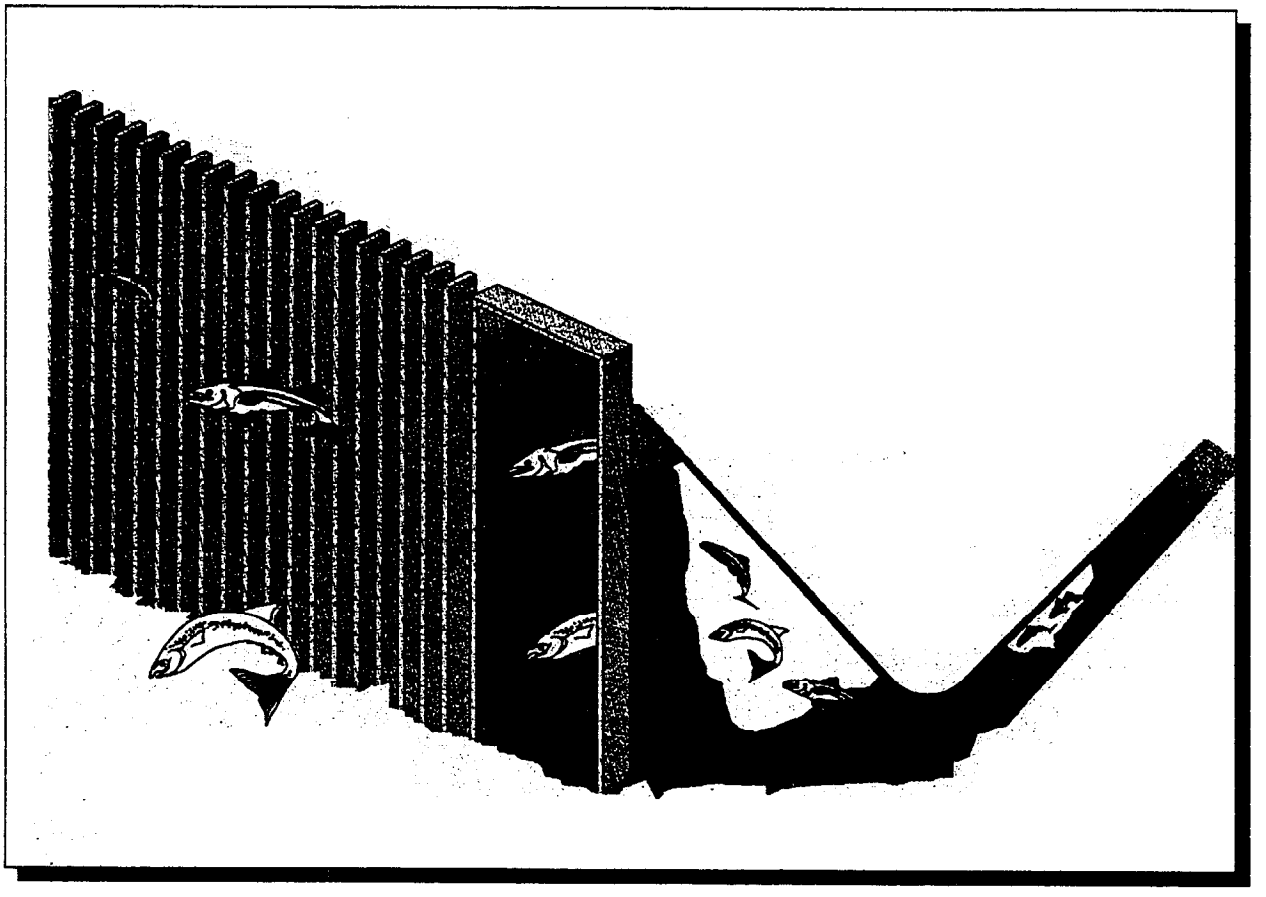

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Chemistry and Water Quality at the Tracy Fish Collection Facility Tracy, California

By

Douglas Craft [1], Lee Mao [2], John Fields [2] and Bruce Moore [2]
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United States Department of the Interior
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Denver Technical Services Center
[1] Fisheries Applications Research Group

And

Mid-Pacific Region
[2] Quality Assurance Branch

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GLOSSARY

MEASUREMENT UNITS

acre	English unit for land area, (1 acre = 2.471 ha)
equivalent	a chemical concentration unit based on reactivity equal to the molar weight divided by the valence of the compound or ion
g	gram, SI mass unit
ha	hectare, SI area unit (1 Ha = 1.00 X 10^4 m^2)
kg	kilogram, SI mass unit
L	liter, SI volume unit
lat/long	latitude/longitude
LC_{50}	lethal concentration that kills 50% of the test organisms within the exposure period of the bioassay
LD_{50}	lethal dosage that kills 50% of the test organisms within the exposure period of the bioassay
M	molarity, moles per liter
m	meter, SI length unit
meq/L	milliequivalents per liter
mg	milligram, SI mass unit, (1 mg = 10^{-3} g)
mg/kg	milligrams per kilogram (1000 g), SI concentration unit applied to solid samples and liquid samples with high salinity
mg/L	milligrams per liter, SI concentration unit
mL	milliliter, SI volume unit, (1000 mL = 1.000 L)
mm	millimeter (10^{-3} m), SI length unit
molal	moles per 1000 g of solution
mole	a chemical concentration unit based on empirical formula, equal to the mass of Avogadro's number (6.023 X 10^{23}) of molecules of a chemical compound, or atoms of an element
mol/L	moles per liter
µeq/L	microequivalents per liter
µg	microgram, SI mass unit, (1 µg = 10^{-6} g)

GLOSSARY

µg/kg	micrograms per kilogram (1000 g), SI concentration unit applied to solid samples and liquid samples with high salinity
µg/L	micrograms per liter, SI concentration unit
µm	micrometer, or micron (10^{-6} m), SI length unit
µS/cm	microsiemens per square centimeter, SI unit for electrical conductivity
mV	millivolt, SI voltage unit
N	normality, expressed in equivalents/liter
NTU	nephelometric turbidity units
ng	nanogram, SI mass unit, (1 ng = 10^{-9} g)
ng/kg	nanograms per kilogram (1000 g), SI concentration unit applied to solid samples and liquid samples with high salinity
ng/L	nanograms per liter, SI concentration unit
ppb	parts per *billion*, equivalent to µg/kg and properly applied to solid sample concentrations
ppm	parts per *million*, equivalent to mg/kg and properly applied to solid sample concentrations
ppt	parts per *trillion*, equivalent to ng/kg and properly applied to solid sample concentrations
SI	Système Internationale d'Unités, the international standard system for metric measurement units
su or s.u.	standard units, usually applied to pH
V	volt, SI voltage unit

ANALYTICAL CHEMISTRY AND WATER QUALITY TERMS

AA	atomic absorption
AAS	atomic absorption spectrophotometer
CVAA	cold vapor atomic absorption
CVAFS	cold vapor atomic fluoresence spectrophotometry
Dissolved	an operationally defined term applied to water analysis results, usually meaning sample is filtered through a 0.45-µm pore-size membrane filter before analysis
EC	electron capture detector, on a GC instrument (also electrical conductivity)

FIA	flow injection analyzer
FID	flame ionization detector, on a GC instrument
GC	gas chromatograph
GC-MS	gas chromatograph - mass spectrometer
GFAA	graphite furnace atomic absorption
IC	ion chromatograph
ICP-ES	inductively-coupled plasma - emisssion spectrograph
ICP-MS	inductively-coupled plasma - mass spectrometer
pH	degree of acidity or alkalinity of a solution
solute	the chemical that is dissolved into the solvent
solvent	the chemical that dissolves the solute
Suspended	an operationally defined term applied to water analysis results, analytes associated with suspended particles larger than 0.45-µm, usually calculated by subtracting dissolved from total
Total	an operationally defined term applied to concentration data, usually meaning an unfiltered sample that is digested or extracted prior to analysis

QUALITY CONTROL - QUALITY ASSURANCE TERMS

ANSI	American National Standards Institute
APHA	American Public Health Association
ASTM	American Society for Testing and Materials
ASQC	American Society for Quality Control
AWWA	American Water Works Association
BDL	below detection limit
blank	a clean check sample used to test for contamination during an instrument run
blind	a certified check sample submitted to a lab disguised as a normal sample
CCB	continuing calibration blank
CLP	EPA Contract Laboratory Program
COC	chain of custody

GLOSSARY

CCV	continuing calibration verification, a certified known concentration check sample analyzed at intervals during an instrument run, used to verify that the instrument remains properly calibrated
check sample	a sample analyzed during an instrument run having known concentrations, not necessarily certified or traceable
DL	detection limit
IB	instrument blank - usually pure water or solvent run to check for contamination
ICB	initial calibration blank
ICV	initial calibration verification, a certified known concentration check sample used to verify that calibration standards were properly prepared and that the instrument is correctly calibrated
IDL	instrument detection limit
IEC	International Electrotechnical Committee
ISO	International Organization for Standardization
Ion Balance	a percentage used to check major ions data that compare cations to anions
J	EPA data validation code for "estimated"
LCS	laboratory control sample, a check sample with known, but not necessarily certified, concentration
LOD	limit of detection, statistically based
LOQ	limit of quantitation, statistically based
MB	method blank, a clean deionized water sample that is digested or extracted following a given method
MDL	method detection limit
MSD	matrix spike duplicate
matrix	the sum of all chemical components in the sample *besides the analyte* being tested
matrix spike	a real sample to which a known amount of an analyte is added, sometime denoted MS
ND	not detected
PQL	practical quantitation limit

GLOSSARY

QA	quality assurance, efforts and tests performed *external to the lab* to make sure that a lab is following the QC requirements. These would include lab and field sampling audits, submission of known concentration samples as blind check sample
QC	quality control, efforts and tests undertaken *in the lab* to check or document analysis data quality
RPD	relative percent difference, a way to calculate precision from duplicate data
Recovery	observed concentration divided by theoretical or true concentration, usually expressed as a percentage
%R	percent recovery, in general, (observed value)÷(true value) X 100
SDG	sample delivery group
spike	a known amount of an analyte added to a real sample or blank
U	EPA validation code for "undetected" (also element uranium)
ULSA	Unique Laboratory Services Agreement, EPA program for contracting special analytical tests not covered under routine contracting programs
WEF	Water Environment Federation

ELEMENTS and ANALYTES

Al	aluminum
As	arsenic
Ag	silver
anions	negatively charged ions, usually HCO_3^-, CO_3^{2-}, SO_4^{2-}, and Cl^-.
B	boron
Ba	barium
BOD	biological oxygen demand
Ca, Ca^{2+}	calcium, or calcium ion
Cd	cadmium
Cl^-	chloride, or chloride ion
Co	cobalt

GLOSSARY

CO_3^{2-}	carbonate, or carbonate ion
COD	chemical oxygen demand
Cr	chromium
Cu	copper
cations	positively charged ions, usually Ca, Mg, Na, and K
DO	dissolved oxygen, mg/L
DOC	dissolved organic carbon
EC	electrical conductivity, µS/cm
Eh	redox potential, Mv
F^-	fluoride, or fluoride ion
Fe	iron
Hg	mercury
HCO_3^-	bicarbonate, or bicarbonate ion
ion	an element or molecule dissolved in water with an electrical charge
K, K^+	potassium, or potassium ion
Me-Hg	methylmercury
Mg, Mg^{2+}	magnesium, or magnesium ion
Mn	manganese
Mo	molybdenum
major ions	higher concentration elements dissolved in water, usually: Ca, Mg, Na, K, HCO_3^-, CO_3^{2-}, SO_4^{2-}, and Cl^-
N	nitrogen
NH_3	ammonia
NH_4^+	ammonium ion
NO_3^-	nitrate, or nitrate ion
NO_2^-	nitrite, or nitrite ion

GLOSSARY

NO_3+NO_2	nitrate plus nitrite
Na, Na^+	sodium, or sodium ion
Ni	nickel
nutrients	a term referring to all nitrogen and phosphorus species, usually includes total-P, ortho-P TKN, NH_3, NO_2, and NO_3
OH^-	hydroxide, or hydroxide ion
o-P, ortho-P	orthophosphate
P	phosphorus
Pb	lead
PO_4^{3-}	orthophosphate, phosphate, or phosphate ion
SO_4^{2-}	sulfate, or sulfate ion
Se	selenium
Sb	antimony
Sn	tin.
T	temperature, °C
TDS	total dissolved solids, mg/L, also called "filterable residue"
Tl	thallium
Ti	titanium
TKN	total Kjeldahl nitrogen
TM	trace metals
TOC	total organic carbon
TSS	total suspended solids, mg/L, also called "non-filterable residue"
t-P, total-P	total phosphorus
U	uranium
V	vanadium
Zn	zinc

GLOSSARY

AGENCY, ORGANIZATIONAL, and LOCATION ABBREVIATIONS

CVP	Central Valley Project
DMC	Delta Mendota Canal
EPA	U.S. Environmental Protection Agency
FGS	Frontier Geosciences, Inc., Seattle, Washington
MP	Mid-Pacific Region, Bureau of Reclamation
SFEI	San Francisco Estuary Institute
SJR	San Joaquin River
SPSS	Statistical Package for the Social Sciences, SPSS, Inc.
TEFF	Tracy Experimental Fish Facility
TFCF	Tracy Fish Collection Facility
TFFIP	Tracy Fish Facility Improvement Program
TPP	Tracy Pumping Plant
TSC	Technical Service Center, Denver, Colorado
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey

EXECUTIVE SUMMARY

This report presents a summary and assessment of the water quality at the Bureau of Reclamation's (Reclamation) Tracy Fish Collection Facility (TFCF), Tracy, California. The TFCF is the fish screen intake structure for the Tracy Pumping Plant (TPP), and provides water that is pumped into Reclamation's Delta Mendota Canal. These facilities are located in the southern region of the San Francisco Bay Delta area (Delta or South Delta) in northern California.

The evaluation in this report was based on historical and published data gathered from several different sources: queries from the Environmental Protection Agency (EPA) STORET database; the 1997 San Joaquin County agricultural chemical application database; a U.S. Geological Survey (USGS) study that measured sub-µg/L concentrations of pesticides and herbicides in the San Joaquin and Sacramento Rivers; data from a permanent Hydrolab probe installed at the TFCF intake; and data from a recent sampling event performed by Reclamation personnel in October 1997. These data were archived in Microsoft® Access 97 database files, and are available on request.

The major ions[1] chemistry and salinity at the TFCF are influenced by a complex set of variables that affect the Old River, a South Delta distributary of the San Joaquin River (SJR). These variables include large-scale Central Valley land use and watershed gradients, precipitation and storm events, seasonal runoff patterns, daily tidal fluctuations, large-scale irrigation water pumping at the TPP and the nearby State of California pumping facility at Clifton Court Forebay, seasonal irrigation and application of agricultural chemicals, and installation and removal of flow-restriction dams in local rivers and canals.

Data gathered for this report suggest that Old River water at the TFCF is a sodium-chloride dominant water with total dissolved solids (TDS) ranging from 300 to 1100 mg/L, and that the salinity and chemistry are primarily influenced by seasonal runoff hydrology and watershed land use patterns. The dominant source water for the Old River is from the SJR; however, daily conductivity (EC) fluctuations of 100 to 300 µS/cm, caused by tidal action, are commonly observed at the TFCF. The daily salinity fluctuations are thought to be caused by up-gradient transport and mixing of lower concentration waters from the Mokelumne River and Sacramento River by the rising estuarine salt wedge.

The overall seasonal and daily trends observed in the TFCF Hydrolab data (the most representative data set with respect to TFCF proximity and half-hourly measurement frequency) are not clearly supported by major ions data collated from the EPA STORET database. The reasons for this general lack of corroboration include low numbers of samples having complete sets of major ions data, infrequent and discontinuous sampling schedules, and scarcity of data from stations sufficiently close to the TFCF to be location-representative. The selected TFCF latitude-longitude(lat-long) box query from the STORET database is generally rich in commonly measured field data, such as conductivity (EC), pH, or dissolved oxygen (DO), but is lacking in more complete sets of data for the major ions, nutrients (nitrogen and phosphorus), trace metals, and trace organics.

The STORET queries for gross water quality variables, nutrients, and biological data do show some indications of seasonal agricultural influence trends, but the trace metal and organics data sets do not contain enough representative data to assess the primary control variables for trace compounds in TFCF water. If the available data are evaluated with respect to California State water quality criteria, trace element data from the October 1997 sampling event and the USGS pesticide data sets suggest that TFCF water is well below levels of concern. However, the fish collected at the TFCF have consistently showed signs of environmental stress and fishery health impairment during summer operations.

While fish morbidity, lesions, and mortality are likely caused by fish exposure to general conditions prevailing in the greater South Delta area, the scarcity of water quality data representative of the TFCF makes assessing the fishery impacts of screen operations or new screen designs a difficult task.

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1 "major ions refers to higher concentration ionic components in natural waters, usually including calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), carbonate (CO_3^{2-}), bicarbonate (HCO_3^-), sulfate (SO_4^{2-}) and chloride (Cl^-)

Given the observed presence of many chemical toxins at low, sub-lethal concentrations in the SJR,
Given the observed presence of many chemical toxins at low, sub-lethal concentrations in the SJR, and the lack of representative historical data in the vicinity of the TFCF, implementation of a defensible quality, temporally representative, and sufficiently low detection limit sampling and analysis program is recommended. Current Subproject 8 plans address these technical issues (as well as costs) by implementation and use of compositing sampling pumps for both trace elements and organic analytes, and solid phase pre-concentration extraction for organic analytes.

INTRODUCTION

This report is the first in a series from Subproject 8, *Chemical Monitoring and Assessment at the Tracy Fish Screen*, which is part of the Tracy Fish Facility Improvement Program (TFFIP). The TFFIP is an interdisciplinary research program started in 1989, and funded to investigate design and operational improvements for the fish screen at the Tracy Fish Collection Facility (TFCF). The fish screen at the TFCF, the intake for the Tracy Pumping Plant (TPP), was designed to prevent fish from being pumped through the TPP into the Delta Mendota Canal (DMC), and represented state-of-the-art technology when originally installed. However, changing fishery and regulatory conditions have mandated updating of screen technology and improvements to address fishery concerns. New fish screen technology developed under the TFFIP will be installed and tested at the Tracy Experimental Fish Facility (TEFF), currently under construction at the TFCF.

The purpose of Subproject 8 is to develop a reference or "baseline" water quality data set that combines historical water chemistry data, agricultural chemical application data, data from continuous Hydrolab probe monitoring of general water quality variables temperature (T), degree of acidity or alkalinity of a solution (pH), conductivity (EC), dissolved oxygen (DO), redox potential (Eh), along with chemical analysis data from future water samples collected at the TFCF. A baseline water quality data set is important to the TFFIP because, as this report will describe, representative water quality data for the TFCF are not generally available. Representative and comprehensive water quality data are needed to identify and understand the local TFCF variables affecting water chemistry in the Old River, and to better understand the relationships between observed fishery health problems and water quality. Without a basic understanding of the toxic components and chemical fishery stressors active in TFCF water, it would be difficult to assess whether fishery health effects are caused by new screen technology installation, or whether the observed effects are due to generalized South Delta water quality.

The Subproject 8 study is being coordinated with personnel at the TFCF and the Quality Assurance Branch in the Bureau of Reclamation (Reclamation) Mid-Pacific (MP) Regional Office, Sacramento, California. Peer reviews of reports and plans are being performed by personnel from the U.S. Geological Survey (USGS), Sacramento, California, the Central Valley Regional Water Quality Control Board, Sacramento, and the San Francisco Bay Estuary Institute (SFEI), San Francisco, California.

Project Background: Both the TFCF and the TPP were built in the early 1950's as part of the Reclamation's Central Valley Project (CVP), a large irrigation infrastructure project that enabled agricultural expansion throughout most of the Central Valley of California. The Tracy facilities are located approximately 8 km northwest of the town of Tracy, California (see map in Figure 1).

The TPP pumps water for irrigation, municipal, and industrial uses from the Old River into the DMC, which flows southeast from the screen and pumping facilities. The California Aqueduct is a similar nearby irrigation facility operated by the State of California (the State facility) at Clifton Court Forebay, located north of the TFCF. Before the CVP and similar State irrigation systems were implemented, the San Joaquin River (SJR) water flowed north unimpeded into San Francisco Bay. The SJR is now diverted south in the DMC, the Friant-Kern Canal, and other State and Federal irrigation canals. Water from the Sacramento-San Joaquin Delta (Delta) is conveyed by a series of pumping stations on the DMC to the Mendota Pool to replace water diverted to the Friant-Kern Canal. DMC water flows by gravity southward down the San Joaquin Valley in a network of canals and then returns by way of the SJR.

Delta water quality and fishery health have been affected by the irrigation infrastructure, expanding water re-use over time, and modern agricultural practices. For example, fish collected at the TFCF during summer months often show symptoms of environmental stress such as skin lesions, damaged gills, poor equilibrium, and mortality during screen operation and temporary holding prior to transport to the SJR. Implementation of the Endangered Species Act has also raised concerns, as several species of threatened fish are showing population declines in the Delta.

General Factors Affecting Water Quality at the TFCF: The chemistry of TFCF intake water from the

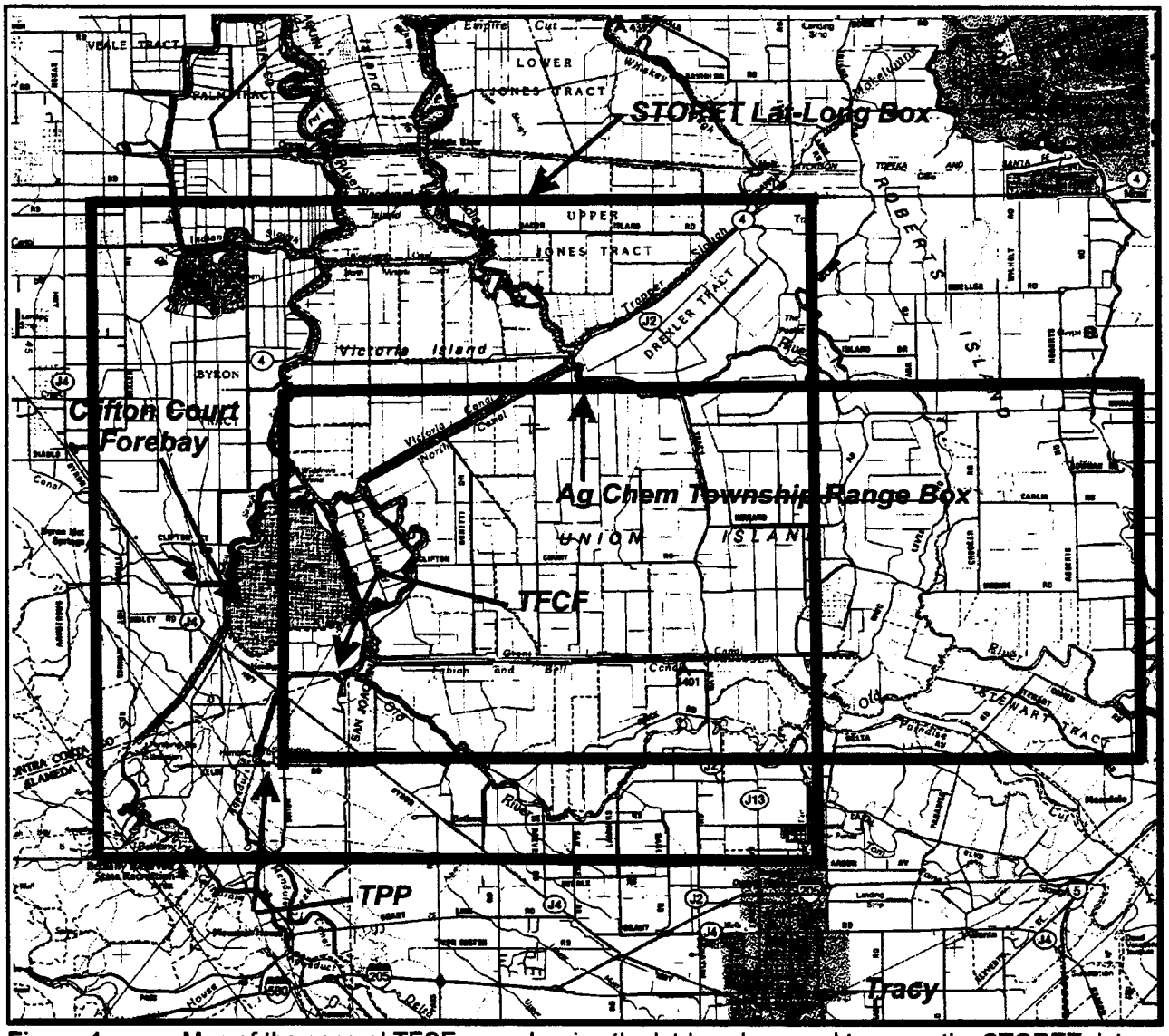


Figure 1 Map of the general TFCF area showing the lat-long box used to query the STORET data base, and the smaller township-range box used to query the San Joaquin County agricultural chemical data base.

Old River, a South Delta distributary of the SJR, is the result of many variables interacting in a complex and poorly understood manner. Local influences include large-scale South Delta mixing of different freshwater sources converging on San Francisco Bay, tidal fluctuations, artificial pumping from the TPP and the State facility at Clifton Court Forebay, irrigation return flows and chemical applications on local crops, and the seasonal installation (in April) and removal (in September) of temporary channel barriers in the Old River and nearby irrigation canals. Finally, year to year variability in the hydrologic cycle, increasing urban population trends, and seasonal variability in precipitation and runoff events add greater complexity to the hydrodynamic factors influencing the water quality at the TFCF.

The Old River at the TFCF intake is a sodium-chloride dominated water with TDS ranging from 300 to 1100 mg/L. The principal influence at the

TFCF is the SJR and its exposure to runoff from the entire southern portion of the Central Valley and its marine sedimentary geology, along with agricultural and urban land use. Daily tidal EC fluctuations of 100 to 300 µS/cm are also commonly observed at the TFCF. These salinity fluctuations are thought to be caused by up-gradient transport and mixing of lower concentration waters from the Mokelumne River and Sacramento River by the rising tidal salt wedge (*State of California, 1999*). These tidal flows are also thought to hydraulically retard SJR flows into the Old River.

While water quality at the TFCF appears to be controlled mainly by large-scale Central Valley runoff and local tidal effects, agricultural activity and associated chemical applications also occur in the immediate vicinity of the TFCF. These irrigation return-flow inputs enter the Grant Line and Fabian and Bell Canals, the Victoria and North Canals, the Tom Paine Slough and the Paradise Cut, along with the Old and Middle Rivers, and represent a highly variable contaminant source for the TFCF water. When detected in the SJR, background concentrations of toxic agricultural chemicals during the early 1990's were observed well below regulated concentrations, in the range of 50 to 800 ng/L (*MacCoy et al., 1995; and Crepeau et al., 1994*). However, local herbicide and pesticide applications may produce higher concentration transient "spikes" that move through the TFCF intake.

Agricultural chemical applications occur during three periods: the winter dormant spray season (December-February); the spring season (March-April); and the summer active growing season (July-September). The mechanisms that transport these chemicals into local TFCF waters have not been specifically investigated, but probably include: irrigation leaching of treated fields and subsequent subsurface drainage; surface runoff in return flow drains; surface and drainage runoff from rain and storm events; leaching and transport through the soil column into local ground waters; and accidental discharges related to chemical applications and storage.

This report provides a TFFIP reference source that summarizes and discusses the available historical data, recently collected chemical analyses data, the 1997 San Joaquin County agricultural chemical application and toxicity data, and chemical structural data. These data have been collated and archived in Microsoft® Access databases. Also provided is a brief discussion of other work and plans for Subproject 8 involving an ongoing calibration and reporting program for the permanent Hydrolab probe installed at the TFCF intake (which measures pH, T, EC, and DO on an semi-continuous 30-minute schedule), and implementation of a cost-effective and defensible-quality sampling and analysis plan involving monthly compositing and preconcentration of samples.

METHODOLOGY

Field Sampling: The single sampling event for this study was performed by Reclamation personnel from the TFCF, MP Regional Office, Sacramento, California, and the first author during October 1997. Five surface water grab samples were collected from stations in the near vicinity of the TFCF in the Old River, the Grant Line and Fabian Canals, and near the intake for the TFCF and the Clifton Court Forebay, and analyzed for major ions, total and dissolved organic carbon (TOC/DOC), nitrogen (N) and phosphorus (P), and trace elements including mercury (Hg), and methylmercury (Me-Hg). Sampling station names, locations, and descriptions are listed in Table 1.

Water column profiles for T, pH, DO, EC, Eh, and turbidity were measured at each sampling site using a Hydrolab Model H-20 multi-probe with the Surveyor 4 data logger. All Hydrolab sensing probes were calibrated the day of sampling. EC was calibrated using a certified standard reference solution (Environmental Resources Associates, Inc., Arvada, Colorado), pH using a 2-buffer (VWR Scientific) calibration, Eh using Zobell's solution (VWR Scientific) or pH buffer. DO was calibrated using saturated air at a measured barometric pressure, and turbidity was calibrated using a 40-mg/L formazin standard (Hydrolab 4000-mg/L stock solution). Calibration for each probe was verified before sampling and at the end of the day using a reference calibration verification solution. Hydrolab profile data and sample notes were recorded in a field notebook.

Raw water samples for major ions, nutrients (all N and P forms), and TOC were collected as surface

Table 1 Sampling locations for the October 1997 sampling event.

Station ID	Description	°N Latitude	°W Longitude	km from TFCF
Site 1	Old River 50 m upstream of temporary barrier abutments	37°48'15"	121°31'52"	2.8
Site 2	Old River 50 m downstream of temporary barrier abutments	37°48'21"	121°32'01"	2.5
Site 3	At temporary barrier abutments upstream of Grant Line Bridge	37°49'12"	121°26'42"	10.1
Site 4	Confluence of Grant Line Canal and Old River	37°49'13"	121°33'07"	0.73
Site 5	Old River at TFCF intake outside debris boom	37°49'01"	121°33'32"	0.15

grab samples from the boat, or with a van Dorn sampler (Wildco Supply) for at-depth samples. Samples were then transferred to labeled, pre-cleaned polyethylene sample bottles (Environmental Sampling Supply, Oakland, California) which were placed on ice in coolers. Samples for major ions and nutrients were shipped overnight to the Reclamation Environmental Research Chemistry Laboratory, Denver, Colorado (the Denver Lab), and TOC/DOC samples were shipped overnight to the Reclamation Pacific Northwest Regional Soil and Water Laboratory (the Boise Lab). The Boise Lab performed 0.45-µm membrane filtration within 24 hours of sample receipt, and samples to both labs were shipped under standard Chain of Custody (COC) procedures. Quality assurance for these samples included collection of duplicate samples submitted as blinds to the labs.

Samples for trace elements (or trace metals) and Hg were grab samples collected using ultra-clean sampling procedures provided by Frontier Geosciences, Inc., Seattle, Washington (FGS) following EPA Method 1669 (*EPA, 1996b*). FGS provided certified pre-cleaned, double-bagged Teflon sample bottles, and also performed requested 0.45-µm filtration within 24 hours of sample receipt. Surface grab samples were collected from a slowly moving boat. Water samples were shipped to FGS by overnight delivery on ice using standard COC forms and procedures.

Quality assurance for these samples included collection of duplicate samples, and field trip blanks (sample bottles filled with deionized water and preservative opened and exposed to air at each sampling station) submitted as blinds to the analytical laboratory.

Analytical Methods for the October 1997 Sampling: The Denver Lab analyzed water samples for major ions and nutrients, using EPA (*EPA, 1983; EPA, 1986*) or APHA-AWWA-WEF *Standard Methods* (*American Public Health Association, 1995*) consensus methods. Calcium (Ca), magnesium (Mg), sodium (Na), and potassium (K) were analyzed using inductively-coupled plasma emission spectrometry (ICP-ES) with a Thermo-Jarrel Ash ICP-61. Ammonia (NH_3), nitrate+nitrite (NO_3+NO_2), and total Kjeldahl nitrogen (TKN), total-phosphorus (t-P), ortho-phosphorus (PO_4^{4-}), were analyzed using automated colorimetric methods on a Perstorp Analytical Model 3570 automated flow-injection analyzer. Sulfate (SO_4^{2-}), and chloride (Cl^-) were analyzed by ion chromatography using a Dionex Model DX-500 Ion Chromatograph. Carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) alkalinity were analyzed using electrometric titration on an automated Brinkmann Model 682 titroprocessor. The Boise Lab analyzed for TOC/DOC using an OI, Inc., Model 700 TOC analyzer following EPA Method 415.1 (*EPA, 1983*).

FGS analyzed for total Hg using EPA Method 1631 (*EPA, 1996c*), which involves bromine monochloride (BrCl) oxidation followed by stannous chloride ($SnCl_2$) reduction, purging volatile Hg onto a gold trap, followed by thermal desorption before detection using Cold Vapor Atomic Fluorescence Spectrophotometry (CVAFS). Me-Hg was analyzed by the FGS Method (*Bloom*

and Fitzgerald, 1983; Bloom, 1989; and Bloom, 1990) and involved distillation extraction and aqueous phase ethylation followed by gas chromatographic (GC) separation before detection using CVAFS. Low concentration trace elements were analyzed using inductively-coupled plasma mass spectrometry (ICP-MS), following EPA Method 1638 (*EPA, 1996a*) using an Elan-Perkin Elmer Model 6000 ICP-MS. Ultra-clean filtration was performed under clean-room conditions.

All analytical service laboratories used in this study had formal quality assurance plans in place which included provision for standard operating procedures, instrument calibration verification, instrument duplicates and spikes, laboratory control samples, and defined corrective actions for each instrument run. All data deliverable packages except for TOC/DOC included Quality Control (QC) reports that allowed evaluation and validation of data quality. While this sampling was performed before a formal *Quality Assurance Project Plan* was implemented, no chemical data from this sampling required special qualification.

Computer and Database Methods: Data presented in this report were collated from several different sources: the EPA STORET database, 1997 agricultural chemical field application data from San Joaquin County, USGS pesticide and herbicide data (*MacCoy et al., 1995; and Crepeau et al., 1994*) and Hydrolab data from the TFCF Geomation data acquisition system. Appendix 1 provides details on data base files, sources, and procedures used in subsequent appendices.

Generally, source files in ASCII format or printed tables were imported into Microsoft® Access (version 2.0), running under Microsoft® Windows 95. Microsoft® Excel (version 5.0) was used to convert ASCII text data source files for subsequent import into Access as *tables*. Within each database, simple or crosstab queries were created to display and export specific information from the data sets for subsequent graphing and statistical analysis using SPSS® (Statistical Package for the Social Sciences, Windows® version 8.0). Queries were exported from Access as Excel (version 3.0) files which were converted to SPSS® using DBMSCopy (version 6.06, SPSS, Inc.). Processed and altered SPSS® files were also returned to Access as new tables, imported via conversion to an Excel spreadsheet. Version 2.0 Access files have also been converted to Access 97 files, and either format is available from the first author on request.

Coding of Non-Detect Data: Chemical analyses data reported as below detection limit were entered as *negative* numbers which corresponded to the inverse of the reported detection limit. For example, <20 µg/L would be coded as -20 µg/L. Concentration data reported as zero values (except for CO_3^{2-}), or as "U" or "ND" without auxiliary indication of instrument detection limits, were coded as -1.00E-05 (which usually prints as "0" in a summary table). In this way, none of the available data had to be censored and the non-detect and detection limit information could be preserved.

However, an important precaution is warranted to prevent biased statistical estimates in cases where non-detects with several detection limits exist, as was observed with several agricultural chemicals measured by the USGS, and the STORET trace element data in this report. Preprocessing to censor non-detect data, averaging of detection limit values, or recoding of data as suggested by Nehls (*Nehls and Akland, 1973*) and others (*Keith et al., 1983; Gilliom et al., 1984; Gilbert, 1987*) is recommended before calculating summary statistics. For the USGS pesticide data, variable detection limits were replaced by the maximum reported detection limit before rank-based calculations were performed.

Because of the limited number of historical samples collected near the TFCF for several nutrient and trace element analytes during some months, calculation of summary statistics may not be worthwhile or informative. Generally, non-parametric (rank-based) statistics were used for STORET data summaries rather than parametric estimates (such as mean, standard deviation, confidence intervals). Rank-based statistics (such as the median, quartiles, and percentiles) are less influenced by spurious data and extreme outliers, and are not affected by distribution assumption violations common with data sets with values near detection limits.

Database Quality Control Procedures: STORET queries were confirmed by checking all 43 station parameters to ensure that all stations were within the selected period of record (post-1960) and the selected lat-long box (121°20' to 121°38' W longitude, and 37°45' to 37°56' N latitude). In all Access database files, crosstab queries were spot checked (from 1 to 3 percent of entries, randomly selected) against the list-format tables to ensure that parameter number short names and concentration values were located under the appropriate column header, and in the proper rows for a given sample. Before performing any statistical summaries using SPSS, analysis spreadsheets exported from Access were visually inspected to check for any unusual data (for example a single sample over 10 times more concentrated than the average) which were then deleted in all Access tables and SPSS data files. USGS data scanned from their report tables (*MacCoy et al., 1995*) were all checked against the printed report values and corrected once the ASCII files were imported into Excel.

RESULTS and DISCUSSION

The Data and Appendices: Data collected for this report come from several sources, and summary tables and figures are presented in the following appendices:

Appendix 1 contains details regarding the data base structure, data tables, queries and field names.

Appendix 2 summarizes the 1980-1996 STORET data from the TFCF lat-long box query described in the methodology. Table A2-1 lists the STORET parameter numbers and associated analyte descriptions. Table A2-2 lists the sampling stations, and by reference, the State and Federal agencies whose data are summarized in later tables. Most of the data collection was performed by California agencies with additional contributions from Reclamation and the USGS.

Table A2-3 summarizes the water quality parameters usually measured in the field (T, pH, DO, EC), by month. Tables A2-4a though 4e provide all-data summaries of major ions for the Tracy query (4a), Suisun Bay (4b), the SJR near Vernalis (4c), the Mokelumne River north of Stockton, California (4d), along with the Sacramento River (4e). Table A2-5 provides a monthly summary of TFCF lat-long query major ions data.

Nutrient data are summarized by month in Table A2-6, and this table ends the "data rich environment" for the STORET data summaries. Trace element summaries in Tables A2-7a through 7b reflect several orders of magnitude fewer data points (2 to 50 samples per analyte compared to >1000 for some nutrient analyses), and unfiltered samples greatly outnumber filtered samples. Tables A2-8a and 8b present the only organic compound data available in this particular lat-long box, and Tables A2-9a and 9b show the available biotic data.

Appendix 3 provides summaries of agricultural chemical application data from the San Joaquin County source. The list of chemicals, their usage class, and chemical structure that are applied in the three township-range quadrangles near the TFCF are found in Table A3-1. Table A3-2 provides a summary of total crop acreage treated and total amounts of chemicals applied by usage class (e.g., herbicide, pesticide), and Table A3-3 provides similar information summarized by individual chemical. Table A3-4 provides a summary of lethal concentration (LC_{50}) toxicity data (*Meister and Sine, 1997; Johnson and Finley, 1980)* for the chemicals applied near the TFCF (See Appendix 1 for additiional details regarding assignment of toxicity scores). Table A3-5 combines the toxicity score information with chemical application data for chemicals with fish toxicity scores $\geq$3.5. Chemical structure diagrams, provided as a convenient reference for expected mass spectral data interpretation of unknowns, are provided for the 16 "compounds of concern" in Table A3-6, and Table A3-7 and the Appendix 3 bar charts for these 16 compounds show

combined monthly application amounts (as kg) of these compounds during 1997.

Appendix 4 summarizes the low-concentration herbicide and pesticide analyses data for the SJR at Vernalis sampling station from the USGS (*MacCoy et al., 1995*) study. Figures A4-1 through A4-9 summarize results for those compounds that were *routinely* detected, using graphs of concentration over time. Tables A4-1a and 1b summarize the median, minimum, and maximum by month for the USGS data set, and Tables A4-3a and 3b provide more detailed rank statistics in the upper percentiles.

Appendix 5 presents the inorganic analyses results from the October 1997 sampling event. Major ions are listed in Table A5-1, nutrients and organic carbon in Table A5-2, and ICP-MS trace elements in Table A5-3. These data provide a single-event "snapshot" observation of water quality in the immediate vicinity of the TFCF during the fall season when local waters probably contain the lowest levels of chemical contaminants.

Appendix 6 provides a summary of the TFCF Hydrolab probe data, including T, pH, EC, and DO. Table A6-1 presents monthly summary data for the period of March 1997 through the middle of February 1998. Representative data for several different variables for the spring and the summer data subsets are shown in Appendix 6, Figures A6-1 through A6-10.

Reliability and Representativeness of Database Data: While the database created for this report certainly provides usable information regarding water quality conditions at the TFCF, the relative scarcity and variable applicability of the different data sources must also be acknowledged. None of the data sets collated were both comprehensive and representative of current conditions at the TFCF. Comprehensive implies that the data set includes many inorganic and organic analytes measured at sufficiently low detection limits, with accessible quality documentation. Ideally, the external data sources should also be representative of current TFCF water quality conditions with respect to sampling site location, the purpose for sampling and analysis, the historical time period, and sampling frequency adequate to characterize variable conditions at the TFCF. The following summarizes the principal limitations of each of the data sets used in this study:

- The STORET data record in this study (Appendix 2) covers a 16-year period (from 1980 to 1996), and earlier data may not be representative of current climatic conditions (especially considering recent extreme El Niño events). Agricultural practices and land use patterns have also changed during this period, with shifts in crop species, chemical applications, along with population increases and greater urban runoff over time in the Central Valley.

  More recent STORET data probably reflect a greater degree of standardization among the different agencies with respect to sampling and analysis, and quality assurance methodology; however, none of the STORET data have readily available quality documentation. Many STORET results were collected to comply with regulatory monitoring requirements, which do not often require the low detection limits associated with background survey concentrations.

  Only one STORET station is located within 1 km of the TFCF, and only two stations are within 5 km (the average STORET station distance from the TFCF in this study is around 11 km).

  Finally, considering the costs associated with environmental sampling and analysis, it is no surprise that very few studies sample frequently enough to catch events such as daily tidal mixing, changes in pumping at Clifton Court Forebay or the TPP, or short-duration chemical concentration spikes from agricultural chemical applications. (This factor is dramatically seen in the USGS data (Appendix 4, Figures A4-1 through A4-9), where agricultural chemicals are only detected

for short periods of time in the SJR at Vernalis.)

- Because pesticide and herbicide applications are regulated by local, State, and Federal agencies, the San Joaquin County agricultural chemical application data (Appendix 3) is probably very reliable, as well as being location representative. However, these data are not measurements of actual water concentrations, and are specific to 1997.

- The USGS Vernalis data (Appendix 4) are probably the best set of analytical measurement data with respect to sampling frequency, uniformity of analytical methods, and documented QC. However, the sampling station at Vernalis is over 30 km south-southeast of the TFCF, and is therefore not location representative of TFCF water quality conditions.

- The October 1997 sampling event data (Appendix 5) are of reliable quality and are location-representative, but they represent only a single day's "snapshot" of conditions that vary both daily and seasonally. Organic analytes were not measured on these samples.

- The TFCF Hydrolab data (Appendix 6) are the most location and sampling frequency representative data set (sensing and recording data every 30 minutes), but frequent bi-weekly calibration and maintenance was not performed until October 1998. Also, the Hydrolab only measures overall water quality parameters: T, pH, DO, and EC.

These comments should not be interpreted as a rejection or discrediting of these data sets. Much of the data, and its detection limits, accuracy, and precision, are no doubt suitable for their original purpose. However, given that the task of this study is to draw conclusions about the water quality at the TFCF based on existing or available data, these limitations should be given appropriate consideration. Therefore, conclusions and trends observed in this report should be considered initial approximations awaiting further study and confirmation.

General Chemistry and Major Ions: The following observations are based on the STORET data (Appendix 2, Tables A2-3 through A2-5), the TFCF Hydrolab data (Appendix 6), and the October 1997 sampling data (Appendix 6, Table A6-1). As mentioned previously, the general major ions chemistry at the TFCF suggests a well-buffered, slightly saline water, with TDS ranging from 300 to 1,100 mg/L, and containing sodium and chloride as the dominant ions.

Monthly median EC, total dissolved solids (TDS), turbidity, temperature, pH, and DO values derived from the STORET data can be seen in Figures 2a through 2c. These summary graphs show the broad general trend of low summer TDS, and DO contrasting with high summer turbidity and temperature. Generally, the TFCF Hydrolab data in Appendix 6 support the STORET data with the exception of EC data in Figure 2a, which shows an anomalous late summer maximum. Appendix 6, Figure A6-1 shows a plot of daily average EC as measured by the TFCF Hydrolab probe, and these data show two minima: one in summer, and one in winter. The STORET EC maximum may be caused by database location non-representativeness. The median DO (Figure 2c) summer minimum is consistent with observed high temperatures, primary productivity, suspended debris and DOC. Along with known seasonal agricultural chemical inputs, these conditions are all associated with fishery stress indicators seen in summer fish salvage at the TFCF. The median STORET pH data do not show any obvious seasonal trend, though higher pH values are seen in the summer.

Daily fluctuation in EC can be significant, as seen in Figures 3a and 3b. These graphs plot TFCF Hydrolab hourly average depth (in cm) and EC data together for April and August 1997. Probe depth is a local TFCF measure of fluctuating tidal water surface, and these plots show a general correlation between high tide depths and low EC. This is suggestive that rising tides from San Francisco Bay are "pushing" low salinity waters, perhaps from the Delta inflow zones of the Mokulemne and Sacramento Rivers, upstream to mix with SJR and Old River source inflows at the TFCF.

Figure 2a Median monthly dissolved solids and conductivity data from the STORET database.

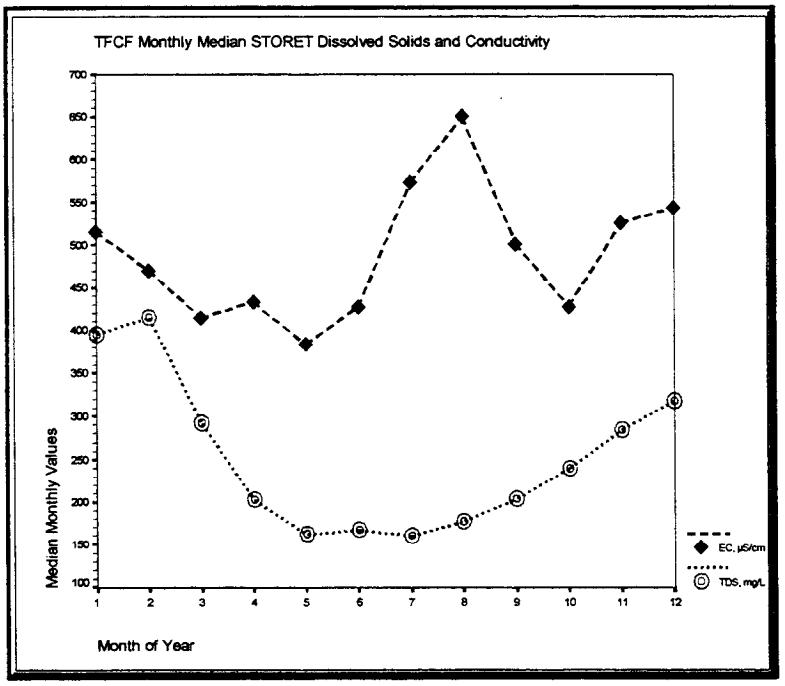


Figure 2b Median monthly turbidity and temperature data from the STORET database.

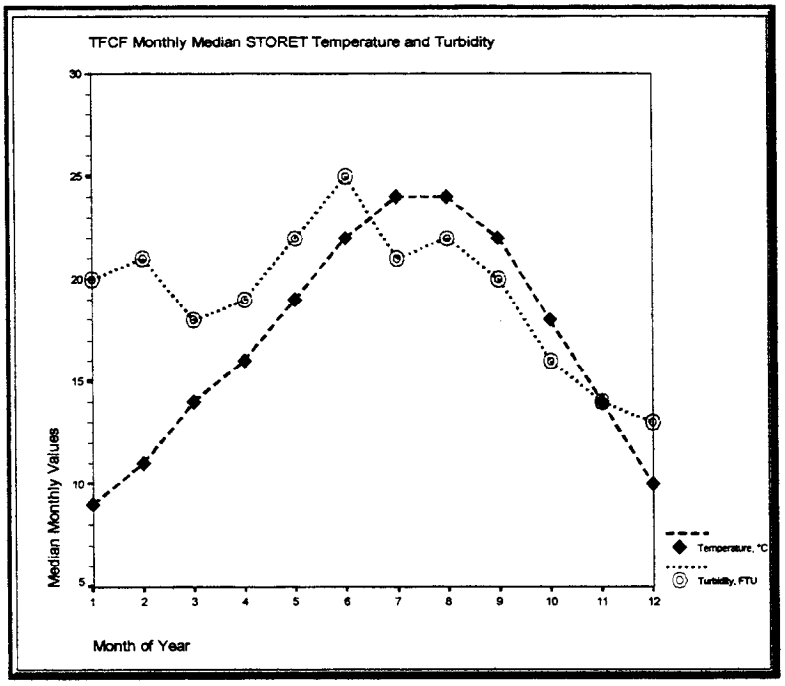


Figure 2c Median monthly pH and dissolved oxygen data from the STORET database.

