of current ground water plume should be collected. Once this information is obtained, an evaluation of the remaining source area, impact on ability to achieve various targeted achievable RAOs for groundwater, and potential remedy modifications shall be conducted via a focused feasibility study which will screen remedial options in light of improving effectiveness of the remedy. ICs should also be put into place preventing drinking water use; • Evaluation of the indoor air pathway should be conducted and, if unacceptable risks are found, they should be remedied; • A discharge permit should be developed and finalized with the City of Tacoma; and • Drums should be removed from the site.
OTHER COMMENTS
None

I.I. Introduction

The purpose of the Five-Year Review is to determine whether a site remedy is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

The Environmental Protection Agency (EPA) is preparing this Five-Year Review report pursuant to CERCLA §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The EPA interpreted this requirement further in the NCP; 40 CFR §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

With oversight from the EPA Region 10 Remedial Project Manager, the United States Army Corps of Engineers (USACE) Seattle District conducted the Five-Year Review of the remedy implemented at the Well 12A Operable Unit (OU) 1 of the South Tacoma Channel (STC) Superfund Site located in Tacoma, Washington. The Well 12A site also includes two other OUs (OU2 BNRR Soil Removal and OU3 Vapor Extraction System) that have completed actions and are summarized in this document. In addition, there are two other active OUs associated with separate sites within the South Tacoma Channel Superfund site: South Tacoma Field (OU4) and Tacoma Landfill (OU5/6). Each STC OU is a separate operable unit but for purposes of the Five-Year Reviews, the reviews are submitted together under one cover. This section documents the results of the Well 12A site review, which was conducted from October 2007 through March 2008.

This is the third Five-Year Review for the Well 12A site. The triggering action for this statutory review is based on the last Five-Year Review for the Well 12A site. The Five-Year Review is required because hazardous substances, pollutants, or contaminants remain in the soil and ground water above levels that allow for unlimited use and unrestricted exposure.

I.II. Site Chronology

Table 1-1. Chronology of Site Events for Well 12A

Event	Date
Site Discovery	September 1981
Interim Priority NPL listing	November 1981
NPL Listing	September 8, 1983
Phase I RI/Focused Feasibility Study completed	January 1983
ROD Signature (Well 12A Stripping Towers IRM)	March 18, 1983
IRM Startup	July 17, 1983
ROD Amendment (Source treatment)	May 3, 1985
Phase II Remedial Investigation/Feasibility Study completed	May 3, 1985
Unilateral Order (PRP1)	June 3, 1985
Remedial Design Start - Ground Water	April 19, 1985
Remedial Design Complete – Ground Water	April 23, 1987
ROD Modification (Vapor Extraction System (VES)/carbon adsorption)	April 28, 1987
Remedial Action Start – Ground Water	June 11, 1987
Remedial Design Start - Soil	March 19, 1985
Consent Decree for Settlement (PRP1)	November 4, 1988
Remedial Design Complete - Soil	June 5, 1991
Remedial Action Start - Soil Vapor Extraction (SVE)	July 19, 1990
Remedial Action Complete - SVE	November 1, 1997
Consent Decree for Settlement (PRP2)	January 31, 1995
First Five-Year Review	July 16, 1998
LNAPL and Soil Investigation Report	September 1999
CB/STC Construction Completion	September 29, 1999
Remediation System Evaluation (RSE)	December 10, 2001
Second Five-Year Review	July 2003
Capture Zone Analysis	September 2005

I.III. Background

A. Site Location

The Well 12A OU of the Commencement Bay, South Tacoma Channel (STC) Superfund site located in Tacoma, Washington approximately 6 miles south of Commencement Bay and directly west of Interstate 5 (Figure 1-1). The Well 12A OU encompasses the source of contamination at the property of the former Time Oil Company, which is located at 3011 South Fife Street (Figures 1-2 and 1-3), and includes the

City of Tacoma's production Well 12A. Well 12A is located on Pine Street between 38th Avenue and South Tacoma Way.

B. Land and Resource Use

Current land use near the former Time Oil property and Well 12A is commercial and industrial. The former Time Oil property is currently owned by Justin Son Pae and is used by Western Moving and Storage and Sine Communications for storage and office space.

Ground water in the aquifer underlying the site is currently used as a drinking water source for the City of Tacoma. Well 12A is one of 13 wells in a well field that provides 40 percent of the summer drinking water for the City. The dominant ground water flow direction is to the southwest (toward Well 12A) when drinking water wells are producing and to the northeast when drinking water wells are not producing.

The site is located within the South Tacoma Ground Water Protection District, which is a special zoning overlay district managed by the Tacoma Pierce County Health Department (TPCHD) and discussed in more detail in Section V. According to the City, use of drinking water wells in the area is likely to increase in the near future based on new development plans in the area. The current demand forecast calls for full use of the City's ground water rights ramping up within about 25 years, beginning in 2010. Ground water in the South Tacoma Channel provides the primary contingency to maintain the municipal drinking water supply in the event that the main source (Green River) is not available.

C. History of Contamination/Initial Response

The former Time Oil property was historically used for various industrial practices including oil recycling and paint and lacquer manufacturing. Oil recycling and solvent processing began in the early 1920s and continued until 1991 with occasional interruptions due to changes in ownership and a large fire in 1976. The Time Oil Company vacated the property in 1991, and the space has since been used as a warehouse for heating, ventilation, and air conditioning equipment storage. The following section describes site investigation activities completed to date.

1. Discovery. On four different occasions between July and September of 1981, chlorinated organic solvents were detected in Well 12A in part per billion (ppb) concentrations (µg/L), above drinking water criteria. As a result, the City of Tacoma Water Department voluntarily removed Well 12A from production during September of that year. EPA completed a site investigation between July and September 1981 and proposed the site for listing on the National Priority List (NPL) on September 1, 1981. The Well 12A site was added to the NPL on September 8, 1983.

2. Phase I Remedial Investigation. EPA authorized a Remedial Investigation (RI) to determine the source, type, and extent of contamination in April 1982. Eleven ground water wells were installed and the results of subsequent ground water sampling and analysis revealed the following concentrations of contaminants of concern (COCs) on site:

- 1,1,2,2-tetrachloroethane (PCA) —17 to 300 µg/L;
- *trans*-1,2-dichloroethene (DCE) — 30 to 100 µg/L;
- trichloroethene (TCE) — 54 to 130 µg/L; and
- tetrachloroethene (PCE) — 1.6 to 5.4 µg/L.

The RI study also determined that the major source of contamination was generally located northeast of Well 12A. It was also determined that the natural, undisturbed ground water flow direction was east and

away from Well 12A. However, with the well field in production, the ground water flow direction reversed, and the contaminant plume traveled towards the wells.

The RI concluded that continued pumping of Well 12A could capture the contaminant plume even if other production wells were pumping. That is, pumping Well 12A could provide a hydraulic barrier to the spread of contamination and protect the rest of the well field. If Well 12A was not pumped to provide a hydraulic barrier, it was hypothesized that other operating wells could be impacted by the contaminant plume and would be lost for drinking water use.

3. Phase I Focused Feasibility Study/Initial Remedial Measures. In January 1983, EPA conducted a Focused Feasibility Study (FFS) to determine the most cost effective treatment for Well 12A that would protect the drinking water supply for the City of Tacoma. The study included an Endangerment Assessment that evaluated risks to the general population if no action was taken. The FFS recommended that a pump and treat system with air stripping be implemented on an interim basis for treatment of Well 12A ground water to control the spread of contamination and prevent the loss of the well field. Carbon adsorption was also considered for treatment of ground water but was more expensive and was (initially) eliminated from further evaluation for use on site.

On March 18, 1983, EPA signed a Record of Decision (ROD) for an Initial Remedial Measure calling for the design and construction of five air stripping towers at Well 12A operating in parallel to treat up to 3,500 gallon per minute (gpm) of contaminated Well 12A ground water. The ROD required treatment to be sufficiently protective of either consumption, or aquatic life if discharged either to Commencement Bay or to the City's sanitary sewer system. The decision criteria used to determine disposal requirements was the concentration equivalent to the $1x10^{-6}$ excess cancer risk level at the tap (after treatment and dilution in the system). Construction of the treatment system was authorized on March 24, 1983, and system startup occurred on July 17, 1983. The system was operated by the City until early November 1983 when production from the well field for peak demand was no longer needed. Since that time, operation of the Well 12A treatment system of air stripping towers has continued on a seasonal basis (during peak demand) to reduce impact to remaining well field and will continue until remediation is completed.

4. Phase II RI/FS. Because the Phase I RI identified only a general source location and not a specific site, EPA authorized a study of historical solvent use and disposal practices in the suspect area in December, 1982. Records of past investigations by TPCHD, Tacoma Water Division, and the Washington State Department of Ecology (Ecology) were reviewed and interviews were conducted with owners of numerous businesses in the area. A follow-up study focused on the historical uses and disposal of PCA in the vicinity of Well 12A. The focus on PCA was based on the fact that the RI determined this chemical to be the predominant contaminant at the site, and an uncommonly used solvent. Since few businesses nearby used PCA, these studies reduced both the number and location of potential sources of the contamination by process of elimination.

In May 1983, EPA authorized a supplemental Remedial Investigation and Feasibility Study (RI/FS) to further define the extent of ground water contamination and to attempt to locate the source. Four monitoring wells were installed and sampled. Ground water located near the Time Oil property contained concentrations of TCE, PCA, and *trans*-1,2-DCE in the low part per million (ppm) range, which was substantially higher than detections in other wells, and orders of magnitude higher than at Well 12A. It was consequently determined that these monitoring wells were at or near the source of contamination.

With the apparent source area narrowed down substantially, EPA obtained air and near surface soil samples along the Burlington Northern railroad spur north of the Time Oil property. Air sampling results showed very low contamination levels, but soil samples contained significant concentrations of TCE and

PCA, confirming that this was the source of the contamination. The soil underlying the railroad track was composed of a fine grained filter cake that had been used during oil reprocessing operations at the site and disposed of on site. The filter cake consists of a tar- like sludge filtered from treated waste oil and is contaminated with high concentrations of lead (1 to 2%) as well as chlorinated organics.

Remedial alternatives were then developed to treat both the soil and ground water at the source and a proposed plan was issued for public comment.

D. Basis for Taking Action

The RI documented the COCs in soil and ground water as PCA, PCE, TCE, and *trans*-1,2-DCE. In addition, vinyl chloride and *cis*-1,2-DCE have been detected in site ground water above the Maximum Contaminant Levels (MCLs). Potential risks associated with exposure to ground water are attributed to the presence of these contaminant concentrations in exceedence of State and Federal MCLs for drinking water. The Endangerment Assessment determined that public health may be threatened either by direct contact at the source area or by consumption of contaminated drinking water if no additional remedial action was taken.

I.IV. Remedial Actions

The following section summarizes remedial actions completed to date and the RODs on which they were based. As discussed above, the initial ROD was solely for the Interim Remedial Measure (IRM) at Well 12A. The ROD was amended in May 1985 to include source area treatment and consisted of the following major elements:

- Continue to operate the IRM (treatment of Well 12A effluent) until such time that the source control and remedial measures render the IRM unnecessary.
- Extract and treat the ground water at the source to remove volatile organics, followed by discharge of a major portion of the treated effluent into Commencement Bay via an existing storm sewer. The remaining treated ground water effluent was to be infiltrated by a drain field at the source area in order to provide flushing of contaminants through the soil column.
- During the design phase, drill and collect soil samples from up to 5 additional 30-foot soil borings in order to better define the extent of soil contamination.
- Remove an appropriate length of railroad track adjacent to the Time Oil property and excavate the discolored, oily, fine-grained filter cake and soils under and adjacent to the railroad spur.
- Install drain field piping in the excavated areas and cover with a permeable material to protect the piping and prevent direct human contact with underlying soils.
- Pave or place a soil cover on the portions of the unpaved Time Oil parking lot not subject to excavation and flushing, in order to prevent direct human contact.
- Transport and dispose of all excavated, contaminated soils in a Resource Conservation and Recovery Act (RCRA)-permitted landfill.
- Maintain institutional controls prohibiting withdrawal of ground water by private parties in portions of the aquifer where levels exceed $1x10^{-6}$ excess cancer risk.
- Monitor ground water to evaluate the performance of the treatment system.
- After two years of operation, evaluate the effectiveness of the ground water extraction and

treatment system in order to estimate the endpoint levels of treatment.

In summary, the selected IRM for the site called for ground water pump and treat at Well 12A using air stripping for treatment, excavation of contaminated soils, and soil treatment by extraction, flushing with treated ground water, or capping based on soil concentrations present. The ROD allowed for the regional administrator to have authority to approve modification to the choice and operation of certain aspects of the treatment system and soil remedy which are found to be "equivalent in effectiveness and cost or are necessary for the protection of health and the environment."

The IRM was amended in an April 28, 1987, memorandum to the Regional Administrator to include soil treatment by VES and a Ground water Extraction and Treatment System (GETS) using carbon adsorption. These treatment systems were proposed to augment the air stripping system used for treatment of Well 12A ground water during periods of peak demand.

The ROD identified four tiered remedial goals that would allow the achievement of ground water cleanup goals. The cleanup goals were based on treating the ground water at the source (the Time Oil property) to levels where concentrations were below the $1x10^{-6}$ excess cancer risk level at Well 12A, or at the Time Oil property boundary. The ROD states that the final targeted achievable goal was to be based on treatment system performance data after two years of implementation. Under CERCLA, the ground water treatment system would be operated until the chosen level of treatment is achieved unless that level proved technically infeasible or placed an unreasonable burden on the fund. The cleanup goal alternatives stated in the ROD are provided below in order of increasing length of treatment time and cost to reach the goal:

- Treat ground water at the source (the Time Oil property) so that Well 12A ground water concentrations would meet requirements for storm sewer discharge to the bay, or with treatment, allow the utilization of the Well 12A ground water for the City water supply after dilution with other waters.
- Treat ground water at the source such that untreated Well 12A ground water could be used (after dilution with water from the rest of the well field) as drinking water.
- Treat ground water at the source such that Well 12A ground water concentrations would satisfy the $1x10^{-6}$ risk level with no dilution.
- Treat ground water such that all ground water within the property boundary satisfies the $1x10^{-6}$ risk level.

Since cleanup levels have not been established for the site, the current default cleanup levels for COCs at Well 12A are the federal MCLs, as presented in Table 1-2.

Table 1-2. Federal MCLs for COCs at Well 12A

Contaminant	Concentration (µg/l)
PCE	5
TCE	5
trans-1,2-DCE	100
cis-1,2-DCE	70
vinyl chloride	2

The soil cleanup goals in the ROD are based on treatment until "the remaining contaminants pose no further threat to the ground water." The ROD allowed for determination of the appropriate soil cleanup levels at a later date.

A. Remedy Implementation

As discussed above, the IRM of ground water pump and treat using air stripping on Well 12A began in 1983 and currently continues to operate when the well is pumped during periods of peak demand.

In September 1987, construction began on the GETS to treat contaminated ground water at the contamination source. The system installation was completed in the Spring of 1988, was upgraded significantly in 1995, and is currently in operation. As of 2001 the GETS treatment has removed more than 16,000 pounds of volatile organic compounds (VOCs) from site ground water.

The pilot VES was installed on the Time Oil property in 1993. The VES system was upgraded from its pilot status and operated until 1998, resulting in the removal of 54,100 pounds of VOCs from the site subsurface.

Soil removals were also conducted at the site. In 1986, 1,200 cubic yards (CY) of contaminated soil were removed from the Burlington Railroad spur and in 1992, approximately 5,000 CY of contaminated filter cake were removed by EPA. No soil flushing or capping activities have been conducted.

To date, the remedy has not included institutional controls for soils or groundwater. The ROD indicates that the remedial action should include maintenance of institutional controls to prohibit withdrawals of ground water from the area of the plume of contamination, and the selection of the endpoint of ground water and soil treatment at the source area. Currently, property owners receive drinking water from the municipal water supply. No existing private drinking water wells have been identified in the site vicinity. The ROD does not identify institutional controls for soil. A determination of whether additional institutional controls on soil were needed was to be conducted in conjunction with the determination of an appropriate cleanup level for the areas to be treated by flushing.

B. System Operation/Operation and Maintenance

The City of Tacoma treats Well 12A ground water by air stripping when pumping from this well, as required in the original ROD. Currently the City only pumps from Well 12A in response to extended pumping of Wells 6 and 11, which are located southwest of the site. Air from the stripping towers is not treated with vapor phase carbon and is discharged to the atmosphere. At influent concentrations less than 100 µg/L and a pumping rate of 670 gpm, the discharge to air is less than 1 pound per day. When pumped, treated water from Well 12A is added to the drinking water supply.

The GETS includes five extraction wells on and near the Time Oil property, which have been operating since 1988, and were expanded in 1995. While the design yield of each of these wells is 50 gpm, each well is currently capable of operating at approximately 10 gpm. When last measured in May 2004, the extraction system collectively pumped approximately 92 gpm. Pumping rates have not been estimated since then.

The GETS is located south of the Time Oil property outside on a concrete pad surrounded by a chain-link fence. The system consists of two bag filters arranged in parallel that precede two 20,000-pound granulated activated carbon (GAC) units arranged in series. Effluent from the second carbon unit is

discharged to the Thea Foss Waterway via storm drains. During carbon replacement, extracted water is stored in a 7,050-gallon effluent tank.

EPA contracted out the operation of the GETS from 1995 until operations were transferred to Ecology in Fall 2005. Ecology reports that the principal costs are currently $140,000 per year, which includes two carbon change outs ($60,000 annually), laboratory services and sampling costs ($40,000 annually), and rental of the ground water treatment system property ($40,000 annually). There have been only incidental repairs since November 2005. The current annual Operation and Maintenance (O&M) cost is less than the O&M costs reported in the last Five-Year Review of $300,000 to $400,000 per year, however the costs reported by Ecology do not include cost associated with conducting long-term ground water monitoring outside of the GETS monitoring or fees for discharge which have historically ranged from $37,000 to $51,000 annually. No discharge fees are being paid since there is currently no discharge permit in place.

Discharge requirements were initially set in the City of Tacoma discharge permit written to EPA. Since transfer of the operations of the GETS to Ecology, the permit has expired and requires transfer to Ecology. This permit transfer is pending. Currently, Ecology manages discharge by monitoring vinyl chloride concentrations in the system. When values in the effluent reach 10 µg/L for vinyl chloride, the carbon is changed out. This action limit value was based on empirical observation of the system and is considered more stringent than the former operating criteria of 10.7 µg/L for the sum of PCA and PCE.

I.V. Progress Since the Last Five-Year Review

Several of the recommendations from the last Five-Year Review were implemented. However, targeted achievable Remedial Action Objectives (RAOs) for both ground water and soil have not been established to date. Because of this, implementation of several recommendations has been postponed pending development of an updated remedy evaluation. The details of path forward for items requiring resolution are discussed in Section VI.

A. Last Protectiveness Statement

The protectiveness statement in the last Five-Year Review follows:

> *Based on the Technical Assessment for the Well 12A operable unit (OU1), the remedy is considered protective in the short-term, because there is no evidence that there is a current exposure. The planned Capture Zone Analysis should verify if the existing ground water extraction and treatment system (GETS) is fully or partially containing the contaminated ground water plume.*

B. Status of Recommendations

The following section presents a summary of the status of recommendations from the last Five-Year Review.

1. Complete Capture Zone Analysis (CZA): Completed. The CZA was conducted in September 2005 to determine the current zone of ground water being captured from continued flow by the GETS pumps based on the current GETS configuration and to recommend a target capture zone for future operations. The CZA also included additional non-aqueous-phase liquid (NAPL) characterization to evaluate potential future remedial actions that could reduce long term O&M.

The primary objectives of the study included the following:

- Evaluate the current capture zone of the GETS, determine whether the GETS provides adequate hydraulic control within the target capture zone, and use these data to optimize GETS performance, if necessary;
- Confirm the presence of a continuous confining layer below the site contamination, determine if contaminants are present in the lower aquifer, and evaluate the vertical hydraulic gradient for use in the CZA; and
- Define a target capture zone for the GETS that will achieve hydraulic containment of contaminated ground water in the source area.

In addition, secondary objectives included:

- Conduct a limited investigation of the lateral and vertical distribution of dense non-aqueous phase liquid (DNAPL) for use in evaluating potential future remedial actions that could reduce long term O&M;
- Investigate lateral distribution and measure thickness of the light non-aqueous phase liquid (LNAPL);
- Evaluate the physical properties and volatile organic content of the LNAPL to determine mobility and potential for recovery;
- Estimate horizontal gradient in the lower aquifer;
- Obtain data for evaluating the potential for natural attenuation at the site;
- Evaluate physical soil properties to support selection of potential future remedial actions;
- Assess presence of 1,4-dioxane at the site; and
- Evaluate ground water concentrations from within a water-bearing zone within the confining layer below the source area.

To conduct the CZA study, the GETS extraction wells were cleaned and redeveloped and monitoring wells were repaired and redeveloped as needed. Seven new wells and the existing well network were resurveyed. Three rounds of ground water sampling were conducted in May 2004, December 2004 and, February/March 2005. In addition, site ground water elevations during Well 12A non-pumping conditions, NAPL gauging, and soil sampling were also conducted. Based on this data, the capture zone for the GETS was modeled.

2. Begin Transfer of O&M to Ecology: Completed. O&M of the GETS was transferred to Ecology in the Fall of 2005.

3. Complete Transfer of O&M to Ecology: Pending. To date, a State Superfund Contract (SSC) has not been finalized with Ecology. Negotiations of this contract are pending the evaluation of the overall remedy.

4. Implement/Construct Capture Zone Report Recommendations: Pending. The CZA was evaluated using the 1985 ROD objective of mitigation and control of ground water and soil contamination in the source area. Therefore, the RAO was assumed to be containment of contaminated ground water in the source area to minimize contaminant migration towards Well 12A. The results of the CZA indicated that

TCE concentrations above the MCL are not currently being captured by the GETS system (Figure 1-4). Concentrations of 1,4-dioxane in ICF-2 and MW-308 also indicate its presence beyond the capture zone. The remaining COC concentrations above MCLs are largely contained within the capture zone of the extraction wells. Since capture of the TCE plume above MCL was deemed impracticable, the CZA report recommended that the target capture zone be expanded to encompass the 500 µg/L TCE contour. The analysis concluded that more than one additional extraction well would be required to accomplish this.

Prior to placement of additional extraction wells, the CZA report recommended:

- Additional ground water modeling to evaluate future pumping scenarios, including modeling evaluation of vertical capture in potentially VOC-impacted areas in the lower aquifer;
- Installation of one to two additional monitoring wells for collection of water level data to the north and east of the former Time Oil building; and
- Development of institutional controls to encompass the entire extent of the contaminated ground water. An updated assessment of the residual risk to human health and the environment for areas not contained by the GETS were also recommended.

Additional details of the CZA analysis are presented in Section I.VI. To date, these recommendations have not been completed. It should also be noted that these recommendations focused primarily on needs related to containment of concentrations above the MCL as the primary RAO. To date, the finalization of achievable and protective ground water RAOs and the evaluation of requirements to achieve them have not been conducted. Further, EPA has not performed an evaluation of only containing the high concentration plume in excess of 500 µg/L TCE and how this option would fit into a protective overall plume management strategy.

5. Develop Institutional Controls: Pending. An Institutional Controls Plan (ICP) has not been developed for the site but is planned pending evaluation of the overall remedy. EPA currently only has an access agreement in place with the current property owner of the Time Oil site, and with other property owners for sampling at their property.

The site is located within the South Tacoma Ground Water Protection District (District) as codified in the Tacoma Municipal Code Chapter 13.09 and revised in 2006. The district was established to reduce or eliminate threats to the drinking water supply. Currently the requirements of this program are managed by TPCHD. This program requires permits and inspections for businesses with either an underground storage tank or more than 200 pounds of hazardous materials on-site. In addition, “high-impact” industries (e.g. chemical manufacturing, creosote manufacturing, and electroplating facilities) are prohibited from being located within the District. Storm water infiltration systems and hazardous substance storage management are also regulated in this code. There are no city ordinances that place formal restrictions on the installation of drinking water wells in this area.

6. Implement Remedial System Evaluation (RSE) Recommendations: Pending. The RSE report recommended additional studies, changes in operation to reduce costs, and modifications to gain site-closeout. The status of each recommendation is summarized in Table 1-3.

Table 1-3. Status of RSE Recommendations, Well 12A

Type	Recommendation	Status
Recommended Studies		
	Obtain accurate and reliable water level measurements and develop associated potentiometric maps.	Completed in the CZA
	Develop a ground water flow model of the Well 12A operable unit.	Completed in the CZA
	Analyze capture zone of extraction wells.	Completed in the CZA
	Make aquifer monitoring program consistent.	Begun. First sampling round since 2005 was conducted in March 2008.
	Ensure annual sampling and analysis of VOCs in water from Well 9A.	Need to re-evaluate sampling recommendation. Since the well is for emergency use only, City of Tacoma conducts sampling only when the well is turned on.
Recommended Changes to Reduce Costs		
	Replace extraction well pumps.	Not conducted-pending evaluation of system performance and finalization of RAOs.
	Examine City of Tacoma Policies on storm water discharge and/or consider alternative discharge locations.	Not conducted-pending evaluation of system performance and finalization of RAOs .
	Consider replacing the carbon adsorption vessels with air stripping unit, depending on the future of the remedy.	Not conducted-pending evaluation of system performance and finalization of RAOs.
Recommended Modifications for Site Closeout.		
	Excavation of remaining filter cake.	Not conducted- pending evaluation of system performance and finalization of RAOs.
	Evaluate remedial process options based on analysis of ground water modeling considering: passive versus aggressive approaches.	Begun. Systematic Planning meeting initiated evaluation in 10/2007 (see Section I.VI).

I.VI. Five-Year Review Process

A. Administrative Components

Members of the City of Tacoma and Ecology were notified of the initiation of the Five-Year Review during the systematic planning meeting conducted on October 24, 2007. The Five-Year Review team was led by Kira Lynch of EPA, Remedial Project Manager (RPM) for the Well 12A Site, and Kym Takasaki of the USACE Seattle District. Chris Maurer from Ecology assisted in the review as the representative for Ecology. Craig Downs from the City of Tacoma also provided information related to the operation of the South Tacoma Drinking water Well field.

B. Components of Review

The review team established the review schedule between October 2007 and May 2008. Components of the review included:

- Community Involvement;
- Document Review;
- Data Review;
- Site Inspection;
- Local Interviews; and
- Five-Year Review Report Development and Review.

C. Community Involvement

Activities to involve the community in the Five-Year Review were initiated with a systematic planning meeting in October, 2007 with EPA, Ecology and the City of Tacoma. In February 2008, EPA printed a notice in the Tacoma News Tribune local newspaper alerting the public about the Five-Year Review.

No comments were received from the public on this review.

D. Document Review

This Five-Year Review consisted of a review of relevant documents as summarized in Attachment 1-1.

Applicable ground water and surface water cleanup standards were also reviewed.

E. Data Review

Sources of data reviewed for the Five-Year Review process included City well data, GETS monitoring data, monitoring well data, CZA results, and soil and NAPL product data. The results of the review are summarized below.

1. City Well Data. The City of Tacoma routinely monitors water quality in their drinking water wells in accordance with the Safe Drinking Water Act. Wells are sampled at the well head either once every three

years or when the well is turned on for use, whichever is more frequent. In addition, water from all combined wells is sampled once a year at the point of entry to the discharge system. Electronic summaries of well head data for Well 12A and Well 9A were reviewed to evaluate exposure risk through the drinking water pathway. Since Well 9A is identified as an emergency use only well, it has only been sampled when the well is turned on (sampling dates presented in Table 1-5). Well 12A has been sampled annually pre- and post-treatment, however the 2007 data is not yet available. These wells were sampled for the full suite of VOCs.

Only compounds with detected results for Well 12A ground water prior to treatment and the nearest adjacent Well 9A are presented in Tables 1-4 and 1-5 below. Pre-treatment values for Well 12A indicate that this well continues to be impacted by the Time Oil plume, with concentrations of TCE exceeding the MCL. Concentrations are variable over time. No exceedences above MCLs have been detected at Well 9A although concentrations of TCE below the MCLs have been reported.

Table 1-4. Detected Concentrations in Well 12A Pretreatment Samples in µg/L, 1999 - 2006

	MCL	**9/99**	**7/00**	**10/01**	**11/02**	**7/03**	**10/04**	**10/05**	**7/06**
TCE	5	**12**	**8.5**	2.1	2.5	**7.7**	**10.6**	3.1	**7**
trans-1,2 –DCE	100	1.4	1.2	<0.5	<0.5	0.8	1.2	<0.5	0.9
PCA	5	0.8	0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5

Bolded values are above the MCL
Post treatment samples were also collected, results are non-detect since 2000

Table 1-5. Detected Concentrations in Well 9A in µg/L, 1999- 2006

	MCL	**9/99**	**6/03**	**5/05**
TCE	5	2.3	1.2	1.5
Chloroform	NA	<0.5	<0.5	<0.5

NA Not available

2. GETS System Monitoring Data. The GETS system is used to extract and treat site ground water. Process monitoring of the system includes collection of ground water samples from the extraction wells and water sample collection on a biweekly basis from the influent (SP-1), intermediate (SP-2), and effluent (SP-3). Samples are analyzed for VOCs only. Intermediate samples represent process water after passing through the first carbon vessel but before passing through the second vessel. Electronic summaries of this data were reviewed. As discussed in Section IV, the need for carbon change out is triggered by the results of SP-3 effluent samples. As part of this Five-Year Review, the effluent data was reviewed to determine compliance with discharge criteria. Sample results from the five extraction wells were reviewed to evaluate trends in source strength. Evaluation of the overall effectiveness of the GETS capture zone was completed in the CZA report, discussed below.

In 1988, EPA and Ecology discussed appropriate effluent discharge criteria to be used to manage the treatment of the effluent prior to discharge. Since agreement between agencies could not be met regarding cleanup criteria and point of compliance, EPA set the standard of 10.7 µg/L for the sum of 1,1,2,2-PCA and PCE to determine when carbon change out was required.

Following takeover of maintenance of the GETS system in 2005, Ecology continued to use the EPA criteria until it developed empirically derived effluent discharge criteria of 10 µg/L for vinyl chloride. This action limit value was based on empirical observation of the system and is considered more stringent than the former operating criteria of 10.7 µg/L for the sum of PCA and PCE. Management of the system using this new discharge criteria was implemented in November 2006. Effluent samples have been below

this value since this time (Attachment 1-2). The former discharge criteria for PCE and PCA was exceeded only once in June 2006.

In addition, discharge at the effluent point was compared to relevant state and federal surface water quality criteria (Table 1-6) for information purposes. It should be noted that since there is no current discharge permit, neither regulated criteria nor point of compliance requirements have been established for this project. Because of this, it cannot be determined if the current discharge criteria is sufficiently protective. A detailed summary of effluent data for chemicals of concern is presented in Attachment 1-2.

Table 1-6. Range of Effluent Data for COCs Compared to Water Quality Criteria, January 2003-January 2008

	Vinyl Chloride (µg/L)	**PCA (µg/L)**	**PCE (µg/L)**	**TCA (µg/L)**	**TCE (µg/L)**	***trans*-1,2 DCE (µg/L)**	***cis*-1,2 DCE (µg/L)**
Minimum detected	0.7J	1.0U	0.5U	0.4J	0.3J	0.1J	0.3J
Maximum detected	110	31	5	2	148	252	413
State Freshwater (1)	2	0.17	0.8	0.6	2.7	NA	NA
State Marine (1)	525	11	8.85	42	81	NA	NA
Federal (2)	0.025	0.17	0.69	0.59	2.5	140	NA
Federal (3)	2.4	4	3.3	16	30	10,000	NA

(1) Washington Administrative Code Chapter 173-201 Ambient Water Quality Criteria for Protection of Human Health (based on National Toxics Rule)

(2) National Recommended Water Quality Criteria for Priority Toxic Pollutants Human Health for consumption of water + organisms

(3) National Recommended Water Quality Criteria for Priority Toxic Pollutants Human Health for consumption of organisms only

Sample results from the five extraction wells were reviewed to evaluate trends in source strength. Maximum concentrations of TCE (2,600 µg/L) were historically detected in EW-2. Currently c**o**ncentrations in this well have decreased to around 200 µg/L. Remaining extractions well concentrations have also decreased over time. This trend may in part be caused by the decreased pumping rates in the extraction wells.

3. Monitoring Well Data. Ground water sampling was conducted in May 2004, December 2004, and February/March 2005 as part of the CZA. All ground water samples were analyzed for volatile organics and select samples from wells with historically high VOC concentrations (CH2M-1, TOW-4, and ICF-2. Figure 1-3) were also analyzed for 1,4-dioxane. Analytical results for ground water samples were presented in the CZA report.

Distribution of ground water COCs exceeding MCLs is presented on Figure 1-4. In general, the TCE plume had the greatest lateral extent. During these sampling events, it appeared that higher concentrations had migrated south from the source area, as COC concentrations in ICF-2 increased. The concentrations within the remaining plume appear to have decreased slightly during the time frame measured. Additional data is required to evaluate temporal trends. In addition, the extent of MCL exceedences has not been established so spatial and temporal trends cannot be fully developed at this time.

Concentrations of 1,4-dioxane between 6.7 and 20 µg/L were detected in extraction well ground water . There is no federal MCL established for this compound. However, an EPA Region 9 tap water value of 6.1 µg/L has been recommended. Detections of 1,4-dioxane were also noted in the GETS influent at concentrations between 0.4 and 3.5 µg/L and in monitoring wells TOW-4, ICF-2 and MW-308 at concentrations between 1.1 and 14 µg/L.

LNAPL was also detected in six source area wells during the May 2004 and December 2004 sampling events and in three wells during the February/March 2005 sampling event. DNAPL was not detected in sampled wells during the CZA, but has historically been identified in other sampling events.

An additional round of ground water sampling was occurring at the time of this review (Spring 2008) to evaluate current conditions, but the results were not available for incorporation into this review.

4. Capture Zone Analysis Data. The GETS capture zone was conducted to evaluate the extent of ground water capture being achieved by the extraction wells. Details of the analysis are provided in the CZA and were not technically reviewed in this Five-Year review, since this had been done by the EPA technical project team. The analysis was conducted using ground water elevation contours, ground water contaminant concentrations, extraction pumping rates and ground water modeling using data from results of the most recent sampling event. The results indicated that TCE concentrations above the MCL are not currently being captured by the GETS system (Figure 1-4). Concentrations of 1,4-dioxane in ICF-2 and MW-308 also indicate its presence beyond the capture zone. The remaining COC concentrations above MCLs are largely contained within the capture zone of the extraction wells.

The CZA report concluded that it would not be feasible or cost effective to capture the full extent of the contaminant plume above MCLs with a pump and treat system. A very large extraction and treatment system would be required to achieve full plume capture given the large area of contamination and hydraulic conductivity of the aquifer.

5. Soil and Product Data. Soil samples were most recently collected during installation of new wells during the CZA study (Figure 1-5). This section summarizes these results to provide a current understanding of the soil contamination known to be left in place. Additional soil data have historically been collected but are not discussed in detail in this document. All historical data are currently being used to develop a comprehensive conceptual site model for future remedial option evaluations. A summary of the soil data from the well installation samples are provided below.

At the near surface, maximum concentrations of 2,600 and 1,900 micrograms per kilogram (µg/kg) for TCE and PCE, respectively, were detected in MW-305. These concentrations are above the Model Toxics Control Act (MTCA) Method A industrial cleanup goals. In addition, concentrations in the non-paved area to the east of site (at MW-307), are also above the MTCA criteria in the upper 15 feet of the soil.

Below 15 feet, the highest COC concentrations were detected in MW-301 soil boring samples at a depth of approximately 48 feet below ground surface (bgs) (Figure 1-6). Concentrations of TCE in the vadose zone soils were up to 1,500 µg/kg (MW-304, Figure 1-6). PCE and TCE concentrations were highest where thin silt layers were encountered near the top of the water table at about 50 feet bgs. Maximum detected PCE and TCE concentrations of 27,000 µg/kg and 101,000 µg/kg, respectively, were detected in MW-301 soil samples collected at the ground water interface. COC concentrations appear to decrease below the ground water smear zone until sand and gravel layers are encountered at about 90 feet bgs. Maximum concentrations of PCE and TCE seen in the CZA below 90 feet were 510 and 2,100 µg/kg, respectively.

Despite previous efforts of source removal, a number of sources in soil, NAPL, and high concentrations of dissolved phase contamination still remain on or near the Time Oil property and continue to act as a reservoir that sustains the contaminant plume. Both LNAPL and DNAPL have been identified on site and an additional area of filter cake has been identified to the east of the Time Oil building and under the rail road tracks. The extent of remaining filter cake estimated based on soil data, historical information, and visual evidence is presented on Figure 1-7. The extent of this material is uncertain due to lack of site characterization data. This material is likely a hazardous waste. The LNAPL exists primarily within a

smear zone near the water table where it coats soil particles and partially fills voids in the soil. The NAPL is known to contain high concentrations of chlorinated solvents. High soil concentrations of chlorinated solvents were found at depths exceeding the historical low ground water level of 40 feet below ground surface. A conceptual site model (CSM) depicting generalized contaminant sources at the site is presented on Figure 1-9. More detailed analysis of the soil concentrations throughout the site is currently being conducted to refine the CSM.

F. Site Inspection

Inspection of the former Time Oil property and the GETS was conducted on March 3, 2008 by the USACE and Ecology representative, Chris Maurer. The purpose of the inspections was to assess the protectiveness of the remedy. Site photographs are presented in Attachment 1-3.

The GETS system and associated extraction wells were observed to be in working condition during the site inspection. The five extraction wells are all in below grade vaults. The electrical and plumbing systems that connect the extraction wells to the treatment system are all below grade. Fencing around the GETS and the associated office/storage trailer was intact.

The former Time Oil property use was confirmed to be commercial and industrial. The site was completely still paved, with the exception of the former warehouse east of the East Tank Farm. This area is covered with rock. Several drums related to EPA sampling and remedial activities were observed near the VES building. According to the EPA RPM, these drums are scheduled for removal in the near future. Two site buildings are present on the site and appear to be used for office and storage space. The adjacent area is also used for commercial and industrial purposes.

G. Interviews

Ecology was interviewed regarding site operating protocols during the site inspection. Mr. Maurer from Ecology provided the discharge criteria previously described in this report. He provided details on the overall operation of the GETS system and associated performance data. He also indicated that no major repairs or maintenance have been required since Ecology began oversight of operations.

The City of Tacoma representative, Craig Downs, was also contacted to obtain City well data, confirm current operations of their drinking water wells, and future water resource uses. This information was used to generate preceding sections of this review.

Because of low community interest of the site, no community members were interviewed.

I.VII. Technical Assessment

A. Is the remedy functioning as intended by the decision documents? No.

1. Remedial Action Performance. The GETS has been effective at reducing contaminant mass, but is only partially containing the contaminant plume, and minimizing contaminant migration towards Well 12A. TCE concentrations above the MCL are not being contained. Since ground water monitoring has not been conducted since 2005, current ground water conditions cannot be determined to verify current remedy performance. Additional ground water sampling was conducted in March 2008 and will be used to evaluate remedial action performance and modifications to the system, as required.

The existing ROD suggests that ultimately the remedial action may need to restore ground water to its highest beneficial use, which is drinking water. Due to the magnitude of the plume and remaining source area it is unlikely that full ground water restoration to drinking water is an obtainable goal within a reasonable timeframe. However, since specific achievable RAOs for the remedy have not been finalized, it cannot be clearly established if the remedy could be modified to function as intended until these are more clearly defined.

The treatment at Well 12A has prevented exposure by preventing concentrations above MCLs from reaching drinking water supply wells. Ground water from drinking water wells in the area is sampled at the wellhead and at the point of entry to the discharge system. The data available from Well 9A indicates concentrations of VOCs have remained below the MCLs over time.

The SVE operation and limited excavation performed to date have reduced the soil concentrations at the site, but the remedy is not functioning as intended for soils. Concentrations remain in place that likely continue to act as a source to groundwater contamination. In addition, direct contact pathway for soils is still complete and potential exposures possible.

2. Systems Operations. O&M has generally been conducted as designed. It should be noted, however, that the extraction well pumping rates have decreased over time and will likely continue to decrease due to aging pumps and system biofouling. The last measured GETS pumping rate (total of 92 gpm in 2005) is well below the rate for which the system was originally designed (500 gpm). Both the Ecology derived discharge criteria for effluent of 10 µg/L and the original effluent criteria for PCE and PCA have been met with one exception.

Before an evaluation of the operation can be completed, discharge criteria and point of compliance must be established in a new discharge permit. In addition the GETS pumping rate required to support a protective plume management strategy needs to be determined.

3. Optimization. The 2003 RSE provided several recommendations for optimizing the system. Some of these recommendations have been incorporated into the site program. However, system upgrades, including pump replacement, examination of alternative discharge options, and addition of air strippers have not been incorporated. In addition, recommendations that could decrease the time frame of overall site closeout are also still pending. These have been on hold pending resolution of RAOs in light of the CZA results.

4. Indicators of remedy problems. As indicated above, the effectiveness of the remedy cannot be evaluated until achievable RAOs have been finalized. The cleanup goal alternatives stated in the ROD are as follows:

- Treat ground water at the source (the Time Oil property) so that contaminant levels reaching Well 12A would allow *untreated* Well 12A ground water to be discharged to the bay, or *treated* Well 12A ground water to be utilized in the City water supply after dilution with water from the rest of the well field.
- Treat ground water at the source in order to establish a level such that *untreated* Well 12A ground water could be used as drinking water after dilution with water from the rest of the well field.
- Treat the ground water at the source such that Well 12A ground water meets the $1x10^{-6}$ excess cancer risk level with no dilution.
- Treat the ground water to a level such that all ground water within the property boundary meets the $1x10^{-6}$ risk level.

Only the first two objectives are currently being met. Based on the CZA, the current system will likely not achieve the remaining objectives, even with significant upgrades. This is in part because there is remaining source material in various forms that continue to impact ground water on Time Oil site. The quantity and stability of the remaining contaminant source must be evaluated to determine the potential future impact of remaining source material on ability to achieve remaining RAOs. Once this determination has been made, an evaluation of targeted ground water and source area RAOs that are achievable and protective must be completed. Following definition of specific targeted achievable RAOs for ground water and the source area, remedy modifications required to achieve those RAOs and the associated approach for system performance monitoring must be evaluated. Determination of soil cleanup values and associated remedies should then be evaluated once ground water RAOs are established.

5. Implementation of Institutional Controls (ICs). No ICs were specified or required in the decision documents for this site; however, site conditions do not allow for unrestricted use/ unrestricted exposure, therefore ICs are required for both soil and groundwater. To date, ICs are still not developed for the site. There is not currently a formal restriction on installing drinking water wells in this area via city ordinance. There are no deed restrictions on the former Time Oil site that prevents pavement removal; therefore, the paved areas should not be considered caps. EPA recently conducted a title search to determine current site ownership and search for restrictions or notices on the properties. EPA has developed an estimate of the area requiring soil land use controls based on a review of the site soil data (Figure 1-7). This area will be mapped with parcels (Figure 1-8) to develop a list of properties requiring institutional controls. Development of ICs should be conducted immediately to provide, at a minimum, short-term protectiveness from exposure to contaminated soil and ground water.

B. Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid? No.

1. Changes in Standards and To Be Considered (TBCs). A review was done to identify any changes in standards that were identified as Applicable or Relevant and Appropriate Requirements (ARARs) in the ROD; newly promulgated standards including revised chemical-specific requirements (such as MCLs); revised action and location-specific requirements; and State standards and TBCs identified in the ROD that bear on the protectiveness of the remedy. Any such changes were then evaluated to establish whether the new requirement indicates that the remedy is no longer protective. A summary table is presented in Attachment 1-4. Current analysis of data includes reviewing the data against the current federal MCLs. The ROD does not specify cleanup standards for site soil contamination. When derived, these should consider direct contact and migration to ground water pathways.

2. Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics. The Endangerment Assessment determined that public health may be threatened either by direct contact at the source area or by consumption of contaminated drinking water if no additional remedial action was taken. Exposure toxicity for TCE is currently under revision. The value that was used in the original baseline risk assessment has been withdrawn by EPA and a new value has yet to be included in EPA's Integrated Risk Information System (IRIS) database. Given this change, risk associated with TCE exposure will also likely change. However, since an active remedy is in place already for TCE, changes to the regulations for TCE do not impact a need for remedy but may impact the total area requiring treatment and the time frame for restoration of ground water. The remedy will continue to be reviewed with respect to the most current MCL.

There have been no cleanup criteria established for site soils, so changes in toxicity or contaminant characteristics cannot be evaluated. Since VOCs remain in the ground water and the vadose zone soils,

there is a risk of contaminant migration through building foundations and exposure through the indoor air pathway that has not been evaluated to date. EPA will be evaluating the indoor air exposure pathway, and will be developing source area soil RAOs that are linked to a protective plume management strategy.

3. Changes in Land use. The site continues to be zoned industrial. As indicated in the data review section, concentration data from CZA indicate that the near surface soils (upper 15 feet) exceed MTCA Method A industrial cleanup goals for volatile organics. The nature and extent of remaining surface soil contamination is not completely defined. However, estimates of remaining filter cake areas have been conducted (Figure 1-7). Since no ICs have been established, it cannot be assumed that the direct exposure pathway is controlled for future land uses.

In addition, the City has indicated that the current demand forecast calls for full use of the City's ground water rights ramping up over 25 years, beginning in 2010. Increases in ground water use in this area will likely impact distribution of chemicals in ground water at the site, by further influencing ground water flow direction and potentially impacting the ability of Well 12A to act as a hydraulic barrier to contaminant migration.

C. Has any other information come to light that could call into question the protectiveness of the remedy? Yes.

Based on initial measurements performed in 2005, 1,4-dioxane exceeds regional screening values for preliminary remediation goals. There is no federal MCL established for this compound; however, the EPA Region 9 tap water PRG of 6.1 µg/L can be used as an initial risk screening number. Based on this information, this review recommends 1,4-dioxane be added to the chemicals of concern for this site.

In addition to the lack of capture discussed above, remaining NAPL sources suggest potential for continuous contaminant releases to ground water that could prevent the RAO of ground water restoration throughout the plume to below MCLs from being achieved. The current capture zone is likely to be reduced even further pending increased pumping needs of the City wells screened in the lower aquifer. Evaluation of impacts of increased pumping should be conducted. In addition, increased demand for ground water use in the area will impact the original hypothesis that pumping Well 12A will protect the other drinking water supply wells. Limited data collected from Well 9A to date indicate that Well 12A may not be acting as a completely effective hydraulic barrier under current conditions.

D. Technical Assessment Summary

According to the data reviewed and the site inspection, the remedy is not protective because of the following:

- A potential threat is present from direct contact with remaining contaminated soils;
- Migration of the contaminated groundwater above the MCLs is not being controlled;
- Potential exposure to indoor air is likely. This exposure pathway requires evaluation to determine if the remedy effectively minimizes risk of this exposure pathway. An ICP that considers remedy protectiveness of pathways of concern should be developed;
- More information is needed to determine the current status of the remedy. This information includes more ground water monitoring data, evaluation of the remaining source zone NAPL, determination of achievability of long term goals for the current remedy, and evaluation of modifications to the remedy needed if the current remedy does not achieve the long term goals;
- An effluent discharge permit is required to establish discharge criteria and point of compliance

requirements by which system O&M can be measured and potential exposure pathways from discharge can be controlled; and

- Drums are present on-site which contain investigative derived wastes; and
- ICs are needed for soil and ground water.

