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Revision 0

Calendar Year 2004 Annual Summary Report for the 100-HR-3, 100-KR-4, and 100-NR-2 Operable Unit Pump-and-Treat Operations

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

United States Department of Energy
P.O. Box 550
Richland, Washington 99352

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TERMS

bgs	below ground surface
BHI	Bechtel Hanford, Inc.
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COC	contaminant of concern
CY	calendar year
DOE	U.S. Department of Energy
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FH	Fluor Hanford, Inc.
FY	fiscal year
HEIS	Hanford Environmental Information System
ISRM	In Situ Redox Manipulation
IX	ion exchange
LWDF	Liquid Waste Disposal Facility
MCL	maximum contaminant level
MR3	MR3 Systems, Inc.
OU	operable unit
PNNL	Pacific Northwest National Laboratory
QC	quality control
RAO	remedial action objective
ROD	Record of Decision
RPD	relative percent difference
SAP	sampling and analysis plan
TPH	total petroleum hydrocarbons

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METRIC CONVERSION CHART

Into Metric Units			**Out of Metric Units**		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerel	millibecquerels	0.027	picocuries

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1.0 INTRODUCTION

Fluor Hanford, Inc. (FH) is currently operating six groundwater pump-and-treat systems across the Hanford Site. Four systems address groundwater in the 100 Areas: the 100-HR-3 Operable Unit (OU) system, which is treating hexavalent chromium at three sites (100-D and 100-H Areas); the 100-KR-4 OU system, which is also treating hexavalent chromium; and the 100-NR-2 OU system, which is treating strontium-90. A treatability test for a new pump-and-treat system, the 189 L/min DR-5 system developed by MR3 Systems, Inc. (MR3), was added in the 100-D Area in calendar year 2004 (CY04). Two pump-and-treat systems are remediating groundwater in the 200 West Area: the 200-UP-1 OU system, which is treating technetium-99, uranium, carbon tetrachloride, and nitrate; and the 200-ZP-1 OU system, which is treating carbon tetrachloride, chloroform, and trichloroethene.

This annual summary report discusses the groundwater remedial actions in the 100 Areas, including interim remedial actions at the 100-HR-3, 100-KR-4, and 100-NR-2 OUs (Figure 1-1). A detailed description of the progress and performance of the In Situ Redox Manipulation (ISRM) barrier is reported separately in another annual summary report (DOE-RL 2005b [pending issuance]).

The interim remedial actions chosen for the 100-HR-3 and 100-KR-4 OUs are pump-and-treat systems that use an ion-exchange (IX) medium for contaminant removal. The systems were designed to achieve three remedial action objectives (RAOs), as well as specific operational and aquifer performance criteria described in the interim remedial action Record of Decision (ROD), *Declaration of the Record of Decision for the 100-HR-3 and 100-KR-4 Operable Units at the Hanford Site (Interim Remedial Actions)* (EPA et al. 1996). The three RAOs are identified as follows:

- **RAO #1:** Protect aquatic receptors in the river bottom substrate from contaminants in groundwater entering the Columbia River.
- **RAO #2:** Protect human health by preventing exposure to contaminants in the groundwater.
- **RAO #3:** Provide information that will lead to a final remedy.

The *Interim Remedial Action Record of Decision (ROD) Declaration, USDOE Hanford 100 Area, 100-NR-1, and 100-NR-2 Operable Units, Hanford Site* (EPA et al. 1999) specifies the selected remedy and activities for the 100-NR-2 OU. Some of these remedial activities are ongoing actions, such as the pump-and-treat operation specified in the *Action Memorandum: N-Springs Expedited Response Action Cleanup Plan, U.S. Department of Energy Hanford Site, Richland, Washington* (Ecology and EPA 1994). The 100-NR-2 RAOs are summarized as follows:

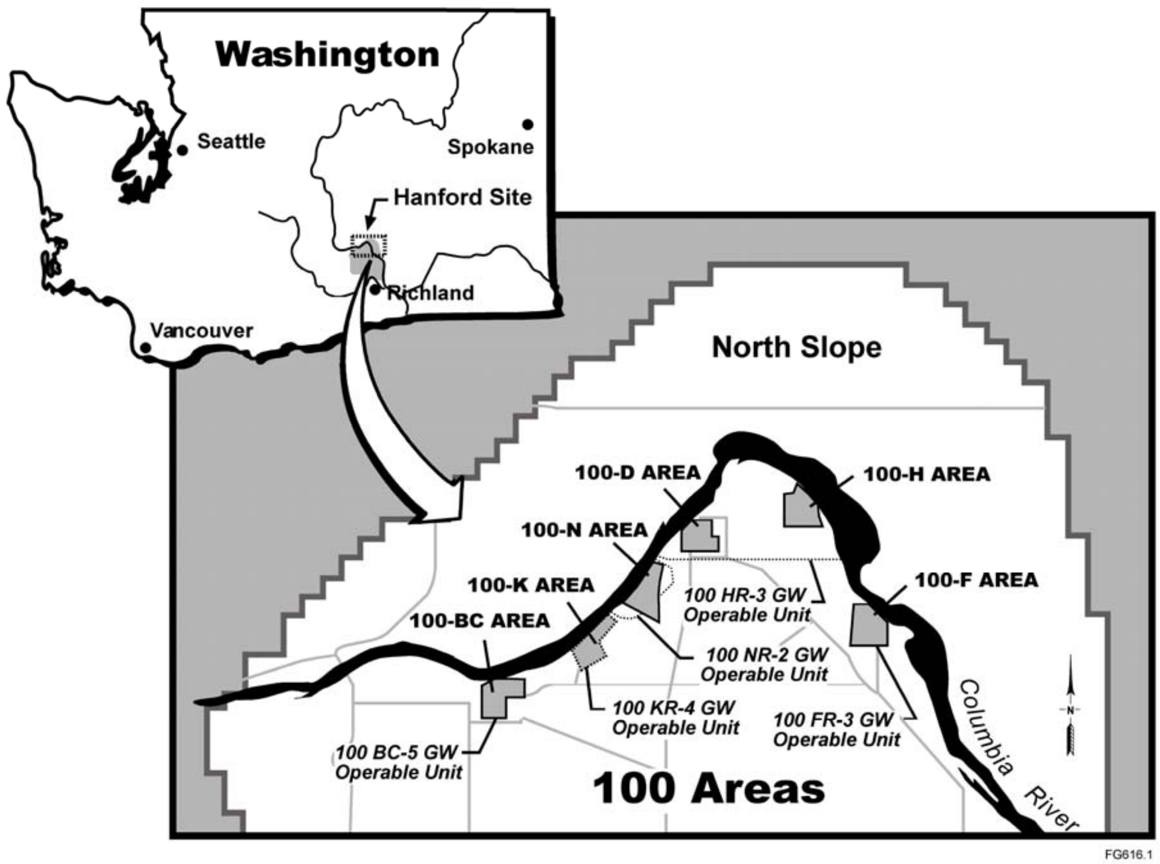
- **RAO #1:** Maintain beneficial uses of the Columbia River and protect the aquifer by reducing contaminant concentrations in the 100-NR-2 groundwater.
- **RAO #2:** Evaluate commercially available treatment options for strontium-90.
- **RAO #3:** Provide data necessary to set demonstrable strontium-90 cleanup standards.

This report discusses progress toward the RAOs in the respective conclusion section for each OU.

This report is organized into three major sections, each presenting the annual summary and performance evaluation for the three respective OUs. Section 2.0 discusses the 100-HR-3 OU, Section 3.0 discusses the 100-KR-4 OU, and Section 4.0 discusses the 100-NR-2 OU. An evaluation of costs is presented in Section 5.0, and the references cited in this report are included as Section 6.0.

This report provides a summary of major CY04 activities, major trends, and significant differences between 2003 and 2004 for each OU. An updated conceptual model is also presented for the 100-NR-2 OU. Additional supporting information is included in Appendices A through M.

Figure 1-1. Location of 100 Area Groundwater Operable Units.



2.0 100-HR-3 OPERABLE UNIT PUMP-AND-TREAT SYSTEM

The 100-HR-3 pump-and-treat facility is located in the north-central part of the Hanford Site along the Columbia River. The 100-HR-3 OU represents the groundwater underlying the source OUs that are associated with the 100-D and 100-H Reactor areas and the adjacent 600 Area (Figure 2-1). Groundwater extraction systems were installed at the 100-D and 100-H Reactor areas in June 1997, with a common treatment facility in a surplus building located near H Reactor. A stand-alone pump-and-treat system, DR-5, was installed in 2004 to treat a new source located in the central portion of the 100-D Area.

Monitoring and extraction well locations for the 100-D Area are shown in Figure 2-2, and the 100-H Area well locations are shown in Figure 2-3. Appendix A provides a history of operations and supporting documents used in the development of the 100-HR-3 pump-and-treat system. Site conceptual models are presented in Appendix B

This section provides the CY04 annual summary report for pump-and-treat operations in the 100-HR-3 OU, as required by the *Remedial Design Report and Remedial Action Work Plan for the 100-HR-3 and 100-KR-4 Groundwater Operable Units Interim Action* (DOE-RL 1996b). Section 2.1 briefly summarizes activities within the OU potentially impacting activities associated with the pump-and-treat system. Section 2.2 summarizes the treatment system's performance. Sections 2.3 and 2.4 review hydraulic conditions, provide capture zone analysis through numerical modeling, and evaluate the contaminant concentrations for the 100-D and 100-H Areas. Section 2.5 discusses quality control (QC) results for groundwater samples. Sections 2.6 and 2.7 provide conclusions and recommendations for the pump-and-treat system. Cost information is presented separately in Section 5.0.

2.1 SUMMARY OF ASSOCIATED ACTIVITIES

A summary of remedial actions for the 100-HR-3 OU and associated contaminant source control activities are discussed in the following subsections.

2.1.1 100-D/DR Area

Multiple leaks and spills of sodium dichromate stock solution (hexavalent chromium) occurred in the 100-D Area during the reactor's operating years (1944 to 1969). Continuing movement of residual soil contamination from these sources is assumed to account for the widely distributed and persistent groundwater contamination beneath much of the 100-D Area. Efforts have been underway since 1997 to reduce releases to the river using a pump-and-treat system and a permeable reactive barrier (which was completed in 2003). In October 2003, an area of elevated hexavalent chromium contamination moved into this area, where concentrations previously had been low. Accordingly, a coordinated effort was initiated in the fall of 2003 that included (1) source identification/removal (Bechtel Hanford, Inc. [BHI]), (2) elimination of artificial recharge as a potential driving force, and (3) groundwater remediation/containment to reduce releases to the river.

Progress in the 100-D/DR Area during 2004 included the following activities:

- Leakage from an extensive network of pressurized water lines is believed to be a potential driving force for transport of soil contaminants to the groundwater. These water lines run through suspect dichromate spill sites in the 100-D Areas. This potential driving force for chromium contamination in the vadose zone was significantly reduced in CY04 by capping all of the water lines and sealing about 75% of those that may have leaked. The remaining water lines will be eliminated after demolition and removal of existing buildings.
- There were renewed efforts to locate and remove soil contamination in fiscal year 2004 (FY04). BHI excavated more than 20 test pits along suspected spill sites southeast of the 182-D reservoir. Dichromate stock solution was offloaded from railroad tank cars in this area and then transferred through buried pipelines. The test pits were sampled with depth, down to 4.6 m below grade and analyzed for soluble or leachable hexavalent chromium. No significant soil contamination was identified with this extended soil survey. Either the source(s) are deeper than 4.6 m below ground surface (bgs) or very localized sources exist but have not yet been discovered.
- Groundwater remedial actions are focused on three separate areas: (1) the northeast sector (the original pump-and-treat), (2) a new "hot spot" pump-and-treat system in the central portion of the 100-D Area, and (3) the southwest sector where a 660-m-long permeable reactive barrier is in place (this is known as the ISRM barrier).

  Activities during 2004 in these areas included the following:

  - Operation of the initial pump-and-treat system. This system continues to contain the chromium plume in the northeastern sector where salmon spawning beds are known to be located off the shoreline.

    Over 164 million L of groundwater were extracted from the 100-D Area during 2004 and treated in the 100-H treatment plant. Average 100-D influent concentration was 193.5 μg/L, and a mass of over 31 kg of chromium was removed. Since startup, over 200 kg, or approximately one-third of the estimated mass in 100-D groundwater (DOE-RL 1997a), have been removed. Average removal efficiency was 95.2%, and the system operated 99.1% of the available run-time.

  - Startup of the new DR-5 pump-and-treat system. This system became operational in late July 2004 and was installed to address chromium-contaminated groundwater that passes the ISRM barrier to the northeast. The pump-and-treat approach was selected instead of extending the ISRM barrier because of unresolved ISRM barrier performance issues. The direction to construct the new pump-and-treat system is specified in *Direction to Implement the Requirements Under the 100-KR-4 Records of Decision (ROD) for the 100-D Area Chromium Plume* (DOE-RL 2004b).

    The new pump-and-treat plant consists of a self-contained, modular IX treatment system that receives groundwater from three extraction wells (199-D5-20, 199-D5-32, and 199-D5-37) (Figure 2-2). These wells are located on the downgradient edge of the plume. One injection well (199-D5-42) returns the treated groundwater to the aquifer. The treatment plant is housed in the 186-D Building, and contains four IX vessels (a lead, lag, polish, and standby vessel). Additional tanks are used to store and mix chemicals for onsite regeneration of the IX medium.

Over 20 million L of water were treated in the first 6 months of CY04, removing 19 kg of chromium. Average influent concentrations were near 958 µg/L, with a removal efficiency of over 99%. Plans for CY05 include expansion of the treatment plant's capacity to accommodate additional extraction wells. Even with the small initial test unit, it is anticipated that more chromium will be removed per year than by the existing 100-HR-3 (100-D and 100-H) extraction/treatment systems. This new pump-and-treat system more than doubles the chromium removal rate from 100-D groundwater.

The new self-contained system at 100-D was designed and constructed by MR3 and uses their HCR-48 IX medium to capture the chromium. The advantage of the MR3 system is that considerable potential cost savings are achieved because no spent resins are shipped offsite for regeneration. The MR3 medium is regenerated in-place by periodically treating the IX columns with a reducing agent and acid. The waste stream from the regeneration process contains trivalent chromium hydroxide, which is converted to a solid cake. The cake is stored at the treatment plant site until it is shipped to the Environmental Restoration Disposal Facility (ERDF) for disposal.

– The ISRM was installed to address the chromium plume in the southwestern portion of the 100-D Area. Installation and treatment of the last of 66 injection wells was completed in 2003. While most of the barrier has functioned as planned, the northeastern end has exhibited a premature decrease in reduction capacity. Two expert panel reviews were held in 2004 to identify possible causes of loss in reductive capacity and to identify possible mitigative actions. Additional details concerning the status of these activities are available in *Fiscal Year 2004 Annual Summary Report for the In Situ REDOX Manipulation Operations* (DOE-RL 2005b [pending issuance]).

- Upgrades to the performance monitoring system continued in CY04. Several new wells were installed, including 199-D8-73, 199-D8-88, and 199-D5-92 (Figure 2-2). In CY05, well 199-D5-92 will replace well 199-D5-37 as an extraction well because of the low production rate in the latter well (11 L/min). In addition, in CY05 monitoring well 199-D5-39 will be converted to an extraction well. This well is located in the center of the high-concentration area and would support acceleration of remediation for the DR-5 system.
- Aquifer tubes were installed at five new locations from December 2003 through January 2004. The sites where placed along the 100-D Area bench, downstream of the D/DR Reactor pump house. The highest shoreline concentration observed in aquifer tubes in CY04 was 360 µg/L in the central shoreline region. The new DR-5 pump-and-treat system was installed to intercept the plume in this area.

2.1.2 100-H Area

A pump-and-treat system has been operating since 1997 to contain and remove hexavalent chromium in the 100-H Area groundwater. The moderate contaminant concentrations in this area are believed to be related to (1) past leakage from a solar evaporator basin that was used to concentrate wastewater (it has since been demolished), and (2) related to the loss of sodium dichromate-laden reactor coolant water during operations from 1949 to 1965. The steady decline in groundwater chromium concentrations since the start of pump-and-treat operations indicates little or no continuing soil sources. Based on the decline in hexavalent chromium concentrations, the RAO in this OU may be achievable in the near future. The status of the pump-and-treat system's operations, system improvements, and related OU activities for CY04 is as follows:

- The 100-HR-3 IX system was modified to include a sacrificial IX resin column. Previously, natural uranium built up on the lead IX resin column, required that the resin be disposed as a mixed waste at the ERDF rather then regenerated. To avoid the frequent expense of mixed waste disposal and the purchase of new resin, the treatment train's manifold piping was modified to allow the lead vessel to function as a uranium-removal column, thereby protecting the remaining three columns for chromium removal. The remaining three vessels continue to rotate through the normal lead/lag/polish operating line-up. This design modification, instituted in March 2004 at both 100-KR-4 and 100-HR-3, has led to a combined cost savings estimated at $500,000 for CY04, compared to CY03 expenditures for replacing lost resin.
- The extraction and injection well network was reconfigured near the end of December 2004. The purpose of these changes was (1) to accelerate the capture and treatment of a smaller remaining portion of the 100-H plume near the river that is above the RAO of 22 μg/L; and (2) to increase the capture zone efficiency in areas that were previously identified using groundwater modeling. To accomplish this objective, monitoring and compliance wells 199-H4-64 and 199-H4-4 were converted to extraction wells (Figure 2-3); existing extraction well 199-H3-2A was converted to an injection well; and former monitoring well 199-H4-18 was converted to a new injection well. Former injection wells 199-H3-4 and 199-H3-5, located southwest of the reactor building, were scheduled to be taken out of service in January 2005. Injection well 199-H3-3 will continue as an injection well. Field work on this project was completed in January 2005. Figure 2-3 presents the well configuration as described above.

2.2 100-HR-3 OPERABLE UNIT TREATMENT SYSTEM PERFORMANCE

This section describes the 100-HR-3 pump-and-treat system's operation and related sampling activities. Information presented includes system availability, changes to system configuration, mass of contaminants removed during operations, contaminant removal efficiencies, quantity and quality of extracted and disposed groundwater, waste generation, and short-term contaminant comparisons. Additional operational details are found in the identified appendices.

2.2.1 System Modification/Operation

As described in Section 2.1, a new pump-and-treat system has been installed in the 100-D Area. A water leak at the 182-D reservoir created a groundwater mound beneath the reservoir and in the surrounding area. The mound allowed the plume to partially bypass the current pump-and-treat system to the northeast and the ISRM barrier to the northwest. A decision was made to install a freestanding pump-and-treat system, specifically located to capture this plume. Three monitoring wells were installed to help bound the plume, with the additional intention to use these wells as extraction wells. Subsequently, wells 199-D5-20, 199-D5-32, and 199-D5-37 were converted to extraction wells.

To treat the extracted groundwater, an innovative IX system was selected, designed, and constructed for the pump-and-treat system. This system, manufactured by MR3, uses an HCR-48 resin for removing hexavalent chromium. While capital costs are higher initially, this system is expected to reduce treatment costs by eliminating offsite resin regeneration costs.

The MR3 system consists of four, 946-L-capacity resin columns, as well as associated piping, filter banks, equalization tanks, manifolds, and process logic control systems. The installed system is capable of processing up to 189 L/min of groundwater. Groundwater flows through three columns in a lead/lag/polish configuration, with a forth vessel held in standby. Additional equipment includes components for onsite regeneration of the resin, storage of process chemicals, and transfer of liquids internally and to the injection wells.

The new pump-and-treat system began operating the end of July 2004. Through the end of CY04, over 20 million L of groundwater have been treated. Influent concentrations of hexavalent chromium have averaged 958 µg/L, while treated effluent has averaged 2.2 µg/L. In a couple of instances, the effluent concentrations have been as high as 20 µg/L and 100 µg/L, initiating shutdown of the pump-and-treat system. These high concentrations occurred while making operational adjustments and changes using this new technology.

Production rates at extraction well 199-D5-37 have been very low. Well 199-D5-37 only produces 11 L/min, whereas the overall system production rate has been 141 L/min. It appears that well 199-D5-37 is completed in a portion of the aquifer where the hydraulic conductivity is extremely low. To increase the rate of remediation and widen the zone of capture, monitoring well 199-D5-92 will replace 199-D5-37 as an extraction well in FY05. This change will still maintain capture in the area of well 199-D5-37 but will increase the rate of contaminant mass removal.

Other current monitoring wells will be converted to extraction wells in FY05 to capture the high-concentration area of the plume. These additions should accelerate remediation and more effectively reduce risk. Wells that may be converted include 199-D5-39 and 199-D5-43. Figure 2-4 and 2-5 provide system schematics, detailing the current configuration for the 100-D and DR-5 pump-and-treat systems.

A summary of operational parameters and total system performance for the 100-HR-3 pump-and-treat in CY04 are presented below. The new DR-5 pump-and-treat system data are not included in the operational parameters presented below:

Total processed groundwater (million L)[a]:		
	CY04	**Since 1997 Startup**
100-D Area	164.2	1,199.3
100-H Area	153.5	1,066.7
Total	**317.7**	**2,266**
Total mass of hexavalent chromium removed (kg)[a]:		
	CY04	**Since 1997 Startup**
100-D Area	30.1	199.0
100-H Area	3.5	38.6
Total	**33.6**	**237.6**

2004 operational parameters [a]**:**	
Removal efficiency (% by mass)	95.2
Waste generation (m^3)[b]	81.6
Low-level radioactive waste generation (m^3)	NA
Regenerated resin installed (m^3)	40.8
New resin installed (m^3)	40.8
Number of resin changeouts	36
2004 system availability [a]**:**	
Total possible run-time (hours)	8,784
Scheduled downtime (hours)	73
Planned operations (hours)	8,711
Unscheduled downtime (hours)	1
Total time on-line (hours)	8,710
Total availability (%)	99.1
Scheduled system availability (%)	99.9

[a] Does not include system parameters for the new DR-5 pump-and-treat system.
[b] Each IX vessel contains 2.3 m^3 of IX resin.
NA = not available

The operational and system highlights for CY04 discussed below pertain to the existing 100-D pump-and-treat and do not include the operational parameters for the new DR-5 system:

- A combined total of 317.7 million L of groundwater was processed in CY04, which is less than the 416.6 million L processed in CY03. The smaller volume of processed water resulted in a total of 33.6 kg of hexavalent chromium being recovered in CY04 compared to 43 kg in CY03. This decrease may be attributed to lower extraction/injection well efficiency due to well losses associated with scaling (calcium carbonate) or biological fouling.
- The average removal efficiency for CY04 was 95.2%, which is an increase from the 93.8% reported in CY03 (Figure 2-6).
- The 100-D Area influent hexavalent chromium concentration average of 193.5 µg/L in CY04 was slightly higher than the CY03 average of 174.5 µg/L.
- The average CY04 hexavalent chromium concentration of 23.5 µg/L for 100-H Area influent was slightly lower than the 27.9 µg/L reported in CY03. Trend plots of CY04 influent and effluent concentrations are presented in Figure 2-7.
- With the exception of one sampling event in mid-April, effluent concentrations were consistently below the maximum allowable concentration of 50 µg/L for the CY04 reporting period.
- Scheduled system availability for CY04 was 99.9%, which is slightly higher than the scheduled availability reported in CY03. The total availability for CY04 was 99.1%, which is higher than the 97.8% on-line availability reported for CY03. The monthly on-line percentages and method used to calculate scheduled and on-line availability are presented in Figure 2-8.

During CY04, 36 spent IX vessels were changed out. The resin changeouts were performed based on a calculated maximum operating time. The purpose of the limits was to reduce the amount of resin requiring regeneration by maximizing its operational life and limiting the possibility of saturating the resin with uranium and creating a low-level radioactive waste that could not be shipped offsite for reprocessing. The time limits are area-dependent because of the different chemical/radiological characteristics of native groundwater at each well. For the 100-D and 100-H Areas, the time limits are approximately 120 and 90 days, respectively. These time limits were not implemented until late in CY02.

During CY04, the vessels that were changed out yielded 81.6 m^3 of spent resin, which was approximately the same as the 80.5 m^3 reported in CY03. Due to the changes described above to accommodate uranium accumulation, no resin was disposed at the ERDF in CY04.

Historical presentation of operational parameters, total system performance, and extraction well chromium concentration and extraction rates are included in Appendix C.

2.3 AQUIFER RESPONSE IN THE 100-D AREA

This section describes the general hydrogeologic conditions in the 100-D Area, the numerical modeling conducted to evaluate the extraction well network, and the changes in contaminant concentrations in monitoring wells.

2.3.1 Hydrogeologic Conditions at the 100-D Area

The hydrogeologic conditions at the 100-D Area are summarized below:

- The prevalent groundwater flow directions are north and northwest, as shown in Figure 2-9. During some spring and summer months, the river elevation is generally higher due to increased run-off and to provide more irrigation water and aid fish migration. This creates a near-shore, short-term groundwater flow reversal from northwest to southeast that is clearly shown in Figure 2-10, when the June and August 2004 river elevations are higher than near-river wells.
- The maximum river stage was 0.152 m lower in CY04 than in CY03; similarly, the minimum Columbia River stage was 0.178 m lower in CY04. Overall, the average Columbia River stage was 0.084 m lower in CY04 than in CY03.
- In 2004, the hydraulic gradient in the area around the original 100-D pump-and-treat system had an average gradient of 0.0005, a maximum gradient of 0.00216, and a net flow direction of 304 degrees azimuth.
- The estimated maximum groundwater flow velocity around the original 100-D pump-and-treat system was 0.16 m/day. This was based on a hydraulic conductivity of 15.2 m/day, an effective porosity of 0.2, with the gradient of 0.00216 derived from a three-point solution of hourly data at wells 199-D8-55, 199-D8-69, and 199-D8-70.
- A typical gradient for November 2004 is calculated from head contours shown Figure 2-9. The distance between monitoring wells 199-D5-39 and 199-D5-36 is 380 m, which is then divided by 0.25 m to give a gradient value of 0.00066.

- The average 2004 extraction well pumping rates ranged from a low of 61.3 L/min in well 199-D8-53 to a high of 120.8 L/min in well 199-D8-68. This continued a downward trend from 84.8 and 185.9 L/min in 2003, and 109.8 and 125.3 L/min in 2002. In support of the new DR-5 pump-and-treat system, three new extraction wells (199-D5-20, 199-D5-32, and 199-D5-37) and one new injection well (199-D5-42) were added to the central portion of the 100-D Area. The largest extraction rate was 110 L/m in well 199-D5-32 (see Appendix D for additional information).
- In 2003, leakage from the 182-D reservoir created a groundwater mound increasing the hydraulic gradient around the reservoir. This resulted in the displacement of the chromium plume radially away from the reservoir and the mixing of groundwater with raw water from the reservoir. In 2004, measures were taken to reduce and eliminate this leakage. These measures included changes to the physical plant and the administrative measure of limiting the reservoir level to no more than 2.4 m. The reservoir and residual mound were monitored by new monitoring wells that were installed for the ISRM barrier project. From the water elevation data collected at these stations, it is apparent that the mound is decaying and that the leakage has been mitigated (Figure 2-11). Appendix D presents a detailed discussion of the aquifer response in 100-HR-3. Appendix E presents hydrographs for 100-D Area wells.

2.3.2 Numerical Modeling and Field Validation of Zone of Influence

A summary of the numerical modeling results supporting the 100-HR-3 pump-and-treat system in the 100-D Area is as follows:

- The hexavalent chromium pump-and-treat plume (from the D and DR Reactors, north to the Columbia River) is within the capture zone of the existing extraction well network, as shown in Figure 2-12.
- A portion of the hexavalent chromium plume north of the 182-D reservoir is located outside the capture zone of the existing extraction well network (Figure 2-12). This portion of the plume is not intercepted by the existing ISRM treatment zone. The DR-5 treatment system has been installed to capture this segment of the plume. A detailed discussion of the numerical model is presented in Appendix F. Table 2-1 presents a comparison of the measured and modeled water table elevations, as well as the average flow rates used in the numerical model.
- Figure 2-12 shows time markers spaced 1 year apart on the flow lines, based on the high November steady-state velocities. The fastest flow lines run from the new injection well, 199-D5-42, to near extraction well 199-5-32, which takes slightly more than 1 year of time for a pore velocity of about 2.2 m/day (800 m/365 days). The slower velocities are less than 1 m/day. This time-velocity snapshot in November is expected to have the largest velocities during the year. The effective porosity was set to a low value of 0.1, which also increases the calculated pore velocities.

2.3.3 Contaminant Monitoring in the 100-D Area

This section summarizes and interprets the analytical results obtained from groundwater wells and aquifer sampling tubes included in the interim remedial action and OU monitoring programs in the 100-D Area. *Interim Action Monitoring Plan for the 100-HR-3 and 100-KR-4 Operable Unit* (DOE-RL 1997b) and *Sampling Changes to the 100-HR-3 and 100-KR-4 Operable Unit* (DOE-RL 1998) define the sampling protocols implemented for CY04. The results presented below are the average annual concentrations for CY04, unless otherwise specified. Data are stored in the Hanford Environmental Information System (HEIS) database.

The principal contaminant of concern (COC) in the 100-D Area is hexavalent chromium. The RAO for reduction of chromium concentration is 22 µg/L at the compliance wells. Strontium-90, tritium, and nitrate are co-contaminants that are actively monitored but are not present in concentrations that exceed ecological risk criteria. In addition, sulfate is a contaminant of interest because it exceeds secondary drinking water standards in a limited number of wells. Institutional controls, implemented to satisfy an RAO, limit human exposure to hexavalent chromium and the co-contaminants.

Section 2.3.3.1 discusses the results of chromium monitoring, and Section 2.3.3.2 discusses the results of co-contaminant monitoring. The discussion of sampling results for the sections presented below exclude the results from those wells within and downgradient of the ISRM barrier. The locations of the monitoring wells and aquifer sampling tubes are shown in Figure 2-2.

The CY04 highlights, using only filtered hexavalent chromium data, are as follows:

- For 2004, average chromium concentrations decreased or were stable in three of four extraction wells and two compliance wells when compared to 2003 average concentrations; however, concentrations continued to remain above the RAO in both the extraction and compliance wells. Average chromium concentrations in CY04 decreased in extraction well 199-D8-54A to 47 µg/L. This was the largest decline in an extraction well for CY04 and represented a 65% decline from the average 2003 concentration of 134.7 µg/L. The largest average chromium concentration in a compliance well was 110.1 µg/L in well 199-D8-70.
- Four of the monitoring wells sampled in CY04 had increasing chromium concentrations. The largest percentage change (120%) was observed in well 199-D5-41, which increased from 976 µg/L in CY03 to 2,150 µg/L.
- Strontium-90 and tritium concentrations were less than the maximum contaminant levels (MCLs) in all 100-D Area samples collected during CY04.

2.3.3.1 100-D Area Chromium Monitoring Results

Chromium decreased in three of four extraction wells, with the largest decrease occurring in well 199-D8-54A. The compliance wells and extraction well 199-D8-72 remained stable for 2004, comparable to the findings reported in 2003 (see table below):

Well	Type	2003[a] Cr (µg/L)	2004[a] Cr (µg/L)	Percent Change[b]
199-D8-53	Extraction	124	76	-38
199-D8-54A	Extraction	134.7[a]	47	-65
199-D8-68	Extraction	118.7	84.5[a]	-29
199-D8-69	Compliance	69.5	69.5	0
199-D8-70	Compliance	125.6	110.1	-12
199-D8-72	Extraction	533	492.7	-8

[a] Average value.
[b] Percent change = (2003 - 2004) / 2003 x 100%. >+20% = increasing and <-20% = decreasing. Stable = -20% to +20%.

Chromium concentrations continued to increase significantly northwest of D Reactor and north of the 182-D reservoir. This area includes the wells presented in the table below, which, with the exception of well 199-D5-44, are located within the high-concentration portion of the northern chromium plume (Figure 2-9). The increase in chromium concentrations in well 199-D5-44, while small, represents a change from an historic trend of nondetectable values. The remaining monitoring wells all had stable to decreasing chromium values when comparing 2004 and 2003 results. The following table presents data for those wells in which chromium concentrations increased more than 20% in CY04 (changes less than 20% are considered stable):

Well	Type	2003[a] Cr (µg/L)	2004[a] Cr (µg/L)	Percent Change[b]
199-D5-15	Monitoring	281.5	559	+99
199-D5-20[c]	Monitoring/ Extraction	846	1,380[d]	+63
199-D5-41	Monitoring	976	2,150	+120
199-D5-44	Monitoring	4.4(U)	8	+82

[a] Average value.
[b] Percent change = (2003 - 2004) / 2003 x 100%. >+20% = increasing and <-20% = decreasing. Stable = -20% to +20%.
[c] Monitoring well converted to extraction well in July 2004.
[d] Value prior to conversion to an extraction well.
(U) = below quantitation limit

Figure 2-9 displays the fall 2004 100-D Area chromium plume generated from samples collected in November and December 2004. The values displayed include filtered total chromium and hexavalent chromium concentrations.

Aquifer sampling tubes located downgradient of the 100-D pump-and-treat system were sampled during March and November 2004. The highest hexavalent chromium values were measured at the aquifer tubes Redox 3-3.3 (223 µg/L) and Redox 3-3.4 (233 µg/L). Aquifer tubes DD-43-3 and DD-44-3 were also above 200 µg/L, with concentrations measured at 206.7 and 222 µg/L, respectively.

In comparison to samples collected at locations in 2003, only aquifer sampling tube DD-17-2 had an increased concentration, while sampling tubes DD-06-03, DD-10-4, and DD-15-3 all had decreasing hexavalent chromium concentrations.

2.3.3.2 100-D Area Co-Contaminant Monitoring Results

The 100-D Area co-contaminants are strontium-90, tritium, and nitrate (DOE-RL 1997b). Sulfate is a constituent of interest.

- None of the samples collected during 2004 or 2003 contained strontium-90 above the 8 pCi/L MCL. The highest 2004 average stronitium-90 concentration was 5 pCi/L in extraction well 199-D8-53.
- None of the samples collected in 2004 contained tritium above the 20,000 pCi/L MCL and, when compared to CY03 values, were either stable or decreasing. The highest 2004 average tritium concentration was 15,000 pCi/L in monitoring well 199-D5-18.
- The highest concentrations of nitrate were detected in samples located around the D and DR Reactors, and south and west of the 182-D reservoir. Nitrate was detected above the 45 mg/L MCL in 11 of 31 wells during 2004. The highest 2004 average nitrate concentration was 70.8 mg/L in well 199-D5-16.
- Sulfate was not detected at or above the 250 mg/L secondary MCL in any of the 29 wells sampled during 2004. The maximum concentration detected during 2004 sampling was 166 mg/L in well 199-D4-22. Sulfate above the 250 mg/L MCL was measured in aquifer tubes D-39-2 and D-41-2, located downgradient of the ISRM barrier.

Appendix G presents sample results for CY04 as well as a historical summary of contaminant and co-contaminant monitoring results for wells and aquifer tubes. Associated contaminant trend charts are presented in Appendix H.

2.4 AQUIFER RESPONSE IN THE 100-H AREA

2.4.1 Hydrogeologic Conditions at the 100-H Area

The hydrogeologic conditions in the 100-H Area are summarized below:

- The most prevalent groundwater flow direction is northeast, as shown in Figure 2-13. During the spring months, the river elevation is generally higher due to increased run-off and to provide more irrigation water and aid fish migration. This creates a near-shore short-term groundwater flow reversal from northeast to southwest that clearly shown in Figure 2-14, where the mid-April, May, and June 2004 river elevations are higher than near-river wells.
- The maximum river stage was 0.152 m lower in FY04 than in FY03; similarly, the minimum Columbia River stage was 0.178 m lower in FY04. Overall, the average Columbia River stage was 0.084 m lower in FY04 than in FY03.
- The maximum hydraulic gradient in the 100-H Area was 0.003 toward the northeast and the average hydraulic gradient is 0.002.
- The net groundwater flow velocity for 2004 over the 100-H Area was 0.006 m/day based on a hydraulic conductivity of 15.2 m/day and a porosity of 0.2. The hydraulic gradient was derived from a three-point solution of hourly water-level data from wells 199-H5-1A, 199-H4-10, and 199-H4-63.

- The average 2004 extraction well pumping rates ranged from 28.4 L/min in well 199-H4-12A to 91.6 L/min in well 199-H4-12A. This compares to a range of 32.2 to 107.5 L/min in 2003 and 41.6 to 88.6 L/min in 2002. Appendix D presents a detailed discussion of aquifer response at 100-HR-3. Appendix E presents hydrographs for 100-H Area wells.

2.4.2 Numerical Modeling

A summary of the numerical modeling results supporting the 100-HR-3 pump-and-treat system in the 100-H Area follows:

- The original 100-H hexavalent chromium pump-and-treat plume has been greatly reduced in area. Most of the remainder of the plume is within the capture zone of the existing extraction well network, as shown in Figure 2-15.
- The model shows an apparent gap in the capture zone between extraction wells 199-H4-12A and 199-H4-11 (Figure 2-15). This gap is largely because of insufficient saturated Hanford formation thickness in the area of extraction well 199-H4-65. This situation results in low flow rates and discontinuous operation of the well. Extraction well 199-H4-65 was modeled with a zero extraction rate because it was down during most of the second half of 2004. A detailed discussion of the numerical model is presented in Appendix F. Table 2-1 presents a comparison of the measured and modeled water table elevations, and the average flow rates used in the numerical model.

  Figure 2-15 shows time markers spaced 180 days apart on the flow lines, based on the high November steady-state velocities. The fastest flow lines are the high conductivity region in the southernmost part of Figure 2-15, where the pore velocities are as high as 6 m/day (1,100 m/180 days) from injection well 199-H3-5 to past monitoring well 199-H6-1. The pore velocities are as low as 1.7 m/day (approximately 300 m/180 days) upgradient from extraction well 199-H4-11. The November velocities are expected to be the highest velocities during the year. The effective porosity was set to a low value of 0.1, which also increases the calculated pore velocities.

2.4.3 Contaminant Monitoring in the 100-H Area

This section summarizes and interprets the analytical results obtained from groundwater monitoring wells and aquifer sampling tubes supporting the 100-H Area pump-and-treat remedial action and the 100-HR-3 OU monitoring program. The *Interim Action Monitoring Plan for the 100-HR-3 and 100-KR-4 Operable Units* (DOE-RL 1997b) and the *Sampling Changes to the 100-HR-3 and 100-KR-4 Operable Unit* (DOE-RL 1998) define the sampling protocols implemented for CY04. The results presented below are the average annual concentrations for CY04, unless otherwise specified. Section 2.4.3.1 includes a discussion of chromium monitoring results. The RAO for chromium concentrations is 22 μg/L at the compliance wells. Section 2.4.3.2 includes a discussion of the monitoring results for the remedial action co-contaminants strontium-90, tritium, nitrate, technetium-99, and uranium.

The CY04 highlights are as follows:

- The 2004 average chromium concentrations were below the RAO of 22 μg/L in all but two extraction wells. Decreases in chromium were observed in extraction wells 199-H4-7, 199-H4-11, 199-H4-12A, and 199-H4-15A when compared to CY03 sampling results.

- Chromium concentrations remained above the RAO of 22 µg/L in all four of the compliance wells. The maximum 2004 compliance well average chromium concentration was 55.1 µg/L in well 199-H4-5. Other compliance well concentrations ranged from 43.7 to 54.7 µg/L chromium.
- The highest chromium concentrations were again downgradient of the former 183-H solar evaporation basins at monitoring well 199-H4-3. The average concentration for this well was 65 µg/L in CY04 compared to 75 µg/L in CY03.
- Fewer well samples were characterized by co-contaminant concentrations that were above MCLs compared to 2003.

2.4.3.1 100-H Area Chromium Monitoring Results

Chromium trends in CY04 were stable to decreasing in four of five extraction wells. Extraction well 199-H4-7 had the largest percent change, followed by wells 199-H4-11, 199-H4-12A, and 199-H4-15A. Extraction wells 199-H4-12A and 199-H4-15A exceeded the RAO with an average annual chromium concentration of 39 µg/L and 40 µg/L, respectively. Well 199-H3-2A was the only extraction well that did not show a significant change in concentration. The four compliance wells were all stable for CY04. Decreases in chromium concentrations were observed at seven monitoring wells in CY04. Chromium concentrations generally remained stable for the remaining monitoring wells located within the plume, while wells outside the plume continue to display decreasing concentration. Figure 2-13 illustrates the 100-H chromium plume and associated historical chromium trends for 2004. The table below summarizes the changes in chromium concentrations from 2003 to 2004 in 100-H extraction wells, compliance wells, and monitoring wells with chromium above 22 µg/L or changes greater than 20%:

Well	Type	2003[a] Cr (µg/L)	2004[a] Cr (µg/L)	Percent Change[b]
199-H4-7	Extraction	33.2	15	-55
199-H4-11	Extraction	33	21.5	-35
199-H4-12A	Extraction	54.9	39	-29
199-H4-15A	Extraction	56.3	40	-29
199-H4-4	Compliance	37.1	43.7	18
199-H4-5	Compliance	67.2	55.1	-18
199-H4-63	Compliance	45.2	48.7	-8
199-H4-64	Compliance	51.9	54.7	+5
199-H4-12B	Monitoring	56.3	55.4	-2
199-H4-14	Monitoring	64.8	39.8	-39
199-H4-3	Monitoring	70	65	-7
199-H4-8	Monitoring	26.5	16	-40
199-H4-13	Monitoring	21.5	23	-7
199-H4-15B	Monitoring	40	36	-10
199-H4-15CS	Monitoring	107	87	-19
199-H4-16	Monitoring	9.5	6	-37
199-H4-17	Monitoring	22	22	0

Well	Type	2003[a] Cr (µg/L)	2004[a] Cr (µg/L)	Percent Change[b]
199-H4-18	Monitoring	19.5	13	-33
199-H4-46	Monitoring	12	8	-33
199-H4-48	Monitoring	11	6.49	-41
199-H4-49	Monitoring	9	6.5	-28

[a] Average concentration.
[b] (2004 - 2003) / 2003 x 100%. >+20% = increasing and <-20% = decreasing. Stable = -20% to +20%.

The CY04 results include filtered, total chromium, and hexavalent chromium concentrations.

Aquifer tubes were sampled downgradient of the 100-H pump-and-treat system during March and November 2004. Aquifer sampling tubes 51-D and 51-M, located south of the 100-H Area, had the highest measured values of hexavalent chromium at 48.2 and 40.5 µg/L, respectively.

In comparison to results from CY03, only aquifer tube 50-S showed an increasing trend in chromium concentration. Tubes 47-D, 49-S, and 50-M had decreasing concentrations of hexavalent chromium, while hexavalent chromium concentrations in aquifer tubes 48-M, 48-S, 49-M, and 50-S remained stable.

2.4.3.2 100-H Area Co-Contaminant Monitoring Results

The 100-H Area co-contaminants are strontium-90, technetium-99, uranium, tritium, and nitrate (DOE-RL 1997b). Further discussion on these co-contaminants is provided below:

- **Strontium-90:** Two wells sampled in 2004 were above the 8 pCi/L MCL; in 2002, five wells were above the 8 pCi/L MCL. The two wells above the strontium-90 MCL (results presented in the table below) are located downgradient of the former 107-H retention basin and the former 116-H-1 liquid waste disposal trench. Both of these facilities were excavated in 1999 through 2000 and were backfilled in 2001. The remaining wells had stable to decreasing values of strontium-90. None of the aquifer tubes measured for strontium-90 exceeded the 8 pCi/L MCL.

Well	Type	2003[a] Sr-90 (pCi/L)	2004[a] Sr-90 (pCi/L)	Percent Change[b]
199-H4-63	Compliance	24.6	38.8	+58
199-H6-11	Monitoring	25.6	15	-41.3

[a] Average concentration.
[b] (2004 – 2003) / 2003 x 100%. >+20% = increasing and <-20% = decreasing. Stable = -20% to +20%.

- **Technetium-99:** All wells and aquifer tubes sampled in CY04 were below the 900 pCi/L MCL. The highest concentration of technetium-99 was measured in well 199-H4-3, with an average concentration of 694 pCi/L, which represents a significant increase from the 48 pCi/L reported in CY03. Well 199-H4-4 had an increase from 65.5 pCi/L in CY03 to 200 pCi/L in CY04. In 2002, well 199-H4-9 contained technetium-99 at 986 pCi/L, which is the only time the well was above the MCL. The 2003 sample result for this well was 169 pCi/L of technetium-99 and has increased to 315 pCi/L in 2004.

- **Uranium:** With the exception of well 199-H4-3, all wells sampled in 2004 were below the 30 µg/L MCL. Monitoring well 199-H4-3, which is located downgradient of the former 183-H solar evaporation basins, was characterized by 93.5 µg/L total uranium in 2004, an increase from the 54.3 µg/L in 2003.
- **Tritium:** All wells analyzed for tritium in CY04 were below the 20,000 pCi/L MCL. The highest average tritium concentration was 5,160 pCi/L in well 699-97-43, which is upgradient of the 100-H Area. Compliance well 199-H4-63 yielded a concentration of 1,630 pCi/L in 2004, which is an increase from the 388 pCi/L reported in 2003. All remaining wells displayed stable to decreasing concentrations for the year.
- **Nitrate:** Of the wells sampled for nitrate in 2004, three results were above the 45 mg/L MCL. Wells exceeding the MCL are located downgradient of the former 183-H solar evaporation basins, which is a possible source; however, nitrate is a widespread contaminant in the 100 Area. The table below summarizes nitrate concentrations in 100-H wells that are above the 45 mg/L MCL:

Well	Type	2003[a] NO_3 (mg/L)	2004[a] NO_3 (mg/L)	Percent Change[b]
199-H4-3	Monitoring	192	240	+25
199-H4-4	Compliance	35	92	+163
199-H4-9	Monitoring	112	130	+16

[a] Average concentration.
[b] (2004 – 2003) / 2003 x 100%. >+20% = increasing and <-20% = decreasing. Stable = -20% to +20%.

Appendix G presents a historical summary of contaminant and co-contaminant monitoring results for wells and aquifer tubes. Associated contaminant trend charts are presented in Appendix H.

2.5 QUALITY CONTROL RESULTS FOR 100-D AND 100-H MONITORING DATA

The QC results for the 100-HR-3 sampling activities involve field or offsite laboratory testing for hexavalent chromium or total chromium.

The highlights of QC data for CY04 100-D and 100-H Area sampling are summarized below. Tables listing the complete QC results are found in Appendix I.

Type Quality Control Sample	Number of Pairs	Number of Pairs <20% RPD	Percent of Pairs <20% RPD
Field replicates (hexavalent chromium)	34	34	100%
Field/offsite laboratory splits (hexavalent chromium)	28	24	86%
Offsite laboratory replicates (total chromium)	13	12	92%
Offsite laboratory splits (total chromium)	12	12	100%

RPD = relative percent difference

The U.S. Environmental Protection Agency's (EPA's) *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA 1988) for field-tested replicates is ±20%. All field replicates were within acceptable limits. There are no functional guidelines for split results or offsite laboratory replicates, but the results correlated well based on the relative percent differences (RPDs).

2.6 CONCLUSIONS

The pump-and-treat system continues to make significant progress toward remediating the contaminant plume along the 100-D and 100-H Area shorelines by extracting groundwater before it reaches the river. In addition, human receptors are protected onsite using institutional controls. Details regarding the operation of the existing pump-and-treat system will be useful in evaluating system upgrades and modifications.

- ***RAO #1: Protect aquatic receptors in the river bottom substrate from contaminants in groundwater entering the Columbia River. The RAO for compliance wells is 22 µg/L based on the 11 µg/L ambient water quality criterion in place at the time of the signing of the ROD and a 1:1 dilution ratio.***

  <u>100-D Area</u>:

  – Approximately 164 million L of groundwater were treated during CY04, and 30.1 kg of hexavalent chromium were removed using the 100-HR-3 and DR-5 pump-and-treat systems.

  – Chromium concentrations decreased or were stable from 2003 to 2004 in three of four 100-D Area extraction wells and remained stable in the two compliance wells. However, chromium concentrations were above the 22 µg/L RAO in all of the extraction and compliance wells.

  – Average hexavalent chromium concentrations of 1,380 µg/L were detected in filtered samples from well 199-D5-20 (which is now an extraction well for DR-5). This represents an increase of 63% from 2003. In addition, well 199-D5-41 was characterized by an average concentration of 2,150 µg/L chromium in 2004, a 120% increase from 2003.

  – Strontium-90 concentrations were less than the MCLs for all 100-D Area samples analyzed during CY04.

  – Average tritium concentrations were less than MCLs in all 100-D Area wells.

- Plume and water table surface maps indicate that the hydraulic barrier separating the northern plume contained by the pump-and-treat system and the southwest plume controlled by the ISRM is dissipating and the plumes appear to be merging.
- Monitoring wells installed near the 182-D reservoir have helped to better delineate the chromium plume and groundwater in this area. These wells were designed for potential use as extraction wells and can be converted to that function for the DR-5 pump-and-treat system as needed.
- With the addition of three new extraction wells, numerical modeling results indicate that the extraction well network is containing the majority of the central and northern portion of the 100-D chromium plume. This is the portion of the plume originally targeted by the interim action ROD (EPA et al. 1996). The southwest 100-D chromium plume is targeted by the ISRM barrier. Modeling indicates that except for a small portion of plume that by passes the barrier on the northwest end, the majority of the plume is captured by the ISRM. Planned expansion of the new DR-5 system includes additional extraction wells in the portion of the flow field that bypasses the northeastern end of the ISRM.

100-H Area:

- Approximately 153.5 million L of groundwater were treated in CY04, and 3.5 kg of hexavalent chromium were removed.
- The 2004 average chromium concentrations were below the RAO of 22 µg/L in all but two extraction wells. Chromium concentrations remained above the RAO of 22 µg/L in all four of the compliance wells. The maximum 2004 compliance well average chromium concentration was 55.1 µg/L in well 199-H4-5. Other compliance well concentrations ranged from 43.7 to 54.7 µg/L chromium.
- The highest average chromium concentrations were downgradient of the former 183-H solar evaporation basins, near monitoring well 199-H4-3, in which the average concentration was 65 µg/L.
- The average 2004 chromium concentration in extraction well 199-H3-2A was 9 µg/L. Concentrations in this well were more than 100 µg/L in 1997 when pump-and-treat operations began, but annual November values have been below the RAO cleanup goal for the past 5 years.
- The 2004 chromium concentrations in the other 100-H Area extraction wells ranged from 15 µg/L in well 199-H4-7 to 40 µg/L in well 199-H4-15A.
- Fewer well samples had co-contaminant concentrations that were above MCLs compared to November 2003.
- Numerical modeling results indicate that the extraction well network generally contains the plume along much of the 100-H Area shoreline. Gaps in capture are due largely to lowered pumping rates in some wells because of a thin, saturated aquifer and low water levels. To address these gaps, several compliance and monitoring wells were converted to extraction wells in January 2005.

- ***RAO #2: Protect human health by preventing exposure to contaminants in groundwater.***

  Results: The interim remedial action ROD establishes a variety of institutional controls that must be implemented and maintained throughout the interim action period. These provisions include some of the following:

  – Access control and visitor escorting requirements

  – Signage providing visual identification and warning of hazardous or sensitive areas (new signs were placed along the river and at major road entrances in each reactor area)

  – Excavation permit process to control all intrusive work (e.g., well drilling and soil excavation)

  – Regulatory agency notification of any trespassing incidents.

  The effectiveness of institutional controls was presented in the *2004 Final Institutional Controls (IC) Assessment Report* (DOE-RL 2004a). The findings of this report indicate that institutional controls were maintained to prevent public access, as required.

- ***RAO #3: Provide information that will lead to a final remedy.***

  In order for a pump-and-treat strategy to work for a final remedy at 100-D, identification and elimination of the continuing source of chromium is fundamental. If the source can be controlled, then the pump-and-treat system could be operated until the concentrations decline to meet the RAO as a final remedy (e.g., in the 100-H Area); if not, then a long-term solution other than pump-and-treat is needed. A permeable reactive barrier (e.g., ISRM) is one possible solution in the event that source control or removal is not possible. The ISRM was installed to provide both immediate treatment of a significant portion of the chromium plume and to provide performance data for evaluation of this approach as a final remedy. Events and new information generated during 2004 that bear on the above final remedy considerations are summarized as follows:

  <u>Source control/identification</u>:

  – Pressurized water lines were leak-tested, and critical sections of the distribution network near suspected source locations were cut and capped in the 100-D Area.

  – Renewed efforts to locate the source of hexavalent chromium in the suspected spill sites in the south-central 100-D Area were unsuccessful during CY04. Either residual soil column sources are deeper than the 4.6-m test pit excavation depth, or there are a few point sources that cannot be located with the investigation spacing used.

  <u>Evaluation of treatment options</u>:

  – Improved cost effectiveness of 100-HR-3 pump-and-treat system was demonstrated with data from the operation of a small, modular, self-contained treatment system (manufactured by MR3) and by employing an inlet sacrifice resin column to minimize the amount of resin that must be shipped to the ERDF. A more cost-effective pump-and-treat system is needed as part of a final remedy (if source control is successful), as well as to reduce the cost of current operations.

- Evaluation of ISRM performance issues intensified during the year. Two expert panel workshops sponsored by U.S. Department of Energy (DOE)-Headquarters were held in Richland, Washington, in April and May 2004. Final reports and recommendations generated from this effort led to plans to investigate mitigation measures for the northeastern end of the ISRM barrier where premature loss in reductive capacity is occurring. Initial characterization (July through August 2004) included determination of vertical velocity profiles in all of the 66 injection wells to determine the extent of suspected preferential flow (high-permeability zones) within the screened interval of the aquifer treatment zone. Recommendations were made for the application of amendments to treat high permeability zones that may have been inadequately treated with the dithionite injection protocol used for the ISRM. Laboratory and field testing to support implementation of the recommendations are planned for FY05 through FY06.
- Alternatives to the ISRM approach for installation of a permeable reactive barrier considered the emplacement of zerovalent iron by hydrofracture or air injection. A vendor cost proposal was solicited for a 2,000-ft barrier using the hydrofracture method. Permeable reactive barrier alternatives may be needed for a final remedy if the soil column sources cannot be located and fixed in place or removed.

2.7 RECOMMENDATIONS

100-D Area:

- Continue water-level monitoring near the 182-D reservoir (1) to determine the effects and magnitude of previous reservoir leakage and the new pump-and-treat system on the hydraulic flow regime, and (2) to measure the impact on the chromium plume extent and movement.
- Evaluate the cost and effectiveness of existing or new wells that could be used to close a capture zone gap between DR-5 and the ISRM barrier. Evaluate the cost and effectiveness for the expansion of the original 100-D and DR-5 pump-and-treat system to target high concentration areas for mass reduction.
- Define the edge of the chromium plume northeast of the original 100-D pump-and-treat system.
- Based upon the results of the 100-KR-4 calcium polysulfide treatability test, evaluate the cost and effectiveness for implementing a similar technology in the 100-D Area.
- Continue to cross-reference source area cleanup activities for integration into the final ROD.

100-H Area:

- Implement changes in extraction well and injection well locations to address plume gaps and focus treatment on higher concentration areas.
- Evaluate the cost and effectiveness of existing and new wells to target high concentration areas for mass reduction.
- Continue to cross-reference source area cleanup activities for integration into the final ROD.

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Figure 2-1. Location of the 100-HR-3 Operable Unit.

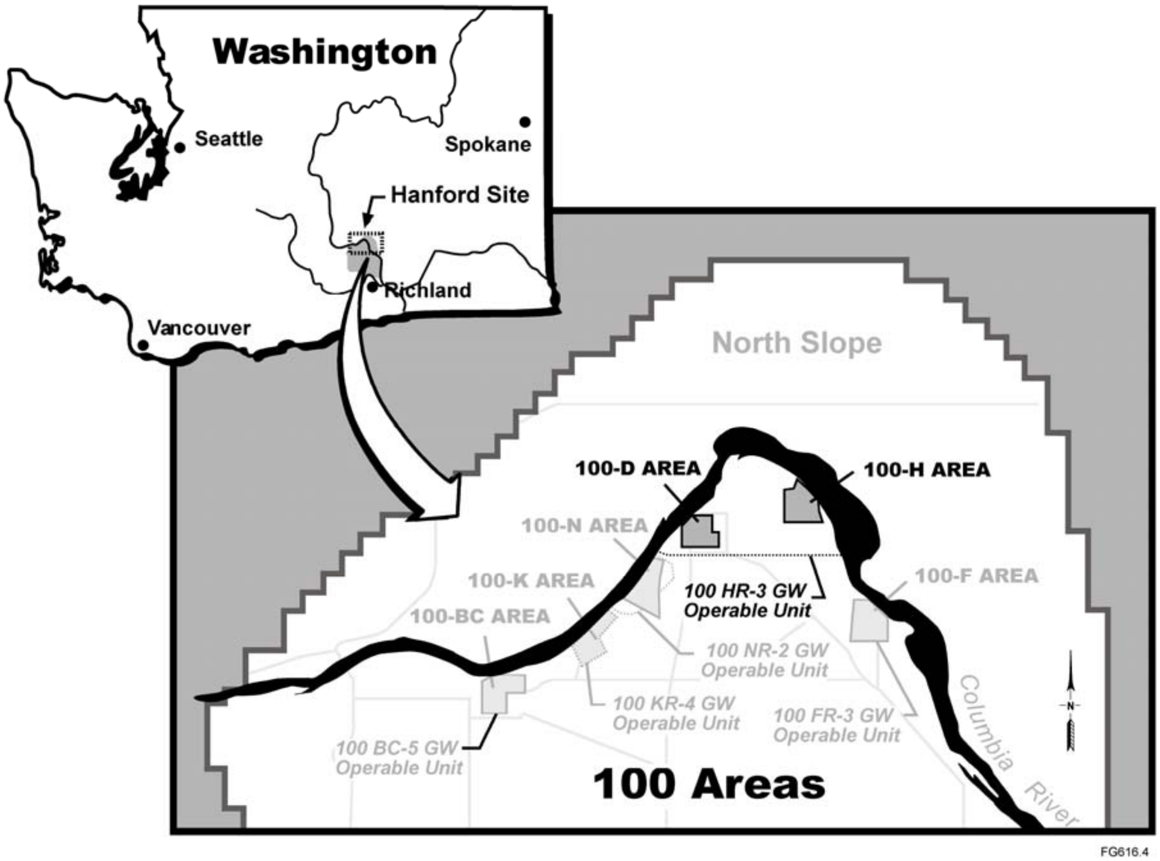


Figure 2-2. 100-HR-3 Operable Unit – 100-D Area Wells and Aquifer Sampling Tubes.

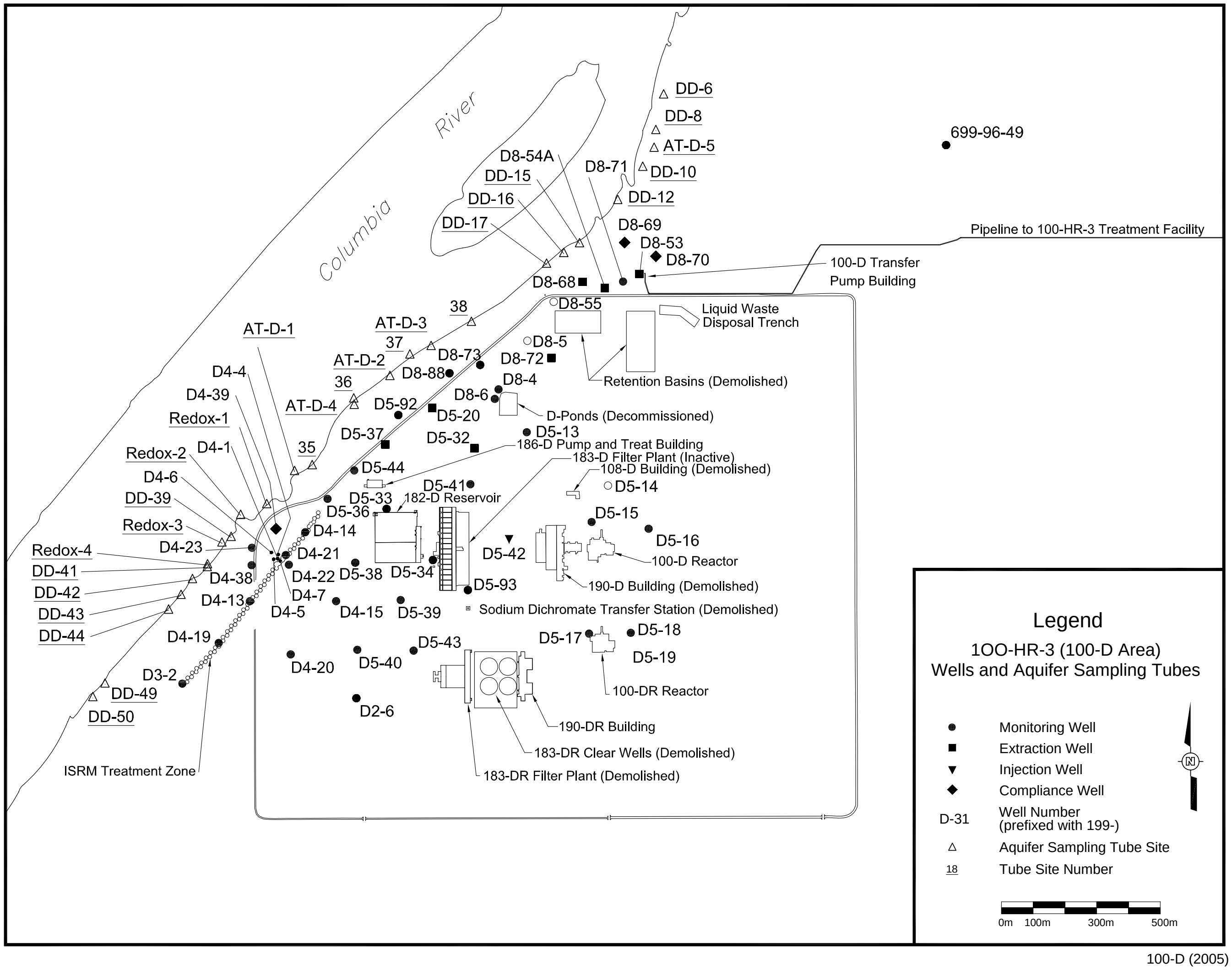
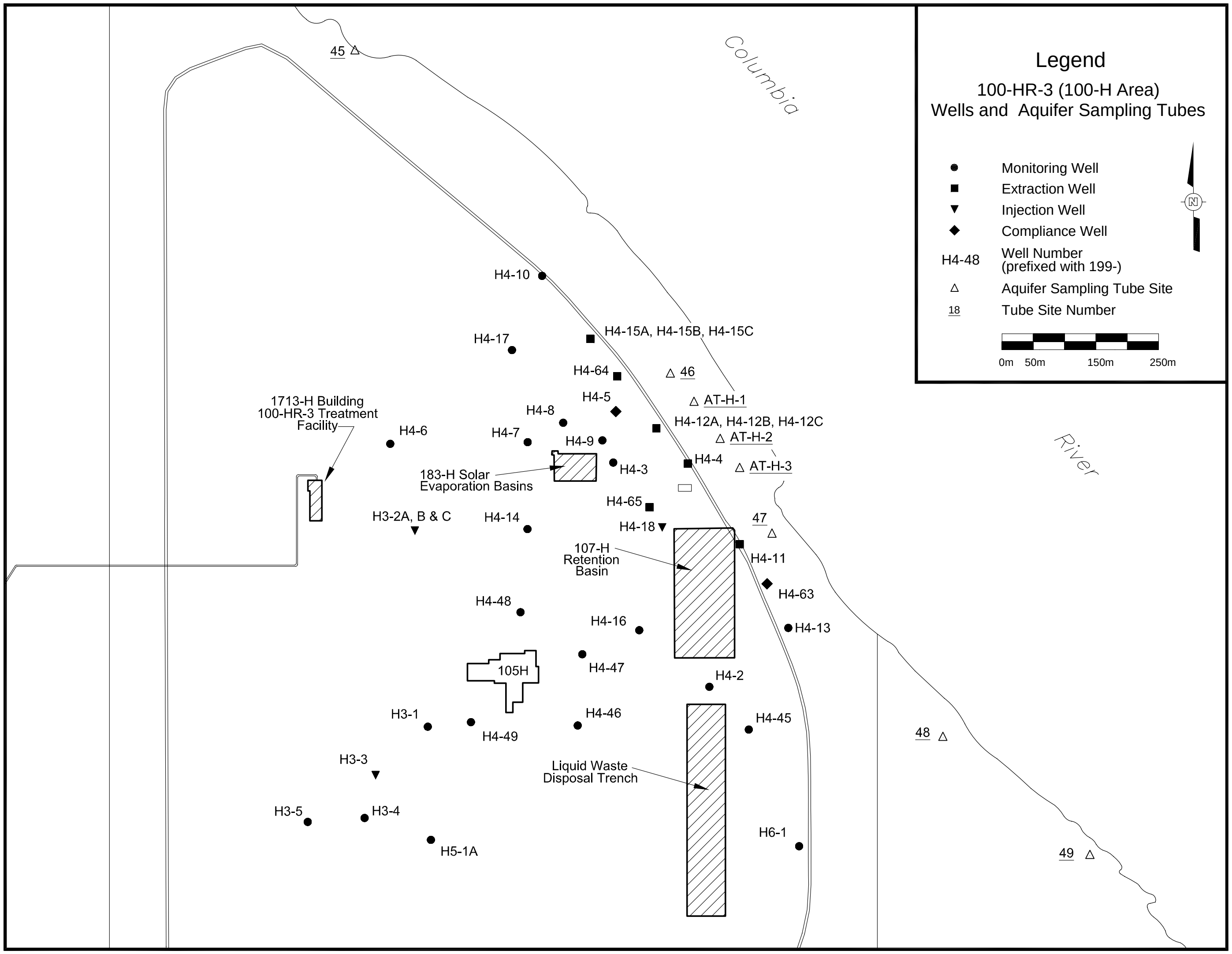


Figure 2-3. 100-HR-3 Operable Unit – 100-H Area Wells and Aquifer Sampling Tubes (as of December 2004)



100-H (2005)

Figure 2-4. 100-HR-3 Pump-and-Treat System Schematic.

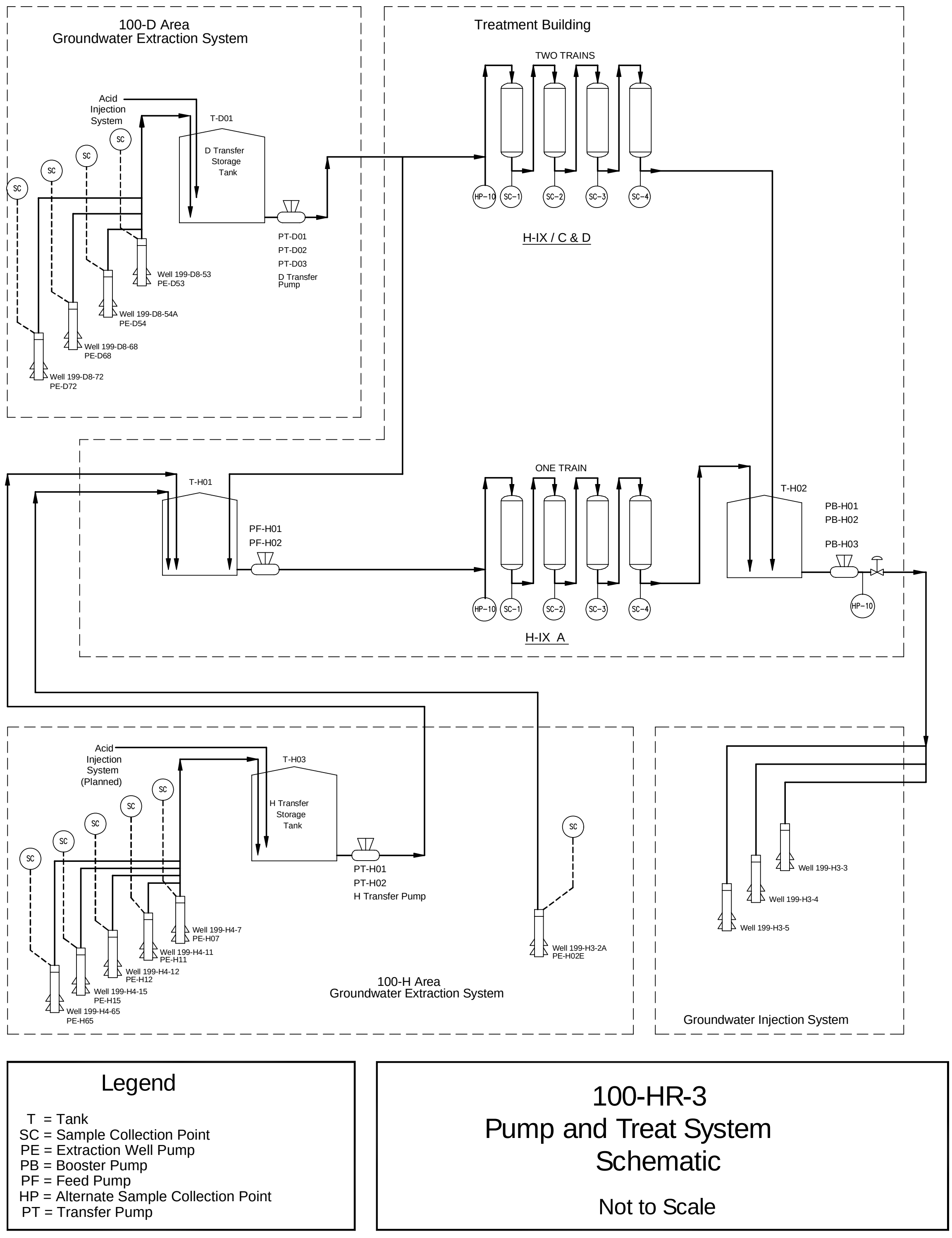


Figure 2-5. DR-5 Pump-and-Treat System Schematic.

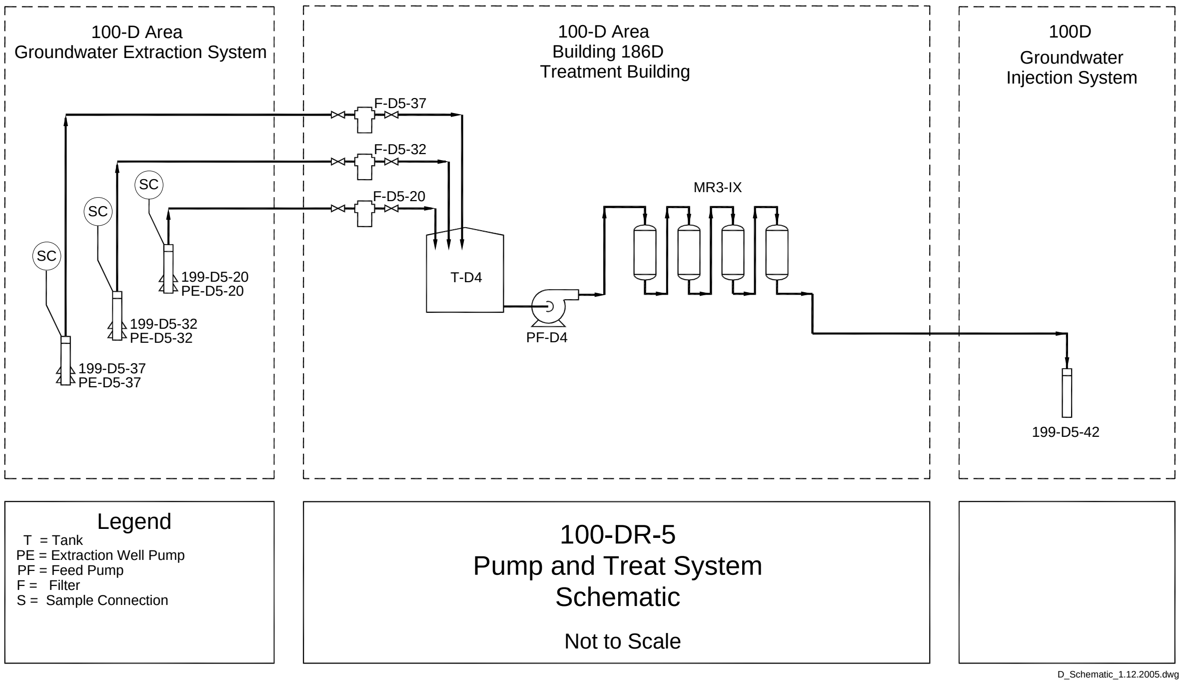
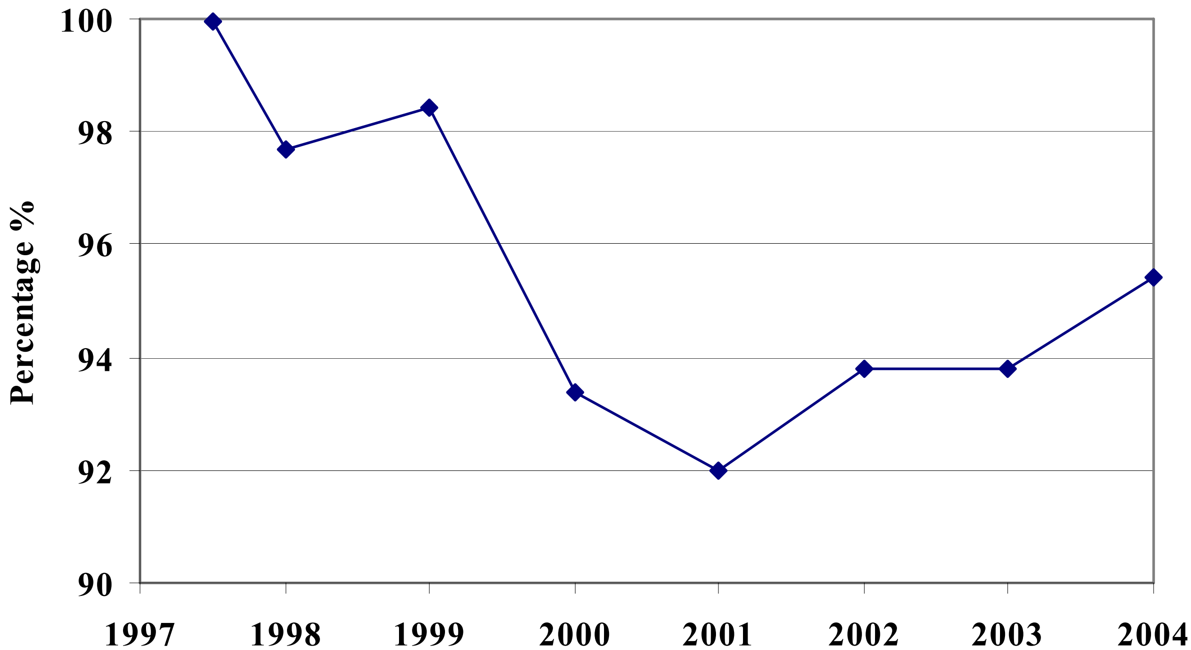


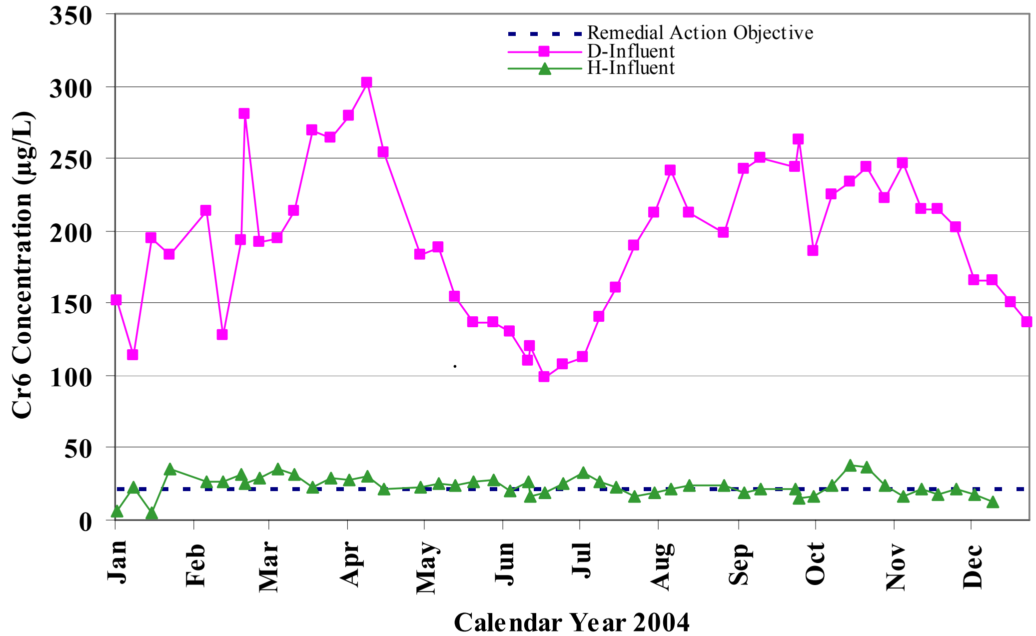
Figure 2-6. 100-HR-3 Pump-and-Treat Trends of Average Removal Efficiencies.[a]

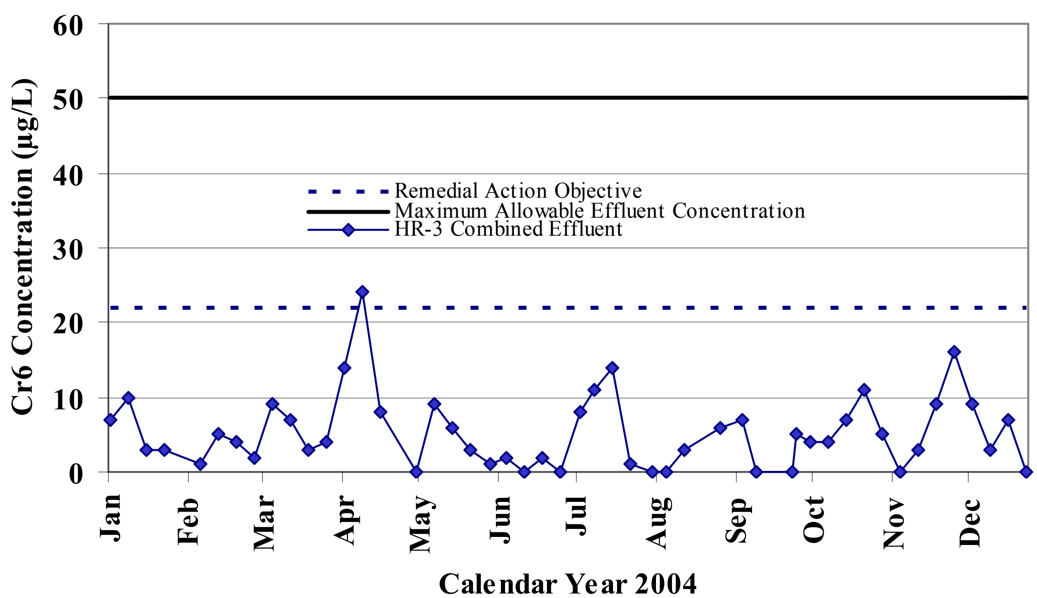


NOTE: The 100-HR-3 pump-and-treat trends of average removal efficiencies do not include the DR-5 pump-and-treat system.

[a] Average removal efficiency is calculated as: (% by mass) = [(influent – effluent) / influent].

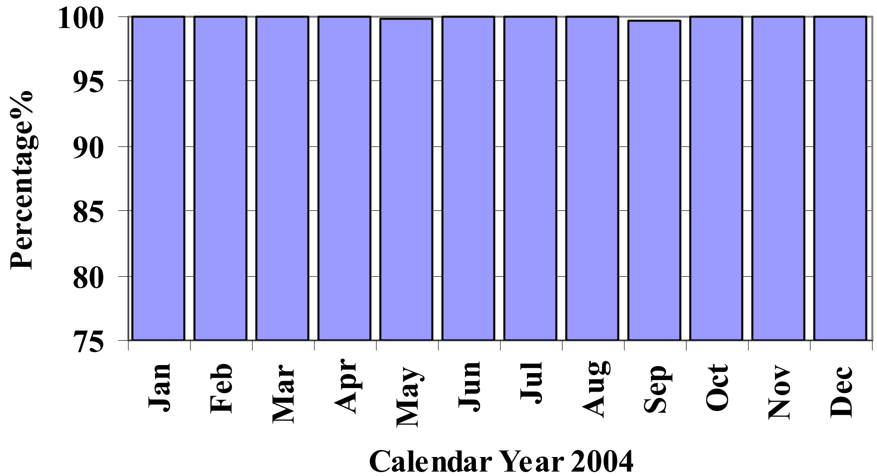
Figure 2-7. Calendar Year 2004 100-HR-3 Pump-and-Treat Trends of Influent and Effluent Hexavalent Chromium Concentrations.





NOTE: Calendar year 2004 100-HR-3 pump-and-treat trends of influent and effluent hexavalent chromium concentrations do not include the DR-5 pump-and-treat system.

Figure 2-8. 100-HR-3 System Availability and On-Line Percentages for Calendar Year 2004.



Summary of system availability:	
Total possible run-time (hours)	8,784
Scheduled downtime (hours)	73
Planned operations (hours)	8,711
Unscheduled downtime (hours)	1
Total time on-line (hours)	8,710
Total availability (%)	99.1
Scheduled system availability (%)	99.9

Scheduled system availability [(total possible run-time – unscheduled downtime) / total possible run-time].

Total availability[(total possible run-time – scheduled and unscheduled downtime) / total possible run-time)].

NOTE: The 100-HR-3 system availability and on-line percentages for calendar year 2004 do not include the DR-5 pump-and-treat system.

Figure 2-9. 100-D Area Chromium Plume Map, Fall 2004.

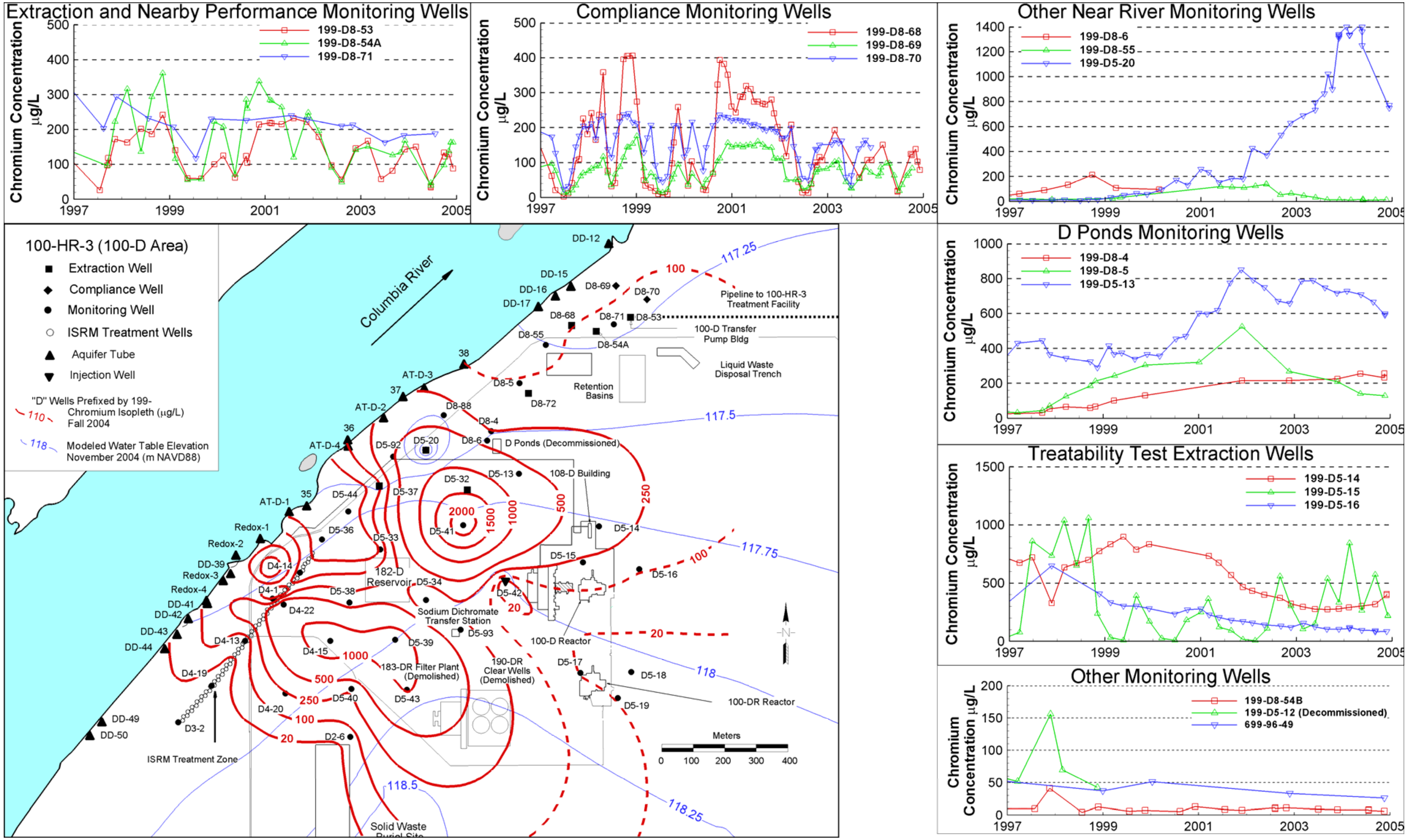


Figure 2-10. Water Elevation Versus Distance from the Columbia River in the 100-D Area Wells.

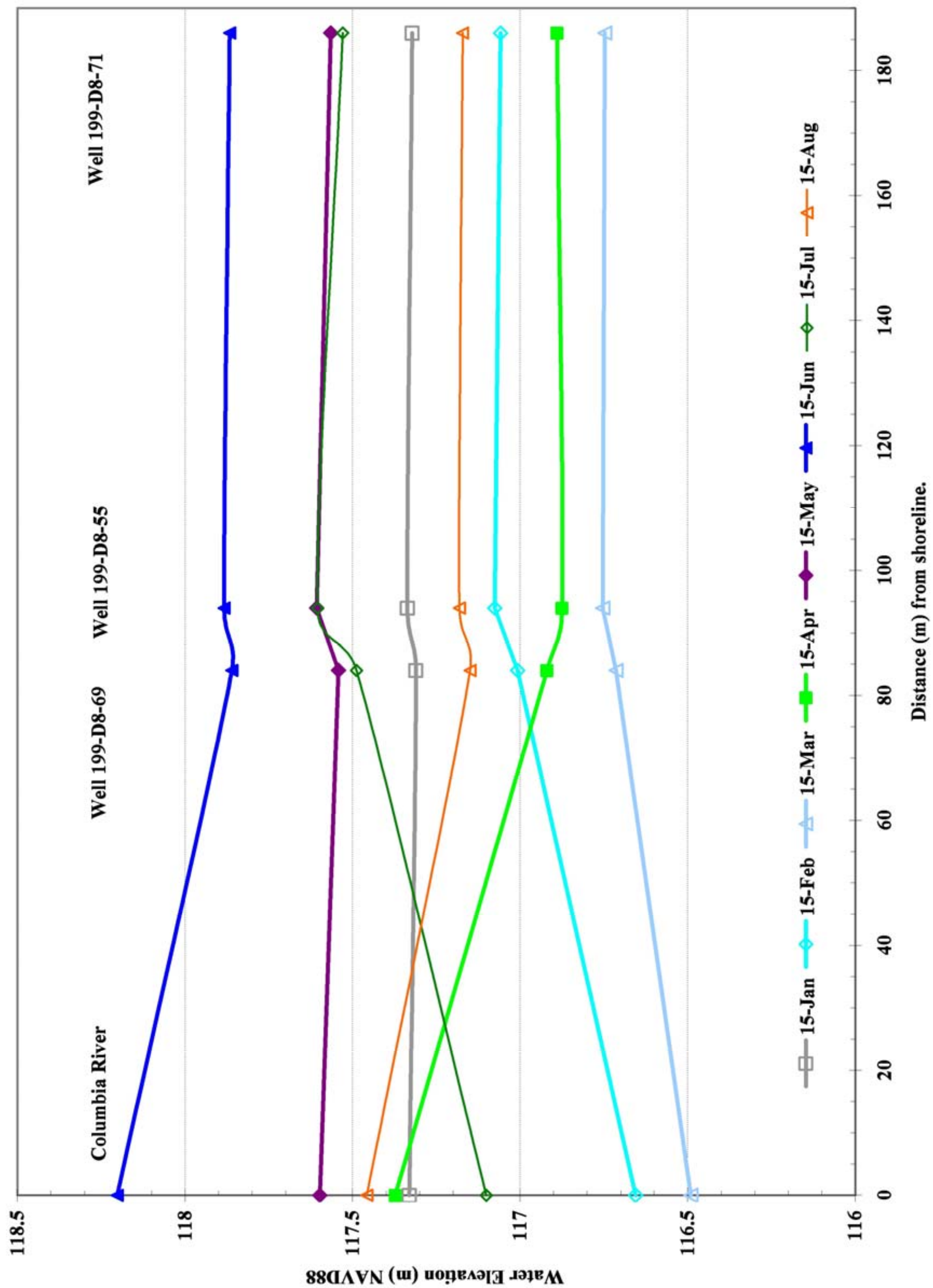


Figure 2-11. Decay of the Groundwater Mound Around the 182-D Reservoir, as Measured at Adjacent Monitoring Well 199-D5-33.

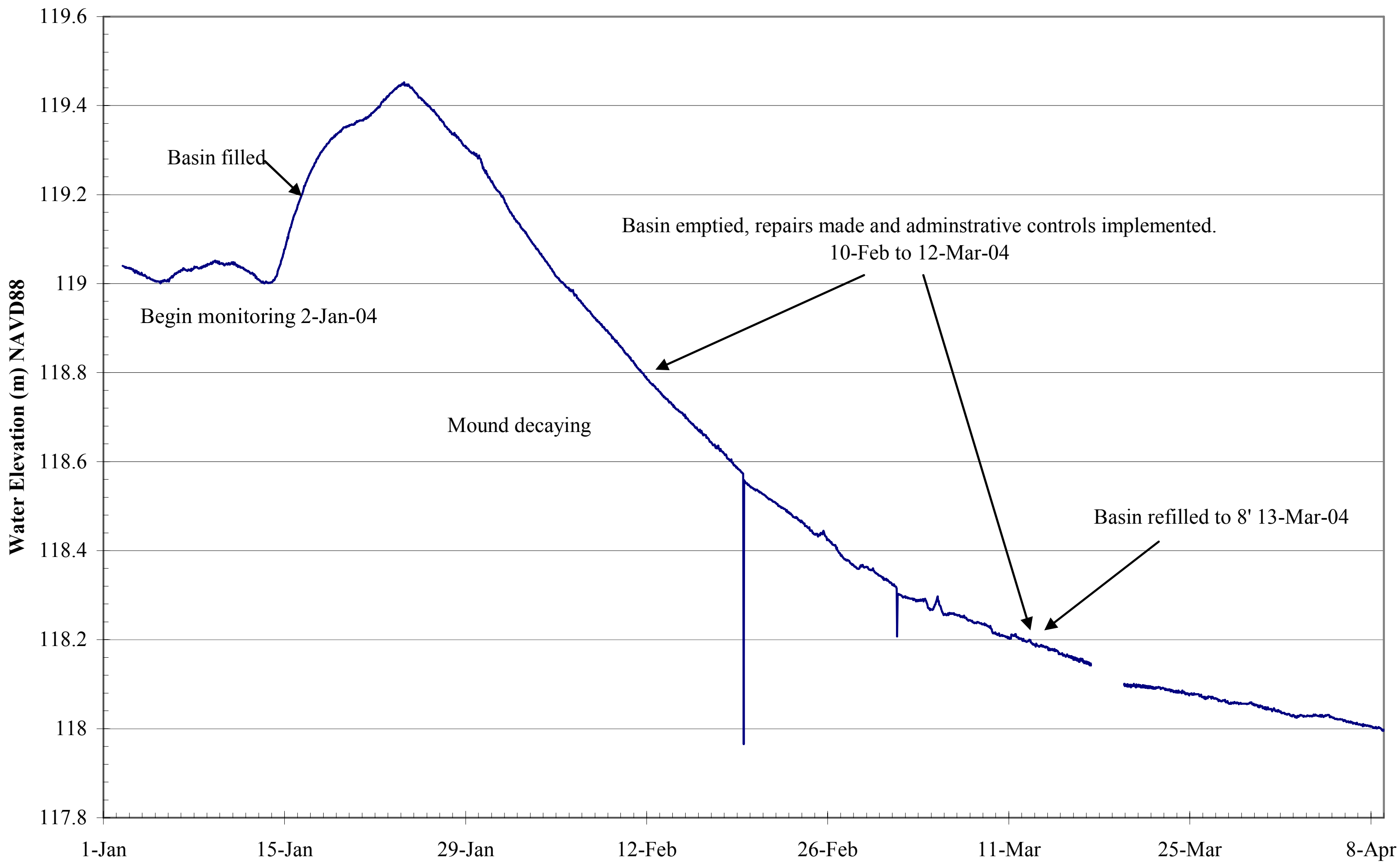


Figure 2-12. Estimated Steady-State Hydraulic Capture Zone Development by 100-HR-3 Operable Unit, 100-D Area Extraction Wells.

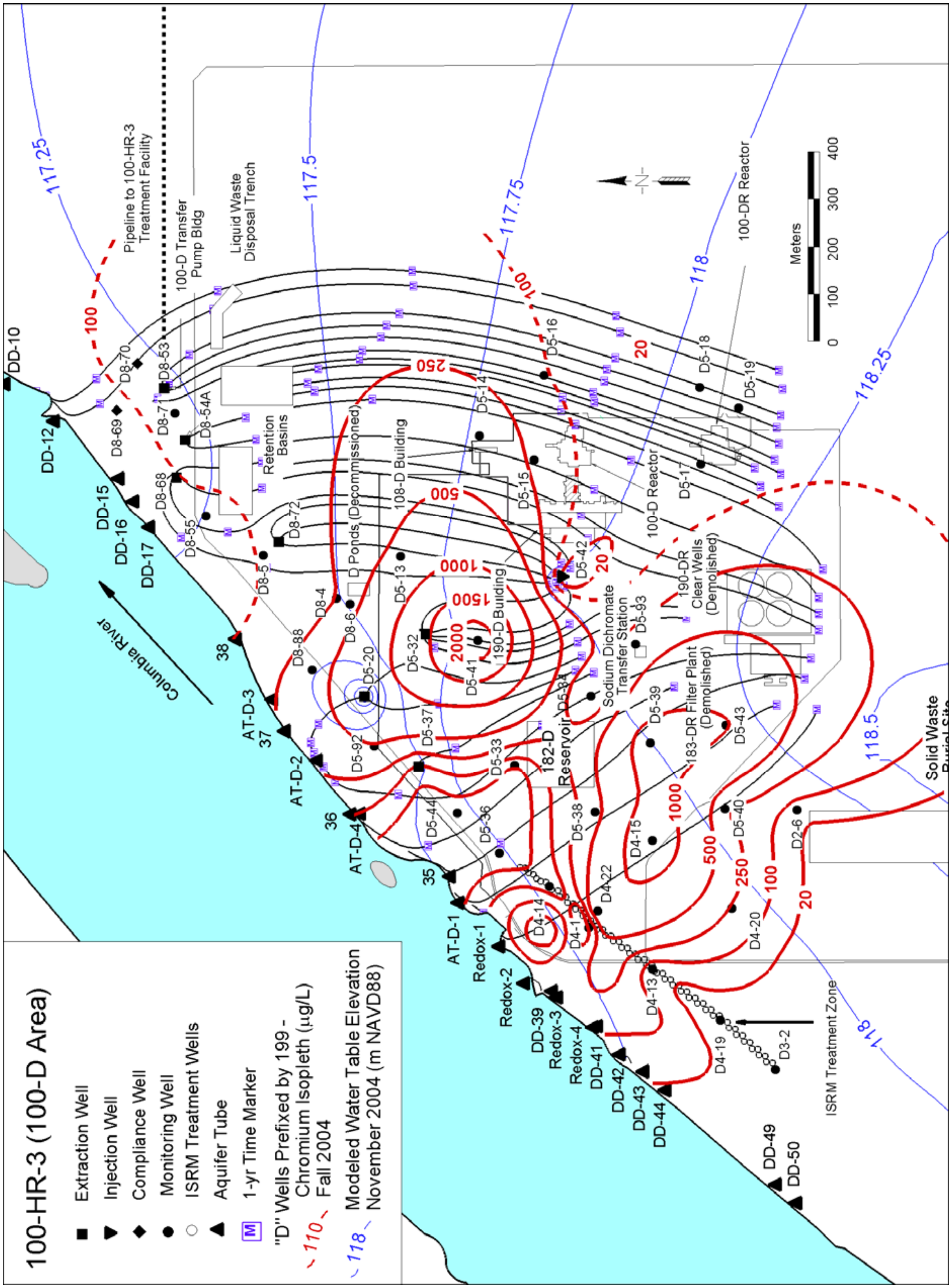


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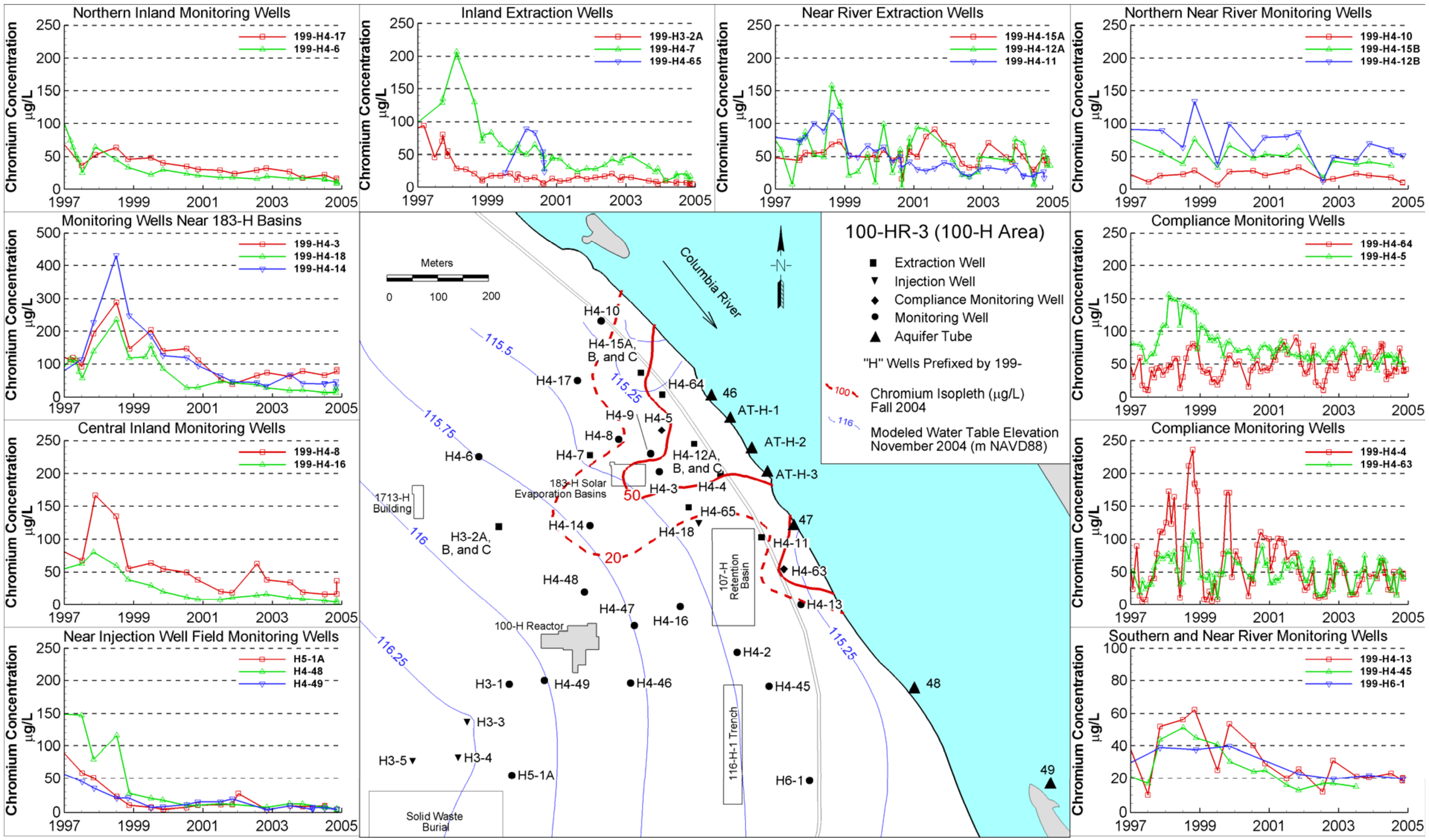
Figure 2-13. 100-H Area Chromium Plume, Fall 2004.



NOTE: Well configuration presented is prior to system reconfiguration in December 2004.

Figure 2-14. Water Elevation Versus Distance from the Columbia River in 100-H Area Wells.

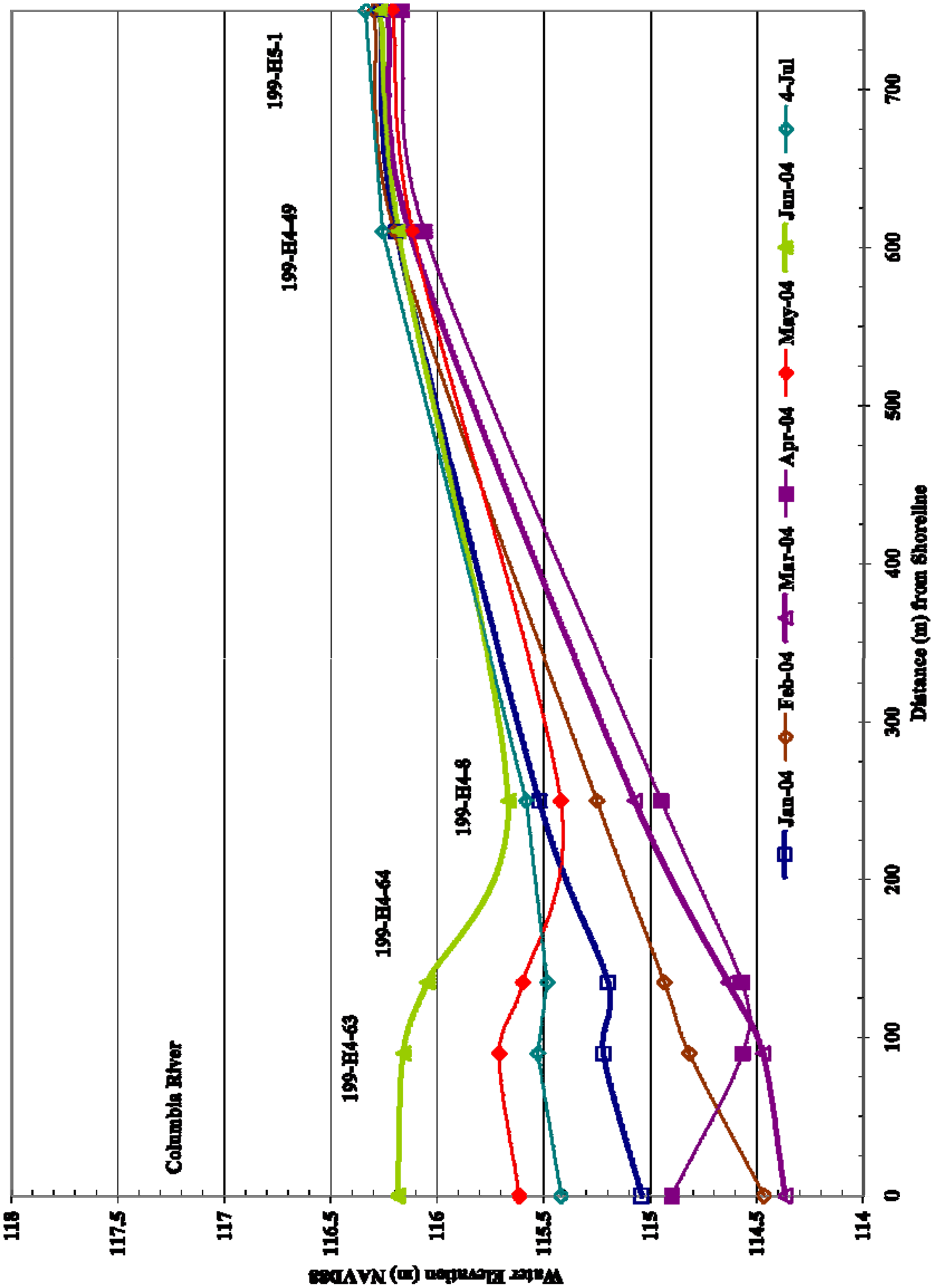
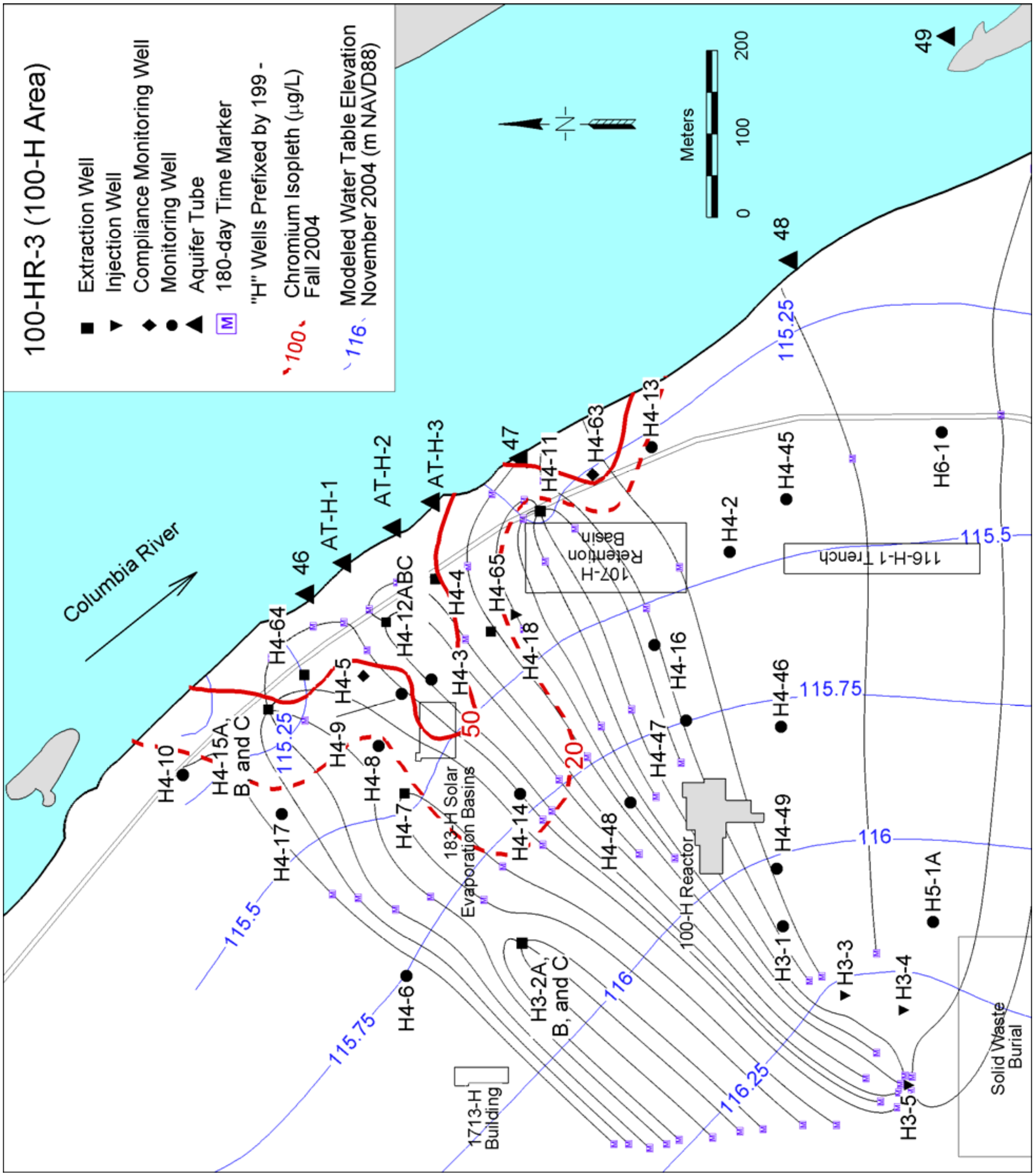


Figure 2-15. Estimated Steady-State Hydraulic Capture Zone Developed by 100-HR-3 Operable Unit, 100-H Area Extraction Wells.



NOTE: Well configuration presented is prior to reconfiguration in December 2004.

Table 2-1. 100-HR-3 (100-H and 100-D Areas) Water-Level Data Used to Develop and Calibrate Numerical Groundwater Flow Models.

Well	Model Analysis. Nov. 2004		Measured Water-Level Elevation, Nov. 2004 (m NAVD88[a])	Modeled Water-Level Elevation, Nov. 2004 (m NAVD88[a])
	Extraction Rate L/min	Injection Rate L/min		
100-H Area				
199-H3-2A	90.8	--	115.75	115.73
199-H4-7	40.1	--	115.09	115.27
199-H4-11	51.5	--	113.42	115.19
199-H4-12A	31	--	114.35	115.23
199-H4-15A	58.3	--	114.35	115.18
199-H4-65	0	--	115.27	115.38
199-H3-3	--	136.3	116.13	116.32
199-H3-4	--	220.7	116.27	116.41
199-H3-5	--	207.4	116.72	116.49
199-H3-2B	--	--	115.75	115.94
199-H3-2C	--	--	115.74	115.94
199-H4-4	--	--	115.11	115.25
199-H4-5	--	--	115.15	115.31
199-H4-8	--	--	115.28	115.42
199-H4-10	--	--	115.20	115.39
199-H4-12B	--	--	115.11	115.24
199-H4-12C	--	--	115.10	115.24
199-H4-15B	--	--	115.20	115.26
199-H4-63	--	--	115.00	115.18
199-H4-64	--	--	115.15	115.27
199-H4-48	--	--	115.75	116.18
199-H5-1A	--	--	116.14	116.32
100-H River	--	--	115.17	115.17
100-D Area				
199-D8-53	68.5	--	115.32	117.17
199-D8-54A	92.4	--	115.43	117.15
199-D8-68	109	--	116.88	117.08
199-D8-72	81.4	--	117.88	117.19
199-D5-20	36	--	--	115.08
199-D5-32	109.8	--	--	117.32
199-D5-37	15.1	--	--	117.39
199-D5-42	--	160.9	120.23	118.18
199-D8-69	--	--	117.08	117.20
199-D8-70	--	--	117.09	117.23
199-D8-71	--	--	117.05	117.22
100-D River	--	--	117.52	117.52

[a] NAVD88, 1983, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland.

-- = No data available

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3.0 100-KR-4 PUMP-AND-TREAT SYSTEM

The 100-KR-4 OU includes the groundwater underlying the 100-KR-1 and 100-KR-2 source OUs. The 100-KR-4 pump-and-treat facility is located along the Columbia River, several miles southwest of the 100-HR-3 OU (Figure 3-1). The 100-KR-4 treatment system and injection/extraction well field are located northeast of the KE Reactor and adjacent to the 116-K-2 mile-long disposal trench. A map of wells and aquifer tube locations in the 100-K Area is presented in Figure 3-2. Appendix A provides a history of operations and supporting documents used in the development of the 100-KR-4 pump-and-treat system. Appendix B presents the associated conceptual model.

The 100-KR-4 interim action is similar to the 100-HR-3 interim action in that the primary COC is hexavalent chromium. Interim action co-contaminants in the 100-KR-4 OU include tritium and strontium-90. Carbon-14 and nitrate are co-contaminants of interest.

This section provides the annual performance report for the 100-KR-4 OU. Primary emphasis is on pump-and-treat operations for the reporting period of January 1 through December 31, 2004. Section 3.1 summarizes groundwater conditions for all of the 100-KR-4 OU, as well as source area remedial actions within the groundwater OU. Section 3.2 summarizes the treatment system's performance, system operations, extraction well operations, and operational sampling. An evaluation of the aquifer response, including hydraulic monitoring, numerical modeling, and contaminant monitoring in the area impacted by pump-and-treat operations, is discussed in Section 3.3. Section 3.4 presents conclusions on the progress toward achieving each RAO and the performance criteria. Section 3.5 provides recommendations to change/enhance the 100-KR-4 OU pump-and-treat system. Cost information for the 100-KR-4 pump-and-treat system is presented separately in Section 5.0.

3.1 SUMMARY OF SOURCE AND GROUNDWATER OPERABLE UNIT ACTIVITIES

The long-term remedy for groundwater contamination in the 100-K Area requires both source and groundwater remedial actions.

3.1.1 Source Area Activities

BHI began excavation activities in both the 100-KR-1 and 100-KR-2 source OUs during 2004. The gas condensate cribs, which are the source of carbon-14 and tritium in groundwater near the KW and KE Reactors, were excavated and backfilled, and work then began to remove the upper 4.6 m of the mile-long trench. Consideration is also being given to installing a drain field in the bottom of the trench prior to backfilling. The drain field could be used to flush water or reductants through the vadose zone to either remove or treat (reduce) hexavalent chromium in the deeper vadose zone beneath the trench.

3.1.2 Groundwater Operable Unit Activities

The groundwater activities associated with the 100-KR-1 and 100-KR-2 source OUs are discussed in the following subsections.

3.1.2.1 100-KR-1 Operable Unit

Groundwater actions associated with 100-KR-1 consisted primarily of groundwater monitoring in the vicinity of the reactor areas, as reported in *Hanford Site Groundwater Monitoring for Fiscal Year 2004* (PNNL 2005). The primary emerging groundwater issue in this area is the localized hexavalent chromium plume near the KW Reactor building. The highest concentration during 2004 (560 µg/L) occurred in well 199-K-107A. Consideration is being given to applying a small-scale pump-and-treat system at this location or injecting a reductant (i.e., calcium polysulfide) to create a localized treatment cell. The calcium polysulfide approach will be field tested in CY05 at the downstream end of the 100-KR-4 OU as an alternative to expanding the pump-and-treat network in that area. If the treatability test is favorable, it may also be used at the KW Reactor's "hot spot" site.

3.1.2.2 100-KR-2 Operable Unit

Groundwater remedial actions in the vicinity of the 100-KR-2 source OU include the ongoing pump-and-treat operation in the vicinity of the 116-K-2 mile-long trench and the planned treatability test (as noted in Section 3.1.2.1). The 100-KR-4 pump-and-treat system began operation in 1997 as a containment and mass removal strategy to reduce the release of hexavalent chromium to the Columbia River in the vicinity of the mile-long trench. The primary source of the residual hexavalent chromium in the aquifer is attributed to the discharge of large volumes of reactor coolant containing approximately 700 µg/L of hexavalent chromium during operations from 1955 to 1971. A large groundwater mound developed around the mile-long trench, raising the water table to 6 m above the present-day water table elevation at a distance of over 1 km inland. There is evidence to suggest that coolant water may have also been transported inland to a distance of over 1 km from the trench. The long-term challenge for a final remedy is to address the widely distributed plume that may also be approaching the 100-N Area.

Other key groundwater issues being tracked in the 100-KR-1 OU include (1) fluctuating tritium concentrations near both reactor areas; (2) the occurrence of low, but measurable, technetium-99 concentrations near the KW Reactor that are of unknown origin; and (3) a possible tritium source near the burial ground (PNNL 2005).

Highlights associated with operation and improvements in the 100-KR-4 pump-and-treat system for CY04 are outlined below:

- Hexavalent chromium concentrations continued to decline in all of the extraction wells located in the vicinity of the mile-long trench. This suggests that cleanup of the aquifer between the injection and extraction wells is moderately effective. A much slower concentration response is evident at extraction well 199-K-112A, located 300 m beyond the northeastern end of the trench. This may be a result of residual chromium in the groundwater that was transported inland during the operating period and that is now migrating into the area between the end of the trench and the 100-N Area.
- Well 199-K-114A, located near the end of the mile-long trench, was converted to an extraction well in the fall of 2004 to enhance the hydraulic capture in this area. Concentrations at this well averaged 107 µg/L in October 2004. Well 199-K-126, located near an area of persistent high chromium concentration, reached a maximum of 97 µg/L in February 2004. Extraction rates from this well range to 227 L/min. Variations in pumping rates and chromium concentration can be attributed to changes in river stage.

This well will be used as an extraction well for the planned calcium polysulfide treatability test.

- In September 2004, well 199-K-131 was drilled at the northeastern edge of the chromium plume and constructed as a monitoring/extraction well. Based on samples taken in October 2004, elevated concentrations of hexavalent chromium (63 µg/L) were encountered, indicating again that the plume is approaching the 100-N Area.
- Aquifer tube data also demonstrate encroachment of the chromium plume between 100-K and the 100-N Area. For example, the highest tube concentration (67 µg/L) was for DK-04-03, located close to new well 199-K-131. This extension of the chromium plume may represent arrival of contaminated groundwater from reactor coolant that was pushed inland during the operation of the K Reactors and is now arriving at the shoreline at the downstream end of the OU. If this hypothesis is correct, a new long-term strategy will be needed to address hexavalent chromium in this area.
- Significant treatment plant improvements were made in 2004 that resulted in a combined estimated annual savings for the 100-KR-4 and 100-HR-3 systems of $500,000 per year. The change involved modifying the IX system so it now includes a sacrificial IX column of resin to remove uranium prior to removal of the chromium. Natural uranium that previously built up on the IX resin led to numerous instances where the uranium content exceeded offsite shipping standards. Consequently, the resin could not be regenerated and was disposed as a mixed waste at the ERDF.
- A new method for chromium treatment at 100-KR-4 has been proposed, accepted, and is currently under development. Calcium polysulfide has been identified as a sulfide-based reduction and metal fixation additive that may help remove hexavalent chromium in groundwater. Calcium polysulfide has been used successfully at a number of sites outside of Hanford to precipitate hexavalent chromium from groundwater. A treatability test plan has been approved (DOE-RL 2005c), and will be implemented in early CY05. Following bench-scale testing to quantify chemical addition requirements, a field treatability test will be conducted at well 199-K-126. Four injection wells will be drilled at equidistant spacing along a 30.5-m radius around the 199-K-126 extraction well. A calcium polysulfide solution will be injected in these wells, captured by pumping at the extraction well, and then held in tanks to settle the precipitated chromium. This system is scheduled to start in the spring of 2005 and is expected to run for 3 to 6 months. It may be extended to other wells or portions of the pump-and-treat system if it is successful in removing hexavalent chromium.

3.2 100-KR-4 TREATMENT SYSTEM PERFORMANCE

This section describes the 100-KR-4 pump-and-treat system's operations and sampling activities for CY04. Specific details include changes to system configuration, system availability, mass of contaminants removed during operations, contaminant removal efficiencies, quantity and quality of extracted and disposed groundwater, waste generation, and contaminant trends. A detailed discussion of this information is presented in the associated appendices.

One significant capital improvement modification was made on the original 100-KR-4 pump-and-treat system in March 2004. A resin-filled tank was added in front of the three resin-filled chromium treatment tanks. This vessel is filled with the same resin as the remainder of the system but is used to preferentially capture uranium in the groundwater. This saves the lead tanks' resins from becoming contaminated with uranium requiring disposal as a mixed waste, rather than being suitable for regeneration. Cost savings for this change are conservatively estimated at $500,000 per year for this and a similar system modification at 100-HR-3. Figure 3-3 presents the current system schematic of the pump-and-treat system for CY04.

A summary of operational parameters and total system performance for CY04 is presented in the table below:

Total processed groundwater:	
Total amount of groundwater treated (since October 1997 startup) (billion L)	2.83
Total amount of groundwater treated during CY04 (million L)	500
Mass of hexavalent chromium removed:	
Total amount of hexavalent chromium removed (since October 1997 startup) (kg)	257.6
Total amount of hexavalent chromium removed in CY04 (kg)	29.6
Summary of operational parameters:	
Removal efficiency (% by mass)	93.6
Waste generation (m^3)	80.5
Regenerated resin installed (m^3)	39
New resin installed (m^3)	41.5
Number of resin changeouts	35
Summary of system availability:	
Total possible run-time (hours)	8,784
Scheduled downtime (hours)	277.5
Planned operations (hours)	8,506.5
Unscheduled downtime (hours)	76
Total time on-line (hours)	8,431
Total availability (%)	95.9
Scheduled system availability (%)	99.1

Key operational and system highlights for CY04 are as follows:

- The 93.6% removal efficiency for CY04 is lower than that reported for CY03 (Figure 3-4).
- The average 100-KR-4 influent hexavalent chromium concentration of 63 µg/L was lower than the CY03 average of 75.1 µg/L.
- The average effluent hexavalent chromium concentration of 4 µg/L for CY04 was comparable to 3.6 µg/L in CY03. Trend plots of CY04 influent and effluent concentrations are presented in Figure 3-5.
- The maximum hexavalent chromium concentration in the effluent was 16 µg/L.