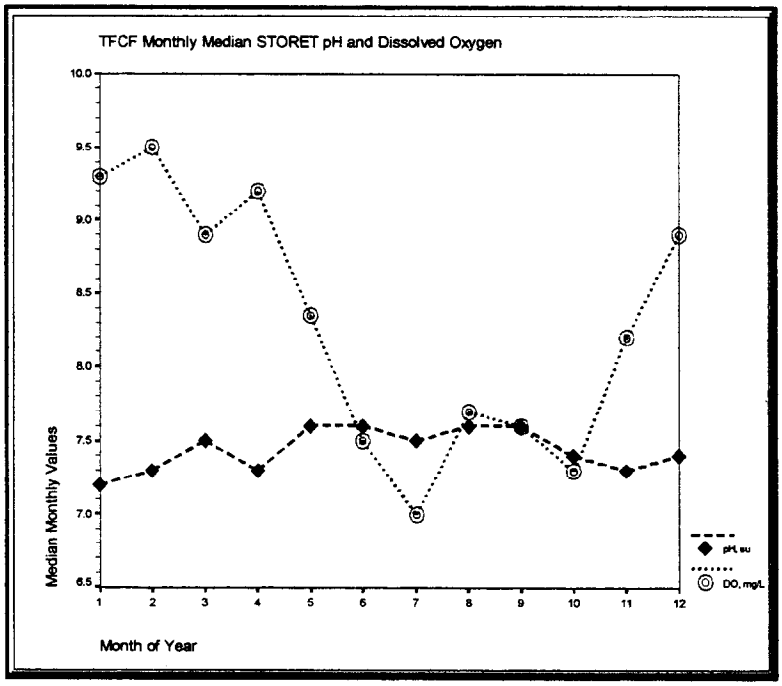


Figure 3a Plot of permanent Hydrolab probe data comparing tidal depth fluctuations with conductivity data for April 1997.

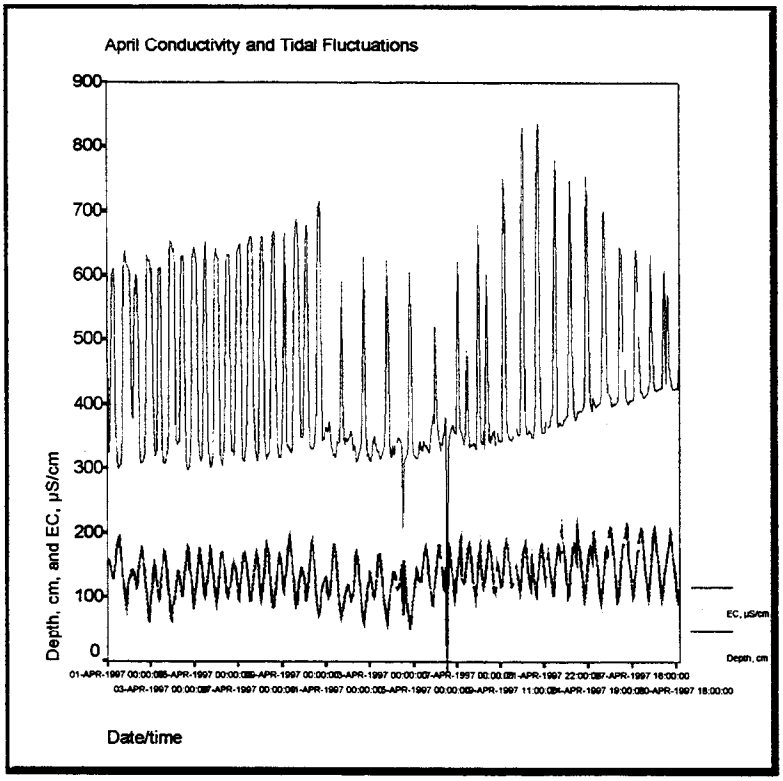
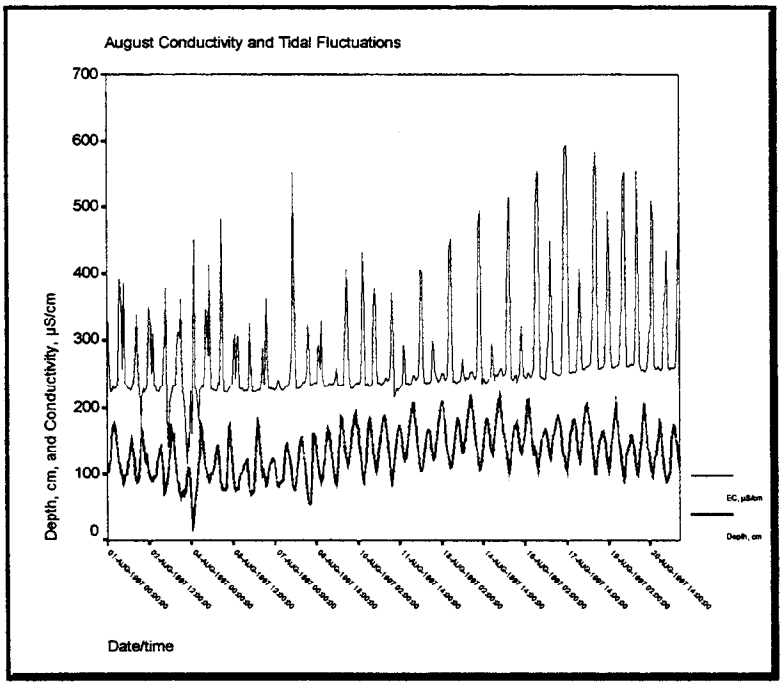


Figure 3b Plot of permanent Hydrolab probe data comparing tidal depth fluctuations with conductivity data for August 1997.



Note that daily EC values show ranges from as low as 10 µS/cm, all the way up to 500 µS/cm. This wide and variable range between minimum and maximum daily EC values could be the result of tidal interactions with local mixing factors. Perhaps the pumping schedules for the TPP and the Clifton Court Forebay facilities are "in phase" or "out of phase" with tidal influences at different times, either minimizing or promoting tidal influence on salinity dilution at the TFCF intake. Another possibility is that storm events may create temporary density layers that either mix with existing water at the TFCF intake, or prevent higher salinity water from being measured at low tide. Despite the visually apparent inverse relationship between tidal depth and EC, a clear statistical correlation was not observed, probably caused by time lags arising from the hydrodynamics and kinetics of flow and mixing in response to tidal depth increases.

The TFCF Hydrolab probe, while having excellent location representativeness, was calibrated on an infrequent schedule until October 1998, when a more rigorous calibration schedule and procedure was adopted. While still informative, Hydrolab data prior to this date are less reliable, especially pH and DO, which use more complicated sensing electrodes that require additional maintenance to maintain accurate calibration. All the Hydrolab sensing probes are also susceptible to fouling from adsorbing organic matter, seston, and debris present in summer TFCF waters.

Figures 4a through 4c show minimum, median, and maximum concentration Stiff diagrams (*Stiff 1951*), for monthly STORET data from the TFCF lat-long query. Stiff diagrams provide a convenient way to visualize and compare major ions data. The diagrams plot milliequivalents per liter (meq/L) concentrations of cations (positive ions) on the left, and anions (negative ions) on the right of a center 0 axis. Note that some of the monthly diagrams are missing due to incomplete data sets (this occurred despite the large amounts of major ions data dating from the early 1980's). These diagrams show that the general water chemistry for median and higher concentration waters are dominated by Na and Cl^-, perhaps indicative of SJR water and runoff exposure to marine evaporite geology in the watershed of the Central Valley. At lower concentrations, cations and anions are present at more equal concentrations, suggestive of greater dilution with low TDS water.

Figure 4a Stiff diagrams for monthly <u>minimum</u> major ions concentrations collected from the STORET database.

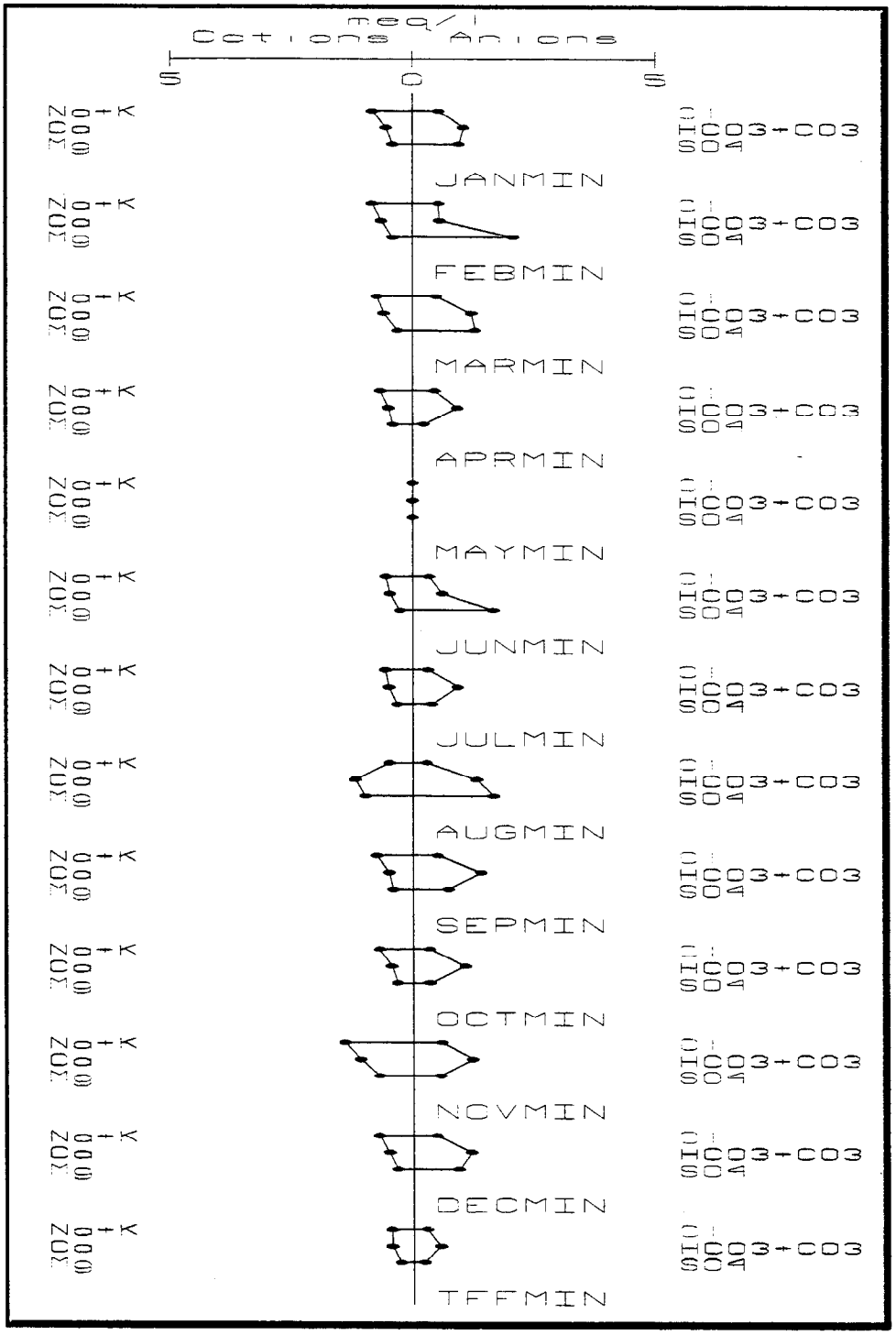


Figure 4b Stiff diagrams for monthly median major ions concentrations collected from the STORET database.

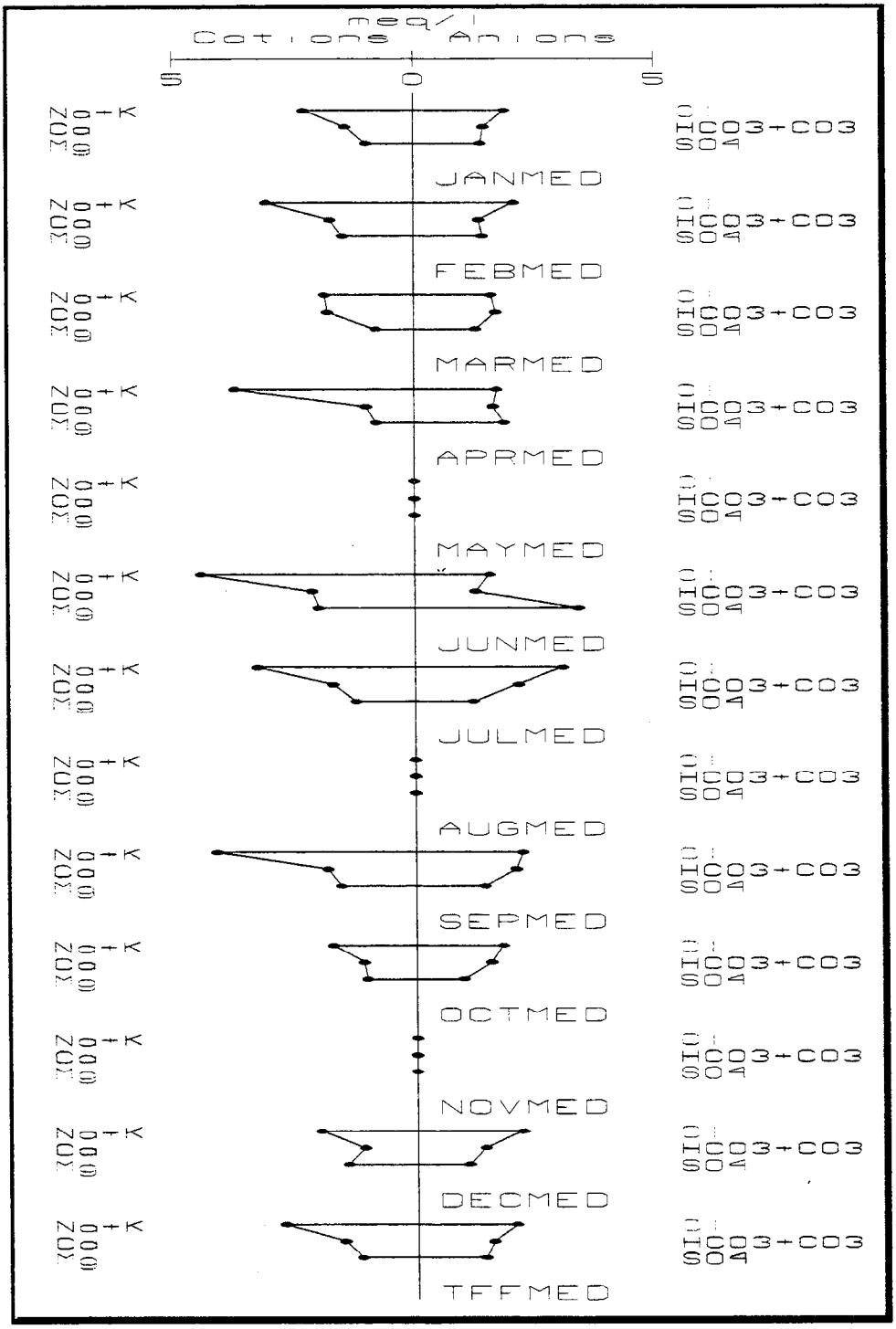
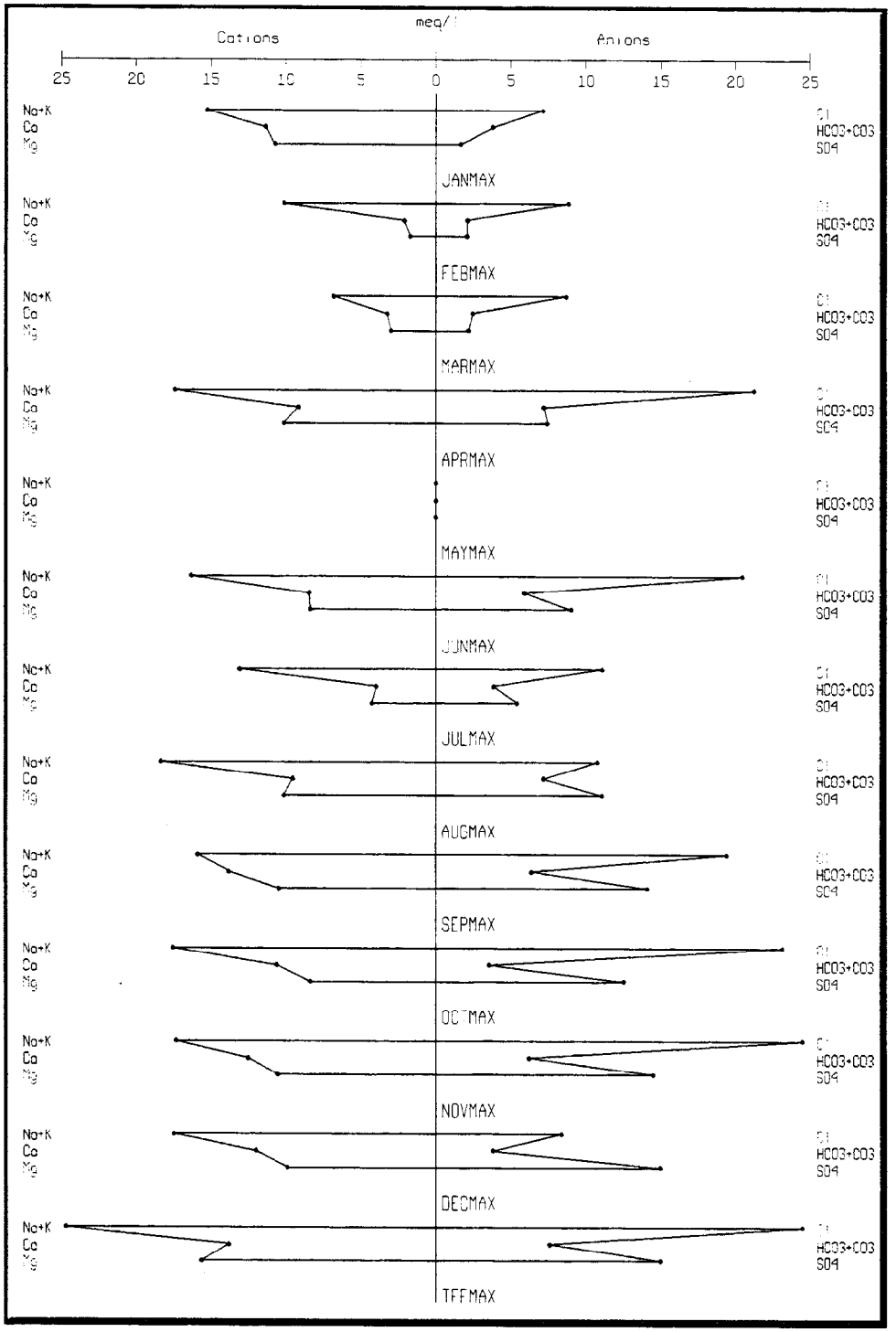


Figure 4c Stiff diagrams for monthly maximum major ions concentrations collected from the STORET database.



How do the median STORET major ions data compare with the October 1997 sample data? Figure 5 shows the Stiff diagrams for the October 1997 sample major ions data, and these diagrams should be visually compared to the median STORET data in Figure 4b. The Figure 5 plots are reasonably similar to the STORET median plot for October, though the trend from top to bottom in Figure 5 shows how much major ions concentrations can change during the course of 8 hours. Note the lower concentrations from Site 1 (sampled in the morning) to Site 5 (sampled last in the afternoon), suggesting possible tidal dilution as the day's sampling proceeded.

A comparison of STORET data for several different South Delta waters may be seen in Figures 6a through 6c, which show Stiff diagrams for minimum (Figure 6a), median (Figure 6b), and maximum (Figure 6c) concentrations (see Appendix 2 for tabular values). Each figure shows major ions from the TFCF lat-long query (TFFMIN, TFFMED, TFFMAX), the SJR at Vernalis, California (VERMIN, VERMED, VERMAX), Suisun Bay near the Sacramento River inflow zone (SUIMIN, SUIMED, SUIMAX), the Mokelumne River north of Stockton, California (MOKMIN, MOKMED, MOKMAX), and the Sacramento River at Sacramento (SACMIN, SACMED, SACMAX).

All Figure 6 plots suggest that TFCF water is slightly higher in concentration compared to the dominant source water from the SJR, perhaps suggesting that water usage, re-usage, and inflows between the SJR and the TFCF may be locally increasing dissolved ion concentrations. Notably, SO_4^{2-} is elevated (especially for the median and maximum data sets) at the TFCF relative to the SJR. Suisun Bay, the only other water source containing appreciable amounts of SO_4^{2-}, is clearly estuarine and high in concentration relative to the Delta waters. The Mokelumne and Sacramento Rivers show the lowest concentrations, even for data maxima.

Median monthly STORET major ions data seen in Figure 7 represent a good example of the limitations of historical data. These plots show a general summer maxima for most ions, which is not consistent with the actual Hydrolab conductivity data from the TFCF. These results are possible when data from samples not representative of the TFCF are compared. Ironically, once again the ions data from the October 1997 sampling (Table 4) are in general agreement with the median STORET values for October.

In summary, the salinity and major ions chemistry at the TFCF appears to be influenced by the complex interaction of several global and local factors. Global influences include the general climate, precipitation and land use patterns of the entire Central Valley watershed, that interact with daily tidal influences. These global factors interact with the local variables of pumping at the TPP and Clifton Court intakes, local storm events and runoff, local irrigation pumping and agricultural return flows, and the installation and removal of the South Delta temporary barriers.

Nutrient (nitrogen and phosphorus) Data: Figure 8a plots median monthly STORET TKN and total-P together using a log-scale. These data suggest that the South Delta water contains consistently detectable levels of N and P, probably indicative of agricultural fertilizer influence, and helps explain the algal blooms observed during summer months at the TFCF. Figure 8b plots median monthly N-species, and includes the TKN data from Figure 8a. Because the entire suite of N and P analyses were seldom observed for the same sample in the STORET data, counterintuitive results are possible, such as Figure 8b NO_3+NO_2 being higher than TKN. This occurs when data from a given month are limited and the available samples are from apparently different locations and source waters.

Given the consistent presence of DO in the TFCF waters, ammonia would not be expected to show elevated concentrations relative to other N-species, but the summer minimum trend for ammonia is counter-intuitive for the observed low DO in summer trend (Figure 2c). Figure 8c is a closeup of the monthly median total-P seen in Figure 7a, presented along with orthophosphate. The seasonal peaks in February and July are clearer in this graph, and ortho-P appears to be correlated with total-P.

The good news for these STORET data is that except for summer ammonia, most of the median N– and P-species concentrations were well above routinely available instrument detection limits. The October 1997 N-P data (Appendix 5, Table A5-2) show general agreement with the median STORET

Figure 5 Stiff diagrams for water samples collected near the TFCF in October 1997. Compare these diagrams with the median Stiff diagrams from STORET queries of nearby waters in Figure 6b.

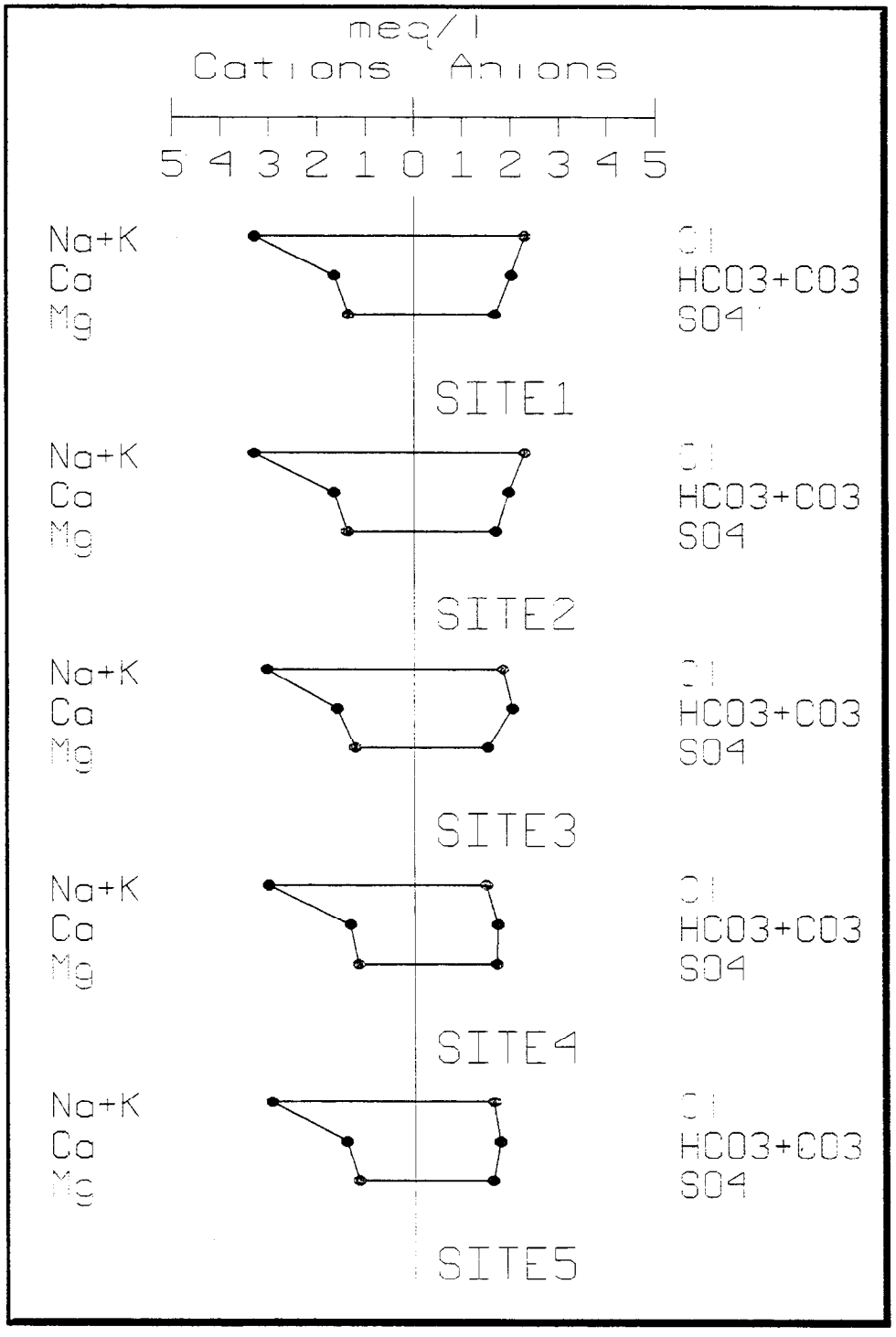


Figure 6a Stiff diagrams comparing **minimum** major ions data from the STORET database for the Tracy lat-long box (TFFMIN), and for stations near the San Joaquin River near Vernalis (VERMIN), Suisun Bay near the inflow of the Sacramento River (SUIMIN), the Mokelumne River north of Stockton (MOKMIN), and the Sacramento River near Sacramento (SACMIN).

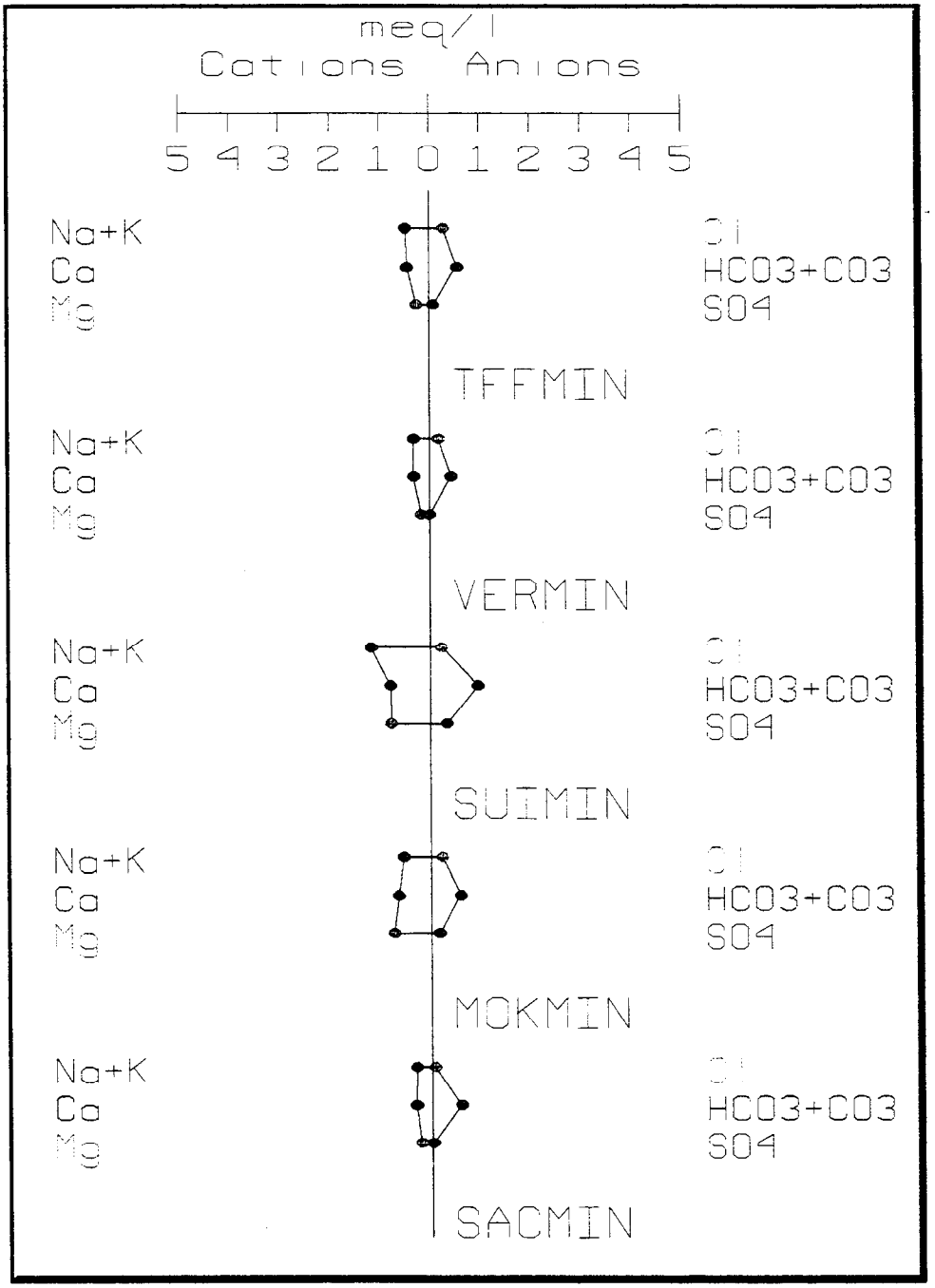


Figure 6b Stiff diagrams comparing **median** major ions data from the STORET database for the Tracy lat-long box (TFFMED), and for stations near the San Joaquin River near Vernalis (VERMED), Suisun Bay near the inflow of the Sacramento River (SUIMED), the Mokelumne River north of Stockton (MOKMED), and the Sacramento River near Sacramento (SACMED).

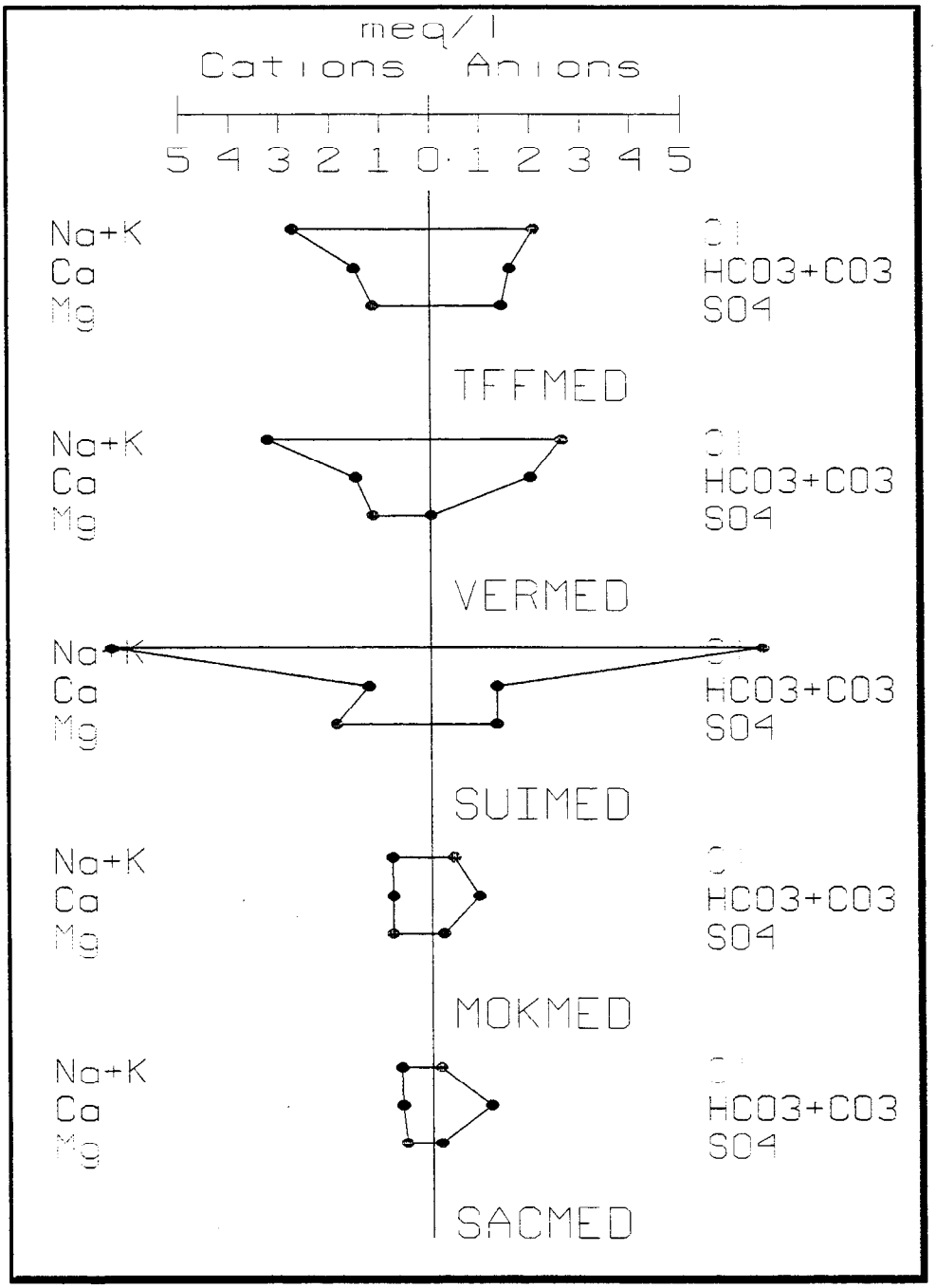


Figure 6c Stiff diagrams comparing **maximum** major ions data from the STORET database for the Tracy lat-long box (TFFMAX), and for stations near the San Joaquin River near Vernalis (VERMAX), Suisun Bay near the inflow of the Sacramento River (SUIMAX), the Mokelumne River north of Stockton (MOKMAX), and the Sacramento River near Sacramento (SACMAX).

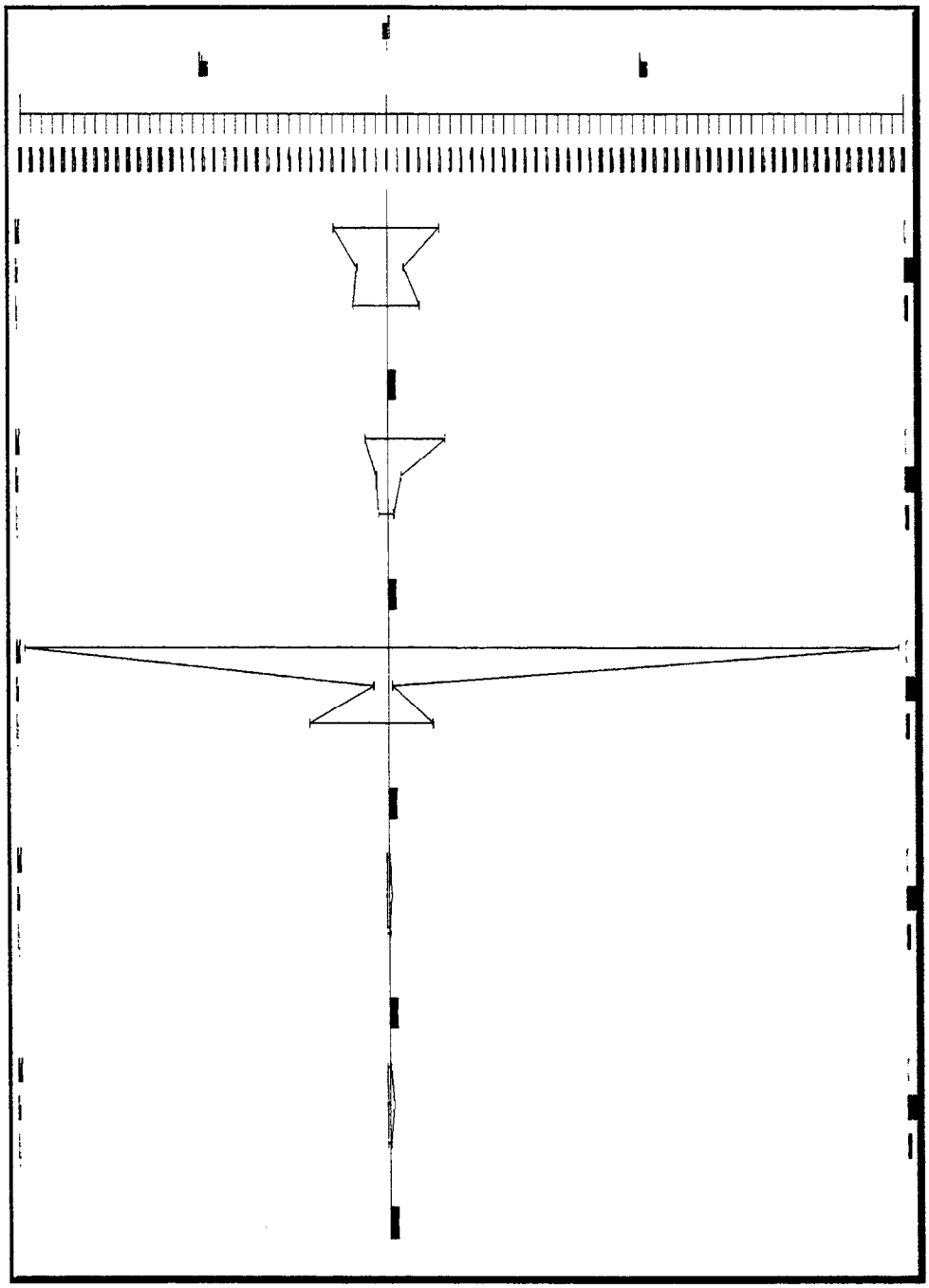


Figure 7 Median monthly major ions data from the STORET TFCF lat-long box query.

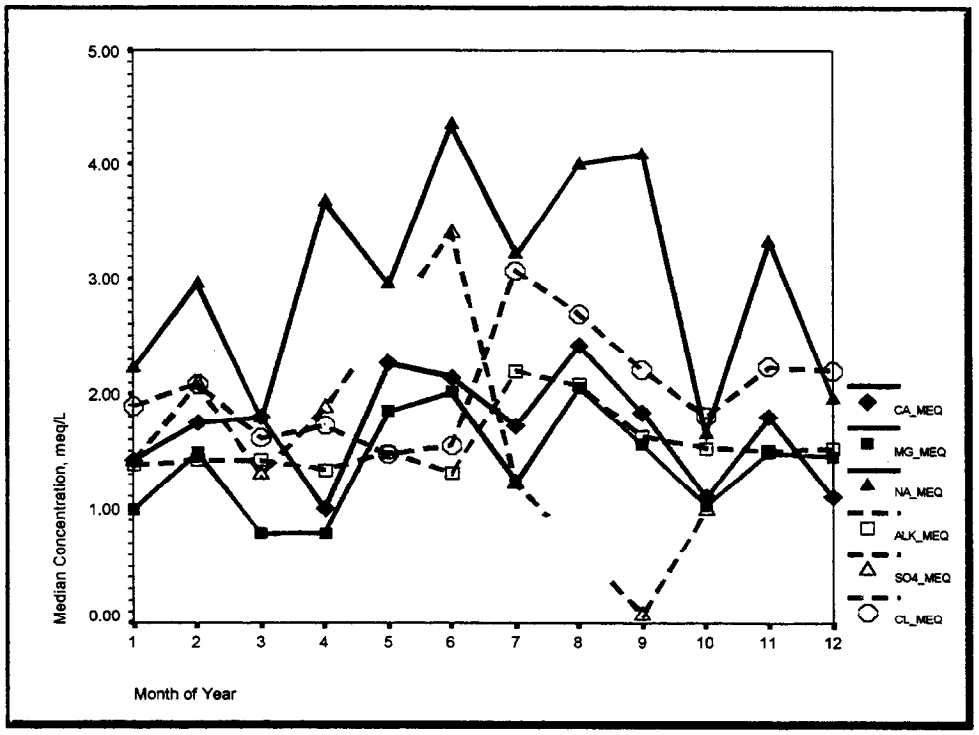


Figure 8a Median monthly total phosphorus and total Kjeldahl nitrogen (TKN) data from the STORET TFCF lat-long box query.

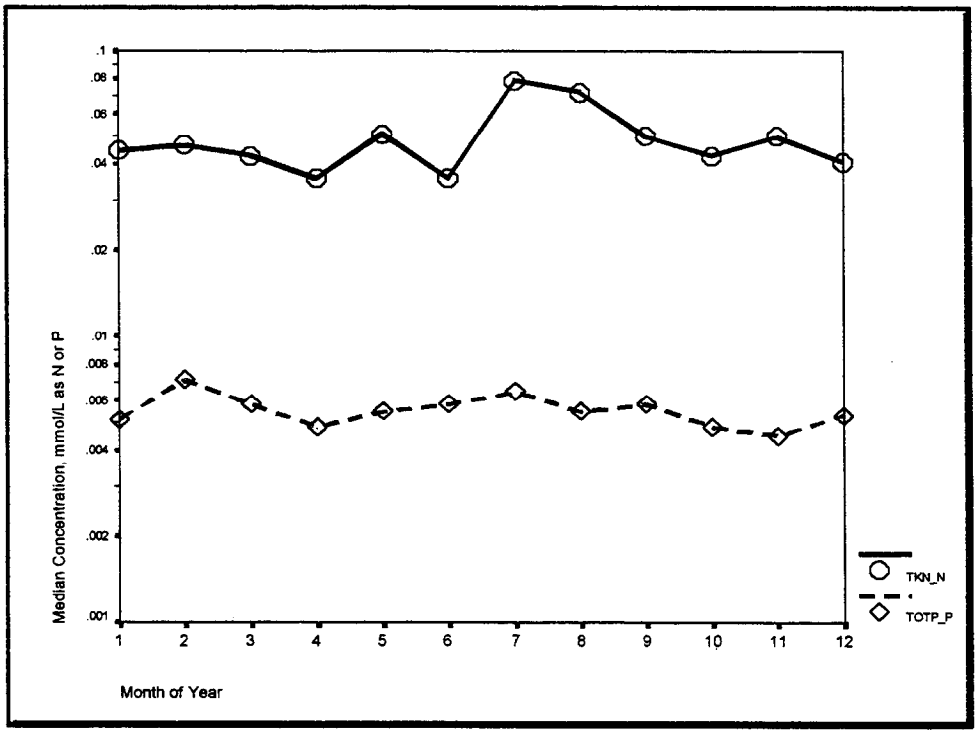


Figure 8b Median monthly dissolved (filtered) nitrogen concentrations from the STORET TFCF lat-long box query.

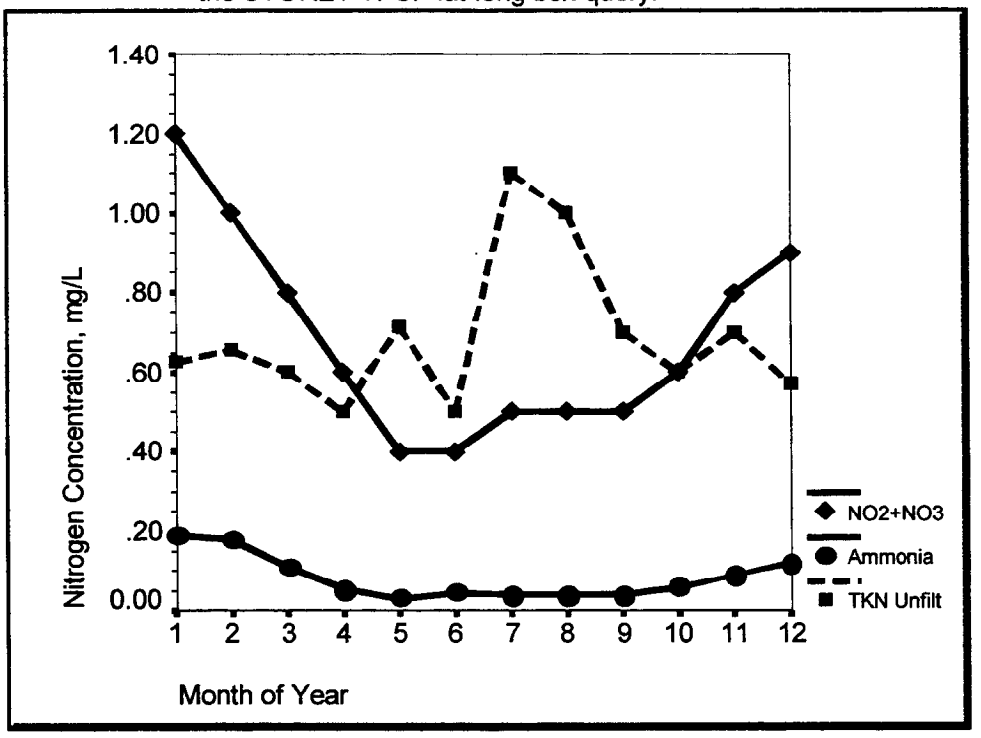
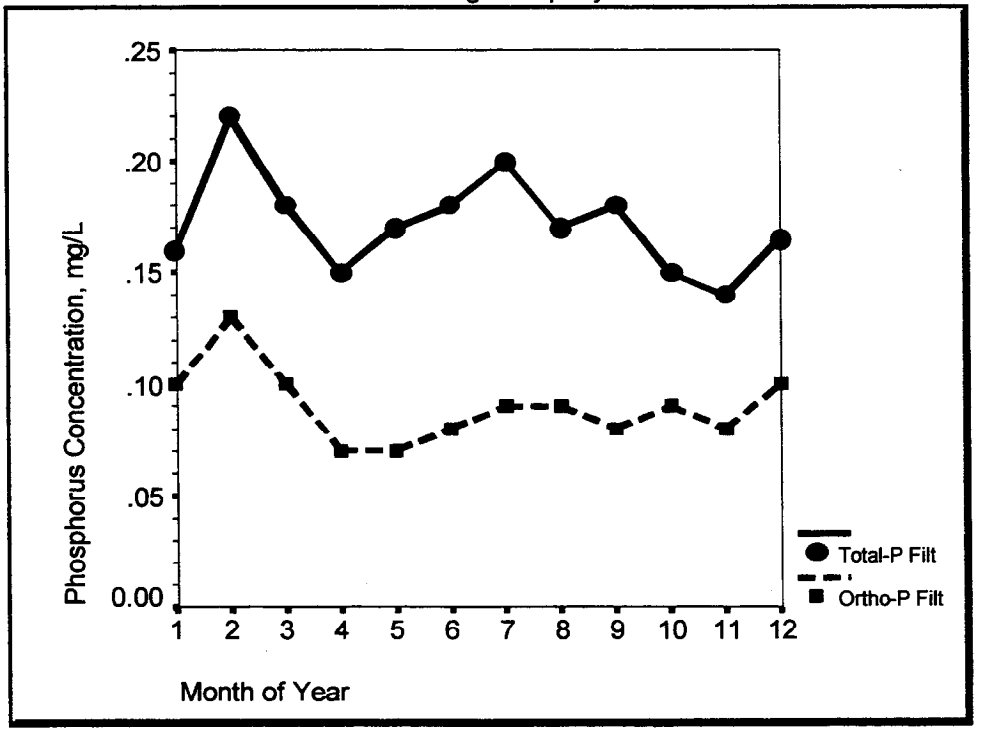


Figure 8c Median monthly dissolved (filtered) phosphorus data from the STORET TFCF lat-long box query.



data. Observed total-P, ortho-P, and TKN are similar to median October STORET values; however, observed ammonia and nitrite+nitrate are approximately twice median October STORET values.