I.VIII. Issues

The EPA RPM is currently using the Triad process of systematic project planning, real-time analytics, and dynamic work strategies to resolve the remedy issues identified in this review. The first systematic planning meeting was conducted in October 2007 to help identify many of the issues presented in this document. Additional planning activities will include evaluation of new ground water monitoring data and source strengths to determine current remedy effectiveness. Subsequently, efforts will focus on screening remedial options to ensure protectiveness and potentially reducing remedy time frame required for the active remedial actions to meet specific measurable RAOs. Table 1-7 presents a summary of issues to be resolved through the systematic planning process.

Table 1-7. Issues for Well 12A Site

Issue	Currently Affects Protectiveness?	Affects Future Protectiveness?
1. Current ground water data and pumping data needed to assess current site conditions needed	**N**	**Y**
2. Indoor air pathway evaluation needed	**Y**	**Y**
3. Lack of targeted achievable RAOs for site, including cleanup endpoints and approach for system performance monitoring	**N**	**Y**
4. Uncertainties in CSM, including remaining source materials in soil and extent of groundwater plume that may impact ability to achieve various RAOs	**N**	**Y**
5. Achievability of targeted RAOs require evaluation – potential ROD modification or enhancements to existing remedy may be required	**N**	**Y**
6. ICs are not in place that prevent exposure to contaminated soil and ground water	**Y**	**Y**
7. Ground water monitoring program that measures changes in the plume needed	**N**	**Y**
8. Discharge permit, including discharge criteria and point of compliance, needed	**Y**	**Y**
9. Drums on site that may contain hazardous waste derived from site investigations	**Y**	**Y**
10. O&M not transferred to Ecology via new SSC	**N**	**N**

I.IX. Recommendations and Follow-Up Actions

Based on the issues listed in Table 1-7 above, a list of recommendations and proposed schedule was developed (Table 1-8).

Table 1-8. Recommendations and Follow-Up Actions for Well 12 A Site

Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness?	
				Current	Future
1. Use new 2008 ground water data and pumping rates for extraction wells to establish current site conditions and capture zones	**EPA**	**EPA**	**December 2008**	**N**	**Y**
2. Conduct modeling to evaluate if indoor air pathway is complete	**EPA**	**EPA**	**July 2008**	**Y**	**Y**
3. Identify potential viable RAOs and back calculate flux changes in source needed to achieve them	**EPA**	**EPA**	**December 2008**	**N**	**Y**
4. Compare potential RAOs to data needs to determine if additional soil or groundwater data needed	**EPA**	**EPA**	**December 2008**	**N**	**Y**
5a. Conduct focused feasibility study to evaluate benefits of additional remedial actions on ability towards achieving various RAOs. This evaluation should also include enhancements of existing remedy, to include changes in existing extraction system and options for targeted source area remediation.	**EPA**	**EPA**	**December 2008**	**N**	**Y**
5b. Generate decision document, as needed to document revised RAOs and or remedy modifications	**EPA**	**EPA**	**June 2009**	**N**	**Y**
6. Develop and implement ICs to prevent exposure to contaminated soil and ground water	**EPA**	**EPA**	**December 2008**	**Y**	**Y**
7. Establish a new ground water monitoring program, including pumping rates for extraction well, and well performance monitoring (dissolved oxygen, redox, biological characteristics, etc.)	**EPA**	**EPA**	**December 2008**	**N**	**Y**

Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness?	
				Current	Future
8. Establish discharge permit, including discharge criteria and point of compliance	**EPA/ Ecology**	**EPA**	**December 2008**	**Y**	**Y**
9. Remove drums from site	**EPA**	**EPA**	**December 2008**	**Y**	**Y**
10. Complete the SSC that will turn all site responsibilities over to Ecology	**EPA/ Ecology**	**EPA**	**December 2009**	**N**	**N**

I.X. Protectiveness Statement

The remedy at Well 12A is not protective because of the following issues:

- A potential threat is present from direct contact with remaining contaminated soils;
- Migration of the contaminated groundwater above the MCLs is not being controlled;
- Potential exposure to indoor air is likely. This exposure pathway requires evaluation to determine if the remedy effectively minimizes risk of this exposure pathway.
- An ICP that considers remedy protectiveness of pathways of concern should be developed to prevent exposure to soil and ground water contaminated above levels of concern.
- An effluent discharge permit is required to establish discharge criteria and point of compliance requirements by which system O&M can be measured and potential exposure pathways from discharge can be controlled; and
- Drums are present on-site which contain investigative derived wastes.

The following actions need to be taken to ensure protectiveness:

- Institutional controls should be developed and implemented to prevent direct contact to remaining soil contamination;
- Additional information on the evaluation of source strength and current extent of current ground water plume should be collected. Once this information is obtained, an evaluation of the remaining source area, impact on ability to achieve various targeted achievable RAOs for groundwater, and potential remedy modifications shall be conducted via a focused feasibility study which will screen remedial options in light of improving effectiveness of the remedy. ICs should also be put into place preventing drinking water use;
- Evaluation of the indoor air pathway should be conducted and, if unacceptable risks are found, they should be remedied;
- A discharge permit should be developed and finalized with the City of Tacoma; and
- Drums should be removed from the site.

I.XI. Next Review

The next Five-Year Review for the Well 12A OU is required by September 2013, five years from the date of this review.

WELL 12A
FIGURES

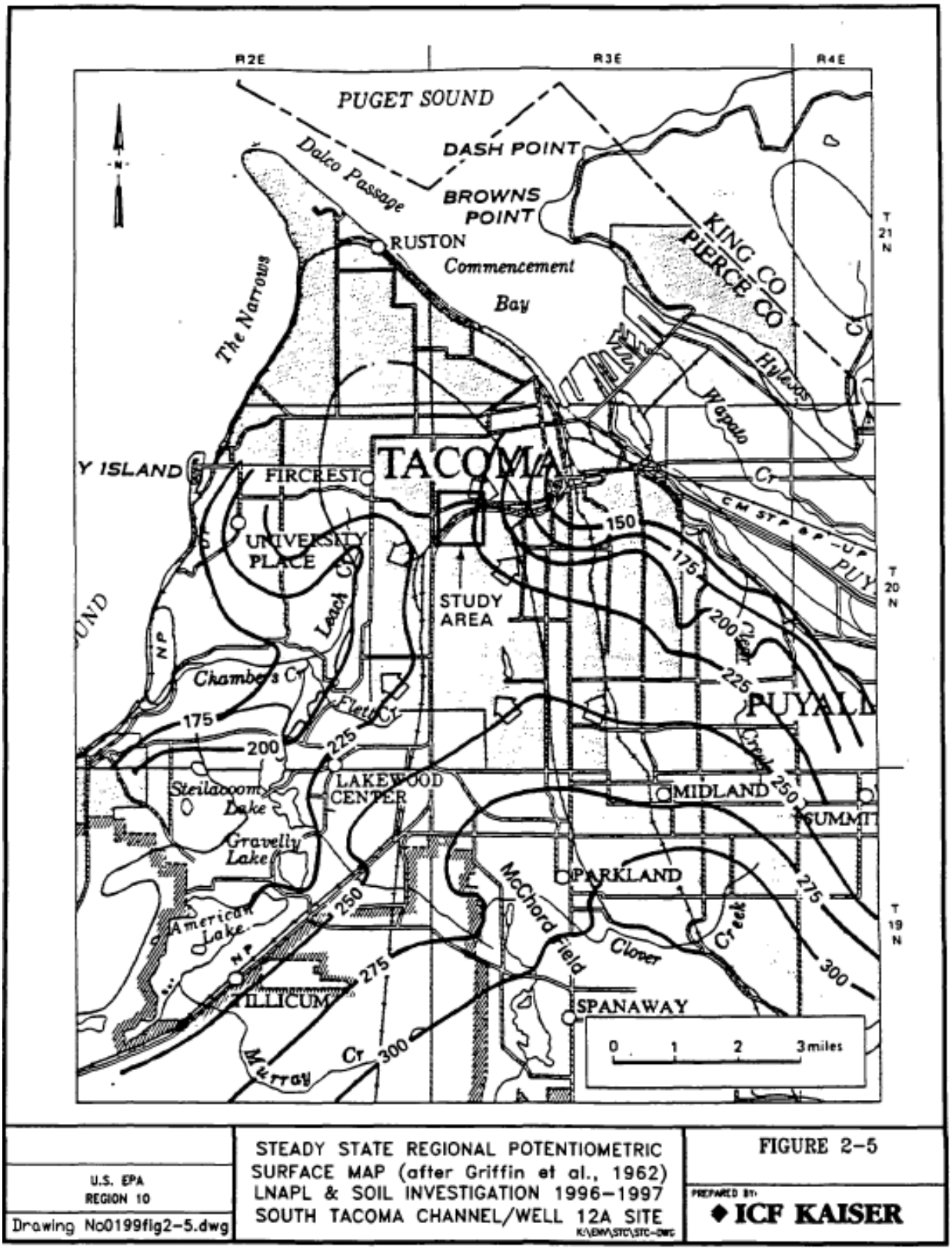


Figure 1-1. Well 12A Site Vicinity Map and Regional Groundwater Flow Direction

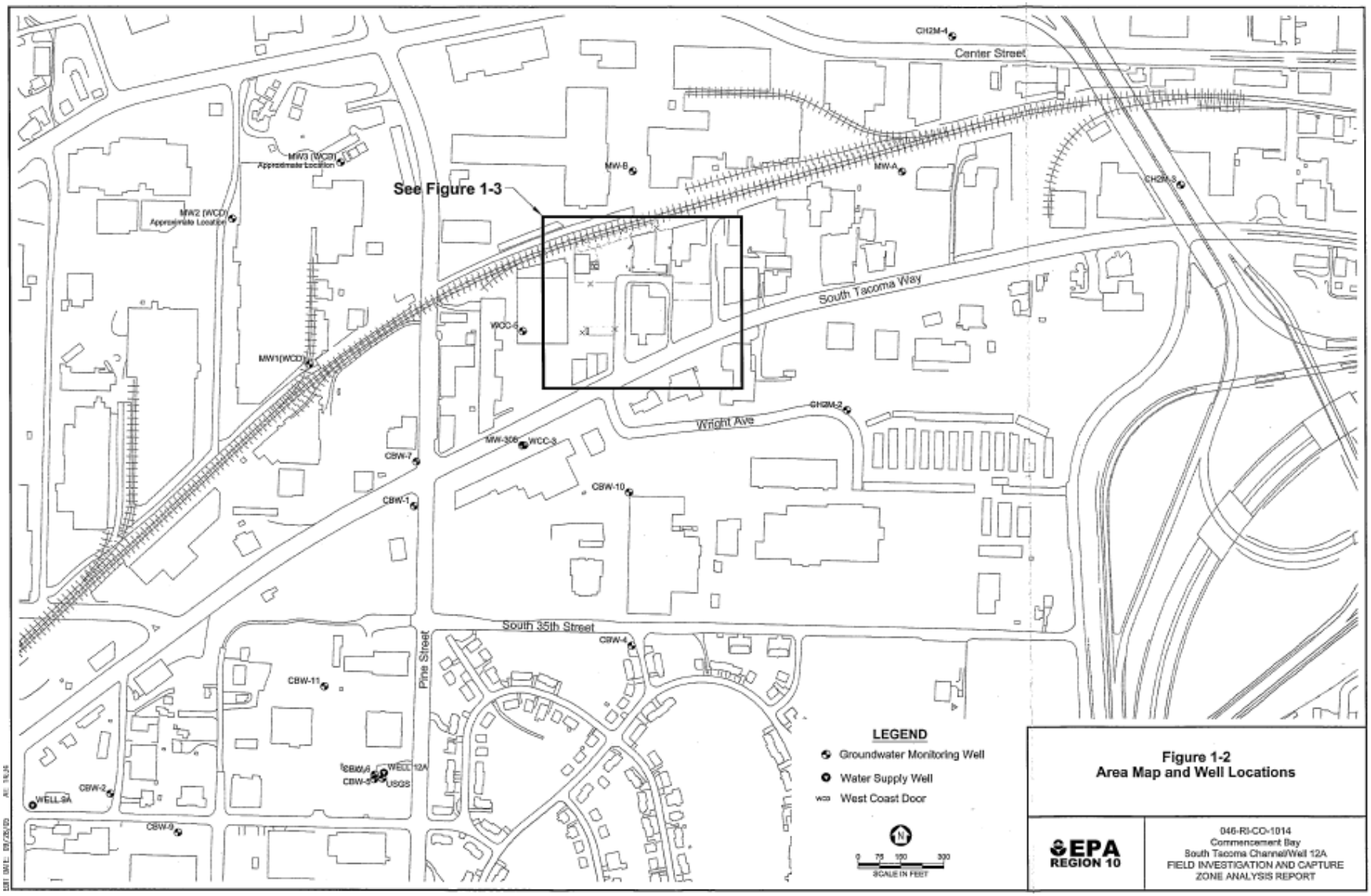
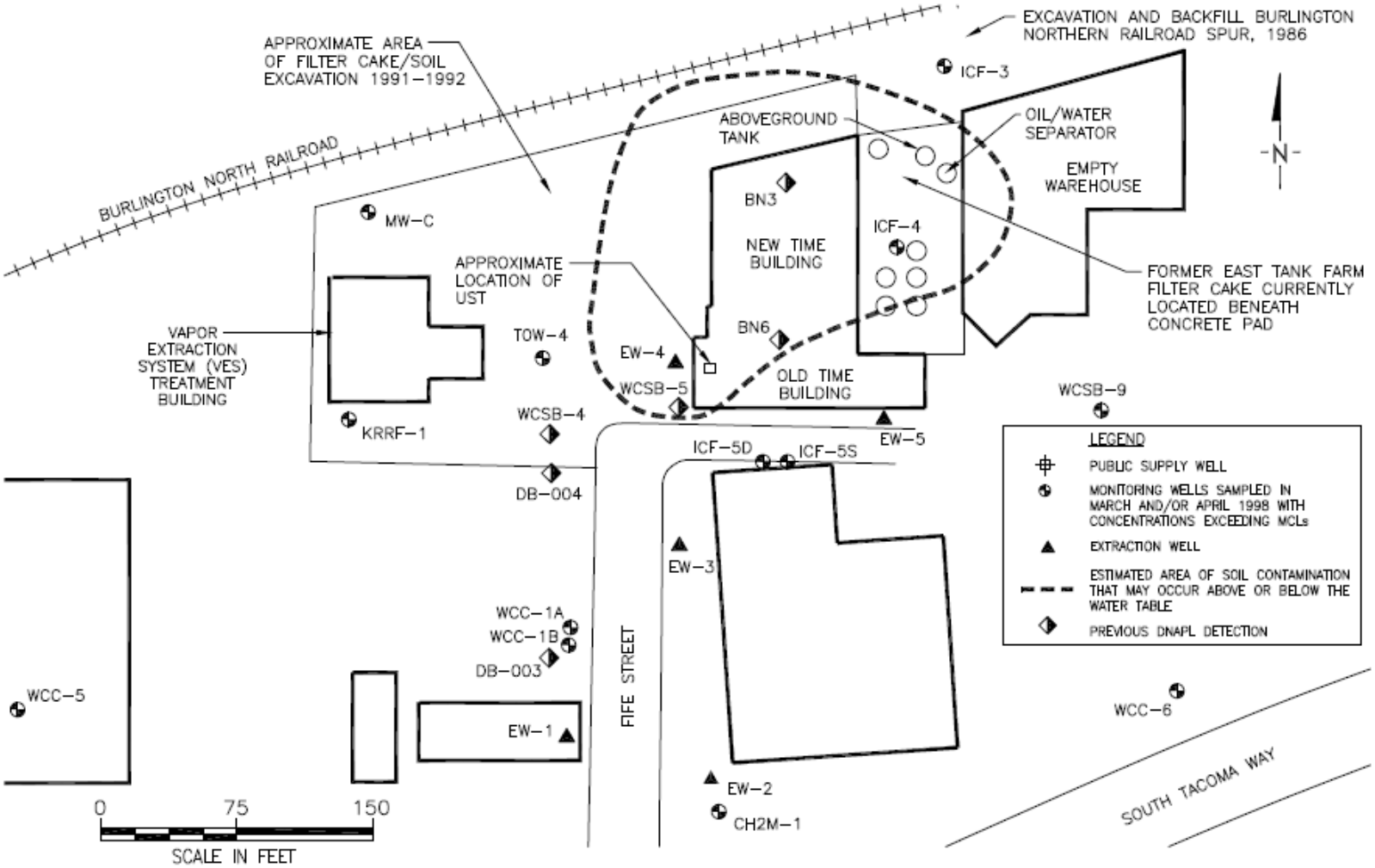


Figure 1-2. Well 12A Site Map Showing Regional Wells



(Note: Figure compiled from Figure 1-2 of the Preliminary Remedial Process Options Screening and Data Gaps Memorandum, Commencement Bay, South Tacoma Channel/Well 12A Superfund Site, Tacoma Washington, October 1999 and Figure 3-1 of the Groundwater Summary Report, South Tacoma Channel/Well 12A Site, Tacoma, Washington, ICF Kaiser, December 1999).

Figure 1-3. Time Oil Site Features and Well Location Map

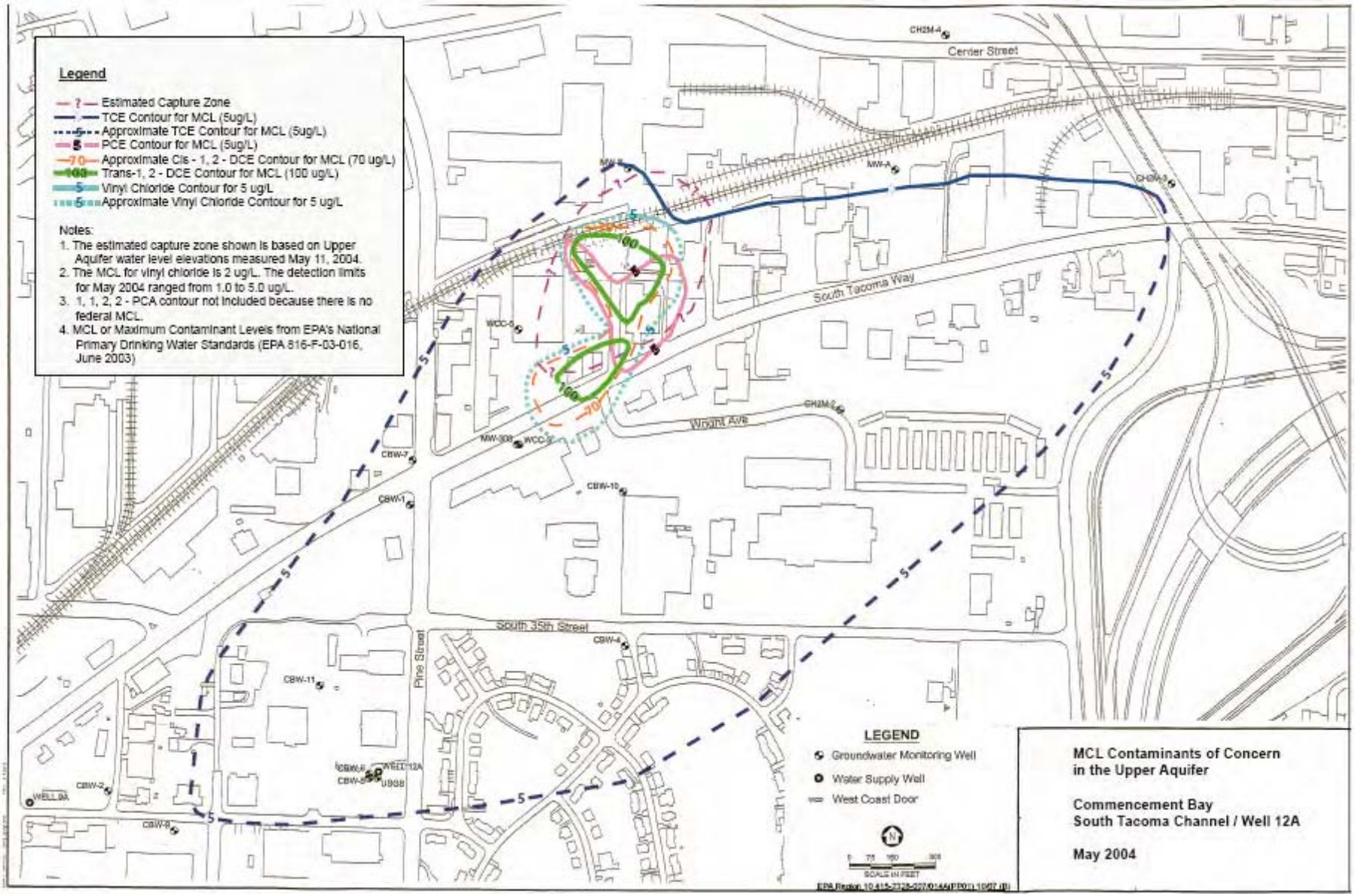


Figure 1-4. Well 12A Lateral Extent of Groundwater Plumes and Estimated Capture Zone

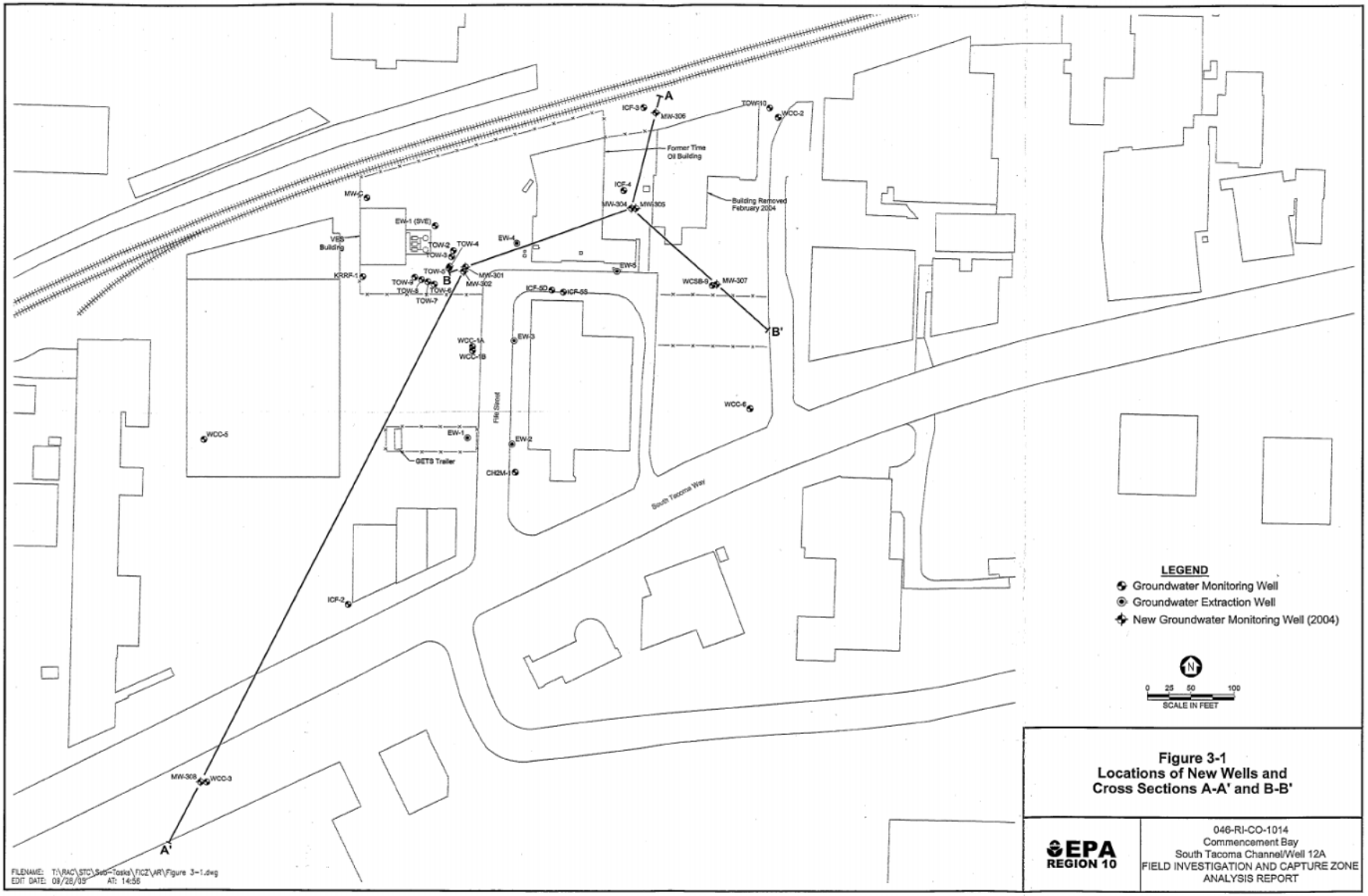


Figure 1-5. Cross Section Location, Well 12A

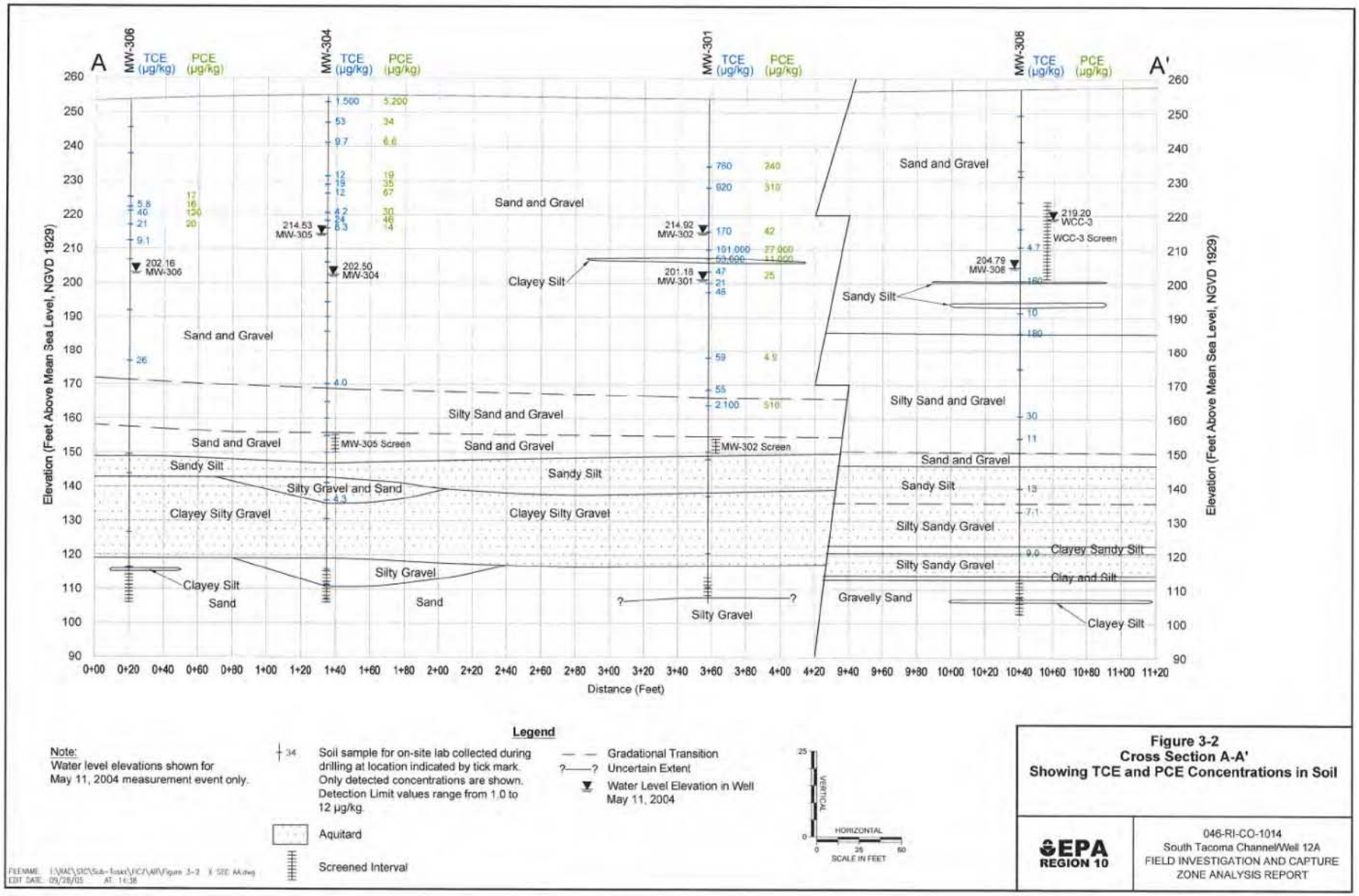


Figure 1-6. Cross Section A-A' with TCE and PCE Concentrations in Soil, Well 12A

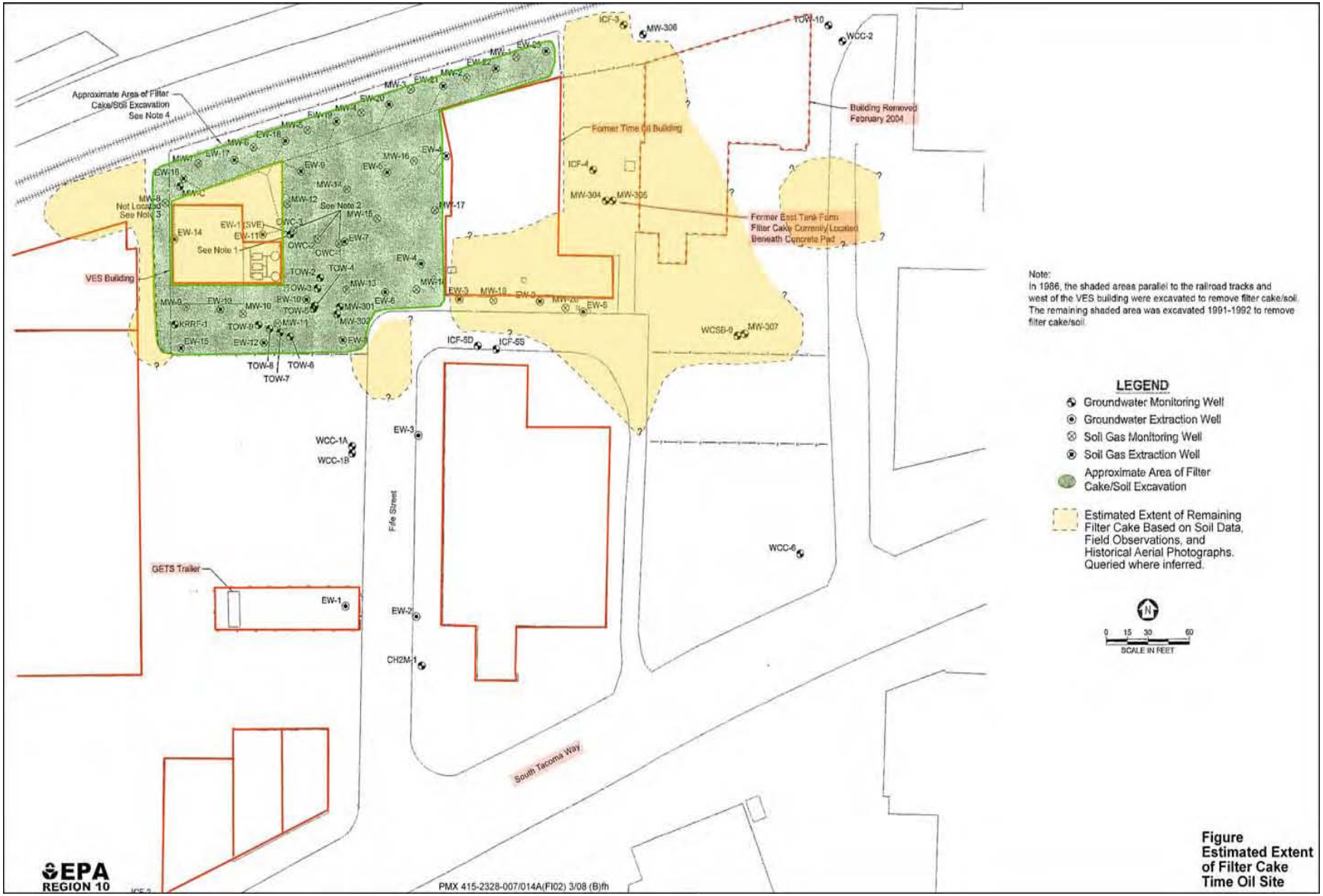


Figure 1-7. Estimated Extent of Remaining Filter Cake, Well 12A

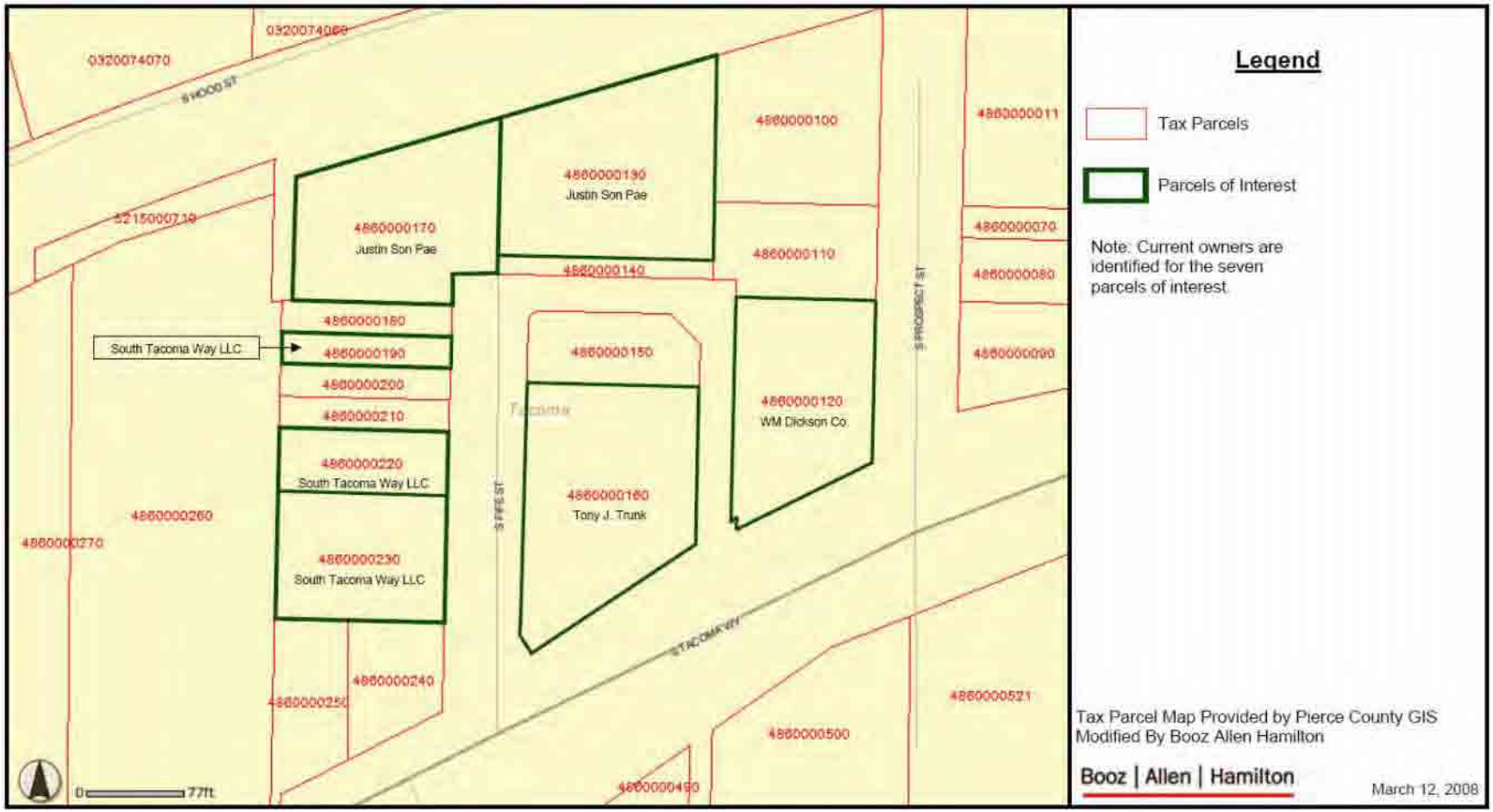


Figure 1-8. Current Tax Parcel Map, Well 12A

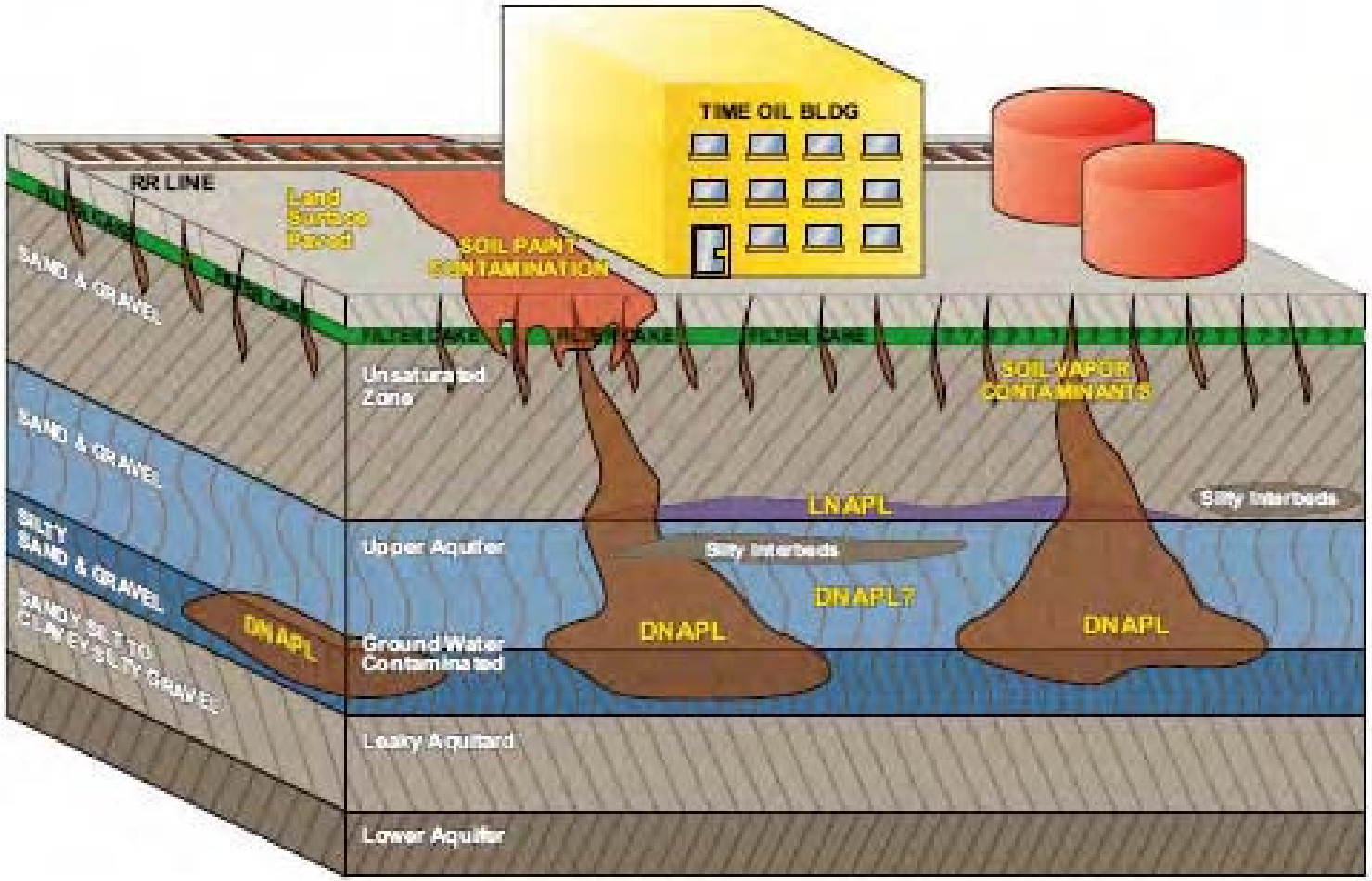


Figure 1-9. Well 12A Conceptual Site Model

WELL 12A
ATTACHMENTS

Attachment 1-1. List of Documents Reviewed, Well 12A

Field Investigation and Capture Zone Analysis Report, Commencement Bay, South Tacoma Channel/Well 12A Superfund Site, Tacoma, Washington, September 2005.

Second Five-Year Review Report for Well 12A, One of Three Operable Units, Commencement Bay, South Tacoma Channel Superfund Site, Tacoma, Washington, July 2003.

Remedial System Evaluation, South Tacoma Channel/Well 12A Superfund Site, Tacoma, WA, December 10, 2001.

Well 12 A monitoring data, City of Tacoma 1994-2007.

Well 12 A Record of Decision Modification, April 28, 1987.

Well 12 A Record of Decision Amendment, May 3, 1985.

Well 12 A Record of Decision, March 18, 1983.

Attachment 1-2. Well 12A GETS Effluent Data, January 2003 – January 2008

Date	Vinyl Chloride (µg/L)	1,1,2,2-PCA (µg/L)	PCE (µg/L)	1,1,2 – TCA (µg/L)	trans -1, 2 DCE (µg/L)	TCE (µg/L)	cis- 1,2 DCE (µg/L)
1/15/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
1/30/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
2/12/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
2/26/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
3/12/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
3/26/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
4/10/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
4/24/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
5/7/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
5/22/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
6/4/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
6/18/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
7/1/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
7/16/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
7/31/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
8/13/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
8/28/03	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U
9/11/03	7.6	1 U	0.5 U	1 U	1 U	0.5 U	1 U
9/25/03	10.6	1 U	0.5 U	1 U	1 U	0.5 U	1 U
10/8/03	23.4 J	1 U	0.5 U	1 U	1 U	0.5 U	1 U
10/30/03	24	1 U	0.5 U	1 U	1 U	0.5 U	1 U
11/13/03	26	1 U	0.5 U	1 U	1 U	0.5 U	1 U
11/26/03	30	1 U	0.5 U	1 U	1 U	0.5 U	1 U
12/10/03	60	1 U	0.5 U	1 U	1 U	0.5 U	1 U
12/23/03	57.3	1 U	1 U	1 U	1 U	1 U	1 U
1/8/04	57	1 U	0.5 U	1 U	1 U	0.5 U	1 U
1/22/04	57.6	1 U	0.5 U	1 U	1 U	0.5 U	1 U
2/4/04	55	1 U	0.5 U	1 U	1 U	0.5 U	1 U
2/18/04	62.8	1 U	0.5 U	1 U	1 U	0.5 U	1 U
3/3/04	58.9	1 U	0.5 U	1 U	1 U	0.5 U	1 U
3/17/04	82	1 U	0.5 U	1 U	1 U	0.5 U	1 U
4/14/04	110	1 U	0.5 U	1 U	1 U	0.5 U	1 U
4/27/04	110	1 U	0.5 U	1 U	1 U	0.5 U	1 U
5/6/04	5.9	1 U	0.5 U	1 U	9.6	0.72	23
5/12/04	5.9	1 U	0.5 U	1 U	8.4	0.5	20
5/26/04	3.3	1 U	0.5 U	1 U	7.4	0.43 J	18
6/10/04	2.9	1 U	0.5 U	1 U	7.8	0.4 J	19
6/23/04	6.2	1 U	0.5 U	1 U	8.4	0.33 J	20
7/7/04	90	1 U	0.5 U	1 U	1 U	0.5 U	1.2
7/22/04	79	1 U	0.5 U	1 U	1 U	0.5 U	0.91J J
8/4/04	65	1 U	0.5 U	1 U	1 U	0.5 U	0.93J J
8/13/04	2 U	1 U	0.5 U	1 U	1 U	0.5 U	1U U

Attachment 1-2. Well 12A GETS Effluent Data, January 2003 – January 2008, Cont.

Date	Vinyl Chloride (µg/L)	1,1,2,2-PCA (µg/L)	PCE (µg/L)	1,1,2 – TCA (µg/L)	trans -1, 2 DCE (µg/L)	TCE (µg/L)	cis- 1,2 DCE (µg/L)
8/26/04	2 U	1 U	0.5 UJ	1 U	1 U	0.5 U	1U U
9/8/04	2 U	1 U	1 U	1 U	1 U	0.5 U	1U U
9/23/04	1 U	1 U	1 U	1 U	1 U	0.5 U	1U U
10/6/04	2 U	1 U	1 U	1 U	1 U	0.5 U	1U U
10/20/04	2 U	1 U	1 U	1 U	1 U	0.5 U	1U U
11/1/04	2 U	1 U	0.5 U	1 U	1 U	0.5 U	1U U
11/16/04	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1U U
12/1/04	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1U U
12/16/04	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1U U
12/29/04	1	1 U	0.5 U	1 U	1 U	0.5 U	1U U
1/17/05	13	1 U	0.5 U	1 U	1 U	0.5 U	1U U
2/4/05	15	1 U	0.5 U	1 U	1 U	0.5 U	1U U
2/16/05	24	1 U	0.5 U	1 U	1 U	0.5 U	1U U
2/25/05	30	1 U	0.5 U	1 U	1 U	0.5 U	1U U
3/14/05	38	1 U	0.5 U	1 U	1 U	0.5 U	1U U
3/25/05	41		0.5 U	1 U	1 U	0.5 U	1U U
4/19/05	48	1 U	0.5 U	1 U	1 U	0.5 U	1U U
4/25/05	51	1 U	0.5 U	1 U	1 U	0.5 U	1U U
5/10/05	40	1 U	0.5 U	1 U	1 U	0.5 U	1U U
5/23/05	42	1 U	0.5 U	1 U	1 U	0.5 U	1U U
9/14/05	2U	1 U	1 U	1 U	1 U	1 U	1U U
9/28/05	7.4	1 U	1 U	1 U	1 U	1 U	0.37 J
10/12/05	6.4	1 U	2 U	1 U	1 U	1 U	1U U
10/26/05	7.7	1 U	2 U	1 U	1 U	1 U	1U U
11/9/05	**12**	1 U	1 U	1 U	5 U	1 U	1U U
11/22/05	**15** J	1 U	2 U	1 U	1 U	1 U	1U U
12/7/05	**21**	1 U	1 U	1 U	1 U	1 U	1U U
12/21/05	**13**	1 U	1 U	1 U	1 U	1 U	1U U
1/11/06	**15**	1 U	1 U	1 U	1 U	1 U	2U U
1/25/06	**17**	1 U	1 U	1 U	1 U	1 U	0.42 J
2/8/06	**17**	1 U	1 U	1 U	1 U	1 U	0.45 J
2/15/06	**18**	1 U	1 U	1 U	1 U	1 U	0.38 J
3/1/06	**25**	1 U	1 U	1 U	0.5 J	1 U	1.7
3/15/06	**23**	1 U	1 U	1 U	1U U	1 U	1.6
3/29/06	**25**	1 U	1 U	1 U	0.39	1 U	1.3
4/13/06	**28**	1 U	1 U	1 U	0.24 J	1 U	1.3
4/27/06	**28**	1 U	1 U	1 U	1U U	1 U	1.3
5/11/06	**26**	1 U	1 U	1 U	0.37 J	1 U	2.1
5/25/06	**27**	1 U	1 U	1 U	1U U	1 U	1.7
6/8/06	4.4	3.9	2.3	0.42 J	17	89	24
6/21/06	**61**	31	5.1	1.8	252	148	413
7/6/06	**28**	1 U	2 U	1 U	2U U	1 U	1.4 J
7/20/06	**27**	1 U	2 U	1 U	2U U	1 U	5
8/3/06	4	6.3	2.6	0.42 J	24	101	41

Attachment 1-2. Well 12A GETS Effluent Data, January 2003 – January 2008, Cont.