- Scheduled system availability for CY04 was 99.1%, which was lower than the 99.3% reported in CY03. The total availability was 95.9%. This is a decrease from the on-line availability of 97.7% reported for CY03. The lower system availability values can be attributed to increased scheduled downtime for maintenance. Figure 3-6 presents the monthly on-line percentages and method used to calculate scheduled and on-line availability for the reporting period.
- During CY04, 35 IX vessels were changed out, generating 80.5 m^3 of spent resin. This amount is significantly lower than the 96.6 m^3 removed in CY03 and can be attributed to the lower volume of water processed during the current reporting period. As with the 100-HR-3 pump-and-treat system, resin changeouts were performed to maximize operating time and to limit the volume of material requiring regeneration or disposal.

The following table presents the pumping flow rates and total run-time (total flow hours / total possible run-time) for extraction wells at the 100-KR-4 pump-and-treat system. Except where noted, the recommended flow rates are based upon updated numerical modeling results that were prepared to support the *Comprehensive Environmental Response, Compensation, and Recovery Act of 1980* (CERCLA) 5-year review design modification. The yearly average flow rates are calculated from actual totalized volumes divided by the total hours in a year:

Well	Recommended Flow Rate (L/min)	Yearly Average Flow Rate (L/min)	Total Flow Hours in CY04	Total Run Time (%)[c]
199-K-129[a]	94.6	95.8	8,037	91.5
199-K-113A	94.6	53.8	8,074	91.9
199-K-114A[e]	94.6	84.8	792	9.0
199-K-115A	94.6	162	6,158	70.1
199-K-116A	151.4	168.1	7,897.5	89.9
199-K-119A	113.6	113.6	7,714.5	87.8
199-K-120A	113.6	151	7,731.5	88
199-K-125A	113.6	151.8	7,897	89.9
199-K-127	151.4	131	6,449	73.4
199-K-126[d]	54.1[b]	67.4	7,691.5	87.6

[a] Extraction well 199-K-112A was replaced with well 199-K-129, which began operating as an extraction well on July 10, 2003.
[b] Recommended flow rate based upon drawdown analysis.
[c] Total flow hours in CY04 / total hours in CY04 x 100%.
[d] Operated as an extraction well until July 2004.
[e] Monitoring well 199-K-114A was converted to an extraction well and began operation in November 2004.

A comparison of the extraction rates shows that wells 199-K-115A, 199-K-116A, 199-K-120A, 199-K-125A, and 199-K-126 were pumped at greater flow rates than recommended. These wells were able to sustain higher yields during the reporting period and were, therefore, used to offset lower rates from wells 199-K-113A and 199-K-127.

The lower-than-recommended flow rates at wells 199-K-113A and 199-K-127 may be attributed to fluctuations in river levels throughout the year, which limited the available drawdown in these wells. Decreased well efficiency due to scaling (calcium carbonate) or biological fouling may also impact pumping rates. During the year, all wells were subject to downtime because of area power-grid outages, equipment failures or maintenance, and construction activities. This downtime is reflected in the yearly average flow-rate calculations and the total run-time percentages for each extraction well.

Historical presentation of operational parameters, total system performance, and extraction well chromium concentrations and extraction rates are provided in Appendix C.

3.3 AQUIFER RESPONSE IN THE 100-K AREA

This section describes the general hydrogeologic conditions in the 100-K Area, numerical modeling conducted to evaluate the extraction well network, and changes in contaminant concentrations in monitoring wells.

3.3.1 Hydrogeologic Conditions at the 100-K Area

The hydrogeologic conditions at the 100-K Area are as follows:

- The most prevalent groundwater flow direction is northwest, as shown in Figure 3-7. During spring and some summer months, the river elevation is generally higher due to increased run-off and increased dam releases to provide more irrigation water and aid fish migration. During higher river stage, flow is inland from the river to the aquifer. This creates a near-shore, short-term groundwater flow reversal from northwest to southeast that is clearly shown in Figure 3-8, where the April to July 2004 river elevations are higher than near-river wells.
- The maximum river stage was 0.15 m lower in CY04 than in CY03; similarly, the minimum Columbia River stage was 0.18 m lower in CY04. Overall, the average Columbia River stage was 0.08 m lower in CY04 than it was in CY03.
- The average hydraulic gradient in 100-K was 0.0007 toward the northwest, with a maximum gradient of 0.0021.
- The net groundwater flow velocity for 2004 over the 100-K Area was 0.053 m/day based on a hydraulic conductivity of 15.2 m/day, a porosity of 0.2, with the gradient of 0.0007 derived from a three-point solution of hourly data from wells 199-K-37, 199-K-18, and 199-K-117A.
- The average 2004 extraction well pumping rates ranged from 53.4 L/min in well 199-K-113A to 168.1 L/min in well 199-K-115. This compares to a range of 54.5 to 166.6 L/min in 2003, and a range of 53 to 153.3 L/min in 2002.

Appendix D presents a detailed discussion of the aquifer response in 100-KR-4. Appendix J presents hydrographs for 100-K Area wells.

3.3.2 Numerical Modeling

The following is a summary of the numerical modeling results supporting the 100-KR-4 pump-and-treat operations:

- The original targeted plume from the 116-K-2 Trench, north to the Columbia River, is within the capture zone of the existing extraction well network, as shown in Figures 3-9.

- The conversion of compliance well 199-K-126 to an extraction well in January 2003 has extended the capture zone further downstream to include an area where monitoring results have confirmed that chromium is above the 22 µg/L RAO. A detailed discussion of the numerical model is presented in Appendix F. Table 3-1 presents a comparison of the measured and modeled water table elevations, as well as the average flow rates used in the numerical model.
- An evaluation of aquifer dynamics based on estimated travel time between injection and extraction wells along capture zone flow lines (Figure 3-9) resulted in the following observations:
  - Travel times (Figure 3-9) for the central portion of the original extraction well network suggest that two to three aquifer pore volumes have been extracted since operations began in 1997. Much longer estimated travel times (i.e., 10 to 15 years) from the injection wells to the northeastern extraction wells, and the far southwestern end, indicate that a longer time will be required to achieve the same degree of cleanup as in the central area of the plume.
  - The decline in chromium concentrations predicted for two central extraction wells is consistent with observed concentrations (see the lower right-hand corner of Figure 3-7). A simple washout model (Appendix F) was used to predict the rate of decline in chromium concentrations, assuming no new input of chromium to the aquifer. A linear projection based on this model suggests that the RAO may be met prior to 2006 for the portion of the aquifer in the capture zone of wells 199-K-119A and 199-K-125A.
  - The relatively close agreement between observed and predicted chromium concentrations implies that the aquifer cleanup rate is controlled primarily by aquifer turnover or travel time between injection and extraction wells. This also implies that there may not be significant input from vadose zone sources; otherwise, the observed chromium concentrations would depart significantly from the predicted concentrations (Figure 3-7). If so, then vadose zone treatment to remove residual chromium may not be needed. Alternatively, decreasing the travel time between injection and extraction wells would be more effective in reducing the chromium concentrations in that portion of the aquifer (southwestern and northeastern ends) where chromium is declining very slowly.
  - The preliminary aquifer dynamics evaluation presented in Appendix F and summarized above emphasizes the importance of evaluating alternative approaches to treating the distal ends of the 100-KR-4 groundwater OU.

3.3.3 Contaminant Monitoring

This section summarizes and interprets the CERCLA analytical results obtained from groundwater monitoring wells supporting the 100-K Area pump-and-treat remedial action. The *Interim Action Monitoring Plan for the 100-HR-3 and 100-KR-4 Operable Unit* (DOE-RL 1997b) and *Sampling Changes to the 100-HR-3 and 100-KR-4 Operable Unit* (DOE-RL 1998) define the sampling protocols implemented for CY04. The results presented below are the average annual concentrations for CY04, unless otherwise specified. Section 3.3.3.1 includes a discussion on chromium monitoring results, and Section 3.3.3.2 includes a discussion about monitoring results for remedial action co-contaminants strontium-90 and tritium. Nitrate and carbon-14 are also constituents of interest.

Complete contaminant monitoring results for CY04 and the historical results for CY97 through CY03 are presented in Appendix G. A summary and highlights for CY04 are discussed below.

- Chromium concentrations decreased in all nine extraction wells. In four wells, chromium decreased more than 20%; however, concentrations remained above the RAO of 22 µg/L in all extraction wells. The maximum average chromium concentration in an extraction well was 93.5 µg/L in well 119-K-126. Chromium concentrations decreased in three of four compliance wells, remaining above the RAO of 22 µg/L in wells 199-K-18, 199-K-20, and 199-K-114A. The maximum chromium concentration in a compliance well was 136.3 µg/L in 199-K-18; the lowest was 7.1 µg/L in well 199-K-117A.
- The farthest downstream monitoring well, 199-K-131, had an average chromium concentration of 63 µg/L. This well became operational as a monitoring well in October 2004.
- The largest average strontium-90 concentration was measured in well 199-K-21 at 39.2 pCi/L in October 2004.
- Tritium was above the 20,000 pCi/L MCL in three pump-and-treat area wells. The highest concentration was 43,000 pCi/L in extraction well 199-K-120A.

3.3.3.1 Chromium Monitoring Results

Chromium concentrations are monitored in extraction wells, compliance wells, monitoring wells and aquifer tubes in the pump-and-treat operational area. Additional CERCLA monitoring wells outside of the area affected by pump-and-treat operations are also sampled for chromium.

The 100-K Area chromium plume and associated historical trends for 2004 are displayed in Figure 3-7. The table below compares the CY03 versus CY04 averaged chromium analytical results for extraction wells, compliance wells, and selected monitoring wells where the reported values exceeded the 22 µg/L RAO or the percent change was greater than 20%. The results shown are for filtered hexavalent chromium, unless indicated otherwise:

Well Name	Well Use	CY03 Average (µg/L)	CY04 Average (µg/L)	Percent Change[a]
199-K-18	Compliance	123.8	136.3	+10%
199-K-19	Monitoring	78.5	66.5	-15%
199-K-20	Compliance	68.8	54.8	-20%
199-K-21	Monitoring	38	25.7	-32%
199-K-22	Monitoring	140	128.5	-8%
199-K-32A	Monitoring	12.4[c]	20.5[c]	+65%
199-K-37	Monitoring	73	84.0	+15%
199-K-113A	Extraction	68.2	51.0	-25%
199-K-114A	Compliance	66.5	65.4	-2%
199-K-115A	Extraction	107.7	83.0	-23%
199-K-116A	Extraction	122.5	80.7	-34%
199-K-117A	Compliance	9.7	7.1	-27%

Well Name	Well Use	CY03 Average (µg/L)	CY04 Average (µg/L)	Percent Change[a]
199-K-119A	Extraction	49.8	37.0	-26%
199-K-120A	Extraction	77	71.5	-7%
199-K-125A	Extraction	45	37.0	-18%
199-K-126[b]	Extraction	105	93.5	-11%
199-K-127	Extraction	66	54.5	-17%
199-K-129	Extraction	67.5	52.5	-22%
199-K-130	Monitoring	60.2	92.9	+54%
199-K-131	Monitoring	--	63.0	NA

[a] Percent change = (CY04 - CY03) / CY03 x 100%. >+20% = increasing and <-20% = decreasing. Stable = -20% to +20%.
[b] Well 199-K-126 converted to extraction well (from compliance well) in November 2004.
[c] Filtered total chromium.
-- = well not sampled or analytical results not available for report preparation
NA = not applicable

Chromium concentrations decreased from 2003 to 2004 in all nine of the extraction wells and decreased 20% or more in five of the extraction wells. Chromium concentrations increased in one compliance well (by 10% in well 199-K-18) and decreased in three compliance wells, to a maximum of 27% in well 199-K-117A. Chromium trends in the monitoring wells were varied. About one-half of the wells showed a decrease and one-half of the wells showed an increase from 2003 to 2004. The largest decrease was 32% in well 199-K-21, and the maximum increase was 65% in well 199-K-32A.

Aquifer tube sites at 100-KR-4 were sampled during late February and early March 2004. These sites are located along the river and are adjacent to the reactors and the 116-K-2 Trench area. The largest chromium concentration measured in CY04 was 67.2 µg/L at tube DK-04-03, which is located approximately 750 m downriver of the northeast end of the 116-K-2 Trench. Of the total aquifer tubes sampled in CY04, nine sites exceeded the 22 µg/L RAO.

3.3.3.2 Co-Contaminant Monitoring Results

Strontium-90 and tritium are listed in the 100-KR-4 ROD (EPA et al. 1996) as co-contaminants. Nitrate and carbon-14 are contaminants of interest that also are monitored as part of the CERCLA sampling program. The co-contaminant monitoring results are summarized as follows:

- **Strontium-90:** One compliance well (199-K-114A), three monitoring wells (199-K-19, 199-K-21, and 199-K-22), and two extraction wells (199-K-113A and 199-K-115A) were characterized by strontium-90 above the 8 pCi/L MCL. The maximum 2004 strontium-90 concentration was 39.2 pCi/L in monitoring well 199-K-21. The overall trend is somewhat downward, with six wells showing a concentration decrease, three wells showing an increase, six wells showing nondetects, and the remaining three wells are without CY03 data for comparison. The maximum increase was 27% in monitoring well 199-K-127; the maximum decrease was 33% in well 199-K-120A. The 2003 versus 2004 results for selected wells and percent change are summarized in the table below:

Well	Type	CY03 Sr-90 (pCi/L)[c]	CY04 Sr-90 (pCi/L)[c]	Percent Change[d]
199-K-18	Compliance	0.2(U) (±0.21)	0.2(U) (±0.3)	NA
199-K-19	Monitoring	[a]	10.3 (±0.8)	NA
199-K-20	Compliance	6.4 (±1.1)	5.8 (±0.6)	-9%
199-K-21	Monitoring	a	39.2 (±1.4)	NA
199-K-22	Monitoring	7.1 (±1.2)	8.9 (±0.8)	+25%
119-K-113A	Extraction	11.5 (±2.8)	9.8 (±2.0)	-3%
199-K-114A	Compliance	20.2 (±3.1)	19.2 (±1.0)	-5%
199-K-115A	Extraction	8.8 (±2)	9.2 (±1.8)	+7%
199-K-116A	Extraction	5.6 (±1.1)	3.4 (±0.8)	-31%
199-K-117A	Compliance	2.2[b] (±0.49)	2.0 (±0.4)	-9%
199-K-119A	Extraction	[a]	-0.04(U) (±0.4)	NA
199-K-120A	Extraction	1.4 (±0.5)	0.9 (±0.5)	-33%
199-K-125A	Extraction	[a]	-0.2 (±0.4)	NA
199-K-126A[e]	Extraction	[a]	0.2(U) (±0.5)	NA
199-K-127	Extraction	3.0 (±1.6)	3.2 (±0.8)	+27%
199-K-129	Extraction	[a]	-0.04(U) (±0.4)	NA
199-K-130	Monitoring	-0.2 (U) (±0.2)	0.2(U) (±0.3)	NA
199-K-131	Monitoring	[a]	0.2(U) (±0.3)	NA

[a] Not sampled during 2003.
[b] Averaged result.
[c] Results rounded to one decimal place. Numbers in parentheses represent counting error.
[d] (2004 - 2003) / 2003 x 100%. >+20% = increasing and <-20% = decreasing. Stable = -20% to +20%.
[e] Well 199-K-126 was converted to an extraction well (from compliance well) in November 2004.
NA = percent change not applicable because of nondetect or not sampled previous year
U = nondetected in sample above contracted detection limit

Strontium-90 was only detected at four aquifer tube sites that were sampled. The maximum level was 1.38 pCi/L in aquifer tube 21-M, downgradient of the 116-K-2 Trench.

- **Tritium:** Four of the wells sampled for tritium had concentrations above the 20,000 pCi/L MCL in CY03, while only three wells were above the MCL in CY04. The CY03 tritium results are compared to the CY04 results in the table below for the four wells that were above 20,000 pCi/L in 2003. The overall tritium trend showed a strong decline in CY04.

Well	Type	CY03 Tritium (pCi/L)	CY04 Tritium (pCi/L)	Percent Change[a]
199-K-18	Compliance	44,275 (±2,600)	34,850 (±540)	-21%
199-K-32A	Monitoring	51,375 (±2,075)	29,300 (±645)	-43%
199-K-111A	Monitoring	46,460 (±1,940)	16,175 (±478)	-65%
199-K-120A	Extraction	64,950 (±9,750)	43,000 (±8,600)	-34%

[a] (2004 – 2003) / 2003 x 100%. >+20% = increasing and <-20% = decreasing. Stable = -20% to +20%.

It is important to note that all of the wells listed above are located at the western end of the 116-K-2 Trench. The source of this tritium may be the 116-K-2 Trench and/or a previously unknown plume beneath the 100-K burial ground that has been displaced to the west by the mounding created by the injection network (PNNL 2002).

Of the wells sampled for tritium in CY04, well 199-K-106A had a concentration of 389,600 pCi/L, which is a decrease of 36% from the CY03 value of 612,000 pCi/L. The CY03 and CY04 results for the wells in the 100-K Reactor areas that were above the 20,000 pCi/L MCL are summarized in the table below:

Well	Type	CY03 Tritium (pCi/L)	CY04 Tritium (pCi/L)	Percent Change[a]
199-K-27	Monitoring	69,448 (±961)	50,675 (±860)	-27%
199-K-29	Monitoring	17,530 (±815)	32,925 (±688)	+88%
199-K-30	Monitoring	264,550 (±10,725)	370,833 (±2,050)	+40%
199-K-32A	Monitoring	51,375 (±2,075)	29,300 (±645)	-43%
199-K-106A	Monitoring	612,000 (±21,640)	389,600 (±2,340)	-36%
199-K-109A	Monitoring	44,000 (±1,850)	32,775 (±650)	-26%

[a] (2004 - 2003) / 2003. >+20% = increasing and <-20% = decreasing. Stable = -20% to +20%.

The maximum tritium concentration for aquifer tubes sites sampled was 11,900 pCi/L at AT-K-3, downgradient from the 116-K-2 Trench.

- **Carbon-14:** All of the wells sampled for Carbon-14 are located outside the pump-and-treat area. The maximum concentration of 2,510 pCi/L was detected in well 199-K-29. The carbon-14 concentration trend varied in these wells from 2003 to 2004. The maximum carbon-14 concentrations in 2003 and 2004 and the annual changes are summarized in the table below for the two wells above the MCL of 2,000 pCi/L:

Well	Type	CY03 C-14 (pCi/L)	CY04 C-14 (pCi/L)	Percent Change[a]
199-K-29	Monitoring	2,620 (±98)	2,510 (±25)	-4%
199-K-34	Monitoring	3,050 (±110)	2,340 (±24)	-23%

[a] (2004 - 2003) / 2003 x 100%. >+20% = increasing and <-20% = decreasing. Stable = -20% to +20%.

Carbon-14 was only detected at two of the aquifer tube sites sampled. Site AT-K-1 had the highest at a level at 22.5 pCi/L, while AT-K-2 had a concentration of 20.1 pCi/L. Both sites are located downgradient from the K East Reactor.

- **Nitrate:** The maximum nitrate concentration for wells sampled within the pump-and-treat area was 91.2 mg/L in compliance well 199-K-18. Nearby well 199-K-111A was also above the MCL at 52.5 mg/L nitrate; however, the other wells in the pump-and-treat area all had nitrate concentrations below the MCL of 45 mg/L. The CY03 and CY04 concentrations in the 10 wells and the percent change are summarized in the table below (note that all concentrations are reported as nitrate):

Well	Type	CY03 NO_3 (mg/L) (as Nitrate)	CY04 NO_3 (mg/L) (as Nitrate)	Percent Change[b]
199-K-18	Compliance	96.2	91.2	-5%
199-K-19	Monitoring	23.0	34.5	+50%
199-K-20	Compliance	11.1	11.5	+4%
199-K-21	Monitoring	[a]	29.0	N/A
199-K-22	Monitoring	15.9	16.8	+6%
199-K-32A	Monitoring	24.2	28.1	+16%
199-K-32B	Monitoring	9.5	8.9	-6%
199-K-37	Monitoring	11.1	10.2	-8%
199-K-111A	Monitoring	52.0	52.5	+1%
199-K-117A	Compliance	8.4	7.1	-15%

[a] Not sampled in 2003.
[b] (2004 - 2003) / 2003 x 100%. >+20% = increasing and <-20% = decreasing.
Stable = -20% to +20%.
NA = data not available for year to year comparison

Samples from monitoring wells in the reactor areas were also analyzed for nitrate in 2004. The concentrations ranged from 7.5 mg/L in well 199-K-110A to 113.5 mg/L in well 199-K-106A. Four of the wells had concentrations above the 45 mg/L MCL, including well 199-K-108A. This well had low concentrations (0.3 mg/L) of nitrate in CY03 but much higher concentrations (75.9 mg/L) in CY04. Septic system drain fields and decontamination solutions containing nitric acid are the possible sources of this contaminant.

- **Technetium-99 and sulfate in aquifer tubes:** Technetium-99 was detected only at aquifer tube site 14-D at a concentration of 119 pCi/L. This site is located upriver of the reactor area. The MCL for technetium-99 is 900 pCi/L.
- **Sulfate:** The maximum sulfate concentration was 69.7 mg/L in aquifer tube 26-D. This site is located the farthest downriver from the 116-K-2 Trench. The secondary drinking water MCL for sulfate is 250 mg/L).

Appendix G presents sample results for CY04 as well as a historical summary of contaminant and co-contaminant monitoring results for wells and aquifer tubes. Associated contaminant trend charts are presented in Appendix K.

3.4 QUALITY CONTROL RESULTS FOR 100-K MONITORING DATA

The QC results for the 100-K sampling included field testing or laboratory testing for hexavalent chromium and total chromium. Additionally, laboratory tests were run for strontium-90 and tritium.

A summary of QC data for 100-KR-4 in CY04 are summarized in the table below. A complete listing of QC results is found in Appendix I.

Type Quality Control Sample	Number of Pairs	Number of Pairs <20% RPD	Percent <20% RPD
Field replicates (hexavalent chromium)	13	12	92%
Field/laboratory split (hexavalent chromium)	23	21	91%
Laboratory replicates (total chromium)	22	12	55%
Laboratory replicates (nitrate)	4	4	100%
Offsite/onsite laboratory splits (nitrate)	2	2	100%
Laboratory replicates (strontium-90)	4	3	75%
Offsite/onsite laboratory splits (strontium-90)	5	5	100%
Laboratory replicates (tritium)	4	4	100%
Offsite/onsite laboratory splits (tritium)	3	0	0%

The EPA's functional guideline for field-tested replicates is an RPD of <20% (EPA 1988). All field replicates, with the exception of one (with a RPD of 43%), satisfied this requirement. There are no functional guidelines for split results or laboratory replicates. All QC results are satisfactory, except the laboratory replicates for total chromium and the laboratory splits for tritium. The tritium split QC results can be considered marginally acceptable because, even though all RPDs were above 20% (the largest RPD was 26.5%), the results were just above the acceptable limit of 20%. The QC results indicate that total chromium results are not consistent between onsite (i.e., Hanford) and offsite laboratories. Since offsite laboratories were seldom used to analyze data, the results of the analyses should be accepted.

3.5 CONCLUSIONS

- ***RAO #1: Protect aquatic receptors in the river bottom substrate from contaminants in groundwater entering the Columbia River.***

  The RAO cleanup goal for compliance wells is 22 µg/L based on the 11 µg/L ambient water quality criterion in place at the time of the signing of the ROD (EPA et al. 1996).

  Results:

  – Approximately 500 million L of groundwater were treated during 2004, and 29.6 kg of hexavalent chromium were removed.

  – Chromium concentrations decreased in all extraction wells but remained above the RAO of 22 µg/L in all of the extraction wells. The maximum chromium concentration in an extraction well was 93.5 µg/L in well 119-K-126. This well is the most recent extraction well, having been converted from a compliance well in

January 2003. Chromium concentrations decreased in three of four compliance wells and remained above the RAO of 22 µg/L in wells199-K-18, 199-K-20, and 199-K-114A. The maximum chromium concentration in a compliance well was 136.3 µg/L in well 199-K-18; the lowest was 7.1 µg/L in well 199-K-117A.

- The two farthest downstream monitoring wells, 199-K-130 and 199-K-131, had average 2004 chromium concentrations of 92.9 µg/L and 63 µg/L, respectively, indicating that the plume extends toward the northeast.
- The maximum strontium-90 concentration in the pump-and-treat area of influence was at compliance well 199-K-21. The concentration was 39.2 pCi/L for strontium-90 in 2004.
- Three pump-and-treat area wells had tritium concentrations above the 20,000 pCi/L MCL. The wells showed concentration decreases of between 21% and 43% from the CY03 levels. The maximum concentration was 43,000 pCi/L in extraction well 199-K-120A, which is a decrease of 34% compared to 2003.
- The area enclosed by the 100 µg/L chromium isopleth has remained the same size since November 2003 but has decreased in size when compared to the 1995 baseline 100-K Area chromium plume.
- Monitoring well 199-K-131 was installed in March 2004 to supplement characterization of the downstream portion of the chromium plume. Analytical results from this well indicate that the chromium plume extends toward the northeast but at decreasing concentrations when compared to well 199-K-130.

• ***RAO #2: Protect human health by preventing exposure to contaminants in groundwater.***

  Result: The interim remedial action ROD establishes a variety of institutional controls that must be implemented and maintained throughout the interim action period. These provisions include some of the following:

  - Access control and visitor escorting requirements
  - Signs providing visual identification and warning of hazardous or sensitive areas (new signs were placed along the river and at major road entrances at each reactor area)
  - Excavation permit process to control all intrusive work (e.g., well drilling and soil excavation)
  - Regulatory agency notification of any trespassing incidents.

  The effectiveness of institutional controls was presented in the *2004 Final Institutional Controls (IC) Assessment Report* (DOE-RL 2004a). The findings of the report indicate that institutional controls were maintained to prevent public access, as required.

• ***RAO #3: Provide information that will lead to a final remedy.***

  Results: Operational data and improvements, as well as special studies and technical reviews, provide information that should contribute to a final remedy. Progress during 2004 included the following:

- Improved cost efficiency in operation of the existing 100-KR-4 treatment plant achieved during 2004 makes pump-and-treat operations more attractive as one potential component of a final remedy. Also, information from the new MR3 pilot plant tested in the 100-D Area during 2004 suggests that further reductions in IX column treatment costs may be possible.
- A DOE-sponsored expert panel/workshop on evaluation of pump-and-treat operations at the Hanford Site was held during 2004. Findings for 100-KR-4 included the need for improved modeling to better understand the distribution of hexavalent chromium in the aquifer. Improved transport modeling may help decide which portions of the contaminated aquifer are amenable to pump-and-treat and which are not. Other considerations were discussed in a final report.
- Plans were made during 2004 to field test a new technology, in situ/ex situ calcium polysulfide treatment, at 100-KR-4. If successful, this technology will be considered for use as part of a treatment train that may be appropriate for a final remedy.
- Related to the above, consideration was given to soil column treatment (deep vadose zone source control) using soil flushing or fixation in-place with reducing agents as one potential piece of a final remedy treatment train.

3.6 RECOMMENDATIONS

- Implement the expert panel's recommendations to conduct numerical modeling of hexavalent chromium transport in groundwater during reactor operations and during the post-shutdown period to the present time. This information will help in developing a long-term strategy and remedy to address the widely distributed, but relatively low, hexavalent chromium concentrations in the vicinity of the 116-K-2 Trench and the surrounding area.
- Rehabilitate existing boreholes and or use other low-cost drilling methods to better delineate the distribution of the chromium plume to the east and northeast of the mile-long trench. Numerical modeling can be used to select optimum location(s) for new test borings.
- Evaluate application of the calcium polysulfide in situ/ex situ method for treatment of the hexavalent chromium hot spot near the KW Reactor building.
- Evaluate technologies that can be used to identify a possible chromium source in the 100-KW and 100-KE reactor area.

Figure 3-1. Location of the 100-KR-4 Operable Unit.

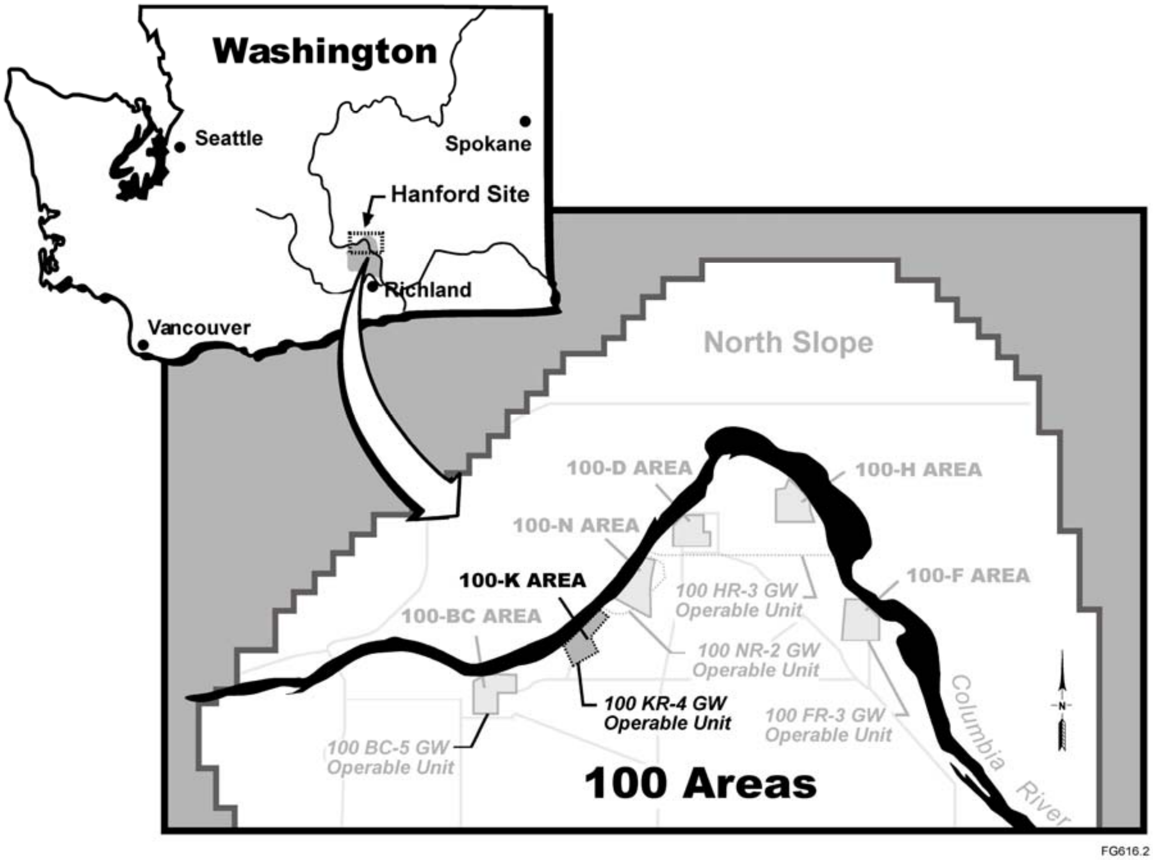
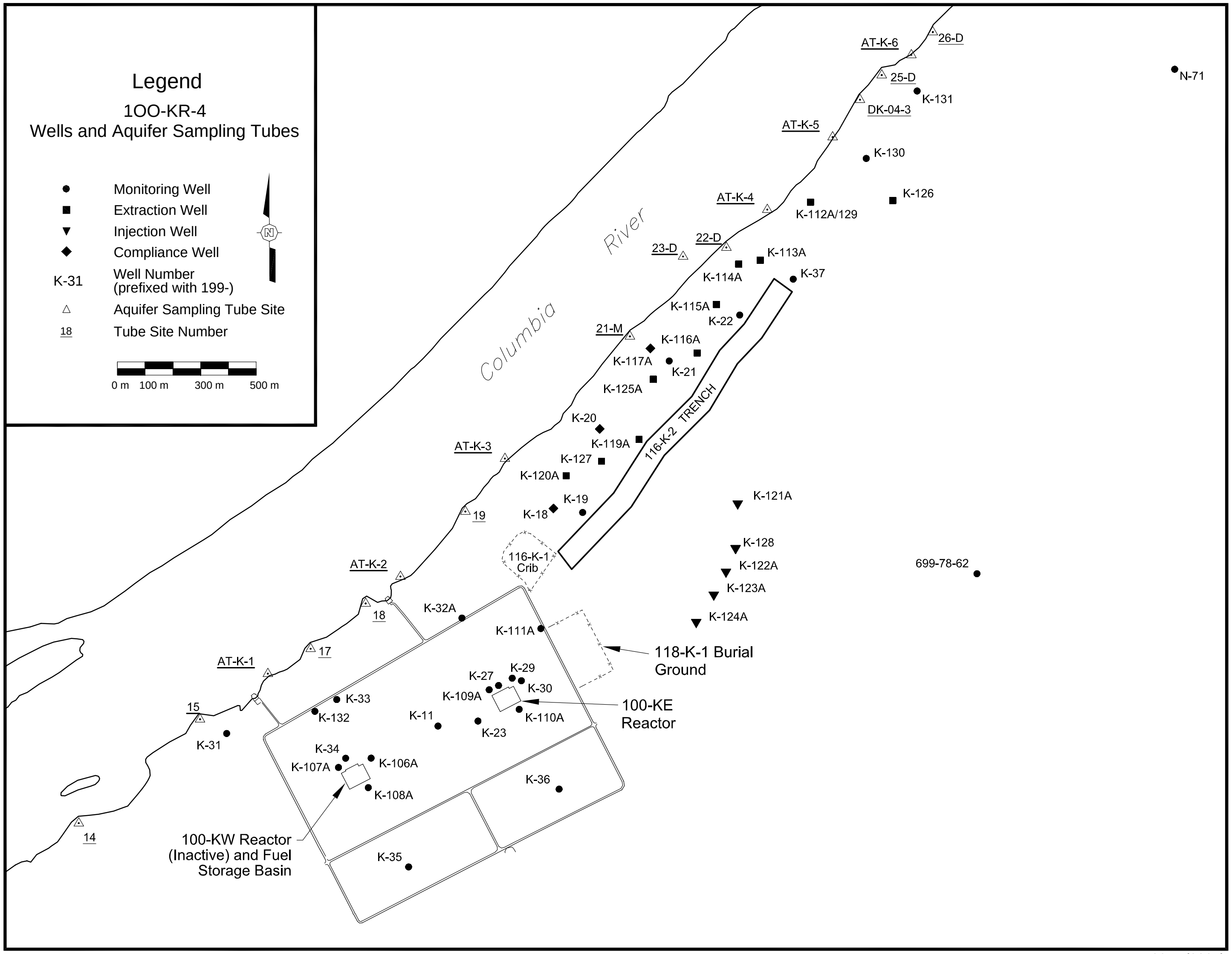
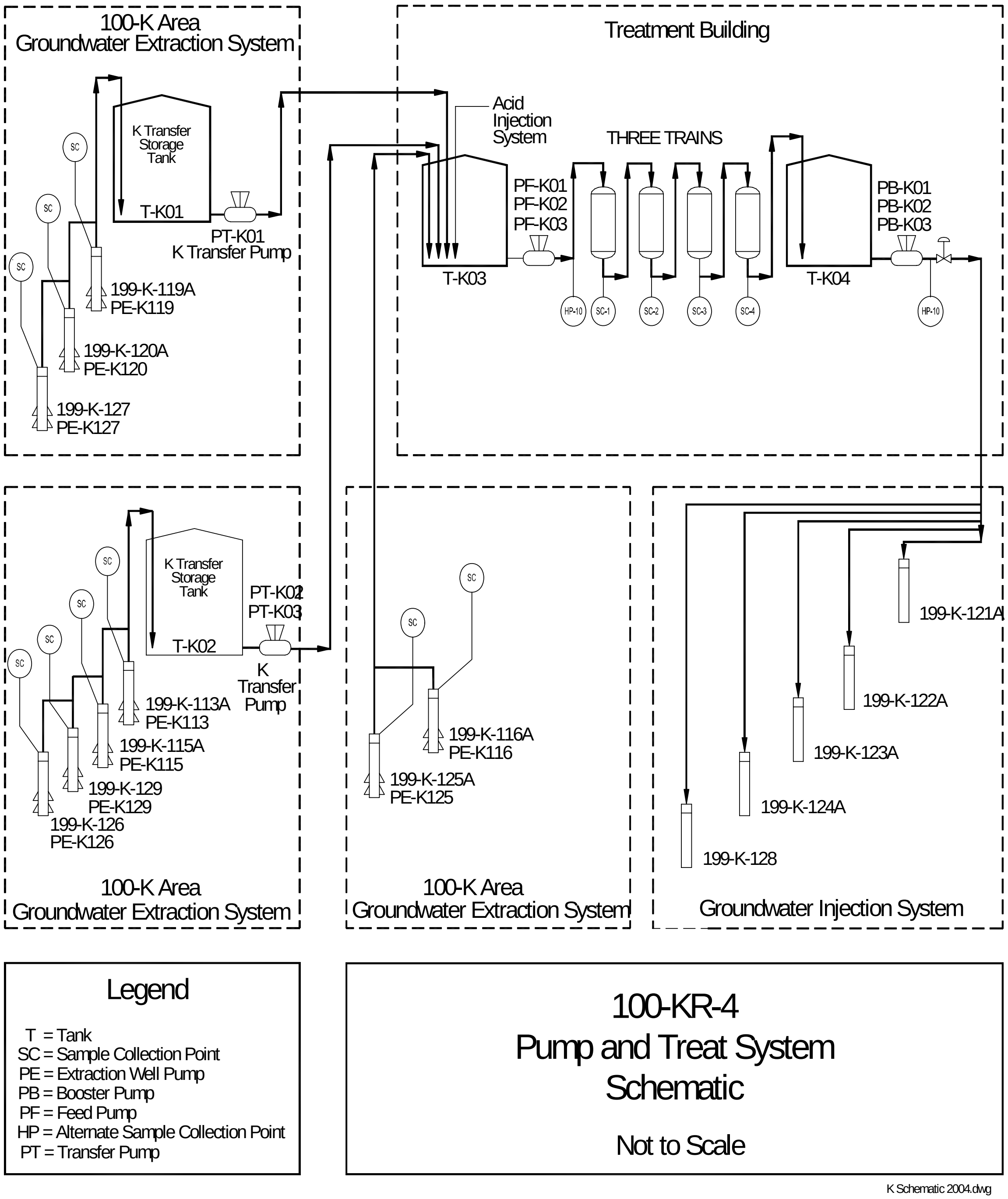


Figure 3-2. 100-KR-4 Operable Unit Wells and Aquifer Sampling Tubes.



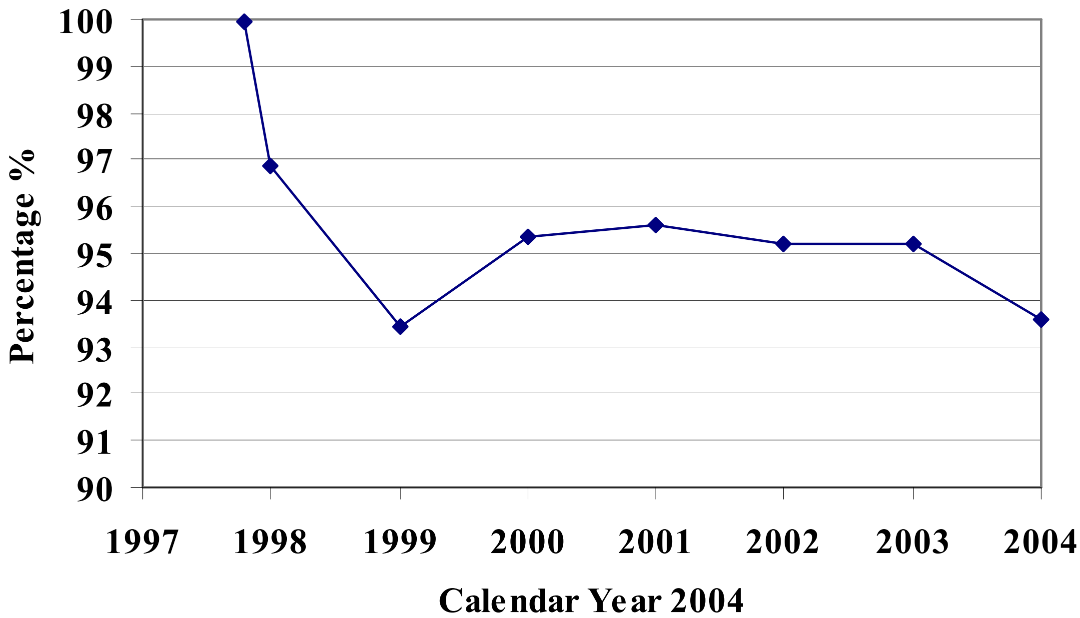
100-K (2005)

Figure 3-3. 100-KR-4 Operable Unit Pump-and-Treat System Schematic.



NOTE: Monitoring well 199-K-114A was converted to an extraction well in late November 2004.

Figure 3-4. 100-KR-4 Pump-and-Treat Trends of Average Removal Efficiencies.



Average removal efficiency (% by mass) = [(influent – effluent) / influent].

Figure 3-5. 100-KR-4 Pump-and-Treat Trends of Influent and Effluent Hexavalent Chromium Concentrations, Calendar Year 2004.

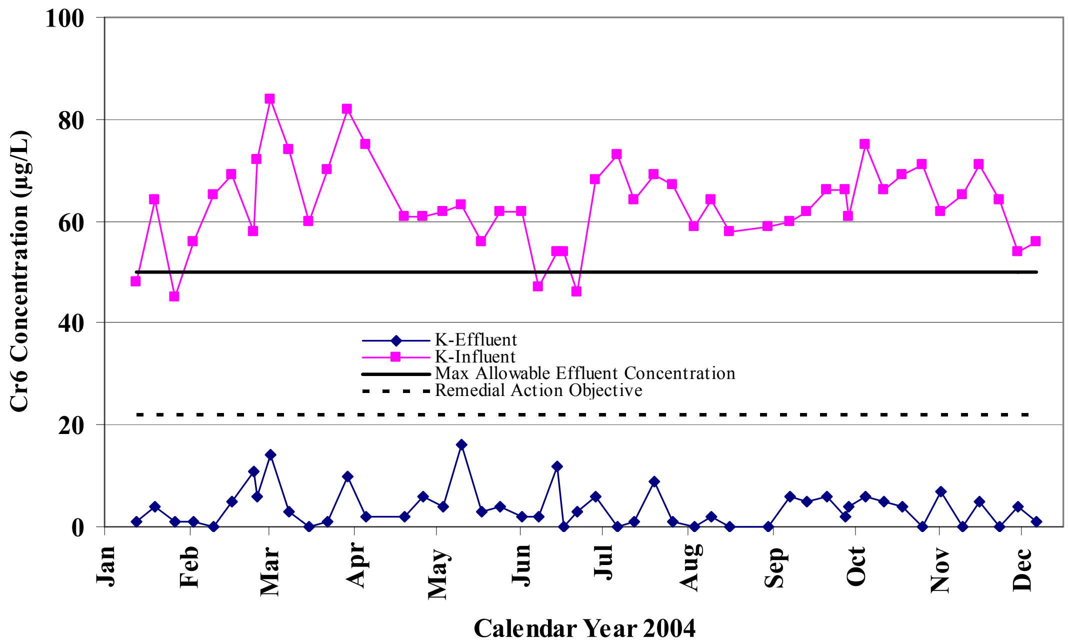
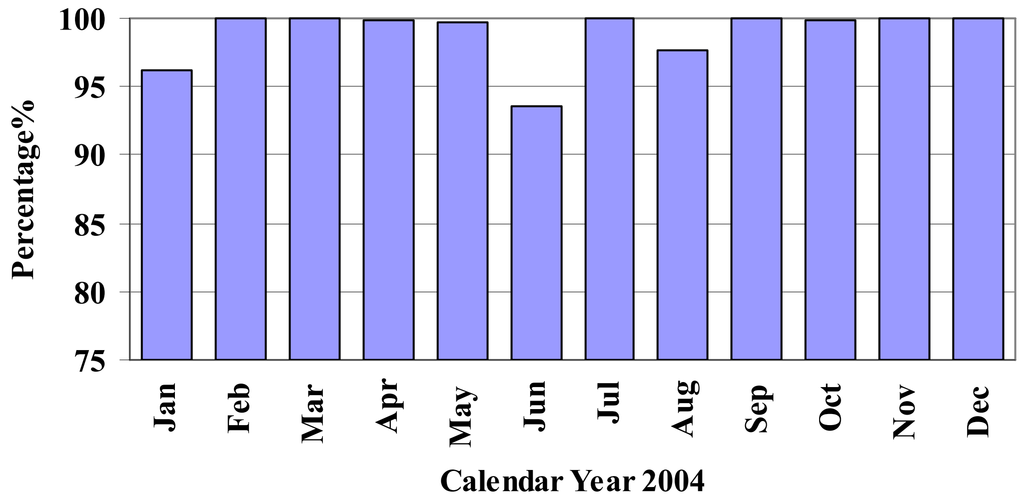


Figure 3-6. 100-KR-4 System Availability and On-Line Percentages for Calendar Year 2004.



Summary of system availability:	
Total possible run-time (hours)	8,784
Scheduled downtime (hours)	277.5
Planned operations (hours)	8,506.5
Unscheduled downtime (hours)	76
Total time on-line (hours)	8,431
Total availability (%)	95.9
Scheduled system availability (%)	99.1

Scheduled system availability [(total possible run-time – unscheduled downtime) / total possible run-time].

Total availability [(total possible run-time – scheduled and unscheduled downtime) / total possible run-time)].

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Figure 3-7. 100-KR-4 Chromium Plume, Fall 2004.

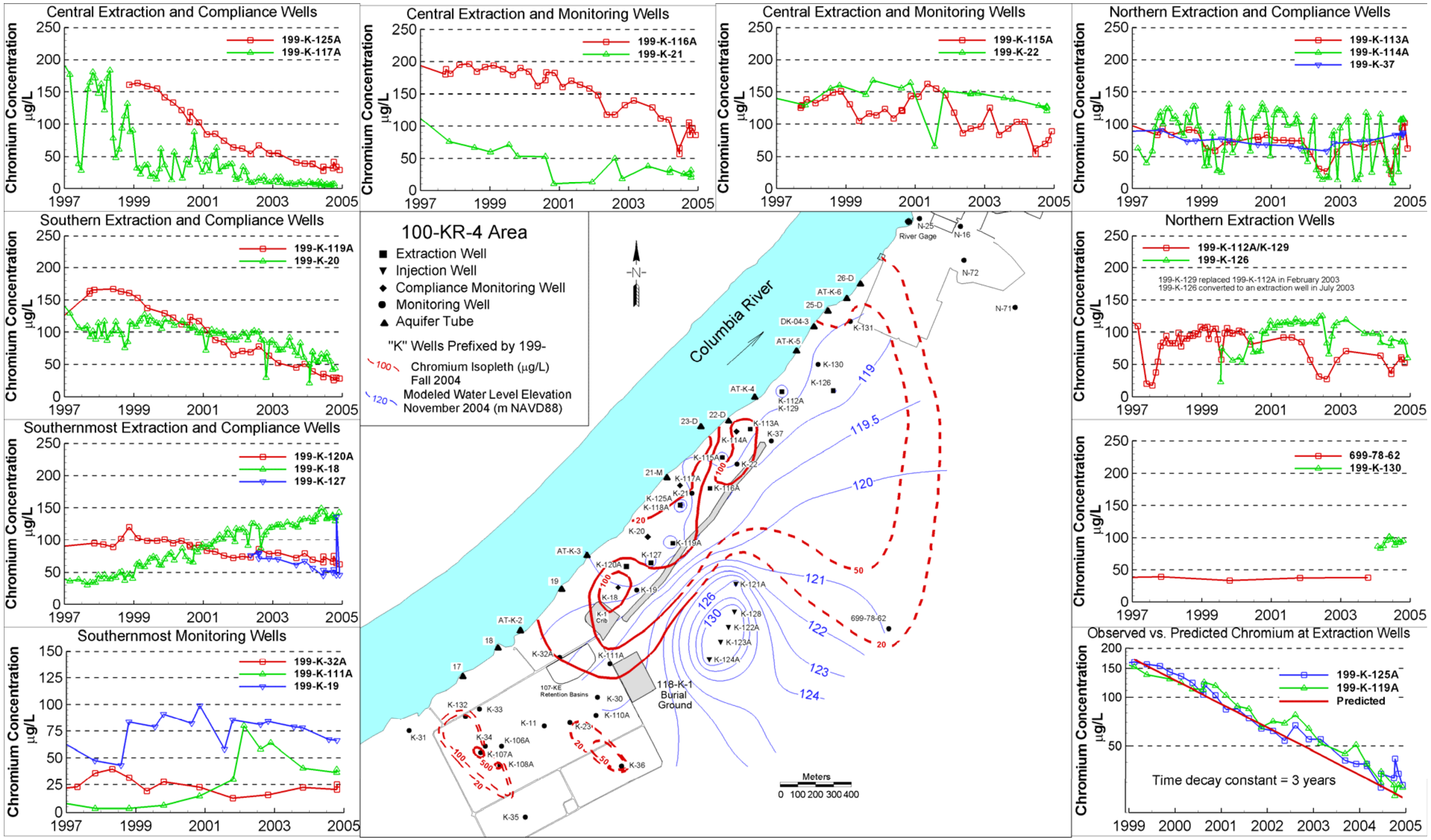

Figure 3-8. Water Elevation Versus Distance from the Columbia River in 100-K Area Wells.

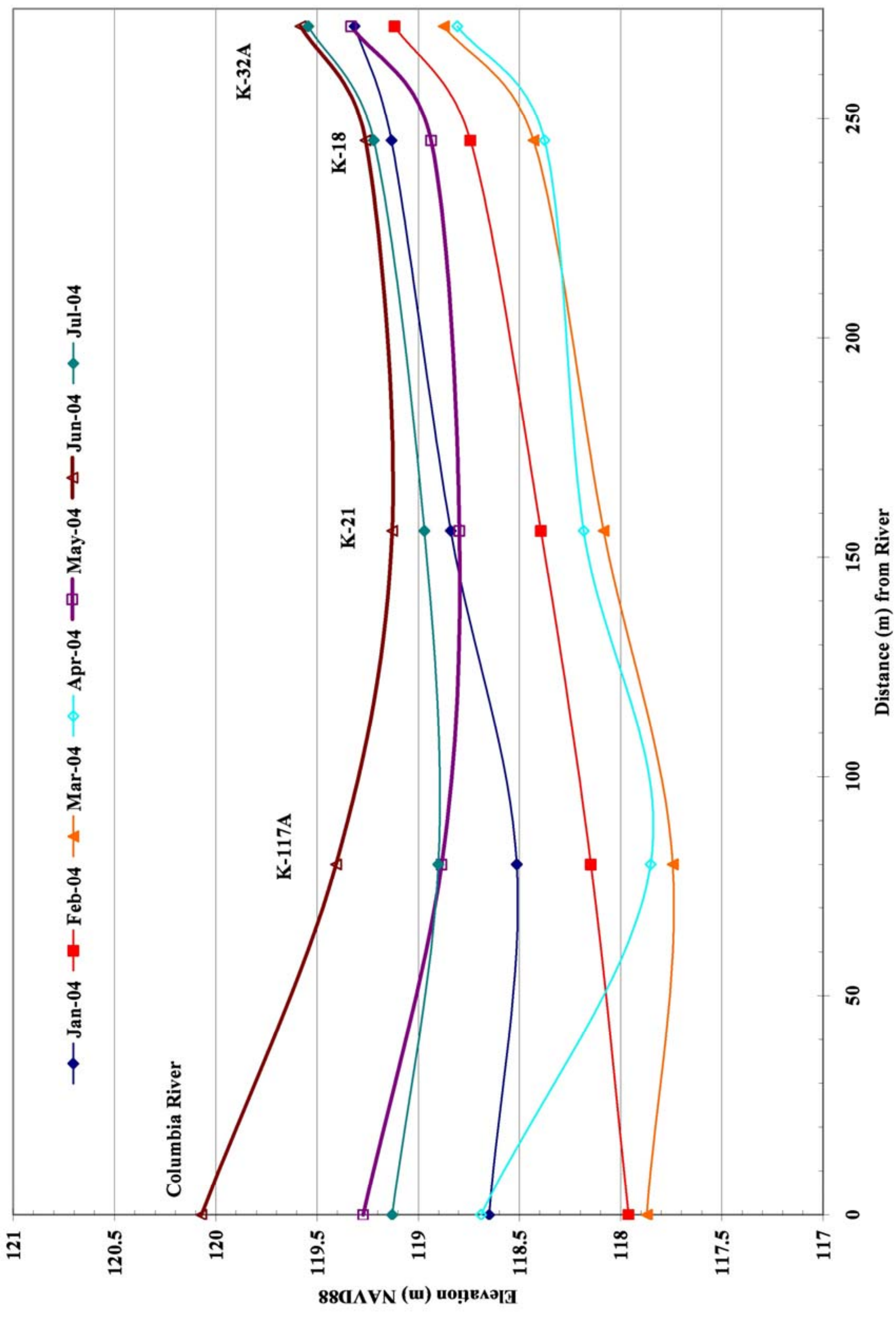

Figure 3-9. Estimated Steady-State Hydraulic Capture Zone Developed by 100-KR-4 Operable Unit Extraction Wells.

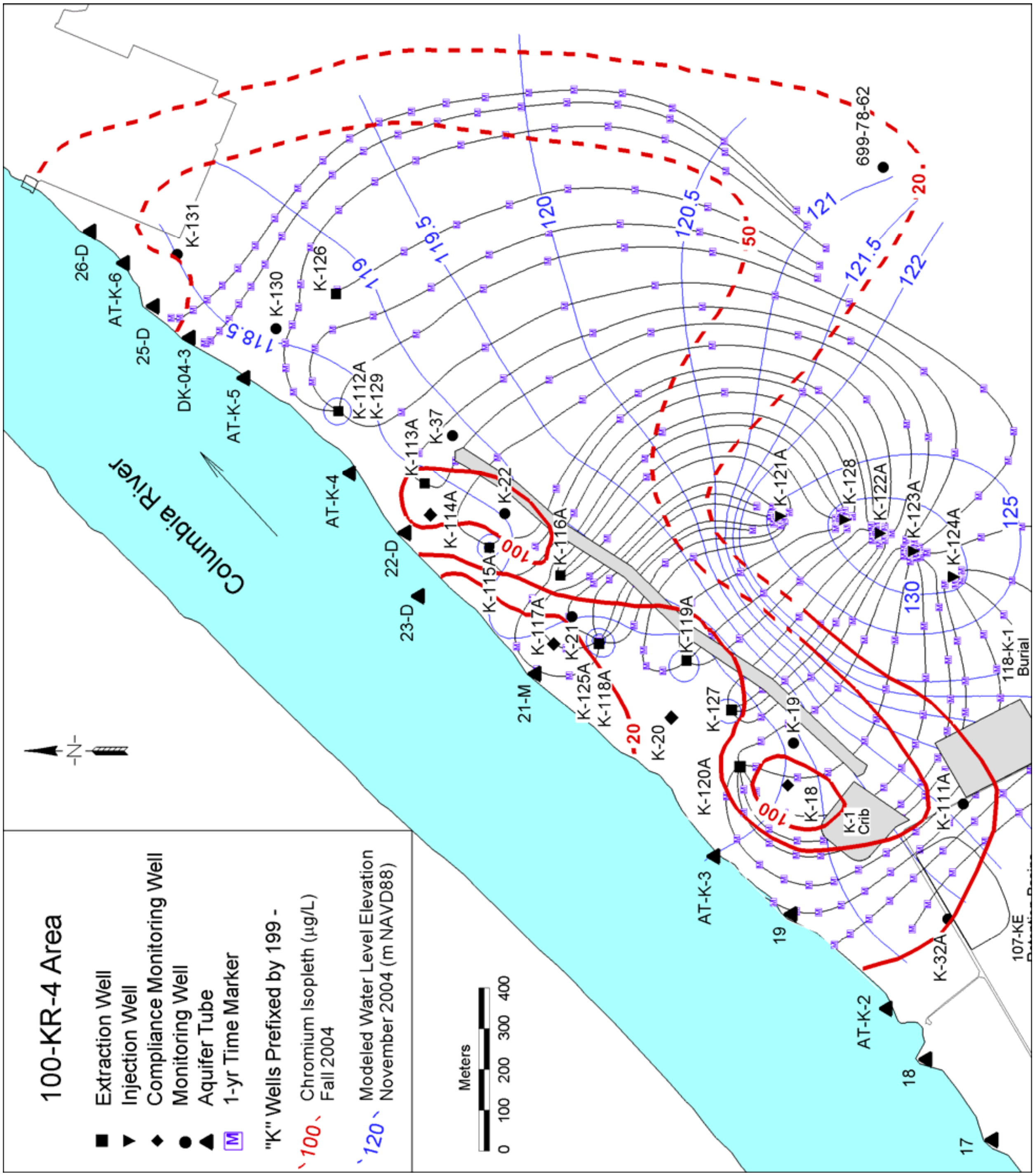

Table 3-1. 100-KR-4 Water-Level Data Used to Develop and Calibrate Numerical Groundwater Flow Models.

Well	Model Analysis, Nov. 2004		Measured Water-Level Elevation, Nov. 2004 (m NAVD88[a])	Modeled Water-Level Elevation, Nov. 2004 (m NAVD88[a])
	Extraction Rate L/min	Injection Rate L/min		
199-K-129	98.4	--	117.89	116.39
199-K-113A	56.8	--	116.62	116.31
199-K-115A	164.7	--	115.91	115.42
199-K-116A	170.3	--	118.42	118.64
199-K-119A	113.6	--	116.64	116.12
199-K-125A	151.4	--	118.28[b]	114.84[c]
199-K-126	60.6	--	119.20	118.12
199-K-127	132.5	--	117.00	116.51
199-K-120A	151.4	--	117.93	117.94
199-K-121A	--	200.6	121.44	132.36
199-K-122A	--	232.8	125.21	147.44
199-K-123A	--	249.8	129.87	150.71
199-K-124A	--	81.4	127.09	138.35
199-K-128	--	259.3	126.49	143.83
199-K-18	--	--	118.59	118.59
199-K-19	--	--	118.67	118.78
199-K-20	--	--	118.38	118.19
199-K-21	--	--	118.39	118.55
199-K-22	--	--	118.32	118.59
199-K-37	--	--	118.70	118.86
199-K-114A	--	--	118.97	118.38
199-K-117A	--	--	118.40	118.43
199-K-118A	--	--	117.30	117.17

[a] NAVD88, 1983, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland.

-- = No data available

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4.0 100-NR-2 PUMP-AND-TREAT SYSTEM

The 100-NR-2 Groundwater OU is located along the Columbia River between the 100-KR-4 OU and the 100-HR-3 OU (Figure 4-1). The 100-NR-2 OU consists of the groundwater underlying and in the vicinity of the source OUs that are associated with the 100-N Area. The 100-NR-2 pump-and-treat system is currently operating to reduce the flux of contaminated groundwater to the Columbia River and to remove strontium-90 from the aquifer. Figure 4-2 shows the location of the extraction and injection wells and the associated compliance and monitoring wells in relation to the primary facilities. Appendix A provides a history of operations and supporting documents used in the development of the 100-NR-2 pump-and-treat system.

This section provides the annual performance report for the 100-NR-2 pump-and-treat system required by the *Interim Remedial Action Record of Decision (ROD) Declaration, USDOE Hanford 100 Area, 100-NR-1 and 100-NR-2 Operable Units, Hanford Site* (EPA et al. 1999). The purpose of this section is to report treatment system and aquifer performance data collected during 2004 and to describe progress toward meeting the goals described in the ROD.

The following subsections summarize and evaluate the performance of the pump-and-treat system, the response of the aquifer in relation to these goals, and the OU contaminants. Section 4.1 provides a brief overview summary of activities pertaining to the 100-NR-2 pump-and-treat system and the source area remedial actions that have occurred within the OU for CY04. Section 4.2 focuses on treatment system performance. Section 4.3 describes aquifer response, including the baseline conditions, hydraulic effects, numerical modeling, contaminant changes during the pump-and-treat operations, and contaminant distributions and trends throughout the OU. Section 4.4 presents the updated conceptual model. Section 4.5 discusses the QC of the analytical samples. Conclusions and recommendations are presented in Section 4.6. Cost information is presented separately in Section 5.0.

4.1 SUMMARY

Progress on source removal and groundwater remediation activities for CY04 is summarized below.

4.1.1 100-NR-1 Operable Unit

The interim action ROD (EPA et al. 1996) requires that the most significant soil contamination in the 100-NR-1 OU be addressed first. Cleanup of the remaining surface and subsurface sites will occur in the future in order of priority, as established by the regulatory agencies. The status and activities at the most contaminated soil sites include the following:

- Cleanup of the major strontium-90 source areas, the 116-N-1 and 116-N-3 Cribs, continued during the year. Excavation to a depth of approximately 4.6 m bgs was completed at 116-N-3 and was nearly complete at 116-N-1.
- The excavated 116-N-3 Crib was backfilled and contoured to match the adjacent undisturbed topography. The mounded or sloped surface of the backfill should reduce infiltration of moisture into the underlying vadose zone.

4.1.2 100-NR-2 Operable Unit

The activities required for the 100-NR-2 OU by the interim ROD to address strontium-90 and other contaminants in groundwater near the source areas consist of (1) operating a pump-and-treat system, (2) maintaining a groundwater monitoring network for tracking changes in contaminant concentrations, (3) investigating alternative treatment technologies, (4) assessing ecological risk of contaminated groundwater, and (5) removing any free product (e.g., diesel) in monitoring wells. The progress for these activities during CY04 is outlined below:

- The pump-and-treat system removed approximately 0.2 Ci during the year, for a total of 1.6 Ci, or only about 2% of the aquifer inventory since the beginning of operations in 1995. Maintenance and repair frequency increased, and a decline in removal efficiency during the year required more frequent changeout of the spent IX media, resulting in an increase in operating costs. The marginal effectiveness of the pump-and-treat remedy to reduce near-shore strontium-90 concentrations in groundwater and increasing operating costs suggest that termination of the pump-and-treat operations should be given serious consideration.
- Network monitoring well data indicate very little change in strontium-90 concentrations compared to prior years, especially near the shoreline. Also, three new wells near the shoreline and aquifer tubes were installed by Pacific Northwest National Laboratory (PNNL) to support an evaluation of the effectiveness of pump-and-treat to reduce the flux of strontium-90 to the river. Elevated manganese and iron persist in well 199-N-18, which is attributed to biodegradation of residual diesel in the aquifer that creates anoxic (reducing) conditions.
- A letter report on the evaluation of alternative strontium-90 treatment technologies was completed in October 2004 (bhi-erc.com/projects/risk/risk_library.htm) and was submitted to the Washington State Department of Ecology (Ecology). A public workshop was held on December 8, 2004, to discuss the findings and recommendations of the report. Laboratory and field studies were also conducted by PNNL to support the evaluation of a proposed treatment train that includes apatite sequestration (primary), phytoremediation (secondary), and natural attenuation. A treatability test plan based on the December 8 workshop and the supporting laboratory studies will be prepared in 2005. Installation of test facilities for one or more of the candidate treatment approaches is planned for 2006.
- A 100-NR-2 ecological risk data quality objectives (DQO) summary report and sampling and analysis plan (SAP), including reconnaissance sampling (spring 2004) to support the DQO process, were completed in CY04 (DOE-RL 2005a). The SAP will guide CY05 field work for an ecological risk report that is due in October 2005. Findings will also support decisions concerning the location and extent of alternative treatment needed to reduce shoreline concentrations of strontium-90 and possibly other COCs (e.g., diesel and the related occurrence of elevated manganese and iron).
- Diesel fuel was removed from the only remaining monitoring well (199-N-18) with observable free product. Diesel in grab samples of water collected during 2004 also appears to have declined in comparison to 2003 and prior years. In addition, the SAP for the ecological risk assessment includes petroleum hydrocarbon sampling (planned for 2005) along the shoreline near this spill site.

4.2 100-NR-2 TREATMENT SYSTEM PERFORMANCE

This section summarizes the CY04 treatment system operations and sampling activities. This information includes system availability, mass of contaminants removed during operations, contaminant removal efficiencies, and quantity and quality of extracted and disposed groundwater. Additional operational details are found in the associated appendices, as referenced in this report.

4.2.1 System Operation

The treatment facility includes an IX system that uses a natural zeolite (clinoptilolite) to remove strontium-90 from the extracted groundwater. In 2004, no major operational modifications were made that changed the performance of the pump-and-treat system. Figure 4-3 presents the current system process flow. A summary of operational parameters for CY04 and for total performance is as follows:

Total processed groundwater:	
Total since September 1995 startup (million L)	1,026.8
Total for CY04 (million L)	107.2
Mass of strontium-90 removed:	
Total since September 1995 startup (Ci)	1.63
Total for CY04 (Ci)	0.15
Average total flow rate of extraction wells for CY04 (L/min)	204
Average extraction well production range (L/min)	22 to 110
Average percent removal[a]	83
Summary of 2004 operational parameters:	
Total possible run-time (hours)	8,784
Scheduled downtime (hours)	337
Planned operation (hours)	8,447
Unscheduled downtime (hours)	830.5
Total time on-line	7,616.5
Total availability (%)	86.7
Scheduled system availability (%)	90.2

[a] Average percent removal, based upon the percent average removed each clino-period for CY04.

Key operational and system highlights for CY04 are as follows:

- The scheduled system availability of 90.2% for CY04 was lower than the 97.6% reported in CY03. The total availability was 86.7%, which was slightly lower than the 88.8% reported for CY03. The lower performance percentages were partially the result of a higher rate of unscheduled downtime in July 2004 and the increased changeout of the spent IX media. The monthly on-line percentages and method used to calculate scheduled and on-line availability are presented in Figure 4-4.
- The average percentage removal of strontium-90 during CY04 was 83% compared to 88.8% in CY03 and 90% in CY02. The lower removal efficiency during CY04 is attributed to the use of a different source of clinoptilolite than in previous years because

the old source was no longer available. Due to the decline in removal efficiency, which reached a low of 75% in August 2004, the changeout cycle was reduced from every 4 weeks to every 3 weeks. Another contributing factor to the loss in removal efficiency may be a change ionic composition of the extracted groundwater. For example, there are some indications that the sulfate plume from the 1324-N crib is being drawn into the southwestern side of the pump-and-treat capture zone.

- As shown in Figure 4-5, the CY04 average influent activity for strontium-90 was 1,970 pCi/L. The average effluent activity for strontium-90 was 499 pCi/L. These values are slightly higher than the CY03 in value of 1,878 pCi/L and effluent value of 327 pCi/L.
- Historical presentation of operational parameters, total system performance, and activities for influent and effluent are provided in Appendix C.

4.3 AQUIFER RESPONSE AT THE 100-N AREA

This section describes the general hydrogeologic conditions in the 100-N Area, numerical modeling conducted to evaluate the extraction well network, and changes in contaminant concentrations in monitoring wells.

4.3.1 Hydrogeologic Conditions at the 100-N Area

The hydrogeologic conditions at the 100-N Area are as follows:

- The most prevalent groundwater flow direction is northwest, as shown in Figure 4-6. During the spring months, the river elevation is generally higher due to increased run-off and to provide more irrigation water and aid fish migration. This creates a near-shore, short-term groundwater flow reversal from northwest to southeast is clearly shown in Figure 4-7, where the April to June 2004 river elevations are higher than near-river wells. This phenomenon was also seen in the January 2004 water-level data.
- The maximum river stage was 0.15 m lower in FY04 than in FY03; similarly, the minimum Columbia River stage was 0.18 m lower in FY04. Overall, the average Columbia River stage was 0.08 m lower in FY04 than it was in FY03.
- The average hydraulic gradient in the 100-N Area was 0.0005 toward the northwest, with a maximum gradient of 0.0014.
- The net groundwater flow velocity for 2004 over the 100-K Area was 0.37 m/day based on a hydraulic conductivity of 15.2 m/day, porosity of 0.2, with the gradient derived from a three-point solution of hourly data from wells 199-N-50, 199-N-3, and 199-N-14.
- The average 2004 extraction well pumping rates ranged from 42 L/min in well 199-N-75 to 126.8 L/min in well 199-N-106A. This compares to a range of 40.1 to 143.8 L/min, respectively, in 2003 and 39 to 138.2 L/min, respectively, in 2002.

Appendix D presents a detailed discussion of aquifer response at 100-NR-2. Appendix L presents hydrographs for 100-N Area wells.

4.3.2 Numerical Modeling

A summary of the numerical modeling results supporting the 100-NR-2 pump-and-treat operations is as follows:

- The strontium-90 pump-and-treat plume is within the 2004 modeled capture zone of the 100-NR-2 extraction well network, as shown in Figure 4-8.
- The modeled November 2004 flow lines in Figure 4-8 compare very closely with the predicted capture flow lines in --*Springs Expedited Response Action Performance Evaluation Report* (DOE-RL 1996a). This comparison suggests that the pump-and-treat system performance is consistent with the results of the predicted model. A detailed discussion of the numerical model is presented in Appendix F. Table 4-1 presents a comparison of the measured and modeled water table elevations, as well as the average flow rates used in the numerical model.
- Figure 4-8 shows time markers spaced 1 year apart on the flow lines, based on the high November steady-state velocities. The northern-most flow line is located in a very high conductivity region of the 100-N Area, based on the 1-year time markers being approximately 900 m apart on this flow line, which is equivalent to a pore velocity of about 2.5 m/day. The time markers in the center of the extraction well system shows much slower flow velocities of about 0.3 m/day (e.g., in front of extraction well 199-N-75). The November velocities are expected to be the highest velocities during the year. The effective porosity was set to a low value of 0.1, which also increases the calculated pore velocities.

4.3.3 Contaminant Monitoring

This section summarizes the 100-N Area groundwater monitoring results collected to support the interim remedial action and OU monitoring program during CY04. An engineering change notice, *Modifications to the Groundwater Sampling and Analysis Schedules for the 100-NR-2 Operable Groundwater Sampling Project and 100-N Area RCRA Monitoring Program* (ECN M-15-96-08 [FDH 1996]), defines the sampling protocols implemented for CY04. The results presented below are the average annual concentrations for CY04, unless otherwise specified.

The principal groundwater COCs in the 100-N Area are strontium-90, tritium, chromium, manganese, sulfate, and petroleum hydrocarbons. CERCLA sampling is conducted in March and September.

4.3.3.1 Strontium-90 Monitoring Results

The configuration of the strontium-90 plume has remained relatively unchanged since the startup of pump-and-treat operations. Figure 4-6 displays the CY04 strontium-90 plume and associated historical trends.

The highest average strontium-90 concentration was found in well 199-N-67, which was measured at 7,203 pCi/L (±2.3 pCi/L). This well is located downgradient of the 1301-N Liquid Waste Disposal Facility (LWDF) and has declined from 26,000 pCi/L in March 1998. The greatest increase in average strontium-90 concentration from 2003 to 2004 was detected in extraction well 199-N-103A, which increased from 233 pCi/L (±48 pCi/L) to 321 pCi/L (±67 pCi/L).

Aquifer tubes were sampled for strontium-90 five times during 2004. Concentrations ranged from a low of 118 pCi/L in aquifer tube NS-4 to a high of 3,830 pCi/L in tube NS-3. Results for aquifer tubes are summarized in Appendix G. Average strontium-90 data for wells that had a greater than 20% change from 2003 to 2004 are summarized below:

Well	Type	CY03 Average Sr-90 (pCi/L)	CY04 Average Sr-90 (pCi/L)	Percent Change[a]
199-N-75	Extraction	424 (±72)	254 (±24)	-40%
199-N-103A	Extraction	233 (±48)	321 (±67)	+39%
199-N-105A	Extraction	724 (±130)	390 (±8.8)	-46%
199-N-2	Monitoring	117 (±21)	55.95 (±11.8)	-52%
199-N-46	Monitoring	4,070 (±700)	2,370 (±27)	-42%

[a] (CY04 – CY03) / CY03 x 100%. >+20% = increasing and <-20% = decreasing.
Stable = -20% to +20%.

4.3.3.2 Contaminants of Concern Monitoring Results

Other COCs in the 100-N Area include tritium, chromium, manganese, nitrate, sulfate, and petroleum hydrocarbons (EPA et al. 1999). The results of the COC monitoring for CY04 are summarized as follows:

- **Tritium:** Concentrations for tritium overall appear to be stable or declining. The highest average tritium concentration, 25,300 pCi/L (±553 pCi/L), was in well 199-N-14, located northwest of the 1301-N LWDF. Average tritium concentrations were above the 20,000 pCi/L MCL in three wells sampled during CY04 compared to five wells sampled in CY03. Tritium data are summarized in the table below for wells in which average concentrations changed more than 20% from 2003 to 2004, or where average concentrations were above the 20,000 pCi/L MCL. The estimated amount of tritium remaining in the area of the recirculation cell between the extraction and injection wells is approximately 2 Ci as of 2004. The tritium in the area of the recirculation cell is hydraulically controlled and prevented from discharging to the river.

Well	Type	CY03 Average H-3 (pCi/L)	CY04 Average H-3 (pCi/L)	Percent Change[a]
199-N-14	Monitoring	30,700 (±1,400)	25,300 (±553)	-18%
199-N-32	Monitoring	25,100 (±1,200)	21,200 (±510)	-15%
199-N-46[b]	Monitoring	73 (±160)	282 (±99.1)	+286%
199-N-50	Monitoring	12,600 (±1,310)	9,700 (±350)	-23%
199-N-75	Extraction	20,400 (±1,000)	15,200 (±447)	-26%
199-N-76	Monitoring	22,400 (±1,100)	22,900 (±507)	-2%
199-N-80	Monitoring	21,700 (±1,100)	17,500 (±1,100)	-19%
199-N-96A	Monitoring	3,735 (±295)	2,310 (±183)	-38%
199-N-99A	Monitoring	3,550 (±290)	365 (±115)	-90%

[a] (CY04 – CY03) / CY03 x 100%. >+20% = increasing and <-20% = decreasing.
Stable = -20% to +20%.
[b] Well 199-N-46 is subject to variation in tritium concentrations due to dilution by river water.

- **Chromium:** Chromium contamination does not appear to be a widespread problem in the 100-N Area and was detected above 22 µg/L only in well 199-N-80, which was completed in the first producing horizon in the confined aquifer. The average CY04 concentration for this well was 170 µg/L and is similar to the 168 µg/L concentration measured in CY03. The source of the elevated chromium is uncertain but may be from deterioration of the stainless-steel well casing.

  The highest CY04 filtered total chromium concentration in a well screened in the unconfined aquifer in the 100-N Area was 15.7 µg/L in well 199-N-64. Aquifer tubes measured for chromium were predominately at detection limits.

- **Manganese:** Manganese is elevated above the 50 µg/L MCL in wells 199-N-16, 199-N-18, 199-N-26, and 199-N-119. The average CY04 concentrations for these wells were 735 µg/L, 2,480 µg/L, 88.9 µg/L, and 76.1 µg/L, respectively. The only aquifer tube above the 50 µg/L MCL was NS-2A at 62.4 µg/L. Well 199-N-18 is located adjacent to a diesel spill site, and the source of the elevated manganese may be due to diesel additives, corrosion of the steel casing, and/or reducing conditions caused by degradation of the residual diesel fuel still present in the aquifer. Likewise, well 199-N-16 is located downgradient from other historic diesel spill sites, and dissolved oxygen has been low in this well; thus, the cause of the elevated manganese at this site also may be related to petroleum hydrocarbon. The cause of elevated manganese in well 199-N-26 is unknown, while elevated values in well 199-N-119 and aquifer sampling tube NS-2A are most likely due to drilling effects associated with their recent installation.

- **Nitrate:** Average CY04 nitrate concentrations exceeded the 45 mg/L MCL in monitoring wells 199-N-2, 199-N-3, 199-N-21, 199-N-26, 199-N-32, 199-N-67, and 199-N-105A and in aquifer tube 50-M. Nitrate concentrations vary greatly in the 100-N Area wells. For example, the average nitrate concentration at well 199-N-67 was 55 mg/L in CY02 and increased to 212 mg/L in CY04. The source of the nitrate is unknown at this time.

  Nitrate data are summarized in the table below for wells in which the average concentration changed more than 20% from 2003 to 2004, or where average concentrations were above the 45 mg/L MCL:

Well	Type	CY03 Average NO_3 (mg/L)	CY04 Average NO_3 (mg/L)	Percent Change[a]
199-N-2	Monitoring	49.8	87.3	+75%
199-N-3	Monitoring	63.9	66.1	+3%
199-N-16	Monitoring	39	9.9	-75%
199-N-21	Monitoring	49.1	48.0	-2%
199-N-26	Monitoring	57.5	81.9	+42%
199-N-32	Monitoring	56.3	62.4	+11%
199-N-67	Monitoring	186	212	+14%
199-N-71	Monitoring	7.08	8.9	+26%
199-N-73	Monitoring	15.9	23.0[b]	+45%

199-N-74	Monitoring	7.08	10.2	+44%
199-N-76	Monitoring	32.5	44.3	+36%
199-N-77	Monitoring	13.7	24.3	+77%
199-N-99A	Monitoring	15.1	19.3	+28%
199-N-105A	Extraction	40.7	57.1	+40%

[a] (CY04 – CY03) / CY03 x 100%. >+20% = increasing and <-20% = decreasing. Stable = -20% to +20%.
[b] Detected at less than the contract-required detection limit but greater than the instrument or method detection limit.

- **Sulfate:** None of the wells or aquifer tubes sampled for sulfate in CY04 had average concentrations above the 250 mg/L secondary drinking water standard. Sulfate data are summarized in the following table for wells in which concentrations changed more than 20% from 2003 to 2004:

Well	Type	CY03 Average SO_4 (mg/L)	CY04 Average SO_4 (mg/L)	Percent Change[a]
199-N-16	Monitoring	141	64	-55%
199-N-96A	Monitoring	117.5	84.6	-28%

[a] (CY04 – CY03) / CY03 x 100%. >+20% = increasing and <-20% = decreasing.

- **Petroleum hydrocarbons:** Well 199-N-18 monitors the area of 100-N where a 300,000-L petroleum leak occurred during the 1960s. The total petroleum hydrocarbons (TPH)-diesel range fluctuated from 440 mg/L in September 2002, to 630,000 mg/L in March 2003, and to 350 mg/L in September 2003. The CY04 average for this well was 183 mg/L. The March 2003 sampling also noted an inch of free product in this well. Similarly, the average annual TPH-gasoline range concentration in this well has declined from 15 mg/L in CY02, to 8.56 mg/L in CY03, and to 2.125 mg/L in CY04.

  A passive treatment method to remove diesel from well 199-N-18 was deployed in October 2003. This approach was chosen because the layer of floating petroleum was too thin for removal by active remediation methods. The passive method uses a polymer (Smart Sponge™) with a molecular structure that selectively absorbs petroleum from the surface of the water (i.e., a sponge) while the device floats at the air/hydrocarbon/water interface. A bundle of four, 0.3-m -long cylinders of the material are lowered into the well for a 2-week period, after which the cylinders are removed, weighed, and replaced with a new pre-weighed bundle.

  The average mass removal rate for CY04 was 0.4 kg/month. The free-product capacity of one absorbent cylinder is about 0.4 kg of fuel, or 1.6 kg for a bundle of four. Accordingly, a changeout frequency of bi-monthly or quarterly appears to be adequate to remove the free product that migrates into the well.

  Monitoring well 199-N-96A, located downgradient from well 199-N-18, has had average annual TPH-diesel range and TPH-gasoline range concentrations below the method detection limits in both CY03 and in CY04.

Smart Sponge™ is a trademark of AbTech Industries, Scottsdale, Arizona.

Appendix G presents the sample results for CY04, as well as a historical summary of contaminant and co-contaminant monitoring results for wells and the aquifer. Associated contaminant trend charts are presented in Appendix M.

4.4 100-NR-2 CONCEPTUAL MODEL UPDATE

The conceptual model for strontium-90 contamination at the 100-N Area is discussed in detail in the *N-Springs Expedited Response Action Performance Evaluation Report* (DOE-RL 1996a). Groundwater chemistry data, water-level data, and operational information gathered since 1995 continue to support the original conceptual model. This update will briefly describe the 1995 conceptual model and provide information about source removal since that time.

The main sources of strontium-90 contamination are the 1301-N LWDF (also known as the 116-N-1 Facility) and the 1325-N LWDF (also known as the 116-N-3 Facility). The 1301-N Facility operated from 1964 to September 1985. The 1325-N Facility operated from 1983 to 1991. These facilities received liquid wastes from N Reactor that contained strontium-90, cobalt-60, cesium-137, plutonium, and tritium. Tritium was transported through the soil column with the liquid wastes, reaching and then moving with the groundwater. Cesium-137, cobalt-60, and plutonium were concentrated in the upper portion of the soil column beneath the LWDFs. Strontium-90 was spread throughout the soil column and into the upper aquifer.

The upper aquifer in the 100-N Area is contained in the Ringold Unit E facies of the Ringold Formation. The base of the upper aquifer is the Ringold Upper Mud Unit. The Ringold Unit E sediments at the 100-N Area are composed of sandy gravel to sandy silt. Strontium-90 is adsorbed onto the aquifer solids and is in equilibrium with dissolved-phase strontium-90. Dissolved-phase strontium-90 that is removed by pump-and-treat operations will come back into equilibrium with the adsorbed phase when extraction ceases. It should also be noted that adsorbed strontium-90 on aquifer solids from past discharges occurs near the shoreline, based on core samples from well 199-N-95A (DOE-RL 1995).

Dissolved-phase strontium-90 likely extends into the riverbed to some extent based on the concentration isopleths shown in Figure 4-6. This source is beyond the influence of the pump-and-treat capture zone, as illustrated later. However, based on sediment core profiles from near the shoreline and near the 1301-N Trench, the expected concentrations of adsorbed strontium-90 in the riverbed should be an order of magnitude lower than in the more central portion of the capture zone in the vicinity of the 1301-N Trench. Additional details regarding the adsorption-desorption process can be found in DOE-RL (1996a). The long-term behavior of strontium-90 (and tritium) in pore fluid in the near-shore aquifer and its implications for a remedial action conceptual model are discussed in the following paragraph.

The concentration history of strontium-90 and tritium in groundwater at the shoreline are shown in Figure 4-9. The data are from monitoring wells 199-N-8 and 199-N-46, which are located adjacent to each other, near the center of the strontium-90 plume. This monitoring location was used to report estimated annual flux of strontium-90 and other contaminants to the river to comply with a National Pollutant Discharge Elimination System discharge permit (1301-N/ 1325-N Cribs). During the operating years, water pumped from well 199-N-8 was sampled continuously and composited monthly for analysis. After 1990, when water was no longer discharged to the soil column from N Reactor operations, only periodic grab samples were collected from adjacent well 199-N-46. Thus, the more recent strontium-90 results are more erratic, probably reflecting a fluctuating water table (river stage) at the time of sample collection.

Nevertheless, the general historical trends of strontium-90 and tritium results shown in Figure 4-9 illustrate two important points relevant to a groundwater remedial action conceptual model:

- Due to the well-known adsorption-desorption kinetics of strontium-90, elevated pore-fluid concentrations persist in the near-shore aquifer long after crib discharges cease and after startup of the pump-and-treat system.
- In sharp contrast to strontium-90, the exponential loss of tritium (which is an ideal tracer for the movement of groundwater) indicates that there is a decoupling between the near-shore stream bank storage zone and the more inland portion of the aquifer impacted by the pump-and-treat capture zone. For example, tritium concentrations persist in monitoring wells that lie between the extraction wells and the injection wells, suggesting a continuing recirculation cell.

These observations suggest that the pump-and-treat system has had little, if any, measurable impact on the near-shore groundwater concentrations of strontium-90, as predicted by previous numerical modeling. Thus, for remedial action purposes, the near-shore aquifer or stream bank storage zone must be considered as a separate, semi-isolated portion of the aquifer that requires a different approach to control strontium-90 concentrations in the near-shore aquifer and discharge to the river.

The January 1995 strontium-90 inventory for the 1301-N and 1325-N LWDF soil column and underlying saturated zone was 1,866 Ci. In this total, 88 Ci were estimated adsorbed to soil particles in the saturated zone and 0.8 Ci were dissolved in groundwater (DOE-RL 1996a). The remaining inventory was assumed to be absorbed to soil particles in the vadose zone beneath the LWDFs.

4.4.1 Inventories and Flux

The total strontium-90 inventory is estimated to have decayed to 1,467 Ci at the end of CY04, not including strontium-90 removed during source area excavation. This calculation was based on a strontium-90 half-life of 28.8 years. During the 10-year period from January 1995 to December 2004, the strontium-90 inventory was reduced 363 Ci by natural decay. The 100-NR-2 pump-and-treat system, operating from September 1995 through December 2004, removed 1.6 Ci of dissolved strontium-90 from the saturated zone. This represents about 2% of the total 80 Ci remaining in the aquifer. The total estimated amount of strontium-90 released to the river during reactor operations was 46 Ci. Present-day annual flux to the river has been computed to be on the order of 0.14 to 0.19 Ci/year (DOE 2001). The pump-and-treat operation removed 0.15 Ci of strontium-90 in CY04.

4.4.2 Plume Distributions

Figure 4-10 presents a historical comparison of the 1995 strontium-90 plume distribution in the 100-N Area based on sample results from 1994 through 1995 in approximately 30 wells (before the October 1995 startup of pump-and-treat operations) and the fall 2004 strontium-90 plume distribution. The difference between the two distributions is largely due to the number of data points used in contouring the plume but generally indicates that the plume has not changed much during the last 10 years.

4.5 QUALITY CONTROL

The data used for QC included offsite laboratory testing for total chromium, manganese, strontium-90, tritium, sulfate, and nitrate.

The highlights of QC data for the CY04 100-N Area sampling are summarized in the table below. Additional tables listing complete QC results are presented in Appendix I

Analyte	Number of Pairs	Number of Pairs <20% RPD	Percent <20% RPD
Total chromium	5	NA	NA
Manganese	5	3	60%
Strontium-90	4	3	50%
Sulfate	5	5	100%
Tritium	5	5	100%
Nitrate	5	5	100%

NA = RPD evaluation cannot be performed

There are no functional guidelines for offsite laboratory replicate results, but the results correlated well based on the percentage of RPD <20%. The RPD calculation could not be performed on samples analyzed for total chromium because results were nondetects and were reported at the contract-required detection limit.

4.6 CONCLUSIONS

- ***RAO #1: Protect the Columbia River from adverse impacts from the 100-NR-2 groundwater so designated beneficial uses of the Columbia River are maintained. Protect associated potential human and ecological receptors using the river from exposure to radiological and nonradiological contaminants present in the unconfined aquifer. Protect the unconfined aquifer by implementing remedial actions that reduce concentrations of radioactive and nonradioactive contaminants present in the unconfined aquifer.***

  Results:

  – Pump-and-treat operations are assumed to reduce the hydraulic gradient between the Columbia River and the extraction wells. This activity is also assumed to decrease the volume of inland strontium-90-contaminated water entering the Columbia River. These assumptions need to be tested.

  – The capture area of the extraction, as configured in the numerical modeling, nearly matches the area predicted in DOE-RL (1996a). The pump-and-treat system is reducing net flux by approximately 96% based on a comparison of measured data and previous modeling results. However, elevated strontium-90 concentrations, especially in the near-shore aquifer, persist and do not appear to have declined as a result of pump-and-treat operations.

- The pump-and-treat system has removed minimal dissolved strontium-90 from the aquifer (1.6 Ci since startup, about 2% of the inventory in the aquifer). Natural decay and excavation of near-surface sources have been much more effective in removing strontium-90 and other radiological inventories than pump-and-treat operations.
- The pump-and-treat system is far less efficient than radioactive decay alone in reducing the amount of strontium-90 in the unconfined aquifer. Continuing to operate the pump-and-treat system in the future will cost an average of approximately $1 million/year (in 2004 dollars) (DOE-RL 2004c) but will increase the amount of strontium-90 removed from the aquifer by only about 10% above the amount removed by radioactive decay. Thus, a different and more cost-effective approach is needed to accomplish the objective of this RAO.

- ***RAO #2: Obtain information to evaluate technologies for strontium-90 removal and evaluate ecological receptor impacts from contaminated groundwater (by October 2004).***

  Results:

  - **Strontium-90 treatment technology evaluation:** As previously indicated, evaluation of alternative technologies to pump-and-treat was a need identified in the interim ROD (EPA et al. 1999) and was included as part of the interim remedy. Accordingly, a letter report on the evaluation of alternative strontium-90 treatment technologies and recommendations was prepared and delivered to Ecology in October 2004 (an interim ROD milestone; posted on the web site bhi-erc.com/Projects/risk/risk_library.htm). In addition, a public workshop was held on December 8, 2004, to discuss the findings and to solicit comments. The outcome of the December 8 meeting was to proceed with a field-scale treatability test phase of apatite sequestration and phytoremediation as a secondary or polishing option.

    Initial laboratory apatite sequestration studies conducted by PNNL during FY04 demonstrated the feasibility of in situ formation of calcium phosphate (apatite) in 100-N sediments by injection of solutions of citrate-complexed calcium and sodium phosphate. The method relies on biodegradation of the citrate, which in turn frees the calcium ions to form a calcium phosphate (apatite) coating on aquifer sediments. Strontium-90 becomes trapped or sequestered in the apatite solid phase. This approach allows the apatite to be more widely disseminated than with trenching methods, creating a broader treatment zone. By careful manipulation, timing, and location of the injection wells, treatment of the smaller portion of contaminated aquifer underlying the near-shore riverbed, as well as creating a permeable reactive barrier for treating the larger strontium-90 plume, may be possible. Field-scale testing is needed to confirm the laboratory results. Finalization of a treatability test plan initiated in December 2004 is pending favorable outcome of the FY05 laboratory results. Other minimally intrusive apatite emplacement options being considered include air injection and hydrofracture emplacement of apatite particles. Concerns expressed during the public workshop over the chemical injection approach included possible leaching effects (i.e., mobilization of some strontium-90 by the salt residue from the chemicals injected). Laboratory studies in FY05 are directed at resolving this issue before proceeding to the field-testing phase.

Greenhouse studies conducted by PNNL during 2004 successfully demonstrated extraction of strontium-90 by coyote willows from N-Springs sediments. Stakeholders and others expressed concerns about offsite dispersal of contaminated leaves and possible food-chain transfer. Accordingly, this issue will be resolved before proceeding to a field demonstration phase. Phytoremediation is the only currently known method that can actually remove strontium-90 from the critical near-shore zone. Without removal of the strontium-90 or fixation in place (apatite sequestration), the elevated strontium-90 concentrations in pore fluid at the shoreline will persist for years. The disadvantage of the phytoremediation method is that the annually harvested willows must be disposed as low-level waste in the ERDF.

– **Ecological receptor impacts:** The DQO process, including reconnaissance sampling to support the DQO effort, was completed during 2004 for the near-shore aquatic and riparian zone ecological risk assessment. The associated SAP (DOE-RL 2005a) will guide the CY05 field work for an ecological risk report that is due in October 2005. The SAP and DQO were coordinated with the River Corridor Baseline Risk Assessment (RCBRA) to avoid duplication of efforts and to ensure comparability of results.

  The associated DQO workbook and SAP are posted on web site www.bhi-erc.com/Projects/risk/risk_library.htm. The COCs include radionuclides, metals, and petroleum hydrocarbons. Results of the assessment will be used to determine the extent of potential strontium-90 treatment needed to protect aquatic and riparian biota along the 100-N Area shoreline. The ecological risk assessment SAP includes provision for metals and petroleum hydrocarbon sampling to evaluate the suspected impact of past diesel spills and miscellaneous sources of metals (e.g., hexavalent chromium).

- ***RAO #3: Prevent destruction of sensitive wildlife habitat. Minimize disruption of cultural resources and wildlife habitat in general and prevent adverse impacts to cultural resources and threatened or endangered species.***

  Results: The interim remedial action ROD (EPA et al. 1999) establishes a variety of institutional controls that must be implemented and maintained throughout the interim action period. These provisions include the following:

  – Access control and visitor escorting requirements

  – Signage providing visual identification and warning of hazardous or sensitive areas (new signs were placed along the river and at major road entrances at each reactor area)

  – Excavation permit process to control all intrusive work (e.g., well drilling and soil excavation)

  – Regulatory agency notification of any trespassing incidents.

  The effectiveness of institutional controls established in the interim action ROD for 100-NR-2 (EPA et al. 1999) was evaluated and summarized for implementation and effectiveness in 2003. The *2004 Final Institutional Controls (IC) Assessment Report* (DOE-RL 2004a) presents the results for the current review. In summary, the report found that institutional controls were maintained to prevent public access, as required.

4.7 RECOMMENDATIONS

- Conduct a short-term shutdown test of the pump-and-treat system to verify the magnitude of the assumed reduction in groundwater and strontium-90 flux to the river. This information is needed to support a proposed treatability test of a natural gradient, strontium-90 sequestration barrier in the aquatic/riparian zone near the old N springs location.

- Determine the cause of the decline in strontium-90 removal efficiency and evaluate possible corrective actions. This should include the possible impact of a change in influent chemical composition due to encroachment of the high sulfate plume from the old 1324-N crib on the southwestern side of the capture zone. This investigation can be timed to occur during the proposed short-term shutdown planned for July 15 through November 15, 2005. The investigation of corrective actions should include possible reconfiguration of extraction/injection well locations if the sulfate plume encroachment hypothesis is confirmed.

Figure 4-1. 100-N Area Operable Unit Location.

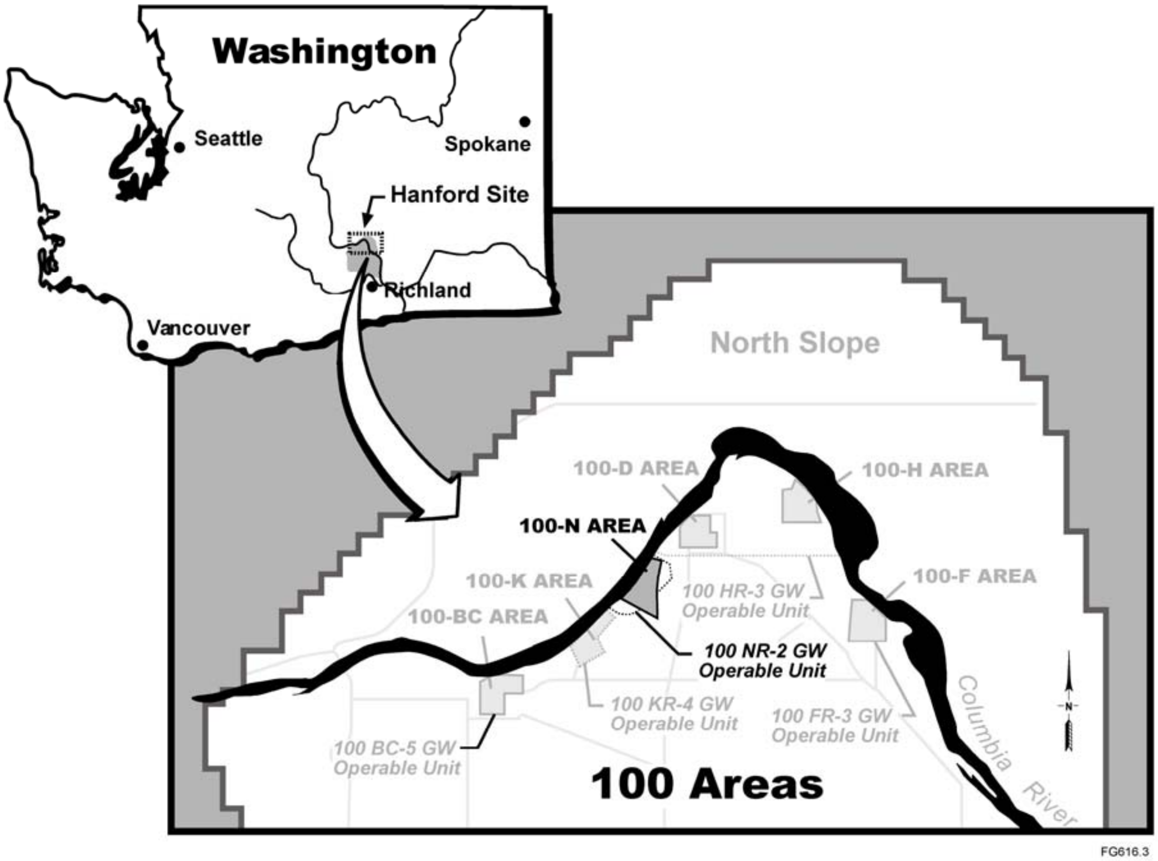


Figure 4-2. 100-NR-2 Operable Unit Wells and Seeps.

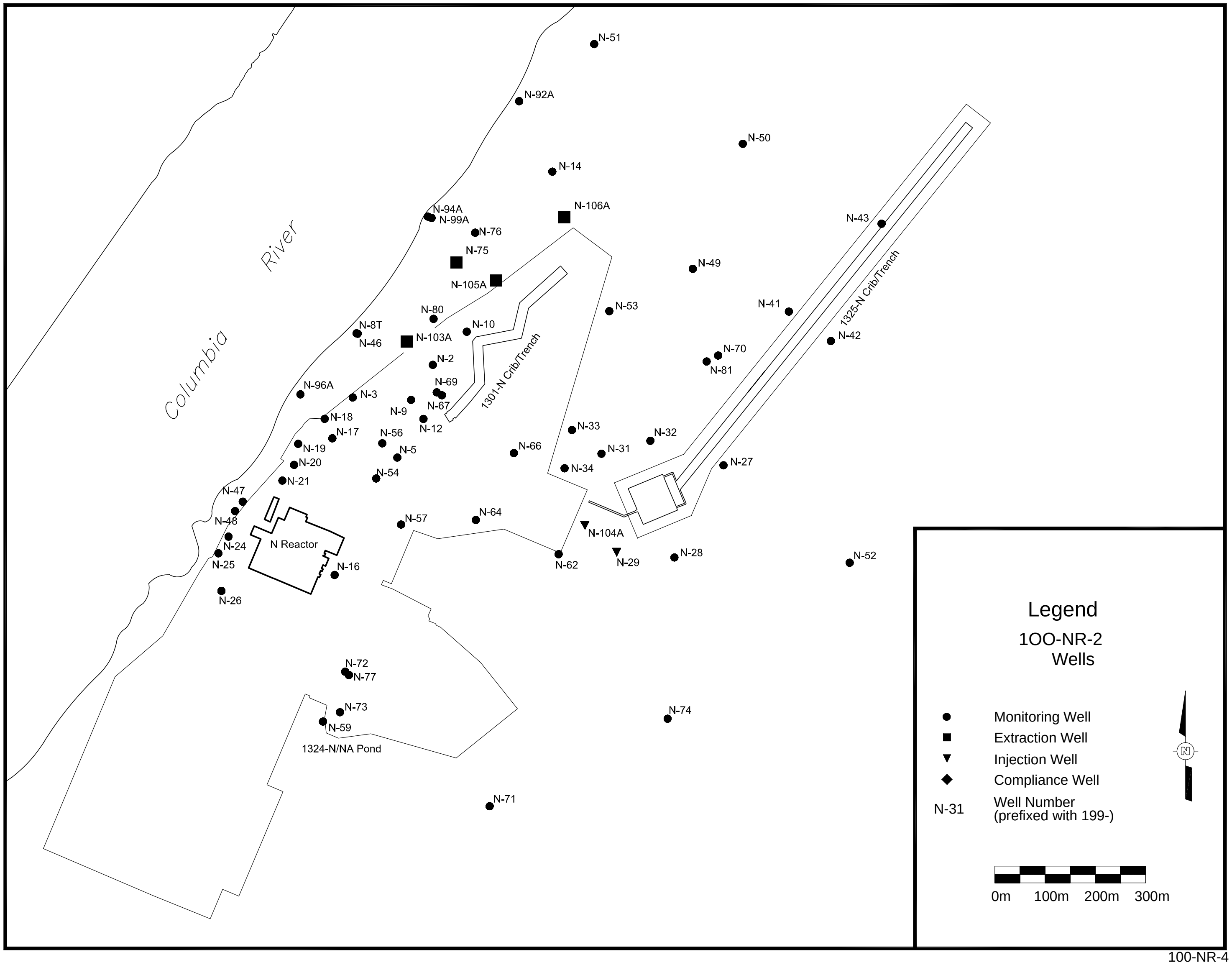


Figure 4-3. 100-NR-2 Pump-and-Treat System Schematic.

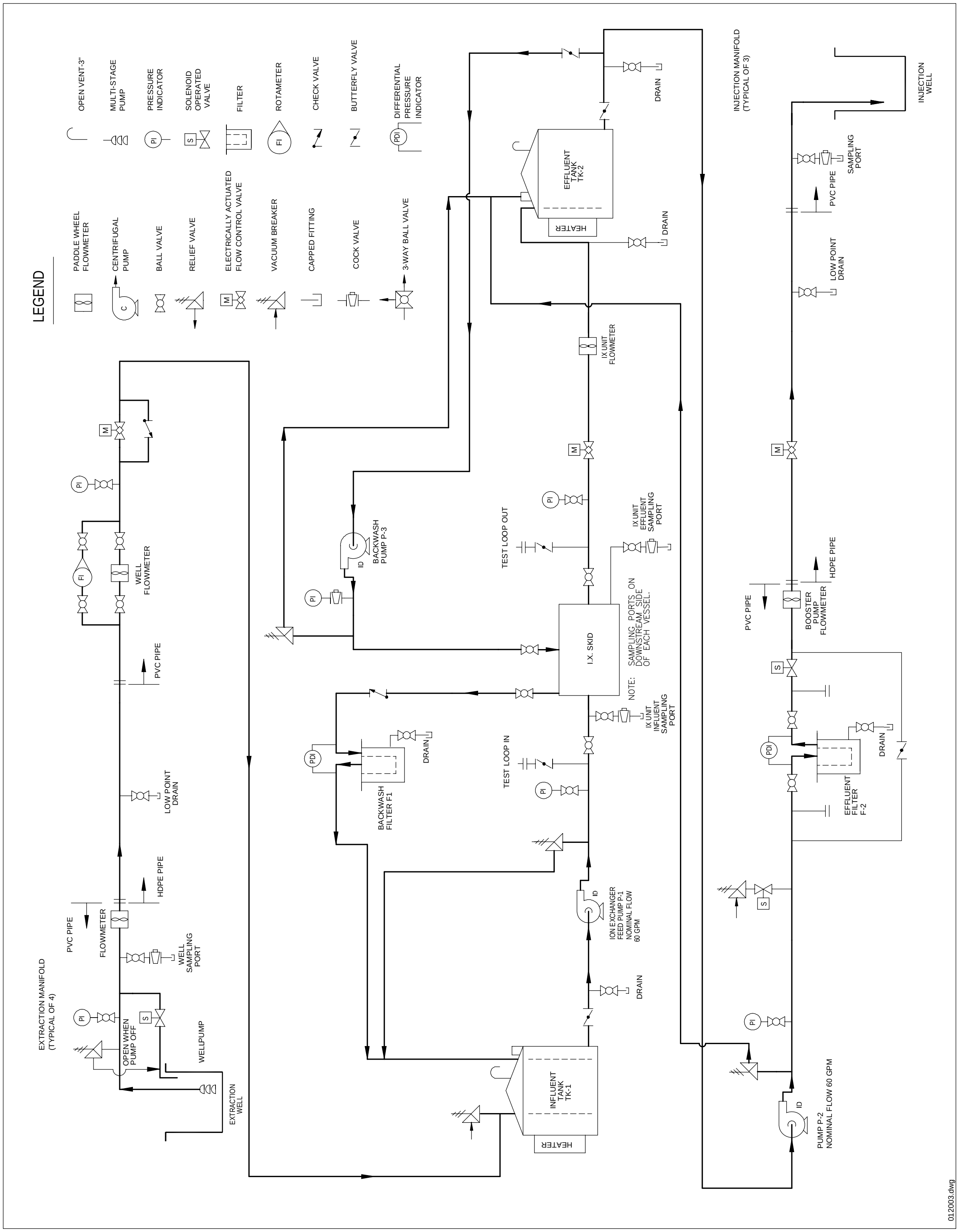
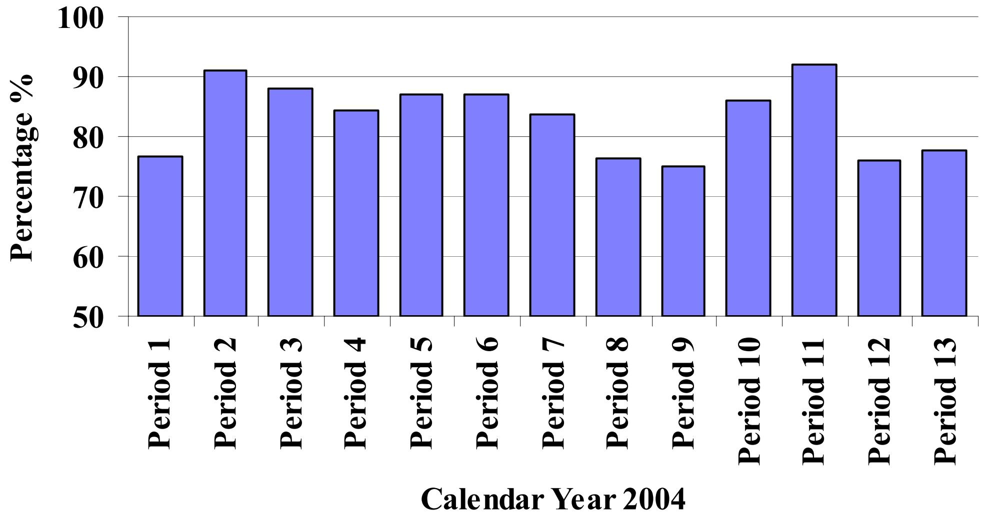


Figure 4-4. 100-NR-2 System Availability and On-Line Percentages for Calendar Year 2004.



NOTE: Clino-periods 1-10 average 28-day cycles; 11 to 13 are 21 days.
Performance measurement based upon mid-point sample for the clino-period.

Summary of system availability:	
Total possible run-time (hours)	8,784
Scheduled downtime (hours)	337
Planned operation (hours)	8,447
Unscheduled downtime (hours)	830.5
Total time on-line	7,616.5
Total availability (%)	86.7
Scheduled system availability (%)	90.2

Scheduled system availability [(total possible run-time – unscheduled downtime) / total possible run-time].

Total availability[(total possible run-time – scheduled and unscheduled downtime) / total possible run-time).

Figure 4-5. 100-NR-2 Pump-and-Treat Trends of Influent and Effluent Strontium-90 Concentrations for Calendar Year 2004.

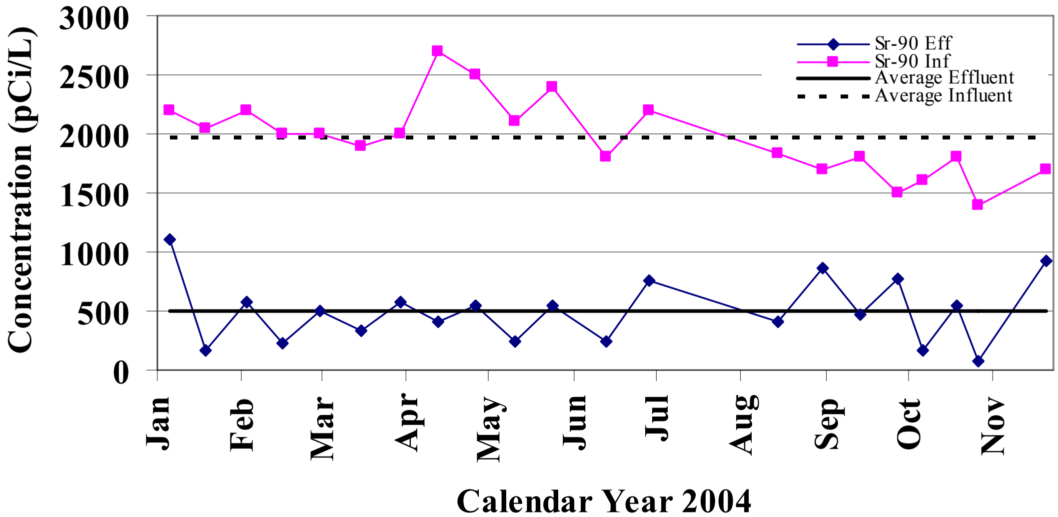


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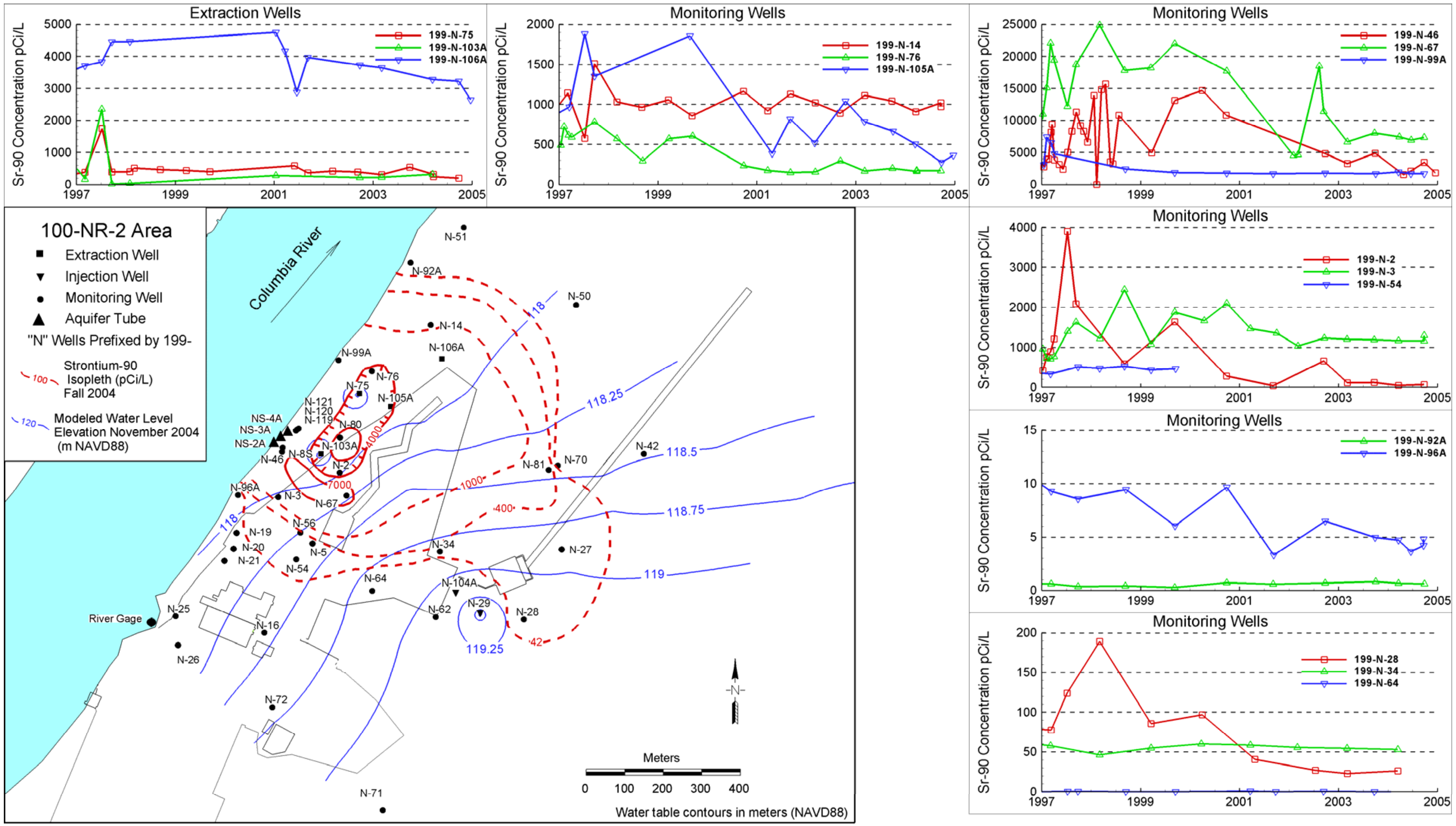
Figure 4-6. 100-NR-2 Strontium-90 Plume, Fall 2004.



*Well 199-N-105A is used as a monitoring well and backup extraction well.

Figure 4-7. Water Elevation Versus Distance from the Columbia River in 100-N Area Wells.

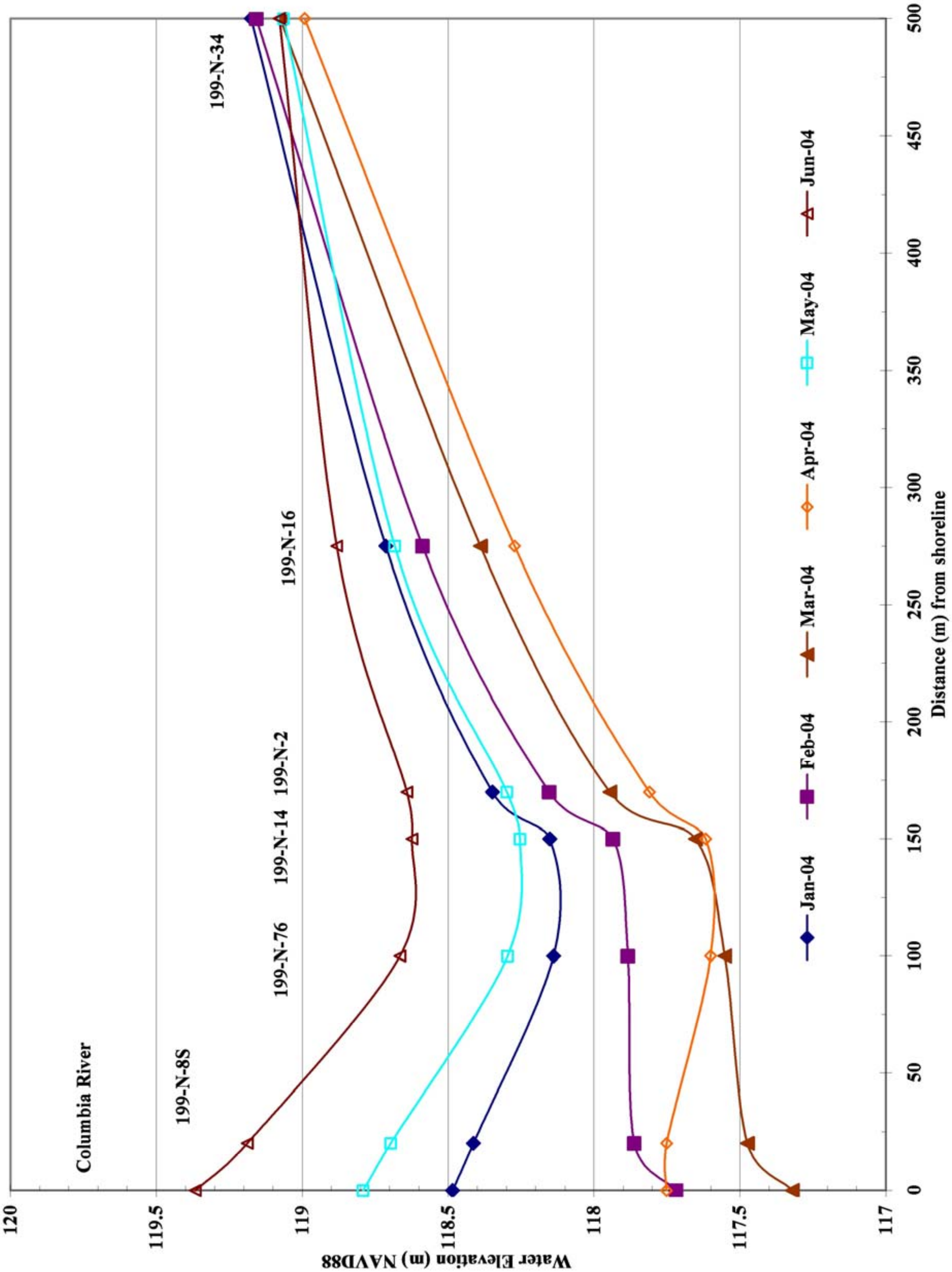


Figure 4-8. Estimated Steady-State Hydraulic Capture Zone
Developed by 100-NR-2 Operable Unit Extraction Wells.

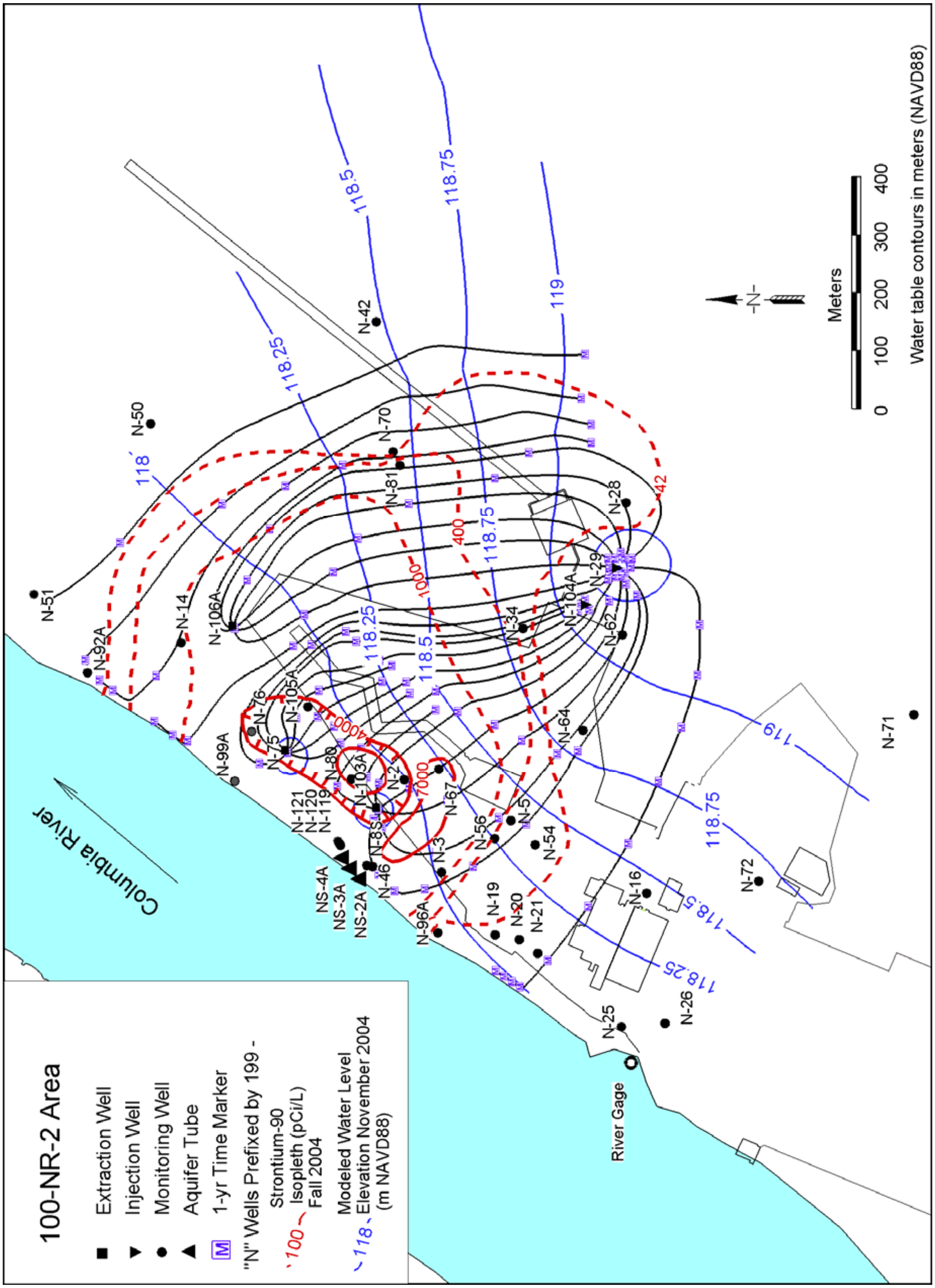
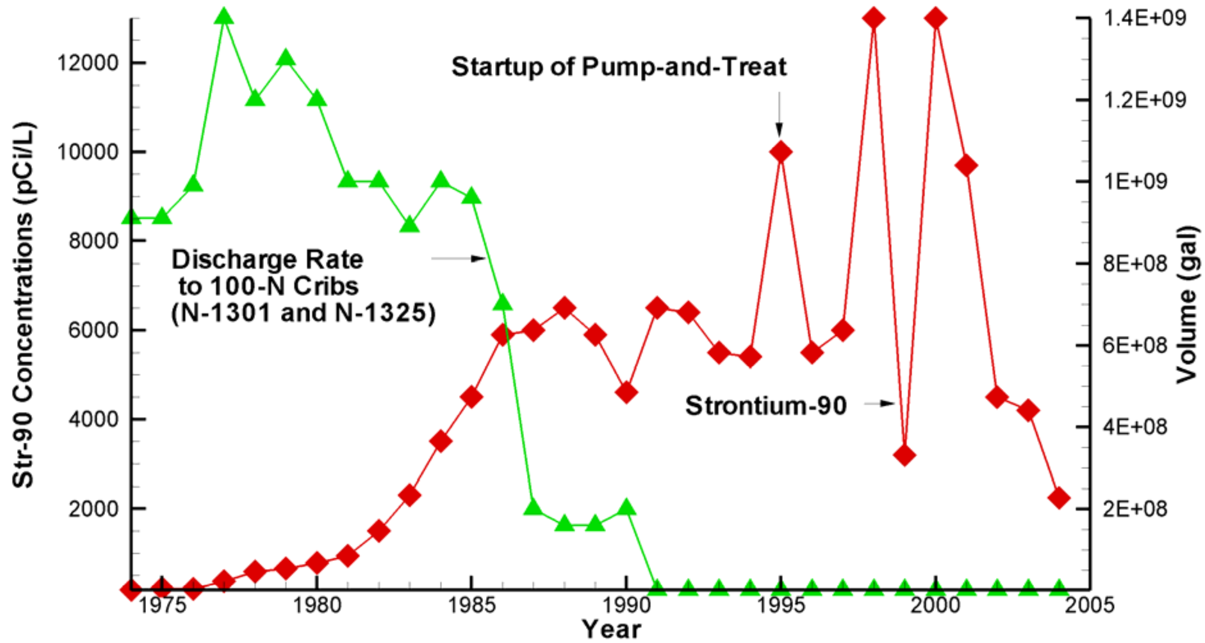


Figure 4-9. Strontium-90 and Tritium in Near-Shore Monitoring Wells 199-N-8 and 199-N-46.