Trace Element Data: The STORET data (Appendix 2, Tables A2-7a through A2-7c) do not provide a robust trace element data set with good temporal representativeness. Very few values represent measurements at low detection limits, and many months have very few or no available data. These data are therefore of limited interpretative value. This is indicative of the greater expense associated with trace element analyses, and the "higher detection limit" effect that established regulated concentrations (as in the Clean Water Act, Safe Drinking Water Act, or State regulations) can create in survey water quality data: Why test for very low concentrations if the regulated level is much higher and cheaper to analyze?

The October 1997 results tabulated in Appendix 5, represent a better and more reliable data set, but are limited as a single sampling event. If we assume that the fall is the time of least contamination (at least with respect to irrigation and agricultural activities), then these results have some value as a "baseline" or "control" data set.

Some of the good news from the October 1997 data is that mercury and methylmercury are very low - unfiltered total-Hg in the 1 to 4 ng/L range, filtered total-Hg in the ≤1-ng/L range, and all methyl-Hg < 0.07 ng/L. (These results also suggest that the ultra-clean sampling protocols were properly performed during sample collection for trace elements and Hg). Both filtered and unfiltered lead (Pb) (<0.4 µg/L), cadmium (Cd) (<0.02 µg/L), thallium (Tl) (<0.005 µg/L), zinc (Zn) (<2 µg/L), and selenium (Se) (<0.8 µg/L) suggest very low concentrations for these toxic elements.

Of greater potential concern are observed concentrations of dissolved uranium (U) (8 to 11 µg/L), dissolved vanadium (V) (3 to 5 µg/L), dissolved arsenic (As) (1.8 to 2.2 µg/L), dissolved chromium (Cr) (1.5 to 2.0 µg/L), and dissolved molybdenum (Mo) (2.5 to 3.1 µg/L). These concentrations are well below regulated levels, but may potentially contribute to fishery toxicity if concentrations increase with local chemical applications.

Organic Compounds: The STORET organics data set (summarized in Table A2-8a) contains limited usable data for industrial organic compounds, such as solvents and degreasers, or agricultural chemicals (seen in Table A2-8b). The reason for the relative scarcity of low concentration data is similar to that for low-concentration metals analyses: cost and regulatory data quality objectives.

Agricultural Chemical Applications: Agricultural chemical application data are summarized in Appendix 3. Table A3-4 summarizes the available LC_{50} fish toxicity data and the average fish toxicity scores. The 114 individual chemicals are sorted from "very toxic" scores (score = 5) to "safe" (score = 1). Table A3-5 identifies the more toxic agricultural compounds and combines the average fish toxicity score with chemical application data. These data represent the 23 compounds with average fish toxicity score > 3.5, and they represent 20.2 percent of total chemicals, 20.6 percent of total solid applications, and 5.92 percent of total liquid applications.

Appendix 3 summaries of the San Joaquin agricultural data show that during 1997, 114 different agricultural chemicals were applied to the 27,000-ha area in the vicinity of the TFCF. Over 95,000 liters (L) of liquid formulations and 222,416 kilograms (kg) of solid formulations were applied.

Insecticides accounted for 27,428 L (28.9 percent of liquid formulation applications) and 125,260 kg (56.3 percent of solid formulation applications). Herbicides were applied at 49,085 L (51.6 percent) and 56,858 kg (25.6 percent). Fungicides were next in total amounts applied at 4,873 L (5.1 percent) and 28,565 kg (12.8 percent), followed by general pesticides (rodenticides, nematacides, pest poisons) at 3,070 L (3.2 percent) and 8,937 kg (4.0 percent). The remaining 16.3 percent of liquid applications and 26.9 percent of solid applications were comprised of relatively nontoxic synergist compounds, and deposition agents (adjuvants, sticking agents, surfactants),

usually applied in conjunction with the toxic compound formulations.

Sixteen *compounds of concern*, those most likely to produce transient concentration spikes in local TFCF water are seen in Table 2. These compounds were selected based on a combination of toxicity and application amounts: compounds with average fish toxicity score > 4.00 with total annual application amounts > 100 kg or 100 L; *and* compounds with average fish toxicity score ≥ 3.5 and < 4.00 with total annual application amounts > 1000 kg or 1000 L.

Tables 3 and 4 provide other information regarding agricultural chemicals that may also be important to TFCF fishery issues. Table 3 lists California State Fish and Game Genus Mean Acute Values (GMAV) for a series of compounds, and provides a cross-reference as to whether these compounds (*Harrington, 1990; Menconi and Harrington, 1992a; Menconi and Gray, 1992b; Menconi and Paul, 1994a; Menconi and Cox, 1994b; Menconi and Siepmann, 1996a; Menconi and Yargeau, 1996b; Menconi and Beckman, 1996c; Siepmann and Jones, 1998; Siepmann and Slater, 1998*) were detected in the USGS study. The list in Table 4 was determined in consultation with Delta environmental researchers, so it represents the compounds that knowledgable South Delta researchers consider worth scrutiny. Note that *most* of these compounds were not detected in high concentrations by the USGS *or* applied to fields in the TFCF vicinity.

The USGS data, which are the best available Delta pesticide data set—both with respect to temporal representativeness and low detection limits—are summarized in Appendix 4. In general, only **carbofuran,** carbaryl, cyanazine, dacthal, **diazinon,** eptam, methidathion, metolachlor, and simazine were consistently detected (boldfaced compounds being identified as compounds of concern for the TFCF from the agricultural data summaries).**Chlorpyrifos,** molinate, pebulate, and thiobencarb were only detected sporadically. Atrazine, alachlor, butylate, **fonofos,** malathion, and napropram were not detected at the detection limits available in the USGS study. Note that all detected compounds were observed at concentrations well under 1 µg/L except for simazine, the only compound to be detected above this level. These data strongly suggest that pesticide residues will be present at very low concentrations much of the time, and present in sub-µg/L concentrations when detected.

Biological Data: Appendix 2, Tables A2-9a and 9b, provide the available STORET biological data, including algal and plankton counts and photosynthetic chemistry data. Much of these data are from a single study that performed consistent sampling over a single agricultural season. The authors will attempt no interpretation of these data in this report, which are simply tabulated and presented.

CONCLUSIONS

The available data suggest that the general chemistry near the TFCF is primarily affected by the seasonal hydrology and large-scale watershed influence, with a significant daily dilution or mixing influence from tidal fluctuations. As expected, nutrients, biological data, and organics show strong indications of agricultural influence.

The trace metal data sets do not contain enough high-quality, temporally-representative data to assess the primary control variables for trace elements in TFCF water (though copper (Cu), applied as a herbicide, would be expected to show agricultural associations).

The October 1997 ICP-MS trace element data does demonstrate the low concentration of many toxic metals and the importance of selecting methods involving either preconcentration or low detection limits (such as ICP-MS or graphite furnace atomic absorption), and the routine application of ultra-clean sampling and contamination-prevention sampling protocols.

If the water data are evaluated with respect to regulated water quality criteria, as in Table 5, the October 1997 samples suggest that TFCF water is well below levels of concern. The USGS data also suggest a similar regulatory conclusion for the pesticides.

Table 2 Agricultural compounds of concern and months when they may be detected in TFCF waters. Boldfaced compounds have fish toxicity scores = 5.00 and significant application amounts. Amounts represent combined liquid and solid amounts expressed as kg, and likely detection months are listed in order of greatest amount.

Compound	*Usage Class*	*1997 App as kg*	*Likely Detection*
Aldicarb	insecticide	1,756	Mar - Apr
Bromoxynil	herbicide	274	Feb - Jan
Carbofuran	**insecticide**	**1,790**	**Mar - Jan**
Chlorpyrifos	**insecticide**	**8,734**	**Mar - Jul**
Desmedipham	herbicide	3,450	Nov - Apr
Diazinon	insecticide	604	Jan - Aug
Esfenvalerate	**insecticide**	**671**	**Jul**
Fenbutatin-oxide	pesticide	111	Jun
Fonofos	**insecticide**	**5,592**	**May**
Metam-sodium	insecticide	4,234	Mar - Aug - Jul
Metolachlor	herbicide	3,405	May - Mar
Oryzalin	herbicide	624	Nov
Oxyfluorfen	**herbicide**	**1,461**	**Nov - Feb**
Permethrin	**insecticide**	**724**	**Sep**
Phosmet	insecticide	1,244	Mar
Trifluralin	**herbicide**	**51,643**	**Feb - Mar - Nov**

Table 3 Some other regulated pesticides found in the San Joaquin and Sacramento Rivers. These data were included in the *toxicity* table in the ***agdata.mdb*** database. Boldface compounds are those identified as compounds of concern based on agricultural chemical application data analysis.

Chemical	*GMAV*[1]	*GMAV*^{other}	*Month*	*Detected in River*[2]
Atrazine	3 drinking water		all, Oct-Feb	Sac
Carbofuran	1.5 dcrab	477 rainbow trout	Mar-Apr	Sac
Chlorpyrifos	0.1 cladoceran	10 rainbow trout	Feb-Mar	SJR
Chlordane	0.1 drinking water			
Diazinon	0.2 amphipod	723 brooktrout	Nov-May	SJR
			Jan-Mar	Sac
Dimethoate	43 stonefly	8,560 rainbow trout	Apr-Aug	SJR
Methidathion	2.2 cladoceran	12.1 rainbow trout	Nov-Mar	Sac
Methomyl	22 cladoceran	1,467 rainbow trout	Dec-Sep	SJR
Methyl Parathion	0.15 cladoceran	3,703 rainbow trout		
Molinate	1.3 mysid	13 rainbow trout	May-Jun	SJR
			May-Jul	Sac
Simazine	.4 drinking water		All,Jan-Mar	SJR
			Nov-Jul	Sac
Thiobencarb	101 waterflea	1200 rainbow trout	May-Jul,Nov	SJR
	0.1 drinking water		May-Sep	Sac
Toxaphene	3 drinking water			

[1] Genus Mean Acute Value, California Department of Fish and Game. Most sensitive genus of aquatic life listed in this column, if data available. *(Menconi et al., 1992a, 1992b, 1994a, 1994b, 1996a, 1996b, 1996c; Siepman and Jones 1998; and Harrington, 1990)*

[2] Based on data from USGS (*MacCoy et.al., 1995*)

Table 4 Other agricultural chemicals of concern identified by delta researchers. Boldface compounds are those identified as compounds of concern based on agricultural chemical application data analysis.

Name	*Compound Class*	*Ag Purpose*	*Target Crops*
Diazinon	phosphorothioate	insecticide	many
Methidathion	phosphorodithioate	insecticide	alfalfa, citrus
Chlorpyrifos	chlorinated	insecticide	alfalfa, cotton
Molinate	carbothioate	herbicide	rice
Thiobencarb (Saturn)	chlorinated	herbicide	rice
Carbofuran	aromatic carbamate	insecticide	corn, peanuts
Diuron	chlorinated aromatic	herbicide	alfalfa, orchards
Simazine	triazine	herbicide	alfalfa, fruit, nuts
Atrazine	triazine	herbicide	many, roadsides
Eptam	aliphatic	herbicide	beans, legumes
Dacthal	chlorinated phthalate	herbicide	many
Carbaryl	aromatic carbamate	insecticide	many
Fonofos (Dyfonate)	phosphorodithioate	insecticide	many
Ziram	Zn-dithiocarbamate	fungicide	orchards
DDT	chlorinated	insecticide	banned
DDE	chlorinated	none (metabolite)	
Toxaphene	chlorinated	insecticide	banned
Chlordane	chlorinated	insecticide	termites, wood

Table 5 Chemical water quality at TFCF compared to national and California water quality standards.

Analyte	*TFCF at intake boom*	*Drinking Water*[1]	*Agricultural Water*[1]	*Aquatic Life*[1]	*Cal 65*[1]
Sulfate	77.4 mg/L	250			
Chloride	57.5 mg/L	250	106		
Conductivity	609 µS/cm	900	700		
Silver*	0.037 µg/L	100		4.1	
Aluminum*	256 µg/L	200			
Arsenic*	2.00 µg/L	50	100	143[3]	5
Barium*	52.2 µg/L	1,000			
Beryllium*	0.0225 µg/L	4	100		
Cadmium*	0.0163 µg/L	5	10	1.1[2] 1.43[3]	
Chromium*	2.1 µg/L	50			
Copper*	1.95 µg/L	1000	200	12[2] 5.2[3]	
Iron*	310 µg/L	300	5,000		
Mercury*	3.74 ng/L	2,000		1,000[3]	
MeHg*	0.025 ng/L				150
Manganese*	55.7 µg/L	50	200	100[4]	
Molybdenum*	2.66 µg/L		10		
Nickel*	0.281 µg/L	100	200	160[2] 29[3]	
Lead*	0.328 µg/L	15	5,000	3.2[2] 1.3[3]	0.25
Antimony*	0.0859 µg/L	6		190	
Selenium*	0.743 µg/L	50	20	5 Se^{+4}=28[3] Se^{+6}=9.5[3]	
Zinc*	1.55 µg/L	5,000	2,000	110[2] 67[3]	

* unfiltered
1 same units as measured at TFF, (State of California, 1998)
2 in water containing 100 mg/L $CaCO_3$, (State of California, 1994, 1997a)
3 Final Critical Value at 50mg/L $CaCO_3$, (EPA, 1995)
4 Aquatic Life in Saltwater, (State of California, 1997b)

However, it is clear that fish at the TFCF are affected by water quality conditions in the Delta, and the demonstrated presence of many chemical toxins at sub-lethal concentrations. Data presented in this study underscore the need for temporal representation in sampling, and the low detected concentrations of toxic compounds that must be considered to determine the water quality interactions converging at the TFCF that may affect native fish populations.

Another factor that must be considered is the short duration spikes of toxins that may pass through the system undetected, and their potential fishery effect on native fish and experimental fish at the TEFF.

The concerns of temporal sampling representativeness, low detection limits, broad variety and number of analytes, short-duration spikes, and high cost may be solved by implementation of pre-concentration and compositing strategies. The Subproject 8 sampling and analysis program at TFCF proposes to implement monthly compositing and pre-concentration of organics by installing a computerized high-capacity Infiltrix sampling pump (Axys Analytical, Sidney, BC), programmed to pump hourly water samples through a 0.45-µm filter and an XAD resin solid phase extraction column. In this way, a significant pre-concentration of analytes (up to 500X) may be accomplished and a broad spectrum of compounds identified using routine open scan GC-MS analysis. Trace elements will also be collected as monthly composites using a commercially available Sigma sampling pump, and the resulting composites will be analyzed using ICP-MS (as used for the October 1997 sampling event). This approach should provide fishery scientists at TEFF and other Delta environmental researchers with a valuable representative baseline data set that is currently unavailable.

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APPENDIX 1

Guide to Access Database Files

Data Sources and Import Procedures: Data were collated from the following sources to create the databases used in this report:

STORET Database Files: The EPA maintains a historical water quality database called STORET (an acronym derived from *STO*rage and *RET*rieval) that contains large volumes of data collected by many state and federal agencies. STORET is publicly available by modem on an EPA mainframe; however, data included in this report were obtained using a CD-ROM version of the data with an MS-DOS query search program (Earthinfo, Inc, Boulder, Colorado). The Earthinfo search program produced query output in Lotus 123 v. 2.0 spreadsheet files in a data-list format.

The STORET data set queried for this report was limited to sampling stations located within a latitude-longitude (lat-long) box bounded by 121°20' to 121°38' W longitude, and 37°46' to 37°56' N latitude (see map in Figure 1), and restricted to samples collected and analyzed since 1980. The lat-long box is approximately 26.5 X 18.5 km, and covers an area of around 48,950 ha (120,960 acres). The northwest corner is located near Discovery Bay and Indian Slough, the southwest corner about 1 km west of Bethany Reservoir, the southeast corner near the intersection of Middle Road and Interstate 5 approximately 5 km east of Tracy, and the northeast corner is in the sewage disposal pond located at the southwest corner of the city of Stockton.

The selection of the Figure 1 lat-long coordinates was somewhat arbitrary, and represented an attempt to keep the selected area within close proximity to the TFCF, while being large enough to include some representative data. Larger query areas would produce larger data sets that would produce less biased summary statistics, but the larger the data set, the less it represents the water quality conditions at the TFCF location.

This TFCF lat-long box query produced 43 sampling stations (see Table A1-1 below and Table A2-2 in Appendix 2) with 197 parameters (measured water quality constituents/variables, found in Appendix 2 Table A2-1). Several sub-set parameter level queries were prepared from the lat-long query for major ions (Calcium - Ca^{2+}, Magnesium - Mg^{2+}, Sodium - Na^{+}, Potassium - K^{+}, Carbonate - CO_3^{2-}, Bicarbonate - HCO_3^{-}, Chloride - Cl^{-}, Sulfate - SO_4^{2-}), nutrients (nitrate - NO_3^{-}, nitrite - NO_2^{-}, Ammonia - NH_3, Total Kjeldahl Nitrogen - TKN, Orthophosphate - PO_4^{3-}, and Total P), trace elements (see Appendix 1 tables), field parameters (pH, Conductivity - EC, Dissolved Oxygen - DO, Redox Potential - Eh), and even some biological data (algae counts, BOD, chlorophyll, etc.). All of these sub-set queries were imported into Access as tables seen in Table A1-2.

The data ("all_") tables are relatively simple files where each record contains a STORET parameter number code (*parmno*), the measured data value (*conc*), an annotation remark (*comment*), STORET station code (*station*), sampling date (*sdate*) and sampling time (*stime*). In order to create spreadsheet/SPSS-compatible (tabular) files from the columnar (list) format in the imported tables, crosstab queries were created (denoted by a "_ctab" suffix). Spreadsheet headings (SPSS® variable names) were added by attaching the relational tables, *tfcf_parms* and *tfcf_station* to the crosstab queries.

Running crosstab queries in Access on large tables uses significant PC memory resources. Given the large size of some of the tables, additional tables were created for *tfcf_st.mdb* that subdivided the larger tables (such as *all_field* and *all_np*) into smaller tables, available so that data users with older PC's having less than 64 Mbyte RAM would be able to run smaller crosstab queries to create output for analysis.

Table A1-1 STORET lat-long query sampling stations and distance from the TFCF.

Station	Agency	Samples	Analytes	Latitude, Decimal Degrees N	Longitude, Decimal Degrees W	Distance from TFCF, km
01N/04E-35R01 M	21CAL-2	4	29	37.883333	121.500000	9.04
01N/04E-36K03 M	21CAL-2	2	14	37.883333	121.483333	9.96
01N/05E-10P01 M	21CAL-2	14	106	37.933333	121.416667	18.04
01N/05E-10Q01 M	21CAL-2	9	64	37.933333	121.400000	19.10
01N/05E-15F01 M	21CAL-2	8	76	37.933333	121.416667	18.04
01N/05E-15G01 M	21CAL-2	13	105	37.933333	121.400000	19.10
01N/05E-15L02 M	21CAL-2	10	81	37.933333	121.416667	18.04
01N/05E-21E03 M	21CAL-2	8	55	37.916667	121.433333	15.69
01N/05E-21F01 M	21CAL-2	11	82	37.916667	121.433333	15.69
01N/05E-21M02 M	21CAL-2	8	54	37.916667	121.433333	15.69
01N/05E-22E01 M	21CAL-2	8	65	37.916667	121.416667	16.76
01N/05E-29C02 M	21CAL-2	9	58	37.900000	121.450000	13.34
01N/05E-29F01 M	21CAL-2	9	60	37.900000	121.450000	13.34
01N/05E-30Q03 M	21CAL-2	3	18	37.900000	121.466667	12.32
01N/05E-31D01 M	21CAL-2	6	47	37.900000	121.466667	12.32
01N/05E-31E01 M	21CAL-2	4	28	37.883333	121.466667	11.00
01N/05E-36M01 M	21CAL-2	13	99	37.883333	121.383333	17.18
01S/04E-02C01 M	21CAL-2	9	52	37.883333	121.500000	9.04
01S/04E-03K01 M	21CAL-2	8	53	37.883333	121.516667	8.28
01S/04E-03P02 M	21CAL-2	11	69	37.866667	121.516667	6.67
01S/04E-04R01 M	21CAL-2	4	29	37.866667	121.533333	5.98
01S/04E-09B01 M	21CAL-2	8	54	37.866667	121.533333	5.98
01S/04E-09C01 M	21CAL-2	9	57	37.866667	121.533333	5.98
01S/04E-09N01 M	21CAL-2	7	52	37.866667	121.550000	5.59
01S/04E-09N02 M	21CAL-2	8	58	37.866667	121.550000	5.59
01S/05E-31H01 M	21CAL-3G	1	38	37.800000	121.450000	9.80
01S/05E-35Q02 M	21CAL-3G	1	38	37.783333	121.383333	15.95
02S/04E-16A01 M	21CAL-2	9	166	37.766667	121.533333	6.03
374645121255601	112WRD	1	53	37.766667	121.416667	13.75
B9D74821274	21CAL-6	57	1509	37.800000	121.450000	9.80
B9D74831269	21CAL-1	577	7854	37.800000	121.433333	11.24
B9D74831269_@	21CAL-6	407	10435	37.800000	121.433333	11.24
B9D74981333	21CAL-1	16945	18016	37.816667	121.550000	.78
B9D75291273	21CAL-1	49	625	37.866667	121.450000	11.09
B9D75351292	21CAL-1	37	497	37.883333	121.483333	9.96
B9D75351292_@	21CAL-6	216	5899	37.883333	121.483333	9.96
B9D75351293	21CAL-1	241	5197	37.883333	121.483333	9.96
B9D75351293_@	21CAL-6	221	5079	37.883333	121.483333	9.96
RMID23	113BUREC	39479	64314	37.883333	121.483333	9.96
RMID40	113BUREC	28879	50922	37.833333	121.383333	15.61
ROLD39	21CAL-81	2758	8564	37.850000	121.566667	3.75
ROLD59	113BUREC	298	4317	37.800000	121.433333	11.24
UID2133	11KEST	38	915	37.766667	121.433333	12.41
					Minimum Distance	.78
					Maximum Distance	19.10
					Mean Distance	11.0948
					Median Distance	11.4008

Table A1-2 Table names and contents in Access database **tfcf_st.mdb** (2,980 Kbytes).

Table Name	*Number of Records*	*Contents*
all_biota	4,414	biological/limnological data
all_field	12,644	field measurements
all_ions	6,126	major ions concentrations
all_np	8,471	nutrients concentration
all_org	78	organic solvents, compounds
all_pest	43	agricultural chemicals, pesticides
all_tm	641	trace elements
tfcf_parms	197	STORET parameter numbers with associated identifiers, short names and units.
tfcf_station	43	STORET station codes, identifiers, latitude, longitude

Another STORET database, **other_st.mdb** (1,060 Kbytes), was created to gather major ions data from Delta sites farther away from the TFCF as a means to compare Tracy water to other potential sources, and for mixing evaluations (see Appendix 2, Tables A2-4a-4d, and report Figures 5a-5c). Data table structure was identical to that in **tfcf_st.mdb**, and analysis output was created from these tables using similar crosstab queries. Table A1-3 describes the contents of **other_st.mdb**:

Table A1-3 Access major ions database **other_st.mdb** (1,060 Kbytes).

Table Name	*Number of Records*	*Contents*
sac_ions	4,251	ions data from Sacramento River stations in and around Sacramento, CA
suis_ions	3,234	ions data from Suisun Bay stations near the Sacramento River Inflow zone.
vern_ions	8,190	ions data from San Joaquin River stations in and around Vernalis CA.

The 3 STORET queries in **other_st.mdb** were imported as tables into Access. The tables included the USGS sampling station (11447650) on the Sacramento River at Sacramento, (summary in Appendix 2, Table A2-4b), several stations (LSBB03, -05, -08, -17, -19, and RSA-060, -063, -066, and -072) in and around Suisun Bay at the inflow of the Sacramento River (Table A2-4c), and the USGS stations (B0701000 and WB05B0702000) on the SJR near Vernalis (Table A2-4d).

Agricultural Chemical Data are archived in the database **agdata.mdb** (results and tables found in Appendix 3). A data file containing 1997 agricultural chemical application information in ASCII list format was obtained from the San Joaquin County Office of the Agricultural Commissioner, and imported as table *san_joaquin*. This large table (83,875 records, >10 Mbytes in ASCII format) contained very detailed information regarding the landowner (*permit_number, grower_id*), location (*township, range, section*), agricultural chemical formulation names (*ag_chem*), associated EPA and safety codes (all *"epa_"* prefix fields), amounts applied, dates applied, and how applied (*pesticide_amt, date_applied, application_method*), as well as crop name (*crop_name*) and acreage (*crop_quantity*) treated.

An initial query (*tfcf_local_agchem*) was created to identify agricultural chemical application records in the *near vicinity* of the TFCF by selecting only township-range quadrangles T1SR4E, T1SR5E, and T1SR6E. These quadrangles (see Figure 1 in the report) represent an approximate rectangle 29.3 X 5.8 km starting at the TFCF and striking east to include the branch point of the SJR and the Old River. This 27,000 ha (67,700 acre) rectangle includes crop land adjacent to the Old River, the branching point of the Old and Middle River and the Middle River in T1SR5E, Grant Line Canal, Fabian and Bell Canal,

Victoria Canal, North Canal, the Clifton Court Forebay Intake, and northern extremes of Paradise Cut and Tom Paine Slough where they enter the Old River.

This initial query was used to develop 2 additional relational tables created to link product application data to toxicity and structural information. Data from the *Farm Chemicals Handbook '97*, and the supplemental *Electronic Pesticide Dictionary '97* CD-ROM (*Meister and Sine, 1997*), and other sources (*Johnson and Finley, 1980*) were used to create tables *toxicity* and *tfcf_chem_list*. Table *tfcf_chem_list* (277 records - see Table A3-1 in Appendix 2) was created by entering ISO (International Standards Organization) common names (*shortname*), usage class (*class*, eg. herbicide, pesticide, pesticide, insecticide, deposition agent), other common names (*cross_ref*), chemical type (*type*, eg. organic, inorganic, biological agent, etc), and chemical class (*chem_class*: carbamate, chlorinated, tricyclic, etc), and IUPAC (International Union of Pure and Applied Chemistry) chemical structure names (*chem_name*) for each of the agricultural chemical product formulations in the query *tfcf_local_agchem.*

Access table *toxicity* (114 records) was created by adding available LC-50 toxicity data (almost all values were for 96-hour or shorter duration acute bioassays) for each of the 114 unique chemicals applied near the TFCF using California (*State of California, 1997a, 1997b, and 1998*) and other regulatory and scientific sources (*Johnson and Finley, 1980*) and *the Farm Chemicals Handbook* '97 (*Meister and Sine, 1997*). LC-50 data were obtained for anadromous fish, resident fish, and various species listed in *The Farm Chemical Handbook '97* (*anadro_LC50, resident_LC50, and FCH_LC50*). Once the LC-50 data were entered, table *toxicity* was exported to SPSS® where all fish LC-50 concentrations (in µg/L) were assigned relative toxicity scores based on the criteria found in Table A1-4 (*Meister and Sine, 1997*):

Table A1-4 Criteria from *The Farm Chemical Handbook '97* used to assign Relative toxicity scores to 96-hour LC-50 data.

Score	*Meaning*	*FCH designation*	*LC-50 Range*
1	safe	PNT	>100,000 µg/L
2	slightly toxic	ST	10,000 to 100,000 µg/L
3	moderately toxic	MT	1,000 to 10,000 µg/L
4	toxic	HT	100 to 1,000 µg/L
5	very toxic	VHT	<100 µg/L

LC-50 data not reported explicitly but annotated as "safe" were assigned LC-50 = 1.00E+09 and score = 1, and unknown or unavailable toxicity data were conservatively assigned score = 2 (slightly toxic - on the assumption that dangerously toxic compounds would be well known and identified). Once scores were assigned to each chemical, they were averaged to obtain the average fish toxicity score. The SPSS® file was then re-imported via Excel into Access to create the updated table *toxicity*. These data were used to identify which agricultural chemicals could potentially pose water quality problems at the TFCF.

USGS Pesticide-Herbicide Data: The figures in Appendix 4 represent summaries of a detailed investigation of agricultural organic chemicals based on almost daily water sample collection from 1991 to 1994. Samples were collected from the SJR at Vernalis and the Sacramento River at Sacramento, and each 2-L sample was preconcentrated using solid phase extraction followed by solvent elution and analysis by gas chromatography-mass spectrometry (GC-MS). Probably the best set of agricultural organic chemical analysis data from the Delta, these data have detection limits in the tens of ng/L (*nanograms* per liter), well below regulated concentrations.

The Vernalis data were scanned directly from the USGS report (*MacCoy, et.al., 1995*), converted to ASCII text files using optical character recognition software, imported into Excel and then SPSS® for data conversion, graphing and summary analysis, and then back to Access as database **usgs.mdb**. The

entire Vernalis data set is in one table, *usgspest,* and no simple or crosstab queries are needed to view or export the data. See Appendix 3 for summary tables from this data set.

Hydrolab Data Collation: The data in Appendix 5 were obtained from the permanent Hydrolab H20 installed at the TFCF and connected to a Geomation, Inc. data acquisition system. ASCII text files in list format (similar to the STORET input files) for monthly data were prepared by TFCF personnel using the Geomation software. The ASCII files were sent by E-mail to the first author, who imported the monthly text files into Excel and then Access top creat the database **hydrolab.mdb**.

Seasonal (3-month) combined Excel files (each with 9 variables-fields per record) were created for the period of March 1997 through February 1998. These files were then imported into Access as tables *spring_1997* (33,506 records), *fall_1997* (38,733 records), *summer_1997* (26,853), and *winter_97_98* (29,891 records). Crosstab queries were used to convert the list-format tables into spreadsheet-style files for analysis output, and the "avg" function was used in the crosstab query design to obtain hourly average values (and considerably smaller output files!). The subsequent seasonal output files were combined via Excel and then imported into SPSS® as a single data set for graphing and analysis.

Database and Field Name Documentation: The descriptive documentation for field names within in each database table are either obvious (as in "Dacthal" or "Pebulate") or included in the files themselves (accessible by highlighting the table and selecting the "Design" button). Since some of the imported data files are large (>10 Mbytes), separate databases for each source were created, and a Pentium-class PC with a minimum of 64 Mbyte of RAM is required to perform some of the queries in Access.

Global Database File: All of the separate database file tables are attached to the "global" database **tracy.mdb**; however, this file contains no queries. In this study, a rudimentary set of data tables and queries were created for each separate database file which will be expanded and updated throughout the course of this project. .

APPENDIX 2

Water Chemistry and Biota Data: Summary of Major Ions, Nutrients, and Trace Element Data Collated from the EPA STORET Data Base

Table A2-1 STORET Parameter Numbers (Access field name Parmno) and associated descriptive fields used in the STORET chemical database for the Tracy Fish Collection Facility.

Parmno	*Parameter Description*	*Shortname*	*CAS Number*	*Units*
10	TEMPERATURE, WATER (DEGREES CENTIGRADE)	t°c		°C
1000	ARSENIC, DISSOLVED (UG/L AS AS)	as_d	7440382	µg/L
1002	ARSENIC, TOTAL (UG/L AS AS)	as_t	7440382	µg/L
1020	BORON, DISSOLVED (UG/L AS B)	b_d	7440428	µg/L
1022	BORON, TOTAL (UG/L AS B)	b_t	7440428	µg/L
1025	CADMIUM, DISSOLVED (UG/L AS CD)	cd_d	7440439	µg/L
1027	CADMIUM, TOTAL (UG/L AS CD)	cd_t	7440439	µg/L
1030	CHROMIUM, DISSOLVED (UG/L AS CR)	cd_d	7440473	µg/L
1032	CHROMIUM, HEXAVALENT (UG/L AS CR)	cr_hex	7440473	µg/L
1034	CHROMIUM, TOTAL (UG/L AS CR)	cr_t	7440473	µg/L
1040	COPPER, DISSOLVED (UG/L AS CU)	cu_d	7440508	µg/L
1042	COPPER, TOTAL (UG/L AS CU)	cu_t	7440508	µg/L
1045	IRON, TOTAL (UG/L AS FE)	fe_d	7439896	µg/L
1046	IRON, DISSOLVED (UG/L AS FE)	fe_t	7439896	µg/L
1049	LEAD, DISSOLVED (UG/L AS PB)	pb_d	7439921	µg/L
1051	LEAD, TOTAL (UG/L AS PB)	pb_t	7439921	µg/L
1055	MANGANESE, TOTAL (UG/L AS MN)	mn_t	7439965	µg/L
1056	MANGANESE, DISSOLVED (UG/L AS MN)	mn_d	7439965	µg/L
1060	MOLYBDENUM, DISSOLVED (UG/L AS MO)	mo_d	7439987	µg/L
1062	MOLYBDENUM, TOTAL (UG/L AS MO)	mo_t	7439987	µg/L
1065	NICKEL, DISSOLVED (UG/L AS NI)	ni_d	7440020	µg/L
1067	NICKEL, TOTAL (UG/L AS NI)	ni_t	7440020	µg/L
1075	SILVER, DISSOLVED (UG/L AS AG)	ag_d	7440224	µg/L
1077	SILVER, TOTAL (UG/L AS AG)	ag_t	7440224	µg/L
1085	VANADIUM, DISSOLVED (UG/L AS V)	v_d	7440622	µg/L
1090	ZINC, DISSOLVED (UG/L AS ZN)	zn_d	7440666	µg/L
1092	ZINC, TOTAL (UG/L AS ZN)	zn_t	7440666	µg/L
11	TEMPERATURE, WATER (DEGREES FAHRENHEIT)	t°f		°F
1105	ALUMINUM, TOTAL (UG/L AS AL)	al_t	7429905	µg/L
1130	LITHIUM, DISSOLVED (UG/L AS LI)	li_d	7439932	µg/L
1132	LITHIUM, TOTAL (UG/L AS LI)	li_t	7439932	µg/L
1145	SELENIUM, DISSOLVED (UG/L AS SE)	se_d	7782492	µg/L
1147	SELENIUM, TOTAL (UG/L AS SE)	se_t	7782492	µg/L
20	TEMPERATURE, AIR (DEGREES CENTIGRADE)	air_t°c		°C
204	DEPTH IN METERS AT WHICH 1% SURFACE LIGHT REMAINS	1%depth		m
300	OXYGEN, DISSOLVED MG/L	do	7782447	mg/L
301	OXYGEN, DISSOLVED, PERCENT OF SATURATION %	do%	7782447	%
310	BOD, 5 DAY, 20 DEG C MG/L	bod5		mg/L
312	BOD, 6 DAY, 20 DEG C MG/L	bod6		mg/L
315	BOD, 7 DAY, 20 DEG C MG/L	bod7		mg/L
31505	COLIFORM,TOT,MPN,CONFIRMED TEST,35C (TUBE 31506)	coli35		N
31615	FECAL COLIFORM,MPN,EC MED,44.5C (TUBE 31614)	coli44t		N
31616	FECAL COLIFORM,MEMBR FILTER,M-FC BROTH,44.5 C	coli44b		E
32101	BROMODICHLOROMETHANE,WHOLE WATER,UG/L	brcl2ch	75274	µg/L
32102	CARBON TETRACHLORIDE,WHOLE WATER,UG/L	ccl4	56235	µg/L
32104	BROMOFORM,WHOLE WATER,UG/L	chbr3	75252	µg/L

Parmno	Parameter Description	Shortname	CAS Number	Units
32105	DIBROMOCHLOROMETHANE,WHOLE WATER,UG/L	br2clch	124481	µg/L
32106	CHLOROFORM,WHOLE WATER,UG/L	chcl3	67663	µg/L
32211	CHLOROPHYLL-A UG/L SPECTROPHOTOMETRIC ACID. METH.	cphyll_a	479618	µg/L
32212	CHLOROPHYLL-B UG/L TRICHROMATIC UNCORRECTED	cphyll_b	519620	µg/L
32214	CHLOROPHYLL-C UG/L TRICHROMATIC UNCORRECTED	cphyll_c	11003455	µg/L
32216	CHLOROPHYLL,TOTAL UG/L TRICHROMATIC UNCORRECTED	cphyll_tot		µg/L
32218	PHEOPHYTIN-A UG/L SPECTROPHOTOMETRIC ACID. METH.	pphytin_a	603178	µg/L
32221	CHLOROPHYLL A,% OF(PHEOPHYTIN A+CHL A),SPEC-ACID.	cphyll_a%		%
335	COD, .025N K2CR2O7 MG/L	cod		mg/L
34010	TOLUENE IN WTR SMPLE GC-MS, HEXADECONE EXTR.(UG/L)	toluene	108883	µg/L
34030	BENZENE IN WTR SMPLE GC-MS, HEXADECONE EXTR.(UG/L)	benzene	71432	µg/L
34301	CHLOROBENZENE TOTWUG/L	cl_benz	108907	µg/L
34311	CHLOROETHANE TOTWUG/L	cl_ethane	75003	µg/L
34371	ETHYLBENZENE TOTWUG/L	et_benz	100414	µg/L
34413	METHYL BROMIDE TOTWUG/L	brch3	74839	µg/L
34418	METHYL CHLORIDE TOTWUG/L	clch3	74873	µg/L
34423	METHYLENE CHLORIDE TOTWUG/L	meth_cl	75092	µg/L
34475	TETRACHLOROETHYLENE TOTWUG/L	tcethene	127184	µg/L
34488	TRICHLOROFLUOROMETHANE TOTWUG/L	cl3fch	75694	µg/L
34496	1,1-DICHLOROETHANE TOTWUG/L	11_dcea	75343	µg/L
34501	1,1-DICHLOROETHYLENE TOTWUG/L	11_dcee	75354	µg/L
34506	1,1,1-TRICHLOROETHANE TOTWUG/L	111_tcea	71556	µg/L
34511	1,1,2-TRICHLOROETHANE TOTWUG/L	112_tcea	79005	µg/L
34516	1,1,2,2-TETRACHLOROETHANE TOTWUG/L	1122tcea	79345	µg/L
34531	1,2-DICHLOROETHANE TOTWUG/L	1_2dcea	107062	µg/L
34536	1,2-DICHLOROBENZENE TOTWUG/L	1_2dcben	95501	µg/L
34541	1,2-DICHLOROPROPANE TOTWUG/L	1_2dcp	78875	µg/L
34546	TRANS-1,2-DICHLOROETHENE, TOTAL, IN WATER UG/L	t1_2dce	156605	µg/L
34566	1,3-DICHLOROBENZENE TOTWUG/L	1_3dcben	541731	µg/L
34571	1,4-DICHLOROBENZENE TOTWUG/L	1_4dcben	106467	µg/L
34576	2-CHLOROETHYL VINYL ETHER TOTWUG/L	2cev_eth	110758	µg/L
34668	DICHLORODIFUOROMETHANE TOTWUG/L	cl2f2c	75718	µg/L
34699	TRANS-1,3-DICHLOROPROPENETOTAL IN WATER UG/L	t13dcpre	10061026	µg/L
34704	CIS-1,3-DICHLOROPROPENE TOTAL IN WATER UG/L	c13dcpre	10061015	µg/L
350	BOD, 14 DAY, 20 DEG C MG/L	bod_14		mg/L
354	BOD, 49 DAY, 20 DEG C MG	bod_49		mg/L
364	BOD, 100 DAY, 20 DEG C MG/L	bod_100		mg/L
39036	ALKALINITY,FILTERED SAMPLE AS CACO3 MG/L	alk_fcal	471341	mg/L
39040	S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE WTR-FPD UG/L	tbpptate	78488	µg/L
39044	CHC(AS DDT),NONE FOUND,WHOLE WATER SAMPLE (UG/L)	chc_ddt		µg/L
39153	ATRAZINE &/OR SIMAZINE IN WHOLE WATER SAMPL UG/L	atrazine		µg/L
39175	VINYL CHLORIDE-WHOLE WATER SAMPLE-UG/L	vinylcl	75014	µg/L
39180	TRICHLOROETHYLENE-WHOLE WATER SAMPLE-UG/L	cl3ethe	79016	µg/L
39330	ALDRIN IN WHOLE WATER SAMPLE (UG/L)	aldrin	309002	µg/L
39340	GAMMA-BHC(LINDANE),WHOLE WATER,UG/L	gamma_bhc	58899	µg/L
39360	DDD IN WHOLE WATER SAMPLE (UG/L)	ddd	72548	µg/L
39365	DDE IN WHOLE WATER SAMPLE (UG/L)	dde	72559	µg/L

Parmno	Parameter Description	Shortname	CAS Number	Units
39370	DDT IN WHOLE WATER SAMPLE (UG/L)	ddt	50293	µg/L
39380	DIELDRIN IN WHOLE WATER SAMPLE (UG/L)	dieldrin	60571	µg/L
39400	TOXAPHENE IN WHOLE WATER SAMPLE (UG/L)	toxaphen	8001352	µg/L
39410	HEPTACHLOR IN WHOLE WATER SAMPLE (UG/L)	heptachl	76448	µg/L
39420	HEPTACHLOR EPOXIDE IN WHOLE WATER SAMPLE (UG/L)	hep_epox	1024573	µg/L
39496	PCB - 1242 PCB SERIES WHOLE WATER SAMPLE UG/L	pcb_1242	53469219	µg/L
39504	PCB - 1254 PCB SERIES WHOLE WATER SAMPLE UG/L	pcb_1254	11097691	µg/L
39508	PCB - 1260 PCB SERIES WHOLE WATER SAMPLE UG/L	pcb_1260	11096825	µg/L
39570	DIAZINON IN WHOLE WATER SAMPLE (UG/L)	diazinon	333415	µg/L
39730	2,4-D IN WHOLE WATER SAMPLE (UG/L)	2_4_d	94757	µg/L
39770	DACTHAL (DCPA) IN WHOLE WATER SAMPLE (UG/L)	dacthal	1861321	µg/L
400	PH (STANDARD UNITS)	ph		SU
403	PH, LAB, STANDARD UNITS SU	lab_ph		SU
410	ALKALINITY, TOTAL (MG/L AS CACO3)	alk_totc	471341	mg/L
425	ALKALINITY, BICARBONATE (MG/L AS CACO3)	hco3_cal	471341	mg/L
430	ALKALINITY, CARBONATE (MG/L AS CACO3)	co3_cal	471341	mg/L
440	BICARBONATE ION (MG/L AS HCO3)	hco3	71523	mg/L
445	CARBONATE ION (MG/L AS CO3)	co3	3812326	mg/L
45605	CABLE LENGTH FEET	cable		ft
46570	HARDNESS, CA MG CALCULATED (MG/L AS CACO3)	hard_cal		mg/L
49002	ALGAE, CRYPTOMONADS (ORGANISMS/ML)	alg_cryp		org/mL
49003	ALGAE, DINOFLAGELLATES (ORGANISMS/ML)	alg_dino		org/mL
49004	ALGAE, GREEN (ORGANISMS/ML)	alg_gr		org/mL
49005	ALGAE, BLUE-GREEN (ORGANISMS/ML)	alg_blgr		org/mL
49006	ALGAE, YELLOW-GREEN (ORGANISMS/ML)	alg_yegr		org/mL
49010	UNKNOWNC AS DDT IN WHOLE WATER SAMPLE (UG/L)	as_ddt		µg/L
515	RESIDUE, TOTAL FILTRABLE (DRIED AT 105C),MG/L	tss		mg/L
530	RESIDUE, TOTAL NONFILTRABLE (MG/L)	tds		mg/L
535	RESIDUE, VOLATILE NONFILTRABLE (MG/L)	resvol		mg/L
540	RESIDUE, FIXED NONFILTRABLE (MG/L)	tds_fix		mg/L
600	NITROGEN, TOTAL (MG/L AS N)	n_t	17778880	mg/L
60050	ALGAE, TOTAL (CELLS/ML)	alg_t		cells/mL
60300	ALGAE, FLAGELLATE GREEN (CELLS/ML)	alg_flag		cells/mL
60370	ALGAE, DIATOMS (CELLS/ML)	alg_diat		cells/mL
605	NITROGEN, ORGANIC, TOTAL (MG/L AS N)	norg_t	17778880	mg/L
606	NITROGEN, ORGANIC, SUSPENDED (MG/L AS N)	norg_s	17778880	mg/L
607	NITROGEN, ORGANIC, DISSOLVED (MG/L AS N)	norg_d	17778880	mg/L
608	NITROGEN, AMMONIA, DISSOLVED (MG/L AS N)	nh3_d	17778880	mg/L
60850	ROTIFERS, TOTAL (/LITER)	rotifers		org/mL
610	NITROGEN, AMMONIA, TOTAL (MG/L AS N)	nh3_t	17778880	mg/L
612	AMMONIA, UNIONZED (MG/L AS N)	nh3_unio	7664417	mg/L
613	NITRITE NITROGEN, DISSOLVED (MG/L AS N)	no2_d	17778880	mg/L
618	NITRATE NITROGEN, DISSOLVED (MG/L AS N)	no3_d	17778880	mg/L
619	AMMONIA, UNIONIZED (CALC FR TEMP-PH-NH4) (MG/L)	nh3_unca	7664417	mg/L
620	NITRATE NITROGEN, TOTAL (MG/L AS N)	no3_t	17778880	mg/L
629	NITROGEN, ORGANIC KJELDAHL, TOTAL (MG/L AS N)	tkn	17778880	mg/L
630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	no2no3t	17778880	mg/L
631	NITRITE PLUS NITRATE, DISS. 1 DET. (MG/L AS N)	no2no3d	17778880	mg/L
635	NITROGEN, AMMONIA&ORG., TOTAL 1 DET (MG/L AS N)	nh3org_t	17778880	mg/L
636	NITROGEN, AMMONIA&ORG., DISS. 1 DET (MG/L AS N)	nh3org_d	17778880	mg/L

Parmno	Parameter Description	Shortname	CAS Number	Units
64	DEPTH OF STREAM, MEAN (FT)	st_depth		ft
640	NITROGEN, INORGANIC, TOTAL (MG/L AS N)	n_inor_t	17778880	mg/L
65	STAGE, STREAM (FEET)	st_stage		ft
653	PHOSPHATE, TOTAL SOLUBLE (MG/L)	po4_ft	14265442	mg/L
665	PHOSPHORUS, TOTAL (MG/L AS P)	p_t	7723140	mg/L
666	PHOSPHORUS, DISSOLVED (MG/L AS P)	p_d	7723140	mg/L
671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHATE (MG/L AS P)	po4_d	7723140	mg/L
680	CARBON, TOTAL ORGANIC (MG/L AS C)	toc	7440440	mg/L
70	TURBIDITY, (JACKSON CANDLE UNITS)	turb_jcu		JCU
70211	TIDE, HIGH OR LOW,BEFORE OR AFTER,HOUR,MINUTE	tide1		
70299	SOLIDS, SUSP. - RESIDUE ON EVAP. AT 180 C (MG/L)	tss_180		mg/L
70300	RESIDUE,TOTAL FILTRABLE (DRIED AT 180C),MG/L	tds_180		mg/L
70507	PHOSPHORUS,IN TOTAL ORTHOPHOSPHATE (MG/L AS P)	po4?	7723140	mg/L
70991	PHYTO-PRODUCTION,AREAL NET,O2 METHOD(G/M2/DAY)	phypro_n		g/m2/d
70992	PHYTO-PRODUCTION,AREAL GROSS, O2 METHOD(G/M2/DAY)	phypro_g		g/m2/d
70993	PHYTO-PRODUCTION,VOL.MAX.GROSS,O2 METHOD(G/M3/DAY)	phypro_m		g/m3/d
70994	RESPIRATION,AREAL PLANKTONIC (G/M2/DAY)	respir_a		g/m2/d
70995	RESPIRATION,VOLUMETRIC PLANKTONIC (G/M3/DAY)	respir_v		g/m3/d
71229	CATCH - NUMBER OF ORGANISMS CAUGHT	catch		caught
71291	ORDER CLADOCERA (NO/LITER)	cladocer		org/L
71296	SUBCLASS COPEPODA (NO/LITER)	copepod		org/L
71851	NITRATE NITROGEN, DISSOLVED (MG/L AS NO3)	no3_dn	14797558	mg/L
71870	BROMIDE (MG/L AS BR)	br	24959679	mg/L
71890	MERCURY, DISSOLVED (UG/L AS HG)	hg_d	7439976	µg/L
71900	MERCURY, TOTAL (UG/L AS HG)	hg_t	7439976	µg/L
75	TURBIDITY, HELLIGE (PPM AS SILICON DIOXIDE)	turb_hel		mg/L
76	TURBIDITY,HACH TURBIDIMETER (FORMAZIN TURB UNIT)	turb_ftu		FTU
77	TRANSPARENCY, SECCHI DISC (INCHES)	secci_in		in
78	TRANSPARENCY, SECCHI DISC (METERS)	secci_m		m
80	COLOR (PLATINUM-COBALT UNITS)	colorpcu		pcu
81551	XYLENE WHL WATER SMPL UG/L	xylene	1330207	µg/L
81595	METHYL ETHYL KETONE WHL WATER SMPL UG/L	mek	78933	µg/L
81596	METHYL-ISOBUTYL KETONE WHL WATER SMPL UG/L	mibk	108101	µg/L
81903	DEPTH OF BOTTOM OF WATER BODY @ SAMPLE SITE, FEET	bottom		ft
90	OXIDATION REDUCTION POTENTIAL (MILLIVOLTS)	eh		mV
900	HARDNESS, TOTAL (MG/L AS CACO3)	hard_tca	471341	mg/L
902	HARDNESS, NON-CARBONATE (MG/L AS CACO3)	hard_ncar	471341	mg/L
915	CALCIUM, DISSOLVED (MG/L AS CA)	ca_d	7440702	mg/L
916	CALCIUM, TOTAL (MG/L AS CA)	ca_t	7440702	mg/L
925	MAGNESIUM, DISSOLVED (MG/L AS MG)	mg_d	7439954	mg/L
927	MAGNESIUM, TOTAL (MG/L AS MG)	mg_t	7439954	mg/L
929	SODIUM, TOTAL (MG/L AS NA)	na_t	7440235	mg/L
930	SODIUM, DISSOLVED (MG/L AS NA)	na_d	7440235	mg/L
932	SODIUM, PERCENT	na%	7440235	%
935	POTASSIUM, DISSOLVED (MG/L AS K)	k_d	7440097	mg/L
937	POTASSIUM, TOTAL MG/L AS K)	K_t	7440097	mg/L

Parmno	Parameter Description	Shortname	CAS Number	Units
94	SPECIFIC CONDUCTANCE,FIELD (UMHOS/CM @ 25C)	ec_field		µS/cm
940	CHLORIDE,TOTAL IN WATER MG/L	cl_t	16887006	mg/L
941	CHLORIDE, DISSOLVED IN WATER MG/L	cl_d	16887006	mg/L
945	SULFATE, TOTAL (MG/L AS SO4)	so4_t	14808798	mg/L
946	SULFATE, DISSOLVED (MG/L AS SO4)	so4_d	14808798	mg/L
95	SPECIFIC CONDUCTANCE (UMHOS/CM @ 25C)	ec		µS/cm
950	FLUORIDE, DISSOLVED (MG/L AS F)	f_d	16984488	mg/L
955	SILICA, DISSOLVED (MG/L AS SI02)	sio2_d	7631869	mg/L

Table A2-2 STORET sampling stations used in chemical data summaries for the Tracy Fish Collection Facility. These stations are located within a lat-long box defined by 37°45'00" N to 37°56'00" N and 121°20'00" W to 121°38'00" W.