Date	Vinyl Chloride (µg/L)	1,1,2,2-PCA (µg/L)	PCE (µg/L)	1,1,2 – TCA (µg/L)	trans -1, 2 DCE (µg/L)	TCE (µg/L)	cis- 1,2 DCE (µg/L)
8/17/06	**38**	1 U	1 U	1 U	0.68 J	1 U	3.8
8/30/06	**31**	2 U	2 U	2 U	0.56 J	2 U	4.1
9/14/06	**30**	1 U	1 U	1 U	0.42	1 U	3.3
9/28/06	**29**	1 U	1 U	1 U	0.6 J	1 U	4.4
10/12/06	3.6	4.5	3.1 J	0.44 J	19	88	30
10/26/06	**30**	2 U	1 U	1 U	0.56 J	1 U	3.7
11/6/06	**18** J	10 U	1 U	1 U	0.37 J	1 U	3
11/21/06	1 U	5 U	1 U	1 U	0.46 J	1 U	0.95
12/8/06	1 U	5 U	1 U	1 U	1 U	1 U	0.36
12/21/06	1 U	2 U	1 U	1 U	1 U	1 U	1U U
1/4/07	1 U	2 U	1 U	1 U	1 U	1 U	1U U
1/18/07	1 U	1 U	1 U	1 U	1 U	1 U	1U U
2/1/07	2 U	1 U	5 U	1 U	1 U	1 U	1U U
2/15/07	5 U	1 U	1 U	1 U	0.14 J	1 U	0.26
3/1/07	5 U	1 U	1 U	1 U	0.13 J	1 U	0.3
3/15/07	2 U	1 U	1 U	1 U	1U U	1 U	0.31
3/29/07	6.4	2 U	2 U	2 U	0.56 J	2 U	2
4/12/07	7.3	2 U	2 U	2 U	2U U	2 U	0.81 J
4/26/07	6.8	1 U	1 U	1 U	0.31 J	2 U	0.9 J
5/10/07	6.2	1 U	1 UJ	1 U	0.28 J	1 U	0.76 J
5/24/07	4.6	1 U	2 U	1 U	4.1	5 U	11
6/7/07	4.4	1 U	2 U	1 U	4	5 U	12
6/18/07	3.1	1 U	1 U	1 U	4.5	1 U	12
7/5/07	1.4	1 U	1 U	1 U	4.8	1 U	13
7/19/07	0.82 J	1 U	1 U	1 U	4.2	1 U	12
8/2/07	0.73 J	1 U	1 U	1 U	4.9	1 U	12
8/16/07	2 U	1 U	2 U	1 U	4.3	1 U	11
8/30/07	4	1 U	2 U	1 U	2.8	1 U	7
9/13/07	4.4	2 U	2 U	1 U	2.4	2 U	6.1
9/27/07	5.9	2 U	2 U	1 U	2.9	2 U	7.2
10/9/07	7.1	1 U	1 U	1 U	2.8	1 U	6.2
10/25/07	7	1 U	2 U	1 U	2.6	1 U	5.9
11/8/07	7.8	1 U	5 U	1 U	2.5	2 U	6.3
11/16/07	8.6	1 U	5 U	1 U	2.6	2 U	6.7
12/6/07	6.5	1 U	2 U	1 U	2	1 U	5.3
12/20/07	7.3	1 U	1 U	1 U	2.4	1 U	5.3
1/17/08	3.4	1 U	1 U	1 U	0.93 J	1 U	2
1/31/08	3.7	1 U	2 U	1 U	1.4	2 U	2.7
MIN	0.7 J	1.0 U	0.5 U	0.4 J	0.1 J	0.3 J	0.3 J
MAX	110	31	5	2	252	148	413

Bold values exceed state determined Discharge criteria
U – Not detected
J –Estimated value

Attachment 1-3. Well 12A Site Photographs

Photo 1. Extraction Well 2

Photo 2. GETS system

Attachment 1-3. Well 12A Site Photographs, Cont.

Photo 3. Gravel pad east of East Tank Farm

Photo 4. Former VES Building (drums on left edge of photo)

Attachment 1-4. Well 12A ARARs Analysis

Other Environmental Laws cited in ROD (1)	How applied to site	Changes to Standard
Section 1412 of the Safe Drinking Water Act (SDWA), 42 U.S.C. 300g-1, "National Drinking Water Regulations"; National Primary Drinking Water Regulations. 40 CFR Part 141	Federal MCL used as standard for drinking water	Exposure toxicity for TCE is currently under revision.
RCRA Closure requirements 40 CFR part 264 Subpart G	• Ground water corrective action required until concentrations of hazardous constituents at the point of compliance achieve either MCLs or alternate concentrations limits • All hazardous wastes at a site be removed, treated on site, or capped in such a way as to minimize the migration of contaminants from the site.	No changes that impact remedy since last Five-Year Review
Clean Air Act, 42 U.S.C. 7401 et seq. District Regulation 8, Rule 5, 40 and 47 (Puget Sound Air Pollution Control Agency)	Regulates air emissions to protect human health and the environment associated with the air stripper at Well 12A	No changes that impact remedy since last Five-Year Review

(1) Clean Water Act not identified in ROD, but is applicable to effluent discharge at site and is evaluated in the Five-Year Review.

II. South Tacoma Field, Operable Unit 4

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: South Tacoma Field, OU 4 for Commencement Bay, South Tacoma Channel Superfund Site		
EPA ID *(from WasteLAN)*: WAD980726301		
Region: 10	**State:** WA	**City/County:** Tacoma/Pierce
SITE STATUS		
NPL status: ☒ Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction ☐ Operating ☒ Complete		
Multiple OUs? ☒ YES ☐ NO (see Well 12A and Tacoma Landfill)	**Site Construction completion date:** 9 /29/ 1999	
Has site been put into reuse? ☐ YES ☒ NO		
REVIEW STATUS		
Lead agency: ☒ EPA ☐ State ☐ Tribe ☐ Other Federal Agency		
Author name: Kym Takasaki and Sharon Gelinas		
Author title: Environmental Scientist and Hydrogeologist	**Author affiliation:** U.S. Army Corps of Engineers, Seattle District	
Review period: 1/2008 to 3/2008		
Date(s) of site inspection: 2/ 20 /2008		
Type of review: ☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion)		
Review number: ☐ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify)		
Triggering action: ☐ Actual RA On-site Construction at OU #___ ☐ Actual RA Start at OU# NA ☐ Construction Completion ☒ Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date *(from WasteLAN)*: 5/14/2003		
Due date *(five years after triggering action date)*: 5/14/2008		

South Tacoma Field, Five-Year Review Summary Form, Cont.

ISSUES
1. Whether the ground water monitoring network and frequency at Pioneer Builders Supply allow for an accurate assessment of monitored natural attenuation (MNA) or plume characterization.
2. Whether MNA at Pioneer Builders Supply has achieved the cleanup goals within the specified time frame.
3. Remaining soil contamination and/or the effects of increased paving in the area of Pioneer Builders Supply may be impacting ground water contamination and require characterization.
4. Upon review of soil characterization data in the Pioneer Builders Supply area, institutional controls (excavation) may be required if soil concentrations are above industrial use criteria.
5. Well STM-1A damaged.
6. Site access controls are not protecting caps.
7. Unknown status of capped areas in grids 879, 785, and 767.
8. Optimization of the ground water monitoring program is required and should consider changes in City of Tacoma pumping rates data and proposed site development.
9. Tents present on property indicating residential use of industrial property.
10. Administrative ICs of EPA access and restrictive covenants may be modified following property transfer.
RECOMMENDATIONS AND FOLLOWUP ACTIONS
1. For groundwater at Pioneer Builders Supply, prepare a revised Work Plan for well installation and sampling per Section II.VII.D.
2. Evaluate all new and existing data to assess time frame for effectiveness of MNA in the Pioneer Builders Supply area, or need for additional actions.
3. Evaluate remaining soil contamination to verify that soil cleanup levels have been achieved in the area of Pioneer Builders Supply. This may include a review of historical data and/or collection of new data.
4. Determine need for ICs for soil based on soil characterization data at Pioneer Builders Supply.
5. Replace well STM-1A and complete a minimum of one additional year of sampling.
6. Conduct fence repairs (fence may be removed when site is redeveloped).
7. Verify status of capped areas in grids 879, 785, and 767.
8. Conduct an optimization of the site-wide ground water monitoring program including a determination of wells critical for assessing the remedy.
9. Work with BNR to determine actions regarding transients living on property.
10. Review need for changes in administrative ICs of EPA access and restrictive covenants.

South Tacoma Field, Five-Year Review Summary Form, Cont.

PROTECTIVENESS STATEMENT

The remedy at South Tacoma Field is not protective because of the following issues:

- In the short term there is an immediate threat to transients using open unused areas of the site based on the potential for direct contact with remaining contaminated soils that exceed the standard for unrestricted use on some portions of the site. The pending commercial/industrial development will significantly reduce the amount of open space currently attractive to transients;

- The MNA groundwater remedy at Pioneer Building Supply has not met the cleanup goal within the time specified in the ROD. It may be that residual, subsurface soil contamination is contributing to the groundwater plume; it may also be that recent paving of large areas in this vicinity is affecting natural attenuation. If residual soil contamination is present, ICs may be required to prevent contact with these soils (e.g., excavation in future construction); and

- Migration of the contaminated groundwater above the cleanup levels at Pioneer Building Supply may not be controlled.

The following actions need to be taken to ensure protectiveness:

- Work with BNR to determine actions regarding transients living on open, unused areas of the site, including access controls along public right-of-ways;

- Develop and implement a revised groundwater monitoring program. Use new groundwater and soil data to assess time frame needed for MNA or modifications to the remedy. Modifications to the remedy may include ICs for residual soil contamination, if present; and

- Evaluate new groundwater data at Pioneer Building Supply to determine if migration of groundwater plumes is controlled.

OTHER COMMENTS

Current exposure to contaminated ground water is controlled by institutional controls to prevent drinking water use.

While soils at depth in the area of Pioneer Builders Supply may pose a threat if excavated, they are currently covered by buildings or pavement and site use is industrial.

II.I. Introduction

The purpose of the Five-Year Review is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

The Agency is preparing this Five-Year Review report pursuant to CERCLA §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The Agency interpreted this requirement further in the NCP; 40 CFR §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

With oversight from the EPA Region 10 Remedial Project Manager, the United States Army Corps of Engineers (USACE) Seattle District conducted the Five-Year review for the South Tacoma Field (STF) operable unit (OU) of the South Tacoma Channel (STC) Superfund Site, which is located in Tacoma Washington. Other active STC OUs include the Tacoma Landfill (OU5/6) and Well 12A (OU1). Each STC OU is treated as separate sites, but for purposes of the Five-Year Review all three sites are submitted under one cover. This section documents the results of the review, which was conducted from January 2008 through March 2008.

This is the second Five-Year Review for the STF site. The triggering action for this statutory review is the earliest completion of the last Five-Year Review Report for sites within the STC OU. Based on timing of the reviews, this date is triggered by the date of the last Five-Year Review for the Tacoma Landfill OU, dated May 14, 2003. The Five-Year Review is required because hazardous substances, pollutants, or contaminants remain in the soil and ground water above levels that allow for unlimited use and unrestricted exposure.

II.II. Site Chronology

Table 2-1. Chronology of Site Events, South Tacoma Field

Event	Date
EPA issues Record of Decision (ROD) for South Tacoma Field	September 29, 1994
Unilateral Administration Order (UAO) for remedial design and action – soil and ground water contamination	January 1996
Consent Decree for remedial design and action supersedes the UAO	January 1997
EPA conducts initial wetland monitoring	January 1997
Tacoma City Light completes remedial design	January 1997
Tacoma City Light initiates Remedial Action	August 1997
Remedial Action (RA) Work Plan for remaining areas completed	April 1998
Wetland Investigation	March 1998
Remedial Action (RA) for remaining areas begins	June 10, 1998
Additional Wetland Investigation	April 1999
Final inspection for RA performed	July 20, 1999
Construction complete (Preliminary Closeout Report)	September 1999
Explanation of Significant Differences (ESD) for groundwater issued	September 29, 1999
Final Site Development & Institutional Controls Plan and Operations & Maintenance Plan (including groundwater monitoring) submitted	March 2000
RA Report for soils approved	September 2000
First Five-Year Review completed	June 2003
Certificate of Completion issued for soils	September 2003
Final Closeout Report for STF Soils	February 24, 2005
Partial Delisting from National Priority List (NPL) for STF Soils	June 15, 2005

II.III. Background

A. Site Location

The site is located in Tacoma, Pierce County, Washington, and extends from approximately South 36th Street on the north, South 56th Street on the south, Tyler Way on the west, and Adams Street on the east (Figures 2-1 and 2-2). The STF OU is approximately 260 acres. The area is lower than surrounding upland areas by as much as 150 feet on the west. The southern half of the site contains industrial and commercial facilities; the northern and western portions are primarily open grass fields. The site includes a former swamp and lake bed that has been filled and covered with grass over time. A small wetland is present in the northern portion of the site.

Storm sewer outfalls discharge water onto the north end of the site that is conveyed across the western

portion in an open channel. Water is not usually present in the southern portion of the channel except in response to heavy rains. However, the channel continues along Madison Street until it feeds into a storm drain culvert 150 feet north of South 56th Street.

The site is located within the South Tacoma Ground Water Protection District, which is a special zoning overlay district managed by the Tacoma Pierce County Health Department (TPCHD). The City of Tacoma operates several drinking water wells within a half mile of the site (Wells 2B/C, 4A, 6B, and 11A) that are used to augment the City's drinking water supply during peak demand periods. According to the City, use of drinking water wells in the area is likely to increase in the near future based on new development plans in the area. The current demand forecast calls for full use of the City's ground water rights within about 25 years, starting by 2010.

B. Land and Resource Use

The site is currently zoned for commercial/industrial use with the exception of an 18 acre strip along the western border which is zoned for residential-commercial transitional use. The western side of the STF site, generally in the area of the old airport, is also used for casual recreation (e.g., biking, dog walking, and flying model airplanes) and illegal dumping of household waste. Businesses operating on the southern half of the STF site include Pioneer Builders Supply, General Plastics, and Industrial Properties which leases warehouse, office, and yard space to businesses. Residential properties are located uphill from and just off the northwest side of the site.

Since the first Five-Year Review in 2003, the three businesses existing at the south end of the site have expanded operations. Burlington Way was the primary public access to the site until the City completed a new access at South 50th Street, which opens the site up to traffic from South Washington Street and South Tacoma Way. Burlington Northern Railroad (BNR) owns the majority of the site (see Figure 2-3), but is in ongoing discussions with ProLogis to potentially sell most of its remaining property for the redevelopment of the site as an industrial park.

C. History of Contamination

A variety of industrial and commercial operations have occupied different portions of the site in the past 100 years. Figure 2-4 shows historic use across the site and general areas of contamination. The South Tacoma Car Shops area operated as a railroad vehicle manufacturing and repair facility from 1892 to 1974. The area was used for manufacturing, repair, and maintenance of railroad equipment including the cleaning and dismantling of rail cars. Foundry facilities operated on-site from 1890 through 1980. An iron foundry produced iron wheels until 1957. A brass foundry produced journal bearings composed primarily of lead, tin, copper, zinc and antimony until 1980. Aircraft maintenance and refueling operations were performed at the South Tacoma Airport from 1936 to 1973. A lake was located beyond the south end of the former runway and, in the late 1940's, was used by seaplanes. A variety of filling activities occurred during the history of the site. Foundry, construction, and domestic wastes reportedly were disposed of as fill material in the Former Swamp/Lake bed area. In the 1930's and 1940's portions of the site reportedly were used as unauthorized dumping areas for household and commercial wastes.

In addition to potential historic contaminant sources, several present day industrial facilities have contributed to the contaminant source areas. Tacoma Public Utilities (Tacoma City Light) has operated a maintenance and repair facility at the northernmost end of the STF site since 1953. The property is covered with asphalt pavement and buildings. Storm water runoff from the property currently drains to modified dry wells that have soil bottoms and inter-connecting piping leading to the City of Tacoma's storm drainage system.

Pioneer Builders Supply purchased land in the southeast portion of the site for the construction of a warehouse and office in 1988. Pioneer used two underground storage tanks (USTs) for about five years to store gasoline and diesel fuel. During removal of these tanks in 1991, petroleum contamination was discovered in surrounding soils. Reportedly, all visible soil contamination was removed during the tank removal. In addition, three other USTs were discovered in the northeast corner of the Pioneer Builders Supply property in 1990 and were subsequently removed. Soils that were visibly contaminated were removed; however, excavation did not occur below ground water level.

D. Initial Response

In 1990, the Environmental Protection Agency (EPA) signed a Consent Order with the Potentially Responsible Parties (PRPs) to conduct a Remedial Investigation and Feasibility Study (RI/FS) at the site. During the RI, contamination was identified at the former railroad maintenance area, the Tacoma Public Utilities area, Pioneer Builders Supply property, and the Amsted property (former foundry area). The Preliminary Closeout Report (Long-Term Remedial Action), prepared and issued by EPA in September 1999, contains a detailed summary of what types of contamination were found at various concentrations and locations across the site. Surface soils, and to a lesser extent, subsurface soils in the railyard and foundry areas were contaminated with high levels of lead, arsenic, copper and zinc. Metal concentrations in surface soil samples from the former swamp/lakebed area were found to be elevated, but to a lesser degree than the more active industrial areas.

At the foundry area on the south end of the site (Amsted property, see Figure 2-4), a relatively small volume of nearly immiscible, heavy fuel oil was found on the surface of the water table. At the Tacoma City Light Property on the north end of the site, elevated concentrations of polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and several other organics were detected in subsurface soils at and underlying some of the dry wells. At Pioneer Builders Supply, also on the south end of the site opposite Amsted, elevated concentrations of 1,2,4-trichlorobenzene, PCBs, petroleum hydrocarbons (TPH), benzene, ethylbenzene, toluene, and xylenes (BETX) were found in subsurface soil in the unsaturated zone beneath and immediately surrounding the location where the three USTs were removed. Benzene, ethylbenzene, and 1,1,2-trichloroethane (TCA) were detected above maximum contaminant levels (MCLs) in ground water at this site.

E. Basis for Taking Action

The human health risk assessment (HHRA), as presented in the ROD, evaluated risks due to contamination in the soil, ground water, surface water and sediment (in ditches). The routes of exposure included soil ingestion, skin contact with soil, and ingestion of ground water. The HHRA considered the risks posed by ingestion and direct contact based on an industrial use scenario. Surface and sub-surface soils that might be carried by wind, surface water runoff, and earth moving activities were also considered. Contamination carried off-site by surface runoff could reach either Chambers or Flett Creeks via the storm water drainage ditch on the west side of the site. It was also possible that Tacoma's drinking water aquifer could be threatened via the surface water run-off or by its hydrologic connection to ground water at the site.

During the comment period for the ROD, it was discovered that about 18 acres on the western portion of the site was zoned Residential-Commercial Transitional District. Based on this information, EPA determined that residential cleanup levels would apply. In conjunction with the ROD, the Agency for Toxic Substances and Disease Registry (ATSDR) issued a public health assessment for the site which reached the same conclusions as the ROD.

For surface soil ingestion under both the residential and industrial scenario, excess cancer risks (greater than $1x10^{-4}$) and hazard quotients greater than 1 for noncancer risks were found to be present. Risks were primarily driven by arsenic, PCBs, and PAHs. Lead was also noted as present above industrial soil standard. In addition, under both industrial and residential standards, excess cancer risk was present for the ground water pathway.

The results of the Ecological Risk Assessment indicated that potential chemical impacts from on site contaminants to the plant species of the grassland were small. EPA also determined that levels of contaminants in the water and sediment in the wetlands/drainage channel were not unusual for urban wetlands with similar water quality problems. The wetland area was determined to serve a beneficial use as a filter for urban storm water runoff.

As described in the ROD, the STF site was broken down into three areas for remediation: STF soils, Pioneer Builders Supply, and Tacoma City Light drywells. Contaminants of concern (COCs) at these areas were identified as follows:

STF Soil:

Soil	
Aluminum	Aldrin
Antimony	Carcinogenic PAHs
Arsenic	(cPAHs)
Beryllium	3,3- Dichlorobenzidine
Copper	PCBs
Lead	Pentachlorophenol
Manganese	
Zinc	

Pioneer Builders Supply:

Soil	Ground Water
Benzene	1,1,2-Trichloroethane
Toluene	Naphthalene
Ethylbenzene	Benzene
Xylenes	Toluene
TPH	Ethylbenzene
	Xylenes
	TPH

Tacoma City Light Dry Wells:

Soil	
Aldrin	3,3-Dichlorobenzidine
Carbazole	PCBs
Carcinogenic PAHs	Pentachlorophenol
1,4-Dichlorobenzene	

II.IV. Remedial Actions

A. Remedy Selection

The ROD for the STF site was signed September 29, 1994. EPA issued a UAO in 1996 for remedial design and action for soil and ground water after the ROD; however, the UAO was superseded when EPA and the PRPs signed a Consent Decree for soil and ground water remedial action (filed January 1997). An ESD that modified the ground water remedy at Pioneer Builders Supply was issued on September 29, 1999. Tacoma Public Works storm water utility declined to participate in monitoring a wetland storm water drainage channel; therefore EPA performed the monitoring required in the ROD and subsequently determined no further action would be required for this area.

The selected remedies for each portion of the site addressed human health risks through exposure to contamination via soil ingestion or contact and ground water ingestion. For soils, the protectiveness of selected active remedies (excavation, removal, and or capping) was bolstered with requirements limiting land use to commercial/industrial. For ground water at Pioneer Builders Supply, the selected remedy of MNA included institutional controls prohibiting use of site water for drinking water to be imposed until the numeric cleanup goals for ground water are met. To address ground water for the balance of the STF, EPA determined that ground water quality would not be compromised by leaching from metals-contaminated soils. A long-term ground water monitoring plan was implemented to verify this conclusion.

1. STF Soils. The selected remedy for STF soils used a combination of treatment, containment, and institutional controls and is described as follows:

a. Excavate soil above hot spots levels, treat using solidification, and consolidate on-site. Areas of consolidated wastes were to be capped either with asphalt or one-foot of clean soil. Soil hotspots were defined in the ROD as areas with contamination exceeding the levels shown on Table 2-2. The consolidation areas are shown on Figure 2-5.

Table 2-2. Soil Hotspot Cleanup Levels, South Tacoma Field

Compound	Cleanup Level (mg/kg)	Basis
Arsenic	570	10-4 risk based on MTCA
Lead	18,000	Based on cost sensitivity analysis in FS
Carcinogenic PAHs	50	Set as 2.5 time MTCA Method A concentration
Total PCBs	50	Based on TSCA
Copper	45,000	Based on leaching to groundwater

b. Excavate, consolidate and contain soils with contamination between the hotspot cleanup levels and capping levels presented on Table 2-3 to a depth of one foot. In addition, any other contaminants in soil

which exceed Washington Model Toxics Control Act (MTCA) Method A industrial cleanup levels were to be excavated, consolidated, and contained. If contamination remained at the one foot interval, the remaining contaminated soils could then be capped or excavation could continue until cleanup levels were achieved. Capped areas are shown on Figure 2-5.

Table 2-3. Soil Capping Levels, South Tacoma Field

Compound	Cleanup Level (mg/kg)
Arsenic	200
Lead	1,000
Carcinogenic PAHs	20
Total PCBs	10

c. Restrict soils to industrial use if contaminant concentrations are above MTCA residential standards but below the capping levels or MTCA industrial standards.

d. Implement a program of institutional controls including: deed restrictions, physical restrictions, an educational program, and a Site Development Plan.

e. General ground water monitoring at selected on- and off-site wells (shown on Figure 2-6) to ensure ground water levels stay below federal drinking water and state MTCA cleanup standards. Wells included in the monitoring program were identified according to historic site use and detected contamination. Amsted wells are located in the vicinity of immobile petroleum hydrocarbon ground water contamination. Ground water monitoring includes PAH and TPH as oil and diesel. STF wells are located at sentinel sites around stabilized and consolidated soil contamination and at off-site locations. Total lead was chosen as the indicator chemical due to the high volume and concentrations of lead-contaminated soil at the site. Biannual monitoring (April and October) was required for two years with a reduction to annual monitoring when data from the first two years showed no significant change in ground water quality.

The ROD states that engineering controls such as fencing and other barriers shall be used to restrict access to the site in areas where industrial cleanup levels are exceeded and to prevent unauthorized (recreationalist/trespasser access) use of the soil-capped areas.

2. Pioneer Builders Supply. The selected remedy in the ROD for soil and ground water at Pioneer Builders Supply was air sparging and in-situ vapor extraction. The remedy was later modified in the ESD to be natural attenuation with institutional controls. Cleanup levels presented in the ROD for soil and ground water still apply to the site and are presented on Table 2-4 and 2-5. The objective of the soil cleanup levels, as stated in the ROD, was to prevent further ground water contamination. For ground water, the objective was to reduce cancer risk to no greater than $1x10^{-5}$. TPH is listed in cleanup goals for ground water since it is a contaminant of concern for Ecology; although, compliance with ground water cleanup goals under CERCLA is based on cleanup of the individual constituents of TPH.

Table 2-4. Pioneer Builders Supply Soil Cleanup Levels

Contaminant	Cleanup Level (mg/kg)	Footnotes from EPA ROD 1994
Total Petroleum Hydrocarbons	100-200	MTCA Industrial Method A - Enforcement for this standard will be taken by Ecology at its discretion
Benzene	0.5	MTCA Industrial Method A
Toluene	40	MTCA Industrial Method A
Ethylbenzene	20	MTCA Industrial Method A
Xylenes	20	MTCA Industrial Method A

Table 2-5. Pioneer Builders Supply Ground Water Cleanup Levels

Contaminant	Cleanup Level (µg/L)	Footnotes from EPA ROD 1994
Total Petroleum Hydrocarbons	1,000	MTCA Industrial Method A Enforcement for this standard will be taken by Ecology at its discretion
Xylene	10,000	Enforcement for this standard will be taken by Ecology at its discretion
1,1,2-Trichloroethane	5	Cleanup level set at federal drinking water standard. If cleanup to these federal drinking water standards is achieved and the ground water still does not achieve the MTCA cumulative risk requirement of risks no greater than 1 in 100,000 or a Hazard Index of no greater than 1, then ground water use will be restricted to non-drinking water purposes.
Naphthalene	32	
Benzene	5	
Toluene	1,000	
Ethylbenzene	700	

The selected approach for this remedy includes the following:

a. Monitor ground water for natural attenuation caused by microbial degradation. The 1994 ROD selected air sparging and soil vapor extraction as the remedy based on the HHRA; however, EPA noted that concentrations of ground water contaminants had dropped significantly between 1990/1991 and 1997. As a result, EPA re-evaluated the need for air sparging and soil vapor extraction and in 1999 issued an ESD to the ROD with the determination that MNA would replace air sparging and soil vapor extraction as the selected ground water remedy. Based on calculations made for the ESD, it was estimated that cleanup levels would be reached in four years. Review of the effectiveness of this remedy would be conducted in Five-Year Reviews. Monitoring locations presented on Figure 7 are sampled annually for volatile organics, and petroleum as gasoline, diesel, and heavy oil.

b. Implement a program of institutional controls in the form of restrictions on ground water use (to non-drinking purposes) in the vicinity of Pioneer Builders Supply. The restricted area was to be defined during the remedial design. The restriction was to continue until ground water cleanup levels were achieved throughout the contaminant plume and cancer risks from all carcinogens were no greater than 1 in 100,000 ($1x10^{-5}$) and the hazard index was less than 1. No institutional controls were identified for soil.

3. Tacoma City Light Dry Wells. The ROD states that contaminated soil with PCB concentrations above 50 mg/kg (milligrams per kilogram) or endrin concentrations above 0.13 mg/kg would be excavated and transported off-site for incineration. In addition, all soils with PCB, PAH and other chemical concentrations above MTCA Method B residential cleanup levels would also be excavated and disposed at an off-site permitted hazardous waste disposal facility. Cleanup levels presented in the ROD based on

MTCA Method B Residential area presented in Table 2-6.

Table 2-6. Tacoma City Light Soil Cleanup Levels

Contaminant	Cleanup Level (mg/kg)
Aldrin	0.059
Carbazole	50
cPAHs	1.0
1,4- Dichlorobenzene	42
3,3-dichlorbenzidine	2.2
PCBs	1.0
Pentachlorophenol	8.3

4. Wetlands/Drainage Channel. A perennial wetland (a possible remnant of the South Tacoma Swamp) is located along the drainage channel at the western edge of the property. The wetland is primarily supported by storm water runoff from the drainage channel. The ROD indicates that monitoring of surface water and sediment was required to observe changes in contamination in this area. These changes would then be reviewed to determine if storm water was having a negative effect on ground water quality beneath the site.

B. Remedy Implementation

1. STF Soils. The remedial action for STF soils began in June 1999. The following work was conducted in accordance with the ROD and the Consent Decree:

- Approximately 6,300 tons of soil exceeding hot-spot concentrations were excavated and treated (i.e., stabilized with a phosphate-based reagent). These soils were consolidated on-site and covered with a clean soil cap.
- 15.4 tons of soil at Pioneer Builders Supply with PCBs exceeding 50 mg/kg were excavated and disposed of off-site.
- 113,607 tons of soil with contaminant concentrations between the capping and hot-spot levels were consolidated and capped.
- An estimated area 13.7 acres of the STF OU was capped.
- Buried tanks, drums and contents were removed and disposed. Associated contaminated soils and solid wastes were also removed and disposed of at a permitted facility.
- Sub-surface soils contaminated over capping levels were capped where excavation and consolidation were not cost-effective.
- Institutional controls prohibiting residential development were implemented.
- Site access controls limiting exposure to caps were installed (e.g., fencing, warning signs on consolidation areas, grid markers for surveying integrity of capped areas over time).
- During construction, air was monitored to assess airborne contaminant concentrations in the work area and at site boundaries.

Only three minor deviations from the ROD and approved Remedial Design (RD) occurred. First, the ROD called for portland cement as a stabilizing agent, instead, a proprietary phosphate-based reagent was used to render metal contaminants stable and insoluble. Second, because the RD assumed portland cement

as the stabilizer, a retaining wall and storm water drainage were designed for the Amsted property. However, the volume of soil needing treatment was smaller than expected since cement was not used, and the retaining wall and associated storm water drainage were unnecessary. Finally, because near-term development was expected on the STF portion of the site, all excavated soil was not fully replaced in anticipation of additional backfill from development. (Note a minimum of six inches of topsoil was place over all soils requiring a cap.)

Some small areas of contamination at concentrations exceeding capping levels could not be excavated because they fell beneath active rail lines. These areas were recorded and are shown on Figure 2-5. The Site Development and Institutional Control Plan (SDICP) contains operation and monitoring requirements for these grid areas to manage exposure during rail maintenance or construction or utility work.

There are three areas of consolidated soil contamination, one at the northern portion of the STF, and two at the southern end of the site (Figure 2-5). Of these three areas, only the northern area was completely fenced as part of the Remedial Action. One of the southern consolidation areas (Amsted) was fenced on three sides of the parcel that were easily accessible from South Proctor Street, while the third side was not fenced because steep slopes naturally limit access and trespass. Exposure is controlled by site use on the Amsted area which is parking and storage for various items (truck containers, logs). For the northern and Amsted areas, future development plans allow redesign and/or removal of the fences. The southernmost area of consolidation was not fenced as part of the Remedial Action. Due to it's visibility from South 56th Street, which is a major thoroughfare, this area is much less attractive for transient use than other parts of the site which are open to less-traveled public right-of-ways where post-remedial soils are a mix of conditions suitable for industrial use/exposure as well as unrestricted use.

2. Pioneer Builders Supply. The ESD determined that ground water monitoring for natural attenuation, rather than aggressive treatment, was appropriate because contaminant concentrations were decreasing and the source (USTs) had been removed. Ground water sampling is conducted annually at Pioneer Builders Supply to monitor the effectiveness of the natural attenuation remedy and is discussed further in section II.VI.E. The ROD established cleanup levels for soils in 1994; however, it is not clear if these levels were achieved during the UST removals in 1990 and 1991. At the time the USTs were removed (during the RI), visibly contaminated soils were excavated but not below the ground water level. Confirmation sample data from the UST removal actions were not assessed so this Five-Year Review cannot confirm that soil cleanup levels established afterward in the ROD were met sub-surface.

3. Tacoma City Light Dry Wells. In 1997, Tacoma City Light remediated their dry well contamination in accordance with the ROD, choosing to perform a more aggressive cleanup than pursued for other areas of the site. Soils contaminated with 50 mg/kg or more PCBs and 0.13 mg/kg or more endrin were excavated and incinerated off-site.

4. Wetland Drainage Channel. As required in the ROD, EPA conducted two rounds of ground water, surface water, and sediment sampling in the drainage channel in November 1996 and September 1997 to characterize surface water run-on and determine if the run-on has affected on-site sediment or ground water. Select surface water and sediment sampling locations were re-sampled in August and November, 1998. Sample results confirmed that surface water and sediment concentrations were similar to other urban runoff channels. The later samples indicated lead was present in sediment at a concentration of 913 mg/kg, compared to soil capping level of 1,000 mg/kg. Arsenic (maximum = 7.57 micrograms per Liter [µg/L]) and cPAHs (0.13 µg/L) were also detected above the MTCA Method B criteria for surface water of 0.09 µg/L and 0.03 µg/L for individual cPAHs, respectively. EPA determined that the source of surface water and sediment contamination found in the wetland and drainage channel resulted from storm water run-on from two City of Tacoma drains and no additional action was required.

C. Operation and Maintenance

Following remedial actions, PRPs were required to perform inspections for operation and maintenance (O&M) of the remedy in accordance with the Operations and Maintenance Plan. Costs for the O&M were not provided by BNR. Monitoring activities include:

1. Inspection/Maintenance Activities:

- Inspecting for signs of unauthorized entry, vandalism or compromise of the perimeter fence at the Amsted Property and BNR Dismantling Yard;
- Inspecting soil caps for signs of failure;
- Inspecting and identifying eroded or blocked drainage courses; and
- Inspecting monitoring wells for vandalism.

2. Ground water Monitoring:
   - Annual monitoring of STF wells to assess the impacts of the consolidated areas on ground water; and
   - Annual monitoring of Pioneer Builders Supply wells to assess the effectiveness of natural attenuation.

Three issues have been noted in the last five O&M reports. These included:

- Monitoring well STM-1A was damaged (monument tipped over) in 2002 and has not been replaced or abandoned.
- Partial cut observed in fence fabric west of MW-1A (Amsted Property) observed in December 2006 and December 2007. Repair has not been conducted; the tear was observed during the February 2008 site inspection.
- Ecology blocks were moved at the Burlington Way entrance both in December 2006 and December 2007. The 2007 Annual Progress Report states that the City later added a second row of blocks. Note: Ecology blocks at Burlington Way were not a component of the approved remedial design or remedial action.

II.V. Progress Since the Last Five-Year Review

Several of the recommendations from the last Five-Year Review have been implemented with the following exception. The Pioneer Builders Supply ground water monitoring program has not been modified as previously requested in the last Five-Year Review.

A. Last Protectiveness Statement

The protectiveness statement in the last Five-Year Review stated:

> *The remedy at STF currently protects human health and the environment. The remedies for soil and general ground water protection (STF and Amsted monitoring wells) are complete except for O&M and protective of human health and the environment in both*

short and long term. The MNA ground water remedy in the area of Pioneer Builders Supply is protective in the short term, based on drinking water prohibitions which will remain in place until it can be clearly shown that MCLs are being met.

B. Status of Recommendations

A summary of the recommendations made in the first Five-Year Review and an evaluation of their progress is presented below.

1. Continue current program of inspection and maintenance: Completed

All annual inspections have been completed since the first Five-Year Review and documents have been provided to EPA for review. Two outstanding maintenance issues exist:

- Holes in fencing need to be repaired, and
- Monitoring well STM-1A (see Figure 2-6) was damaged (monument tipped over) in 2002 and has not been replaced or abandoned. Subsequently, ground water samples have not been collected at STM-1a since 2001. BNR has requested closure of this and other wells.

Annual ground water monitoring has been completed since the first Five-Year Review with the exception of 2003. During this time period, the contractor was waiting for EPA's response to a request to reduce monitoring requirements. It should be noted that monitoring well CBS-9A, near the southeast property boundary, is scheduled for annual monitoring; however, it has not been sampled since 2000 because it was abandoned during construction activities. CBS-9A has only been sampled twice (April and October 2000) since remedial actions have been completed, but was sampled extensively prior to implementation of the actions and has not had historical contamination. EPA approved the closure of this well prior to the last Five-Year Review.

2. Provide Agency Oversight on future Development Plans: Completed/Ongoing

Future site development plans require Agency involvement as specified in the SDICP. As noted previously, existing businesses and public access to the site have expanded and changed since 2003, and more changes are planned before the next Five Year Review. Developers shall ensure that any planned future development of STF will be consistent with the existing SDICP.

3. Re-evaluate and revise the MNA ground water monitoring strategy at Pioneer Builders Supply area: Pending submittal and approval of Work Plan

An initial review of the MNA ground water monitoring strategy was conducted in the last Five-Year Review. Three additional wells equidistant, about 70-80 feet, from NMW-1A (source) were recommended. BNR submitted a workplan for installation of these wells, which was not approved. Although these additional wells have not been installed, annual ground water monitoring at existing wells indicates that a re-evaluation of the MNA strategy is still warranted. Discussion of current recommendations to the monitoring approach is presented in Section II.VII.D.

4. Monitor the revised network of wells at Pioneer Builders Supply area: Pending submittal and approval of Work Plan

The last Five-Year Review recommended further ground water monitoring quarterly for at least one year at the Pioneer Builders Supply Area. Since the additional monitoring wells at Pioneer Builders Supply

were never installed, additional quarterly sampling has not been conducted. The current well network has been monitored annually in accordance with the O&M plan and generally indicates that re-evaluation of the MNA strategy is still warranted.

II.VI. Five-Year Review Process

A. Administrative Components

BNR and ProLogis were notified of the initiation of the Five-Year Review during meetings held in February, 2008. The Five-Year Review team was led by Kris Flint of EPA, Remedial Project Manager (RPM), and included Kym Takasaki (Geochemist), Emile Pitre (Chemical Engineer), and Sharon Gelinas (Hydrogeologist) of the USACE Seattle District.

B. Components of Review

From January to March 2008, the review team established the review schedule whose components included:

- Community Involvement;
- Document Review;
- Data Review;
- Site Inspection;
- Local Interviews; and
- Five-Year Review Report Development and Review.

C. Community Involvement

Activities to involve the community in the Five-Year Review included a notice run in the Tacoma News Tribune local newspaper in February 2008 that a Five-Year Review was to be conducted. No comments have been received by the community on this review.

D. Document Review

This Five-Year Review consisted of a review of relevant documents as summarized in Attachment 2-1. Applicable soil, ground water and surface water cleanup standards were also reviewed.

E. Data Review

1. STF Ground Water Monitoring. Annual ground water monitoring was used to assess impacts of the soil consolidation areas on local ground water. The data provided in the 2002 to 2007 annual reports were reviewed. It should be noted that the month in which samples are collected has varied; the last three rounds were conducted in January, while previous years were conducted in October or December. Sampling was not conducted in 2003, since review was pending on proposed revisions to the sampling approach. All STF and Amsted wells are analyzed for total lead. The Amsted wells are also analyzed for TPH as oil and diesel, and PAHs.

STF ground water monitoring data are presented in Attachment 2-2 and well locations are shown on Figure 2-6. Concentrations of total lead in all STF wells have been below the cleanup levels since 2002 indicating that lead is not impacting site ground water. As stated above, monitoring well STF-1A has not been sampled since October 2001 due to damage. Even though STF-1A did not contain lead concentrations above the cleanup level prior to the damage, this well should be replaced and sampled to verify that ground water to the east of the southern consolidation area has not been impacted.

At the Amsted property, TPH, PAHs, and lead are analyzed to assess impacts of remaining petroleum hydrocarbon contamination. TPH as diesel is occasionally detected at monitoring well MW-1A; however, the cleanup level was only exceeded once in December 2004. During this same sampling event, low concentrations of several PAHs were detected at MW-1A and VMW-1 below their respective cleanup levels. Concentrations of TPH and PAHs have been below cleanup levels since this event in 2004, so it is not clear if ground water will remain protected by the soil containment remedy. Continued monitoring is necessary at the Amsted property to verify that ground water is not being impacted from the remaining contamination.

2. Pioneer Builders Supply Ground Water Monitoring. Annual ground water monitoring at Pioneer Builders Supply is used to evaluate the effectiveness of MNA as a ground water remediation method. The data provided in the 2002 to 2007 annual reports were reviewed. As noted for STF ground water, the month in which samples are collected has varied; the last three rounds were conducted in January, while previous years were conducted in October or December. Sampling was not conducted in 2003, since review was pending on proposed revisions to the monitoring approach.

Pioneer Builders Supply ground water monitoring data are shown in Attachment 2-3. TPH and Volatile Organic Compounds (VOCs) at NMW-1A (within the UST excavation area) show concentration fluctuations without consistent decreasing trends that would signal natural attenuation. In fact, concentrations of several contaminants showed increasing concentrations in 2006 and 2007, suggesting that residual source remains in sub-surface soils. The area of impervious surface (e.g., pavement, roofs) increased during this time which might also be affecting MNA. It should also be noted that carbon tetrachloride was detected for the first time in January 2008 at NMW-11A, near the eastern property boundary, at a concentration of 0.37 µg/L. Although the ROD does not address carbon tetrachloride, the federal MCL for this compound is 5 µg/L.

It has been noted that the ground water flow direction is highly variable across the site and is likely influenced by seasonal precipitation and pumping activities elsewhere in the aquifer (e.g. City of Tacoma wells). Ground water elevations are presented in Attachment 2-4. A review of the elevation data indicate that a ground water mound existed near NMW-1A in October 2004, which would cause ground water to flow radially outward from this point. In contrast, elevation data in January 2006 indicates that the highest ground elevation is at NWM-9A and the ground water flow direction ranged from south-east to north-east. As noted in Attachment 2-4, the top of casing elevations for NMW-9A and NMW-10A were lowered in 2006 due to construction activities and elevations for these two wells were calculated using the top of casing elevation from NMW-1A. Since the accuracy of these elevations is questionable, a complete review of 2007 ground water flow could not be completed.

Contaminant concentrations and ground water elevation data over time were compared to evaluate potential trends at NMW-1A (within the UST excavation area). The increase in contaminant concentrations observed in 2006 and 2007 correlates with an increase in water elevations, however, when concentrations decreased in 2008, ground water elevations continued to increase. Given that ground water data are only collected once per year and that the ground water flow direction is highly variable, contaminant trends attributed to the effects of water table fluctuations across a residual source in soil cannot be completely established. The current monitoring program's frequency and sampling locations do

not provide adequate information to assess whether MNA is occurring. Additional information is needed on ground water flow, plume extent, and the potential for a residual source of contamination in soil.

3. City Well Data. The City of Tacoma intermittently operates several drinking water supply wells in the South Tacoma Channel. The City of Tacoma routinely monitors water quality in their drinking water wells in accordance with the Safe Drinking Water Act. Wells are sampled at the well head either once every three years or when the well is turned on for use, whichever is more frequent. In addition, water from all combined wells is sampled once a year at the point of entry to the discharge system. The STF OU is adjacent to City drinking water supply Wells 2B/C, 4A, 6A/B, and 11A. Electronic data from these wells were reviewed to verify that drinking water has not been impacted by the STF. None of the City wells had detectable concentrations of lead except for one: when Well 4A was turned on for sampling in 2007, lead was detected at 2µg/L (MCL for lead is 15 µg/L). Well 4A has not had detections of VOCs during any sampling event. Well 2B has had detections of trichloroethene, toluene and xylenes. City Wells 6A/B, and 11A have had detections of trichloroethene, chloroform, and trichlorofluoromethane in the last five years. None of the contamination in the City wells appear to be related to the STF. In addition, all concentrations are below the federal MCLs, so there is no current risk from this exposure pathway. Results from samples collected annually at the point of entry to the distribution system have remained not detected for volatile organics.

F. Site Inspection

Inspection at the site was conducted on February 20, 2008, by the RPM, the USACE review team, BNR, and ProLogis. Photographs taken during the site inspection are presented in Attachment 2-7. The inspection consisted of checking survey markers for capped areas, soil caps and vegetation, fencing around consolidated waste units, and general land use. During the site visit, several issues were noted:

- Holes in the fencing in the northern consolidation area had been cut and evidence of foot traffic within the fenced area was observed;
- Holes in the fencing in the southern consolidation area had been cut. The fence in this area does not completely surround the site. The eastern edge along Burlington Way consists solely of Ecology blocks to prevent vehicle access;
- Partial cut in fence west of MW-1A identified in past reports observed;
- Recreational vehicles were seen using the northern portion of the site. However, capped surfaces in this area appeared undisturbed;
- Survey marker at grid 554 could not be located. This area was overgrown by blackberries;
- Survey marker at grid 879 appeared to have been removed, a flooded hole, approximately one foot deep, was observed where the marker should have been;
- Markers for grids 785 and 767 could not be located. This area appeared disturbed; piles of soil and standing water were noted.
- Significant illegal dumping of residential waste was noted in the western area;
- Two tents were noted in the western area suggesting transient use of the area.

G. Interviews

Nathan Graves from Kennedy Jenks, consultant to BNR was interviewed on methods for conducting operations and maintenance activities. Scott Strine from ProLogis was also interviewed to discuss the

potential future land use of site. Because of low community interest of the site except for development issues, no community members were interviewed.

II.VII. Technical Assessment

A. Is the remedy functioning as intended by the decision documents? No

1. Remedial Action Performance. The selected remedy for soil hot spots was to excavate and treat on-site using solidification. For remaining contaminated soils which exceeded capping levels, excavation and capping was conducted. The required access controls (fences, signs, and ecology blocks) to ensure cap integrity have been implemented in accordance with the approved design. The fenced areas are described in Section II.IV.B.1. (Remedial Action Implementation for STF soils). The fence surrounding the northern consolidation area has a hole that allows access to the capped area that BNR has been directed to correct. The fence at the Amsted consolidation area also has a hole which should be repaired to limit access even though that fence is not actually part of the remedy. The southern most consolidation area is not fenced, but does have ecology blocks meant to prevent vehicle access and these have been moved and replaced in the past. Elsewhere on STF, there are no physical restrictions from other capped areas other than ecology blocks at site entrances preventing vehicle entry. Current access controls have not been effective at restricting public access for dumping and transient living (as evidenced by tents).

General ground water monitoring for the STF consolidation areas indicate soil contamination and cleanup activities are not posing a threat to ground water. Detected concentrations of lead continue to be below the cleanup level (Attachment 2-3). The Amsted wells have been below detection levels for all sampled analytes for the past three years. Continued ground water monitoring will be conducted to ensure protectiveness of groundwater in this area.