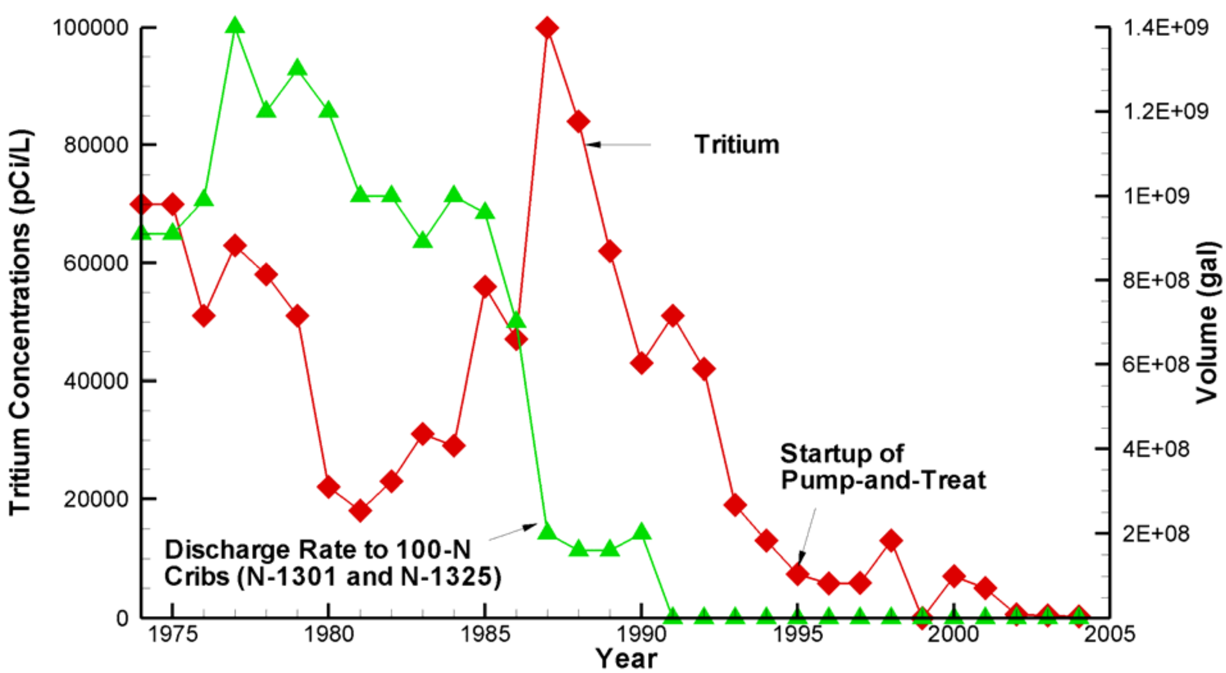


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Figure 4-10. 100-NR-2 Operable Unit Strontium-90 Plume Map, 1995 and 2004.

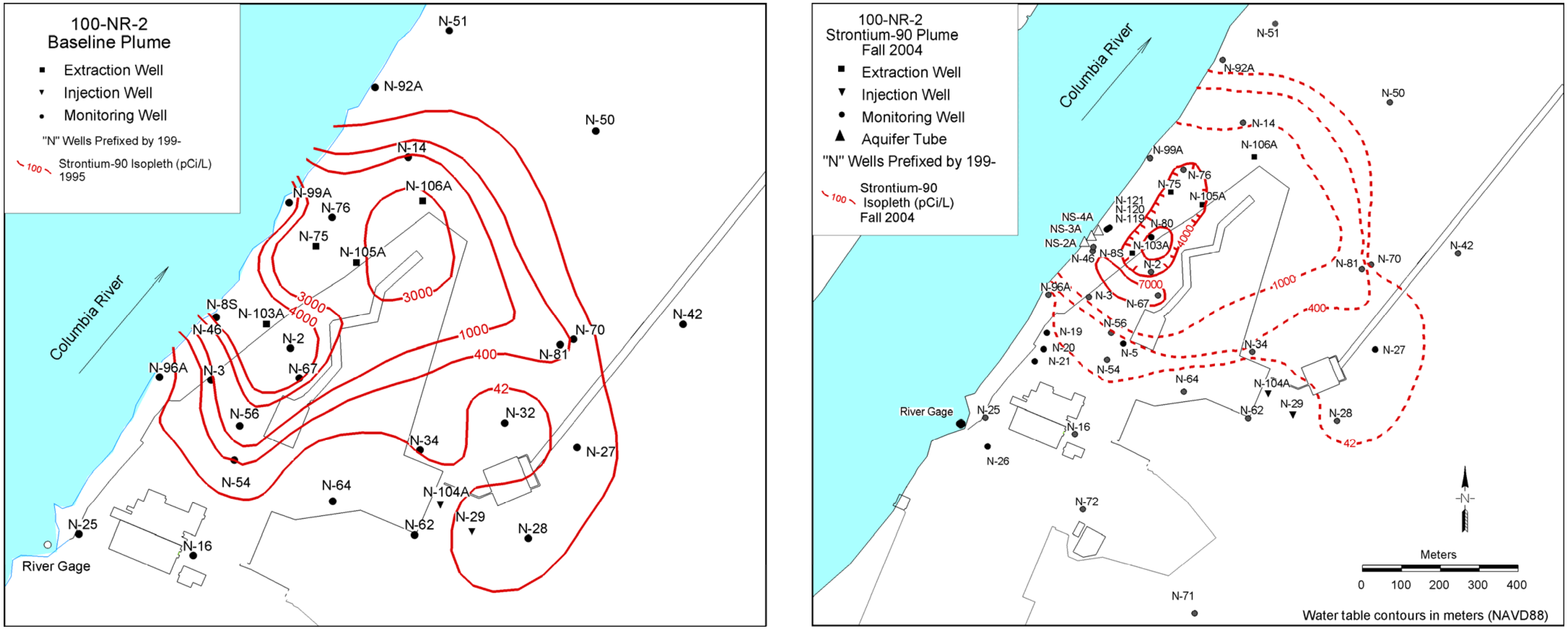

Table 4-1. 100-NR-2 Water-Level Data Used to Develop and Calibrate Numerical Groundwater Flow Models.

Well	Extraction Rate L/min	Injection Rate L/min	Measured Elevation, Nov. 2004 (m NAVD88a)	Modeled Elevation, Nov. 2004 (m NAVD88a)
199-N-75	45.4	--	--	117.21
199-N-103A	53	--	118.00	117.11
199-N-105A	0	--	116.12	117.91
199-N-106A	107.9	--	117.02	117.80
199-N-104A	--	130.6	124.18	119.21
199-N-29	--	208.2	121.67	120.00
199-N-2	--	--	118.09	117.98
199-N-3	--	--	118.10	118.02
199-N-8S	--	--	117.90	117.88
199-N-14	--	--	117.81	117.88
199-N-16	--	--	118.41	118.44
199-N-34	--	--	118.96	118.83
199-N-50	--	--	118.01	118.03
199-N-72	--	--	118.69	118.70
199-N-76	--	--	117.67	117.85
199-N-92A	--	--	118.26	117.82
199-N-99	--	--	--	117.84

[a] NAVD88, 1983, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland.

-- = No data available

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5.0 PUMP-AND-TREAT SYSTEM COST DATA

Actual costs for the 100-HR-3, 100-KR-4, and 100-NR-2 pump-and-treat systems were recorded in FH's Hanford Data Integrator. The data are used to determine the actual capital and expense costs associated with a specific activity during the FY. Specific activities are briefly described below:

- **Capital design:** Includes design activities to construct the pump-and-treat systems and designs for major system upgrades and modifications.
- **Capital construction:** Includes oversight labor, material, and subcontractor fees for capital equipment, initial construction, construction of new wells, redevelopment of existing wells, and modifications to the pump-and-treat system.
- **Project support:** Includes project coordination-related activities and technical consultation as required during the course of the facility design, construction, acceptance testing, and operation.
- **Operations and maintenance:** Represents facility supplies, labor, and craft supervision costs associated with operating the facility. It also includes costs associated with routine field screening and engineering support as required during the course of pump-and-treat operation and periodic maintenance.
- **Performance monitoring:** Includes system and groundwater sampling and sample analysis as required in accordance with the 100-HR-3 and 100-KR-4 interim action work plan (DOE-RL 1996b).
- **Waste management:** Includes the cost for the management of spent resin at 100-HR-3 and 100-KR-4 and spent clinoptilolite in accordance with applicable laws for suspect hazardous, toxic, and regulated wastes. It includes waste designation sampling and analysis. Also included are resin regeneration costs and new resin purchase.

Costs are burdened and are based on actual operating costs incurred during FY04. A comparison between FY03 and FY04 costs is presented in the following sections.

5.1 100-HR-3 PUMP-AND-TREAT SYSTEM COSTS

The cost breakdown for the 100-HR-3 pump-and-treat system is presented in Figure 5-1. Total construction and operation costs for FY04 are higher when compared to FY03. Cost increases are attributed to capital construction costs and increased operations and maintenance costs. As shown in Figure 5-1, the cost breakdown indicates that the majority of the costs, in decreasing order, are charged to operations and maintenance (41%), waste management (19%), capital construction (19%), project support (8%), design (8%) and performance monitoring (5%). Based on the total FY04 cost ($2,576,000), the yearly production rate of 317.7 million L and 33.6 kg of hexavalent chromium removed, the annual treatment costs equate to $0.008/L or $74.66/g of hexavalent chromium removed. These treatment costs are similar to FY02 treatment costs but are significantly higher than FY03.

A second pump-and-treat system (DR-5, which includes three extraction wells, a separate treatment system, and injection wells) was constructed in the D/DR Reactor area. As presented in Figure 5-2, the total FY04 costs for the new system were $2,090,100. The cost breakdown indicates that the majority of the cost was incurred for treatment system capital construction

(77%), followed, in decreasing order, by design (11.7%), project support (8.4%), operations and maintenance (2.3%), performance monitoring (0.08%) and waste management (0.03%).

5.2 100-KR-4 PUMP-AND-TREAT SYSTEM COSTS

The cost breakdown for the 100-KR-4 pump-and-treat system is shown in Figure 5-3. Compared to FY03, the total construction and operations costs were slightly lower in FY04. As shown in Figure 5-2, the cost breakdown indicates that the majority of the costs, in decreasing order, are charged to operations and maintenance (52%), waste management (22%), project support (10%), design (8%), performance monitoring (4%), and treatment system capital construction (4%). Based on the FY04 cost ($2,147,200), the yearly production rate of 500 million L and 29.6 kg of hexavalent chromium removed, the annual treatment costs equate to $0.004/L, or $72.53/g of hexavalent chromium removed. The treatment costs for FY04 compared to FY03 are the same per liter of groundwater processed but are slightly higher per gram of hexavalent chromium removed due to the reduction in total quantity removed.

5.3 100-NR-2 PUMP-AND-TREAT SYSTEM COSTS

The cost breakdown for the 100-NR-2 pump-and-treat system is presented in Figure 5-4. Compared to FY03, total construction and operations costs were significantly higher in FY04. Cost increases are attributed to higher cost for design, project support, operations and maintenance, and performance monitoring costs. As shown in Figure 5-4, the cost breakdown indicates that the majority of the costs, in decreasing order, are charged to operations and maintenance (56%), project support (33%), performance monitoring (8%), and waste management (3%). Based on the FY04 cost ($989,700), the yearly production rate of 107.2 million L and 0.1572 Ci of strontium-90 removed, the annual treatment costs equate to $0.009/L, or $6,294,600/Ci of strontium-90 removed. The treatment costs were significantly higher in FY04 compared to FY03.

Figure 5-1. 100-HR-3 Pump-and-Treat System Costs. (2 sheets)

Cost Breakdown for 100-HR-3 Pump-and-Treat Construction and Operations									
Description	Actual Costs (Dollars x 1,000)								
	1996	1997	1998	1999	2000	2001[a]	2002[b]	2003	2004
Design	2,040.0	--	--	--	--	97.7	15.4	8.1	196.1
Treatment system capital construction	164.0	--	--	--	57.7	(36.1)	750.3	--	496.6
Project support	--	741.0	264.9	265.3	276.7	225.8	309.3	229.8	211.8
Operations and maintenance	948.0	3,437.0	1,533.3	1,650.8	799.1	739.2	816.6	733.7	1,049.5
Performance monitoring	--	259.0	0.4	--	173.7	219.9	120	163.2	120.3
Waste management	--	--	--	--	895.3	424.9	720.1	877.2	501.7
Totals	**$3,152**	**$4,437**	**$1,799**	**$1,916**	**$2,202**	**$1,671**	**$2,732**	**$2,012**	**$2,576**

- = not available

[a] 2001 costs corrected for Project Support and Waste Management. Initial expense calculations for 2001 were not properly categorized.

[b] 2002 accrual costs corrected for appropriate split between Bechtel Hanford, Inc. and Fluor Hanford, Inc.

100-HR-3 Pump-and-Treat System Fiscal Year 2004 Cost Breakdown (by Percentage)

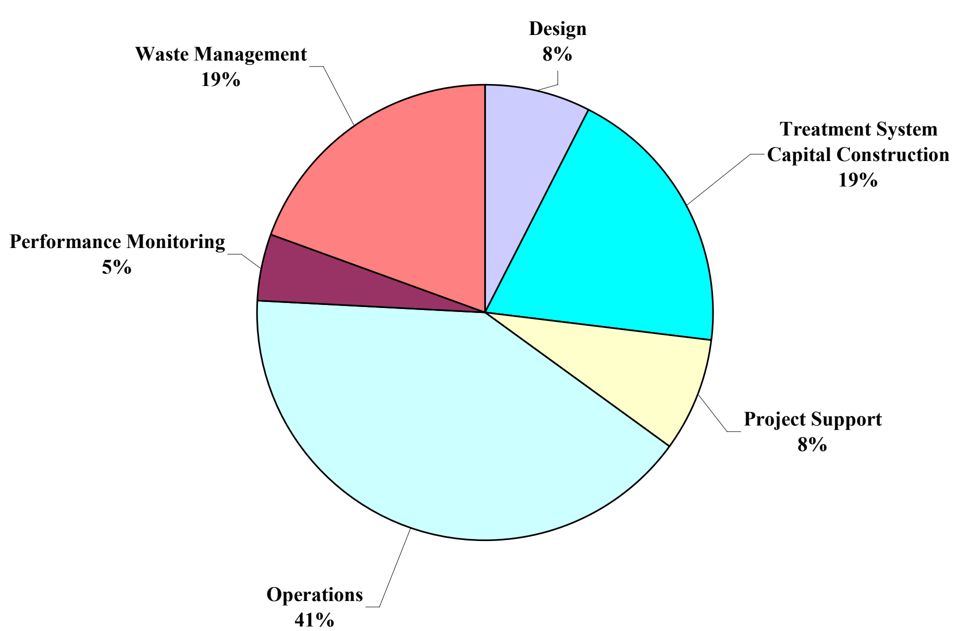


Figure 5-1. 100-HR-3 Pump-and-Treat System Costs. (2 sheets)

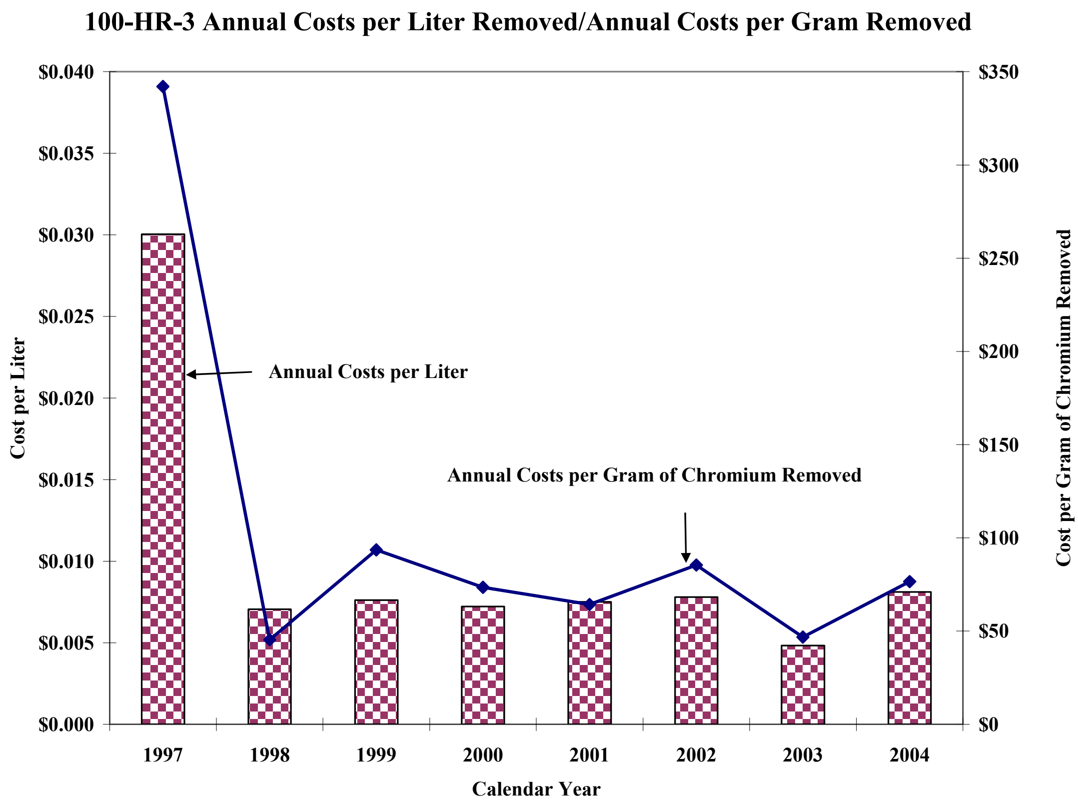


Figure 5-2. DR-5 Pump-and-Treat System Costs.

Cost Breakdown for DR-5 Pump-and-Treat Construction and Operations

Description	Actual Costs (Dollars x 1,000)
	2004
Design	244
Treatment system capital construction	1,620.3
Project support	175.1
Operations and maintenance	48.3
Performance monitoring	1.7
Waste management	.7
Total	**$2,090.1**

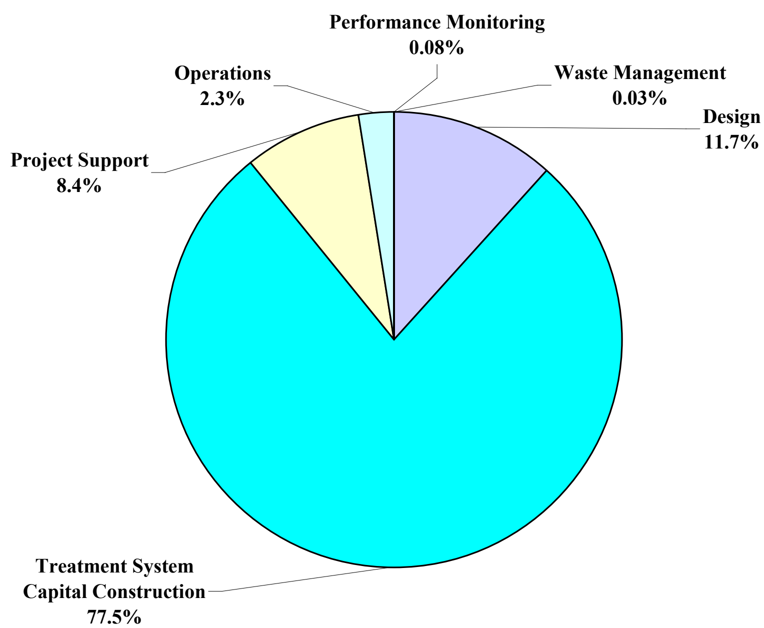


Figure 5-3. 100-KR-4 Pump-and-Treat System Costs. (2 sheets)

Cost Breakdown for 100-KR-4 Pump-and-Treat Construction and Operations									
Description	**Actual Costs(Dollars x 1,000)**								
	1996	**1997**	**1998**	**1999**	**2000**	**2001[a]**	**2002[b]**	**2003**	**2004**
Design	1,060.0	163.0	85.4	0.2	--	96.5	55.2	70.8	163.9
Treatment system capital construction	81.0	--	--	--	109.1	(0.1)	860.1	379.9	94.2
Project support	--	327.0	208.4	157.2	143.0	188.2	257.8	171.0	211.8
Operations and maintenance	869.0	2,525.0	1,028.9	717.4	538.0	578.6	771.9	789.7	1,118.2
Performance monitoring	--	382.0	1.4	--	111.2	122.6	124.6	119.7	83.3
Waste management	--	--	--	--	481.8	367.5	343.3	684.7	475.8
Totals	**2,010**	**$3,397**	**$1,324**	**$875**	**$1,383**	**$1,353**	**$2,413**	**$2,216**	**$2,147**

- = not available

[a] 2001 costs corrected for Project Support and Waste Management. Initial expense calculations for 2001 were not properly categorized.

[b] 2002 accrual costs corrected for appropriate split between Bechtel Hanford, Inc. and Fluor Hanford, Inc.

100-KR-4 Pump-and-Treat System Fiscal Year 2004 Cost Breakdown (by Percentage)

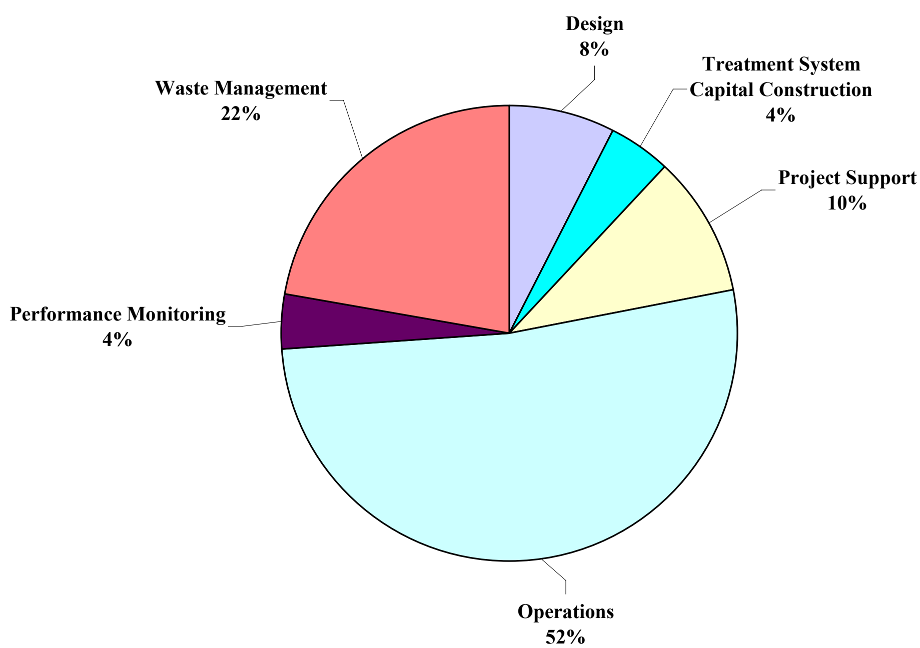


Figure 5-3. 100-KR-4 Pump-and Treat System Costs. (2 sheets)

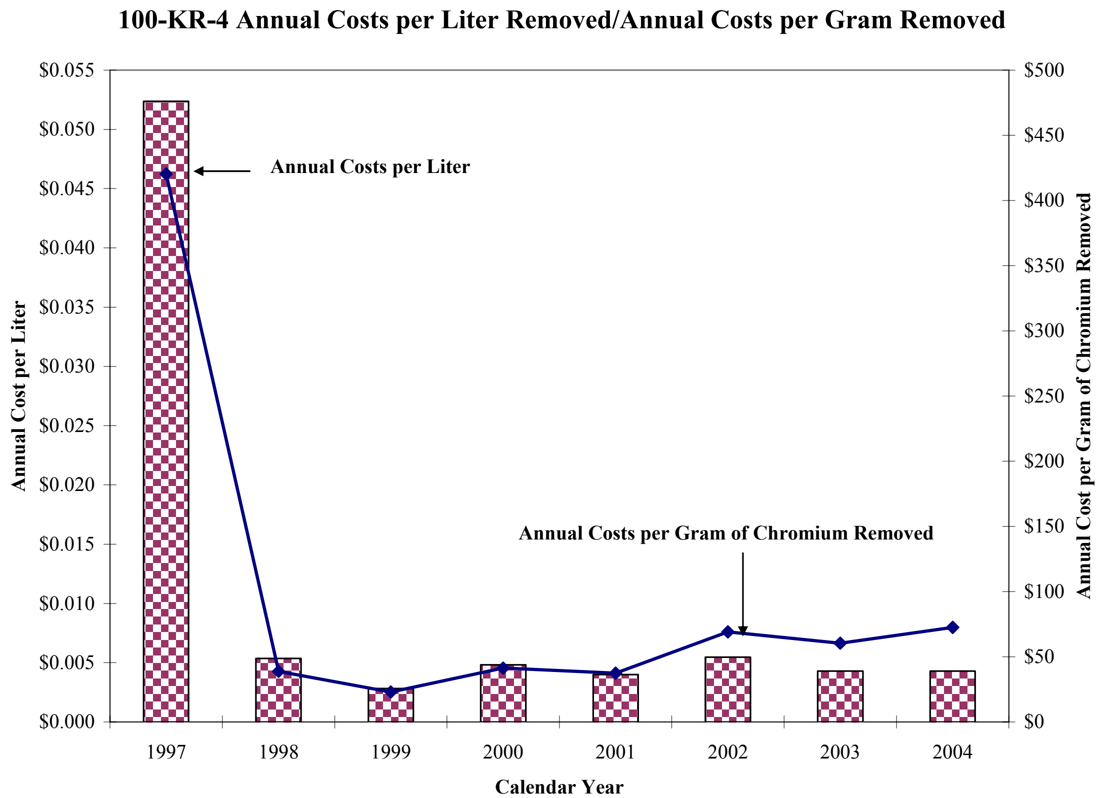


Figure 5-4. 100-NR-2 Pump-and Treat System Costs. (2 sheets)

Cost Breakdown for 100-NR-2 Pump-and-Treat Construction and Operations									
Description	Actual Costs (Dollars x 1,000)								
	1996	1997	1998	1999	2000	2001[a]	2002[b]	2003	2004
Design	2,289.4	951.8	32.6	0.2	--	--	--	--	--
Treatment system capital construction	55.0	--	-	--	--	--	--	--	--
Project support	--	119.4	136.0	113.1	96.3	183.5	219.4	133.0	329.7
Operations and maintenance	2,622.7	1,027.8	425.2	657.4	462.2	631.5	631.8	604.3	553.0
Performance monitoring	--	--	--	--	82.6	83.1	72.4	51.6	79.6
Waste management	--	--	--	--	131.6	112.5	100	45.4	27.4
Totals	**$4,967**	**$2,099**	**$594**	**$771**	**$773**	**1,011**	**$1,024**	**$834**	**$989.7**

\- = not available

[a] 2001 costs corrected for Project Support and Waste Management. Initial expense calculations for 2001 were not properly categorized.

[b] 2002 accrual costs corrected for appropriate split between Bechtel Hanford, Inc. and Fluor Hanford, Inc.

100-NR-2 Pump-and-Treat System Fiscal Year 2004 Cost Breakdown (by Percentage)

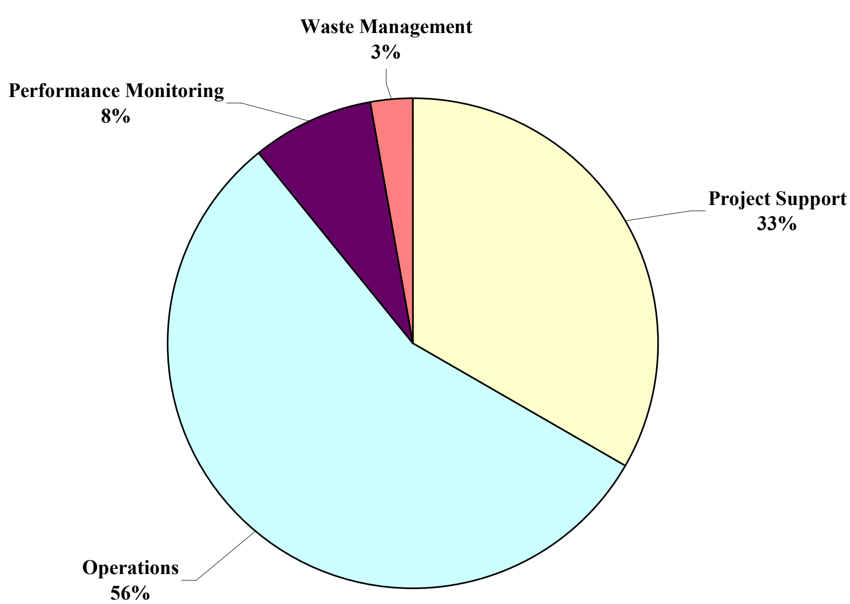
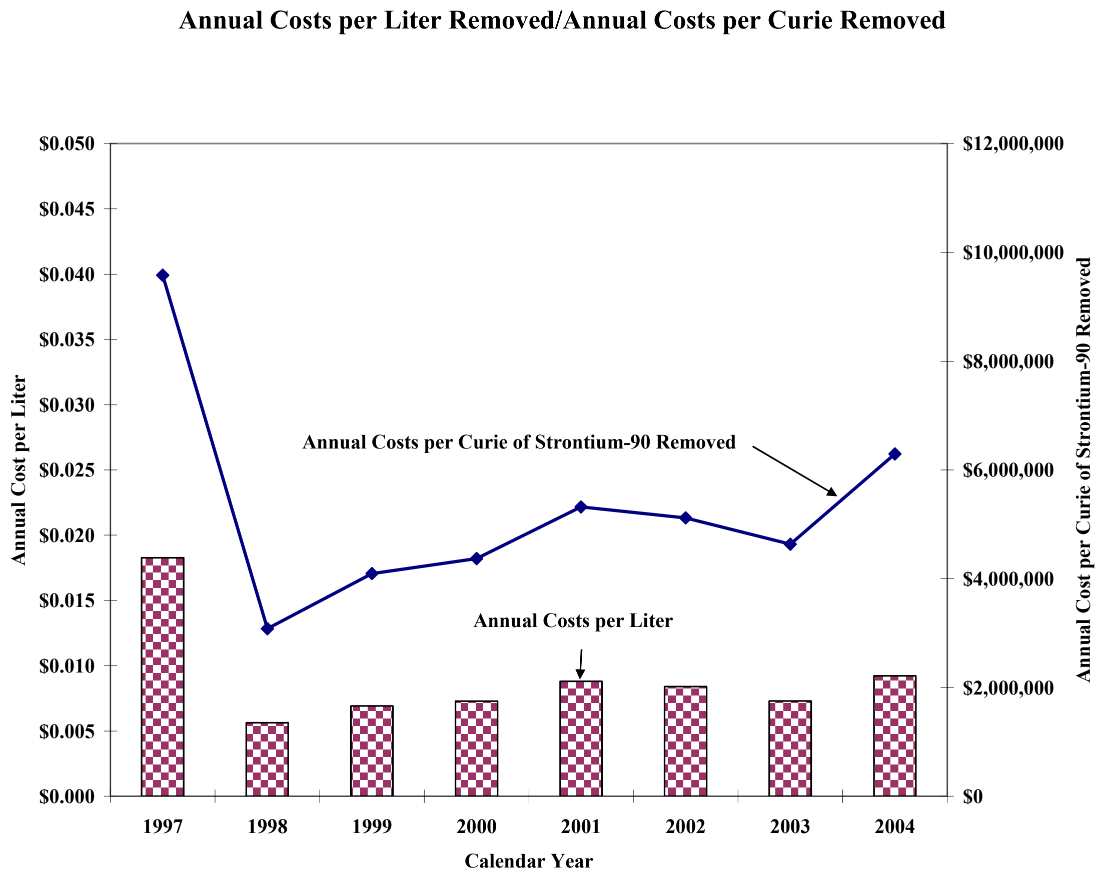


Figure 5-4. 100-NR-2 Pump-and Treat System Costs. (2 sheets)



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APPENDIX A

HISTORY

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APPENDIX A

HISTORY

A1.0 100-HR-3 HISTORY

In September 1994, the *Limited Field Investigation Report for the 100-HR-3 Operable Unit* (DOE-RL 1994a), including a qualitative risk assessment, was completed. Hexavalent chromium was identified as a contaminant of concern for ecological receptors in the Columbia River. In August 1995, the *100-HR-3 Operable Unit Focused Feasibility Study* (DOE-RL 1995a) and the *Proposed Plan for Interim Remedial Measure at the 100-HR-3 Operable Unit* (DOE-RL 1995d) were finalized. The proposed plan recommended the use of a pump-and-treat system to mitigate chromium migration into the river. In 1994, a pilot-scale pump-and-treat system was deployed, and in December 1995 the *Pilot-Scale Treatability Test Summary Report for the 100-HR-3 Operable Unit* (DOE-RL 1995c) was issued. The report indicated that removing hexavalent chromium from extracted groundwater in the 100-HR-3 Operable Unit (OU) using a resin treatment (ion-exchange) system was viable.

In April 1996, the *Declaration of the Record of Decision for the 100-HR-3 and 100-KR-4 Operable Units at the Hanford Site (Interim Remedial Actions)* (EPA et al. 1996) was issued for the pump-and-treat system for the 100-HR-3 OU. The interim remedial action Record of Decision (ROD) specified installation of a pump-and-treat system in the 100-HR-3 and 100-KR-4 OUs to intercept portions of the hexavalent chromium plumes that impact the Columbia River. Full-time operation of the 100-HR-3 treatment system was initiated July 1, 1997. On August 5, 1998, the pump-and-treat system was modified to permit groundwater from the 100-D Area to be treated separately from 100-H Area groundwater.

In October 1999, the *U.S. Department of Energy Hanford Site – 100 Area Benton County, Washington, Amended Record of Decision Summary and Responsiveness Summary (100-HR-3 Operable Unit* (EPA et al. 1999) was approved, which modified the selected remedial action by deploying an innovative treatment technology, In Situ Redox Manipulation (ISRM), to address the groundwater chromium plume located southwest of the D/DR Reactors. This plume is not within the established treatment zone for the pump-and-treat system for the interim action. The initial phase of the ISRM remedial action was implemented in 2000. The monitoring results of the ISRM for fiscal year 2004 are reported in the *Fiscal Year 2004 Annual Summary Report for the In Situ Redox Manipulation Operations* (DOE-RL 2005 [pending issuance]).

Additional detailed site characterization and background information on the OU and the pump-and-treat activity are provided in the limited field investigation (LFI) report (DOE-RL 1994a) and focused feasibility study (FFS) (DOE-RL 1995a). Further information on the pump-and-treat system design and operation can be found in the *Remedial Design Report and Remedial Action Work Plan for the 100-HR-3 and 100-KR-4 Groundwater Operable Units Interim Action* (DOE-RL 1996b) and *100-HR-3 and 100-KR-4 Operable Units Interim Action Performance Evaluation Report* (DOE-RL 1998a). Groundwater monitoring requirements are described in *Interim Action Monitoring Plan for the 100-HR-3 and 100-KR-4 Operable Units* (DOE-RL 1997a). Additional background/current information is available in *Hanford Site Groundwater Monitoring for Fiscal Year 2004* (PNNL 2005).

Although salmon spawning habitat has been identified as potentially being at risk in some river channel areas adjacent to Hanford Site chromium plumes, the segment along the 100-H Area is not a major spawning area (Dauble and Watson 1997).

A2.0 100-KR-4 HISTORY

In July 1994, the LFI report (DOE-RL 1994b), including a qualitative risk assessment, was completed. The report concluded that an interim remedial measure (IRM) was not warranted based on human health risk, but an IRM could be justified for ecological concerns related to chromium. In October 1995, the *100-KR-4 Operable Unit Focused Feasibility Study* (DOE-RL 1995b) and the *Proposed Plan for Interim Remedial Measure at the 100-KR-4 Operable Unit* (DOE-RL 1995e) were completed. The proposed plan recommended a pump-and-treat IRM to mitigate chromium migration into the Columbia River.

In April 1996, an interim remedial action ROD (EPA et al. 1996) was issued for the pump-and-treat system in the 100-KR-4 OU. The ROD specified installation of a pump-and-treat system in the 100-HR-3 and 100-KR-4 OUs to intercept portions of the chromium plumes that impact the Columbia River. Full-time operation of the treatment system was initiated on October 1, 1997.

Detailed site characterization and background information on the OU and the pump-and-treat activity are provided in the FFS (DOE-RL 1995b) and the proposed plan (DOE-RL 1995e). Further information on the pump-and-treat system's design and operation can be found in the work plan (DOE-RL 1996b) and interim action performance evaluation report (DOE-RL 1998a). Groundwater monitoring requirements are described in the interim action monitoring plan (DOE-RL 1997a). Additional background/current information is available in *Hanford Site Groundwater Monitoring for Fiscal Year 2004* (PNNL 2005).

A3.0 100-NR-2 HISTORY

On September 23, 1994, the Washington State Department of Ecology (Ecology) and the U.S. Environmental Protection Agency (EPA) issued an action memorandum to the U.S. Department of Energy, Richland Operations Office (RL) to immediately initiate groundwater remedial actions in the 100-N Area (Ecology and EPA 1994). The requested remedial actions included the design, construction, and operation of a groundwater pump-and-treat system and the construction of a sheet-pile barrier wall at N-Springs. However, in a letter dated March 1995, Ecology and EPA concurred with RL that installation of the sheet-pile wall could not be achieved in the manner specified. This conclusion was based on a construction test conducted in December 1994 (Ecology 1995).

Ecology and EPA subsequently directed RL to proceed with installing a pump-and-treat system as an expedited response action. The N-Springs pump-and-treat system was completed by August 1995 and began full operation by September 1995, meeting *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 2003) Milestone M-16-12D.

From system startup in September 1995 through November 8, 1996, the N-Springs pump-and-treat system operated at a nominal rate of 189 L/min. During this period, the system consisted of four extraction wells (199-N-75, 199-N-103A, 199-N-106A, and 199-N-105A, with three wells operating and one well as a backup) and two injection wells (199-N-29 and 199-N-104A).

Based on recommendations in the *N-Springs Expedited Response Action Performance Evaluation Report* (DOE-RL 1996a) and the *N-Springs Pump-and-Treat Optimization Study* (DOE-RL 1997b), the system was shut down and upgraded to operate at 227 L/min between November 8 and December 17, 1996. The pump-and-treat system was brought back on-line on December 17, 1996, and has continued to operate since that time. Under this configuration, the network consists of three extraction wells (199-N-75, 199-N-103A, and 199-N-106A) and two injection wells (199-N-29 and 199-N-104A), with well 199-N-105A serving as a backup extraction well.

Additional information regarding the progress of the 100-NR-2 pump-and-treat operations is provided in previous fiscal year summary reports (DOE-RL 1998b, 1999, 2001). Additional background/current information is available in *Hanford Site Groundwater Monitoring for Fiscal Year 2004* (PNNL 2005).

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APPENDIX B

CONCEPTUAL MODELS

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FIGURES

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APPENDIX B

CONCEPTUAL MODELS

B1.0 100-D CONCEPTUAL MODEL UPDATE

This section describes the sources of the chromium contamination in the 100-D Area, the site hydrogeology, man-made influences on flow, and the changes to the plume caused by the treatment systems.

Sodium dichromate, $Na_2Cr_2O_7$, is a corrosion inhibitor that was added to reactor coolant water during normal operations. The hexavalent form of chromium found in sodium dichromate is highly mobile and is toxic to aquatic organisms, particularly salmon fry. The trivalent form of chromium readily adsorbs to soil particles and is relatively insoluble in groundwater with a pH of >6.0. For convenience, hexavalent chromium is simply referred to as "chromium" in this text, unless noted otherwise.

Coolant water containing sodium dichromate in solution leaked from cooling water retention basins and large-diameter underground piping, introducing chromium to the soil column and ultimately to the groundwater. In addition, radiologically contaminated coolant water was disposed in process effluent trenches, french drains, or cribs. Chromic acid, H_2CrO_4, is a strong oxidizer that was used to decontaminate and clean reactor equipment, and the contaminated solution was then disposed to french drains. Transfer lines leading from the sodium dichromate transfer station to the reactors may have leaked to the vadose zone. These transfer lines are located near and parallel to raw water lines. A summary of waste sites that may be a source of chromium contamination in the 100-D/DR Reactor area is presented in *Conceptual Site Models for Groundwater Contamination at 100-BC-5, 100-KR-4, 100-HR-3, and 100-FR-3 Operable Units* (BHI 1996).

Known disposal and spill sites have been investigated by boring from the surface and collecting samples to detect near-surface contamination. An investigation was conducted in 2000 around the sodium dichromate transfer station in the 100-D Area (PNNL 2000). This investigation was not successful in locating significant near-surface chromium sources.

Another soil investigation was conducted in November 2003 during the drilling of monitoring well 199-D5-34. Samples were collected at 1.5-m intervals from the surface to the water table at a depth of 33.5 m. Hexavalent chromium was not detected in any of the soil samples. This well was located adjacent to a french drain that was a suspected disposal site for excess sodium dichromate.

In 2004, soil sampling was performed in response to concerns regarding high concentrations of chromium in the groundwater, which pointed to the source area around the sodium dichromate transfer station. Sampling was conducted to locate soil contamination associated with spills and releases of sodium dichromate from tanker cars staged on the tracks and potential pipeline leakage during past operations. Test pit samples and near-surface samples were collected. Results of this investigation are described in *Results of Hexavalent Chromium Sampling Near 100-D Area Sodium Dichromate Transfer Station and Railroad Tracks* (BHI 2004). Of the 116 samples collected, 16 samples were above the reporting limit of 0.35 mg/kg, and 2 samples were above the 2.0 mg/kg standard for protection of groundwater and the Columbia River.

Typical unconfined aquifer hydrostratigraphy in the 100-D Area includes the Hanford formation, the Ringold Unit E, and the Ringold Upper Mud Unit. The thickness of the Ringold Unit E varies significantly from north to south, and it may have been eroded locally in the north so the Hanford formation was deposited directly on the Ringold Upper Mud Unit. Two of the 100-D pump-and-treat extraction wells (199-D8-53 and 199-D8-54A) appear to be located where the Hanford formation is deposited directly on the Ringold Upper Mud Unit. The unconfined aquifer in these wells is located in Hanford formation sand and gravel with locally silty intervals. These wells are characterized by high well efficiency (e.g., significant production per foot of drawdown).

In the southern part of the 100-D Area, the Hanford formation was deposited on the Ringold Unit E. The unconfined aquifer in this area is within the Ringold Unit E, composed of more consolidated silt, sand, and gravel with locally cemented intervals. The wells associated with the In Situ Redox Manipulation (ISRM) were screened in Ringold Unit E sediments and almost universally are not as efficient (e.g., less production per foot of drawdown) as those wells screened in the Hanford formation. A more detailed description of the 100-D Area stratigraphy is presented in the conceptual site model report (BHI 1996) and the *Remedial Design Report and Remedial Action Work Plan for the 100-HR-3 and 100-KR-4 Groundwater Operable Units Interim Action* (DOE-RL 1996).

Groundwater flow in the 100-D Area is predominantly to the north in the pump-and-treat area and northwest in the southern portion of the 100-D Area, near the ISRM. Flow direction is affected by the elevation (stage) of the Columbia River, artificial mounding caused by operational practices associated with the 182-D Reservoir, and variation in the hydrostratigraphy.

Groundwater flow is generally toward the Columbia River (i.e., gaining stream), except near the river during May through August when the elevation (stage) is higher because of increased upriver dam releases. These releases raise the stage of the river and may reverse the flow direction (i.e., losing stream). The releases are managed to balance summer irrigation demand and power (electricity) production and to maintain safe reservoir elevations.

Facilities that have most recently affected the groundwater flow regimes in the 100-D Area include the 120-D-1 Ponds and the 182-D reservoir. Normal disposal practices and leakage from these facilities may have been responsible for mounding between the reactor buildings and the Columbia River. The 120-D-1 Ponds were closed to disposal in 1995. The 182-D reservoir was emptied from November 2002 to April 2003 and remained empty until mid-July 2003, when it was filled to capacity. Reservoir construction joints were repaired while the reservoir was empty. The fall 2003 water table elevation map suggests that the repairs were not effective because a groundwater mound is present in the area surrounding the 182-D reservoir. However operational practices were changed in 2004 to eliminate leakage from this reservoir. Changes in flow direction caused by mound dissipation have resulted in the north plume and southwest plumes coalescing (Figure B-1).

In addition, hydrostratigraphy also influences flow velocity and direction. Northeast of the ISRM barrier, an eroded channel through the Ringold Upper Mud Unit has been filled with Ringold Unit E sediments. The Ringold Unit E sediments have a higher hydraulic conductivity than the Ringold Upper Mud materials and, therefore, may act as a preferential flow channel to the north.

Additional site characterization since 1995 led to the discovery of the southwest 100-D plume, which was outside the capture zone of the pump-and-treat extraction wells. The ISRM barrier was built to control this southwest plume. The southwest 100-D plume was separated from the north plume (i.e., the pump-and-treat plume) by groundwater mounds created by disposal to the 120-D-1 Ponds, leakage from the 182-D reservoir, and possibly by injection into wells south of the DR Reactor during 1995 during the pilot-scale pump-and-treat test.

The highest remaining concentrations are in the southwest plume area, notably in well 199-D5-39, where chromium has been measured above 4,500 µg/L. The source of this plume may be the former sodium dichromate/chromic acid transfer station upgradient (east) of well 199-D5-39. Figure B-1 presents a baseline comparison with current configuration of the chromium plume.

B2.0 100-H CONCEPTUAL MODEL UPDATE

This section describes the sources of chromium contamination in the 100-H Area, the site hydrogeology, man-made influences on flow, and the changes to the plume caused by the treatment systems.

Sodium dichromate, $Na_2Cr_2O_7$, is a corrosion inhibitor that was added to reactor coolant water during normal operations. The hexavalent form of chromium found in sodium dichromate is highly mobile and is toxic to aquatic organisms, particularly salmon fry. The trivalent form of chromium readily adsorbs to soil particles and is relatively insoluble in groundwater with a pH of >6.0.

Coolant water containing sodium dichromate in solution leaked from cooling water retention basins and large-diameter underground piping, introducing chromium to the soil column and ultimately to groundwater. Specific facilities that have leaked include the 183-H solar evaporation basins and the 107-H retention basins. A summary of waste sites that may be a source of chromium contamination in the 100-H Reactor area is provided in the conceptual site model report (BHI 1996).

The 100-D Area may have been the source of a chromium plume west of the 100-H Area. Leaking cooling water retention basins created a significant mound of sodium dichromate contaminated water that flowed radially, including east, from the 100-D retention basin area. Two of the 600 Area wells, namely wells 699-96-43 and 699-97-43 (located upgradient [west] of the 100-H Area), have been characterized by chromium concentrations near 100 µg/L since the start of pump-and-treat operations. This plume may have traveled from the 100-D Area.

Typical unconfined aquifer hydrostratigraphy in the 100-H Area includes the Hanford formation and the Ringold Upper Mud Unit. The unconfined aquifer is located in the saturated Hanford formation, with the top of the Ringold Upper Mud Unit as its base. The thickness of the unconfined aquifer at the 100-H area varies significantly, as shown in Figure B-2 (isopach map of saturated Hanford formation). Extraction wells located near the Columbia River are characterized by 3 to 4.5 m of saturated Hanford formation. As shown in Figure B-2, the saturated thickness of the Hanford formation thins to as little as 0.6 m in the 600 Area, which is west of the 100-H Area (well 699-96-43). Additional details regarding 100-H Area hydrostratigraphy are found in conceptual site model report (BHI 1996) and the remedial design report/remedial action work plan (DOE-RL 1996).

Groundwater flow in the 100-H Area is predominantly to the northeast. Flow direction is affected by the elevation (stage) of the Columbia River, artificial mounding caused by operational practices (especially injection wells), and hydrostratigraphy.

Groundwater flow generally is toward the Columbia River (i.e., gaining stream), except near the river during May through August when the elevation (stage) is higher because of increased upriver dam releases. These releases raise the stage of the river and may reverse the flow direction (i.e., losing stream). The releases are managed to balance summer irrigation demand and power (electricity) production and to maintain safe reservoir elevations.

Leakage from the former 107-H retention basins created a groundwater mound in the 100-H Area. This mound could have pushed chromium-contaminated groundwater to the west. These basins were in use until about 1965, and any mounding has since dissipated.

Hydrostratigraphy has a strong influence on aquifer conditions in the 100-H Area. The minimal thickness of the saturated Hanford formation west of the 100-H Area (0.6 to 2.1 m) in wells 699-96-43 and 699-97-43 restricts the flow into the 100-H Area. In addition, a thin aquifer along the Columbia River limits drawdown in extraction wells and, therefore, restricts pumping rates.

The original target area of the pump-and-treat system, which came on-line in 1997, was a wedge-shaped, 100 µg/L chromium isopleth that extended to well 199-H3-2A and was bounded along the shoreline by the 50 µg/L chromium isopleth (Figure B-3). Maximum concentrations within this target area were >100 µg/L in well 199-H3-2A. This high-concentration area around well 199-H3-2A moved to the near-river wells in subsequent years. Figure B-3 shows baseline and the current plume configuration for the 100-H Area.

The capture zone of the original extraction wells included a gap between extraction wells 199-H4-12A and 199-H4-11. This gap was closed in 2000 with the addition of well 199-H4-65. However, limitations on pumping rates in this well and adjacent extraction wells caused by lowered water levels have caused incomplete hydraulic capture in this area.

Injection wells 199-H3-3, 199-H3-4, and 199-H3-5 have had the effect of pushing contaminants downgradient, which is evident in concentration trend for chromium in well 199-H3-2A.

B3.0 100-KR-4 CONCEPTUAL MODEL UPDATE

This section describes the sources of chromium contamination in the 100-K Area, the site hydrogeology, man-made influences on flow, and the changes to the plume caused by the treatment systems.

Sodium dichromate, $Na_2Cr_2O_7$, is a corrosion inhibitor that was added to reactor coolant water during normal operations. The hexavalent form of chromium found in sodium dichromate is highly mobile and is toxic to aquatic organisms, particularly salmon fry. The trivalent form of chromium is readily adsorbed by soil particles and is relatively insoluble in groundwater with a pH of >6.0.

The primary source of chromium contamination in the 100-K Area is the 116-K-2 Trench. Large volumes of chromium-contaminated reactor coolant water and other reactor effluents were discharged into the trench between 1955 and 1971. The 116-K-2 Trench is approximately 1,250 m long, 14 m wide, and 5 m deep in its original configuration. The trench was excavated parallel to and about 250 m from the Columbia River (DOE-RL 1996). Lists of other potentially significant sources that may have contributed to chromium contamination in the 100-K Area are presented in conceptual site model report (BHI 1996) and in *Summary of Hanford Site Groundwater Monitoring for Fiscal Year 2002* (PNNL 2003).

The reactor coolant water and other liquids discharged to the trench contained an estimated 300,000 kg of sodium dichromate, as well as other chemical wastes and a significant radiological inventory. An estimated 2,100 Ci of radionuclides were disposed to the trench (Dorian and Richards 1978, WHC 1994).

The unconfined aquifer in the 100-K Area is situated in the Ringold Unit E facies of the Ringold Formation. The base of the unconfined aquifer is formed by Ringold Formation paleosols and overbank deposits. The Ringold Unit E facies in the 100-K Area may be more cemented and less eroded than in the surrounding 100 Areas. This is evidenced by Coyote Rapids, located upstream of the 100-K Area, which is made up of very resistant, well-cemented Ringold Unit E sediments. Additional hydrostratigraphic description is presented in the remedial design report and remedial action work plan (DOE-RL 1996) and in *Geology of the 100-K Area, Hanford Site, South-Central Washington* (WHC 1993).

Groundwater flow in the 100-K Area is predominantly to the northwest. Flow direction is affected by the elevation (stage) of the Columbia River, artificial mounding caused by operational practices, and hydrogeology.

Groundwater flow is generally toward the Columbia River, except near the river during May through August when the elevation (stage) is higher because of increased upriver dam releases. These releases raise the river level and may reverse the groundwater flow direction (inland flow). The releases are managed to balance summer irrigation demand and power (electricity) production and to maintain safe river elevations for fisheries management.

When the K Reactors were in operation, the full length of the 116-K-2 Trench was filled to capacity with reactor coolant water. A groundwater mound about 6 m higher than the natural water table caused flow inland (southeast) and toward the river (northwest). Mounding has been observed at well 699-78-62, which is located approximately 1.6 km from the 116-K-2 Trench. Any mounding should have long since dissipated; however, the contaminated groundwater is moving downgradient.

Hydrogeology has a strong influence on flow rate in the 100-K Area. The hydraulic conductivities vary greatly from 200 m/day in local areas downgradient of the 116-K-2 Trench to 2 m/day in the injection well area. The range of hydraulic conductivities is likely a function of the degree of cementation of the Ringold Unit E sediments. Slug test results are reported in the conceptual site model report (BHI 1996).

The original 100-K pump-and-treat target area was oblong in shape, on the downstream side of the 116-K-2 Trench, extending the full length of the trench (Figure B-4). The 100 μg/L chromium isopleth extended the full length of the trench. Six extraction wells were constructed to capture the known plume at the time.

The November 2004 100-K chromium plume map is shown in Figure B-4. Monitoring well 199-K-131 was added to the network during 2004 to monitor downstream concentrations of chromium. This well contained 78 μg/L of hexavalent chromium in November 2004. Data from well 199-K-131 and 100-N Area wells indicate that the plume extends just into the 100-N Area.

B4.0 REFERENCES

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WHC, 1994, *100-K Area Technical Baseline Report*, WHC-SD-EN-TI-239, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Figure B-1. 100-D Operable Unit Chromium Plume Map, 1995 and 2004.

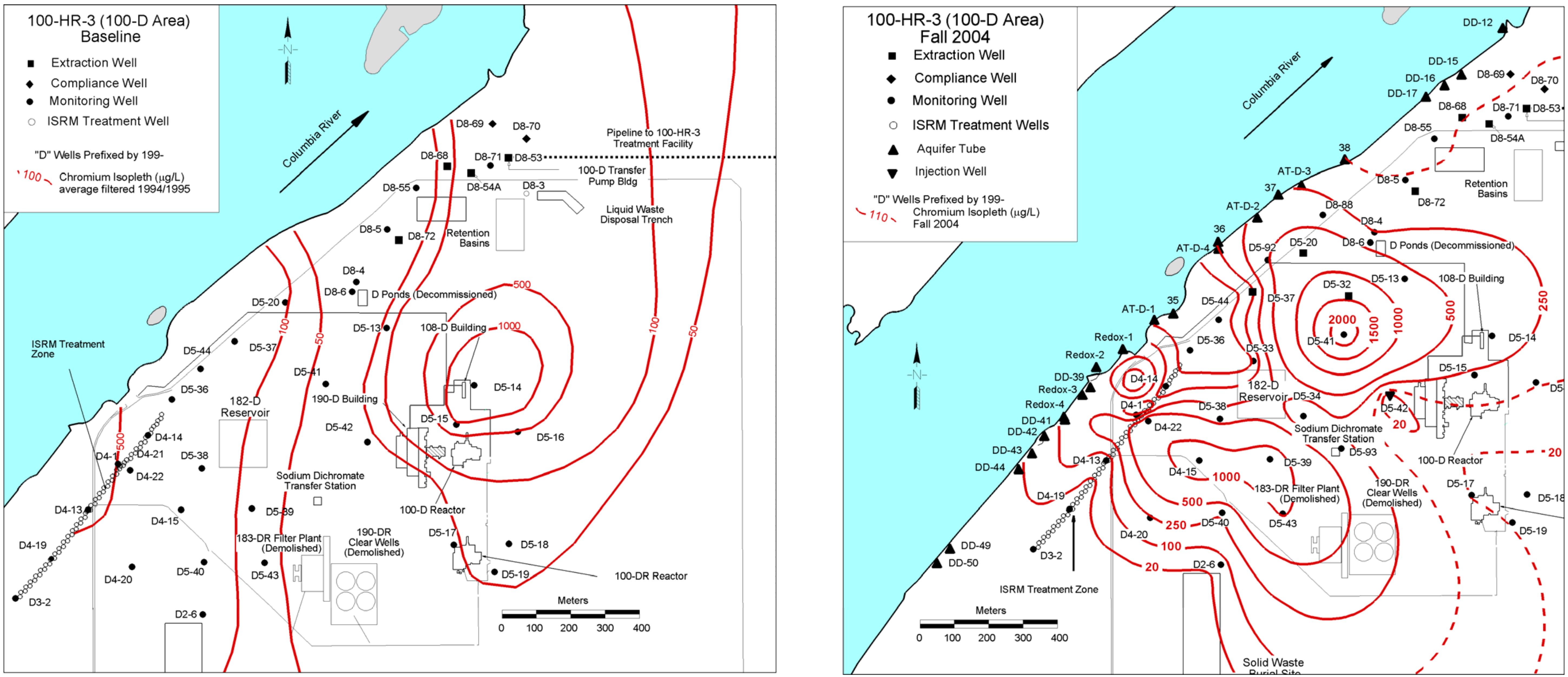

Figure B-2. Saturated Thickness of Uppermost Aquifer Underlying the 100-H Area.

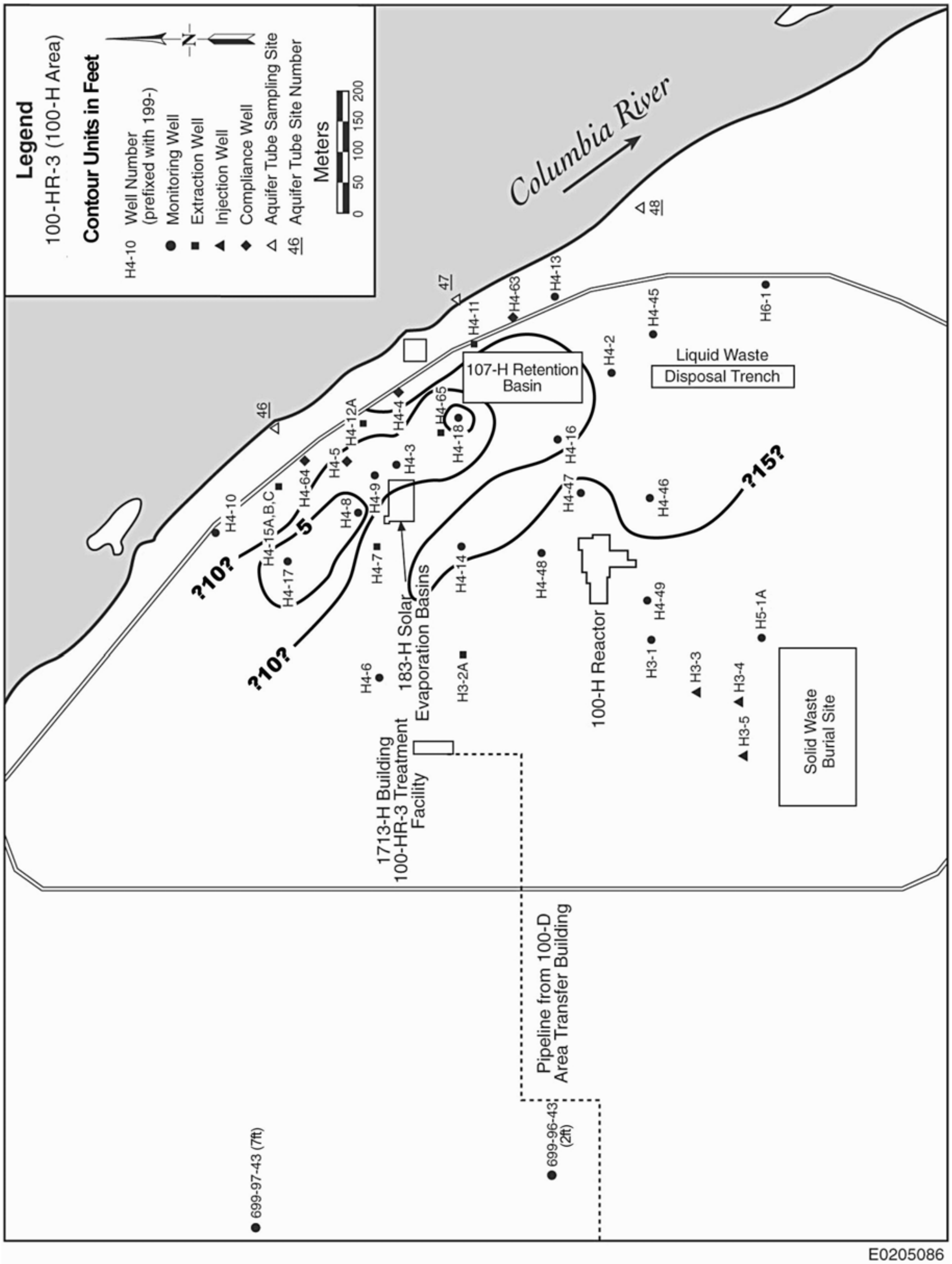

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Figure B-3. 100-H Area Chromium Plume Map, 1995 and 2004.

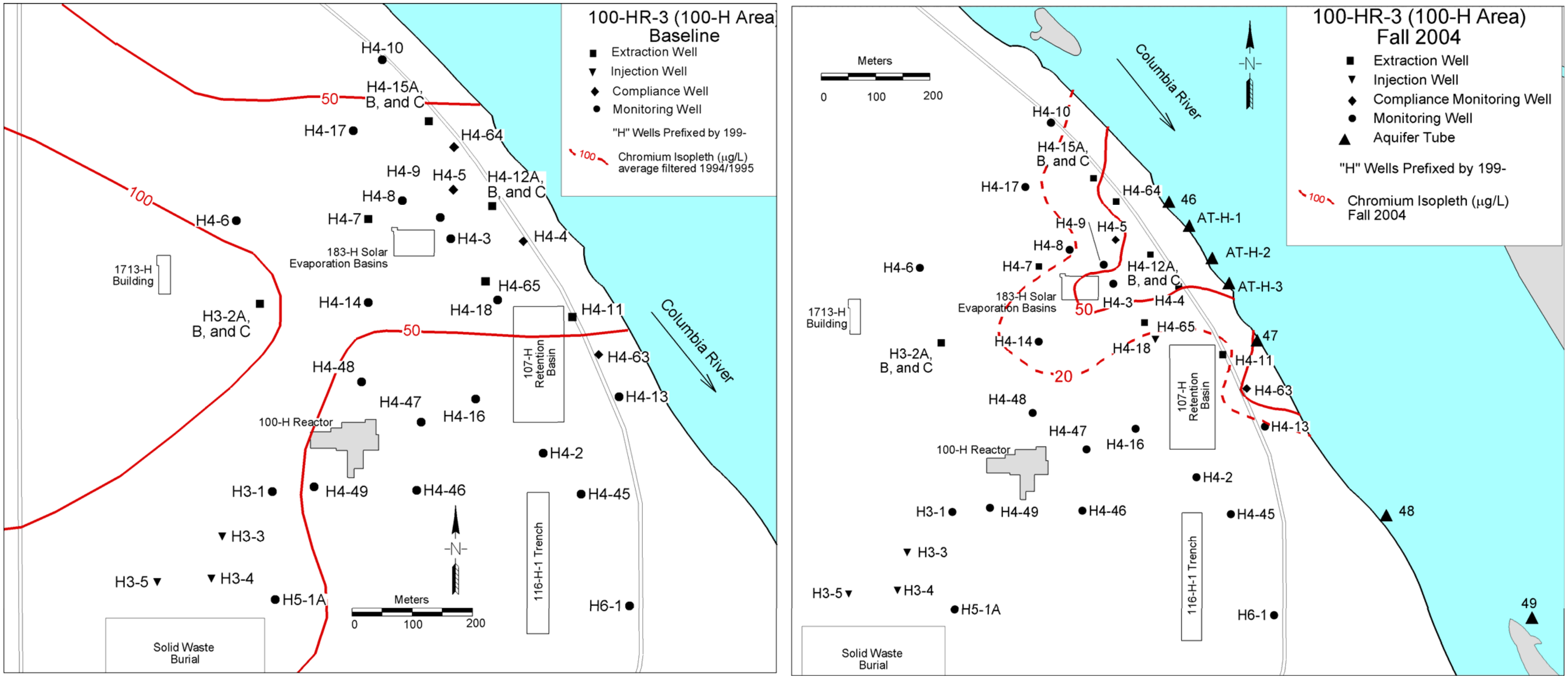
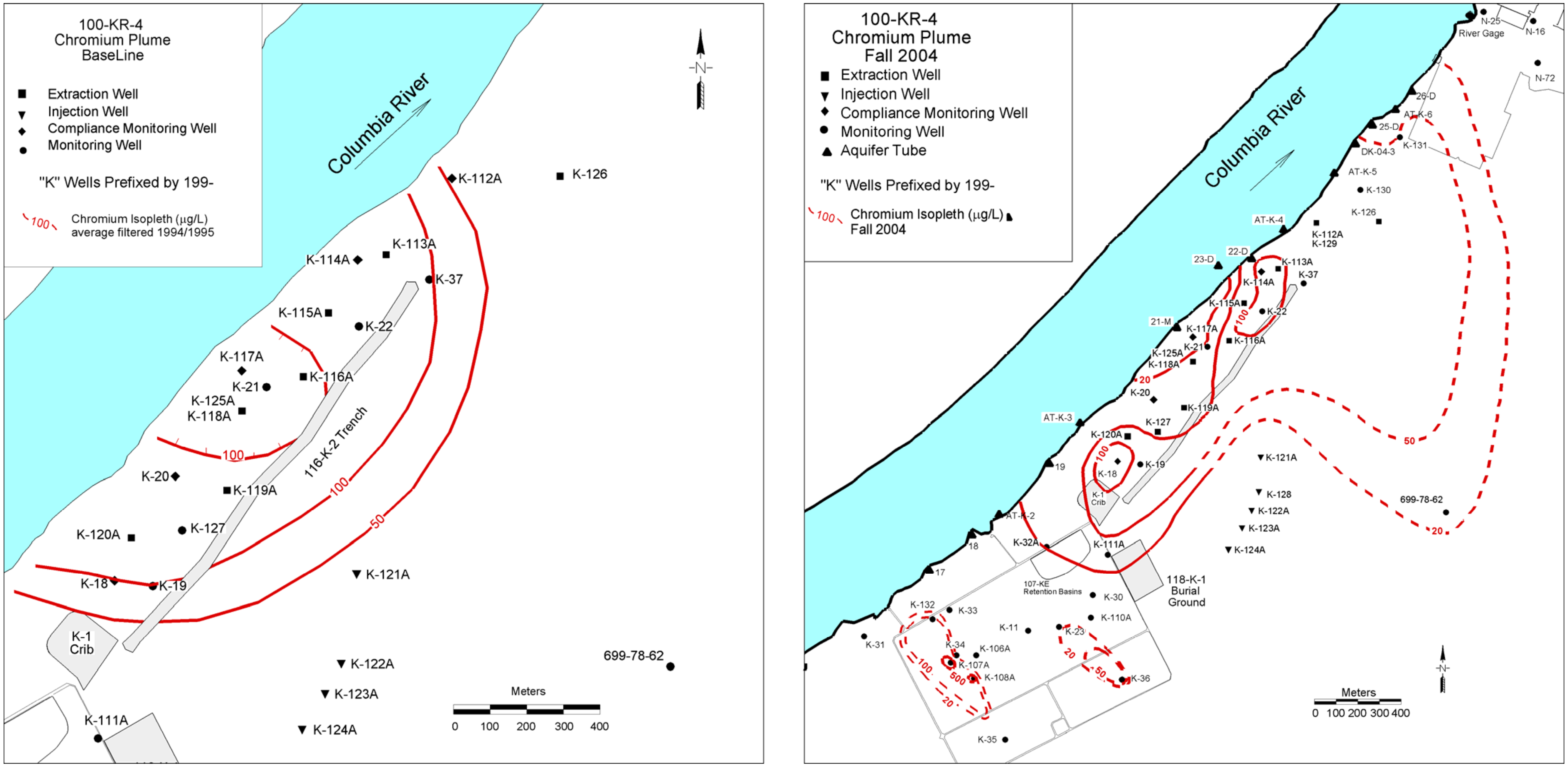


Figure B-4. 100-K Chromium Plume Map and Baseline, 1995 and 2004.



APPENDIX C

TREATMENT SYSTEM PERFORMANCE

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CONTENTS

TABLES

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APPENDIX C

TREATMENT SYSTEM PERFORMANCE

C1.0 100-HR-3 TREATMENT SYSTEM PERFORMANCE

The following tables present a summary of 100-HR-3 pump-and-treat operational parameters:

- Table C-1 provides the 100-HR-3 pump-and-treat summary of operations.
- Table C-2 provides the minimum, maximum, and average chromium concentrations for extraction wells in 100-HR-3.
- Table C-3 provides a comprehensive presentation of system availability since system startup.
- Table C-4 presents average extraction rates since system startup and the percentage run-time for extraction wells.

C2.0 100-KR-4 TREATMENT SYSTEM PERFORMANCE

The following tables present a summary of the 100-KR-4 pump-and-treat operational parameters:

- Table C-5 provides the 100-KR-4 pump-and-treat summary of operations.
- Table C-6 provides the minimum, maximum, and average chromium concentrations for extraction wells in 100-KR-4.
- Table C-7 provides a comprehensive presentation of system availability since system startup.
- Table C-8 presents average extraction rates since system startup and the percentage run-time for extraction wells.

C3.0 100-NR-2 TREATMENT SYSTEM PERFORMANCE

The following tables present a summary of the 100-NR-2 pump-and-treat operational parameters:

- Table C-9 provides the volume of groundwater treated and strontium removed since startup of operations at 100-NR-2, presented on a quarterly schedule.
- Table C-10 provides the average strontium-90 activities for influent and effluent tanks at the 100-NR-2 pump-and-treat system.
- Table C-11 provides the average extraction rates for calendar year 1995 (CY95) to CY04 and percentage of run-time for extraction wells.
- Table C-12 provides the summary of system availability.

Table C-1. 100-HR-3 Pump-and-Treat Summary of Operations.

Activity	CY00	CY01	CY02	CY03	CY04
System availability (%)	97.3	97.0	99.8	99.8	99.9
100-D Area volume treated (L)	135,722,674	96,664,047	184,133,793	237,450,895	164,244,767
100-H Area volume treated (L)	169,440,167	125,915,402	166,434,370	179,197,084	153,462,037
Total volume treated (L)	305,162,841	222,579,449	350,568,163	416,647,979	317,706,804
100-D Area contaminant mass removed (g)	25,295	20,548	28,067	38,331	30,145
100-H Area contaminant mass removed (g)	4,658	5,848	3,977	4,660	3,529
Total contaminant mass removed (g)	29,953	26,396	32,044	42,992	33,675
Removal efficiency (% by mass)	93.4	92.0	93.8	93.8	95.2
Waste generation (m^3)[a]	62.1	69	66.7	80.5	81.6
Low-level radioactive waste generation (m^3)	27.6	36.8	13.4	4.5	NA
Regenerated resin installed (m^3)	13.8	36.8	32.2 m^3	43	40.8
New resin installed (m^3)	48.3	25.3	34.5 m^3	36.2	40.8
Number of resin changeouts	27	30	29	35	36

[a] Each ion-exchange vessel contains 2.3 m^3 of ion-exchange resin.
CY = calendar year
NA = not available

Table C-2. 100-HR-3 Extraction Well Chromium Concentrations.

Location/ Well	CY01 Avg. Cr^{+6} (µg/L)	CY01 Min. Cr^{+6} (µg/L)	CY01 Max. Cr^{+6} (µg/L)	CY02 Avg. Cr^{+6} (µg/L)	CY02 Min. Cr^{+6} (µg/L)	CY02 Max. Cr^{+6} (µg/L)	CY03 Avg. Cr^{+6} (µg/L)	CY03 Min. Cr^{+6} (µg/L)	CY03 Max. Cr^{+6} (µg/L)	CY04 Avg. Cr^{+6} (µg/L)	CY04 Min. Cr^{+6} (µg/L)	CY04 Max. Cr^{+6} (µg/L)
199-D8-53	210	178	314	130	20	220	103	23	167	91.4	34	150
199-D8-54A	243	120	322	134	19	221	106	11	168	119	40	163
199-H3-2A	11	5(U)	51	14	7	28	11	4	30	6.8	4	10
199-H4-7	23	16	53	33	16	68	27	14	51	15	9	21
199-H4-11	32	11	219	25	8	64	27	18	42	21.6	17	27
199-H4-12A	67	39	100	27	2	60	53	16	125	39	6	70
199-H4-15A	64	27	91	39	6	72	50	35	74	40.8	27	50
199-D8-68	—	—	—	—	—	—	87	8	192	99.2	16	150
199-D8-72	—	—	—	—	—	—	490	291	626	486.6	408	540
199-H4-65	—	—	—	—	—	—	23.5	15	38	—	—	—
100-D Area influent[a]	227	130	269	166	67	261	176.1	70	292	194.1	98	302
100-H Area influent[a]	54	20	117	26	5	56	28	16	102	23	5	38
Effluent tank	11	1(U)	49	6	1(U)	20	7.3	0(U)	99	5.4	0(U)	24

NOTE: Data presented herein are stored in the project-specific database. The chromium data are also stored in the Hanford Environmental Information System database. The data are collected in support of operations. This table excludes CY00 information due to space limitations.

[a] Before the system modification on August 5, 1998, the influent for the 100-D and 100-H Areas was combined.

CY = calendar year
U = undetected
— = not applicable

Table C-3. 100-HR-3 Summary of System Availability
(July 1, 1997, to December 31, 2004).

Year	Total Time On-Line (hours)	Total Possible Run-Time (hours)	Scheduled Downtime (hours)	Unscheduled Downtime (hours)	Total Availability (%)[a]	Scheduled Availability (%)[b]
1997	3,866	4,416	2	548	87.5	87.6
1998	7,038	8,760	368	1,355	80.3	84.5
1999	7,782	8,760	290	689	88.8	92.1
2000	8,397	8,784	157	230	95.6	97.4
2001	8,411	8,760	92	258	96.0	97.1
2002	8,525	8,760	218	17	97.3	99.8
2003	8,570.5	8,760	173	16.5	97.8	99.8
2004	8,710	8,784	73	1	99.1	99.9

[a] Total availability = (total possible run-time - scheduled and unscheduled downtime) / total possible run-time.
[b] Scheduled availability = (total possible run-time - unscheduled downtime) / total possible run-time.

Table C-4. 100-HR-3 Average Extraction Rates, Calendar Year 1997 to Calendar Year 2004. (4 sheets)

Well	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Design Flow Rate (gpm)	Avg. Monthly Flow Rate (gpm)	Total Run-Time (%)[a]
1997															
199-D8-53	No data available.					39.6	25.3	28.0	33.3	39.3	31.8	24.6	40.0	31.7	78.3
199-D8-54A						39.8	25.4	28.2	32.4	38.6	31.8	24.8	40.0	31.6	78.3
199-H3-2A						40.2	42.1	26.9	32.1	32.9	17.6	30.1	40.0	31.7	88.0
199-H4-11						15.1	16.3	12.5	11.6	16.8	16.5	19.2	20.0	15.4	87.0
199-H4-12A						14.7	16.1	12.3	9.4	15.2	16.7	19.4	10.0	14.8	86.4
199-H4-15A						14.8	16.1	12.5	10.2	15.7	16.5	19.4	10.0	15.0	87.0
199-H4-65						—	—	—	—	—	—	—	20.0	—	—
199-H4-7						27.7	27.8	25.0	21.0	13.4	—	—	20.0	23.0	50.5
1998															
199-D8-53	23.7	39.3	35.7	37.0	41.7	34.4	18.2	35.3	40.3	37.7	37.7	24.2	40.0	33.8	84.4
199-D8-54A	23.8	39.1	35.7	37.0	41.7	34.3	18.7	35.2	40.1	41.0	40.7	29.9	40.0	34.8	86.0
199-H3-2A	21.4	18.6	18.5	18.4	20.1	18.4	8.4	19.4	17.7	17.1	16.5	16.4	40.0	17.6	87.9
199-H4-11	10.1	10.3	11.8	16.2	19.9	14.4	4.6	10.4	13.6	17.4	16.7	19.4	20.0	13.7	81.6
199-H4-12A	10.2	9.9	8.1	9.5	10.9	11.3	4.8	10.6	8.2	9.8	9.4	10.9	10.0	9.5	82.7
199-H4-15A	10.5	12.9	8.0	9.4	11.1	11.3	4.6	10.2	7.8	9.1	8.7	10.2	10.0	9.5	82.7
199-H4-65	—	—	—	—	—	—	—	—	—	—	—	—	20.0	—	—
199-H4-7	3.7	19.5	15.7	15.0	4.1	2.0	9.0	18.6	11.5	5.8	9.6	11.2	20.0	10.5	66.3

Table C-4. 100-HR-3 Average Extraction Rates, Calendar Year 1997 to Calendar Year 2004. (4 sheets)

Well	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Design Flow Rate (gpm)	Avg. Monthly Flow Rate (gpm)	Total Run-Time (%)[a]
1999															
199-D8-53	23.5	33.8	33.7	33.6	33.7	33.8	30.5	22.9	17.4	33.0	23.2	26.2	40.0	28.8	84.7
199-D8-54A	28.1	41.5	41.4	41.3	41.3	41.3	37.3	27.9	20.8	39.6	29.8	34.2	40.0	35.4	84.7
199-H3-2A	13.3	17.5	19.2	19.3	19.5	19.7	17.6	14.8	13.0	12.1	20.4	10.5	40.0	16.4	83.8
199-H4-11	16.0	18.1	19.5	21.4	23.7	23.9	21.7	17.6	15.5	14.2	23.9	10.3	20.0	18.8	82.5
199-H4-12A	10.7	13.6	11.9	12.2	13.7	13.8	12.4	10.2	8.7	8.0	13.4	5.9	10.0	11.2	82.5
199-H4-15A	10.6	13.5	11.7	7.9	5.1	13.4	12.1	9.5	8.4	7.8	13.2	5.8	10.0	9.9	75.1
199-H4-65	—	—	—	—	—	—	—	0.4	—	—	—	—	20.0	0.4	0.4
199-H4-7	9.7	12.0	11.0	10.8	12.2	12.4	11.3	9.5	7.8	7.1	11.9	5.2	20.0	10.1	82.5
2000															
199-D8-53	28.5	29.3	34.5	39.8	39.9	39.9	40.2	40.1	39.9	36.5	34.3	32.4	40.0	36.3	95.8
199-D8-54A	33.9	37.8	38.3	40.1	40.1	40.0	40.0	40.0	39.9	39.7	36.4	32.8	40.0	38.2	94.0
199-H3-2A	27.7	23.2	17.2	19.8	20.2	20.1	20.1	19.9	19.2	19.6	21.5	18.4	40.0	20.6	84.5
199-H4-11	13.3	11.2	13.2	20.0	20.1	20.0	20.0	20.0	19.8	19.9	20.0	20.4	20.0	18.2	84.5
199-H4-12A	11.2	9.3	10.2	15.0	14.9	14.9	14.9	14.9	14.7	13.8	13.4	14.5	10.0	13.5	84.5
199-H4-15A	10.9	9.5	7.6	15.1	15.1	15.0	15.0	15.0	15.0	15.0	15.0	15.0	10.0	13.6	81.5
199-H4-65	3.5	9.9	2.7	6.4	12.9	12.6	11.9	9.4	—	—	—	—	20.0	8.7	58.9
199-H4-7	10.6	9.9	16.7	19.9	20.2	20.2	20.3	20.3	18.6	14.3	13.6	15.6	20.0	16.7	88.7

Table C-4. 100-HR-3 Average Extraction Rates, Calendar Year 1997 to Calendar Year 2004. (4 sheets)

Well	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Design Flow Rate (gpm)	Avg. Monthly Flow Rate (gpm)	Total Run-Time (%)[a]
2001															
199-D8-53	32.4	32.3	32.2	31.8	28.8	32.6	23.8	20.2	18.6	18.2	19.5	23.1	40.0	26.1	91.2
199-D8-54A	32.3	32.2	32.1	32.1	24.6	32.2	24.0	20.0	19.7	20.5	20.7	33.1	40.0	27.0	92.5
199-H3-2A	17.6	17.6	18.5	20.0	18.5	19.8	18.7	20.3	18.5	18.4	18.5	20.2	40.0	18.9	95.1
199-H4-11	19.9	19.9	19.8	19.7	18.4	19.6	18.2	17.0	17.0	17.8	19.1	23.2	20.0	19.1	95.2
199-H4-12A	14.6	10.7	11.1	7.0	6.3	9.2	6.8	6.2	6.1	6.0	6.5	8.5	10.0	8.3	88.3
199-H4-15A	15.0	15.0	14.9	14.8	13.0	16.2	14.7	10.4	10.2	10.2	10.3	10.4	10.0	12.9	95.7
199-H4-65	—	—	—	—	—	—	—	—	—	—	—	—	20.0	—	—
199-H4-7	15.0	12.5	11.4	8.1	6.6	6.8	6.2	5.5	5.5	5.3	5.3	5.4	20.0	7.8	94.2
2002															
199-D8-53	27.4	32.4	25	19.4	31.3	40.5	43.2	44	23.9	18.2	21.7	20.9	40.0	29.0	89.3
199-D8-54A	34.1	32.3	29.5	23.5	31.1	40.2	40.1	40.9	34.1	22.4	34.3	34.3	40.0	33.1	91.9
199-H3-2A	20.1	20.2	21.7	23.1	17.3	20.1	20.5	20.2	20	24.9	36.2	36.2	40.0	23.4	95.6
199-H4-11	21.4	21.4	21.1	18.6	19.8	22	21.7	21.4	21.2	21.6	22.9	23.6	20.0	21.4	96.6
199-H4-12A	8.9	10.3	8.2	13.9	15.8	14.8	14.7	13.7	8.5	8.1	8.3	8.2	10.0	11.1	91.1
199-H4-15A	12.8	15.4	15.3	14.2	16.9	19.2	19.3	19	18.5	18.5	18.6	18.5	10.0	17.2	96.3
199-H4-65	—	—	—	—	—	—	—	—	—	—	—	—	20.0	—	—
199-H4-7	6.4	8.8	7.3	7.3	11.7	20.3	21.6	21.1	18.4	15.5	15.1	14.9	20.0	14.0	93.6

Table C-4. Average Extraction Rates, Calendar Year 1997 to Calendar Year 2003. (4 sheets)

Well	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total Hours On-Line	Avg. Monthly Flow Rate (gpm)	Total Run-Time (%)[a]
2003															
199-D8-53	16.6	12.2	12.6	28.5	35.6	41	33.3	22.7	11.8	11.6	18.9	23.9	7,826.5	22.4	89.3
199-D8-54A	29.8	22.7	22.5	40.3	42.7	45.8	38.8	31.8	20.4	18.9	29.5	23.7	8,052	30.5	91.9
199-D8-68	—	—	—	—	—	—	—	—	—	—	—	—	5,346.5	49.1	61.0
199-D8-72	—	—	—	—	—	—	—	—	—	—	—	—	5,323	25.1	60.7
199-H3-2A	36.2	36.2	36.1	36.2	33.2	23.5	20.1	22.9	24.3	24.2	24.2	24.2	8,374	28.4	95.5
199-H4-11	24	25.6	25.7	25.7	23.6	21.2	20.4	24	24.6	25.2	23	24.7	8,464.5	23.9	96.6
199-H4-12A	7.3	5.6	6.3	8.4	11.3	11.5	11.1	9.1	6.3	6.4	8.7	9	7,976.5	8.4	91
199-H4-15A	18.5	18.6	18.6	19.8	19.1	19	19.2	20	18.7	16.5	19.6	19.8	8,432	18.9	96.2
199-H4-65	—	—	—	—	11.9	11.7	11.2	—	—	—	5.3	4.5	260	8.9	2.9
199-H4-7	12	10.5	9.8	11.7	12.5	12.8	17.5	18.6	15.9	11	14.8	13.5	8,195	13.3	93.5
2004															
199-D8-53	26.1	17.4	11.7	13.2	16.3	17	16	16.2	14.5	12.5	15.2	18.2	7,786.00	16.2	88.6
199-D8-54A	22.6	24.3	24.9	23.3	25.8	25.1	22.4	—	—	21.9	23.6	24.2	5,571	24	63.4
199-D8-68	50.2	50.3	21.8	24.9	31.1	29.4	25.9	29.6	30.7	30.5	29	29.7	8,161.00	31.9	92.9
199-D8-72	27.9	24.8	21.4	21.9	22.2	22.2	21.7	21.6	21.4	21.3	21.3	22	8,169	22.5	93
199-H3-2A	24.2	24.2	24.1	24.1	24.2	24.4	24.4	24.3	24.2	24.1	23.9	24	8,377	24.2	95.4
199-H4-11	24.3	24.4	21.9	22.8	24.7	24.7	24.7	24.6	24.6	24.6	—	13.6	6,578.00	23.5	74.9
199-H4-12A	9.6	8	6.2	6.6	7.4	7.2	6.7	7.3	7.5	7.9	7.9	8.2	7,742.00	7.5	88.1
199-H4-15A	19.7	19.7	19	19.3	20	19.9	19.7	19.7	19.7	19.6	19.4	19.5	8,092	19.6	92.1
199-H4-65	—	—	—	—	—	11.9	11.7	—	—	—	—	—	744.5	11.8	8.5
199-H4-7	14.7	13	10.6	8.8	9.4	9.8	10.2	10	10.2	10.3	10.5	10.6	7,646	10.5	87

[a] Total hours on-line / total possible run-time.
gpm = gallons per minute
— = not applicable

Table C-5. 100-KR-4 Pump-and-Treat Summary of Operations for Calendar Year 2004.

Activity	CY00	CY01	CY02	CY03	CY04
System availability (%)	98.8	97.0	98.3	99.3	99.1
Total volume treated (L)	286,663,199	338,815,034	445,740,587	517,640,068	500,016,928
Total contaminant mass removed (g)	33,535	36,233	35,291	36,657	29,603
Removal efficiency (% by mass)	95.4	95.6	95	95.2	93.6
Waste generation (m^3)[a]	59.8	64.4	58	96.6	80.5
Regenerated resin installed (m^3)	11.5	55.2	25.3	52.1	39
New resin installed (m^3)	48.3	9.2	55.2	43	41.5
Number of resin changeouts	26	28	35	42	35

[a] Each ion-exchange vessel contains 2.3 m^3 of ion-exchange resin.
CY = calendar year

Table C-6. 100-KR-4 Extraction Well Chromium Concentrations.

Location/ Well	1998 Avg. Cr^{+6} (µg/L)	1999 Avg. Cr^{+6} (µg/L)	2000 Avg. Cr^{+6} (µg/L)	2001 Avg. Cr^{+6} (µg/L)	2002 Avg. Cr^{+6} (µg/L)	2002 Min. Cr^{+6} (µg/L)	2002 Max. Cr^{+6} (µg/L)	2003 Avg. Cr^{+6} (µg/L)	2003 Min. Cr^{+6} (µg/L)	2003 Max. Cr^{+6} (µg/L)	2004 Avg. Cr^{+6} (µg/L)	2004 Min. Cr^{+6} (µg/L)	2004 Max. Cr^{+6} (µg/L)
199-K-112A	N/A	N/A	N/A	90	75	26	118	72	60	81	NA	NA	NA
199-K-113A	85	72	80	75	51	1 (U)	92	63	41	77	66.1	23	102
199-K-115A	136	122	128	151	94	16	136	95	52	126	84.4	54	138
199-K-116A	179	187	179	164	126	70	157	113	61	146	84.1	57	110
199-K-118A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA	NA	NA	NA	NA	NA
199-K-119A	158	146	111	85	75	28	107	54	38	89	30.2	25	39
199-K-120A	98	105	97	77	69	3	90	76	63	86	69.4	62	80
199-K-125A	166	157	116	77	67	49	108	50	30	149	34.1	28	42
199-K-126	—	—	—	—	—	—	—	102	76	132	83.3	60	97
199-K-127	—	—	—	—	—	—	—	61	31	75	60.8	45	136
199-K-129	—	—	—	—	—	—	—	67	51	87	52	35	64
100-K Area influent	144	132	123	114	85	44	107	75	55	93	62.9	45	84
Effluent tank	5	8.7	6	5	4	1	10	3.1	1	11	3.8	1	16

NOTE: Data presented herein are stored in the project-specific database. Data from 1997 have been excluded due to space limitations.
N/A = not available
— = not applicable

Table C-7. 100-KR-4 Summary of System Availability (July 1, 1997, to December 31, 2004).

Year	Total Time On-Line (hours)	Total Possible Run-Time (hours)	Scheduled Downtime (hours)	Unscheduled Downtime (hours)	Total Availability (%)[a]	Scheduled Availability (%)[b]
1997	2,374	4,416	0	2,042	53.8	53.8
1998	7,742	8,760	10	1,009	88.4	88.5
1999	8,629	8,760	61	70	98.5	99.2
2000	8,387	8,784	292	105	95.5	98.8
2001	8,466	8,760	29	266	96.6	97.0
2002	8,255	8,760	359	145	94.3	98.3
2003	8,563	8,760	142	55	96.7	99.3
2004	8,431	8,784	277.5	75.5	95.9	99.1

[a] Total availability = (total possible run-time - scheduled and unscheduled downtime) / total possible run-time.
[b] Scheduled availability = (total possible run-time - unscheduled downtime) / total possible run-time.

Table C-8. 100-KR-4 Average Extraction Rates, Calendar Year 1997 to Calendar Year 2003. (3 sheets)

Well	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Design Flow Rate (gpm)	Avg. Monthly Flow Rate (gpm)	Total Run-Time (%)[a]
1997															
199-K-113A	No data available.									24.0	21.1	23.0	25.0	22.7	91.7
199-K-115A										24.6	21.3	22.3	25.0	22.7	89.9
199-K-116A										16.3	19.3	22.8	25.0	19.5	78.9
199-K-119A										24.4	21.5	22.1	25.0	22.6	89.9
199-K-120A										24.3	21.4	23.0	25.0	22.9	79.8
1998															
199-K-113A	26.1	25.7	25.6	17.5	—	—	17.8	24.4	25.5	25.0	12.9	12.4	25.0	21.3	74.8
199-K-115A	25.5	25.6	24.9	18.0	3.0	30.5	26.6	25.5	25.2	24.9	29.1	29.3	25.0	24.0	89.3
199-K-116A	25.7	25.7	25.0	27.0	12.0	45.5	43.3	46.4	46.3	38.9	25.9	24.2	25.0	32.1	90.4
199-K-119A	25.1	25.5	25.3	18.0	5.6	29.4	25.8	24.2	25.0	24.7	25.2	25.1	25.0	23.2	89.6
199-K-120A	25.1	25.3	25.8	18.2	5.4	26.9	26.8	26.5	25.2	24.9	25.5	25.6	25.0	23.4	90.4
199-K-125A	No data available.									9.9	25.8	24.9	25.0	20.2	71.3
1999															
199-K-113A	25.1	25.4	25.1	25.1	25.4	25.8	25.6	30.2	28.1	25.3	23.9	23.9	25.0	25.7	97.3
199-K-115A	25.8	26.0	25.8	25.9	25.4	25.9	25.7	29.6	33.8	34.0	34.2	29.4	25.0	28.5	97.3
199-K-116A	25.9	26.2	25.7	25.8	25.7	25.8	25.8	30.1	35.3	33.8	29.7	14.9	25.0	27.1	92.3
199-K-119A	25.0	24.7	25.5	25.6	25.6	25.5	23.0	—	—	9.0	34.7	25.0	25.0	24.4	74.2
199-K-120A	25.7	25.5	25.6	25.6	25.6	26.0	25.9	30.1	34.9	34.7	34.2	24.7	25.0	28.2	96.2
199-K-125A	28.2	27.1	25.8	26.2	19.4	26.6	26.0	30.0	34.3	32.6	34.5	30.5	25.0	28.4	95.3

Table C-8. 100-KR-4 Average Extraction Rates, Calendar Year 1997 to Calendar Year 2003. (3 sheets)

Well	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Design Flow Rate (gpm)	Avg. Monthly Flow Rate (gpm)	Total Run-Time (%)[a]
2000															
199-K-113A	15.3	23.5	22.2	20.7	5.5	9.6	24.7	24.2	22.6	22.7	23.1	23.6	25.0	19.8	67.6
199-K-115A	16.0	24.8	23.6	22.6	35.4	39.4	36.9	25.2	25.1	25.0	25.4	25.6	25.0	27.1	91.8
199-K-116A	20.8	25.0	26.7	22.9	23.3	22.3	24.9	34.9	45.1	45.2	45.7	45.8	25.0	31.9	96.5
199-K-119A	17.0	25.0	24.8	22.9	23.3	22.3	25.0	25.0	27.3	29.7	25.5	25.6	25.0	24.5	92.9
199-K-120A	17.1	24.8	24.6	22.9	23.3	22.4	24.8	25.2	26.6	28.0	25.5	25.7	25.0	24.2	92.9
199-K-125A	17.7	25.1	24.2	22.0	22.2	17.8	—	25.1	24.8	24.8	24.7	25.5	25.0	23.1	92.4
2001															
199-K-112A	--	27.8	20.1	22.2	22.1	23.2	24.1	20.8	20.2	21.2	22.2	22.1	25.0	22.4	75.8
199-K-113A	22.4	20.5	17.8	14.3	14.8	17.9	15.0	15.1	13.9	13.8	14.5	15.6	25.0	16.3	92.8
199-K-115A	25.3	26.3	23.5	24.0	25.3	25.5	25.0	25.2	23.9	25.2	25.7	31.0	25.0	25.5	95.9
199-K-116A	45.7	45.0	41.4	40.8	45.0	45.3	45.3	45.2	43.5	42.7	39.9	41.2	25.0	43.4	95.5
199-K-119A	26.6	25.5	24.3	23.9	25.1	25.3	25.2	25.3	24.5	25.2	25.2	25.2	25.0	25.1	95.6
199-K-120A	25.6	25.3	24.2	24.1	25.2	25.5	25.2	25.5	24.5	25.2	25.2	25.3	25.0	25.1	95.6
199-K-125A	25.4	25.6	24.2	24.2	25.3	25.2	25.4	25.3	24.4	25.5	25.2	25.4	25.0	25.1	95.8
2002															
199-K-112A	25.1	23.5	24.1	15.4	16.8	20.8	20.7	20.2	26.4	26.6	25.4	25.0	25.0	22.5	86.8
199-K-113A	15.6	15.7	14.0	0.0	20.1	22.1	21.4	18.2	15.1	13.4	17.1	17.6	25.0	15.9	79.7
199-K-115A	35.3	35.7	35.4	24.1	38.0	43.2	42.9	40.3	44.2	44.1	44.1	44.1	25.0	39.3	94.1
199-K-116A	44.5	44.1	44.0	30.1	43.3	44.9	44.7	41.9	44.4	44.4	44.5	44.6	25.0	43.0	93.4
199-K-119A	25.6	27.3	26.8	23.7	28.7	28.9	29.9	29.1	29.5	29.2	29.2	29.2	25.0	28.1	93.2
199-K-120A	27.0	28.6	28.3	24.2	29.8	30.6	30.4	28.8	29.9	29.7	29.5	29.4	25.0	28.9	93.2
199-K-125A	25.4	26.3	25.6	24.5	36.0	38.5	39.8	37.5	41.0	40.7	40.5	40.6	25.0	34.7	93.4

Table C-8. Average Extraction Rates, Calendar Year 1997 to Calendar Year 2003. (3 sheets)

Well	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total Flow Hours	Avg. Monthly Flow Rate (gpm)	Total Run-Time (%)[a]
2003															
199-K-112A/ 199-K-129	24.9	24.1	23.8	24.8	25.2	—	24.3	20.8	20.5	20.4	22.8	24.7	7,328.5	23.3	83.6
199-K-113A	14.9	11.3	12	13.1	15.2	20.6	17.9	14.9	13	12.2	13.6	14.5	8,378.5	14.4	95.6
199-K-115A	43.9	43.7	43.7	44	44.5	44.8	43.7	42.7	44	43.9	44.1	44.2	8,522	43.9	97.2
199-K-116A	40.3	22.9	38.6	42.9	44.4	44.6	43.7	43.2	44.7	44.9	45.1	45.4	8,420	41.7	96.1
199-K-119A	29	29.2	29.7	29.8	30.4	35.8	35.4	30.5	30.4	30.1	30.1	30.5	8,521.5	30.9	97.2
199-K-120A	29.3	29.4	30	30.1	30.5	30.7	30.3	30.6	33.2	33.4	37.5	40.3	8,522.5	32.1	97.2
199-K-125A	37.3	26.7	37.6	29.2	29.7	35.1	33.6	32.9	35.3	37.9	39.3	40.7	8,483.5	34.6	96.8
199-K-126	11.8	12.7	13.0	13.3	14.8	15.1	16.8	15.5	14.7	15.0	14.2	13.9	8,154.5	14.2	93.0
199-K-127	36.9	26.5	39.9	40.1	40.4	40.7	40.0	34.7	35.1	34.9	35.1	35.5	8,523.5	36.7	97.3
2004															
199-K-112A/	26.5	24.9	24.6	23.7	24.9	24.6	25.2	27.1	25.9	26.6	25.4	24.6	8,037.0	25.3	91.5
199-K-129	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
199-K-113A	13.5	13.5	12.2	12.5	15.2	16.3	15.5	14.2	13.2	13.5	15.1	15.2	8,074.0	14.2	91.9
199-K-115A	43.2	44.1	43.8	43.8	44.4	44.7	44.6	39.5	39.8	39.9	38.4	40.2	6,158.0	42.8	70.1
199-K-116A	45.5	45	45.2	45.4	44.9	44.8	44.8	45	44.7	44.7	42.1	40.4	7,897.5	44.4	89.9
199-K-119A	31	30	30.2	30.7	29.7	29.9	29.9	30	30.1	30.2	28.4	30.2	7,714.5	30	87.8
199-K-120A	39.7	38.8	39.6	41	40.8	40.4	39.9	40.1	39.9	39.9	37.7	40.4	7,731.5	39.9	88
199-K-125A	41.8	40.9	40.7	40.3	40	39.8	39.9	40.3	40.2	40.1	36.7	40	7,897.0	40.1	89.9
199-K-126	15.2	15.1	17.1	18	19.9	19.2	18.2	17.8	18.7	18.1	14.4	0	6,449.0	17.8	73.4
199-K-127	35	34	34.7	35.2	34.6	34.7	34.6	34.9	34.8	34.8	33.1	34.9	7,691.5	34.6	87.6

NOTE: Well 199-K-112A was not in service as an extraction well until 2001.

[a] Total hours on-line / total possible run-time.

-- = well out of operation

gpm = gallons per minute

Table C-9. Volume of Groundwater Treated and Strontium Removed Since Startup of Operations at 100-NR-2. (2 sheets)

Reporting Period	Liters Treated	Strontium Removed (Ci)
September 1995 – December 1996	114,627,001	0.13113
January 1997 – March 1997	27,323,363	0.04482
April 1997 – June 1997	31,035,673	0.07458
July 1997 – September 1997	28,848,891	0.05394
October 1997 – December 1997	27,959,680	0.04294
January 1998 – March 1998	22,129,512	0.03940
April 1998 – June 1998	28,336,727	0.06093
July 1998 – September 1998	28,029,708	0.04816
October 1998 - December 1998	25,219,497	0.04873
January 1999 – March 1999	29,723,159	0.05532
April 1999 – June 1999	29,715,000	0.05193
July 1999 – September 1999	29,278,950	0.05005
October 1999 - December 1999	23,614,586	0.03255
January 2000 - March 2000	27,370,448	0.04793
April 2000 - June 2000	25,148,800	0.03809
July 2000 - September 2000	25,696,052	0.04419
October 2000 - December 2000	27,798,844	0.04655
January 2001 - March 2001	28,992,043	0.05472
April 2001 - June 2001	26,424,003	0.03651
July 2001 - September 2001	29,298,351	0.04715
October 2001 - December 2001	29,946,018	0.04667
October 2002 - December 2002	29,946,018	0.04667
January 2002 - March 2002	30,665,715	0.04719
April 2002 - June 2002	29,506,579	0.04333
July 2002 - September 2002	30,160,865	0.05248
October 2002 - December 2002	31,339,176	0.05168
January 2003 – March 2003	31,006,631	0.05143
April 2003 – June 2003	30,730,999	0.04869
July 2003 – September 2003	21,170,307	0.03546
October 2003 – December 2003	31,198,431	0.04976

Table C-9. Volume of Groundwater Treated and Strontium Removed Since Startup of Operations at 100-NR-2. (2 sheets)

Reporting Period	Liters Treated	Strontium Removed (Ci)
January 2004 – March 2004	30,676,503	0.04875
April 2004 – June 2004	27,285,703	0.04983
July 2004 – September 2004	19,745,742	0.02544
October 2004 – December 2004	29,489,895	0.03216
Totals	**1,039,438,870**	**1.67916**

Table C-10. Average Strontium-90 Activities for Influent and Effluent Tanks at the 100-NR-2 Pump-and-Treat System.

Tank	**Average Strontium-90 Activity (pCi/L)**										**Annual Comparison**[a]
	CY95	**CY96**	**CY97**	**CY98**	**CY99**	**CY00**	**CY01**	**CY02**	**CY03**	**CY04**	
System influent (TK-1)	944	1,353	2,143	2,393	2,046	1,972	1,761	1,914	1,878	1,970	Stable
System effluent (T-400)	138	210	349	450	355	377	265	327	264	499	Stable

[a] Annual comparison is the percent difference between CY02 and CY01 (or two most recent years) and is calculated by the following equation: (CY03 - CY02) / CY02 x 100%. Wells are considered stable if there is less than a 20% change in concentration from CY00 to CY01.
CY = calendar year

Table C-11. 100-NR-2 Average Extraction Rates, Calendar Year 1995 to Calendar Year 2004. (3 sheets)

Well	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Design Flow Rate (gpm)	Avg. Monthly Flow Rate (gpm)	Total Run-Time (%)[a]
1995															
199-N-75	No data available.								12.4	12.7	10.5	10.7	15.0	11.5	81.8
199-N-103A									12.2	11.8	12.6	—	15.0	12.2	56.5
199-N-105A									18.3	14.4	13.9	13.5	15.0	—	88.9
199-N-106A									14.9	14.6	14.8	14.2	25.0	14.6	93.0
1996															
199-N-75	10.2	9.5	11.2	10.9	8.8	12.6	12.1	11.1	11.5	9.6	9.5	13.9	15.0	10.9	93.5
199-N-103A	—	—	—	13.3	—	12.3	14.1	14.3	13.0	13.9	14.2	14.0	15.0	13.7	84.0
199-N-105A	12.4	15.3	14.8	16.1	17.0	16.1	15.9	15.1	18.9	30.6	—	—	15.0	—	86.7
199-N-106A	15.9	16.0	16.2	17.2	17.5	14.6	14.8	15.1	15.7	17.6	18.0	56.6	25.0	19.6	94.9
1997															
199-N-75	14.4	16.7	17.0	17.3	17.0	16.3	16.5	16.2	16.0	15.8	16.0	16.3	15.0	16.3	100.0
199-N-103A	14.5	12.4	13.1	13.3	13.7	14.8	97.9	20.4	16.1	15.4	16.0	16.0	15.0	22.0	99.3
199-N-105A	—	—	—	—	—	—	—	—	—	—	—	—	15.0	—	16.7
199-N-106A	54.1	33.7	33.6	33.8	34.1	30.8	30.3	30.8	30.7	30.8	31.1	31.2	25.0	33.7	100.0
1998															
199-N-75	16.2	15.6	16.4	14.0	14.8	13.4	14.9	15.2	14.3	9.1	10.7	11.9	15.0	13.9	91.8
199-N-103A	16.4	15.6	16.2	14.9	16.5	15.1	15.6	15.6	14.4	10.8	17.2	18.3	15.0	15.6	92.7
199-N-105A	—	—	—	—	—	0.1	—	—	0.0	0.0	0.0	0.0	15.0	0.0	0.1
199-N-106A	30.2	27.3	29.0	26.4	30.3	28.0	28.6	30.1	27.9	21.7	30.7	31.5	25.0	28.5	92.6

Table C-11. 100-NR-2 Average Extraction Rates, Calendar Year 1995 to Calendar Year 2004. (3 sheets)

Well	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Design Flow Rate (gpm)	Avg. Monthly Flow Rate (gpm)	Total Run-Time (%)[a]
1999															
199-N-75	12.0	12.2	14.3	15.4	14.0	14.5	15.0	14.9	14.1	14.6	12.5	8.8	15.0	13.5	90.2
199-N-103A	18.7	18.9	18.5	17.3	17.4	17.2	17.6	17.4	17.2	17.4	14.5	11.4	15.0	17.0	90.4
199-N-105A	—	—	0.2	—	0.6	—	0.2	0.4	—	0.4	—	—	15.0	0.4	0.1
199-N-106A	31.8	32.0	30.9	28.3	29.6	29.1	29.5	26.7	27.6	28.9	23.9	18.2	25.0	28.1	90.2
2000															
199-N-75	12.7	13.6	13.5	12.0	13.8	12.7	11.6	5.8	12.8	11.8	10.8	9.2	15.0	11.7	79.0
199-N-103A	15.6	16.7	16.5	14.7	16.2	15.2	14.2	15.5	10.9	11.5	14.0	14.6	15.0	14.6	88.4
199-N-105A	—	—	0.0	—	0.0	0.0	0.6	11.5	17.5	14.9	19.4	0.0	15.0	7.1	5.3
199-N-106A	25.5	28.6	29.2	24.7	26.3	24.6	22.0	31.0	36.0	36.3	36.6	36.3	25.0	29.8	88.1
2001															
199-N-75	10.6	10.5	10.1	10.0	11.2	—	8.2	7.7	8.0	8.9	8.7	9.2	15.0	9.4	76.4
199-N-103A	14.3	13.6	13.6	15.3	13.7	13.4	14.2	16.0	16.3	16.8	17.1	17.3	15.0	15.1	93.9
199-N-105A	—	—	—	24.3	10.8	11.0	13.0	15.3	17.8	24.2	23.0	14.1	15.0	17.0	19.9
199-N-106A	34.8	36.8	36.5	36.7	36.4	36.5	37.3	37.3	37.2	37.6	37.3	37.5	25.0	36.8	90.6
2002															
199-N-75	8.7	9.1	9.3	8.1	11.1	12.5	10.1	11.1	11.4	10.7	11.0	11.0	15.0	10.3	88.4
199-N-103A	17.4	17.3	17.2	17.0	17.1	15.6	16.9	16.5	16.6	16.7	16.8	16.7	15.0	16.8	94.7
199-N-105A	—	—	22.1	19.7	18.2	—	28.0	—	—	—	—	—	15.0	22.0	6.3
199-N-106A	37.8	37.5	37.4	32.7	34.0	36.0	35.8	35.9	36.9	37.5	37.3	37.3	25.0	36.3	94.7

Table C-11. Average Extraction Rates, Calendar Year 1995 to Calendar Year 2002. (3 sheets)

Well	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total Hours On-Line	Average Monthly Flow Rate (gpm)	Total Run-Time (%)[a]
2003															
199-N-75	11.1	10.2	10.1	10.5	10.5	10.6	10.7	10.6	10.5	11	11	11	7,779	10.6	88.8
199-N-103A	16.1	16.1	15.9	16.2	16.4	16.4	16.4	16.3	10.5	15	15.1	15	7,622	15.5	87.0
199-N-105A	20.5	—	17.3	—	—	—	—	—	10.5	—	—	—	101	16.1	1.2
199-N-106A	36.9	38.1	38.1	38.4	38.2	38.2	38.4	38.5	10.5	37.1	38	38	7,778.5	35.7	88.8
2004															
199-N-75	11	11	11	10.4	10.6	10.5	10.6	12.8	12.1	12.4	11.1	10	7,617.0	11.1	86.7
199-N-103A	15	14.5	13.7	13	13.7	13.5	0	5.9	0	0	0	0	3,691.5	13.9	42
199-N-105A	0	0	27.2	0	0	21.1	20.1	21.4	21	21.1	21.4	20.4	3,911.0	21.1	44.5
199-N-106A	38.3	38.1	38.4	38.5	38.6	33.3	30.9	27.6	28.8	28.3	28.5	30.3	7,593.5	33.5	86.4

[a] Total hours on-line / total possible run-time.
-- = well out of operation
gpm = gallons per minute

Table C-12. 100-NR-2 Summary of System Availability (September 1, 1995, to December 31, 2003).

Year	Total Time On-Line (hours)	Total Possible Run-Time (hours)	Scheduled Downtime (hours)	Unscheduled Downtime (hours)	Total Availability (%)[a]	Scheduled Availability (%)[b]
1995	2,244	2,928	0	684	76.6	76.6
1996	7,202	8,784	0	1,582	82.0	82.0
1997	6,768	8,760	96	1,896	77.3	78.4
1998	7,401	8,760	0	1,359	84.5	84.5
1999	7,841	8,760	376	544	89.5	93.8
2000	7,573	8,784	946	265	86.2	97.0
2001	8,266	8,760	344	151	94.4	98.3
2002	8,323	8,760	328	109	95	98
2003	7,776.5	8,760	789.5	194	88.8	97.7
2004	7,616.5	8,784	337	830.5	86.7	90.2

[a] Total availability = (total possible run-time - scheduled and unscheduled downtime) / total possible run-time.
[b] Scheduled availability = (total possible run-time - unscheduled downtime) / total possible run-time.

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APPENDIX D

AQUIFER RESPONSE

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CONTENTS

FIGURES

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APPENDIX D

AQUIFER RESPONSE

This appendix details the methodologies used to evaluate aquifer response in the 100-D, 100-H, 100-K, and 100-N Areas in terms of hydraulic change observed in the aquifer during calendar year 2004 (CY04). Water-level and groundwater chemistry measurements were collected at wells located in the 100-D and 100-H Areas as part of *Resource Conservation and Recovery Act of 1976* (RCRA); *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA); and interim remedial action performance monitoring. Monitoring requirements specific to the interim remedial action are listed in the *Remedial Design Report and Remedial Action Work Plan for the 100-HR-3 and 100-KR-4 Groundwater Operable Units Interim Action* (DOE-RL 1996), and the *Interim Action Monitoring Plan for the 100-HR-3 and 100-KR-4 Operable Units* (DOE-RL 1997).

D1.0 HYDRAULIC MONITORING

Evaluating the impact of the pump-and-treat system on the aquifer requires distinguishing between water-level changes caused by the extraction wells from those caused by changes in river stage. Drawdown in the extraction and monitoring wells provides measurable and quantifiable evidence of the hydraulic impact on the aquifer by the pump-and-treat system.

To determine this hydraulic impact, hourly water-level data were collected from the operation and monitoring wells and correlated to hourly river-stage data. Regression lines were fit to the water-level data collected while the extraction wells were operating and to the data collected while the extraction wells were shut down. Offsets in the regression lines corresponding to pumping startup or shutdown were used to determine drawdown in the wells within the immediate influence of the river. To minimize the amount of skew in the aquifer water-level data resulting from trends in the river stage, the analysis was limited to periods when the river stage remained relatively constant, with no sudden or large changes relative to the daily cycles.

In reference to the discussions presented below, it should be noted that the Columbia River flow rates in fiscal year 2004 (FY04) were slightly lower than in FY03, which were slightly lower than levels during CY02 but well above CY01 (which was a drought year). The flow regime during CY04 falls into the average range of the last 5 years (average river elevations at the 100-D river gauge for CY04 = 117.67; for CY03 = 117.70; for CY02 = 117.89; for CY01 = 117.10; and for CY00 = 117.98 m [NAVD88]).

In 2003, leakage from the 182-D reservoir had created a groundwater mound and increased the hydraulic gradient around the reservoir. This resulted in the displacement of the chromium plume radially away from the reservoir and the mixing of groundwater with leaked raw water from the reservoir. In 2004, measures were taken to reduce and eliminate this leakage. These measures included changes to the physical plant and the administrative measure of limiting the reservoir level to no more than 2.4 m. The reservoir leakage and residual mound were monitored by new monitoring wells installed for the In Situ Redox Manipulation barrier project. From the water-elevation data collected at these stations (see Appendix E), it is apparent that the mound is decaying and that the leakage has been eliminated, or at least reduced to the point were the impact is not observable.

D2.0 AQUIFER RESPONSE IN THE 100-D AREA

D2.1 100-D AREA EXTRACTION WELLS

The 100-D pump-and-treat system operated four wells (199-D8-53, 199-D8-54B, 199-D8-68, and 199-D8-72) throughout CY04. The water-level data for the extraction wells are included in Appendix E. The productivity during CY04 continued a declining trend compared to CY03 and CY02. The wells operated as follows:

- Well 199-D8-53 pumped at an average of 61.3 L/min, with a maximum rate of 116.2 L/min.
- Well 199-D8-54A pumped at an average of 90.8 L/min, with a maximum rate of 103.3 L/min.
- Well 199-D8-68 pumped at an average of 120.8 L/min, with a maximum rate of 191.2 L/min.
- Well 199-D8-72 pumped at an average of 85.2 L/min and a maximum of 106 L/min.

Figure D-1 depicts the aquifer response of wells in the 100-D Area.

D2.2 100-D AREA MONITORING WELLS

Five monitoring wells are currently equipped with pressure transducers and data loggers that record hourly water-level measurements. No drawdown calculations were performed, as the pump-and-treat shutdowns and restarts did not correspond to a steady river stage that would be appropriate for using the calculation method. The drawdown is assumed to be similar to that previously calculated. The water-level data are contained in Appendix E.

D3.0 AQUIFER RESPONSE IN THE 100-H AREA

D3.1 100-H AREA EXTRACTION AND INJECTION WELLS

The 100-H pump-and-treat system operated six extraction wells (199-H3-2A, 199-H4-7, 199-H4-11, 199-H4-12A, 199-H4-15A, and 199-H4-65) and three injection wells (199-H3-3, 199-H3-4, and 199-H4-5). The productivity during CY04 for the 100-H Area extraction wells was comparable with that of CY03. The wells operated as follows:

- Well 199-H3-2A sustained the highest average flow rate at 91.6 L/min, with a maximum rate of 92.7 L/min.
- Well 199-H4-11 had the next highest flow rate, averaging 89 L/min and a maximum rate of 95.8 L/min.
- Well 199-H4-7 averaged 39.7 L/min, with a maximum rate of 75.7 L/min.
- Well 199-H4-12A averaged 28.4 L/min, with a maximum rate of 39.4 L/min.
- Well 199-H4-15A averaged 74.2 L/min and a maximum rate of 75.7 L/min.
- Again this year, because of a lack of available water, well 199-H4-65 was used for only a short time and averaged 44.7 L/min, with a maximum rate of 45.4 L/min during its brief time in service.

- Well 199-H3-3 injected at an average rate of 121.9 L/min and a maximum of 247.6 L/min.
- Well 199-H3-4 injected at an average rate of 231.7 L/min and a maximum rate of 404.7 L/min.
- Well 199-H3-5 injected at an average rate of 184.7 L/min, with a maximum rate of 357.3 L/min.

The injection wells continue to exhibit very little buildup, which suggests that a decrease in injection efficiency has not occurred. The water-level data are contained in Appendix E. Figure D-2 depicts the aquifer response of wells in the 100-H Area.

D3.2 100-H AREA MONITORING WELLS

Thirteen monitoring wells are currently equipped with pressure transducers and data loggers that record hourly water-level measurements to help assess the hydraulic capture and containment of the extraction wells. Nine of the wells monitor the water level near the extraction wells, two wells monitor the water near the injection wells, and two wells are screened in the aquifer below the Ringold Upper Mud Unit, which is a separate, lower aquifer.

The monitoring well data are similar to that observed in CY03. There continues to be no sign of buildup in the two observation wells (199-H4-49 and 199-H5-1A) that are monitoring the water table near the injection well field. The water-level data are present graphically in Appendix E.

D4.0 AQUIFER RESPONSE IN THE 100-K AREA

D4.1 100-K AREA EXTRACTION AND INJECTION WELLS

The extraction and injection configuration at 100-KR-4 remained the same for CY04. The production characteristics of the eight extraction wells are widely variable. The extraction wells operated at average flow rates between 55.3 to 168.1 L/min (overall average = 121.9 L/min) during the year. This is roughly the same range as the last 2 years (overall average = 120.8 L/min in CY03 and 114.3 L/min in CY02). The productivity during CY04 for the 100-K Area extraction wells was comparable with CY03 and CY02. The wells operated as follows:

- Well 199-K-116A sustained the highest average flow rate at 168.1 L/min and the highest maximum flow rate at 173.4 L/min.
- Well 199-K-115A sustained the next highest average flow rate at 162.8 L/min and a maximum rate at 170 L/min.
- Well 199-K-113A achieved the lowest average flow rate at 53.4 L/min, with a maximum of 69.7 L/min.
- Well 199-K-119A averaged 113.6 L/min, with a maximum of 146.5 L/min.
- Well 199-K-120A averaged 151 L/min, with a maximum of 156.3 L/min.
- Well 199-K-125A averaged 151.8 L/min, with a maximum of 162.4 L/min.
- Well 199-K-126 averaged 67.4 L/min, with a maximum of 75.7 L/min.

- Well 199-K-127 averaged 131 L/min, with a maximum rate of 136.3 L/min.
- Well 199-K-129 averaged 96.1 L/min, with a maximum of 113.6 L/min.

The average injection rates for wells 199-K-121A, 199-K-122A, 199-K-123A, 199-K-124, and 199-K-128 were 198.4 L/min, 219.2 L/min, 232.4 L/min, 73.4 L/min, and 247.6 L/min, respectively. These averages were similar to those in both CY03 and CY02. The water-level data for the extraction and injection wells are provided in Appendix J. Figure D-3 depicts the aquifer response of wells in the 100-K Area.

D4.2 100-K AREA MONITORING WELLS

Eight monitoring wells are currently equipped with pressure transducers and data loggers that record hourly water-level measurements to help assess the hydraulic capture and containment of the extraction wells. The water-level data for the monitoring wells are provided in Appendix J.

D5.0 AQUIFER RESPONSE IN THE 100-N AREA

The hydraulic impact of the pump-and-treat system on groundwater levels was monitored by in-well transducers and correlated to hourly river-stage data (Appendix L). An evaluation of these data indicates that the Columbia River flow rates during CY04 were similar to those observed during both CY03 and CY02.