Station	Agency	Beginning Sample Date	Ending Sample Date	Period of Record, Days	Total Samples	Total Analyses	Station Description	°N Latitude	°W Longitude
01N/04E-35R01 M	21CAL-2	4/8/80	11/9/81	580	4	29	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:53	121:30
01N/04E-36K03 M	21CAL-2	10/15/79	4/10/80	178	2	14	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:53	121:29
01N/05E-10P01 M	21CAL-2	6/3/75	11/6/81	2348	14	106	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:56	121:25
01N/05E-10Q01 M	21CAL-2	9/7/77	11/5/81	1520	9	64	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:56	121:24
01N/05E-15F01 M	21CAL-2	4/11/78	11/6/81	1305	8	76	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:56	121:25
01N/05E-15G01 M	21CAL-2	10/14/68	11/5/81	4770	13	105	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:56	121:24
01N/05E-15L02 M	21CAL-2	6/24/75	4/3/80	1745	10	81	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:56	121:25
01N/05E-21E03 M	21CAL-2	4/13/78	11/9/81	1306	8	55	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:55	121:26
01N/05E-21F01 M	21CAL-2	6/3/75	4/8/80	1771	11	82	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:55	121:26
01N/05E-21M02 M	21CAL-2	4/11/78	11/6/81	1305	8	54	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:55	121:26
01N/05E-22E01 M	21CAL-2	4/11/78	11/6/81	1305	8	65	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:55	121:25
01N/05E-29C02 M	21CAL-2	9/13/77	11/6/81	1515	9	58	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:54	121:27
01N/05E-29F01 M	21CAL-2	9/13/77	11/6/81	1515	9	60	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:54	121:27
01N/05E-30Q03 M	21CAL-2	6/17/76	4/10/80	1393	3	18	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:54	121:28
01N/05E-31D01 M	21CAL-2	4/17/79	11/9/81	937	6	47	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:54	121:28
01N/05E-31E01 M	21CAL-2	4/12/78	4/9/81	1093	4	28	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:53	121:28
01N/05E-36M01 M	21CAL-2	10/15/68	11/10/81	4774	13	99	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:53	121:23
01S/04E-02C01 M	21CAL-2	10/11/68	4/8/80	4197	9	52	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:53	121:30
01S/04E-03K01 M	21CAL-2	4/11/78	11/5/81	1304	8	53	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:53	121:31
01S/04E-03P02 M	21CAL-2	6/3/75	4/9/80	1772	11	69	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:52	121:31
01S/04E-04R01 M	21CAL-2	4/9/80	11/9/81	579	4	29	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:52	121:32
01S/04E-09B01 M	21CAL-2	4/13/78	11/9/81	1306	8	54	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:52	121:32
01S/04E-09C01 M	21CAL-2	6/3/75	4/9/80	1772	9	57	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:52	121:32
01S/04E-09N01 M	21CAL-2	10/13/78	11/9/81	1123	7	52	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:52	121:33
01S/04E-09N02 M	21CAL-2	4/12/78	11/9/81	1307	8	58	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:52	121:33
01S/05E-31H01 M	21CAL-3G	7/1/86	7/1/86	0	1	38	39-1057 WELL NO 01	37:48	121:27
01S/05E-35Q02 M	21CAL-3G	7/1/86	7/1/86	0	1	38	39-1063 WELL NO 01	37:47	121:23
02S/04E-16A01 M	21CAL-2	9/30/57	7/8/87	10873	9	166	LAT AND LONG CALCULATED FROM TOWNSHIP AND RANGE	37:46	121:32
374645121255601	112WRD	5/5/84	5/5/84	0	1	53	2S/5E-8A1M WELL 1B	37:46	121:25
B9D74821274	21CAL-6	9/4/91	2/2/95	1247	57	1509	OLD RIVER AT OAK ISLAND	37:48	121:27
B9D74831269	21CAL-1	1/1/01	3/1/88	31836	577	7854	OLD RIVER AT TRACY RD BR	37:48	121:26

Station	Agency	Beginning Sample Date	Ending Sample Date	Period of Record, Days	Total Samples	Total Analyses	Station Description	°N Latitude	°W Longitude
B9D74831269_@	21CAL-6	2/2/68	8/16/91	8596	407	10435	OLD RIVER AT TRACY RD BR	37:48	121:26
B9D74981333	21CAL-1	7/1/70	2/28/87	6086	16945	18016	1200' W OF CONFLU OF S END OF W CANAL & OLD RIVR	37:49	121:33
B9D75291273	21CAL-1	1/1/01	9/14/88	32033	49	625	MIDDLE RIVER AT TRACY ROAD BRIDGE	37:52	121:27
B9D75351292	21CAL-1	4/7/87	9/14/88	526	37	497	MIDDLE RIVER A UNION POINT	37:53	121:29
B9D75351292_@	21CAL-6	10/5/82	2/3/95	4504	216	5899	DOCK AT UNION POINT MARINA ON RIGHT BANK	37:53	121:29
B9D75351293	21CAL-1	1/1/01	3/6/85	30745	241	5197	MIDDLE RIVER AT BORDEN HIGHWAY	37:53	121:29
B9D75351293_@	21CAL-6	2/2/68	10/5/82	5359	221	5079	MIDDLE RIVER AT BORDEN HIGHWAY	37:53	121:29
RMID23	113BUREC	1/1/01	2/29/96	34757	39479	64314	MIDDLE RIVER AT JUNCTION WITH VICTORIA CANAL	37:53	121:29
RMID40	113BUREC	1/1/01	2/29/96	34757	28879	50922	MIDDLE RIVER 1.7 KM NORTH OF JCT WITH OLD R	37:50	121:23
ROLD39	21CAL-81	6/5/61	8/1/88	9919	2758	8564	OLD RIVER NORTHWEST OF CONEY ISLAND	37:51	121:34
ROLD59	113BUREC	1/1/01	12/11/80	29199	298	4317	OLD RIVER AT TRACY ROAD BRIDGE	37:48	121:26
UID2133	11KEST	9/23/82	8/8/86	1415	38	915	AA TILE DRAIN SUMP 2.7 MI N/O TRACY	37:46	121:26
TOTALS	**first**	**9/30/57**	**2/29/96**	**last**	**90417**	**185903**			

Table A2-3 Gross-property field water quality data summarized by month, collated from the EPA STORET database for samples in the vicinity of the Tracy Fish Collection Facility.

Month	Statistic	Dissolved Oxygen, mg/L	Conductivity, µS/cm	pH, SU	Secci Disk Depth, inches	Temperature, °C	TDS/180°, mg/L	Turbidity, FTU
January	N	47	33	42	5	60	301	43
	Median	**9.3000**	**515.0000**	**7.2000**	**12.0000**	**9.0000**	**396.0000**	**20.0000**
	Minimum	4.30	186.00	6.50	7.00	6.00	100.00	.40
	Maximum	10.60	3690.00	7.80	18.00	15.60	2385.00	55.00
February	N	59	39	57	6	85	283	56
	Median	**9.5000**	**470.0000**	**7.3000**	**10.5000**	**11.0000**	**415.0000**	**21.0000**
	Minimum	.40	212.00	6.90	8.00	6.50	111.00	7.00
	Maximum	11.20	3800.00	8.00	14.00	16.00	2576.00	80.00
March	N	71	42	71	5	84	298	66
	Median	**8.9000**	**414.5000**	**7.5000**	**13.0000**	**14.0000**	**292.0000**	**18.0000**
	Minimum	3.80	203.00	6.70	12.00	10.00	126.00	6.00
	Maximum	14.10	3720.00	8.50	16.00	20.00	2582.00	43.00
April	N	96	61	165	5	104	324	73
	Median	**9.2000**	**433.0000**	**7.3000**	**12.0000**	**16.0000**	**203.0000**	**19.0000**
	Minimum	.00	190.00	5.80	8.00	11.00	109.00	10.00
	Maximum	16.20	3540.00	8.70	22.00	20.00	2354.00	70.00
May	N	92	70	97	5	121	342	73
	Median	**8.3500**	**383.5000**	**7.6000**	**10.0000**	**19.0000**	**162.0000**	**22.0000**
	Minimum	.10	115.00	6.00	7.00	14.00	58.00	9.00
	Maximum	16.60	3920.00	9.20	13.00	27.30	15000.00	150.00
June	N	97	71	105	5	141	319	76
	Median	**7.5000**	**427.0000**	**7.6000**	**10.0000**	**22.0000**	**167.0000**	**25.0000**
	Minimum	5.30	100.00	6.50	6.00	15.60	60.00	9.00
	Maximum	12.70	3220.00	9.00	12.00	27.10	2280.00	80.00
July	N	101	67	106	6	171	316	85
	Median	**7.0000**	**573.0000**	**7.5000**	**11.5000**	**24.0000**	**160.0000**	**21.0000**
	Minimum	2.40	132.00	6.60	6.00	16.70	78.00	10.00
	Maximum	15.00	3040.00	9.00	12.00	30.00	2068.00	45.00

Month	Statistic	Dissolved Oxygen, mg/L	Conductivity, µS/cm	pH, SU	Secci Disk Depth, inches	Temperature, °C	TDS/180°, mg/L	Turbidity, FTU
August	N	102	71	101	5	142	316	84
	Median	7.7000	650.0000	7.6000	12.0000	24.0000	177.5000	22.0000
	Minimum	1.40	179.00	6.50	10.00	10.00	105.00	9.00
	Maximum	12.10	3470.00	8.90	14.00	27.20	2370.00	65.00
September	N	107	61	105	5	121	284	87
	Median	7.6000	501.0000	7.6000	12.0000	22.0000	204.0000	20.0000
	Minimum	1.20	162.00	6.00	11.00	17.00	102.00	7.00
	Maximum	13.40	3620.00	9.00	14.00	25.00	2490.00	65.00
October	N	107	52	130	3	116	276	78
	Median	7.3000	427.5000	7.4000	15.0000	18.0000	240.0000	16.0000
	Minimum	1.40	145.00	6.00	12.00	14.00	92.00	7.00
	Maximum	10.60	3660.00	8.30	15.00	22.60	2432.00	34.00
November	N	66	37	83	5	94	279	56
	Median	8.2000	525.0000	7.3000	17.0000	14.0000	284.0000	14.0000
	Minimum	2.70	205.00	6.10	16.00	7.80	132.00	5.00
	Maximum	10.40	3570.00	7.90	22.00	20.00	2500.00	46.00
December	N	51	28	49	5	57	285	50
	Median	8.9000	543.0000	7.4000	16.0000	10.0000	318.0000	13.0000
	Minimum	4.80	165.00	6.40	13.00	5.00	66.00	1.00
	Maximum	12.10	3690.00	8.10	24.00	16.40	2508.00	29.00
Total	N	996	632	1111	60	1296	3623	827
	Median	8.1000	479.0000	7.5000	12.0000	19.0000	233.0000	18.0000
	Minimum	.00	100.00	5.80	6.00	5.00	58.00	.40
	Maximum	16.60	3920.00	9.20	24.00	30.00	15000.00	150.00

Table A2-4a Major ions data summaries from the STORET database for samples from the vicinity of the Tracy Fish Collection Facility.

Statistic	pH SU	EC µS/cm	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	CO_3 mg/L	HCO_3 mg/L	Cl mg/L	SO_4 mg/L
N	139	**632**	210	209	324	148	119	122	1152	38
Mean	7.7209		46.8033	24.0981	87.3241	3.1480	.4790	123.1066	102.0095	114.5237
Median	**7.7000**	**479.0000**	**30.5000**	**14.0000**	**61.5000**	**3.0000**	**.0000**	**96.5000**	**73.0000**	**68.5000**
Minimum	4.40	100.00	9.00	3.20	11.00	-1.00	-1.00	34.00	10.00	3.90
Maximum	9.80	3920.00	277.00	190.00	560.00	15.00	14.00	434.00	868.00	603.00

Table A2-4b Major ions data summaries from the STORET database for samples from the vicinity of Suisun Bay, California.

Statistic	pH SU	EC µS/cm	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	CO_3 mg/L	HCO_3 mg/L	Cl mg/L	SO_4 mg/L
N	135	347	5	5	5	5	51	51	79	5
Mean	7.7570	12336.314	57.2000	156.5000	1309.0000	38.3000	.3725	80.5686	2628.7215	345.4000
Median	**7.8000**	**12600.000**	**25.0000**	**23.0000**	**142.0000**	**7.4000**	**.0000**	**80.0000**	**2340.0000**	**63.0000**
Minimum	6.70	127.00	16.00	9.50	26.00	2.10	.00	58.00	8.00	16.00
Maximum	8.80	33040.00	137.00	442.00	3800.00	132.00	4.00	106.00	8400.00	1000.00

Table A2-4c Major ions data summaries from the STORET database for samples from the vicinity of the San Joaquin River near Vernalis, California.

Statistic	pH SU	EC µS/cm	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	CO_3 mg/L	HCO_3 mg/L	Cl mg/L	SO_4 mg/L
N	1077	986	282	282	442	302	474	489	432	363
Mean	7.6914	686.8286	32.4578	15.5014	74.7176	3.3510	.6118	124.9202	100.9236	14.4105
Median	**7.6000**	**675.5000**	**30.0000**	**14.0000**	**73.0000**	**3.1000**	**.0000**	**121.0000**	**92.5000**	**.7000**
Minimum	6.20	80.00	6.50	2.10	7.00	.90	.00	26.00	6.00	.00
Maximum	10.70	9960.00	105.00	51.00	234.00	9.40	28.00	322.00	960.00	130.00

Table A2-4d Major ions data summaries from the STORET database for samples from the Mokelumne River north of Stockton.

Statistic	pH SU	EC µS/cm	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	CO_3 mg/L	HCO_3 mg/L	Cl mg/L	SO_4 mg/L
N	19	331	2	2	2	2	10	11	3	2
Mean	7.6842	167.9305	15.5000	9.5000	17.0000	1.0000	.0000	57.9091	14.0000	11.5000
Median	**8.0000**	**142.0000**	**15.5000**	**9.5000**	**17.0000**	.	.	**58.0000**	**16.0000**	**11.5000**
Minimum	7.00	35.00	13.00	9.00	12.00	1.00	.00	36.00	8.00	8.00
Maximum	8.00	1315.00	18.00	10.00	22.00	1.00	.00	71.00	18.00	15.00

Table A2-4e Major ions data summaries from the STORET database for samples from the vicinity of the Sacramento River near Sacramento, California.

Statistic	pH SU	EC µS/cm	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	CO_3 mg/L	HCO_3 mg/L	Cl mg/L	SO_4 mg/L
N	391	394	328	328	356	107	109	238	355	328
Mean	7.6257	152.7056	12.2107	6.4363	9.8848	7.9131	1.835E-02	71.7941	6.7859	9.0945
Median	**7.7000**	**150.0000**	**12.0000**	**6.3000**	**9.5500**	**7.9000**	**.0000**	**71.5000**	**6.0000**	**9.0000**
Minimum	6.50	43.00	6.40	2.60	3.00	7.10	.00	36.00	2.00	1.00
Maximum	8.30	270.00	18.00	12.00	21.00	8.60	2.00	118.00	15.00	22.00

Table A2-5 Summary by month of STORET major ions data for samples in the vicinity of the Tracy Fish Collection Facility.

Month	Statistic	pH, SU	Ca, mg/L	Mg, mg/L	Na, mg/L	K, mg/L	Alkalinity as CaCO3, mg/L	CO3, mg/L	HCO3, mg/L	Cl, mg/L	SO4, mg/L	Dissolved Silica, mg/L as SiO2	Boron, Filtered, mg/L	Boron, Unfiltered, mg/L	Turbidity, FTU
January	N	16	28	28	33	23	27	10	11	80	6	78	9	2	79
	Mean	7.5000	34.4286	16.9714	63.6061	3.0783	75.4074	.0000	104.7273	84.7625	66.0000	16.2718	-91.1111	950.0000	19.1316
	Median	**7.4500**	**28.5000**	**12.0000**	**51.0000**	**3.0000**	**69.0000**	.	**89.0000**	**67.0000**	**67.5000**	**16.6000**	**-200.0000**	**950.0000**	**15.0000**
	Minimum	7.20	11.00	5.00	18.00	1.60	48.00	.00	64.00	19.00	46.00	9.90	-500.00	750.00	.40
	Maximum	8.20	227.00	130.00	348.00	5.00	191.00	.00	230.00	254.00	80.00	37.00	780.00	1150.00	60.00
February	N	4	13	13	33	9	15	6	6	74	1	62		1	97
	Mean	8.5500	30.5385	15.3846	75.1818	3.7222	83.4667	.0000	81.8333	90.4324	100.0000	15.9000		1100.0000	23.1237
	Median	**8.6000**	**35.0000**	**18.0000**	**68.0000**	**4.2000**	**71.0000**	.	**83.0000**	**74.0000**	.	**15.4000**		.	**17.0000**
	Minimum	7.30	13.00	5.00	18.00	2.00	28.00	.00	34.00	19.00	100.00	10.00		1100.00	5.00
	Maximum	9.70	42.00	21.00	230.00	4.80	231.00	.00	127.00	314.00	100.00	23.00		1100.00	80.00
March	N	6	12	12	17	9	25	7	7	77	1	82	3	2	116
	Mean	7.7000	32.9167	11.4500	52.8235	2.7111	80.2400	.1429	104.4286	83.4286	62.0000	15.1951	-166.6667	1150.0000	18.0690
	Median	**7.6500**	**36.0000**	**9.5000**	**41.0000**	**3.2000**	**71.0000**	**.0000**	**104.0000**	**57.0000**	.	**15.0000**	**-500.0000**	**1150.0000**	**16.5000**
	Minimum	7.40	12.00	3.70	16.00	1.60	31.00	-1.00	74.00	17.00	62.00	10.00	-500.00	1100.00	3.00
	Maximum	8.20	65.00	36.00	156.00	3.40	226.00	3.00	143.00	308.00	62.00	21.00	500.00	1200.00	50.00
April	N	21	28	28	32	22	47	15	16	123	7	121	33	1	135
	Mean	7.4048	45.1071	21.9357	87.2188	2.8182	96.0000	.6667	126.8125	110.9106	126.1429	15.5793	284.8485	1200.0000	20.7481
	Median	**7.6000**	**20.0000**	**9.6000**	**84.5000**	**2.1500**	**67.0000**	**.0000**	**100.0000**	**61.0000**	**90.0000**	**15.0000**	**300.0000**	.	**17.0000**
	Minimum	6.10	10.00	5.00	16.00	-1.00	2.00	-1.00	56.00	16.00	11.00	4.00	-200.00	1200.00	4.00
	Maximum	7.90	184.00	123.00	397.00	5.60	343.00	8.00	424.00	753.00	358.00	130.00	1200.00	1200.00	70.00
May	N	8	10	10	29	4	32	6	6	104		111	4	4	136
	Mean	7.7875	77.7000	45.5000	87.5517	5.1500	82.8125	.0000	104.8333	81.5000		12.6126	1227.5000	1350.0000	22.5588
	Median	**7.8000**	**45.5000**	**22.5000**	**68.0000**	**2.6000**	**74.5000**	.	**98.0000**	**52.0000**		**13.6000**	**1105.0000**	**1200.0000**	**20.0000**
	Minimum	7.40	11.00	5.00	14.00	.40	30.00	.00	90.00	14.00		.50	700.00	1000.00	6.00
	Maximum	8.50	260.00	190.00	560.00	15.00	208.00	.00	129.00	317.00		22.00	2000.00	2000.00	150.00
June	N	16	18	18	22	11	42	12	12	115	4	109	4	2	144
	Mean	7.8125	54.5667	30.3500	137.1364	3.2273	108.7381	.5833	120.6667	109.1739	210.5000	11.9651	1277.5000	1150.0000	23.5694
	Median	**7.8000**	**43.0000**	**24.5000**	**100.0000**	**3.7000**	**65.5000**	**.0000**	**77.0000**	**55.0000**	**163.5000**	**13.0000**	**805.0000**	**1150.0000**	**22.0000**
	Minimum	6.80	9.60	3.20	12.00	1.40	3.00	.00	37.00	12.00	80.00	.20	.00	1100.00	7.00
	Maximum	8.40	170.00	102.00	373.00	4.40	496.00	7.00	347.00	726.00	435.00	22.00	3500.00	1200.00	80.00

Month	Statistic	pH, SU	Ca, mg/L	Mg, mg/L	Na, mg/L	K, mg/L	Alkalinity as CaCO3, mg/L	CO3, mg/L	HCO3, mg/L	Cl, mg/L	SO4, mg/L	Dissolved Silica, mg/L as SiO2	Boron, Filtered, mg/L	Boron, Unfiltered, mg/L	Turbidity, FTU
July	N	20	26	26	30	21	52	17	17	121	8	142	21	2	158
	Mean	7.9750	34.8846	18.8577	90.9667	2.7429	102.0577	2.1176	125.2941	119.7025	77.1250	13.1239	485.7143	1250.0000	21.1456
	Median	**8.1000**	**34.5000**	**15.0000**	**74.0000**	**2.3000**	**110.0000**	**.0000**	**131.0000**	**109.0000**	**58.5000**	**14.1000**	**300.0000**	**1250.0000**	**21.0000**
	Minimum	7.10	10.00	4.00	13.00	.20	39.00	.00	56.00	11.00	19.00	.40	-200.00	1100.00	6.00
	Maximum	8.40	80.00	52.00	298.00	4.80	194.00	14.00	204.00	393.00	260.00	19.00	3200.00	1400.00	45.00
August	N	7	10	9	35	6	29	5	6	104		121	4	3	153
	Mean	7.9000	70.2000	40.6667	93.0286	2.6500	99.8276	.6000	191.8333	112.2308		14.9273	1902.5000	1366.6667	20.9150
	Median	**8.0000**	**48.5000**	**25.0000**	**92.0000**	**3.1500**	**104.0000**	**.0000**	**159.5000**	**95.5000**		**15.0000**	**2235.0000**	**1400.0000**	**21.0000**
	Minimum	7.50	24.00	12.00	11.00	.50	44.00	.00	80.00	10.00		1.00	400.00	1300.00	5.00
	Maximum	8.10	191.00	123.00	420.00	4.20	191.00	3.00	434.00	382.00		40.10	2740.00	1400.00	65.00
September	N	10	13	13	20	7	32	11	11	100	1	124	8	2	158
	Mean	7.8900	76.8462	37.2308	128.4500	2.8429	96.5313	.0000	155.7273	107.4900	3.9000	15.3839	1115.0000	1600.0000	18.1146
	Median	**8.0500**	**37.0000**	**19.0000**	**94.0000**	**2.0000**	**81.5000**	**.**	**127.0000**	**78.5000**	**.**	**15.0000**	**950.0000**	**1600.0000**	**19.0000**
	Minimum	7.00	10.00	5.00	17.00	.50	51.00	.00	85.00	18.00	3.90	6.20	100.00	1400.00	4.00
	Maximum	8.20	277.00	127.00	361.00	7.00	226.00	.00	390.00	688.00	3.90	44.00	3500.00	1800.00	65.00
October	N	15	32	32	34	28	54	17	17	103	10	128	19	2	139
	Mean	7.3800	38.5469	19.7500	70.8529	3.8607	88.8889	.0000	113.4706	103.7961	144.8000	14.9914	158.4211	1650.0000	14.9928
	Median	**7.6000**	**22.0000**	**12.5000**	**38.0000**	**3.5000**	**76.5000**	**.**	**95.0000**	**64.0000**	**47.5000**	**15.0000**	**200.0000**	**1650.0000**	**15.0000**
	Minimum	4.40	9.00	4.00	15.00	1.80	.00	.00	65.00	12.00	17.00	5.70	-500.00	1600.00	4.00
	Maximum	8.20	212.00	102.00	400.00	6.00	196.00	.00	217.00	820.00	603.00	23.00	1510.00	1700.00	34.00
November	N	9	11	11	30	2	18	7	7	81		73	10	2	99
	Mean	7.7667	70.9091	35.7727	87.9333	1.8000	87.2778	.0000	136.4286	105.7160		16.0932	663.0000	1600.0000	14.0000
	Median	**7.9000**	**36.0000**	**18.0000**	**76.5000**	**1.8000**	**75.0000**	**.**	**82.0000**	**79.0000**		**15.0000**	**450.0000**	**1600.0000**	**14.0000**
	Minimum	7.10	22.00	8.50	32.00	1.00	56.00	.00	74.00	21.00		8.40	200.00	1500.00	4.00
	Maximum	8.00	251.00	128.00	397.00	2.60	209.00	.00	380.00	868.00		37.00	2100.00	1700.00	46.00
December	N	7	9	9	9	6	12	6	6	70		65		1	90
	Mean	7.9571	47.6667	26.9556	96.3333	2.3333	91.0000	.0000	110.1667	96.9429		16.2462		1400.0000	12.6778
	Median	**7.7000**	**22.0000**	**17.6000**	**45.0000**	**2.1500**	**76.0000**	**.**	**86.5000**	**78.0000**		**16.0000**		**.**	**11.0000**
	Minimum	7.40	10.00	4.00	16.00	.50	59.00	.00	73.00	17.00		11.00		1400.00	1.00
	Maximum	9.80	240.00	120.00	400.00	4.50	186.00	.00	230.00	297.00		21.00		1400.00	29.00
Total	**N**	**139**	**210**	**209**	**324**	**148**	**385**	**119**	**122**	**1152**	**38**	**1216**	**116**	**24**	**1504**
	Mean	**7.7209**	**46.8033**	**24.0981**	**87.3241**	**3.1480**	**92.9273**	**.4790**	**123.1066**	**102.0095**	**114.5237**	**14.6525**	**473.6522**	**1329.1667**	**19.3667**
	Median	**7.7000**	**30.5000**	**14.0000**	**61.5000**	**3.0000**	**74.0000**	**.0000**	**96.5000**	**73.0000**	**68.5000**	**15.0000**	**300.0000**	**1250.0000**	**17.0000**
	Minimum	**4.40**	**9.00**	**3.20**	**11.00**	**-1.00**	**.00**	**-1.00**	**34.00**	**10.00**	**3.90**	**.20**	**-500.00**	**750.00**	**.40**
	Maximum	**9.80**	**277.00**	**190.00**	**560.00**	**15.00**	**496.00**	**14.00**	**434.00**	**868.00**	**603.00**	**130.00**	**3500.00**	**2000.00**	**150.00**

Table A2-6 Nutrient data summaries by month from the STORET database for samples in the vicinity of the Tracy Fish Collection Facility. All concentrations are in mg/L as N or as P.

Month	Statistic	Ammonia Filtered	Ammonia Unfiltered	Ammonia+ Organic N Unfiltered	Ammonia+ Organic N Unfiltered	Nitrite Filtered	Nitrite+ Nitrate Filtered	Nitrite+ Nitrate Unfiltered	Nitrate Filtered	Nitrate Unfiltered	Total Phosphorus Unfiltered	Ortho-Phosphorus Filtered	Total Kjeldahl Nitrogen Unfiltered
January	N	37	41	2	54	2	58	12	7	6	66	67	14
	Median	**.1900**	**.2100**	**.6000**	**.7500**	.	**1.2000**	**1.0600**	**.8600**	**.9500**	**.1600**	**.1000**	**.6250**
	Minimum	.04	.08	.40	.30	.02	.30	.56	.56	.70	.08	.04	.20
	Maximum	.81	.90	.80	2.10	.02	3.70	3.70	3.70	2.70	.45	.44	1.20
February	N	39	30	2	58	2	56	7	7	2	69	68	12
	Median	**.1800**	**.1400**	**.1500**	**.8000**	.	**1.0000**	**.8100**	**.8100**	**1.1400**	**.2200**	**.1300**	**.6550**
	Minimum	.04	-.01	.10	.20	.02	.30	.51	.51	.68	.08	.00	.12
	Maximum	1.60	.38	.20	3.10	.02	3.40	10.00	1.60	1.60	.79	.52	1.10
March	N	62	41	1	84	5	88	8	8	4	77	80	14
	Median	**.1100**	**8.000E-02**	.	**.6000**	**1.000E-02**	**.8000**	**1.2350**	**.9200**	**2.0000**	**.1800**	**.1000**	**.6000**
	Minimum	.01	.01	.40	.30	.00	.20	.37	.37	.80	.08	.01	.30
	Maximum	.64	.38	.40	2.00	.05	3.00	18.00	1.80	3.00	.39	.26	1.60
April	N	68	60	4	100	6	105	13	12	6	89	96	20
	Median	**5.500E-02**	**4.000E-02**	**.3500**	**.6000**	**.0000**	**.6000**	**.7100**	**.7150**	**.4150**	**.1500**	**7.000E-02**	**.5000**
	Minimum	-.01	-.08	.30	.30	.00	.00	-.02	.00	.20	.05	.00	.28
	Maximum	.44	.74	.60	2.10	.02	2.30	10.70	1.15	.90	.44	.27	2.00
May	N	67	48	5	98	6	100	8	9	2	84	85	18
	Median	**3.000E-02**	**3.000E-02**	**.3000**	**.7000**	**1.000E-02**	**.4000**	**.4700**	**.4600**	**.5750**	**.1700**	**7.000E-02**	**.7150**
	Minimum	-.01	.00	.10	.10	-.01	-.10	.03	.03	.34	.06	.00	.20
	Maximum	.10	.15	.40	3.50	.02	1.90	9.00	.81	.81	.55	.29	3.40
June	N	74	49	4	104	5	108	10	9	4	88	90	18
	Median	**4.500E-02**	**3.000E-02**	**.2500**	**.6000**	**.0000**	**.4000**	**.4350**	**.2500**	**.5000**	**.1800**	**8.000E-02**	**.5000**
	Minimum	-.01	-.10	.10	.20	.00	.00	.02	.02	.16	.10	-.10	.30
	Maximum	.42	.09	.30	2.30	.01	1.70	6.00	.80	.51	.66	.24	2.30
July	N	82	63	7	113	6	121	16	14	6	97	105	20
	Median	**4.000E-02**	**2.000E-02**	**.6000**	**.7000**	**1.000E-02**	**.5000**	**.3550**	**.3550**	**.6100**	**.2000**	**9.000E-02**	**1.1000**
	Minimum	-.01	-.08	-.10	-.10	.00	.00	-.10	.00	-.10	.07	.00	.20
	Maximum	.27	.30	1.20	2.50	.03	2.20	7.40	.98	1.00	.74	.29	2.50
August	N	78	54	5	108	5	112	10	11	2	92	88	19
	Median	**4.000E-02**	**4.000E-02**	**.6000**	**.6000**	**2.000E-02**	**.5000**	**.5650**	**.4000**	.	**.1700**	**9.000E-02**	**1.0000**
	Minimum	.00	.00	-.10	.20	.00	.10	.10	.10	1.10	.06	.04	.30
	Maximum	.24	.36	.80	2.10	.04	2.00	6.41	1.10	1.10	2.70	.41	2.10

Month	Statistic	Ammonia Filtered	Ammonia Unfiltered	Ammonia+ Organic N Unfiltered	Ammonia+ Organic N Unfiltered	Nitrite Filtered	Nitrite+ Nitrate Filtered	Nitrite+ Nitrate Unfiltered	Nitrate Filtered	Nitrate Unfiltered	Total Phosphorus Unfiltered	Ortho-Phosphorus Filtered	Total Kjeldahl Nitrogen Unfiltered
September	N	79	53	4	112	5	113	10	14	2	89	85	19
	Median	**4.000E-02**	**5.000E-02**	**.7500**	**.6000**	**2.000E-02**	**.5000**	**.5700**	**.6250**	**.7400**	**.1800**	**8.000E-02**	**.7000**
	Minimum	-.01	.00	.40	.20	.00	.00	.01	.01	.68	.05	.03	.20
	Maximum	.16	.31	.80	2.10	.02	1.60	3.60	1.34	.80	.48	.31	1.70
October	N	71	69	4	106	5	109	21	16	8	93	104	23
	Median	**6.000E-02**	**.1200**	**.8500**	**.6000**	**1.000E-02**	**.6000**	**.6300**	**.7600**	**.5000**	**.1500**	**9.000E-02**	**.6000**
	Minimum	.00	-.10	.40	.20	.01	.10	.07	.07	.32	.07	-.10	.30
	Maximum	1.40	.76	1.10	2.70	.02	1.50	3.30	1.80	1.00	.47	.27	1.20
November	N	43	33	4	61	2	59	10	8	1	72	69	11
	Median	**9.000E-02**	**.1400**	**.8000**	**.6000**	**.**	**.8000**	**1.0200**	**.7350**	**.**	**.1400**	**8.000E-02**	**.7000**
	Minimum	-.01	.01	.30	.20	.01	.20	.53	.53	.66	.04	.03	.20
	Maximum	.74	.58	.90	2.00	.01	2.00	1.60	1.25	.66	1.11	.34	1.40
December	N	43	34	3	60	2	59	9	8	1	74	70	12
	Median	**.1200**	**.1900**	**.6000**	**.7000**	**.**	**.9000**	**.8500**	**.8000**	**.**	**.1650**	**.1000**	**.5700**
	Minimum	.02	-.01	.60	.30	.01	.50	.53	.53	.60	.07	.01	.30
	Maximum	.43	.92	.70	2.10	.01	1.90	5.80	1.50	.60	.40	.31	1.20
Total	**N**	**743**	**575**	**45**	**1058**	**51**	**1088**	**134**	**123**	**44**	**990**	**1007**	**200**
	Median	**6.000E-02**	**6.000E-02**	**.4000**	**.6000**	**1.000E-02**	**.6000**	**.7000**	**.6400**	**.6800**	**.1700**	**9.000E-02**	**.6000**
	Minimum	**-.01**	**-.10**	**-.10**	**-.10**	**-.01**	**-.10**	**-.10**	**.00**	**-.10**	**.04**	**-.10**	**.12**
	Maximum	**1.60**	**.92**	**1.20**	**3.50**	**.05**	**3.70**	**18.00**	**3.70**	**3.00**	**2.70**	**.52**	**3.40**

Table A2-7a Trace element data summaries by month from the STORET database for samples in the vicinity of the Tracy Fish Collection Facility. Data reported as less than detection limit are indicated by negative numbers where the absolute value of the negative value represents the detection limit. Zero values represent data below unknown detection limits.

		Ag, Silver		As, Arsenic		Cd, Cadmium		Cr, Chromium		Cu, Copper		Hg, Mercury	
Month	**Statistic**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Hexavalent**	**Total**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**
January	N		3	1	6	1	6	1	6	1	6		5
	Median		**-1.0000**		**1.5000**		**-1.0000**		**5.0000**		**6.5000**		**-1.0000E-05**
	Minimum		-5.00	.00	-2.00	.00	-5.00	1.00	.00	10.00	1.00		-1.00
	Maximum		-1.00	.00	3.00	.00	10.00	1.00	58.00	10.00	17.00		2.00
February	N		2	1	4	2	4	1	4	2	4	1	4
	Median		**-.5000**		**1.0000**		**-1.5000**		**-1.0000E-05**	**-5.0000**	**6.5000**		**-5.0005E-02**
	Minimum		-2.00	.00	-10.00	.00	-10.00	-1.00	-2.00	-10.00	-2.00	.00	-.10
	Maximum		1.00	.00	41.00	.00	.00	-1.00	3.00	.00	10.00	.00	2.00
March	N	1	2	1	2	1	2		2	1	2	1	2
	Median										**4.0000**		
	Minimum	-2.00	-1.00	-2.00	2.00	-2.00	-1.00		3.00	2.00	3.00	2.00	-.10
	Maximum	-2.00	-1.00	-2.00	2.00	-2.00	-1.00		3.00	2.00	5.00	2.00	-.10
April	N	1	1	1	1	1	1	1	1	1	1	1	1
	Median												
	Minimum	-2.00	-1.00	-2.00	2.00	-4.00	-1.00	-1.00	2.00	-4.00	5.00	2.00	-.10
	Maximum	-2.00	-1.00	-2.00	2.00	-4.00	-1.00	-1.00	2.00	-4.00	5.00	2.00	-.10
May	N		3	5	8	6	7	2	8	6	9	1	8
	Median			**5.0000**	**2.0000**	**-1.0000E-05**	**-1.0000E-05**	**3.0000**	**1.0000**	**-1.0000E-05**	**6.0000**		**-1.0000E-05**
	Minimum		-1.00	.00	-4.00	-10.00	-1.00	-1.00	-2.00	-50.00	-4.00	-.10	-.10
	Maximum		-1.00	10.00	10.00	10.00	1.00	7.00	10.00	10.00	10.00	-.10	1.00
June	N		3		3		3	2	3		3		3
	Median		**-1.0000**		**2.0000**		**-1.0000**	**.0000**	**1.0000**		**3.0000**		**.1000**
	Minimum		-2.00		2.00		-2.00	-1.00	-4.00		-4.00		-.10
	Maximum		-1.00		3.00		-1.00	1.00	3.00		4.00		2.00
July	N		1		1		1		2		2		2
	Median								**3.5000**		**-9.0000**		**.0000**
	Minimum		-1.00		3.00		-1.00		-1.00		-20.00		-.10
	Maximum		-1.00		3.00		-1.00		8.00		2.00		.10
August	N		2		2	1	3	2	2	1	3		2
	Median				**3.5000**		**-1.0000**	**-3.5000**	**3.0000**		**-20.0000**		**.0000**
	Minimum		-1.00		3.00	-10.00	-10.00	-10.00	-1.00	-100.00	-100.00		-.10
	Maximum		-1.00		4.00	-10.00	-1.00	3.00	7.00	-100.00	1.00		.10

		Ag, Silver		As, Arsenic		Cd, Cadmium		Cr, Chromium		Cu, Copper		Hg, Mercury	
Month	Statistic	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Hexavalent	Total	Filtered	Unfiltered	Filtered	Unfiltered
September	N		2	4	6	4	6		6	4	6		6
	Median		4.5000	.	3.0000	.	-1.0000E-05		-1.0000E-05	5.0000	10.0000		.
	Minimum		-1.00	.00	.00	.00	-1.00		.00	.00	-1.00		.10
	Maximum		10.00	.00	10.00	.00	.00		8.00	10.00	10.00		.10
October	N		1		1		1		2		2		1
	Median		.		.		.		4.0000		3.0000		.
	Minimum		-1.00		3.00		-1.00		2.00		2.00		-.10
	Maximum		-1.00		3.00		-1.00		6.00		4.00		-.10
November	N		2		2		2		3		3		2
	Median		.		-.5000		.		3.0000		1.0000		.4500
	Minimum		-1.00		-4.00		-1.00		-1.00		1.00		-.10
	Maximum		-1.00		3.00		-1.00		9.00		2.00		1.00
December	N		3		2		3	2	3		3		3
	Median		.		-.5000		.	1.5000	2.0000		4.0000		.1000
	Minimum		-1.00		-4.00		-1.00	1.00	1.00		2.00		-.10
	Maximum		-1.00		3.00		-1.00	2.00	4.00		5.00		1.00
Total	N	2	25	13	38	16	39	11	42	16	44	4	39
	Median	.	-1.0000	-1.0000E-05	2.0000	-1.0000E-05	-1.0000	1.0000	2.0000	-1.0000E-05	3.5000	1.0000	-1.0000E-05
	Minimum	-2.00	-5.00	-2.00	-10.00	-10.00	-10.00	-10.00	-4.00	-100.00	-100.00	-.10	-1.00
	Maximum	-2.00	10.00	10.00	41.00	10.00	10.00	7.00	58.00	10.00	17.00	2.00	2.00

Table A2-7b Trace element data summaries by month from the STORET database for samples in the vicinity of the Tracy Fish Collection Facility. Data reported as less than detection limit are indicated by negative numbers where the absolute value of the negative value represents the detection limit. Zero values also represent data below unknown detection limits.

		Mo, Molybdenum		Ni, Nickel		Pb, Lead		Se, Selenium		V, Vanadium	Zn, Zinc	
Month	Statistic	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Filtered	Unfiltered
January	N		4		4	1	5		4		1	6
	Median		16.0000		.5000	.	-1.0000E-05		2.0000		.	5.5000
	Minimum		-4.00		-5.00	.00	-2.00		-5.00		10.00	-10.00
	Maximum		24.00		6.00	.00	12.00		5.00		10.00	18.00
February	N		2		2	2	4	1	2		1	3
	Median		2.5000		25.5000	5.0000	6.0000	.	2.5000		.	9.0000
	Minimum		-4.00		11.00	.00	-2.00	.00	1.00		10.00	.00
	Maximum		9.00		40.00	10.00	10.00	.00	4.00		10.00	260.00
March	N	1	2	1	2	1	2	2	2		1	2
	Median	.	12.5000	.	5.5000	.	4.5000	.5000	4.5000		.	.
	Minimum	10.00	11.00	14.00	-1.00	12.00	2.00	.00	4.00		3.00	-10.00
	Maximum	10.00	14.00	14.00	12.00	12.00	7.00	1.00	5.00		3.00	-10.00
April	N	1	1	1	1	1	1	1	1		1	1
	Median	.	.	.	.	.	.	.	.		.	.
	Minimum	13.00	6.00	12.00	9.00	10.00	2.00	1.00	3.00		35.00	10.00
	Maximum	13.00	6.00	12.00	9.00	10.00	2.00	1.00	3.00		35.00	10.00
May	N	1	5		4	6	8	1	5	1	6	9
	Median	.	15.0000		6.0000	-1.0000E-05	-1.0000E-05	.	2.0000	.	-1.0000E-05	13.0000
	Minimum	13.00	5.00		-5.00	-10.00	-10.00	-1.00	-1.00	23.00	-50.00	-10.00
	Maximum	13.00	24.00		11.00	3.00	2.00	-1.00	5.00	23.00	.00	160.00
June	N		3		3		3		3			3
	Median		13.0000	.	10.0000		2.0000		1.0000			30.0000
	Minimum		8.00		1.00		1.00		-1.00			5.00
	Maximum		15.00		24.00		9.00		5.00			40.00
July	N		2		2		1		2			2
	Median		.		7.0000		.		.			7.5000
	Minimum		12.00		2.00		-1.00		3.00			-5.00
	Maximum		12.00		12.00		-1.00		3.00			20.00
August	N		2		2	1	3		3		1	4
	Median		5.0000		18.0000	.	1.0000		2.0000		.	-1.0000
	Minimum		4.00		8.00	-10.00	-10.00		2.00		-500.00	-500.00
	Maximum		6.00		28.00	-10.00	1.00		3.00		-500.00	10.00

		Mo, Molybdenum		Ni, Nickel		Pb, Lead		Se, Selenium		V, Vanadium	Zn, Zinc	
Month	Statistic	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Filtered	Unfiltered
September	N		2		2	4	6		2		4	6
	Median		10.0000		10.0000	.	-1.0000E-05		2.5000		5.0000	-1.0000E-05
	Minimum		8.00		8.00	.00	-1.00		2.00		.00	-10.00
	Maximum		12.00		12.00	.00	.00		3.00		10.00	10.00
October	N		2		2		1		2			1
	Median		10.0000		19.5000		.		.			.
	Minimum		8.00		8.00		3.00		2.00			-10.00
	Maximum		12.00		31.00		3.00		2.00			-10.00
November	N		3		3		2		3			2
	Median		12.0000		5.0000		-1.5000		3.0000			24.0000
	Minimum		11.00		4.00		-2.00		2.00			10.00
	Maximum		17.00		6.00		-1.00		5.00			38.00
December	N		3		3		3		3			3
	Median		12.0000		6.0000		-1.0000		2.0000			-10.0000
	Minimum		7.00		-5.00		-1.00		2.00			-10.00
	Maximum		16.00		26.00		2.00		5.00			4.00
Total	N	3	31	2	30	16	39	5	32	1	15	42
	Median	13.0000	12.0000	13.0000	7.5000	-1.0000E-05	-1.0000E-05	-1.0000E-05	2.5000	.	-1.0000E-05	4.5000
	Minimum	10.00	-4.00	12.00	-5.00	-10.00	-10.00	-1.00	-5.00	23.00	-500.00	-500.00
	Maximum	13.00	24.00	14.00	40.00	12.00	12.00	1.00	5.00	23.00	35.00	260.00

Table A2-7c Trace element data summaries by month from the STORET database for samples in the vicinity of the Tracy Fish Collection Facility. Data reported as less than detection limit are indicated by negative numbers where the absolute value of the negative value represents the detection limit. Zero values also represent data below unknown detection limits.