The selected remedy for the ground water at Pioneer Builders Supply is MNA. The 1999 ESD predicted that COC concentrations would decrease to below cleanup levels within four years (2003). As of January 2008, concentrations of TPH as gasoline, benzene, and 1,4-dichlorobenzene still exceed cleanup levels at monitoring well NMW-1A. The consistent decreasing trends which would indicate MNA have not been observed while concentrations of TPH as gasoline and diesel and several other VOCs increased at NMW-1A in October 2002, January 2006, and January 2007. As noted previously, increasing groundwater contaminant concentrations may be due to residual source material near monitoring well NMW-1A, as well as localized changes to the hydrologic regime caused by increased impervious area. No data is available for residual soil concentrations that may be contributing to the plume and no soil remedy, other than the UST removals in 1990 and 1991, has occurred to date. Additional soil data will help evaluate if remaining soil concentrations are contributing to the plume.

As identified in the last Five-Year Review, the local ground water regime in this area is highly variable depending on seasonal precipitation recharge and pumping activities elsewhere in the aquifer. The last Five-Year Review indicated problems with MNA ground water monitoring network and sample collection timing. The design of the Pioneer Builders Supply ground water monitoring program should be modified to ensure the selected remedy can be monitored appropriately.

2. Systems Operations. O&M has generally been conducted as designed, with the exception of wells STM-1A and CBS-9A not being sampled. Only the closure of CBS-9A has been approved by EPA.

3. Optimization. To date, no optimization studies have been performed at the site.

4. Implementation of ICs. Remaining soil and groundwater contamination at the site do not allow for unrestricted use/ unrestricted exposure, so ICs are required for both media. The current Site Development and Institutional Control Plan (SDICP) outlines several ICs for the site. EPA is responsible for monitoring the effectiveness of the ICs, and uses checks on the development status as a tool to ensure this restriction. BNR is responsible for the implementation, maintenance, and inspection of the ICs.

Implementation of the required controls was reviewed in this Five-Year Review. The ICs and their implementation status are provided in Table 2-7. It should be noted that the SDICP does not explicitly describe the objectives of each of these activities, but it is inferred that they include protection of direct contact to soil under industrial uses and prevention of groundwater use for drinking. Selected controls have been put in place in a legally defensible manner. The SDICP provides maps for where the ICs should be applied.

The area restricted is sufficiently protective based on the distribution of contaminants with the exception of the Pioneer Building Supply area, where there are no ICs to manage exposure to sub-surface soils (e.g., excavation for structures).

Table 2-7. Institutional Control Summary, South Tacoma Field

Institutional Control	Implementation
Granting EPA access to monitor and inspect the site	In place. Will need to review when property transfer occurs.
Limiting land use for industrial purposes	Zoning indicates industrial use except for the western portion.
Assuring maintenance of caps that contain contaminated soils	Fencing and Signage Deed restrictions preventing exposure to soil Annual Site Inspections
Prohibiting ground water use in the vicinity of Pioneer Building Supply	Copy of restrictive covenant for BNR parcels reviewed and in place.
Recording Restrictive Covenants and leases with the Pierce County Auditor	Copy of restrictive covenant for BNR parcels reviewed and in place. Will need to review when property transfer occurs.
Notifying EPA of ownership transfers or lease agreements regarding the site	Notifications being received by EPA
Developing safety guidelines for future potential site workers	Generated in IC plan
Developing a fact sheet to distribute to the community	Developed in IC plan

A title search was not conducted, but copies of the filed restrictive covenants and leasee agreements on BNR lands were reviewed to confirm that the covenants remain in place. Restrictive covenants on groundwater use are in place. To date, the property has not been sold, leased, or subdivided to any new parties. Leasee agreements currently notify parties of application ICs.

Although land use controls are in place, review of current site conditions demonstrate that the property is not being used in a manner consistent with industrial land use restrictions. Site access controls are not ensuring this land use is maintained. There was evidence of pedestrian site access observed in the capped areas, including dirt bikes, dumping, and tents mentioned in Section II.VI.

In summary, the current ICs require modification to prevent residential land use and to include capping requirements for soils beneath Pioneer Building if it is determined that concentrations are present in soil above industrial use criteria. In addition, following property development and transfer, the ICs currently in place need to be reviewed to confirm that they continue to run with the land and to verify future protectiveness based on land use changes.

5. Indicators of remedy problems.

Soil. Several issues with respect to ICs and site access were noted, including transient use for residential purposes and missing ICs on the Pioneer Building Supply soils.

Ground Water. Based on the review of the ground water data at Pioneer Builders Supply, MNA is not occurring at the predicted rate, potentially due to a residual source present in soils contributing to the ground water contamination. In addition, the current monitoring program is not sufficient to evaluate the remedy.

B. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid? Yes

1. Changes in Standards and To Be Considered (TBCs). A review was done to identify any changes in standards that were identified as Applicable or Relevant and Appropriate Requirements (ARARs) in the ROD; newly promulgated standards including revised chemical-specific requirements (such as MCLs); revised action and location-specific requirements; and State standards and TBCs identified in the ROD that bear on the protectiveness of the remedy. Any such changes were then evaluated to establish whether the new requirement indicates that the remedy is no longer protective. A summary table is presented in Attachment 2-8. Generally, the standards and toxicological values used at the time of remedy selection have remained unchanged with the following exceptions previously noted in the last Five-Year Review.

Soil. As discussed in the previous Five-Year Review, Washington Department of Ecology modified MTCA substantially in 2001. MTCA Method A Industrial Cleanup Levels were used for soil capping levels. The Method A Industrial cleanup levels decreased since the ROD for arsenic (from 200 to 20 mg/kg) and total PAHs (from 20 to 2 mg/kg) during the modification of MTCA in 2001 (see Attachment 5). Revisions to these criteria were based on the protection of ground water, so they do not likely impact the protectiveness of the remedy with respect to industrial worker direct contact exposure but may impact protectiveness of ground water. Ongoing monitoring of ground water will be conducted to confirm that ground water concentrations remain below cleanup levels.

For informational purposes, a comparison of the revised criteria to concentrations reported in the Remedial Action Report was conducted. There are at least four uncapped grids (535, 537, 789, and 900) that had concentration in soil above the revised total PAH concentration of 2 mg/kg. Generally, arsenic concentrations in soil are below the revised criteria for this compound. However, the arsenic detection limit for many samples was 81 mg/kg, four times the revised cleanup level of 20 mg/kg.

The objective of the subsurface soil cleanup goals at Pioneer Builders Supply was to prevent further ground water contamination. MTCA Method A industrial criteria was used for soil cleanup levels; however, it cannot be confirmed if remaining soil concentrations meet this criteria. As seen in Attachment 2-5, the Method A cleanup levels have decreased since the ROD for benzene (from 0.5 to 0.03 mg/kg), toluene (from 40 to 7 mg/kg), ethylbenzene (from 20 to 6 mg/kg), and xylenes (from 20 to 9 mg/kg). Revisions to these criteria were based primarily on the protection of ground water. Review of remaining soil concentrations at the site in light of these new criteria should be reviewed to determine potential

impacts to the remedy. Data on subsurface soil concentrations were collected during the RI. More recent data is not available.

Ground Water. At Pioneer Builders Supply, ground water cleanup levels for benzene, ethylbenzene, toluene, total xylenes, and 1,2-dichloroethane were based on the federally set MCLs for drinking water. The cleanup level for naphthalene was based on MTCA Method B. Attachment 2-6 compares cleanup levels identified in the ROD and revised MTCA cleanup levels (specifically revised default concentrations under Method A and B) for all chemicals detected in ground water. Dichlorobenzenes (1,2- and 1,4-) and 1,2,4-trichlorobenzene are contaminants that were not specifically addressed in the ROD or ESD; however, they are frequently detected at this site and have also been addressed by revisions to MTCA. Carbon tetrachloride was detected for the first time in January 2008 at NMW-11A and has been included on Attachment 2-6.

The remedy at Pioneer Builders Supply requires restrictions on ground water use to non drinking water until cleanup levels are achieved and the MTCA cumulative risk requirements of no greater than 1 in 100,000 or a Hazard Index not exceeding 1 are achieved. Since concentrations for some analytes are still above cleanup levels identified in the ROD, changes to the regulations do not impact protectiveness of the remedy. However, revised criteria for drinking water will impact the time frame in which site water use restrictions can be lifted.

2. Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics. As mentioned above, during the site inspection there was evidence of people living on the property and using the area for recreational use. These people are not industrial workers and have unauthorized access to the area. They most likely have minimal education on safety procedures to minimize contact with contaminated soil. Further action is required to reduce the exposure pathway to these people.

Since site development is pending, future access to capped areas will be prevented by the presence of structures and parking lots in the future. Timing of site development should be tracked to monitor protectiveness of the capped areas.

3. Changes in Land use. The City has indicated that the current demand forecast calls for increasing use from current levels to full use of their ground water rights within the next 25 years, beginning in 2010. Increased ground water demand in this area will likely impact distribution of chemicals in ground water at the STF by further influencing ground water flow direction.

It should also be noted that site development is pending that would reduce open area to the site. This development is being coordinated with EPA Region 10 to ensure that the development does not impact remedy effectiveness.

C. Has any other information come to light that could call into question the protectiveness of the remedy? No.

No other information has come to light that could call into question the protectiveness of the remedy.

D. Technical Assessment Summary

Based on ground water sampling results from the Amsted and STF monitoring wells, soils remaining at these areas do not appear to be impacting site ground water. Once STM-1A is replaced, an additional year of ground water monitoring should be conducted. When this is complete, optimization of the current site-wide ground water monitoring network should be conducted and include an evaluation wells critical for assessing the remedy. Potential changes due to site development and increased production from the City

of Tacoma drinking water wells should also be taken into consideration. Several issues with respect to ICs and site access were noted, including transient use for residential purposes and missing ICs on the Pioneer Building Supply soils.

The MNA remedy at Pioneer Builders Supply is not functioning as intended. Concentrations have not decreased to below cleanup goals within the time specified in the ROD. Rather, concentrations have fluctuated over time, potentially indicating residual source in soil. Evaluation of the remedy should address ground water flow, plume extent, and the potential for residual soil contamination to be a continuing source to ground water. Potential impacts from increased production of the City of Tacoma drinking water wells may also need to be evaluated in the future.

As indicated in the last Five-Year Review, modifications to the ground water monitoring network and sampling program are required to determine if MNA is occurring at the site. The recommendations described in the last Five-Year Review, with minor modification described below should be implemented. These recommendations include:

- Install three wells equidistant from NMW-1A to include: 1) west of NMW-1A, 2) southwest of NMW-1A, and 3) along the property boundary between NMW-11A and NMW-8A..
- After the wells are installed, collect water levels quarterly over the course of one year.
- Re-survey measuring point elevations at all monitoring wells to ensure accuracy.
- Collect ground water samples and analyze for TPH and VOCs quarterly for one year to look for trends and to evaluate when annual samples should be collected in the future.
- Evaluate the effect of fluctuating ground water flow directions and water levels on contaminant concentrations and distribution.
- Review trends in carbon tetrachloride and other volatile organics detected at the site.

II.VIII. Issues

Table 2-8 presents a summary of issues identified at the site.

Table 2-8. Issues for South Tacoma Field

Issue	Currently Affects Protectiveness?	Affects Future Protectiveness?
Pioneer Builders Supply		
1. Whether the ground water monitoring network and frequency at Pioneer Builders Supply allow for an accurate assessment of MNA or plume characterization.	**N**	**Y**
2. Whether MNA has achieved the cleanup goals within the specified time frame.	**Y**	**Y**
3. Remaining soil contamination at the Pioneer Builders supply may be contributing to ground water contamination and requires characterization.	**N**	**Y**
4. Upon review of soil characterization data, institutional controls may be required if soil concentrations are above industrial use criteria.	**N**	**Y**

Issue	Currently Affects Protectiveness?	Affects Future Protectiveness?
Remaining Site		
5. Well STM-1A damaged and not being sampled.	**N**	**Y**
6. Site access controls are not protecting caps. Holes in fencing at various locations.	**Y**	**Y**
7. Unknown status of capped areas in grids 879, 785, and 767.	**N**	**Y**
8. Optimization of the ground water monitoring program is required and should consider changes in City of Tacoma pumping rates data and proposed site development.	**N**	**Y**
9. Tents present on property indicating residential use of industrial property.	**Y**	**Y**
10. Administrative ICs of EPA access and restrictive covenants may be modified following property transfer.	**N**	**Y**

II.IX. Recommendations and Follow-Up Actions

Based on recommendations from the technical review of MNA at Pioneer Builders Supply, the MNA remedy is not functioning as intended in the ESD. Region 10 will work with the PRPs to determine a more accurate well network and monitoring scheme to assess MNA over the next five-year period. Table 2-9 presents a summary of recommendations at the site.

Table 2-9. Recommendations and Follow-Up Actions, South Tacoma Field

Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness?	
				Current	Future
Pioneer Building Supply					
1. Prepare a revised Work Plan for well installation and sampling per Section II.VII.D.	**BNR**	**EPA**	**January 2009**	**N**	**Y**
2. Evaluate all new and existing data to assess time frame for effectiveness of MNA, or need for additional actions.	**BNR**	**EPA**	**January 2010**	**Y**	**Y**
3. Evaluate remaining soil contamination to verify that soil cleanup levels have been achieved. This may include a review of historical data and/or collection of new data.	**BNR**	**EPA**	**January 2009**	**N**	**Y**
4. Determine need for ICs for soil based on soil characterization data	**EPA**	**EPA**	**January 2009**	**N**	**Y**

Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness?	
				Current	Future
Remaining Site					
5. Replace well STM-1A and complete minimum of one additional year of sampling.	**BNR**	**EPA**	**March/ April 2010**	**N**	**Y**
6. Conduct fence repairs (fences may be removed as site is redeveloped)	**BNR**	**EPA**	**September 2008**	**Y**	**Y**
7. Verify status of capped areas in grids 879, 785, and 767.	**BNR**	**EPA**	**September 2008**	**Y**	**Y**
8. Conduct an optimization of the site-wide ground water monitoring program including a determination of wells critical for assessing the remedy.			**September 2010**		
9. Work with BNR to determine actions regarding transients living on property.	**EPA**	**EPA**	**September 2008**	**N**	**Y**
10. Review need for changes in administrative ICs of EPA access and restrictive covenants.	**EPA**	**EPA**	**Following site property transfer (estimated 2008)**	**N**	**Y**

II.X. Protectiveness Statement

The remedy at South Tacoma Field is not protective because of the following issues:

- In the short term there is an immediate threat to transients using open, unused areas of the site based on the potential for direct contact with remaining contaminated soils that exceed the standard for unrestricted use on some portions of the site. The pending commercial/industrial development will significantly reduce the amount of open space currently attractive to transients.

- The MNA groundwater remedy at Pioneer Building Supply has not met the cleanup goal within the time specified in the ROD. It may be that residual, subsurface soil contamination is contributing to the groundwater plume; it may also be that recent paving of large areas in this vicinity is affecting attenuation. If residual soil contamination is present, ICs may be required to prevent contact with these soils (e.g., excavation in future construction); and

- Migration of the contaminated groundwater above the cleanup levels at Pioneer Building Supply may not be controlled.

The following actions need to be taken to ensure protectiveness:

- Work with BNR to determine actions regarding transients living on open, unused areas of the site, including access controls along public right-of-ways;

- Develop and implement a revised groundwater monitoring program. Use new groundwater and soil data to assess time frame needed for MNA, or modifications to the remedy. Modifications to the remedy may include ICs for residual soil contamination, if present; and

- Evaluate new groundwater data at Pioneer Building Supply to determine if migration of groundwater plumes is controlled.

II.XI. Next Review

The next Five-Year Review for the STF OU is required by September 2013, five years from the date of this review.

SOUTH TACOMA FIELD
FIGURES

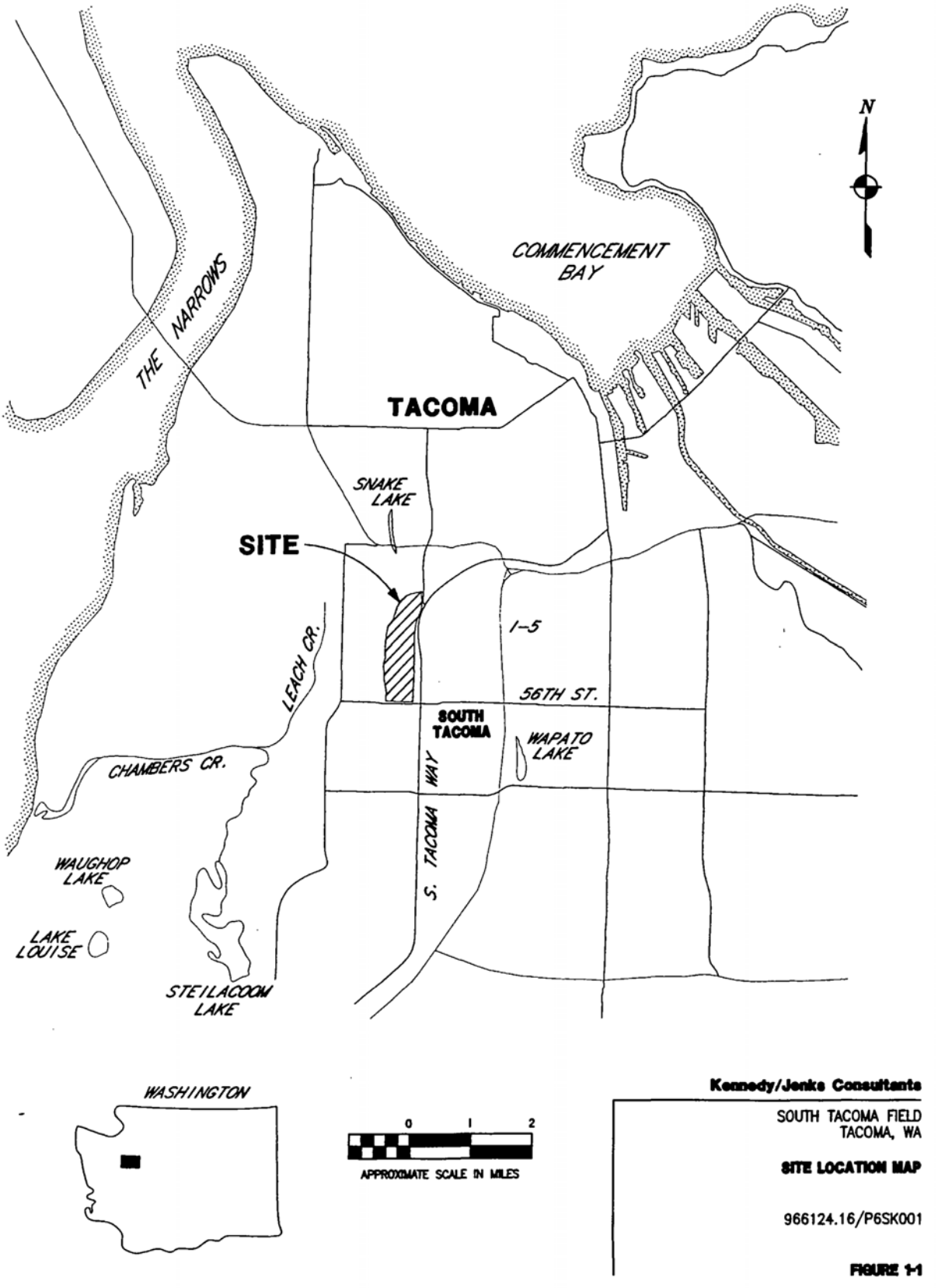


Figure 2-1. South Tacoma Field Site Vicinity Map

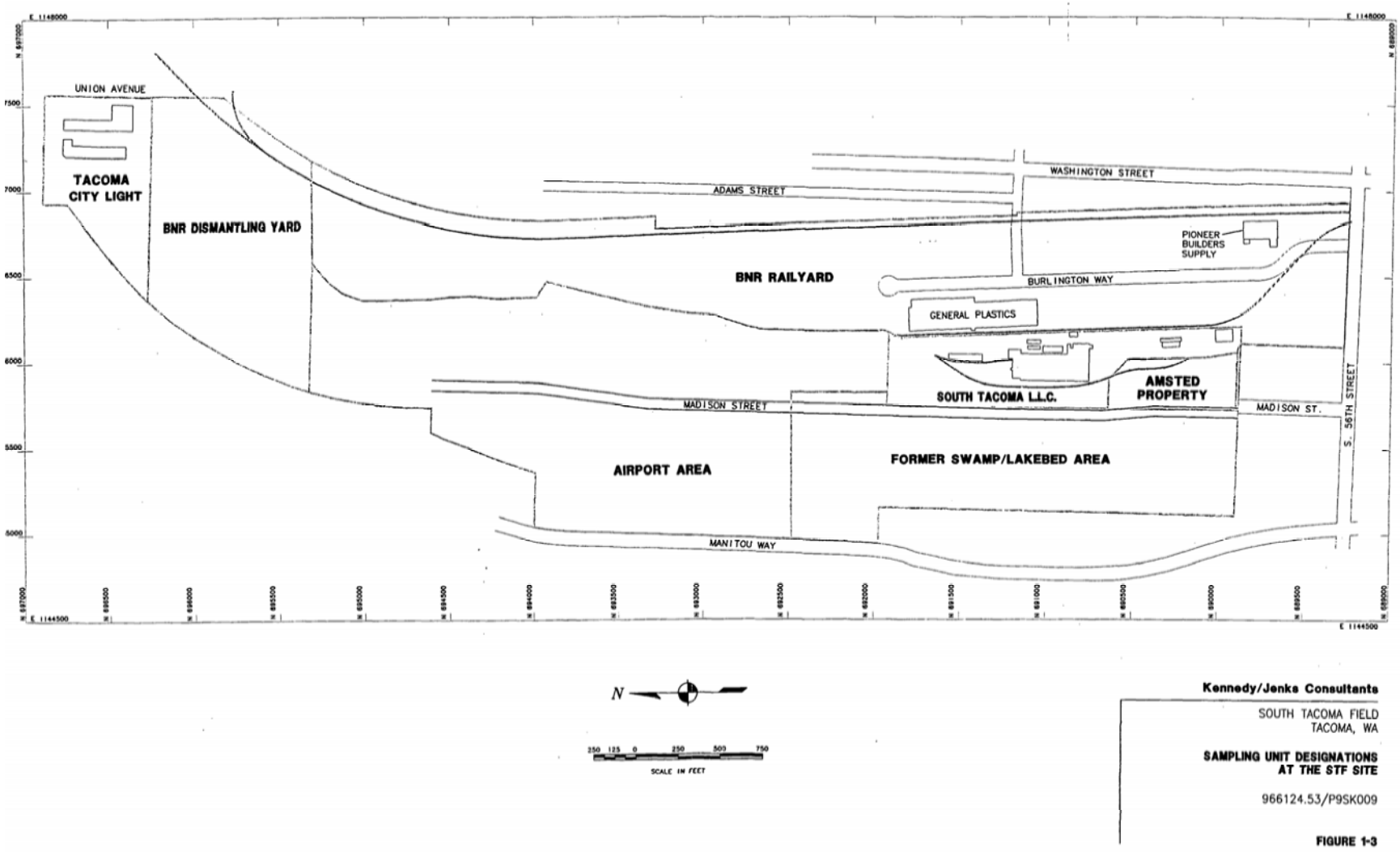
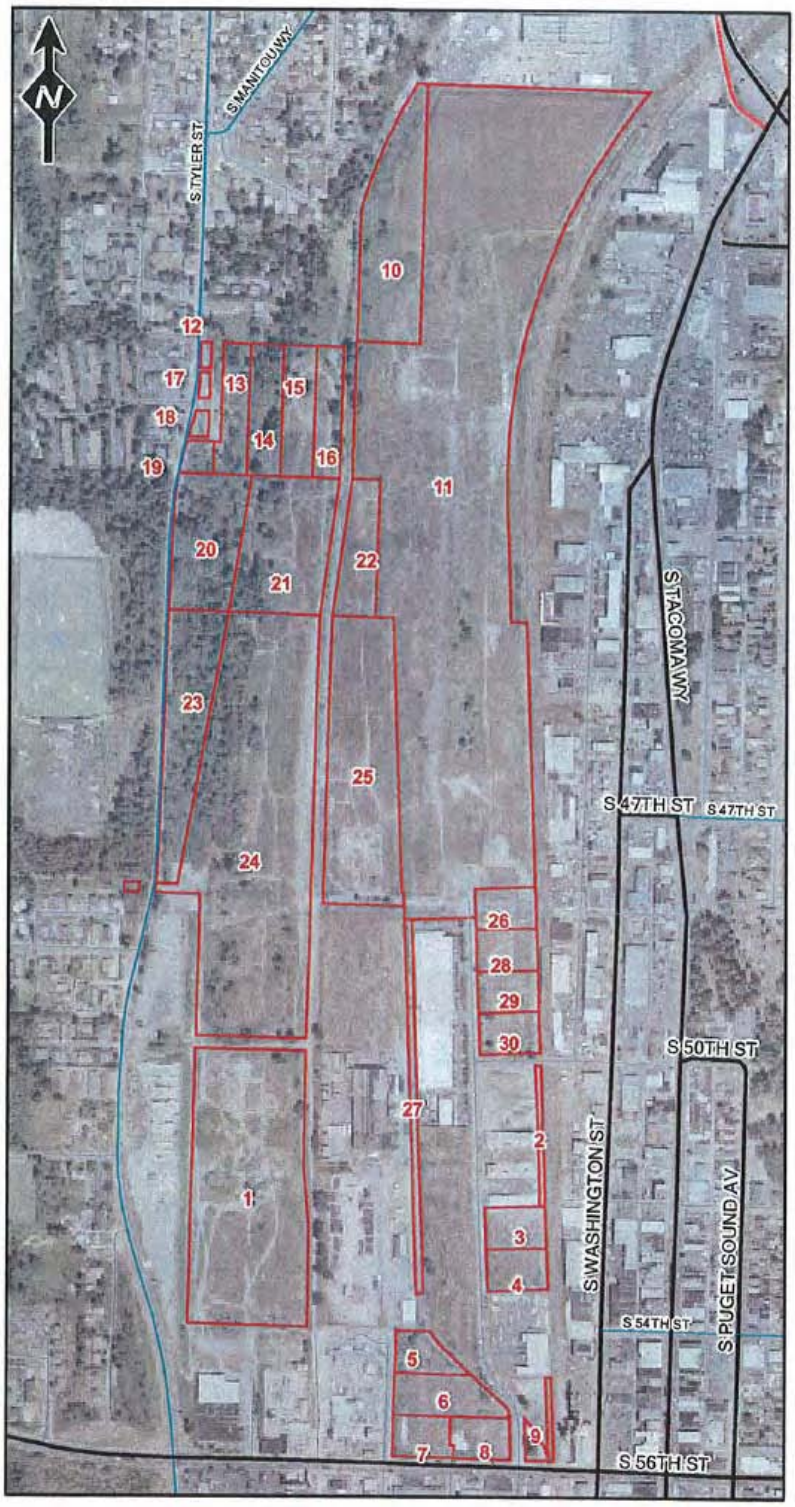
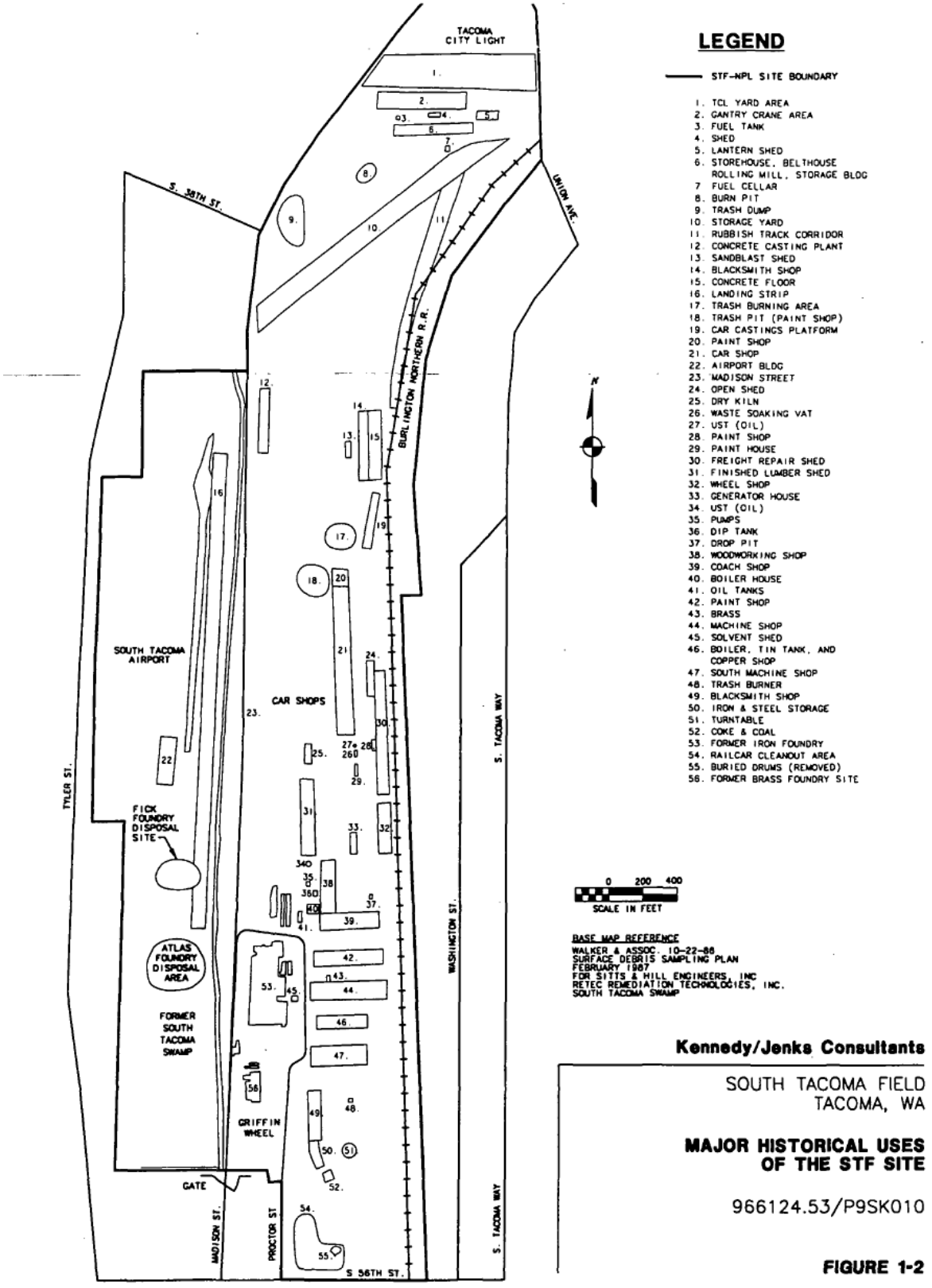


Figure 2-2. South Tacoma Field Site Sub-Area Map



Parcel #	Taxpayer	Acres	Map #
0220241001	BN SF RR	16.77	1
2783010062	BN RR	0.39	2
2783010050	BN SF RR	1.32	3
2783010040	BN SF RR	1.32	4
2783010231	BN LEASING CORP	1.18	5
2783010241	BN LEASING CORP	2.18	6
2783010252	BN LEASING CORP	1.29	7
2783010251	BN SF RR	1.29	8
2783010011	BN LEASING CORP	0.55	9
0220131131	BN SF RR	6.98	10
0220131130	BN SF RR	55.61	11
5735000010	BN SF RR	0.19	12
5735000110	BN SF RR	2.06	13
5735000120	BN SF RR	2.06	14
5735000130	BN SF RR	2.06	15
5735000140	BN SF RR	2.15	16
5735000030	BN SF RR	0.19	17
5735000050	BN SF RR	0.26	18
5735000070	BN SF RR	0.37	19
0220134004	BN SF RR	2.92	20
0220134800	BN SF RR	6.43	21
0220134011	BN SF RR	2.62	22
3740000140	BN SF RR	6.29	23
3740000086	BN SF RR	16.88	24
3740000181	BN SF RR	10.90	25
2783010120	BN SF RR	1.32	26
2783010260	BN SF RR	1.57	27
2783010110	BN SF RR	1.32	28
2783010100	BN SF RR	1.32	29
2783010090	BN SF RR	1.32	30

Figure 2-3. Burlington Northern Ownership Tax Parcel Map at South Tacoma Field



LEGEND

STF-NPL SITE BOUNDARY

1. TCL YARD AREA
2. GANTRY CRANE AREA
3. FUEL TANK
4. SHED
5. LANTERN SHED
6. STOREHOUSE, BELTHOUSE ROLLING MILL, STORAGE BLDG
7. FUEL CELLAR
8. BURN PIT
9. TRASH DUMP
10. STORAGE YARD
11. RUBBISH TRACK CORRIDOR
12. CONCRETE CASTING PLANT
13. SANDBLAST SHED
14. BLACKSMITH SHOP
15. CONCRETE FLOOR
16. LANDING STRIP
17. TRASH BURNING AREA
18. TRASH PIT (PAINT SHOP)
19. CAR CASTINGS PLATFORM
20. PAINT SHOP
21. CAR SHOP
22. AIRPORT BLDG
23. MADISON STREET
24. OPEN SHED
25. DRY KILN
26. WASTE SOAKING VAT
27. UST (OIL)
28. PAINT SHOP
29. PAINT HOUSE
30. FREIGHT REPAIR SHED
31. FINISHED LUMBER SHED
32. WHEEL SHOP
33. GENERATOR HOUSE
34. UST (OIL)
35. PUMPS
36. DIP TANK
37. DROP PIT
38. WOODWORKING SHOP
39. COACH SHOP
40. BOILER HOUSE
41. OIL TANKS
42. PAINT SHOP
43. BRASS
44. MACHINE SHOP
45. SOLVENT SHED
46. BOILER, TIN TANK, AND COPPER SHOP
47. SOUTH MACHINE SHOP
48. TRASH BURNER
49. BLACKSMITH SHOP
50. IRON & STEEL STORAGE
51. TURNTABLE
52. COKE & COAL
53. FORMER IRON FOUNDRY
54. RAILCAR CLEANOUT AREA
55. BURIED DRUMS (REMOVED)
56. FORMER BRASS FOUNDRY SITE

Figure 2-4. South Tacoma Field Major Historical Uses

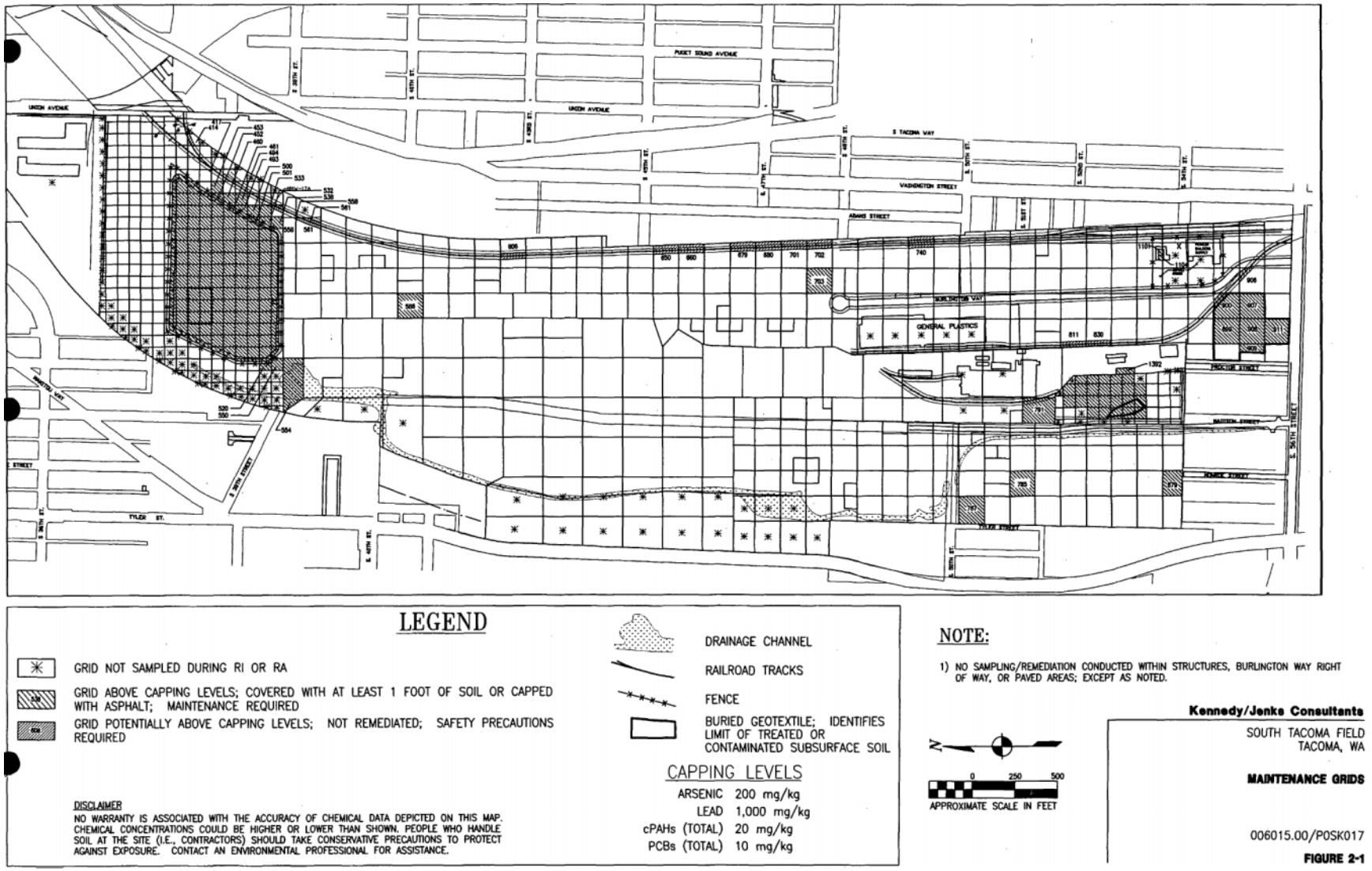


Figure 2-5. South Tacoma Field Containment Areas

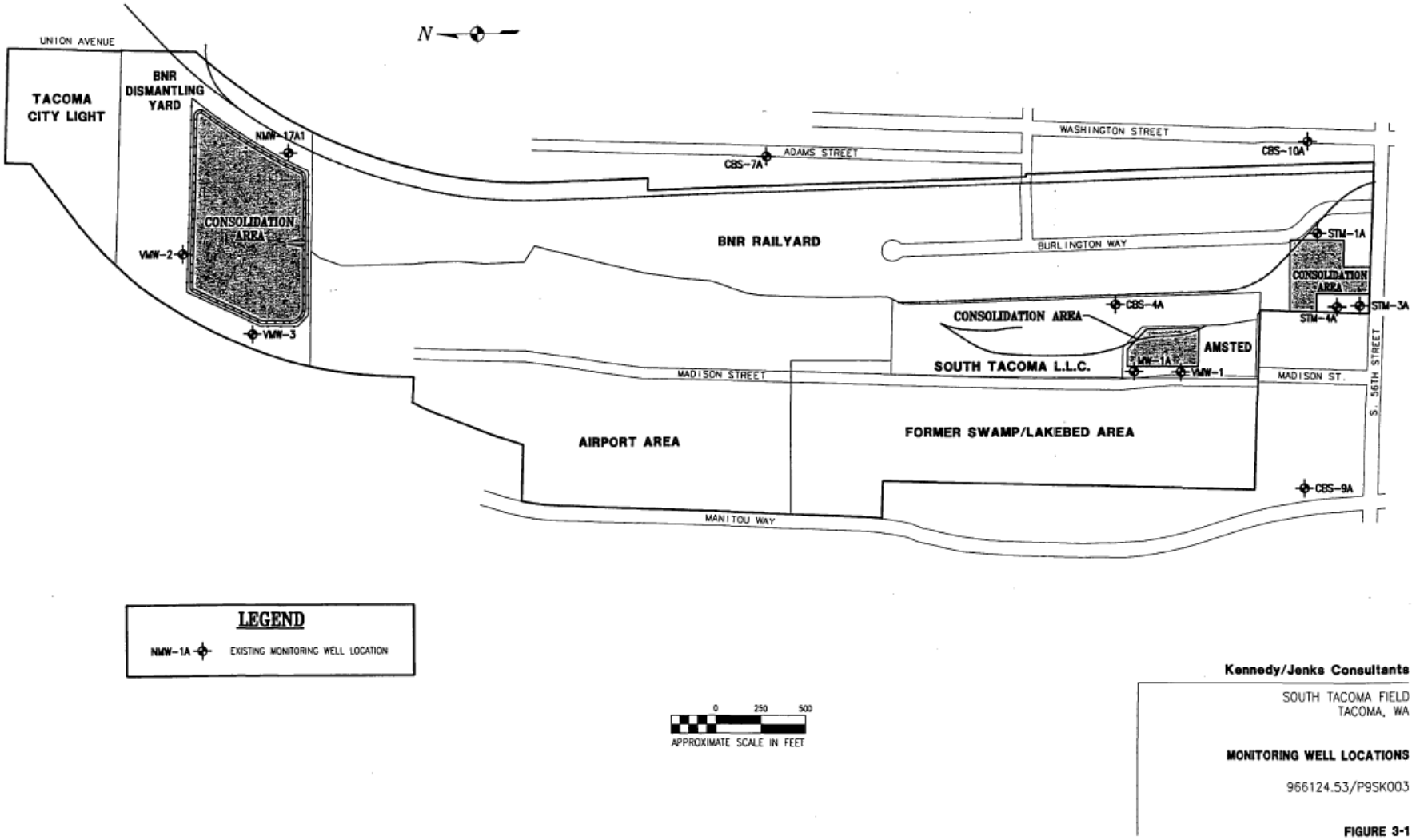


Figure 2-6. South Tacoma Field Monitoring Well Locations

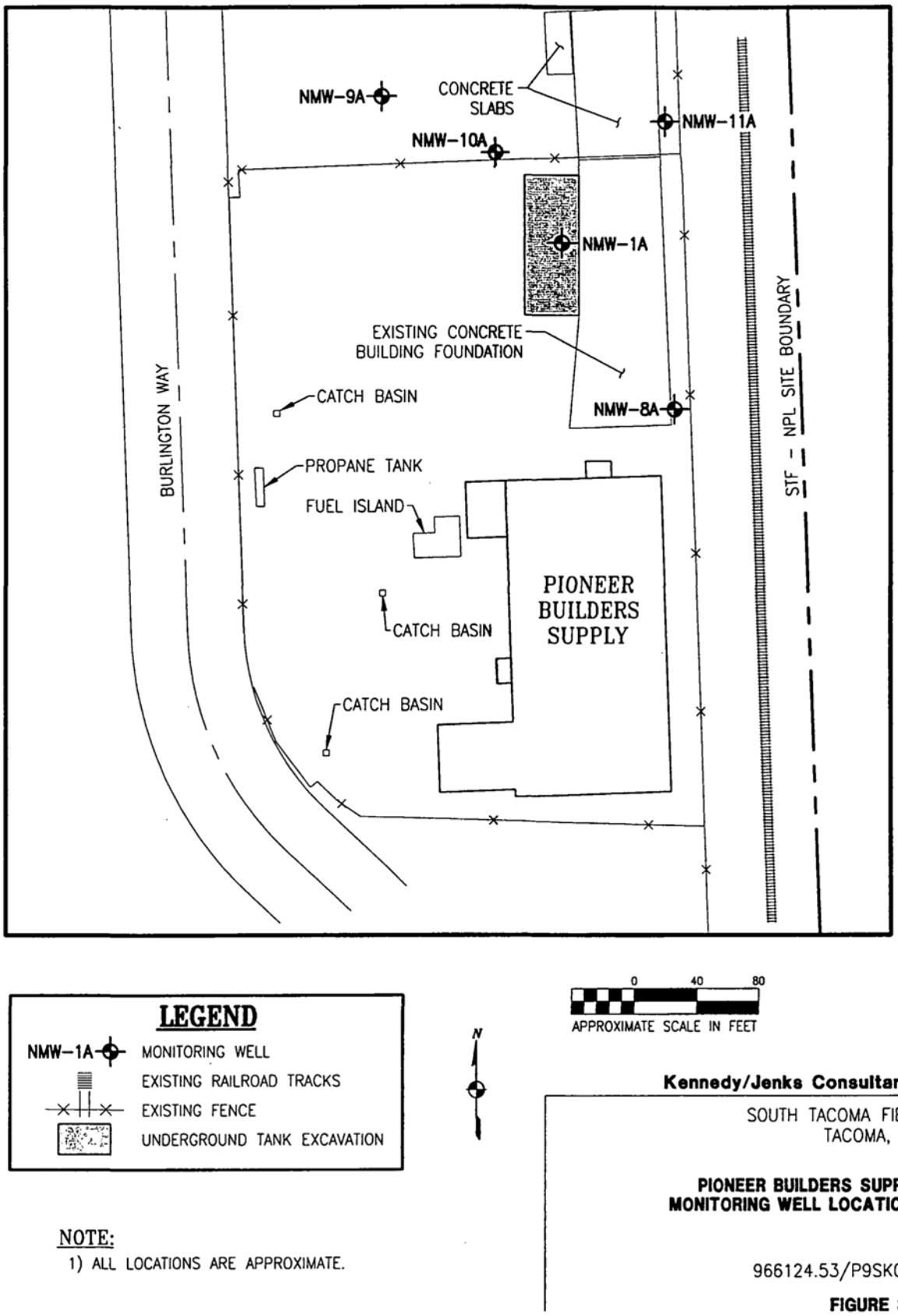


Figure 2-7. Monitoring Well Locations, Pioneer Builders Supply

SOUTH TACOMA FIELD
ATTACHMENTS

Attachment 2-1. List of Documents Reviewed, South Tacoma Field

ICF Kaiser, Wetland Drainage Channel Investigation Report (Sampling Event 1), March, 1998.

ICF Kaiser, Wetland Drainage Channel Investigation Report (Sampling Event 2), April, 1999.

Kennedy Jenks Consultants. Remedial Action Report, South Tacoma Field Site, March, 2000.

Kennedy Jenks Consultants. Site Development and Institutional Controls Plan for South Tacoma Field Site, Tacoma, Washington. March 2000.

Kennedy Jenks Consultants. Operations and Maintenance Plan for South Tacoma Field Site, Tacoma, Washington. March 2000.

Kennedy Jenks Consultants. 2004 Annual Progress Report. February 8, 2005.

Kennedy Jenks Consultants. 2005 Annual Progress Report. April 11, 2006.

Kennedy Jenks Consultants. 2006 Annual Progress Report. March 23, 2007.

Kennedy Jenks Consultants. 2007 Annual Progress Report. February 15, 2008.

US EPA, Region 10. Record of Decision for Commencement Bay South Tacoma Channel, South Tacoma Field Operable Unit. September 1994.

US EPA, Region 10. Explanation of Significant Differences for South Tacoma Field Record of Decision, Commencement Bay, South Tacoma Channel Superfund Site. August 1999.

US EPA, Region 10. First Five-Year Review Report for South Tacoma Field, Tacoma, Washington. June 2003.

US EPA, Region 10. Final Closeout Report for Soils, Commencement Bay, South Tacoma Channel Superfund Site, South Tacoma Field Operable Unit. February 2005.