The 100-N pump-and-treat system operated four extraction wells (199-N-75, 199-N-103A, 199-N-105A, and 199-N-106A) and two injection wells (199-N-29 and 199-N-104A). The productivity during CY04 for the 100-N Area extraction wells was comparable with that of CY03. The wells operated as follows:

- Well 199-N-106A sustained the highest average flow rate at 126.8 L/min, with a maximum rate of 147.3 L/min.
- Well 199-N-75 had the lowest average flow rate at 42 L/min, with a maximum rate of 68.1 L/min.
- Well 199-N-103A averaged 52.6 L/min and a maximum of 58.7 L/min.
- Well 199-N-105A averaged 78.9 L/min and a maximum of 104.5 L/min.
- Well 199-N-29 injected at an average rate of 185.9 L/min and a maximum of 229.8 L/min.
- Well 199-N-104A injected at an average rate of 51.1 L/min and a maximum of 89.3 L/min.

Figure D-4 depicts the aquifer response of wells in the 100-N Area.

D6.0 REFERENCES

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

DOE-RL, 1996, *Remedial Design Report and Remedial Action Work Plan for the 100-HR-3 and 100-KR-4 Groundwater Operable Units Interim Action*, DOE/RL-96-84, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1997, *Interim Action Monitoring Plan for the 100-HR-3 and 100-KR-4 Operable Units*, DOE/RL-96-90, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

NAVD88, 1983, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland.

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq.

Figure D-1. Water Elevation Versus Distance from the Columbia River in the 100-D Area Wells.

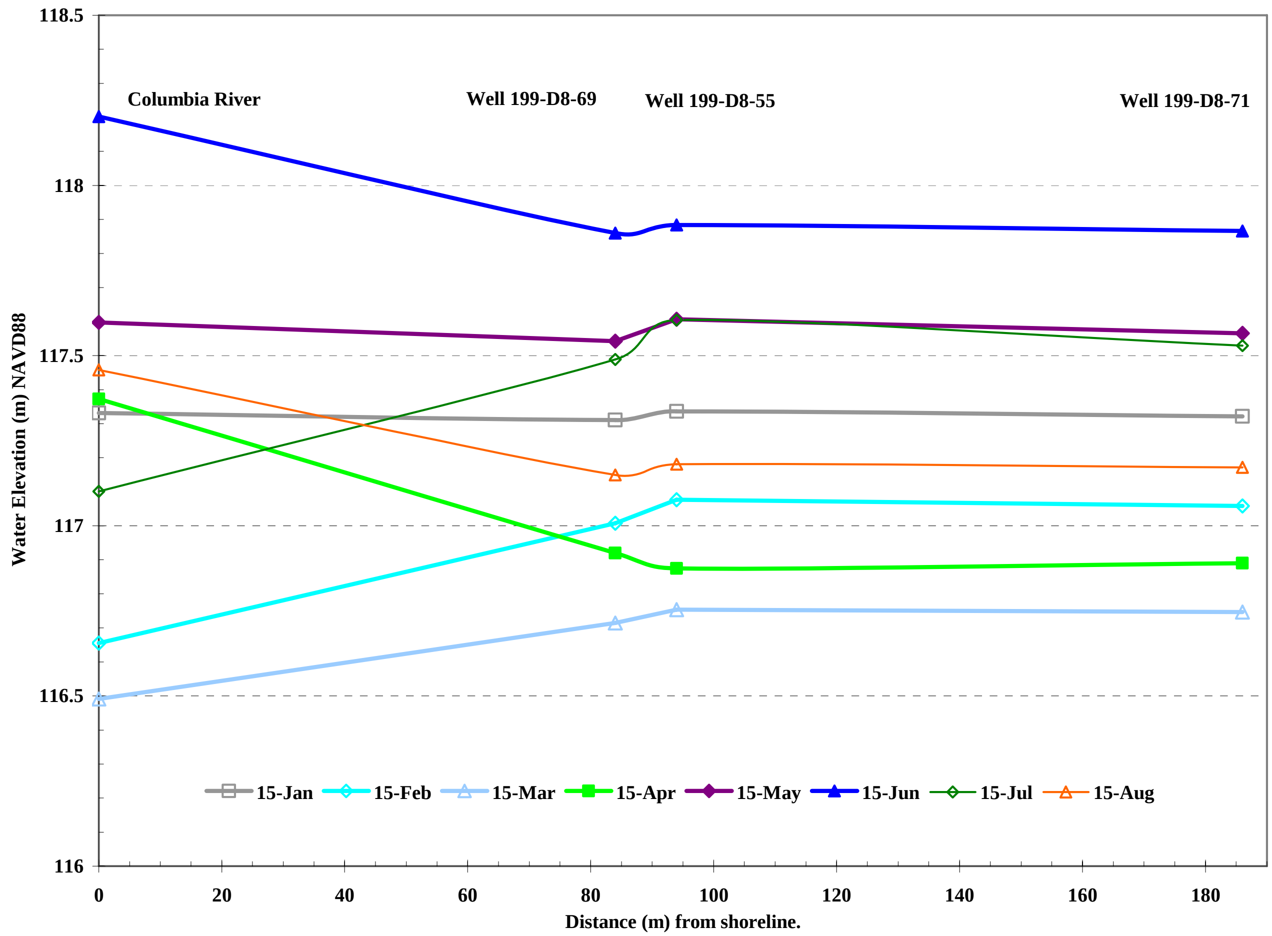


Figure D-2. Water Elevation Versus Distance from the Columbia River in 100-H Area Wells.

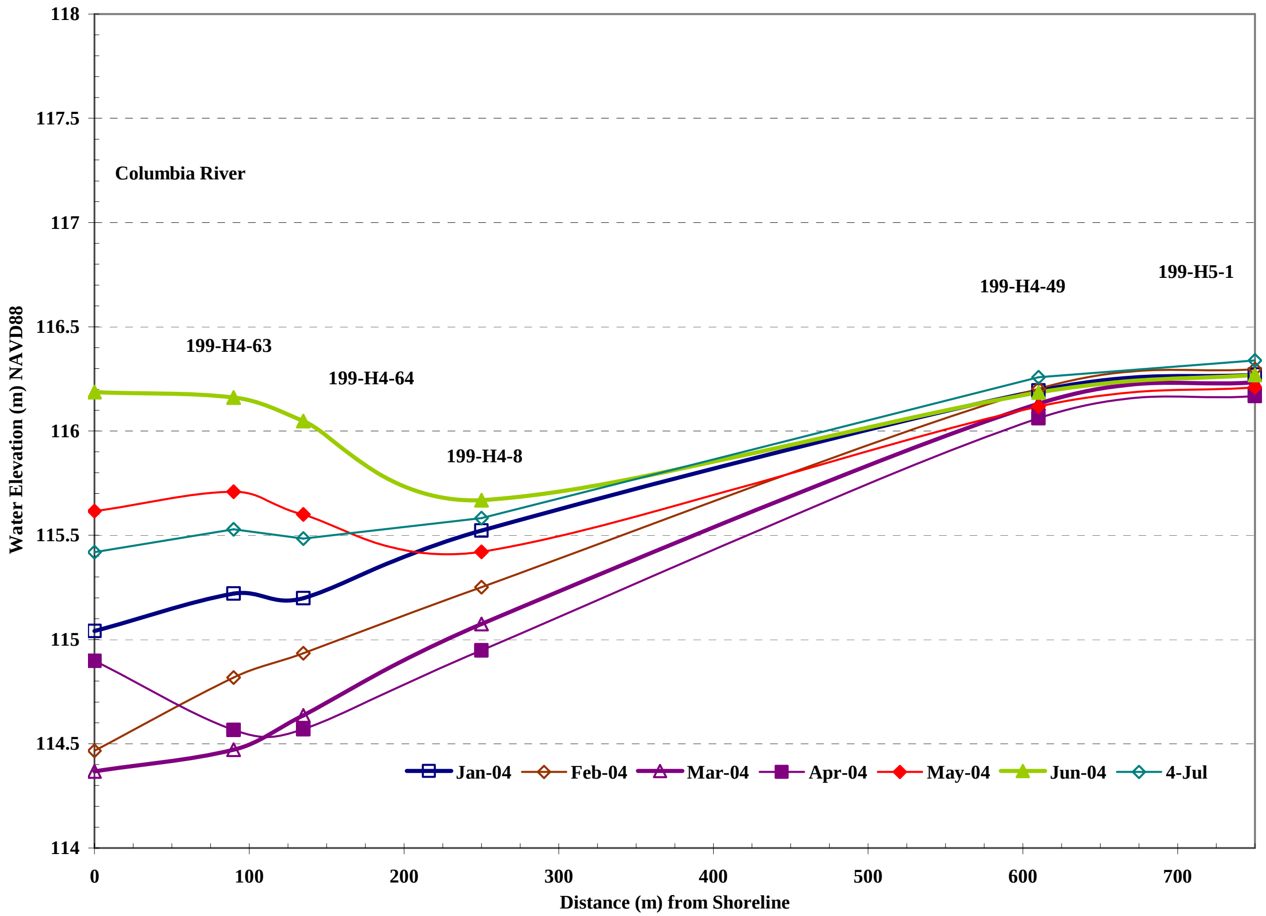


Figure D-3. Water Elevation Versus Distance for the Columbia River in 100-K Area Wells.

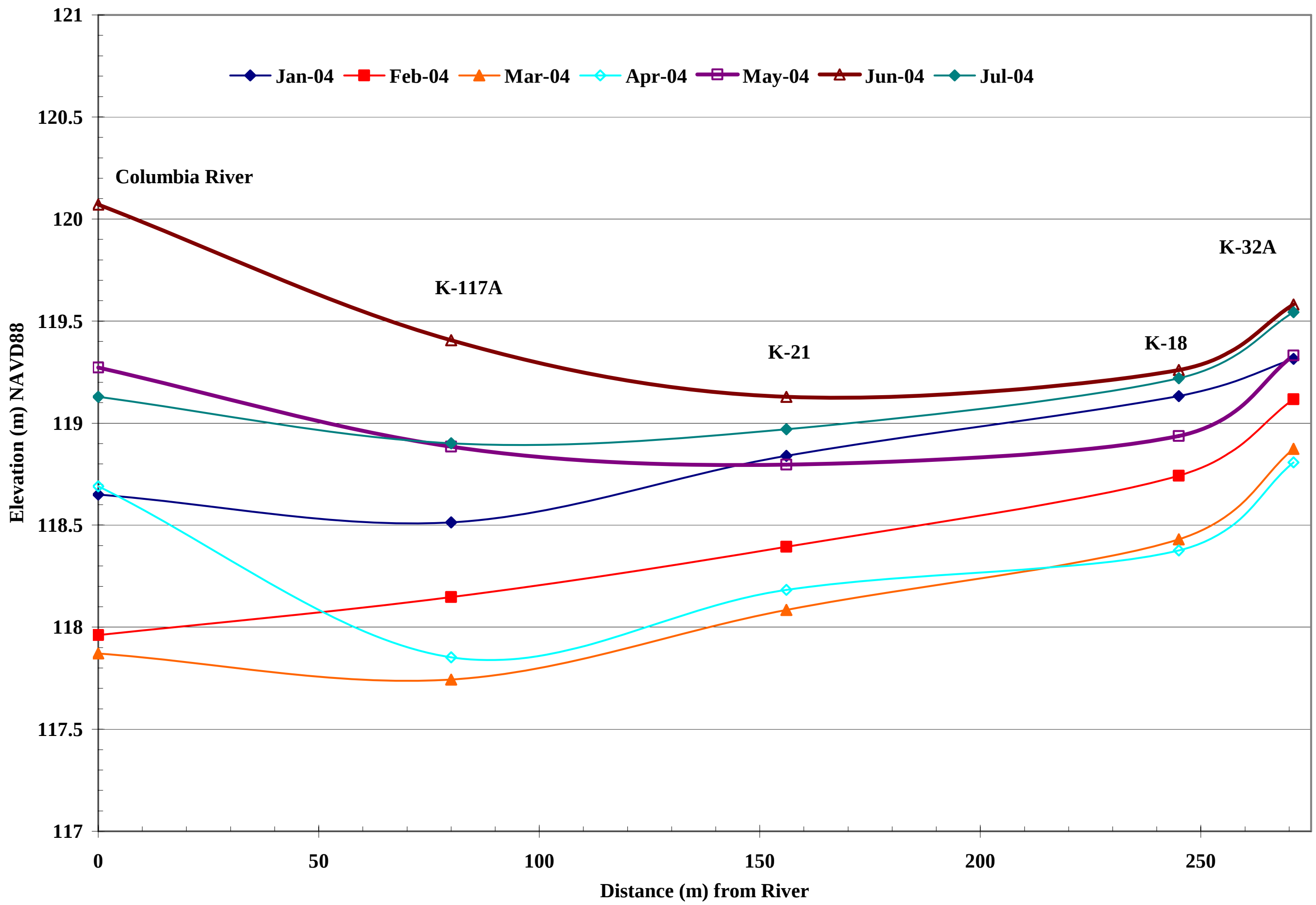
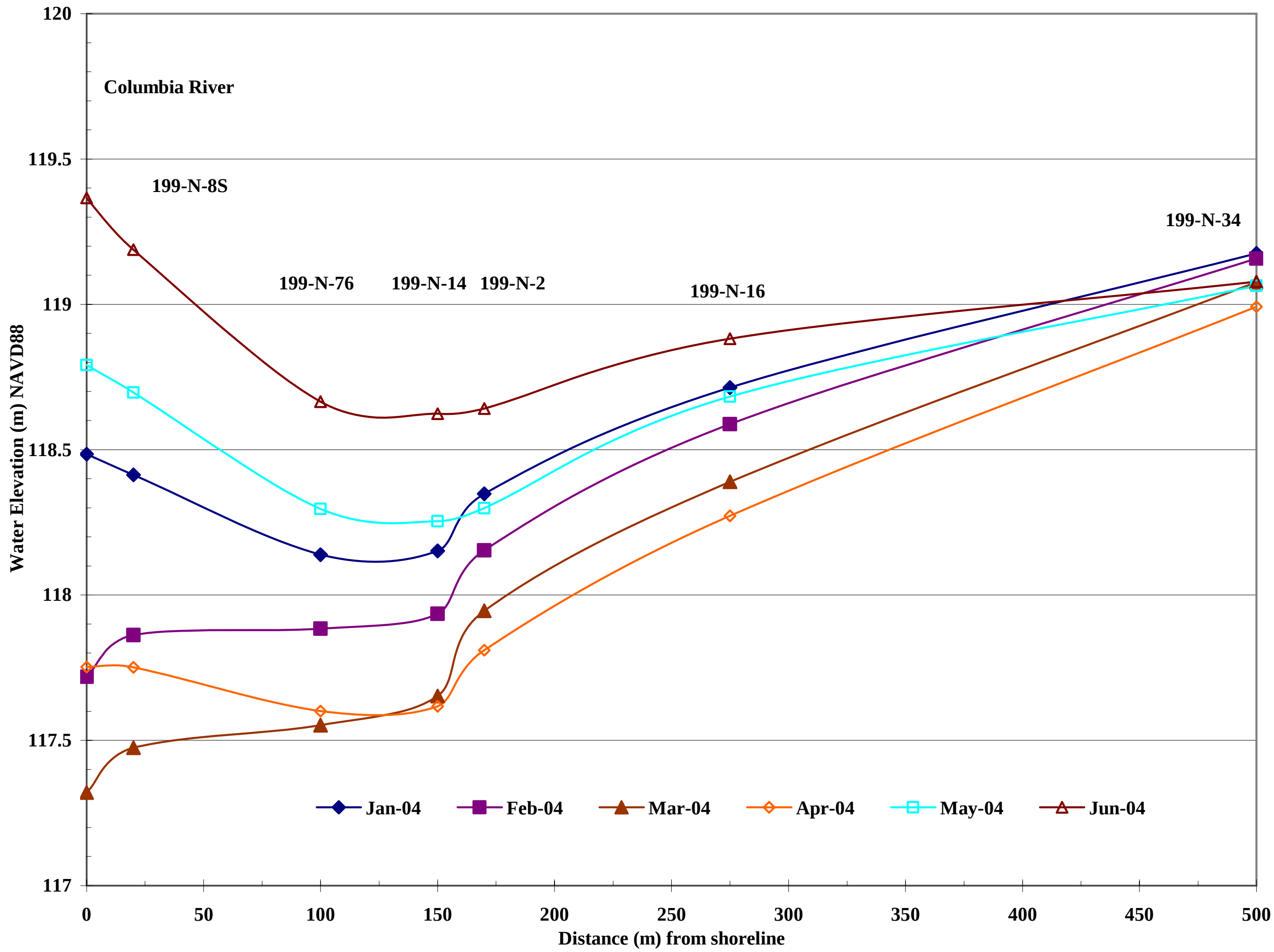


Figure D-4. Water Elevation Versus Distance from the Columbia River in 100-N Area Wells.



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APPENDIX E

HYDROGRAPHS FOR THE 100-HR-3 OPERABLE UNIT

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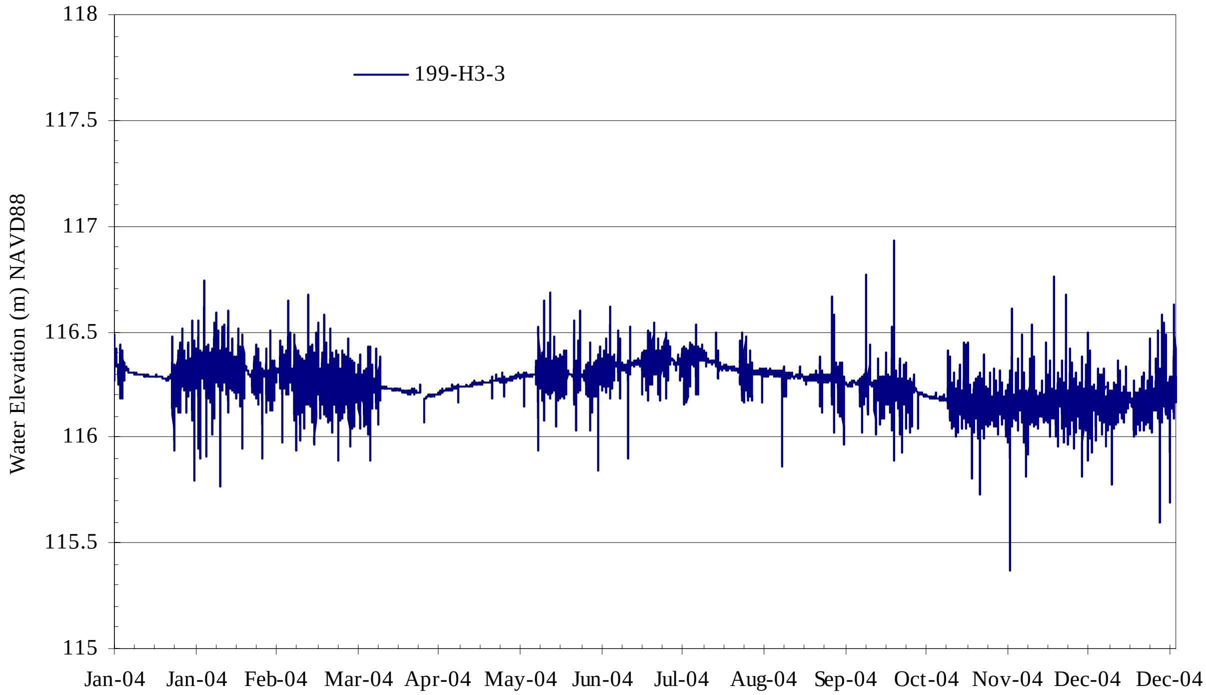
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117
116.5
116
115.5
115
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199-H3-3
Jan-04
Jan-04
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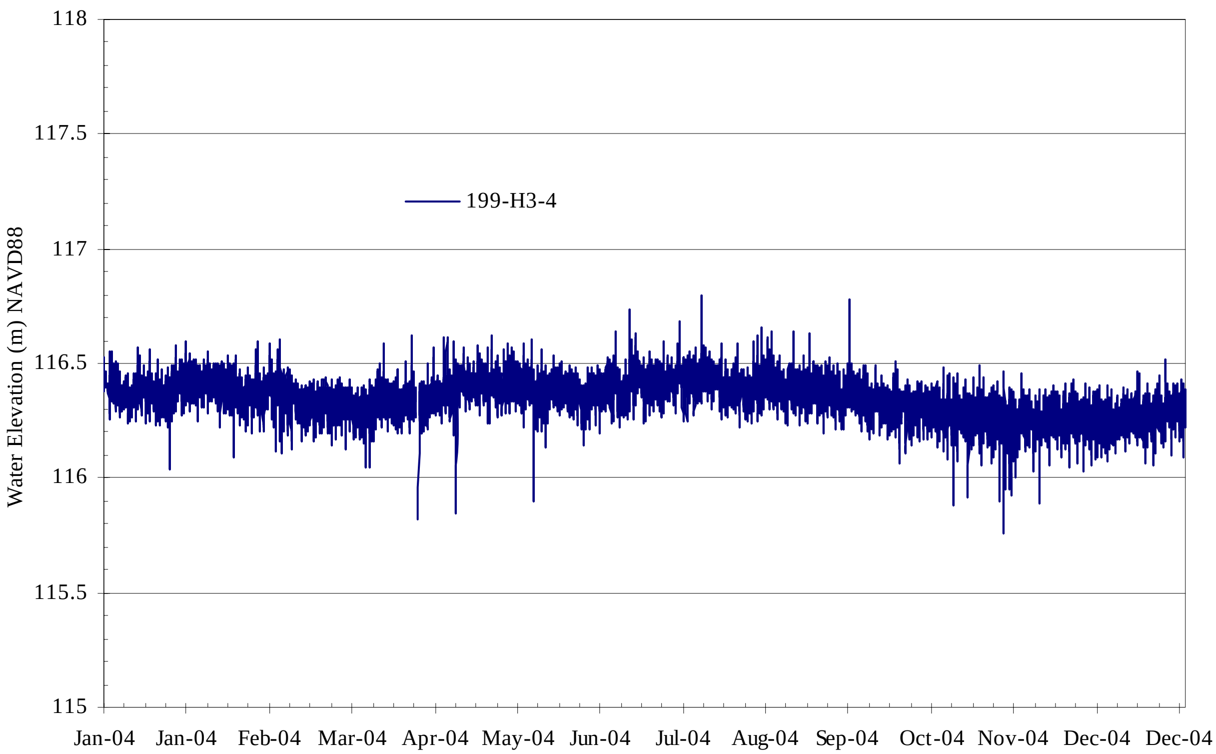
Nov-04
Dec-04
Dec-04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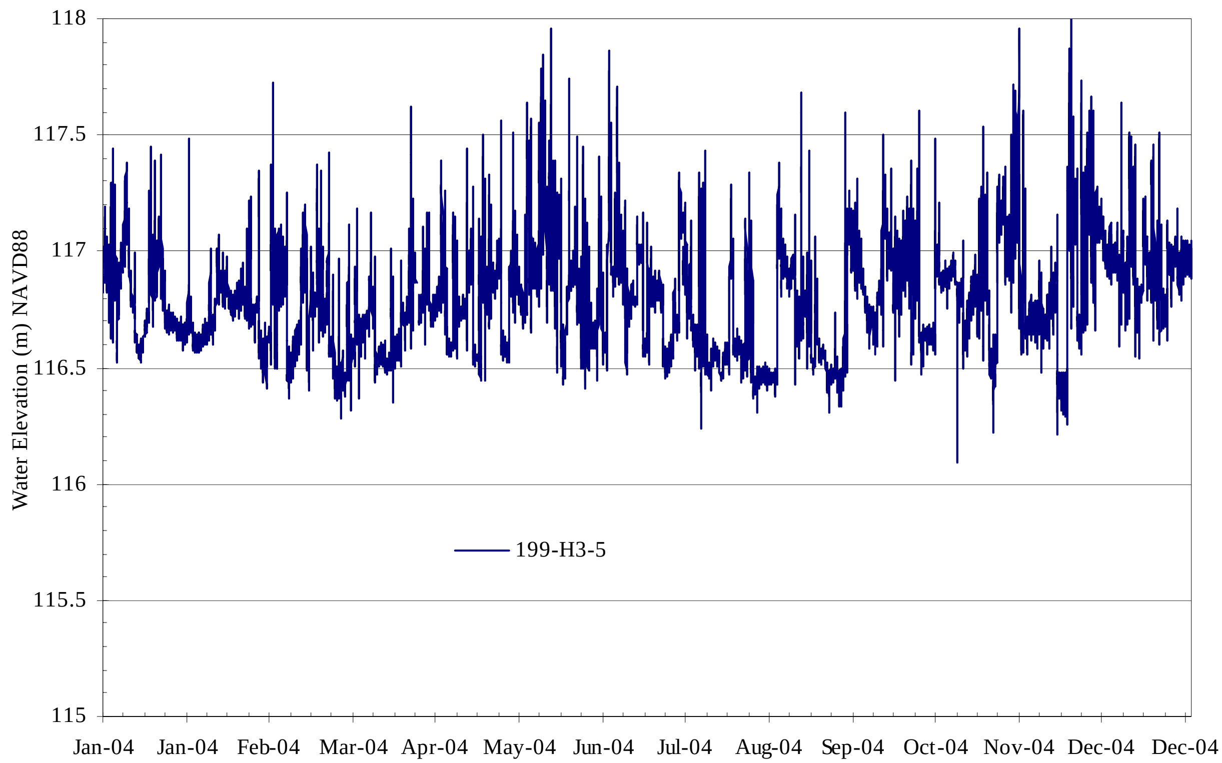
Dec-04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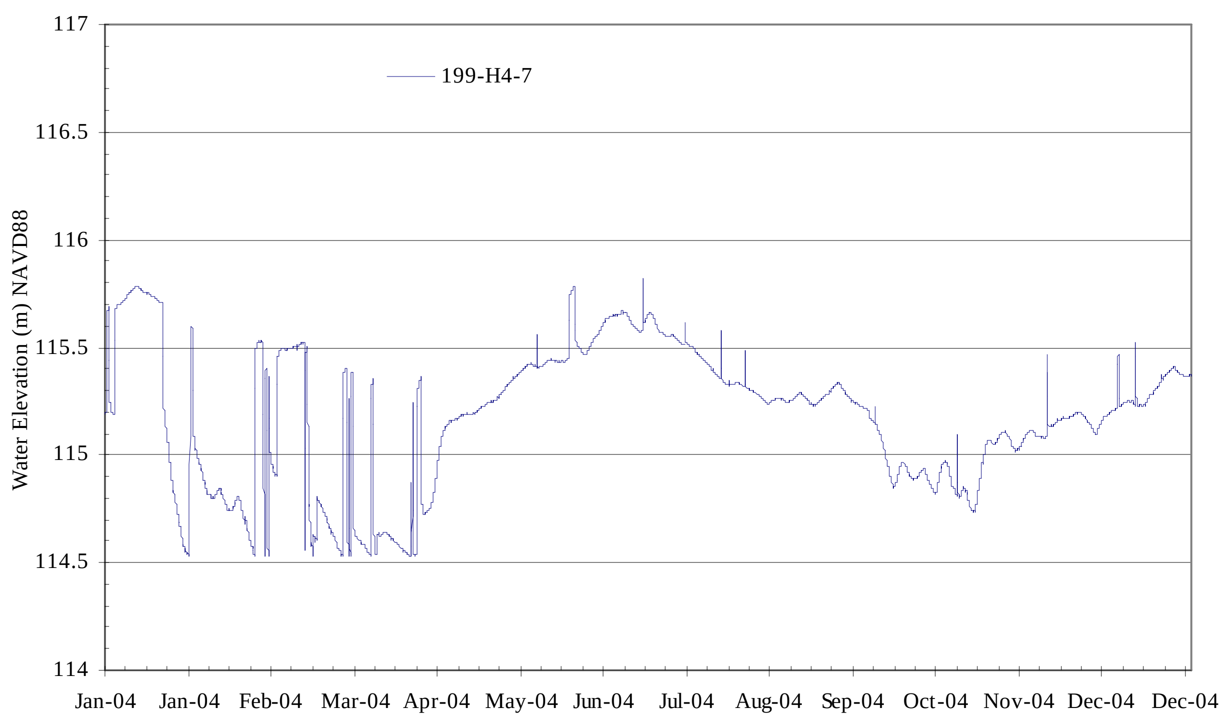
Dec-04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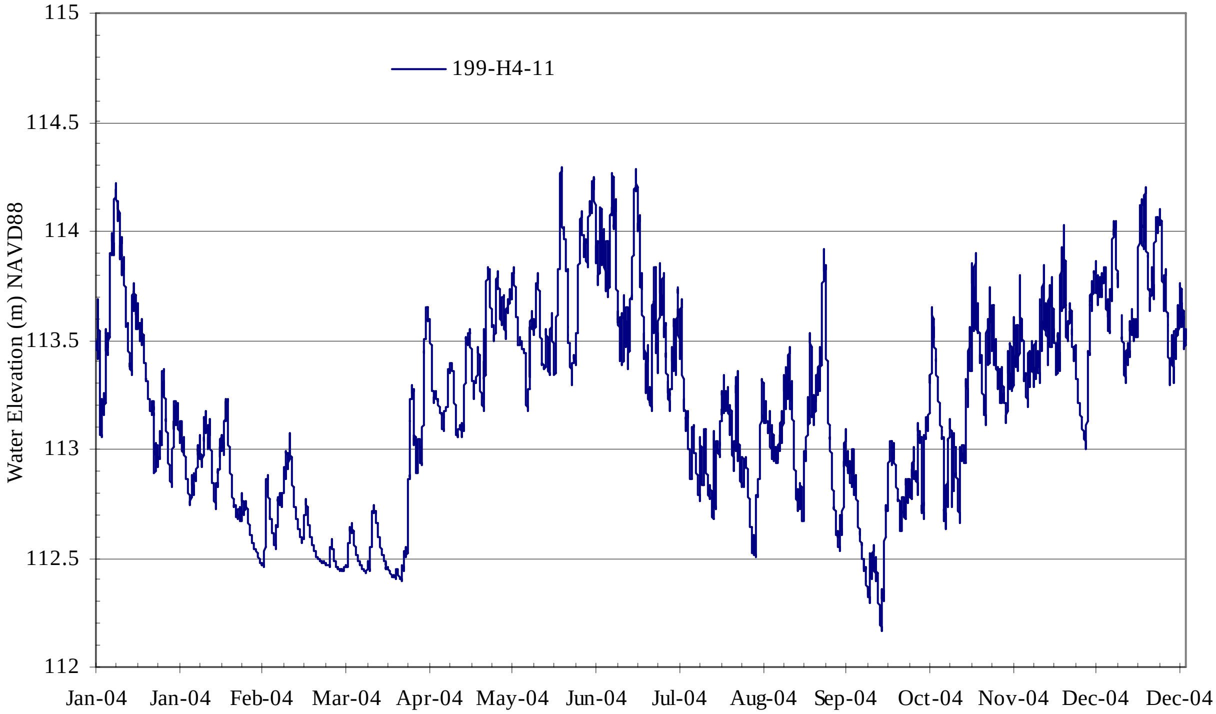

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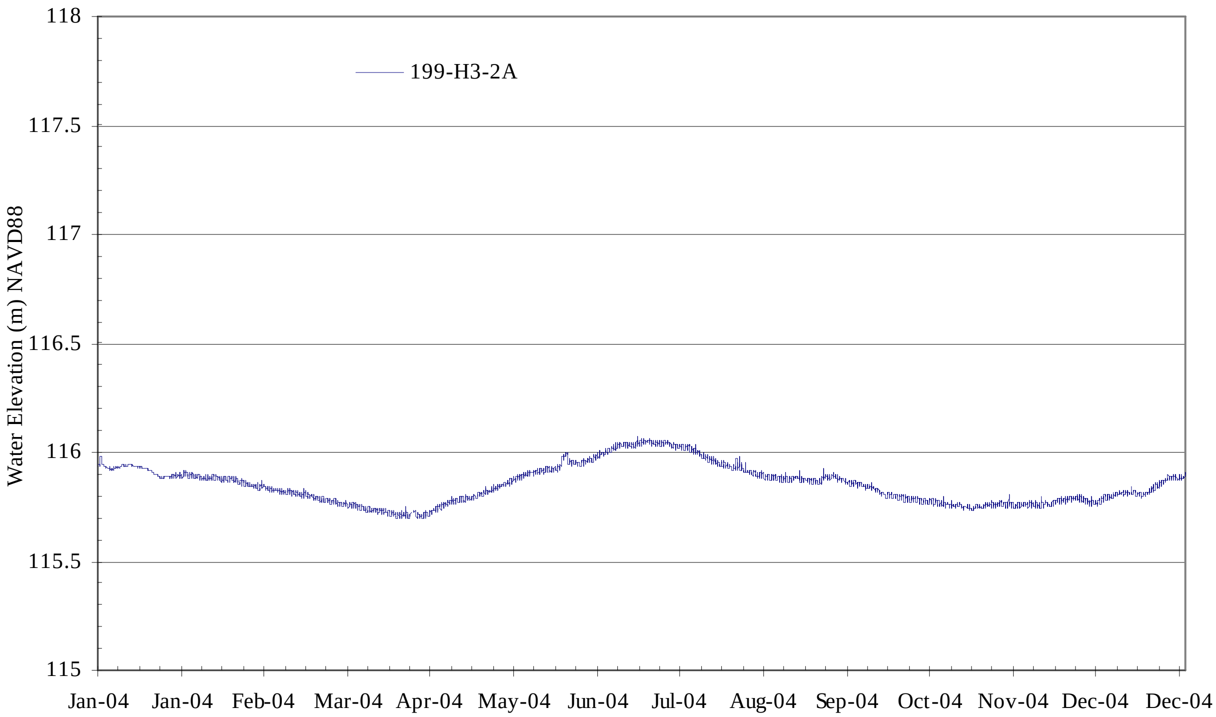
Dec-04



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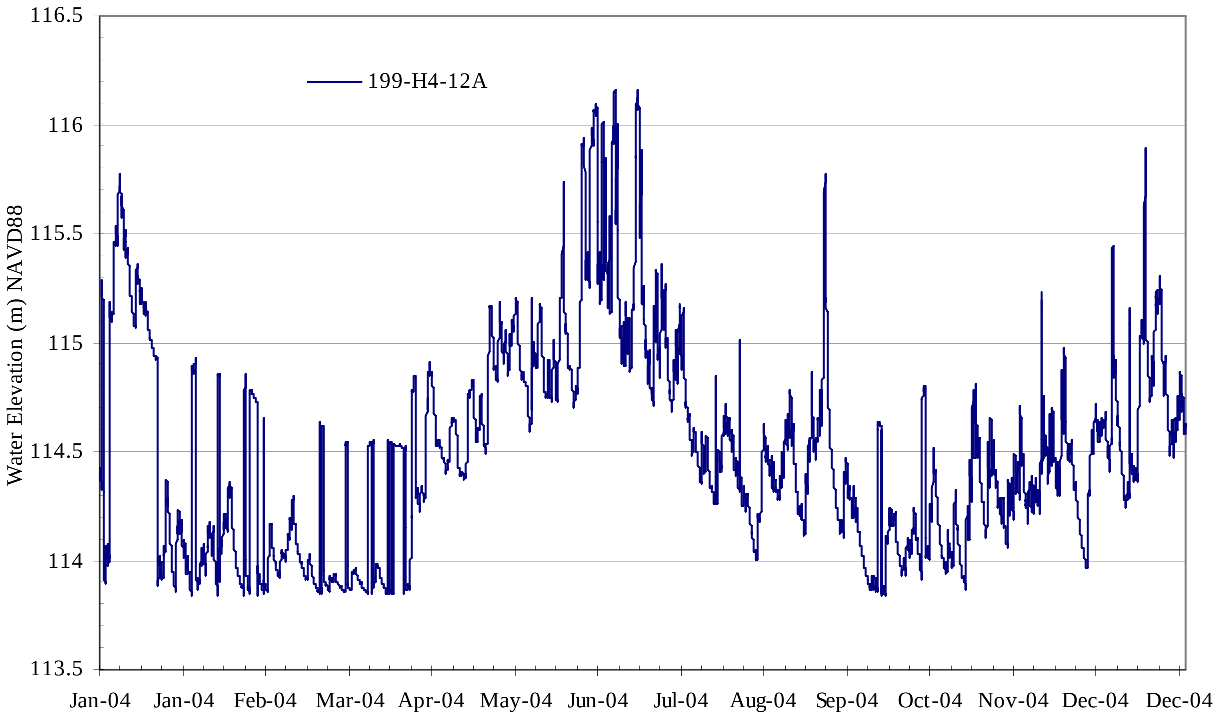
Dec-04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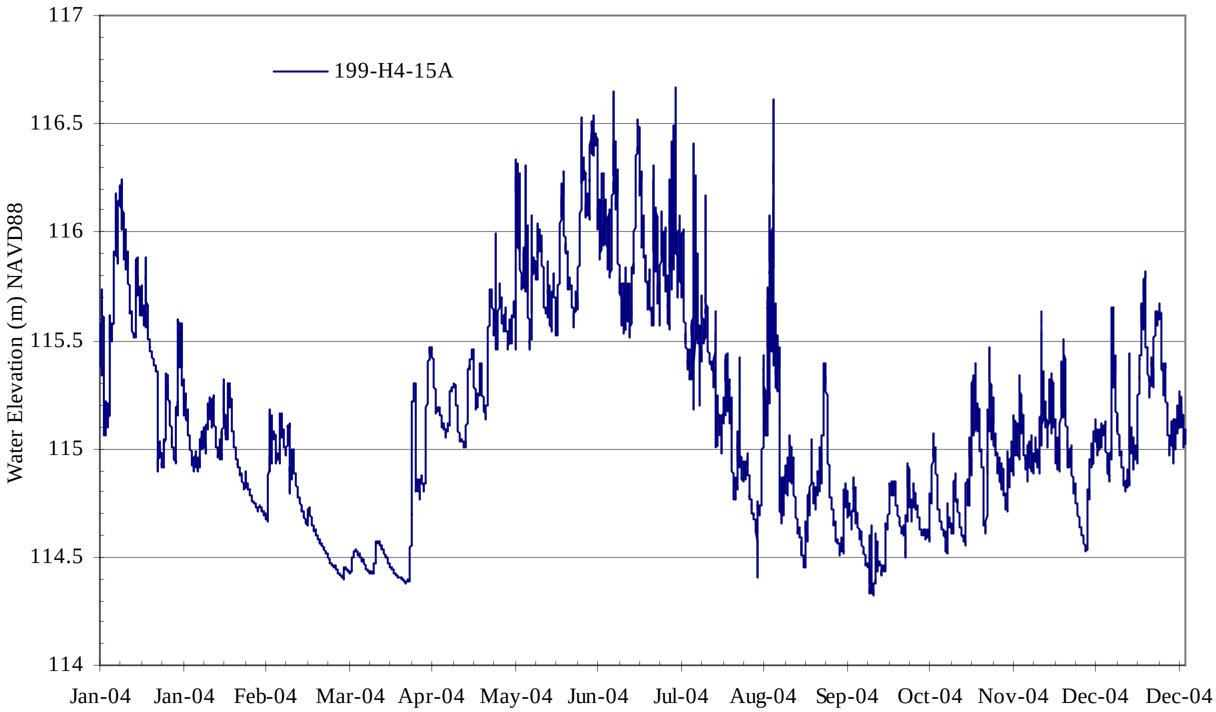
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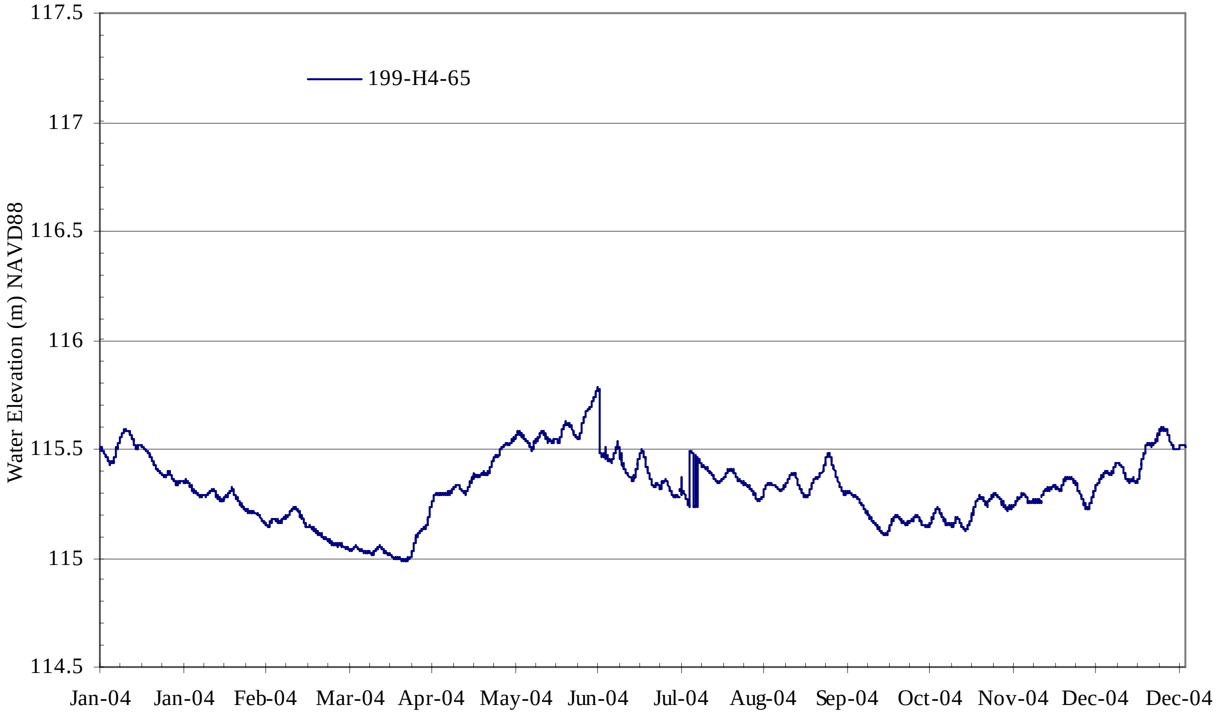
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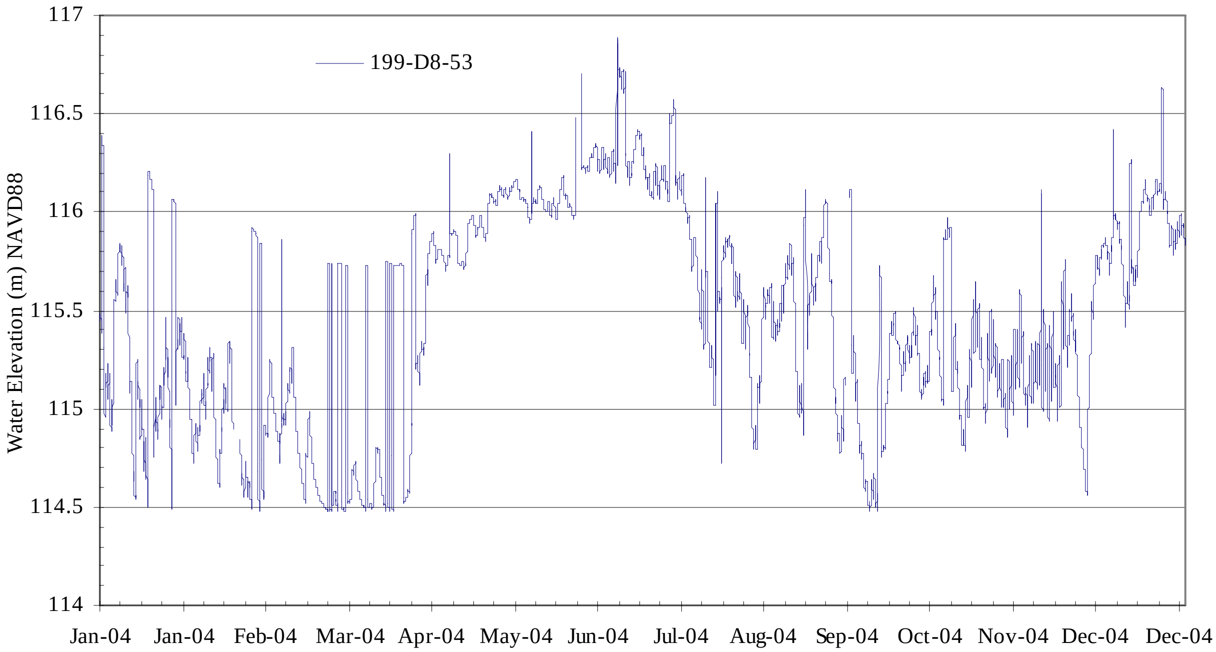
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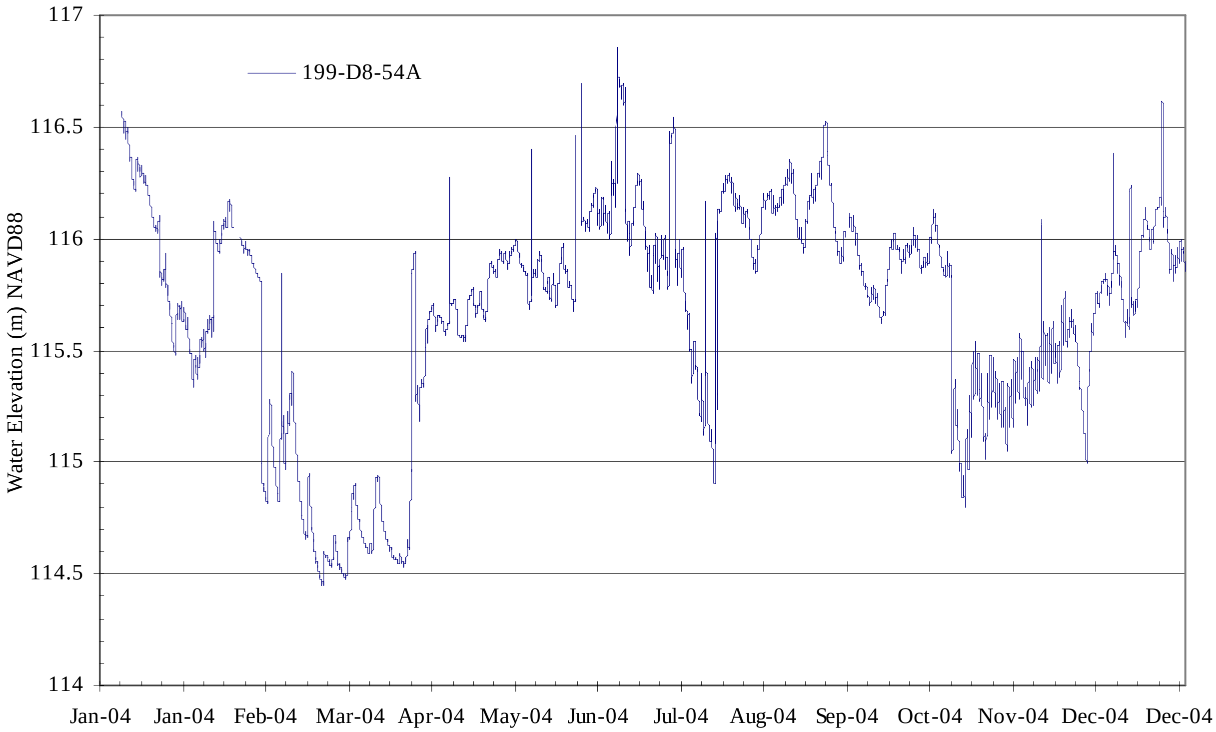
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Water Elevation (m) NAVD88
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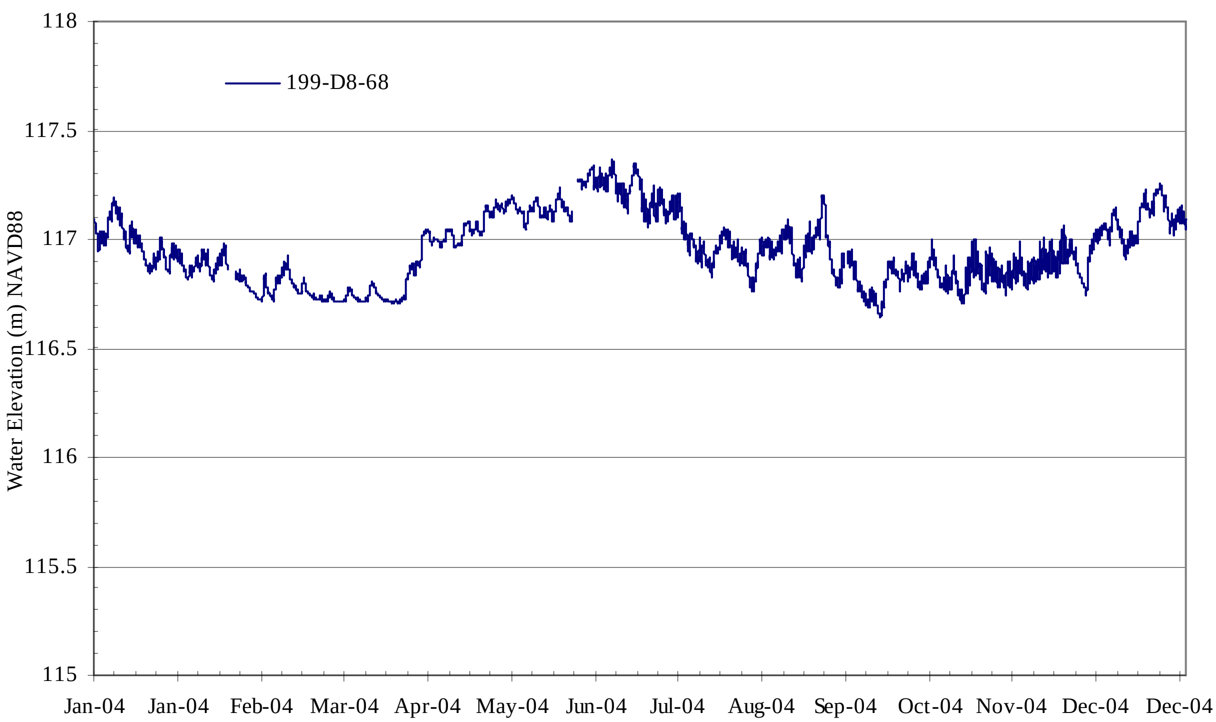
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04


118
117.5
117
116.5
116
115.5
115
199-D8-68
Water Elevation (m) NAVD88
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
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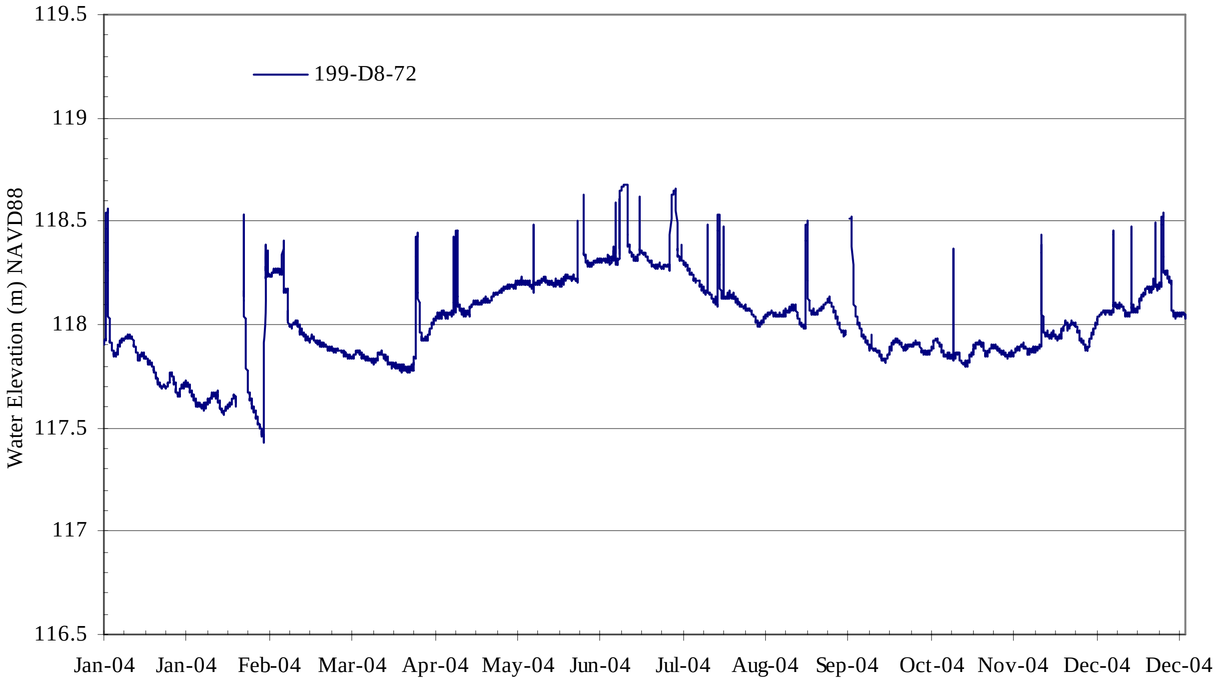
Nov-04
Dec-04
Dec-04


199-D8-72
Water Elevation (m) NAVD88
119.5
119
118.5
118
117.5
117
116.5
Jan-04
Jan-04
Feb-04
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May-04
Jun-04
Jul-04
Aug-04
Sep-04
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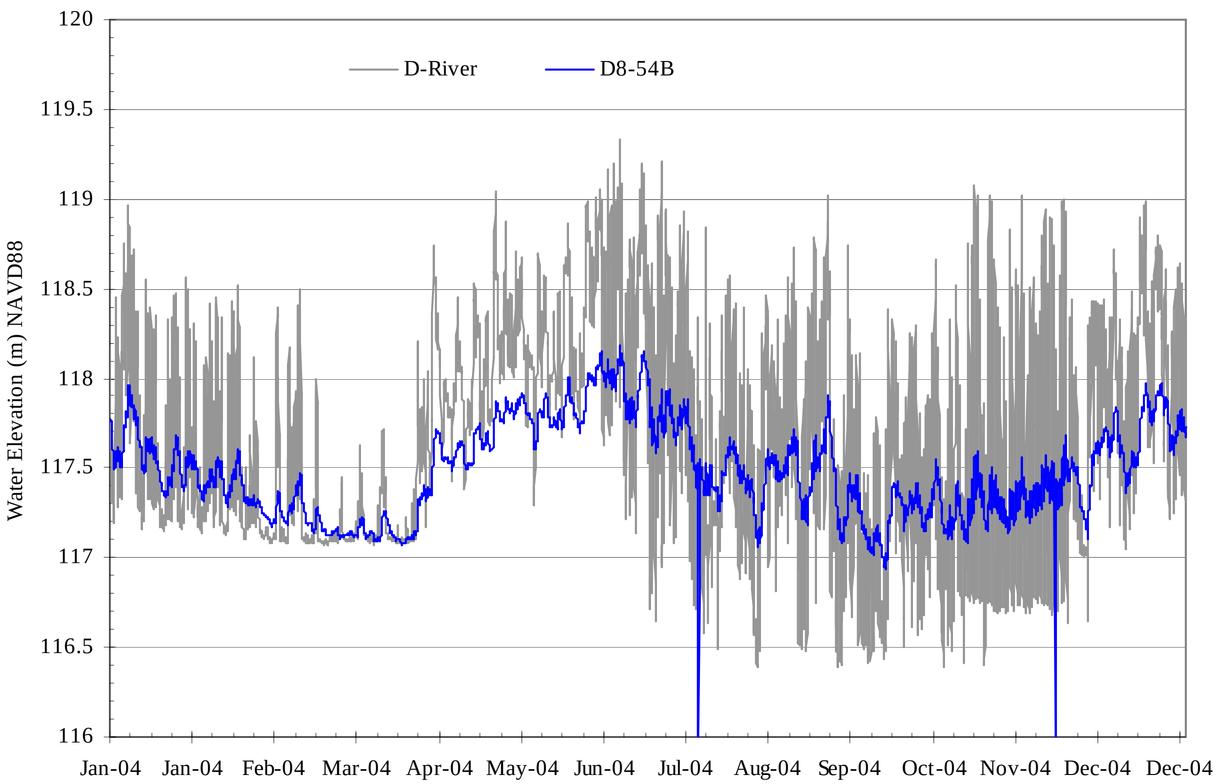
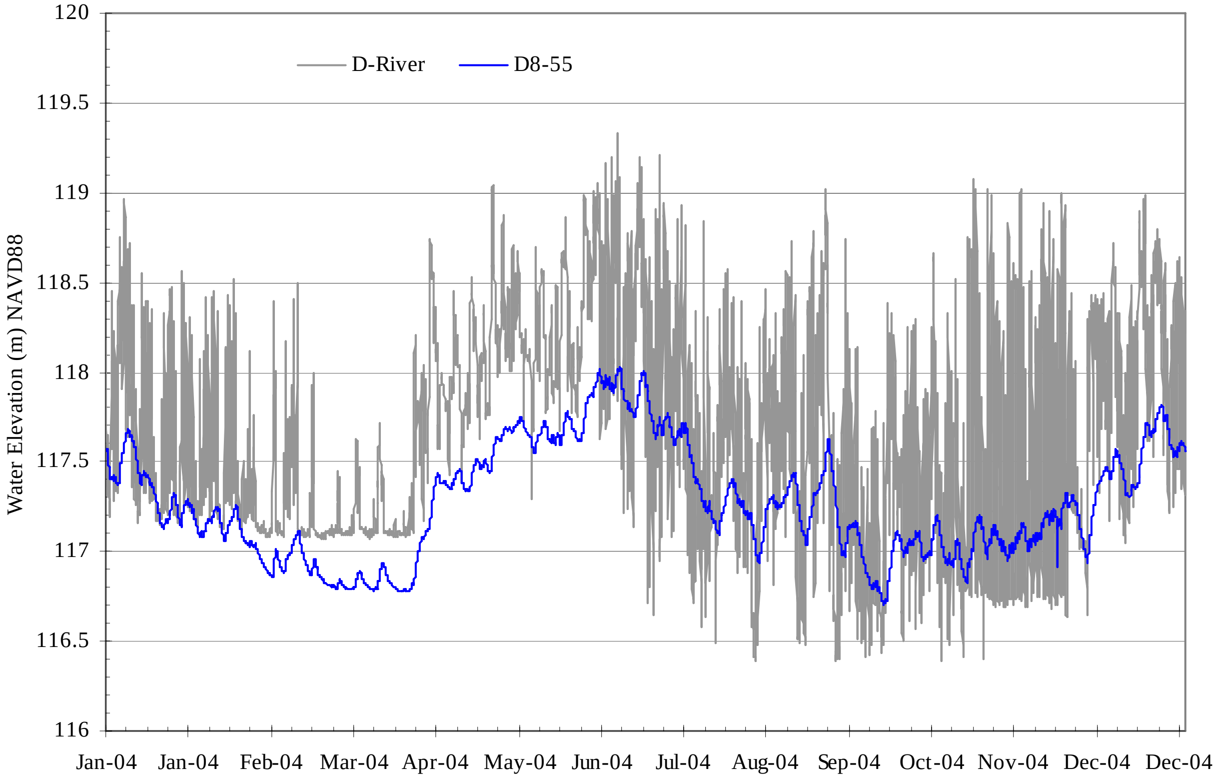
Nov-04
Dec-04
Dec-04


D-River
D8-54B
Water Elevation (m) NAVD88
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04


D-River
D8-55
Water Elevation (m) NAVD88
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Jan-04
Feb-04
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Apr-04
May-04
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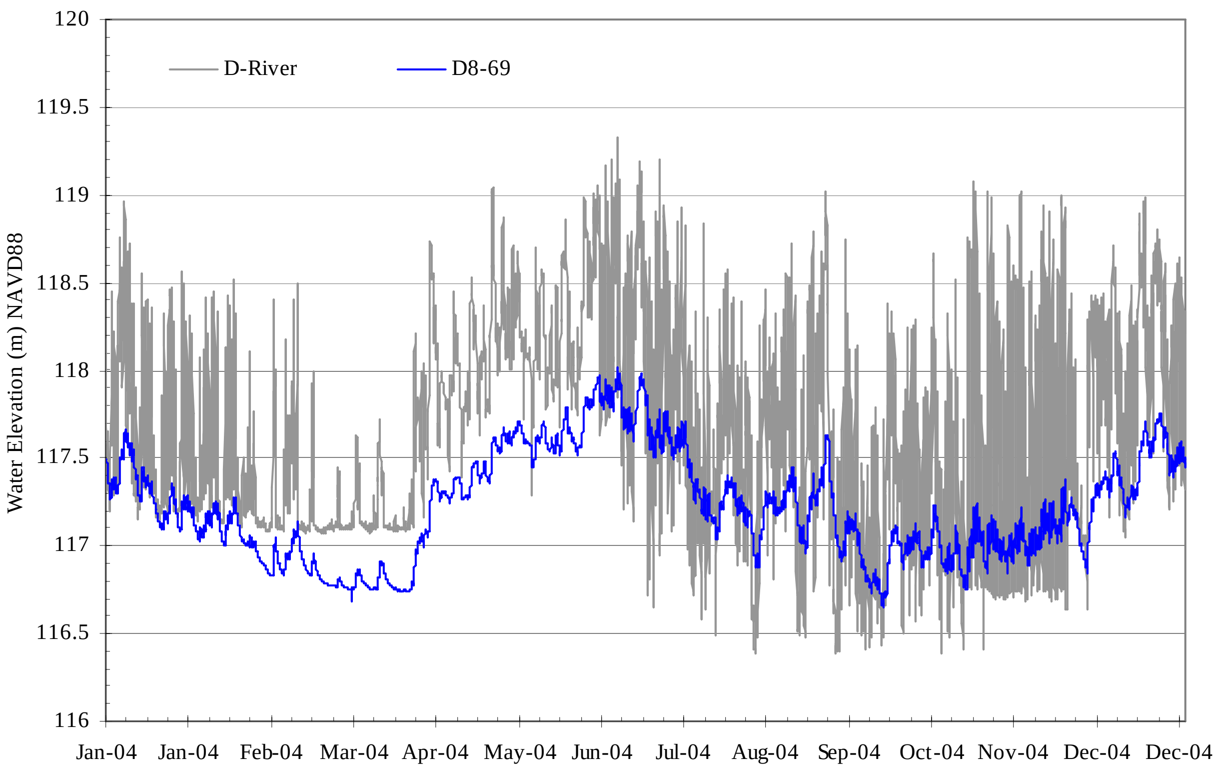
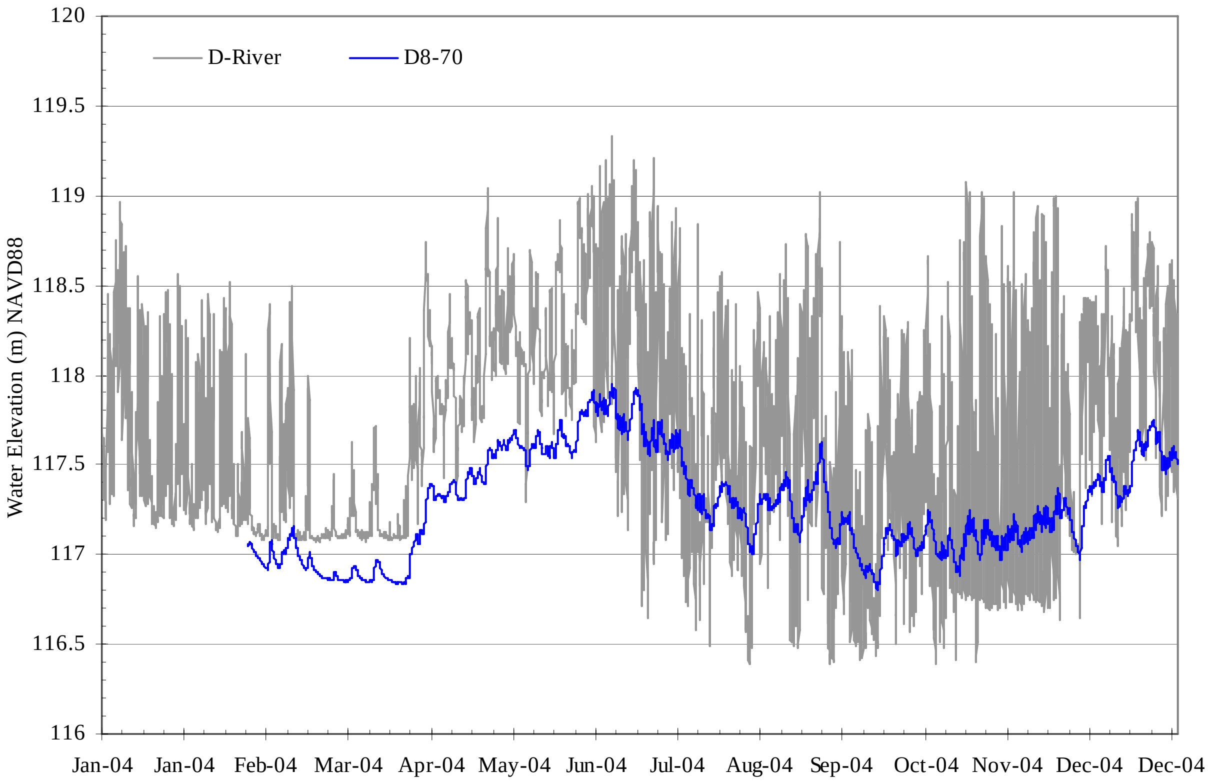
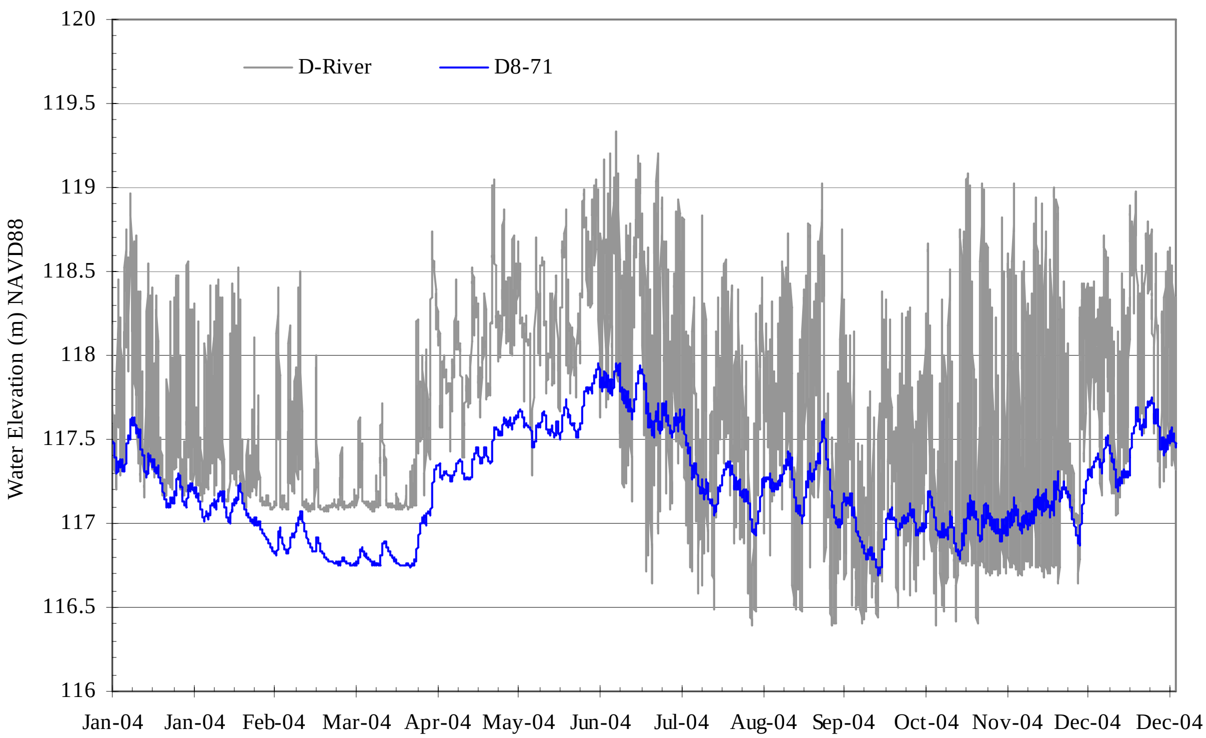
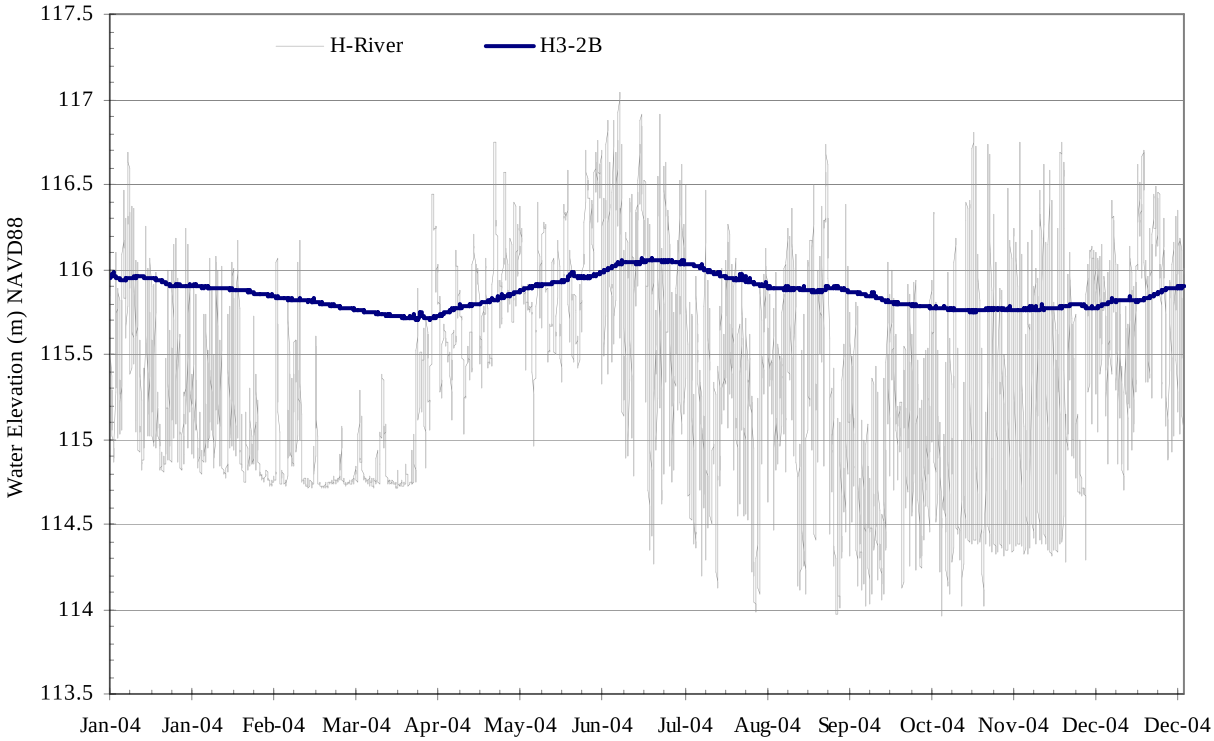
Nov-04
Dec-04
Dec-04


D-River
D8-69
Water Elevation (m) NAVD88
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04


D-River
D8-70
Water Elevation (m) NAVD88
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04 Jan-04 Feb-04 Mar-04 Apr-04 May-04 Jun-04 Jul-04 Aug-04 Sep-04 Oct-04 Nov-04 Dec-04 Dec-04


D-River
D8-71
Water Elevation (m) NAVD88
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04 Jan-04 Feb-04 Mar-04 Apr-04 May-04 Jun-04 Jul-04 Aug-04 Sep-04 Oct-04 Nov-04 Dec-04 Dec-04


H-River
H3-2B
Water Elevation (m) NAVD88
117.5
117
116.5
116
115.5
115
114.5
114
113.5
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
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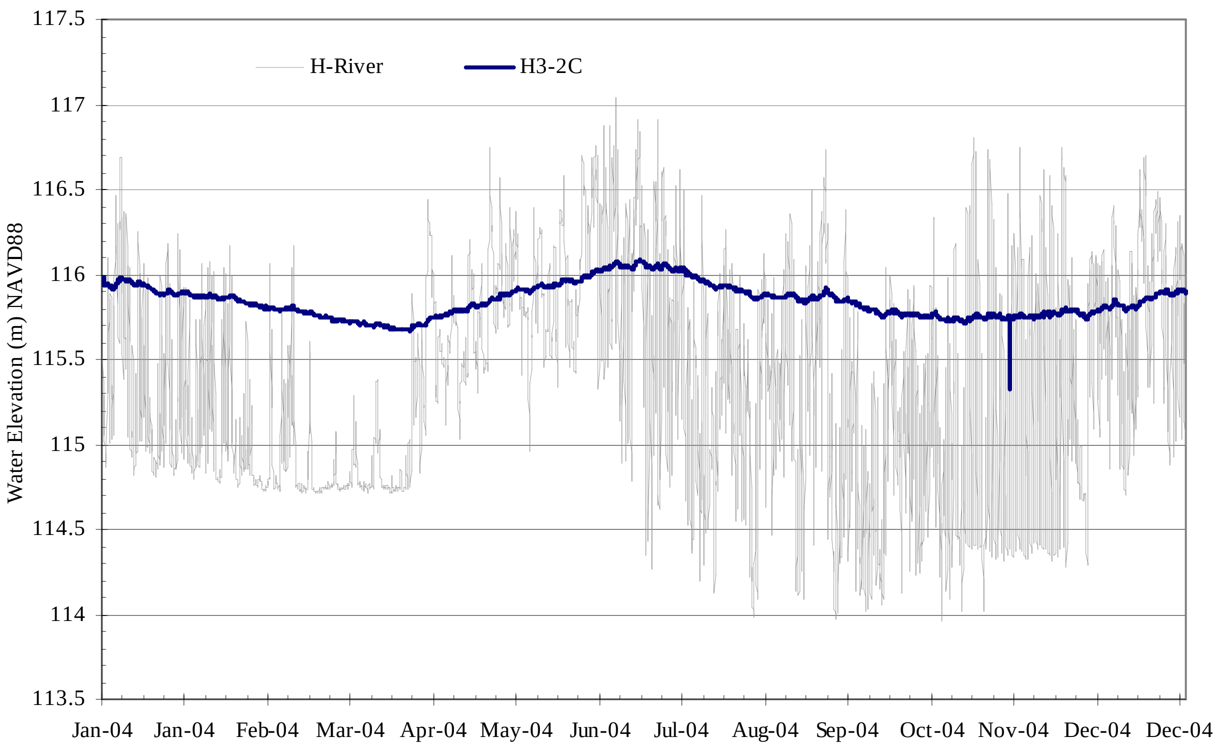
Nov-04
Dec-04
Dec-04


H-River
H3-2C
Water Elevation (m) NAVD88
117.5
117
116.5
116
115.5
115
114.5
114
113.5
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
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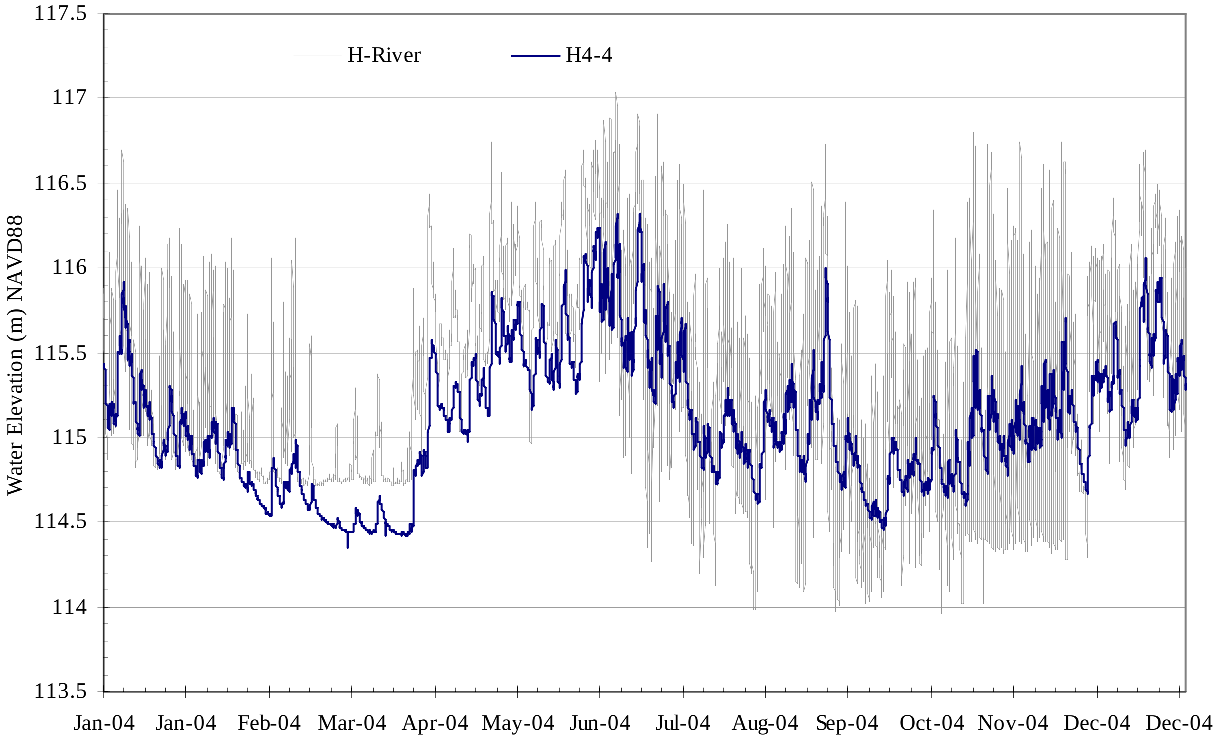
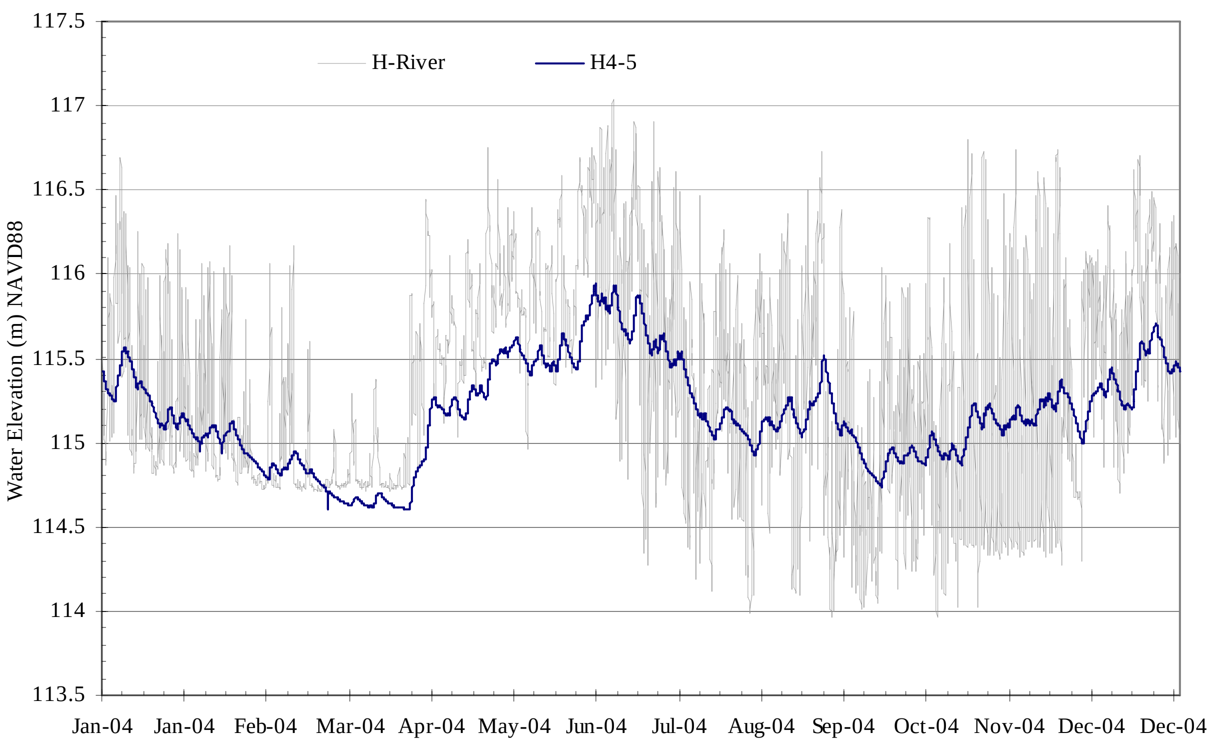
Nov-04
Dec-04
Dec-04


117.5
117
116.5
116
115.5
115
114.5
114
113.5
Water Elevation (m) NAVD88
H-River
H4-4
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04


117.5
117
116.5
116
115.5
115
114.5
114
113.5
Water Elevation (m) NAVD88
H-River
H4-5
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
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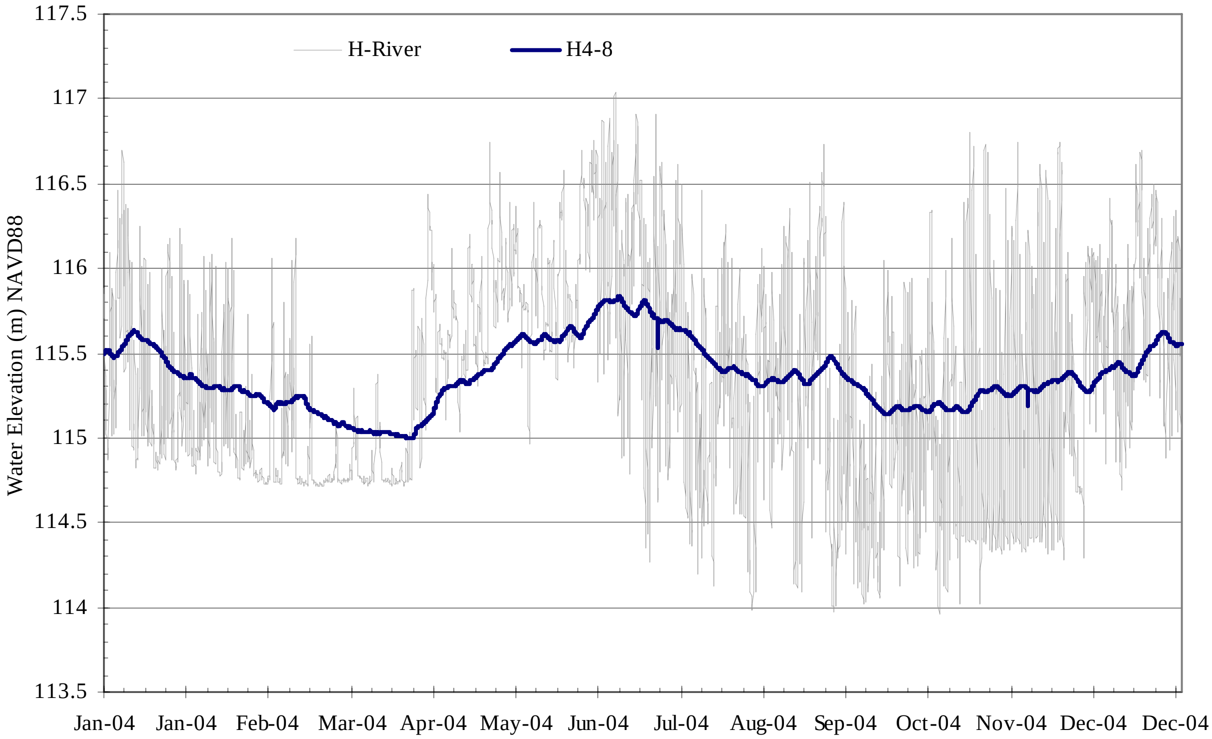
Nov-04
Dec-04
Dec-04


117.5
117
116.5
116
115.5
115
114.5
114
113.5
Water Elevation (m) NAVD88
H-River
H4-8
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
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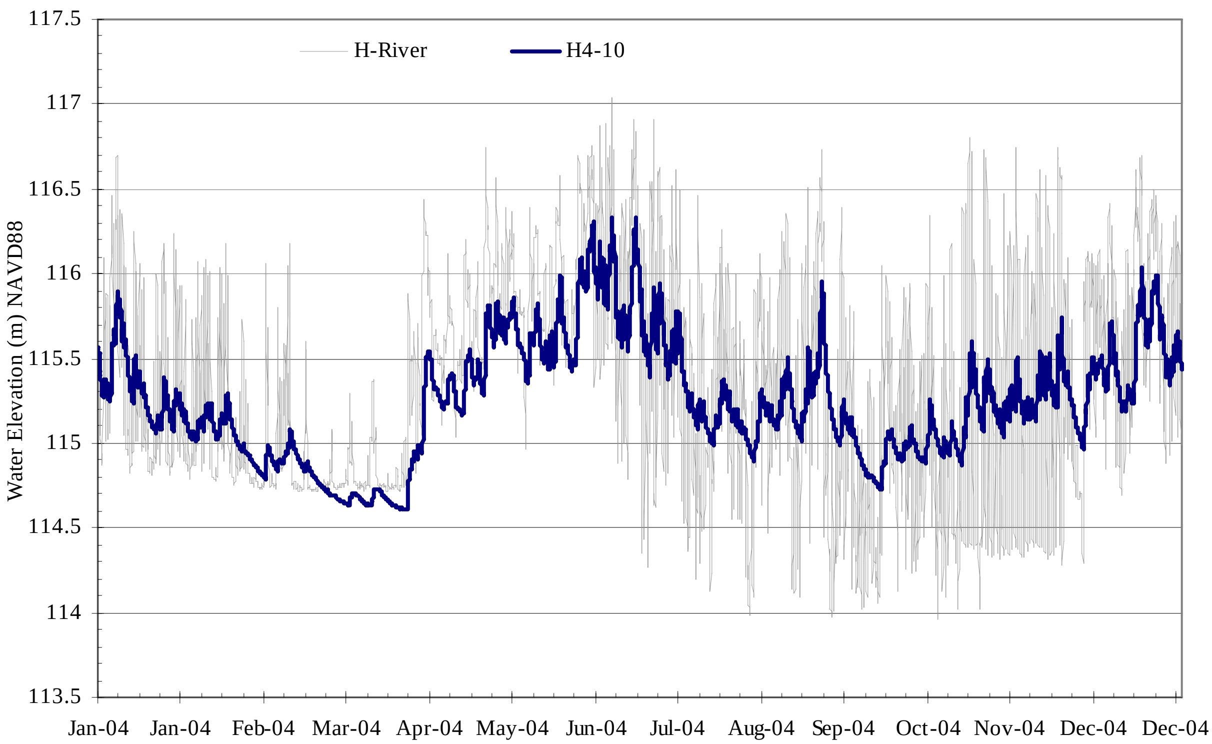
Nov-04
Dec-04
Dec-04


117.5
117
116.5
116
115.5
115
114.5
114
113.5
Water Elevation (m) NAVD88
H-River
H4-10
Jan-04
Jan-04
Feb-04
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May-04
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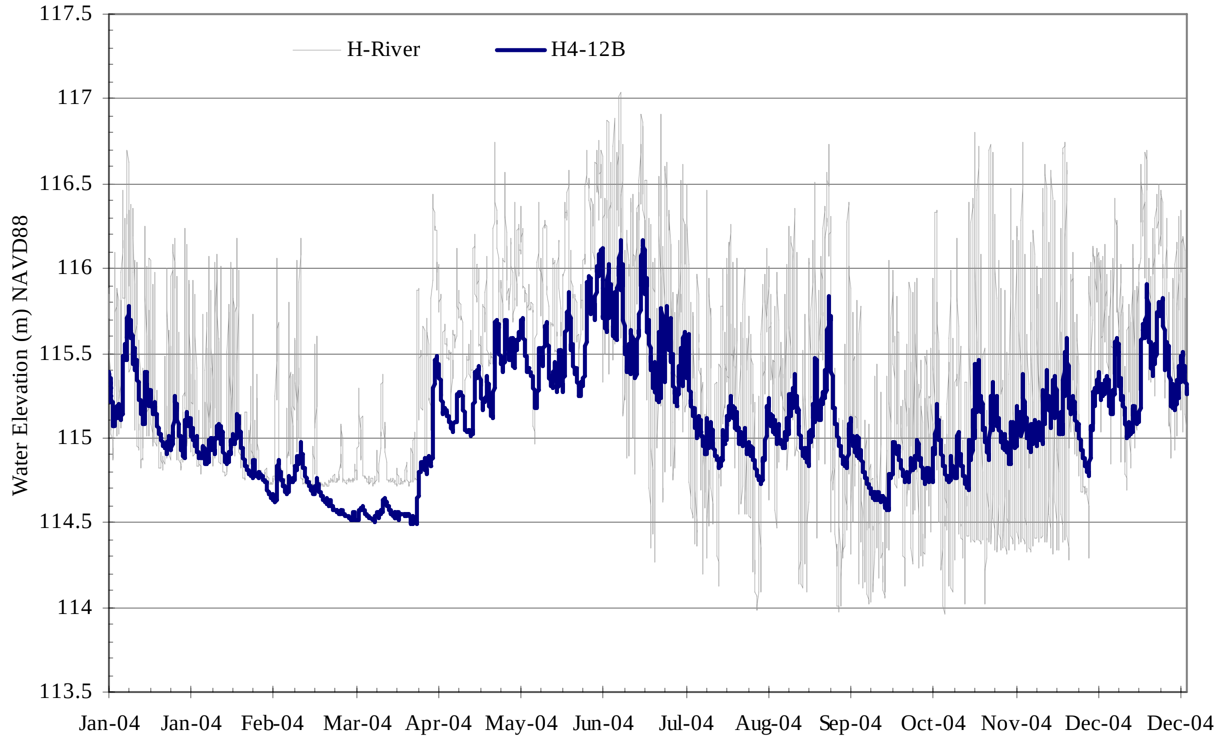
Nov-04
Dec-04
Dec-04


H-River
H4-12B
Water Elevation (m) NAVD88
117.5
117
116.5
116
115.5
115
114.5
114
113.5
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
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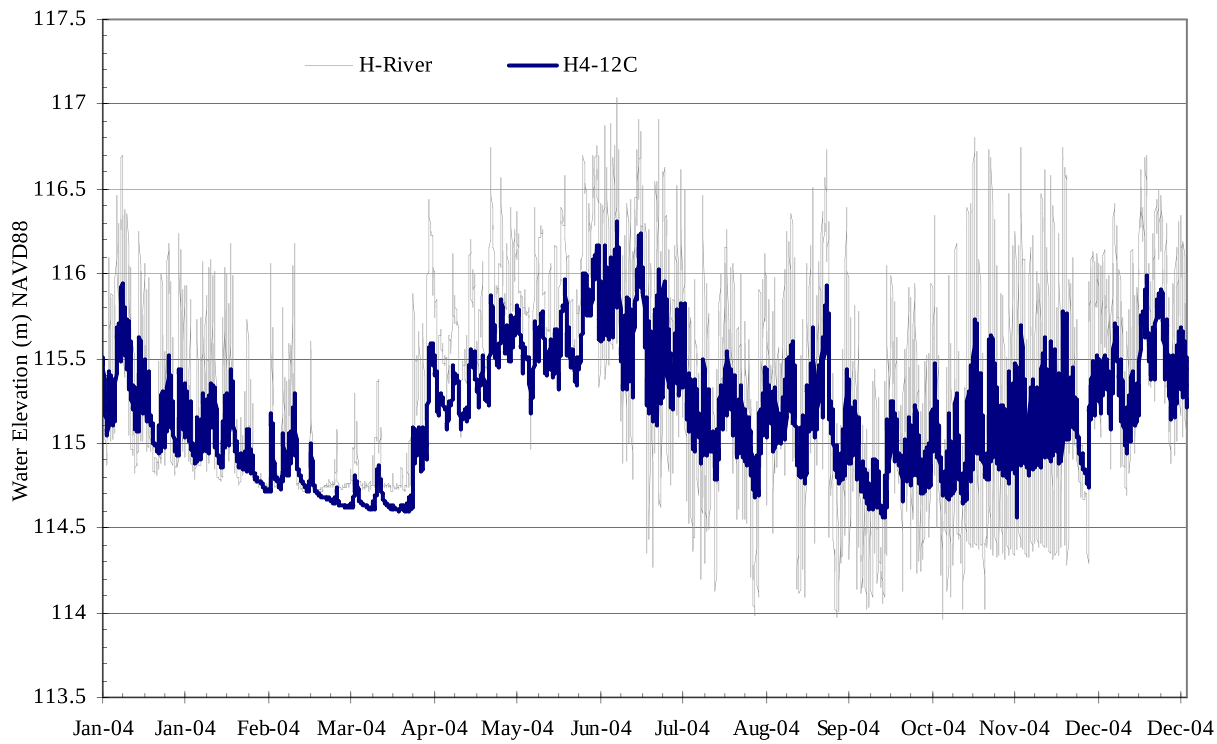
Oct-04
Nov-04
Dec-04
Dec-04


H-River
H4-12C
Water Elevation (m) NAVD88
117.5
117
116.5
116
115.5
115
114.5
114
113.5
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
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Jul-04
Aug-04
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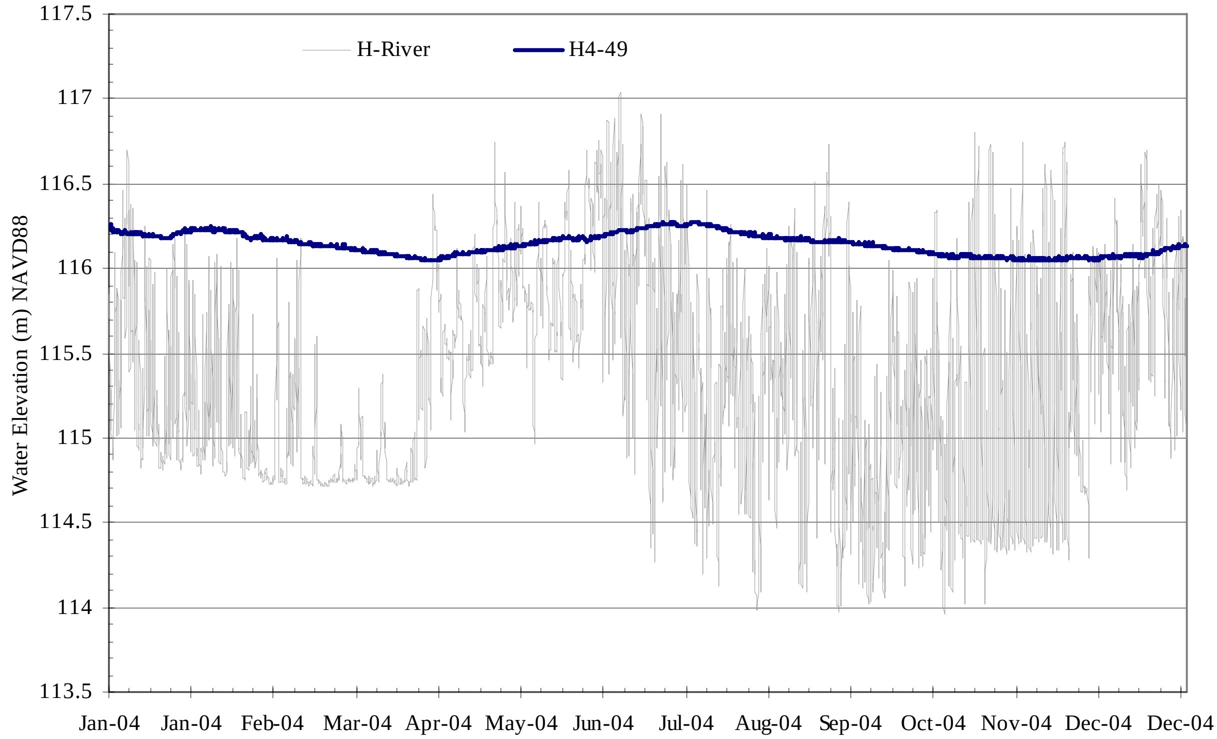
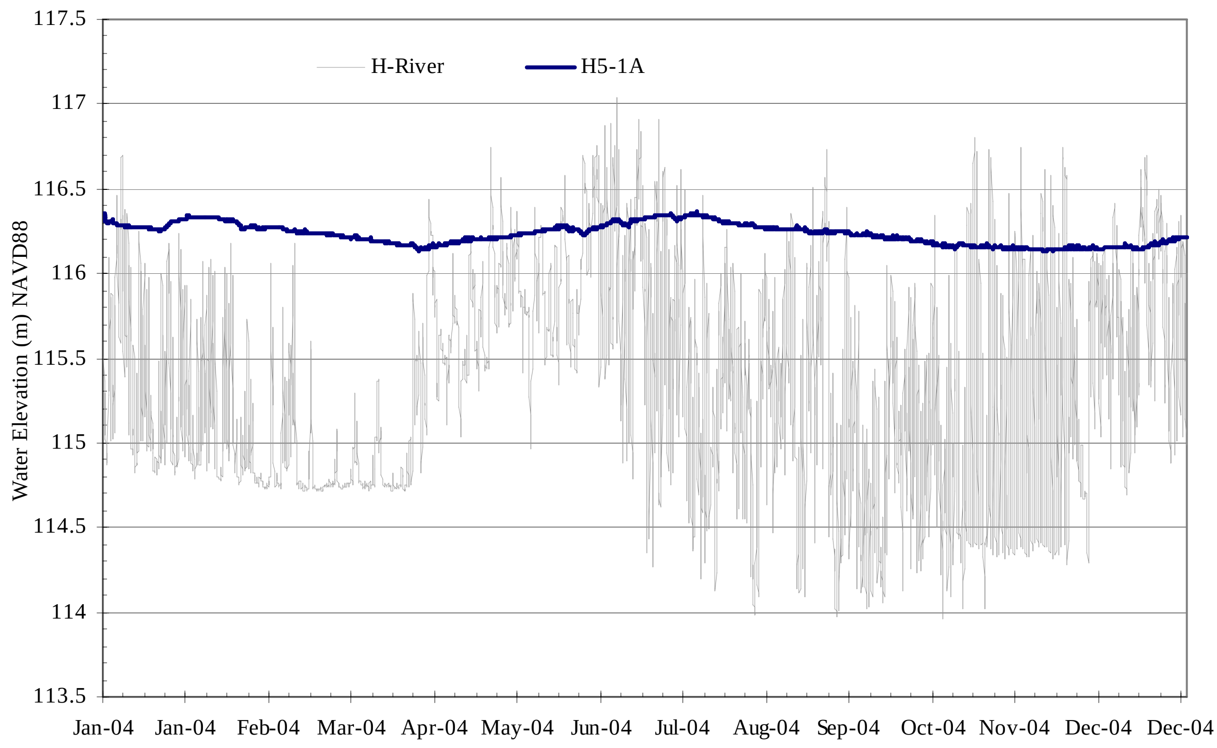
Nov-04
Dec-04
Dec-04


117.5
117
116.5
116
115.5
115
114.5
114
113.5
Water Elevation (m) NAVD88
H-River
H4-49
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04


117.5
117
116.5
116
115.5
115
114.5
114
113.5
Water Elevation (m) NAVD88
H-River
H5-1A
Jan-04
Jan-04
Feb-04
Mar-04
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May-04
Jun-04
Jul-04
Aug-04
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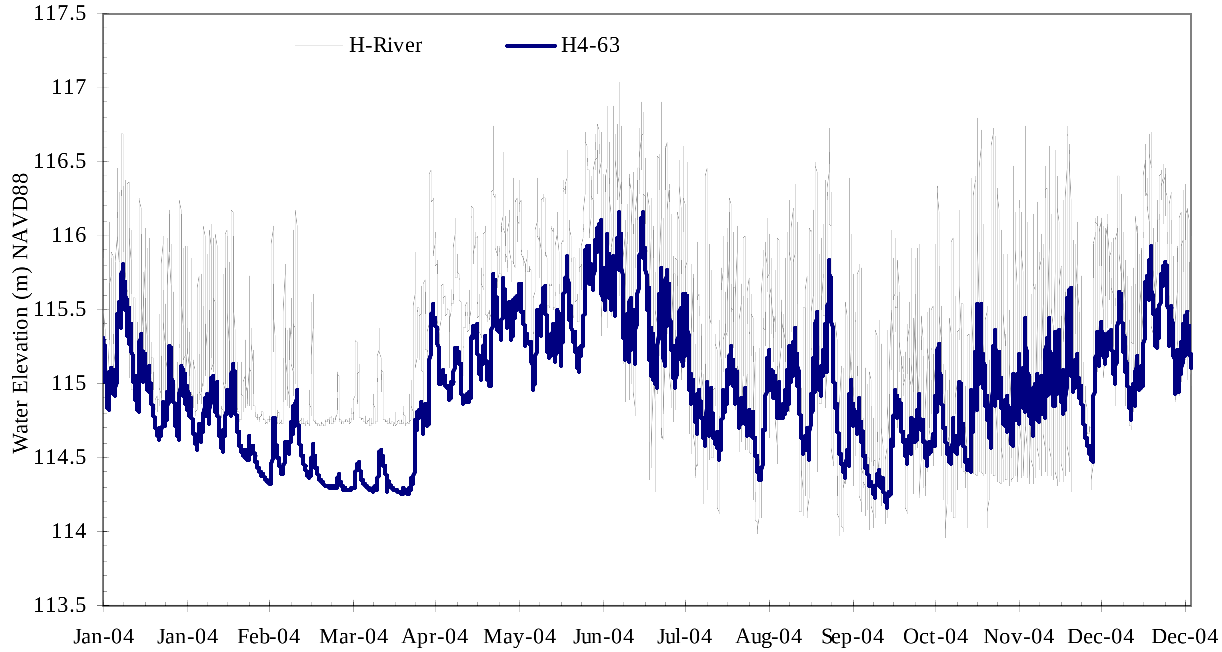
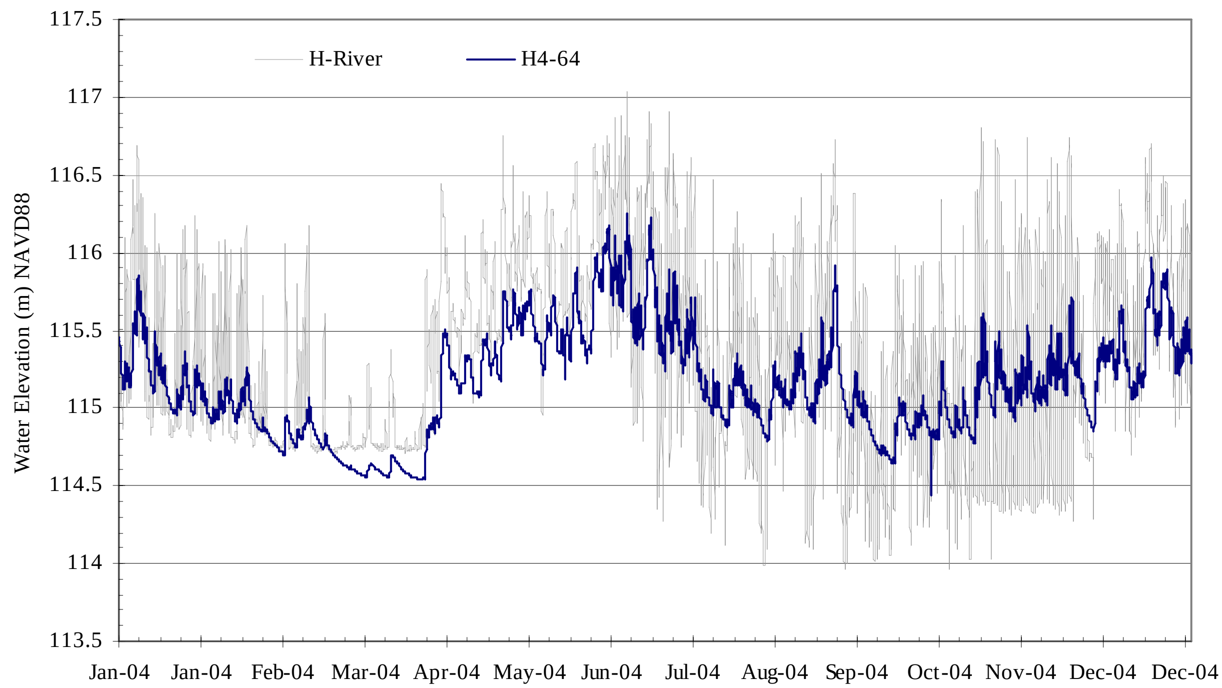
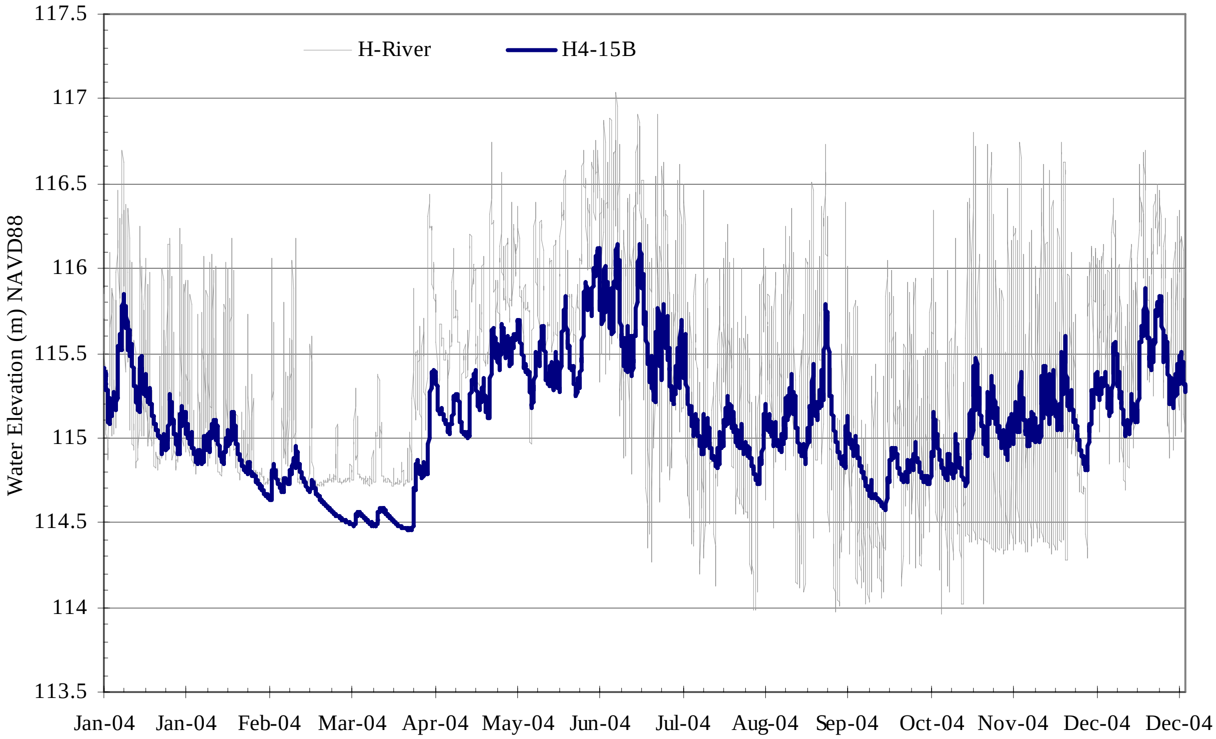
Oct-04
Nov-04
Dec-04
Dec-04


H-River
H4-63
Water Elevation (m) NAVD88
117.5
117
116.5
116
115.5
115
114.5
114
113.5
Jan-04 Jan-04 Feb-04 Mar-04 Apr-04 May-04 Jun-04 Jul-04 Aug-04 Sep-04 Oct-04 Nov-04 Dec-04 Dec-04


H-River
H4-64
Water Elevation (m) NAVD88
117.5
117
116.5
116
115.5
115
114.5
114
113.5
Jan-04 Jan-04 Feb-04 Mar-04 Apr-04 May-04 Jun-04 Jul-04 Aug-04 Sep-04 Oct-04 Nov-04 Dec-04 Dec-04



117.5
117
116.5
116
115.5
115
114.5
114
113.5
Water Elevation (m) NAVD88
H-River
H4-15B
Jan-04
Jan-04
Feb-04
Mar-04
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May-04
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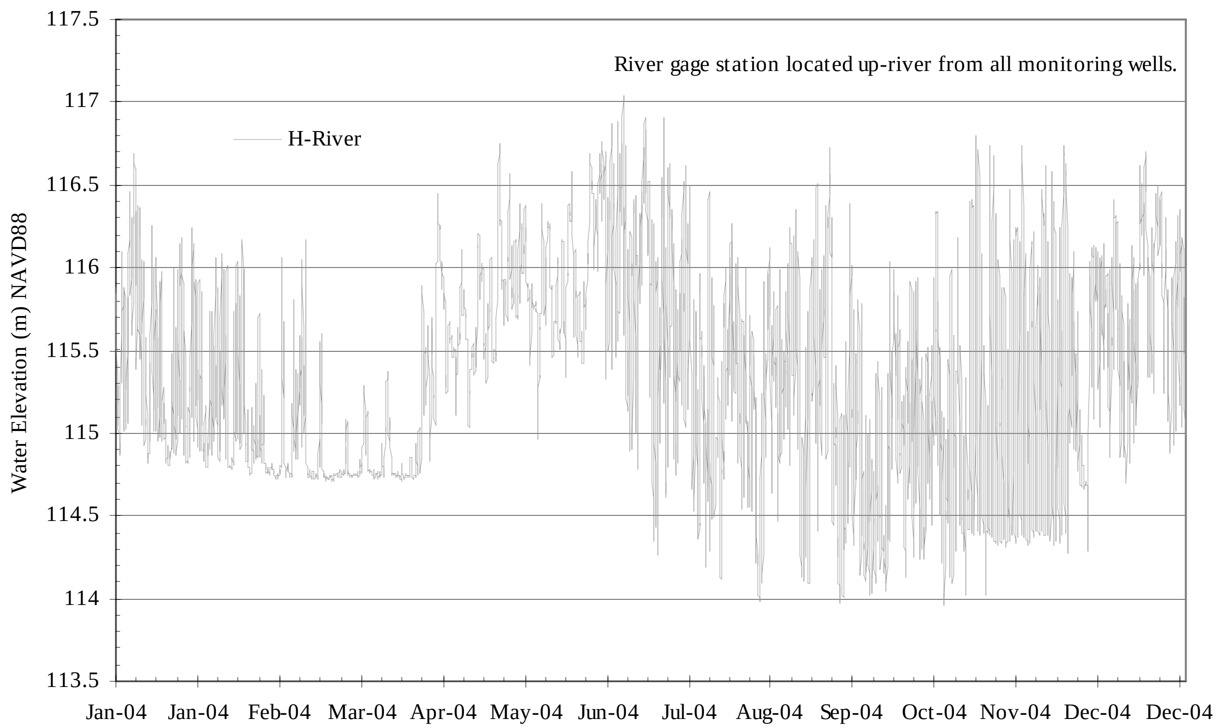
Nov-04
Dec-04
Dec-04



117.5
117
116.5
116
115.5
115
114.5
114
113.5
Water Elevation (m) NAVD88
River gage station located up-river from all monitoring wells.
H-River
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04

APPENDIX F

NUMERICAL MODELING

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CONTENTS

FIGURES

TABLES

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APPENDIX F

NUMERICAL MODELING

F1.0 100-HR-3, 100-KR-4, AND 100-NR-2 NUMERICAL MODELING CONSTRAINTS

This section details the constraints that are applicable for the 100-D, 100-H, 100-K, and 100-N numerical modeling effort.

Groundwater numerical modeling is used to evaluate effectiveness of the extraction wells in preventing the discharge of contaminated groundwater (and by inference, chromium) into the Columbia River. By lowering the water table during pumping, the extraction wells develop a hydraulic sink that reduces the net flow through the target area into the river. The modeling evaluations were performed using November hydraulic boundary conditions (average river levels) to calculate the steady-state heads and flow lines. Flow lines shown on the figures in this appendix are steady-state approximations; the actual flow lines vary in time and space because of the highly variable nature of the water table near the river where the stage elevation fluctuates daily. The modeling does not include the transient effects of the changing river stage on the water table, bank storage, or actual contaminant transport, nor is any attempt made to estimate the actual area of hydraulic capture during the year. The difficulty and level of complexity involved in incorporating those transient effects greatly exceed the intended scope and purpose of the modeling. For example, the river water level usually varies by approximately 2 m every day, so a time-average value was used in the model for each spatial grid cell. The river level declines in the downstream direction with a hydraulic gradient of 0.00023.

To ensure a conservative evaluation of the extraction well hydraulic capture that is consistent with the steady-state boundary conditions, the modeling used November 2004 water-level data to establish water-level boundary conditions. November water-level data corresponded with the period of sustained low flow in the Columbia River, when the water table acquired the steepest gradient toward the river. The groundwater gradient and flow through the target area (and contaminant discharge) to the Columbia River appeared to be greatest during this time. Evaluating the performance of the extraction wells against November water-level and river-stage boundary conditions provides a conservative and relevant evaluation of the effectiveness of the pump-and-treat system in accomplishing the goal of protecting the aquatic receptors in the river bottom substrate from the groundwater contaminants. During other times of the year when the river stage is higher, the hydraulic capture may appear more effective, as the flow lines extend more laterally and farther toward the river from the extraction wells. However, capture during these times may include river and bank storage water, which does not appear to contain elevated levels of contaminants, namely chromium.

The transport mechanism of contaminants across the river/aquifer interface is not well understood, but certain observations have been made. River water entering the aquifer during times of high or increasing river stage appears to displace groundwater back from the river, with little actual dilution occurring between the river and the wells. This phenomenon is evidenced by the decrease in chromium concentrations observed in the monitoring wells near the river during the months of spring run-off, followed by the rebound in concentration when the river stage recedes in the fall. If the concentrations had become diluted, then they would not rebound as there is no concentrating mechanism present in the aquifer. The bank storage water discharging back into the Columbia River does not appear to contain elevated levels of chromium and, thus, does not add to the contaminant transport to the river.

F2.0 100-D AREA GROUNDWATER NUMERICAL MODELING

The 100-D numerical model was developed initially to support design of the pump-and-treat systems. The transmissivity distributions in the model were developed from a limited set of hydraulic properties (e.g., *Limited Field Investigation Report for the 100-HR-3 Operable Unit* [DOE-RL 1993], *Limited Field Investigation Report for the 100-KR-4 Operable Unit* [DOE-RL 1994], and *Remedial Design Report and Remedial Action Work Plan for the 100-HR-3 and 100-KR-4 Groundwater Operable Units Interim Action* [DOE-RL 1996b]) and were then updated in *100-HR-3 and 100-KR-4 Operable Units Interim Action Performance Evaluation Report* (DOE-RL 1998) to include aquifer property analyses based on data collected by the hydraulic monitoring network and pump-and-treat operations. Refinements to the 100-D transmissivity distribution have been made as additional data have become available, including geologic layering and hydraulic conductivity distributions from Pacific Northwest National Laboratory's Sitewide model. A comparison of the modeled water levels to the current year's water levels (measured in November 2004) is presented in Table F-1.

Flow lines terminating at the extraction wells in Figure F-1 show the approximate area of the aquifer through which each extraction well removes groundwater. The total area encompassed by the flow lines terminating at each extraction well represents the capture zone of that extraction well. Wells 199-D8-53, 199-D8-54A, 199-D8-68, and 199-D8-72 fully penetrate the unconfined aquifer, so the flow lines represent the groundwater travel occurring throughout the depth of the aquifer. The flow-line calculations are independent of the travel time, and as stated previously, the actual flow paths vary throughout the year. Because the purpose of the pump-and-treat system is to reduce discharge of contaminated groundwater to the Columbia River, the flow lines shown on the figures in this appendix are only representative of the conditions during the time when groundwater flow toward the river would be greatest.

Figure F-1 also shows time markers spaced 1 year apart on the flow lines, based on the high November steady-state velocities. The fastest flow lines run from the new injection well, 199-N5-42, to near extraction well 199-D8-68, which takes slightly more than 1 year of time for a pore velocity of about 2.2 m/day (800 m/365 days). The slower velocities are less than 1 m/day and located before new extraction wells 199-D5-37 and 199-D5-32, assuming the high November values. However, this time-velocity snapshot in November produces the largest velocities, as explained previously. In reality, the time markers would be closer together, indicating slower velocities averaged over the years. The effective porosity was set to a low value of 0.1, which also increases the calculated pore velocities.

Contaminated groundwater is contained and prevented from discharging into the Columbia River along the river and downgradient of the capture zones. The conversion of monitoring wells 199-D5-20, 199-D5-32, and 199-D5-37 to extraction wells and well 199-D5-42 to an injection well have extended the capture zone in the southwestern direction from well 199-D8-72 to well 199-D5-37. Flow lines terminating at the river in Figure F-1 indicate areas where the groundwater may bypass the extraction wells (north of well 199-D8-53 and south of well 199-D5-37) and discharge into the river. Some groundwater flow lines circumvent the pump-and-treat system to the north, but the contaminant monitoring data indicate that the extraction wells are containing the original high-concentration area of the plume. The chromium concentration in well 199-D8-71, located between extraction wells 199-D8-53 and 199-D8-54A, remained slightly above 100 µg/L during 2004. Furthermore, the concentration in well 199-D8-69, located between well 199-D8-53 and the river, ranged between 10 and 100 µg/L and averaged approximately 50 µg/L for the year. The concentration in well 199-D8-70, which appears to be located just outside of the capture zone of well 199-D8-53, ranged between 35 and 165 µg/L and averaged 133 µg/L for 2003.

F3.0 100-H AREA GROUNDWATER NUMERICAL MODELING

The 100-H numerical model was developed initially to support design of the pump-and-treat systems. The transmissivity distributions in the model were developed from hydraulic properties (DOE-RL 1993, 1994, 1996b) and then were updated (DOE-RL 1998, 1999) to include aquifer property analyses based on data collected by the hydraulic monitoring network and pump-and-treat operations. A comparison of the modeled water levels to the current year's water levels measured in November 2004 is presented in Table F-1.

Flow lines terminating at the extraction wells in Figure F-2 show the approximate area of the aquifer through which each extraction well removes groundwater. The total area encompassed by the flow lines terminating at each extraction well represents the capture zone of that extraction well. All of the extraction wells fully penetrate the unconfined aquifer, so the flow lines represent the groundwater travel occurring throughout the depth of the aquifer. The flow-line calculations are independent of the travel time, and as stated previously, the actual flow paths vary throughout the year. Because the purpose of the pump-and-treat system is to reduce discharge of contaminated groundwater to the Columbia River, the flow lines shown on the figures are only representative of the conditions during the time when groundwater flow toward the river would be greatest.

Figure F-2 also shows time markers spaced 180 days apart on the flow lines, based on the high November steady-state velocities. The fastest flow lines are the high conductivity region in the southernmost part of Figure F-3, where the pore velocities are as high as 6 m/day (1,100 m/ 180 days) from injection well 199-H3-5 to past monitoring well 199-H6-1. The effective porosity was set to a low value of 0.1, which also increases the calculated pore velocities. The pore velocities are as low as 1.7 m/day (approximately 300 m/180 days) upgradient from extraction well 199-H4-11.

Contaminated groundwater is contained and prevented from discharging into the Columbia River and downgradient of the capture zones. Flow lines terminating at the river in Figure F-2 indicate areas where the groundwater may bypass the extraction wells and discharge into the river. The capture zone extends from well 199-H4-10 to well 199-H4-11. There is a break in the capture between wells 199-H4-12A and 199-H-4-11, which is a consequence of the low flow rate in wells 199-H4-12A and well 199-H4-65 not being able to operate because of the low water level in the wells. Groundwater flow lines circumvent well 199-H4-11 to the south. The contaminant monitoring data indicate that the extraction wells are containing the remaining high-concentration area of the plume, whereas the concentrations observed in the areas where the flow lines bypass the extraction wells are close to the compliance level. In compliance well 199-H4-4, located between wells 199-H4-12A and 199-H-4-11, the concentration averaged 22 µg/L in the fall months of 2004. In compliance well 199-H4-63, located south of well

199-H-4-11, the concentration averaged 48.7 µg/L in 2004 and 40.2 µg/L in the fall months of 2004.

Overall, the pump-and-treat system appears to have improved conditions in the aquifer. The extraction of the contaminated groundwater and the arrival of the treated injection water appear to be reducing the hexavalent chromium concentration throughout the original targeted plume area. The progress of the injected water along the flow lines and the consequent reduction in concentration has been observed in monitoring wells 199-H3-2B, 199-H4-14, and 199-H4-8, as well as in extraction wells 199-H3-2A, 199-H4-7, and 199-H4-12A.

F4.0 100-K AREA NUMERICAL MODEL

The 100-K numerical model was developed initially to support design of the pump-and-treat systems. The transmissivity distributions in the model were developed from hydraulic properties (DOE-RL 1993, 1994, 1996b) and then were updated (DOE-RL 1998, 1999) to include aquifer property analyses based on data collected by the hydraulic monitoring network and pump-and-treat operations. A comparison of the modeled water levels to the current year's water levels measured in November 2004 is presented in Table F-2.