		Fe, Iron		Mn, Manganese	
Month	Statistic	Filtered	Unfiltered	Filtered	Unfiltered
January	N	6	1	1	6
	Median	95.0000	.	.	77.5000
	Minimum	-60.00	70.00	40.00	50.00
	Maximum	970.00	70.00	40.00	260.00
February	N	4	2	2	4
	Median	879.0000	.	.	102.0000
	Minimum	40.00	360.00	10.00	80.00
	Maximum	1700.00	360.00	10.00	400.00
March	N	2	1	1	2
	Median	.	.	.	115.0000
	Minimum	30.00	135.00	100.00	110.00
	Maximum	30.00	135.00	100.00	120.00
April	N	1	1		1
	Median	.	.		.
	Minimum	210.00	16.00		390.00
	Maximum	210.00	16.00		390.00
May	N	8	6	6	8
	Median	1200.0000	30.0000	15.0000	70.0000
	Minimum	20.00	-100.00	-50.00	40.00
	Maximum	1500.00	50.00	1300.00	1300.00
June	N	3			3
	Median	48.0000			110.0000
	Minimum	40.00			50.00
	Maximum	140.00			210.00
July	N	2			2
	Median	.0000			71.5000
	Minimum	-30.00			53.00
	Maximum	30.00			90.00
August	N	3	1	1	3
	Median	68.0000	.	.	50.0000
	Minimum	-30.00	-100.00	-50.00	50.00
	Maximum	620.00	-100.00	-50.00	120.00
September	N	6	4	4	6
	Median	790.0000	30.0000	.	30.0000
	Minimum	60.00	20.00	10.00	30.00
	Maximum	860.00	40.00	10.00	80.00
October	N	1			1
	Median	.			.
	Minimum	20.00			100.00
	Maximum	20.00			100.00

		Fe, Iron		Mn, Manganese	
Month	**Statistic**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**
November	N	2			2
	Median	**35.0000**			**130.0000**
	Minimum	-10.00			110.00
	Maximum	80.00			150.00
December	N	3			3
	Median	**30.0000**			**90.0000**
	Minimum	-30.00			80.00
	Maximum	60.00			150.00
Total	**N**	**41**	**16**	**15**	**41**
	Median	**80.0000**	**30.0000**	**10.0000**	**80.0000**
	Minimum	**-60.00**	**-100.00**	**-50.00**	**30.00**
	Maximum	**1700.00**	**360.00**	**1300.00**	**1300.00**

Table A2-8a General organic chemicals data (µg/L) available from the STORET database for samples in the vicinity of the Tracy Fish Collection Facility. Note the lack of available data, and hence the absence of summary statistics. Data reported as less than detection limit are indicated by negative numbers where the absolute value of the negative value represents the detection limit. Zero values represent data below unknown detection limits.

Sampling Date	1,2-dichlorobenzene	1,2-dichloroethane	1,2-dichloropropane	1,3-dichlorobenzene	1,4-dichlorobenzene	1,1-dichloroethane	trichlorofluoro-methane	1,1-dichloroethylene
07/01/1986	-.40	-.10	-.10	-.40	-.40	-.10	-.20	-.20
07/01/1986	-.40	-.10	-.10	-.40	-.40	-.10	-.20	-.20

SamplingDate	1,1,1-trichloroethane	1,1,1-trichloro-ethane	1,1,2,2-tetrachloro-ethane	2-chloroethyl vinyl ether	benzene	dibromochloro-methane	methyl bromide	bromodichloro-methane
07/01/1986	-.10	-.10	-.10	-.50	-.20	-.10	-.50	-.10
07/01/1986	-.10	-.10	-.10	-.50	-.20	-.10	-.50	-.10

Sampling Date	cis-1,3-dichloropropene	carbon tetrachloride	bromoform	chloroform	chlorobenzene	chloroethane	dichlorodifluoro-methane	trichloroethene
07/01/1986	-.20	-.20	-.20	-.10	-.20	-.50	-.50	-.20
07/01/1986	-.20	-.20	-.20	-.10	-.20	-.50	-.50	-.20

Sampling Date	methyl chloride	ethyl benzene	methylethyl ketone	methylene chloride	methyl-isobutyl ketone	PCB Arocior 1242	PCB Arocior 1254	PCB Arocior 1260
07/01/1986	-.10	-.20	-.40	-.30	-.40	.	.	.
07/01/1986	-.10	-.20	-.40	-.30	-.40	.	.	.
01/09/1974	.	.	.	.	.	.00	.00	.00

Sampling Date	trans-1,2-dichloroethene	trans-1,3-dichloropropene	S,S,S-tributyl phospho-rotrithioate	tetrachloro-ethylene	toluene	vinyl chloride	trichlorofluoro-methane	xylene
07/01/1986	-.10	-.40	.	-.10	-.20	-.20	-.20	-.40
07/01/1986	-.10	-.40	.	-.10	-.20	-.20	-.20	-.40
03/04/1965	.	.	.00	.	.	.	.	.
01/09/1974	.	.	.00	.	.	.	.	.
09/14/1976	.	.	.00	.	.	.	.	.
05/10/1977	.	.	.00	.	.	.	.	.
09/01/1977	.	.	.00	.	.	.	.	.

Table A2-8b Pesticide (µg/L) data available from the STORET database for samples in the vicinity of the Tracy Fish Collection Facility. Note the lack of available data, and hence the absence of summary statistics. Data reported as less than detection limit are indicated by negative numbers where the absolute value of the negative value represents the detection limit. Zero values represent data below unknown detection limits.

Sampling Date	2,4-D	Aldrin	Atrazine	Dacthal	DDD	DDE	DDT	Diazinon
02/18/1965	.	.00	.	.	.	.	.	.
03/18/1965	.	.	.	.	.00	.	.00	.
04/01/1965	.	.	.	.	.00	.	.	.
04/15/1965	.	.	.	.	.00	.00	.00	.
04/29/1965	.	.	.	.	.01	.	.00	.
05/20/1965	.	.	.	.	.00	.00	.	.
06/10/1965	.	.	.	.	.00	.	.	.
11/02/1965	.	.01	.	.	.	.	.	.
08/28/1973	.	.	.	.02	.	.	.	.
01/25/1977	.	.	.05	.	.	.	.	.
03/06/1985	.08	.	.29	.	.	.	.	.09
05/01/1973	.	.00	.	.	.	.00	.01	.
08/28/1973	.	.00	.	.02	.	.00	.03	.
N	1	4	2	2	6	4	5	1
Median	.	3.000E-03	.1700	.	2.000E-03	2.000E-03	3.000E-03	.
Minimum		.00	.05	.02	.00	.00	.00	
Maximum		.01	.29	.02	.01	.00	.03	

Sampling Date	Dieldrin	Gamma BHC	Heptachlor Epoxide	Heptachlor	Toxaphene
02/18/1965	.00	.	.	.	.
03/18/1965	.00	.	.	.	.
04/01/1965	.00	.	.	.	.
04/15/1965	.00	.	.	.	.
04/29/1965	.00	.	.	.	.
05/20/1965	.00	.	.	.	.
06/10/1965	.00	.	.	.	.
05/01/1973	.00	.00	.00	.00	.10
08/28/1973	.00	.00	.00	.00	.10
N	9	2	2	2	2
Median	2.000E-03	.	.	.	.
Minimum	.00	.00	.00	.00	.10
Maximum	.00	.00	.00	.00	.10

Table A2-9a Biological data summarized by month, collated from the STORET database for sampling stations in the vicinity of the Tracy Fish Collection Facility.

Month	Statistic	Green Algae, org/mL	Blue-Green Algae, org/mL	Yellow-Green Algae, org/mL	Flagellate Algae, org/mL	Dinoflagellate Algae, org/mL	Cryptomonads Algae, org/mL	Diatoms, cells/mL	Total Algae, org/mL
January	N	4	4	4	4	4	4	4	4
	Median	146.0000	.0000	7.5000	.	.	.	40.0000	193.5000
	Minimum	.00	.00	.00	.00	.00	.00	.00	.00
	Maximum	353.00	10.00	20.00	.00	.00	.00	232.00	615.00
February	N	4	4	4	4	4	4	4	4
	Median	259.0000	6.0000	27.5000	.0000	.	.0000	447.5000	657.5000
	Minimum	76.00	.00	20.00	.00	.00	.00	171.00	455.00
	Maximum	1354.00	69.00	46.00	25.00	.00	23.00	989.00	2481.00
April	N	4	4	4	4	4	4	4	4
	Median	1135.0000	26.5000	98.5000	14.5000	.	20.5000	2007.0000	3823.0000
	Minimum	454.00	.00	.00	.00	.00	10.00	564.00	1099.00
	Maximum	2290.00	616.00	194.00	44.00	.00	109.00	3432.00	5572.00
May	N	4	4	4	4	4	4	4	4
	Median	784.0000	18.0000	.	.	.0000	6.0000	4086.0000	5018.0000
	Minimum	24.00	.00	.00	.00	.00	.00	252.00	288.00
	Maximum	1650.00	264.00	.00	.00	22.00	84.00	7854.00	9614.00
June	N	4	4	4	4	4	4	4	4
	Median	267.0000	127.0000	.	11.0000	.	30.0000	2397.0000	2948.0000
	Minimum	.00	.00	.00	.00	.00	.00	204.00	252.00
	Maximum	792.00	264.00	.00	68.00	.00	741.00	4480.00	6065.00
July	N	6	6	6	6	6	6	6	6
	Median	134.0000	12.0000	.	.0000	.0000	30.0000	1502.0000	1706.0000
	Minimum	.00	.00	.00	.00	.00	.00	532.00	532.00
	Maximum	770.00	606.00	.00	66.00	60.00	154.00	5016.00	6568.00
August	N	4	4	4	4	4	4	4	4
	Median	160.0000	171.0000	.	.0000	.0000	40.0000	3086.0000	3487.0000
	Minimum	.00	.00	.00	.00	.00	.00	684.00	720.00
	Maximum	374.00	418.00	.00	44.00	36.00	60.00	5082.00	5918.00

Month	Statistic	Green Algae, org/mL	Blue-Green Algae, org/mL	Yellow-Green Algae, org/mL	Flagellate Algae, org/mL	Dinoflagellate Algae, org/mL	Cryptomonads Algae, org/mL	Diatoms, cells/mL	Total Algae, org/mL
September	N	6	6	6	6	6	6	6	6
	Median	473.0000	48.0000	.0000	.0000	.0000	4.5000	3209.5000	4316.0000
	Minimum	.00	.00	.00	.00	.00	.00	233.00	233.00
	Maximum	1180.00	154.00	37.00	66.00	22.00	140.00	7238.00	7788.00
October	N	6	6	6	6	6	6	6	6
	Median	162.0000	36.0000	5.0000	.0000	.0000	21.0000	1744.0000	2620.5000
	Minimum	10.00	.00	.00	.00	.00	.00	272.00	282.00
	Maximum	837.00	286.00	81.00	66.00	5.00	182.00	4708.00	5126.00
November	N	6	6	6	6	6	6	6	6
	Median	220.0000	.0000	.0000	.0000	.	.0000	614.0000	909.0000
	Minimum	.00	.00	.00	.00	.00	.00	.00	.00
	Maximum	605.00	44.00	99.00	88.00	.00	61.00	1873.00	1958.00
December	N	3	3	3	3	3	3	3	3
	Median	154.0000	.0000	.0000	.	.	.0000	439.0000	638.0000
	Minimum	.00	.00	.00	.00	.00	.00	.00	.00
	Maximum	183.00	5.00	174.00	.00	.00	20.00	484.00	821.00
Total	N	51	51	51	51	51	51	51	51
	Median	183.0000	10.0000	.0000	.0000	.0000	10.0000	1224.0000	1608.0000
	Minimum	.00	.00	.00	.00	.00	.00	.00	.00
	Maximum	2290.00	616.00	194.00	88.00	60.00	741.00	7854.00	9614.00

Table A2-9b Biological data summarized by month collated from the STORET database for sampling stations in the vicinity of the Tracy Fish Collection Facility.

Month	Statistic	Order Cladocera, org/L	Rotifers, org/L	Copepods, org/L	Gross Areal Phyto-Production g/m2/day	Volume Max Gross Phyto-Production g/m3/day	Net Areal Phyto-Production g/m2/day	5-Day BOD, mg/L	Pheophytin-A, µg/L	Chlorophyll-A, µg/L
January	N							14	61	69
	Median							**1.7500**	**3.8400**	**4.0000**
	Minimum							.90	.81	.00
	Maximum							9.00	31.34	66.84
February	N							12	68	68
	Median							**2.0000**	**3.4750**	**4.0500**
	Minimum							1.30	.00	.00
	Maximum							5.60	19.07	27.00
March	N							1	93	93
	Median							.	**4.4000**	**8.3400**
	Minimum							-.30	.12	.77
	Maximum							-.30	31.00	82.00
April	N	1	1	1	2	2	2	16	110	118
	Median	.	.	.	.	.	.	**1.6000**	**6.8300**	**11.1150**
	Minimum	.00	34.00	11.00	.94	1.58	.01	.80	1.08	1.07
	Maximum	.00	34.00	11.00	.94	1.58	.01	8.60	61.00	274.79
May	N	1	1	1	2	2	2	5	113	113
	Median	.	.	.	.	.	**.0000**	**2.4000**	**11.1200**	**20.8400**
	Minimum	23.00	28.00	22.00	.32	.72	-.90	.70	.35	1.98
	Maximum	23.00	28.00	22.00	.32	.72	.90	10.80	83.36	364.33
June	N	1	1	1	2	2	2	12	121	121
	Median	.	.	.	.	.	**.0000**	**3.5000**	**9.7300**	**20.8400**
	Minimum	17.00	40.00	40.00	1.36	2.36	-1.08	-1.00	.46	1.47
	Maximum	17.00	40.00	40.00	1.36	2.36	1.08	8.20	100.34	300.00
July	N	1	1	1	5	5	5	18	124	128
	Median	.	.	.	**1.3800**	**2.6600**	**1.7800**	**1.6000**	**10.3750**	**15.6700**
	Minimum	9.00	434.00	26.00	.63	1.44	-2.10	.20	.93	1.24
	Maximum	9.00	434.00	26.00	6.33	8.83	2.14	14.00	114.24	220.00

Month	Statistic	Order Cladocera, org/L	Rotifers, org/L	Copepods, org/L	Gross Areal Phyto-Production g/m2/day	Volume Max Gross Phyto-Production g/m3/day	Net Areal Phyto-Production g/m2/day	5-Day BOD, mg/L	Pheophytin-A, µg/L	Chlorophyll-A, µg/L
August	N	1	1	1	2	2	2	9	114	114
	Median	.	.	.	.	.	.	1.3000	12.2500	17.6900
	Minimum	28.00	625.00	52.00	2.40	2.72	2.28	-4.80	.28	1.54
	Maximum	28.00	625.00	52.00	2.40	2.72	2.28	2.90	101.89	213.04
September	N	1	1	1	2	2	2	8	128	128
	Median	.	.	.	.	.	.0000	2.0000	11.3450	18.7600
	Minimum	2.00	1240.00	24.00	1.25	1.19	-1.00	1.50	.00	1.39
	Maximum	2.00	1240.00	24.00	1.25	1.19	1.00	6.30	58.00	170.00
October	N	1	1	1				9	118	124
	Median	.	.	.				1.1000	7.3200	10.8100
	Minimum	18.00	185.00	15.00				.60	-3.51	.46
	Maximum	18.00	185.00	15.00				6.90	45.00	96.00
November	N	1	1	1				9	72	72
	Median	.	.	.				1.7000	4.1950	5.4400
	Minimum	12.00	43.00	6.00				1.40	1.21	.39
	Maximum	12.00	43.00	6.00				12.50	21.42	63.00
December	N							10	68	72
	Median							1.5000	4.0050	2.9700
	Minimum							1.30	.74	.00
	Maximum							8.00	24.97	83.05
Total	N	8	8	8	15	15	15	123	1190	1220
	Median	14.5000	114.0000	23.0000	1.3600	2.3600	1.0000	1.7000	6.7500	9.8800
	Minimum	.00	28.00	6.00	.32	.72	-2.10	-4.80	-3.51	.00
	Maximum	28.00	1240.00	52.00	6.33	8.83	2.28	14.00	114.24	364.33

APPENDIX 3

Agricultural Chemicals Applied Near the Tracy Fish Collection Facility:

Summary of Background Data, Toxicity, and Application Data Collated from the San Joaquin County Agricultural Database

Table A3-1 Common (ISO) names for agricultural chemicals and their IUPAC or CAS chemical structure name applied in the vicinity of the Tracy Fish Collection Facility during 1997. These data were obtained from San Joaquin County and cross-referenced with information from *The 1997 Farm Chemicals Handbook* (Meister and Sine, 1997).

Chemical Common Name (ISO)	*Usage Class*	*IUPAC or CAS Chemical Structure Name*
(No Mfg) Herbicide Activator	synergist	unknown
2,4-D	herbicide	2,4-dichlorophenoxyacetic acid
2,4-DB	herbicide	4-(2,4-dichlorophenoxy)butyric acid
41-A	deposition agent	polyacrylamide/polysaccharide
67-33	unknown	unknown
Abamectin	insecticide	Avermectin B1
Acephate	insecticide	O,S-dimethyl acetylphosphoramidothioate
Ad-Wet	deposition agent	unknown
Agri-Dex	deposition agent	Hydrocarbons
Alachlor	herbicide	2-chloro-2,6-diethyl-N-(methoxymethyl) acetanilide
Aldicarb	insecticide	2-methyl-2-(methylthio)propionaldehyde O-(methylcarbamoyl)oxime
Bacillus thuringiensis var. aizawai	insecticide	Bacillus thuringiensis var. aizawai
Bacillus thuringiensis var. kurstak	insecticide	Bacillus thuringiensis var. kurstak
Bayfolan Plus	unknown	unknown
Bensulide	herbicide	S-2-benzenesulfonamidoethyl O,O-di-isopropyl phosphorodithioate
Bifenthrin	insecticide	[1a,3a-(Z)]-(±)-(2 methyl[1,1-biphenyl]-3-yl) methyl 3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2- dimethylcyclopropanecarboxylate
Bivert Deposition Agent	deposition agent	Amine salts of vegetable fatty acids + organic aromatic acid + aromatic + aliphatic petroleum distillate
Break EC	unknown	unknown
Bromacil + diuron	herbicide	5-bromo-3-sec-butyl-6-methyluracil
Bromoxynil	herbicide	3,5-dibromo-4-hydroxybenzonitrile
Captan	fungicide	N-trichloromethylthio-4-cyclohexene-1,2-dicarboximide
Carbaryl	insecticide	1-naphthyl methylcarbamate
Carbofuran	insecticide	2,3-dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate
Chloridazon	herbicide	5-amino-4-chloro-2-phenyl-3(2H)-pyridazinone
Chloropicrin	pesticide	Trichloronitromethane
Chloropicrin+Methyl Bromide	insecticide	Methyl bromide + chloropicrin
Chlorothalonil	fungicide	Tetrachloroisophthalonitrile
Chlorpyrifos	insecticide	O,O-diethyl O-(3,5,6-trichloro-2-pyridinyl) phosphorothioate
Clean Crop Super 94 Oil	deposition agent	hydrocarbons
CMR Herbicide Activator	synergist	unknown
Copper Hydroxide	fungicide	Cu(OH)2

Chemical Common Name (ISO)	Usage Class	IUPAC or CAS Chemical Structure Name
Copper Oxide	fungicide	CuO
Copper Sulfate, Basic	fungicide	CuSO4
Coumafuryl	pesticide	3-(a-acetonylfurfuryl)-4-hydroxycoumarin
Cryolite	insecticide	Na3AlF6
Cyanazine	herbicide	2-[[4-chloro-6-(ethylamino)-1,3,5-triazin-2-yl]amino] -2-methylpropionitrile
Cycloate	herbicide	S-ethyl cyclohexyl(ethyl)thiocarbamate
Cyfluthrin	insecticide	Cyano(4-fluoro-3-phenoxyphenyl)methyl 3-(2,2-dichloro-ethenyl)-2,2-dimethylcyclopropane
Cymate 267	unknown	unknown
DCPA	herbicide	Dimethyl tetrachloroterephthalate
Desmedipham	herbicide	3-phenylcarbamoyloxycarbanilate
Diazinon	insecticide	O,O,-diethyl O-[6-methyl-2-(1-methylethyl)-4- pyrimidinyl] phosphorothioate
Dichlorprop + Benzaton + MCPA	herbicide	(RS)-2-(2,4-dichlorophenoxy)propionic acid
Dicofol	pesticide	2,2,2-trichloro-1,1-bis(4-chlorophenyl)ethanol
Diflubenzuron	insecticide	N-[{(4-chlorophenyl)amino}carbonyl]-2,6- difluoro-benzamide
Dimethoate	insecticide	O,O-dimethyl S-methylcarbamoylmethyl phosphorodithioate
Diphacinone	pesticide	2-(diphenylacetyl)-1,3-indandione
Diquat Dibromide	herbicide	1,1-ethylene-2,2-bipyridylium ion. 6,7-dihydrodipyrido(1,2-a:2,1-c)pyrazinedlium ion, dibromide monohydrate salt
Disulfoton	insecticide	O,O-diethyl S-[2-(ethylthio)ethyl] phosphorodithioate
Diuron	herbicide	N-(3,4-dichlorophenyl)-N,N-dimethylurea.
Dyne-amic	deposition agent	unknown
EPTC	herbicide	S-ethyl dipropylthiocarbamate
Esfenvalerate	insecticide	(S)-a-cyano-3-phenoxybenzyl (S)-2-(4-chlorophenyl)-3-methylbutyrate
Ethalfluralin	herbicide	N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4- (trifluromethyl)benzenamine
Ethephon	herbicide	(2-chloroethyl)phosphonic acid
Ethofumesate	herbicide	(±)2-ethoxy-2,3-dihydro-3,3-dimethyl-5- benzofuranyl methanesulfonate
Fenamiphos	insecticide	Ethyl 3-methyl-4-(methylthio)phenyl (1-methylethyl)phosphoramidate
Fenarimol	fungicide	a-(2-chlorophenyl)-a-(4-chlorophenyl)-5- pyrimidine-methanol
Fenbutatin-oxide	pesticide	Bis[tris (2-methyl-2-phenylpropyl)tin] oxide
First Choice Herbicide Activator	synergist	unknown
First Choice Non-Ionic Spreader	deposition agent	unknown
First Choice SurpHtac Adjuvant	synergist	unknown
Foam Fighter	deposition agent	unknown
Fonofos	insecticide	O-ethyl S-phenyl ethylphosphonodithioate
Fosetyl-aluminum	bactericide	Aluminum tris (O-ethyl phosphonate)
Glyphosate	herbicide	Isopropylamine salt of N-(phosphonomethyl)glycine

Chemical Common Name (ISO)	Usage Class	IUPAC or CAS Chemical Structure Name
Glyphosate-Isopropylammonium	herbicide	Isopropylamine salt of N-(phosphonomethyl)glycine
Halosulfuron-methyl	herbicide	Methyl 5-{[(4,6-dimethoxy-2-pyrimidinyl)amino] carbonylaminosulfonyl}-3-chloro-1-methyl-1H-pyrazole-4-carboxylate
Helena Quest	deposition agent	Proprietary blend of the ammonium salts of polyacrylic, hydroxycarboxylic, and phosphoric acids
Hexazinone	herbicide	3-cyclohexyl-6-(dimethylamino)-1-methyl- 1,3,5-triazine-2,4(1H,3H)-dione
Imazethapyr	herbicide	(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)- 5-oxo-1H-imidazol-2-yl] -5-ethyl-3-pyridinecarboxylic acid
Imidacloprid	insecticide	1-[(6-chloro-3-pyridinyl)methyl]-N-nitro-2- imidazolidinimine
Iprodione	fungicide	3-(3,5-dichlorophenyl)-N-(1-methylethyl)-2,4-dioxo-1-imidazolidinecarboxamide
Kelthane	pesticide	2,2,2-trichloro-1,1-bis(4-chlorophenyl)ethanol
Kinetic	deposition agent	unknown
Knapp Sterl-Kleen	unknown	unknown
Latron AG-98	deposition agent	unknown
Latron CS-7	deposition agent	unknown
Leaf Act 80A Spreader-Activator	synergist	unknown
Leaf Act 80B Buffer-Spreader	deposition agent	unknown
Leaf Act 80HE Herbicide Enhancer	synergist	unknown
Leaf Act 80S Spreader-Sticker	deposition agent	unknown
Linuron	herbicide	3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea
Malathion	insecticide	Diethyl (dimethoxythiophosphorylthio)succinate
Mancozeb	fungicide	zinc-manganese ethylene bisdithiocarbamate
MCPA	herbicide	(4-chloro-2-methylphenoxy)acetic acid (IUPAC & CAS); 4-chloro-o-tolyloxyacetic acid
Metalaxyl	fungicide	N-(2,6-dimethylphenyl)-N-(methoxyacetyl)-DL- alanine methyl ester
Metam-sodium	insecticide	Sodium N-methyldithiocarbamate
Metambane	herbicide	3,6-dichloro-2-methoxybenzoic acid; 3,6-dichloro-o-anisic acid
Methamidophos	insecticide	O,S-Dimethyl phosphoramidothioate
Methidathion	insecticide	S-2,3-dihydro-5-methoxy-2-oxo-1,3,4- thiadiazol-3-ylmethyl O,O-dimethyl phosphorodithioate
Methomyl	insecticide	O,O-dimethyl O-(4-nitrophenyl) phosphorothioate
Methyl Parathion	insecticide	O,O-dimethyl O-(4-nitrophenyl) phosphorothioate
Metolachlor	herbicide	2-chloro-N-(2-ethyl-6-methylphenyl) -N-(2-methoxy-1-methylethyl) acetamide
Metribuzin	herbicide	4-amino-6-(1,1-dimethylethyl)-3-(methylthio)- 1,2,4- triazin-5(4H)-one
Milo Bait	pesticide	unknown
MON-35085	unknown	unknown
Monterey Nutrient Buffer	deposition agent	unknown
MOS Concentrate	deposition agent	hydrocarbons
Naled	insecticide	1,2-dibromo-2,2-dichloroethyl dimethyl phosphate
Napropamide	herbicide	(RS)-N,N-diethyl-2-(1-naphthyloxy) propionamide

Chemical Common Name (ISO)	*Usage Class*	*IUPAC or CAS Chemical Structure Name*
Nicosulfuron	herbicide	2-(4,6-dimethoxypyrimidin-2-ylcarbamoylsulfamoyl)-N,N-dimethylnicotinamide
No-Foam A	deposition agent	unknown
No-Foam B	deposition agent	unknown
No-Foam Herbicide Activator	synergist	unknown
Norflurazon	herbicide	6-chloro-N-methyl-N'-(1-methylethyl)-1,3,5- triazine-2,4-diamine
Nutra-Plus	fertilizer	Zn
Nutra-Wet	deposition agent	unknown
Nutrient Buffer 8-8-2	fertilizer	Mn and Zn
Orchard Master	unknown	unknown
Oryzalin	herbicide	3,5-dinitro-N4,N4-dipropylsulfanilamide
Oxydemeton-methyl	insecticide	S-[2-(Ethylsulfinyl)ethyl] O,O-dimethyl phosphorothioate
Oxyfluorfen	herbicide	2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4- (trifluoromethyl-benzene
Para Spred	deposition agent	Parrafins, hydrocarbons
Paraquat	herbicide	1,1-dimethyl-4,4-bipyridinium ion, di-chloride salt
Pebulate	herbicide	S-Propyl butyl(ethyl)thiocarbamate
Peerless	unknown	unknown
Pendimethalin	herbicide	N-(1-ethylpropyl)-3,4-dimethyl-2,6- dinitrobenzenamine
Permethrin	insecticide	3-phenoxybenzyl (1RS)-cis,trans-3-(2,2- dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate
Phosmet	insecticide	O,O-dimethyl phosphorodithioate S-ester with N-(mercaptomethyl)phthalimide
Phosphoric Acid	deposition agent	H3PO4
Pinolene	deposition agent	unknown
Piperonyl Butoxide	synergist	a-[2-(2-Butoxyethoxy)ethoxy]-4,5- methylenedioxy -2-propyltoluene
Pronamide	herbicide	3,5-dichloro-N-(1,1-dimethyl-2-propynyl) benzamide
Propargite	pesticide	2-[4-(1,1-dimethylethyl)phenoxy]cyclohexyl 2-propynyl sulfite
RNA Activator 85	synergist	unknown
RNA Buffer	synergist	unknown
RNA Buffer-Activator	synergist	unknown
RNA Cotton Oil Surfactant	deposition agent	unknown
RNA Crop Oil Concentrate	deposition agent	unknown
RNA Spreader-Binder	deposition agent	unknown
RNA Tri-Ad 73	unknown	unknown
Select	herbicide	(E,E)-(±)-2[1][[(3-chloro-2-propenyl)oxy]imino] [propyl]5-[2 (ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one
Sethoxydim	herbicide	2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]- 3-hydroxy-2-cyclohexen-1-one
Silwet L-77	deposition agent	unknown
Simazine	herbicide	2-chloro-4,6-bis(ethylamino)-s-triazine

Chemical Common Name (ISO)	*Usage Class*	*IUPAC or CAS Chemical Structure Name*
Sodium Chlorate	herbicide	NaClO3
Source 1 No Foam B	deposition agent	unknown
Special Super-Adhesive	deposition agent	unknown
Spray-Aide	deposition agent	unknown
Sulfur	fungicide	S
SurpHtac	deposition agent	Monocarbamide dihydrogensulfate
SurpHtac Adjuvant	synergist	unknown
Sylgard 309	deposition agent	unknown
Systhane	fungicide	a-butyl-a-(4-chlorophenyl)-1H-1,2,4-triazole-1- propanenitrile
Thiophanate-methyl	fungicide	Dimethyl [(1,2-phenylene)bis- (iminocarbonothioyl)] bis[carbamate]; dimethyl 4,4-o-phenylenebis[3-thioallophanate]
Triclopyr	herbicide	(3,5,6-trichloro-2-pyridinyloxy)acetic acid
Triflumizole	fungicide	(E)-4-chloro-a,a,a-trifluoro-N-(1-imidazol- 1-yl-2-propoxyethylidene)-o-toluidine
Trifluralin	herbicide	a,a,a-Trifluoro-2,6-dinitro-N,N-dipropyl- p-toluidine
Triforine	fungicide	N,N-[1,4-piperazinediylbis(2,2,2- trichloroethylidene)]-bis[formamide]
Tro-Fol	unknown	unknown
Unifilm 707	deposition agent	Alkylarylpolyoxyethylene glycols + isopropanol
Upbeet	herbicide	unknown
Vinclozolin	fungicide	3-(3,5-dichlorophenyl)-5-methyl-5-vinyl-1,3- oxazolidine-2,4-dione
WFSI 2220	unknown	unknown

Table A3-2 Summary of agricultural chemical amounts applied to cropland, by class or type of chemical, along the Old River in the near vicinity of the Tracy Fish Collection Facility during 1997. These data summarize applications for Ranges 4E, 5E and 6E, within Township 1S, based on data obtained from San Joaquin County.

Ag Chemical Usage Class	*Statistic*	*Crop Area Treated, ha*	*Product Volume Applied, L*	*Product Weight Applied, kg*
bactericide	N	5		5
	Sum	145.28		400.72
	% of Total Sum	.2%		.2%
deposition agent	N	632	624	8
	Sum	10516.07	5657.59	1094.19
	% of Total Sum	13.6%	6.0%	.5%
fertilizer	N	7	7	
	Sum	48.16	15.71	
	% of Total Sum	.1%	.0%	
fungicide	N	217	87	130
	Sum	3512.89	4872.50	28564.69
	% of Total Sum	4.6%	5.1%	12.8%
herbicide	N	1507	1148	359
	Sum	28021.95	49084.95	56858.41
	% of Total Sum	36.3%	51.6%	25.6%
insecticide	N	1316	772	544
	Sum	23606.56	27428.58	125260.75
	% of Total Sum	30.6%	28.9%	56.3%
pesticide	N	138	82	56
	Sum	2049.17	3070.47	8937.33
	% of Total Sum	2.7%	3.2%	4.0%
synergist	N	523	521	2
	Sum	8525.26	4298.82	5.23
	% of Total Sum	11.1%	4.5%	.0%
unknown	N	48	47	1
	Sum	670.49	642.64	1295.58
	% of Total Sum	.9%	.7%	.6%
Total	***N***	***4393***	***3288***	***1105***
	Sum	***77095.83***	***95071.25***	***222416.90***

Table A3-3 Summary of agricultural chemicals and amounts applied to cropland along the Old River in the near vicinity of the Tracy Fish Collection Facility during 1997. These data summarize applications for Ranges 4E, 5E and 6E, within Township 1S, based on data obtained from San Joaquin County.

Ag Chemical Common Name (ISO)	*Statistic*	*Crop Area Treated, ha*	*Product Volume Applied, L*	*Product Weight Applied, kg*
No Mfg) Herbicide Activator	N	15	13	2
	Sum	312.82	370.63	5.23
	% of Total Sum	.4%	.4%	.0%
2,4-D	N	71	71	
	Sum	1092.37	2646.34	
	% of Total Sum	1.4%	2.8%	
2,4-DB	N	9	9	
	Sum	122.22	655.68	
	% of Total Sum	.2%	.7%	
41-A	N	99	96	3
	Sum	1495.12	201.25	.19
	% of Total Sum	1.9%	.2%	.0%
67-33	N	1		1
	Sum	3.24		1295.58
	% of Total Sum	.0%		.6%
Abamectin	N	12	12	
	Sum	246.86	163.22	
	% of Total Sum	.3%	.2%	
Acephate	N	34		34
	Sum	562.19		730.82
	% of Total Sum	.7%		.3%
Ad-Wet	N	2	2	
	Sum	57.06	21.16	
	% of Total Sum	.1%	.0%	
Agri-Dex	N	4	4	
	Sum	70.82	121.92	
	% of Total Sum	.1%	.1%	
Alachlor	N	2	2	
	Sum	46.54	430.61	
	% of Total Sum	.1%	.5%	
Aldicarb	N	6		6
	Sum	147.71		1755.83
	% of Total Sum	.2%		.8%
Bacillus thuringiensis var. aizawai	N	4		4
	Sum	52.61		58.89
	% of Total Sum	.1%		.0%
Bacillus thuringiensis var. kurstak	N	37	3	34
	Sum	730.62	331.24	652.18
	% of Total Sum	.9%	.3%	.3%
Bayfolan Plus	N	5	5	
	Sum	79.08	367.38	
	% of Total Sum	.1%	.4%	
Bensulide	N	1	1	
	Sum	2.02	23.66	
	% of Total Sum	.0%	.0%	
Bifenthrin	N	5	5	
	Sum	30.35	14.40	
	% of Total Sum	.0%	.0%	

Ag Chemical Common Name (ISO)	Statistic	Crop Area Treated, ha	Product Volume Applied, L	Product Weight Applied, kg
Bivert Deposition Agent	N	8	8	
	Sum	134.76	71.96	
	% of Total Sum	.2%	.1%	
Break EC	N	2	2	
	Sum	40.06	11.84	
	% of Total Sum	.1%	.0%	
Bromacil + diuron	N	3		3
	Sum	13.76		163.08
	% of Total Sum	.0%		.1%
Bromoxynil	N	12	12	
	Sum	225.41	273.95	
	% of Total Sum	.3%	.3%	
CMR Herbicide Activator	N	9	9	
	Sum	276.40	367.49	
	% of Total Sum	.4%	.4%	
Captan	N	6		6
	Sum	74.46		692.37
	% of Total Sum	.1%		.3%
Carbaryl	N	25		25
	Sum	447.95		6237.46
	% of Total Sum	.6%		2.8%
Carbofuran	N	80	80	
	Sum	1695.44	1789.58	
	% of Total Sum	2.2%	1.9%	
Chloridazon	N	5		5
	Sum	197.49		265.28
	% of Total Sum	.3%		.1%
Chloropicrin	N	10		10
	Sum	19.51		7999.98
	% of Total Sum	.0%		3.6%
Chloropicrin+Methyl Brom	N	3		3
	Sum	4.89		1949.71
	% of Total Sum	.0%		.9%
Chlorothalonil	N	38	34	4
	Sum	681.49	1641.05	206.57
	% of Total Sum	.9%	1.7%	.1%
Chlorpyrifos	N	194	192	2
	Sum	3936.03	8726.04	8.15
	% of Total Sum	5.1%	9.2%	.0%
Clean Crop Super 94 Oil	N	1	1	
	Sum	28.33	1344.00	
	% of Total Sum	.0%	1.4%	
Copper Hydroxide	N	20		20
	Sum	294.01		1384.37
	% of Total Sum	.4%		.6%
Copper Oxide	N	14		14
	Sum	118.98		268.18
	% of Total Sum	.2%		.1%
Copper Sulfate, Basic	N	1		1
	Sum	28.33		317.10
	% of Total Sum	.0%		.1%

Ag Chemical Common Name (ISO)	Statistic	Crop Area Treated, ha	Product Volume Applied, L	Product Weight Applied, kg
Coumafuryl	N	1		1
	Sum	11.74		52.10
	% of Total Sum	.0%		.0%
Cryolite	N	2		2
	Sum	63.54		426.73
	% of Total Sum	.1%		.2%
Cyanazine	N	2	2	
	Sum	36.83	174.72	
	% of Total Sum	.0%	.2%	
Cycloate	N	1	1	
	Sum	29.14	69.12	
	% of Total Sum	.0%	.1%	
Cyfluthrin	N	1	1	
	Sum	25.09	3.72	
	% of Total Sum	.0%	.0%	
Cymate 267	N	2	2	
	Sum	19.02	33.83	
	% of Total Sum	.0%	.0%	
DCPA	N	1		1
	Sum	.81		7.25
	% of Total Sum	.0%		.0%
Desmedipham	N	65	65	
	Sum	1657.72	3450.09	
	% of Total Sum	2.2%	3.6%	
Diazinon	N	14	13	1
	Sum	246.45	423.05	181.20
	% of Total Sum	.3%	.4%	.1%
Dichlorprop + Benzaton + MCPA	N	5	5	
	Sum	44.92	145.23	
	% of Total Sum	.1%	.2%	
Dicofol	N	19	12	7
	Sum	348.92	625.36	277.87
	% of Total Sum	.5%	.7%	.1%
Diflubenzuron	N	9		9
	Sum	112.75		126.39
	% of Total Sum	.1%		.1%
Dimethoate	N	113	113	
	Sum	2058.97	2736.16	
	% of Total Sum	2.7%	2.9%	
Diphacinone	N	1		1
	Sum	11.74		29.45
	% of Total Sum	.0%		.0%
Diquat Dibromide	N	2	2	
	Sum	16.19	26.88	
	% of Total Sum	.0%	.0%	
Disulfoton	N	115	115	
	Sum	2491.94	2954.50	
	% of Total Sum	3.2%	3.1%	
Diuron	N	140	63	77
	Sum	2843.63	3825.08	2846.37
	% of Total Sum	3.7%	4.0%	1.3%

Ag Chemical Common Name (ISO)	Statistic	Crop Area Treated, ha	Product Volume Applied, L	Product Weight Applied, kg
Dyne-amic	N	13	13	
	Sum	308.09	769.25	
	% of Total Sum	.4%	.8%	
EPTC	N	53	45	8
	Sum	1116.96	3683.05	3093.99
	% of Total Sum	1.4%	3.9%	1.4%
Esfenvalerate	N	68	68	
	Sum	1190.35	671.31	
	% of Total Sum	1.5%	.7%	
Ethalfluralin	N	14	14	
	Sum	243.62	674.07	
	% of Total Sum	.3%	.7%	
Ethephon	N	25	25	
	Sum	473.44	1227.03	
	% of Total Sum	.6%	1.3%	
Ethofumesate	N	38	38	
	Sum	799.26	787.32	
	% of Total Sum	1.0%	.8%	
Fenamiphos	N	2	2	
	Sum	4.45	126.72	
	% of Total Sum	.0%	.1%	
Fenarimol	N	2	2	
	Sum	63.54	14.13	
	% of Total Sum	.1%	.0%	
Fenbutatin-oxide	N	7		7
	Sum	93.81		111.66
	% of Total Sum	.1%		.1%
First Choice Herbicide Activator	N	22	22	
	Sum	273.37	233.42	
	% of Total Sum	.4%	.2%	
First Choice Non-ionic Surfactant	N	23	23	
	Sum	296.23	116.34	
	% of Total Sum	.4%	.1%	
First Choice SurpHtac Adjuvant	N	1	1	
	Sum	12.14	2.13	
	% of Total Sum	.0%	.0%	
Foam Fighter	N	1	1	
	Sum	5.67	.04	
	% of Total Sum	.0%	.0%	
Fonofos	N	22		22
	Sum	455.64		5592.17
	% of Total Sum	.6%		2.5%
Fosetyl-aluminum	N	5		5
	Sum	145.28		400.72
	% of Total Sum	.2%		.2%
Glyphosate	N	3	3	
	Sum	46.54	129.06	
	% of Total Sum	.1%	.1%	
Glyphosate-isopropylammonium	N	167	167	
	Sum	2528.58	5016.65	
	% of Total Sum	3.3%	5.3%	

Ag Chemical Common Name (ISO)	Statistic	Crop Area Treated, ha	Product Volume Applied, L	Product Weight Applied, kg
Halosulfuron-methyl	N	6		6
	Sum	53.82		4.42
	% of Total Sum	.1%		.0%
Helena Quest	N	47	47	
	Sum	824.79	143.64	
	% of Total Sum	1.1%	.2%	
Hexazinone	N	114	76	38
	Sum	2104.25	3750.46	464.69
	% of Total Sum	2.7%	3.9%	.2%
Imazethapyr	N	3	2	1
	Sum	80.13	6.39	4.25
	% of Total Sum	.1%	.0%	.0%
Imidacloprid	N	4	2	2
	Sum	92.27	31.91	3.33
	% of Total Sum	.1%	.0%	.0%
Iprodione	N	2	1	1
	Sum	34.40	33.60	6.80
	% of Total Sum	.0%	.0%	.0%
Kelthane	N	3	3	
	Sum	91.05	72.35	
	% of Total Sum	.1%	.1%	
Kinetic	N	52	52	
	Sum	903.79	138.31	
	% of Total Sum	1.2%	.1%	
Knapp Steri-Kleen	N	1	1	
	Sum	16.19	.77	
	% of Total Sum	.0%	.0%	
Latron AG-98	N	1	1	
	Sum	40.47	.88	
	% of Total Sum	.1%	.0%	
Latron CS-7	N	10	10	
	Sum	212.87	44.08	
	% of Total Sum	.3%	.0%	
Leaf Act 80A Spreader-Activator	N	58	58	
	Sum	944.74	383.13	
	% of Total Sum	1.2%	.4%	
Leaf Act 80B Buffer-Spreader	N	15	15	
	Sum	269.04	64.78	
	% of Total Sum	.3%	.1%	
Leaf Act 80HE Herbicide	N	2	2	
	Sum	93.08	160.36	
	% of Total Sum	.1%	.2%	
Leaf Act 80S Spreader-Sticker	N	27	27	
	Sum	400.60	112.35	
	% of Total Sum	.5%	.1%	
Linuron	N	24		24
	Sum	528.21		914.95
	% of Total Sum	.7%		.4%
MCPA	N	10	10	
	Sum	144.07	102.80	
	% of Total Sum	.2%	.1%	

Ag Chemical Common Name (ISO)	Statistic	Crop Area Treated, ha	Product Volume Applied, L	Product Weight Applied, kg
MON-35085	N	1	1	
	Sum	3.24	3.84	
	% of Total Sum	.0%	.0%	
MOS Concentrate	N	1	1	
	Sum	40.47	96.00	
	% of Total Sum	.1%	.1%	
Malathion	N	33	33	
	Sum	389.79	757.79	
	% of Total Sum	.5%	.8%	
Mancozeb	N	9	9	
	Sum	109.67	325.25	
	% of Total Sum	.1%	.3%	
Metalaxyl	N	57	34	23
	Sum	1001.20	911.13	290.15
	% of Total Sum	1.3%	1.0%	.1%
Metam-sodium	N	4	4	
	Sum	11.33	4233.60	
	% of Total Sum	.0%	4.5%	
Metambane	N	6	6	
	Sum	125.53	37.17	
	% of Total Sum	.2%	.0%	
Methamidophos	N	16	16	
	Sum	290.97	535.37	
	% of Total Sum	.4%	.6%	
Methidathion	N	2		2
	Sum	13.76		61.61
	% of Total Sum	.0%		.0%
Methomyl	N	267		267
	Sum	3032.56		1531.90
	% of Total Sum	3.9%		.7%
Methyl Parathion	N	73	73	
	Sum	968.78	2793.14	
	% of Total Sum	1.3%	2.9%	
Metolachlor	N	71	71	
	Sum	1153.88	3405.34	
	% of Total Sum	1.5%	3.6%	
Metribuzin	N	31	2	29
	Sum	768.22	3.73	446.59
	% of Total Sum	1.0%	.0%	.2%
Milo Bait	N	6		6
	Sum	6.88		7.70
	% of Total Sum	.0%		.0%
Monterey Nutrient Buffer	N	86	86	
	Sum	1390.10	454.43	
	% of Total Sum	1.8%	.5%	
Naled	N	3	3	
	Sum	19.22	15.05	
	% of Total Sum	.0%	.0%	
Napropamide	N	39	9	30
	Sum	833.01	583.68	2457.93
	% of Total Sum	1.1%	.6%	1.1%

Ag Chemical Common Name (ISO)	Statistic	Crop Area Treated, ha	Product Volume Applied, L	Product Weight Applied, kg
Nicosulfuron	N	10	2	8
	Sum	192.35	1.39	3.50
	% of Total Sum	.2%	.0%	.0%
No-Foam A	N	2	2	
	Sum	12.55	4.38	
	% of Total Sum	.0%	.0%	
No-Foam B	N	4	4	
	Sum	141.64	168.04	
	% of Total Sum	.2%	.2%	
No-Foam Herbicide Activator	N	6	6	
	Sum	125.45	238.97	
	% of Total Sum	.2%	.3%	
Norflurazon	N	4		4
	Sum	76.89		203.85
	% of Total Sum	.1%		.1%
Nutra-Plus	N	2	2	
	Sum	32.37	7.68	
	% of Total Sum	.0%	.0%	
Nutra-Wet	N	39	39	
	Sum	722.49	169.31	
	% of Total Sum	.9%	.2%	
Nutrient Buffer 8-8-2	N	5	5	
	Sum	15.78	8.03	
	% of Total Sum	.0%	.0%	
Orchard Master	N	2	2	
	Sum	9.71	21.24	
	% of Total Sum	.0%	.0%	
Oryzalin	N	2	2	
	Sum	70.42	623.83	
	% of Total Sum	.1%	.7%	
Oxydemeton-methyl	N	9	9	
	Sum	117.76	258.96	
	% of Total Sum	.2%	.3%	
Oxyfluorfen	N	66	66	
	Sum	1008.12	1460.60	
	% of Total Sum	1.3%	1.5%	
Para Spred	N	1	1	
	Sum	52.61	123.03	
	% of Total Sum	.1%	.1%	
Paraquat	N	87	87	
	Sum	1735.18	3214.01	
	% of Total Sum	2.3%	3.4%	
Pebulate	N	27	27	
	Sum	551.18	2742.60	
	% of Total Sum	.7%	2.9%	
Peerless	N	4	4	
	Sum	34.40	20.47	
	% of Total Sum	.0%	.0%	
Pendimethalin	N	9	9	
	Sum	127.72	548.04	
	% of Total Sum	.2%	.6%	

Ag Chemical Common Name (ISO)	Statistic	Crop Area Treated, ha	Product Volume Applied, L	Product Weight Applied, kg
Permethrin	N	14	14	
	Sum	266.69	724.22	
	% of Total Sum	.3%	.8%	
Phosmet	N	37		37
	Sum	686.83		1244.21
	% of Total Sum	.9%		.6%
Phosphoric Acid	N	13	13	
	Sum	189.80	38.10	
	% of Total Sum	.2%	.0%	
Pinolene	N	101	101	
	Sum	1571.40	660.91	
	% of Total Sum	2.0%	.7%	
Piperonyl Butoxide	N	1	1	
	Sum	5.26	.97	
	% of Total Sum	.0%	.0%	
Pronamide	N	2		2
	Sum	17.40		41.22
	% of Total Sum	.0%		.0%
Propargite	N	87	76	11
	Sum	1222.36	2634.08	866.59
	% of Total Sum	1.6%	2.8%	.4%
RNA Activator 85	N	67	67	
	Sum	1175.29	1273.83	
	% of Total Sum	1.5%	1.3%	
RNA Buffer	N	318	318	
	Sum	5158.30	1152.40	
	% of Total Sum	6.7%	1.2%	
RNA Buffer-Activator	N	3	3	
	Sum	24.36	4.71	
	% of Total Sum	.0%	.0%	
RNA Cotton Oil Surfactant	N	2	2	
	Sum	105.22	246.06	
	% of Total Sum	.1%	.3%	
RNA Crop Oil Concentrate	N	24	24	
	Sum	388.09	324.93	
	% of Total Sum	.5%	.3%	
RNA Spreader-Binder	N	14	14	
	Sum	302.95	79.28	
	% of Total Sum	.4%	.1%	
RNA Tri-Ad 73	N	22	22	
	Sum	343.34	103.93	
	% of Total Sum	.4%	.1%	
Select	N	10	10	
	Sum	210.03	279.71	
	% of Total Sum	.3%	.3%	
Sethoxydim	N	53	53	
	Sum	953.17	1314.27	
	% of Total Sum	1.2%	1.4%	
Silwet L-77	N	1	1	
	Sum	28.33	8.41	
	% of Total Sum	.0%	.0%	

Ag Chemical Common Name (ISO)	Statistic	Crop Area Treated, ha	Product Volume Applied, L	Product Weight Applied, kg
Simazine	N	6	5	1
	Sum	148.12	762.72	10.38
	% of Total Sum	.2%	.8%	.0%
Sodium Chlorate	N	7	7	
	Sum	122.62	1163.52	
	% of Total Sum	.2%	1.2%	
Source 1 No Foam B	N	1	1	
	Sum	24.28	28.80	
	% of Total Sum	.0%	.0%	
Special Super-Adhesive	N	5		5
	Sum	32.78		1094.00
	% of Total Sum	.0%		.5%
Spray-Aide	N	7	7	
	Sum	42.90	14.97	
	% of Total Sum	.1%	.0%	
Sulfur	N	147	9	138
	Sum	4079.97	1821.12	129513.38
	% of Total Sum	5.3%	1.9%	58.2%
SurpHtac	N	21	21	
	Sum	337.06	83.75	
	% of Total Sum	.4%	.1%	
SurpHtac Adjuvant	N	21	21	
	Sum	124.04	110.80	
	% of Total Sum	.2%	.1%	
Sylgard 309	N	5	5	
	Sum	64.75	4.70	
	% of Total Sum	.1%	.0%	
Systhane	N	22		22
	Sum	352.89		96.77
	% of Total Sum	.5%		.0%
Thiophanate-methyl	N	4		4
	Sum	41.68		46.66
	% of Total Sum	.1%		.0%
Triclopyr	N	6	6	
	Sum	54.63	132.57	
	% of Total Sum	.1%	.1%	
Triflumizole	N	3		3
	Sum	41.68		14.58
	% of Total Sum	.1%		.0%
Trifluralin	N	292	173	119
	Sum	5368.92	5713.61	45929.67
	% of Total Sum	7.0%	6.0%	20.7%
Triforine	N	5	5	
	Sum	72.84	65.74	
	% of Total Sum	.1%	.1%	
Tro-Fol	N	3	3	
	Sum	40.47	3.65	
	% of Total Sum	.1%	.0%	
Unifilm 707	N	2	2	
	Sum	21.04	2.53	
	% of Total Sum	.0%	.0%	

Ag Chemical Common Name (ISO)	Statistic	Crop Area Treated, ha	Product Volume Applied, L	Product Weight Applied, kg
Upbeet	N	3		3
	Sum	56.66		.99
	% of Total Sum	.1%		.0%
Vinclozolin	N	1		1
	Sum	8.90		19.93
	% of Total Sum	.0%		.0%
WFSI 2220	N	3	3	
	Sum	46.54	13.48	
	% of Total Sum	.1%	.0%	
Total	***N***	***4393***	***3288***	***1105***
	Sum	***77095.83***	***95071.25***	***222416.90***

Table A3-4 Fish bioassay toxicity data as LC_{50} values in µg/L, for agricultural chemicals applied in the near vicinity of the Tracy Fish Collection Facility during 1997. Data are from the San Joaquin County agricultural application database, and toxicity references (*Meister and Sine 1997; Johnson and Finley, 1980)*. A toxicity score of 1 represents an essentially nontoxic compound, while a score of 5 suggests a very toxic compound.