Attachment 2-2. South Tacoma Field Ground Water Monitoring Data

Well	Date	PAHs			Total Lead (mg/L)	TPH-Diesel (mg/L)	TPH-Oil (mg/L)
		Anthracene (µg/L)	Benzo(g,h,i) perylene (µg/L)	Other PAHs (µg/L)			
MCL		***na***	***na***	***na***	***0.015***	***na***	***na***
Cleanup Level [1]		**4,800**	***na***	***na***	***0.015***	***0.5***	***0.5***
CBS-4A	Apr-00	ND	ND	ND	<0.001	<0.246	<0.496
CBS-4A	Oct-00	ND	ND	ND	<0.001	<0.247	<0.497
CBS-4A	Oct-01	ND	ND	ND	<0.001	<0.248	<0.498
CBS-4A	Oct-02	ND	ND	ND	<0.001	<0.249	<0.499
CBS-4A	Dec-04	<0.100	<0.100	ND	<0.001	<0.250	<0.500
CBS-4A	Jan-06	ND	ND	ND	<0.001	<0.248	<0.495
CBS-4A	Jan-07	ND	ND	ND	<0.001	<0.269	<0.538
CBS-4A	Jan-08	ND	ND	ND	<0.001	<0.250	<0.500
MW-1A	Apr-00	ND	ND	ND	<0.001	**0.32**	<0.500
MW-1A	Oct-00	ND	ND	ND	**0.002**	<0.250	<0.500
MW-1A	Oct-01	ND	ND	ND	<0.001	**0.32**	<0.500
MW-1A	Oct-02	ND	ND	ND	**0.00124**	<0.250	<0.500
MW-1A	Dec-04	**0.313**	**0.111**	ND	<0.001	**1.14**	<0.500
MW-1A	Jan-06	ND	ND	ND	<0.001	**0.254**	<0.500
MW-1A	Jan-07	ND	ND	ND	<0.001	<0.272	<0.543
MW-1A	Jan-08	ND	ND	ND	<0.001	<0.250	<0.500
VMW-1	Apr-00	ND	ND	ND	**0.005**	<0.250	<0.500
VMW-1	Oct-00	ND	ND	ND	**0.004**	<0.250	<0.500
VMW-1	Oct-01	ND	ND	ND	**0.022**	<0.250	<0.500
VMW-1	Oct-02	ND	ND	ND	<0.001	<0.250	<0.500
VMW-1	Dec-04	**0.102**	<0.100	ND	<0.001	<0.250	<0.500
VMW-1	Jan-06	ND	ND	ND	<0.001	<0.269	<0.538
VMW-1	Jan-07	ND	ND	ND	<0.001	<0.260	<0.521
VMW-1	Jan-08	ND	ND	ND	<0.001	<0.236	<0.472
CBS-10A	Apr-00	--	--	--	**0.008**	–	–
CBS-10A	Oct-00	--	--	--	<0.001	–	–
CBS-10A	Oct-01	--	--	--	<0.001	–	–
CBS-10A	Oct-02	--	--	--	**0.00537**	–	–
CBS-10A	Dec-04	--	--	--	**0.00248**	–	–
CBS-10A	Jan-06	--	--	--	**0.00145**	–	–
CBS-10A	Jan-07	--	--	--	**0.00117**	–	–
CBS-10A	Jan-08	--	--	--	<0.001	–	–
CBS-9A	Apr-00	--	--	--	<0.001	–	–
CBS-9A	Oct-00	--	--	--	<0.001	–	–
CBS-7A	Apr-00	--	--	--	<0.001	–	–
CBS-7A	Oct-00	--	--	--	**0.005**	–	–
CBS-7A	Oct-01	--	--	--	<0.001	–	–
CBS-7A	Oct-02	--	--	--	**0.00117**	–	–

Attachment 2-2. South Tacoma Field Ground Water Monitoring Data, Cont.

Well	Date	PAHs			Total Lead (mg/L)	TPH-Diesel (mg/L)	TPH-Oil (mg/L)
		Anthracene (µg/L)	Benzo(g,h,i) perylene (µg/L)	Other PAHs (µg/L)			
MCL		***na***	***na***	***na***	***0.015***	***na***	***na***
Cleanup Level [1]		**4,800**	***na***	***na***	***0.015***	***0.5***	***0.5***
CBS-7A	Dec-04	--	--	--	**0.00107**	–	–
CBS-7A	Jan-06	--	--	--	<0.001	–	–
CBS-7A	Jan-07	--	--	--	<0.001	--	--
CBS-7A	Jan-08	--	--	--	**0.00726**	--	--
NMW-17A1	Apr-00	--	--	--	<0.001	--	--
NMW-17A1	Oct-00	--	--	--	<0.001	--	--
NMW-17A1	Oct-01	--	--	--	**0.001**	--	--
NMW-17A1	Oct-02	--	--	--	<0.001	--	--
NMW-17A1	Dec-04	--	--	--	<0.001	--	--
NMW-17A1	Jan-06	--	--	--	<0.001	--	--
NMW-17A1	Jan-07	--	--	--	<0.001	--	--
NMW-17A1	Jan-08	--	--	--	<0.001	--	--
STM-100(STM-4A Dup)	Apr-00	--	--	--	**0.018**	--	--
STM-100	Oct-00	--	--	--	**0.009**	--	--
STM-100	Oct-01	--	--	--	**0.003**	--	--
STM-100	Oct-02	--	--	--	**0.00826**	--	--
STM-100	Dec-04	--	--	--	**0.00685**	--	--
STM-100	Jan-06	--	--	--	**0.00782**	--	--
STM-100	Jan-07	--	--	--	**0.00896**	--	--
STM-100	Jan-08	--	--	--	**0.00416**	--	--
STM-1A	Apr-00	--	--	--	**0.005**	--	--
STM-1A	Oct-00	--	--	--	**0.011**	--	--
STM-1A	Oct-01	--	--	--	<0.001	--	--
STM-3A	Apr-00	--	--	--	**0.005**	--	--
STM-3A	Oct-00	--	--	--	**0.001**	--	--
STM-3A	Oct-01	--	--	--	**0.003**	--	--
STM-3A	Oct-02	--	--	--	**0.00139**	--	--
STM-3A	Dec-04	--	--	--	**0.00226**	--	--
STM-3A	Jan-06	--	--	--	**0.00256**	--	--
STM-3A	Jan-07	--	--	--	**0.00602**	--	--
STM-3A	Jan-08	--	--	--	<0.001	--	--
STM-4A	Apr-00	--	--	--	**0.016**	--	--
STM-4A	Oct-00	--	--	--	**0.01**	--	--
STM-4A	Oct-01	--	--	--	**0.004**	--	--
STM-4A	Oct-02	--	--	--	**0.00995**	--	--
STM-4A	Dec-04	--	--	--	**0.0028**	--	--
STM-4A	Jan-06	--	--	--	**0.0133**	--	--
STM-4A	Jan-07	--	--	--	**0.00821**	--	--
STM-4A	Jan-08	--	--	--	**0.00395**	--	--
VMW-2	Apr-00	--	--	--	**0.006**	--	--

Attachment 2-2. South Tacoma Field Ground Water Monitoring Data, Cont.

Well	Date	PAHs			Total Lead (mg/L)	TPH-Diesel (mg/L)	TPH-Oil (mg/L)
		Anthracene (µg/L)	Benzo(g,h,i) perylene (µg/L)	Other PAHs (µg/L)			
MCL		***na***	***na***	***na***	***0.015***	***na***	***na***
Cleanup Level [1]		**4,800**	***na***	***na***	***0.015***	***0.5***	***0.5***
VMW-2	Oct-00	--	--	--	**0.009**	--	--
VMW-2	Oct-01	--	--	--	**0.004**	--	--
VMW-2	Oct-02	--	--	--	**0.0182**	--	--
VMW-2	Dec-04	--	--	--	<0.001	--	--
VMW-2	Jan-06	--	--	--	**0.004**	--	--
VMW-2	Jan-07	--	--	--	<0.001	--	--
VMW-2	Jan-08	--	--	--	**0.00973**	--	--
VMW-3	Apr-00	--	--	--	**0.002**	--	--
VMW-3	Oct-00	--	--	--	**0.018**	--	--
VMW-3	Oct-01	--	--	--	**0.002**	--	--
VMW-3	Oct-02	--	--	--	**0.00292**	--	--
VMW-3	Dec-04	--	--	--	**0.00643**	--	--
VMW-3	Jan-06	--	--	--	**0.00641**	--	--
VMW-3	Jan-07	--	--	--	**0.00756**	--	--
VMW-3	Jan-08	--	--	--	<0.001	--	--

Shaded values represent exceedences of the cleanup level
-- – Analysis was not performed for specified well
ND – not detected
(1) When MCLs not available, MTCA ground water cleanup levels, based on protection of drinking water, are used (MTCA METHOD B)

Attachment 2-3. Pioneer Builders Supply Ground Water Monitoring Data for Contaminants of Concern, 1999-2008

Well	Date	TPH-Gas (mg/L)	TPH-Diesel (mg/L)	TPH-Oil (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)	1,4-Dichloro-benzene (µg/L)	1,2,4-Trichloro-benzene (µg/L)	Naph-thalene (µg/L)
MCL		***na***	***na***	***na***	***5***	***1000***	***700***	***10000***	***75***	***70***	***na***
Cleanup Level (1)		***0.8***	***0.5***	***0.5***	***5***	***1000***	***700***	***10000***	***1.82***	***80***	***160***
NMW-100 (NMW-1A Dup)	Dec-04	**0.626**	<0.250	<0.500	<1.00	<1.00	**6.5**	**2.28**	<1.00	<1.00	<1.00
NMW-100	Jan-06	**3.66**	<0.286	<0.505	**6.23**	**31.7**	**177**	**148**	<1.00	**1.12**	**25.2**
NMW-100	Jan-07	**3.44**	<0.255	<0.510	**24.3**	**37.1**	**130**	**167**	**11.4**	**3.19**	**57.4**
NMW-100	Jan-08	**1.50**	<0.250	<0.500	**5.69**	**9.20**	**65.1**	**55.4**	**2.36**	<1.00	**7.21**
NMW-10A	May-99	<0.25	**0.44**	--	<1.0	<1.0	**3.1**	**8.1**	<1.0	<5.0	--
NMW-10A	Aug-99	**0.68**	**1.6**	<0.50	**7.6**	**20**	**52**	**63.6**	<1.0	<5.0	**25**
NMW-10A	Nov-99	<0.25	<0.25	<0.50	<1.0	**1.1**	**3.3**	**5.7**	<1.0	<5.0	<5.0
NMW-10A	Jan-00	<0.25	**0.25**	<0.50	<1.0	<1.0	<1.0	<2.0	--	<5.0	--
NMW-10A	Oct-01	<0.25	<0.25	<0.50	**1**	**7.9**	**5.4**	**8.6**	--	<5.0	<5.0
NMW-10A	Oct-02	**0.984**	**0.536**	<0.50	<1.00	<1.00	<1.00	<2.00	<1.00	<1.00	<1.00
NMW-10A	Dec-04	<0.050	<0.250	<0.500	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	**1.27**
NMW-10A	Jan-06	<0.050	**0.542**	<0.515	<1.00	<1.00	<100	<3.00	<1.00	<1.00	<1.00
NMW-10A	Jan-07	**0.129**	<0.284	<0.495	**5.96**	**0.26**	**0.99**	**0.53**	<0.200	<1.00	<2.50
NMW-10A	Jan-08	**0.0592**	<0.240	<0.481	**0.58**	<0.200	<0.200	<0.750	<0.200	<1.00	<2.50
NMW-11A	May-99	<0.25	<0.250	--	<1.0	<1.0	<1.0	<2.0	<1.0	<5.0	--
NMW-11A	Aug-99	<0.25	<0.250	<0.50	<1.0	<1.0	<1.0	<2.0	<1.0	<5.0	<5.0
NMW-11A	Nov-99	<0.25	<0.250	<0.50	<1.0	**1.9**	**5.5**	**12.4**	<1.0	<5.0	<5.0
NMW-11A	Jan-00	<0.25	<0.250	<0.50	<1.0	<1.0	<1.0	<2.0	--	<5.0	--
NMW-11A	Oct-01	<0.25	<0.250	<0.50	<1.0	<1.0	<1.0	<2.0	<1.0	<5.0	<5.0
NMW-11A	Oct-02	<0.050	<0.250	<0.500	<1.00	<1.00	<1.00	<2.00	<1.00	<1.00	<1.00
NMW-11A	Dec-04	<0.050	<0.250	<0.500	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00

Attachment 2-3. Pioneer Builders Supply Ground Water Monitoring Data for Contaminants of Concern, 1999-2008, Cont.

Well	Date	TPH-Gas (mg/L)	TPH-Diesel (mg/L)	TPH-Oil (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)	1,4-Dichloro-benzene (µg/L)	1,2,4-Trichloro-benzene (µg/L)	Naph-thalene (µg/L)
MCL		***na***	***na***	***na***	***5***	***1000***	***700***	***10000***	***75***	***70***	***na***
Cleanup Level (1)		***0.8***	***0.5***	***0.5***	***5***	***1000***	***700***	***10000***	***1.82***	***80***	***160***
NMW-11A	Jan-06	<0.050	<0.245	<0.490	<1.00	<1.00	<100	<3.00	<1.00	<1.00	<1.00
NMW-11A	Jan-07	<0.050	<0.258	<0.515	<0.200	<0.200	<1.00	<0.750	<0.200	<1.00	<2.50
NMW-11A	Jan-08	<0.050	<0.243	<0.485	<0.200	<0.200	<0.200	<0.750	<0.200	<1.00	<2.50
NMW-1A	May-99	**1**	**0.68**	--	**32**	**8.1**	**20**	**5.2**	**2**	**98**	--
NMW-1A	Aug-99	**0.97**	**0.44**	<0.50	**11**	**9**	**20**	**31.7**	**1.6**	**110**	**7.6**
NMW-1A	Nov-99	**7.1**	**0.38**	<0.50	**21**	**120**	**280**	**552**	**8.2**	**7.4**	**84**
NMW-1A	Jan-00	**0.46**	**0.38**	<0.500	**12**	**1.6**	**1**	**3.3**	--	**13**	--
NMW-1A	Oct-01	**3.4**	<0.250	<0.500	**3.1**	**16**	**78**	**113**	**1.1**	<5.0	**14**
NMW-1A	Oct-02	**5.66**	**0.859**	<0.500	**7.81**	**38.3**	**148**	**272.3**	**4.15**	<1.00	**88.3**
NMW-1A	Dec-04	**0.629**	<0.250	<0.500	<1.00	<1.00	**6.5**	**2.18**	**1.03**	<1.00	<1.00
NMW-1A	Jan-06	**3.66**	<0.301	<0.602	**6.18**	**31.5**	**177**	**147**	<1.00	**1.12**	**25.7**
NMW-1A	Jan-07	**3.62**	<0.258	<0.515	**23.5**	**36.4**	**128**	**166**	**11.1**	**3.03**	**54.4**
NMW-1A	Jan-08	**1.51**	<0.238	<0.476	**5.61**	**9.08**	**64.5**	**56.5**	**2.40**	**1.08**	**7.64**
NMW-8A	May-99	<0.25	<0.25	--	<1.0	<1.0	<1.0	<2.0	<1.0	<5.0	--
NMW-8A	Aug-99	<0.25	<0.25	<0.50	<1.0	<1.0	<1.0	<2.0	<1.0	<5.0	<5.0
NMW-8A	Nov-99	<0.25	<0.25	<0.50	<1.0	<1.0	<1.0	<2.0	<1.0	<5.0	<5.0
NMW-8A	Jan-00	<0.25	<0.25	<0.50	<1.0	<1.0	<1.0	<2.0	--	<5.0	--
NMW-8A	Oct-01	<0.25	<0.25	<0.50	<1.0	<1.0	**1.2**	**2**	<1.0	<5.0	<5.0
NMW-8A	Oct-02	<0.25	<0.25	<0.50	<1.0	<1.0	<1.0	<2.0	<1.0	<1.00	<1.00
NMW-8A	Dec-04	<0.050	<0.250	<0.500	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00
NMW-8A	Jan-06	<0.050	**0.677**	<0.510	<1.00	<1.00	<100	<3.00	<1.00	<1.00	<1.00
NMW-8A	Jan-07	<0.050	<0.284	<0.568	<0.200	<0.200	<1.00	<0.750	<0.200	<1.00	<2.50
NMW-8A	Jan-08	<0.050	<0.238	<0.476	<0.200	<0.200	<0.200	<0.750	<0.200	<1.00	<2.50
NMW-9A	May-99	<0.25	<0.25	--	<1.0	<1.0	<1.0	<2.0	<1.0	<5.0	--
NMW-9A	Aug-99	<0.25	**0.26**	<0.500	<1.0	<1.0	<1.0	<2.0	<1.0	<5.0	<5.0
NMW-9A	Nov-99	**0.4**	<0.25	<0.500	<1.0	**1.9**	**3.8**	**8.3**	<1.0	<5.0	<5.0
NMW-9A	Jan-00	<0.25	<0.25	<0.500	<1.0	<1.0	<1.0	<2.0	--	<5.0	--
NMW-9A	Oct-01	<0.25	<0.25	<0.500	<1.0	<1.0	<1.0	<2.0	<1.0	<5.0	<5.0

Attachment 2-3. Pioneer Builders Supply Ground Water Monitoring Data for Contaminants of Concern, 1999-2008, Cont.

Well	Date	TPH-Gas (mg/L)	TPH-Diesel (mg/L)	TPH-Oil (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)	1,4-Dichloro-benzene (µg/L)	1,2,4-Trichloro-benzene (µg/L)	Naph-thalene (µg/L)
MCL		***na***	***na***	***na***	***5***	***1000***	***700***	***10000***	***75***	***70***	***na***
Cleanup Level (1)		***0.8***	***0.5***	***0.5***	***5***	***1000***	***700***	***10000***	***1.82***	***80***	***160***
NMW-9A	Oct-02	<0.25	<0.25	<0.500	<1.0	<1.0	<1.0	<2.0	<1.0	<1.00	<1.00
NMW-9A	Dec-04	**0.0733**	**0.279**	<0.500	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00
NMW-9A	Jan-06	<0.050	**0.321**	<0.581	<1.00	<1.00	<100	<3.00	<1.00	<1.00	<1.00
NMW-9A	Jan-07	<0.050	<0.284	<0.495	<0.200	<0.200	<1.00	<0.750	<0.200	<1.00	<2.50
NMW-9A	Jan-08	<0.050	<0.243	<0.485	<0.200	<0.200	<0.200	<0.750	<0.200	<1.00	<2.50

Shaded values represent exceedences of the cleanup level
-- – Analysis was not performed for specified well

(1) When MCLs not available, MTCA ground water cleanup levels, based on protection of drinking water, are used (MTCA METHOD B)

Attachment 2-4. Pioneer Builders Supply Ground Water Elevation Data

Well ID	Top of Well Casing Elevation (feet)	12/26/2007		1/11/2007		1/10/2006		10/29/2004	
		Depth to Water (feet)	Water Level Elevation (feet)	Depth to Water (feet)	Water Level Elevation (feet)	Depth to Water (feet)	Water Level Elevation (feet)	Depth to Water (feet)	Water Level Elevation (feet)
NMW-1A	252.72	29.86	222.86	30.58	222.14	32.84	219.88	34.17	218.55
NMW-8A	253.93	31.08	222.85	31.89	222.04	33.84	220.09	35.91	218.02
NMW-9A[(a)]	253.79	29.77	222.95	30.21	222.51	33.42	220.37	36.08	217.71
NMW-10A[(a)]	253.78	30.29	222.43	30.86	221.86	33.47	220.31	36.03	217.75
NMW-11A	253.94	31.21	222.73	32.03	221.91	34.09	219.85	36.04	217.90

(a) The PVC casings for NMW-9A and NMW-10A were lowered in 2006 during construction for expansion of the Pioneer Builders Supply facility when the original stand-pipe monuments were replaced with surface-flush monuments. The top of casing elevations for both 2007 measurements were based on the elevation for NMW-1A, which is also a surface-flush monument.

Attachment 2-5. Soil Cleanup Levels, South Tacoma Field

Cleanup Levels (mg/kg)	ROD Values						2008 values	
	STF Hot spot concentration		STF Capping Levels		Pioneer Builders Soil Cleanup Levels		Soil Capping Levels	
Arsenic	570	c	***200***	a			***20***	a
Lead	18,000	d	1,000	a			1,000	a
PAHs total	***50***	e	***20***	a			***2***	a
PCBs total	50	f	10	a			10	a
Copper	45,000	g						
Benzene					0.5	A	**0.03**	a
Toluene					40	A	**7**	a
Ethylbenzene					20	A	**6**	a
Xylenes					20	A	**9**	a
TPH					100-200	a,b	100	a

"a" indicates Method A industrial cleanup level
"b" indicates enforcement by Ecology at its discretion
"c" set at the 1x10-4 risk level using MTCA exposure assumptions
"d" set at 18,000 ppm based on cost sensitivity analysis in the FS. Cost effectiveness decreases below 18,000 ppm
"e" set at 2.5 times the MTCA Method A industrial
"f" TSCA requirement
"g" based on leaching to ground water

Attachment 2-6. Ground Water Cleanup Levels, South Tacoma Field

Compound detected in GW	ROD		Current Values		
	GW Cleanup Levels (µg/L)		MCL (µg/L)	Method B Calculated (µg/L)	
TPH-gas	1,000	a,b	None	800	h
TPH-diesel			None	500	g
TPH-oil			None	500	g
1,1,2-Trichloroethane	5	c	5	0.768	i
Naphthalene	32	f	None	160	j
Benzene	5	c	5	0.795	k
Toluene	1,000	c	1,000	640	l
Ethylbenzene	700	c	700	800	m
Xylenes	10,000	b	10,000	16,000	n
Lead	NE		0.015	0.015	d
Acetone	NE		None	800	f
2-Butanone	NE		None	4800	f
n-Butylbenzene	NE		None	None	
sec-Butylbenzene	NE		None	None	
tert-Butylbenzene	NE		None	None	
Carbon Tetrachloride	NE		5	0.34	e
1,2-Dichlorobenzene	NE		600	720	f
1,3-Dichlorobenzene	NE		None	None	
1,4-Dichlorobenzene	NE		75	1.82	e
1,2-Dichloroethane	NE		5	0.481	e
n-Hexane	NE		None	480	f
Isopropylbenzene	NE		None	None	
p-Isopropyltoluene	NE		None	None	
n-Propylbenzene	NE		None	None	
1,2,3-Trichlorobenzene	NE		None	None	
1,2,4-Trichlorobenzene	NE		70	80	f
1,3,5-Trimethylbenzene	NE		None	400	f
1,2,4-Trimethylbenzene	NE		None	400	f
Anthracene	NE		None	4800	f
Benzo(g,h,i)perylene	NE		None	None	

Attachment 2-6. Ground Water Cleanup Levels, South Tacoma Field, Cont.

Notes:

NE –Not established in the ROD. Current cleanup federal and state standards presented for compounds detected in site ground water.
"a" indicates Method A cleanup level
"b" indicates enforcement by Ecology at its discretion
"c" cleanup level set at federal drinking water standard. Must achieve MTCA cumulative risk not exceeding 1 per 100,000 or a Hazard Index not greater than 1. Otherwise, drinking water use will not be allowed
"d" MTCA Method A concentration
“e” MTCA Method B calculated concentration using standard formula values for carcinogenic effects
"f" MTCA Method B calculated concentration using standard formula values for non-carcinogenic effects
"g" 2001 revised MTCA Method A
"h" indicates benzene present in ground water, as seen at Pioneer Builders Supply.
"i" calculated concentration per revised Method B calculation is 0.768 µg/L and 320 µg/L for carcinogenic and non-carcinogenic effects, respectively. Revised MTCA allows use of MCL for this contaminant.
“j” concentration per revised Method B calculation is 160 µg/L for non-carcinogenic effects.
"k" concentration per revised Method A is 5 µg/L and revised Method B calculation is 0.795 µg/L and 24 µg/L for carcinogenic and non-carcinogenic effects, respectively. Revised MTCA allows use of MCL for this contaminant.
“l” concentration per revised Method B calculation for non-carcinogenic effects is 640 µg/L.
“m” concentration per revised Method A is 700 µg/L and per revised Method B calculation is 800 µg/L for non-carcinogenic effects.
“n” concentration per revised Method A based on total petroleum and on prevention of adverse aesthetic effect. Revised Method B calculation is 16,000 µg/L for non-carcinogenic effects.

Attachment 2-7. South Tacoma Field Site Photographs

Photo 1. Hole in North Containment Area Fence

Photo 2. Cap Grid 879, jersey barriers placed to block vehicle access.

Attachment 2-7. South Tacoma Field Site Photographs, Cont.

Photo 3. Two tents in southwest portion of site.

Photo 4. Southwest area of site, near grid 767 and 785.

Attachment 2-7. South Tacoma Field Site Photographs, Cont.

Photo 5: Storm water channel on western boundary of site.

Attachment 2-8. ARARs Analysis, South Tacoma Field

ARARs cited in ROD	How applied to site (per ROD)	Changes to Standard
Washington State Model Toxics Control Act (RCW 70.105D; WAC 173-340)	Industrial criteria used for capping levels. Some ground water cleanup levels used MTCA levels.	Updated in 2001 – see text for updates to standards
Resource Conservation and Recovery Act (RCRA, 49 CFR 261) Washington State Dangerous Waste Regulations (WAC 173-303)	Land Disposal Restrictions provisions for placement of hazardous hot spot soils left in place. Closure requirements met by conducting a hybrid-landfill closure at site that includes cap maintenance and ground water monitoring.	No changes that impact remedy since last Five-Year Review
Toxic Substances Control Act (TSCA 15 U.S.C 2601-2671; 40 CRF Part 761.60)	Soils with PCB concentrations greater than 50 mg/kg destroyed by incineration or disposed in chemical waste landfill.	No changes that impact remedy since last Five-Year Review
Transportation of Hazardous Materials (49 CFR, RCW 46.48, WAC 446-50)	Any soil removals should be compliant with these requirements.	No changes that impact remedy since last Five-Year Review
Section 1412 of the Safe Drinking Water Act (SDWA), 42 U.S.C. 300g-1, "National Drinking Water Regulations"; National Primary Drinking Water Regulations. 40 CFR Part 141	Federal MCLs shall be met to prevent exposure to the public to contaminated drinking water.	Exposure toxicity for TCE is currently under revision.
Clean Air Act, 42 U.S.C. 7401), Washington State Clean Air Act (RCW 70.94, WAC 173-400-460) and Puget Sound Air Pollution Control Authority	If air emissions from ground water treatment systems – not applicable to current remedy.	No changes that impact remedy since last Five-Year Review
Clean Water Act (CWA) Section 402) Floodplain management (Executive Order 11988) and Protection of Wetlands (Executive Order 11900)	Regulate actions that occur in wetlands and floodplains. Remedial actions in drainage channel are limited to ICs and were not anticipated to adversely impact drainage channel.	No changes that impact remedy since last Five-Year Review

Attachment 2-8. ARARs Analysis, South Tacoma Field, Cont.

ARARs cited in ROD	How applied to site (per ROD)	Changes to Standard
Washington State Minimum Standard for the Construction and Maintenance of Wells (RCW 18.104, WAC 173-160)	Standards for wells should be met during remediation and monitoring.	No changes that impact remedy since last Five-Year Review
Washington State Criteria for Municipal Solid Waste Landfills (70.95 RCW, WAC 173-351)	Appropriate for off-site disposal of solid waste.	No changes that impact remedy since last Five-Year Review

III. Tacoma Landfill, Operable Unit No. 5/6

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: Tacoma Landfill, OU 5/6 for Commencement Bay, South Tacoma Channel Superfund Site		
EPA ID *(from WasteLAN)*: WAD980726301		
Region: 10	**State:** WA	**City/County:** Tacoma/Pierce
SITE STATUS		
NPL status: ☒ Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction ☒ Operating ☐ Complete		
Multiple OUs?* ☒ YES ☐ NO (see Well 12A and South Tacoma Field)	**Site Construction completion date:** 9/29/1999	
Has site been put into reuse? ☐ YES ☒ NO		
REVIEW STATUS		
Lead agency: ☒ EPA ☐ State ☐ Tribe ☐ Other Federal Agency		
Author name: Kym Takasaki and Sharon Gelinas		
Author title: Environmental Scientist and Hydrogeologist	**Author affiliation:** U.S. Army Corps of Engineers, Seattle District	
Review period: 1/2008 to 3/2008		
Date(s) of site inspection: 2/20 /2008		
Type of review: ☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion)		
Review number: ☐ 1 (first) ☐ 2 (second) ☒ 3 (third) ☐ Other (specify)		
Triggering action: ☐ Actual RA On-site Construction at OU #___ ☐ Actual RA Start at OU# NA ☐ Construction Completion ☒ Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date *(from WasteLAN)*: 5 /16/2003		
Due date *(five years after triggering action date)*: 5/16/ 2008		

Tacoma Landfill, Five-Year Review Summary Form, Cont.

ISSUES

1. Methane gas concentrations continue to be above LEL near Home Depot.
2. Damaged landfill gas probes around site.
3. Outstanding request for abandonment of gas probe SPS-13.
4. The extent of the vinyl chloride and 1,2-DCA plumes horizontally at depth near Leach Creek is unknown.
5. Reporting limits for surface water samples are higher than the most current surface water quality criteria.
6. GETS effluent at point of discharge and Leach Creek surface water samples is not evaluated using the most current surface water quality criteria.
7. The residential wells are being used for drinking versus outdoor water need to be verified.
8. Exceedences of vinyl chloride early warning levels and arsenic MCL at EW-12 and arsenic MCL at EW-10 (residences reportedly not hooked up municipal supply).
9. Groundwater concentrations of arsenic are consistently detected above the MCL in wells near the Landfill property boundary and at several residential wells; however, the reason is not clear and should be determined (e.g., reducing conditions causing mobilization)
10. Effects of increased pumping from City wells on the ground water plume if extraction wells are shut off are unknown.
11. Potential pathway exists for soil vapor intrusion from contaminated ground water.
12. Outstanding request for modifications to the extraction well operation and well sampling.
13. Closure plan pending negotiation.

RECOMMENDATIONS AND FOLLOWUP ACTIONS

1. Continue to monitor gas probes at Home Deport for another year to evaluate effectiveness of extraction wells in reducing gas concentrations.
2. Determine which landfill gas probes are critical for monitoring and replace/repair broken gas probes, as required.
3. EPA/Ecology to determine if SPS-13 is critical for monitoring and provide recommendation for abandonment to the City.
4. Develop sampling approach for additional surface water and ground water data for the vinyl chloride and 1,2- DCA plumes near point of discharge (Leach Creek) and west of the Creek (see above text for recommended requirements). Conduct sampling, as required.
5. Reduce reporting limits for surface water and effluent samples to below the new surface water quality criteria.
6. Evaluate GETS effluent at point of discharge and surface water samples against newer surface water criteria, including WAC 173-201 and human health criteria to determine if modifications to discharge and or sampling are required. Modifications to decision document may be required.
7. Verify status of residential wells – to be conducted by the City in coordination with Tacoma Pierce County Health Department.

Tacoma Landfill, Five-Year Review Summary Form, Cont.

RECOMMENDATIONS AND FOLLOWUP ACTIONS, CONT.
8. Address exceedences of vinyl chloride and arsenic at EW-12 and arsenic at EW-10 pending status of well use. If in use, determine need to hook up residences to municipal drinking water.
9. Determine if arsenic is site-related or if reducing conditions from the Landfill are causing mobilization. Evaluate effects of elevated arsenic on the human health pathway.
10. Complete a ground water model to evaluate the effects of increased pumping of City wells.
11. Evaluate the potential for a completed ground water to indoor air pathway.
12. EPA/Ecology to provide recommendations for modifications to extraction well operation and well sampling.
13. EPA/Ecology approves Final Closure Plan. Request due from the City no later than on January 31, 2009 (based on 2/24/05 authorization of 2nd Closure Extension)
PROTECTIVENESS STATEMENT
A protectiveness determination of the remedy at the Tacoma Landfill cannot be made at this time until further information is obtained. An evaluation of impacts from the remaining ground water plumes to Leach Creek and migration west of the creek is required. Surface water and GETS effluent discharge data need to be evaluated against more current surface water criteria and reporting limits should be lowered as applicable. Concentrations of COCs in two residential wells not connected to municipal water supply exceed the performance criteria. Pending a site visit to determine status of these wells, additional actions may be required at these homes. Finally, additional evaluations on the effects of elevated arsenic concentrations on human health and the ground water to indoor air pathway are required. It is expected that these actions will take one year to complete, at which time a protectiveness determination can be made (between August and December 2009). Details of project completion dates are presented in Table 3-3.
OTHER COMMENTS
None

III.I. Introduction

The purpose of the Five-Year Review is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

The Agency is preparing this Five-Year Review report pursuant to CERCLA §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The Agency interpreted this requirement further in the NCP; 40 CFR §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

With oversight from the EPA Region 10 Remedial Project Manager, the United States Army Corps of Engineers (USACE) Seattle District conducted the Five-Year Review of the remedy implemented at the Tacoma Landfill Operable Unit (OU) of the South Tacoma Channel (STC) Superfund Site located in Tacoma, Washington. Other STC OUs include the Well 12A (OU 1) and South Tacoma Field (OU 4). Each STC OU is treated as a separate site but for purposes of Five-Year Reviews have been submitted together under one cover. This report documents the results of the review, which was conducted from January 2008 through March 2008.

This is the third Five-Year Review for the Tacoma Landfill. The triggering action for this statutory review is the earliest completion of the last Five-Year Review Report for sites within the STC OU. Based on timing of the reviews, this date is triggered by the date of the last Five-Year Review for the Tacoma Landfill OU, dated May 14, 2003. The Five-Year Review is required because hazardous substances, pollutants, or contaminants remain in the soil and ground water above levels that allow for unlimited use and unrestricted exposure.

III.II. Site Chronology

Table 3-1. Chronology of Site Events, Tacoma Landfill

Event	Date
Tacoma Landfill begins operation	1960
Investigation detects hazardous substances in ground water and soils near site	1983
Landfill placed on the National Priorities List	1983
Landfill gases cause small explosion at a neighboring business	1986
Tacoma begins Remedial Investigation and Feasibility Study (RI/FS) pursuant to Consent Order with the State	1986
RI/FS completed	1988
EPA issues Record of Decision (ROD)	1988
Consent Decree is finalized between Tacoma, Washington State Department of Ecology (Ecology) and EPA	1991
Landfill cap and gas management system construction completed	1993
Ground water pump and treat system construction completed	1995
First Five-Year Review completed	1997
First 5-year Extension on Closure requested September1997, issued May 1998	1997/1998
Treatment of ground water at on-site facility discontinued	1998
Extracted ground water discharge diverted from sanitary sewer to storm sewer	2002
Second Five-Year Review completed	2003
Second 5-year Extension on Closure requested August 2004, issued February 2005	2004/2005

III.III. Background

A. Site Location

The City of Tacoma Refuse Utility operates a solid waste disposal facility known as the Tacoma Landfill which is located within the City of Tacoma in Pierce County, Washington. Specifically, the Landfill is situated in Sections 12 and 13 of Township 20 North, Range 2 East, near the western border of Tacoma. The Landfill covers 240 acres and is bounded approximately by South 31st Street on the north, Tyler Street on the east, South 48th Street on the south, and Orchard Street on the west. See Figures 3-1 and 3-2 for site location.

The site is located within the South Tacoma Ground Water Protection District, which is a special zoning overlay district managed by the Tacoma Pierce County Health Department (TPCHD). The City of Tacoma operates several drinking water wells within a half mile of the site that are used to augment the City's drinking water supply during peak demand periods. According to the City, use of drinking water wells in the area is likely to increase in the near future based on new development plans in the area. The current

demand forecast calls for full use of the City's ground water rights within about 25 years, starting by 2010. Ground water in the South Tacoma Channel provides the primary contingency to maintain the municipal drinking water supply in the event that the main source (Green River) is not available.

B. Land and Resource Use

The Tacoma Landfill began operations in 1960, and has been operating as a sanitary landfill under a permit issued by the TPCHD. The wastes disposed of at the Landfill include garbage, rubbish, industrial wastes, construction and demolition wastes, street refuse, litter, and bulky waste. The Landfill does not accept hazardous waste for disposal; however, the Landfill received wastes in the 1960s and 1970s that have since been designated as hazardous wastes under state and federal law. Most of the site has already been filled. The last section of the site to be filled is called the Central Area which covers approximately 31 acres. This section was developed in 1987. The Central Area was constructed with a flexible membrane bottom liner and leachate collection system and has not accepted waste since December 2002. In addition to waste disposal, the site is the operations center for all solid waste management activities in the City of Tacoma. Solid wastes transported to the site are segregated, processed, and removed from the site.

The City is currently improving the operational efficiency and safety at the Landfill by separating residential customer traffic from City refuse collection and long-haul traffic. This Landfill Access Improvement Project (LAIP) consists of improving existing roads, constructing a new truck scale, installing a motorized gate, and street improvements at 34th Street. Figure 3-3 shows the proposed LAIP improvements and a layout of the site.

The Landfill is surrounded primarily by residential and commercial development with some open land and industrial development. The site is surrounded by a fence. Ground water beneath the site is hydraulically connected to the drinking water aquifer used by both the City of Tacoma and the City of Fircrest. The dominant ground water flow direction is to the south and west and towards Leach Creek located approximately 1/2 mile west of the Landfill. Leach Creek flows into Chambers Creek which enters Puget Sound approximately five miles southwest of the Landfill. A ground water divide has been observed at the site when the City of Tacoma wells are in use; the ground water flow direction in the southern portions of the Landfill changes to the southeast.

Ground water level measurements indicate that the City of Tacoma wells located to the east within half a mile of the site in the South Tacoma Channel (Wells 2B/C, 4A, 6A/B and 11A) potentially influence the ground water flow direction at the Landfill. The City of Fircrest wells, located northwest of the site, are generally cross gradient from the Landfill. Private residential wells are also present in the area. However, residences whose wells have been impacted have been connected to municipal water. Drilling of new wells in the area affected by contamination from the site is currently prohibited by the Cities of Tacoma, Fircrest, and University Place.

C. History of Contamination

In 1983, EPA conducted an investigation and detected hazardous compounds in samples of ground water and soil near the Landfill. This led the EPA to include the Landfill on the National Priorities List (NPL) of hazardous sites as part of the South Tacoma Channel site. Through a cooperative agreement with EPA, the Washington Department of Ecology (Ecology) began an investigation into contamination at the site in 1984.

In 1986, the City of Tacoma assumed responsibility for conducting the RI/FS under a response Order on Consent issued by Ecology.

D. Initial Response

Ground water contamination, primarily volatile organic compounds (VOCs), was detected at the perimeter of the Landfill and extended in a south westerly direction toward Leach Creek, during the RI. Because of the concern about public health effects of the contamination, particularly vinyl chloride, residents whose wells were impacted or threatened were hooked up to the Tacoma municipal water system in the rnid-1980s. Landfill gases were found to be migrating from the Landfill to residences and businesses adjacent to the site. The landfill gases contained methane, which can cause explosions at certain concentrations, and VOCs, which can cause negative health effects at elevated concentrations. Because of a concern over the migration of landfill gases, the first stage of a landfill gas management system was constructed in 1986.

E. Basis for Taking Action

Monitoring at the site revealed that hazardous substances had been released from the Landfill into the soils, ground water, and air at the site. The hazardous substances released to ground water include a variety of volatile and semi- volatile organic compounds and heavy metals, many of which were greater than State and Federal drinking water standards. Attachment 3-1 presents a list of media sampled and chemicals detected during the RI. Vinyl chloride was the most pervasive compound found in ground water and represented the greatest health risk to human health. Landfill gases were found to contain a wide variety of VOCs as well as methane. VOCs represent a risk to human health if the gases seep into neighboring homes and businesses. The methane in the gases represents the greatest risk to human health as it can cause explosions when it accumulates to certain concentrations. Accumulation of landfill gas in a utility vault at a company located adjacent to the Landfill resulted in a small explosion in May 1986.

The following indicator chemicals were identified in the Endangerment Assessment from the RI:

- Vinyl Chloride
- Benzene
- 1,2-Dichloroethane
- Methylene Chloride
- 1,1-Dichloroethane
- Chloroethane
- Toluene

EPA and Ecology later added three additional indicator chemicals in the ROD:

- Xylenes
- 1,1,1-Tichloroethane
- Ethylbenzene

III.IV. Remedial Actions

A. Remedy Selection

On March 31, 1988, EPA issued the ROD which selected the final remedial action for the site based on the RI/FS. On November 13, 1989, a Consent Decree between EPA, Ecology, and the City of Tacoma was lodged in federal court. The Decree addressed implementation of the remedial actions specified in the ROD. This Consent Decree was not accepted by the Court and was subsequently modified. The modified Decree was entered by the Court on May 17, 1991.

The ROD required treatment to reduce contaminant levels in the ground water to or below cleanup standards with treatment performance levels for indicator chemicals based on federal Maximum Contaminant Levels (MCLs) and discharge to surface water. The goal of the extraction is defined as preventing any further degradation of existing water quality beyond the boundaries of the existing plume. The ROD specifies treatment standards based on the point of discharge, but allowed for discharge to either Leach Creek or the sanitary sewer. Extraction was required until water quality at the edge of the filled area met or exceeded MCLs, or previously established and approved health-based standards. In addition, consideration of potential impacts to public and private water supplies and to adjacent Leach Creek were required in the decision to shut off the system. The remedial action objectives outlined in the ROD are as follows:

- Reduce the production of leachate by placing constraints on further site operations and by capping the Landfill.
- Eliminate off-site gas migration through the gas extraction system.
- Prevent further migration of the contaminated ground water plume via a ground water extraction system.
- Further protect public health and the environment via monitoring of ground water, surface water, gas probes, and air emissions.
- Provide an alternate water supply (Tacoma municipal water) to any residences deprived of their domestic supply due to demonstrated contamination from the Landfill or due to the action of the extraction-treatment system.
- Establish a closure plan for the Landfill consistent with Washington State Minimal Functional Standards for Landfill Closure (WAC 173-304).
- Establish institutional controls (ICs) to assure that the remedial action will continue to protect human health and the environment.

A methodology to determine treatment performance standards for indicator compounds was developed in the ROD. If MCLs were not available, the lower of either ambient water quality criteria (AWQC) for protection of human health for water and fish consumption or chronic fresh water criteria for the protection of fish was used. For compounds that did not have either an MCL or AWQC, a value was derived based on an EPA Region 10 risk assessment. The ROD also states that if discharge is to either Leach Creek or Flett Creek, the effluent must meet or exceed MCLs or chronic fresh water criteria, whichever is lower, and meet water quality standards for waters of Washington State (WAC 173-201). Attachment 3-3 presents the

treatment standards and discharge criteria for indicator compounds presented in the ROD. Since effluent is currently discharged to surface water, surface water discharge criteria presented in the Consent Decree are also included in Attachment 3-3.

B. Remedy Implementation

The following remedial measures have been completed:

1. Landfill Cover. A landfill cover was installed over areas containing buried waste in two stages from 1990 to 1992 with the exception of the cell in the Central Area. The cover was installed on approximately 125 acres of the 240 acre site. The purpose of the cover is to minimize rainwater and surface water infiltration into the Landfill thereby reducing the production of leachate which is the source of ground water contamination. The cover consists of two 60 mil High Density Polyethylene (HDPE) liners separated by a leak detection and water collection layer with the exception of four acres which became part of an expanded operations area. These four acres were capped with a geomembrane layer and then covered by buildings or low permeable asphalt pavement. The permeability of the asphalt cover is regularly checked with lysimeters installed in the cover. The asphalt cover and capped areas are regularly inspected and maintained in accordance with the Operations and Closure Plan. The capped areas are inspected for evidence of erosion, settlement, ponding of water, improper or inadequate vegetation, burrowing animals, cracking, and other parameters as outlined in the Operations and Closure Plan.

The Central Area is the only portion of the site with a bottom liner. The Central Area cell was developed and first used in 1987 and then expanded to its current 31 acres in 1990. Waste has not been put into the Central Area since December 2002. The bottom liner is composed of two liners separated by a leak detection and leachate collection system. The side slopes in the Central Area consists of a single liner which separates the Central Area from the old Landfill. Leachate is generated by the precipitation that falls onto this area. The Central Area was constructed with a leachate collection system which collects leachate and transports it to the sanitary sewer system for treatment and disposal. To date, approximately eight acres of the southern Central Area has been filled to grade and currently has a temporary cap. When the Central Area is eventually closed in accordance with requirements in the Consent Decree, it will be covered with a cover similar to the one installed over the rest of the Landfill. General landfill closure requirements are discussed in Section III.VII.

2. Landfill Gas Management. A landfill gas management system was installed in several phases starting in 1986. The system currently consists of over 300 gas extraction well stations each consisting of one to four wells completed to various depths, piping for transferring the collected gas to a flare station where the gas is destroyed, and the flare station. It is being expanded into the Central Area as areas get filled to final grade. See Figure 3-4 for the location of the gas extraction wells. The effectiveness of the landfill gas management system is evaluated through regular monitoring of gas probes situated within and adjacent to the Landfill for pressure (vacuum) and methane concentrations. VOCs are not currently analyzed as part of the program. The gas monitoring system includes approximately 78 gas monitoring probes around the perimeter of the Landfill and an additional 56 off-site probes up to 1,000 feet from the edge of the Landfill. Each probe consists of one to five monitoring ports completed to various depths. See Figure 3-5 for the location of the gas monitoring probes.

The purpose of the landfill gas management system is to control the migration of landfill gases. Specifically, the system was designed to meet State of Washington Criteria for Municipal Solid Waste Landfills which require that methane concentrations must not exceed the lower explosive limit (LEL), 5%

methane by volume, at the property boundary of a landfill and not exceed 100 parts per million (ppm) in off-site structures. A landfill gas management system is a dynamic system affected by changes in the barometric pressure, pressure changes created by the development of landfill gas within the landfill and the vacuum applied by the gas collection system. Because of the dynamic nature of the system, some fluctuations of both the pressure and methane readings at the probe stations are normal. It is from these fluctuations that the need for adjustments to the gas system is identified. Changes in pressure alone do not trigger adjustments to the system, because they are generally temporary in nature and result from changes in the barometric pressure.

The City signed a contract in 1995 to lease the landfill gas field to a private company for the purpose of constructing an electrical generation facility at the Landfill. This facility became operational in 1998, but was shut down in 2003 due to low energy sales, the end of gas credits, and low gas production. Currently, all gas is collected and sent to the flare station for destruction.

3. Ground water Extraction and Treatment System (GETS). The GETS system was constructed in 1992 and 1993 and consisted of 19 point of compliance (POC) wells (W1 through W19) and 9 edge-of-plume (EOP) wells (W30 through W38), pipelines to transport the extracted ground water to a treatment facility, and a ground water treatment system. See Figure 3-6 for the location of the extraction wells. The POC wells are located on the down gradient edge of the Landfill and their purpose is to capture contaminated ground water before it flows outside of the Landfill boundary. The EOP wells are located along Leach Creek and their purpose is to clean up contaminated ground water at the edge of the plume and prevent contamination from impacting Leach Creek and ground water beyond the creek. Once extracted from the EOP and POC wells, ground water was transported via pipelines to a treatment facility. The treatment facility is equipped with two air strippers to remove VOCs; an acid wash system to periodically remove scale buildup from the internal packing material in the towers; and a control building where overall operations, control and monitoring of the ground water extraction/treatment facilities are managed. The treated ground water was then discharged to the sanitary sewer system for further treatment and disposal.