Flow lines terminating at the extraction wells in Figure F-3 show the approximate area of the aquifer through which each extraction well removes groundwater. The flow lines indicate where a particle of water travels in the aquifer and whether the water is captured by the extraction wells or discharged into the river. Because the extraction wells fully penetrate the unconfined aquifer, the flow lines represent groundwater travel throughout the depth of the aquifer. The total area encompassed by the flow lines terminating at each extraction well represents the capture zone of that extraction well. The flow-line calculations are independent of the travel time, and as stated previously, the actual flow paths vary throughout the year. Because the purpose of the pump-and-treat system is to reduce discharge of contaminated groundwater to the Columbia River, the flow lines shown on the figures are only representative of the conditions during the time when groundwater flow toward the river would be greatest.

Figure F-3 also shows time markers spaced 1 year apart on the flow lines, based on the high November steady-state velocities. The slowest flow lines, which have pore velocities of around 0.3 m/day (approximately 110 m/365 days) for most of the distance, are located northeast and southwest of the extraction wells in the center. The pore velocities upgradient and between the extraction wells 199-K-119A and 199-K-125A are the largest with values around 1.5 m/day (approximately 540 m/365 days), which are enhanced by injection wells 199-K-121A and 199-K-122A. There is high hydraulic conductivity in this region, and the effective porosity is set to a low value of 0.1, which also increases the calculated pore velocities. The high velocities are the main reason that the chromium levels are so low for extraction wells 199-K-119A and 199-K-125A. The low velocities and the high chromium plume upgradient from extraction well 199-K-120A in the southwest indicate that the concentration levels there will remain above 50 µg/L for 4 years or more. Compliance well 199-K-18, located near well 199-K-120A, is actually in the peak contaminant plume and should show reduced levels in 1 or 2 years.

An exponential decay model is developed in Section F4.1 for the removal rate of contaminants from extraction wells. The model indicates that the travel time from an injection well to an extraction well can be used to predict the concentrations in the future. Such predictions can indicate the presence of new vadose zone contaminant input. For extraction wells 199-K-119A and 199-K-125A, no new contaminant input from the vadose zone is indicated.

Hydraulic capture extends almost entirely the length of the extraction wells between wells 199-K-126 in the north and 199-K-120A in the south. The location of all of the 100-K Area extraction wells resulted from discussions with cultural resources representatives and the Tribes, and the wells were placed to minimize impacts to cultural resource sites (DOE-RL 1996b). The locations of wells 199-K-119A, 199-K-127, and 199-K-120A were particularly difficult because of their proximity to a highly sensitive area. Because of the high transmissivity around well 199-K-116A, the capture zone resulting from pumping in that well is very small compared to the capture zones surrounding the other extraction wells; however, all of the groundwater appears to be captured by the extraction wells. North of the extraction wells, groundwater bypasses the system in the vicinity of well 199-K-130.

The effects of the hydraulic containment are most evident in compliance well 199-K-117A, which is located immediately downgradient of extraction well 199-K-116A. The concentration of hexavalent chromium in wells 199-K-117A and 199-K-116A measured 171 µg/L and 181 µg/L, respectively, in November 1997 at the start of operations. These concentrations represented the highest values observed in any of the extraction and compliance wells at the start of operations. While the concentration in well 199-K-116A has decreased steadily to about 86 µg/L in December 2004, the concentration in well 199-K-117A dropped to less than 50 µg/L in June 2001 and has remained below 25 µg/L since April 2002. The extraction well appears to be preventing the highest concentration of hexavalent chromium from reaching the compliance well in the most highly transmissive portion of the targeted area.

The effects of the hydraulic containment are not as apparent in the other compliance wells, although the concentrations are trending downward in wells 199-K-20 and 199-K-119A. The concentration in well 199-K-20 has trended downward since mid-1999 (from approximately 120 µg/L to 44 µg/L in October 2004). The variability in the data from well 199-K-114A, primarily because of its closeness to the river, makes establishing a trend difficult. The concentration observed during the late fall months trended downward since 1999, but during the fall months of 2004, the average concentration increased to above 100 µg/L after bottoming in July 2004 at a value of 8 µg/L. An increase in concentration has been observed in well 199-K-18, reaching a value of 143 µg/L in November 2004, because of the low pore velocities and highly concentrated plume upgradient from the well, as shown in Figure F-3.

F4.1 EVALUATION OF AQUIFER CLEANUP DYNAMICS

Using the travel times between injection and extraction wells (time markers in Figures F-1 to F-4), some inferences can be made about the nature and extent of mobile contaminants (e.g., hexavalent chromium) removal from the aquifer. For example, a semi-log plot of chromium concentration versus time should approximate a straight line if only washout or purging of a contaminant from the aquifer is occurring. If additional contaminant input occurs over the period of observations, the observed concentrations will depart significantly from the expected linear model.

The expected rate of decline can be estimated from a simple exponential washout model (Graham and Johnson 1991) as follows:

$$C(t) = Co\,[\exp(-Q/V) * t] \qquad \text{(Equation 1)}$$

where:
- C(t) = chromium (μg/L) in the extracted water at time, t (year)
- Co = initial concentration at some starting time
- Q = the extraction rate in volume per unit time
- V = pore fluid volume in the portion of the aquifer being treated.

The "Q/V" term is a rate constant and requires knowing the volume of the aquifer. Where the pore volume is unknown, an equivalent expression for the "Q/V" term can be derived by assuming that one aquifer volume is removed during the average travel time along particle flow paths between injection and extraction well pairs. A macro-scale "Q" and "V" can be computed in terms of travel time (T) for a particle to travel between injection and extraction well, average groundwater velocity (v), porosity (p), distance or length of the aquifer (x), and cross-sectional area (A) as follows:

$$Q = A * v * p \qquad \text{(Equation 2)}$$

$$V = A * x * p \qquad \text{(Equation 3)}$$

The length (x) of the aquifer is related to velocity by the product of travel time (T) and velocity, or x = v * T; substituting for "x" in Equation 3):

$$V = A * v * p * T \qquad \text{(Equation 4)}$$

Then dividing Equation 2 by Equation 4, the cross-sectional area (A), porosity, and groundwater velocity (v) cancel out, and the macro-scale "Q/V" term reduces to the following:

$$Q/V = 1 / T \qquad \text{(Equation 5)}$$

Thus, using the average travel time (T) in years between injection and extraction wells (e.g., average of particle path time markers in Figure F-3 for the 100-K Area), the derived rate constant (i.e., 1 / T) can be substituted in Equation 1 to provide an approximation of chromium concentration versus pumping time.

A basic assumption in applying the above to 100-KR-4 OU pump-and-treat conditions is that the initial concentration (Co) is uniform in the aquifer being treated. This is a reasonable assumption for evaluation of pump-and-treat cleanup dynamics for at least some of the extraction wells. In reality, there are some higher concentrated regions in the aquifer, which could increase the concentration at an extraction well, but such an increase would not be due to new contaminant input from the vadose zone.

The application of Equations 1 through 5 is illustrated in Figures F-5 and F-6 (also in the lower right-hand corner of Figure 3-7 in the main text of this annual report). The predicted concentration over time shown in the figures uses an average travel time (T) of 3 years (from time markers on particle path lines) and a time decay constant (1 / T) from the best-fit of the data. For well 199-K-119A, the best-fit determined value of "T" is 3.308 years and 3.37 years for well 199-K-125A, which slightly larger than the 3 years and the two predicted curves with different time decay constants are shown in each figure. The observed data for the two extraction wells, 119-K-119A and 119-K-125A, are in reasonable agreement with the predicted concentration (the "R^2" value of fitted curves is around 0.96 for both best-fits). This suggests that the washout of cleanup of the aquifer treated by the theoretical capture zone for the two wells is occurring in an expected manner. Also, new contaminant input from vadose zone drainage or other sources must be minimal, otherwise a significant departure from the linear model would exist. The efficacy of many of the other extraction well pairs can be analyzed in a similar manner. Qualitatively, the time-concentration patterns of the more northeasterly pairs suggest much slower decline in chromium concentration because the travel times are much longer. This is also the case for extraction well 199-K-120A, which also has a highly concentrated plume before it. The path between injection and extraction wells would have to be shortened to increase the rate of decline.

In conclusion, it appears that the sluggish pump-and-treat system response for the northeast end of the network is more related to simple aquifer turnover dynamics than to additional new input. The significance of this hypothesis is that it may mean that efforts should be focused more on changing network configuration than on considering vadose zone treatment in the vicinity of the 100-KR-2 Trench.

F5.0 100-N AREA GROUNDWATER NUMERICAL MODELING

Numerical modeling is used to evaluate the hydraulic capture and containment achieved by the pump-and-treat system. The *N-Springs Expedited Response Action Performance Evaluation Report* (DOE-RL 1996a) recommended operating the pump-and-treat system at a combined flow rate of 244 L/min using wells 199-N-75, 199-N-103A, and 199-N-106A, with well 199-N-105A serving as a backup. This configuration of wells resulted in the greatest reduction of groundwater entering the river. The current model for evaluating the hydraulic capture of the pump-and-treat system used the same distribution of properties as the model and the capture analysis presented in the performance evaluation report (DOE-RL 1996a). Table F-3 shows a comparison of the modeled and measured water levels for November 2004. Even though extraction well 199-N-103A was down during November, it was included in the simulation because that is the normal operating condition.

Flow lines terminating at the extraction wells in Figure F-4 show the approximate area of the aquifer through which each extraction well removes groundwater. The flow lines indicate where a particle of water travels in the aquifer and whether the water is captured by the extraction wells or discharged into the river. Because the extraction wells fully penetrate the unconfined aquifer, the flow lines represent groundwater travel throughout the depth of the aquifer. The total area encompassed by the flow lines terminating at each extraction well represents the capture zone of that extraction well. The flow-line calculations are independent of the travel time, and as stated previously, the actual flow paths vary throughout the year. Because the purpose of the pump-and-treat system is to reduce discharge of contaminated groundwater to the Columbia River, the flow lines shown on the figures are only representative of the conditions during the time when groundwater flow toward the river would be greatest.

Figure F-4 also shows time markers spaced 1 year apart on the flow lines, based on the high November steady-state velocities. The northern-most flow line is located in a very high conductivity region of the 100-N Area, as the 1-year time markers are approximately 900 m apart on this flow line, which is equivalent to a pore velocity of about 2.5 m/day. The time markers in the center of the extraction well system shows much slower flow velocities of approximately

0.3 m/day (e.g., in front of extraction well 199-N-75). The effective porosity was set to a low value of 0.1, which also increases the calculated pore velocities.

The reduction in net groundwater flow to the river does not include the seasonal and diurnal effects of bank storage (i.e., the quantity of river water that enters into bank storage and then re-enters into the river). The capture model is based on an average steady-state river-stage elevation. Understanding the bank storage effects on strontium-90 transport is important because bank storage may result in a higher flux of strontium-90 to the river than is predicted by the flow and transport transient model (DOE-RL 1996a). River water flowing into the aquifer when the river is high equilibrates with adsorbed contaminants (e.g., strontium-90). When the river stage decreases, the bank storage transports the desorbed contaminants and discharges into the river. For an example of transient modeling in the 100-N Area, see the *Hanford 100-N Area Remediation Options Evaluation Summary Report* (DOE 2001).

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Figure F-1. Estimated Steady-State Hydraulic Capture Zone Development by 100-HR-3 Operable Unit, 100-D Area Extraction Wells and Nearby Flow Field.

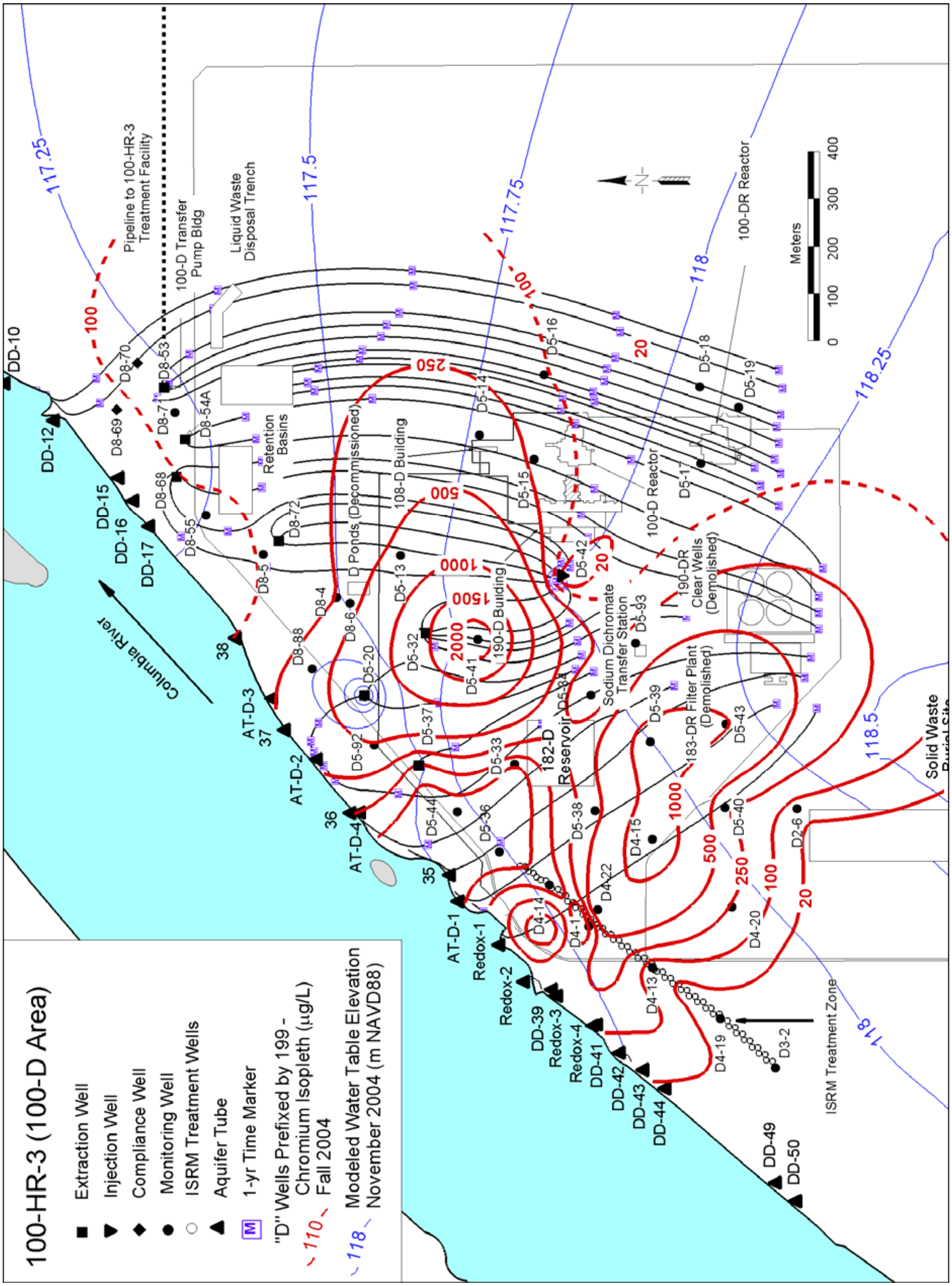

Figure F-2. Estimated Steady-State Hydraulic Capture Zone Developed by 100-HR-3 Operable Unit 100-H Area Extraction Wells and Nearby Flow Field.

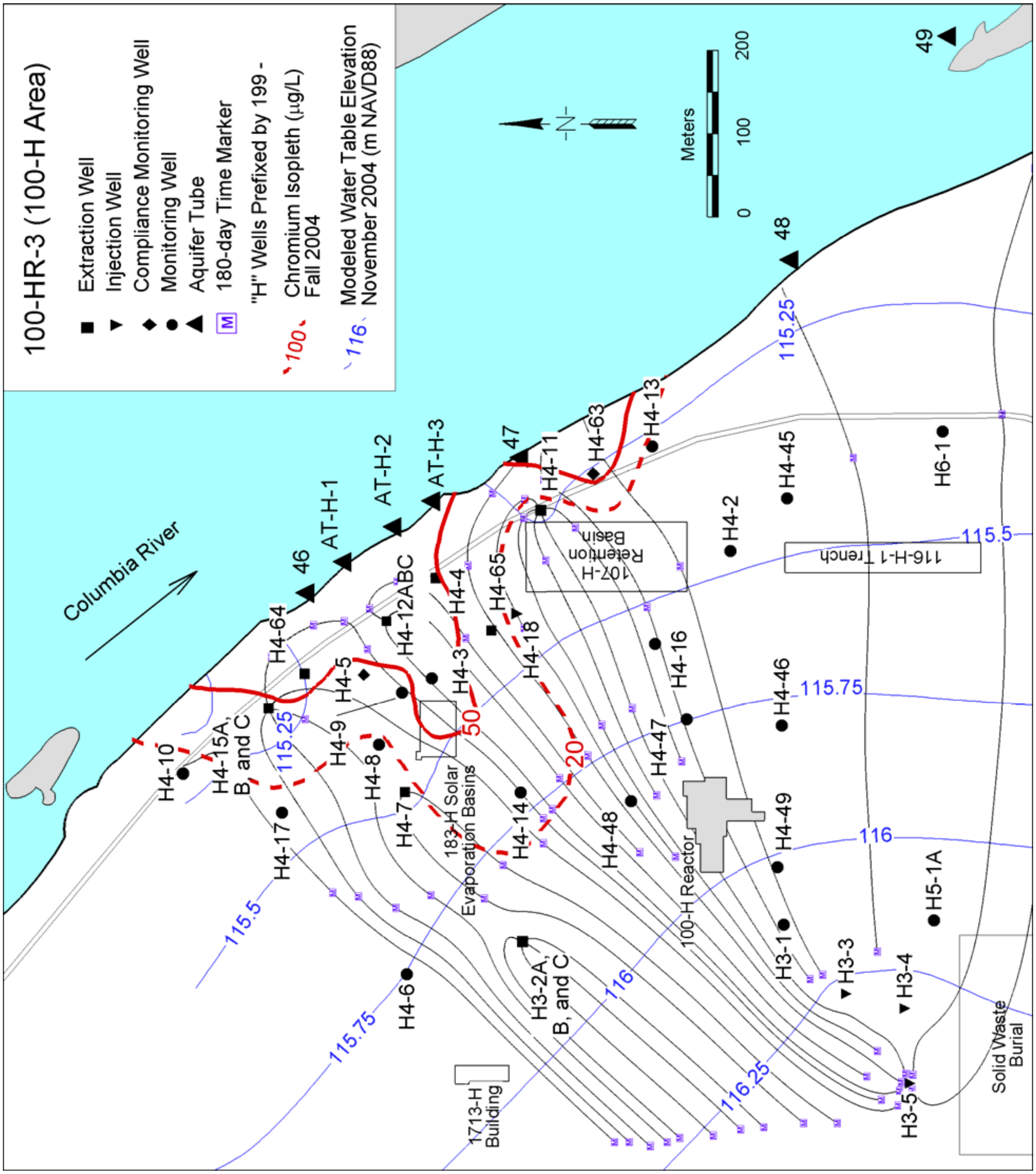

Figure F-3. Estimated Steady-State Hydraulic Capture Zone Developed by 100-KR-4 Operable Unit Extraction Wells and Nearby Flow Field.

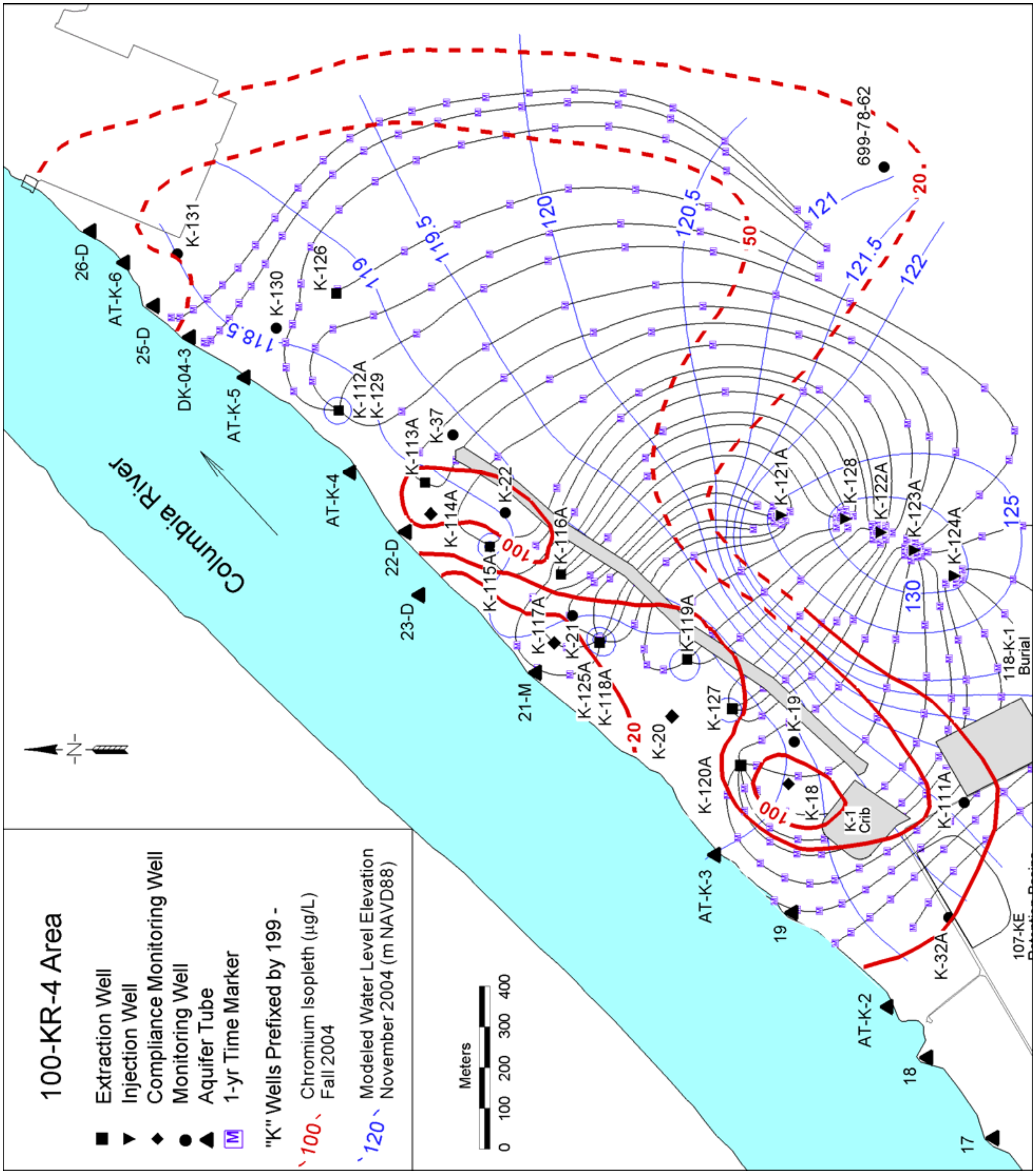

Figure F-4. Estimated Steady-State Hydraulic Capture Zone Developed by 100-NR-2 Operable Unit Extraction Wells and Nearby Flow Field.

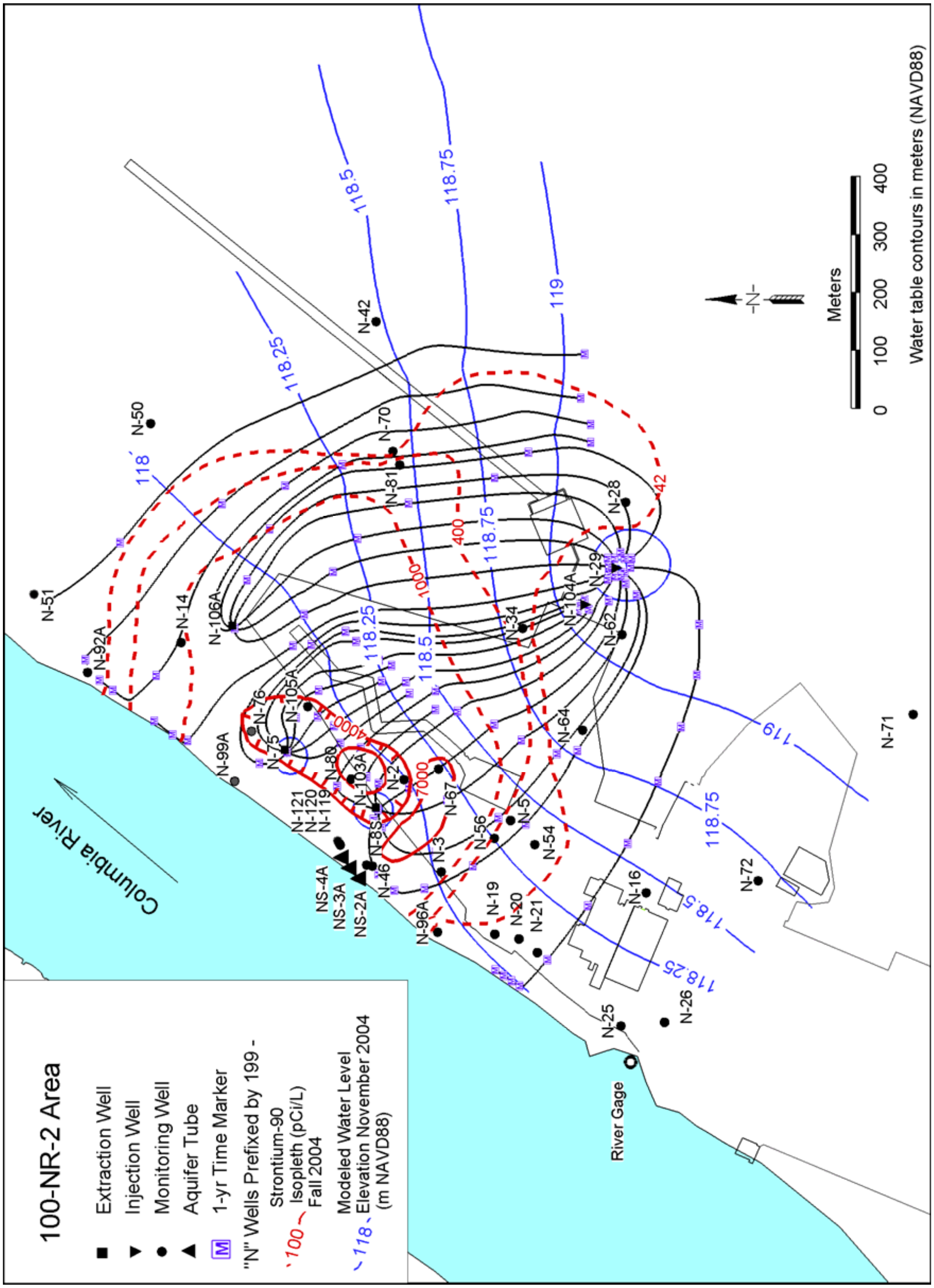

Figure F-5. Observed and Predicted Chromium Levels in Extraction Well 199-K-119A.

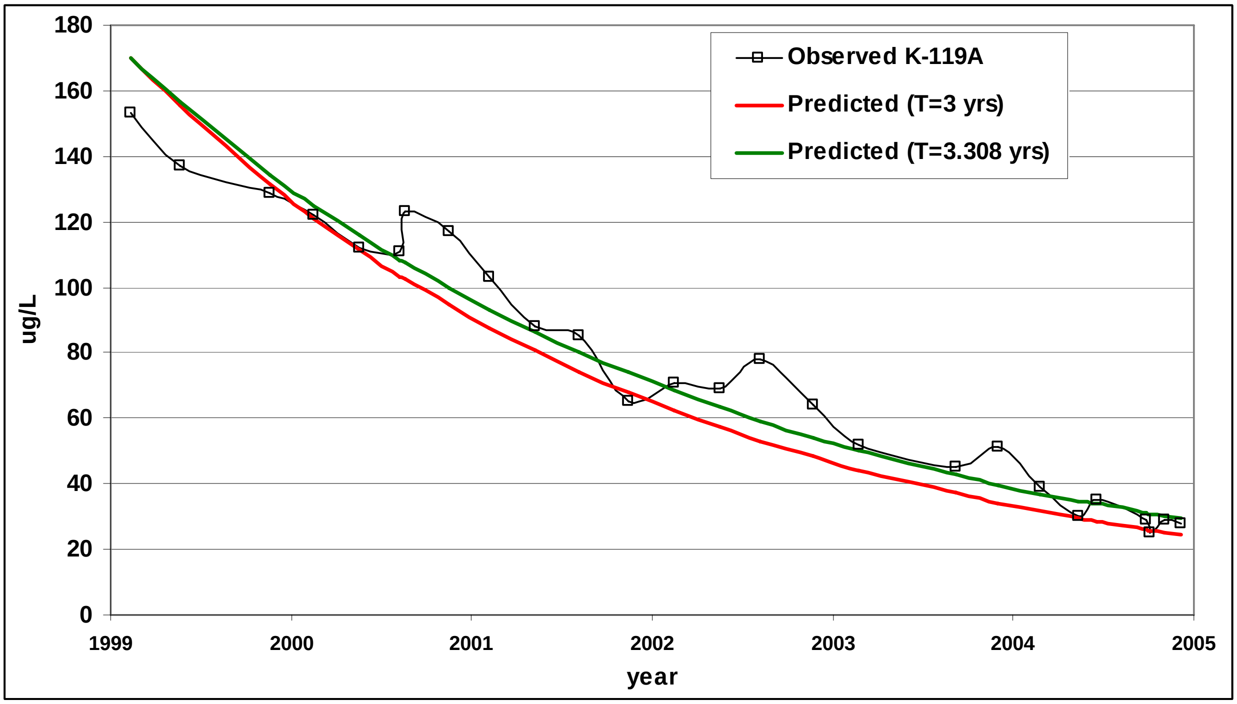

Figure F-6. Observed and Predicted Chromium Levels in Extraction Well 199-K-125A.

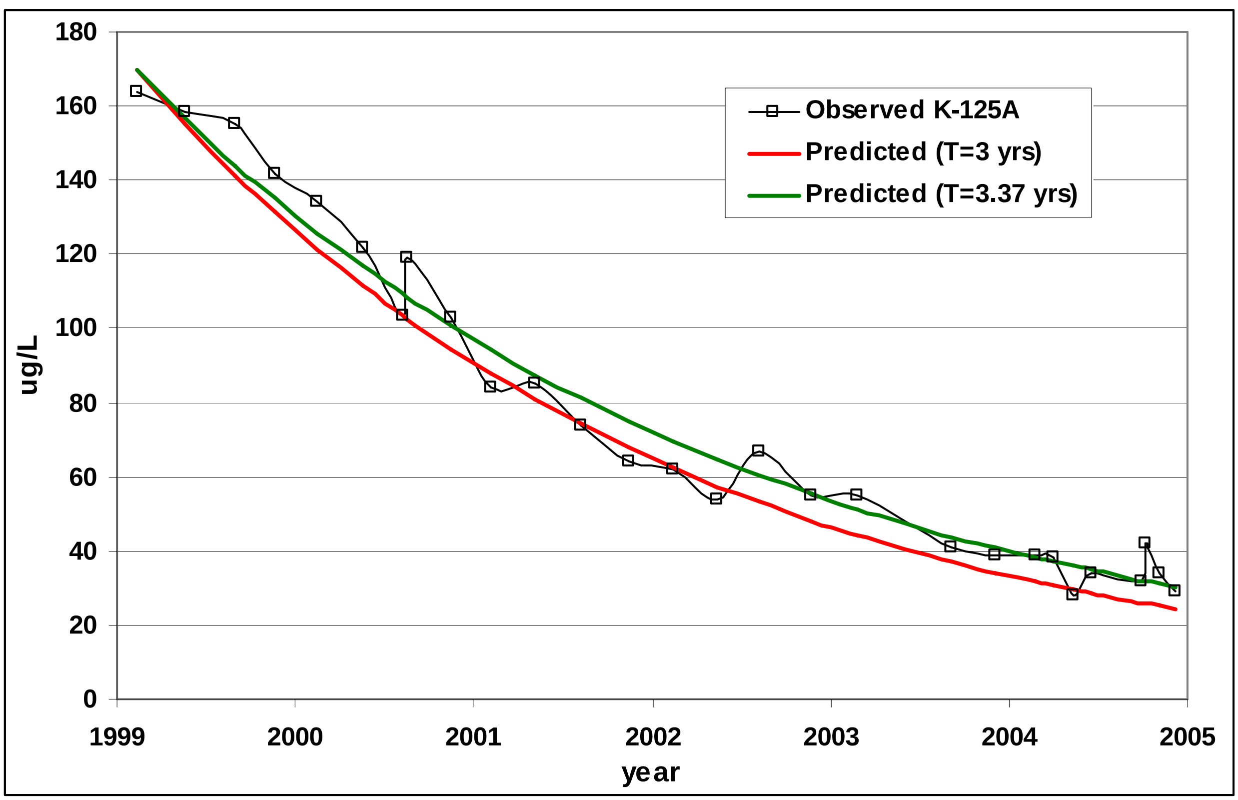

Table F-1. 100-HR-3 (100-H and 100-D Areas) Water-Level Data Used to Develop and Calibrate Numerical Groundwater Flow Models.

Well	Model Analysis. Nov. 2004		Measured Water-Level Elevation, Nov. 2004 (m NAVD88[a])	Modeled Water-Level Elevation, Nov. 2004 (m NAVD88[a])
	Extraction Rate, L/min	Injection Rate, L/min		
100-H Area				
199-H3-2A	90.8	—	115.75	115.73
199-H4-7	40.1	—	115.09	115.27
199-H4-11	51.5	—	113.42	115.19
199-H4-12A	31	—	114.35	115.23
199-H4-15A	58.3	—	114.35	115.18
199-H4-65	0	—	115.27	115.38
199-H3-3	—	136.3	116.13	116.32
199-H3-4	—	220.7	116.27	116.41
199-H3-5	—	207.4	116.72	116.49
199-H3-2B	—	—	115.75	115.94
199-H3-2C	—	—	115.74	115.94
199-H4-4	—	—	115.11	115.25
199-H4-5	—	—	115.15	115.31
199-H4-8	—	—	115.28	115.42
199-H4-10	—	—	115.20	115.39
199-H4-12B	—	—	115.11	115.24
199-H4-12C	—	—	115.10	115.24
199-H4-15B	—	—	115.20	115.26
199-H4-63	—	—	115.00	115.18
199-H4-64	—	—	115.15	115.27
199-H4-48	—	—	115.75	116.18
199-H5-1A	—	—	116.14	116.32
100-H river	—	—	115.17	115.17
100-D Area				
199-D8-53	68.5	—	115.32	117.17
199-D8-54A	92.4	—	115.43	117.15
199-D8-68	109	—	116.88	117.08
199-D8-72	81.4	—	117.88	117.19
D5-20	36	—	—	115.08
D5-32	109.8	—	—	117.32
D5-37	15.1	—	—	117.39
D5-42	—	160.9	120.23	118.18
199-D8-69	—	—	117.08	117.20
199-D8-70	—	—	117.09	117.23
199-D8-71	—	—	117.05	117.22
100-D river	—	—	117.52	117.52

[a] NAVD88, 1983, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland.

Table F-2. 100-KR-4 Water-Level Data Used to Develop and Calibrate Numerical Groundwater Flow Models.

Well	Model Analysis, Nov. 2004		Measured Water-Level Elevation, Nov. 2004 (m NAVD88[a])	Modeled Water-Level Elevation, Nov. 2004 (m NAVD88[a])
	Extraction Rate, L/min	Injection Rate, L/min		
199-K-112A	98.4	—	117.89	116.39
199-K-113A	56.8	—	116.62	116.31
199-K-115A	164.7	—	115.91	115.42
199-K-116A	170.3	—	118.42	118.64
199-K-119A	113.6	—	116.64	116.12
199-K-125A	151.4	—	118.28[off]	114.84[on]
199-K-126	60.6	—	119.20	118.12
199-K-127	132.5	—	117.00	116.51
199-K-120A	151.4	—	117.93	117.94
199-K-121A	—	200.6	121.44	132.36
199-K-122A	—	232.8	125.21	147.44
199-K-123A	—	249.8	129.87	150.71
199-K-124A	—	81.4	127.09	138.35
199-K-128	—	259.3	126.49	143.83
199-K-18	—	—	118.59	118.59
199-K-19	—	—	118.67	118.78
199-K-20	—	—	118.38	118.19
199-K-21	—	—	118.39	118.55
199-K-22	—	—	118.32	118.59
199-K-37	—	—	118.70	118.86
199-K-114A	—	—	118.97	118.38
199-K-117A	—	—	118.40	118.43
199-K-118A	—	—	117.30	117.17

[a] NAVD88, 1983, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland.

Table F-3. 100-NR-2 Water-Level Data Used to Develop and Calibrate Numerical Groundwater Flow Models.

Well	Extraction Rate, L/min	Injection Rate, L/min	Measured Elevation, Nov. 2004 (m NAVD88[a])	Modeled Elevation, Nov. 2004 (m NAVD88[a])
199-N-75	45.4	—	—	117.21
199-N-103A	53	—	118.00	117.11
199-N-105A	0	—	116.12	117.91
199-N-106A	107.9	—	117.02	117.80
199-N-104A	—	130.6	124.18	119.21
199-N-29	—	208.2	121.67	120.00
199-N-2	—	—	118.09	117.98
199-N-3	—	—	118.10	118.02
199-N-8S	—	—	117.90	117.88
199-N-14	—	—	117.81	117.88
199-N-16	—	—	118.41	118.44
199-N-34	—	—	118.96	118.83
199-N-50	—	—	118.01	118.03
199-N-72	—	—	118.69	118.70
199-N-76	—	—	117.67	117.85
199-N-92A	—	—	118.26	117.82
199-N-99	—	—	—	117.84

[a] NAVD88, 1983, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland.

APPENDIX G

CONTAMINANT MONITORING

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CONTENTS

TABLES

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APPENDIX G

CONTAMINANT MONITORING

The annual averages for contaminant monitoring discussed below were developed using data from the Hanford Environmental Information System database and were based on the following guidelines:

- Select filtered hexavalent chromium values first when present, followed by nonfiltered hexavalent chromium, then select filtered chromium values.
- Remove flagged suspect (Y) or rejected (R) values, use "U" qualified data when they are the only results available, and identify these results in the table.
- Duplicate sample results were averaged; laboratory splits were excluded.
- For the co-contaminants discussed below, select nonfiltered values.
- For radionuclides, include the total error for the annual comparison.
- Average the annual results after implementing criteria presented above. If radiological results are averaged, then average the total error.
- Short-term chromium concentrations and associated co-contaminant trends at individual wells were evaluated by comparing the calendar year 2003 (CY03) and CY04 annual averages. The short-term concentration trend was considered stable if the difference between CY03 and CY04 averages was less than 20%.
- The list of wells, analytes, and sampling schedule used in the development of the tables are defined in the *Revised FY2003 Sampling Schedule for Groundwater Remediation Monitoring* (FH 2002).

G1.0 100-HR-3 CONTAMINANT MONITORING

The historical trend plot of contaminants and co-contaminants for the 100-D and 100-H Areas is presented in Appendix J.

- **100-D chromium monitoring results:** Chromium is monitored in the 100-D Area in extraction wells, compliance wells, monitoring wells and aquifer tubes. The average annual chromium concentrations for 1997 through 2004 are presented in Table G-1.
- **100-D co-contaminant monitoring results:** The 100-D Area co-contaminants are strontium-90 and tritium (*Interim Action Monitoring Plan for the 100-HR-3 and 100-KR-4 Operable Units* [DOE-RL 1997]). Other contaminants of concern (COCs) include nitrate and sulfate. Table G-2 presents the average annual co-contaminant concentrations and short-term concentration trends (where they could be developed).
- **100-H chromium monitoring results:** Chromium is monitored in the 100-H Area in extraction wells, compliance wells, monitoring wells and aquifer tubes. Average annual chromium concentrations for 1997 through 2004 are presented in Table G-3.

- **100-H co-contaminant monitoring results:** The 100-H Area co-contaminants are strontium-90, technetium-99, tritium, uranium, and nitrate (DOE-RL 1997). A summary of 100-H Area co-contaminant results is provided in Table G-4.

G2.0 100-KR-4 CONTAMINANT MONITORING

The principal COC addressed by pump-and-treat operations in the 100-K Area is chromium. Co-contaminants relevant to pump-and-treat operations are tritium and strontium-90 (DOE-RL 1997). Nitrate and carbon-14 are contaminants of interest. The historical summary of 100-K Area contaminants and co-contaminants is presented in Appendix K.

- **100-K chromium monitoring results:** Chromium is monitored throughout the 100-K pump-and-treat area in extraction wells, compliance wells, monitoring wells and aquifer tubes. Additional *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) monitoring wells outside of the area influenced by pump-and-treat operations are also monitored for chromium. The average annual chromium concentrations for 1997 through 2004 are presented in Table G-5.
- **100-K co-contaminant monitoring results:** Strontium-90 and tritium are 100-K Area pump-and-treat co-contaminants. Nitrate and carbon-14 are 100-K contaminants of interest that are also monitored as part of the CERCLA sampling. A summary of 100-K co-contaminant results is presented in Table G-6.

G3.0 100-NR-2 CONTAMINANT MONITORING

The principal groundwater COCs in the 100-N Area are strontium-90, tritium, chromium, manganese, sulfate, and petroleum hydrocarbons. The major annual sampling event is in September and March. The governing document for sampling is the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 2003) Change Control Form, Control Number M-15-96-08, dated October 9, 1996.

The historical summary of 100-NR-2 contaminants and co-contaminants is presented in Appendix L.

- **100-NR-2 strontium-90 monitoring results:** Strontium-90 was monitored in extraction wells, monitoring wells and aquifer tubes during CY04. A summary of average strontium-90 concentrations since 1997 is presented in Table G-7.
- **100-NR-2 co-contaminant monitoring results:** Other COCs in the 100-N Area include tritium, chromium, manganese, nitrate, sulfate, and petroleum hydrocarbons (EPA et al. 1999). Table G-8 provides the average annual COC concentrations discussed below and the short-term concentration trends (where they could be developed) from 1997 to 2004.

G4.0 AQUIFER SAMPLING TUBE RESULTS

Samples for principal groundwater COCs and associated co-contaminants were collected in the various operable units (OUs) from aquifer sampling tubes at 100-NR-2, at 100-KR-4, at the 100-D Area, and at the 100-H Area for the 100-HR-3 OU in CY04. The results are presented separately by location, date sampled, sample results, and OU in Tables G-9 through G-12.

G5.0 REFERENCES

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Table G-1. Selected Chromium Data for 100-D Area Wells. (2 sheets)

Well Name	Well ID	CY97 Average (µg/L)	CY98 Average (µg/L)	CY99 Average (µg/L)	CY00 Average (µg/L)	CY01 Average (µg/L)	CY02 Average (µg/L)	CY03 Average (µg/L)	CY 04 Average (µg/L)	Annual Comparison[b]	Well Use
199-D5-13	A4570	412.7	311.2	379.2	436.8	641	717	759.5	701	Stable	M
199-D5-14	A4571	458	709.6	839	—	602	395	281	303	Stable	M
199-D5-15	A4572	777	644	150.2	72	193	244	281.5	559	Increasing	M
199-D5-16	A4573	648	410	313	251.5	204	136	120.8	98.6	Stable	M
199-D5-17	A4574	21.3	26.3	28	—	20.0	12	15.2	15.2[d]	Stable	M
199-D5-18	A4575	—	33.2	—	—	20.9	13	—	12.2[d]	c	M
199-D5-19	A4576	—	32	21.1	—	24.3	—	11.1	12.5[d]	Stable	M
199-D5-20	A4577	9.3	11	49	140.3	201	487	845.8	1,380	Increasing	M
199-D5-32	C4185	—	—	—	—	—	—	—	843	c	M
199-D5-33	C4186	—	—	—	—	—	—	—	5.0	c	M
199-D5-34	C4187	—	—	—	—	—	—	—	6.5	c	M
199-D5-36	B8744	—	—	—	—	—	—	—	6.6	c	M
199-D5-37	B8745	—	—	37.2	69.8	167	296	482.4	199	Decreasing	M
199-D5-38	B8747	—	—	—	—	—	—	—	134	c	M
199-D5-39	B8748	—	—	—	—	—	—	—	911	c	M
199-D5-40	B8749	—	—	—	—	—	—	—	207	c	M
199-D5-41	B8751	—	—	30	96.5	125	310	976.3	2,150	Increasing	M
199-D5-42	B8752	—	—	1.6(U)	5(U)	12	18	41.2	38.5	Stable	M
199-D5-43	B8753	—	—	—	—	—	—	—	1,270	c	M
199-D5-44	B8754	—	—	5(U)	5(U)	4(U)	5(U)	4.4(U)	8.0	Increasing	M
199-D5-92	C4583	—	—	—	—	—	—	—	486	c	M
199-D8-4	A4579	53.5	61.4	115.5	141	216	216	225	255	Stable	M
199-D8-5	A4580	70	145.7	273.2	—	422	268	205	140	Decreasing	M
199-D8-6	A4585	87.5	172	107	95.4	—	—	—	—	c	M
199-D8-53	A4581	89	185.2	100	131	—	101	124	76.0	Decreasing	E
199-D8-54A	A4582	112.9	277.9	115	233	248	95	134.7	47.0	Decreasing	E

Table G-1. Selected Chromium Data for 100-D Area Wells. (2 sheets)

Well Name	**Well ID**	**CY97 Average (µg/L)**	**CY98 Average (µg/L)**	**CY99 Average (µg/L)**	**CY00 Average (µg/L)**	**CY01 Average (µg/L)**	**CY02 Average (µg/L)**	**CY03 Average (µg/L)**	**CY 04 Average (µg/L)**	**Annual Comparison[b]**	**Well Use**
199-D8-54B	A4583	41.3	4	6.6	7.4	8	10	8.3	7.5	Stable	M
199-D8-55	A4584	15.2	—	26	61.5	116	102	25.3	11.8	Decreasing	M
199-D8-68	B2772	66.7	243	93.5	204	269	84	118.7	84.5	Decreasing	C/E
199-D8-69	B2773	47.9	98.9	69	92.3	141	58	69.9	69.5	Stable	C
199-D8-70	B2774	135.4	204.5	139	194.9	206	127	125.6	110.1	Stable	C
199-D8-71	B2812	248.5	232	177.5	226	235	212	172.5	188.0	Stable	M
199-D8-72	C3829	—	—	—	—	—	—	—	492.7	c	E
199-D8-73	C4517	—	—	—	—	—	—	—	178.0	c	M
699-96-49	A5358	—	37	41.8	40.5	—	33	—	24.5[d]	c	M
699-97-51A	A5362	31.5	42	41.8	44.4	47.6	34	35.9	33.8[d]	Stable	M

[a] Remedial action objective for compliance wells is two times the Washington State ambient water quality criteria, which is 11 µg/L for hexavalent chromium. Results are filtered hexavalent chromium, unless otherwise noted.

[b] Annual comparison is the percent difference between CY03 and CY04 (or the two most recent years) and is calculated by the following equation: (CY04 - CY03) / CY03 x 100%. Wells are considered stable if there is less than a 20% change in concentration from CY03 to CY04.

[c] Insufficient data available for comparison.

[d] Results are filtered total chromium (inductively coupled plasma).

C = compliance well
CY = calendar year
E = extraction well
ID = identification
M = monitoring well
— = well not sampled or analytical results not available for report preparation

Table G-2. 100-D Area Co-Contaminant Summary. (6 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
Strontium-90 (pCi/L)											
A4569	199-D5-12[b]	29.5 (±7.3)	34.6 (±6.4)	28.9 (±4.3)	—	—	—	—	—	c	M
A4570	199-D5-13	0.006(U) (±0.25)	—	—	—	—	—	—	—	c	M
A4571	199-D5-14	-0.1(U) (±0.2)	—	—	—	—	0.034(U) (±0.26)	—	—	c	M
A4572	199-D5-15	1.5(J) (±0.6)	—	—	—	1.9 (±0.8)	3.08 (±0.94)	4.87 (±1.0)	3.68 (±0.58)	Decreasing	M
A4573	199-D5-16	0.7(U) (±0.3)	—	—	—	0.32 (±0.34)	0.23(U) (±0.4)	0.40(U) (±0.35)	0.13(U) (±0.40)	Stable	M
A4574	199-D5-17	-0.15(U) (±0.23)	—	—	—	—	—	—	—	c	M
A4576	199-D5-19	—	0.9(J) (±0.34)	—	—	—	—	—	—	c	M
A4577	199-D5-20	0.1(U) (±0.2)	—	—	—	—	—	—	—	c	M
C4583	199-D5-92	—	—	—	—	—	—	—	-0.05(U) (±0.17)	c	M
B4579	199-D8-4	0.2(U) (±0.2)	—	—	—	—	—	—	—	c	M
A4580	199-D8-5	0.002(U) (±0.2)	—	—	—	—	—	—	—	c	M
A4581	199-D8-53	3.1(J) (±1.3)	4.9 (±1.2)	2.49 (±0.8)	4.1 (±0.7)	5.7 (±0.7)	3.64 (±0.355)	3.09 (±0.47)	5.00 (±1.5)	Increasing	E
A4582	199-D8-54A	2.97 (±1.2)	5.6 (±1.3)	2.52 (±1.3)	5.9 (±1.2)	6.8 (±0.9)	4.03 (±0.67)	4.5 (±0.76)	3.99 (±0.58)	Stable	E
A4583	199-D8-54B	-0.05(U)	—	—	—	—	—	—	—	c	M

Table G-2. 100-D Area Co-Contaminant Summary. (6 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
A4584	199-D8-55	1.2(J) (±0.5)	—	—	0.2(U) (±0.2)	0.02(U) (±0.02)	1.23 (±0.57)	0.643 (±0.28)	0.139(U) (±0.29)	Decreasing	M
B2772	199-D8-68	35.2 (±12.3)	11 (±2.3)	7.2 (±1.3)	9.6 (±1.8)	13.1 (±1.5)	6.82 (±1.3)	6.46 (±1.02)	4.91 (±0.65)	Decreasing	C/E
B2773	199-D8-69	0.8(J) (±0.4)	1.0(J) (±0.4)	0.7(J) (±0.2)	0.8(U) (±0.4)	0.8 (J) (±0.3)	0.715 (±0.37)	0.763 (±0.34)	0.799 (±0.30)	Stable	C
B2774	199-D8-70	0.8(J) (±0.5)	1.5(J) (±0.5)	2.1(J) (±0.8)	1.2(J) (±0.7)	—	1.93 (±0.61)	2.27 (±0.59)	2.23 (±0.40)	Stable	C
C3829	199-D8-72	—	—	—	—	—	0.008(U) (±0.23)	0.029(U) (±0.28)	2.0 (±1.2)	Increasing	E
C4517	199-D8-73	—	—	—	—	—	—	—	0.031(U) (±0.11)	c	M
C4536	199-D8-88	—	—	—	—	—	—	—	0.096(U) (±0.18)	c	M
Tritium (pCi/L)											
A4569	199-D5-12[b]	14,300 (±1,210)	32,800 (±2,570)	27,900 (±2,200)	—	—	—	—	—	c	None
A4570	199-D5-13	446 (±232)	415 (±229)	443 (±140)	—	1,313 (±160)	1,280 (±210)	2,110 (±210)	2,330 (±250)	Stable	M
A4571	199-D5-14	—	2,270 (±395)	6,000 (±660)	—	7,190 (±650)	8,270 (±480)	8,930 (±480)	10,200 (±460)	Stable	M
A4572	199-D5-15	250(U) (±213)	16,650 (±1638)	862 (±150)	—	6,775 (±1,100)	11,400 (±600)	8,890 (±470)	9,015 (±435)	Stable	M
A4573	199-D5-16	—	13,800 (±1,200)	14,300 (±1,500)	—	16,050 (±1,600)	13,800 (±680)	12,900 (±620)	11,600 (±480)	Stable	M
A4574	199-D5-17	12,900 (±1,106)	16,300 (±1,360)	14,300 (±1,500)	—	14,625 (±1,550)	14,600 (±710)	1,900 (±840)	—	c	M
A4575	199-D5-18	—	16,000 (±1,350)	—	—	14,700 (±1,500)	13,700 (±720)	—	15,700 (±560)	c	M
A4576	199-D5-19	—	—	11,600 (±1,200)	—	12,300 (±1,200)	—	13,100 (±630)	11,600 (±480)	Stable	M
A4577	199-D5-20	—	-81.7(U) (±206)	12.7(U) (±130)	—	1,860 (±120)	171(U) (±140)	70.4(U) (±105)	—	c	M

Table G-2. 100-D Area Co-Contaminant Summary. (6 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
B8744	199-D5-36	—	—	—	—	—	—	—	133(U) (±150)	c	M
B8745	199-D5-37	—	—	17.4(U) (±120)	22.4(U) (±110)	-53.4(U) (±110)	144(U) (±140)	60.4(U) (±110)	—	c	M
B8747	199-D5-38	—	—	—	—	—	—	—	41.8(U) (±130)	c	M
B8748	199-D5-39	—	—	—	—	—	—	—	239(U) (±160)	c	M
B8749	199-D5-40	—	—	—	—	—	—	—	881 (±190)	c	M
B8751	199-D5-41	—	—	—	—	—	—	—	-123(U) (±140)	c	M
B8752	199-D5-42	—	—	7.7(U) (±110)	131(U) (±100)	137(U) (±100)	-57.9(U) (±130)	102(U) (±110)	—	c	M
B8753	199-D5-43	—	—	—	—	—	—	—	465 (±160)	c	M
B8754	199-D5-44	—	—	12.5(U) (±110)	41.3(U) (±120)	121(U) (±120)	65.4 (±125)	34.1(U) (±110)	125(U) (±150)	Stable	M
C4583	199-D5-92	—	—	—	—	—	—	—	115(U) (±140)	c	M
B4579	199-D8-4	100.3(U) (±212)	61.4(U) (±210)	252(J) (±120)	117(U) (±97)	169(U) (±100)	237(U) (±150)	394 (±130)	385 (±110)	Stable	M
A4580	199-D8-5	115(U) (±209)	127(U) (±213)	249(J) (±120)	—	525(J) (±140)	340 (±160)	236(U) (±120)	—	c	M
A4581	199-D8-53	3,000 (±441)	6,455 (±752)	1,850 (±120)	5,210 (±695)	10,850 (±11,00)	5,115 (±570)	5,005 (±872)	1,200 (±300)	Decreasing	E
A4582	199-D8-54A	2,483 (±394)	8,600 (±1,046)	1,500 (±120)	6,710 (±861)	13,250 (±1,400)	5,400 (±600)	6,085 (±1,100)	6,240 (±320)	Stable	E
A4583	199-D8-54B	—	-35(U)	87.1(U)	7.3(U)	152(U) (±120)	-13.8(U) (±120)	106(U) (±110)	—	c	M
A4584	199-D8-55	—	—	—	14.6(U) (±91)	42.6(U) (±110)	160(U) (±140)	99.3(U) (±110)	-18.3(U) (±140)	Stable	M

Table G-2. 100-D Area Co-Contaminant Summary. (6 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
A4585	199-D8-6	169(U) (±216)	358(J) (±223)	—	—	—	—	—	—	c	M
B2772	199-D8-68	2,015 (±339)	6,935 (±725)	4,885 (±530)	7,610 (±815)	9,360 (±990)	2,755 (±285)	1,851 (±412)	120(U) (±60)	Decreasing	E/C
B2773	199-D8-69	2,620 (±380)	6,390 (±605)	3,750 (±420)	6,360 (±690)	9,360 (±990)	3,460 (±290)	3,260 (±260)	3,110 (±205)	Stable	C
B2774	199-D8-70	7,463 (±728)	11,875 (±1,010)	9,763 (±939)	11,900 (±1,200)	—	7,180 (±440)	7,120 (±410)	6,350 (±290)	Stable	C
B2812	199-D8-71	—	—	—	6,420 (±628)	—	—	—	—	c	M
C3829	199-D8-72	—	—	—	—	—	913 (±180)	1,072 (±235)	690 (±210)	Decreasing	E
C4517	199-D8-73	—	—	—	—	—	—	—	118(U) (±96)	c	M
C4537	199-D8-88	—	—	—	—	—	—	—	29.5(U) (±90)	c	M
Nitrate (mg/L)											
A4568	199-D2-6	—	—	—	—	—	—	—	52.2	c	M
B8750	199-D4-20	—	—	—	—	—	—	—	60.4	c	M
B8778	199-D4-22	—	—	—	—	—	—	—	44.3	c	M
A4569	199-D5-12[b]	90	95	—	—	—	—	—	—	c	M
A4570	199-D5-13	65	62	57	—	54	90	65.1	58.0	Stable	M
A4571	199-D5-14	60	58	63	—	59	66	63.5	67.7	Stable	M
A4572	199-D5-15	57	81	17	—	35	66	71.7	69.5	Stable	M
A4573	199-D5-16	64	69	87	—	72	80	74.4	70.8	Stable	M
A4574	199-D5-17	74	89	83	—	60	49	48.3	48.3	Stable	M
A4575	199-D5-18	—	91	—	—	74	83	—	58.4	c	M
A4576	199-D5-19	—	81	95	—	53	—	53.1	44.3	Stable	M
A4577	199-D5-20	13	18	21	—	22	25	25.2	16.4	Decreasing	M
C4186	199-D5-32	—	—	—	—	—	—	—	26.6	c	M
C4187	199-D5-33	—	—	—	—	—	—	—	1.86	c	M
C4237	199-D5-34	—	—	—	—	—	—	—	16.4	c	M
B8744	199-D5-36	—	—	—	—	—	—	—	3.74	c	M

Table G-2. 100-D Area Co-Contaminant Summary. (6 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
B8745	199-D5-37	—	—	15	14	14	15	11.5	7.08	Decreasing	M
B8747	199-D5-38	—	—	—	—	—	—	—	39.0	c	M
B8748	199-D5-39	—	—	—	—	—	—	—	25.2	c	M
B8749	199-D5-40	—	—	—	—	—	—	—	53.6	c	M
B8751	199-D5-41	—	—	—	—	—	—	—	24.3	c	M
B8752	199-D5-42	—	—	21	26	23	33	43.8	—	c	M
B8753	199-D5-43	—	—	—	—	—	—	—	47.0	c	M
B8754	199-D5-44	—	—	4	4	3	3.2	3.1	2.70	Stable	M
B4579	199-D8-4	41	45	84	86	90	94	46.9	57.5	Increasing	M
A4580	199-D8-5	10	25	38	—	42	32	26.1	19.0	Decreasing	M
A4581	199-D8-53	—	—	—	—	—	33.4	27.7	10.9	Decreasing	E
A4582	199-D8-54A	—	—	—	—	—	33.7	35.5	10.2	Decreasing	E
A4583	199-D8-54B	2	2	2	2	2	2	2	2.12	Stable	M
A4584	199-D8-55	7	—	—	10	18	18	3	1.77	Decreasing	M
A4585	199-D8-6	21	38	73	100	—	—	—	—	c	M
B2772	199-D8-68	—	—	—	57	48	19	15.3	12.3	Stable	E/C
B2774	199-D8-70	29	38	43	—	—	—	41.6	39.4	Stable	C
B2812	199-D8-71	—	—	44	—	—	—	—	—	c	M
C3829	199-D8-72	—	—	—	—	—	42.6	41.6	24.3	Decreasing	E
Sulfate (mg/L)											
A4568	199-D2-6	—	—	—	—	—	—	—	125	c	M
B8750	199-D4-20	—	—	—	—	—	—	—	137	c	M
B8778	199-D4-22	—	—	—	—	—	—	—	166	c	M
A4569	199-D5-12[b]	231	238	—	—	—	—	—	—	c	None
A4570	199-D5-13	102	94	99	—	104	121	108	98.8	Stable	M
A4571	199-D5-14	81	92	111	—	116	134	119.5	123	Stable	M
A4572	199-D5-15	97	158	33	—	72	122	125	110	Stable	M
A4573	199-D5-16	112	133	150	—	154	156	151	146	Stable	M
A4574	199-D5-17	147	92	99	—	101	96.8	109	110	Stable	M
A4575	199-D5-18	—	148	—	—	140	144	—	120	c	M
A4576	199-D5-19	—	171	183	—	142	—	131	124	Stable	M
A4577	199-D5-20	50	99	78	—	88	64	65.6	41.3	Decreasing	M

Table G-2. 100-D Area Co-Contaminant Summary. (6 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
C4186	199-D5-32	—	—	—	—	—	—	—	58.5	c	M
C4187	199-D5-33	—	—	—	—	—	—	—	12.5	c	M
C4237	199-D5-34	—	—	—	—	—	—	—	57.8	c	M
B8744	199-D5-36	—	—	—	—	—	—	—	15.5	c	M
B8745	199-D5-37	—	—	38	35	32	33	36.4	24.3	Decreasing	M
B8747	199-D5-38	—	—	—	—	—	—	—	78.3	c	M
B8748	199-D5-39	—	—	—	—	—	—	—	64.5	c	M
B8749	199-D5-40	—	—	—	—	—	—	—	102	c	M
B8751	199-D5-41	—	—	—	—	—	—	—	68.9	c	M
B8752	199-D5-42	—	—	74	71	78	69	78.7	176	Increasing	M
B8753	199-D5-43	—	—	—	—	—	—	—	110	c	M
B8754	199-D5-44	—	—	19	15	21	13	15.1	14.7	Stable	M
B4579	199-D8-4	76	88	114	118	101	137	90	106	Stable	M
A4580	199-D8-5	26	43	59	—	82	57	50.9	41.7	Stable	M
A4583	199-D8-54B	63	65	64	65.1	67	67	65.9	63.2	Stable	M
A4584	199-D8-55	19	—	—	23	38	31	11.4	10.6	Stable	M
A4585	199-D8-6	47	74	146	191	—	—	—	—	c	M
B2772	199-D8-68	—	—	—	130	135	58.6	58.1	59.6	Stable	E/C
B2774	199-D8-70	64	89	100	—	—	—	114	118	Stable	C
B2812	199-D8-71	—	—	83	—	—	—	—	—	c	M

[a] Annual comparison is the percent difference between CY03 and CY04 (or the two most recent years) and is calculated by the following equation: (CY04 - CY03) / CY03 x 100%. Wells are considered stable if there is less than a 20% change in concentration from CY03 to CY04.
[b] Well decommissioned.
[c] Insufficient data available for comparison.

C = compliance well
CY = calendar year
E = extraction well
ID = identification
J = estimated
M = monitoring well
U = undetected
— = well not sampled or analytical results not available for report preparation

Table G-3. Selected Chromium Data for 100-H Area Wells.[a] (2 sheets)

Well Name	Well ID	CY97 Average (µg/L)	CY98 Average (µg/L)	CY99 Average (µg/L)	CY00 Average (µg/L)	CY01 Average (µg/L)	CY02 Average (µg/L)	CY03 Average (µg/L)	CY04 Average (µg/L)	Annual Comparison[b]	Well Use
199-H3-1	A4610	76.6	—	—	—	—	—	—	—	c	M
199-H3-2A	A4612	59.1	12.3	10.3	8.6	13.1	15	8.4	9.00	Stable	E
199-H3-2C	A4613	76.5	15.8	16	8.9	16.9	9.2	10.3	—	c	M
199-H4-10	A4614	21.6	27.6	22.6	22.1	32	13.4	21.5	18.0	Decreasing	M
199-H4-11	A4615	75	102.5	55.8	49.4	33	28	33	21.5	Decreasing	E
199-H4-12A	A4616	56.5	103.4	31.1	65.0	47.1	34	54.9	39.0	Decreasing	E
199-H4-12B	A4617	89	98.5	58.3	71.3	83	30	56.3	55.4	Stable	M
199-H4-12C	A4618	213	174.4	192.8	152.0	139	148	121.5	132	Stable	M
199-H4-13	A4619	47.1	61.2	52.8	30.0	26	21	21.5	23.0	Stable	M
199-H4-14	A4620	170.5	278.6	146.3	112.8	62	37	64.8	39.8	Decreasing	M
199-H4-15A	A4621	49	62.5	49.6	55.1	57.1	43	56.3	40.0	Decreasing	E
199-H4-15B	A4622	55	57.5	50	50	57	30	40	36.0	Stable	M
199-H4-15CS	A4625	88.8	92.9	99	107	114	116	107	87.0	Stable	M
199-H4-16	A4626	71.0	48.4	22.9	10	11	15	9.5	6.00	Decreasing	M
199-H4-17	A4627	44	58.7	44	31.7	27	30	22	22.0	Stable	M
199-H4-18	A4628	109.6	151.2	109.5	28.5	47	32	19.5	13.0	Decreasing	M
199-H4-3	A4629	151.2	187.2	150.9	130	46	68	70	65.0	Stable	M
199-H4-4	A4630	53.8	156	51.6	68.8	75	32	37.1	43.7	Stable	C
199-H4-45	A4631	34.8	47	35.4	23.4	15	17	15	—	c	M
199-H4-46	A4632	45	31.1	21.8	11.2	15	19	12	8.00	Decreasing	M
199-H4-47	A4633	85.6	29.6	8.6	4.1(U)	7	3.4(U)	—	3.67(U)[d]	c	M
199-H4-48	A4634	101.9	71.7	18.5	9.8	11	10	11	6.49	Decreasing	M
199-H4-49	A4635	40.2	21	7.4	13.5	18	11	9	6.50	Decreasing	M
199-H4-5	A4636	77.7	132.6	88.2	71.7	71	61	67.2	55.1	Stable	C
199-H4-6	A4637	53.8	37.2	25.0	21.1	18	18	17	15.4	Stable	M
199-H4-63	B2776	47.3	73.7	59.6	57.8	51	36	45.2	48.7	Stable	C

Table G-3. Selected Chromium Data for 100-H Area Wells.[a] (2 sheets)

Well Name	Well ID	CY97 Average (µg/L)	CY98 Average (µg/L)	CY99 Average (µg/L)	CY00 Average (µg/L)	CY01 Average (µg/L)	CY02 Average (µg/L)	CY03 Average (µg/L)	CY04 Average (µg/L)	Annual Comparison[b]	Well Use
199-H4-64	B2777	32.9	59.6	37.0	43.2	68	37	51.9	54.7	Stable	C
199-H4-65	B8759	—	—	5(U)	60	—	—	—	—	c	E
199-H4-7	A4638	—	138.4	54.7	45.7	16.9	41.4	33.2	15.0	Decreasing	E
199-H4-8	A4639	116.5	81.3	58.5	41.8	19	50	26.5	16.0	Decreasing	M
199-H4-9	A4640	71	—	115	107	27	51	35.6	—	c	M
199-H5-1A	A4641	54.5	14.2	5.2	8.4	13	13	7.6	8.35	Stable	M
199-H6-1	A4642	38.8	37.6	39.6	37.7	22.4	19	21.3	19.7[d]	Stable	M
699-93-48A	A5356	14.6	—	13.2	—	14.6	—	12.8	—	c	M
699-96-43	A5357	82.9	104.5	—	104	98.4	85	—	—	c	M
699-96-49	A5358	—	—	—	—	—	—	—	24.5[d]	c	M
699-97-43	A5360	78.2	87.9	91.8	102	—	112	104	97.4[d]	c	M
699-97-51A	A5362	31.5	42	41.8	44.4	47.6	34	35.9	33.8[d]	Stable	M

[a] Remedial action objective for compliance wells is two times the Washington State ambient water quality criteria, which is 11 µg/L for hexavalent chromium. Results are filtered hexavalent chromium unless otherwise noted.

[b] Annual comparison is the percent difference between CY03 and CY04 (or two most recent years) and is calculated by the following equation: (CY04 - CY03) / CY03 x 100%. Wells are considered stable if there is less than a 20% change in concentration from CY03 to CY04.

[c] Insufficient data available for comparison.

[d] Results are filtered total chromium (inductively coupled plasma).

B = analyte detected at value less than the contract-required detection limit but greater than the instrument or method detection limit
C = compliance well
CY = calendar year
E = extraction well
ID = identification
M = monitoring well
U = undetected
— = well not sampled or analytical results not available for report preparation

Table G-4. 100-H Area Co-Contaminant Summary.[a] (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[b]	Well Use
Strontium-90 (pCi/L)											
A4612	199-H3-2A	0.11(U) (±0.18)	-0.06(U) (±0.37)	0.12(U) (±0.31)	-0.16(U) (±0.26)	-0.06(U) (±0.21)	-0.41(U)	0.198(U) (±0.27)	-0.5(U) (±0.5)	Stable	E
A4615	199-H4-11	24.30 (±1.2)	28.40 (±1.2)	21.75 (±1.4)	24.6 (±1.2)	27.8 (±1.0)	19.1 (±1.8)	25.6 (±2.9)	15.0 (±2.2)	Decreasing	E
A4616	199-H4-12A	0.74(J) (±0.25	25 (±1.2)	0.56(J) (±0.31)	0.24(U) (±0.3)	0.12(U) (±0.28)	0.09(U) (±0.19)	0.22(U) (±0.36)	1.0 (±0.6)	Increasing	E
A4621	199-H4-15A	0.03(U) (±0.18)	-0.06(U) (±0.37)	-0.13(U) (±0.29)	-0.12(U) (±0.26)	-0.10(U)	-0.03(U) (±0.10)	0.08(U) (±0.29)	-0.006(U) (±0.063)	Stable	E
A4626	199-H4-16	—	—	12.80 (±3.1)	6.03 (±1.5)	6.89 (±1.75)	9.64 (±2.2)	6.66 (±1.1)	4.77 (±0.51)	Decreasing	M
A4628	199-H4-18	3.78 (±0.96)	—	3.37 (±0.96)	3.92 (±1.11)	1.28 (±0.51)	2.2 (±0.69)	2.27 (±0.51)	1.64 (±0.48)	Decreasing	M
A4629	199-H4-3	—	—	1.00(U) (±1.03)	—	—	—	—	—	c	M
A4630	199-H4-4	10.80 (±4.72)	5.49 (±1.32)	5.21 (±1.28)	0.73(J) (±0.36)	1.96(J) (±0.93)	1.23 (±0.48)	2.34 (±0.49)	2.84 (±0.39)	Increasing	C
A4631	199-H4-45	—	19.30 (±3.73)	19.20 (±4.5)	18.50 (±4.3)	19.5 (±4.6)	18.2 (±4)	—	—	c	M
A4632	199-H4-46	—	—	2.47 (±0.76)	2.29 (±0.69)	3.21 (±0.93)	2.15 (±0.68)	—	2.16 (±0.38)	c	M
A4633	199-H4-47	—	0.19(U) (±0.26)	0.06(U) (±0.24)	0.10(U) (±0.16)	0.11(U) (±0.27)	0.048(U) (±0.24)	—	0.549 (±0.240)	c	M
A4636	199-H4-5	0.35(U) (±1.45)	0.04(U) (±0.22)	-0.08(U) (±0.27)	0.82(U) (±0.58)	0(U) (±2.9)	0.075(U) (±0.38)	0.21(U) (±0.2)	0.049(U) (±0.170)	Stable	C
B2776	199-H4-63	47.70 (±14.0)	47.60 (±8.51)	33.55 (±7.01)	38.00 (±5.0)	38.1 (±4.8)	20.2 (±4.4)	24.6 (±3.8)	38.8 (±1.3)	Increasing	C
B2777	199-H4-64	0.23(U) (±0.25)	0.12(U) (±0.27)	-0.05(U) (±1.3)	-0.16(U) (±2.02)	-0.12(U) (±0.32)	-0.066(U) (±0.38)	0.441 (±0.235)	0.113(U) (±0.250)	Decreasing	C

Table G-4. 100-H Area Co-Contaminant Summary.[a] (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[b]	Well Use
B8759	199-H4-65	—	—	—	3.6 (±0.5)	—	—	1.83	—	c	E
A4638	199-H4-7	0.32(U) (±0.28)	0.24(U) (±0.44)	0.06(U) (±0.10)	-0.09(U) (±0.28)	-0.12(U) (±0.23)	-0.011(U) (±0.11)	0.14(U) (±0.3)	-0.30(U) (±0.39)	Stable	E
A4642	199-H6-1	—	9.04 (±1.84)	9.47 (±2.3)	7.44 (±1.9)	8.94 (±2.3)	8.19 (±2)	9.26 (±1.5)	7.91 (±0.75)	Stable	M
Tritium (pCi/L)											
A4610	199-H3-1	8,870 (±829)	—	—	—	—	—	—	—	c	M
A4612	199-H3-2A	3,546 (±446)	3,482 (±420)	4,115 (±460)	3,435 (±395)	4,297 (±488)	4,775 (±447)	3,005 (±403)	2,545 (±340)	Stable	E
A4613	199-H3-2C	3,070 (±426)	1,410 (±299)	2,075 (±311)	587 (±240)	-69(U) (±110)	734 (±160)	29.2(U) (±120)	51.6(U) (±91.0)	Stable	M
A4614	199-H4-10	799 (±247)	3,190 (±365)	2,230 (±270)	1,630 (±240)	3,270 (±380)	972 (±180)	1,570 (±200)	876 (±130)	Decreasing	M
A4615	199-H4-11	1,275 (±288)	3,105 (±403)	1,780 (±240)	1,420 (±307)	3,520 (±420)	1,505 (±230)	2,680 (±460)	500 (±150)	Decreasing	E
A4616	199-H4-12A	1,610 (±301)	1,605 (±275)	447 (±140)	1,498 (±222)	2,620 (±330)	978 (±190)	1,980 (±370)	54(U) (±32)	Decreasing	E
A4618	199-H4-12C	200(U) (±209)	40(U) (±208)	80(U) (±98)	31(U) (±110)	37(U) (±120)	64(U) (±130)	59.2(U) (±120)	34.9(U) (±95.0)	Stable	M
A4619	199-H4-13	1,380 (±255)	4,570 (±470)	3,660 (±430)	3,610 (±410)	1,570 (±275)	1,840 (±220)	2,000 (±210)	1,115 (±145)	Decreasing	M
A4620	199-H4-14	—	3,570 (±438)	—	3,590 (±400)	—	4,110 (±320)	—	3,110 (±210)	c	M
A4621	199-H4-15A	1,157 (±279)	1,855 (±291)	2,460 (±310)	2,135 (±277)	2,220 (±320)	1,650 (±235)	1,980 (±370)	910 (±230)	Decreasing	E
A4626	199-H4-16	—	6,630 (±623)	—	2,260 (±290)	—	3,290 (±280)	—	969 (±140)	c	M

Table G-4. 100-H Area Co-Contaminant Summary.[a] (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[b]	Well Use
A4627	199-H4-17	—	3,600 (±397)	—	3,410 (±421)	—	3,370 (±280)	—	2,200 (±180)	c	M
A4628	199-H4-18	2,810 (±389)	3,770 (±472)	3,795 (±436)	3,450 (±400)	3,540 (±400)	3,630 (±290)	3,120 (±280)	2,730 (±200)	Stable	M
A4629	199-H4-3	2,630 (±377)	2,640 (±392)	3,005 (±387)	3,390 (±380)	3,210 (±370)	3,180 (±280)	3,000 (±270)	2,610 (±190)	Stable	M
A4630	199-H4-4	1,770 (±310)	2,280 (±329)	1,612 (±271)	2,070 (±270)	1,930 (±260)	810 (±170)	1,480 (±200)	1,420 (±160)	Stable	C
A4631	199-H4-45	2,490 (±366)	5,400 (±589)	5,440 (±590)	4,710 (±530)	4,550 (±510)	3,470 (±290)	—	—	c	M
A4632	199-H4-46	—	6,370 (±659)	—	3,995 (±459)	—	4,470 (±330)	—	3,420 (±220)	c	M
A4633	199-H4-47	4,200 (±490)	5,460 (±576)	2,395 (±335)	—	1,060 (±180)	—	—	462 (±120)	c	M
A4634	199-H4-48	6,110 (±628)	—	4,450 (±480)	—	5,650 (±620)	—	2,990 (±270)	—	c	M
A4635	199-H4-49	9,130 (±843)	—	3,860 (±450)	—	6,430 (±700)	—	—	3,570 (±230)	c	M
A4636	199-H4-5	2,590 (±374)	2,790 (±393)	2,630 (±300)	2,900 (±350)	2,790 (±340)	2,120 (±245)	2,945 (±250)	2,370 (±190)	Stable	C
A4637	199-H4-6	—	4,490 (±464)	—	3,780 (±440)	—	4,240 (±320)	—	2,795 (±200)	c	M
B2776	199-H4-63	1,390 (±288)	3,150 (±362)	3,130 (±350)	3,020 (±350)	2,380 (±300)	244(U) (±140)	388 (±170)	1,630 (±160)	Increasing	C
B2777	199-H4-64	1,750 (±313)	2,700 (±328)	1,860 (±240)	2,200 (±290)	1,690 (±240)	1,240 (±190)	1,385 (±195)	1,320 (±150)	Stable	C
B8759	199-H4-65	—	—	—	3,780 (±440)	—	—	4,090 (±460)	—	c	E

Table G-4. 100-H Area Co-Contaminant Summary.[a] (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[b]	Well Use
A4638	199-H4-7	3,040 (±418)	3,205 (±407)	3,260 (±390)	3,450 (±400)	3,390 (±380)	4,000 (±436)	3,705 (±580)	2,400 (±500)	Decreasing	E
A4639	199-H4-8	—	3,070 (±422)	—	3,450 (±400)	—	2,980 (±270)	—	2,720 (±200)	c	M
A4640	199-H4-9	2,100 (±337)	—	2,720 (±320)	—	3,170 (±370)	—	2,600 (±230)	—	c	M
A4641	199-H5-1A	7,400 (±720)	—	3,020 (±350)	—	6,420 (±690)	—	2,390 (±230)	—	c	M
A4642	199-H6-1	4,030 (±477)	5,890 (±624)	5,580 (±620)	5,740 (±610)	4,740 (±530)	4,110 (±320)	3,720 (±280)	3,030 (±200)	Stable	M
A5356	699-93-48A	—	—	1,500 (±210)	—	980 (±180)	—	852	—	c	M
A5357	699-96-43	—	8,370 (±802)	—	—	7,440 (±790)	6,210 (±430)	—	—	c	M
A5358	699-96-49	—	—	—	—	—	—	—	1,920 (±180)	c	M
A5360	699-97-43	5,510 (±585)	5,270 (±561)	5,543 (±572)	5,880 (±570)	6,470 (±700)	5,460 (±390)	—	5,160 (±260)	c	M
A5362	699-97-51A	—	—	—	—	—	—	—	2,170 (±180)	c	M
Nitrate (mg/L)											
A4612	199-H3-2A	27	43	36	35	41	37	31	31	Stable	E
A4613	199-H3-2C	24	15	22	8	3	10	3	2.9	Stable	M
A4614	199-H4-10	15	34	22	16	30	10	18	10	Decreasing	M
A4615	199-H4-11	51	40	26	30	38	21	37	16	Decreasing	E
A4616	199-H4-12A	136	92	32	55	51	33	68	33	Decreasing	E
A4618	199-H4-12C	7	6	6	5.4	5	5	4.9	4.4	Stable	M
A4619	199-H4-13	57	46	58	39	41	44	38	33	Stable	M
A4620	199-H4-14	—	36	44	35	36	43	35	30	Stable	M

Table G-4. 100-H Area Co-Contaminant Summary.[a] (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[b]	Well Use
A4621	199-H4-15A	23	24	29	27	27	19	23	20	Stable	E
A4626	199-H4-16	—	57	46	23	27	44	23	17	Decreasing	M
A4627	199-H4-17	—	38	—	41	—	42	—	33	c	M
A4628	199-H4-18	102	47	51	40	38	44	38	35	Stable	M
A4629	199-H4-3	437	100	380	120	87	25	192	240	Increasing	M
A4630	199-H4-4	131	242	142	78	69	19	35	92	Increasing	C
A4631	199-H4-45	45	59	60	46	40	44	—	—	c	M
A4632	199-H4-46	—	54	53	40	41	53	—	42	c	M
A4633	199-H4-47	38	54	23	6	10	12	—	6.0	c	M
A4634	199-H4-48	40	42	40	17	42	40	30	32	Stable	M
A4635	199-H4-49	54	—	27	77	42	33	—	33	c	M
A4636	199-H4-5	—	59	58	44	42	57	44	34	Decreasing	C
A4637	199-H4-6	30	46	—	41	—	42	—	31	c	M
B2776	199-H4-63	74	38	51	37	37	10	14	34	Increasing	C
B2777	199-H4-64	50	37	40	35	27	23	22	24	Stable	C
B8759	199-H4-65	—	—	—	82	—	—	46	—	c	E
A4638	199-H4-7	—	42	44	44	42	51	50	44	Stable	E
A4639	199-H4-8	—	47	—	44	—	80	—	33	c	M
A4640	199-H4-9	—	—	190	—	—	474	112	130	Stable	M
A4641	199-H5-1A	31	39	26	33	42	37	46	27	Decreasing	M
A4642	199-H6-1	48	64	65	58	46	45	—	43	c	M
A5356	699-93-48A	88	—	16	—	16	—	15	—	c	M
A5358	699-96-49	—	—	—	—	—	—	—	15.9	c	M
A5360	699-97-43	24	33	31	30	26	26	—	19	c	M
A5362	699-97-51A	—	—	—	—	—	—	—	20.8	c	M

Table G-4. 100-H Area Co-Contaminant Summary.[a] (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[b]	Well Use
Technetium-99 (pCi/L)											
A4612	199-H3-2A	1.66(U) (±8.15)	2.98(U) (±14.4)	30.30 (±5.9)	39.8 (±3.7)	2.09(U) (±3.8)	2.51(U) (±86.1)	2.74(U) (±2.5)	-5.50(U) (±5.50)	Stable	E
A4613	199-H3-2C	3.98(U) (±16.1)	-0.72(U) (±15.3)	—	—	—	—	—	—	c	M
A4615	199-H4-11	53.80 (±16.3)	41.77 (±16.6)	35.0 (±7.5)	36.6 (±9.8)	9.17(J) (±3.6)	11.1 (J) (±7.5)	9.96 (±2.6)	4.00 (±2.00)	Decreasing	E
A4616	199-H4-12A	508 (±70.1)	241.5 (±37.3)	82.2 (±16.8)	124.4 (±19.4)	90.1 (±14.7)	52.1 (±10.6)	140.8 (±23)	129 (±7.10)	Stable	E
A4618	199-H4-12C	2.64(U) (±8.2)	2.5(U) (±17.2)	-2.10(U) (±12)	-5.1(U) (±12)	4.26(U) (±7.2)	4.46(U) (±8.6)	-0.38(U) (±5.3)	-0.069(U) (±3.50)	Stable	M
A4621	199-H4-15A	4.87(U) (±13)	3.3(U) (±15.3)	28.2 (±5.3)	29.6 (±8.4)	1.58(U) (±4.1)	2.64(U) (±5.9)	3.22(U) (±4.3)	-2.84(U) (±3.80)	Stable	E
A4628	199-H4-18	143.06 (±21.7)	11.0(U) (±17.9)	27.8(J) (±13.5)	11.8(J) (±12)	9.3(U) (±7.5)	14 (±8.8)	5.33(U) (±5.6)	(4.49U) (±3.70)	Stable	M
A4629	199-H4-3	1,376 (±160)	187 (±34.4)	1,070 (±89)	272 (±34)	243 (±21)	321 (±28)	48 (±55)	694 (±14.0)	Increasing	M
A4630	199-H4-4	604 (±63.5)	652.0 (±84)	511 (±58.8)	471 (±50)	131.5 (±19.3)	26.6 (±9.1)	65.6 (±11)	200 (±8.45)	Increasing	C
A4636	199-H4-5	1,130 (±120)	90.2 (±23.4)	60.15 (±12)	33.4 (±5)	27.1 (±5)	70.7 (±12)	24 (±6.7)	14.9 (±4.20)	Decreasing	C
A4637	199-H4-6	0.08(U) (±4.33)	—	—	—	—	—	—	—	c	M
B2776	199-H4-63	30.1 (±18.8)	6.1(U) (±16.5)	13.1(J) (±18)	6.14(U) (±5.8)	7.36(U) (±8.7)	-1.49(U) (±8.4)	1.78(U) (±5.5)	5.12(U) (±3.90)	Stable	C
B2777	199-H4-64	7.81(U) (±17)	1.88(U) (±17)	-4.66(U) (±12.4)	-0.91(U) (±3.1)	-0.52(U) (±2.9)	1.56(U) (±8.3)	2.05(U) (±5.5)	2.26(U) (±4.20)	Stable	C
B8759	199-H4-65	—	—	—	166 (±22)	—	—	16 (±3.1)	—	c	E
A4638	199-H4-7	2,080 (±210)	35.3 (±19.2)	34.6 (±5.6)	65 (±17)	10(U) (±6.6)	54.88 (±11.4)	26.03 (±5.17)	27.6 (±5.85)	Stable	E
A4640	199-H4-9	68.9 (±13)	—	616 (±55)	198 (±27)	—	986 (±70)	169 (±16)	315 (±10.4)	Increasing	M

Table G-4. 100-H Area Co-Contaminant Summary.[a] (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[b]	Well Use
Uranium (µg/L)											
A4612	199-H3-2A	4.05	3.31	1.95	—	1.52	1	1.45	1.10	Decreasing	E
A4615	199-H4-11	8.54	9.62	6.12	6.03	5.43	3.2	4.74	2.69	Decreasing	E
A4616	199-H4-12A	20.42	20.45	5.38	20	13.33	5.6	19.49	6.77	Decreasing	E
A4618	199-H4-12C	1.64	1.67	1.64	1.25	1.67	1.2	1.31	1.74	Increasing	M
A4621	199-H4-15A	1.67	2.48	2.18	2.16	2.8	1.3	1.60	1.47	Stable	E
A4628	199-H4-18	18.35	7.33	7.33	4.96	3.55	3.6	2.72	3.24	Stable	M
A4629	199-H4-3	126.8	21.3	157	49.3	21.5	119	54.3	93.5	Increasing	M
A4630	199-H4-4	29.9	55.55	29.38	22.98	33.35	8.3	12.18	24.7	Increasing	C
A4636	199-H4-5	27.10	11.10	7.46	5.41	4.42	4.4	4.88	3.92	Stable	C
A4637	199-H4-6	9.14	—	—	—	—	—	—	—	c	M
B2776	199-H4-63	5.27	4.85	5.60	4.82	3.64	1.6	2.1	4.16	Increasing	C
B2777	199-H4-64	2.83	2.96	2.42	2.77	2.49	1.4	1.44	1.57	Stable	C
A4638	199-H4-7	106	5.22	3.88	3.26	2.64	3.3	3.00	2.46	Stable	E
A4640	199-H4-9	9.34	—	25.3	13.3	—	54	14.8	15.8	Stable	M

[a] Remedial action objective for compliance wells is two times the Washington State ambient water quality criteria, which is 11 µg/L for hexavalent chromium.
[b] Annual comparison is the percent difference between CY03 and CY04 (or the two most recent years) and is calculated by the following equation: (CY04 - CY03) / CY03 x 100%. Wells are considered stable if there is less than a 20% change in concentration from CY03 to CY04.
[c] Insufficient data available for comparison.

C = compliance well
CY = calendar year
E = extraction well
ID = identification
J = estimated
M = monitoring well
U = undetected
— = well not sampled or analytical results not available for report preparation

Table G-5. Summary of Hexavalent Chromium Concentrations and Trends Within 100-K Area Wells.[a] (2 sheets)

Well Name	Well ID	CY97 Average (µg/L)	CY98 Average (µg/L)	CY99 Average (µg/L)	CY00 Average (µg/L)	CY01 Average (µg/L)	CY02 Average (µg/L)	CY03 Average (µg/L)	CY04 Average (µg/L)	Annual Comparison[b]	Well Use
199-K-18	A4647	36.4	39.9	70	81.7	103	112.3	123.8	136.3	Stable	C
199-K-19	A4648	47.4	70	89	91	71	82.5	78.5	66.5	Stable	M
199-K-20	A4649	103.9	99.5	115	107.4	92	88.9	68.8	54.8	Decreasing	C
199-K-21	A4650	75.5	66.5	71	31.5	9	34.0	38	25.7	Decreasing	M
199-K-22	A4651	130	120	158	159	110	147.7	140	128.5	Stable	M
199-K-23	A4652	—	48.1	—	10.5	51	47.8[d]	18.1[d]	—	c	M
199-K-31	A4656	12.4	10.6	12	15	—	10.6[d]	—	11.4[d]	c	M
199-K-32A	A4657	35.6	31.4	28	22.6	12.7	15.5[d]	12.4[d]	20.5[d]	Increasing	M
199-K-33	A4659	21.7	25.8	17	17.2	9.3	13[d]	—	—	c	M
199-K-34	A4660	—	14.8	—	44.4	71	16.5[d]	13.5[d]	12.0[d]	Stable	M
199-K-35	A4661	—	12.8	—	16.8	—	11.8[d]	5.6[d]	9.90[d]	Increasing	M
199-K-36	A4662	18.5	109	102	244	1,050	497.3	105.5	51.0	Decreasing	M
199-K-37	A4663	88.4	56.6	71	68	66	64.0	73	84.0	Increasing	M
199-K-107A	A9843	197.2	319.7	506	425.5	360	636.3	524.3	530.0	Stable	M
199-K-108A	A9844	113.1	200.7	200	7	4	8.0	4.9(U)	11.7	Increasing	M
199-K-112A	B2799	63.3	82.9	98	95.7	90	57.7	71	—	c	E
199-K-113A	B2800	57.7	84.6	72	80.4	77.3	43.0	68.2	51.0	Decreasing	E
199-K-114A	B2801	86	107.2	64	100.7	105.5	49.4	66.5	65.4	Stable	C
199-K-115A	B2802	93.6	136	122	128.1	153.9	98.3	107.7	83.0	Decreasing	E
199-K-116A	B2803	159.3	179	187	179.4	166.1	125.8	122.5	80.7	Decreasing	E
199-K-117A	B2804	115.4	113.2	32	44.2	41	16.3	9.7	7.1	Decreasing	C
199-K-119A	B2806	122.5	15,706	146	111.4	85.6	70.5	49.8	37.0	Decreasing	E
199-K-120A	B2807	60.4	97.7	105	97.3	80.1	77.8	77	71.5	Stable	E
199-K-125A	B8559	—	165.8	157	115.5	81.4	59.5	45	37.0	Stable	E
199-K-126	B8560	—	—	56	83.9	112.2	97.7	105	93.5	Stable	C/E

Table G-5. Summary of Hexavalent Chromium Concentrations and Trends Within 100-K Area Wells.[a] (2 sheets)

Well Name	Well ID	CY97 Average (µg/L)	CY98 Average (µg/L)	CY99 Average (µg/L)	CY00 Average (µg/L)	CY01 Average (µg/L)	CY02 Average (µg/L)	CY03 Average (µg/L)	CY04 Average (µg/L)	Annual Comparison[b]	Well Use
199-K-127	C3662	—	—	—	—	—	74.4	66	54.5	Stable	E
199-K-129	C4117	—	—	—	—	—	—	67.5	52.5	Decreasing	C
199-K-130	C4120	—	—	—	—	—	—	60.2	92.9	Increasing	M
199-K-131	C4561	—	—	—	—	—	—	—	63.0	c	M
699-78-62	A5332	39.4	—	—	—	—	—	36.4	—	c	M

[a] Remedial action objective for compliance wells is two times the Washington State ambient water quality criteria, which is 11 µg/L for hexavalent chromium. Results are filtered hexavalent chromium unless otherwise noted.

[b] Annual comparison is the percent difference between CY03 and CY04 (or the two most recent years) and is calculated by the following equation: (CY04 - CY03) / CY03 x 100%. Wells are considered stable if there is less than a 20% change in concentration from CY03 to CY04.

[c] Insufficient data available for comparison.

[d] Results are filtered total chromium (inductively coupled plasma).

C = compliance well
CY = calendar year
E = extraction well
ID = identification
M = monitoring well
— = well not sampled or analytical results not available for report preparation

Table G-6. 100-K Area Co-Contaminant Summary. (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
Strontium-90 (pCi/L)											
199-K-18	A4647	0.31(U) (±0.5)	0.13(U) (±0.2)	-0.11(U) (±0.5)	-0.18(U) (±0.5)	0.251(U) (±0.7)	-0.14(U) (±0.37)	0.17(U) (±0.21)	0.20(U) (±0.32)	Stable	C
199-K-19	A6468	—	—	—	—	—	—	—	10.3 (±0.83)	b	M
199-K-20	A4649	18.10 (±1.24)	22.60 (±1.48)	16.55 (±0.83)	8.62 (±0.51)	9.01 (±1.0)	8.42 (±2)	6.4 (±1.1)	5.8 (±0.56)	Stable	C
199-K-21	A4650	—	—	46.8 (±9.73)	38.6 (±9.1)	—	39.59 (±8.4)	—	39.2 (±1.4)	b	M
199-K-22	A4651	—	8.19 (±1.76)	9.24 (±2.3)	7.45 (±1.8)	5.65 (±1.5)	7.87 (±1.9)	7.12 (±1.2)	8.9 (±0.76)	Increasing	M
199-K-23	A4652	0.11(U) (±0.26)	0.25(U) (±0.35)	—	0.02(U) (±0.21)	—	—	—	—	b	M
199-K-27	A4653	—	—	—	—	—	—	—	0.5 (±0.21)	b	M
199-K-30	A4655	-0.57(U) (±0.91)	—	0.08(U) (±0.17)	0.27(U) (±0.71)	0.33(U) (±2.0)	0.35(U) (±0.98)	1.34(U) (±1.1)	0.7 (±0.365)	Stable	M
199-K-32A	A4657	1.64(J) (±0.51)	2.14 (±0.64)	1.80(J) (±0.60)	1.74(J) (±0.58)	—	—	—	—	b	M
199-K-33	A4659	0.86(J) (±0.45)	1.39(J) (±0.54)	2.08(U) (±3.9)	2.65(U) (±4.2)	—	—	—	—	b	M
199-K-34	A4660	32.7 (±6.44)	23.8 (±4.66)	30.5 (±8.77)	—	41.9 (±9.7)	31.7 (±6.8)	29.8 (±4.9)	24.3 (±1.1)	Stable	M
199-K-107A	A9843	55.9 (±14.5)	50.2 (±9.7)	39.1 (±8.62)	—	41 (±9.5)	35.6 (±7.6)	35.3 (±5.3)	31.5 (±1.3)	Stable	M
199-K-108A	A9844	1.3(U) (±1.0)	0.01(U) (±1.45)	—	—	—	—	—	—	b	M
199-K-109A	A9828	13,621 (±4,142)	5,527 (±1,101)	4,386 (±991)	4,030 (±441)	3,258 (±480)	1,245.6 (±183.6)	1,195.8 (±203.4)	1,694 (±24.14)	Increasing	M
199-K-110A	A9829	1.61(J) (±0.59)	0.2(U) (±0.26)	0.2(U) (±0.27)	0.2(U) (±0.26)	0.2(U) (±0.32)	—	—	—	b	M

Table G-6. 100-K Area Co-Contaminant Summary. (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
199-K-112A	B2799	2.19 (±0.65)	0.9(U) (±1.1)	0.16(U) (±0.27)	—	-0.02(U) (±0.24)	0.13(U) (±0.35)	—	—	b	E
199-K-113A	B2800	10.1 (±3.82)	14 (±1.6)	12.8 (±1.43)	11.8 (±1.4)	11.2 (±1.4)	9.99 (±1.25)	10.1 (±1.4)	9.8 (±2)	Stable	E
199-K-114A	B2801	27.2 (±5.53)	21.1 (±4.15)	18.0 (±1.9)	20.6 (±2.5)	18.6 (±2.9)	17.5 (±3.9)	20.2 (±3.1)	19.15 (±0.955)	Stable	C
199-K-115A	B2802	12.2 (±4.7)	13.8 (±3.76)	11.6 (±1.3)	11.5 (±1.3)	10.8 (±1.3)	8.86 (±1.15)	8.6 (±1.2)	9.2 (±1.8)	Stable	E
199-K-116A	B2803	7.03 (±2.52)	7.78 (±1.88)	7.05 (±0.85)	6.74 (±0.85)	6.86 (±0.92)	5.36 (±0.94)	4.9 (±0.75)	3.4 (±0.78)	Decreasing	E
199-K-117A	B2804	1.91 (±0.76)	2.07 (±0.61)	1.90 (±0.39)	1.96 (±0.70)	1.26 (±0.40)	1.55 (±0.595)	2.2 (±0.5)	2 (±0.36)	Stable	C
199-K-119A	B2806	0.6(U) (±0.4)	0.33(U) (±0.23)	0.29(J) (±0.22)	0.17(U) (±0.24)	0.02(U) (±0.27)	-0.05(U) (±0.32)	0.22(U) (±0.24)	-0.04(U) (±0.4)	Stable	E
199-K-120A	B2807	0.92(J) (±0.47)	0.95(J) (±0.33)	1.02(J) (±0.26)	1.18(J) (±0.30)	1.14(J) (±0.34)	1.89 (±0.48)	1.34 (±0.38)	0.9 (±0.5)	Decreasing	E
199-K-125A	B8559	—	0.09(U) (±0.32)	0.22(U) (±0.37)	0.03(U) (±0.23)	0.00(U) (±0.24)	0.08(U) (±0.33)	0.08(U) (±0.29)	-0.2(U) (±0.4)	Stable	E
199-K-126	B8560	—	—	-0.14(U) (±0.28)	-0.79(U) (±2)	-0.304(U) (±0.36)	-0.10(U) (±0.27)	0.14(U) (±0.23)	0.2(U) (±0.47)	Stable	C/E
199-K-127	C3662	—	—	—	—	—	2.73 (±0.49)	2.52 (±0.46)	3.2 ±0.8)	Increasing	E
199-K-129	C4117	—	—	—	—	—	—	-0.24(U) (±0.26)	-0.04(U) (±0.4)	Stable	E
199-K-130	C4120	—	—	—	—	—	—	0.4(B) (±0.8)	0.2(U) (±0.25)	Stable	M
199-K-131	C4561	—	—	—	—	—	—	—	0.2(U) (±0.29)	b	M

Table G-6. 100-K Area Co-Contaminant Summary. (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
Tritium (pCi/L)											
199-K-18	A4647	21,000 (±1,770)	31,450 (±2,483)	36,500 (±2,656)	35,850 (±2,834)	37,357 (±2,743)	44,350 (±1,650)	44,275 (±2,600)	34,850 (±540)	Decreasing	C
199-K-19	A4648	7,615 (±788)	12,200 (±1,080)	4,030 (±470)	2,010 (±311)	598 (±160)	947 (±170)	464 (±130)	383 (±140)	Stable	M
199-K-20	A4649	553 (±248)	510 (±236)	343(J) (±180)	223(J) (±120)	368(J) (±140)	577 (±150)	1,500 (±180)	2,440 (±180)	Increasing	C
199-K-21	A4650	675 (±256)	—	613 (±200)	443 (±140)	424 (±120)	421 (±170)	—	378.5 (±130)	b	M
199-K-22	A4651	1,720 (±328)	623 (±235)	156(U) (±130)	420(J) (±215)	-27.7(U) (±130)	287 (±130)	134(U) (±120)	184(U) (±130)	Stable	M
199-K-23	A4652	3,050 (±412)	351(J) (±229)	—	70.3(U) (±94)	—	283(U) (±130)	40.4(U) (±100)	—	b	M
199-K-27	A4653	27,500 (±2,195)	22,240 (±1,845)	10,595 (±887)	6,731 (±595)	3,823 (±442)	1,688 (±198)	69,448 (±961)	50,675 (±860)	Decreasing	M
199-K-29	A5480	10,598 (±2,195)	9,532 (±1,845)	19,022 (±887)	13,767 (±917)	35,625 (±1,868)	65,300 (±2,700)	17,530 (±815)	32,925 (±687.5)	Increasing	M
199-K-30	A4655	312,500 (±22,917)	1,331,000 (±97,238)	953,077 (±52,077)	1,091,300 (±56,110)	877,200 (±36,400)	388,400 (±15,580)	264,550 (±10,725)	370,833 (±2,050)	Increasing	M
199-K-31	A4656	1,370 (±304)	1,750 (±323)	1,100 (±190)	1,210 (±251)	1,090 (±180)	832 (±160)	1,240 (±190)	1,070 (±170)	Stable	M
199-K-32A	A4657	5,700 (±622)	5,008 (±557)	8,035 (±784)	30,950 (±2,688)	67,220 (±4,510)	62,825 (±2,650)	51,375 (±2,075)	29,300 (±645)	Decreasing	M
199-K-32B	A4658	3.59(U) (±227)	51(U) (±196)	217(J) (±120)	48.7(U) (±110)	-160(U) (±120)	-52.2(U) (±120)	-41.4(U) (±105)	25.8(U) (±82.5)	Stable	M
199-K-33	A4659	11,670 (±1051)	3,310 (±435)	3,047 (±405)	1,905 (±306)	407 (±192)	989 (±170)	893.5 (±165)	—	b	M
199-K-34	A4660	3,835 (±482)	4,250 (±498)	2,835 (±394)	1,715 (±298)	1,470 (±306)	779.75 (±205)	1,477 (±190)	1,965 (±200)	Increasing	M

Table G-6. 100-K Area Co-Contaminant Summary. (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
199-K-35	A4661	—	1,400 (±289)	—	1,105 (±185)	—	773.5 (±155)	570 (±140)	861 (±160)	Increasing	M
199-K-36	A4662	310(J) (±130)	540 (±234)	299(J) (±174)	486 (±202)	256(J) (±140)	552 (±150)	376 (±130)	344 (±140)	Stable	M
199-K-37	A4663	273(U) (±230)	299(J) (±175)	222(J) (±120)	68.6(U) (±95)	-72(U) (±130)	148(U) (±130)	46.9(U) (±110)	95.9(U) (±120)	Stable	M
199-K-106A	A9842	20,588 (±643)	6,998 (±694)	19,773 (±1,249)	21,819 (±1,258)	97,425 (±6,875)	185,000 (±7,250)	612,000 (±21,640)	389,600 (±2,340)	Decreasing	M
199-K-107A	A9843	1,550 (±313)	1,160 (±263)	1,060 (±250)	948 (±242)	902 (±231)	932.75 (±210)	762 (±160)	755 (±160)	Stable	M
199-K-108A	A9844	519 (±238)	434 (±228)	405 (±176)	108(U) (±181)	48(U) (±178)	91.52(U) (±152.5)	-15.3(U) (±105)	124.7(U) (±120)	Stable	M
199-K-109A	A9828	167,017 (±12,353)	59,829 (±4,169)	45,151 (±2,517)	25,340 (±1,544)	17,792 (±1,308)	12,342 (±718)	44,000 (±1,850)	32,775 (±650)	Decreasing	M
199-K-110A	A9829	61(U) (±213)	56(U) (±196)	340 (±200)	77(U) (±197)	445 (±240)	52.3(U) (±146)	53.0(U) (±110)	48.7(U) (±115)	Stable	M
199-K-111A	A9830	334(J) (±234)	154(U) (±206)	359(J) (±130)	13,681 (±1,461)	75,838 (±4238)	79,820 (±4,100)	46,460 (±1,940)	16,175 (±477.5)	Decreasing	M
199-K-112A	B2799	277(J) (±179)	69(U) (±207)	252(J) (±120)	—	323(J) (±130)	—	—	—	b	E
199-K-113A	B2800	334(J) (±233)	210(J) (±130)	130(U) (±120)	136(U) (±120)	134(U) (±120)	-4.3(U) (±120)	94.5(U) (±140)	-44(U) (±110)	Stable	E
199-K-114A	B2801	202(U) (±210)	201(U) (±216)	-24.6(U) (±120)	112(U) (±110)	93.4(U) (±130)	112 (±120)	68.8(U) (±110)	94.8(U) (±88)	Stable	C
199-K-115A	B2802	316(J) (±218)	320(J) (±130)	250(J) (±110)	235(J) (±115)	318(J) (±130)	390 (±140)	214.5 (±150)	-8.1(U) (±81)	Decreasing	E
199-K-116A	B2803	501 (±236)	373 (±172)	379 (±130)	390 (±125)	561 (±140)	619 (±150)	1,093 (±260)	960 (±260)	Stable	E
199-K-117A	B2804	468 (±228)	447 (±233)	202(J) (±100)	69.1(U) (±120)	-137(U) (±130)	154(U) (±120)	51.6(U) (±110)	130(U) (±120)	Stable	C

Table G-6. 100-K Area Co-Contaminant Summary. (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
199-K-118A	B2805	626	—	—	—	—	—	—	—	b	—
199-K-119A	B2806	461 (±236)	760 (±226)	328(J) (±125)	846 (±163)	2,200 (±280)	2,950 (±360)	3,925 (±920)	4,600 (±970)	Stable	E
199-K-120A	B2807	73,650 (±5,714)	61,000 (±5,550)	74,200 (±7,503)	62,300 (±6,339)	33,550 (±3,453)	58,700 (±5,900)	64,950 (±9,750)	43,000 (±8,600)	Decreasing	E
199-K-125A	B8559	—	650 (±150)	1,249 (±200)	3,525 (±416)	5,720 (±622)	6,730 (±730)	5,945 (±925)	5,700 (±1,100)	Stable	E
199-K-126	B8560	—	—	6,140 (±660)	7,230 (±770)	5,680 (±620)	3,485 (±345)	2,840 (±440)	1,600 (±400)	Decreasing	C/E
199-K-127	C3662	—	—	—	—	—	453 (±140)	1,450 (±295)	1,700 (±295)	Stable	E
199-K-129	C4117	—	—	—	—	—	—	78(U)	85(U) (±160)	Stable	E
199-K-130	C4120	—	—	—	—	—	—	4,390 (±410)	3,605 (±195)	Stable	M
199-K-131	C4561	—	—	—	—	—	—	—	3,880 (±220)	b	M
699-78-62	A5332	3.85(U)	—	33.8(U)	—	-23.5(U)	—	—	—	b	M
Nitrate (mg/L)											
199-K-106A	A9842	93.6	101.8	94.2	93.3	82.7	79.5	120.2	113.5	Stable	M
199-K-107A	A9843	30.9	29.2	25.0	21.7	19.8	19.6	19.1	21.8	Stable	M
199-K-108A	A9844	32.2	38.0	40.5	2.0	0.8	0.2	0.3	75.9	Increasing	M
199-K-109A	A9828	20.9	18.1	20.9	12.9	10.4	11.4	11.6	13.7	Stable	M
199-K-11	A4643	54.9	32.7	37.7	—	47.4	60,4	74.4	68.2	Stable	M
199-K-110A	A9829	16.6	16.2	16.7	10.5	8.7	4.1	7.5	7.5	Stable	M
199-K-111A	A9830	62.4	61.8	60.0	66.0	68.2	57.8	52.0	52.5	Stable	M
199-K-117A	B2804	—	—	2.6	4.6	5.3	1.7	8.4	7.1	Stable	C
199-K-18	A4647	99.8	96.0	77.4	83.1	82.6	93.0	96.2	91.2	Stable	C

Table G-6. 100-K Area Co-Contaminant Summary. (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
199-K-19	A4648	54.0	131	85.0	43.0	24.2	23.5	23.0	34.5	Increasing	M
199-K-20	A4649	40.4	57.1	35.0	13.4	8.9	9.7	11.1	11.5	Stable	C
199-K-21	A4650	27.1	—	34.8	30.1	26.2	23.5	—	29	c	M
199-K-22	A4651	61.1	24.5	16.0	19.0	13.5	14.6	15.9	16.8	Stable	M
199-K-23	A4652	83.2	80.4	—	65.3	47.4	48.7	72.2	—	c	M
199-K-27	C3662	21.8	21.8	26.5	16.8	23.9	27.9	22.1	22.9	Stable	M
199-K-29	C4117	27.2	18.6	19.0	27.6	34.0	25.2	17.5	27.1	Increasing	M
199-K-30	A4655	42.3	88.7	80.5	95.2	110.1	64.9	66.8	82.9	Increasing	M
199-K-31	A4656	15.1	20.0	19.0	20.0	20.3	21.2	21.2	21.7	Stable	M
199-K-32A	A4657	59.8	70.4	21.6	28.7	23.0	19.9	24.2	28.1	Stable	M
199-K-32B	A4658	10.3	10.7	10.0	11.0	9.3	10.2	9.5	8.9	Stable	M
199-K-33	A4659	97.0	71.8	71.2	55.0	48.6	56.7	64.2	—	c	M
199-K-34	A4660	50.0	67.3	35.1	34.8	29.9	18.3	17.8	17.2	Stable	M
199-K-35	A4661	—	11.4	—	12.8	—	11.6	12.4	12.8	Stable	M
199-K-36	A4662	14.3	37.7	24.9	23.0	21.9	29.9	22.6	28.8	Increasing	M
199-K-37	A4663	7.7	12.0	12.0	12.0	11.0	11.5	11.1	10.2	Stable	M
699-78-62	A5332	—	—	11	0	16.4	—	—	—	c	M
Carbon-14 (pCi/L)											
199-K-11	A4643	—	—	—	150(J) (±12)	76.7 (±9)	68.6(B) (±6.2)	99.7 (±7.6)	98 (±5.9)	Stable	M
199-K-23	A4652	—	21.6(J) (±5.8)	—	84(J) (±9.3)	—	—	—	—	b	M
199-K-27	C3662	320 (±18.8)	317 (±18.6)	374 (±21.9)	—	172 (±13)	—	—	—	b	M
199-K-29	C4117	4,610 (±215)	4,440 (±207)	4,400 (±188)		2,500 (±105)	2,500 (±92)	2,620 (±96)	2,510 (±25)	Stable	M
199-K-30	A4655	15,900 (±731)	14,650 (±694)	13,850 (±579)	16,300 (±1,600)	6,220 (±265)	6,430 (±230)	6,930 (±250)	—	b	M
199-K-32A	A4657	94.5(J) (±5.8)	92.1(J) (±5.8)	209 (±9.0)	232 (±28)	267 (±26)	213 (±11)	182 (±10)	178 (±6.6)	Stable	M

Table G-6. 100-K Area Co-Contaminant Summary. (7 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
199-K-33	A4659	6,950 (±41.1)	7,015 (±41.3)	—	9,997 (±142)	—	8,230 (±290)	8,950 (±320)	—	b	M
199-K-34	A4660	4,790 (±34.3)	4,520 (±117)	4,380 (±32.3)	5,150 (±74)	3,020 (±27)	4,350 (±160)	3,050 (±110)	2,340 (±24)	Decreasing	M
199-K-106A	A9842	35,667 (±1,640)	31,100 (±1,480)	23,650 (±2,044)	—	7,180 (±945)	20,900 (±740)	15,500 (±550)	—	b	M
199-K-107A	A9843	—	—	463 (±10.1)	—	232 (±8.2)	233 (±12)	247 (±13)	188 (±7.6)	Decreasing	M
199-K-108A	A9844	2,715 (±25.8)	3,910 (±43.9)	3,595 (±31.8)	1,260 (±45)	371 (±21.5)	413 (±18)	164 (±9.7)	380 (±10)	Increasing	M
199-K-109A	A9828	48.9(J) (±7.1)	145(J) (±11)	168 (±13.1)	—	53.8 (±8.0)	182 (±10)	95.2 (±8.9)	192 (±39)	Increasing	M
199-K-110A	A9829	—	—	87.2 (±9.5)	—	40.0 (±7.2)	35.1 (±4.9)	61.4 (±5.9)	—	b	M
199-K-111A	A9830	64.7(J) (±7.6)	108(J) (±9.5)	177(B) (±21)	180(J) (±37)	186 (±25)	206 (±22.5)	171 (±10)	166 (±7.2)	Stable	M

[a] Annual comparison is the percent difference between CY03 and CY04 (or the two most recent years) and is calculated by the following equation: (CY04 - CY03) / CY03 x 100%. Wells are considered stable if there is less than a 20% change in concentration from CY03 to CY04.

[b] Not trended because of insufficient data for comparison.

B = associated blank has result ± 2 times minimum detectable activity
C = compliance well
CY = calendar year
E = extraction well
I = injection well
J = estimated result
M = monitoring well
— = well not sampled or analytical results not available during report preparation

Table G-7. 100-N Area Strontium-90 Summary. (3 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
Strontium-90 (pCi/L)											
A4669	199-N-2	1,625 (±675)	587.5 (±109)	1,640 (±180)	280 (±50)	36.4 (±5.2)	662.5 (±107)	117 (±21)	55.95 (±11.8)	Decreasing	M
A4679	199-N-3	1,033.3 (±341)	2,040 (±344)	1,278 (±186)	1,960 (±205)	1,433.3 (±153)	1,135 (±120)	1,188 (±212)	1,210 (±0.6)	Stable	M
A4664	199-N-14	1,177 (±333)	997.0 (±206)	997 (±206)	957 (±128)	1,165 (±120)	933.33 (±98)	1,075 (±190)	966 (±10.5)	Stable	M
A4665	199-N-16	0.3(U) (±0.3)	0.3(U) (±0.5)	0.7(J) (±0.3)	0.5(U) (±3.2)	0.1(U) (±0.4)	0.127(U) (±0.41)	0.374(U) (±0.22)	0.443 (±0.4)	Increasing	M
A4667	199-N-18	—	—	392 (±89)	—	—	—	—	—	c	M
A4668	199-N-19	44.2 (±12.1)	36.5 (±6.7)	32.1 (±5.8)	30.7 (±7.2)	—	24.3 (±5.8)	28.2 (±6.1)	26.1 (±0.34)	Stable	M
A4675	199-N-26	0.2(U) (±0.2)	0.2(U) (±0.2)	—	—	—	—	—	—	c	M
A4676	199-N-27	474 (±167)	—	—	258 (±58)	212 (±48)	197 (±42)	178 (±27)	158 (±0.58)	Stable	M
A4677	199-N-28	100 (±31.6)	189 (±35)	85.8 (±16.7)	96.8 (±22)	40.5 (±9.3)	27 (±5.8)	22.9 (±4.9)	26.2 (±1.9)	Stable	M
A4681	199-N-32	0.85(J) (±0.4)	0.95(J) (±0.43)	4.29 (±1.4)	0.48(U) (±2.1)	4.66 (±0.91)	-0.275(U) (±1.45)	0.335(U) (±28)	0.288(U) (±11)	Stable	M
A4682	199-N-33	—	—	56.9 (±10.1)	—	—	—	—	—	c	M
A4683	199-N-34	57.8 (±11.1)	46.2 (±8.27)	54.9 (±10.5)	59.9 (±14)	58.6 (±13)	55.5 (±13)	54.6 (±13)	53.1 (±1.9)	Stable	M
A4689	199-N-41	0.53 (J) (±0.33)	0.6(U) (±2.2)	0.2(U) (±0.3)	0.1(U) (±0.3)	0.02(U) (±0.2)	0.193(U) (±0.36)	0.522(U) (±2.0)	0.00523(U) (±6.1)	Stable	M
A5833	199-N-46	5,929 (±1,710)	8,850 (±1,510)	9,010 (±1,612)	12,750 (±2,050)	9,690 (±1,710)	4,810 (±650)	4,070 (±700)	2,370 (±27)	Decreasing	M
A4695	199-N-52	0.1(U) (±0.2)	0.1(U) (±0.2)	0.0(U) (±0.1)	—	—	—	—	—	c	M

Table G-7. 100-N Area Strontium-90 Summary. (3 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
A4697	199-N-54[d]	388 (±116)	500.3 (±101)	447 (±63.9)	—	—	—	—	—	c	M
A4699	199-N-56	—	—	—	—	—	—	—	145 (±11)	c	M
A4700	199-N-57	24.7 (±4.82)	22 (±4.2)	14.6 (±2.9)	13.8 (±3.3)	8.92 (±2.2)	9.87 (±2.45)	8.78 (±2.1)	7.34 (±15)	Stable	M
A4708	199-N-64	0.5(U) (±0.4)	0.2(U) (±0.3)	0.3(U) (±0.2)	—	0.6(U) (±1.2)	0.54(U) (±0.3)	0.181(U) (±0.17)	-0.0829(U) (±0.039)	Stable	M
A4711	199-N-67	17,425 (±4,913)	22,040 (±3,950)	18,833 (±2,916)	17,700 (±1,800)	—	9,757.5 (±1,717.5)	7,310 (±1,300)	7,203 (±2.3)	Stable	M
A4713	199-N-70	0.1(U) (±0.2)	0.1(U) (±0.3)	0.1(U) (±0.2)	0.6(U) (±0.3)	0.7(U) (±0.4)	0.52(U) (±0.59)	0.234(U) (±0.2)	-0.207(U) (±0.65)	Stable	M
A4714	199-N-71	0.4(U) (±0.3)	0.1(U) (±0.2)	—	—	—	—	—	—	c	M
A4717	199-N-74	0.4(U) (±0.3)	0.0(U) (±0.2)	—	—	—	0.03(U) (±0.22)	—	—	c	M
A4718	199-N-75[b]	394 (±147)	462 (±119)	430.3 (±68)	—	480.5 (±55.8)	407.5 (±53.75)	424 (±72)	254 (±24)	Decreasing	E
A4719	199-N-76	673.1 (±173.9)	433.5 (±95.0)	582.7 (±76.6)	236 (±25)	161.3 (±25.8)	227 (±23)	182 (±28)	170 (±58)	Stable	M
A4720	199-N-80	0.6(U) (±0.4)	0.4(U) (±0.4)	0.3(U) (±1.8)	2.9 (±0.8)	0.6 (±0.3)	0.37(U) (±0.35)	0.307(U) (±0.28)	0.561(U) (±0.29)	Stable	M
A5443	199-N-81	1,328.7 (±447)	1,213.3 (±231.3)	1,180 (±202.4)	998.5 (±177.3)	725 (±162)	795.33 (±144.33)	630 (±112)	587 (±15.6)	Stable	M
A9878	199-N-92A	0.5(U) (±1.0)	0.4(U) (±0.3)	0.3(U) (±0.5)	0.7(U) (±0.8)	1.0 (±0.4)	0.69(U) (±1.2)	0.832(U) (±0.77)	0.6215(U) (±0.97)	Stable	M
A9882	199-N-96A	8.9(J) (±3.4)	9.5 (±2.0)	6.1 (±1.2)	9.7 (±1.1)	3.3 (±1.4)	6.48 (±1.5)	5.19 (±0.93)	4.535 (±1.34)	Stable	M
A9910	199-N-99A	5,440 (±1,694)	2,440 (±372)	1,890 (±210)	1,810 (±190)	1,700 (±170)	1,790 (±285)	1,710 (±250)	1,790 (±1.77)	Stable	M

Table G-7. 100-N Area Strontium-90 Summary. (3 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
A9988	199-N-103A[b]	847 (±190)	34.2 (±6.2)	—	—	229 (±48)	219 (±45)	233 (±48)	321 (±67)	Increasing	E
B2408	199-N-105A[b]	1,400 (±510)	—	1,857 (±420)	—	603 (±142)	778.5 (±170)	724 (±130)	390 (±8.8)	Decreasing	M/E
A9988	199-N-106A[b]	3,997 (±1,357)	4,460 (±1,640)	—	—	3,942 (±912)	3,730	3,640 (±750)	3,250 (±4.57)	Stable	E
C4471	199-N-119	—	—	—	—	—	—	—	299.5 (±2.9)	c	M
C4472	199-N-120	—	—	—	—	—	—	—	9.83 (±4.55)	c	M
B4473	199-N-121								2.1 (±0.46)	c	M

[a] Annual comparison is the percent difference between CY02 and CY03 (or the two most recent years) and is calculated by the following equation: (CY04 - CY03) / CY03 x 100%. Wells are considered stable if there is less than a 20% change in concentration from CY03 to CY04.
[b] Extraction well. Well 199-N-105A is a backup extraction well.
[c] Not trended because of insufficient data for comparison.
[d] Decommissioned.