Chemical ISO Common Name	*Usage Class*	*Farm Chemicals Handbook LC50, µg/L*	*Anadromous Fish LC50, µg/L*	*Resident Fish LC50, µg/L*	*Average Fish Toxicity Score*
Fonofos	insecticide	50			5.00
Bifenthrin	insecticide	150			5.00
Bromoxynil	herbicide	50			5.00
Carbofuran	insecticide	240			5.00
Chlorpyrifos	insecticide	180		30	5.00
Esfenvalerate	insecticide				5.00
Fenbutatin-oxide	pesticide	6.6			5.00
Oxyfluorfen	herbicide	200			5.00
Permethrin	insecticide				5.00
Methidathion	insecticide		14	9	4.67
Diazinon	insecticide		92	194	4.33
Aldicarb	insecticide	1500	560	50	4.33
Trifluralin	herbicide		72	953	4.33
Kelthane	pesticide				4.00
DCPA	herbicide				4.00
Naled	insecticide	132	249	1730	4.00
Metam-sodium	insecticide				4.00
Bensulide	herbicide	1500	700	550	4.00
Oryzalin	herbicide	2880			4.00
Phosmet	insecticide				4.00
Pendimethalin	herbicide				4.00
Desmedipham	herbicide	3800			4.00
Metolachlor	herbicide			45	3.50
Ethofumesate	herbicide	15000	800	2500	3.33
Alachlor	herbicide	3700	1980	6530	3.33
Diuron	herbicide	3500	8850	6294	3.33
Methyl Parathion	insecticide		2260	7010	3.33
Methomyl	insecticide	800	1600	1160	3.33
Dicofol	pesticide		81000		3.00
EPTC	herbicide	19000			3.00
Cycloate	herbicide	4500	5020	10000	3.00
Cyanazine	herbicide	16000			3.00
Sethoxydim	herbicide				3.00
2,4-DB	herbicide	4000			3.00
Pebulate	herbicide	7400			3.00
Oxydemeton-methyl	insecticide	23000			3.00
Carbaryl	insecticide	28000			3.00
Malathion	insecticide	200000	67.4	1470	3.00
Dimethoate	insecticide	30200	8620	9440	2.67
2,4-D	herbicide	5000		20300	2.50
Bromacil + diuron	herbicide	28000	35000	87450	2.33

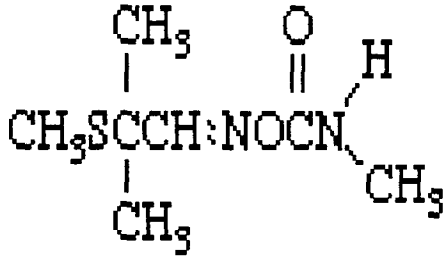
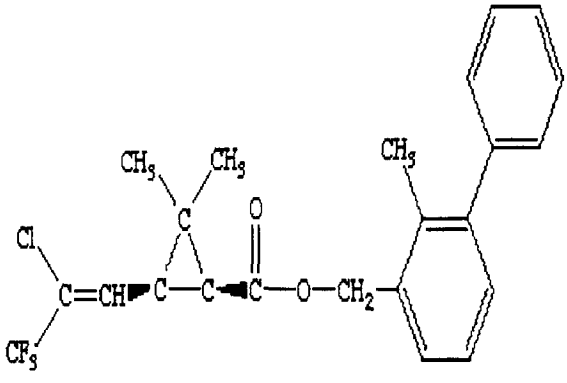
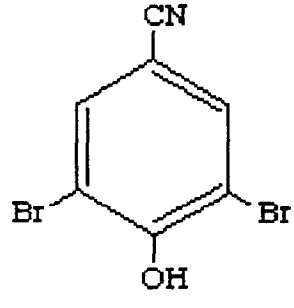
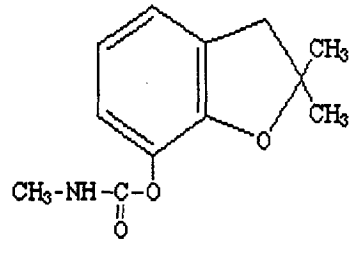
Chemical ISO Common Name	Usage Class	Farm Chemicals Handbook LC50, µg/L	Anadromous Fish LC50, µg/L	Resident Fish LC50, µg/L	Average Fish Toxicity Score
Coumafuryl	pesticide				2.00
Chloridazon	herbicide	46000			2.00
Simazine	herbicide	56000	12020	93680	2.00
Diphacinone	pesticide				2.00
Disulfoton	insecticide				2.00
Cyfluthrin	insecticide				2.00
Triclopyr	herbicide				2.00
Imidacloprid	insecticide				2.00
Napropamide	herbicide				2.00
Fenamiphos	insecticide				2.00
Methamidophos	insecticide			69000	2.00
Propargite	insecticide		1.00E+09	1.00E+09	2.00
Milo Bait	pesticide				2.00
Linuron	herbicide	3300	1.00E+09	1.00E+09	2.00
Imazethapyr	herbicide				2.00
Halosulfuron-methyl	herbicide				2.00
Select	herbicide	120000			2.00
Ethalfluralin	herbicide				2.00
Paraquat	herbicide		33760	127500	1.67
Cryolite	insecticide	47000	47000	1.00E+09	1.67
Diquat Dibromide	herbicide		39070	128000	1.67
Metribuzin	herbicide			1.00E+09	1.50
MCPA	herbicide	117000	1.00E+09		1.50
Abamectin	insecticide		1.00E+09		1.33
Pronamide	herbicide	72000	1.00E+09	1.00E+09	1.33
Chloropicrin	pesticide		1.00E+09	1.00E+09	1.33
Sodium Chlorate	herbicide		2772000	2084000	1.33
Ethephon	herbicide	720000			1.00
Sulfur	insecticide		1.00E+09	1.00E+09	1.00
Nicosulfuron	herbicide	1000000			1.00
Norflurazon	herbicide	200000	1.00E+09	1.00E+09	1.00
Bacillus thuringiensis	insecticide		1.00E+09	1.00E+09	1.00
Metambane	herbicide	706000			1.00
Hexazinone	herbicide	320000			1.00
Acephate	insecticide	1000000			1.00
Glyphosate	herbicide				1.00
Diflubenzuron	insecticide	140000			1.00

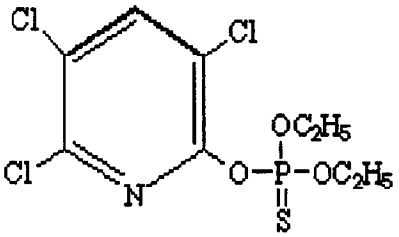
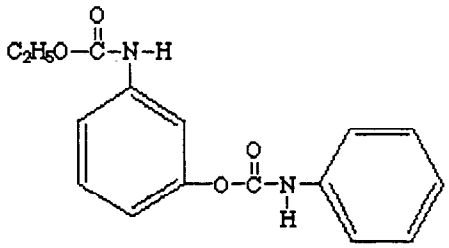
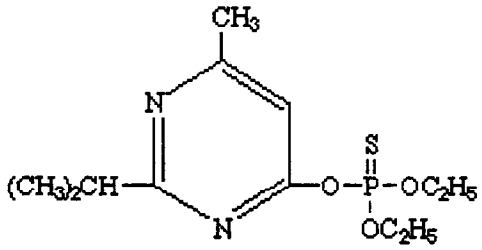
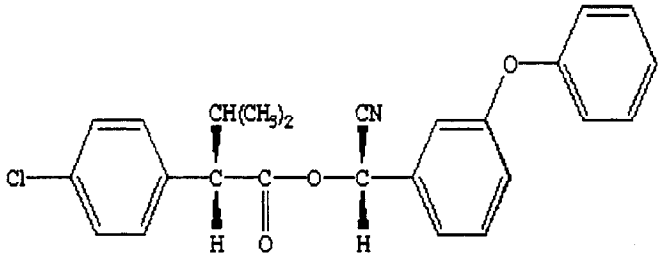
Table A3-5 Summary of 1997 agricultural chemicals and amounts applied within the near vicinity of the Tracy Fish Collection Facility. These chemicals represent the more toxic compounds having fish toxicity scores greater than 3.5. Data from San Joaquin County agricultural application database. ***Italicized*** chemicals represent toxicity score > 4 and application > 100 kg or 100 L, or toxicity score ≥ 3.5 and ≤ 4 with application > 1000 kg or 1000 L.

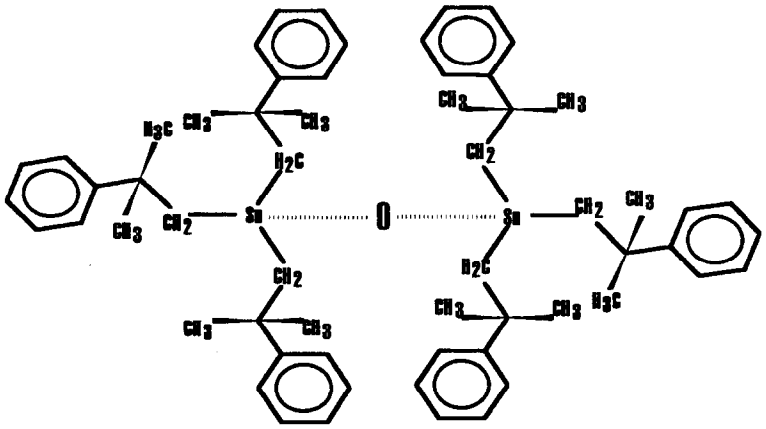
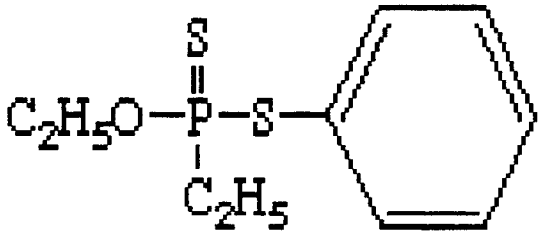
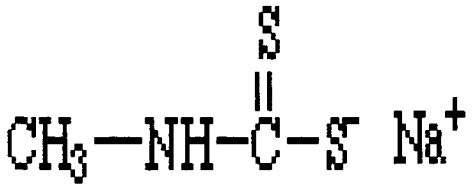
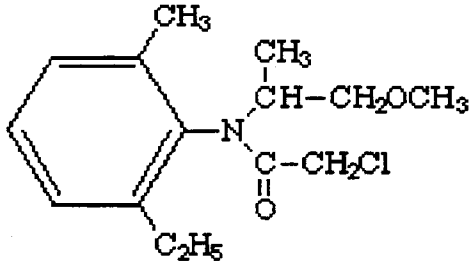
Chemical Common ISO Name	*Statistic*	*Average Fish Toxicity Score*	*1997 Solid Formulation Applied, kg*	*1997 Liquid Formulation Applied, L*	*Total Chemical Application Area, ha*	*Average Solid Application, kg/ha*	*Average Liquid Application, L/ha*
Aldicarb	Mean	4.33				11.59	
	Sum		**1759.70**		147.71		
Bensulide	Mean	4.00					11.7
	Sum			**23.66**	2.02		
Bifenthrin	Mean	5.00					0.468
	Sum			**14.20**	30.35		
Bromoxynil	Mean	5.00					1.32
	Sum			**270.05**	225.41		
Carbofuran	Mean	5.00					1.04
	Sum			**1764.17**	1695.44		
Chlorpyrifos	Mean	5.00				1.68	2.91
	Sum		**8.17**	**8614.28**	3936.03		
DCPA	Mean	4.00				8.97	
	Sum		**7.26**		0.81		
Desmedipham	Mean	4.00					2.38
	Sum			**3401.03**	1657.72		
Diazinon	Mean	4.33				8.97	1.57
	Sum		**181.60**	**417.04**	246.45		
Esfenvalerate	Mean	5.00					.608
	Sum			**661.95**	1190.35		
Fenbutatin-oxide	Mean	5.00				1.20	
	Sum		**111.91**		93.81		
Fonofos	Mean	5.00				13.4	
	Sum		**5604.52**		455.64		
Kelthane	Mean	4.00					.783
	Sum			**71.32**	91.05		
Metam-sodium	Mean	4.00					377
	Sum			**4173.40**	11.33		
Methidathion	Mean	4.66				4.49	
	Sum		**61.74**		13.76		

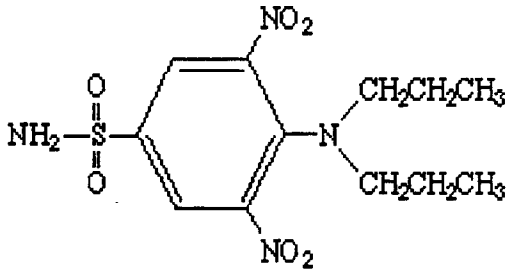
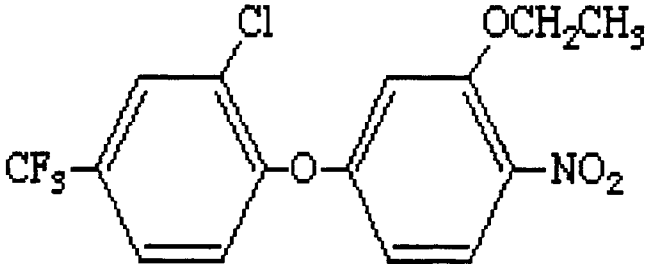
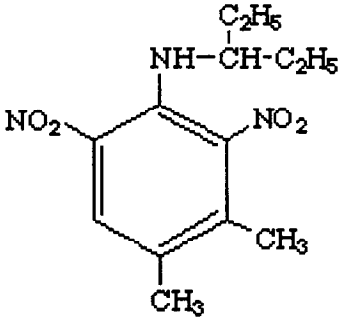
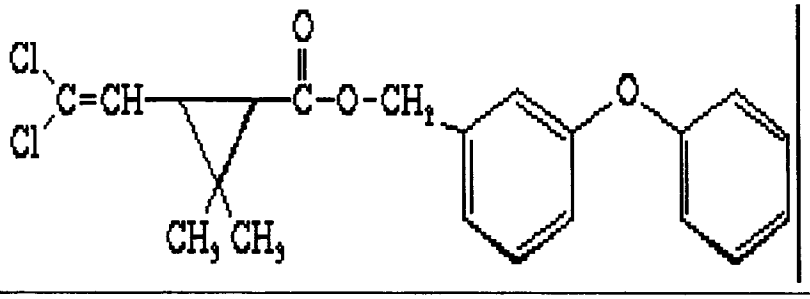
Chemical Common ISO Name	Statistic	Average Fish Toxicity Score	1997 Solid Formulation Applied, kg	1997 Liquid Formulation Applied, L	Total Chemical Application Area, ha	Average Solid Application, kg/ha	Average Liquid Application, L/ha
Metolachlor	Mean	3.50					2.87
	Sum			3358.98	1153.88		
Naled	Mean	4.00					1.19
	Sum			14.86	19.22		
Oryzalin	Mean	4.00					6.26
	Sum			623.61	70.42		
Oxyfluorfen	Mean	5.00					1.16
	Sum			1447.13	1008.12		
Pendimethalin	Mean	4.00					4.49
	Sum			540.25	127.72		
Permethrin	Mean	5.00					7.27
	Sum			714.23	266.69		
Phosmet	Mean	4.00				2.19	
	Sum		1246.96		686.83		
Trifluralin	Mean	4.33				21.7	1.69
	Sum		46031.06	5635.07	5368.92		

Table A3-6 Chemical structures for the more toxic agricultural chemical compounds applied in larger quantities.

Chemical Common ISO Name	*Average Fish Toxicity Score*	*1997 Solid Formulation Applied, kg*	*1997 Liquid Formulation Applied, L*	*Total Chemical Application Area, ha*
Aldicarb	4.33	**1759.70**		147.71
				
Bifenthrin	5.00		**14.20**	30.35
				
Bromoxynil	5.00		**270.05**	225.41
				
Carbofuran	5.00		**1764.17**	1695.44
				

Chemical Common ISO Name	*Average Fish Toxicity Score*	*1997 Solid Formulation Applied, kg*	*1997 Liquid Formulation Applied, L*	*Total Chemical Application Area, ha*
Chlorpyrifos	5.00	**8.17**	**8614.28**	3936.03
				
Desmedipham	4.00		**3401.03**	1657.72
				
Diazinon	4.33	**181.60**	**417.04**	246.45
				
Esfenvalerate	5.00		**661.95**	1190.35
				

Chemical Common ISO Name	Average Fish Toxicity Score	1997 Solid Formulation Applied, kg	1997 Liquid Formulation Applied, L	Total Chemical Application Area, ha
Fenbutatin-oxide	5.00	**111.91**		93.81
				
Fonofos	5.00	**5604.52**		455.64
				
Metam-sodium	4.00		**4173.40**	11.33
				
Metolachlor	3.50		**3358.98**	1153.88
				

Chemical Common ISO Name	Average Fish Toxicity Score	1997 Solid Formulation Applied, kg	1997 Liquid Formulation Applied, L	Total Chemical Application Area, ha
Oryzalin	4.00		**623.61**	70.42
				
Oxyfluorfen	5.00		**1447.13**	1008.12
				
Pendimethalin	4.00		**540.25**	127.72
				
Permethrin	5.00		**714.23**	266.69
				

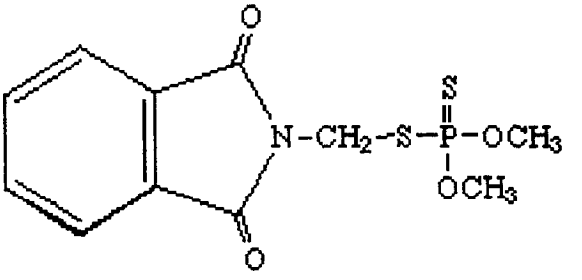
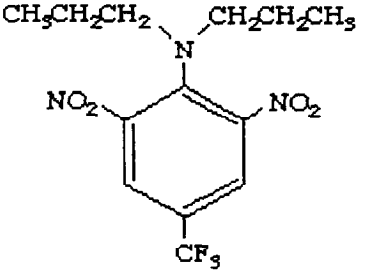
Chemical Common ISO Name	Average Fish Toxicity Score	1997 Solid Formulation Applied, kg	1997 Liquid Formulation Applied, L	Total Chemical Application Area, ha
Phosmet	4.00	**1246.96**		686.83
				
Trifluralin	4.33	**46031.06**	**5635.07**	5368.92
				

Table A3-7 Summary *by chemical* of 1997 agricultural chemical applications in the vicinity of the Tracy Fish Collection Facility for chemicals with average fish toxicity score toxicity scores > 4 and application > 100 kg or 100 L, or toxicity score ≥ 3.5 and ≤ 4 with application > 1000 kg or 1000 L.

Chemical ISO Common Name	Average Fish Toxicity Score	Month	Comment	1997 Monthly Liquid Formulation Applications, L	1997 Monthly Solid Formulation Applications, kg	Crop Area for Applied Chemical. ha
Aldicarb	4.33	3	Mar max		932.27	59.49
		4			823.55	88.22
		Total			**1755.83**	**147.71**
Bromoxynil	5.00	1		86.17		59.49
		2	Feb max	187.78		165.92
		Total		**273.95**		**225.41**
Carbofuran	5.00	1		259.65		220.55
		3	Mar max	1508.31		1456.67
		6		21.62		18.21
		Total		**1789.58**		**1695.44**
Chlorpyrifos	5.00	1		259.65		220.55
		2		62.40		44.92
		3	Mar max 1	5670.85		2166.13
		4		139.70		113.72
		5		28.57		12.14
		6		663.13		233.34
		7	Jul max 2	754.37		434.63
		8		682.16		380.41
		9		103.75		69.20
		10		279.36	2.72	120.19
		11		82.10	5.44	140.79
		Total		**8726.04**	**8.15**	**3936.03**
Desmedipham	4.00	2		314.88		78.51
		4	Apr max 2	509.45		230.27
		5		308.89		203.15
		6		81.75		59.08
		11	Nov max 1	1597.63		861.70
		12		637.48		225.01
		Total		**3450.09**		**1657.72**
Diazinon		1	Jan max 1	134.40		28.33
		5		48.00	181.20	40.47
		7		94.31		53.01
		8	Aug max 2	107.94		92.27
		9		38.40		32.37
		Total		**423.05**	**181.20**	**246.45**
Esfenvalerate	5.00	6		45.85		201.78
		7	Jul max	460.11		700.43
		8		106.10		190.61
		9		53.50		89.03
		10		5.76		8.50
		Total		**671.31**		**1190.35**
Fenbutatin-oxide	5.00	6	Jun max		111.66	93.81
		Total			**111.66**	**93.81**
Fonofos	5.00	3			940.09	82.96
		4			838.05	62.73
		5	May max		3814.03	309.95
		Total			**5592.17**	**455.64**

Chemical ISO Common Name	Average Fish Toxicity Score	Month	Comment	1997 Monthly Liquid Formulation Applications, L	1997 Monthly Solid Formulation Applications, kg	Crop Area for Applied Chemical. ha
Metam-sodium	4.00	3	Mar max 1	2524.80		6.88
		7	Jul max 3	768.00		1.62
		9	Aug max 2	940.80		2.83
		Total		**4233.60**		**11.33**
Metolachlor	3.50	2		72.00		20.23
		3	Mar max 2	1195.32		367.66
		4		865.57		311.53
		5	May max 1	1220.27		432.21
		6		52.19		22.26
		Total		**3405.34**		**1153.88**
Oryzalin	4.00	5		18.20		5.67
		11	Nov max	605.63		64.75
		Total		**623.83**		**70.42**
Oxyfluorfen	5.00	1		5.38		7.69
		2	Feb max 2	125.02		326.58
		3		98.48		131.93
		4		1.42		2.83
		7		5.27		10.72
		8		7.68		3.24
		10		309.43		152.08
		11	Nov max 1	768.63		182.07
		12		139.30		190.97
		Total		**1460.60**		**1008.12**
Permethrin	5.00	3		22.50		151.76
		4		15.28		20.64
		6		17.41		29.14
		8		42.52		45.73
		9	Sep max	626.50		19.42
		Total		**724.22**		**266.69**
Phosmet	4.00	2			72.48	64.75
		3	Mar max		650.78	535.97
		5			404.98	60.22
		6			52.55	11.74
		7			63.42	14.16
		Total			**1244.21**	**686.83**
Trifluralin	4.33	1			8652.30	384.05
		2	Feb max 1	177.10	17913.43	1004.55
		3	Mar max 2	2307.25	9542.90	1714.62
		4		1015.64	3807.92	803.47
		5		1035.09	4375.98	781.45
		6		574.07	1637.14	518.91
		7		26.76		12.55
		10		4.34		2.43
		11	Nov max 3	499.20		105.22
		12		74.15		41.68
		Total		**5713.61**	**45929.67**	**5368.92**

Figure A3-1 Kilograms of Aldicarb applied during 1997 near the TFCF.

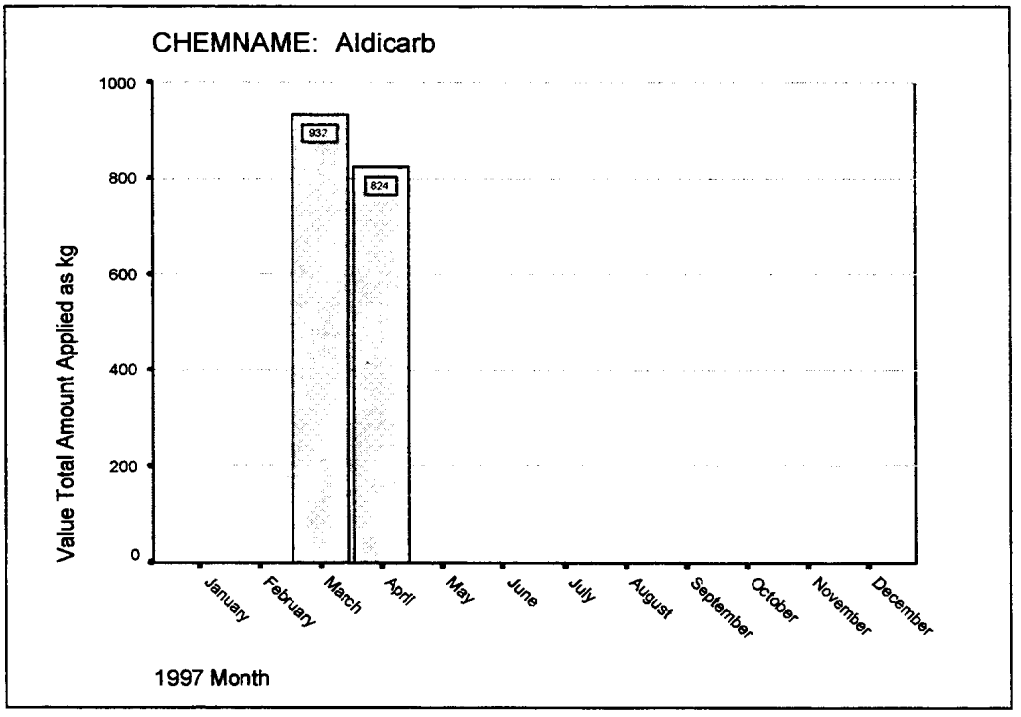


Figure A3-2 Kilograms of Bromoxynil applied during 1997 near the TFCF.

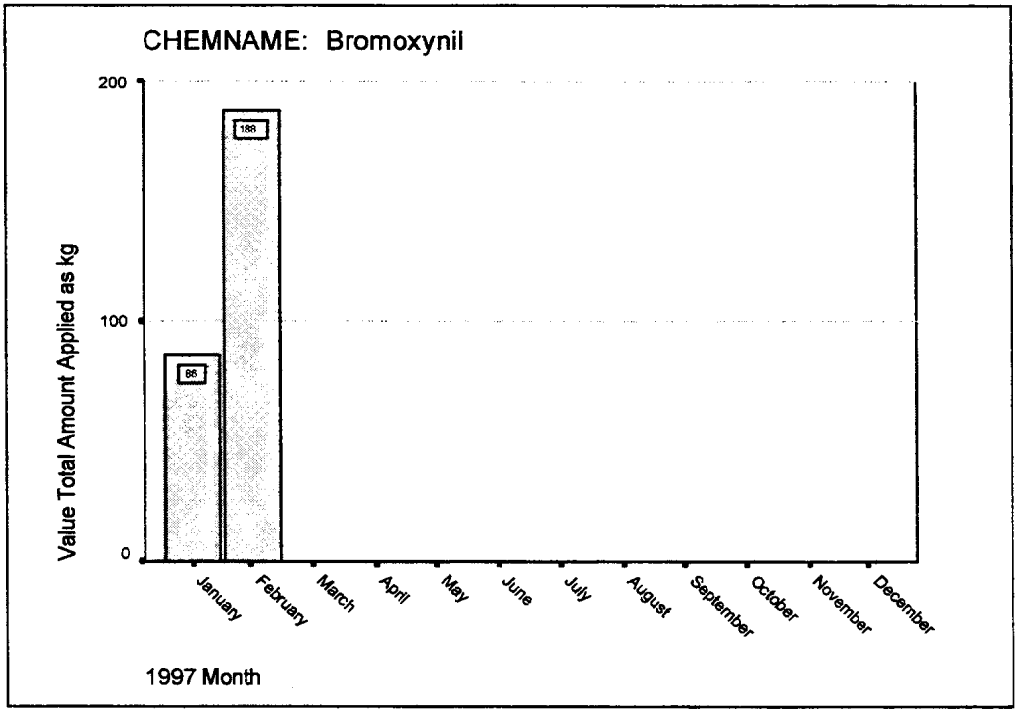


Figure A3-3 Kilograms of Carbofuran applied during 1997 near the TFCF.

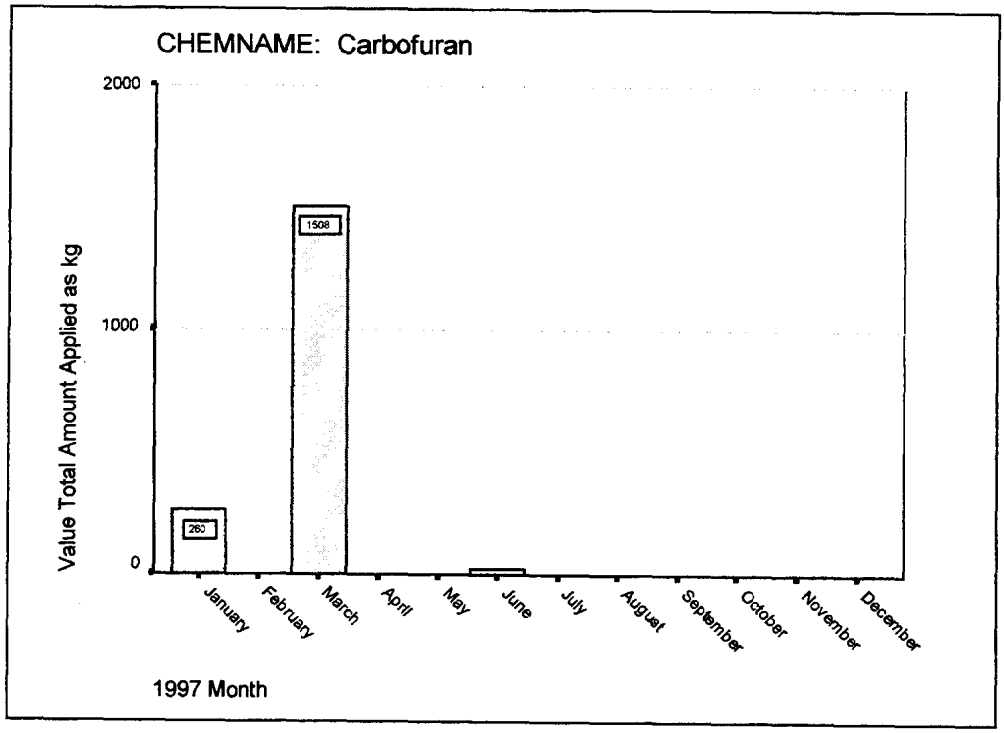


Figure A3-4 Kilograms of Chlorpyrifos applied during 1997 near the TFCF.

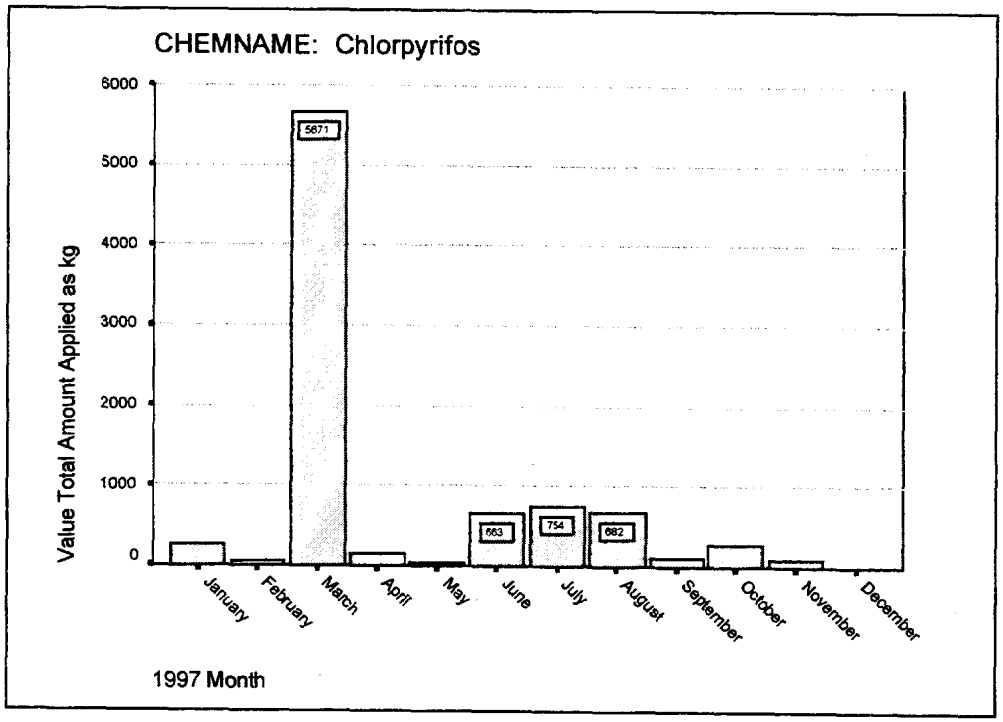


Figure A3-5 Kilograms of Desmedipham applied during 1997 near the TFCF.

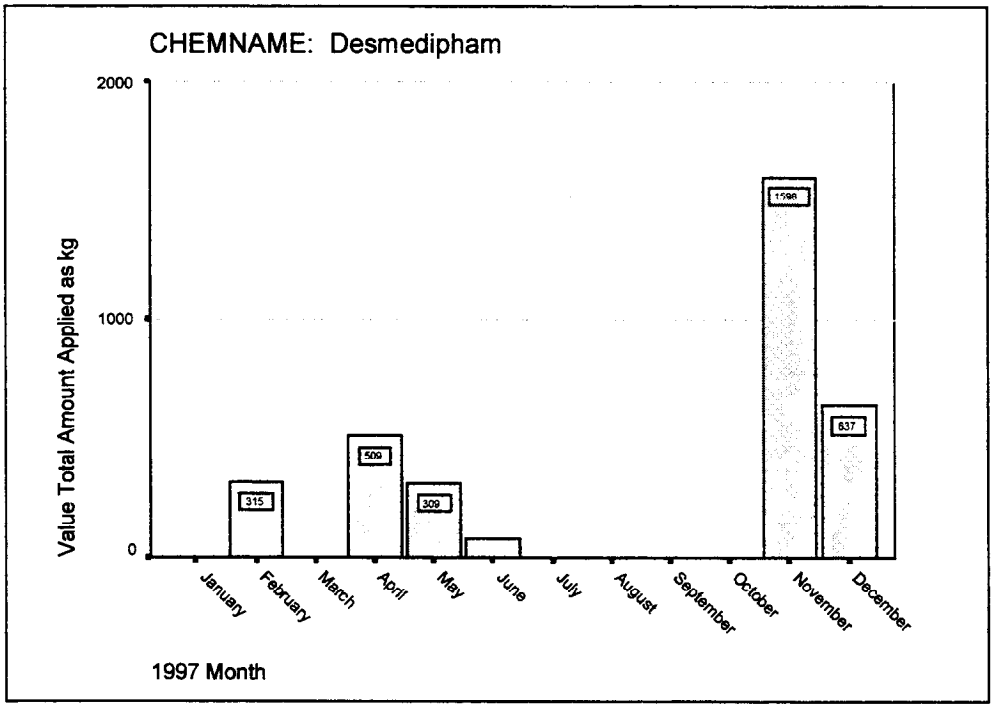


Figure A3-6 Kilograms of Diazinon applied during 1997 near the TFCF.

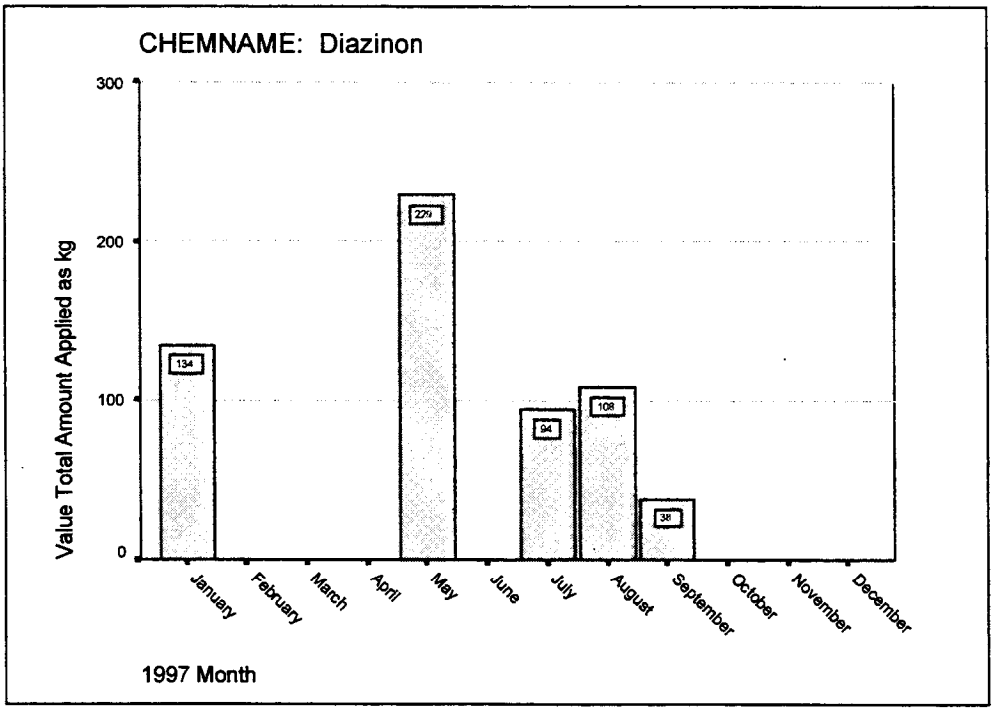


Figure A3-7 Kilograms of Esfenvalerate applied during 1997 near the TFCF.

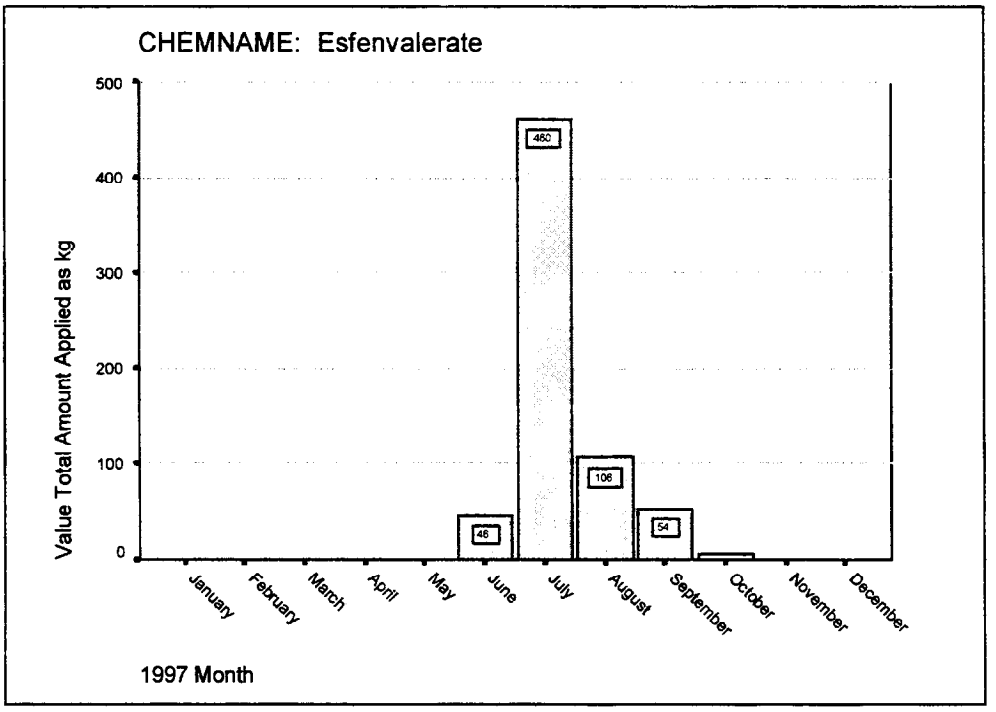


Figure A3-8 Kilograms of Fenbutatin-oxide applied during 1997 near the TFCF.

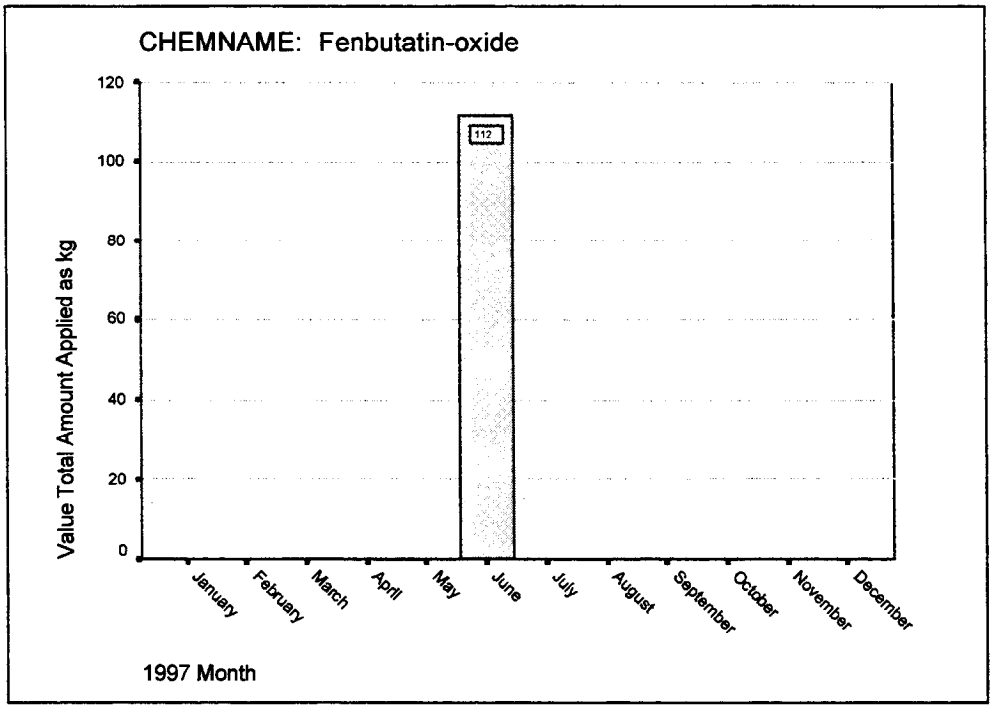


Figure A3-9 Kilograms of Fonofos applied during 1997 near the TFCF.

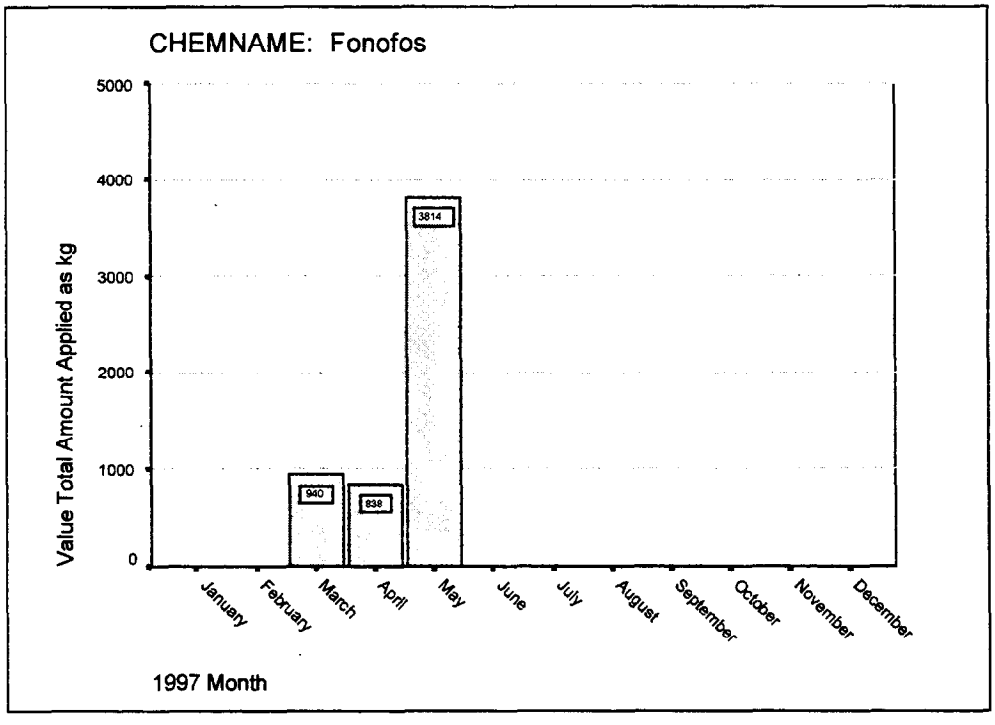


Figure A3-10 Kilograms of Metam-sodium applied during 1997 near the TFCF.

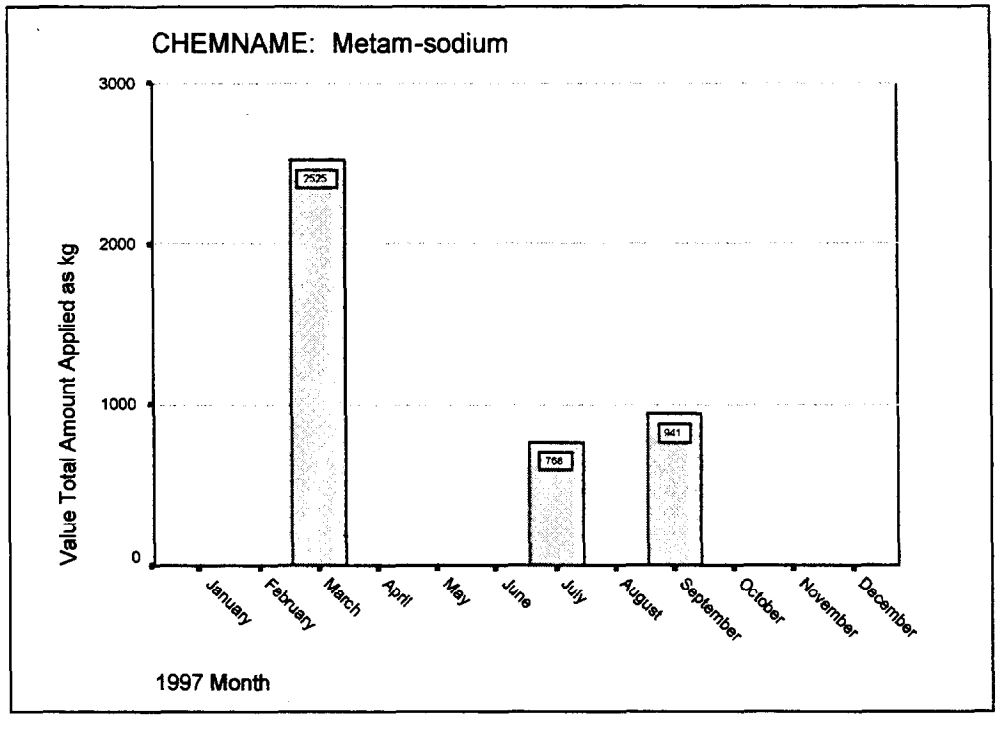


Figure A3-11 Kilograms of Metolachlor applied during 1997 near the TFCF.