Based on ground water monitoring and several years of experience in operating the ground water extraction system, improvements were made in 1995 through 1997. Monitoring of well yields indicated that some wells in the EOP system were not extracting at their designed flow rate and that flows from other wells were decreasing. In 1995 and 1996, a well rehabilitation program was conducted to increase the amount of ground water being extracted from the EOP wells. Although the well rehabilitation program was successful in increasing flows from most wells, new wells were needed to increase total flow along the EOP system to design yields. In 1996 and 1997, four new wells (W40 through W43) were constructed along the EOP system, primarily in the extreme south end making the total number of EOP wells currently being pumped 13. Enhancement of the POC system was prompted by ground water monitoring data at a monitoring well near the City of Fircrest municipal well field. Ground water quality data from this well indicated that vinyl chloride concentrations increased from 1991 through 1995 during the summer time when the municipal water needs are high. In response, the POC system was expanded by installing three new wells (identified as W20, W21, and W22) to the north near the Fircrest well making the total number of POC wells currently being pumped 22.

Since the operation of the EOP ground water extraction system reduced the base flows in Leach Creek, the City maintained stream flows using water from a well located northwest of the Landfill. The augmentation well began operation on 1993 and was initially operated to maintain a minimum of 1.5 cubic feet per second (cfs) in Leach Creek as measured at the 40th Street gauging system. The minimum flow requirement was increased to 1.6 cfs when new EOP extraction wells began operation in 1997.

Configuration of the pipeline to the treatment facility allows ground water extracted from highly contaminated areas to mix with ground water from less contaminated areas, which can effectively dilute contaminant concentrations prior to treatment. By 1998, the combined water from all ground water extraction wells met performance standards specified in the ROD for discharge into the sanitary sewer for six consecutive quarters and the treatment system was mothballed. The extracted ground water was then discharged into the sanitary sewer for treatment and disposal. By August 2002, the combined water from all the ground water extraction wells met performance standards specified by the ROD and by Ecology for discharge to surface water for four consecutive quarters. In response, the City requested to temporarily change the discharge of extracted ground water from the sanitary sewer to Leach Creek and to evaluate the feasibility of a permanent discharge. EPA and Ecology approved that request and the City periodically discharged all or a portion of extracted ground water to Leach Creek. By 2003, a permanent discharge channel and holding basin was constructed and all of the extracted ground water was discharged to Leach Creek. The City subsequently ceased monitoring flow levels in the creek, although they do continue to monitor the chemistry of the combined water from all the extraction wells to verify that performance standards are met. Surface water and ground water effluent data are discussed further in Section III.VI.E.

4. Alternate Drinking Water Supply. The City of Tacoma is required to provide an alternate water supply to all residents whose wells became or become contaminated by the Landfill. The City has connected most affected residents to the Tacoma municipal water system. Additional information on status of residential wells is presented in Section III.V. According to the criteria established for this site, a well is considered contaminated when the concentration of a chemical exceeds 20% of its drinking water standard or health-based level. Private wells still in use in the vicinity of the Landfill, as well as monitoring wells between the Landfill and the private wells, are monitored on a regular basis. Monitoring and contingency plans have been developed to track the contaminated plume and to respond to a potential expansion of the contaminated plume. See Figures 3-7 and 3-8 for maps of the ground water flow direction. It should be noted that not all of the old wells have been abandoned; some may still be used for outdoor purposes such as lawn or garden watering.

In 1995, Tacoma asked the neighboring City of Fircrest to limit the amount of water being pumped from its municipal well closest to the Landfill, Fircrest Well # 5, because of the potential threat of pulling in landfill contaminants at higher pumping levels. In 1996, Tacoma drilled a new well to replace Fircrest Well #5. The old well has been temporarily closed. The Fircrest wells located closest to the Landfill along with nearby monitoring wells are regularly sampled by the City. Contaminants from the Landfill have not been detected in any of these wells (see Attachment 3-4), with the exception of two detections of methylene chloride in late 2007, which slightly exceeded performance standards at monitoring well TL-01B. These detections likely resulted from minor contamination to the well during well re-installation of the previously used ground water sampling pump after a new road was constructed as part of the LAIP.

5. Recycling and Household Hazardous Waste Collection. The City began recycling and household hazardous waste collection programs in the mid 1980s. The purposes of these programs are to reduce the total volume of waste going into the Landfill and to minimize the amount of hazardous substances going into the Landfill. Tacoma's recycling program includes curb side collection of a variety of materials including glass, cans, plastic bottles, newsprint and other waste paper, and yard waste. Drop off locations have been established for waste oil, household batteries, tires, appliances, and other items containing potentially hazardous substances. The City also provides assistance to businesses regarding recycling opportunities and proper procedures for disposing of wastes containing hazardous substances.

6. Institutional Control Plan. The ROD generally identifies that Institutional Controls (ICs) should be developed. The Consent Decree specified that ICs should be developed to prevent installation of drinking water wells within the vicinity of the Landfill. The City developed an IC Plan dated July 17, 1992 which outlines procedures to prohibit drilling of water supply wells within and adjacent to the Landfill and to prohibit any activity that will negatively impact the remedies constructed at the Landfill. The Plan was conditionally approved by EPA and Ecology on August 17, 1992. The Cities of Tacoma, Fircrest, and University Place have enacted ordinances which prohibit the drilling of private water supply wells between Tyler Street, Center Street, South 56th Street and Leach Creek (Figure 3-2). The City of Tacoma filed a restrictive covenant in 2001 that included measures to restrict site use, including:

- No ground water may be taken for domestic use from the property;
- Any activity on the property causing a release or exposure from contaminated soils, ground water or methane gas is prohibited; and
- The site shall not be developed for residential use or used for residential purposes.

The City has also developed a long-range plan for site use after closure of the Central Area cell. The long-range plan includes continued use of a portion of the site for solid waste transfer activities and recreational use of the rest of the site when no longer needed for remediation activities. The entire site is currently surrounded by chain link fencing with gates that are locked when the Landfill is closed.

C. Operation and Maintenance

1. Landfill Cover. While most of the cover has been performing as designed and is meeting performance standards, water is periodically still found flowing in between the upper and lower landfill covers in an area on the west side of the Landfill after periods of rain. Since the water is collected prior to contacting garbage, it is treated as storm water and is discharged into a catch basin that is connected with the storm sewer system. After several attempts to locate and fix a source of leakage, the City requested no further investigations of the leakage. EPA, Ecology, and TPCHD agreed that all practicable investigation and repair methods had been applied. The West Area secondary flows are monitored on a monthly basis.

A small amount of leachate (percolated surface water) is finding its way between the two bottom liners in the Central Area. This leachate is being collected by the leak detection/collection system and is transported to the sanitary sewer for treatment and disposal. As part of the 2007/2008 Tacoma Landfill Soil Waste Permit (issued by TPCHD), the City was required to estimate the amount of anticipated leachate generated and to monitor flow volumes on a daily basis. Electronic flow meters were installed in the leachate collection line to monitor daily flow volumes and estimates of leachate generation were prepared by the City's contractor, CH2M HILL, using the Hydrologic Evaluation of Landfill Performance (HELP) model. Leachate flows are reported to TPCHD, EPA, and Ecology on a monthly basis.

Regular inspections of the landfill cover system by the City of Tacoma revealed evidence of minor damage such as local subsidence, erosion, ponded water, tears in the geomembrane liner accidentally caused by landfill operators, and cracks in the asphalt. These problems are normal at active landfills and are corrected by the City during routine maintenance activities.

In addition to routine cap repairs, the need for several larger landfill cap repairs or extensions were identified. In July 2004, an abandoned 8-inch water main broke within the landfill cap area near 40th and Orchard Streets and washed out sediment material from below the cap. The City determined that the entire section of the cap impacted by the water main break should be replaced and completed construction in late 2004. A smaller section was washed out again in 2007 and is currently being repaired. In 2005, historic refuse was discovered at depths of 10 to 15 feet below grade outside the eastern site boundary. The City determined that it would be more protective to extend the cap in this area. Construction on the cap extension began in late 2007 and will be completed in 2008.

2. Landfill Gas Management. In 1996 the City discovered that leachate was collecting in some gas extraction wells and was impacting the effectiveness of the landfill gas management system. Further study found a fairly extensive zone of leachate in the south end of the capped Landfill. The origin of this perched leachate is not known, but is believed to be residual leachate created prior to construction of the Landfill cover. Based on these findings, the City conducted leachate pump tests through the existing gas probes and found that there is a substantial perched zone of leachate and that the leachate could be pumped out through the gas probes. The City has been periodically pumping out leachate in the south and central areas since 1996 on an as-needed basis. The leachate is pumped out mainly to increase the efficiency of the gas extraction wells and is discharged into the City's sanitary sewer system for treatment.

When a Home Depot store was constructed adjacent to and just north of the Landfill in 2000, several ground water and soil gas monitoring wells were removed and then replaced after construction. One of the newly constructed gas monitoring wells located in the Home Depot parking lot had detections of methane gas in excess of the LEL (>5%). The Home Depot store was reportedly constructed on old fill material not related the Tacoma Landfill. Investigations by the City and TPCHD confirmed elevated levels of methane gas on the Home Depot property; however, the early investigations did not determine whether the methane was coming from the Landfill or the fill material that underlies the site. One sampling event conducted by the City inside the Home Depot building indicated that methane gas was either not detected or detected at levels well below standards. Even though the origin of the methane at Home Depot was not established, the City of Tacoma agreed to take actions to reduce the potential for landfill gas to migrate to the Home Depot property. At a meeting between the City, EPA, Ecology, and the TPCHD in early 2002, the City agreed to install additional gas extraction wells at the Landfill, to install additional soil gas monitoring wells, and to eliminate the potential for landfill gas to migrate to the Home Depot property through a 42-inch storm sewer line. This work was completed in 2006 and is discussed in Section III.V below.

Maintenance inspections of gas extraction wells and monitoring probes elsewhere across the site identified several issues:

- Many gas extraction wells in the Central Area were not producing the expected levels, possibly due to broken or shifting pipes. The City installed six additional extraction wells in the Central Area to increase gas extraction coverage in 2006.
- Several perimeter gas monitoring probes, near the Orchard Terrace Apartment Complex, were found to be broken or unsuitable for monitoring. These monitoring probes were installed in garbage near the western Landfill property boundary. Several gas probes were subsequently installed at the Apartment Complex to monitor gas migration. The City has not replaced the probes at the property boundary because there is a high density of probes in this area and probes within the complex have shown no apparent gas migration.

- Several gas monitoring probes around the site have become damaged due to settlement or probe deterioration. The City is currently in discussions with TPCHD regarding which probes are critical for monitoring and should be replaced.

The City has requested that off-site gas monitoring probe SPS-13 (see Figure 3-5) be abandoned because the property owner would like the sampling easement for additional building space. Methane detected at SPS-13 has been attributed to localized import of fill material rather than gas migration from the Landfill and has reportedly decreased. Landfill gas data at SPS-13 is further discussed in Section III.VI.

3. GETS. Extraction and site wells are monitored in accordance with the Operations and Closure Plan. Recently, the sampling was increased to support the modification requests for this system.

Flow and water quality in Leach Creek is sampled each quarter at several locations downgradient of the Landfill. Monitoring indicates that the Landfill has negligible impact to the water quality of Leach Creek and that minimal flow requirements are being met. Samples are also collected quarterly at several locations before and after the settling pond to monitor the quality of extraction water being discharged into Leach Creek. If water quality does not meet the treatment discharge standards, the water can be diverted to the sanitary sewer for disposal. The City has indicated that the settling pond will be upgraded to a storm-water detention pond during the new LAIP construction. Surface water sampling results from Leach Creek are summarized in Attachment 3-6. Sample data from locations at the catch basin (point leaving the Landfill site) and at the GETS outfall (location upstream of holding pond) are presented in Attachment 3-5.

Flows from the ground water extraction wells have gradually decreased over time. The City periodically treats the wells to remove the natural soil bacteria growth on the well screens, which then allows the wells to increase their extraction rates. Even with the periodic treatment and taking into consideration ground water variations due to seasonality and annual recharge, extraction rates have continued to decline.

Due to the declining extraction well performance and improving ground water quality conditions off-site, the City of Tacoma requested permission to shut down all of the extraction wells except W-1 and W-15, within the ground water contaminant plumes on the western boundary of the Landfill. EPA and Ecology are currently evaluating this proposal. Ground water monitoring data are further discussed in Section III.VI. The City also proposed a significant change to the ground water monitoring program which consists of:

- Sample EOP and POC extraction wells quarterly for one year and then abandon wells accordingly;
- Sample surface water station LC-04 quarterly for one year;
- Sample Tacoma Landfill monitoring wells quarterly for one year, then annually until long-term Consent Decree requirements fulfilled;
- Sample Performance monitoring wells quarterly for one year, then bi-annually for 30 years;
- Stop monitoring all existing wells (residential drinking water wells); and
- EPA is currently evaluating this proposal.

4. Other Activities. Other projects at the Tacoma Landfill that have occurred since the second Five-Year Review include the following:

- An investigation to determine the feasibility of mining areas for recyclable refuse to make space for additional waste. It was determined that costs associated with separating and cleaning wastes were too high.
- LAIP to build new roads, new unattended truck scale for solid waste collection trucks, new security gate at the main Landfill entrance, improvements to 34th Street. Project includes landfill cap repairs required for new roadways in the central and southern area.
- Stormwater control demonstration project of pervious pavement in a 36,000 square foot area east of employee parking area.
- Installation of a Landfill Engineering Trailer including a 2,240 square foot modular building and 6,000 square foot paved parking area.
- Installed an additional acre of paved area, for staging long haul transfer trailers, storing equipment, and other materials at the East Trailer Storage Area.
- Several preload projects including White Goods, Greenhouse, Truck Wash, and West Parking Area. Settlement repairs due to the Greenhouse preload area began in 2007 and are nearing completion now.

III.V. Progress Since the Last Five-Year Review

Most of the recommendations from the last Five-Year Review have been implemented. The one outstanding recommendation is associated with the status of residential wells.

A. Previous Protectiveness Statement

The protectiveness statement in the last Five-Year Review (2003) stated:

> *The remedy at this site is expected to be protective upon completion and, in the interim, exposure pathways that could result in unacceptable risks are being controlled by the operation of remedial controls such as the pump and treat system and gas management systems and by institutional controls.*

B. Status of Recommendations

A summary of the recommendations made in the previous Five-Year Review (2003) and an evaluation of their progress is presented below.

1. Enhance landfill gas extraction adjacent to Home Depot and conduct additional investigations: Completed

The City installed four new gas monitoring probes and one new gas extraction well in 2006 at the northern Landfill boundary to monitor gas migration onto the Home Depot property. The additional data from these wells supports the previous conclusion that methane concentrations detected on the Home Depot property are not migrating from the Landfill, but are likely historical gas remnants from community dumping that occurred in the area before the Landfill was established in the 1960s. With the exception of a brief spike in

2007, methane concentrations at gas monitoring probe HD has decreased since the installation of the additional gas extraction well. In addition, the installation of the new extraction well helps control any releases from the Landfill in this area.

2. Monitor flows of water collected in leak detection system and report results. The agencies will determine the need for additional action based on these results: Completed and ongoing

The City took several steps to determine the source of the leachate from the West 1 Area in 2002 and 2003. An electric leak location survey detected several leaks in the primary cap and sewer manhole liner connections and were subsequently repaired. The secondary flows were reduced; however, they occasionally exceeded the modeled leakage rates. Several additional tests were completed including applying water to the ditch along the west side of the area and a smoke test along the west side. No additional leaks were detected. The City then requested no further investigations be required. EPA, Ecology, and TPCHD agreed that all practicable investigations and repair methods had been applied and no further investigations were warranted.

The 2005 Closure extension granted by EPA and Ecology required monitoring of the Central Area's leachate collection system, leachate detection system, and surface runoff collection system to track protectiveness of the remedy. Measured leachate collection could be compared to modeled leachate generation to evaluate leachate capture. The City submitted estimates of the leachate that would be generated and collected in May 2005 and installed meters to monitor the leachate collection systems in November 2005. Monitoring data have been submitted since January 2006, with the exception of September 2006 through May 2007 due to a broken meter and landfill road building activities. Total leachate detection monthly flows ranged between 25,000 and 127,000 gallons and appear to be related to precipitation. Monthly flows generally correlate with expected modeled monthly flows.

3. Fill up to grade and place temporary cap in Central Area in compliance with Operations and Closure Plan to control odors. Revise and implement Odor Control Plan: Completed

The eight acres of the Central Area that are filled to grade are covered with a temporary cap consisting of about 2-feet of soil covered with temporary tarps. The City submitted an Odor Control Plan in 2003. Proposed mitigation measures included installation of two to three new extraction wells to address landfill gas extraction coverage issues in the Southern end, installation of semi-permanent header collection pipes to reduce buildup of condensate, correct any leachate ponding issues, change operation procedures so waste is processed in a timely manner (waste removed from the main tipping floor every night and the floor swept by a mechanical sweeper), and reduce amount of liquids in yard wastes.

Six additional extraction wells were installed in the Central Area in the Spring of 2006 to ensure adequate gas extraction and ensure odor control. Leachate is pumped from wells in the Central Area on an as-needed basis to increase efficiency of wells and further control odors.

4. Evaluate effectiveness of Bird Management Plan and adjust as necessary: Completed

The City submitted a Draft Bird Management Plan in 2002. Proposed mitigation measures included installation of streamers, wire barriers on buildings and structures, operation controls, and habitat controls. As observed during the site visit, bird management mitigation measures appeared to prevent bird access. No complaints have been noted at this time with respect to bird management.

5. Remove visual obstructions from Landfill cover: Completed

Limited amounts of debris were observed along the northwestern portion of the site, near the settling pond. In accordance with the Solid Waste Permit, the City is required to remove excess accumulation of litter and waste debris on all waste handling surfaces at the end of the working day, and as needed during operating hours.

6. Identify all residences in the area potentially impacted by the Landfill that are not hooked up to a city water supply. If any of the above wells are contaminated by the Landfill, extend city water to them: Pending

The second Five-Year Review (2003) could not verify the list of residences that were reportedly using wells as sole domestic water supply that were hooked up to municipal water and/or using wells only for outdoor purposes. Without this information, it could not be confirmed that the system established to replace contaminated wells was effective. The City of Tacoma and TPCHD are currently planning a residential sampling event for 2008 to check the status of all residential wells, collect samples, and talk to residents about the monitoring program.

III.VI. Five-Year Review Process

A. Administrative Components

The City of Tacoma was notified of the initiation of the Five-Year Review during the quarterly Consent Decree meeting conducted in February, 2008. The Five-Year Review team was led by Kris Flint of EPA, Remedial Project Manager (RPM), and included Kym Takasaki (Geochemist), Emile Pitre (Chemical Engineer), and Sharon Gelinas (Hydrogeologist) of the USACE Seattle District.

B. Components of Review

From January to March 2008, the review team established the review schedule whose components included:

- Community Involvement;
- Document Review;
- Data Review;
- Site Inspection;
- Local Interviews; and
- Five-Year Review Report Development and Review.

C. Community Involvement

A notice was run in the Tacoma News Tribune local newspaper in February 2008 notifying the community that a Five-Year Review was to be conducted and asking for public comment. No comments were received.

D. Document Review

This Five-Year Review included a review of relevant documents as summarized in Attachment 3-2.

Applicable ground water cleanup standards, as listed in the 1988 ROD and the Consent Decree, were also reviewed.

E. Data Review

Electronic data compiled in the City's database from 2003-2007 were reviewed to evaluate current site conditions. Site summaries by sampling type are presented below. Reports from the 2007 sampling activities have not been provided to EPA at the time of this Five-Year Review.

1. Site Ground water Monitoring. A summary of the ground water monitoring data from site wells at the Tacoma Landfill from 2003 through 2007 is presented in Attachment 3-4. Monitoring and extraction wells are grouped according to the well locations designated in the Consent Decree Annual Reports. Ground water performance standards are listed in Attachments 3-3 and 3-4.

Two lobes of the historical ground water plume remain at the site: the north area vinyl chloride plume and the south area 1,2-dichloroethane (DCA) plume. Additional characterization for these two areas was completed as a one time investigation in 2005 and is documented in the report: "End of Plume Residual Plume Characterization Report, Tacoma Landfill – North Area & South Area," prepared by Landau Associates and dated February 2006 (End of Plume Report). Figures 3-9 through 3-12 show the historical and 2006 plumes presented in this report.

The north area vinyl chloride plume has shown a significant decrease in contaminant concentrations since the RI (see Figures 3-9 and 3-10). Low levels of vinyl chloride remain near the Landfill boundary at POC extraction well W-15 and near Leach Creek at EOP extraction well W-36 and monitoring well TL-07A. During 2007, vinyl chloride concentrations at W-15, W-36, and TL-07A ranged from 1.3 micrograms per Liter (µg/L) to 2.5 µg/L (the MCL for vinyl chloride is 2 µg/L). Figure 3-10 indicates that the north area vinyl chloride plume ends or discharges to Leach Creek as concentrations of vinyl chloride at existing residential well EW-12 (west of Leach Creek) were not detected. However, this depiction does not include the data from 2006, where vinyl chloride was detected in this well (see surface water and residential sampling discussed below). As noted in End of Plume Report, EOP extraction well W-36 is screened in a deeper portion of the aquifer than the remaining shallow ground water plume near Leach Creek and may be drawing a portion of the plume downward. Additional recommendations regarding monitoring of the vinyl choride plume are presented in Section III.IX.

The south area 1,2-DCA plume has also shown a significant decrease in contaminant concentrations since the RI (see Figures 3-11 and 3-12). Historically, the highest concentration area extended from POC extraction wells W-1 through W-5 to about 600 feet west of monitoring well TL-26. As presented in the End of Plume Report (a report resulting from the one time characterization investigation), the residual 1,2-DCA ground water plume is centered near monitoring well TL-26A, with smaller, less concentrated pockets (below ground water performance standards) located near monitoring wells P-3/4 and TL-20. Figure 3-12 indicates that the 1,2-DCA plume ends or discharges to Leach Creek. However, there is no data on the west side of the creek to confirm this. One monitoring well, P-10, is located to the west of Leach Creek (see Figure 3-6 for location) and has not historically detected any VOCs; however, it has not been sampled since 1995. Additional recommendations regarding monitoring of this plume is presented in Section III.IX.

The historical south area plume also contained elevated concentrations of tetrachloroethene (PCE), trichloroethene (TCE), and vinyl chloride. Concentrations of PCE, TCE, and vinyl chloride have not been detected above their respective performance standards at ground water monitoring locations downgradient

of the Landfill property boundary in the past five years. Elevated concentrations of PCE and TCE are still detected at monitoring well TL-11 located at the southwest corner of the Landfill. During 2007, detected concentrations at TL-11 ranged from 11 µg/L to 14 µg/L of PCE and 20 µg/L to 26 µg/L of TCE (the MCL for PCE and TCE is 5 µg/L). Nearby extraction well W-1 appears to be controlling contaminant migration from TL-11.

Elsewhere, arsenic concentrations were detected above what the City refers to as an early warning level, which is 20% of the 1988 ROD's MCL 50 µg/L, or 10 µg/L. The current MCL is also 10 µg/L. These arsenic detections occur along the western boundary of the Landfill at the POC extraction wells and monitoring wells TL-11, TL-10, TL-05, and TL-04. With the exception of P-08, arsenic has not recently been detected above the current MCL at down-gradient monitoring wells.

Elevated concentrations of iron and manganese are frequently detected at extraction wells and monitoring wells located near extraction wells. These elevated concentrations are likely associated with the operation of the extraction wells. Since there is no primary MCL for iron and manganese, concentrations are compared to surface water discharge standards since the extracted ground water ultimately discharges to Leach Creek.

As stated in Section III.IV.C above, the City of Tacoma submitted a request to shutdown all of the EOP extraction wells and all of the POC extraction wells, except W-1 and W-15. Included in this request, was a proposed change to the ground water monitoring program following the extraction well shutdown. An additional submittal requested elimination of ground water analytical monitoring at all residential wells. EPA and Ecology are in the process of reviewing these requests. Several outstanding issues include: (1) the effect of potential increased pumping at the City of Tacoma wells on the remaining ground water plume if the extraction wells are turned off, (2) whether the Central Area is contributing to the residual ground water contamination, and (3) whether elevated arsenic concentrations present a risk to human health.

2. GETS Effluent Data. A summary of the GETS effluent data from 2003 through 2007 is presented in Attachment 3-5. The City collects effluent samples from the ground water extraction system at several locations prior to discharge to Leach Creek including the catch basin (last sampling point before leaving site) and GETS outfall (last sampling point before entry to Leach Creek).

The 1988 ROD states that the lower of the MCL or chronic fresh water criteria should be used to evaluate discharge to Leach Creek. The ROD also recognizes that Leach Creek supports coho and chum salmon spawning and states that effluent should meet water quality standards in WAC 173-201. In 2006, the State of Washington incorporated EPA guidance on water quality criteria by reference, thereby making AWQC for the protection of water and fish consumption applicable criteria. Since the new AWQC are lower than water quality criteria presented in the 1988 ROD, detection levels for some compounds will need to be lowered to determine protectiveness.

All monitored compounds from the past five years have been below both 1988 performance standards and the new AWQC, with the exception of vinyl chloride and 1,2-DCA which have reporting limits above the 2006 AWQC.

3. Surface Water Monitoring. A summary of surface water sampling at Leach Creek from 2003 through 2007 is presented in Attachment 3-6. As discussed above, AWQC may be more appropriate to evaluate surface water samples from Leach Creek. It should also be noted that the reporting limits for vinyl chloride, 1,2-DCA, and arsenic are above the AWQC.

Water quality downgradient from the north area vinyl chloride plume is monitored in Leach Creek, a ground water discharge point. Concentrations of vinyl chloride have not been detected in Leach Creek since 1992; however, historical Leach Creek sampling locations were not located at the most likely point of discharge for the north area vinyl chloride plume. A new surface water sampling location, LC-04, was developed in 2006 and is located directly down-gradient of monitoring well TL-07A. Vinyl chloride was not detected at LC-04 in 2006 or 2007.

Water quality downgradient from the south area 1,2-DCA plume is also monitored in Leach Creek. Concentrations of 1,2-DCA have not been detected in surface water samples collected from Leach Creek; however, sampling locations are not located at the most likely point of discharge. The closest surface water sampling location is LC-02, over 1,200 feet down-stream of monitoring well TL-20.

Arsenic, iron, and manganese have been detected in samples collected from Leach Creek as shown in Attachment 3-6. Arsenic has consistently been detected above the new AWQC in surface water samples in Leach Creek.

WAC 173-201 specifies the pH should be between 6.5 and 8.5, with no more than 0.5 change caused by human activities for the protection of fish spawning and rearing. The pH measured in surface water samples has been as low as 5.6, while the pH measured in the extracted ground water is typically greater than 6, indicating potential pH problems in the creek. Other field parameters appear to be in compliance with the new AWQC with the exception of dissolved oxygen which is not monitored and could not be reviewed. Compliance with the newer requirements in WAC 173-201 should be monitored.

4. Residential Wells. A summary of the ground water monitoring data for residential wells from 2003 through 2007 is presented in Attachment 3-7. Existing residential wells are sampled according to the schedule in the Operations and Closure Plan. All of the land owners for the existing wells, with the exception of EW-10 and EW-12, have reportedly been hooked up to Tacoma Water. A residential survey is being planned for 2008 to confirm the status of all residential wells. As shown in Attachment 3-7, VOCs have not been detected in any EW well above ground water performance standards; however, several VOCs have exceeded early warning values (20% of performance standard). A summary of VOC detections at residential wells in the last five years is as follows:

- EW-12
  - Vinyl chloride was detected twice in 2006 at EW-12 above the early warning value; however, all ground water samples in 2007 were non-detect for vinyl chloride.
  - EW-12 is reportedly still in use for drinking water and located downgradient (west of Leach Creek) of the north area vinyl chloride plume.
- EW-09
  - Methylene chloride was detected four times at EW-09 above the early warning value between February 2003 and February 2005.
  - Trichloroethene was detected four times at EW-09 above the early warning value between February 2005 and March 2007.
  - Total Xylenes were detected once at EW-09 above the early warning value in February 2004.
  - EW-09 is reportedly hooked up to municipal water.

Arsenic has also been consistently detected above the current MCL at existing wells EW-00, EW-12 (reportedly still in use for drinking), EW-13, EW-19, and EW-30R and sporadically detected above the current MCL at EW-09, EW-10 (currently in use for drinking water), EW-16, EW-21, and EW-24. Detections of arsenic in existing wells may not be associated with Landfill operations; however, monitoring well data near the Landfill indicate that reducing conditions at the Landfill may be mobilizing arsenic.

The Consent Decree states that in the event that early warning values are exceeded, the City shall notify EPA and submit a memorandum which identifies actions that shall be taken in response to these exceedences to ensure that performance standards are met.

5. Landfill Gas Monitoring. Concentrations of methane in excess of the LEL have been consistently detected in gas monitoring probes HD and HD-A, located on the Home Depot property to the north of the Landfill. The highest concentrations were seen in the yellow probe and ranged 0 to 24% methane by volume during the most recently reported events (January – June 2007). A new gas extraction well was installed in May 2006 to remove the remnant landfill gas on the Home Depot property. Since the extraction well was installed, methane concentrations have been decreasing. Methane concentrations at yellow HD probe still exceed the lower explosive limit, but are expected to continue to decrease with time with the installation of the new extraction well. Monitoring will continue at this location.

Methane concentrations above the LEL were sporadically detected at gas monitoring probe PS-19D, located adjacent to the Orchard Terrace Apartment Complex. Probe stations near this apartment complex were installed through or adjacent to a lift of garbage to avoid underground utilities previously installed along the Landfill boundary. The methane exceedences have not occurred over a sustained period of time and are within levels indicative of normal system fluctuations.

As stated in Section III.IV.C above, the City has requested that monitoring probe SPS-13 be abandoned. Methane concentrations at SPS-13 have been attributed to local filling rather than gas migration from the Landfill. Methane is sporadically detected at concentrations ranging between 0 and 3% methane by volume (January 2004 through June 2007).

F. Site Inspection

Inspection at the site was conducted on February 20, 2008, by the RPM, the USACE review team, Dave Bosch from TPCHD, and Cal Taylor from the City of Tacoma. Site photographs are presented in Attachment 3-8. The purpose of the inspection was to observe waste handling and disposal activities, remedial measures constructed at the site, activities around the site, and any odor, noise, or bird problems.

Several areas of the cap were observed to be in the process of being repaired. Those areas included the water main break area along the western property boundary and the eastern landfill cap extension. The temporary cap on the Central Area was observed to be in place.

No significant odor, noise, or bird problems were observed at the time of the site visit. Some minor noise and odor issues were associated with the transfer station; however, it appeared to be within the normal operational parameters. Limited amounts of debris were observed along the northwestern portion of the site, near the settling pond. The debris did not cause obstructions of the landfill cap in this area.

Extraction wells at the site appeared to be in good condition. During the site visit, several extraction wells were observed being rehabilitated.

G. Interviews

Calvin Taylor from the City of Tacoma was interviewed on issues pertaining to operation and maintenance of the remediation systems and landfill cap. Dave Bosch from TPCHD was interviewed regarding the status of the existing well sampling program. Because of low community interest in environmental issues at the site, no community members were interviewed.

III.VII. Technical Assessment

A. Is the remedy functioning as intended by the decision documents? Pending

The current remedy including the Landfill cover, gas management, and ground water extraction and treatment systems may not be functioning as intended by the ROD. First, a better understanding of the horizontal extent of the ground water plumes at depth (vinyl chloride and 1,2-DCA) near Leach Creek is required before remedy effectiveness can be determined. Next, continued monitoring of the gas at the Home Depot is needed to ensure the gas is controlled, even though it is not associated with the Landfill proper. The current state of each ROD objective and any indicators of remedy problems are described below.

1. Reduce the production of leachate by placing constraints on further site operations and by capping the Landfill. A temporary cap and leachate collection system has been installed in the Central Area and is being monitored as required. Waste has not been deposited in the Central Area since December 2002.

2. Eliminate off-site gas migration through the gas extraction system. The gas extraction system is controlling off-site gas migration and is being monitored in accordance with the Landfill Gas Monitoring Plan. Off-site detections of methane greater than the LEL (i.e., Home Depot) appear to have sources that did not originate from the Landfill:

- Methane gas has been detected consistently above the LEL (>5%) over the last five years in the Home Depot area; however, concentrations are likely gas remnants from community dumping that occurred in the area before the Landfill was established in the 1960s. An additional extraction well and four gas monitoring probes were installed at the Landfill near this area to help decrease methane concentrations and monitor for potential gas migration.
- Concentrations of methane are elevated at probe SPS-13 and PS-19D near the Orchard Terrace Apartments. Readings from these sites appear to be related to garbage or yard waste deposited in these areas outside of the Landfill footprint. Monitoring in the building of the Orchard Terrace complex indicates the building itself is not currently impacted. Continued landfill gas monitoring will be used to track these areas.
- Several probes have been noted as not functioning or as being broken. These probes should be repaired or replaced as needed, to fulfill the requirements of the Landfill Gas Monitoring Plan.

3. Prevent further migration of the contaminated ground water plume via a ground water extraction system. The current ground water extraction system has reduced the size of the plumes in both the north and south areas; however, the success of preventing further migration is uncertain. Given the relatively

small areas of remaining ground water contamination, it is not clear if continued extraction will help reduce concentrations further. An evaluation of changes in plumes over time should be conducted to determine if continued extraction is required. This evaluation should also include additional investigation to determine the extent of the plumes west of Leach Creek and evaluate if the system is preventing migration of the plumes at depth. Until this evaluation is conducted, remedy effectiveness cannot be determined.

The combined effluent from the ground water extraction system meets ROD and state requirements for discharge to surface waters without treatment. However, since vinyl chloride and 1,2-DCA concentrations remain above more current surface water quality criteria in monitoring wells near Leach Creek and the GETS discharge does not have sufficiently low reporting limits, impact to Leach Creek cannot be evaluated at this time. Additional data is required to evaluate if the site is impacting the Landfill either through direct groundwater or effluent discharge to the creek.

Arsenic and total iron were not included in the list of indicator chemicals in the ROD. However, elevated arsenic concentrations were observed at many POC extraction wells and monitoring wells in the north area near the vinyl chloride plume. There were also elevated levels of total iron in many of the well and surface water samples. Exposure points including effluent discharge, drinking water well head, and surface water are being monitored to track these concentrations. The site should also be examined as a whole to evaluate whether these compounds are a result of the Landfill.

4. Further protect public health and the environment via monitoring of ground water, surface water, gas probes, and air emissions. Sampling of ground water, surface water, gas and air have been conducted as required. Ground water, surface water and landfill gas data indicate that human health and the environment are generally being protected, with the exception of the arsenic MCL exceedences noted in EW-10. TPCHD and the City will be consulting with the home owner this summer.

It should be noted that the ROD does not currently require treatment of the remaining ground water such that all ground water within the property boundary is below acceptable risk levels. Therefore, some type of long term monitoring will likely be required as long as contaminants remain in ground water.

5. Provide an alternate water supply (Tacoma municipal water) to any residences deprived of their domestic supply due to demonstrated contamination from the Landfill or due to the action of the extraction-treatment system. The status of well water use and hook up to municipal water will be conducted in 2008 to verify this objective has been met. As noted in the City's request for reduction in sampling of residential wells, two wells are not connected to the municipal system (EW-10 and EW-12) and they show concentrations of vinyl chloride above early warning levels and/or arsenic above the federal MCL. The City and TPCHD will need to confirm whether these wells are used for drinking water or just for non-potable purposes (e.g., yard watering) before the protectiveness of alternate water supply can be evaluated.

6. Establish a closure plan for the Landfill consistent with Washington State Minimal Functional Standards for Landfill Closure (WAC 173-304). The Consent Decree states that final closure of the Landfill shall occur no later than December 31, 1999, but that the EPA may agree to provide, after providing notice and opportunity for public comment, up to three five-year extensions of this deadline if the City can demonstrate to the satisfaction of EPA all of the following:

- That the continued operation of the Landfill shall not result in a release or substantial threat of release to the environment;

- That performance standards for the extraction/treatment system have been achieved;
- That since the effective date of the Consent Decree, the Settling Defendant has instituted and is operating an aggressive solid waste recycling and hazardous materials collection program; and
- That other feasible solid waste management alternatives to disposal at the Landfill do not exist.

In accordance with the Consent Decree, the City has already requested two extensions of the Landfill closure date. The first extension was approved May 11, 1998 for closure on December 31, 2004. The agency approved a second extension on February 24, 2005 with anticipated final closure on December 31, 2009. If the City plans to request a third extension, that request would be due no later than January 31, 2009. EPA may or may not grant that extension request. Regardless of the date of closure, the final closure plan will be based on current conditions at the time of closure and aimed at long-term protectiveness of human health and the environment.

The City maintains a Solid Waste Permit for the Landfill that is managed by TPCHD. The last permit renewal (2008) identified closure extension as an area of non-compliance and required actions by the City of Tacoma.

7. Establish institutional controls to assure that the remedial action will continue to protect human health and the environment. Remaining contamination at the site does not allow for unrestricted use/ unrestricted exposure, so ICs are required for both soil and groundwater. As outlined in the Institutional Controls Plan (ICP), ICs on local ground water were developed to ensure that the remedial action is protective of health and the environment. EPA is responsible for monitoring the effectiveness of the ICs. The TPCHD, Ecology, and the City of Tacoma are responsible for the implementation, maintenance, and inspection of the ICs. The City ordinances and notice to drillers prohibiting installation of wells in the area adjacent to the Tacoma Landfill remain in place. TPCHD and Ecology are responsible for monitoring this, and use the City permitting process requiring demonstration of drinking water supply for new structures as a tool to ensure this restriction.

The ICP provides maps for where the ICs should be applied. The area restricted is sufficiently protective based on the distribution of contaminants. All landowners in the vicinity of the Landfill whose wells have been impacted are connected to City water, with the exception of EW-10 and EW-12.

A title search was not conducted on the Landfill, since the property is owned in its entirety by the City and is an active facility. However, the restrictive covenant for the Landfill was reviewed, remains in effect, and should run with the land if the property is ever transferred. In the event of changes to future land use, the ICs currently in place would need to be reviewed for future protectiveness.

The current ICs are appropriate and do not require modification at this time. However, duration of required ICs should be documented more clearly.

8. Systems Operations. Operations and maintenance have generally been conducted as designed.

9. Optimization. The City of Tacoma has submitted a request to shutdown all of the extraction wells except W-1 and W-15. If shutdown is granted, the ground water monitoring program would have to be modified. EPA and Ecology are in the process of reviewing these requests. Several issues have arisen during their review; therefore, a determination on their request is pending. Issues include:

1. The effect of increased pumping from the City of Tacoma wells on the ground water plume if the extraction wells are shut off. The City of Tacoma is in the process of completing a study to address concerns due to increased pumping.
2. Determine if the Central Area is actively contributing to ground water contamination. Additional HELP modeling refinements may help evaluate leachate capture in this area.
3. The effect of elevated arsenic concentrations along the western Landfill boundary on the human health pathway.

The City also submitted a request to stop analytical monitoring at existing wells. Based on a review of the system presented for this Five-Year Review, it is recommended that the existing monitoring program should continue until issues associated with the extraction well shutdown request have been resolved. If shut down, at least one year of quarterly monitoring at the monitoring wells should be conducted to determine the impact of ground water quality following cessation of pumping.

B. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid? No

1. Changes in Standards and To Be Considered (TBCs). A review was done to identify any changes in standards that were identified as Applicable or Relevant and Appropriate Requirements (ARARs) in the ROD; newly promulgated standards including revised chemical-specific requirements (such as MCLs); revised action and location-specific requirements; and State standards and TBCs identified in the ROD that bear on the protectiveness of the remedy. Any such changes were then evaluated to establish whether the new requirement indicates that the remedy is no longer protective. A summary table is presented in Attachment 3-9. Generally, the standards and toxicological values used at the time of remedy selection have remained unchanged except that the MCL for arsenic was updated and toxicity values for TCE were revised. These changes may affect protectiveness as described below.

The 1988 ROD was issued when the arsenic MCL was 50 µg/L and, in 2002, it was reduced to 10 µg/L. Homes in the area that have wells are reportedly connected to the municipal water, with two exceptions. For the homes where residents reportedly drink municipal water, the change in standard has no impact on protectiveness. However, arsenic concentrations above the new MCL have been detected in the two wells not connected to municipal water and protectiveness cannot be determined for those homes at this time. Upcoming site visits by the City and TPCHD shall verify what type of use actually occurs and will inform any recommendations for future actions.

The MCL for TCE was 5 µg/L when the ROD was issued in 1988 and remains unchanged. Since that time, the toxicity factor used to estimate the excess cancer risk associated with exposure to TCE has been revised. EPA withdrew the value that was used in the original baseline risk assessment and has not yet put a new value into the Integrated Risk Information System (IRIS) database. Since TCE concentrations are already above the MCL and are solely within the Landfill footprint, changes to the regulations for TCE do not impact protectiveness of the remedy. However, revised criteria for drinking water will impact the time frame in which site water use restrictions can be lifted.

State requirements promulgated in WAC 173-201 and chronic surface water quality criteria were used, in part, in the ROD to evaluate discharge to Leach Creek, which is used for coho and chum spawning, and may also include rainbow and cutthroat trout. Since the ROD, changes in both criteria have occurred. Chronic values are no longer promulgated for several compounds, as noted in Attachment 3-3. The revised WAC code has been updated to incorporate the EPA National Recommended Surface Water criteria. As presented in Attachment 3-3, the values for consumption of water and fish are lower than surface water discharge criteria presented in the Consent Decree for 1,2-DCA, vinyl chloride, and methylene chloride. As presented in Attachment 3-6, concentrations of VOCs in surface water from Leach Creek have not been detected between 2003 and 2007. Reporting limits for 1,2-DCA and vinyl chloride are above the surface water quality criteria so impacts from these changes cannot be evaluated. Lowered reporting limits for surface water and GETS effluent samples for 1,2-DCA and vinyl chloride are required and values for the protection of human health consumption of organisms and organisms and water should be considered ARARs.

2. Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics. The ROD for the Tacoma Landfill site described current and future land uses accurately and identified likely exposure pathways. The potential risk due to the intrusion of VOCs into indoor air has recently been recognized as a significant pathway that was not fully appreciated at the time that the original baseline risk evaluation was prepared. Given the successful landfill gas control program, it is unlikely indoor air of adjacent residences or business is a complete pathway. However, the potential for contaminated ground water to act as a source of contamination to soil gas that may impact indoor air has not been evaluated and may represent a potentially complete pathway.

Groundwater monitoring data indicates that arsenic is found in site monitoring, extraction, and residential wells at concentrations above the MCL. However, this compound was not identified in the ROD as an indicator compound. Additional evaluation is required to determine if arsenic is site-related.

3. Changes in Land Use. The City has indicated that the current demand forecast calls for full use of the City's ground water rights ramping up over 25 years, beginning in 2010. Increases in ground water use in this area will likely impact distribution of chemicals in ground water at the site, by further influencing ground water flow direction.

4. Institutional Controls. Although the toxicity value has changed for TCE, it doesn't affect the protectiveness of the ICs. Contamination levels have decreased since the ROD so no additional ICs are needed. However, if it is determined that arsenic is a site-related compound, review of the current ICs will be needed to verify that they are sufficiently protective.

C. Has any other information come to light that could call into question the protectiveness of the remedy? No

There is no other information that calls into question the protectiveness of the remedy or changes to ICs.

D. Technical Assessment Summary

The remedy may not be functioning as intended based on the following findings.

- The current leachate and gas monitoring system appears to control releases from the site. Even though gas at the Home Depot is not believed to originate from the Landfill, monitoring there

should continue to confirm that methane concentrations at Home Depot are sufficiently controlled.

- For groundwater, the current extraction system pumping effectiveness continues to decrease. Modifications to the system are currently being evaluated by EPA and Ecology. Extent of the remaining plumes to the west of Leach Creek requires evaluation. Impacts to surface water quality from both plume and effluent sources should also be evaluated during consideration of changes to the current extraction system.
- A determination should also be made on whether arsenic in groundwater is a site related compound.
- Two residential wells at residences not hooked up to drinking water appear to have concentrations above the early warning level for vinyl chloride and/or the MCL for arsenic. Pending the site visits planned by TPCHD, further action may be required at these residences.

Discussions between the City, EPA, and Ecology are pending with respect to the final closure of the Landfill operations.

Determinations on environmental indicators will need to be updated pending additional data analysis recommended in this review.

III.VIII. Issues

Table 3-2 presents a summary of issues identified at the Tacoma Landfill.

Table 3-2. Issues for Tacoma Landfill

Issue	Currently Affects Protectiveness?	Affects Future Protectiveness?
1. Methane gas concentrations continue to be above LEL near Home Depot.	**N***	**Y**
2. Damaged landfill gas probes around site	**N**	**Y**
3. Outstanding request for abandonment of gas probe SPS-13	**N**	**Y**
4. The extent of the vinyl chloride and 1,2-DCA plumes horizontally at depth near Leach Creek is unknown.	**Y**	**Y**
5. Reporting limits for surface water samples are higher than the most current surface water quality criteria.	**N**	**Y**
6. GETS effluent at point of discharge and Leach Creek surface water samples is not evaluated using the most current surface water quality criteria.	**Y**	**Y**
7. The residential wells being used for drinking versus outdoor water need to be verified.	**Y**	**Y**
8. Exceedences of vinyl chloride early warning levels and arsenic MCL at EW-12 and arsenic MCL at EW-10 (residences reportedly not hooked up municipal supply)	**Y**	**Y**

Issue	Currently Affects Protectiveness?	Affects Future Protectiveness?
9. Groundwater concentrations of arsenic above MCL in wells near the Landfill property boundary and at several residential wells; however the reason is not clear and should be determined (e.g., reducing conditions causing mobilization).	**Y**	**Y**
10. Effects of increased pumping from City wells on the ground water plume if extraction wells are shut off are unknown.	**N**	**Y**
11. Potential pathway exists for soil vapor intrusion from contaminated ground.	**N**	**Y**
12. Outstanding request for modifications to the extraction well operation and well sampling	**N**	**Y**
13. Closure plan pending negotiation	**N**	**Y**

* The City is reducing the landfill gas at the Home Depot property through gas extraction wells located at the NPL site's northern property boundary. The City has conducted a study of the landfill gas at the Home Depot property and determined that there was not active gas migration from the Landfill.

III.IX. Recommendations and Follow-Up Actions

Based on the issues listed in Table 3-2 above, a list of recommendations and proposed schedule was developed (Table 3-3 below). These recommendations include additional sampling data to evaluate the extent of the vinyl chloride and 1,2-DCA plumes at depth and determine if Leach Creek is a plume discharge area. This sampling should include:

- Evaluation of appropriate surface water sampling locations and methodologies. It is likely that pore water sampling via probes is more appropriate to quantify discharge than direct sampling from the creek surface water.
- Installation of wells with screened intervals similar to the extraction wells to evaluate deeper migration of the plumes. A review of the well screen depth at EW-12 may indicate this well is suitable for this purpose for the northern vinyl chloride plume.
- Selection of sampling parameters, including volatile organics and physical parameters to include dissolved oxygen.