CY = calendar year
E = extraction well
I = injection well
NS = not sampled
M = monitoring well
(U) = not detected in sample
— = well not sampled or analytical results not available during report preparation

Table G-8. 100-N Area Contaminants of Concern Summary. (9 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
Tritium (pCi/L)											
A4669	199-N-2	21,000 (±1,720)	37,900 (±2,940)	32,600 (±3,300)	38,200 (±3,144)	34,300 (±3,500)	15,950 (±1,355)	17,100 (±870)	17,700 (±460)	Stable	M
A4679	199-N-3	10,043 (±912)	10,073 (±1,000)	5,020 (±553)	4,643 (±517)	3,787 (±441)	4,357.5 (±482.5)	3,575 (±310)	2,990 (±183)	Stable	M
A4664	199-N-14	38,350 (±3,018)	44,900 (±3,456)	42,725 (±4,154)	41,650 (±4,210)	36,800 (±3,700)	38,000 (±3,866.6)	30,700 (±1,400)	25,300 (±553)	Stable	M
A4667	199-N-18	5,710 (±606)	4,320 (±504)	4,620 (±480)	—	—	—	—	—	c	M
A4676	199-N-27	29,500 (±2,330)	25,200 (±2,020)	25,200 (±2,600)	22,000 (±2,200)	22,700 (±2,300)	20,300 (±2,100)	19,700 (±970)	15,800 (±430)	Stable	M
A4677	199-N-28	—	—	25,800 (±2,030)	24,000 (±1,400)	21,000 (±1,300)	20,300 (±1,200)	18,300 (±850)	17,000 (±480)	Stable	M
A4681	199-N-32	76,250 (±5,905)	46,250 (±3,553)	31,070 (±2,957)	28,133 (±2,867)	23,067 (±2,011)	25,000 (±2,550)	25,100 (±1,200)	21,200 (±510)	Stable	M
A4682	199-N-33	—	—	(±2,090)	—	—	—	—	—	c	M
A4683	199-N-34	—	—	24,100 (±1,900)	22,000 (±1,300)	22,800 (±1,300)	21,100 (±1,200)	18,800 (±870)	16,300 (±470)	Stable	M
A4689	199-N-41	—	—	—	10,300 (±780)	11,000 (±800)	12,500 (±840)	13,100 (±870)	12,100 (±410)	Stable	M
A5833	199-N-46	6,614 (±600)	8,708 (±900)	5,140 (±540)	7,030 (±725)	5,010 (±590)	681 (±205)	73 (±160)	282 (±99.1)	Increasing	M
A4693	199-N-50	22,500 (±1,820)	22,600 (±1,820)	19,900 (±2,000)	18,000 (±1,800)	15,600 (±1,600)	12,500 (±1,300)	12,600 (±1,310)	9,700 (±350)	Decreasing	M
A4694	199-N-51	14,900 (±1,270)	21,500 (±1,750)	14,050 (±1,451)	16,550 (±1,413)	14,950 (±1,312)	8,800 (±930)	11,300 (±625)	9,520 (±353)	Stable	M
A4695	199-N-52	9,280 (±848)	11,000 (±986)	9,450 (±861)	9,070 (±690)	—	7,260 (±590)	—	—	c	M
A4708	199-N-64	11,000 (±1,000)	7,990 (±764)	9,000 (±950)	8,990 (±950)	9,470 (±1,000)	8,820 (±930)	16,200 (±830)	14,900 (±450)	Stable	M

Table G-8. 100-N Area Contaminants of Concern Summary. (9 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
A4711	199-N-67	19,700 (±1,000)	21,100 (±1,720)	14,950 (±1,240)	—	—	15,200 (±950)	16,200	17,400 (±480)	Stable	M
A4713	199-N-70	27,600 (±2,200)	24,200 (±1,940)	22,800 (±1,933)	22,900 (±2,300)	20,900 (±2,100)	18,700 (±1,900)	16,500 (±840)	13,500 (±500)	Stable	M
A4714	199-N-71	257(U) (±198)	792 (±254)	—	—	—	—	—	—	c	M
A4717	199-N-74	11,700 (±1,020)	11,800 (±1,050)	8,080 (±880)	—	—	8,090 (±630)	—	—	c	M
A4718	199-N-75	30,800 (±2,437)	30,800 (±2,420)	26,567 (±2,497)	—	21,500 (±2,200)	21,075 (±1,925)	20,400 (±1,000)	15,200 (±447)	Decreasing	E
A4719	199-N-76	58,150 (±5,041)	53,500 (±4,100)	47,400 (±4,817)	34,500 (±3,500)	29,550 (±2,751)	30,500 (±3,100)	22,400 (±1,100)	22,900 (±507)	Stable	M
A4720	199-N-80	37,600 (±2,920)	34,400 (±2,680)	30,600 (±2,587)	28,800 (±2,900)	25,600 (±2,600)	25,600 (±2,600)	21,700 (±1,100)	17,500 (±1,100)	Decreasing	M
A5443	199-N-81	20,900 (±1,720)	24,750 (±1,985)	25,000 (±2,600)	22,300 (±2,300)	20,800 (±2,100)	18,050 (±1,450)	18,350 (±1,400)	16,900 (±385)	Stable	M
A9878	199-N-92A	19,500 (±1,929)	30,600 (±2,410)	10,300 (±1,100)	29,100 (±3,000)	29,150 (±2,404)	21,500 (±2,200)	12,500 (±680)	10,300 (±365)	Stable	M
A9882	199-N-96A	3,170 (±421)	4,320 (±497)	1,045 (±226)	3,270 (±380)	3,370 (±390)	1,980 (±260)	3,735 (±295)	2,310 (±183)	Decreasing	M
A9910	199-N-99A	—	4,610 (±523)	46(U) (±130)	6,640 (±720)	16,700 (±1,700)	4,225 (±420)	3,550 (±290)	365 (±115)	Decreasing	M
B2408	199-N-105A[b]	—	—	23,200 (±1,334)	—	—	—	—	—	c	M/E
B4471	199-N-119	—	—	—	—	—	—	—	-49.1 (±94.8)	c	M
B4472	199-N-120	—	—	—	—	—	—	—	73.1 (±104)	c	M
B4473	199-N-121	—	—	—	—	—	—	—	1,010 (±153)	c	M

Table G-8. 100-N Area Contaminants of Concern Summary. (9 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
Chromium (µg/L)											
A4669	199-N-2	3.8	5.1	5.6	6.9	7.6	4.35e	4.1(U)	3.9(U)	Stable	M
A4679	199-N-3	3.5	4.2(U)	4.6	3.6	1.8(U)	7.25	4.1(U)	3.7(U)	Stable	M
A4664	199-N-14	3.7	4.3	4.4	3.5(U)	4.8	4.9	4(B)	3.7(U)	Decreasing	M
A4665	199-N-16	3.5(U)	4.2(U)	3.2	3.5(U)	5.4	1.1	4.4(U)	4.3(U)	Stable	M
A4667	199-N-18	—	2.1(U)	3.2(U)	4.1(U)	0.56(U)	6(B)	4.4(U)	8.3(B)	Increasing	
A4668	199-N-19	—	—	4.8(U)	4.6(U)	—	3.4	—	—	c	M
A4671	199-N-21	3.8	5.8	2.9	—	2.6	2.2	4.4(U)	3.9(U)	Stable	M
A4675	199-N-26	—	—	6.5	4.6(U)	2.9	—	9.4(B)	5.5(B)	Decreasing	M
A4676	199-N-27	7.8	11	9.8	8.9	9.6	8.5	10.5	6(B)	Decreasing	M
A4677	199-N-28	5.2	3.5	4.8(U)	4.8	3.6	3.4(U)	3.8(U)	4.4(U)	Stable	M
A4681	199-N-32	3.1(U)	3.5	2.8	2.5	3.4	1.5e	4.1(U)	3.9(U)	Stable	M
A4682	199-N-33	7	5.4	4.8(U)	—	—	—	—	—	c	M
A4683	199-N-34	2.7(U)	2.7(U)	4.8(U)	4.6(U)	3.8	0.73(U)	4.5(B)	4.4(U)	Decreasing	M
A4689	199-N-41	6.3	6.6	7.8	6.3	9.3	12	15.4	11.7	Decreasing	M
A5833	199-N-46	—	—	—	—	—	—	—	3.3(U)	c	M
A5834	199-N-47	—	—	4.8	4.6	—	—	—	—	c	M
A4695	199-N-52	—	—	9.6	6.4	—	8.5	—	—	c	M
A4697	199-N-54[b]	3.5	4	4.3	—	—	—	—	—	c	M
A4700	199-N-57	2.7	5.2	4.8	7.7	—	6.1	8.9	6.2(B)	Decreasing	M
A4708	199-N-64	57.5	124	25.7	—	12.1	4.6	15.7	8.5(B)	Decreasing	M
A4711	199-N-67	5.3	5.8	6.1	3.5(U)	—	7	4.4(U)	5.2(U)	Stable	M
A4679	199-N-70	11.2	10.9	10.6	12.3	—	14	12.2	5.8(B)	Decreasing	M
A4714	199-N-71	2.7(U)	2.7(U)	4.0(U)	5.0	—	3.3	5.4(B)	11.4	Increasing	M
A4715	199-N-72	—	—	—	—	—	—	—	4.4(U)	c	M
A4716	199-N-73	2.7(U)	2.8(U)	4.5(U)	4.1(U)	5.1(B)	2.4(B)	3.8(U)	4.4(U)	Stable	M
A4717	199-N-74	11.6	24.8	9.9	8.9	13.3	12.2	10.5	7.7(B)	Decreasing	E

Table G-8. 100-N Area Contaminants of Concern Summary. (9 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
A4718	199-N-75	3.2	2.7(U)	3.7	—	4.6(U)	2.3e	4.4(B)	4(U)	Decreasing	M
A4719	199-N-76	3.5(U)	3.5(U)	2.7	3.5(U)	4.6(U)	4.6	5.5(B)	3.5(B)	Decreasing	M
A5442	199-N-77	2.7(U)	2.7(U)	4.8(U)	4.3(U)	2.6(U)	2.2(U)	7.1(B)	4.4(U)	Decreasing	
A4720	199-N-80	178	181	176	172	173	168	168	170	Stable	M
A5443	199-N-81	11.4	9.6	8.7	9.4	8.3	9.1	11.0	6.5(U)	Decreasing	M
A9878	199-N-92A	3.4	4.2	4.3	4.7	5.7	7.7	4.4(U)	3.3(U)	Stable	M
A9882	199-N-96A	4.7	5.6	4.3	3.5(U)	4.8(U)	2.6	4.4(U)	10.0	Increasing	M
A9910	199-N-99A	—	4.9(U)	4.3	3.5(U)	4.8(U)	1.9	4.4(U)	3.9	Increasing	E
B2408	199-N-105A	2.9	4.2(U)	4.8(U)	4.6(U)	3.6	0.73(U)	3.8(U)	4.4(U)	Stable	M/E
C4471	199-N-119	—	—	—	—	—	—	—	3.9(U)	c	M
C4472	199-N-120	—	—	—	—	—	—	—	3.9(U)	c	M
C4473	199-N-121	—	—	—	—	—	—	—	3.9(U)	c	M
Nitrate (mg/L)											
A4669	199-N-2	48.1	125.8	70.2	93.7	108.3	25	49.8	87.3	Increasing	M
A4679	199-N-3	36.6	41.6	32.2	52.5	78	50.5	63.98	66.1	Stable	M
A4664	199-N-14	37.9	26.9	23	31	59.9	25.26	30.8	28.4	Stable	M
A4665	199-N-16	39	0.85	35	1.9	35.2	19.3	39	9.9	Decreasing	M
A4671	199-N-21	66.6	44.7	58	-	37.8	47.8	49.1	48.0	Stable	M
A4675	199-N-26	85	91	75	62	51	—	57.5	81.9	Increasing	M
A4676	199-N-27	60.6	23.6	25	20.3	20	26.2	30.1	31.4	Stable	M
A4677	199-N-28	38	30	37	35	38	37	34.5	39.0	Stable	M
A4681	199-N-32	61.3	46.5	37.8	40.3	40.6	43.25	56.25	62.4	Stable	M
A4683	199-N-34	—	—	—	—	—	—	—	42.9	c	M
A4689	199-N-41	—	—	—	—	—	—	—	24.8(B)	c	M
A5833	199-N-46	—	—	—	—	—	—	—	4.63	c	M
A4697	199-N-54	39.8	62	50.3	—	—	—	—	—	c	M
A4700	199-N-57	—	—	—	—	—	—	—	41.6	c	M
A4708	199-N-64	89.4	63.3	42	39.3	37.5	25	33.2	38.5	Stable	M

Table G-8. 100-N Area Contaminants of Concern Summary. (9 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
A4711	199-N-67	117.1	190	130.8	140	—	54.95	186	212	Stable	M
A4713	199-N-70	19.2	29.6	32	27	21.5	19.2	19.5	19.5	Stable	M
A4714	199-N-71	1	2	3	4	4	6	7.08	8.85	Increasing	M
A4715	199-N-72	—	—	—	—	—	—	—	35.9	c	M
A4716	199-N-73	4	9	12	15	17	11	15.9	23.0(B)	Increasing	M
A4717	199-N-74	7	8	8	9	7	7	7.08	10.2	Increasing	M
A4718	199-N-75	19.3	31	34.9	—	29.7	28.43	34.2	32.0	Stable	E
A4719	199-N-76	13.9	21.4	26	36	31	30.7	32.48	44.3	Increasing	M
A5442	199-N-77	2	5	9	11	6	9	13.7	24.3	Increasing	M
A4720	199-N-80	9.0	9.3	10	9.6	9.4	9.05	9.3	8.85	Stable	M
A5443	199-N-81	52.1	61.1	51	35.2	27.2	35.1	25.75	30.4	Stable	M
A9878	199-N-92A	16.4	10	10	11	16.6	16	13.3	15.1	Stable	M
A9882	199-N-96A	30.8	14.5	17.8	17	8.3	43.4	26.35	23.2	Stable	M
A9910	199-N-99A	—	16.6	4.7	12	11.4	26.8	15.1	19.3	Increasing	M
B2408	199-N-105A	110	70	35	46	47	35	40.7	57.1	Increasing	E
C4471	199-N-119	—	—	—	—	—	—	—	9.5	c	M
C4472	199-N-120	—	—	—	—	—	—	—	4.5	c	M
C4473	199-N-121	—	—	—	—	—	—	—	6.9	c	M
Manganese (µg/L)											
A4669	199-N-2	2.4	9.5	3.6	3.9	0.9(U)	1.56	6.2	3.5(B)	Decreasing	M
A4679	199-N-3	56.2	25.6	20.6	1.3	3.7	4.1	4.5	4.9(B)	Stable	M
A4664	199-N-14	3.2	2.4	1.8	1.4	0.6(U)	0.79e	1.8	1.3(B)	Decreasing	M
A4665	199-N-16	1,040	918	987	1,190	388.5	880	1,110	735	Decreasing	M
A4667	199-N-18	—	4,470	5,780	5,320	—	5,180	3,700	2,480	Decreasing	M
A4668	199-N-19	—	—	5.5	4.8	—	2.15	—	—	c	M
A4671	199-N-21	3.2	7.8	1.6	—	4.1	0.72	0.81(U)	2.9(B)	Increasing	M
A4675	199-N-26	—	—	35.7	71.6	—	—	12.5	88.9	Increasing	M
A4676	199-N-27	3.9	5.7	1.8	3.7	2.8(U)	1.2	1.1	5.6(B)	Increasing	M

Table G-8. 100-N Area Contaminants of Concern Summary. (9 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
A4677	199-N-28	8.5	4.1	4.8	5.9	—	3.2	1.5(U)	2.3	Increasing	M
A4681	199-N-32	15.5	15.4	18.4	13.7	27.9	11	9.1	10.5(B)	Stable	M
A4682	199-N-33	78	255.5	43.6	—	—	—	—	—	c	M
A4683	199-N-34	1.8	2.8	3.3	1.4	—	0.4(U)	4.3(B)	27.7	Increasing	M
A4689	199-N-41	2.5	3.5	6.1	4.1	—	1.8	4.4(B)	5.0(B)	Stable	M
A5833	199-N-46	—	—	—	—	—	—	—	1.2(B)	c	M
A4695	199-N-52	—	—	5.2	2.4	—	1.6	—	—	c	M
A4697	199-N-54	5.5	4.3	0.7	—	—	—	—	—	c	-
A4700	199-N-57	8.8	3.7	3.5	2.2	—	0.4(U)	3.5(B)	4.2(B)	Increasing	M
A4702	199-N-59	3.7	3.8	2.0	1.7	—	4.4	—	—	c	M
A4708	199-N-64	94.2	3.3	4.3	—	1.6(U)	0.59	2.48	4.2(B)	Increasing	M
A4711	199-N-67	—	3.0	1.7	1.2(U)	—	—	3.6	4.7(B)	Increasing	M
A4713	199-N-70	2.0	1.6	1.2	0.7	2.8(U)	0.865	0.97	1.8(B)	Increasing	M
A4714	199-N-71	1.6	2.3	5.6	1.6	—	0.9	3.6	3.0(B)	Stable	M
A4715	199-N-72	2.8	2.8	1.9	1.4(U)	—	3	4.4(B)	3.8(B)	Stable	M
A4716	199-N-73	2.5	2.2	1.6	1.6	—	1.7	3.7	1.3(B)	Decreasing	M
A4717	199-N-74	1.8	3.9	2.5	1.5	2.8(U)	0.38	2.6	2.7(B)	Stable	M
A4718	199-N-75	2.5	2.1	1.4	—	2.8(U)	1.34	1.9	1.7(B)	Stable	E
A4719	199-N-76	1.8	2.2	0.9	1.2(U)	2.8(U)	0.69	2.4	1.2(U)	Decreasing	M
A5442	199-N-77	0.9	2.6	1.7	1.4(U)	—	0.4(U)	1.5(U)	2.1(B)	Increasing	M
A4720	199-N-80	3.7	1.2	2.1	1.2(U)	2.8(U)	1.5	0.81(U)	2.5(B)	Increasing	M
A5443	199-N-81	4.1	4.2	4.5	1.7	2.8(U)	1.44	1.67	1.7(B)	Stable	M
A9878	199-N-92A	2.0	1.5	6.9	1.2(U)	1.6(U)	0.39	0.81(U)	12.9(B)	Increasing	M
A9882	199-N-96A	58.7	18.4	4.9	2.8	54	1.3	2.2	3.45(B)	Increasing	M
A9910	199-N-99A	—	2.2	2.5	1.2(U)	2.8(U)	1.47	0.81(U)	1.75(B)	Increasing	M
B2408	199-N-105A	2.4	1.8	3.4	2.4	—	0.4	3.1	2.1(B)	Decreasing	M/E
C4471	199-N-119	—	—	—	—	—	—	—	76.1	c	M
C4472	199-N-120	—	—	—	—	—	—	—	46.4	c	M
C4473	199-N-121	—	—	—	—	—	—	—	219	c	M

Table G-8. 100-N Area Contaminants of Concern Summary. (9 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
Sulfate (mg/L)											
A4669	199-N-2	28.9	60	89.2	72.3	77.3	75.4	62.2	53.8	Stable	M
A4679	199-N-3	251.2	236.8	236	245	258.3	195.5	194	196	Stable	M
A4664	199-N-14	82	38.8	33.8	44.8	45.1	36.76	40.8	39.9	Stable	M
A4665	199-N-16	454	100	107.5	74.9	65.9	101	141	64	Decreasing	M
A4667	199-N-18	1.25	1.2	1.8	1.5	1.5	0.5	0.43	0.70	Increasing	M
A4668	199-N-19	214	200	124	103	—	115	—	—	c	M
A4671	199-N-21	261.5	205	187	—	112.5	118	99.3	96	Stable	M
A4675	199-N-26	119	93.7	158	150	188	—	128	104	Stable	M
A4676	199-N-27	100	82.1	72	81.8	76.3	66.2	62.3	64	Stable	M
A4677	199-N-28	276	33.3	53.5	54.4	66.2	74.1	61	65.3(B)	Stable	M
A4681	199-N-32	37	36.3	41.3	52.5	65.8	57.85	57.6	58.6	Stable	M
A4682	199-N-33	—	—	52.9	—	—	—	—	—	c	M
A4683	199-N-34	54.7	39.7	61.2	61	70.8	72	65	72.9(B)	Stable	M
A4689	199-N-41	46.3	62.9	105	124	112	114	110	117(B)	Stable	M
A4695	199-N-52	—	—	53.6	47.3	—	50.3	—	—	c	M
A4697	199-N-54	191	174.3	181.5	—	—	—	—	—	c	—
A4700	199-N-57	191	166	150	124	121	117	104	106(B)	Stable	M
A4702	199-N-59	282	332.3	349.5	339.3	—	384	—	—	c	M
A4708	199-N-64	214	201	203	—	162.5	143	75.6	78.8	Stable	M
A4711	199-N-67	35.1	81.7	112	86.3	—	76.15	52.6	50.8	Stable	M
A4713	199-N-70	74	79.6	86.4	83.9	84.5	93.8	88.8	84.4	Stable	M
A4714	199-N-71	27.3	32.9	38.2	46.1	57.1	48.8	54	57.7	Stable	M
A4715	199-N-72	320	244.5	184	141.5	149	118	99	116(B)	Stable	M
A4716	199-N-73	358	336.5	290	220.5	190.5	125	119	137(B)	Stable	M
A4717	199-N-74	71.3	75.5	70	63.3	68.7	67.8	63	69.7	Stable	M
A4718	199-N-75	25.2	36.2	45.8	—	62	51.87	50	44.4	Stable	E
A4719	199-N-76	20.8	24.3	28.5	41.1	45.1	44.75	48.9	51.5	Stable	M

Table G-8. 100-N Area Contaminants of Concern Summary. (9 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
A5442	199-N-77	249	208	157.5	121.5	102.5	95.9	90.8	108	Stable	M
A4720	199-N-80	48.2	47.5	50	47.7	50.6	49.7	48.8	49.6	Stable	M
A5443	199-N-81	132.2	94.7	98.2	82	77.4	105.63	76.2	70.4	Stable	M
A9878	199-N-92A	20	15.6	12.6	20.2	31.9	40.2	33.9	35.7	Stable	M
A9882	199-N-96A	165	101	67.5	105	96.9	96	117.5	84.6	Decreasing	M
A9910	199-N-99A	106.8	21	12.5	17.2	16.6	16.3	14.4	13.2	Stable	M
B2408	199-N-105A	33.8	45.8	57.1	65.8	54.5	73.4	53.1	56.3(B)	Stable	M/E
C4471	199-N-119	—	—	—	—	—	—	—	9.35	c	M
C4472	199-N-120	—	—	—	—	—	—	—	12.75	c	M
C4473	199-N-121	—	—	—	—	—	—	—	28.6	c	M
Total Petroleum Hydrocarbons (µg/L), Diesel Range											
A4679	199-N-3	—	—	—	92(U)	92(U)	50(U)	55(U)	56.7(U)	Stable	M
A4665	199-N-16	—	—	—	—	—	—	6,500	5,600	Decreasing	M
A4667	199-N-18	—	—	16,000	23,000	6,800,000	440,000	1.58E+08	183,000	Decreasing	M
A4668	199-N-19	—	—	—	—	—	50(U)	50(U)	53.3(U)	Stable	M
A4671	199-N-21	—	—	—	—	—	—	—	60(U)	c	M
A4675	199-N-26	—	—	—	—	—	—	—	60(U)	c	M
A4699	199-N-56	—	—	—	—	—	—	—	60(U)	c	M
A9882	199-N-96A	—	—	—	—	50(U)	1500	60(U)	50(U)	Stable	M
Total Petroleum Hydrocarbons (µg/L), Gasoline Range											
A4679	199-N-3	—	—	—	100(U)	50(U)	50(U)	55(U)	50(U)	Stable	M
A4665	199-N-16	—	—	—	—	—	—	100(U)	123(U)	Stable	M
A4667	199-N-18	—	—	120	—	4.30E+07	15,000	8,550	2,125	Decreasing	M
A4668	199-N-19	—	—	—	—	50(U)	50(U)	50(U)	130	Increasing	M
A4671	199-N-21	—	—	—	—	—	—	—	60(U)	c	M
A4675	199-N-26	—	—	—	—	—	—	—	60(U)	c	M
A4699	199-N-56	—	—	—	—	—	—	—	60(U)	c	M
A9882	199-N-96A	—	—	—	—	50(U)	50(U)	60(U)	45(U)	Stable	M

Table G-8. 100-N Area Contaminants of Concern Summary. (9 sheets)

Well ID	Well Name	CY97 Average	CY98 Average	CY99 Average	CY00 Average	CY01 Average	CY02 Average	CY03 Average	CY04 Average	Annual Comparison[a]	Well Use
Oil and Grease (µg/L)											
A4679	199-N-3	—	—	—	—	—	5,500	920(U)	—	c	M
A4665	199-N-16	—	—	—	—	—	1,500	920(U)	—	c	M
A4667	199-N-18	—	—	—	—	—	42,300	399,375	—	c	M
A4668	199-N-19	—	—	—	—	—	9,900	920(U)	—	c	M
A9882	199-N-96A	—	—	—	—	—	1,300	920(U)	—	c	M

[a] Annual comparison is the percent difference between CY03 and CY04 (or the two most recent years) and is calculated by the following equation: (CY04 - CY03) / CY03 x 100%. Wells are considered stable if there is less than a 20% change in concentration from CY03 to CY04.
[b] Decommissioned.
[c] Not trended because of insufficient data for comparison.
B = analyte detected at value less than the contract-required detection limit but greater than the instrument or method detection limit
C = compliance well
CY = calendar year
E = extraction well
M = monitoring well
U = undetected
— = well not sampled or analytical results not available during report preparation

Table G-9. Aquifer Sampling Tube Results[a] for Calendar Year 2004, 100-HR-3/100-D Groundwater Operable Unit.

Aquifer Sampling Tube Number	Date Sampled	Tritium (pCi/L)	Sulfate (mg/L)	Hexavalent Chromium (µg/L)	Specific Conductance (µS/cm)
AT-D-1-D	04-Mar-04	—	—	18.1	252
AT-D-1-M	04-Mar-04	—	—	6.5	253
AT-D-1-S	04-Mar-04	—	36.7	8.1	311
AT-D-2-S	04-Mar-04	—	27.3	156	298
AT-D-3-D	04-Mar-04	—	48.2	294	343
AT-D-4-D	04-Mar-04	—	13.2	—	161
DD-06-3	09-Mar-04	—	—	3.6	171
DD-10-4	09-Mar-04	—	—	1.5(U)	169
DD-12-2	09-Mar-04	—	—	2.6	134
DD-15-3	09-Mar-04	—	—	12.5	169
DD-17-2	09-Mar-04	—	—	51.3	233
DD-39-1	09-Mar-04	—	—	37.2	627
DD-39-2	09-Mar-04	—	267.0	75.4	912
DD-41-1	09-Mar-04	—	—	5.4	141
DD-41-2	09-Mar-04	—	268.0	149.0	936
DD-41-3	09-Mar-04	—	—	103.5	402
DD-42-2	09-Mar-04	—	9.5	119.0	304
DD-43-2	29-Nov-04	—	—	3.0	—
DD-43-3	09-Mar-04	—	—	206.7	578
DD-44-3	09-Mar-04	—	—	222.0	574
DD-44-4	09-Mar-04	16,955	19.0	118.5	577
DD-49-2	09-Mar-04	—	—	23.0	320
DD-49-3	09-Mar-04	—	—	20.2	237
DD-49-4	09-Mar-04	—	—	21.4	259
DD-50-2	09-Mar-04	—	—	27.4	278
DD-50-3	09-Mar-04	12,300	—	30.2	299
DD-50-4	09-Mar-04	—	—	13.6	229
Redox-1-3.3	29-Nov-04	—	—	19.0	—
Redox-1-6.0	29-Nov-04	—	18.6	123.0	—
Redox-2-3.0	29-Nov-04	—	—	42.0	—
Redox-2-6.0	29-Nov-04	—	134.0	38.0	—
Redox-3-3.3	29-Nov-04	—	—	223.0	—
Redox-3-4.6	29-Nov-04	—	164.0	233.0	—
Redox-4-3.0	29-Nov-04	—	—	79.0	—
Redox-4-6.0	29-Nov-04	—	188.0	85.0	—

[a] Some results are averaged.
— = not analyzed for this constituent.
U = undetected

Table G-10. Aquifer Sampling Tube Results[a] for Calendar Year 2004,
100-HR-3/100-H Groundwater Operable Unit.

Aquifer Sampling Tube Number	Date Sampled	Strontium-90 (pCi/L)	Technetium-99 (pCi/L)	Hexavalent Chromium (µg/L)	Specific Conductance (µS/cm)
47-D	11-Mar-04	—	—	6.3	150.4
48-M	11-Mar-04	—	—	16.2	517.8
48-S	11-Mar-04	—	—	13.7	519.7
49-D	11-Mar-04	—	—	18.8	412.0
49-M	11-Mar-04	—	—	13.1	384.7
49-S	11-Mar-04	—	—	3.6	181.8
50-M	11-Mar-04	—	—	21.5	548.9
50-S	11-Mar-04	—	—	19.6	456.6
51-D	17-Mar-04	—	—	48.2	480.7
51-M	17-Mar-04	—	—	40.5	510.0
51-S	17-Mar-04	—	—	22.0	418.7
AT-H-1-D	11-Mar-04	0.4(U)	-0.9(U)	8.5	297.3
AT-H-1-M	11-Mar-04	—	—	6.9	304.1
AT-H-1-S	11-Mar-04	—	—	10.2	316.0
AT-H-2-D	11-Mar-04	1.2(U)	0.2(U)	8.3	241.8
AT-H-2-M	17-Nov-04	—	—	3.0	—
AT-H-2-S	17-Nov-04	—	—	5.0	—
AT-H-3-D	11-Mar-04	2.4	2.6(U)	11.2	233.8
AT-H-3-S	17-Nov-04	—	—	12.0	—

[a] Some results are averaged.
— = not analyzed for this constituent
U = undetected

Table G-11. Aquifer Sampling Tube Results[a] for Calendar Year 2004, 100-KR-4 Groundwater Operable Unit.

Aquifer Sampling Tube Number	Date Sampled	Tritium (pCi/L)	Sr-90 (pCi/L)	Tc-99 (pCi/L)	C-14 (pCi/L)	Sulfate (mg/L)	Hexavalent Chromium (µg/L)	Specific Conductance (µS/cm)
14-D	23-Feb-04	6,740	0.456	119	—	46.5	6.4	389.7
15-M	23-Feb-04	—	—	—	—	—	1.5(U)	132.0
19-D	23-Feb-04	92(U)	0.415	3.06(U)	4.65(U)	11.5	1.5(U)	167.3
21-M	23-Feb-04	116(U)	1.380	—	—	9.9	37.3	210.7
21-S	24-Feb-04	—	—	—	—	—	1.5(U)	—
22-D	24-Feb-04	80(U)	0.709	—	—	22.4	34.6	232.4
25-D	24-Feb-04	—	—	—	—	—	4.2	153.7
26-D	24-Feb-04	3,090	—	—	—	69.7	36.3	392.4
26-M	24-Feb-04	—	—	—	—	—	4.2	163.3
26-S	24-Feb-04	—	—	—	—	—	1.5(U)	104.4
AT-K-1-D	02-Mar-04	198(U)	—	-1.89(U)	22.5	11.8	2.0	211.4
AT-K-2-D	02-Mar-04	83.6(U)	—	-1.92(U)	20.1	11.2	5.3	207.6
AT-K-3-D	02-Mar-04	—	—	—	—	—	37.0	319.0
AT-K-3-M	02-Mar-04	—	—	—	—	—	52.6	323.0
AT-K-3-S	02-Mar-04	11,900	-0.666(U)	—	—	54.1	62.6	409.0
AT-K-5-D	02-Mar-04	951	-0.075(U)	—	—	39.3	58.7	306.1
AT-K-6-M	02-Mar-04	5,240	-0.063(U)	—	—	67.6	34.2	395.6
DK-04-2	24-Feb-04	3,760	—	—	—	49.7	62.8	312.5
DK-04-3	24-Feb-04	—	—	—	—	—	67.2	345.4

[a] Some results are averaged.
— = not analyzed for this constituent
U = undetected

Table G-12. Aquifer Sampling Tube Results[a] for Calendar Year 2004, 100-NR-2 Groundwater Operable Unit. (3 sheets)

Aquifer Sampling Tube Number	Date Sampled	Sr-90 (pCi/L)	Nitrate (mg/L)	Sulfate (mg/L)	Manganese (µg/L)	Chromium (µg/L)	Specific Conductance (µS/cm)
49-S	11-Mar-04	—	—	—	—	—	181.8
49-M	11-Mar-04	—	—	—	—	—	384.7
49-D	11-Mar-04	—	32.3	50	—	—	412
50-S	11-Mar-04	—	0	0	—	—	456.6
50-M	11-Mar-04	—	49.1	72.8	—	—	548.9
NS-2A-168cm	09-Apr-04	—	2.32	9.44	—	—	—
NS-2A-168cm	09-Apr-04	—	0	0	0.651	0.02(U)	—
NS-2A-23cm	09-Apr-04	—	1.06	9.72	—	—	—
NS-2A-23cm	09-Apr-04	—	0	0	62.4	0.544	—
NS-2A-87cm	09-Apr-04	1,340	1.67	9.56	—	—	138
NS-2A-87cm	09-Apr-04	—	0	0	44.7	0.436	138
NS-3A-10cm	09-Apr-04	—	0.33	8.3	—	—	—
NS-3A-10cm	09-Apr-04	—	0	0	0.67	0.02(U)	—
NS-3A-176cm	09-Apr-04	553	0.93	9.29	—	—	135
NS-3A-176cm	09-Apr-04	—	0	0	23.9	0.174	135
NS-3A-87cm	09-Apr-04	2,800	1.02	9.81	—	—	138
NS-3A-87cm	09-Apr-04	—	0	0	2.88	0.118	138
NS-4A-138cm	09-Apr-04	501	3.75	10.3	—	—	159
NS-4A-138cm	09-Apr-04	—	0	0	8.57	0.993	159
NS-4A-17cm	09-Apr-04	—	4.82	11.2	—	—	—
NS-4A-17cm	09-Apr-04	—	0	0	0.648	1.75	—
NS-2A-168cm	09-Jun-04	423	0	0	—	—	163.3
NS-2A-168cm	09-Jun-04	—	1.06	9.05	—	—	163.3
NS-2A-168cm	09-Jun-04	—	0	0	—	—	163.3
NS-2A-23cm	09-Jun-04	611	0	0	—	—	159.8
NS-2A-23cm	09-Jun-04	—	0.45	8.07	—	—	159.8
NS-2A-23cm	09-Jun-04	—	0	0	—	—	159.8
NS-2A-87cm	09-Jun-04	1,500	0	0	—	—	162.5
NS-2A-87cm	09-Jun-04	—	3.96	9.86	—	—	162.5
NS-2A-87cm	09-Jun-04	—	0	0	—	—	162.5
NS-3A-10cm	09-Jun-04	1,150	0	0	—	—	173.8
NS-3A-10cm	09-Jun-04	—	0.24	5.93	—	—	173.8
NS-3A-10cm	09-Jun-04	—	0	0	—	—	173.8
NS-3A-176cm	09-Jun-04	766	0	0	—	—	149.9
NS-3A-176cm	09-Jun-04	—	0.68	9.43	—	—	149.9
NS-3A-176cm	09-Jun-04	—	0	0	—	—	149.9
NS-3A-87cm	09-Jun-04	3,830	0	0	—	—	173.1
NS-3A-87cm	09-Jun-04	—	0.07	7.05	—	—	173.1

Table G-12. Aquifer Sampling Tube Results[a] for Calendar Year 2004, 100-NR-2 Groundwater Operable Unit. (3 sheets)

Aquifer Sampling Tube Number	Date Sampled	Sr-90 (pCi/L)	Nitrate (mg/L)	Sulfate (mg/L)	Manganese (µg/L)	Chromium (µg/L)	Specific Conductance (µS/cm)
NS-3A-87cm	09-Jun-04	—	0	0	—	—	173.1
NS-4A-138cm	09-Jun-04	118	0	0	—	—	139.2
NS-4A-138cm	09-Jun-04	—	0.29	7.14	—	—	139.2
NS-4A-138cm	09-Jun-04	—	0	0	—	—	139.2
NS-4A-17cm	09-Jun-04	650	0	0	—	—	173.2
NS-4A-17cm	09-Jun-04	—	0.15	7.55	—	—	173.2
NS-4A-17cm	09-Jun-04	—	0	0	—	—	173.2
NS-2A-168cm	16-Aug-04	—	0	0	—	—	137
NS-2A-23cm	16-Aug-04	—	0	0	—	—	164
NS-2A-87cm	16-Aug-04	—	0	0	—	—	158
NS-3A-10cm	16-Aug-04	—	0	0	—	—	159
NS-3A-176cm	16-Aug-04	—	0	0	—	—	162
NS-3A-87cm	16-Aug-04	—	0	0	—	—	151
NS-4A-138cm	16-Aug-04	—	0	0	—	—	173
NS-4A-17cm	16-Aug-04	—	0	0	—	—	155
NS-2A-168cm	25-Sep-04	355	0	0	—	—	161.1
NS-2A-168cm	25-Sep-04	—	5.52	10.5	—	—	—
NS-2A-23cm	25-Sep-04	798	0	0	—	—	162.8
NS-2A-23cm	25-Sep-04	—	3.38	11.6	—	—	—
NS-2A-87cm	25-Sep-04	1,350	0	0	—	—	160.3
NS-2A-87cm	25-Sep-04	—	6.88	10.9	—	—	—
NS-3A-10cm	25-Sep-04	617	0	0	—	—	139.3
NS-3A-10cm	25-Sep-04	—	0.34	10.8	—	—	—
NS-3A-176cm	25-Sep-04	663	0	0	—	—	156
NS-3A-176cm	25-Sep-04	—	3.76	12.4	—	—	—
NS-3A-87cm	25-Sep-04	2,660	0	0	—	—	136.1
NS-3A-87cm	25-Sep-04	—	2.34	11.2	—	—	—
NS-4A-138cm	25-Sep-04	218	0	0	—	—	129.6
NS-4A-138cm	25-Sep-04	—	1.21	11.2	—	—	—
NS-4A-17cm	25-Sep-04	492	0	0	—	—	151.9
NS-4A-17cm	25-Sep-04	—	4	12	—	—	—
NS-3A-10cm	11-Nov-04	2,410	0	0	—	—	—
NS-3A-87cm	11-Nov-04	2,470	0	0	—	—	—
50-M	18-Nov-04	—	46.5	64.6	—	—	—
49-D	18-Nov-04	—	27.9	45.6	—	—	—
NS-4A-17cm	15-Dec-04	—	0	0	3.8	3.3(U)	—
NS-4A-17cm	15-Dec-04	—	1.64	9.1	—	—	—
NS-4A-17cm	15-Dec-04	472	0	0	—	—	—
NS-3A-10cm	15-Dec-04	—	0	0	114	3.3(U)	—

Table G-12. Aquifer Sampling Tube Results[a] for Calendar Year 2004, 100-NR-2 Groundwater Operable Unit. (3 sheets)

Aquifer Sampling Tube Number	Date Sampled	Sr-90 (pCi/L)	Nitrate (mg/L)	Sulfate (mg/L)	Manganese (µg/L)	Chromium (µg/L)	Specific Conductance (µS/cm)
NS-3A-10cm	15-Dec-04	—	0.531	8.8	—	—	—
NS-3A-10cm	15-Dec-04	490	0	0	—	—	—
NS-4A-138cm	15-Dec-04	—	0	0	189	3.3(U)	—
NS-4A-138cm	15-Dec-04	—	0.797	8.2	—	—	—
NS-4A-138cm	15-Dec-04	266	0	0	—	—	—
NS-2A-168cm	15-Dec-04	—	0	0	44.7	3.3(U)	—
NS-2A-168cm	15-Dec-04	—	2.08	9.2	—	—	—
NS-2A-168cm	15-Dec-04	316	0	0	—	—	—
NS-3A-87cm	15-Dec-04	—	0	0	2.5	3.3(U)	—
NS-3A-87cm	15-Dec-04	—	0.841	9	—	—	—
NS-3A-87cm	15-Dec-04	3,020	0	0	—	—	—
NS-3A-176cm	15-Dec-04	—	0	0	5.5	3.3(U)	—
NS-3A-176cm	15-Dec-04	—	1.15	9.2	—	—	—
NS-3A-176cm	15-Dec-04	552	0	0	—	—	—
NS-2A-87cm	15-Dec-04	—	0	0	26.7	3.3(U)	—
NS-2A-87cm	15-Dec-04	—	1.28	9.1	—	—	—
NS-2A-87cm	15-Dec-04	1,180	0	0	—	—	—
NS-2A-23cm	15-Dec-04	—	0	0	34.6	3.4	—
NS-2A-23cm	15-Dec-04	—	0.841	8.6	—	—	—
NS-2A-23cm	15-Dec-04	783	0	0	—	—	—

[a] Some results are averaged.
— = not analyzed for this constituent
U = undetected

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APPENDIX H

100-HR-3 CONTAMINANT TREND PLOTS

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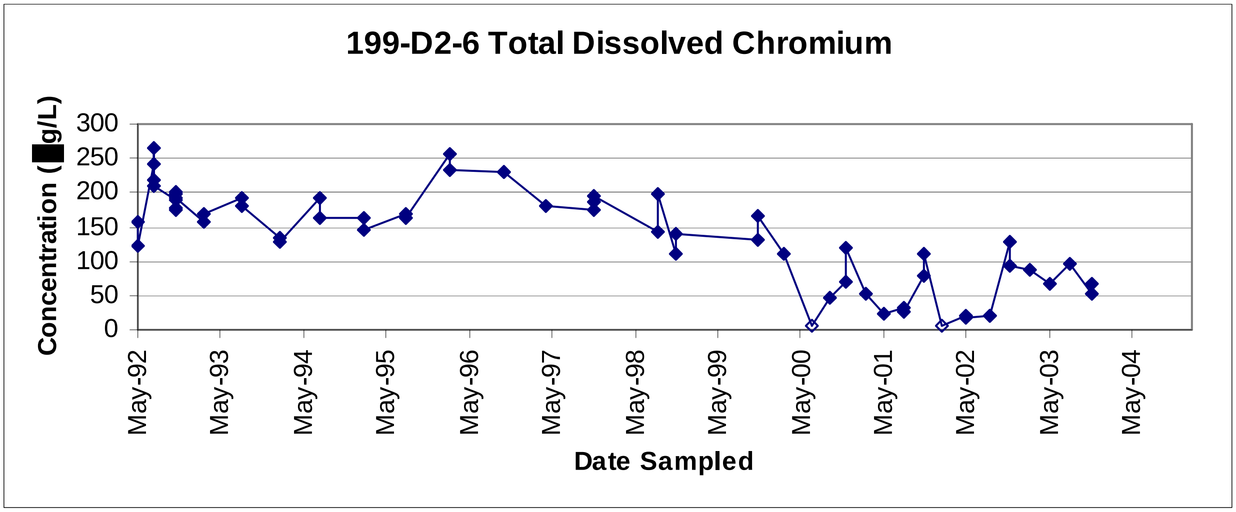
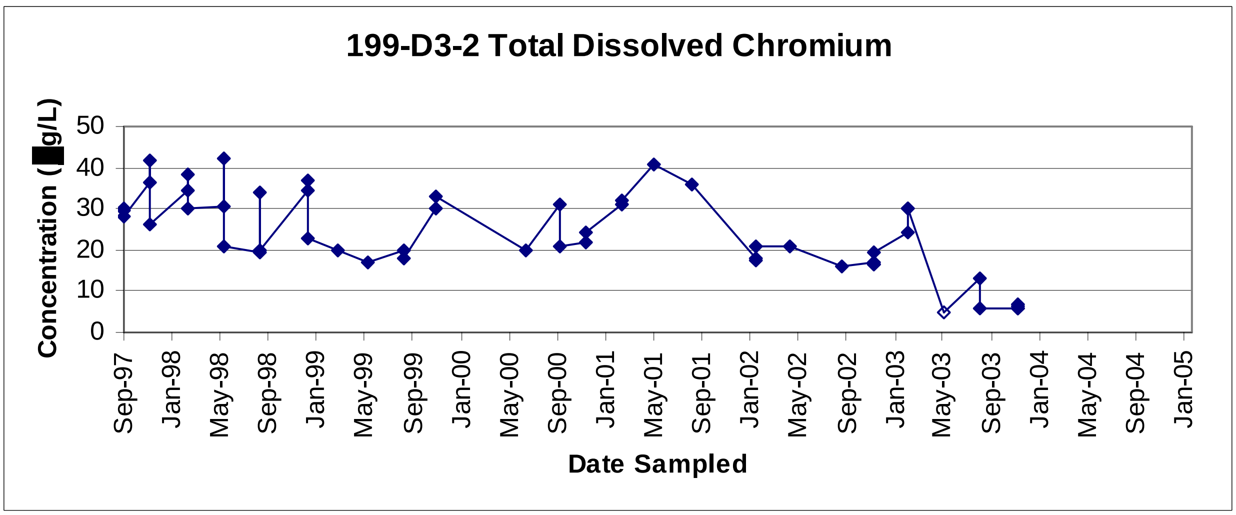
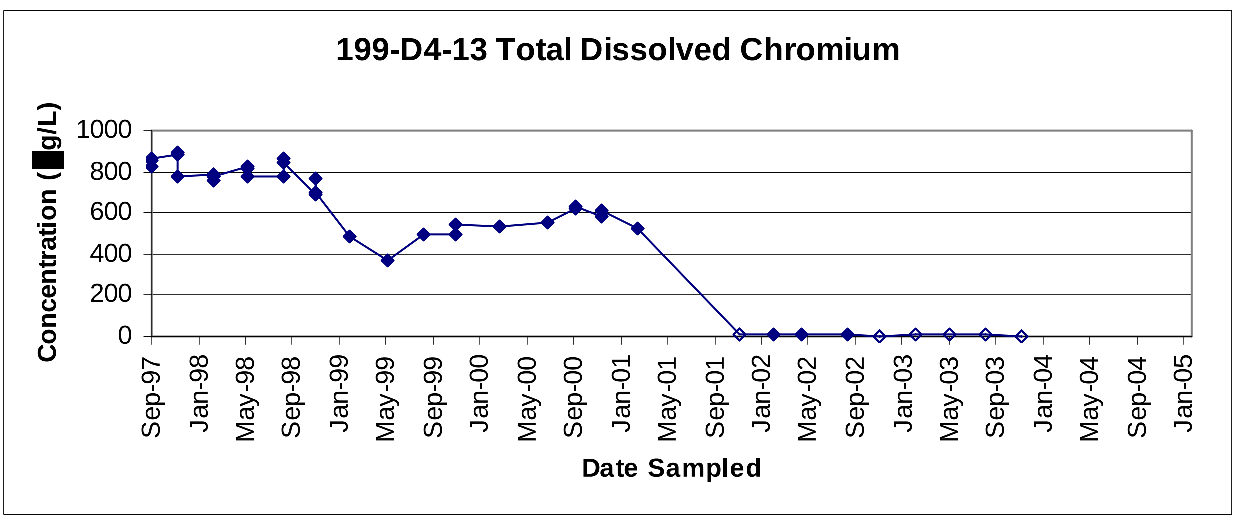
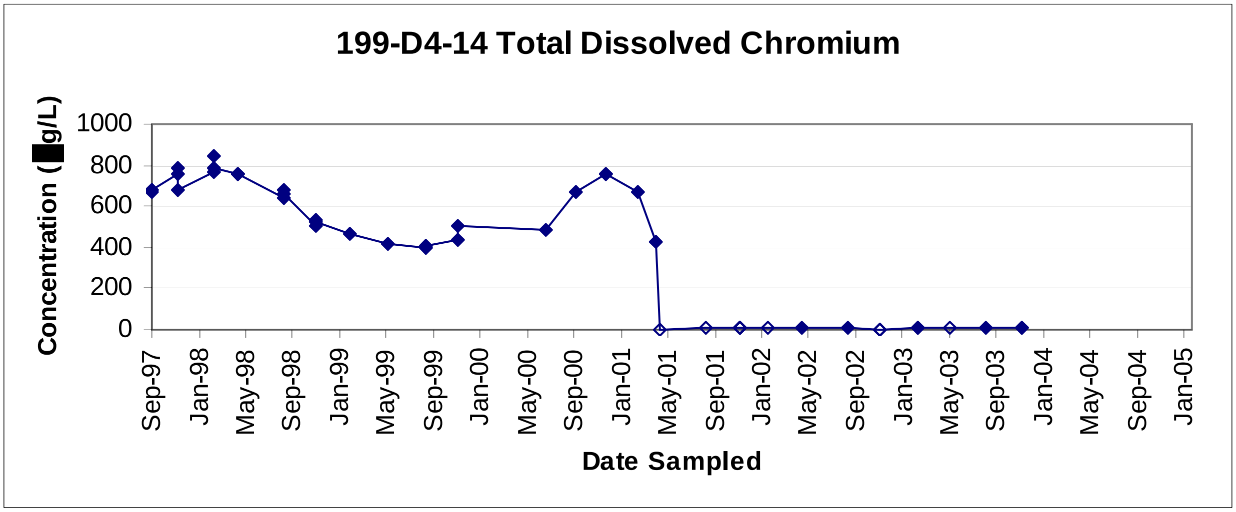
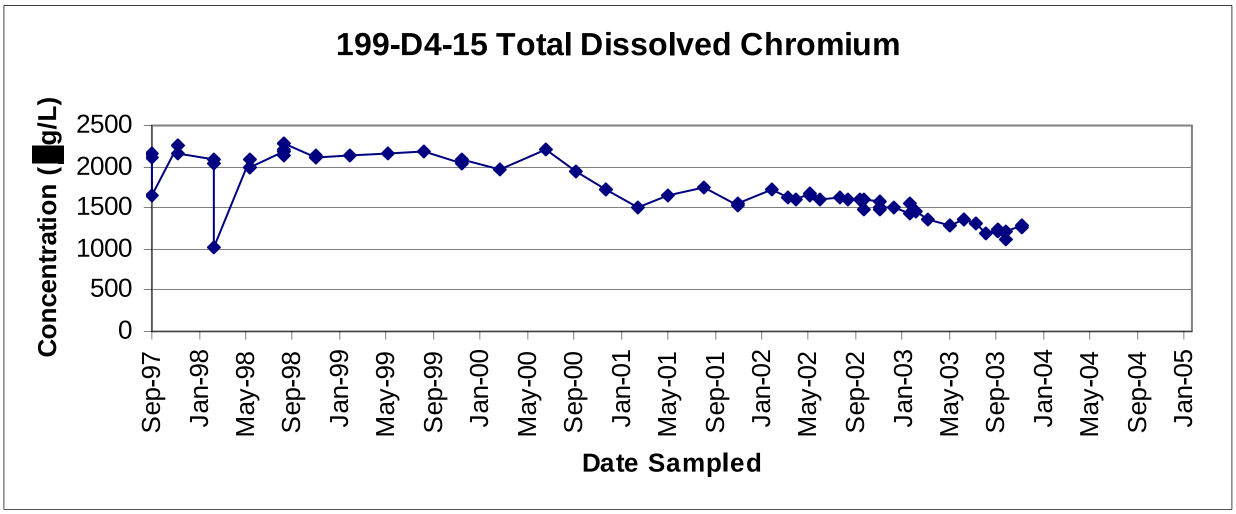
100-D AREA TREND PLOTS

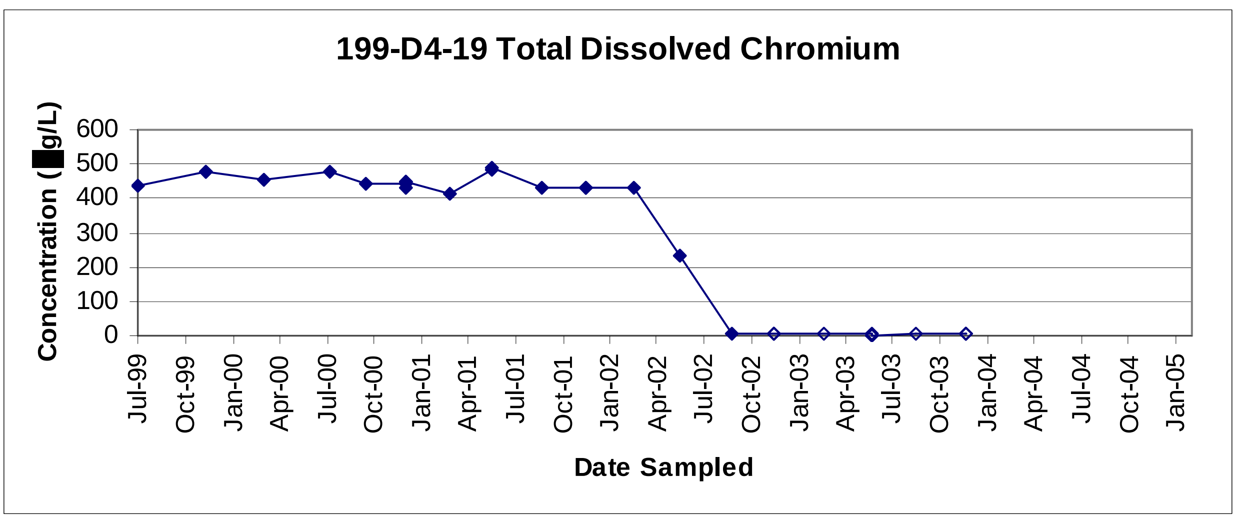

199-D2-6 Total Dissolved Chromium
Concentration (■g/L)
300
250
200
150
100
50
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

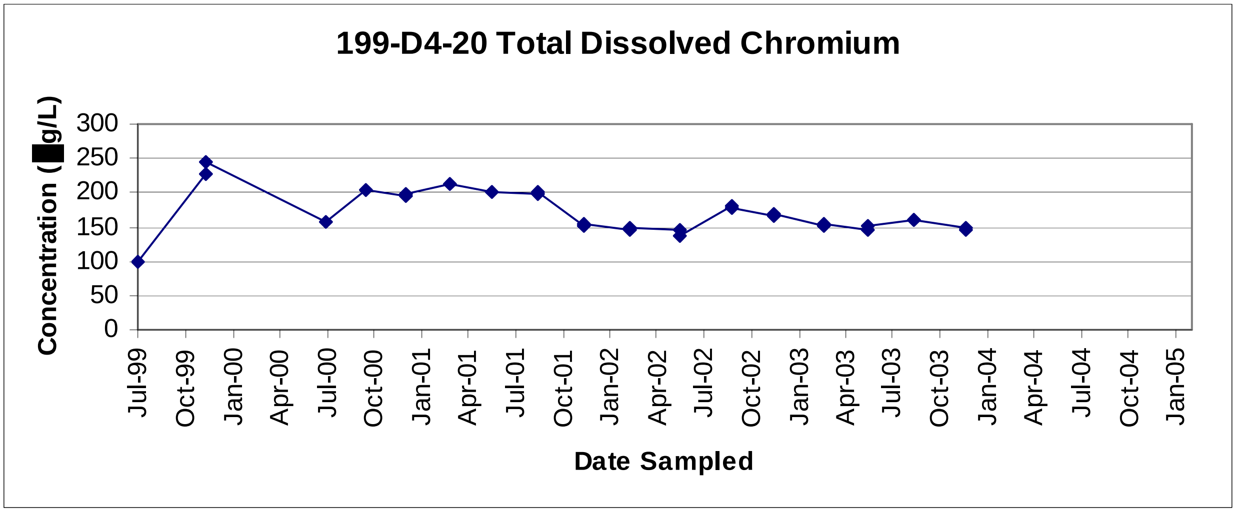

199-D3-2 Total Dissolved Chromium
Concentration (■g/L)
50
40
30
20
10
0
Sep-97
Jan-98
May-98
Sep-98
Jan-99
May-99
Sep-99
Jan-00
May-00
Sep-00
Jan-01
May-01
Sep-01
Jan-02
May-02
Sep-02
Jan-03
May-03
Sep-03
Jan-04
May-04
Sep-04
Jan-05
Date Sampled


199-D4-13 Total Dissolved Chromium
Concentration (■g/L)
1000
800
600
400
200
0
Sep-97
Jan-98
May-98
Sep-98
Jan-99
May-99
Sep-99
Jan-00
May-00
Sep-00
Jan-01
May-01
Sep-01
Jan-02
May-02
Sep-02
Jan-03
May-03
Sep-03
Jan-04
May-04
Sep-04
Jan-05
Date Sampled


199-D4-14 Total Dissolved Chromium
Concentration (■g/L)
1000
800
600
400
200
0
Sep-97 Jan-98 May-98 Sep-98 Jan-99 May-99 Sep-99 Jan-00 May-00 Sep-00 Jan-01 May-01 Sep-01 Jan-02 May-02 Sep-02 Jan-03 May-03 Sep-03 Jan-04 May-04 Sep-04 Jan-05
Date Sampled


199-D4-15 Total Dissolved Chromium
Concentration (■g/L)
2500
2000
1500
1000
500
0
Sep-97 Jan-98 May-98 Sep-98 Jan-99 May-99 Sep-99 Jan-00 May-00 Sep-00 Jan-01 May-01 Sep-01 Jan-02 May-02 Sep-02 Jan-03 May-03 Sep-03 Jan-04 May-04 Sep-04 Jan-05
Date Sampled


199-D4-19 Total Dissolved Chromium
Concentration (■g/L)
600
500
400
300
200
100
0
Jul-99 Oct-99 Jan-00 Apr-00 Jul-00 Oct-00 Jan-01 Apr-01 Jul-01 Oct-01 Jan-02 Apr-02 Jul-02 Oct-02 Jan-03 Apr-03 Jul-03 Oct-03 Jan-04 Apr-04 Jul-04 Oct-04 Jan-05
Date Sampled


199-D4-20 Total Dissolved Chromium
Concentration (µg/L)
300
250
200
150
100
50
0
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
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Apr-03
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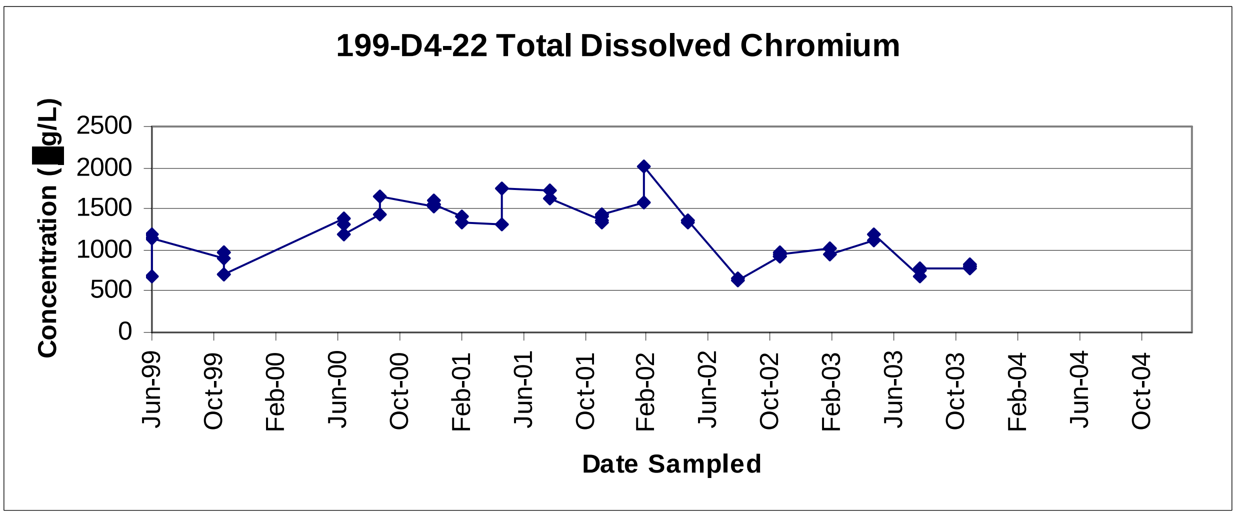
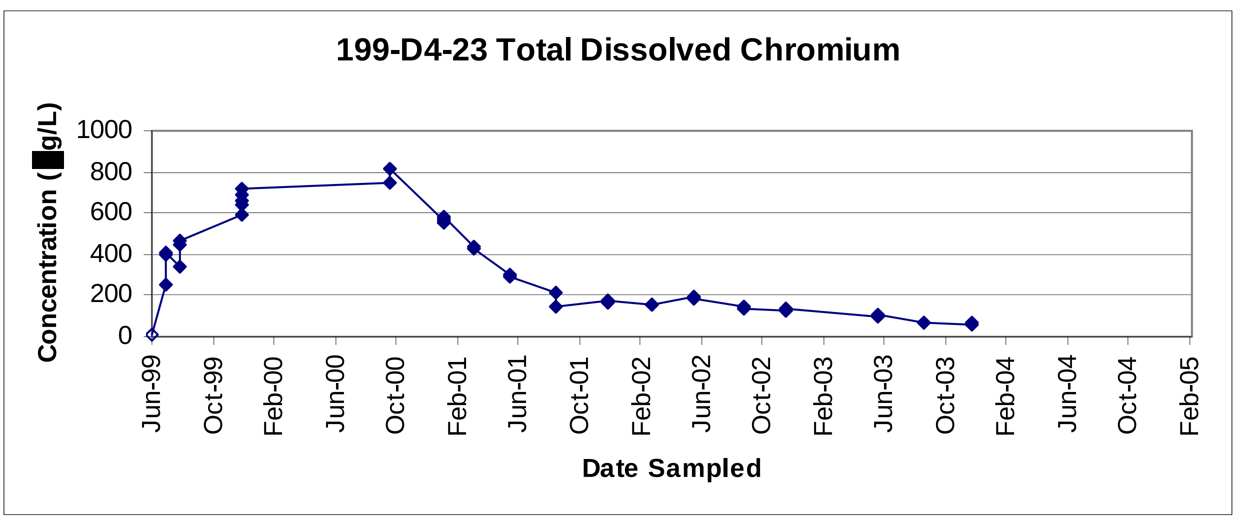
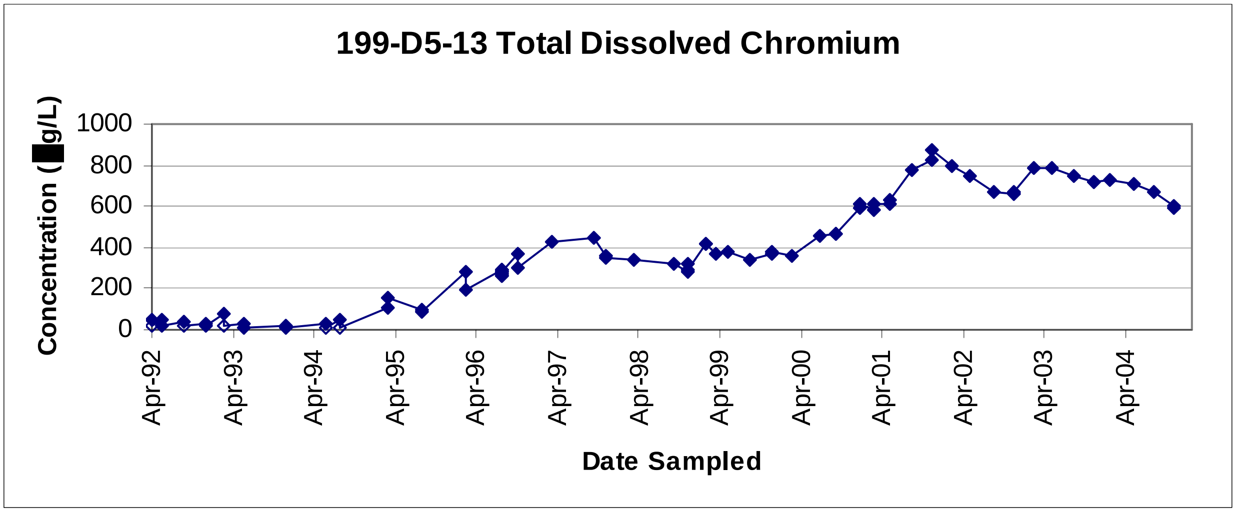
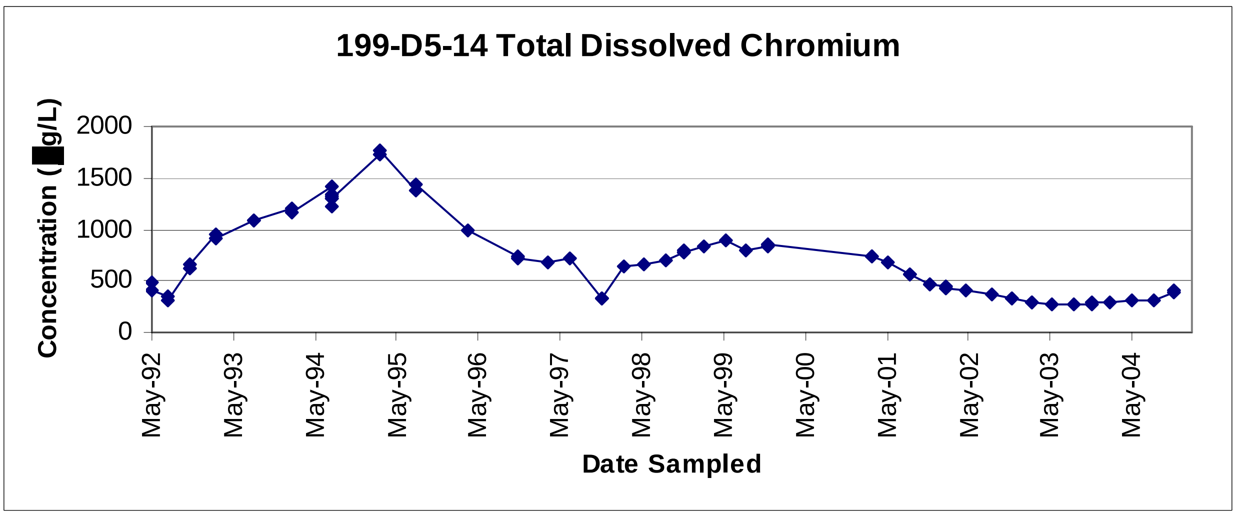
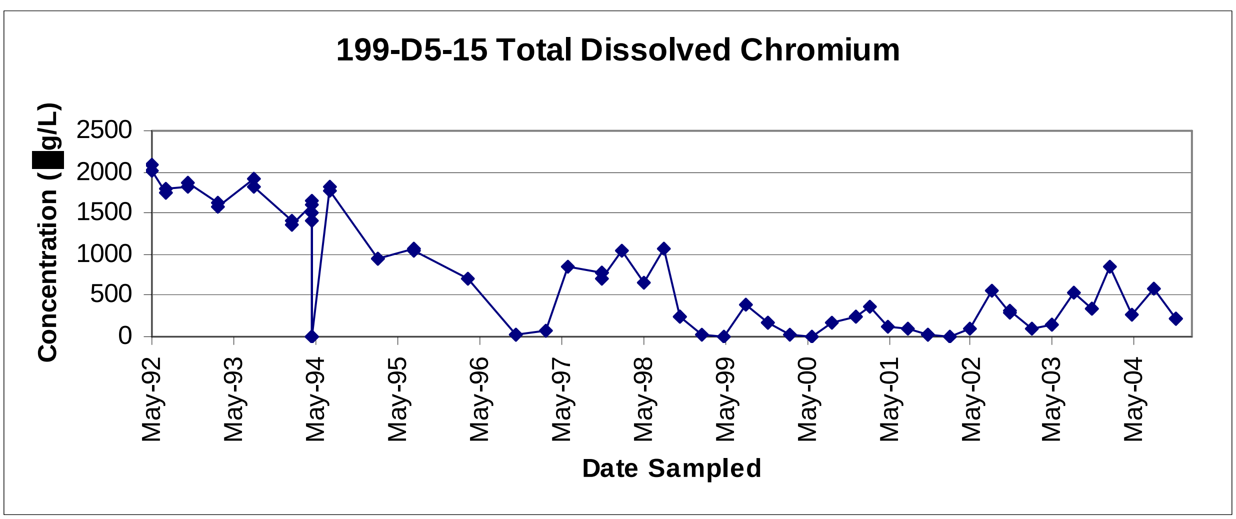
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Date Sampled

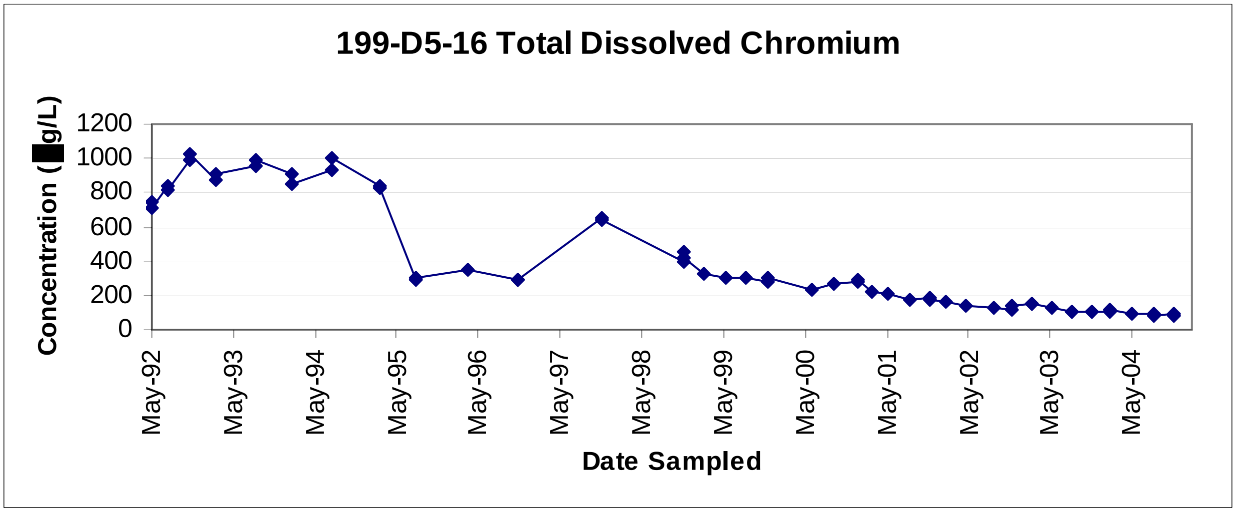

199-D4-22 Total Dissolved Chromium
Concentration (µg/L)
2500
2000
1500
1000
500
0
Jun-99
Oct-99
Feb-00
Jun-00
Oct-00
Feb-01
Jun-01
Oct-01
Feb-02
Jun-02
Oct-02
Feb-03
Jun-03
Oct-03
Feb-04
Jun-04
Oct-04
Date Sampled

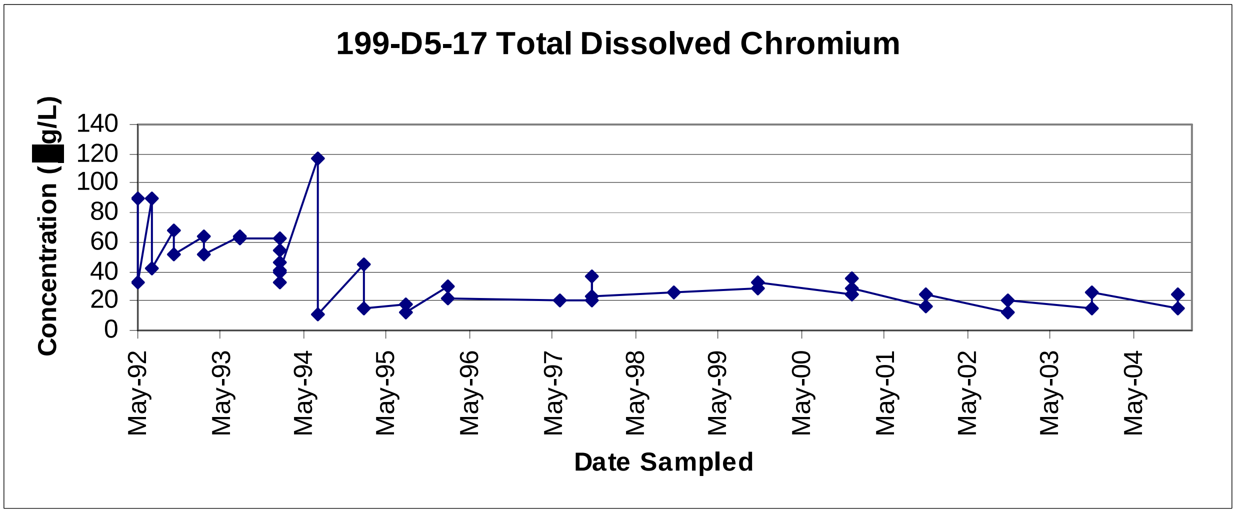

199-D4-23 Total Dissolved Chromium
Concentration (µg/L)
1000
800
600
400
200
0
Jun-99
Oct-99
Feb-00
Jun-00
Oct-00
Feb-01
Jun-01
Oct-01
Feb-02
Jun-02
Oct-02
Feb-03
Jun-03
Oct-03
Feb-04
Jun-04
Oct-04
Feb-05
Date Sampled

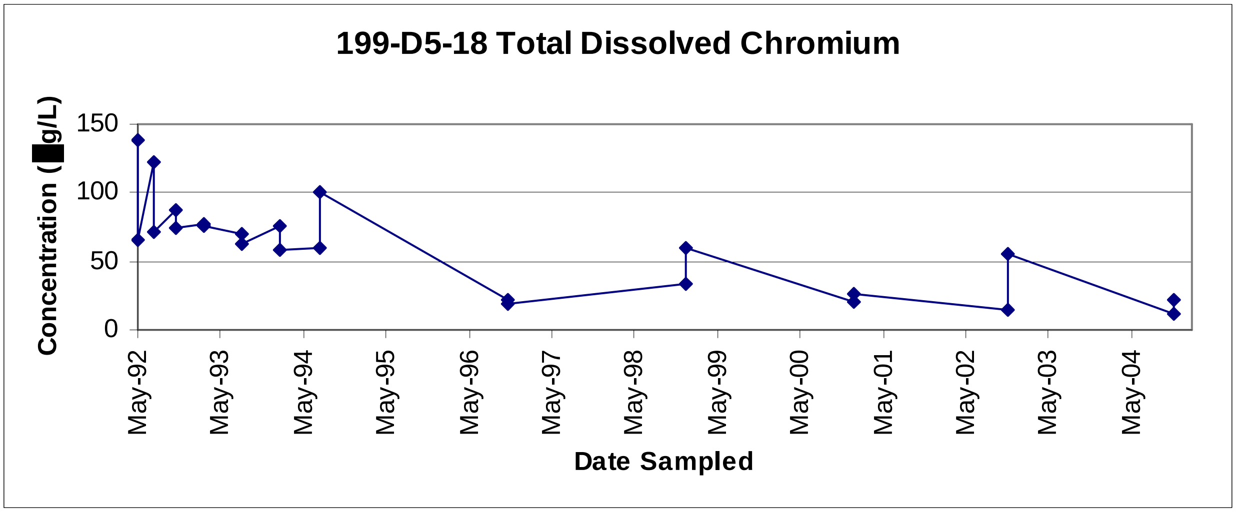

199-D5-13 Total Dissolved Chromium
Concentration (■g/L)
0
200
400
600
800
1000
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled

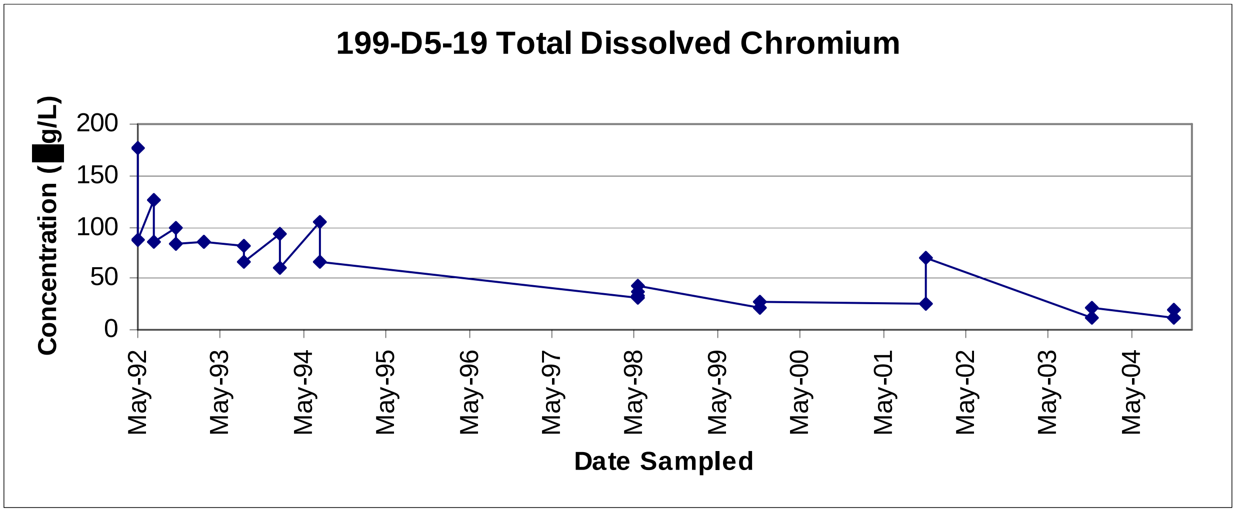

199-D5-14 Total Dissolved Chromium
Concentration (■g/L)
0
500
1000
1500
2000
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

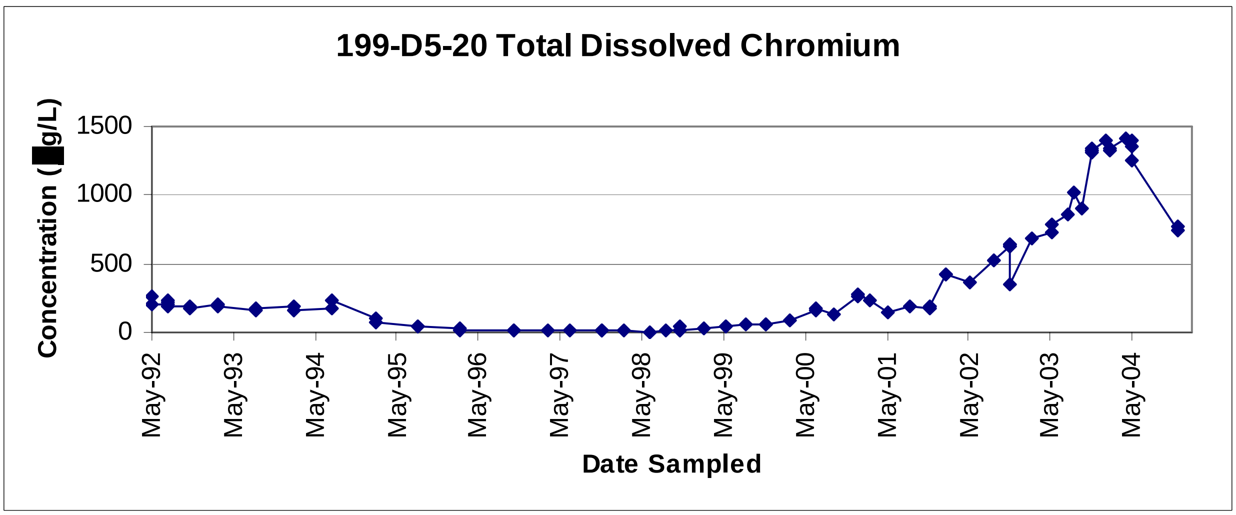

199-D5-15 Total Dissolved Chromium
Concentration (■g/L)
0
500
1000
1500
2000
2500
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

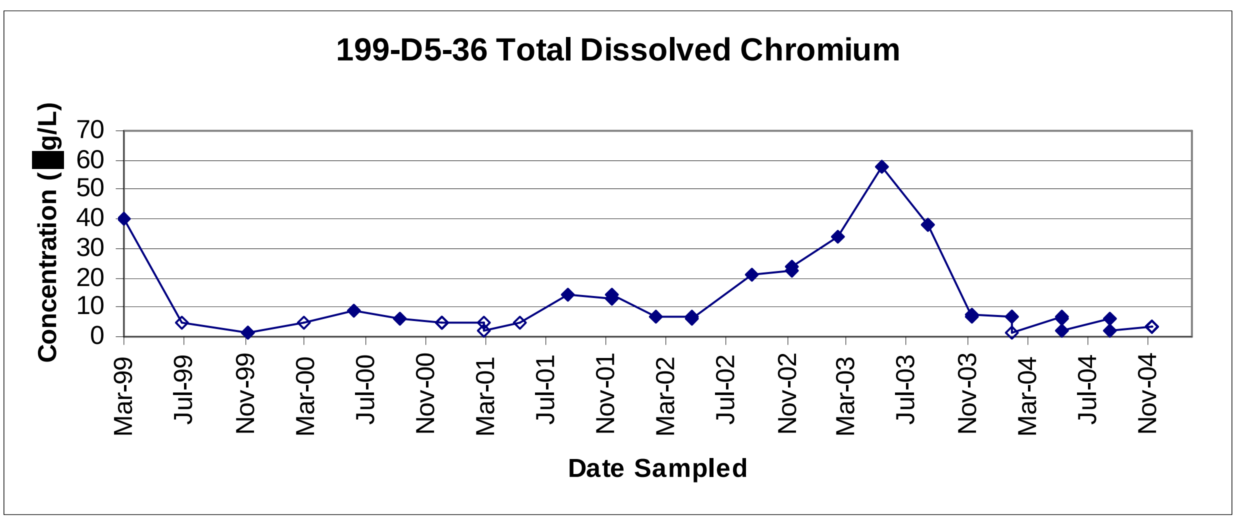

199-D5-16 Total Dissolved Chromium
Concentration (■g/L)
1200
1000
800
600
400
200
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

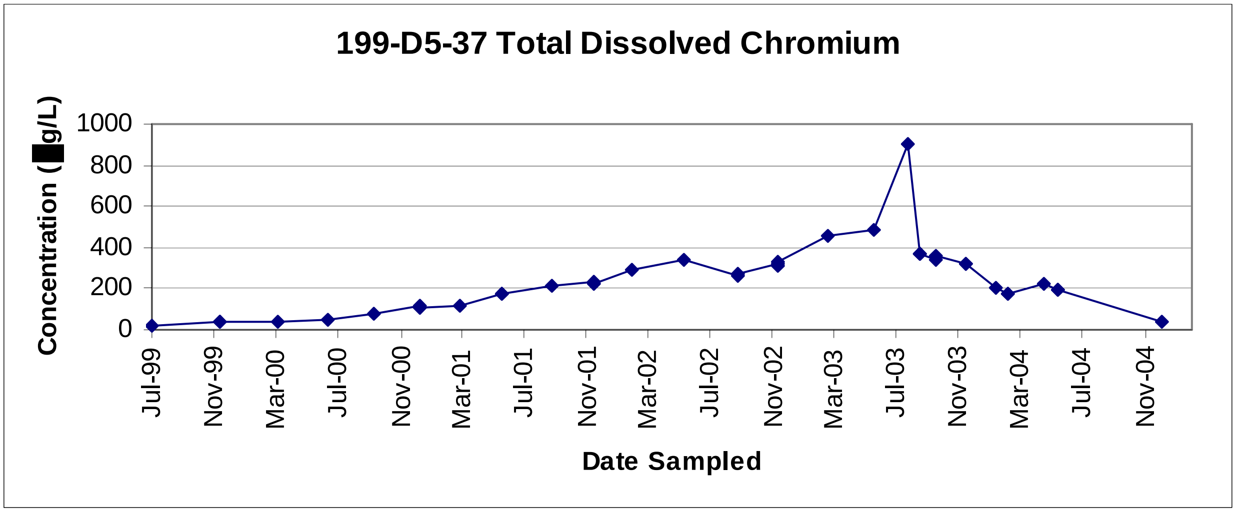

199-D5-17 Total Dissolved Chromium
Concentration (■g/L)
140
120
100
80
60
40
20
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

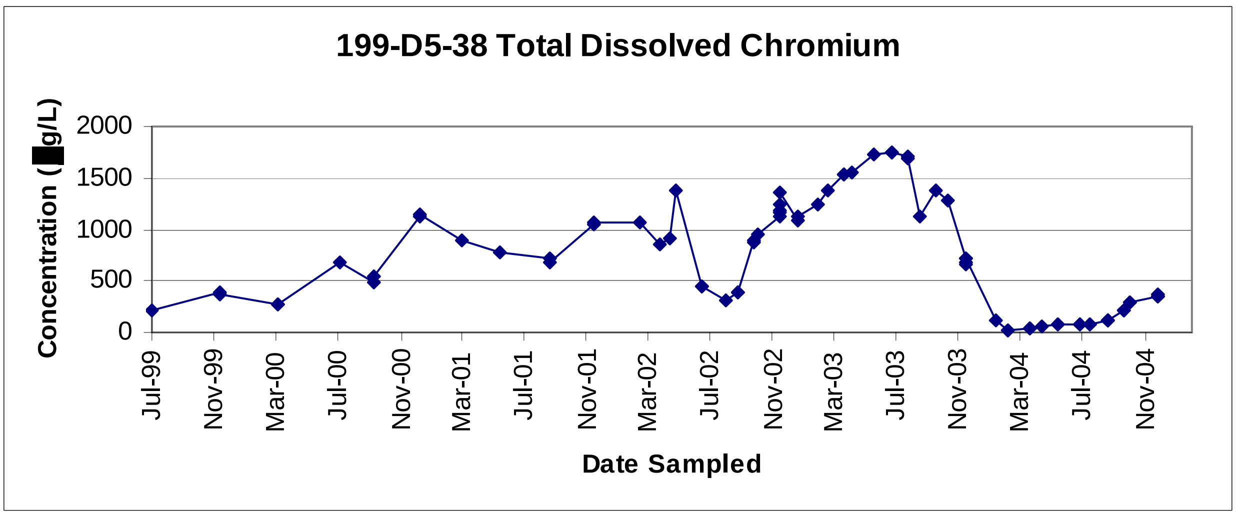

199-D5-18 Total Dissolved Chromium
Concentration (■g/L)
150
100
50
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

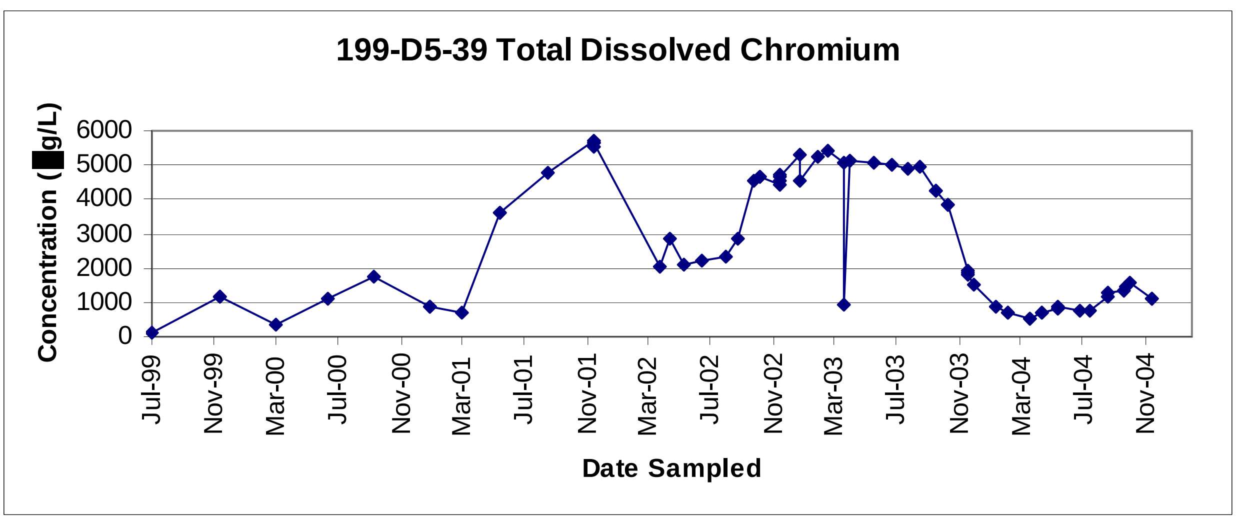

199-D5-19 Total Dissolved Chromium
Concentration (g/L)
200
150
100
50
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

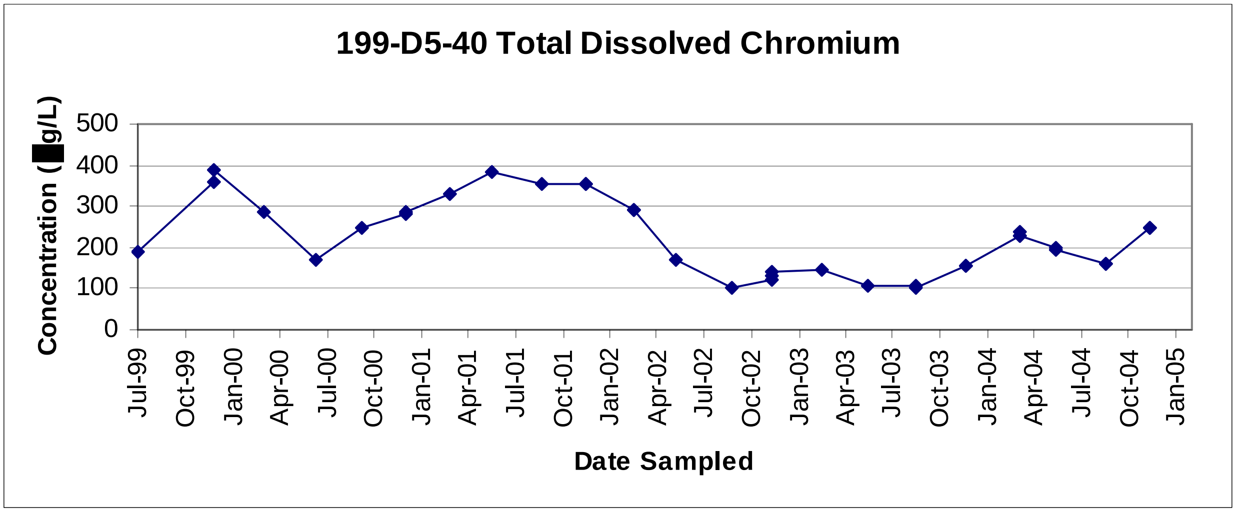

199-D5-20 Total Dissolved Chromium
Concentration (g/L)
1500
1000
500
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

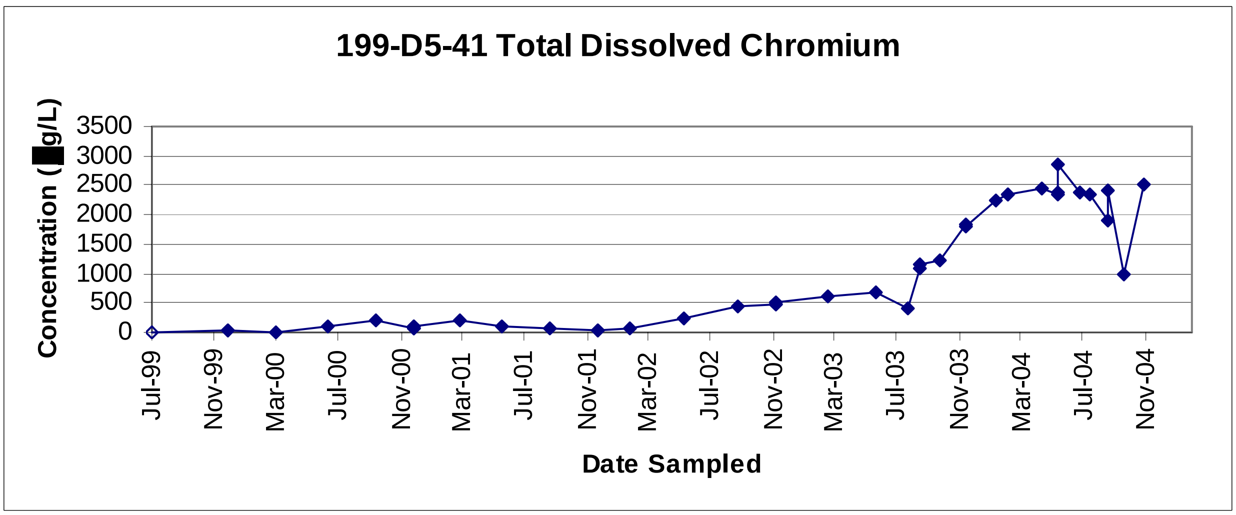

199-D5-36 Total Dissolved Chromium
Concentration (g/L)
70
60
50
40
30
20
10
0
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Date Sampled

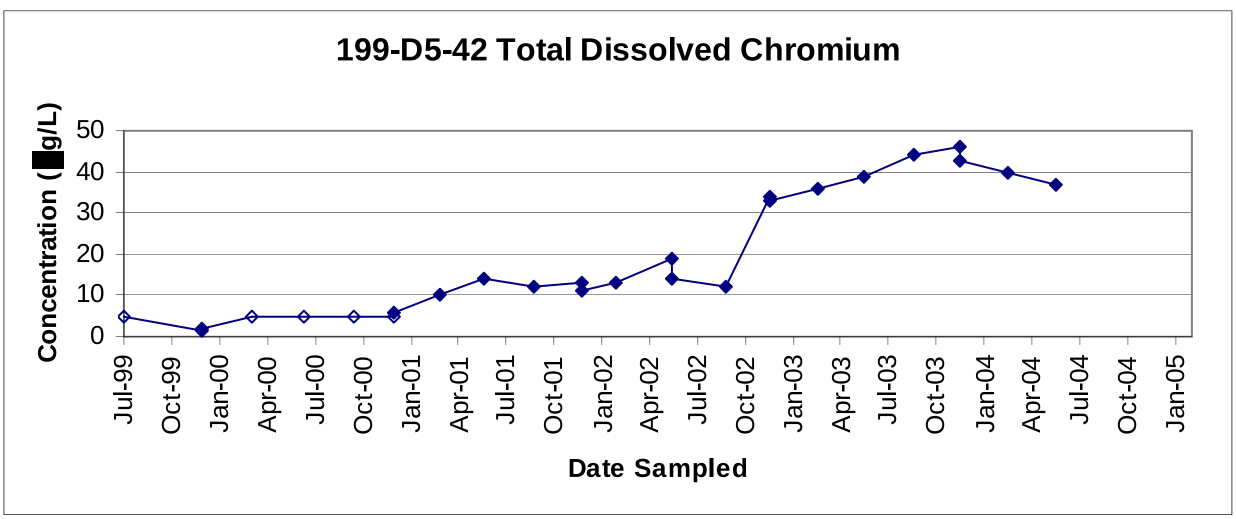

199-D5-37 Total Dissolved Chromium
Concentration ([redacted]g/L)
1000
800
600
400
200
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Date Sampled

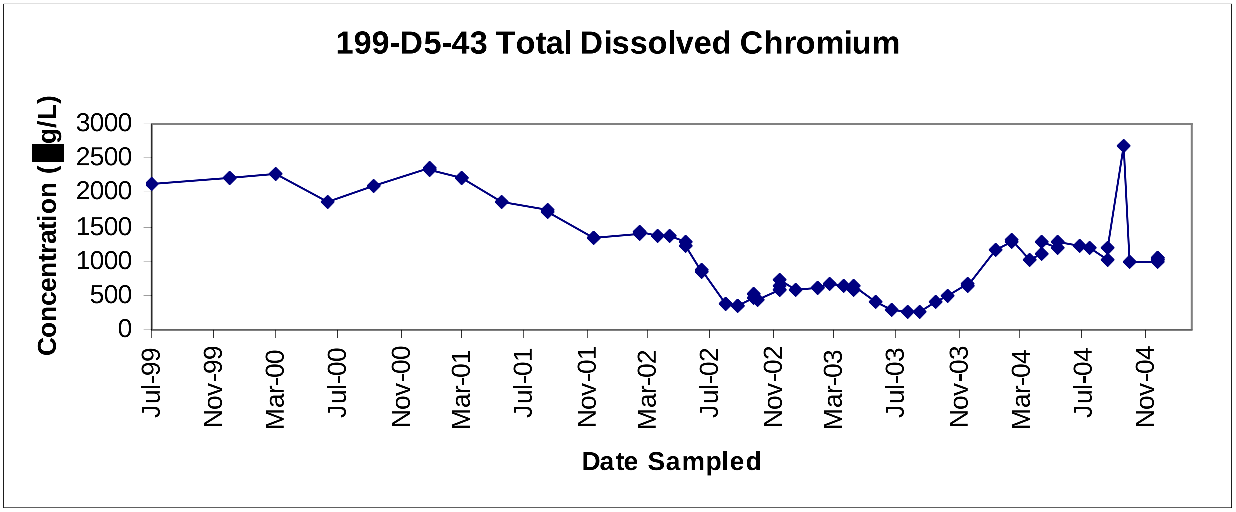

199-D5-38 Total Dissolved Chromium
Concentration ([redacted]g/L)
2000
1500
1000
500
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Date Sampled

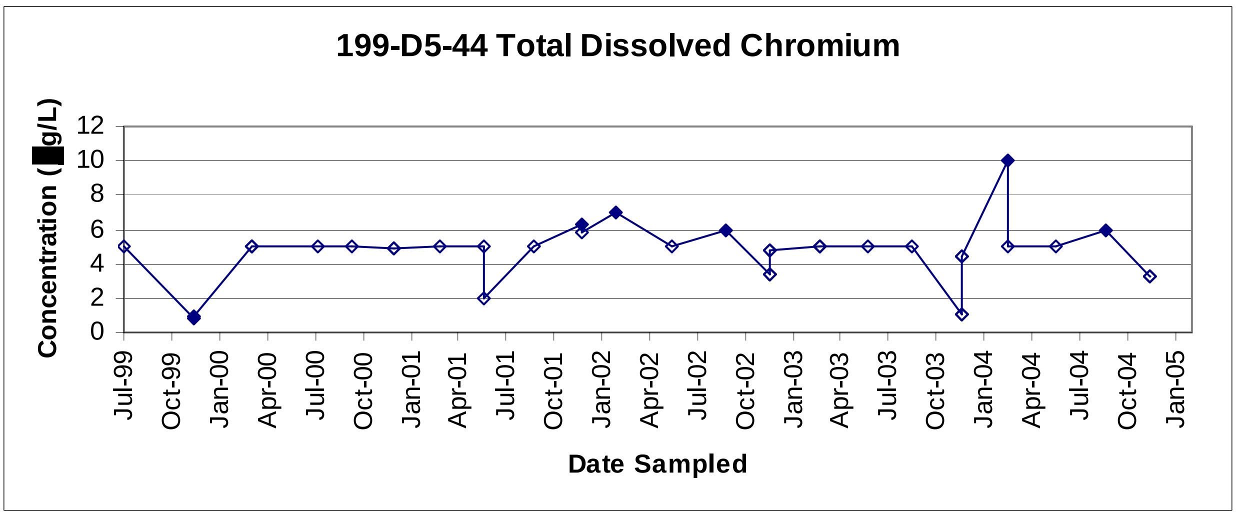

199-D5-39 Total Dissolved Chromium
Concentration ([redacted]g/L)
6000
5000
4000
3000
2000
1000
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Date Sampled

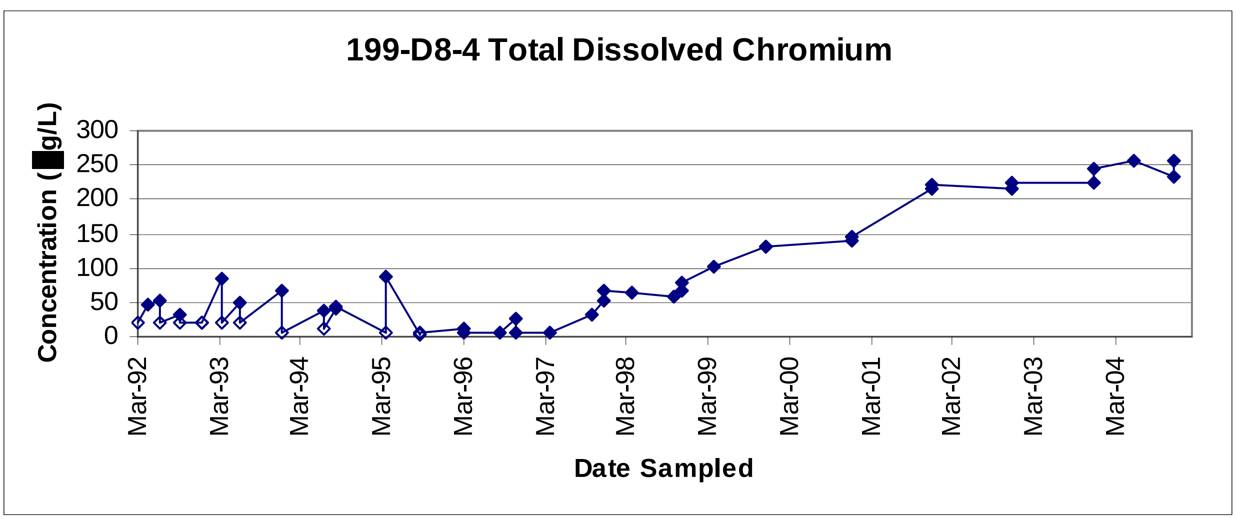

199-D5-40 Total Dissolved Chromium
Concentration (■g/L)
500
400
300
200
100
0
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Date Sampled

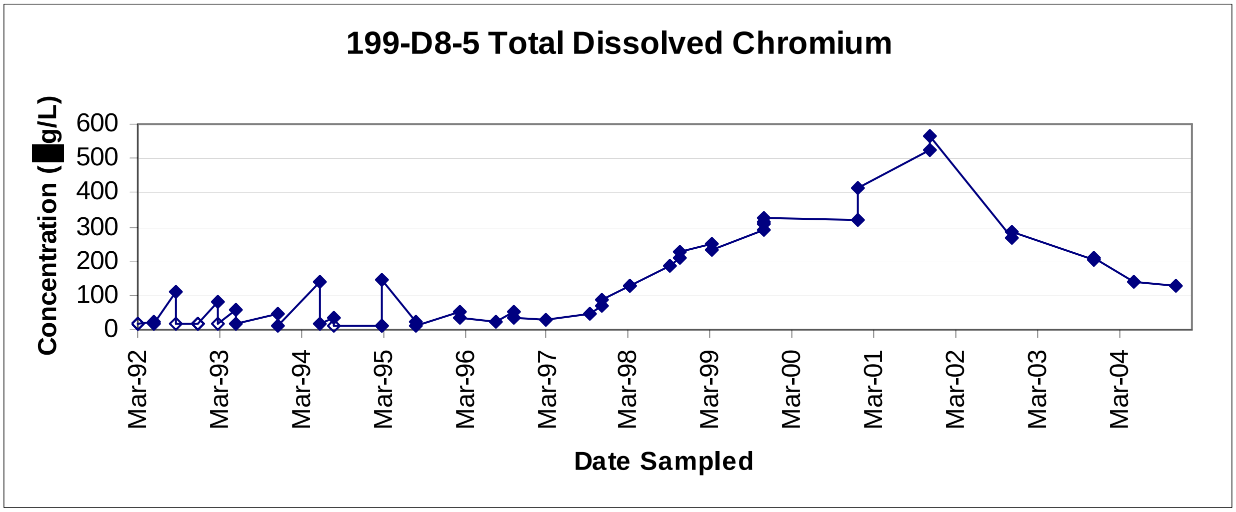

199-D5-41 Total Dissolved Chromium
Concentration (■g/L)
3500
3000
2500
2000
1500
1000
500
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Date Sampled

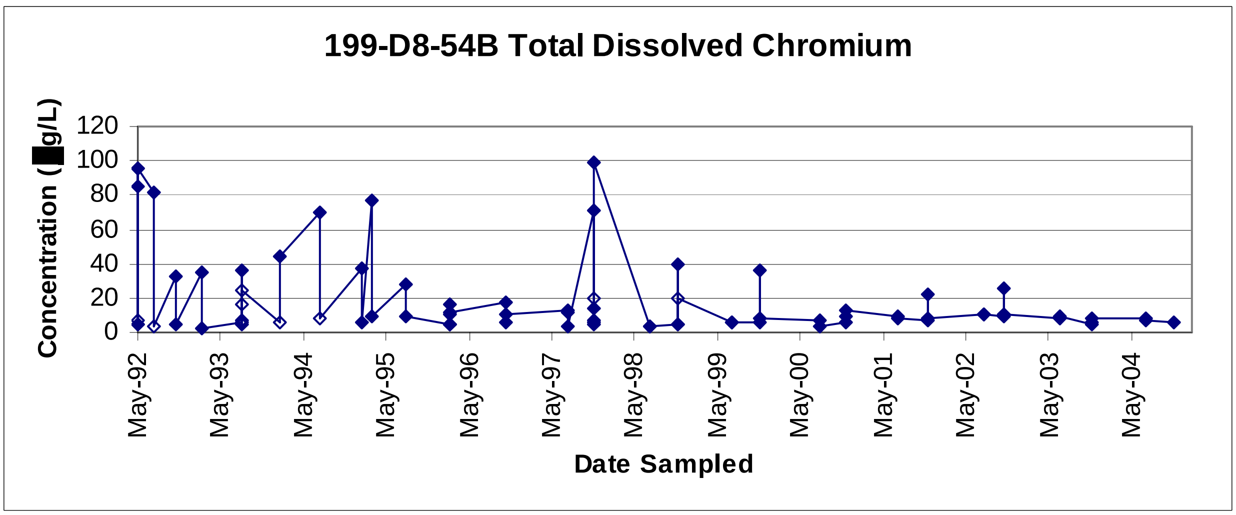

199-D5-42 Total Dissolved Chromium
Concentration (■g/L)
50
40
30
20
10
0
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Date Sampled

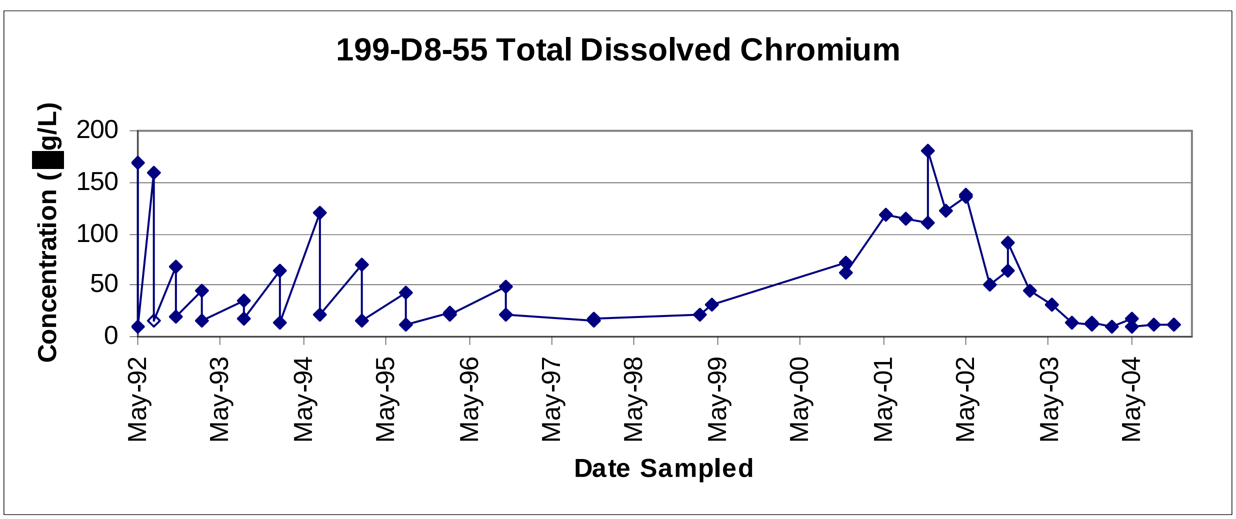

199-D5-43 Total Dissolved Chromium
Concentration (■g/L)
3000
2500
2000
1500
1000
500
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Date Sampled

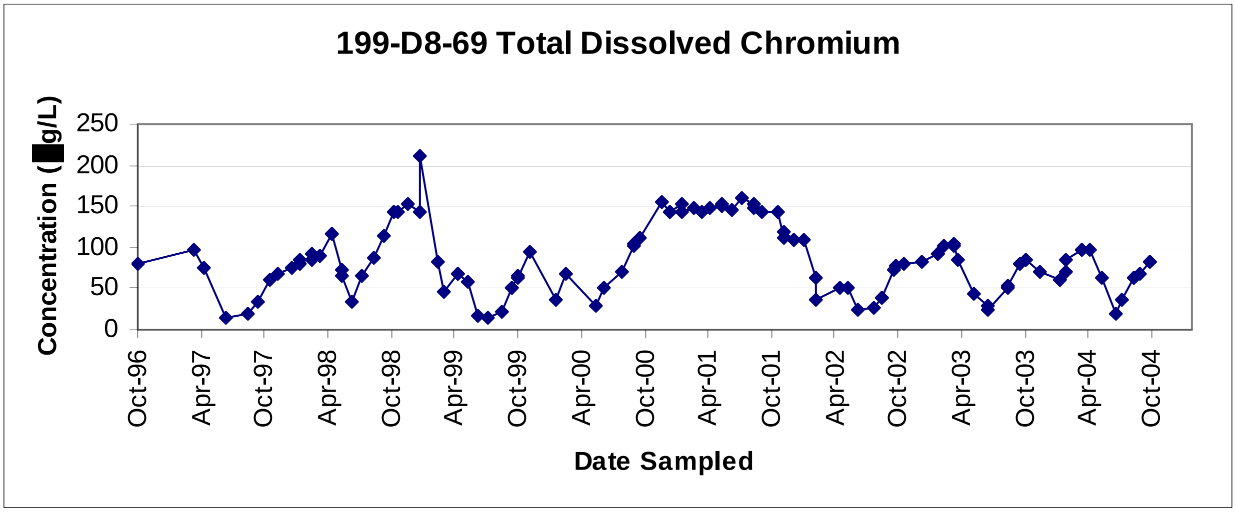

199-D5-44 Total Dissolved Chromium
Concentration (■g/L)
12
10
8
6
4
2
0
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Date Sampled

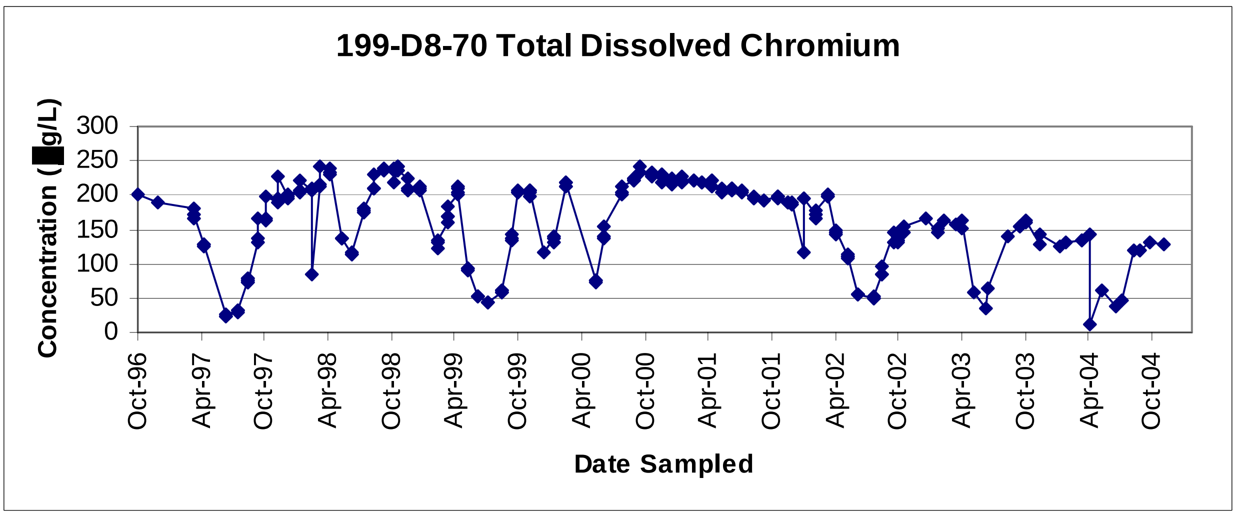

199-D8-4 Total Dissolved Chromium
Concentration (■g/L)
300
250
200
150
100
50
0
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

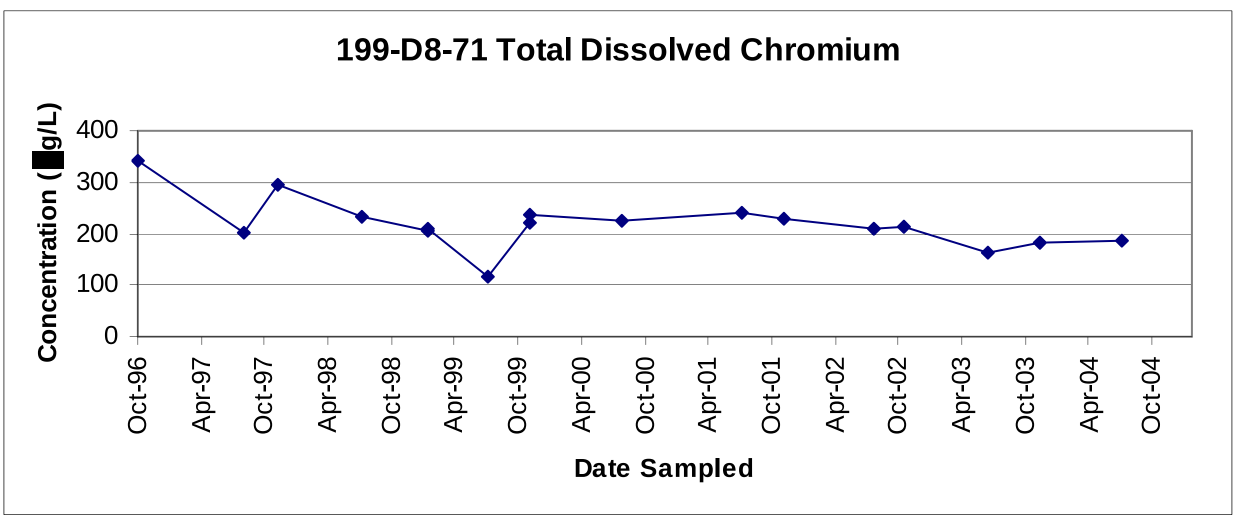

199-D8-5 Total Dissolved Chromium
Concentration (■g/L)
0
100
200
300
400
500
600
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

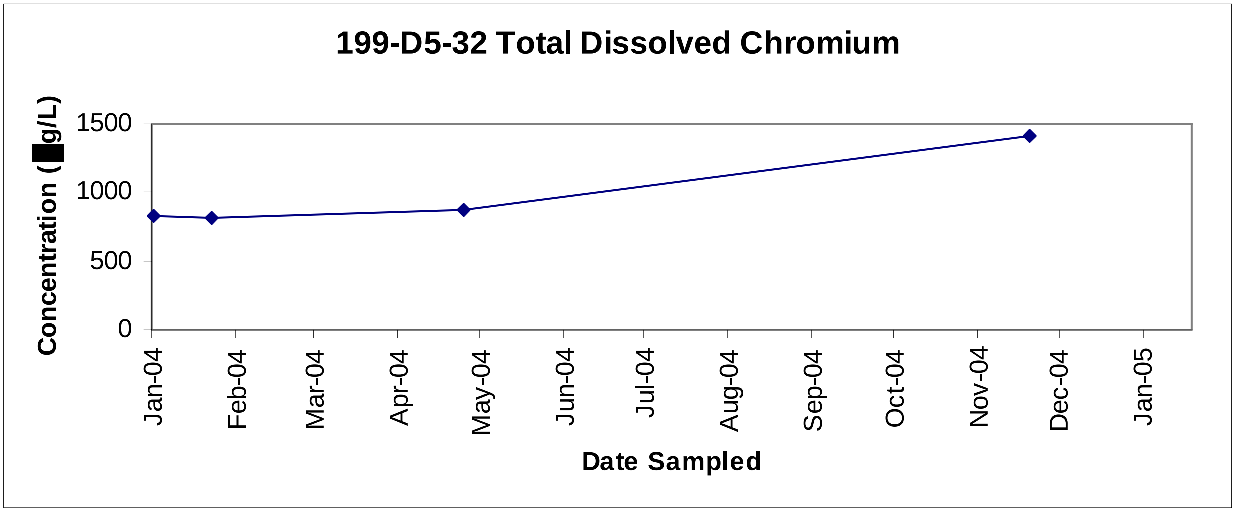

199-D8-54B Total Dissolved Chromium
Concentration (■g/L)
0
20
40
60
80
100
120
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

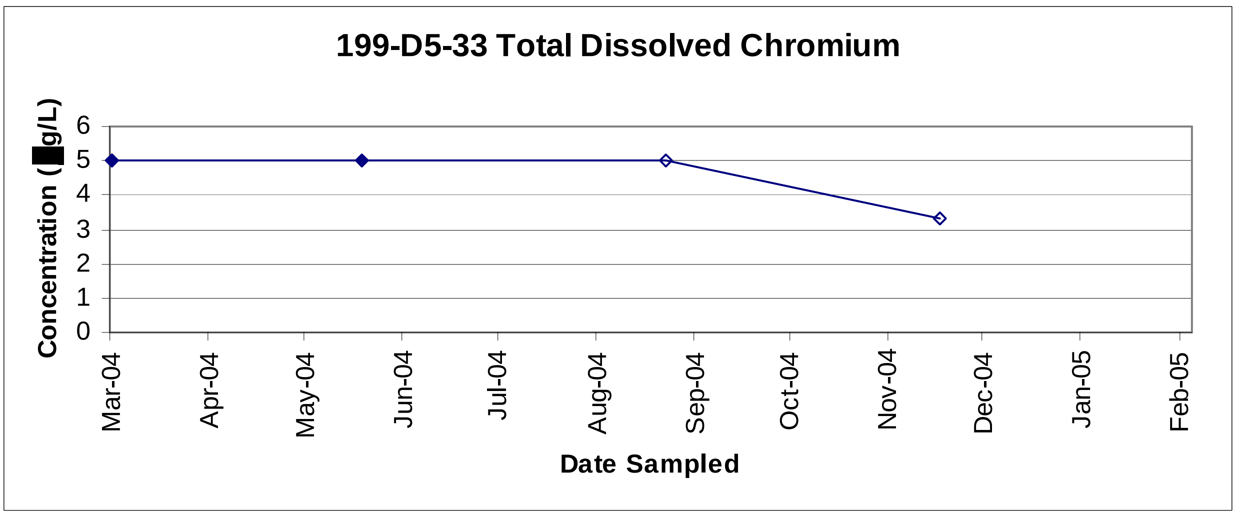

199-D8-55 Total Dissolved Chromium
Concentration (■g/L)
0
50
100
150
200
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

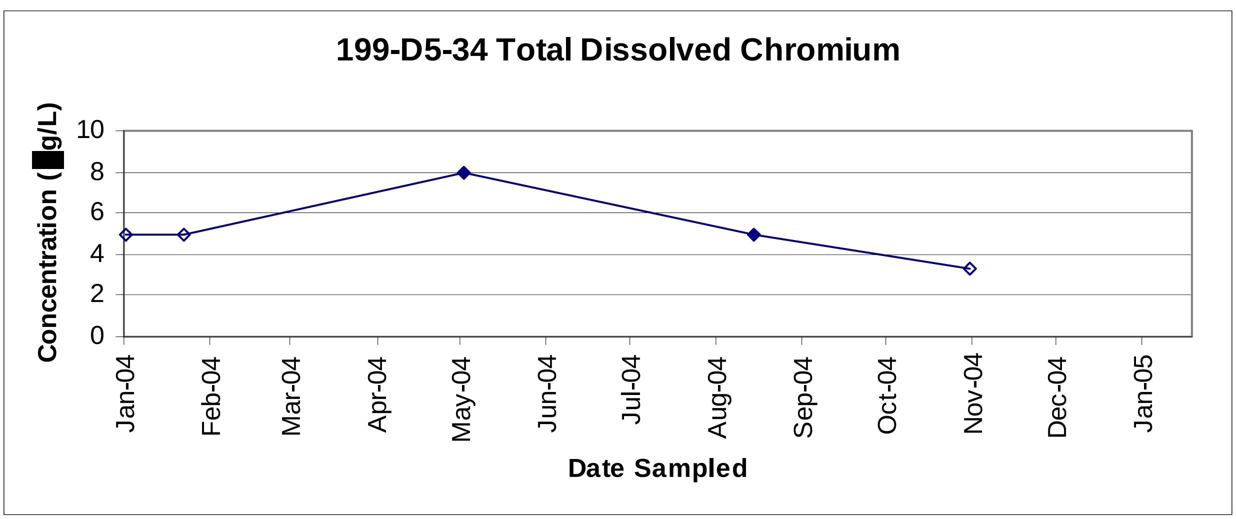

199-D8-69 Total Dissolved Chromium
Concentration ([redacted]g/L)
250
200
150
100
50
0
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled

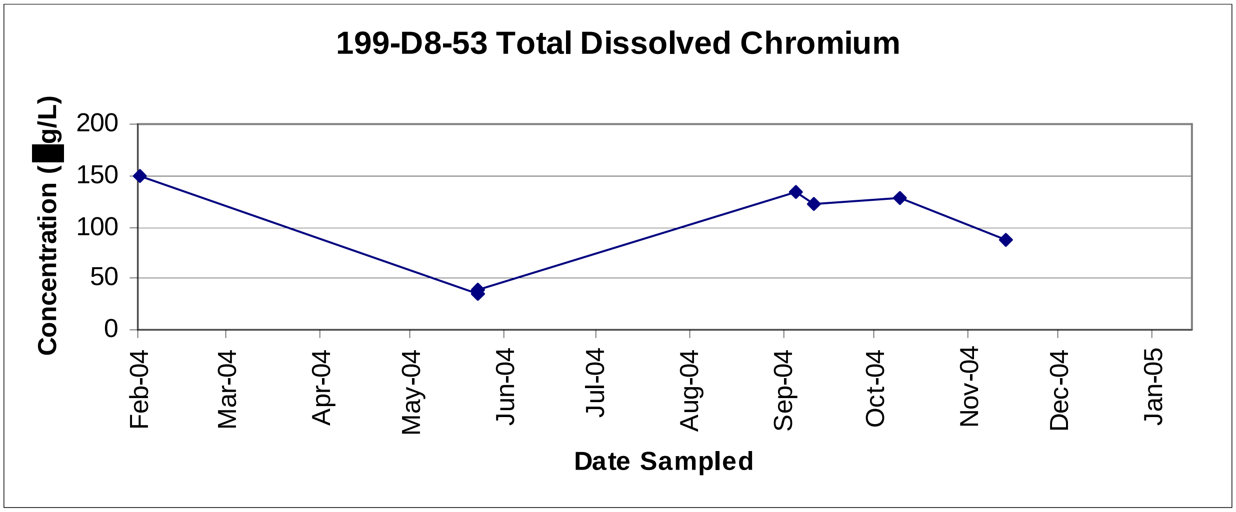

199-D8-70 Total Dissolved Chromium
Concentration ([redacted]g/L)
300
250
200
150
100
50
0
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled

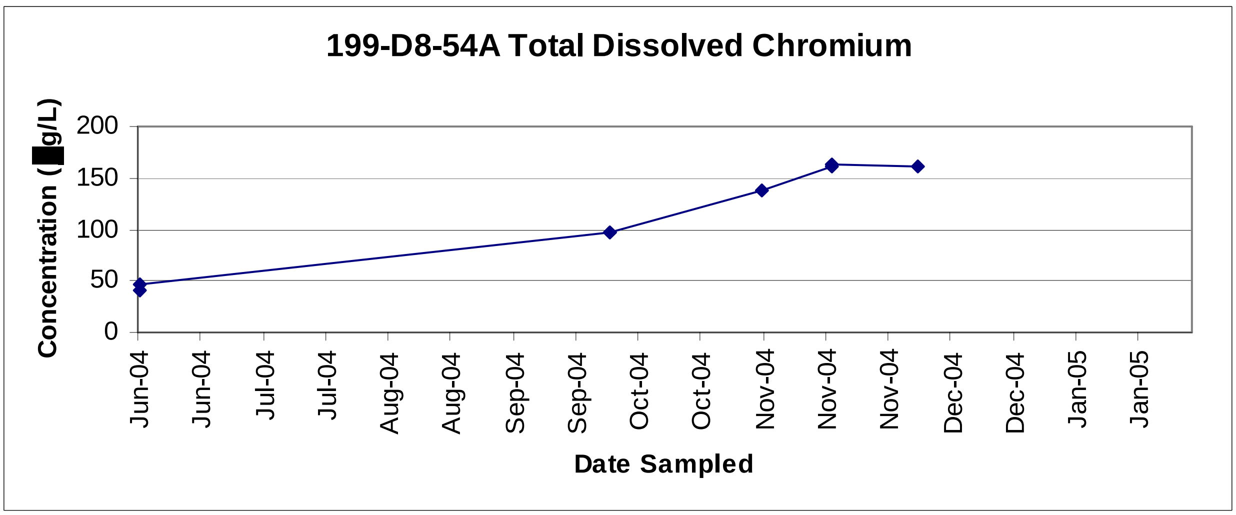

199-D8-71 Total Dissolved Chromium
Concentration ([redacted]g/L)
400
300
200
100
0
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled

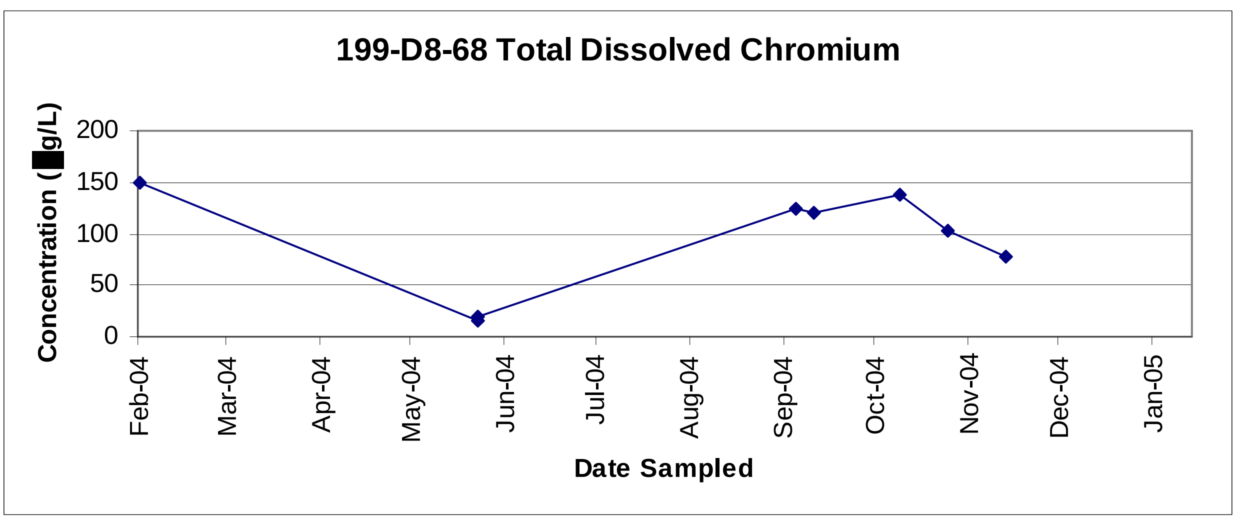

199-D5-32 Total Dissolved Chromium
Concentration (■g/L)
1500
1000
500
0
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

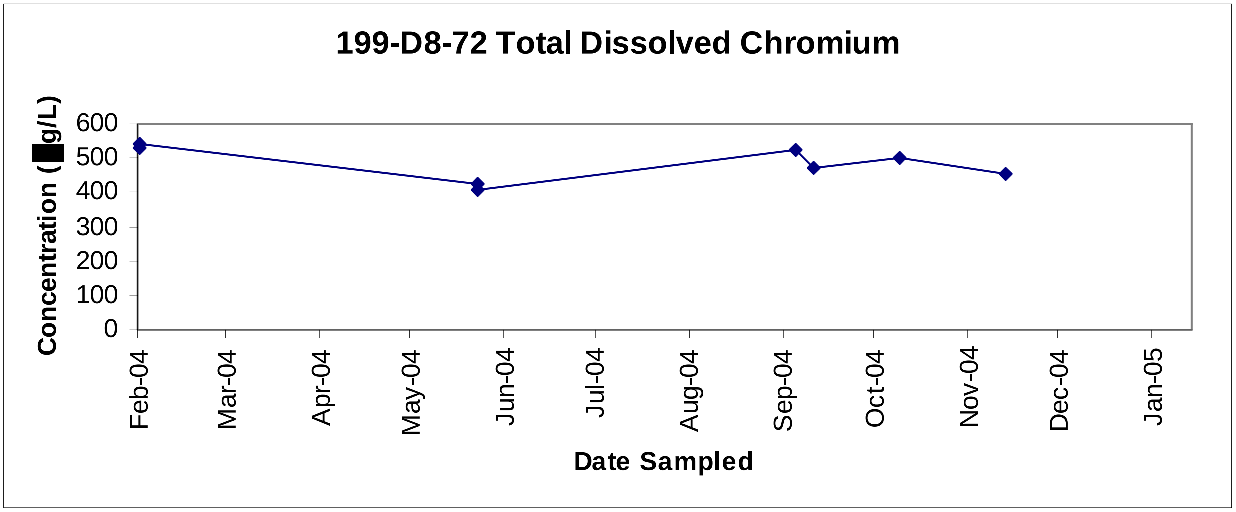

199-D5-33 Total Dissolved Chromium
Concentration (■g/L)
6
5
4
3
2
1
0
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled

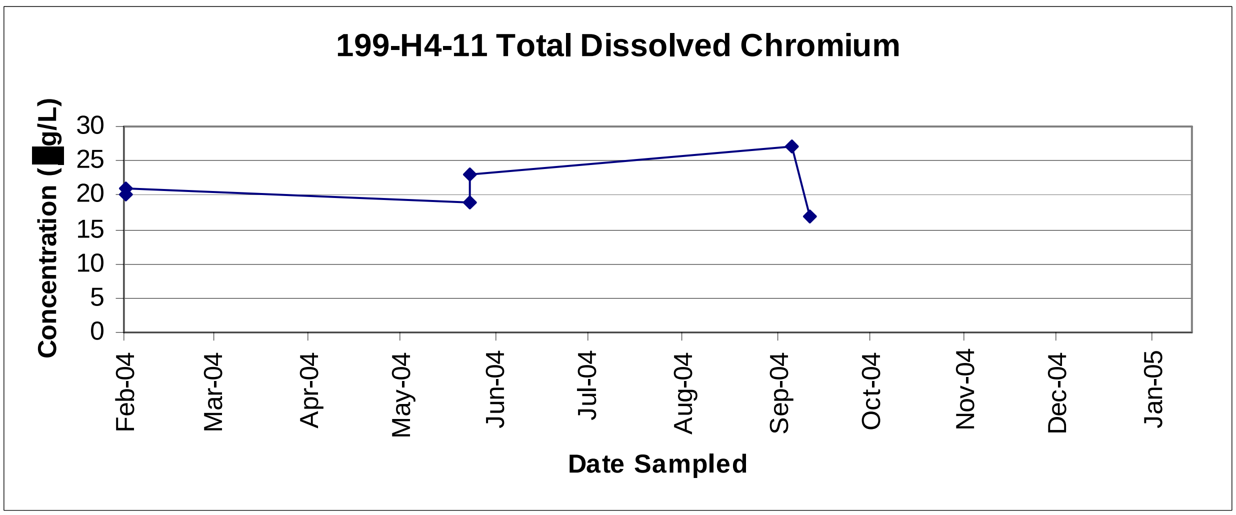

199-D5-34 Total Dissolved Chromium
Concentration (■g/L)
10
8
6
4
2
0
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

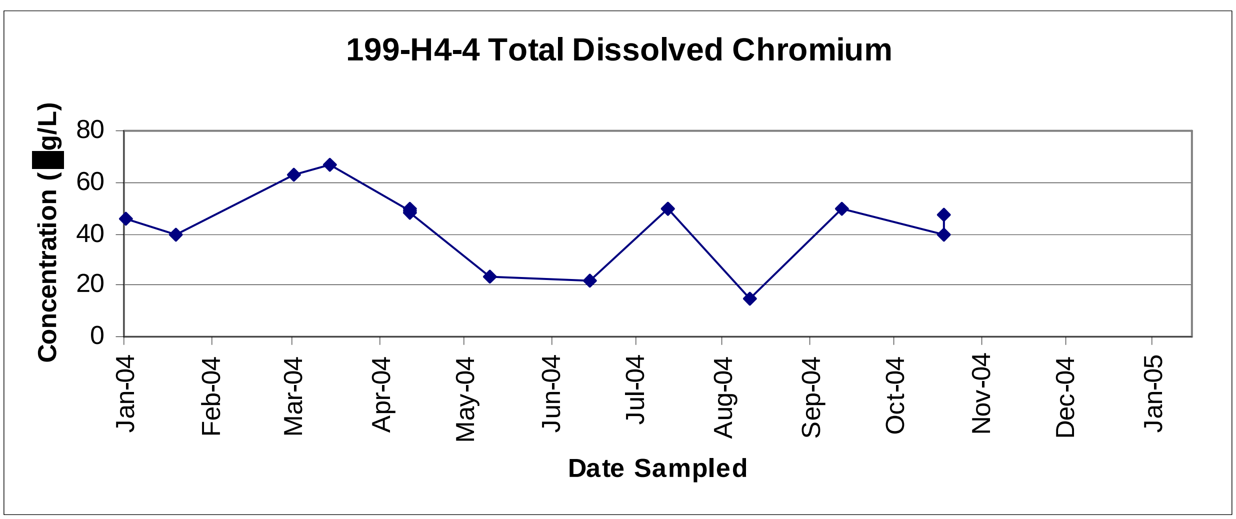

199-D8-53 Total Dissolved Chromium
Concentration ([redacted]g/L)
200
150
100
50
0
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

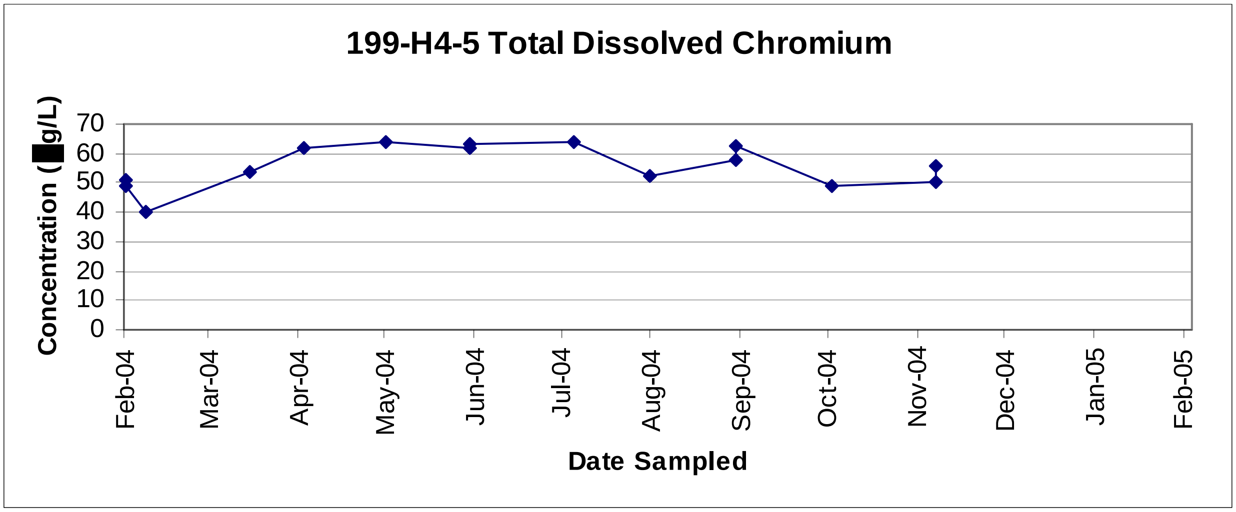

199-D8-54A Total Dissolved Chromium
Concentration ([redacted]g/L)
200
150
100
50
0
Jun-04
Jun-04
Jul-04
Jul-04
Aug-04
Aug-04
Sep-04
Sep-04
Oct-04
Oct-04
Nov-04
Nov-04
Nov-04
Dec-04
Dec-04
Jan-05
Jan-05
Date Sampled

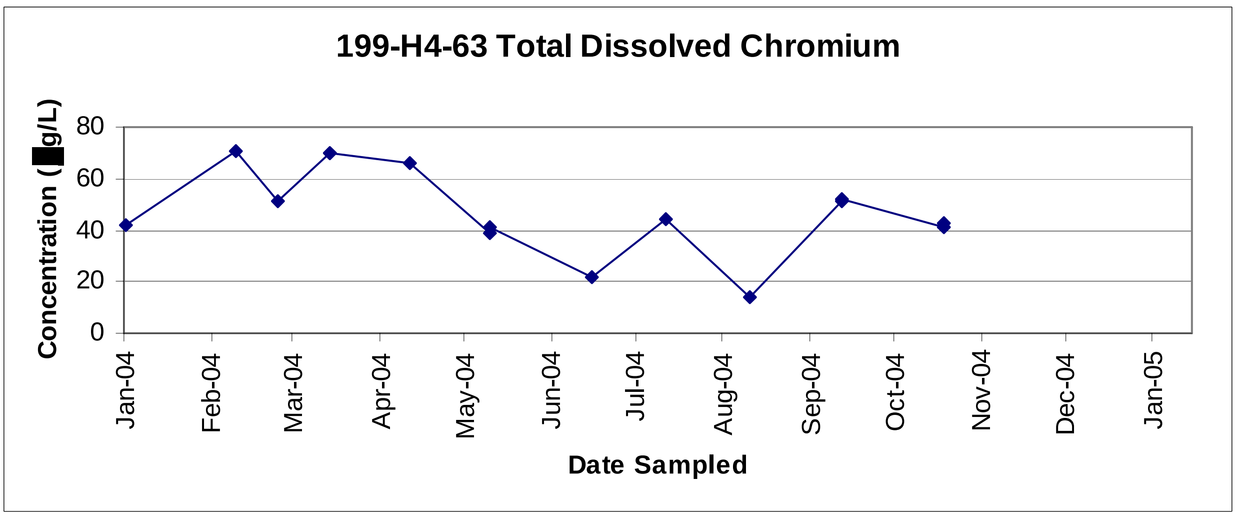

199-D8-68 Total Dissolved Chromium
Concentration ([redacted]g/L)
200
150
100
50
0
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

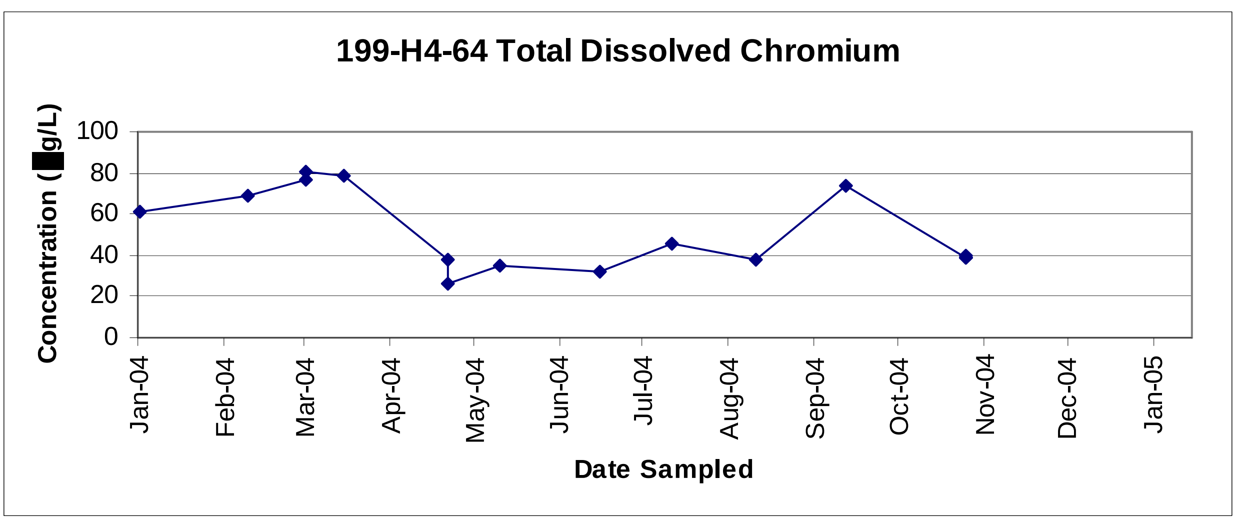

199-D8-72 Total Dissolved Chromium
Concentration (■g/L)
600
500
400
300
200
100
0
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

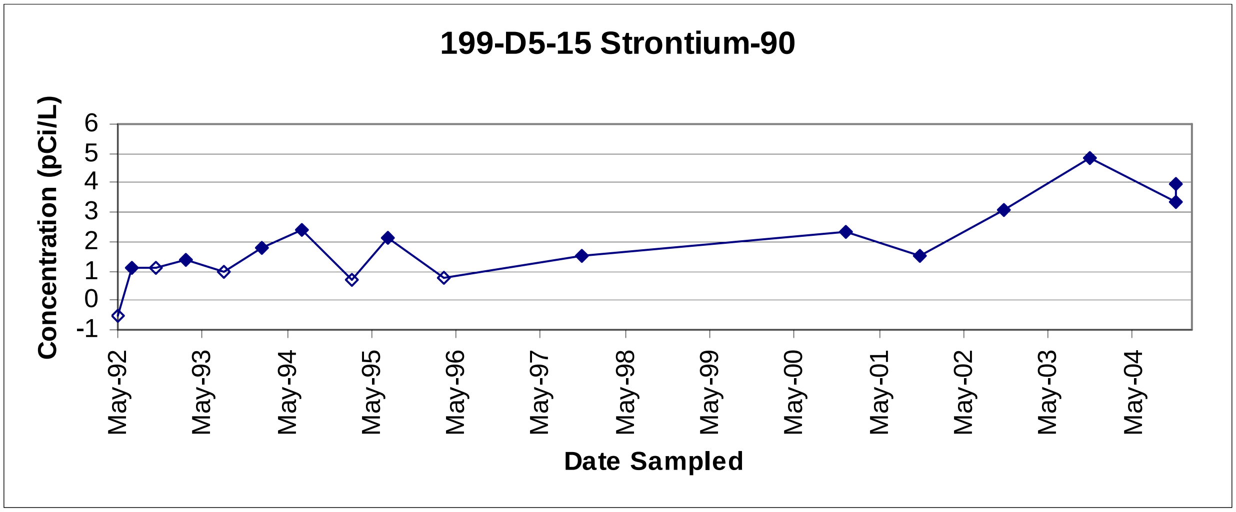

199-H4-11 Total Dissolved Chromium
Concentration (■g/L)
30
25
20
15
10
5
0
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

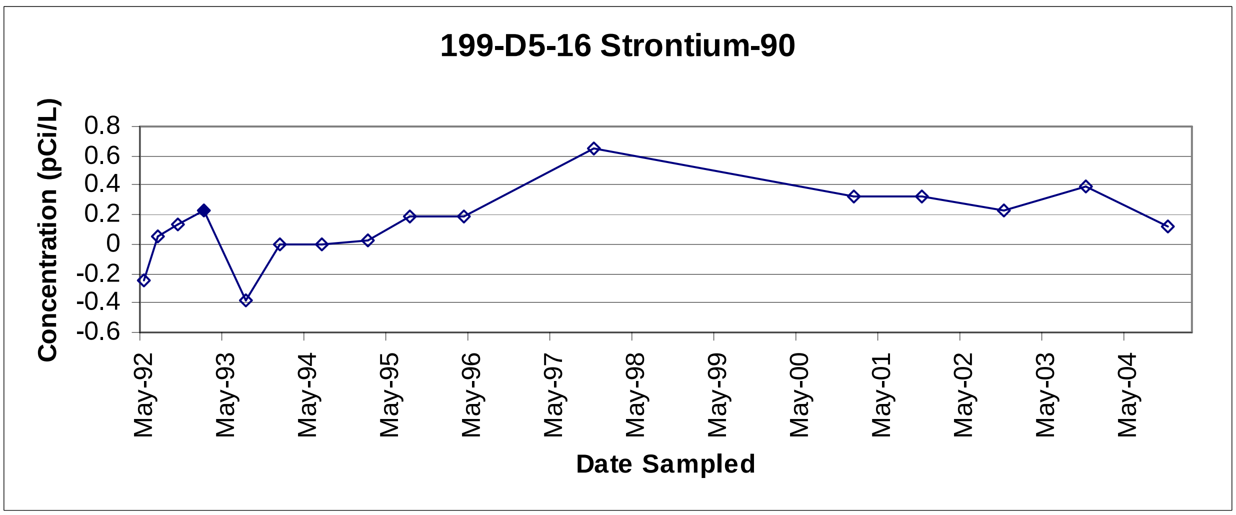

199-H4-4 Total Dissolved Chromium
Concentration (■g/L)
80
60
40
20
0
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

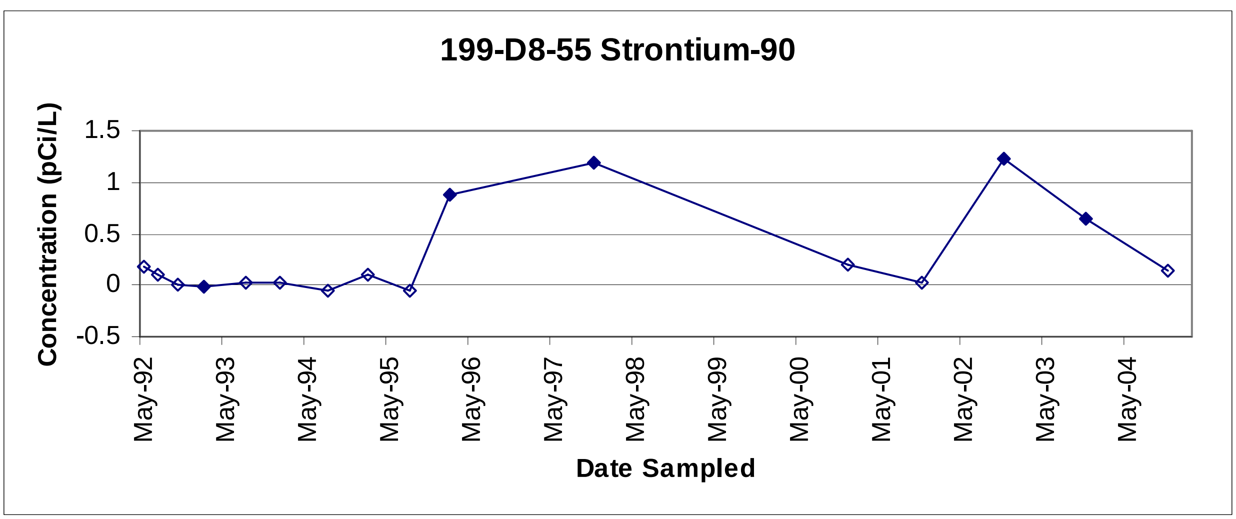

199-H4-5 Total Dissolved Chromium
Concentration (■g/L)
70
60
50
40
30
20
10
0
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled

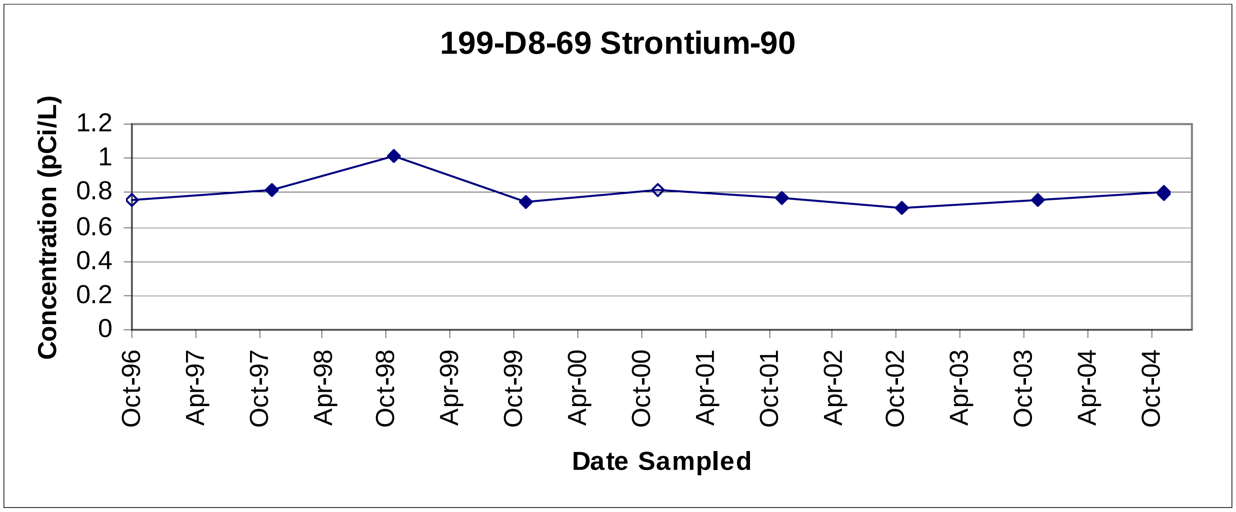

199-H4-63 Total Dissolved Chromium
Concentration (■g/L)
80
60
40
20
0
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

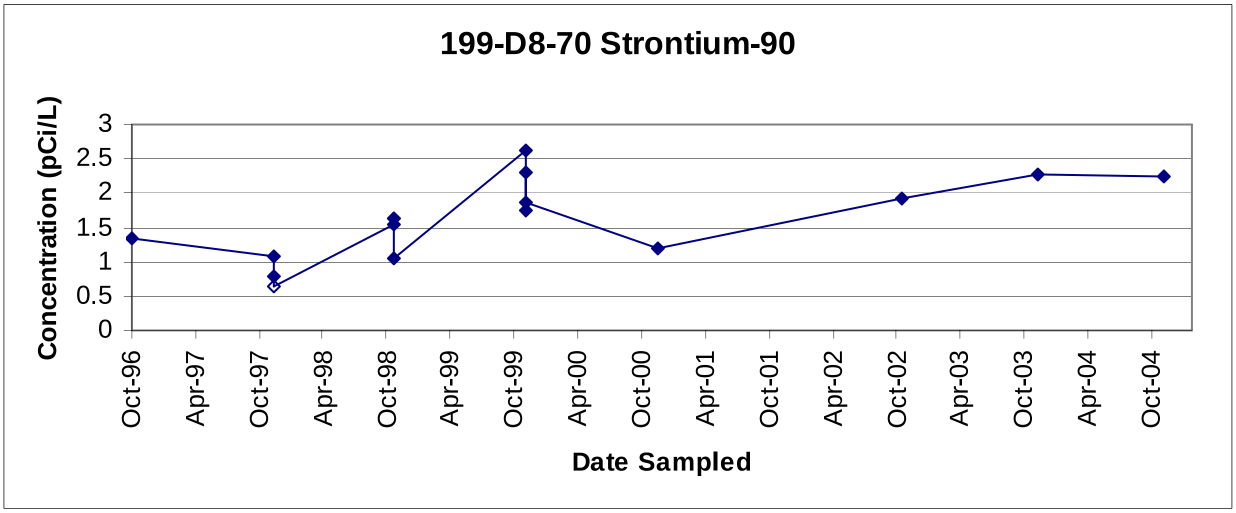

199-H4-64 Total Dissolved Chromium
Concentration (■g/L)
100
80
60
40
20
0
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

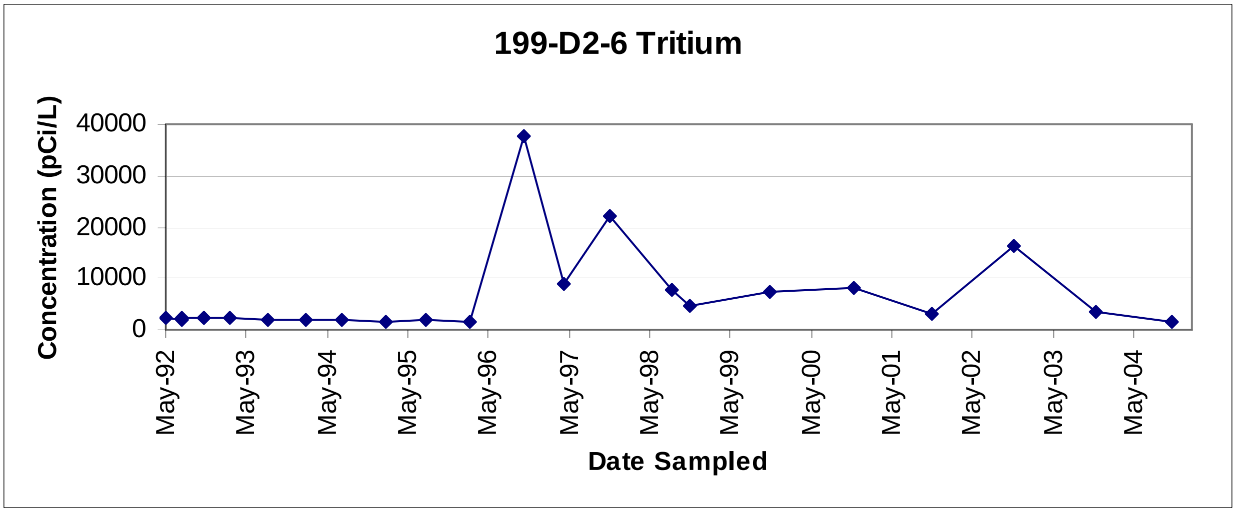

199-D5-15 Strontium-90
Concentration (pCi/L)
6
5
4
3
2
1
0
-1
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

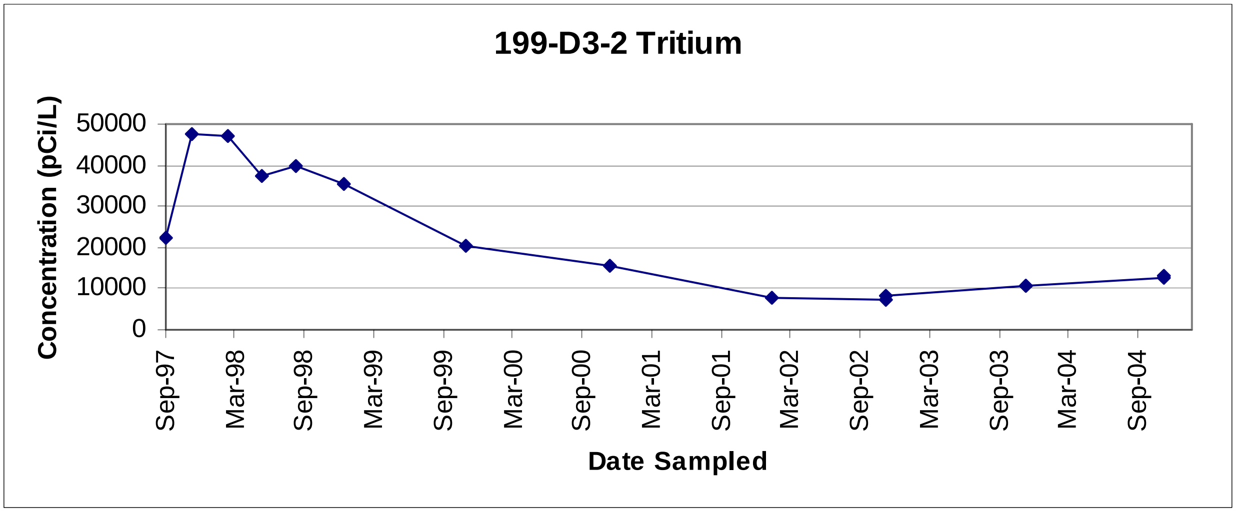

199-D5-16 Strontium-90
Concentration (pCi/L)
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

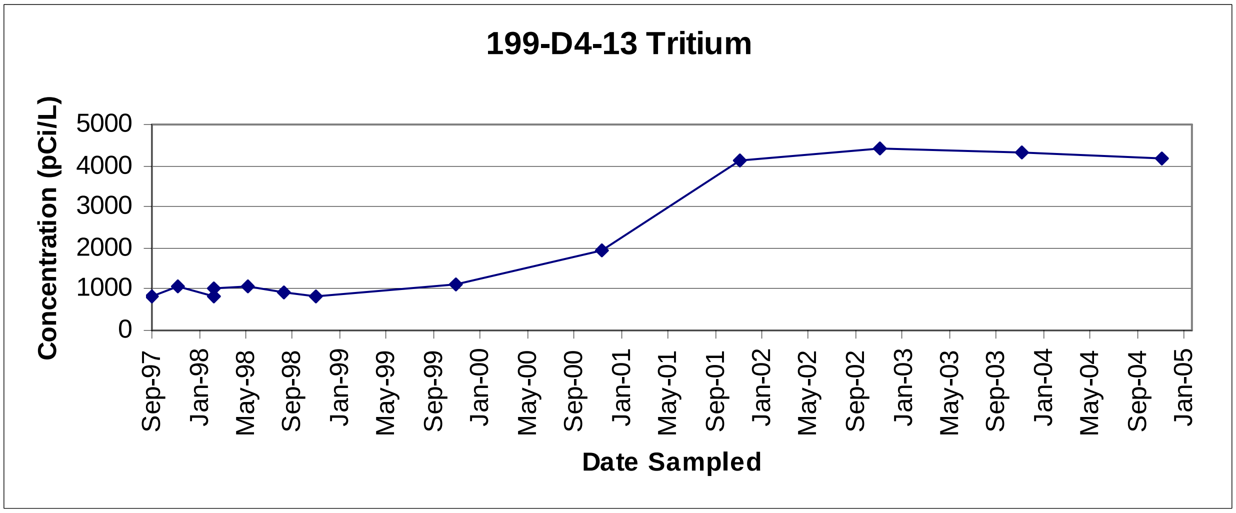

199-D8-55 Strontium-90
Concentration (pCi/L)
1.5
1
0.5
0
-0.5
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D8-69 Strontium-90
Concentration (pCi/L)
1.2
1
0.8
0.6
0.4
0.2
0
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled


199-D8-70 Strontium-90
Concentration (pCi/L)
3
2.5
2
1.5
1
0.5
0
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled


199-D2-6 Tritium
Concentration (pCi/L)
40000
30000
20000
10000
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D3-2 Tritium
Concentration (pCi/L)
50000
40000
30000
20000
10000
0
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled


199-D4-13 Tritium
Concentration (pCi/L)
5000
4000
3000
2000
1000
0
Sep-97
Jan-98
May-98
Sep-98
Jan-99
May-99
Sep-99
Jan-00
May-00
Sep-00
Jan-01
May-01
Sep-01
Jan-02
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May-03
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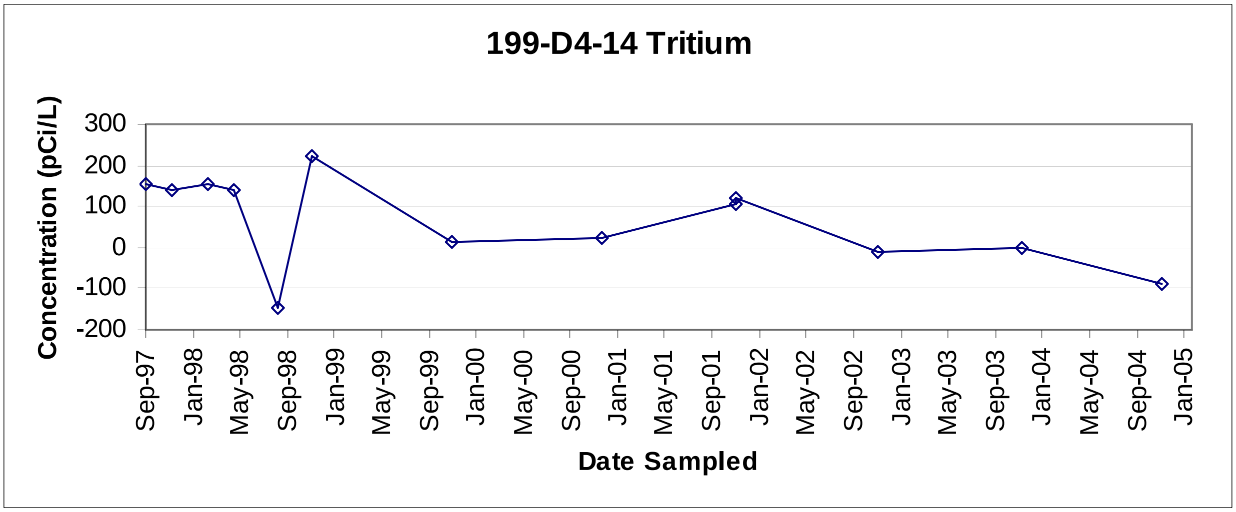
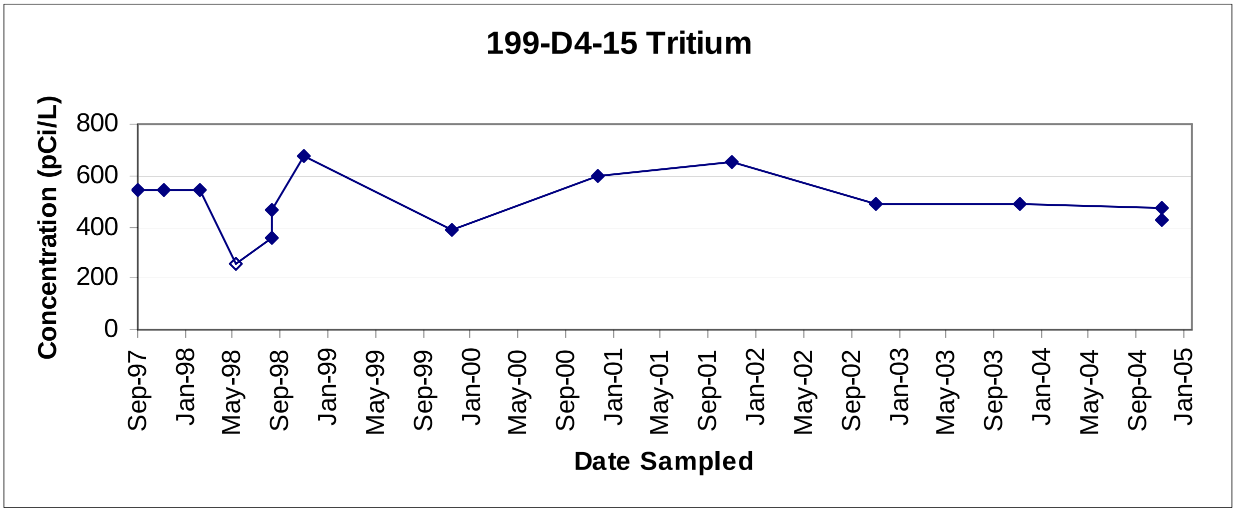
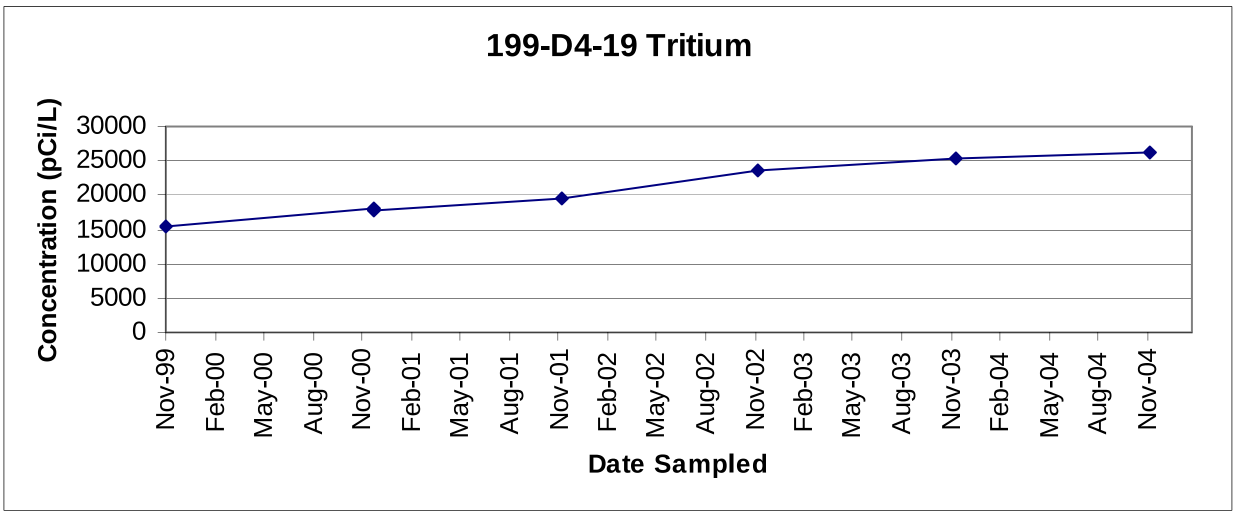
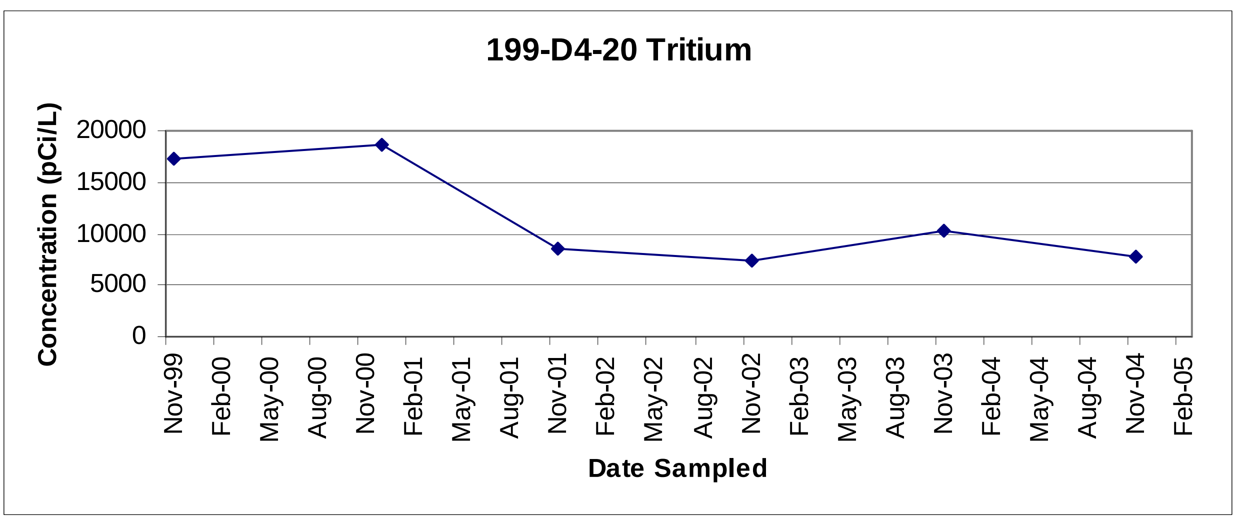
Jan-04
May-04
Sep-04
Jan-05
Date Sampled


199-D4-14 Tritium
Concentration (pCi/L)
300
200
100
0
-100
-200
Sep-97
Jan-98
May-98
Sep-98
Jan-99
May-99
Sep-99
Jan-00
May-00
Sep-00
Jan-01
May-01
Sep-01
Jan-02
May-02
Sep-02
Jan-03
May-03
Sep-03
Jan-04
May-04
Sep-04
Jan-05
Date Sampled


199-D4-15 Tritium
Concentration (pCi/L)
800
600
400
200
0
Sep-97
Jan-98
May-98
Sep-98
Jan-99
May-99
Sep-99
Jan-00
May-00
Sep-00
Jan-01
May-01
Sep-01
Jan-02
May-02
Sep-02
Jan-03
May-03
Sep-03
Jan-04
May-04
Sep-04
Jan-05
Date Sampled


199-D4-19 Tritium
Concentration (pCi/L)
30000
25000
20000
15000
10000
5000
0
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
May-03
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Date Sampled


199-D4-20 Tritium
Concentration (pCi/L)
20000
15000
10000
5000
0
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
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May-03
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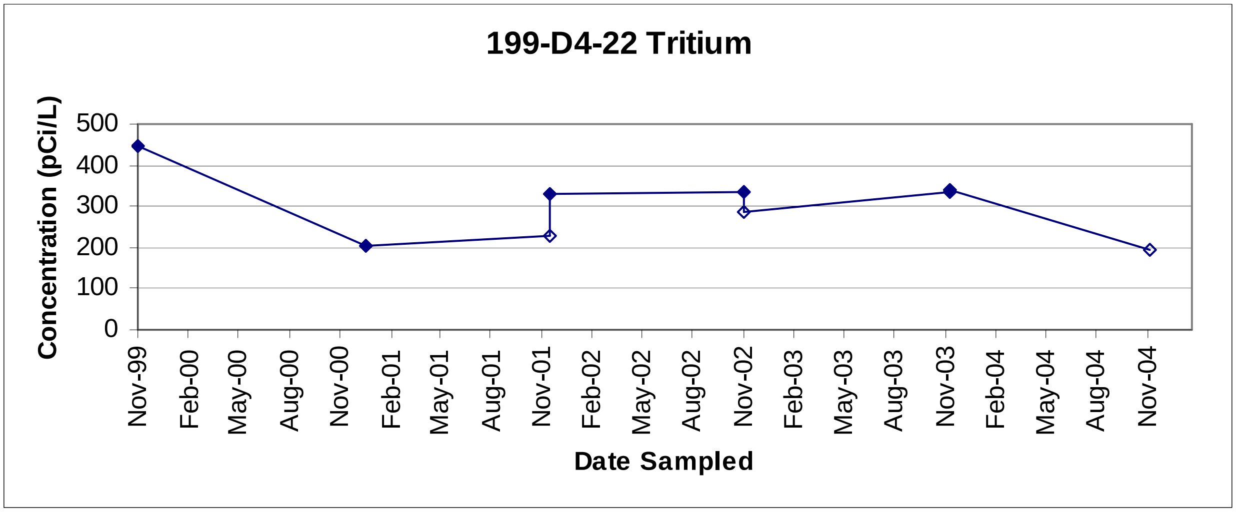
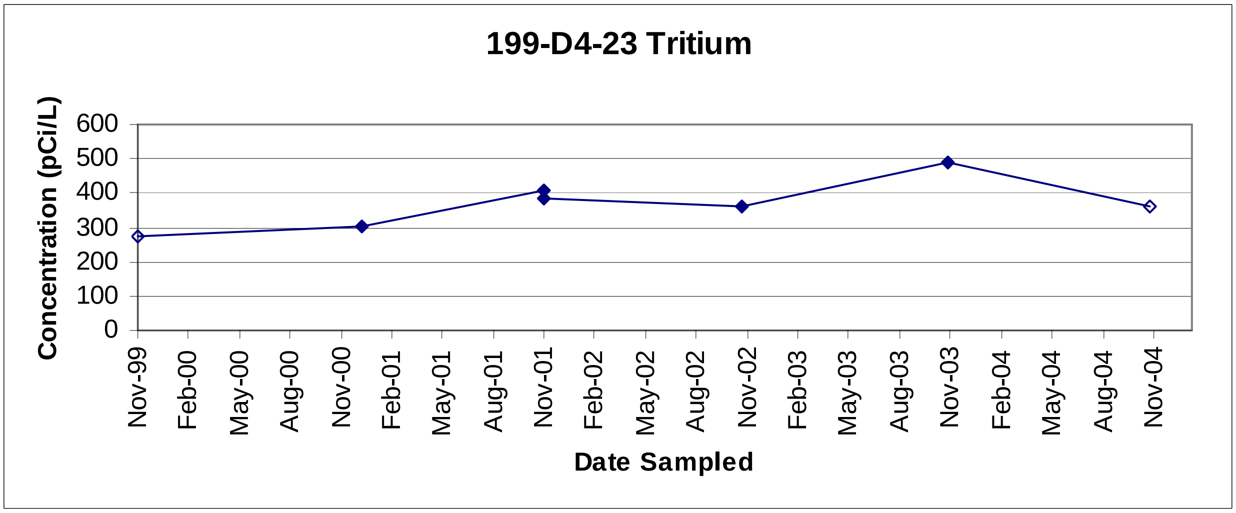
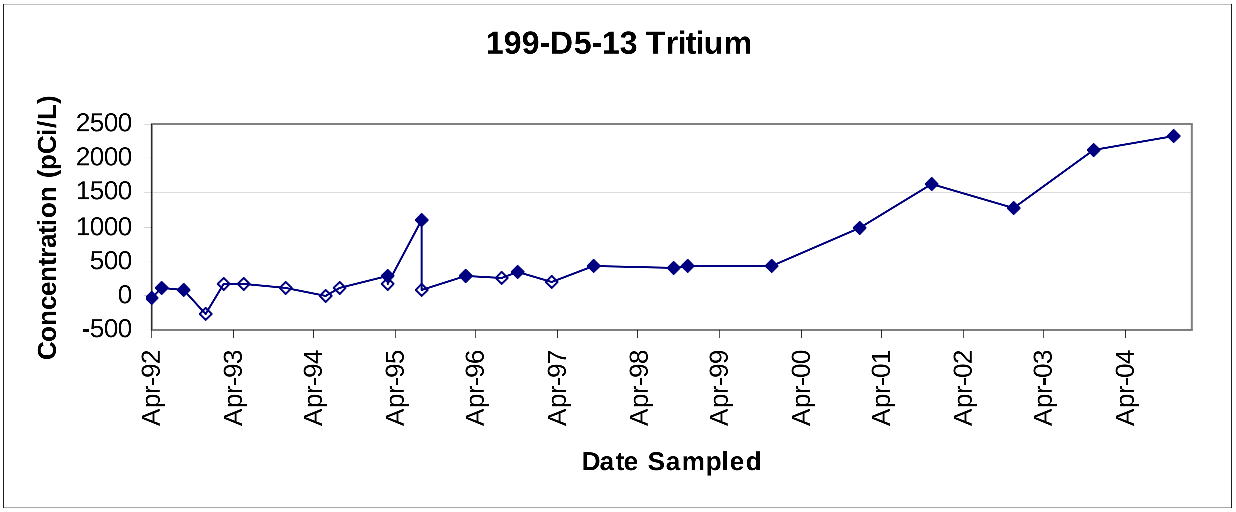
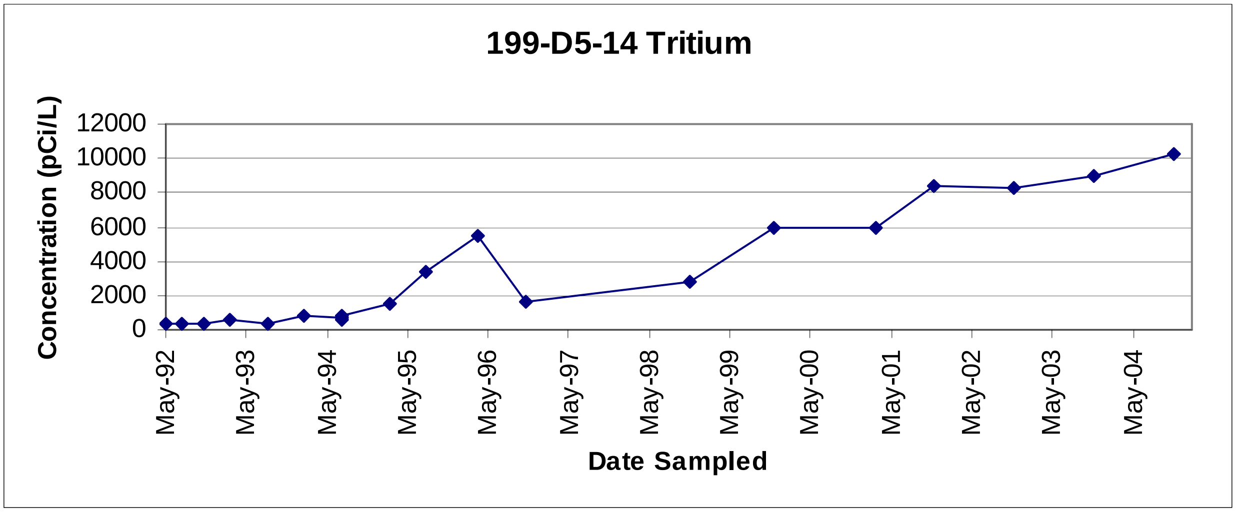
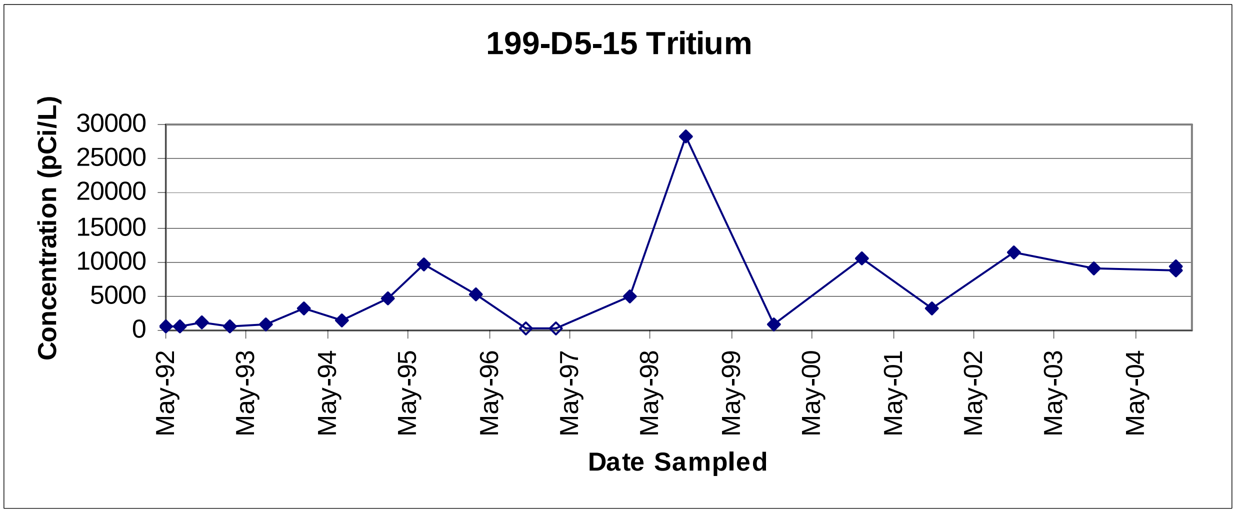
May-04
Aug-04
Nov-04
Feb-05
Date Sampled

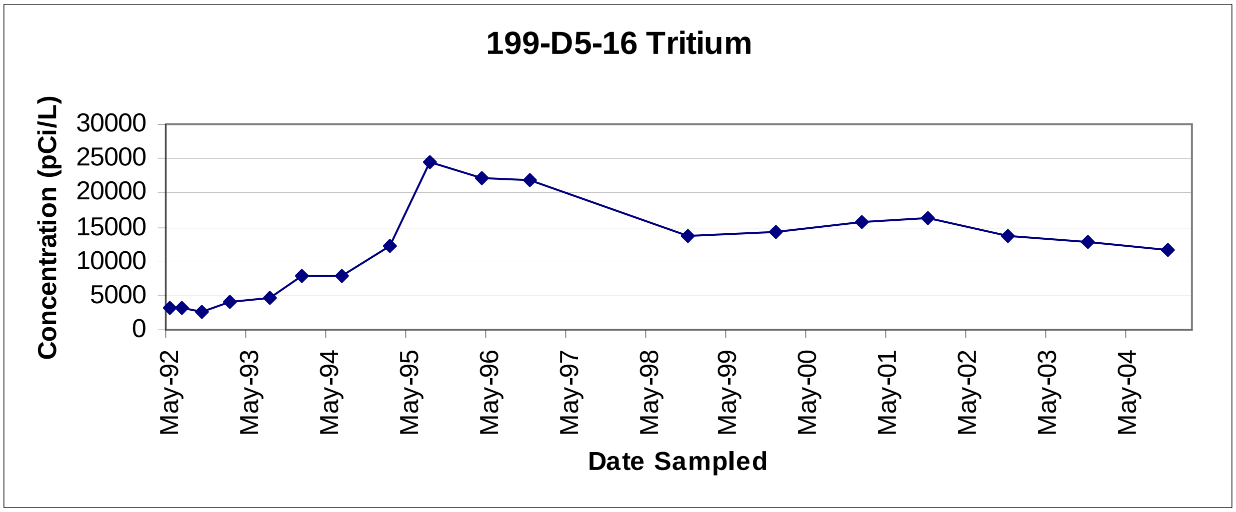

199-D4-22 Tritium
Concentration (pCi/L)
500
400
300
200
100
0
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
May-03
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Date Sampled

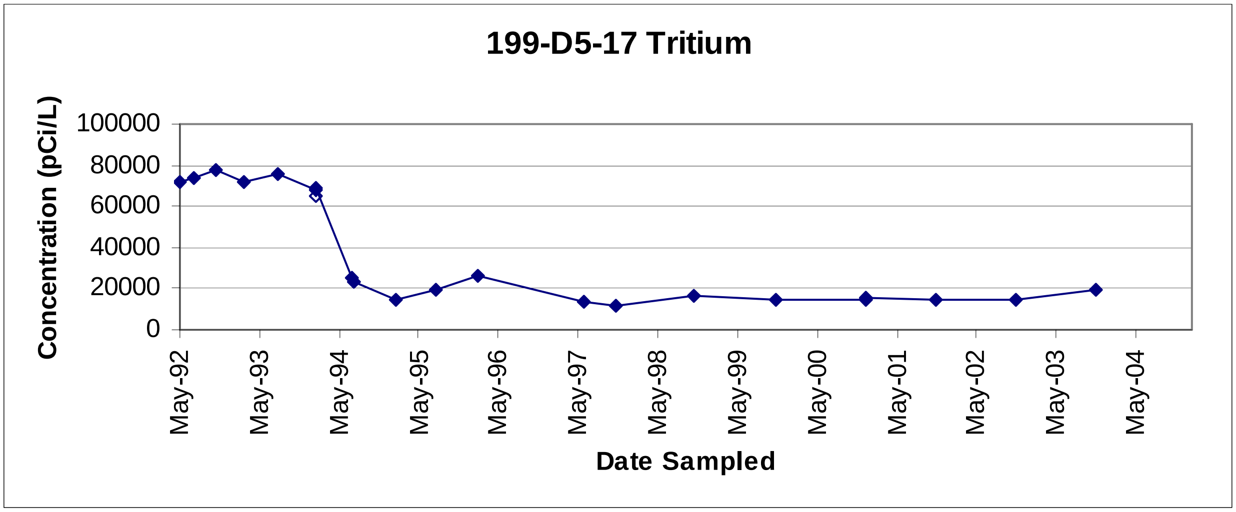

199-D4-23 Tritium
Concentration (pCi/L)
600
500
400
300
200
100
0
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
May-03
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Date Sampled

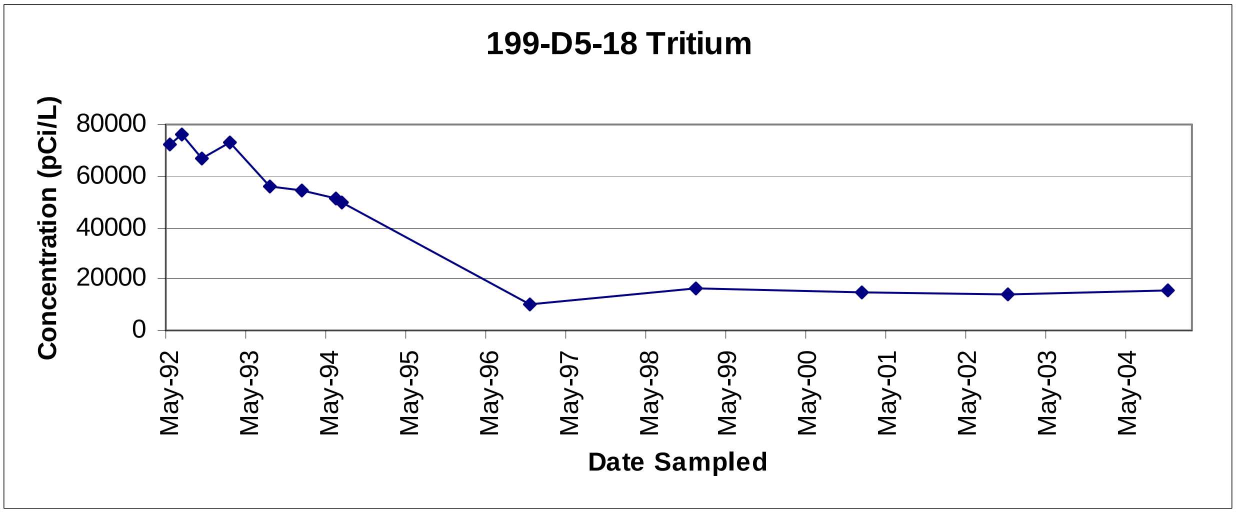

199-D5-13 Tritium
Concentration (pCi/L)
2500
2000
1500
1000
500
0
-500
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled

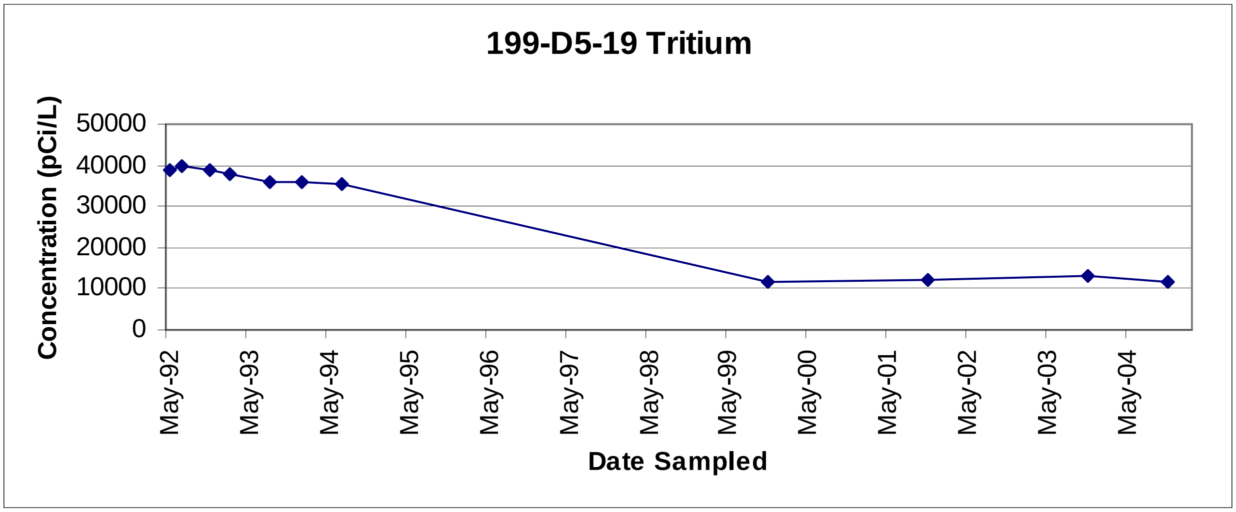

199-D5-14 Tritium
Concentration (pCi/L)
12000
10000
8000
6000
4000
2000
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

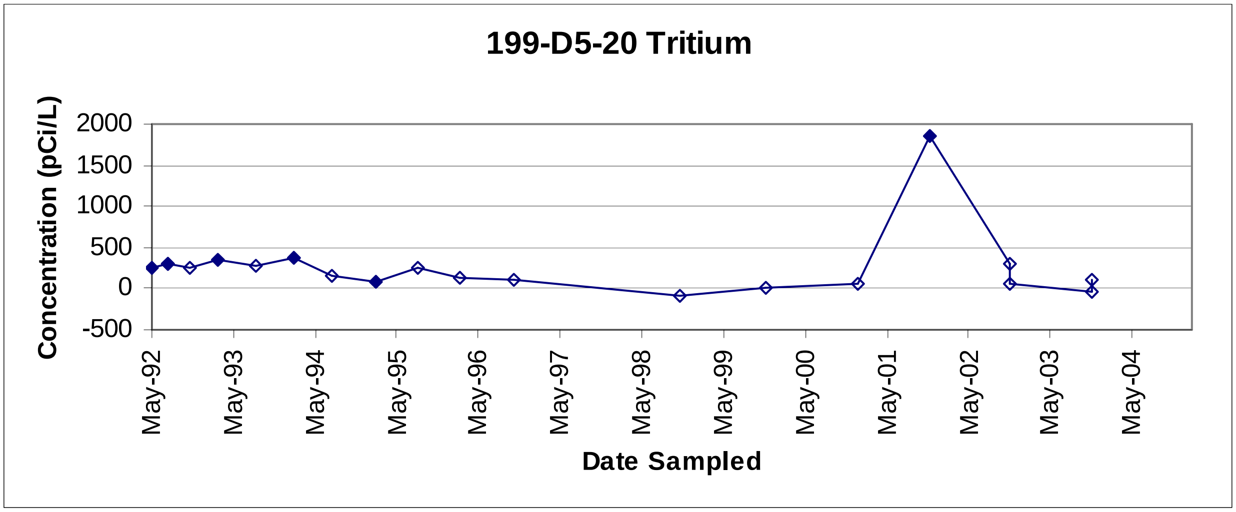

199-D5-15 Tritium
Concentration (pCi/L)
30000
25000
20000
15000
10000
5000
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

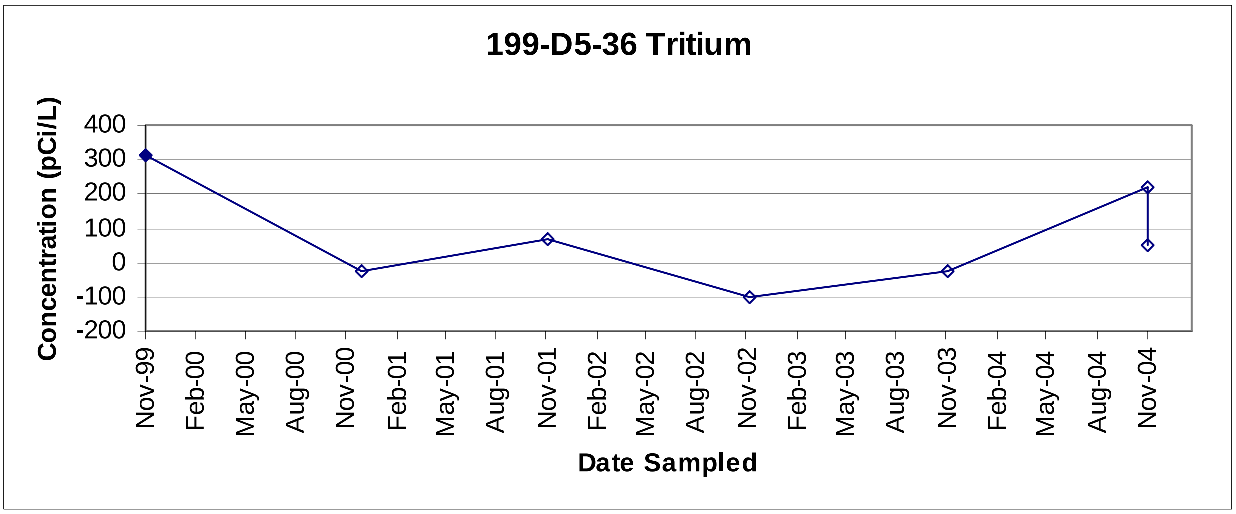

199-D5-16 Tritium
Concentration (pCi/L)
30000
25000
20000
15000
10000
5000
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

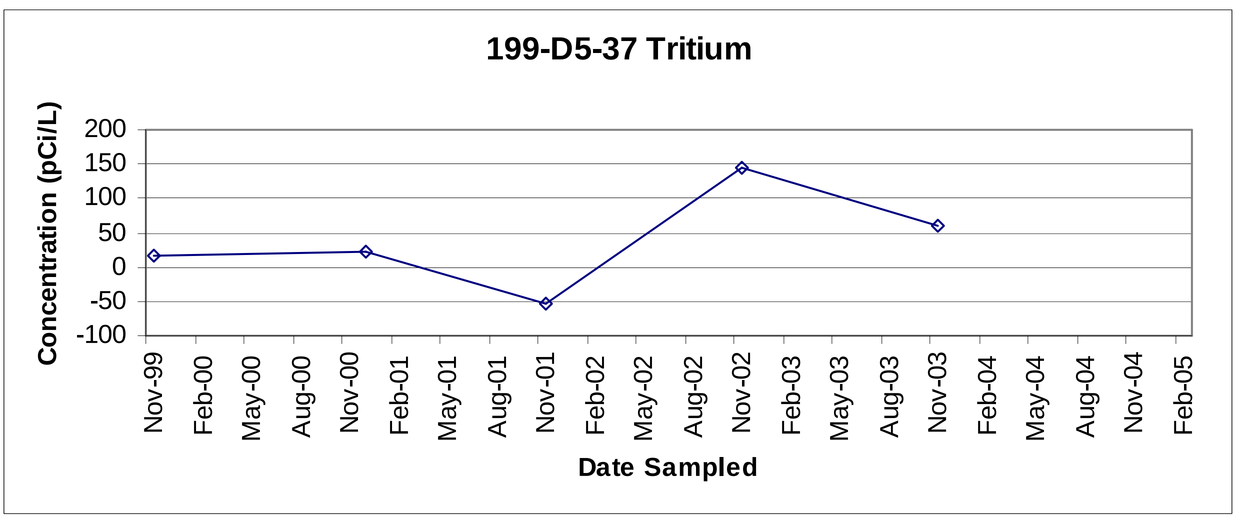

199-D5-17 Tritium
Concentration (pCi/L)
100000
80000
60000
40000
20000
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D5-18 Tritium
Concentration (pCi/L)
80000
60000
40000
20000
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D5-19 Tritium
Concentration (pCi/L)
50000
40000
30000
20000
10000
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D5-20 Tritium
Concentration (pCi/L)
2000
1500
1000
500
0
-500
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D5-36 Tritium
Concentration (pCi/L)
400
300
200
100
0
-100
-200
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
May-03
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Date Sampled


199-D5-37 Tritium
Concentration (pCi/L)
200
150
100
50
0
-50
-100
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
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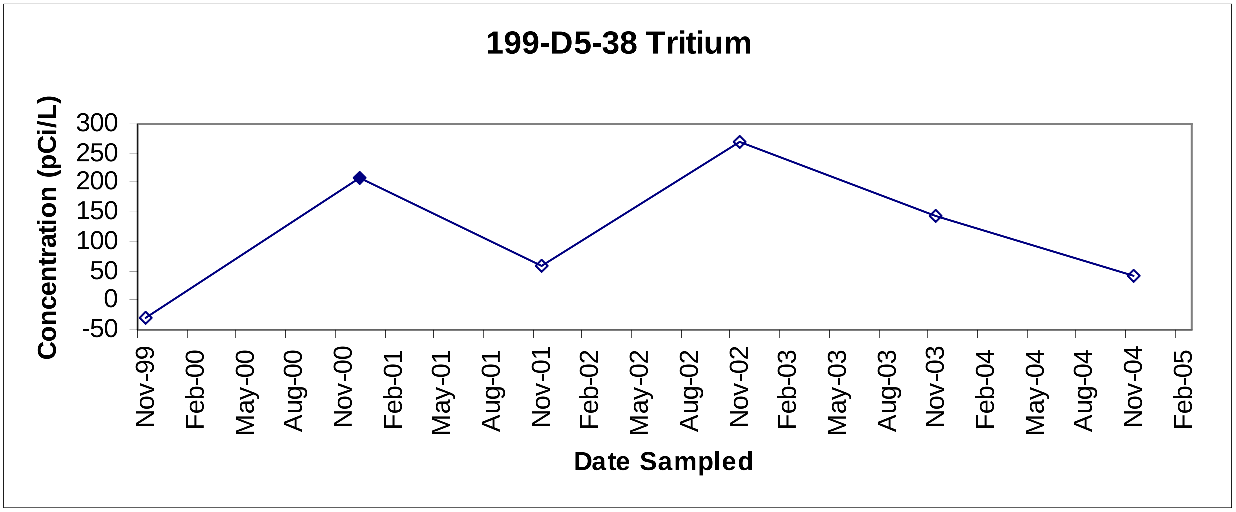
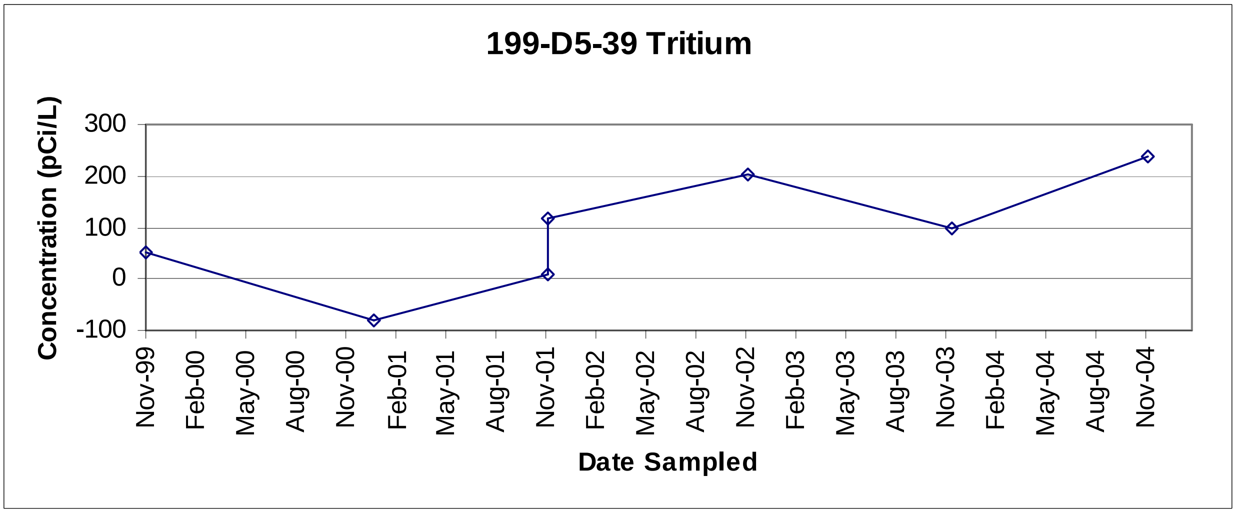
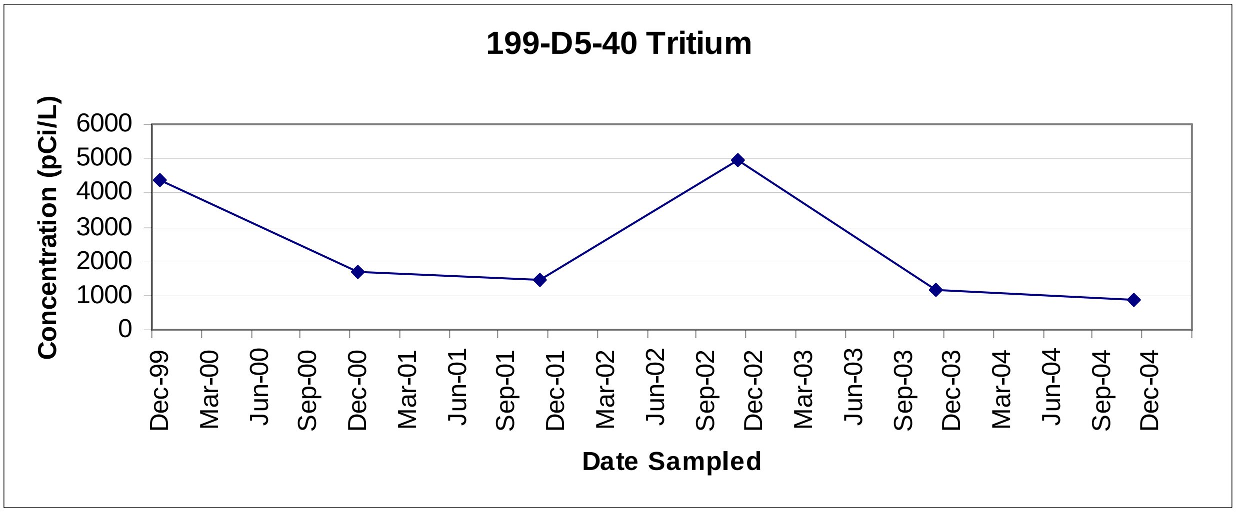
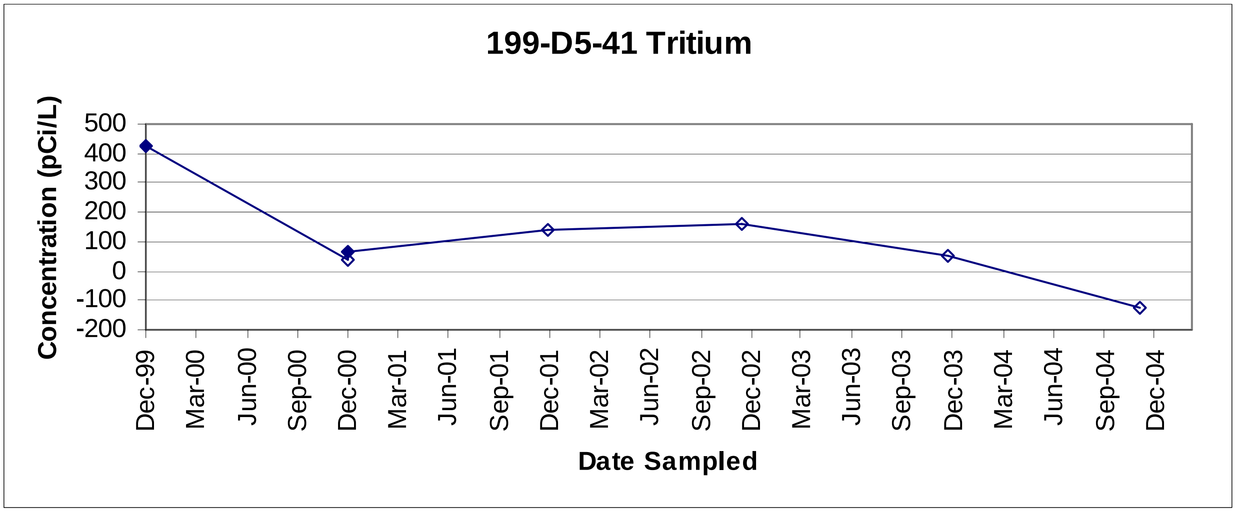
Aug-04
Nov-04
Feb-05
Date Sampled


199-D5-38 Tritium
Concentration (pCi/L)
300
250
200
150
100
50
0
-50
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
May-03
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Feb-05
Date Sampled


199-D5-39 Tritium
Concentration (pCi/L)
300
200
100
0
-100
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
May-03
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Date Sampled


199-D5-40 Tritium
Concentration (pCi/L)
6000
5000
4000
3000
2000
1000
0
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
Sep-04
Dec-04
Date Sampled


199-D5-41 Tritium
Concentration (pCi/L)
500
400
300
200
100
0
-100
-200
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
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Sep-02
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Mar-03
Jun-03
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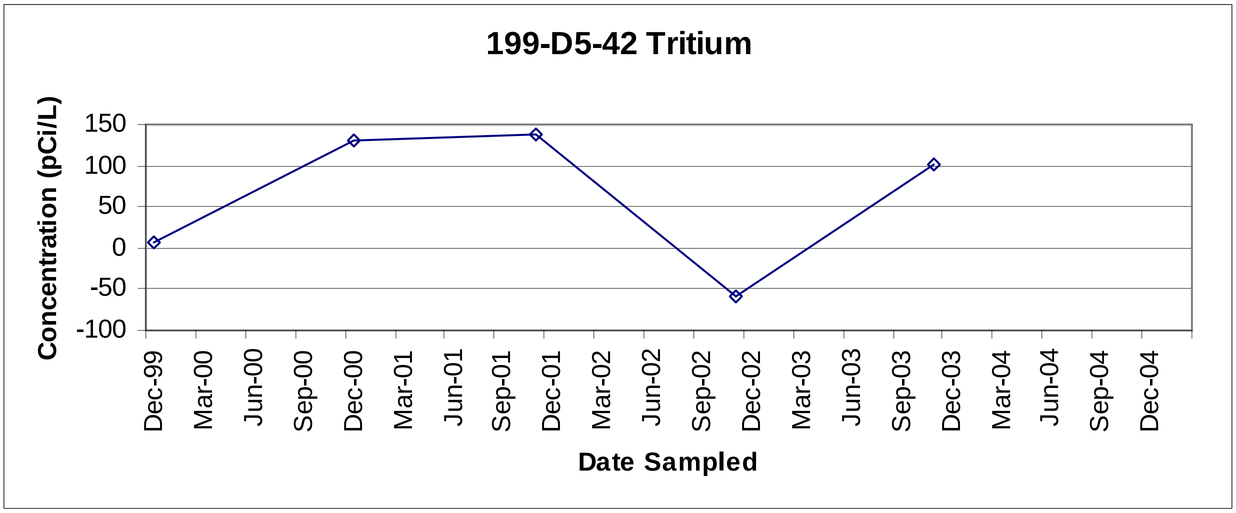
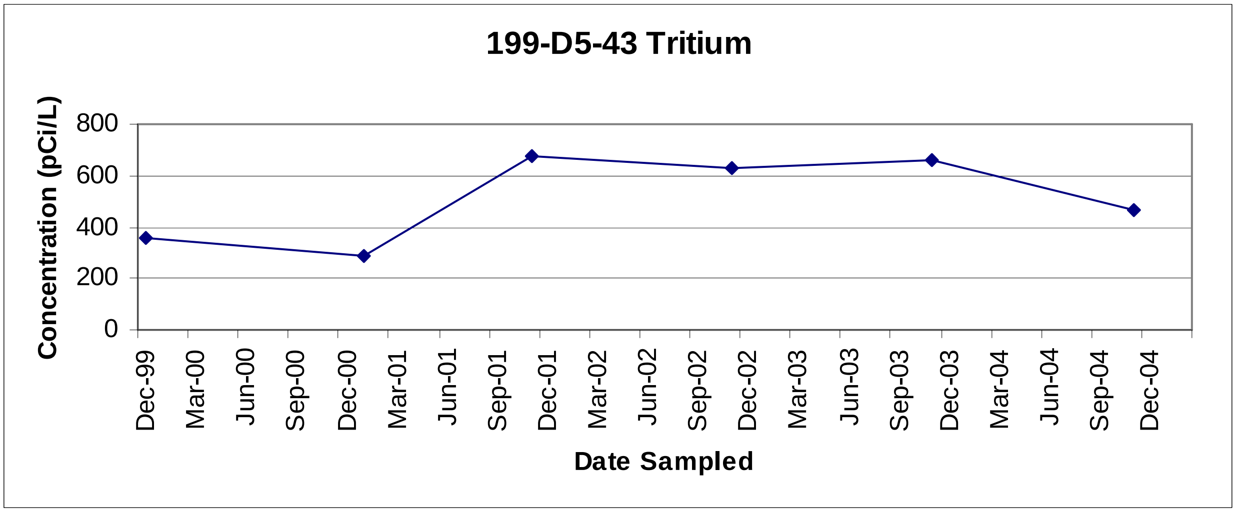
Jun-04
Sep-04
Dec-04
Date Sampled


199-D5-42 Tritium
Concentration (pCi/L)
150
100
50
0
-50
-100
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
Sep-04
Dec-04
Date Sampled


199-D5-43 Tritium
Concentration (pCi/L)
800
600
400
200
0
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
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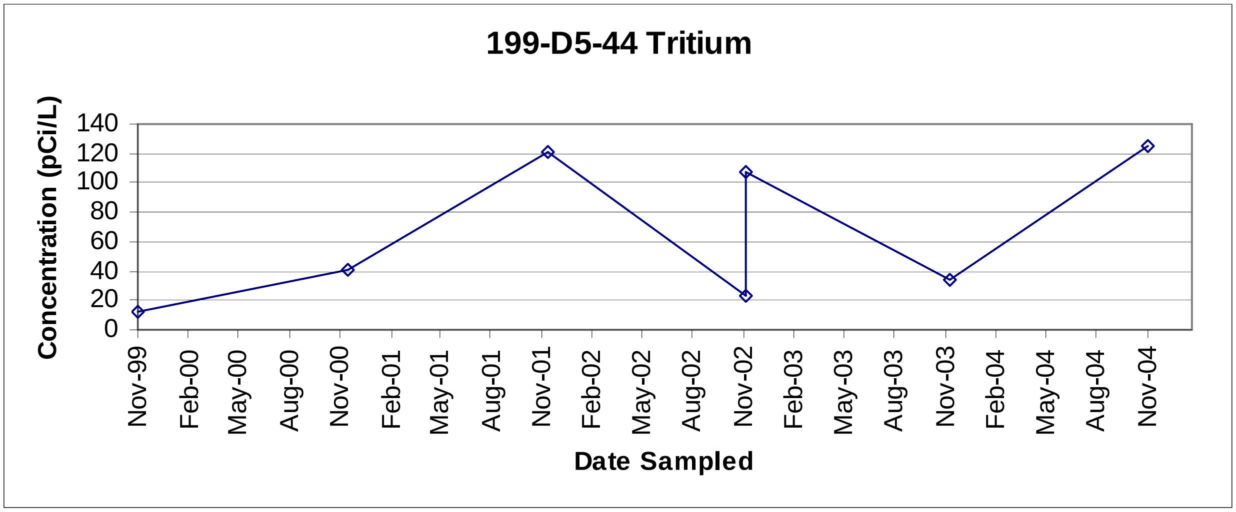
Jun-04
Sep-04
Dec-04
Date Sampled



199-D5-44 Tritium
Concentration (pCi/L)
140
120
100
80
60
40
20
0
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
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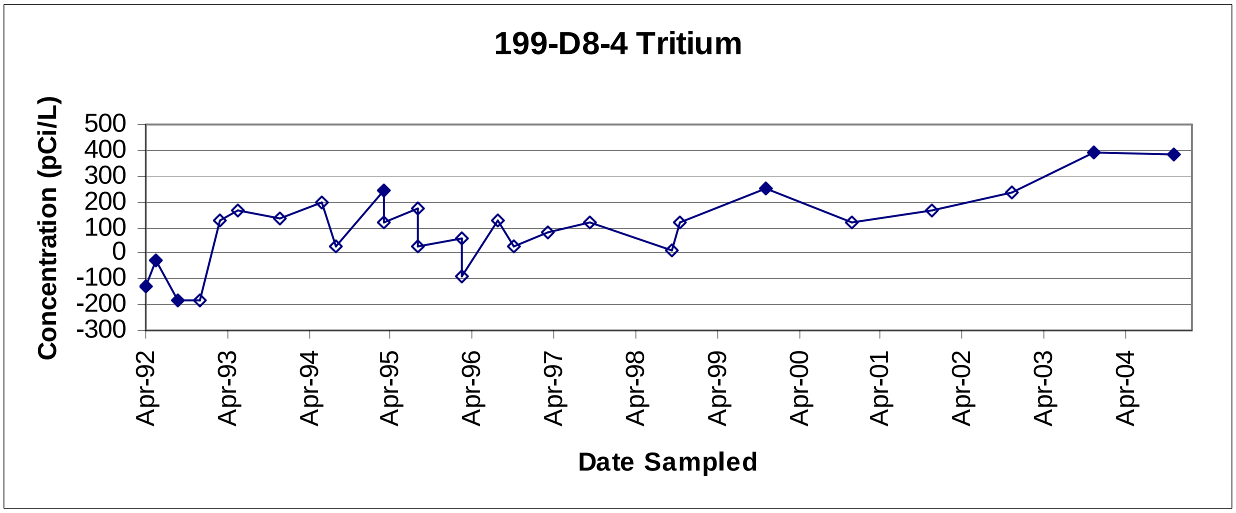
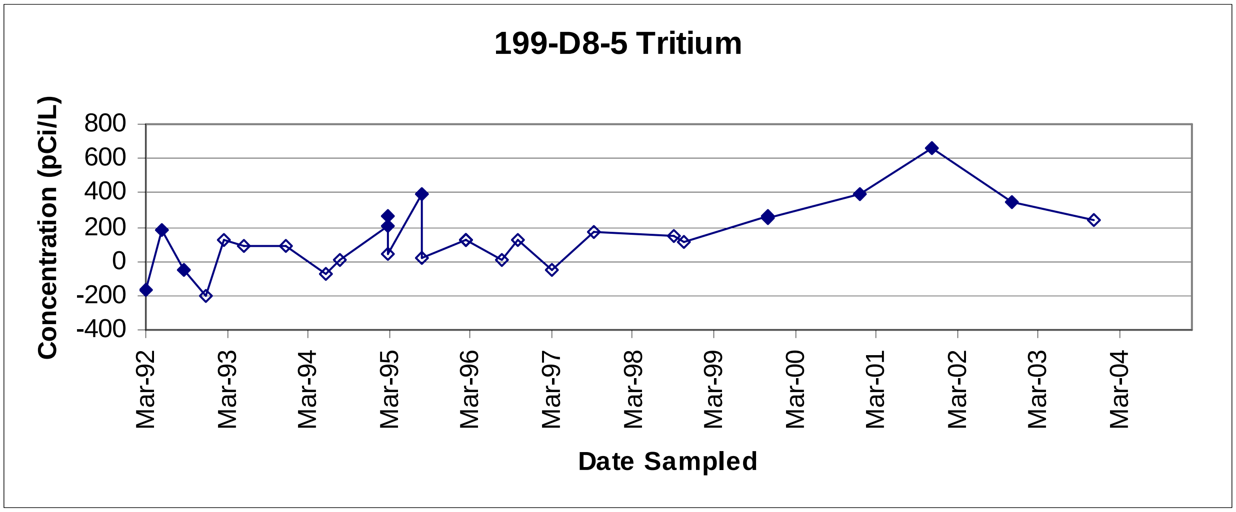
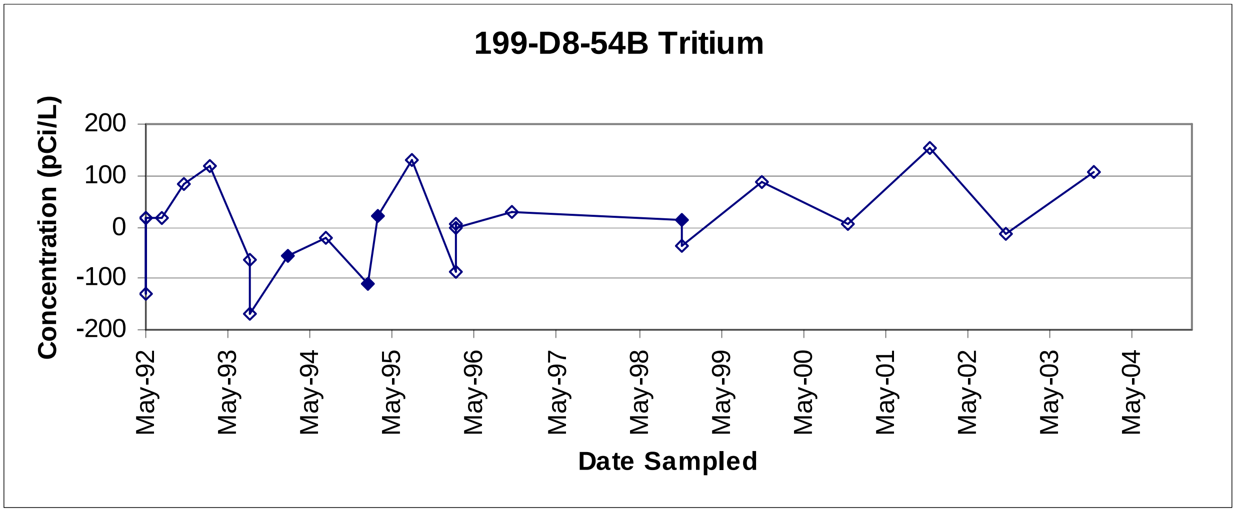
Feb-04
May-04
Aug-04
Nov-04
Date Sampled

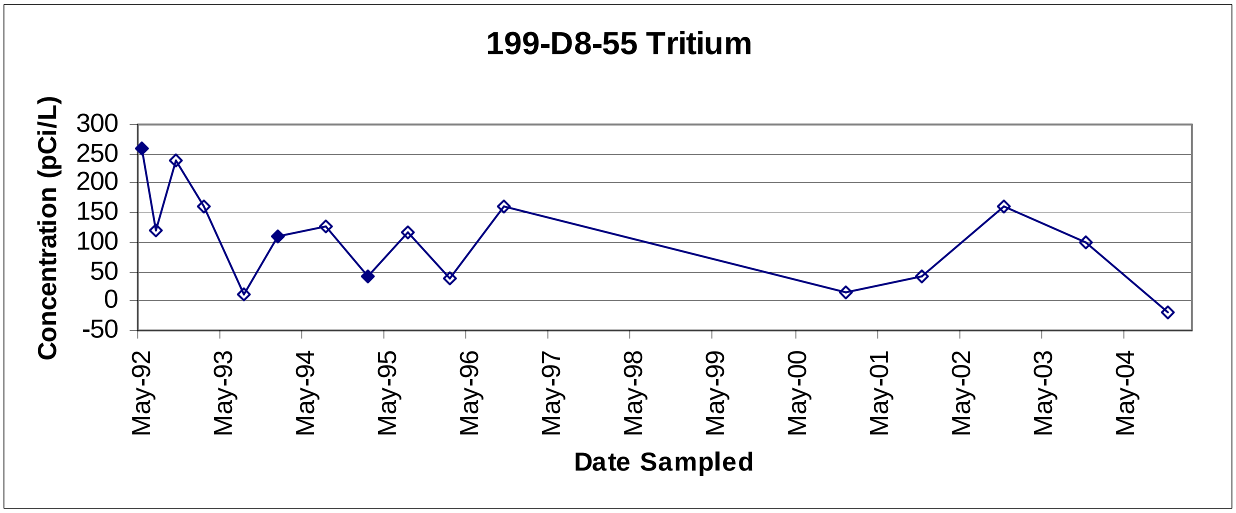


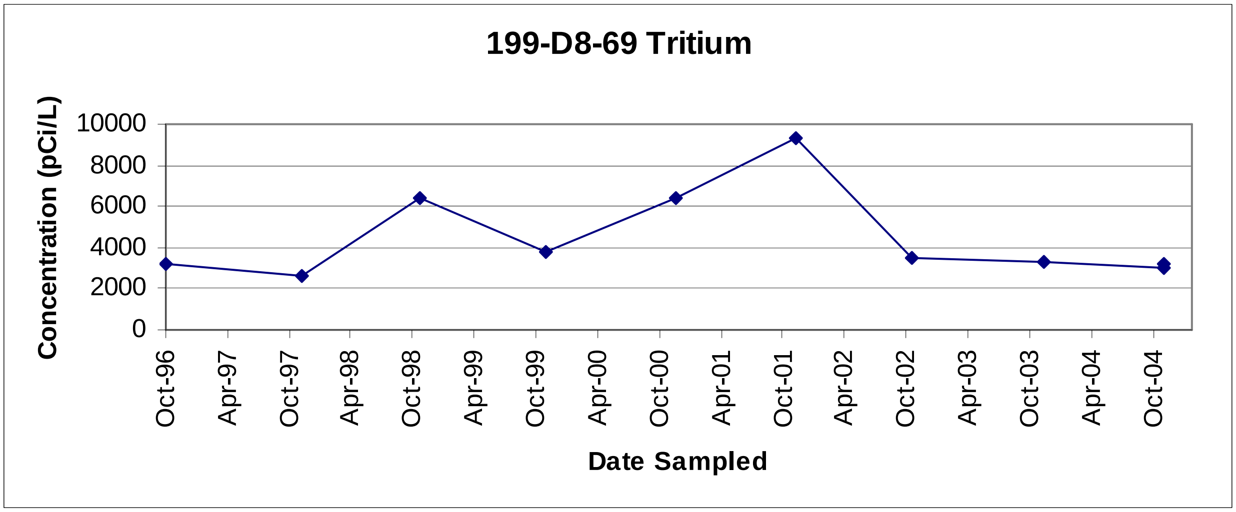
199-D8-4 Tritium
Concentration (pCi/L)
500
400
300
200
100
0
-100
-200
-300
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled



199-D8-5 Tritium
Concentration (pCi/L)
800
600
400
200
0
-200
-400
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled


199-D8-54B Tritium
Concentration (pCi/L)
200
100
0
-100
-200
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D8-55 Tritium
Concentration (pCi/L)
300
250
200
150
100
50
0
-50
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D8-69 Tritium
Concentration (pCi/L)
10000
8000
6000
4000
2000
0
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
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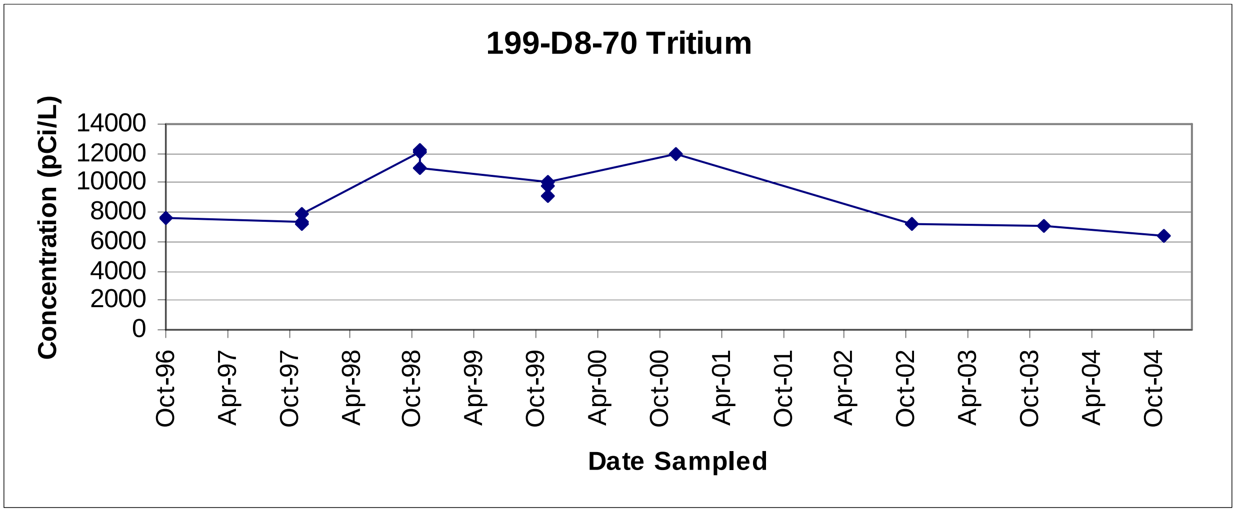
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled


199-D8-70 Tritium
Concentration (pCi/L)
14000
12000
10000
8000
6000
4000
2000
0
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
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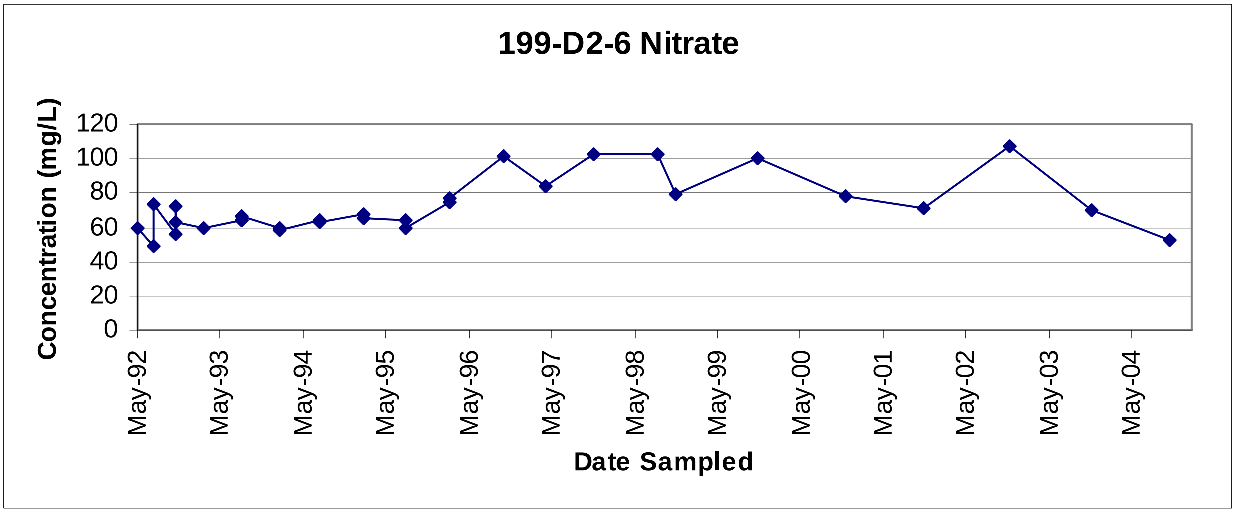
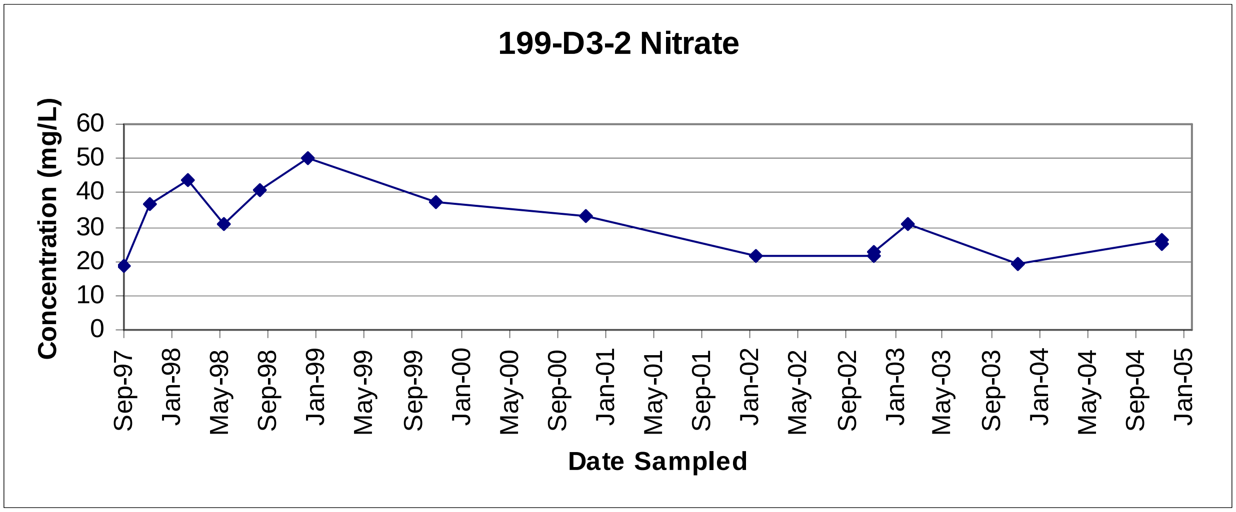
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled


199-D2-6 Nitrate
Concentration (mg/L)
120
100
80
60
40
20
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D3-2 Nitrate
Concentration (mg/L)
60
50
40
30
20
10
0
Sep-97
Jan-98
May-98
Sep-98
Jan-99
May-99
Sep-99
Jan-00
May-00
Sep-00
Jan-01
May-01
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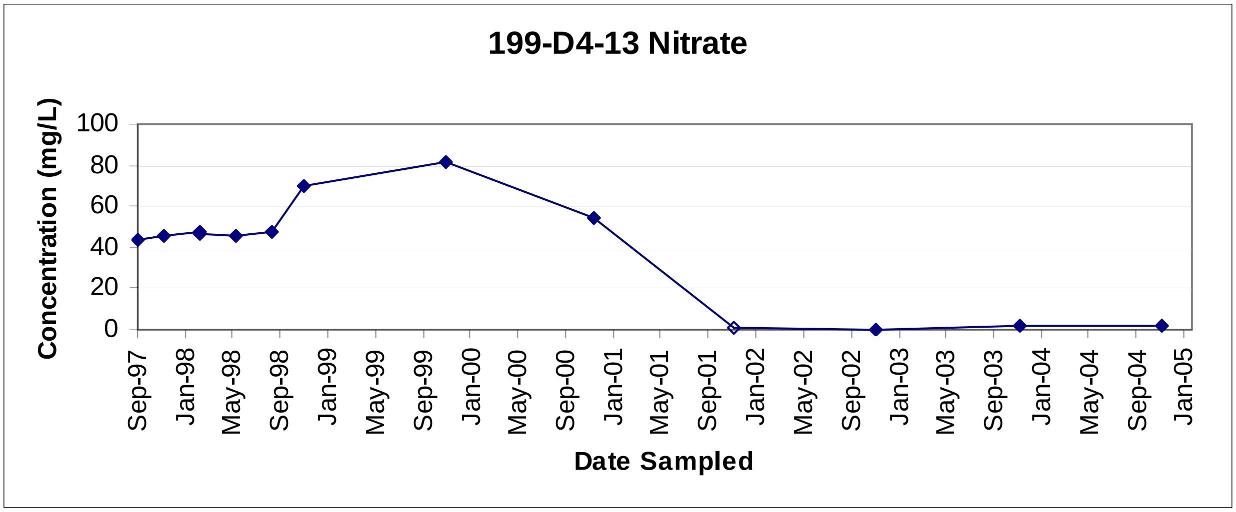
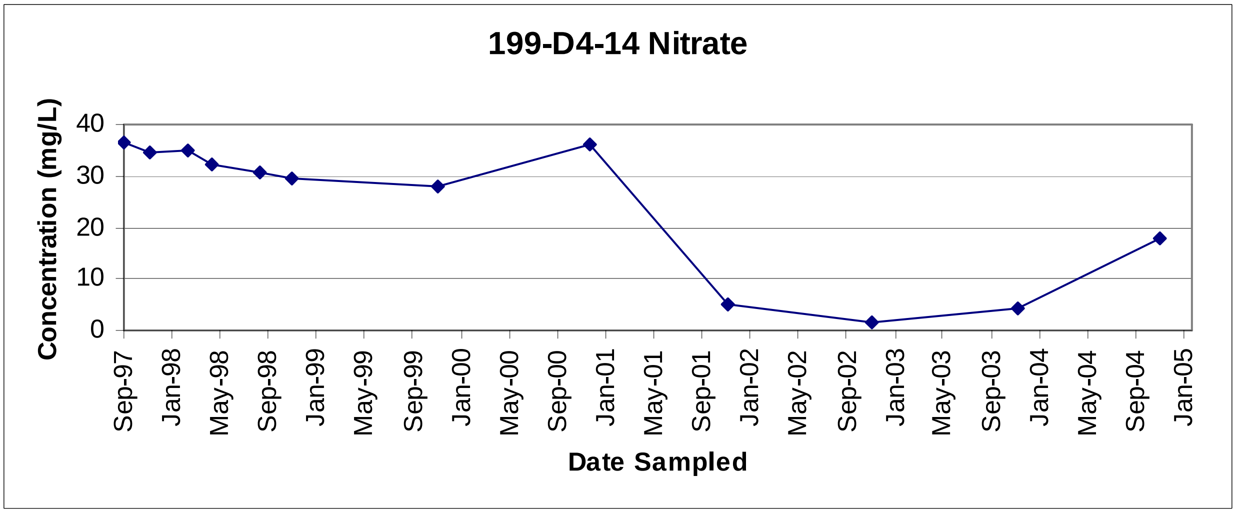
Sep-04
Jan-05
Date Sampled


199-D4-13 Nitrate
Concentration (mg/L)
100
80
60
40
20
0
Sep-97 Jan-98 May-98 Sep-98 Jan-99 May-99 Sep-99 Jan-00 May-00 Sep-00 Jan-01 May-01 Sep-01 Jan-02 May-02 Sep-02 Jan-03 May-03 Sep-03 Jan-04 May-04 Sep-04 Jan-05
Date Sampled


199-D4-14 Nitrate
Concentration (mg/L)
40
30
20
10
0
Sep-97 Jan-98 May-98 Sep-98 Jan-99 May-99 Sep-99 Jan-00 May-00 Sep-00 Jan-01 May-01 Sep-01 Jan-02 May-02 Sep-02 Jan-03 May-03 Sep-03 Jan-04 May-04 Sep-04 Jan-05
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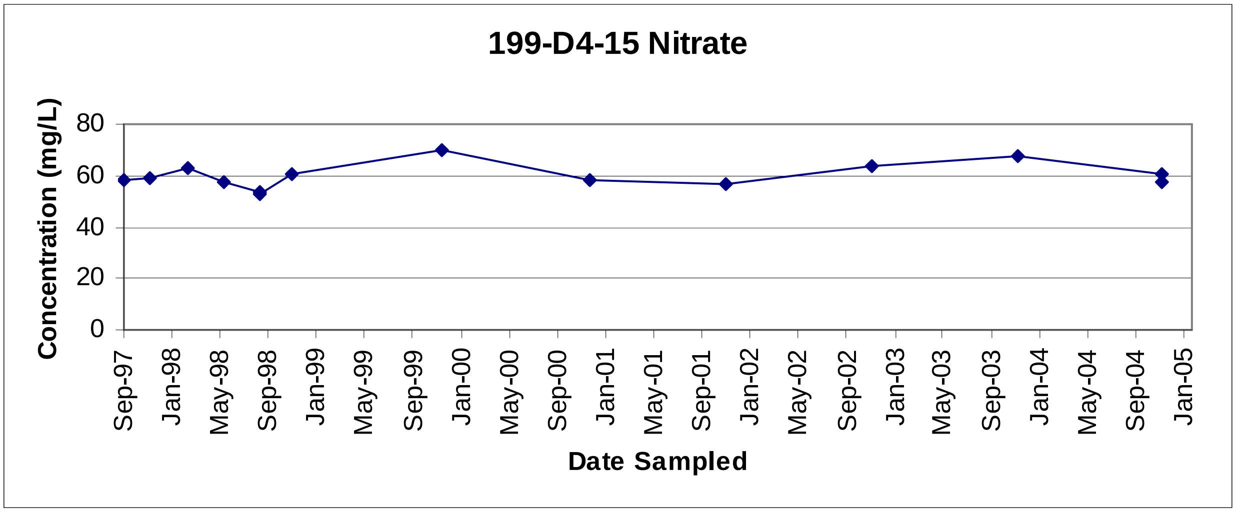
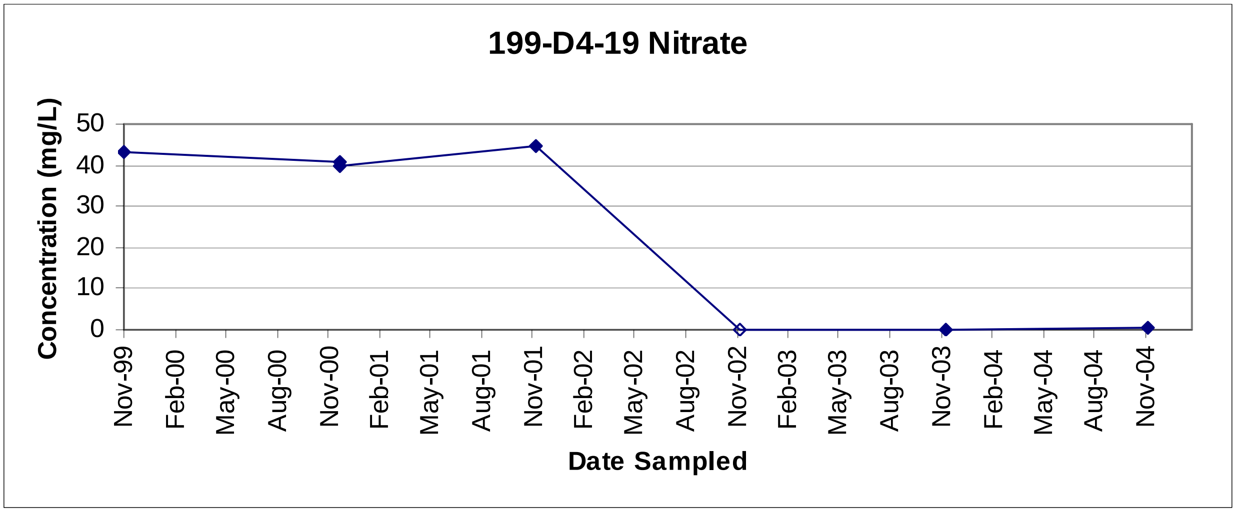
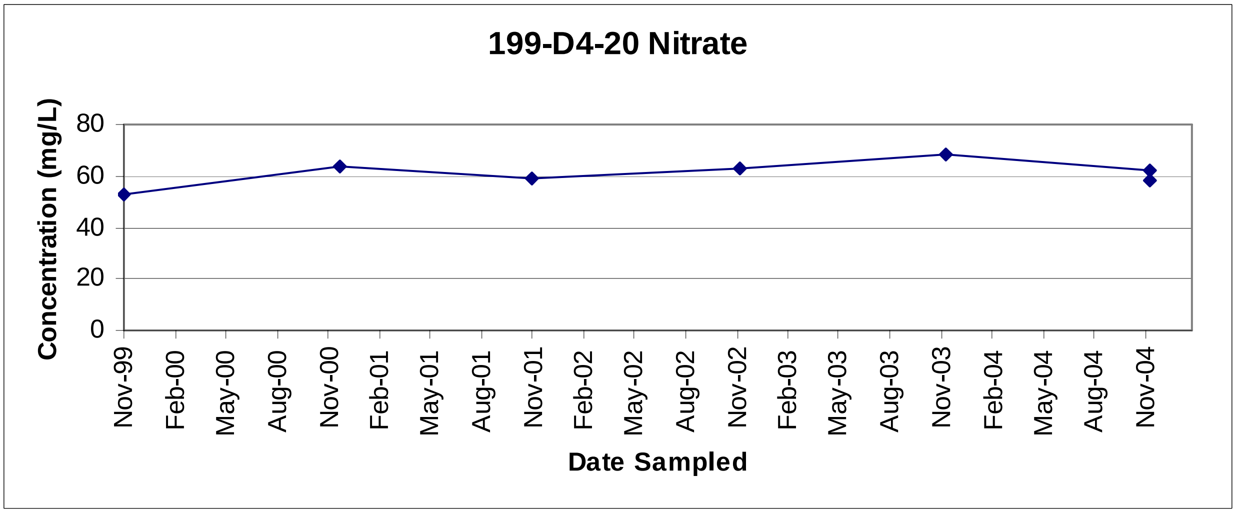
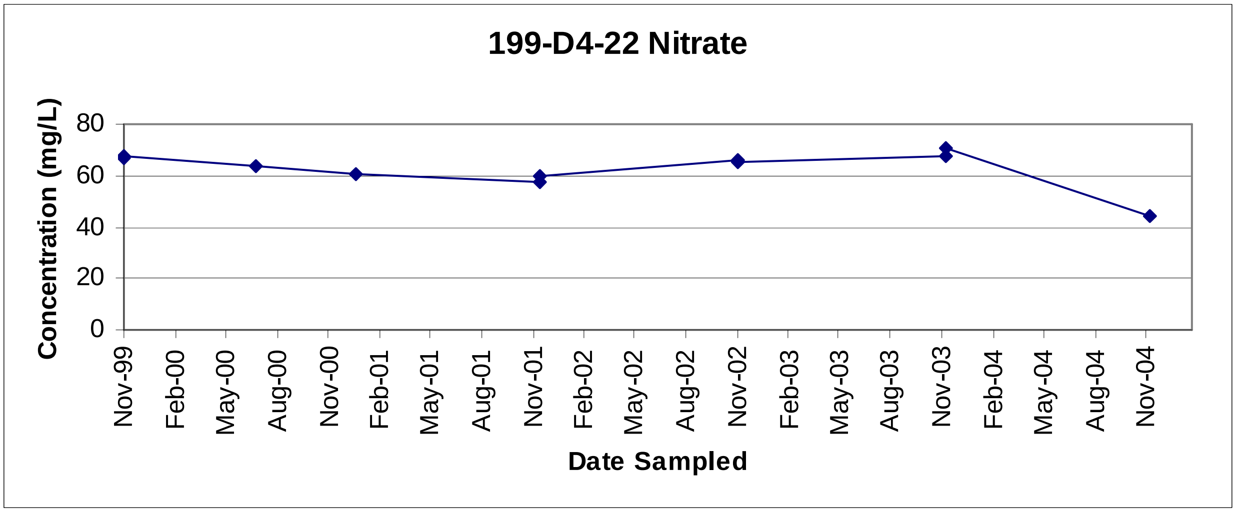
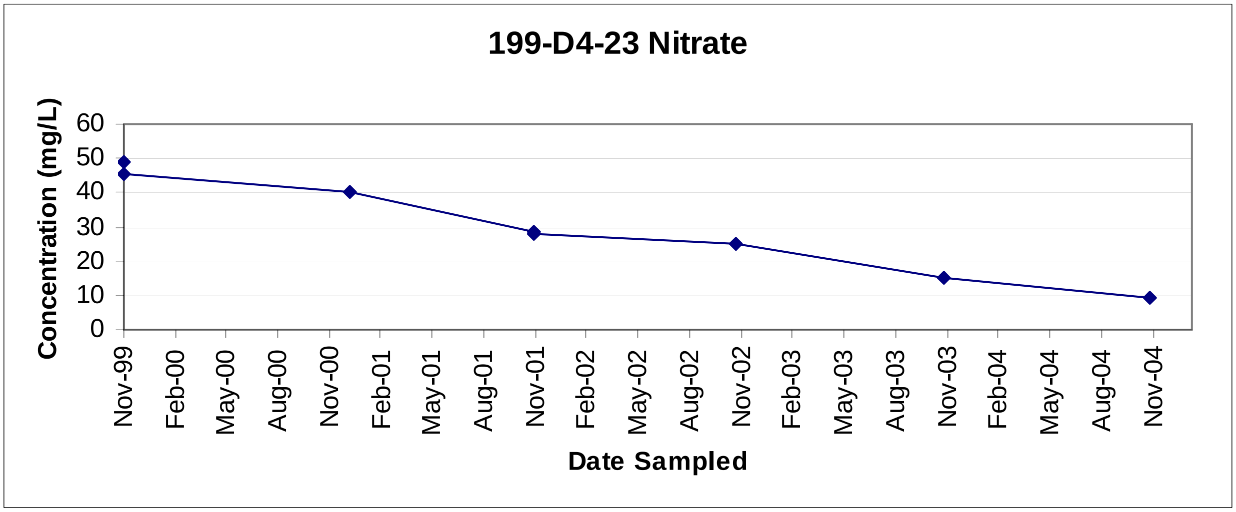
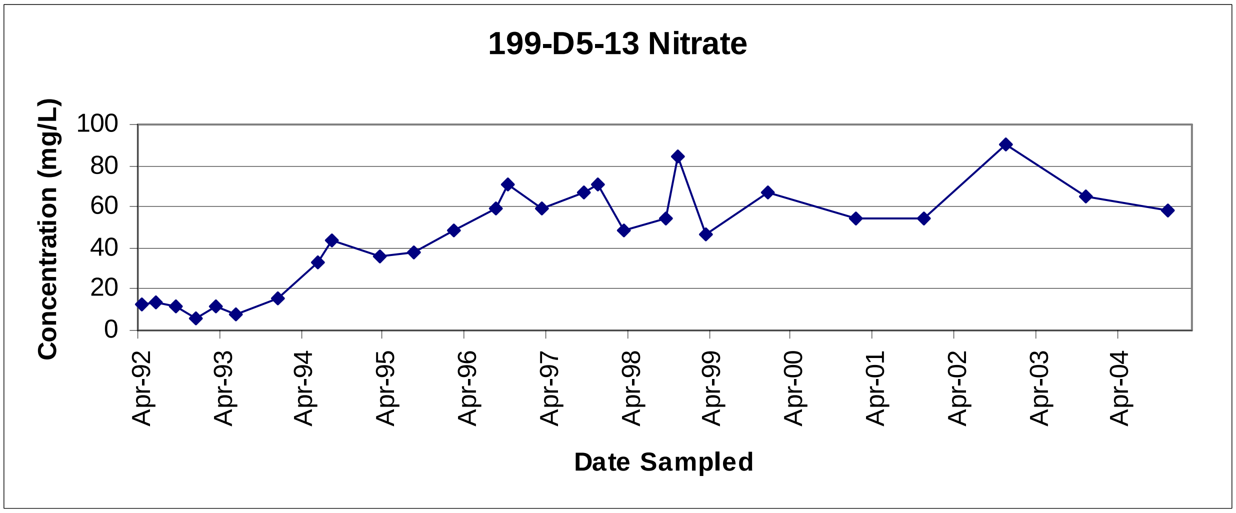