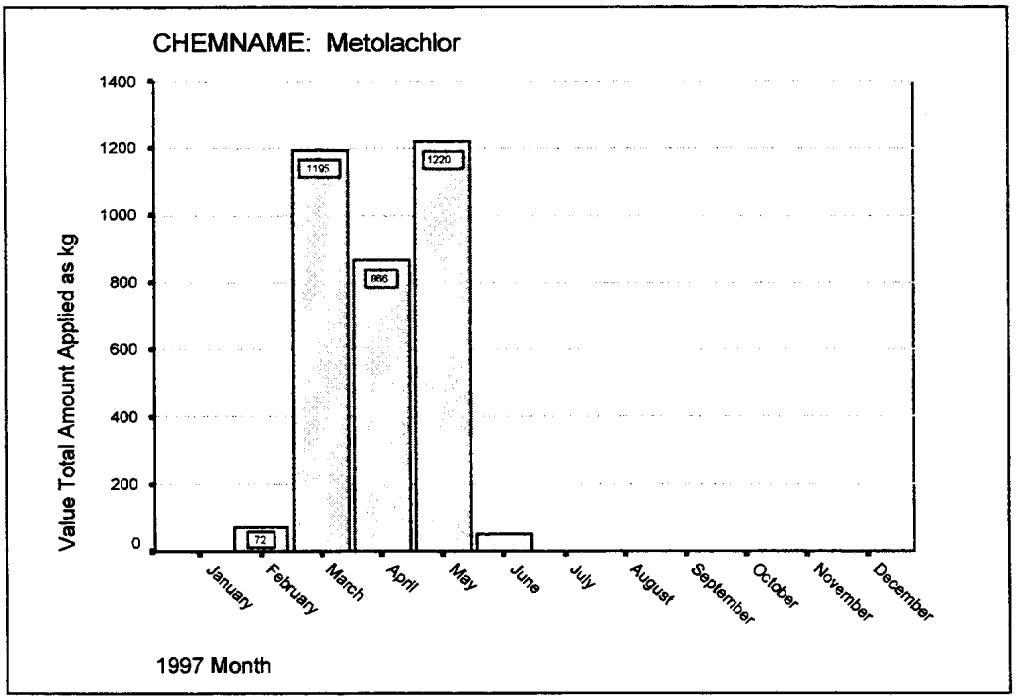


Figure A3-12 Kilograms of Oryzalin applied during 1997 near the TFCF.

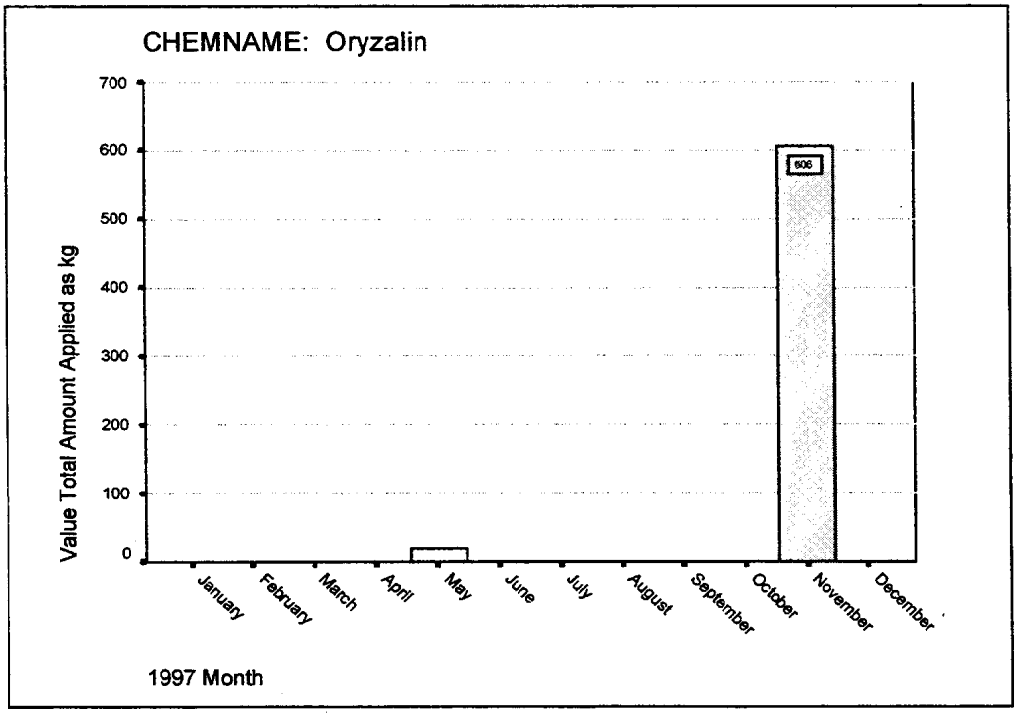


Figure A3-13 Kilograms of Oxyfluorfen applied during 1997 near the TFCF.

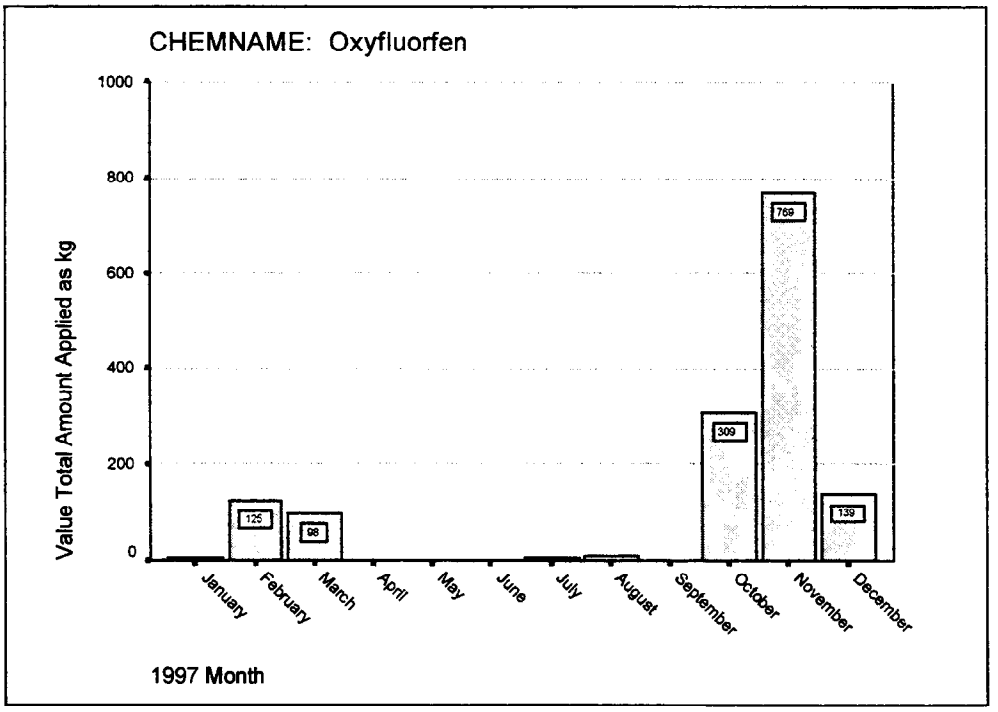


Figure A3-14 Kilograms of Phosmet applied during 1997 near the TFCF.

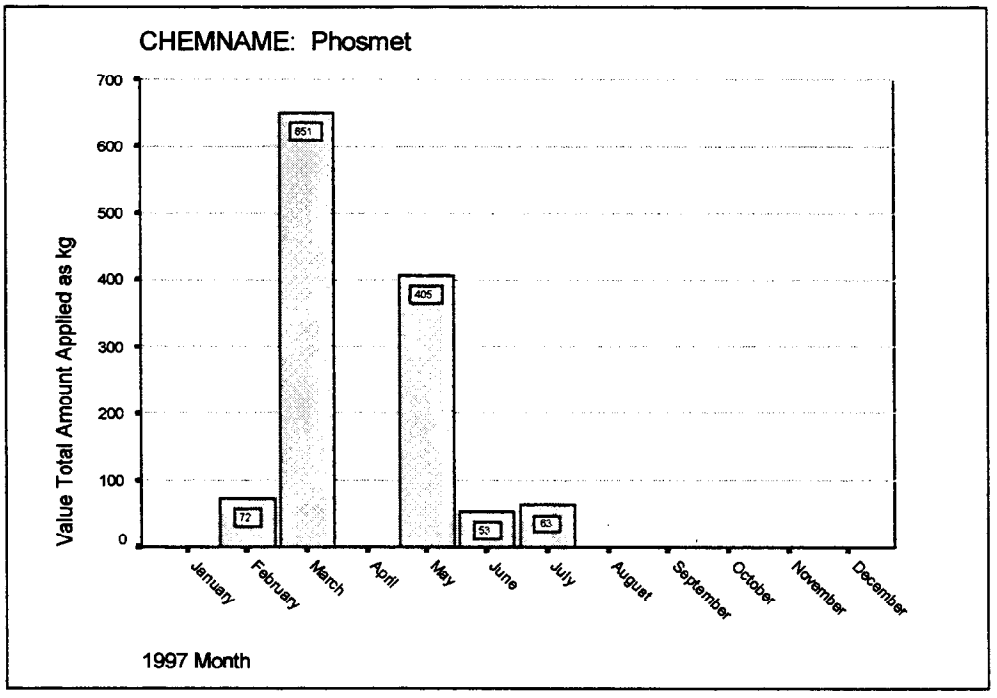


Figure A3-15 Kilograms of Permethrin applied during 1997 near the TFCF.

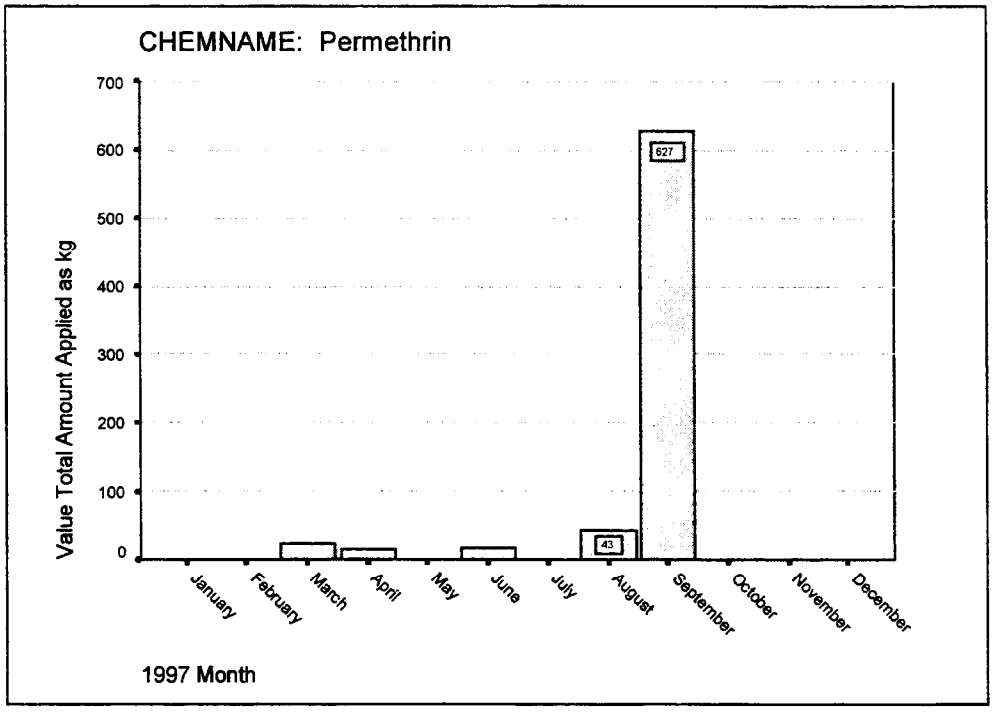
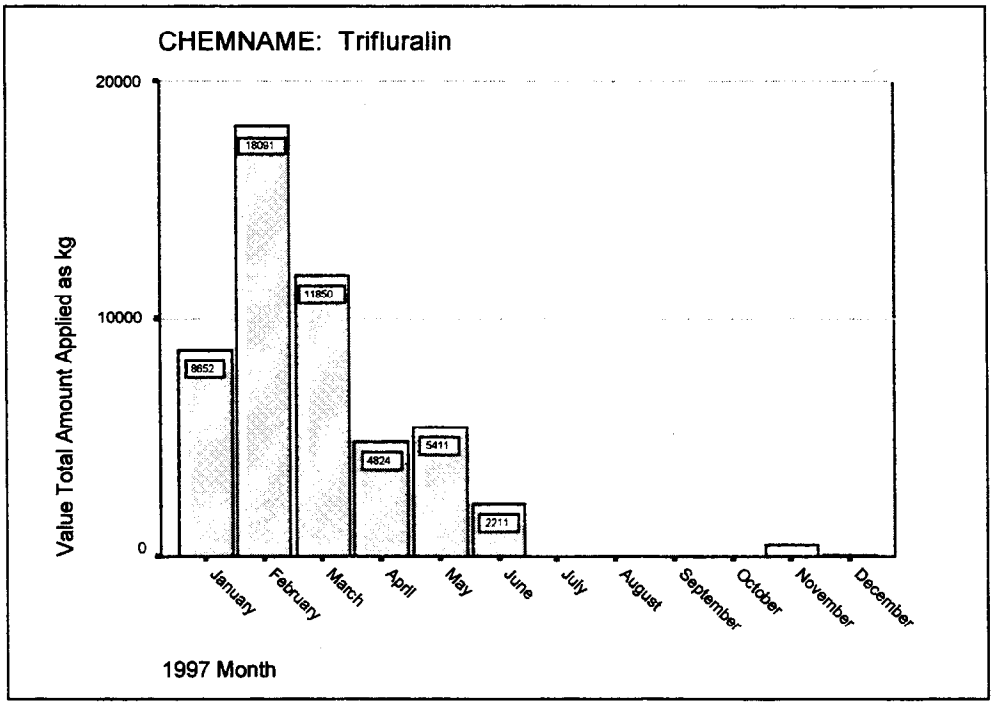


Figure A3-16 Kilograms of Trifluralin applied during 1997 near the TFCF.



APPENDIX 4

Graphical and Statistical Summary of Pesticide and Herbicide Data: USGS Analysis Results for Samples Collected at Vernalis, California

Table A4-1 Rank statistics as percentiles for the entire USGS Vernalis data set. All values are in ng/L. Variable detection limits have been recoded as the inverse of the maximum reported detection limit.

Percentiles	ALACHLOR	ATRAZINE	BUTYLATE	CARBARYL	CARBOFURAN	CHLORPYRIFOS	CYANAZINE	DACTHAL	DIAZINON	EPTAM
Valid N	117	410	117	515	640	640	192	293	640	293
Missing N	523	230	523	125	0	0	448	347	0	347
25	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
50	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
75	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	31.7500	-129.0000
80	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	109.4000	-63.0000	47.8000	-129.0000
85	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	146.3000	-63.0000	59.0000	-129.0000
90	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	218.5000	-63.0000	77.9000	-129.0000
95	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	304.0500	-63.0000	158.6000	232.7000
99	-22.0000	-35.0000	-19.0000	98.5200	75.5900	-35.0000	604.0500	88.1800	370.4000	494.3400
99.5	-22.0000	-35.0000	-19.0000	185.1400	93.7450	-35.0000	804.0000	138.7000	570.7250	628.8800
99.9	-22.0000	-35.0000	-19.0000	197.0000	105.0000	43.0000	804.0000	181.0000	714.0000	674.0000

Percentiles	FONOFOS	MALATHION	METHIDATHION	METOLACHLOR	MOLINATE	NAPROPAM	PEBULATE	SIMAZINE	THIOBENCARB	TRIFLURALIN
Valid	410	410	515	293	515	117	117	640	601	410
Missing	230	230	125	347	125	523	523	0	39	230
25	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
50	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
75	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	129.0000	-60.0000	-60.0000
80	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	175.0000	-60.0000	-60.0000
85	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	229.0000	-60.0000	-60.0000
90	-24.0000	-45.0000	-63.0000	50.6000	-53.0000	-28.0000	-44.0000	289.8000	-60.0000	-60.0000
95	-24.0000	-45.0000	73.6000	59.3000	-53.0000	-28.0000	46.7000	444.0000	-60.0000	-60.0000
99	-24.0000	-45.0000	429.2000	114.1200	38.5600	-28.0000	974.9000	998.9400	-60.0000	-60.0000
99.5	-24.0000	-45.0000	648.5800	116.5300	94.5200	-28.0000	1046.0000	1083.3850	109.9000	-60.0000
99.9	-24.0000	-45.0000	802.0000	117.0000	145.0000	-28.0000	1046.0000	1747.0000	528.0000	-60.0000

Table A4-2a Rank statistics as percentiles by month for the entire USGS Vernalis data set, Alachlor to Eptam. All values are in ng/L. Variable detection limits have been recoded as the inverse of the maximum reported detection limit.

MONTH		STATISTIC	ALACHLOR	ATRAZINE	BUTYLATE	CARBARYL	CARBOFURAN	CHLORPYRIFOS	CYANAZINE	DACTHAL	DIAZINON	EPTAM
January	N	Valid	20	44	20	64	73	73	20	38	73	38
		Missing	53	29	53	9	0	0	53	35	0	35
	Percentiles	25	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		50	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	53.0000	-129.0000
		75	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	105.0000	-129.0000
		80	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	135.0000	-129.0000
		85	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	179.5000	-63.0000	172.2000	-129.0000
		90	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	235.3000	-63.0000	204.6000	-129.0000
		95	-22.0000	-35.0000	-19.0000	14.5000	-31.0000	-35.0000	268.3500	-55.3000	290.1000	-129.0000
		99	-22.0000	-35.0000	-19.0000	51.0000	-31.0000	-35.0000	270.0000	91.0000	395.0000	-129.0000
		99.5	-22.0000	-35.0000	-19.0000	51.0000	-31.0000	-35.0000	270.0000	91.0000	395.0000	-129.0000
		99.9	-22.0000	-35.0000	-19.0000	51.0000	-31.0000	-35.0000	270.0000	91.0000	395.0000	-129.0000
February	N	Valid	27	57	27	68	84	84	27	54	84	54
		Missing	57	27	57	16	0	0	57	30	0	30
	Percentiles	25	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	30.2500	-129.0000
		50	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	146.0000	-63.0000	63.5000	-129.0000
		75	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	269.0000	-63.0000	114.0000	-129.0000
		80	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	386.0000	-63.0000	164.0000	-129.0000
		85	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	505.0000	-63.0000	201.0000	-129.0000
		90	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	537.0000	-63.0000	286.5000	-129.0000
		95	-22.0000	-35.0000	-19.0000	60.5000	-31.0000	-35.0000	708.4000	-25.2500	508.2500	-129.0000
		99	-22.0000	-35.0000	-19.0000	197.0000	-31.0000	43.0000	804.0000	181.0000	714.0000	-129.0000
		99.5	-22.0000	-35.0000	-19.0000	197.0000	-31.0000	43.0000	804.0000	181.0000	714.0000	-129.0000
		99.9	-22.0000	-35.0000	-19.0000	197.0000	-31.0000	43.0000	804.0000	181.0000	714.0000	-129.0000
March	N	Valid	14	42	14	58	72	72	14	44	72	44
		Missing	58	30	58	14	0	0	58	28	0	28
	Percentiles	25	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000

MONTH		STATISTIC	ALACHLOR	ATRAZINE	BUTYLATE	CARBARYL	CARBOFURAN	CHLORPYRIFOS	CYANAZINE	DACTHAL	DIAZINON	EPTAM
		50	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	145.5000	-63.0000	-35.0000	-129.0000
		75	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	265.2500	-63.0000	52.0000	-129.0000
		80	-22.0000	-35.0000	-19.0000	-44.0000	-6.6000	-35.0000	296.0000	-63.0000	57.2000	-129.0000
		85	-22.0000	-35.0000	-19.0000	-44.0000	53.1500	-35.0000	313.2500	-63.0000	61.1500	-129.0000
		90	-22.0000	-35.0000	-19.0000	-44.0000	59.0000	-35.0000	321.5000	-63.0000	71.8000	-129.0000
		95	-22.0000	-35.0000	-19.0000	-44.0000	77.4500	-35.0000	324.0000	-63.0000	99.4000	-129.0000
		99	-22.0000	-35.0000	-19.0000	-44.0000	96.0000	-35.0000	324.0000	-63.0000	110.0000	-129.0000
		99.5	-22.0000	-35.0000	-19.0000	-44.0000	96.0000	-35.0000	324.0000	-63.0000	110.0000	-129.0000
		99.9	-22.0000	-35.0000	-19.0000	-44.0000	96.0000	-35.0000	324.0000	-63.0000	110.0000	-129.0000
April	N	Valid	14	44	14	55	70	70	14	40	70	40
		Missing	56	26	56	15	0	0	56	30	0	30
	Percentiles	25	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		50	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		75	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		80	-22.0000	-35.0000	-19.0000	-44.0000	34.8000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		85	-22.0000	-35.0000	-19.0000	-44.0000	39.4000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		90	-22.0000	-35.0000	-19.0000	42.6000	47.7000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		95	-22.0000	-35.0000	-19.0000	73.4000	68.3000	-35.0000	-50.0000	-63.0000	-35.0000	105.6500
		99	-22.0000	-35.0000	-19.0000	178.0000	105.0000	-35.0000	-50.0000	-63.0000	49.0000	578.0000
		99.5	-22.0000	-35.0000	-19.0000	178.0000	105.0000	-35.0000	-50.0000	-63.0000	49.0000	578.0000
		99.9	-22.0000	-35.0000	-19.0000	178.0000	105.0000	-35.0000	-50.0000	-63.0000	49.0000	578.0000
May	N	Valid	0	27	0	28	42	42	15	15	42	15
		Missing	42	15	42	14	0	0	27	27	0	27
	Percentiles	25		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		50		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		75		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		80		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		85		-35.0000		14.5000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		90		-35.0000		47.3000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		95		-35.0000		50.0000	-31.0000	-35.0000	-50.0000	-63.0000	26.2000	-129.0000
		99		-35.0000		50.0000	-31.0000	-35.0000	-50.0000	-63.0000	41.0000	-129.0000

MONTH		STATISTIC	ALACHLOR	ATRAZINE	BUTYLATE	CARBARYL	CARBOFURAN	CHLORPYRIFOS	CYANAZINE	DACTHAL	DIAZINON	EPTAM
		99.5		-35.0000		50.0000	-31.0000	-35.0000	-50.0000	-63.0000	41.0000	-129.0000
		99.9		-35.0000		50.0000	-31.0000	-35.0000	-50.0000	-63.0000	41.0000	-129.0000
June	N	Valid	0	26	0	26	40	40	14	14	40	14
		Missing	40	14	40	14	0	0	26	26	0	26
	Percentiles	25		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		50		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	12.5000
		75		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	301.0000
		80		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	340.0000
		85		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	388.0000
		90		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	446.5000
		95		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	489.0000
		99		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	489.0000
		99.5		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	489.0000
		99.9		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	489.0000
July	N	Valid	0	28	0	29	43	43	15	15	43	15
		Missing	43	15	43	14	0	0	28	28	0	28
	Percentiles	25		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		50		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		75		-35.0000		-44.0000	-31.0000	-35.0000	92.0000	-63.0000	-35.0000	198.0000
		80		-35.0000		-44.0000	-31.0000	-35.0000	148.8000	-63.0000	-35.0000	260.4000
		85		-35.0000		-44.0000	-31.0000	-35.0000	215.8000	-63.0000	-35.0000	280.8000
		90		-35.0000		-44.0000	-31.0000	-35.0000	386.2000	-63.0000	-35.0000	316.4000
		95		-35.0000		-44.0000	-31.0000	-35.0000	589.0000	-63.0000	-35.0000	365.0000
		99		-35.0000		-44.0000	35.0000	-35.0000	589.0000	-63.0000	39.0000	365.0000
		99.5		-35.0000		-44.0000	35.0000	-35.0000	589.0000	-63.0000	39.0000	365.0000
		99.9		-35.0000		-44.0000	35.0000	-35.0000	589.0000	-63.0000	39.0000	365.0000
August	N	Valid	0	28	0	29	44	44	16	16	44	16
		Missing	44	16	44	15	0	0	28	28	0	28
	Percentiles	25		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		50		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		75		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	36.0000	95.2500

MONTH		STATISTIC	ALACHLOR	ATRAZINE	BUTYLATE	CARBARYL	CARBOFURAN	CHLORPYRIFOS	CYANAZINE	DACTHAL	DIAZINON	EPTAM
		80		-35.0000		-44.0000	-31.0000	-35.0000	11.2000	-63.0000	49.0000	211.4000
		85		-35.0000		-44.0000	-31.0000	-35.0000	104.2000	-63.0000	60.5000	244.4000
		90		-35.0000		39.0000	-31.0000	-35.0000	187.2000	-63.0000	75.0000	377.9000
		95		-35.0000		78.0000	-31.0000	-35.0000	232.0000	-63.0000	111.2500	674.0000
		99		-35.0000		96.0000	-31.0000	-35.0000	232.0000	-63.0000	250.0000	674.0000
		99.5		-35.0000		96.0000	-31.0000	-35.0000	232.0000	-63.0000	250.0000	674.0000
		99.9		-35.0000		96.0000	-31.0000	-35.0000	232.0000	-63.0000	250.0000	674.0000
September	N	Valid	0	28	0	29	43	43	15	15	43	15
		Missing	43	15	43	14	0	0	28	28	0	28
	Percentiles	25		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		50		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		75		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		80		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	179.0000
		85		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	365.8000
		90		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	446.6000
		95		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	458.0000
		99		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	458.0000
		99.5		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	458.0000
October	N	Valid	12	27	12	41	41	41	12	12	41	12
		Missing	29	14	29	0	0	0	29	29	0	29
	Percentiles	25	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		50	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		75	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		80	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		85	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		90	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		95	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		99	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		99.5	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		99.9	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000

MONTH		STATISTIC	ALACHLOR	ATRAZINE	BUTYLATE	CARBARYL	CARBOFURAN	CHLORPYRIFOS	CYANAZINE	DACTHAL	DIAZINON	EPTAM
November	N	Valid	14	29	14	43	43	43	14	14	43	14
		Missing	29	14	29	0	0	0	29	29	0	29
	Percentiles	25	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		50	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		75	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		80	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		85	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		90	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		95	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		99	-22.0000	-35.0000	-19.0000	45.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		99.5	-22.0000	-35.0000	-19.0000	45.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		99.9	-22.0000	-35.0000	-19.0000	45.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
December	N	Valid	16	30	16	45	45	45	16	16	45	16
		Missing	29	15	29	0	0	0	29	29	0	29
	Percentiles	25	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		50	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	-129.0000
		75	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	53.5000	-63.0000	-35.0000	-129.0000
		80	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	103.6000	-63.0000	-35.0000	-129.0000
		85	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	127.0500	-63.0000	-35.0000	-129.0000
		90	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	146.9000	-63.0000	-35.0000	-129.0000
		95	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	156.0000	-63.0000	-35.0000	-129.0000
		99	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	156.0000	-63.0000	48.0000	-129.0000
		99.5	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	156.0000	-63.0000	48.0000	-129.0000
		99.9	-22.0000	-35.0000	-19.0000	-44.0000	-31.0000	-35.0000	156.0000	-63.0000	48.0000	-129.0000
		99.9		-35.0000		-44.0000	-31.0000	-35.0000	-50.0000	-63.0000	-35.0000	458.0000

Table A4-2b Rank statistics as percentiles by month for the entire USGS Vernalis data set, Fonofos to Trifluralin. All values are in ng/L. Variable detection limits have been recoded as the inverse of the maximum reported detection limit.

MONTH		STATISTIC	FONOFOS	MALATHION	METHIDATHION	METOLACHLOR	MOLINATE	NAPROPAM	PEBULATE	SIMAZINE	THIOBENCARB	TRIFLURALIN
January	N	Valid	44	44	64	38	64	20	20	73	64	44
		Missing	29	29	9	35	9	53	53	0	9	29
	Percentiles	25	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		50	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	119.0000	-60.0000	-60.0000
		75	-24.0000	-45.0000	30.7500	-47.0000	-53.0000	-28.0000	-44.0000	225.0000	-60.0000	-60.0000
		80	-24.0000	-45.0000	38.0000	-47.0000	-53.0000	-28.0000	-44.0000	273.6000	-60.0000	-60.0000
		85	-24.0000	-45.0000	63.5000	-47.0000	-53.0000	-28.0000	-44.0000	301.9000	-60.0000	-60.0000
		90	-24.0000	-45.0000	170.5000	-47.0000	-53.0000	-28.0000	-44.0000	429.2000	-60.0000	-60.0000
		95	-24.0000	-45.0000	476.2500	-47.0000	-53.0000	-28.0000	-44.0000	615.1000	-60.0000	-60.0000
		99	-24.0000	-45.0000	802.0000	-47.0000	-53.0000	-28.0000	-44.0000	1068.0000	-60.0000	-60.0000
		99.5	-24.0000	-45.0000	802.0000	-47.0000	-53.0000	-28.0000	-44.0000	1068.0000	-60.0000	-60.0000
		99.9	-24.0000	-45.0000	802.0000	-47.0000	-53.0000	-28.0000	-44.0000	1068.0000	-60.0000	-60.0000
February	N	Valid	57	57	68	54	68	27	27	84	68	57
		Missing	27	27	16	30	16	57	57	0	16	27
	Percentiles	25	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		50	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	212.0000	-60.0000	-60.0000
		75	-24.0000	-45.0000	70.5000	-47.0000	-53.0000	-28.0000	-44.0000	426.0000	-60.0000	-60.0000
		80	-24.0000	-45.0000	88.4000	-47.0000	-53.0000	-28.0000	-44.0000	492.0000	-60.0000	-60.0000
		85	-24.0000	-45.0000	106.6500	-47.0000	-53.0000	-28.0000	-44.0000	760.7500	-60.0000	-60.0000
		90	-24.0000	-45.0000	173.3000	-47.0000	-53.0000	-28.0000	-44.0000	844.5000	-60.0000	-60.0000
		95	-24.0000	-45.0000	320.4500	-47.0000	-53.0000	-28.0000	-44.0000	1077.5000	-60.0000	-60.0000
		99	-24.0000	-45.0000	586.0000	-47.0000	-53.0000	-28.0000	-44.0000	1747.0000	-60.0000	-60.0000
		99.5	-24.0000	-45.0000	586.0000	-47.0000	-53.0000	-28.0000	-44.0000	1747.0000	-60.0000	-60.0000
		99.9	-24.0000	-45.0000	586.0000	-47.0000	-53.0000	-28.0000	-44.0000	1747.0000	-60.0000	-60.0000
March	N	Valid	42	42	58	44	58	14	14	72	58	42
		Missing	30	30	14	28	14	58	58	0	14	30
	Percentiles	25	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	107.2500	-60.0000	-60.0000
		50	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	212.5000	-60.0000	-60.0000
		75	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	319.2500	-60.0000	-60.0000

MONTH		STATISTIC	FONOFOS	MALATHION	METHIDATHION	METOLACHLOR	MOLINATE	NAPROPAM	
		80	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.000
		85	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.000
		90	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.000
		95	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.000
		99	-24.0000	-45.0000	62.0000	-47.0000	-53.0000	-28.0000	-44.000
		99.5	-24.0000	-45.0000	62.0000	-47.0000	-53.0000	-28.0000	-44.000
		99.9	-24.0000	-45.0000	62.0000	-47.0000	-53.0000	-28.0000	-44.000
April	N	Valid	44	44	55	40	55	14	1
		Missing	26	26	15	30	15	56	5
	Percentiles	25	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.000
		50	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.000
		75	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	450.750
		80	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	471.000
		85	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	606.000
		90	-24.0000	-45.0000	-63.0000	39.4000	-53.0000	-28.0000	848.500
		95	-24.0000	-45.0000	-63.0000	56.7500	-53.0000	-28.0000	1046.000
		99	-24.0000	-45.0000	-63.0000	116.0000	-53.0000	-28.0000	1046.000
		99.5	-24.0000	-45.0000	-63.0000	116.0000	-53.0000	-28.0000	1046.000
		99.9	-24.0000	-45.0000	-63.0000	116.0000	-53.0000	-28.0000	1046.000
May	N	Valid	27	27	28	15	28	0	
		Missing	15	15	14	27	14	42	4
	Percentiles	25	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000		
		50	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000		
		75	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000		
		80	-24.0000	-45.0000	-63.0000	35.4000	-53.0000		
		85	-24.0000	-45.0000	-63.0000	59.6000	-53.0000		
		90	-24.0000	-45.0000	-63.0000	64.8000	-53.0000		
		95	-24.0000	-45.0000	-63.0000	69.0000	-53.0000		
		99	-24.0000	-45.0000	-63.0000	69.0000	-53.0000		
		99.5	-24.0000	-45.0000	-63.0000	69.0000	-53.0000		
		99.9	-24.0000	-45.0000	-63.0000	69.0000	-53.0000		

MONTH		STATISTIC	FONOFOS	MALATHION	METHIDATHION	METOLACHLOR	MOLINATE	NAPROPAM	PEBULATE	SIMAZINE	THIOBENCARB	TRIFLURALIN
June	N	Valid	26	26	26	14	26	0	0	40	40	26
		Missing	14	14	14	26	14	40	40	0	0	14
	Percentiles	25	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000			-82.0000	-60.0000	-60.0000
		50	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000			-82.0000	-60.0000	-60.0000
		75	-24.0000	-45.0000	-63.0000	55.2500	-53.0000			70.7500	-60.0000	-60.0000
		80	-24.0000	-45.0000	-63.0000	62.0000	12.4000			82.0000	-60.0000	-60.0000
		85	-24.0000	-45.0000	-63.0000	72.5000	58.8500			88.7000	-60.0000	-60.0000
		90	-24.0000	-45.0000	-63.0000	96.5000	93.8000			90.8000	-60.0000	-60.0000
		95	-24.0000	-45.0000	-63.0000	117.0000	128.5500			95.9500	-60.0000	-60.0000
		99	-24.0000	-45.0000	-63.0000	117.0000	145.0000			103.0000	528.0000	-60.0000
		99.5	-24.0000	-45.0000	-63.0000	117.0000	145.0000			103.0000	528.0000	-60.0000
		99.9	-24.0000	-45.0000	-63.0000	117.0000	145.0000			103.0000	528.0000	-60.0000
July	N	Valid	28	28	29	15	29	0	0	43	43	28
		Missing	15	15	14	28	14	43	43	0	0	15
	Percentiles	25	-24.0000	-45.0000	-63.0000	52.0000	-53.0000			-82.0000	-60.0000	-60.0000
		50	-24.0000	-45.0000	-63.0000	58.0000	-53.0000			-82.0000	-60.0000	-60.0000
		75	-24.0000	-45.0000	-63.0000	71.0000	-53.0000			-82.0000	-60.0000	-60.0000
		80	-24.0000	-45.0000	-63.0000	71.0000	-53.0000			-82.0000	-60.0000	-60.0000
		85	-24.0000	-45.0000	-63.0000	73.4000	-53.0000			-24.0000	-60.0000	-60.0000
		90	-24.0000	-45.0000	-63.0000	85.0000	-53.0000			70.4000	-60.0000	-60.0000
		95	-24.0000	-45.0000	-63.0000	100.0000	-53.0000			80.8000	-60.0000	-60.0000
		99	-24.0000	-45.0000	-63.0000	100.0000	-53.0000			82.0000	-60.0000	-60.0000
		99.5	-24.0000	-45.0000	-63.0000	100.0000	-53.0000			82.0000	-60.0000	-60.0000
		99.9	-24.0000	-45.0000	-63.0000	100.0000	-53.0000			82.0000	-60.0000	-60.0000
August	N	Valid	28	28	29	16	29	0	0	44	44	28
		Missing	16	16	15	28	15	44	44	0	0	16
	Percentiles	25	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000			-82.0000	-60.0000	-60.0000
		50	-24.0000	-45.0000	-63.0000	47.5000	-53.0000			-82.0000	-60.0000	-60.0000
		75	-24.0000	-45.0000	-63.0000	52.5000	-53.0000			-82.0000	-60.0000	-60.0000
		80	-24.0000	-45.0000	-63.0000	56.0000	-53.0000			-82.0000	-60.0000	-60.0000
		85	-24.0000	-45.0000	-63.0000	62.0500	-53.0000			63.2500	-60.0000	-60.0000
		90	-24.0000	-45.0000	-63.0000	81.1000	-53.0000			69.5000	-60.0000	-60.0000

MONTH		STATISTIC	FONOFOS	MALATHION	METHIDATHION	METOLACHLOR	MOLINATE	NAPROPAM	PEBULATE	SIMAZINE	THIOBENCARB	TRIFLURALIN
		95	-24.0000	-45.0000	-63.0000	114.0000	-53.0000			91.2500	-60.0000	-60.0000
		99	-24.0000	-45.0000	-63.0000	114.0000	-53.0000			98.0000	-60.0000	-60.0000
		99.5	-24.0000	-45.0000	-63.0000	114.0000	-53.0000			98.0000	-60.0000	-60.0000
		99.9	-24.0000	-45.0000	-63.0000	114.0000	-53.0000			98.0000	-60.0000	-60.0000
September	N	Valid	28	28	29	15	29	0	0	43	43	28
		Missing	15	15	14	28	14	43	43	0	0	15
	Percentiles	25	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000			-82.0000	-60.0000	-60.0000
		50	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000			-82.0000	-60.0000	-60.0000
		75	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000			71.0000	-60.0000	-60.0000
		80	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000			75.2000	-60.0000	-60.0000
		85	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000			78.4000	-60.0000	-60.0000
		90	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000			82.0000	-60.0000	-60.0000
		95	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000			95.4000	-60.0000	-60.0000
		99	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000			119.0000	-60.0000	-60.0000
		99.5	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000			119.0000	-60.0000	-60.0000
October	N	Valid	27	27	41	12	41	12	12	41	41	27
		Missing	14	14	0	29	0	29	29	0	0	14
	Percentiles	25	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		50	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		75	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		80	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		85	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		90	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	65.4000	-60.0000	-60.0000
		95	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	69.9000	-60.0000	-60.0000
		99	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	77.0000	-60.0000	-60.0000
		99.5	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	77.0000	-60.0000	-60.0000
		99.9	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	77.0000	-60.0000	-60.0000
November	N	Valid	29	29	43	14	43	14	14	43	43	29
		Missing	14	14	0	29	0	29	29	0	0	14
	Percentiles	25	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		50	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		75	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000

MONTH		STATISTIC	FONOFOS	MALATHION	METHIDATHION	METOLACHLOR	MOLINATE	NAPROPAM	PEBULATE	SIMAZINE	THIOBENCARB	TRIFLURALIN
		80	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		85	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		90	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		95	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		99	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		99.5	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		99.9	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
December	N	Valid	30	30	45	16	45	16	16	45	45	30
		Missing	15	15	0	29	0	29	29	0	0	15
	Percentiles	25	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		50	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	-82.0000	-60.0000	-60.0000
		75	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	92.5000	-60.0000	-60.0000
		80	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	140.4000	-60.0000	-60.0000
		85	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	155.2000	-60.0000	-60.0000
		90	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	185.0000	-60.0000	-60.0000
		95	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000	-28.0000	-44.0000	249.8000	-60.0000	-60.0000
		99	-24.0000	-45.0000	70.0000	-47.0000	-53.0000	-28.0000	-44.0000	273.0000	-60.0000	-60.0000
		99.5	-24.0000	-45.0000	70.0000	-47.0000	-53.0000	-28.0000	-44.0000	273.0000	-60.0000	-60.0000
		99.9	-24.0000	-45.0000	70.0000	-47.0000	-53.0000	-28.0000	-44.0000	273.0000	-60.0000	-60.0000
		99.9	-24.0000	-45.0000	-63.0000	-47.0000	-53.0000			119.0000	-60.0000	-60.0000

Figure A4-1 Concentrations of **Simazine** in ng/L as measured by USGS (*MacCoy, et.al, 1994*) in the San Joaquin River near Vernalis, California, plotted by sampling date from January 1991 through April 1994. Negative values are below detection limit observations coded as negative numbers.

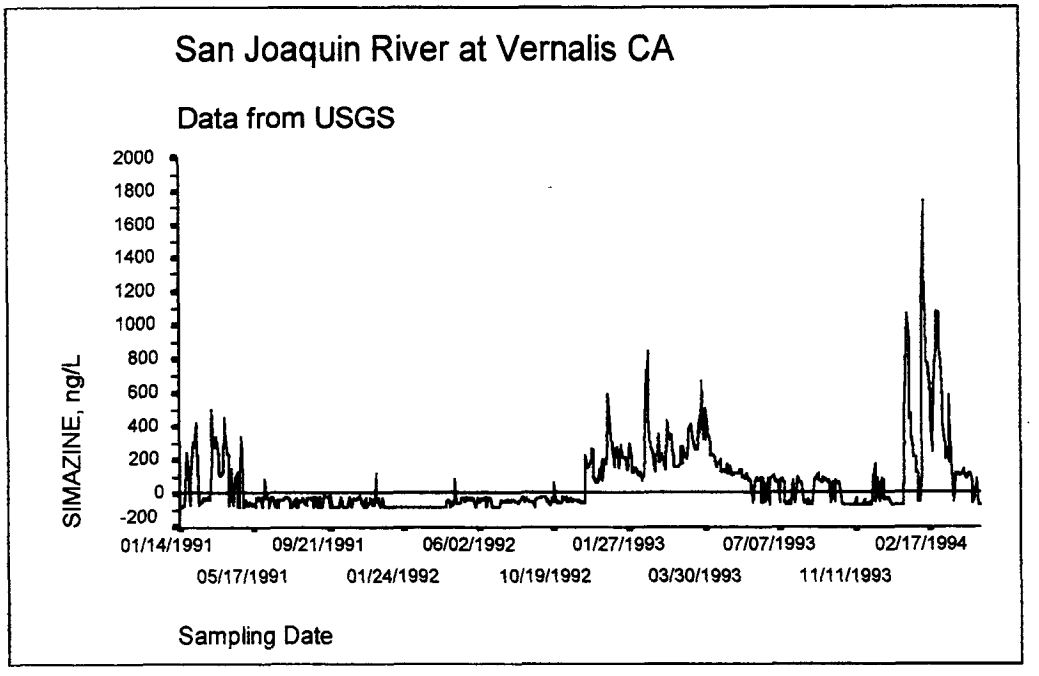


Figure A4-2 Concentrations of **Diazinon** in ng/L as measured by USGS (*MacCoy, et.al, 1994*) in the San Joaquin River near Vernalis, California, plotted by sampling date from January 1991 through April 1994. Negative values are below detection limit observations coded as negative numbers.

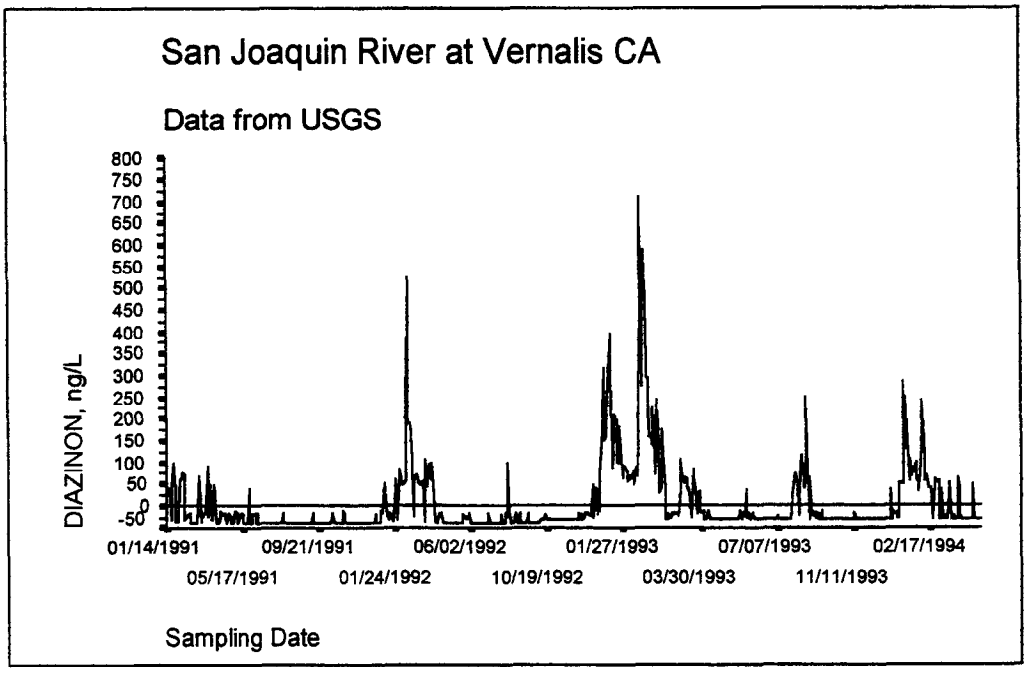


Figure A4-3 Concentrations of **Carbaryl** in ng/L as measured by USGS (*MacCoy, et.al, 1994*) in the San Joaquin River near Vernalis, California, plotted by sampling date from January 1991 through April 1994. Negative values are below detection limit observations coded as negative numbers.

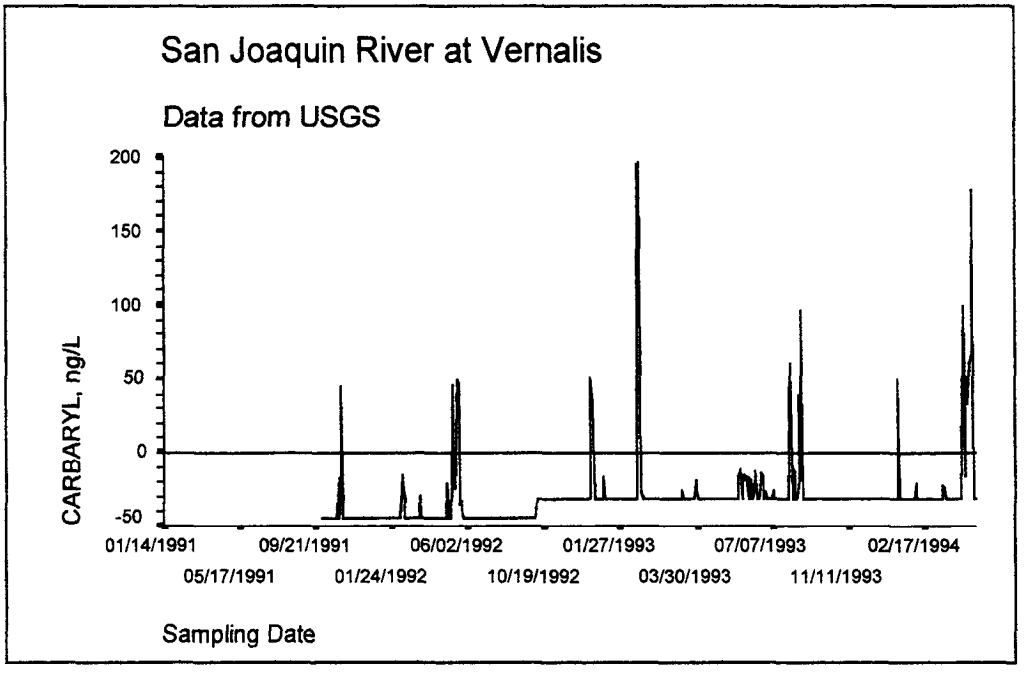


Figure A4-4 Concentrations of **Metolachlor** in ng/L as measured by USGS (*MacCoy, et.al, 1994*) in the San Joaquin River near Vernalis, California, plotted by sampling date from January 1991 through April 1994. Negative values are below detection limit observations coded as negative numbers.