Table 3-3 - Recommendations and Follow-Up Actions for Tacoma Landfill

Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
				Current	Future
1. Continue to monitor gas probes at Home Deport for another year to evaluate effectiveness of extraction wells in reducing gas concentrations.	**City of Tacoma**	**EPA/ Ecology**	**August 2009**	**N**	**Y**
2. Determine which landfill gas probes are critical for monitoring and replace/repair broken gas probes, as required.	**City of Tacoma**	**EPA/ Ecology/ TPCHD**	**August 2009**	**N**	**Y**
3. EPA/Ecology to determine if SPS-13 is critical for monitoring and provide recommendation for abandonment to the City.	**EPA/ Ecology**	**EPA/ Ecology**	**December 2008**	**N**	**Y**
4. Develop sampling approach for additional surface water and ground water data for the vinyl chloride and 1,2- DCA plumes near point of discharge (Leach Creek) and west of the Creek (see above text for recommended requirements). Conduct sampling, as required.	**City of Tacoma**	**EPA/ Ecology**	**August 2008 – December 2009**	**Y**	**Y**
5. Reduce reporting limits for surface water and effluent samples to below surface water quality criteria.	**City of Tacoma**	**EPA/ Ecology**	**July 2008**	**N**	**Y**
6. Evaluate GETS effluent at point of discharge and surface water samples against applicable surface water criteria, including WAC 173-201 and human health criteria to determine if modifications to discharge and or sampling are required. Modifications to decision document may be required.	**City of Tacoma**	**EPA/ Ecology**	**January 2009**	**Y**	**Y**
7. Verify status of residential wells with a site visit to be conducted by the City in coordination with TPCHD.	**TPCHD**	**EPA/ Ecology**	**November 2008**	**Y**	**Y**

Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
				Current	Future
8. Address exceedences of vinyl chloride and arsenic at EW-12 and arsenic at EW-10 pending status of well use. If in use, determine need to hook up residences to municipal drinking water.	**City of Tacoma/ TPCHD**	**EPA/ Ecology/ TPCHD**	**January 2009**	**Y**	**Y**
9. Determine if arsenic is site-related or if reducing conditions from the Landfill are causing mobilization. Evaluate effects of elevated arsenic on the human health pathway.	**City of Tacoma**	**EPA/ Ecology**	**August 2009**	**Y**	**Y**
10. Complete a ground water model to evaluate the effects of increased pumping of City wells.	**City of Tacoma**	**EPA/ Ecology**	**September 2008**	**N**	**Y**
11. Evaluate the potential for a completed ground water to indoor air pathway.	**City of Tacoma**	**EPA/ Ecology/**	**August 2009**	**Y**	**Y**
12. EPA/Ecology to provide recommendations for modifications to extraction well operation and well sampling.	**EPA/ Ecology**	**EPA/ Ecology**	**January 2010**	**N**	**Y**
13. EPA/Ecology approves Final Closure Plan. Request due from the City no later than on January 31, 2009 (based on 2/24/05 authorization of 2nd Closure Extension).	**EPA/ Ecology**	**EPA/ Ecology**	**December 2009**	**N**	**Y**

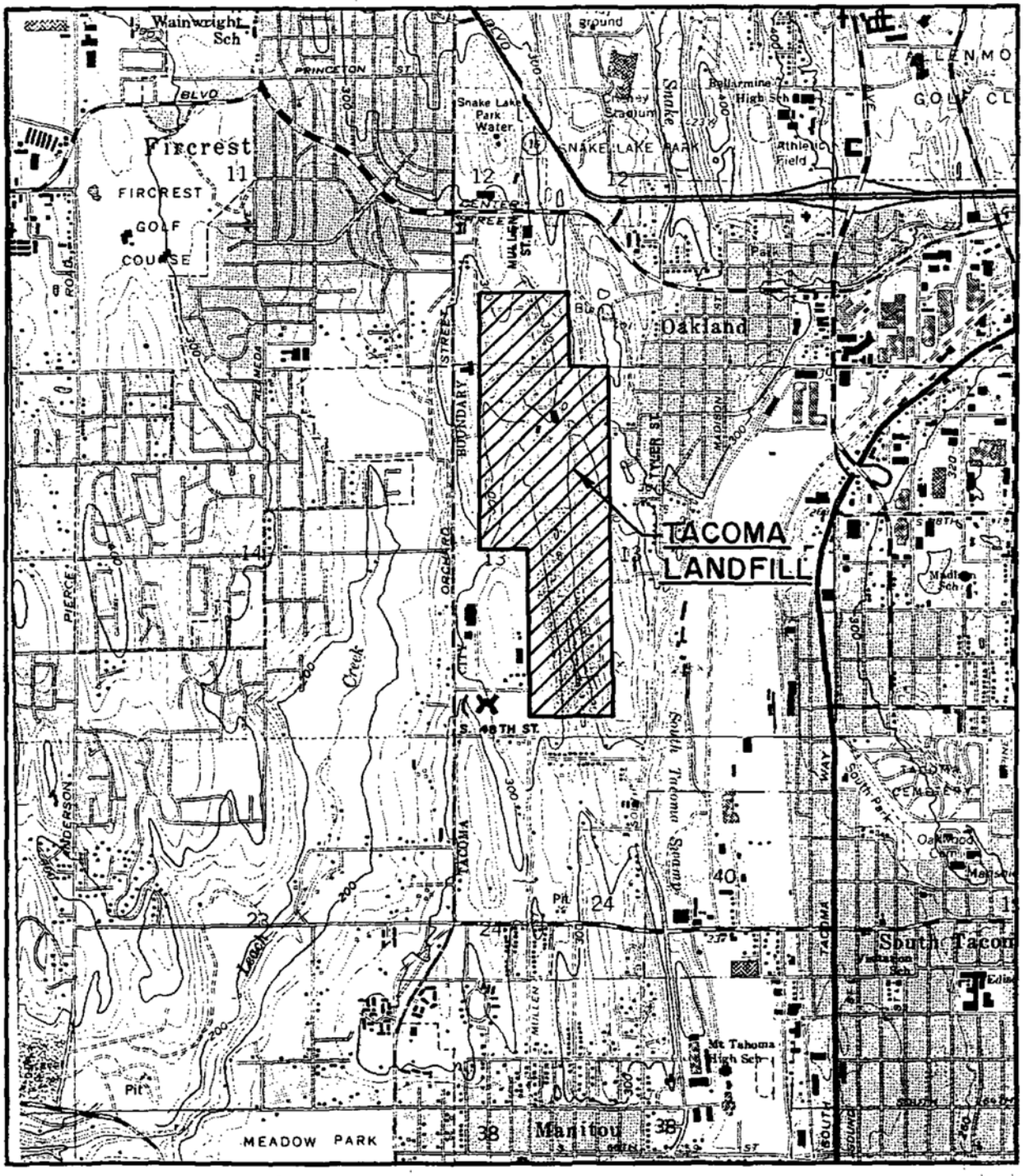
III.X. Protectiveness Statement

A protectiveness determination of the remedy at the Tacoma Landfill cannot be made at this time until further information is obtained. An evaluation of impacts from the remaining ground water plumes to Leach Creek and migration west of the creek is required. Surface water and GETS effluent discharge data need to be evaluated against more current surface water criteria and reporting limits should be lowered as applicable. Concentrations of COCs in two residential wells not connected to municipal water supply exceed the performance criteria. Pending a site visit to determine status of these wells, additional actions may be required at these homes. Finally, additional evaluations on the effects of elevated arsenic concentrations on human health and the ground water to indoor air pathway are required. It is expected that these actions will take one year to complete, at which time a protectiveness determination can be made (between August and December 2009). Details of project completion dates are presented in Table 3-3.

III.XI. Next Review

The next Five-Year Review for the Tacoma Landfill OU is required by September 2013, five years from the date of this review.

TACOMA LANDFILL
FIGURES



0 1000 2000 4000

SCALE : 1" = 2000'

N

FIGURE 1-2
VICINITY MAP
TACOMA LANDFILL RI/FS

Figure 3-1. Tacoma Landfill Vicinity Map

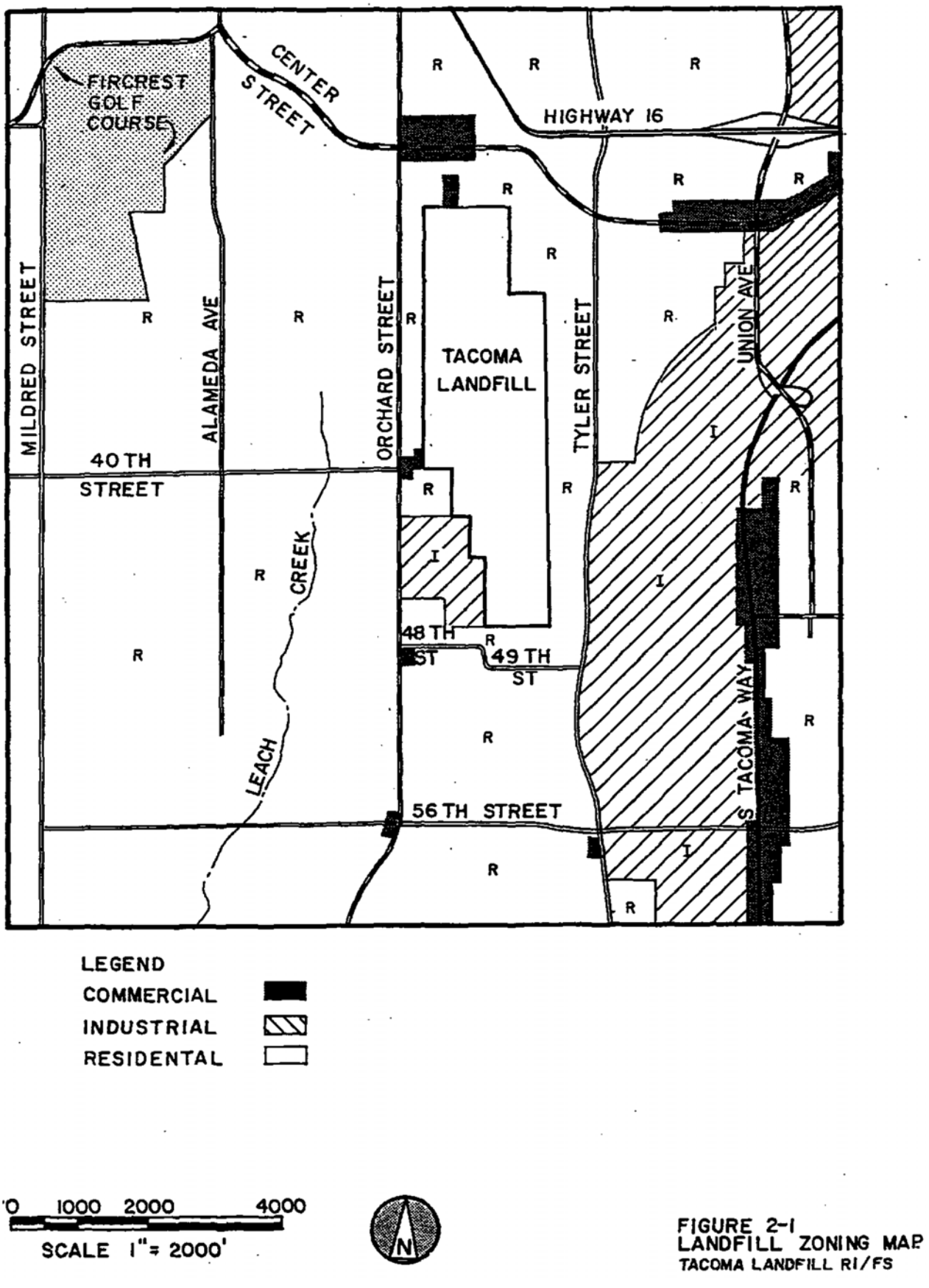
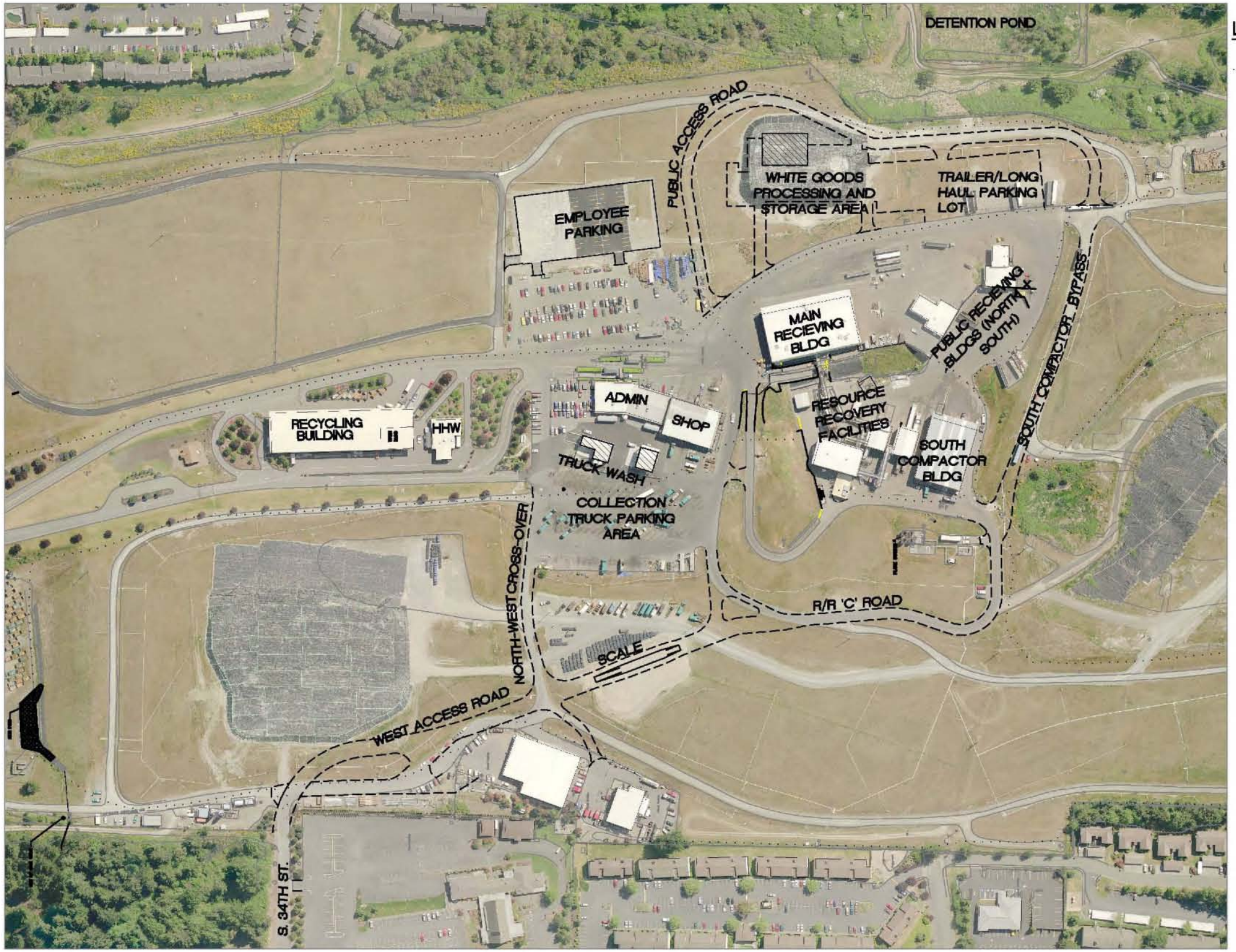


Figure 3-2. Tacoma Landfill Zoning Map



LEGEND:

APPROX EDGE OF EX LANDFILL CAP

WORK UNDER CONSTRUCTION

GRAPHIC SCALE
0 50 100 200 400
1 Inch = 200 ft.

CITY OF TACOMA

TACOMA LANDFILL FACILITY OVERVIEW MAP

DECEMBER 2006

APPENDIX D
FIGURE 1

Figure 3-3. Tacoma Landfill Site Layout

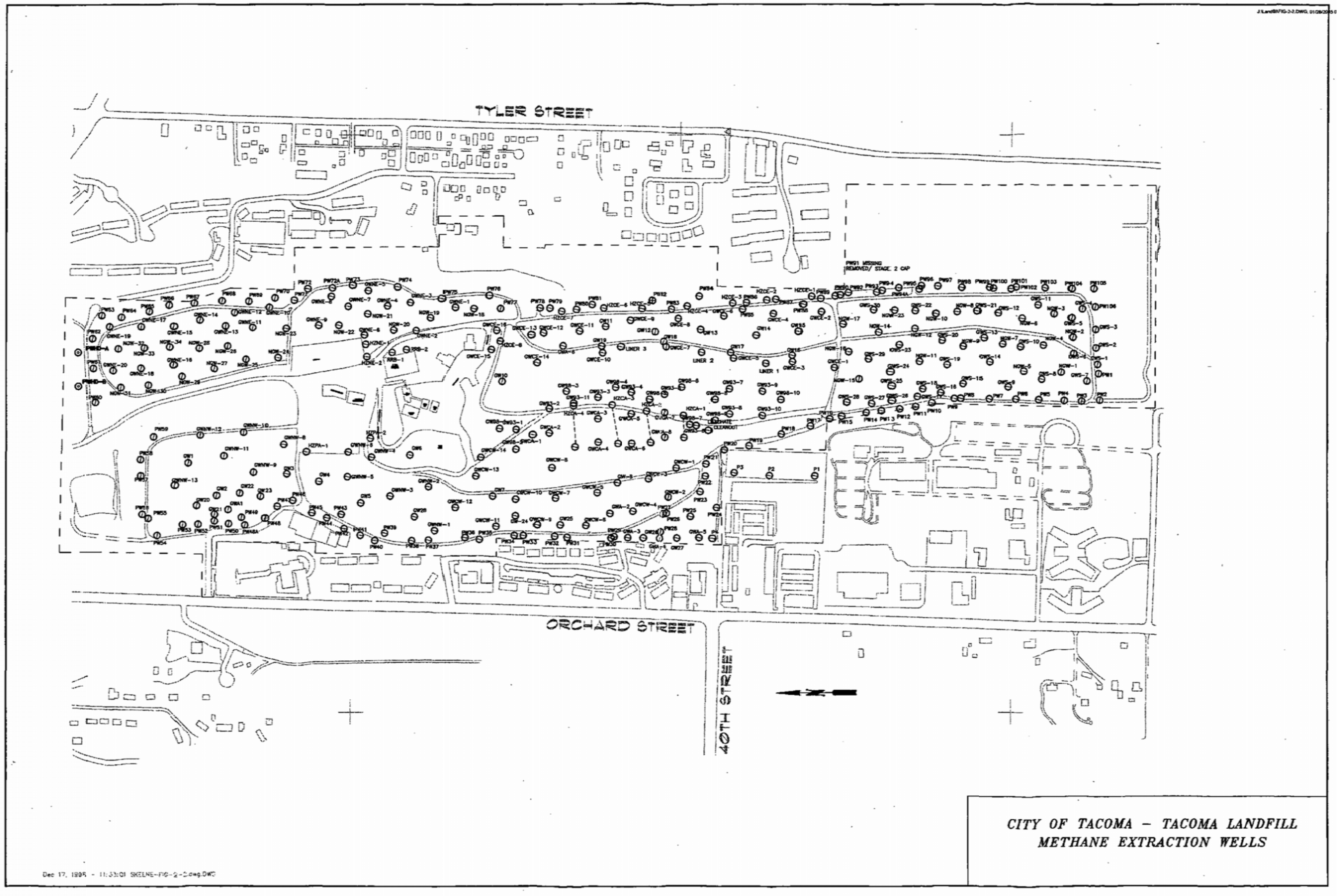


Figure 3-4. Tacoma Landfill Gas Extraction Well Locations

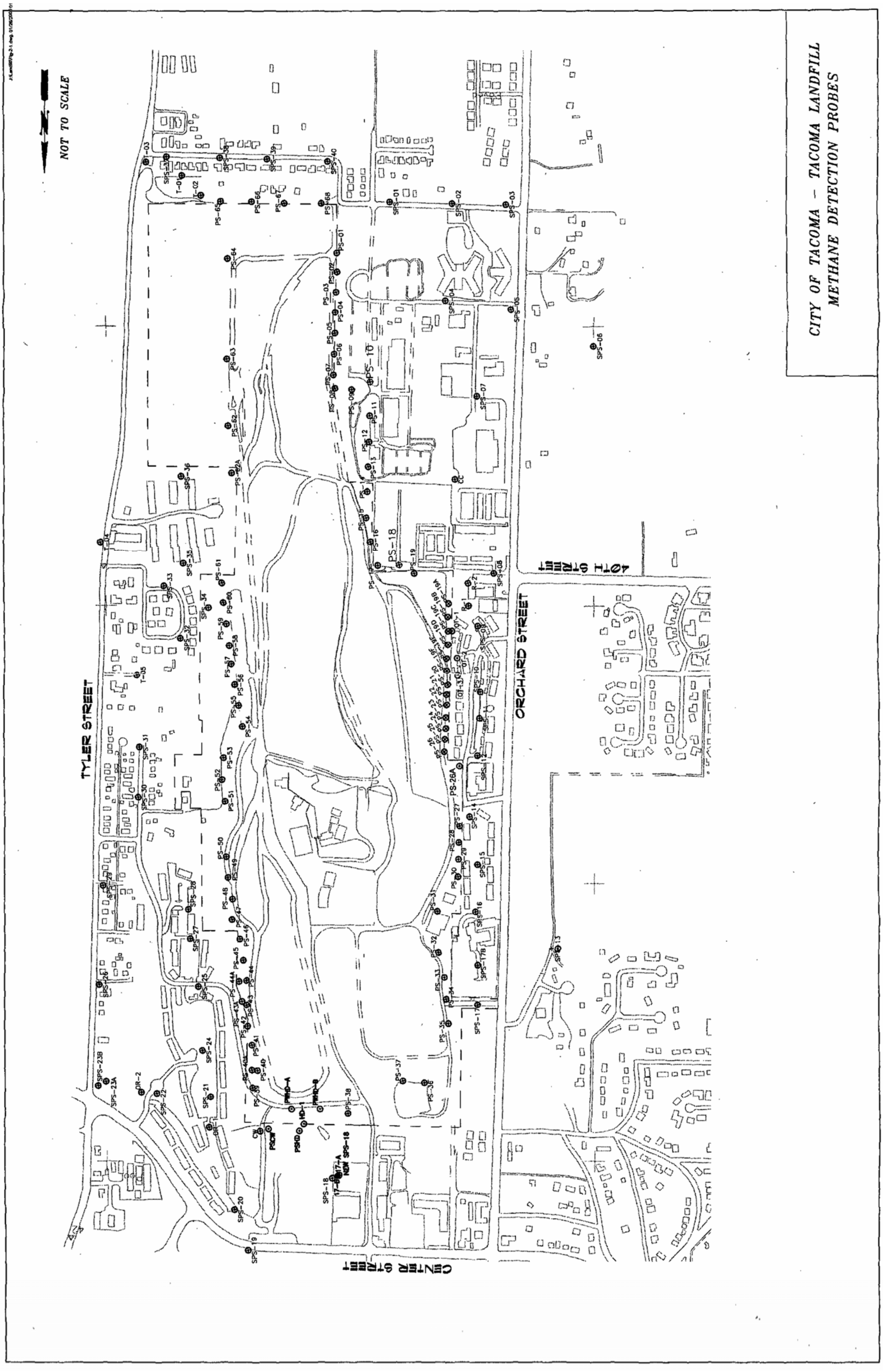


Figure 3-5. Tacoma Landfill Gas Monitoring Probe Locations

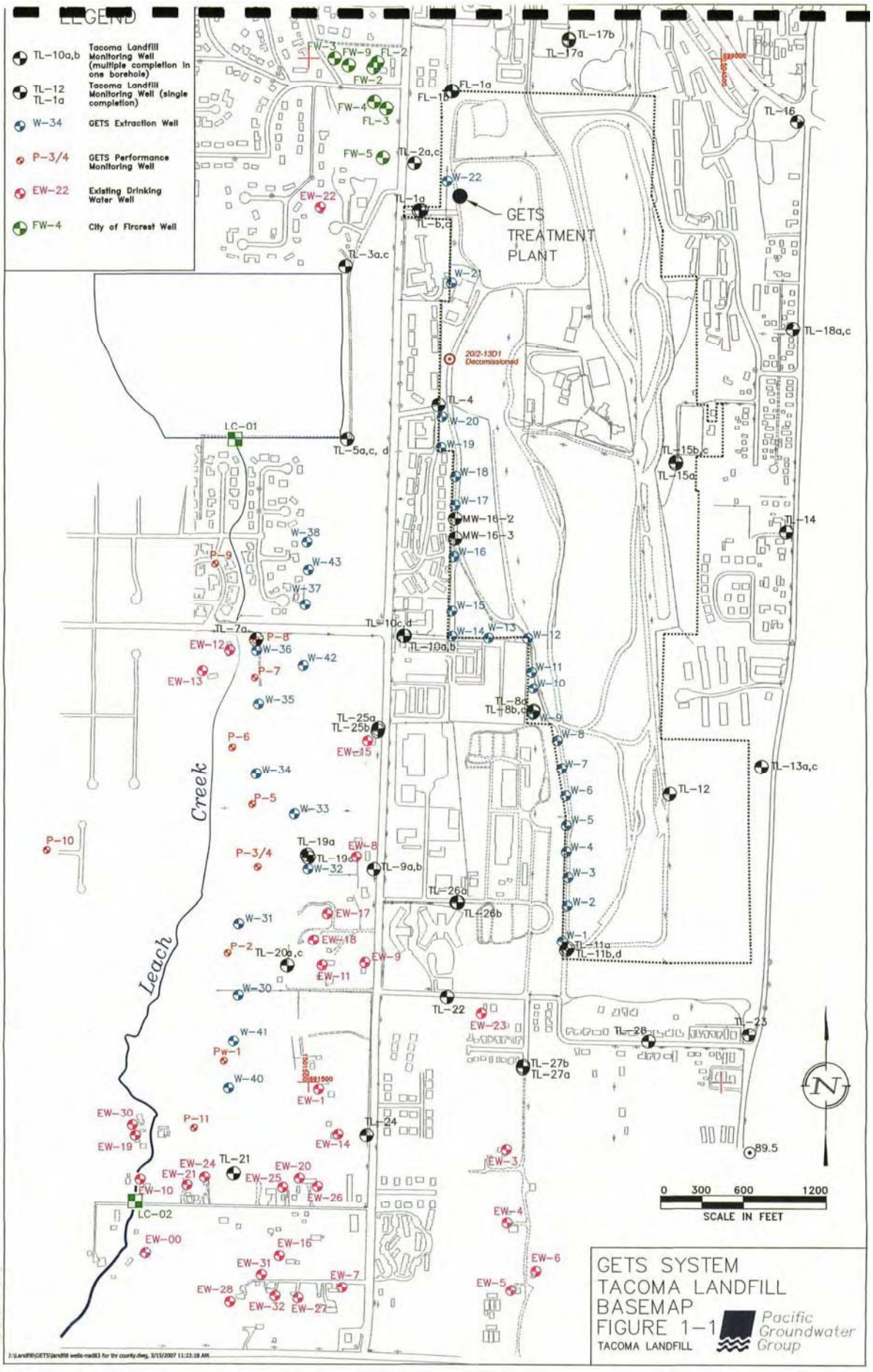


Figure 3-6. Tacoma Landfill Groundwater Monitoring Network

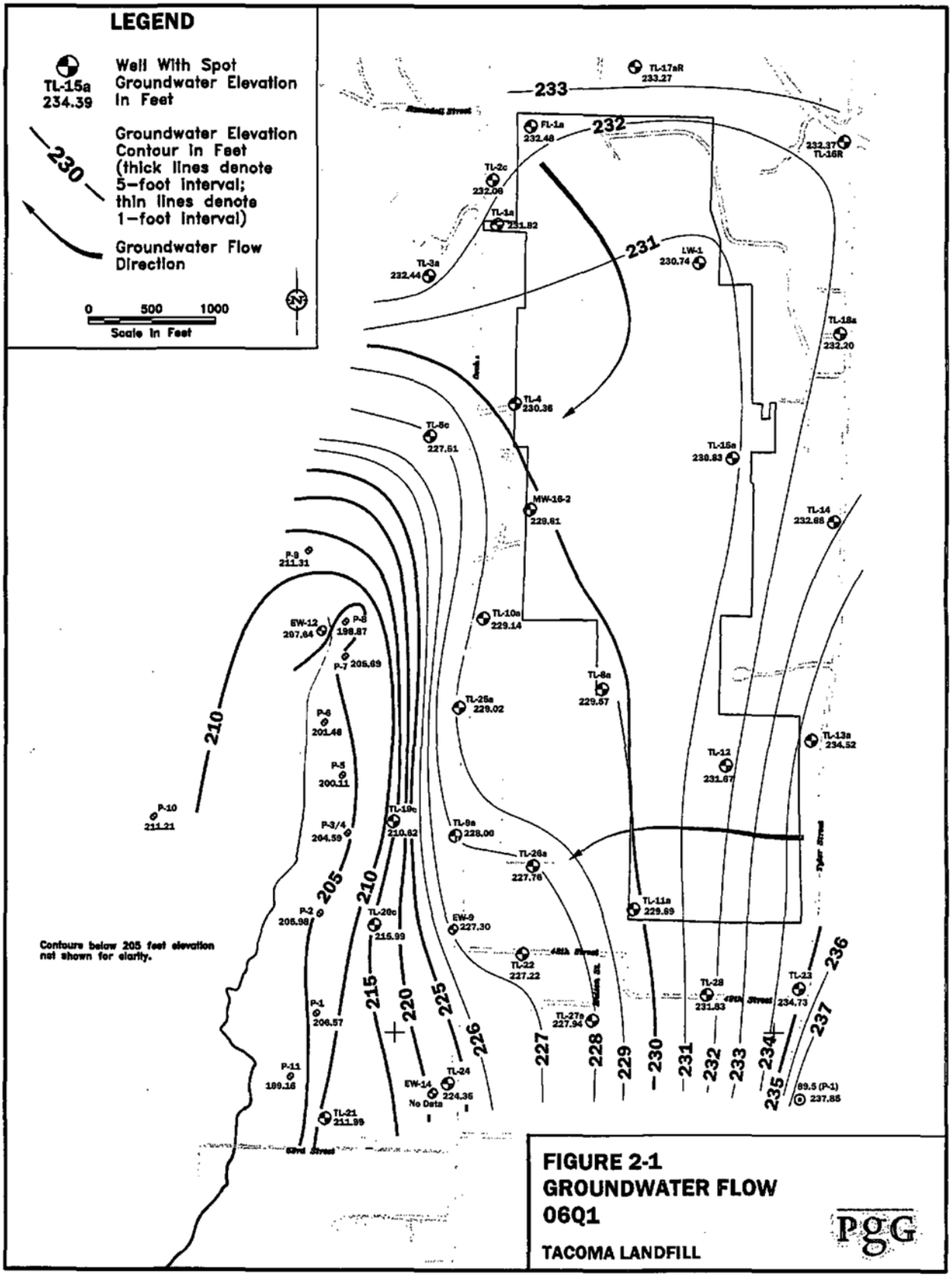


Figure 3-7. Tacoma Landfill Groundwater Flow Contours, First Quarter 2006

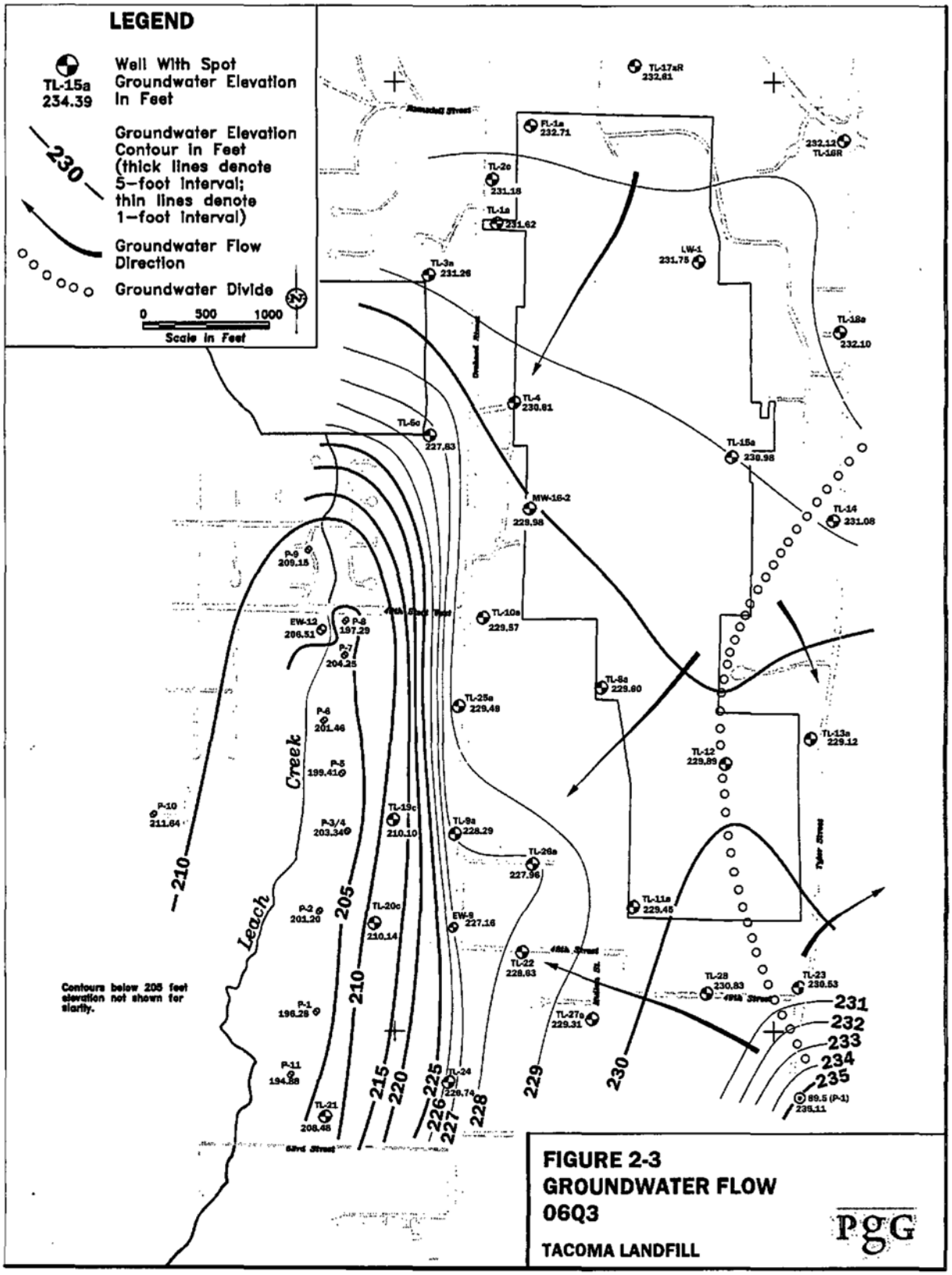


Figure 3-8. Tacoma Landfill Groundwater Flow Contours, Third Quarter 2006

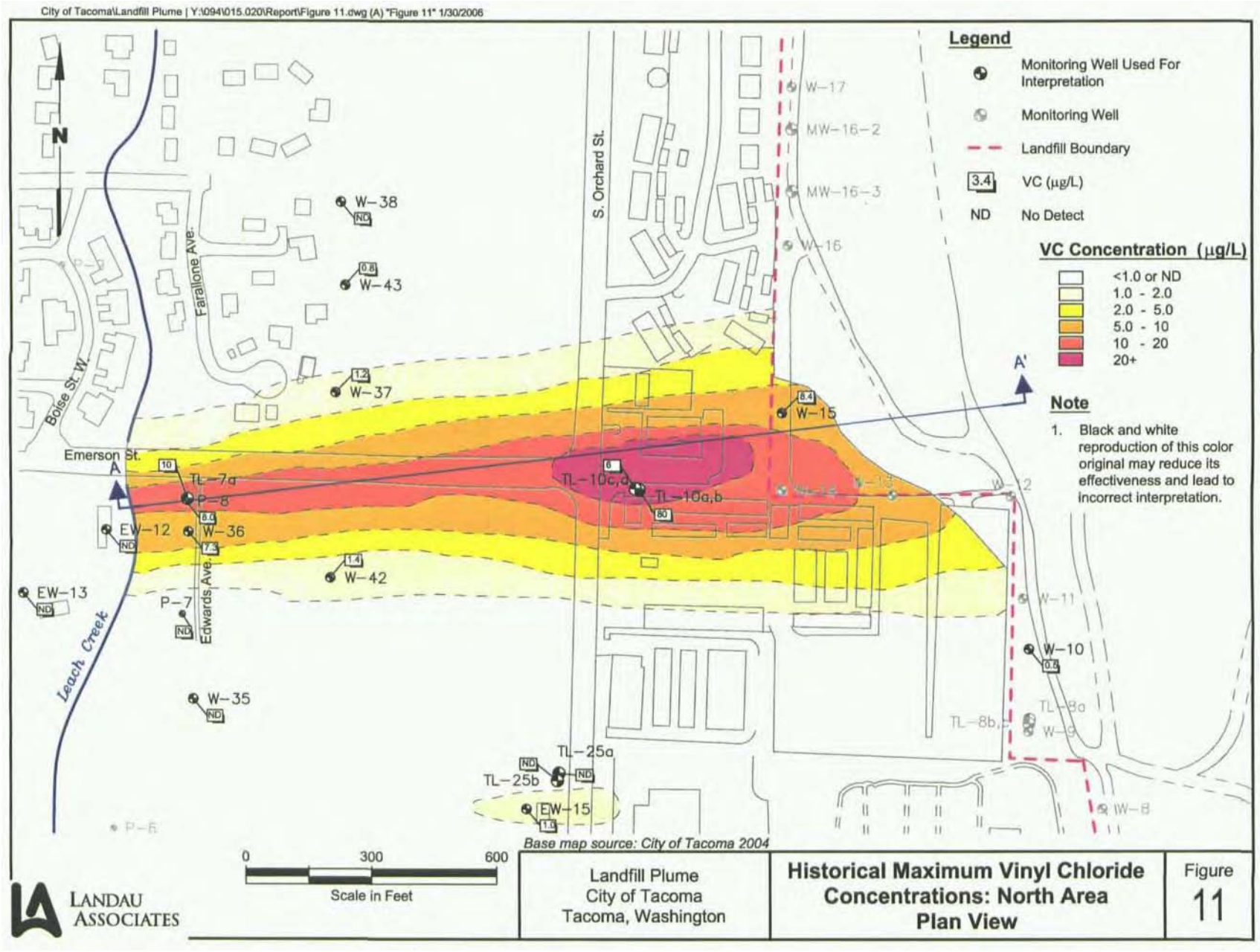


Figure 3-9. Tacoma Landfill Maximum Vinyl Chloride Concentrations (1988-Present)

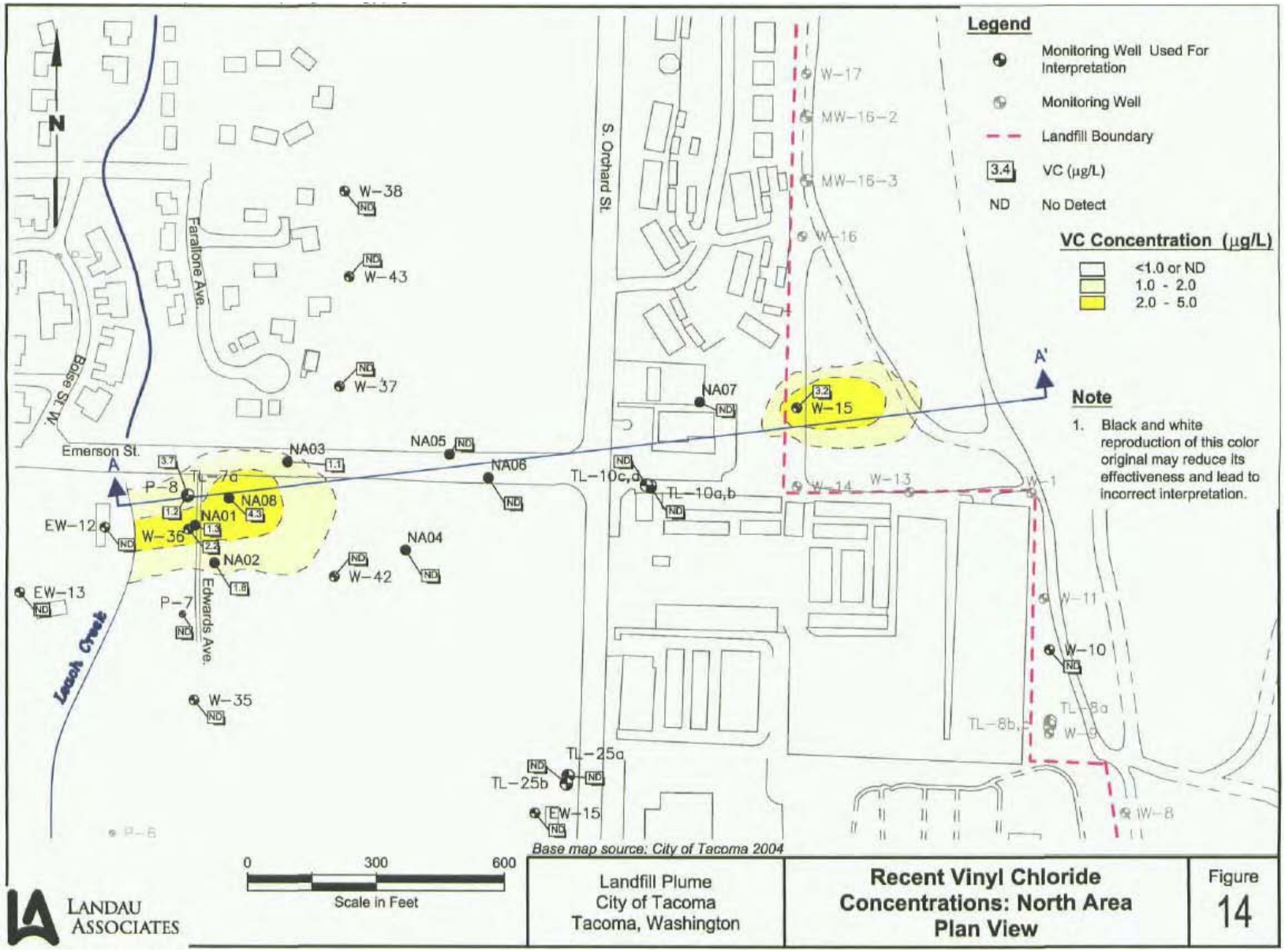


Figure 3-10. Tacoma Landfill Vinyl Chloride Concentrations (2006)

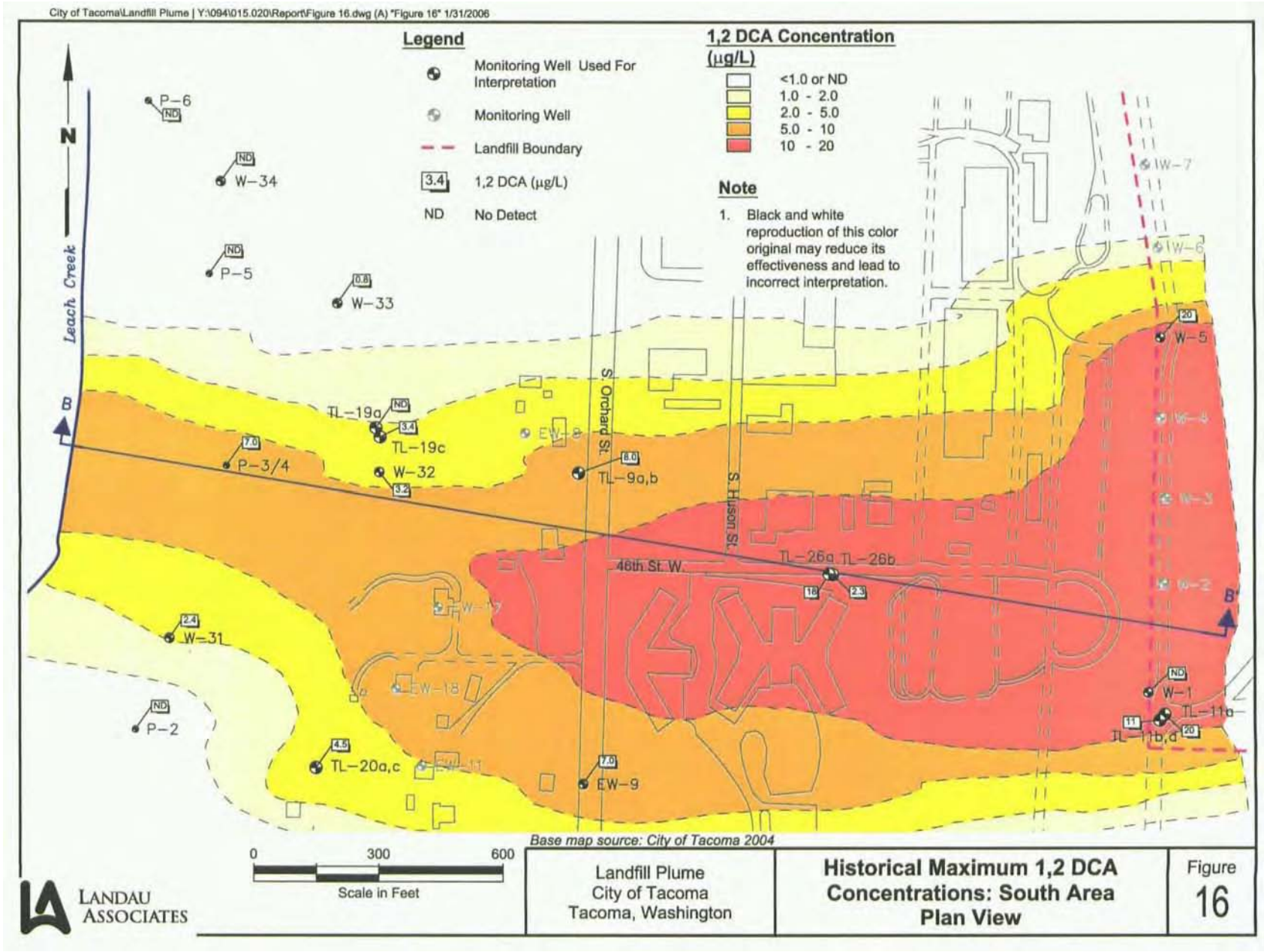


Figure 3-11. Tacoma Landfill Maximum 1,2 Dichloroethane Concentrations (1988-Present)

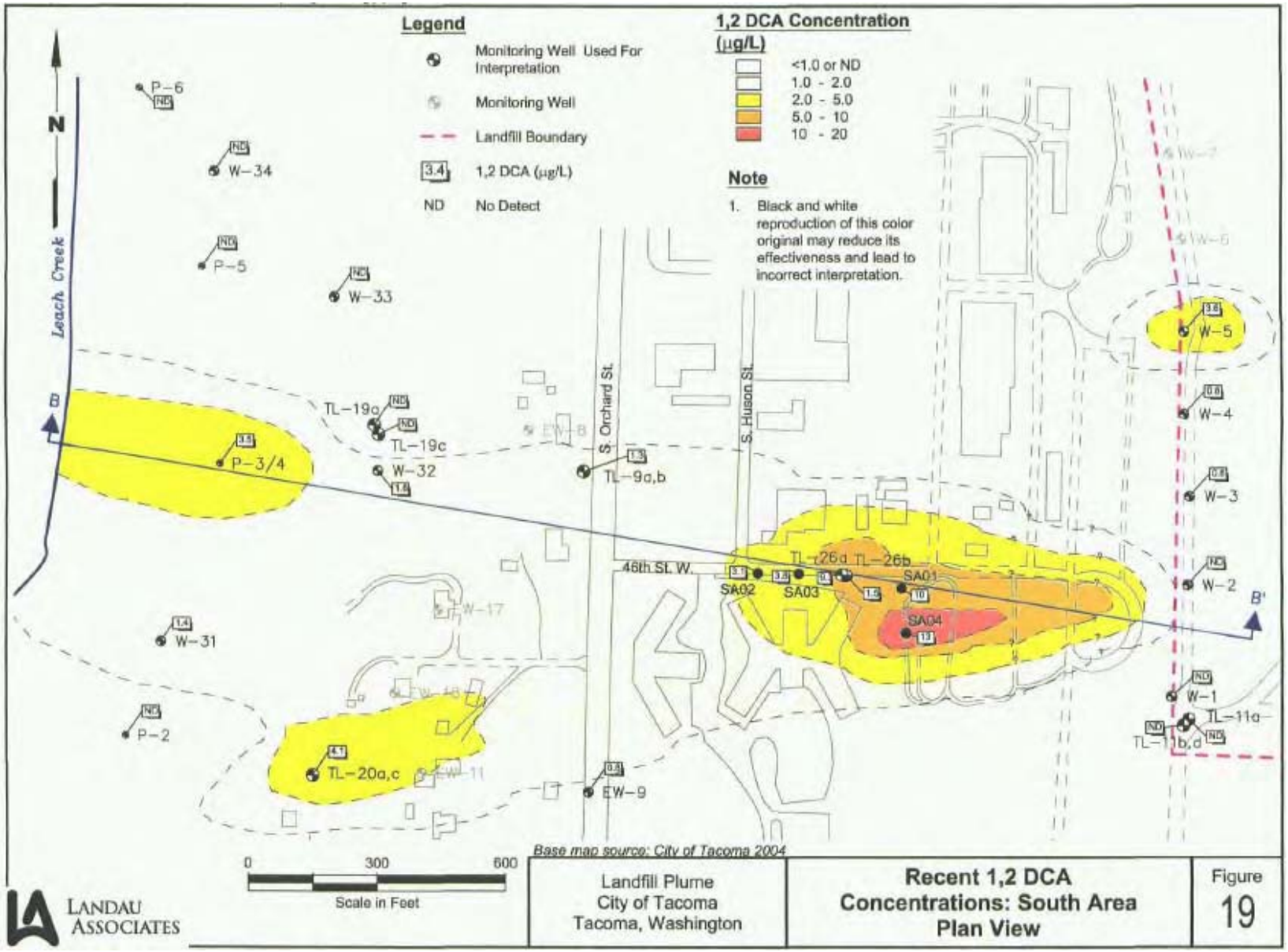


Figure 3-12. Tacoma Landfill 1,2 Dichloroethane Concentrations (2006)

TACOMA LANDFILL
ATTACHMENTS

Attachment 3-1. Chemicals Detected During RI, Tacoma Landfill

Chemical	Subsurface Soil	Ground Water	Surface Water	Sanitary Sewer and Leachate	Sediment	Gas[(1)]
VOCs						
Tetrachloroethene	X	X		X	X	X
Trans-1,2-Dichloroethene	X	X		X		
Trichloroethene	X	X		X	X	X
1,1-Dichloroethene		X		X	X	X
Vinyl Chloride		X		X		X
1,1,1-Trichloroethene		X				X
1,1-Dichloroethane		X		X		X
1,2-Dichloethane		X				X
Chloroethane		X		X		X
Benzene		X		X	X	X
Ethylbenzene		X	X	X		X
Chlorobenzene		X		X		X
Toluene	X	X	X	X	X	X
Xylene (Total)	X	X		X		X
2-Butanone	X	X		X	X	X
2-Hexanone				X		X
1,2-Dicholoropropane		X		X		X
Trans-1,3-Dichloropropane		X				X
Styrene						X
Carbon Disulfide						X
Chloroform		X	X	X		
Chloromethane						X
Bromo-dichloromethane						
Methylene Chloride	X	X		X	X	X
Acetone	X	X		X	X	X
4-Methyl-2-pentanone		X		X		
SVOCs						
Hexachlorobenzene		X				--
PNAs		X			X	--
Phenol		X		X		--

Attachment 3-1. Chemicals Detected During RI, Tacoma Landfill, Cont.

Chemical	Subsurface Soil	Ground Water	Surface Water	Sanitary Sewer and Leachate	Sediment	Gas[(1)]
Phthalate Esters		X			X	--
1,4-Dichlorobezene				X		--
N-Nitro-Sodi-phenylamene				X		--
Benzyl Alcohol				X		--
Benzoic Acid				X		--
4-Methyl Phenol				X		--
Isophorone					X	--
Metals						
Arsenic	X	X	X	X	X	--
Cadmium		X	X	X	X	--
Chromium	X	X	X	X	X	--
Copper	X	X	X	X	X	--
Mercury	X	X	X	X	X	--
Nickel	X	X	X	X	X	--
Lead	X	X	X	X	X	--
Zinc	X	X	X	X	X	--
Iron	X	X	X	X	X	--
Aluminum	X	--	X	--	X	--
Manganese	X	X	X	X	X	--

(1) Samples not analyzed for SVOCs or metals
NA – Not Analyzed

Attachment 3-2. List of Documents Reviewed, Tacoma Landfill

CH2M HILL. Final Phase II Mining Pilot Study – Test Pits, Workplan, City of Tacoma Landfill. January 2007.

CH2M HILL. City of Tacoma Landfill Reclamation Feasibility Study. November 9, 2007.

CH2M HILL. Draft Memorandum, Landfill Gas Migration Control, Tacoma Landfill. November 12, 2007.

City of Tacoma. Institutional Control Plan. July 17, 1992.

City of Tacoma. City of Tacoma Landfill Odor Control Plan. June 30, 2003.

City of Tacoma. Annual Summary of Inspections for the Tacoma Landfill Cap, Condensate Collection System and Central Area Leachate Collection System. 2003 and 2004.

City of Tacoma. Tacoma Landfill Biannual Gas System Evaluation Reports. January 1, 2004 through June 30, 2007.

City of Tacoma. Tacoma Landfill Consent Decree Annual Reports. 2003 through 2006.

City of Tacoma. Quarterly Summaries of Ground water, Surface Water, and Leachate Data for Tacoma Landfill. First Quarter 2003 through Third Quarter 2007.

City of Tacoma. Tacoma Landfill, Second Five-Year Closure Extension Request. August 2004.

City of Tacoma. Tacoma Landfill Operations and Closure Plan. September 2004.

City of Tacoma. Letter to EPA re: Home Depot and General Landfill Gas Update. December 15, 2005.

City of Tacoma. Central Area Flow Metering. January 2006 – September 2007.

City of Tacoma. Letter to EPA re: Request to Stop Existing Water Supply Wells Monitoring. November 6, 2006.

City of Tacoma. Letter to EPA re: Request to Shutdown Tacoma Landfill Ground Water Extraction Wells. November 14, 2006.

City of Tacoma. Letter to TPCHD re: Proposal for Central Area Leachate Flow Metering. June 1, 2007.

City of Tacoma. Letter to EPA re: Request to Abandon Gas Monitoring Probe SPS-13. March 7, 2007.

City of Tacoma. Letter to EPA re: Requests for Changes to Ground Water System at Tacoma Landfill. August 28, 2007.

EPA. Record of Decision, Commencement Bay, South Tacoma Channel, EPA ID: WAD980726301; OU 05. March 31, 1988.

EPA. Tacoma Landfill Superfund Site. First Five-Year Review. September 19, 1997.

EPA. Tacoma Landfill Superfund Site. Second Five-Year Review. May 14, 2003.

EPA. Letter to City of Tacoma re: Proposed Mining Project. February 27, 2007.

Landau Associates. End of Plume Residual Plume Characterization Report. Tacoma Landfill – North Area & South Area. February 1, 2006.

Parametrix. Draft Tacoma Landfill Bird Management Plan. March 2002.

Tacoma Landfill Consent Decree. March 1991.

Attachment 3-2. List of Documents Reviewed, Tacoma Landfill, Cont.

Tacoma Pierce County Health Department (TPCHD). Tacoma Landfill 2007-2008, 2006-2007, 2005-2006, Solid Waste Permit Renewal, #27-051.

TPCHD. TPCHD response to the proposed Tacoma Landfill Mining Pilot Project, "Phase II". February 21, 2007.

TPCHD. Conditional Approval – Phase II Landfill Mining Pilot Project in the Central Area of the Tacoma Landfill. May 30, 2007.

Attachment 3-3. Tacoma Landfill Consent Decree Indicator Compounds, Treatment Level Compared to Current Value

Indicator Compound	Consent Decree Performance Levels for Treatment Discharge to Surface Water (1) (µg/l)	Current values MCL (µg/l)	Organism only (2) (µg/l)	For water and fish ingestion by humans (2) (µg/l)
Benzene	5	5	51	2.2
Chloroethane	20			
1,1 Dichloroethane	20			
1,2-Dichloroethane	5	5	37	0.38
Ethyl benzene	320	700	2,100	530
Methylene Chloride	5		590	4.6
Toluene	175	1000	15,000	1,300
1,1,1 -Trichloroethane	200	200		MCL (200)
Vinyl Chloride	2	2	2.4	0.025
Xylenes	10	10,000		

Blank values indicate no criteria established

(1) Based on EPA Ambient Water Quality for Water, 1986 freshwater criteria. Treatment system effluent must also meet water quality standards, as set forth in WAC 173-201

(2) National Recommended Water Quality Criteria, 2006, chronic fresh water criteria not published for these chemicals; incorporated by reference into WAC 173-201

Attachment 3-4. Tacoma Landfill Ground Water Data Summary, 2003-2007

Analyte (ug/L)	Performance Standard (ug/L)	2003			2004			2005			2006			2007		
		Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency
Background Wells																
1,1,1-Trichloroethane	200[a]	ND (0.5)	5.5	8\27	ND (0.5)	4.2	7\27	ND (0.5)	4	7\27	ND (0.5)	3.1	8\27	ND (0.5)	1.9	5\26
1,1-Dichloroethane	20[b]	ND (0.5)	9.3	13\27	ND (0.5)	6.9	9\27	ND (0.5)	5.8	7\27	ND (0.5)	5.1	8\27	ND (0.5)	3.3	7\26
1,2-Dichloroethane	5[a]	ND (0.5)	3.4	4\27	ND (0.5)	1.2	4\27	ND (0.5)	0.7	2\27	ND (0.5)	0.5	1\27	ND (0.5)	1.6	1\26
1,2-Dichloroethene, Total	70[a]	ND (0.5)	3.9	8\27	ND (0.5)	3.5	8\27	ND (0.5)	2.8	7\27	ND (0.5)	3.2	8\27	ND (0.5)	3.2	6\26
Benzene	5[a]	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\26
Chlorobenzene	100[a]	ND (0.5)	ND (0.5)	0\20	--	--	--	ND (0.5)	ND (0.5)	0\5	ND (0.5)	ND (0.5)	0\22	ND (0.5)	ND (0.5)	0\26
Chloroethane	20[b]	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\26
Ethylbenzene	320[b]	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\26
Methylene Chloride	5[a]	ND (0.5)	ND (1.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\26
Tetrachloroethene	5[a]	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\26
Toluene	175[b]	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\26
Trichloroethene	5[a]	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\26
Vinyl Chloride	2[a]	ND (0.5)	0.9	1\12	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\26
Xylenes, Total	10[b]	ND (0.5)	0.9	2\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\27	ND (0.5)	ND (0.5)	0\26
Arsenic, Dissolved	10[a]	ND (1.7)	3.2	1\4	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic, Total	10[a]	ND (1.9)	6.8	9\27	ND (1.4)	15.5	9\27	ND (1.7)	17.5	12\27	ND (1.7)	14.4	11\27	ND (1.9)	17.1	9\26
Iron, Dissolved	1500[c]	11200	11200	1\1	--	--	--	--	--	--	--	--	--	--	--	--
Iron, Total	1500[c]	31.8	23000	10\10	62.5	24800	10\10	26.1	27800	10\10	52.6	32900	10\10	45.5	24500	9\9
Manganese, Dissolved	1900[c]	1370	1370	1\1	--	--	--	--	--	--	--	--	--	--	--	--
Manganese, Total	1900[c]	1.49	1260	10\10	1.32	1290	10\10	0.21	1400	10\10	1.97	1250	10\10	ND (0.34)	1170	7\9
Adjacent Wells																
1,1,1-Trichloroethane	200[a]	ND (0.5)	0.8	2\13	ND (0.5)	0.6	2\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13
1,1-Dichloroethane	20[b]	ND (0.5)	3.8	8\13	ND (0.5)	3.6	9\13	ND (0.5)	3.7	5\13	ND (0.5)	2.9	5\13	ND (0.5)	2.6	5\13
1,2-Dichloroethane	5[a]	ND (0.5)	3.1	4\13	ND (0.5)	3.8	5\13	ND (0.5)	3.5	5\13	ND (0.5)	3.5	5\13	ND (0.5)	2.7	5\13
1,2-Dichloroethene, Total	70[a]	ND (0.5)	21	11\13	ND (0.5)	19	12\13	ND (0.5)	12	12\13	0.6	12	13\13	0.6	9.7	13\13
Benzene	5[a]	ND (0.5)	0.6	1\13	ND (0.5)	0.5	1\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13
Chlorobenzene	100[a]	ND (0.5)	ND (0.5)	0\10	--	--	--	ND (0.5)	ND (0.5)	0\3	ND (0.5)	ND (0.5)	0\10	ND (0.5)	ND (0.5)	0\13
Chloroethane	20[b]	ND (0.5)	ND (0.5)	0\13	ND (0.5)	0.6	1\13	ND (0.5)	0.6	1\13	ND (0.5)	0.5	1\13	ND (0.5)	ND (0.5)	0\13
Ethylbenzene	320[b]	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13
Methylene Chloride	5[a]	ND (0.5)	ND (0.7)	0\13	ND (0.5)	ND (1)	0\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13
Tetrachloroethene	5[a]	ND (0.5)	31	5\13	ND (0.5)	27	5\13	ND (0.5)	16	5\13	ND (0.5)	17	5\13	ND (0.5)	14	5\13
Toluene	175[b]	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13
Trichloroethene	5[a]	ND (0.5)	47	9\13	ND (0.5)	37	9\13	ND (0.5)	28	9\13	ND (0.5)	32	9\13	ND (0.5)	26	9\13
Vinyl Chloride	2[a]	ND (0.5)	1.1	4\12	ND (0.5)	2.1	3\13	ND (0.5)	1.5	4\13	ND (0.5)	1.6	4\13	ND (0.5)	1.5	4\13
Xylenes, Total	10[b]	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13	ND (0.5)	ND (0.5)	0\13
Arsenic, Dissolved	10[a]	ND (1.8)	ND (1.8)	0\1	2.7	2.7	1\1	ND (2)	ND (2)	0\1	ND (1.4)	ND (1.4)	0\1	3.6	3.6	1\1
Arsenic, Total	10[a]	5.1	27.8	13\13	2	50.1	13\13	4.5	44.3	13\13	2.8	49.3	13\13	5.7	38.1	13\13
Iron, Dissolved	1500[c]	63.6	63.6	1\1	25.2	25.2	1\1	101	101	1\1	37.7	37.7	1\1	84.1	84.1	1\1
Iron, Total	1500[c]	1110	18500	4\4	843	6420	4\4	903	11700	4\4	1080	6770	4\4	885	7720	4\4
Manganese, Dissolved	1900[c]	71.6	71.6	1\1	36.4	36.4	1\1	14.7	14.7	1\1	56	56	1\1	32.8	32.8	1\1
Manganese, Total	1900[c]	536	5190	4\4	53.6	6420	4\4	291	5220	4\4	221	6010	4\4	224	5050	4\4

Attachment 3-4. Tacoma Landfill Ground Water Data Summary, 2003-2007

Analyte (ug/L)	Performance Standard (ug/L)	2003			2004			2005			2006			2007		
		Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency
Within Plume Wells																
1,1,1-Trichloroethane	200[a]	ND (0.5)	18	2\118	ND (0.5)	24	2\118	ND (0.5)	26	1\122	ND (0.5)	23	3\112	ND (0.5)	11	3\117
1,1-Dichloroethane	20[b]	ND (0.5)	16	66\118	ND (0.5)	14	64\118	ND (0.5)	12	67\122	ND (0.5)	13	67\120	ND (0.5)	11	71\128
1,2-Dichloroethane	5[a]	ND (0.5)	16	36\118	ND (0.5)	13	34\118	ND (0.5)	9.3	33\122	ND (0.5)	13	32\114	ND (0.5)	13	30\119
1,2-Dichloroethene, Total	70[a]	ND (0.5)	23	40\118	ND (0.5)	25	36\118	ND (0.5)	15	41\122	ND (0.5)	22	40\114	ND (0.5)	21	38\121
Benzene	5[a]	ND (0.5)	ND (0.5)	0\118	ND (0.5)	0.5	1\118	ND (0.5)	ND (1.2)	0\122	ND (0.5)	ND (0.5)	0\112	ND (0.5)	ND (0.5)	0\117
Chlorobenzene	100[a]	ND (0.5)	ND (0.5)	0\89	--	--	--	ND (0.5)	ND (0.5)	0\33	ND (0.5)	ND (0.5)	0\89	ND (0.5)	ND (0.5)	0\117
Chloroethane	20[b]	ND (0.5)	0.9	21\118	ND (0.5)	0.9	14\118	ND (0.5)	1.3	17\124	ND (0.5)	1.1	18\114	ND (0.5)	0.6	5\117
Ethylbenzene	320[b]	ND (0.5)	ND (0.5)	0\118	ND (0.5)	ND (0.5)	0\118	ND (0.5)	ND (0.5)	0\122	ND (0.5)	ND (0.5)	0\112	ND (0.5)	ND (0.5)	0\117
Methylene Chloride	5[a]	ND (0.5)	ND (0.5)	0\118	ND (0.5)	ND (1.7)	0\118	ND (0.5)	ND (0.5)	0\122	ND (0.5)	ND (0.5)	0\112	ND (0.5)	0.5	1\117
Tetrachloroethene	5[a]	ND (0.5)	2	4\118	ND (0.5)	1.3	4\118	ND (0.5)	1.3	4\122	ND (0.5)	1.1	4\112	ND (0.5)	1.1	4\117
Toluene	175[b]	ND (0.5)	ND (0.5)	0\118	ND (0.5)	ND (0.5)	0\118	ND (0.5)	ND (1.3)	0\122	ND (0.5)	ND (0.5)	0\112	ND (0.5)	ND (0.5)	0\117
Trichloroethene	5[a]	ND (0.5)	3.3	4\118	ND (0.5)	2.9	4\118	ND (0.5)	2.8	4\122	ND (0.5)	2.9	4\112	ND (0.5)	2.8	4\117
Vinyl Chloride	2[a]	ND (0.5)	3.8	34\93	ND (0.5)	3.7	38\118	ND (0.5)	7.2	36\124	ND (0.5)	3	34\115	ND (0.5)	1.7	24\117
Xylenes, Total	10[b]	ND (0.5)	0.9	1\118	ND (0.5)	ND (0.5)	0\118	ND (0.5)	ND (0.5)	0\122	ND (0.5)	ND (0.5)	0\112	ND (0.5)	ND (0.5)	0\117
Arsenic, Dissolved	10[a]	ND (1.8)	ND (1.8)	0\2	1.5	1.5	1\1	ND (2)	ND (2)	0\1	ND (1.4)	ND (1.4)	0\1	ND (1.6)	ND (1.6)	0\1
Arsenic, Total	10[a]	ND (1.9)	34.9	25\85	ND (1.4)	119	34\86	ND (1.7)	18.9	31\87	ND (1.7)	18.7	38\87	ND (1.9)	47.4	63\104
Iron, Dissolved	1500[c]	46.7	173	2\2	60.8	60.8	1\1	29.4	29.4	1\1	ND (18)	ND (18)	0\1	620	620	1\1
Iron, Total	1500[c]	ND (6.3)	151000	21\22	5.2	206000	23\23	ND (2.3)	41100	21\23	ND (5.8)	13200	22\23	ND (100)	153000	19\27
Manganese, Dissolved	1900[c]	7.55	1400	2\2	1.57	1.57	1\1	6.16	6.16	1\1	1.5	1.5	1\1	7.93	7.93	1\1
Manganese, Total	1900[c]	1.73	2340	22\22	0.6	3610	23\23	ND (0.13)	2700	20\23	ND (1.39)	2720	21\23	ND (0.34)	2370	27\29
Downgradient Wells																
1,1,1-Trichloroethane	200[a]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45
1,1-Dichloroethane	20[b]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45
1,2-Dichloroethane	5[a]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45
1,2-Dichloroethene, Total	70[a]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45
Benzene	5[a]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45
Chlorobenzene	100[a]	ND (0.5)	ND (0.5)	0\33	--	--	--	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\34	ND (0.5)	ND (0.5)	0\45
Chloroethane	20[b]	ND (0.5)	0.5	2\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	0.6	1\45	ND (0.5)	2	1\45	ND (0.5)	ND (0.5)	0\45
Ethylbenzene	320[b]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45
Methylene Chloride	5[a]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (1)	0\44	ND (0.5)	ND (13)	0\45	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45
Tetrachloroethene	5[a]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45
Toluene	175[b]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (1.3)	0\45	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45
Trichloroethene	5[a]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45
Vinyl Chloride	2[a]	ND (0.5)	1.2	3\23	ND (0.5)	1.4	4\44	ND (0.5)	2.9	4\45	ND (0.5)	1.6	4\45	ND (0.5)	1.3	4\45
Xylenes, Total	10[b]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45	ND (0.5)	ND (0.5)	0\45
Arsenic, Dissolved	10[a]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic, Total	10[a]	ND (1.9)	12.9	10\36	ND (1.4)	11.8	15\37	ND (1.7)	17.5	16\37	ND (1.7)	14.4	15\39	ND (1.9)	15	20\37
Iron, Dissolved	1500[c]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron, Total	1500[c]	ND (6.3)	754	7\9	ND (3.1)	247	6\9	ND (2.3)	488	8\10	ND (5.8)	443	7\11	ND (100)	359	8\10
Manganese, Dissolved	1900[c]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese, Total	1900[c]	ND (0.37)	881	8\9	0.89	833	9\9	ND (0.13)	827	7\10	ND (0.39)	841	8\11	ND (0.34)	816	9\10

Attachment 3-4. Tacoma Landfill Ground Water Data Summary, 2003-2007

Analyte (ug/L)	Performance Standard (ug/L)	2003			2004			2005			2006			2007		
		Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency
Fircest Wells																
1,1,1-Trichloroethane	200[a]	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\63	ND (0.5)	ND (0.5)	0\58	ND (0.5)	ND (0.5)	0\48
1,1-Dichloroethane	20[b]	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\63	ND (0.5)	ND (0.5)	0\58	ND (0.5)	ND (0.5)	0\48
1,2-Dichloroethane	5[a]	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\63	ND (0.5)	ND (0.5)	0\58	ND (0.5)	ND (0.5)	0\48
1,2-Dichloroethene, Total	70[a]	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\63	ND (0.5)	ND (0.5)	0\58	ND (0.5)	0.8	1\48
Benzene	5[a]	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (1.2)	0\63	ND (0.5)	ND (0.5)	0\58	ND (0.5)	ND (0.5)	0\48
Chlorobenzene	100[a]	ND (0.5)	ND (0.5)	0\45	--	--	--	ND (0.5)	ND (0.5)	0\19	ND (0.5)	ND (0.5)	0\43	ND (0.5)	ND (0.5)	0\48
Chloroethane	20[b]	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\63	ND (0.5)	ND (0.5)	0\58	ND (0.5)	ND (0.5)	0\48
Ethylbenzene	320[b]	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\63	ND (0.5)	ND (0.5)	0\58	ND (0.5)	ND (0.5)	0\48
Methylene Chloride	5[a]	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (1)	0\60	ND (0.5)	ND (0.5)	0\63	ND (0.5)	ND (0.5)	0\58	ND (0.5)	7	2\48
Tetrachloroethene	5[a]	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\63	ND (0.5)	ND (0.5)	0\58	ND (0.5)	ND (0.5)	0\48
Toluene	175[b]	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (1.3)	0\63	ND (0.5)	ND (0.5)	0\58	ND (0.5)	ND (0.5)	0\48
Trichloroethene	5[a]	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\63	ND (0.5)	ND (0.5)	0\58	ND (0.5)	ND (0.5)	0\48
Vinyl Chloride	2[a]	ND (0.5)	ND (0.5)	0\28	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\63	ND (0.5)	ND (0.5)	0\58	ND (0.5)	ND (0.5)	0\48
Xylenes, Total	10[b]	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\60	ND (0.5)	ND (0.5)	0\63	ND (0.5)	ND (0.5)	0\58	ND (0.5)	ND (0.5)	0\48
Arsenic, Dissolved	10[a]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic, Total	10[a]	ND (1.9)	ND (2)	0\20	ND (1.4)	3	9\20	ND (1.7)	ND (3.7)	0\20	0.7ND (1)	3.1	9\24	ND (1.9)	4.4	7\17
Iron, Dissolved	1500[c]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron, Total	1500[c]	6.6	190	5\5	18.9	648	5\5	27.7	101	5\5	9.7	132	5\5	ND (100)	115	4\5
Manganese, Dissolved	1900[c]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese, Total	1900[c]	0.1ND (2)	1080	3\5	1.22	1020	5\5	0.7ND (2)	275	2\5	0.41	218	5\5	ND (0.34)	114	1\5
EOP Extraction Wells																
1,1,1-Trichloroethane	200[a]	ND (0.5)	1.5	4\48	ND (0.5)	1.6	4\47	ND (0.5)	1.6	5\47	ND (0.5)	1.1	5\44	ND (0.5)	1	6\48
1,1-Dichloroethane	20[b]	ND (0.5)	5.8	25\48	ND (0.5)	5	24\47	ND (0.5)	5.5	23\47	ND (0.5)	5.2	23\44	ND (0.5)	4.3	24\48
1,2-Dichloroethane	5[a]	ND (0.5)	2.4	8\48	ND (0.5)	1.8	9\47	ND (0.5)	1.8	8\47	ND (0.5)	1.6	9\44	ND (0.5)	1.5	8\48
1,2-Dichloroethene, Total	70[a]	ND (0.5)	2.2	17\48	ND (0.5)	1.8	17\47	ND (0.5)	2.1	18\47	ND (0.5)	2.2	21\45	ND (0.5)	2.1	23\48
Benzene	5[a]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\43	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\48
Chlorobenzene	100[a]	ND (0.5)	ND (0.5)	0\33	--	--	--	ND (0.5)	ND (0.5)	0\11	ND (0.5)	ND (0.5)	0\33	ND (0.5)	ND (0.5)	0\48
Chloroethane	20[b]	ND (0.5)	0.7	11\44	ND (0.5)	1	8\43	ND (0.5)	0.9	8\44	ND (0.5)	2.8	9\44	ND (0.5)	0.6	1\48
Ethylbenzene	320[b]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\43	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\48
Methylene Chloride	5[a]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (1.4)	0\43	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	0.8	1\48
Tetrachloroethene	5[a]	ND (0.5)	ND (0.5)	0\48	ND (0.5)	ND (0.5)	0\47	ND (0.5)	ND (0.5)	0\47	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\48
Toluene	175[b]	ND (0.5)	48	3\44	ND (0.5)	ND (0.5)	0\43	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\48
Trichloroethene	5[a]	ND (0.5)	ND (0.5)	0\48	ND (0.5)	ND (0.5)	0\47	ND (0.5)	ND (0.5)	0\47	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\48
Vinyl Chloride	2[a]	ND (0.5)	2.1	11\39	ND (0.5)	5.1	14\47	ND (0.5)	2.5	8\47	ND (0.5)	2.2	12\44	ND (0.5)	2.5	8\48
Xylenes, Total	10[b]	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\43	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\44	ND (0.5)	ND (0.5)	0\48
Arsenic, Dissolved	10[a]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic, Total	10[a]	ND (1.9)	9	7\44	ND (1.4)	ND (8.8)	12\43	ND (1.7)	13.7	13\44	ND (1.7)	13.1	15\44	ND (1.9)	15.2	29\52
Iron, Dissolved	1500[c]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron, Total	1500[c]	ND (6.3)	1350	5\12	ND (3.1)	2160	5\12	ND (2.3)	2530	4\12	20.4	3150	10\10	ND (100)	4030	8\14
Manganese, Dissolved	1900[c]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese, Total	1900[c]	28.2	2190	12\12	20.1	2170	12\12	16.2	2080	12\12	4.69	1950	10\10	12.9	2390	14\14

Attachment 3-4. Tacoma Landfill Ground Water Data Summary, 2003-2007

Analyte (ug/L)	Performance Standard (ug/L)	2003			2004			2005			2006			2007		
		Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency
POC Extraction Wells																
1,1,1-Trichloroethane	200[a]	ND (0.5)	ND (0.5)	0\28	ND (0.5)	ND (0.5)	0\28	ND (0.5)	0.7	1\43	ND (0.5)	1.3	6\84	ND (0.5)	1.2	7\83
1,1-Dichloroethane	20[b]	ND (0.5)	4.8	12\28	ND (0.5)	4.3	12\28	ND (0.5)	3.4	21\43	ND (0.5)	3	44\84	ND (0.5)	2.5	43\83
1,2-Dichloroethane	5[a]	ND (0.5)	5.7	4\28	ND (0.5)	4.5	4\28	ND (0.5)	3.9	6\43	ND (0.5)	4.4	12\84	ND (0.5)	4.7	9\83
1,2-Dichloroethene, Total	70[a]	ND (0.5)	5.7	20\28	ND (0.5)	4.6	20\28	ND (0.5)	5	32\43	ND (0.5)	4.4	61\84	ND (0.5)	4.4	62\83
Benzene	5[a]	ND (0.5)	0.7	7\28	ND (0.5)	0.7	5\28	ND (0.5)	0.7	5\43	ND (0.5)	0.7	6\84	ND (0.5)	0.6	4\83
Chlorobenzene	100[a]	ND (0.5)	ND (0.5)	0\21	--	--	--	ND (0.5)	ND (0.5)	0\7	ND (0.5)	ND (0.5)	0\63	ND (0.5)	0.6	3\83
Chloroethane	20[b]	ND (0.5)	0.7	6\28	ND (0.5)	0.8	1\28	ND (0.5)	0.6	3\43	ND (0.5)	0.6	4\84	ND (0.5)	ND (0.5)	0\83
Ethylbenzene	320[b]	ND (0.5)	ND (0.5)	0\28	ND (0.5)	ND (0.5)	0\28	ND (0.5)	1.4	1\43	ND (0.5)	ND (0.5)	0\84	ND (0.5)	ND (0.5)	0\83
Methylene Chloride	5[a]	ND (0.5)	ND (0.5)	0\28	ND (0.5)	ND (0.5)	0\28	ND (0.5)	1ND (2)	0\43	ND (0.5)	ND (0.5)	0\84	ND (0.5)	ND (0.5)	0\83
Tetrachloroethene	5[a]	ND (0.5)	2.4	11\28	ND (0.5)	2.3	11\28	ND (0.5)	1.3	10\43	ND (0.5)	1.8	20\84	ND (0.5)	1.8	21\83
Toluene	175[b]	ND (0.5)	ND (0.5)	0\28	ND (0.5)	ND (0.5)	0\28	ND (0.5)	ND (0.5)	0\43	ND (0.5)	ND (0.5)	0\84	ND (0.5)	ND (0.5)	0\83
Trichloroethene	5[a]	ND (0.5)	7.1	16\28	ND (0.5)	6.6	16\28	ND (0.5)	4.4	20\43	ND (0.5)	4.4	33\84	ND (0.5)	4	34\83
Vinyl Chloride	2[a]	ND (0.5)	2.6	19\25	ND (0.5)	2.6	15\28	ND (0.5)	3.4	22\43	ND (0.5)	3.2	32\84	ND (0.5)	2.4	26\83
Xylenes, Total	10[b]	ND (0.5)	ND (0.5)	0\28	ND (0.5)	ND (0.5)	0\28	ND (0.5)	6.9	1\43	ND (0.5)	ND (0.5)	0\84	ND (0.5)	ND (0.5)	0\83
Arsenic, Dissolved	10[a]	--	--	--	6.7	6.7	1\1	--	--	--	21.2	35.2	3\3	33.8	33.8	1\1
Arsenic, Total	10[a]	5.2	43	26\28	5.3	44.4	28\28	ND (2.3)	153	42\43	ND (1.6)	155	82\84	ND (2.2)	88.4	82\83
Iron, Dissolved	1500[c]	--	--	--	--	--	--	--	--	--	464	3690	3\3	4950	4950	1\1
Iron, Total	1500[c]	152	3680	7\7	135	4610	7\7	176	8270	7\7	ND (17.9)	9900	20\21	ND (100)	18000	19\21
Manganese, Dissolved	1900[c]	--	--	--	--	--	--	--	--	--	1230	2790	3\3	1260	1260	1\1
Manganese, Total	1900[c]	1180	3490	7\7	1170	3480	7\7	1030	3060	7\7	726	4710	21\21	686	3370	21\21

Notes:

Shading indicates value exceeded the performance standard.

[a] Primary Maximum Contaminant Level (MCL)

[b] Tacoma Landfill Consent Decree (5/17/91) Health Based Criteria (HBC)

[c] Leach Creek Discharge Standard

Attachment 3-5. Tacoma Landfill Discharge Effluent Data Summary, 2003-2007

Analyte (ug/L)	Performance Standard (ug/L)	Ambient Water Quality Criteria[1]	2003			2004			2005			2006			2007		
			Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency
Catch Basin																	
1,1,1-Trichloroethane	200[a]	na	--	--	--	0.5 U	1 U	0/9	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4
1,1-Dichloroethane	20[b]	330	--	--	--	0.5 U	0.9	7/9	0.58	0.77	4/4	0.5 U	1	3/4	0.5 U	0.5	3/4
1,2-Dichloroethane	5[a]	0.38	--	--	--	0.5 U	0.5	1/9	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4
1,2-Dichloroethene, Total	70[a]	na	--	--	--	0.5 U	0.9	7/9	0.5 U	0.75	3/4	0.5 U	0.8	2/4	0.5 U	0.6	2/4
Benzene	5[a]	2.2	--	--	--	0.5 U	1 U	0/9	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4
Chlorobenzene	100[a]	130	--	--	--	0.5 U	1 U	0/9	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/3	0.5 U	0.5 U	0/4
Chloroethane	20[b]	na	--	--	--	0.5 U	1 U	0/9	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4
Ethylbenzene	320[b]	530	--	--	--	0.5 U	1 U	0/9	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4
Methylene Chloride	5[a]	na	--	--	--	0.5 U	1 U	0/9	0.5 U	1 U	0/4	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4
Tetrachloroethene	5[a]	0.69	--	--	--	0.5 U	1 U	0/9	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4
Toluene	175[b]	1300	--	--	--	0.5 U	1 U	0/9	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4
Trichloroethene	5[a]	2.5	--	--	--	0.5 U	1 U	0/9	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4
Vinyl Chloride	2[a]	0.025	--	--	--	0.5 U	1 U	0/9	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4
Xylenes, Total	10[b]	na	--	--	--	0.5 U	2 U	0/9	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/4
Arsenic, Dissolved	10[a]	0.018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic, Total	10[a]	0.018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron, Dissolved	1500[c]	na	--	--	--	8.9 B	43 B	7/9	--	--	--	3.48 B	32.2 B	3/4	5.31 B	63.4 B	4/4
Iron, Total	1500[c]	na	--	--	--	220	1310	9/9	--	--	--	235	1160	4/4	163	1080	4/4
Manganese, Dissolved	1900[c]	na	--	--	--	1340	1580	9/9	--	--	--	1210	1550 J	4/4	791	1310	4/4
Manganese, Total	1900[c]	na	--	--	--	1390	1790	9/9	--	--	--	1200	1650	4/4	825	1540	4/4
GETS Outfall																	
1,1,1-Trichloroethane	200[a]	na	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
1,1-Dichloroethane	20[b]	330	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
1,2-Dichloroethane	5[a]	0.38	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
1,2-Dichloroethene, Total	70[a]	na	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
Benzene	5[a]	2.2	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
Chlorobenzene	100[a]	130	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
Chloroethane	20[b]	na	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
Ethylbenzene	320[b]	530	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
Methylene Chloride	5[a]	na	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
Tetrachloroethene	5[a]	0.69	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
Toluene	175[b]	1300	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
Trichloroethene	5[a]	2.5	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
Vinyl Chloride	2[a]	0.025	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
Xylenes, Total	10[b]	na	--	--	--	--	--	--	--	--	--	0.5 U	0.5 U	0/4	0.5 U	0.5 U	0/2
Arsenic, Dissolved	10[a]	0.018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic, Total	10[a]	0.018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron, Dissolved	1500[c]	na	--	--	--	--	--	--	--	--	--	7 UJ	33.9 B	2/16	10.9 B	28.5 B	2/2
Iron, Total	1500[c]	na	--	--	--	--	--	--	--	--	--	194	2140	4/4	223	299	2/2
Manganese, Dissolved	1900[c]	na	--	--	--	--	--	--	--	--	--	602	1380 J	4/4	485	974	2/2
Manganese, Total	1900[c]	na	--	--	--	--	--	--	--	--	--	792	1420	4/4	500	980	2/2

Notes:

[1] National Recommended Water Quality Criteria, Human Health protection for consumption of water and fish (EPA 440/5-86-001)

[a] Primary Maximum Contaminant Level (MCL)

[b] Tacoma Landfill Consent Decree (5/17/91) Health Based Criteria (HBC)

[c] Leach Creek Discharge Standard

na not available

Attachment 3-6. Tacoma Landfill Surface Water Data Summary, 2003-2007

Analyte (ug/L)	Performance Standard (ug/L)	Ambient Water Quality Criteria[1]	2003			2004			2005			2006			2007		
			Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency
Surface Water (Leach Creek)																	
1,1,1-Trichloroethane	200[a]	na	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\6	ND (0.5)	ND (0.5)	0\14	ND (0.5)	ND (0.5)	0\8
1,1-Dichloroethane	20[b]	330	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\6	ND (0.5)	ND (0.5)	0\14	ND (0.5)	ND (0.5)	0\8
1,2-Dichloroethane	5[a]	0.38	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\6	ND (0.5)	ND (0.5)	0\14	ND (0.5)	ND (0.5)	0\8
1,2-Dichloroethene, Total	70[a]	na	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\6	ND (0.5)	ND (0.5)	0\14	ND (0.5)	ND (0.5)	0\8
Benzene	5[a]	2.2	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\6	ND (0.5)	ND (0.5)	0\14	ND (0.5)	ND (0.5)	0\8
Chlorobenzene	100[a]	130	ND (0.5)	ND (0.5)	0\9	--	--	--	--	--	--	ND (0.5)	ND (0.5)	0\10	ND (0.5)	ND (0.5)	0\8
Chloroethane	20[b]	na	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\6	ND (0.5)	ND (0.5)	0\14	ND (0.5)	ND (0.5)	0\8
Ethylbenzene	320[b]	530	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\6	ND (0.5)	ND (0.5)	0\14	ND (0.5)	ND (0.5)	0\8
Methylene Chloride	5[a]	na	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (1.1)	0\12	ND (0.5)	ND (0.5)	0\6	ND (0.5)	ND (0.5)	0\14	ND (0.5)	ND (0.5)	0\8
Tetrachloroethene	5[a]	0.69	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\6	ND (0.5)	ND (0.5)	0\14	ND (0.5)	ND (0.5)	0\8
Toluene	175[b]	1300	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\6	ND (0.5)	ND (0.5)	0\14	ND (0.5)	ND (0.5)	0\8
Trichloroethene	5[a]	2.5	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\6	ND (0.5)	ND (0.5)	0\14	ND (0.5)	ND (0.5)	0\8
Vinyl Chloride	2[a]	0.025	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\6	ND (0.5)	ND (0.5)	0\14	ND (0.5)	ND (0.5)	0\8
Xylenes, Total	10[b]	na	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\12	ND (0.5)	ND (0.5)	0\6	ND (0.5)	ND (0.5)	0\14	ND (0.5)	ND (0.5)	0\8
Arsenic, Dissolved	10[a]	0.018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic, Total	10[a]	0.018	ND (1.9)	8.6	10\15	ND (1.9)	7.1	9\16	ND (2.3)	13.5	7\8	2.5	7.7	18\18	3.9	9	9\9
Iron, Dissolved	1500[c]	na	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron, Total	1500[c]	na	136	183	4\4	224	453	4\4	--	--	--	664	1060	3\3	332	409	5\5
Manganese, Dissolved	1900[c]	na	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese, Total	1900[c]	na	124	905	4\4	76.6	601	4\4	--	--	--	170	403	4\4	106	376	4\4

Notes:

Shading indicates value exceeded the performance standard or ambient water quality standard.

[1] National Recommended Water Quality Criteria, Human Health protection for consumption of water and fish (EPA 440/5-86-001)

[a] Primary Maximum Contaminant Level (MCL)

[b] Tacoma Landfill Consent Decree (5/17/91) Health Based Criteria (HBC)

[c] Leach Creek Discharge Standard

na not available

Attachment 3-7. Tacoma Landfill Residential Well Data Summary, 2003-2007

Analyte	Performance Standard (ug/L)	2003			2004			2005			2006			2007		
		Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency	Minimum	Maximum	Detection Frequency
1,1,1-Trichloroethane	200[a]	0.5 U	0.5 U	0 / 55	0.5 U	0.5 U	0 / 50	0.5 U	0.5 U	0 / 51	0.5 U	0.5 U	0 / 52	0.5 U	0.5 U	0 / 52
1,1-Dichloroethane	20[b]	0.5 U	1.4 J	1 / 55	0.5 U	0.5 U	0 / 50	0.5 U	2.3 J	2 / 51	0.5 U	2.4	1 / 52	0.5 U	2	1 / 52
1,2-Dichloroethane	5[a]	0.5 U	0.5 U	0 / 53	0.5 U	0.5 U	0 / 49	0.5 U	0.8 J	2 / 51	0.5 U	0.5	1 / 52	0.5 U	0.5 U	0 / 52
Benzene	5[a]	0.5 U	0.5 U	0 / 55	0.5 U	0.5 U	0 / 50	0.5 U	0.5 U	0 / 51	0.5 U	0.5 U	0 / 52	0.5 U	0.5 U	0 / 52
Chloroethane	20[b]	0.5 U	0.5 U	0 / 55	0.5 U	0.5 U	0 / 50	0.5 U	0.5 U	0 / 51	0.5 U	1	1 / 52	0.5 U	0.5 U	0 / 52
Ethylbenzene	230[b]	0.5 U	0.5 U	0 / 55	0.5 U	0.6	1 / 50	0.5 U	0.5 U	0 / 51	0.5 U	0.5 U	0 / 52	0.5 U	0.5 U	0 / 52
Methylene Chloride	5[a]	0.5 U	2.2	1 / 55	0.5 U	1	1 / 50	0.5 U	1.2 J	2 / 51	0.5 U	0.5 U	0 / 52	0.5 U	0.5 U	0 / 52
Toluene	175[b]	0.5 U	0.5 U	0 / 55	0.5 U	0.5 U	0 / 50	0.5 U	0.5 U	0 / 51	0.5 U	0.5 U	0 / 52	0.5 U	0.5 U	0 / 52
Vinyl Chloride	2[a]	0.5 U	0.5 U	0 / 24	0.5 U	0.5 U	0 / 50	0.5 U	0.5 U	0 / 51	0.5 U	0.6	3 / 52	0.5 U	0.5 U	0 / 52
Xylenes, Total	10[b]	0.5 U	0.7	1 / 55	0.5 U	3.5	1 / 50	0.5 U	1.1 J	2 / 51	0.5 U	0.5 U	0 / 52	0.5 U	0.5 U	0 / 52
Iron, Dissolved	1500[c]	1840	1840	1 / 1	1560	11000	2 / 2	--	--	--	1850	1850	1 / 1	5250	5250	1 / 1
Iron, Total	1500[c]	3.1 UJ	9420	52 / 55	17.8 B	99300	39 / 50	20 B	26800	47 / 51	16 B	47100	49 / 52	14 U	30300	41 / 52
Manganese, Dissolved	1900[c]	159	159	1 / 1	137	616	2 / 2	--	--	--	436	436	1 / 1	543	543	1 / 1
Manganese, Total	1900[c]	0.13 UJ	493	52 / 55	0.082 U	899	38 / 50	0.305 UJ	595	42 / 51	0.59 UJ	604	49 / 52	0.43 B	613	38 / 52
Arsenic, Total	10[a]	1.9 U	16.9	32 / 55	1.4 U	62	37 / 50	1.7 U	37	32 / 51	0.71 U	17.9	40 / 52	1.9 U	20.5	41 / 52

Notes:

Shading indicates the value exceeded the performance standard.

[a] Primary Maximum Contaminant Level (MCL)

[b] Tacoma Landfill Consent Decree (5/17/91) Health Based Criteria (HBC)

[c] Leach Creek Discharge Standard

Attachment 3-8. Tacoma Landfill Site Photographs

Photo 1: Temporary cap at Central Area.

Photo 2: Landfill cap and gas extraction system piping.

Attachment 3-8. Tacoma Landfill Site Photographs, Cont.

Photo 3: Mothballed ground water treatment facility.

Photo 4: Transfer station and flares.

Attachment 3-9. Tacoma Landfill ARARs Analysis

Other Environmental Laws cited in ROD*	How applied to site	Changes to Standard
Resource Conservation and Recovery Act (RCRA, 49 CFR 261) Washington State Dangerous Waste Regulations and Washington State Minimal Functional Standards for Solid waste Handling	Ground water corrective action required until concentrations of hazardous constituents at the point of compliance achieve either MCLs or alternate concentrations limits All hazardous wastes at a site be removed, treated on site, or capped in such a way as to minimize the migration of contaminants from the site	No changes that impact remedy since last Five-Year Review
Section 1412 of the Safe Drinking Water Act (SDWA), 42 U.S.C. 300g-1, "National Drinking Water Regulations"; National Primary Drinking Water Regulations. 40 CFR Part 141	Federal MCLs shall be met to prevent exposure to the public to contaminated drinking water Affected water supplies will be connected to City Water.	Exposure toxicity for TCE is currently under revision.
Clean Air Act, 42 U.S.C. 7401)	Regulates air emissions to protect human health and the environment associated with air stripper (if used) and any flares used at site.	Air stripper not used on site. Flares under permit. No changes that impact remedy since last Five-Year Review
Clean Water Act (CWA) Section 402) NPDES Requirements	Treatment and release of effluent. Landfill cap will reduce leachate generation.	ROD specifies no permit required for on site remedial activities.

*Although not specified in the ROD, The City also maintains a Solid Waste Permit for the Landfill, managed by TPCHD under the authority of RCW 70.95 and in accordance with WAC 173-351 and 173-350