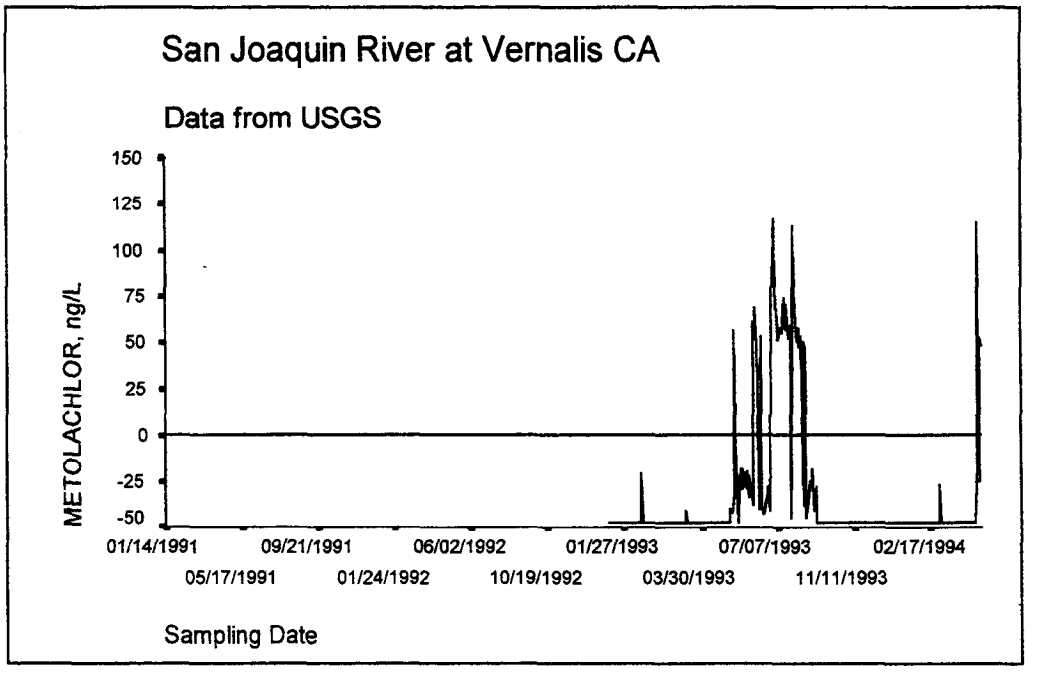


Figure A4-5 Concentrations of **Methidathion** in ng/L as measured by USGS (*MacCoy, et.al, 1994*) in the San Joaquin River near Vernalis, California, plotted by sampling date from January 1991 through April 1994. Negative values are below detection limit observations coded as negative numbers.

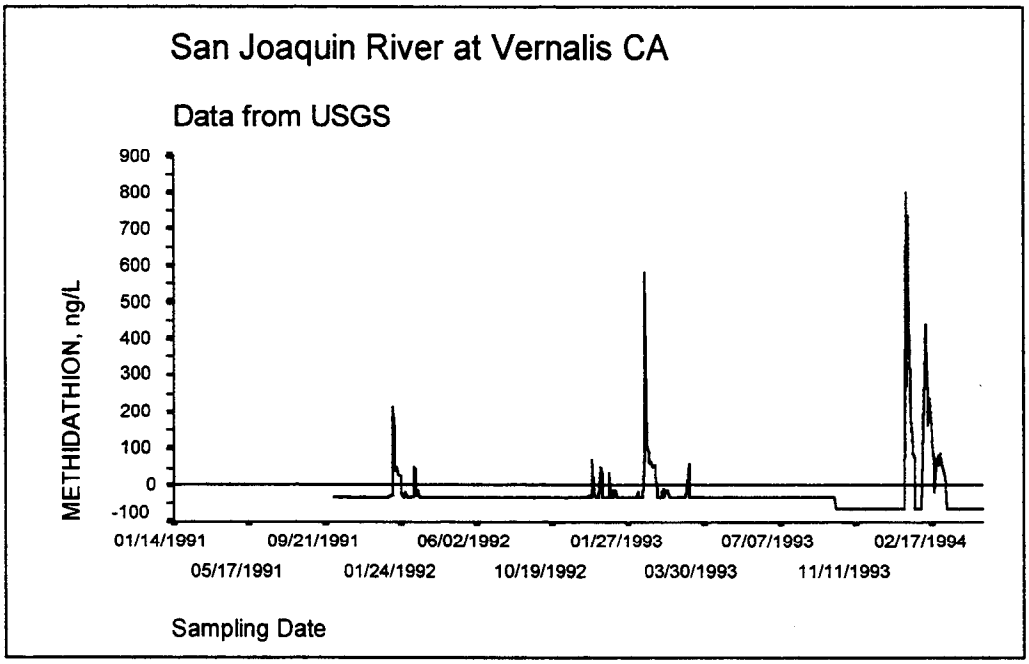


Figure A4-6 Concentrations of **Carbofuran** in ng/L as measured by USGS (*MacCoy, et.al, 1994*) in the San Joaquin River near Vernalis, California, plotted by sampling date from January 1991 through April 1994. Negative values are below detection limit observations coded as negative numbers.

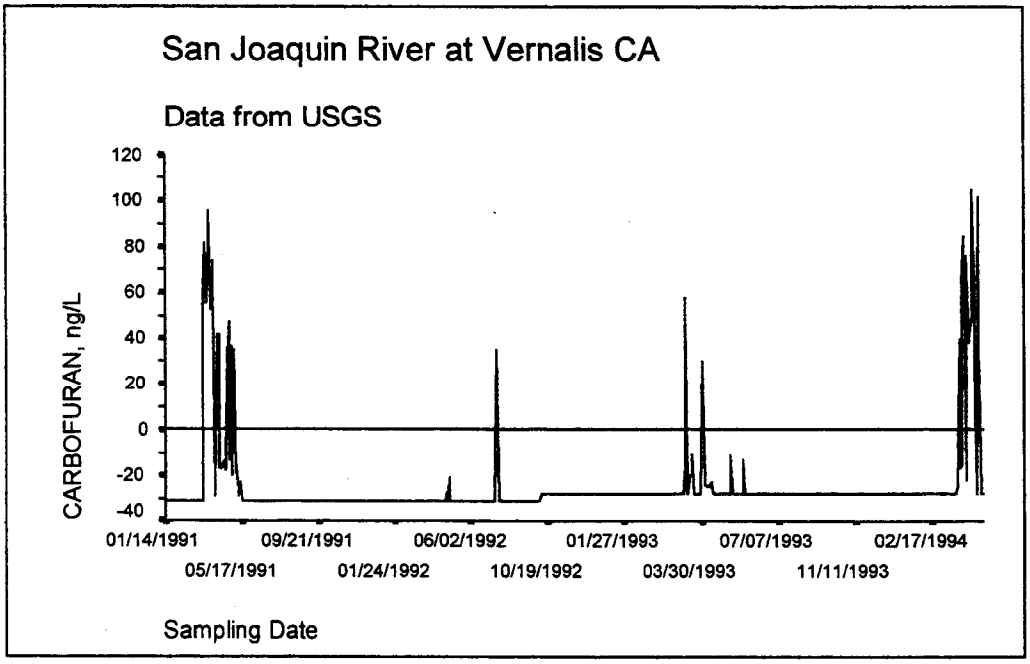


Figure A4-7 Concentrations of **Cyanazine** in ng/L as measured by USGS (*MacCoy, et.al, 1994*) in the San Joaquin River near Vernalis, California, plotted by sampling date from January 1991 through April 1994. Negative values are below detection limit observations coded as negative numbers.

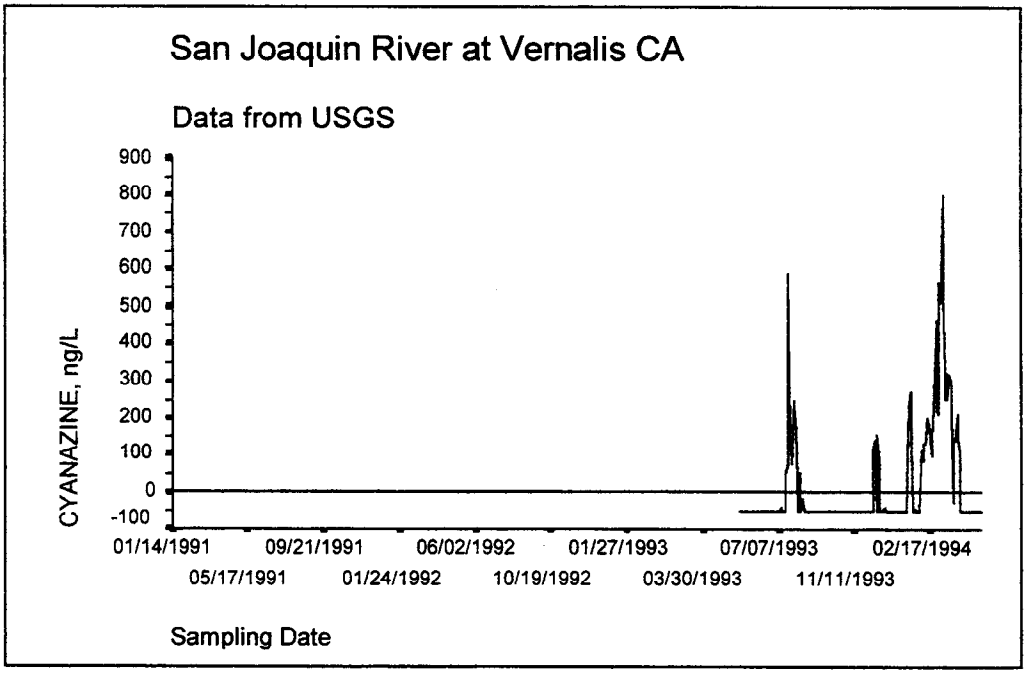


Figure A4-8 Concentrations of **Dacthal** in ng/L as measured by USGS (*MacCoy, et.al, 1994*) in the San Joaquin River near Vernalis, California, plotted by sampling date from January 1991 through April 1994. Negative values are below detection limit observations coded as negative numbers.

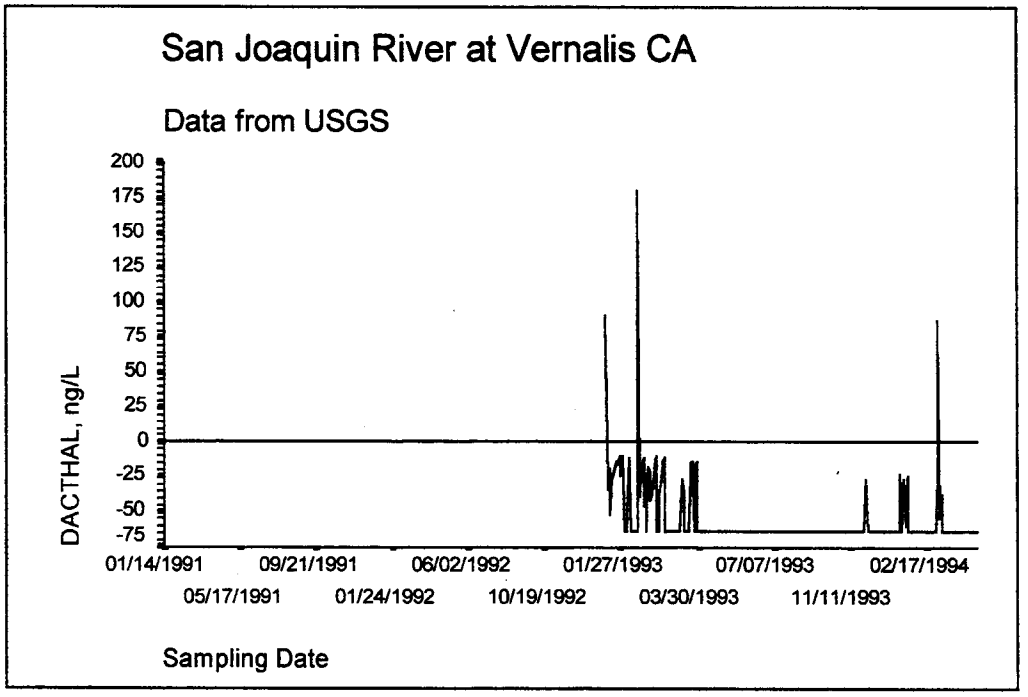
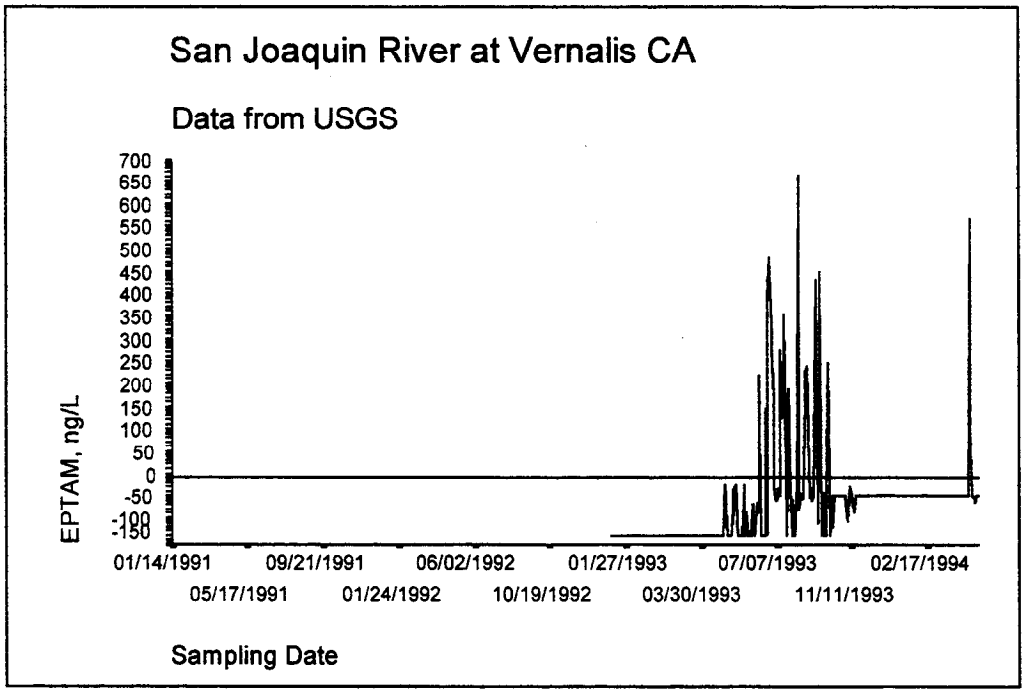


Figure A4-9 Concentrations of **Eptam** in ng/L as measured by USGS (*MacCoy, et.al, 1994*) in the San Joaquin River near Vernalis, California, plotted by sampling date from January 1991 through April 1994. Negative values are below detection limit observations coded as negative numbers.



APPENDIX 5

Analytical Data from the October 1997 Sampling Event

Table A5-1 Major ions data from the October 1997 sampling event. All concentrations are in mg/L unless otherwise noted.

Station	pH, su	CO3	HCO3	SO4	Cl	Ca	Mg	Na	K	sum of ions	TDS	TSS	EC, µS/cm
Site 1	7.31	0	122	80.3	80.9	33.2	16.6	74.7	2.38	410	357	5.76	677
Site 2	7.33	0	119	81.1	80.8	33.4	16.8	74.6	2.89	409	346	5.33	685
Site 3	7.44	0	123	72.7	64.6	32.2	14.9	69.0	2.24	379	335	24.8	631
Site 4	7.30	0	104	81.3	52.1	26.8	14.2	67.8	2.81	349	321	16.4	604
Site 5	7.27	0	107	77.4	57.5	28.4	14.1	66.8	2.40	354	325	39.1	609

Table A5-2 Nutrient data from the October 1997 sampling event. All concentrations are in mg/L unless otherwise noted. "_U" represents unfiltered or total concentrations, "ON" is organic-N, calculated from ammonia and Total Kjeldahl Nitrogen by difference.

STATION	TP_U	OP_U	NO3+NO2_U	NH3_U	ON_U	TOC	DOC
Site 1	.200	.184	1.25	.223	.427	3.80	3.60
Site 2	.200	.186	1.24	.214	.376	3.80	3.60
Site 3	.200	.158	1.71	.114	.496	3.60	3.20
Site 4	1.500	.128	1.28	.082	.308	3.50	3.20
Site 5	.380	.146	1.41	.089	.441	3.60	3.20

Table A5-3 Trace element data from the October 1997 sampling event. All concentrations are in µg/L, exc HG_F) and methylmercury (MEHG_U, MEHG_F) which are expressed in ng/L. "_U" represents "_F" represents filtered or dissolved concentrations. Negative values represent data below the the absolute value representing the LOD). Except for mercury data, all other trace elements w

	Silver		Aluminum		Arsenic		Barium	
STATION	AG_U	AG_F	AL_U	AL_F	AS_U	AS_F	BA_U	BA
Site 1	.0273	.0241	181.00	16.00	2.25	2.11	49.8	49.
Site 2	.0699	.0679	141.00	15.80	2.16	2.14	49.6	47.
Site 3	.0625	.0662	210.00	8.14	2.07	1.81	55.0	49.
Site 4	.0654	.0333	343.00	15.90	2.10	1.80	52.2	44.
Site 5	.0373	.0221	256.00	13.30	2.00	1.89	52.2	47.

	Beryllium		Cadmium		Cobalt		Chromium	
STATION	BE_U	BE_F	CD_U	CD_F	CO_U	CO_F	CR_U	CR_
Site 1	.0024	-.0006	.0125	.0102	.250	.184	2.23	1.57
Site 2	.0089	-.0006	.0123	.0134	.219	.171	1.93	1.93
Site 3	.0154	.0006	.0156	.0098	.274	.114	2.24	1.71
Site 4	.0289	-.0006	.0137	.0117	.325	.099	2.14	1.75
Site 5	.0225	-.0006	.0163	.0119	.300	.106	2.10	1.76

	Copper		Iron		Total Mercury		Methylmercury	
STATION	CU_U	CU_F	FE_U	FE_F	HG_U	HG_F	MEHG_U	MEHG
Site 1	1.68	1.43	176.0	15.8	**1.98**	**.710**	**.0400**	**.0220**
Site 2	1.56	1.37	118.1	12.3	**2.33**	**1.070**	**.0330**	**.0270**
Site 3	1.76	1.24	281.1	10.0	**4.04**	**.920**	**.0680**	**.0140**
Site 4	2.07	1.35	388.5	11.5	**3.93**	**1.050**	**.0470**	**.0120**
Site 5	1.95	1.36	310.3	11.4	**3.74**	**.780**	**.0250**	**.0090**

	Manganese		Molybdenum		Nickel		Lead	
STATION	MN_U	MN_F	MO_U	MO_F	NI_U	NI_F	PB_U	PB_F
Site 1	73.7	59.5	2.96	3.08	.0684	-.0400	.1490	.0173
Site 2	66.9	58.6	2.95	3.00	-.0400	-.0400	.1130	.0195
Site 3	59.8	2.0	2.87	3.03	-.0400	-.0400	.2940	.0107
Site 4	56.2	2.8	2.53	2.54	.4309	-.0400	.3420	.0605
Site 5	55.7	2.3	2.66	2.80	.2811	-.0400	.3280	.0124

	Antimony		Selenium		Strontium		Thallium	
STATION	SB_U	SB_F	SE_U	SE_F	SR_U	SR_F	TL_U	TL_F
Site 1	.1010	.1040	.547	.567	427	439	.0028	.0020
Site 2	.1070	.1070	.511	.555	424	425	.0022	.0019
Site 3	.0848	.0805	.638	.746	376	375	.0026	.0015
Site 4	.0948	.0870	.540	.486	331	309	.0046	.0006
Site 5	.0859	.0857	.743	.651	339	341	.0027	.0012

	Uranium		Vanadium		Zinc	
STATION	U_U	U_F	V_U	V_F	ZN_U	ZN_F
Site 1	9.49	9.66	4.96	4.62	1.250	.680
Site 2	9.47	9.44	4.75	4.58	.988	.666
Site 3	10.30	10.20	3.95	3.26	1.430	.565
Site 4	7.98	7.34	4.54	3.47	1.810	.562
Site 5	8.47	8.49	4.25	3.53	1.550	.540

APPENDIX 6

Statistical and Graphical Summary of TFCF Permanent Hydrolab Probe Data: Hourly Average Values March 1997 through February 1998

Table A6-1 Statistical summary *by month* of March 1997 through February 1998 water quality parameters measured by the In Situ Hydrolab H-20 probe installed at the intake of the TFCF behind the debris boom. *These data summarize hourly average values.*

Month	Statistic	EC, µS/cm	pH, su	T, °C	DO, mg/L	Eh, mV	BATT_V
Mar 1997	N	636	631	631	631	631	188
	Mean	354.8042	8.0587	14.7912	8.9493	609.2998	12.2411
	Median	**331.0000**	**8.0750**	**15.1200**	**8.2650**	**610.0000**	**12.1000**
	Minimum	150.00	7.61	10.41	7.49	551.00	10.35
	Maximum	601.00	8.50	18.46	11.59	647.50	13.69
Apr 1997	N	616	610	607	612	609	193
	Mean	432.0774	7.9568	16.9767	8.7154	588.2781	12.1235
	Median	**378.0000**	**8.3742**	**16.1950**	**8.7700**	**584.0000**	**12.1194**
	Minimum	63.00	6.96	13.66	6.98	512.50	10.30
	Maximum	835.50	9.37	31.07	13.33	655.00	13.67
May 1997	N	314	391	390	391	391	211
	Mean	460.0117	7.4463	20.9509	7.4950	644.5418	12.6436
	Median	**432.5000**	**7.2400**	**21.0733**	**7.4450**	**670.0000**	**12.7531**
	Minimum	276.00	7.07	17.72	5.95	541.50	11.01
	Maximum	599.00	8.54	23.73	10.70	697.00	13.91
June 1997	N	103	125	125	125	125	122
	Mean	332.7751	7.7650	23.1920	7.2685	601.6507	12.6847
	Median	**272.5000**	**7.7500**	**23.3300**	**7.2900**	**599.5000**	**12.7712**
	Minimum	245.00	7.63	11.47	6.07	573.00	10.72
	Maximum	556.00	7.94	24.52	7.99	637.00	13.44
July 1997	N	505	614	612	614	613	607
	Mean	285.1393	7.7675	24.6302	7.2398	633.0495	13.4576
	Median	**251.0000**	**7.8000**	**24.7300**	**7.3250**	**644.0000**	**13.5766**
	Minimum	171.00	7.12	21.94	5.11	551.50	11.29
	Maximum	576.50	8.11	26.37	8.45	691.50	13.93
Aug 1997	N	494	493	493	493	493	493
	Mean	274.5469	7.5484	24.6123	7.0390	616.9669	13.5692
	Median	**248.0000**	**7.5300**	**24.5900**	**7.0000**	**608.0000**	**13.6006**
	Minimum	115.50	7.10	12.45	5.83	541.50	11.04
	Maximum	594.00	8.25	26.76	8.23	671.00	13.92
Sept 1997	N	403	402	401	402	402	400
	Mean	337.6278	-28.8538	22.8112	7.2213	507.3483	13.1266
	Median	**313.0000**	**8.4475**	**22.6550**	**7.5375**	**503.5000**	**12.9511**
	Minimum	4.00	-9999.00	.00	3.82	459.00	11.00
	Maximum	571.00	8.99	28.73	9.53	659.00	13.84
Oct 1997	N	743	743	742	743	743	735
	Mean	462.2069	7.0488	17.9678	9.7447	603.1006	13.7206
	Median	**461.5000**	**7.0750**	**17.5950**	**9.8800**	**598.0000**	**13.7296**
	Minimum	10.00	6.53	8.10	8.27	519.00	13.42
	Maximum	645.50	7.93	22.55	11.54	672.00	14.05
Nov 1997	N	715	713	711	713	712	709
	Mean	532.4240	7.3552	14.8956	9.8095	682.2156	13.8328
	Median	**500.0000**	**7.3750**	**14.3000**	**9.8400**	**683.5000**	**13.8485**
	Minimum	275.00	6.77	6.41	8.68	643.50	13.34
	Maximum	784.00	7.71	17.66	11.15	716.50	14.10

Month	Statistic	EC, µS/cm	pH, su	T, °C	DO, mg/L	Eh, mV	BATT_V
Dec 1997	N	674	645	635	653	643	686
	Mean	664.2814	7.4603	9.4174	10.7023	578.8292	13.9743
	Median	**623.0000**	**7.4600**	**9.3300**	**10.4300**	**569.0000**	**13.9642**
	Minimum	391.00	7.21	.00	9.02	531.50	12.60
	Maximum	984.00	7.84	12.71	12.61	688.00	14.30
Jan 98	N	707	698	687	701	694	703
	Mean	481.7270	7.5917	9.9346	9.8066	555.4765	13.9358
	Median	**437.5000**	**7.7200**	**10.1850**	**9.6250**	**555.0000**	**13.9302**
	Minimum	243.00	6.51	4.00	7.65	512.50	13.60
	Maximum	979.00	7.99	12.29	11.92	616.00	14.22
Feb 98	N	106	105	105	105	105	105
(incomplete)	Mean	385.5377	7.8506	10.9572	9.2380	607.4571	13.9259
	Median	**382.2500**	**7.8500**	**10.9750**	**9.4900**	**609.0000**	**13.9245**
	Minimum	234.00	7.70	10.65	7.52	586.00	13.78
	Maximum	607.00	7.99	11.24	10.13	625.50	14.08
Total	**N**	**6016**	**6170**	**6139**	**6183**	**6161**	**5152**
	Mean	**438.7461**	**5.2073**	**17.0942**	**8.8478**	**604.0321**	**13.5293**
	Median	**421.5000**	**7.6000**	**16.9450**	**8.9300**	**597.0000**	**13.7420**
	Minimum	**4.00**	**-9999.00**	**.00**	**3.82**	**459.00**	**10.30**
	Maximum	**984.00**	**9.37**	**31.07**	**13.33**	**716.50**	**14.30**

Figure A6-1 Plot of hourly average conductivity measured March through May 1997 by the *in situ* Hydrolab probe at the TFCF.

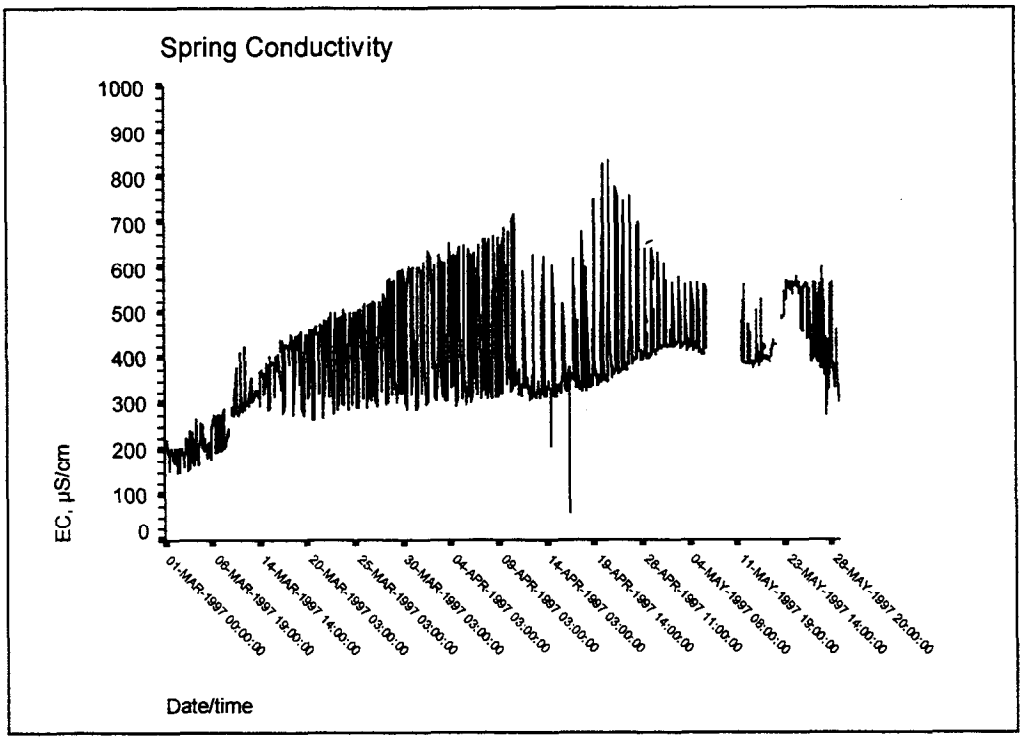


Figure A6-2 Plot of hourly average dissolved oxygen measured March through May 1997 by the *in situ* Hydrolab probe at the TFCF.

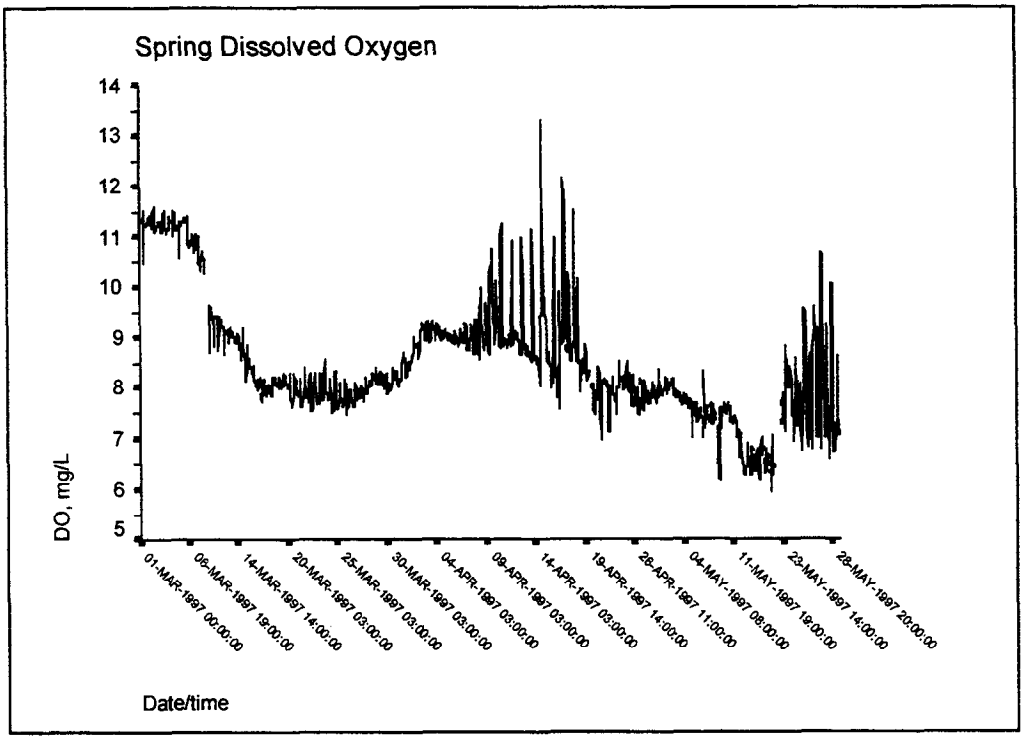


Figure A6-3 Plot of hourly average probe depth (showing daily tidal fluctuations) measured March through May 1997 by the *in situ* Hydrolab probe at the TFCF.

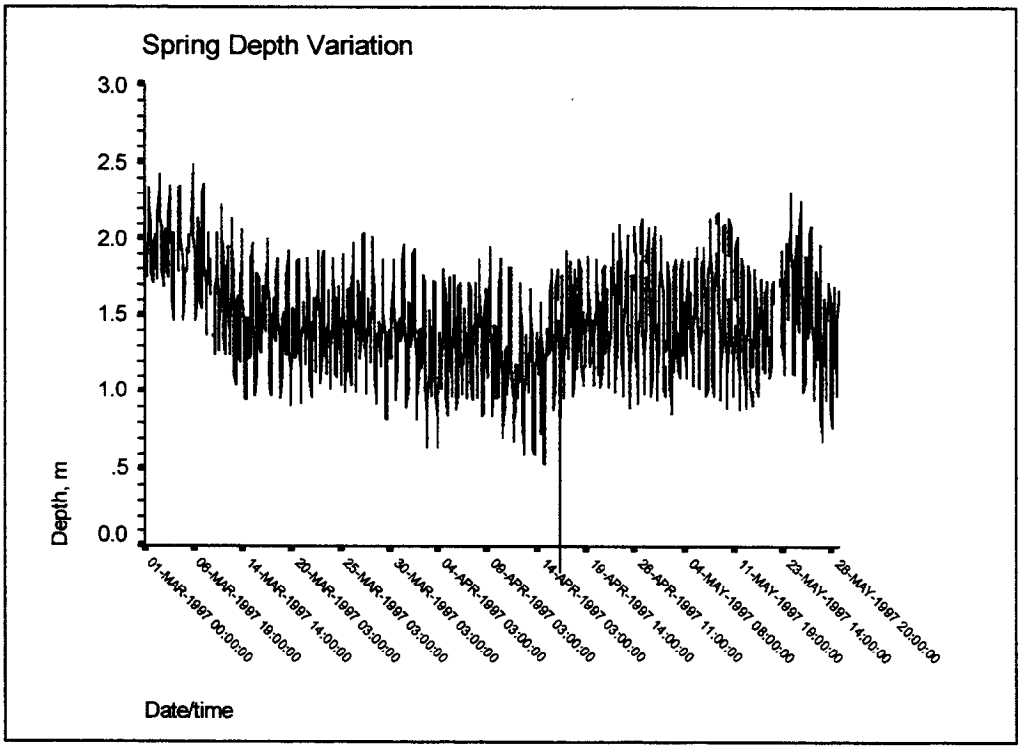


Figure A6-4 Plot of hourly average pH measured March through May 1997 by the *in situ* Hydrolab probe at the TFCF.

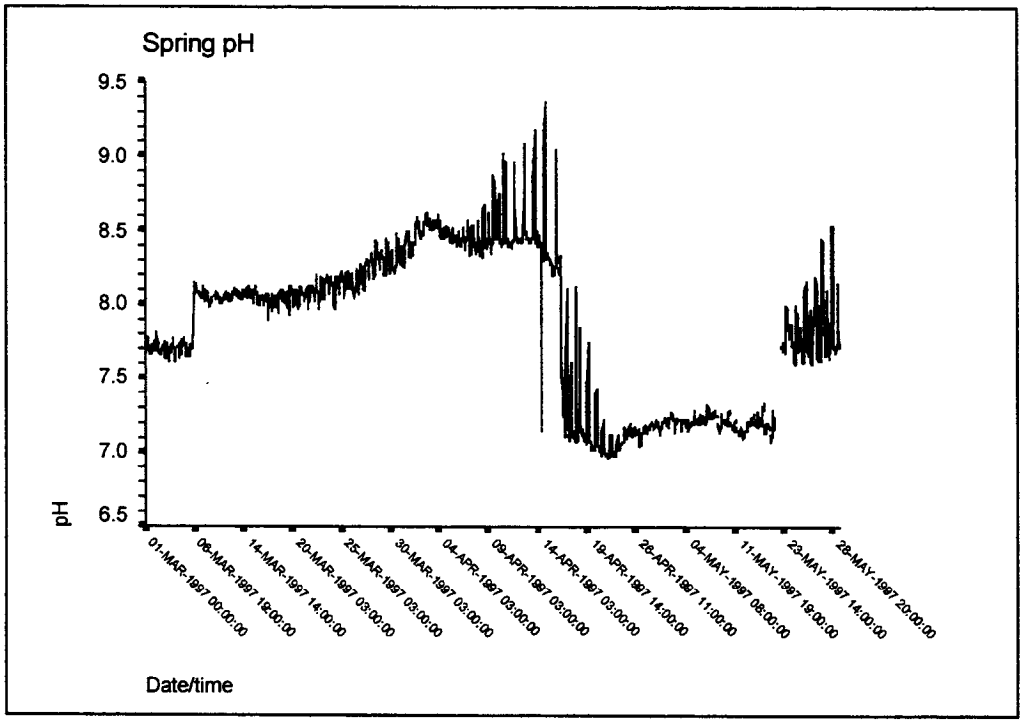


Figure A6-5 Plot of hourly average temperature measured March through May 1997 by the *in situ* Hydrolab probe at the TFCF.

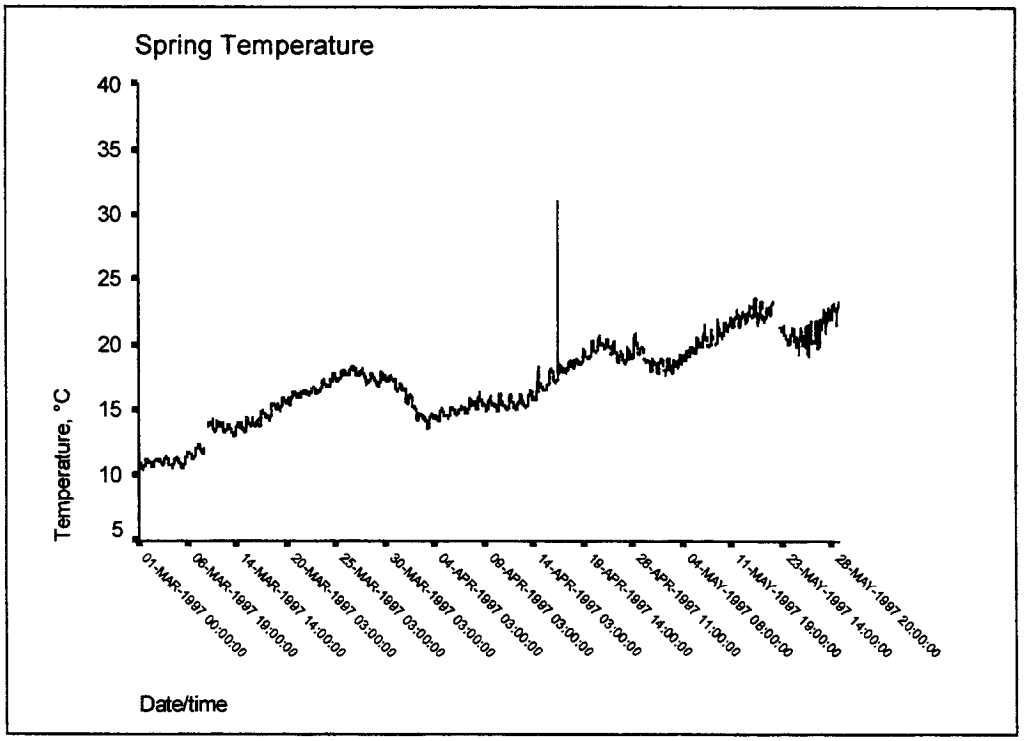


Figure A6-6 Plot of hourly conductivity measured June through August 1997 by the *in situ* Hydrolab probe at the TFCF.

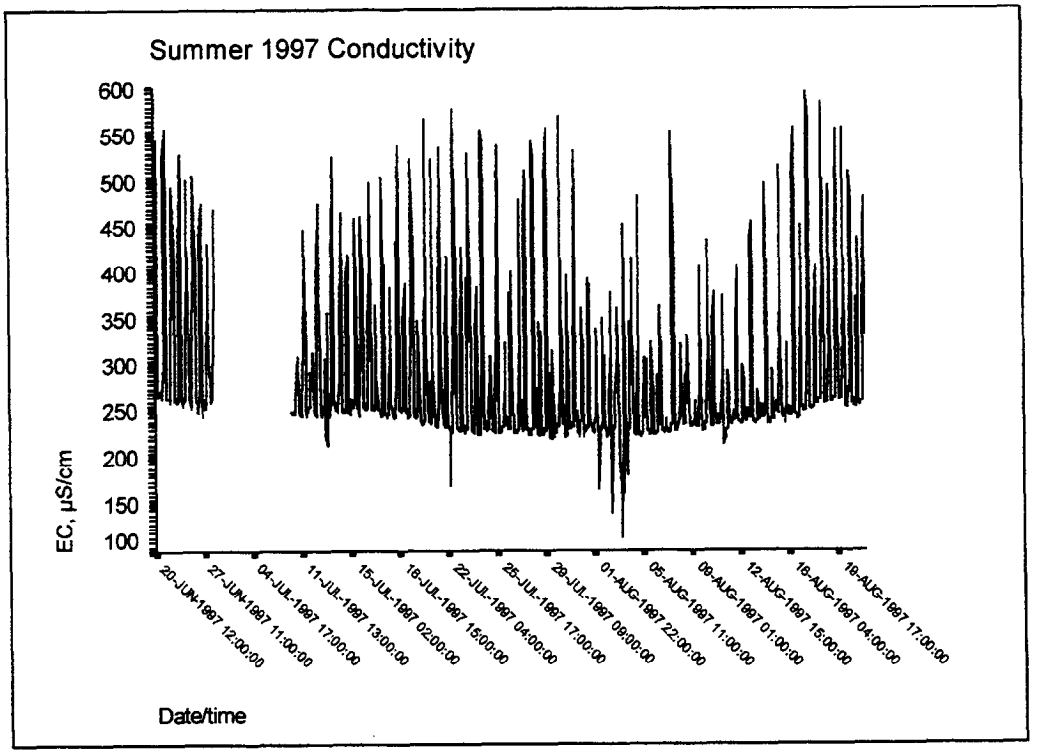


Figure A6-7 Plot of hourly average dissolved oxygen measured June through August 1997 by the *in situ* Hydrolab probe at the TFCF.

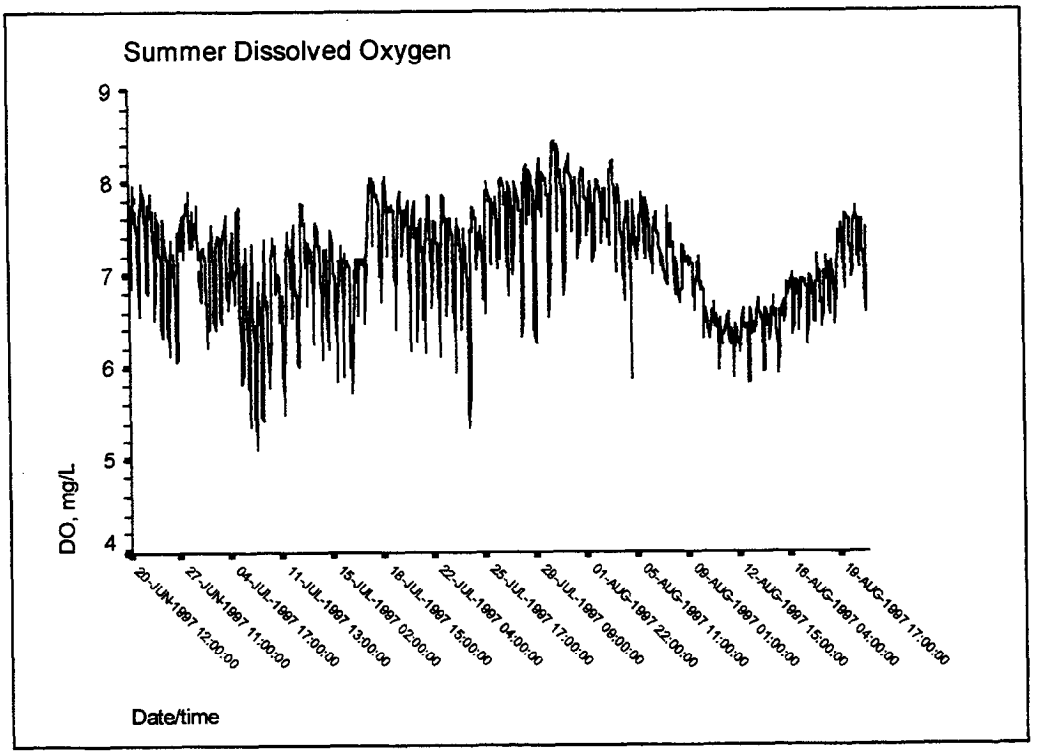


Figure A6-8 Plot of hourly average probe depth (showing daily tidal fluctuations) measured June through August 1997 by the *in situ* Hydrolab probe at the TFCF.

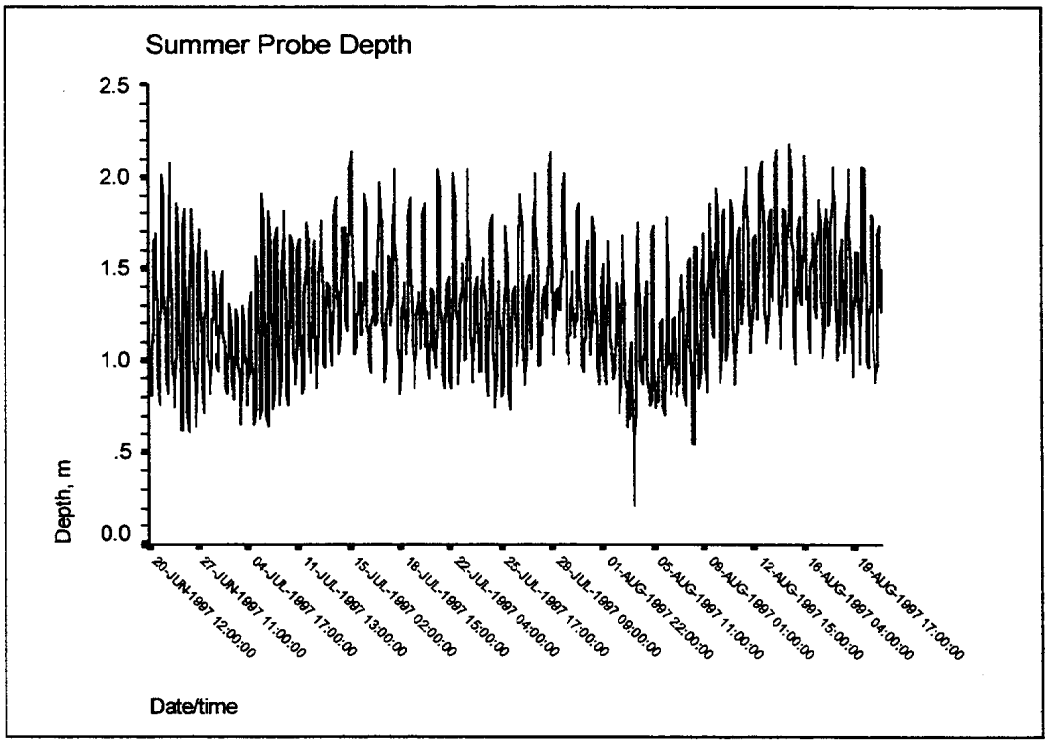


Figure A6-9 Plot of hourly average pH measured June through August 1997 by the *in situ* Hydrolab probe at the TFCF.

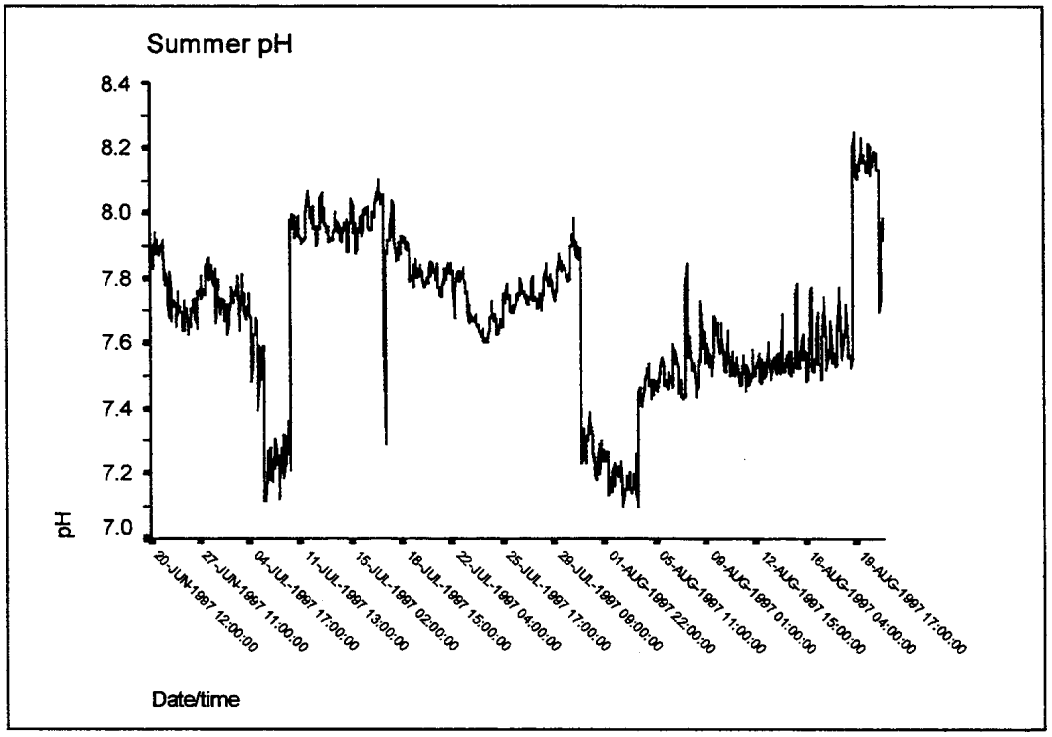


Figure A6-10 Plot of hourly average temperature measured June through August 1997 by the *in situ* Hydrolab probe at the TFCF.