199-D4-15 Nitrate
Concentration (mg/L)
80
60
40
20
0
Sep-97 Jan-98 May-98 Sep-98 Jan-99 May-99 Sep-99 Jan-00 May-00 Sep-00 Jan-01 May-01 Sep-01 Jan-02 May-02 Sep-02 Jan-03 May-03 Sep-03 Jan-04 May-04 Sep-04 Jan-05
Date Sampled

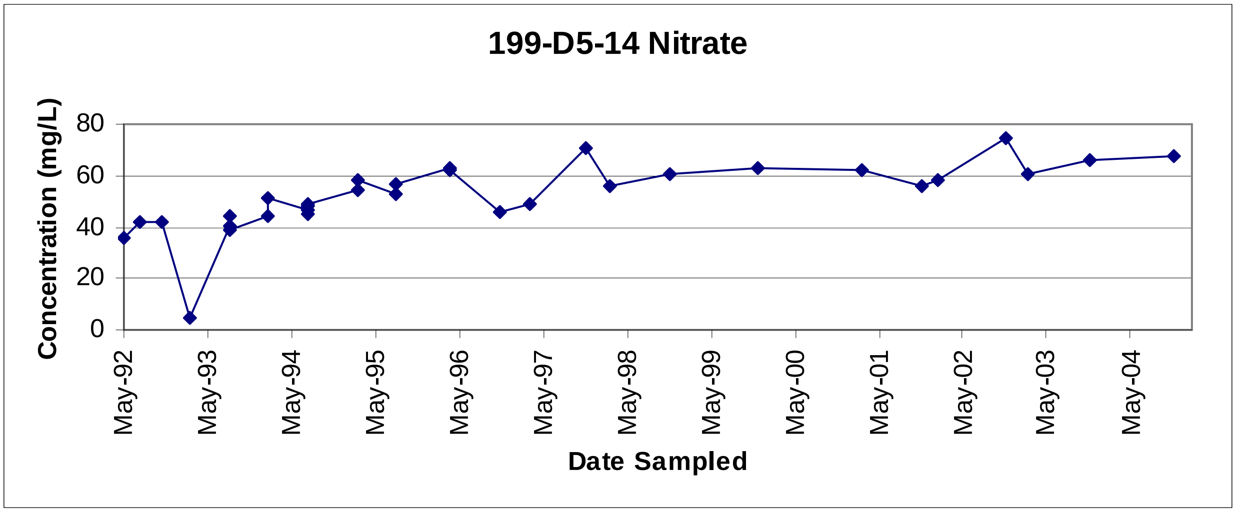

199-D4-19 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
May-03
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Date Sampled

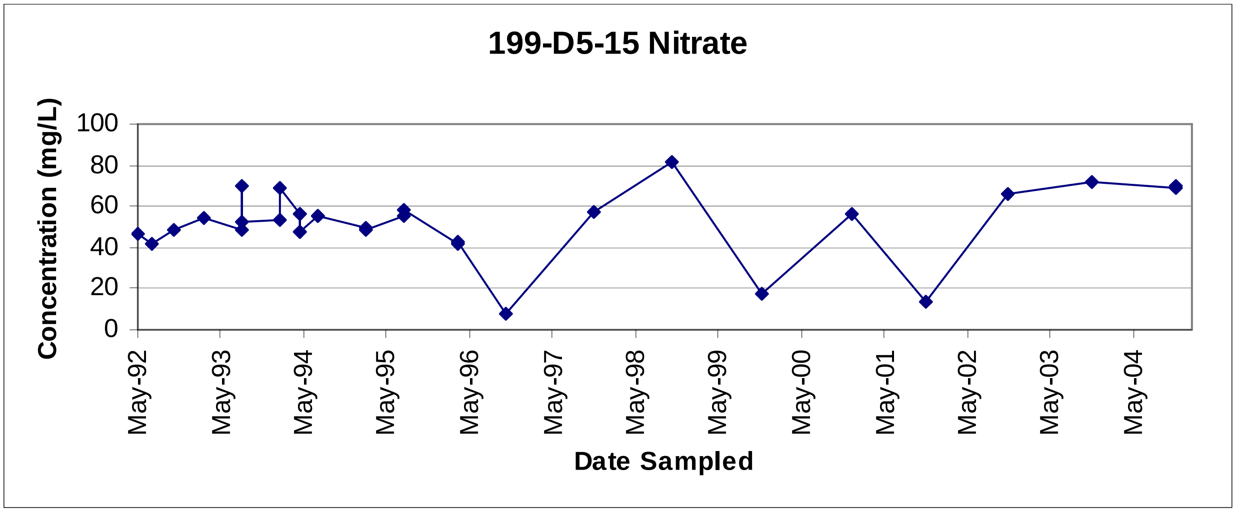

199-D4-20 Nitrate
Concentration (mg/L)
0
20
40
60
80
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
May-03
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Date Sampled

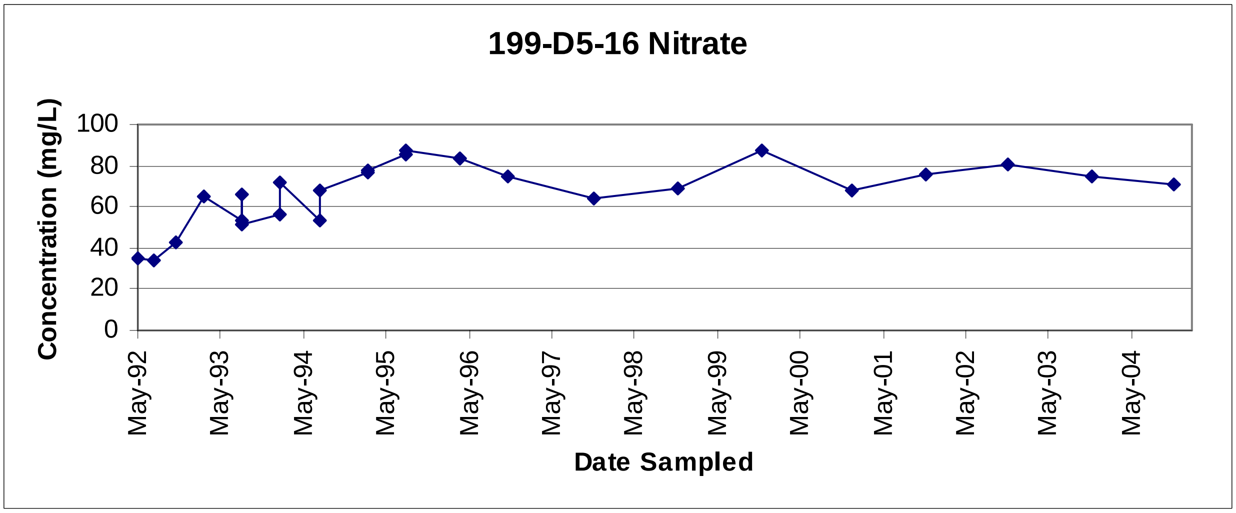

199-D4-22 Nitrate
Concentration (mg/L)
0
20
40
60
80
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
May-03
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Date Sampled

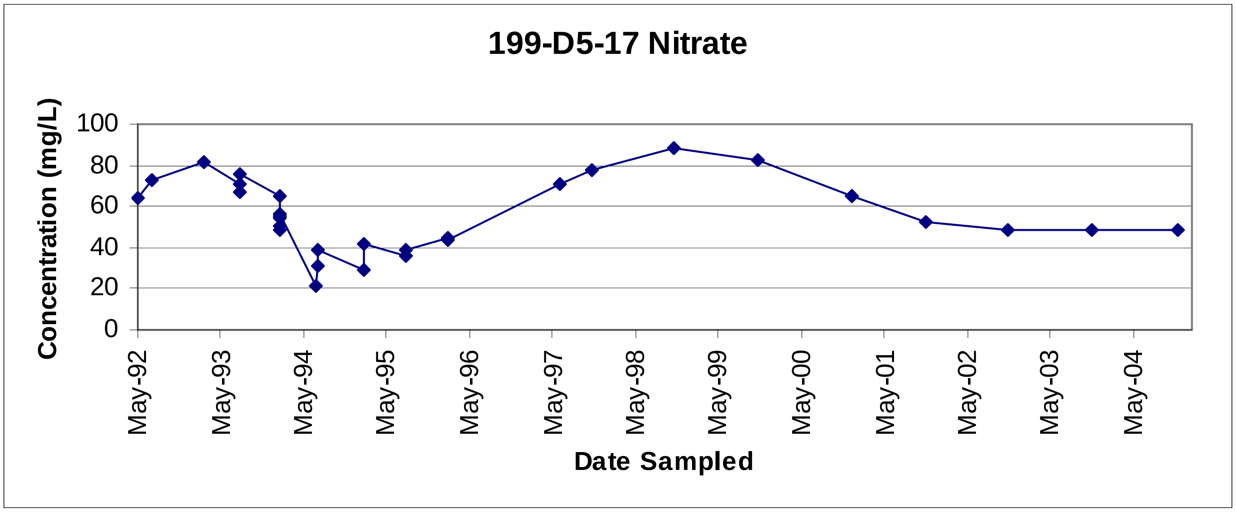

199-D4-23 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
60
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
May-03
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Date Sampled

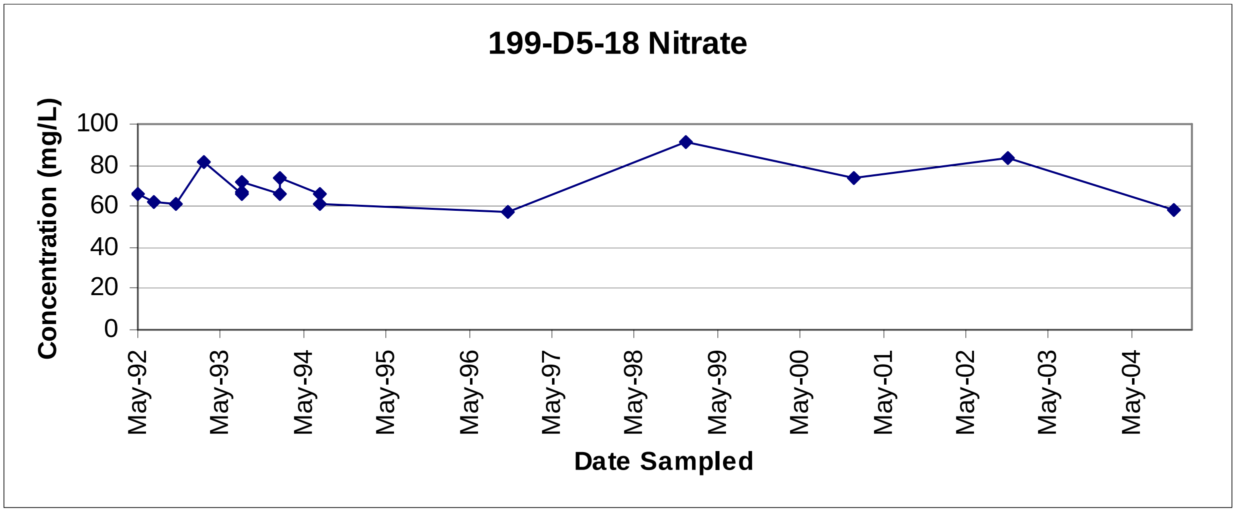

199-D5-13 Nitrate
Concentration (mg/L)
0
20
40
60
80
100
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled

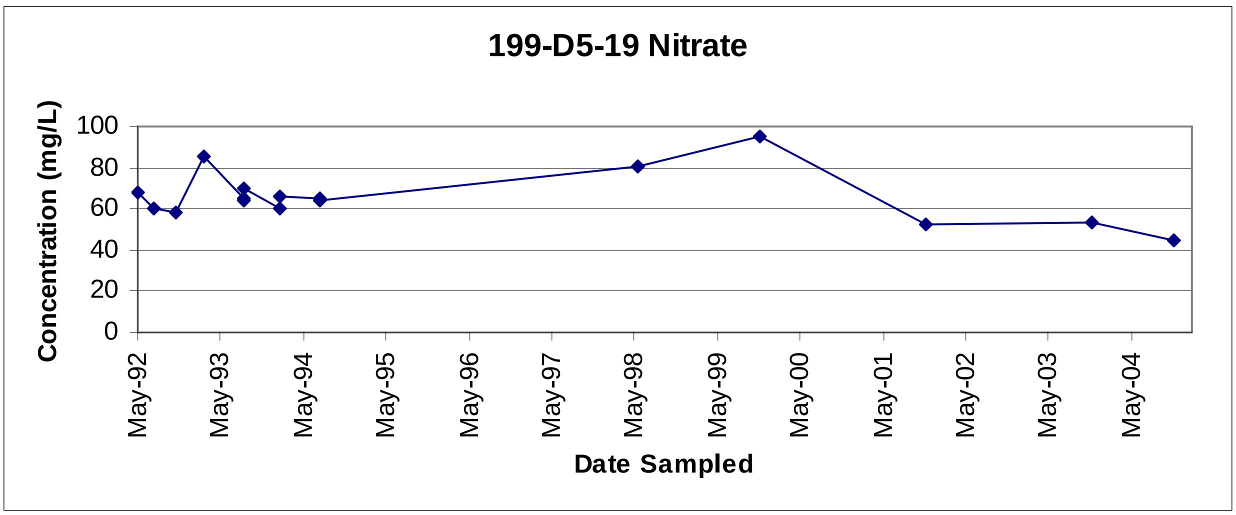

199-D5-14 Nitrate
Concentration (mg/L)
0
20
40
60
80
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

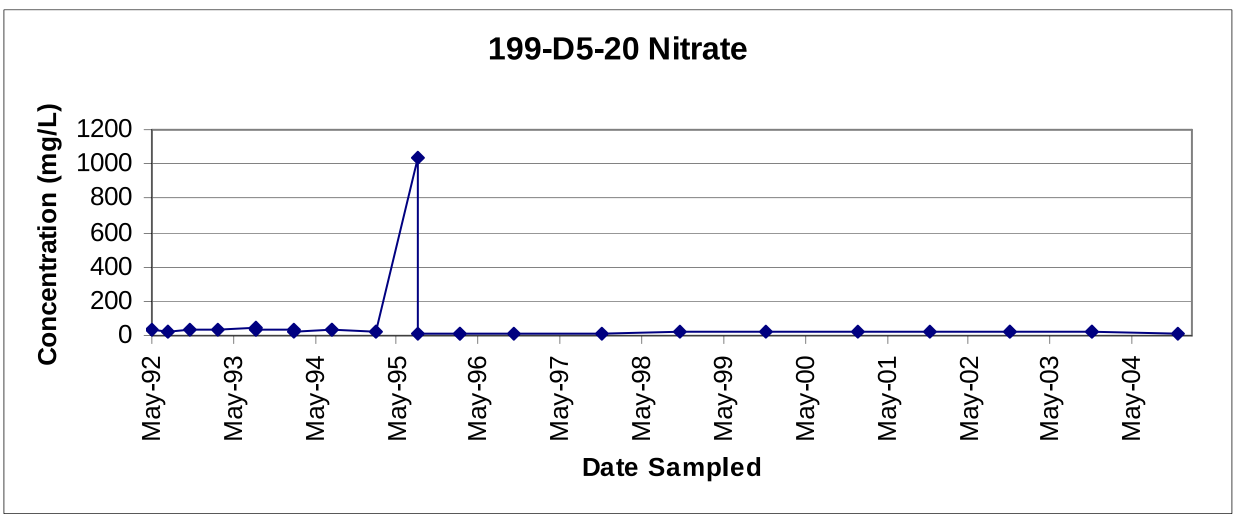

199-D5-15 Nitrate
Concentration (mg/L)
100
80
60
40
20
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

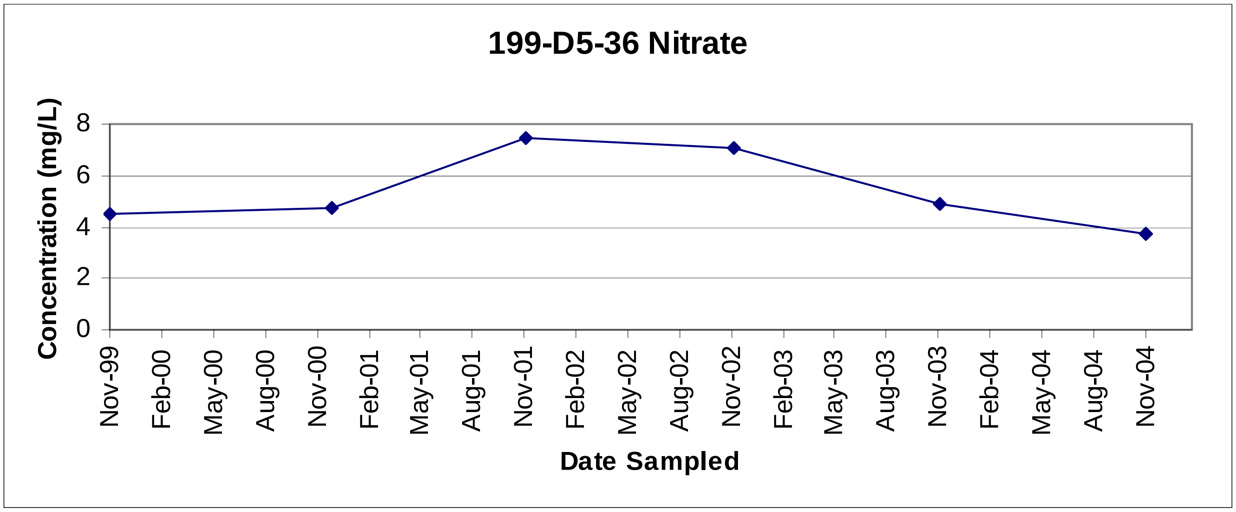

199-D5-16 Nitrate
Concentration (mg/L)
100
80
60
40
20
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

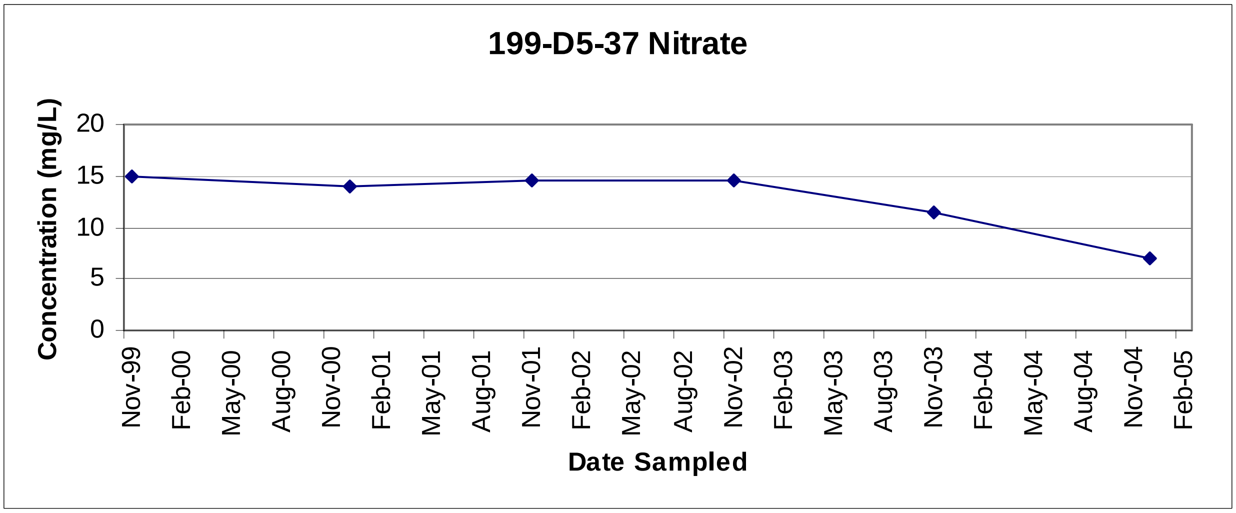

199-D5-17 Nitrate
Concentration (mg/L)
100
80
60
40
20
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

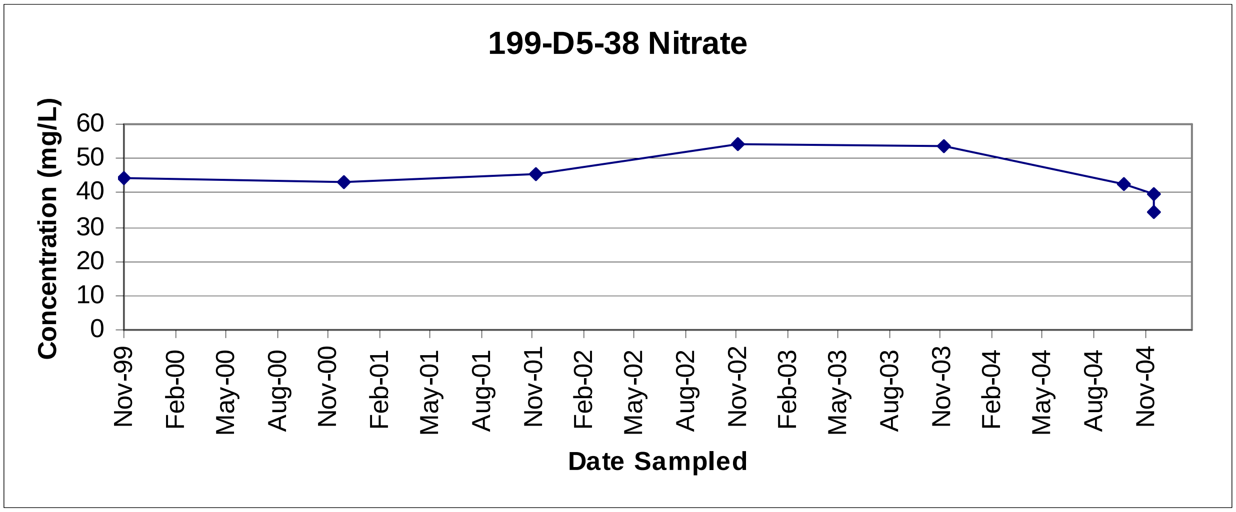

199-D5-18 Nitrate
Concentration (mg/L)
100
80
60
40
20
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

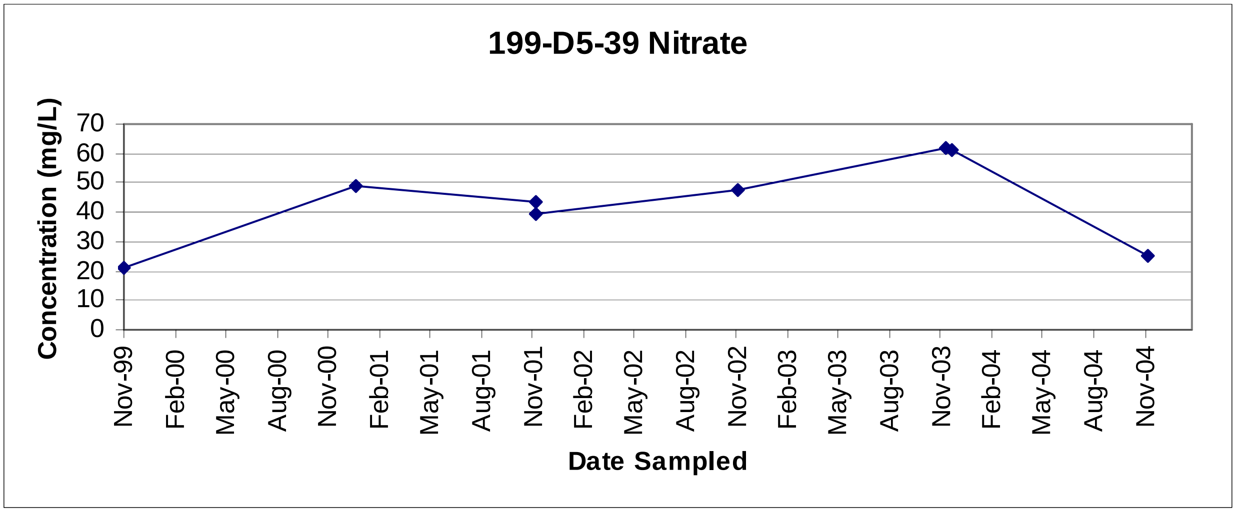

199-D5-19 Nitrate
Concentration (mg/L)
100
80
60
40
20
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D5-20 Nitrate
Concentration (mg/L)
1200
1000
800
600
400
200
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D5-36 Nitrate
Concentration (mg/L)
0
2
4
6
8
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
May-03
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Date Sampled


199-D5-37 Nitrate
Concentration (mg/L)
0
5
10
15
20
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
May-03
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Feb-05
Date Sampled


199-D5-38 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
60
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
May-03
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Date Sampled


199-D5-39 Nitrate
Concentration (mg/L)
70
60
50
40
30
20
10
0
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
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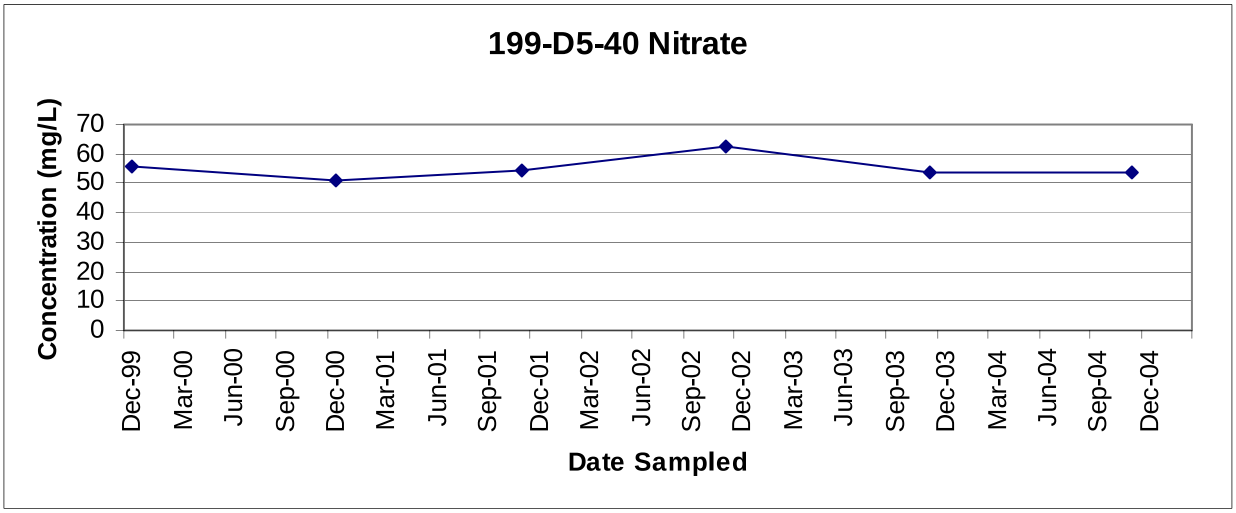
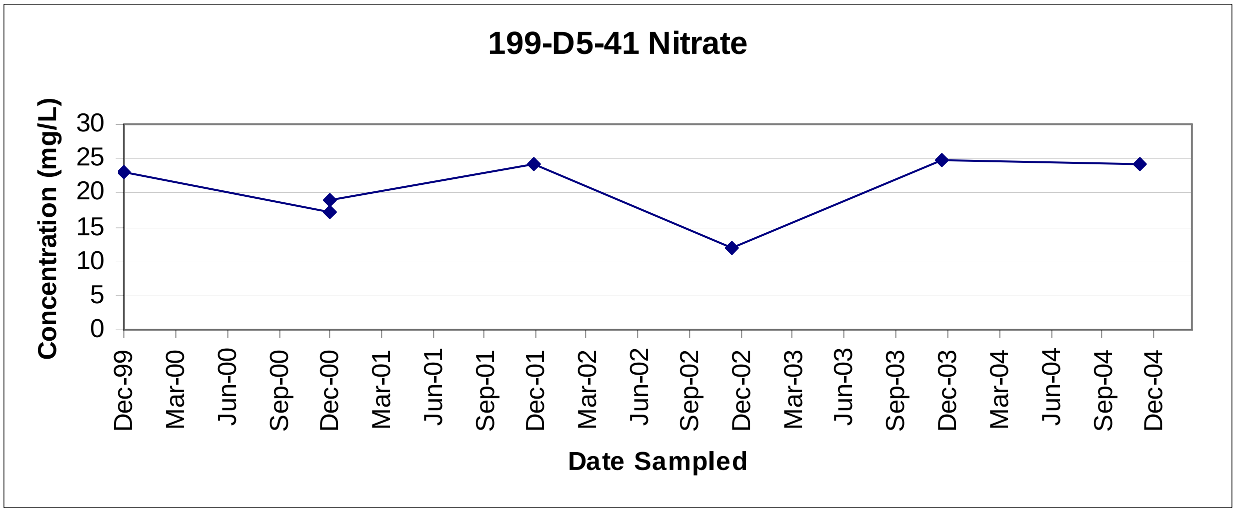
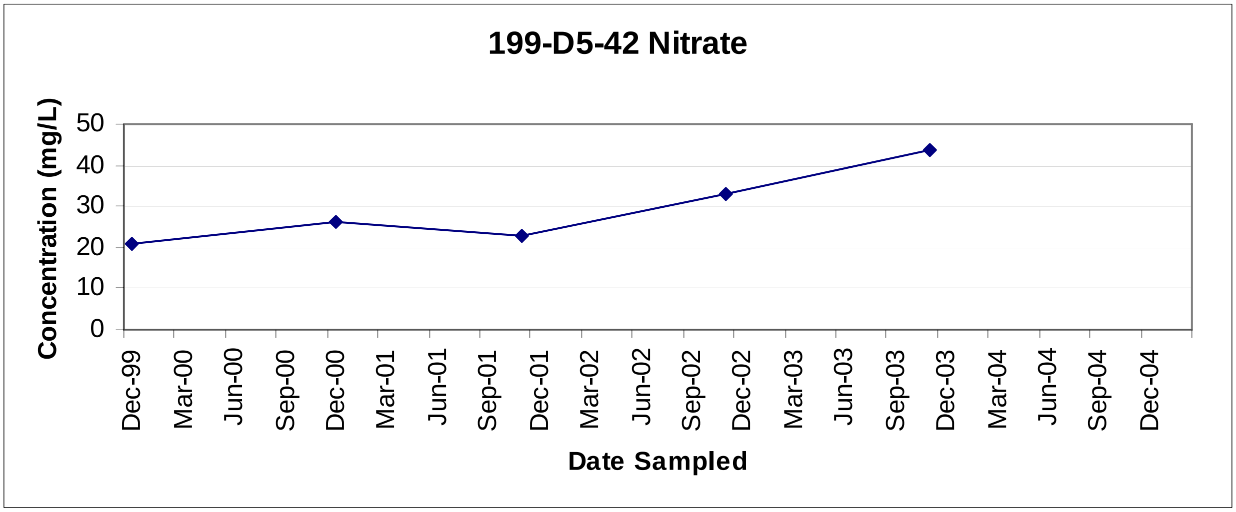
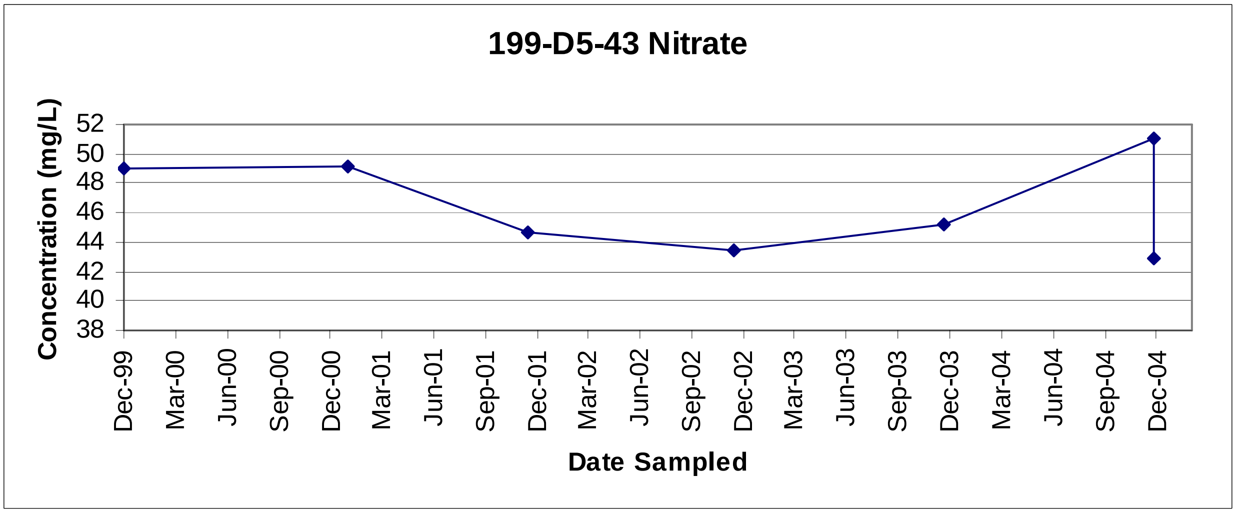
May-04
Aug-04
Nov-04
Date Sampled


199-D5-40 Nitrate
Concentration (mg/L)
70
60
50
40
30
20
10
0
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
Sep-04
Dec-04
Date Sampled


199-D5-41 Nitrate
Concentration (mg/L)
30
25
20
15
10
5
0
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
Sep-04
Dec-04
Date Sampled


199-D5-42 Nitrate
Concentration (mg/L)
50
40
30
20
10
0
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
Sep-04
Dec-04
Date Sampled


199-D5-43 Nitrate
Concentration (mg/L)
52
50
48
46
44
42
40
38
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
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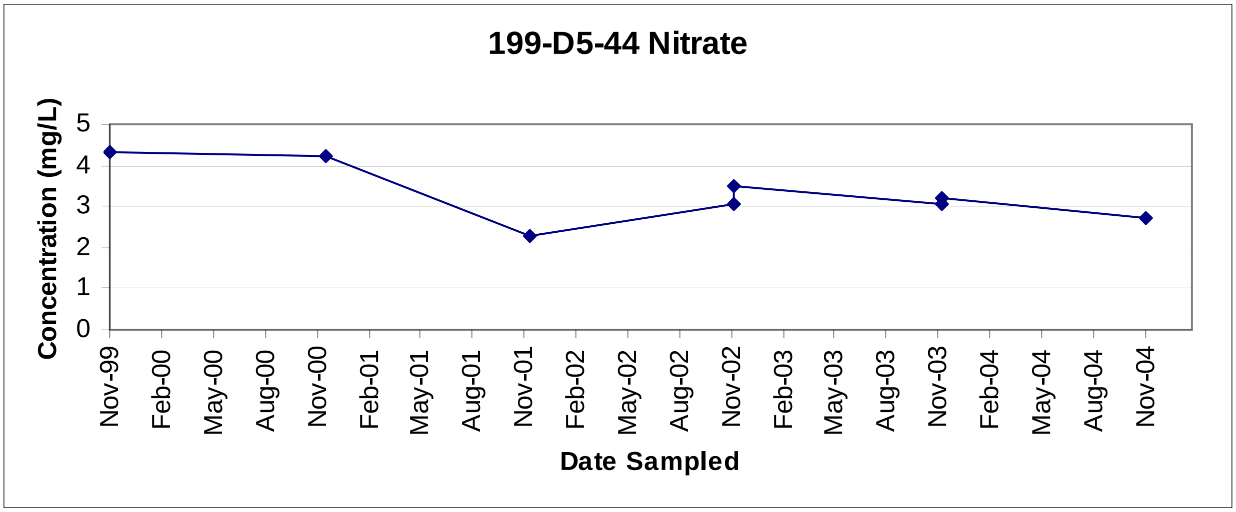
Jun-04
Sep-04
Dec-04
Date Sampled


199-D5-44 Nitrate
Concentration (mg/L)
5
4
3
2
1
0
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
May-02
Aug-02
Nov-02
Feb-03
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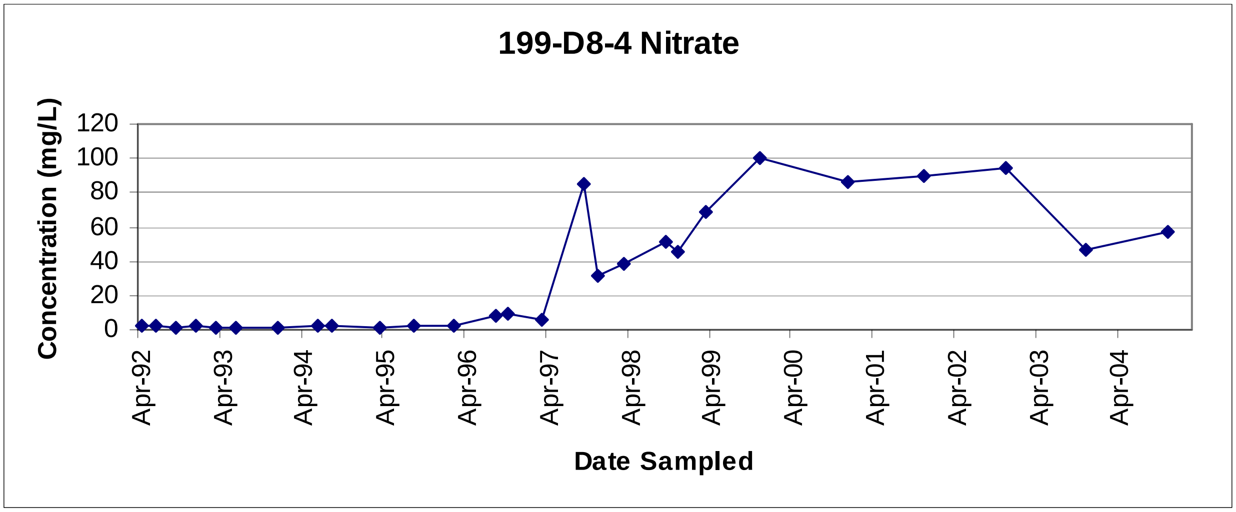
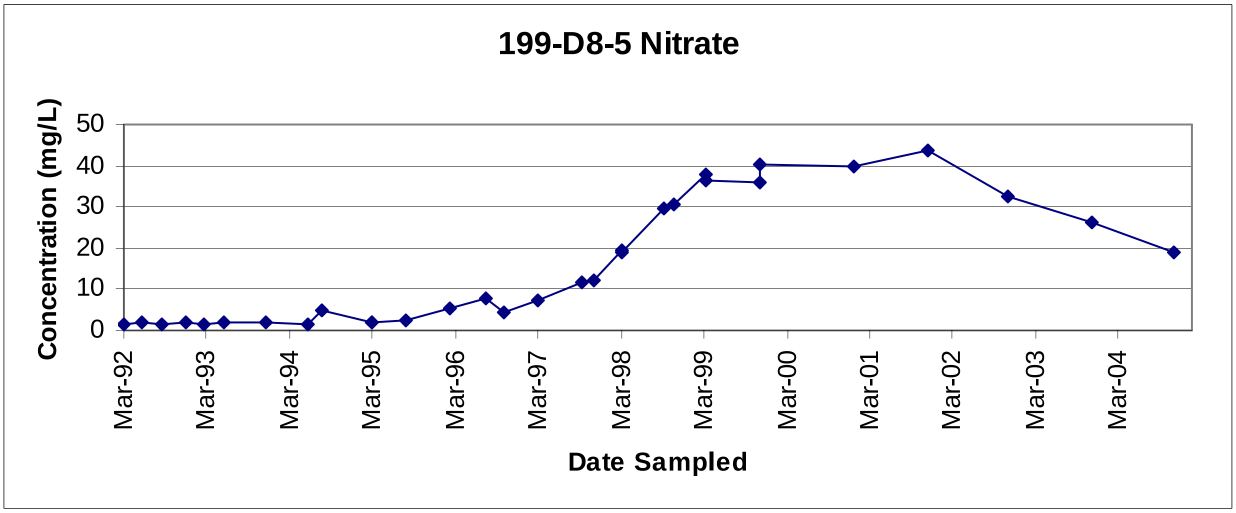
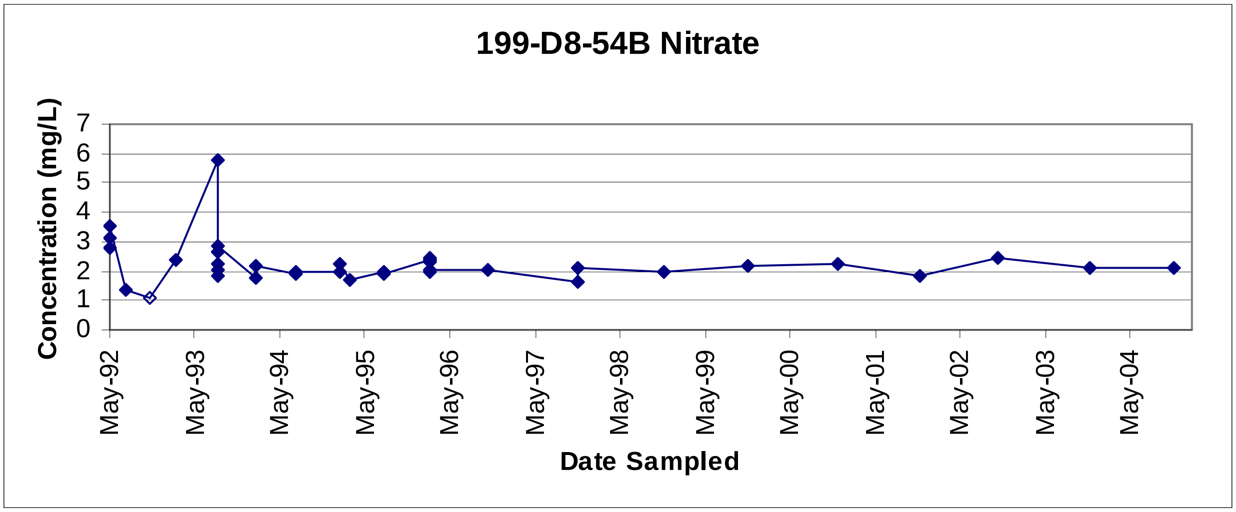
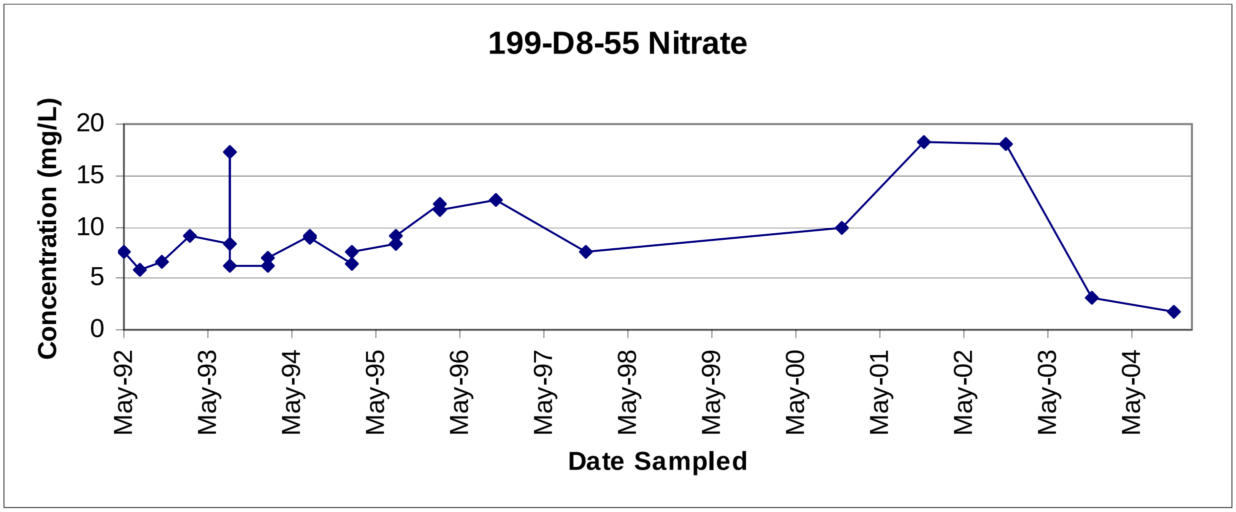
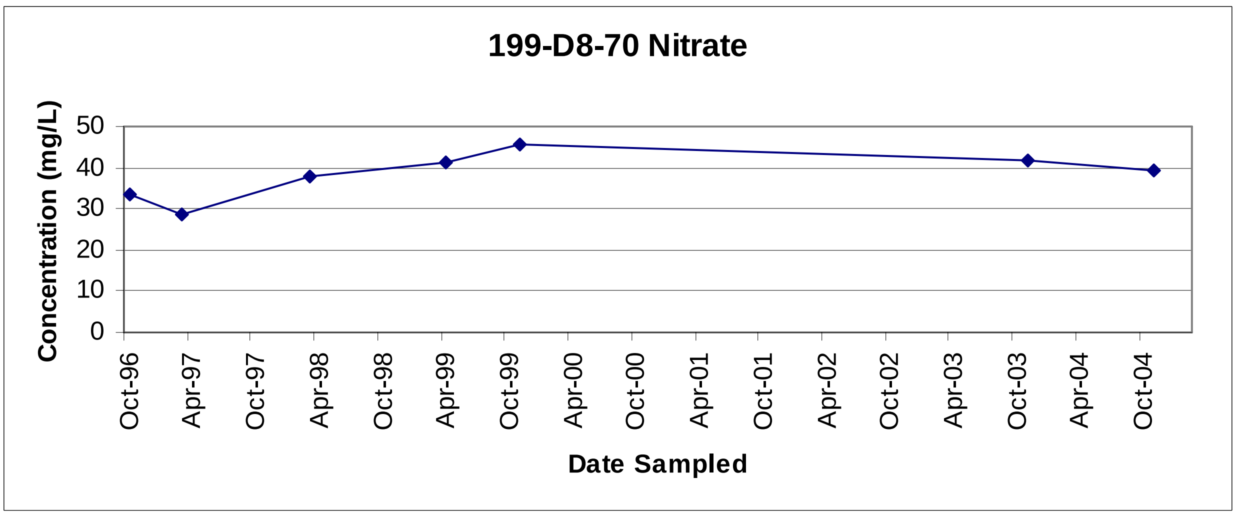
Aug-03
Nov-03
Feb-04
May-04
Aug-04
Nov-04
Date Sampled


199-D8-4 Nitrate
Concentration (mg/L)
0
20
40
60
80
100
120
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled


199-D8-5 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled


199-D8-54B Nitrate
Concentration (mg/L)
0
1
2
3
4
5
6
7
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D8-55 Nitrate
Concentration (mg/L)
0
5
10
15
20
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D8-70 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
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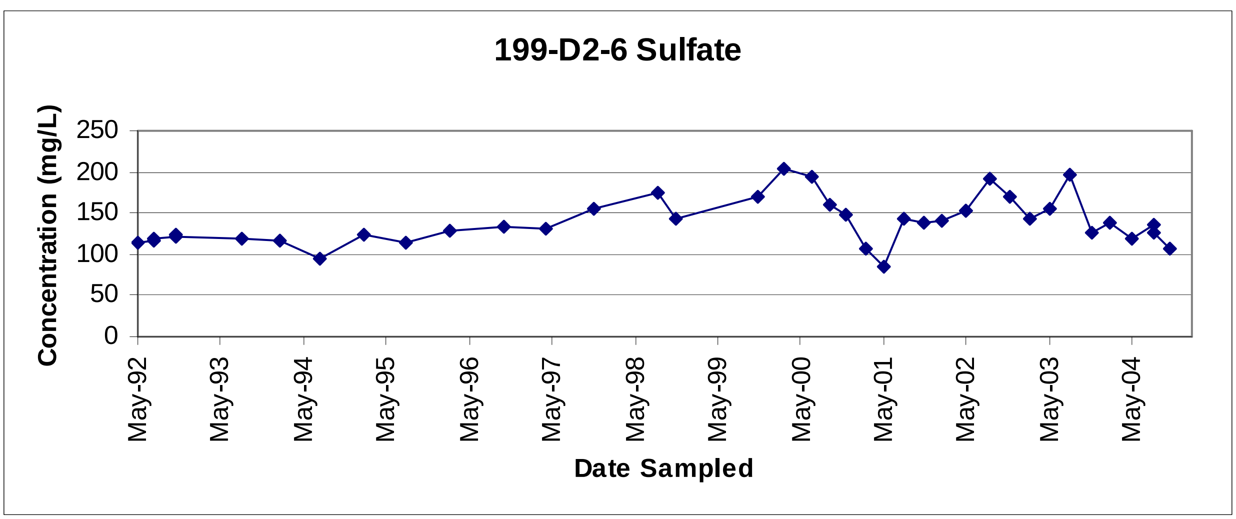
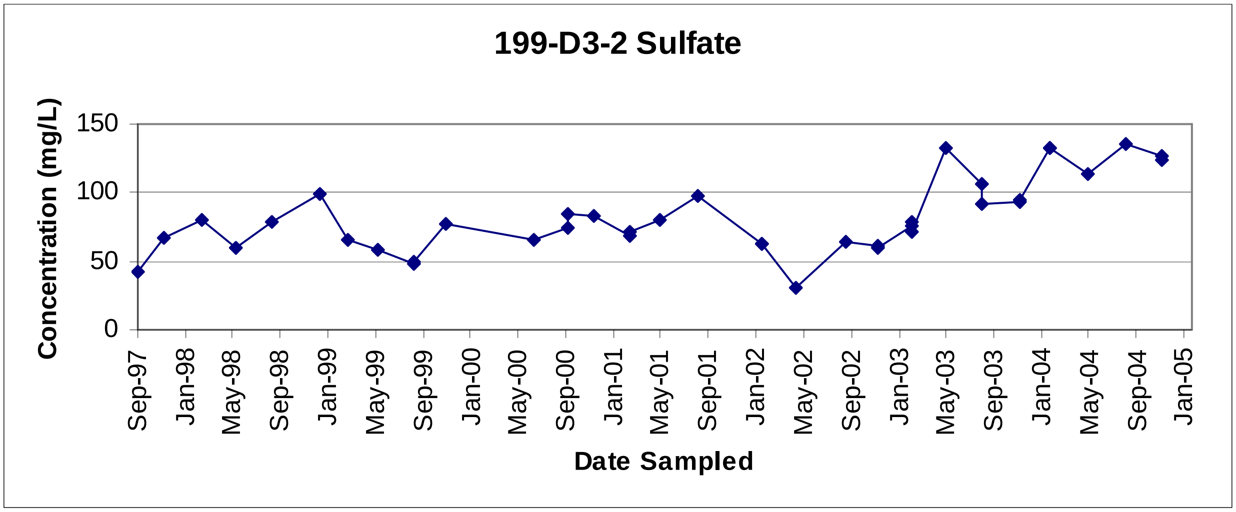
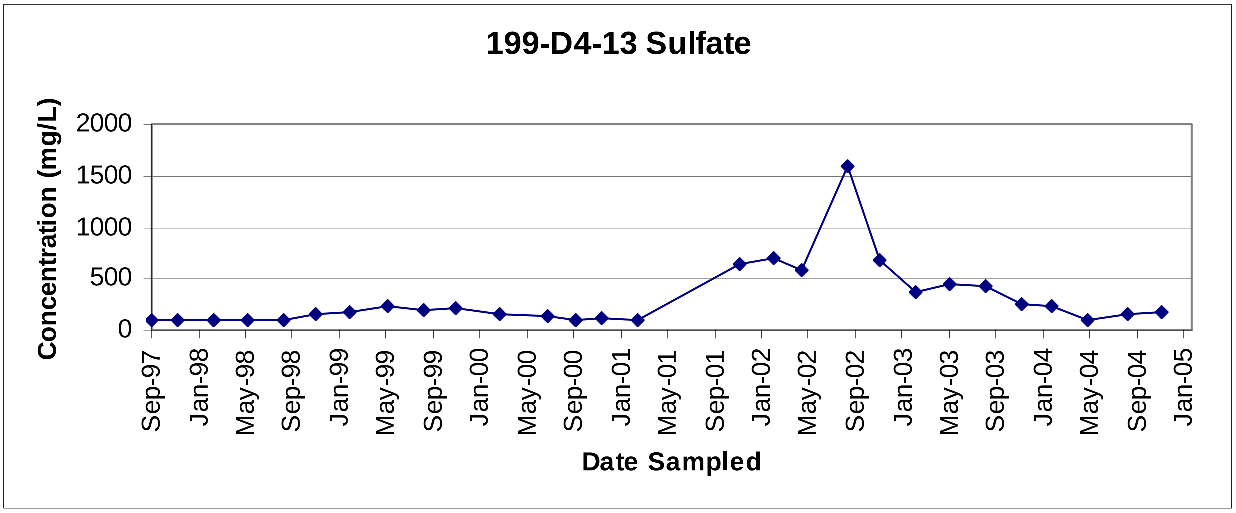
Oct-03
Apr-04
Oct-04
Date Sampled


199-D2-6 Sulfate
Concentration (mg/L)
0
50
100
150
200
250
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D3-2 Sulfate
Concentration (mg/L)
0
50
100
150
Sep-97
Jan-98
May-98
Sep-98
Jan-99
May-99
Sep-99
Jan-00
May-00
Sep-00
Jan-01
May-01
Sep-01
Jan-02
May-02
Sep-02
Jan-03
May-03
Sep-03
Jan-04
May-04
Sep-04
Jan-05
Date Sampled


199-D4-13 Sulfate
Concentration (mg/L)
0
500
1000
1500
2000
Sep-97
Jan-98
May-98
Sep-98
Jan-99
May-99
Sep-99
Jan-00
May-00
Sep-00
Jan-01
May-01
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Jan-04
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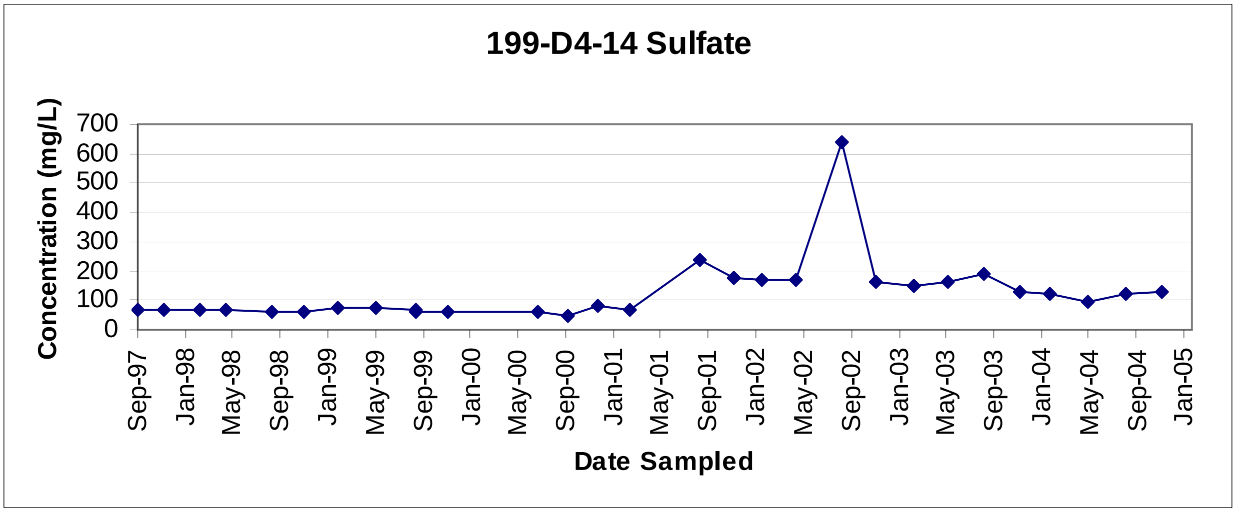
Sep-04
Jan-05
Date Sampled


199-D4-14 Sulfate
Concentration (mg/L)
0
100
200
300
400
500
600
700
Sep-97
Jan-98
May-98
Sep-98
Jan-99
May-99
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Sep-00
Jan-01
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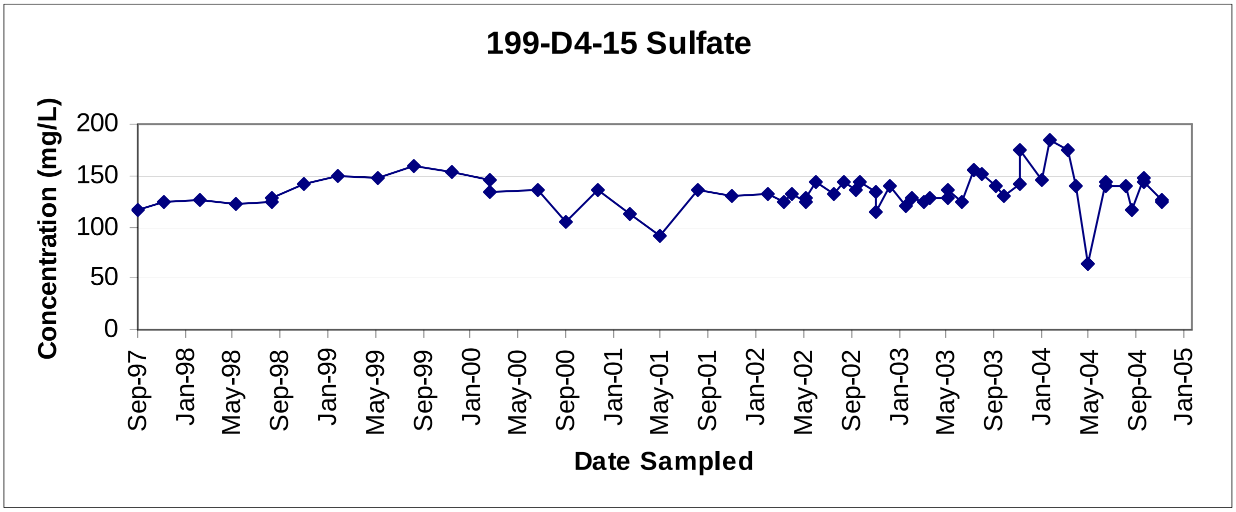
Sep-04
Jan-05
Date Sampled


199-D4-15 Sulfate
Concentration (mg/L)
200
150
100
50
0
Sep-97
Jan-98
May-98
Sep-98
Jan-99
May-99
Sep-99
Jan-00
May-00
Sep-00
Jan-01
May-01
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Jan-02
May-02
Sep-02
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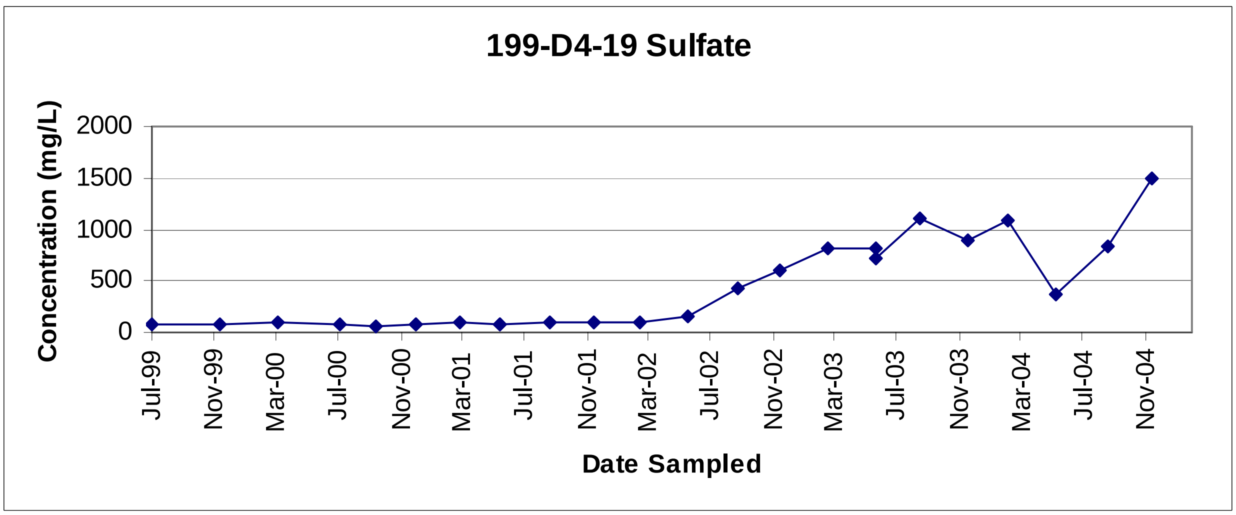
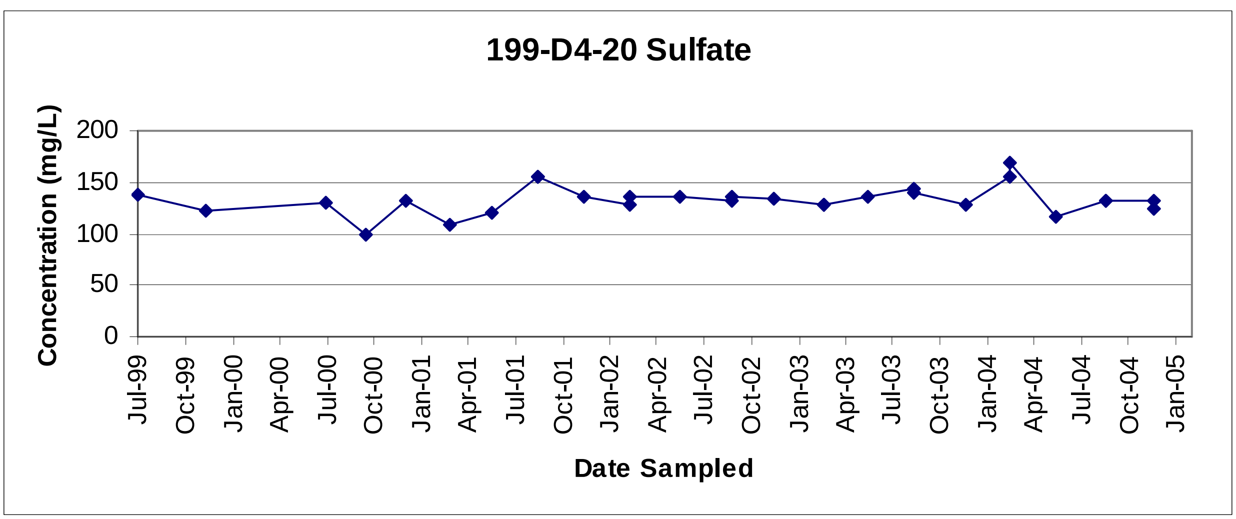
May-03
Sep-03
Jan-04
May-04
Sep-04
Jan-05
Date Sampled


199-D4-19 Sulfate
Concentration (mg/L)
2000
1500
1000
500
0
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Date Sampled


199-D4-20 Sulfate
Concentration (mg/L)
200
150
100
50
0
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
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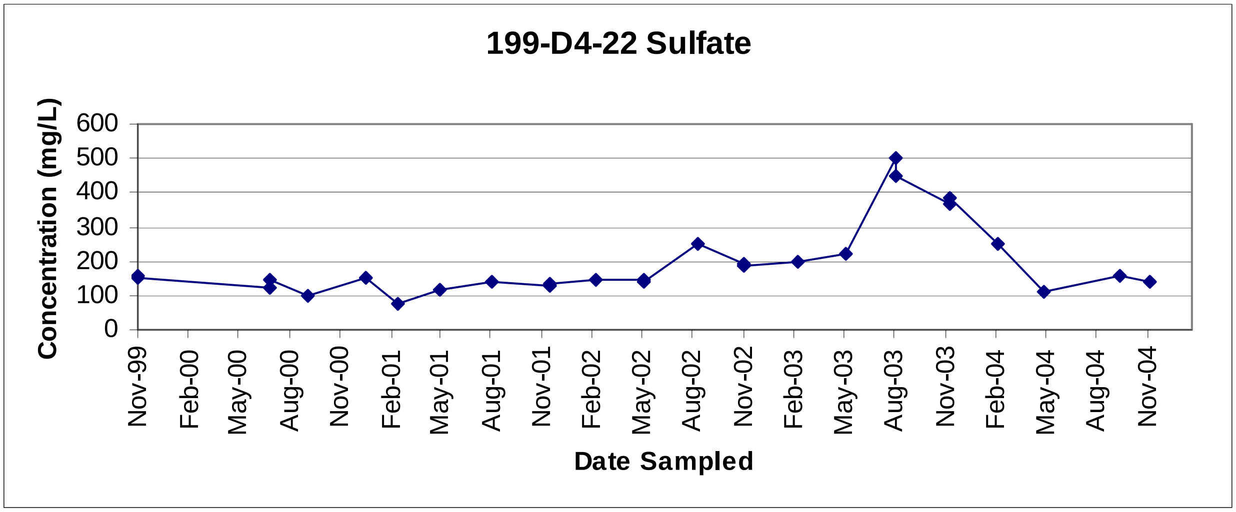
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Date Sampled


199-D4-22 Sulfate
Concentration (mg/L)
600
500
400
300
200
100
0
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
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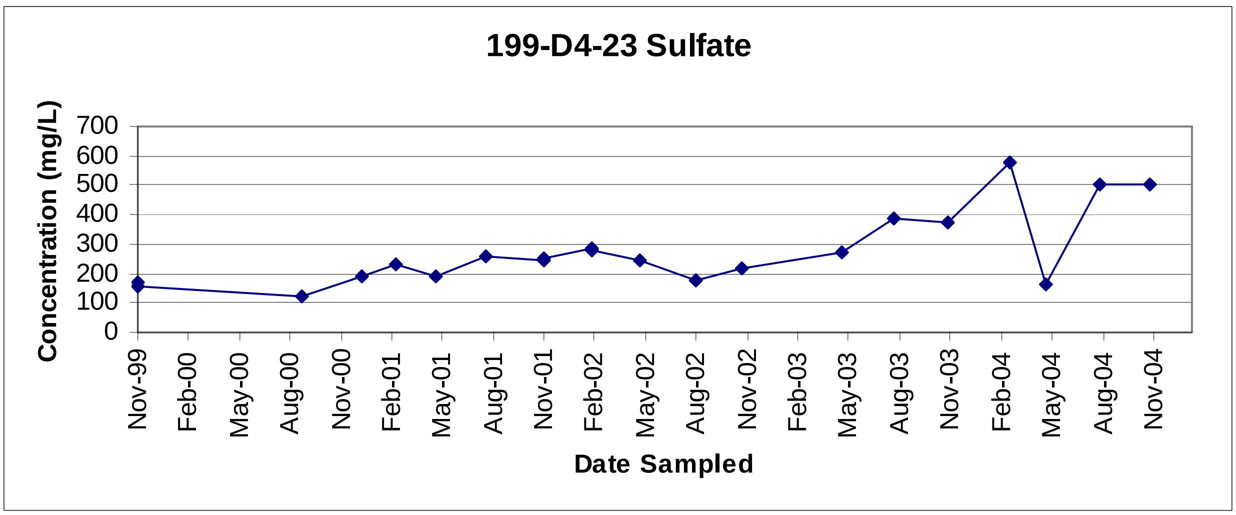
May-04
Aug-04
Nov-04
Date Sampled


199-D4-23 Sulfate
Concentration (mg/L)
700
600
500
400
300
200
100
0
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
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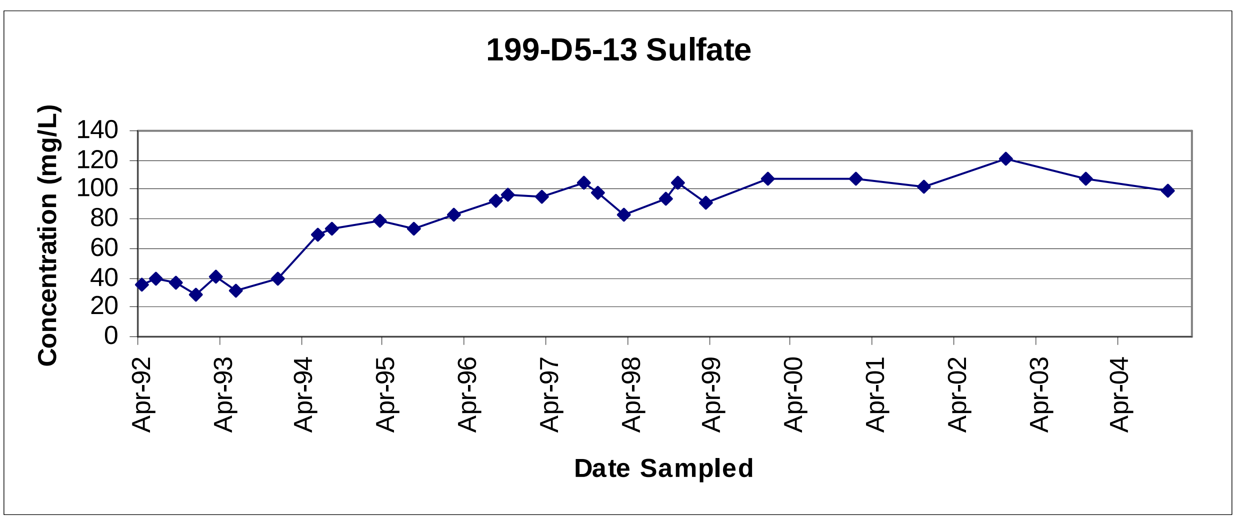
Feb-04
May-04
Aug-04
Nov-04
Date Sampled


199-D5-13 Sulfate
Concentration (mg/L)
140
120
100
80
60
40
20
0
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
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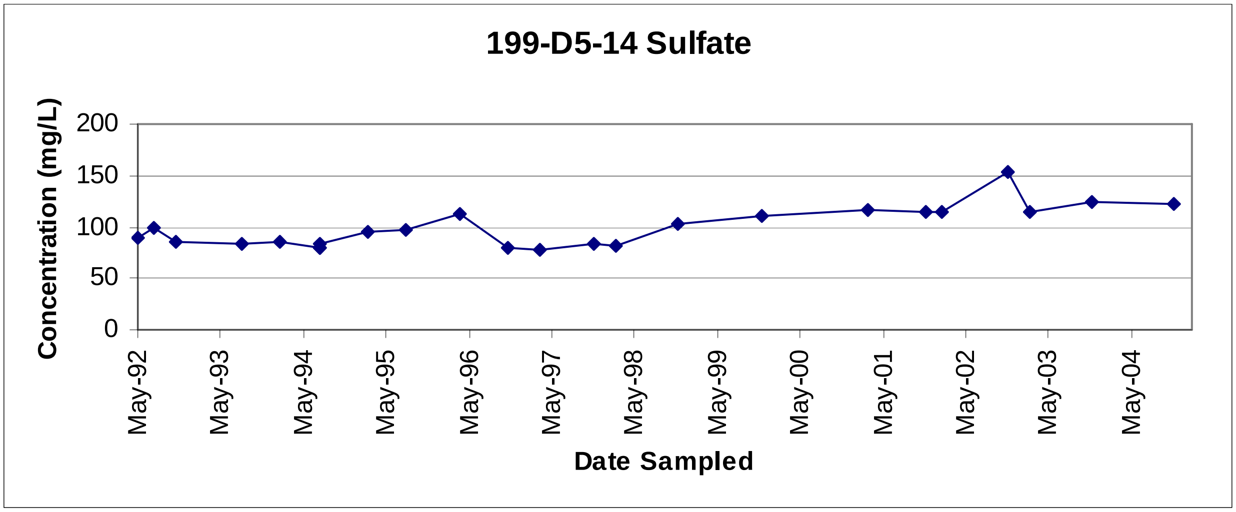
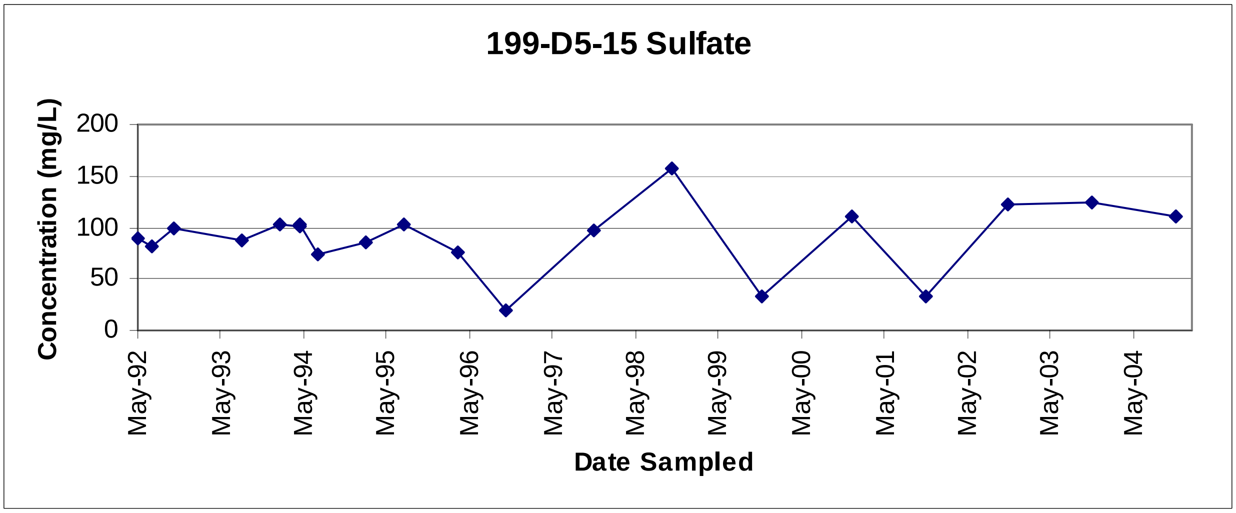
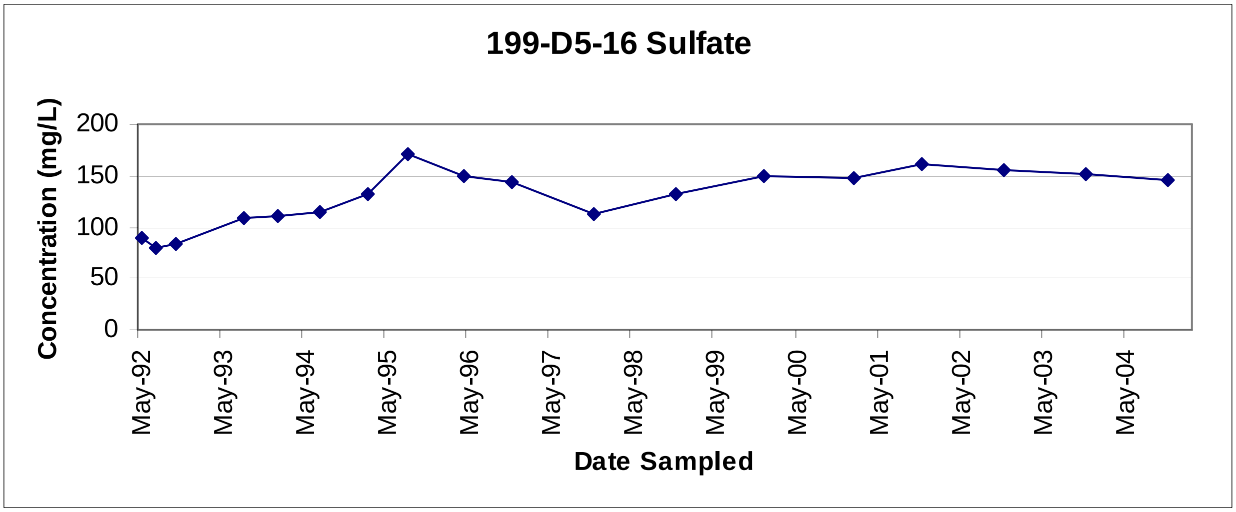
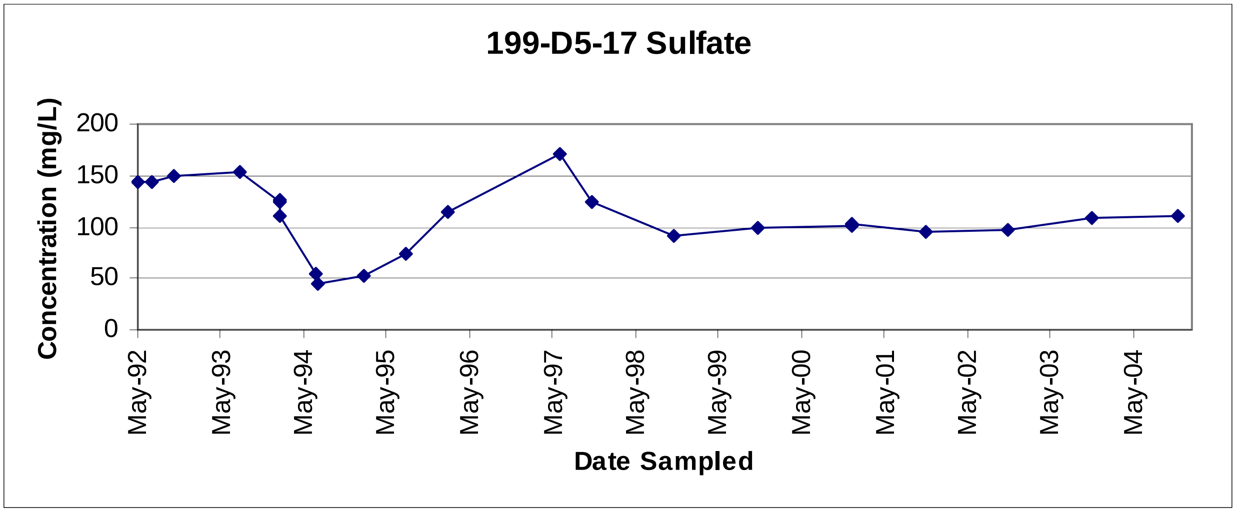
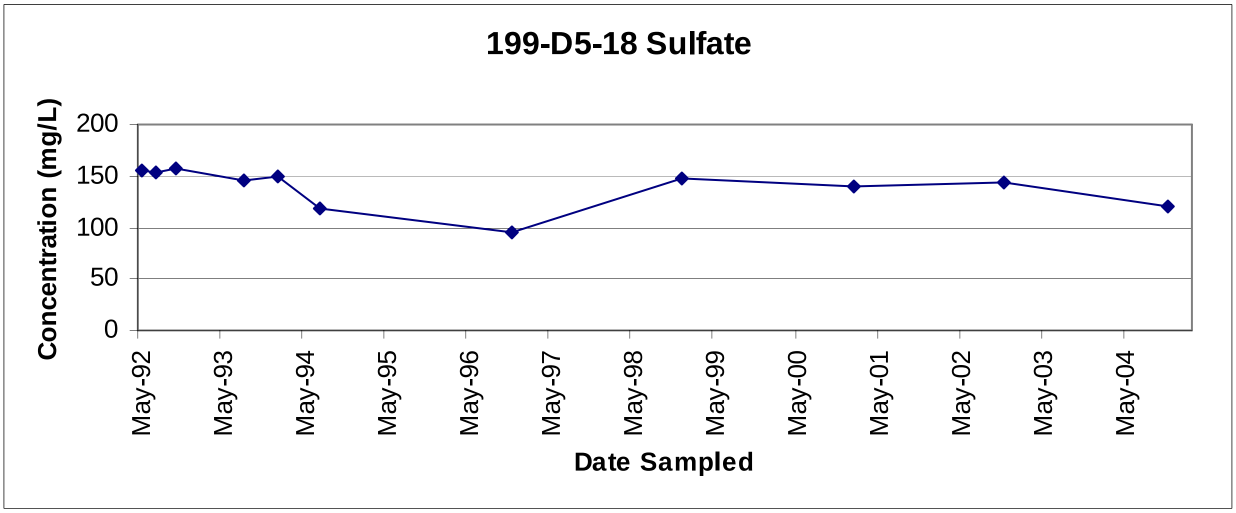
Apr-04
Date Sampled


199-D5-14 Sulfate
Concentration (mg/L)
0
50
100
150
200
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D5-15 Sulfate
Concentration (mg/L)
0
50
100
150
200
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D5-16 Sulfate
Concentration (mg/L)
0
50
100
150
200
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D5-17 Sulfate
Concentration (mg/L)
200
150
100
50
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D5-18 Sulfate
Concentration (mg/L)
200
150
100
50
0
May-92
May-93
May-94
May-95
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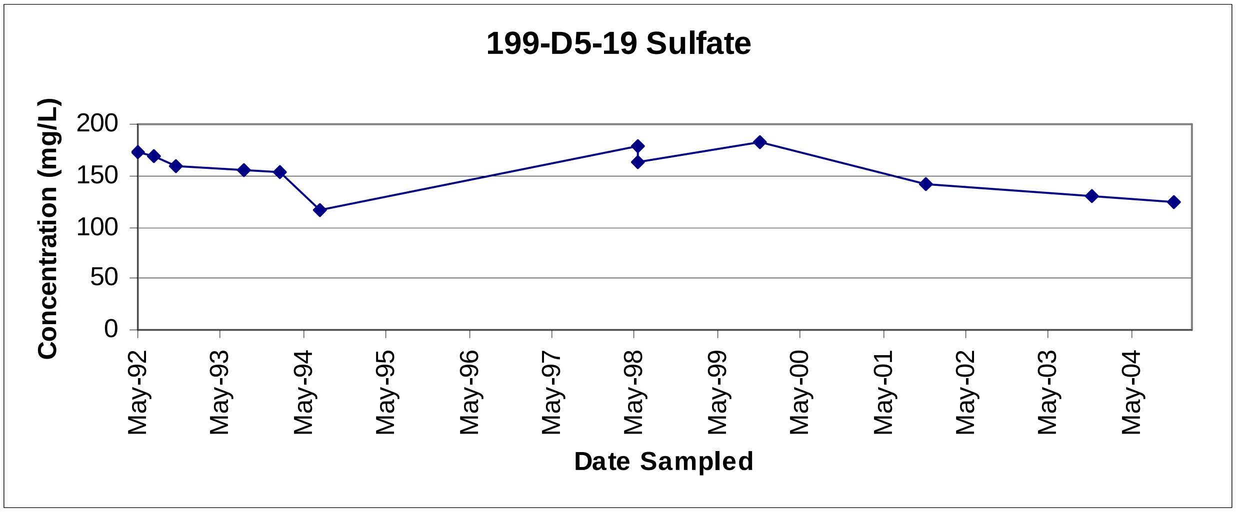
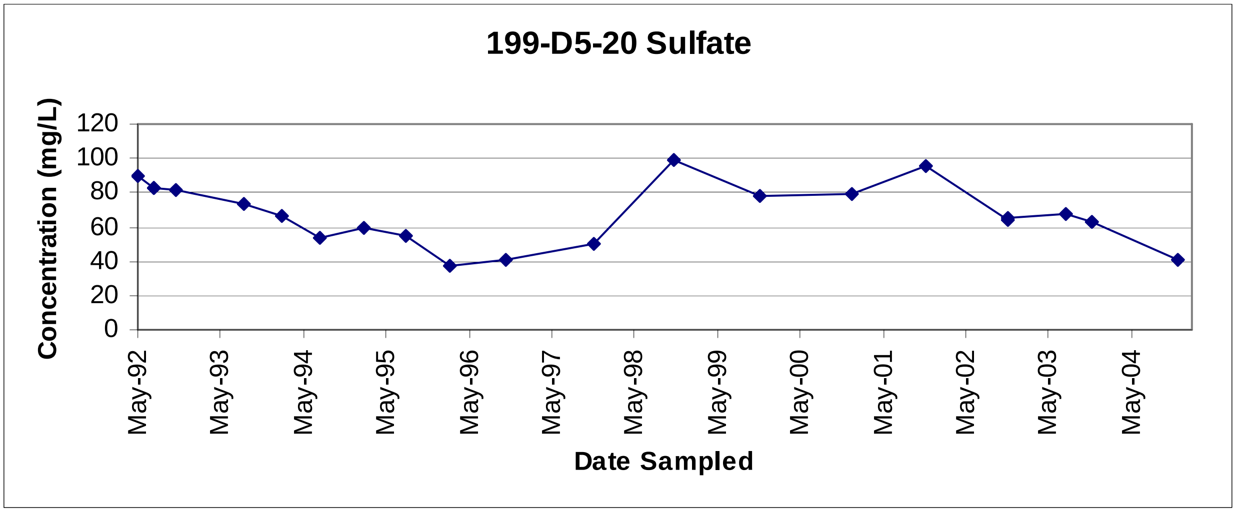
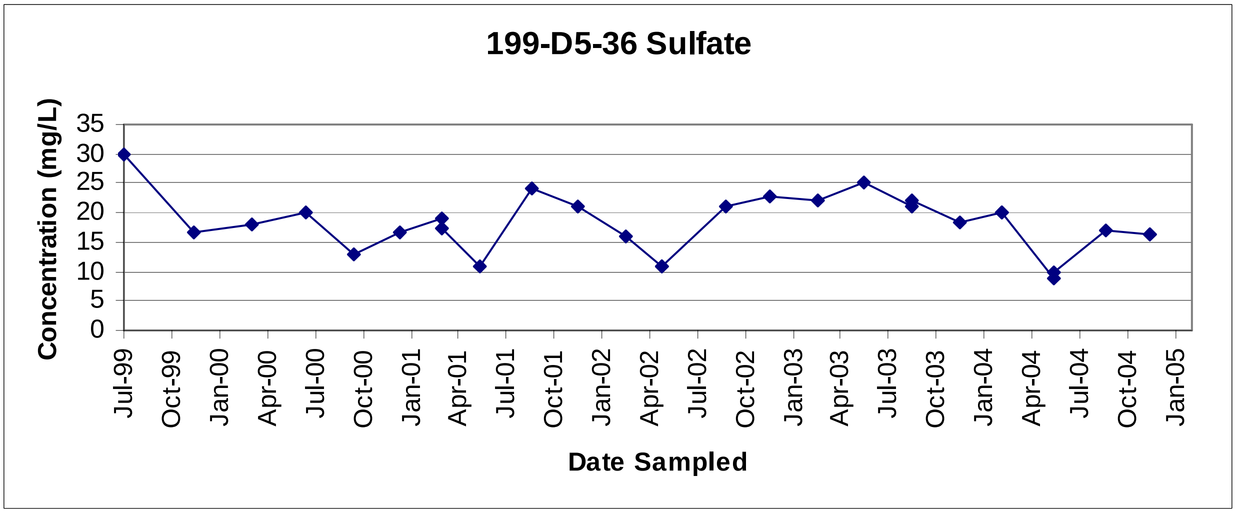
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D5-19 Sulfate
Concentration (mg/L)
200
150
100
50
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D5-20 Sulfate
Concentration (mg/L)
120
100
80
60
40
20
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D5-36 Sulfate
Concentration (mg/L)
35
30
25
20
15
10
5
0
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
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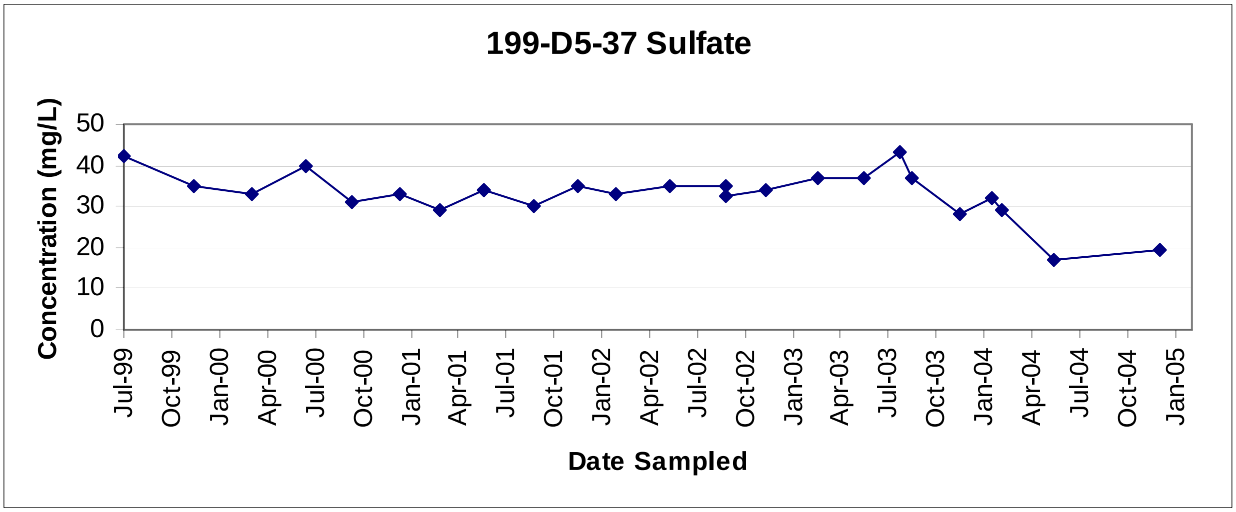
Oct-04
Jan-05
Date Sampled


199-D5-37 Sulfate
Concentration (mg/L)
50
40
30
20
10
0
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
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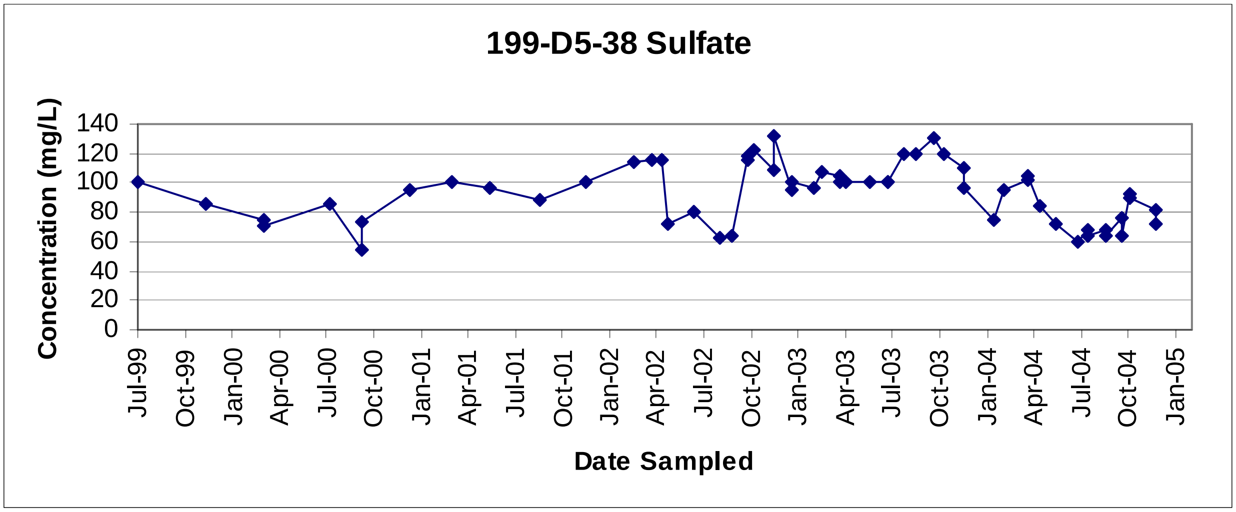
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Date Sampled


199-D5-38 Sulfate
Concentration (mg/L)
140
120
100
80
60
40
20
0
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
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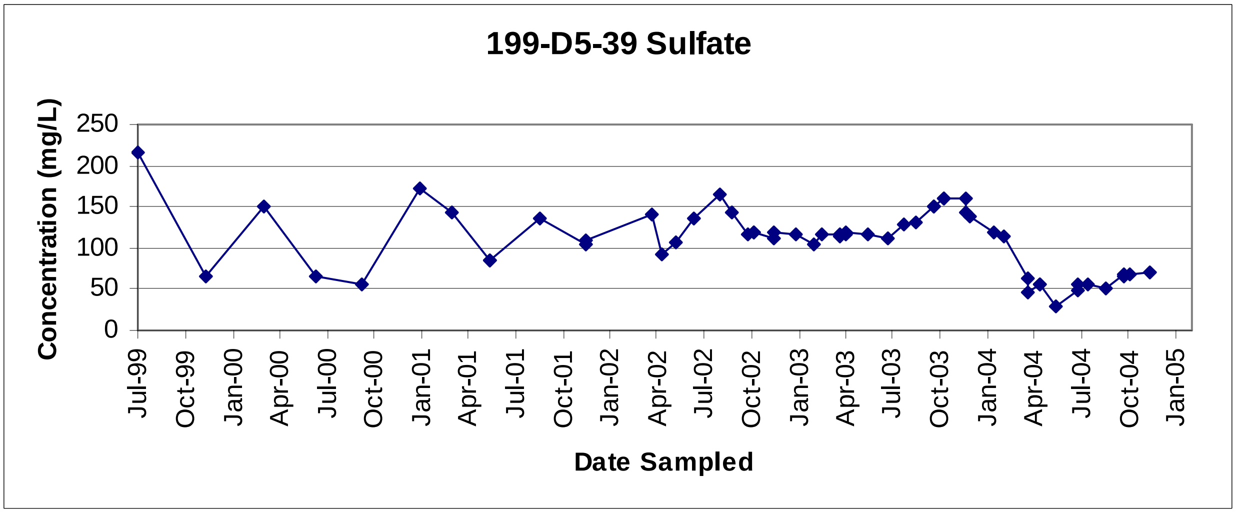
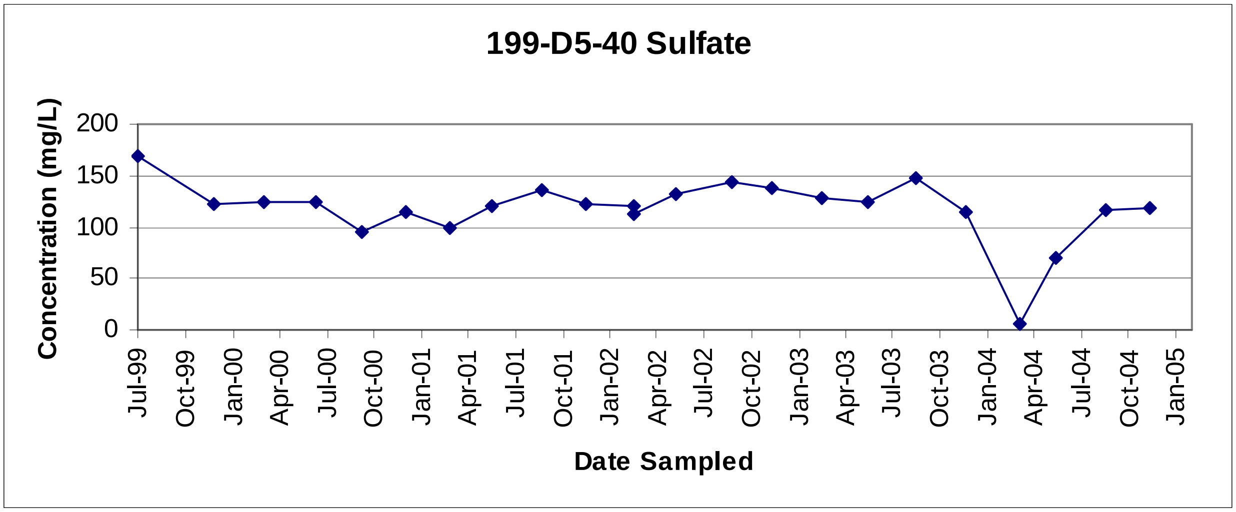
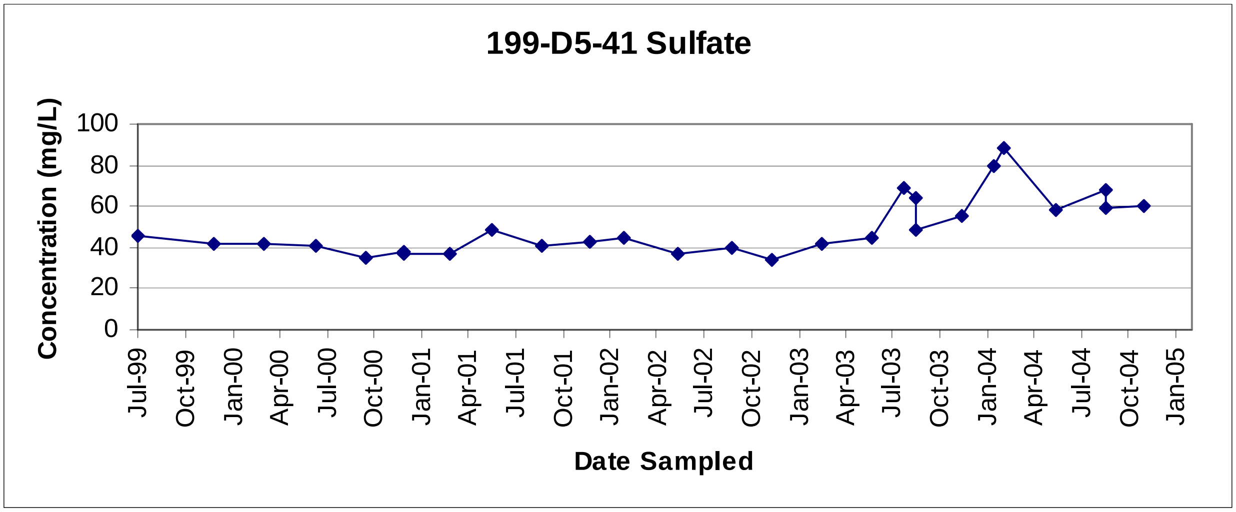
Oct-04
Jan-05
Date Sampled


199-D5-39 Sulfate
Concentration (mg/L)
250
200
150
100
50
0
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Date Sampled


199-D5-40 Sulfate
Concentration (mg/L)
200
150
100
50
0
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Date Sampled


199-D5-41 Sulfate
Concentration (mg/L)
100
80
60
40
20
0
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
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Apr-03
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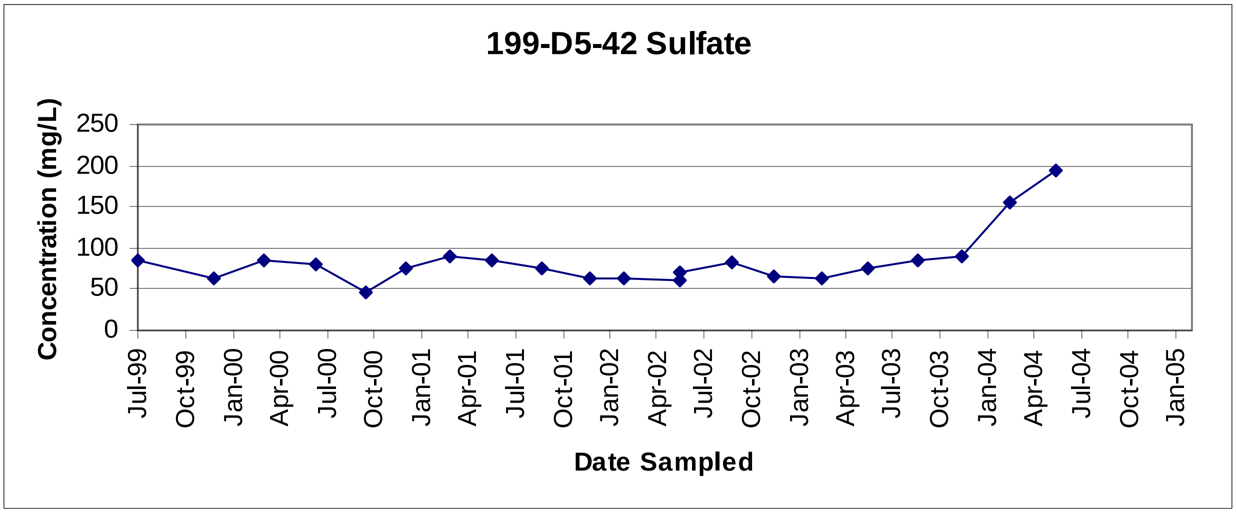
Apr-04
Jul-04
Oct-04
Jan-05
Date Sampled


199-D5-42 Sulfate
Concentration (mg/L)
250
200
150
100
50
0
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
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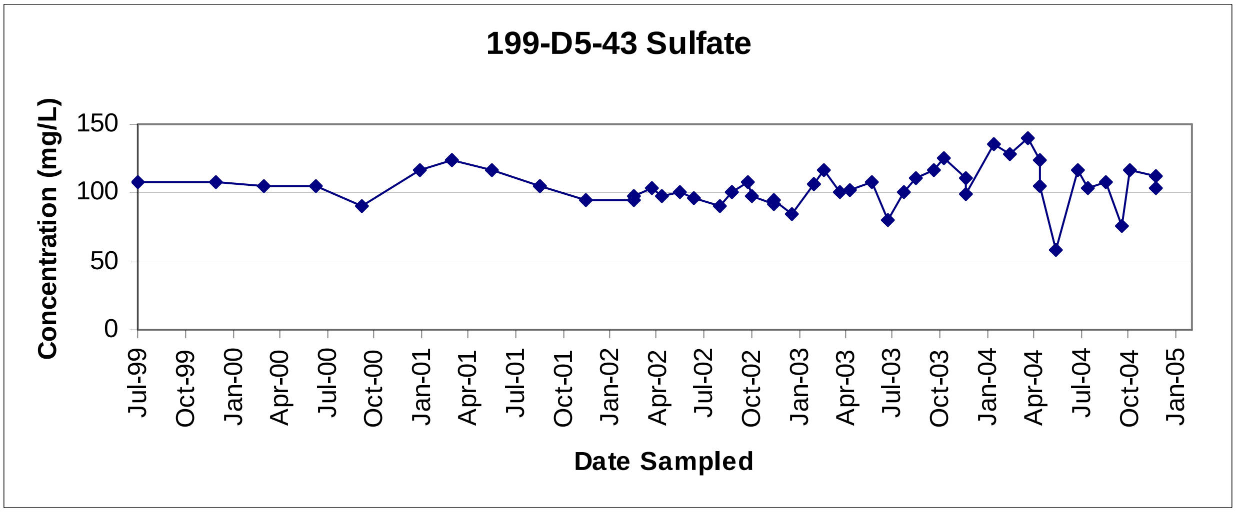
Oct-04
Jan-05
Date Sampled


199-D5-43 Sulfate
Concentration (mg/L)
150
100
50
0
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
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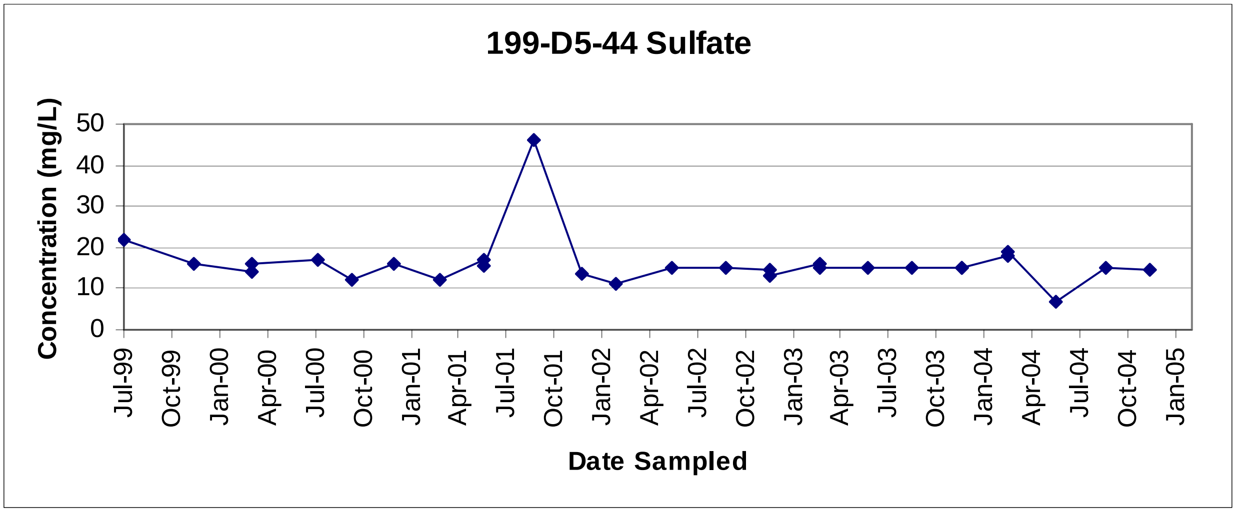
Jan-05
Date Sampled


199-D5-44 Sulfate
Concentration (mg/L)
0
10
20
30
40
50
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
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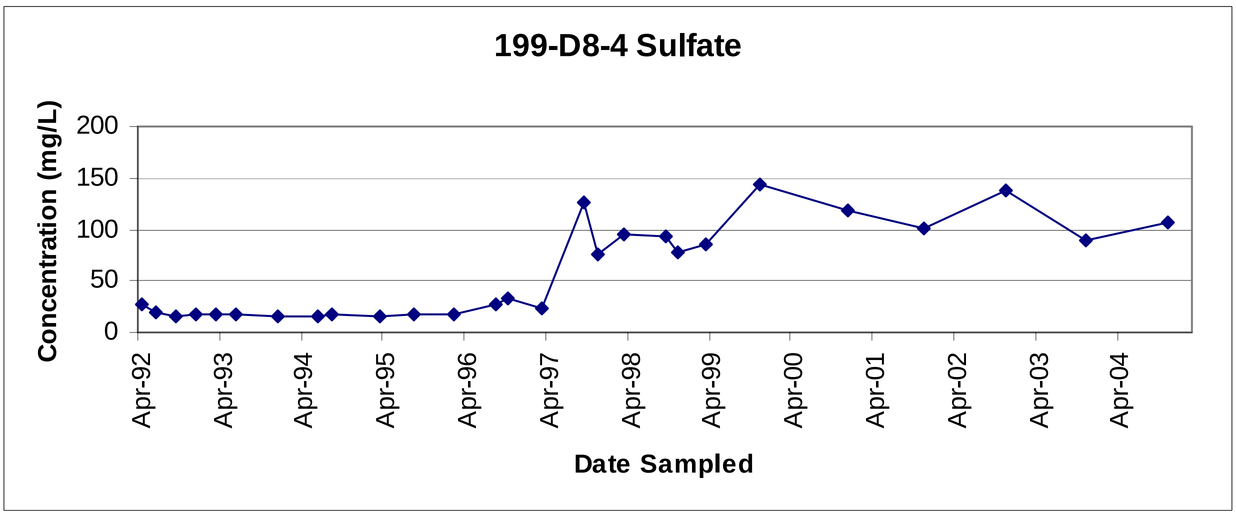
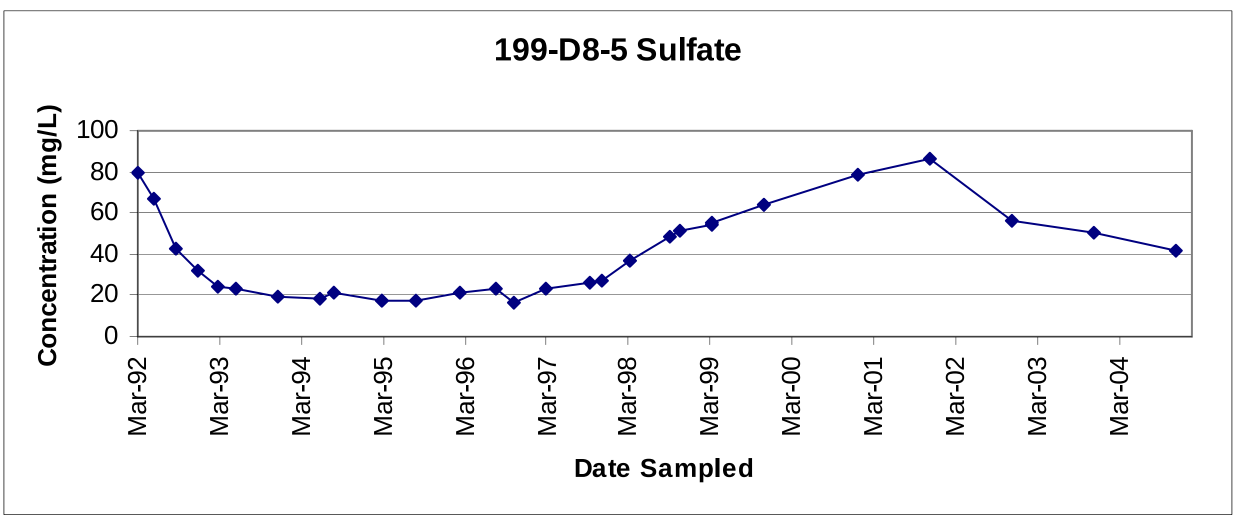
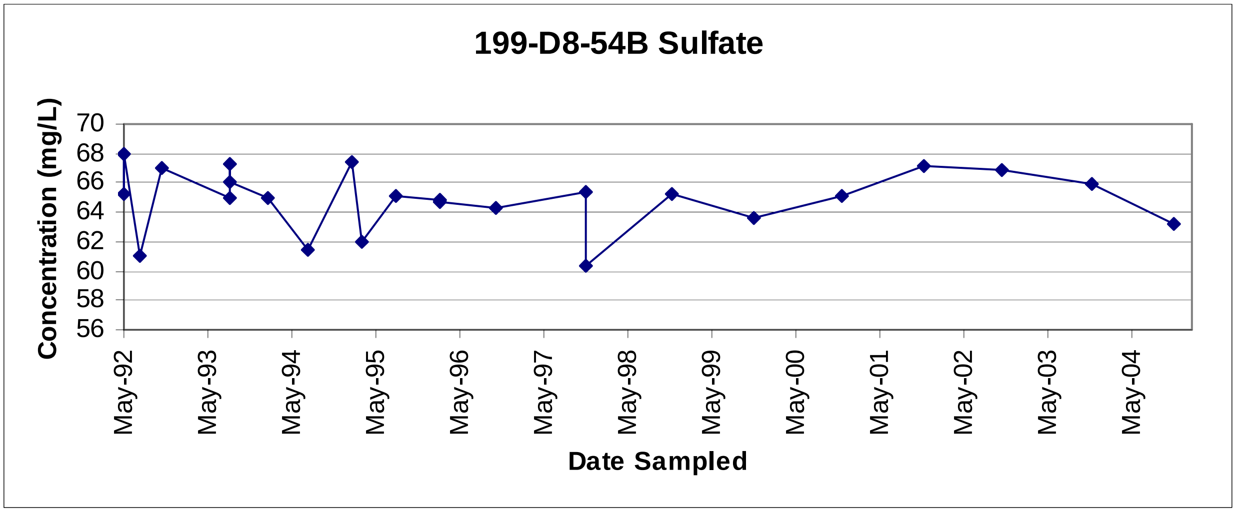
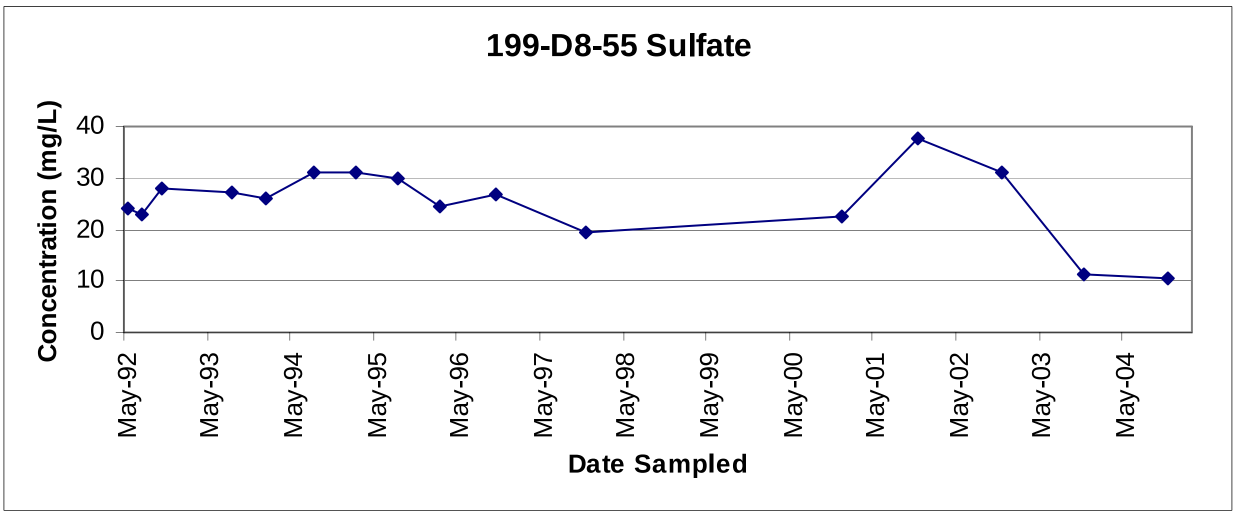
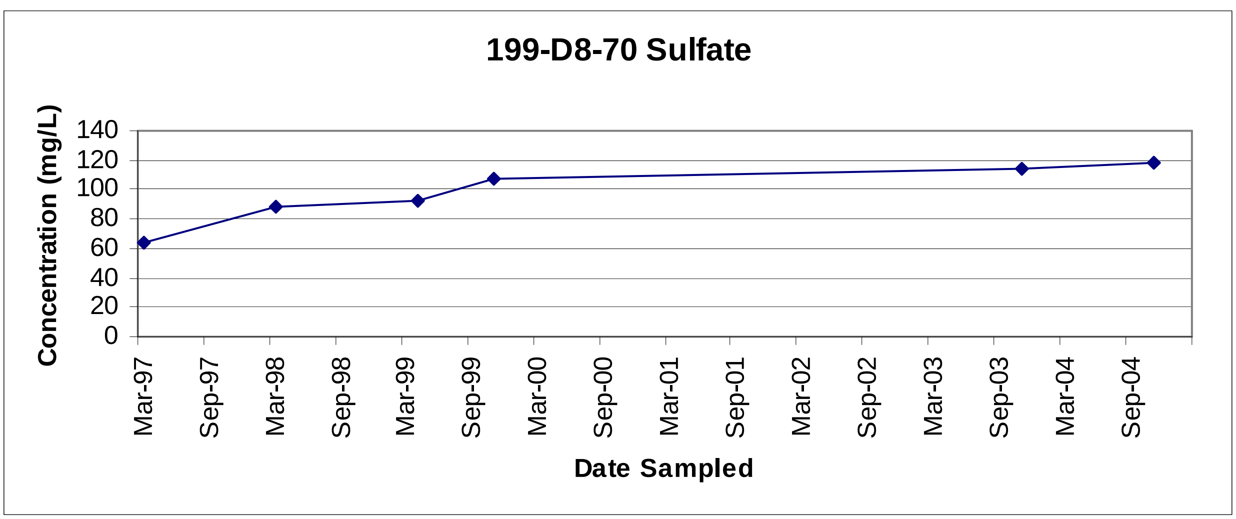
Oct-04
Jan-05
Date Sampled


199-D8-4 Sulfate
Concentration (mg/L)
0
50
100
150
200
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled


199-D8-5 Sulfate
Concentration (mg/L)
0
20
40
60
80
100
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled


199-D8-54B Sulfate
Concentration (mg/L)
70
68
66
64
62
60
58
56
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D8-55 Sulfate
Concentration (mg/L)
40
30
20
10
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-D8-70 Sulfate
Concentration (mg/L)
140
120
100
80
60
40
20
0
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
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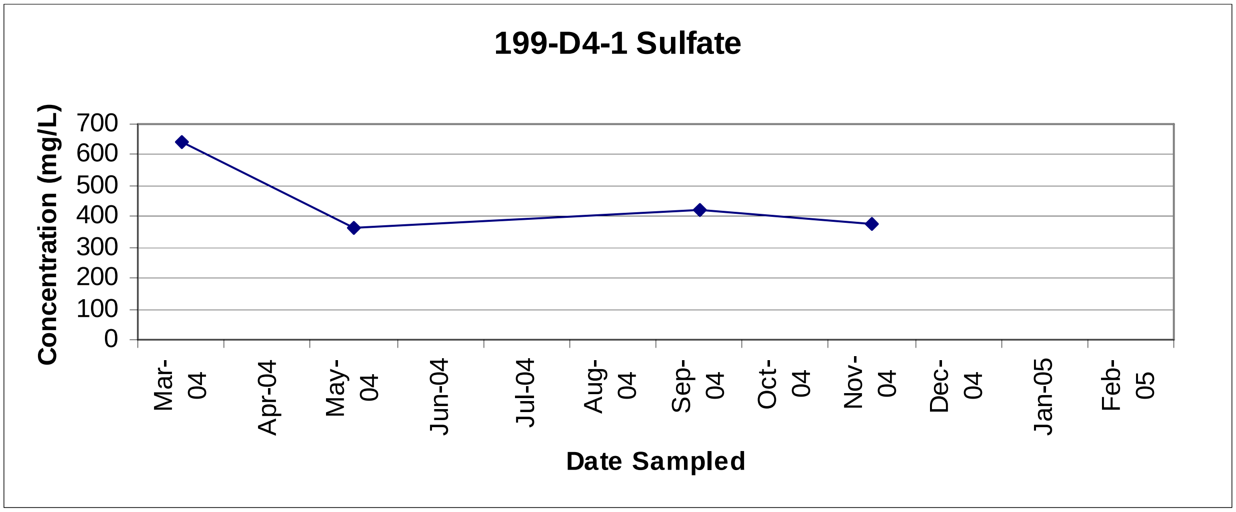
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled


199-D4-1 Sulfate
Concentration (mg/L)
700
600
500
400
300
200
100
0
Mar-04
Apr-04
May-04
Jun-04
Jul-04
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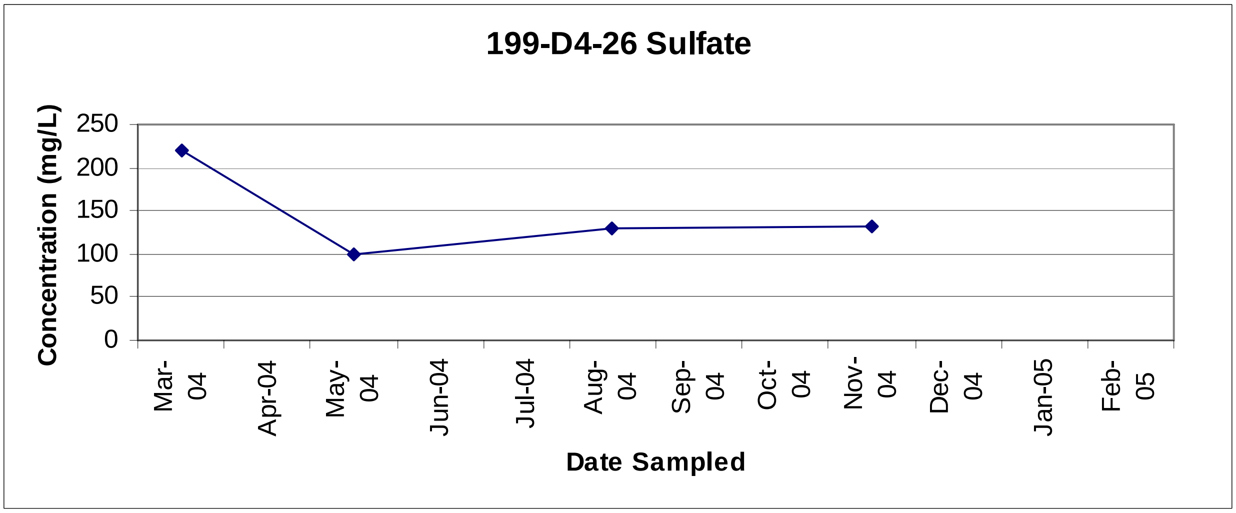
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-D4-26 Sulfate
Concentration (mg/L)
250
200
150
100
50
0
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
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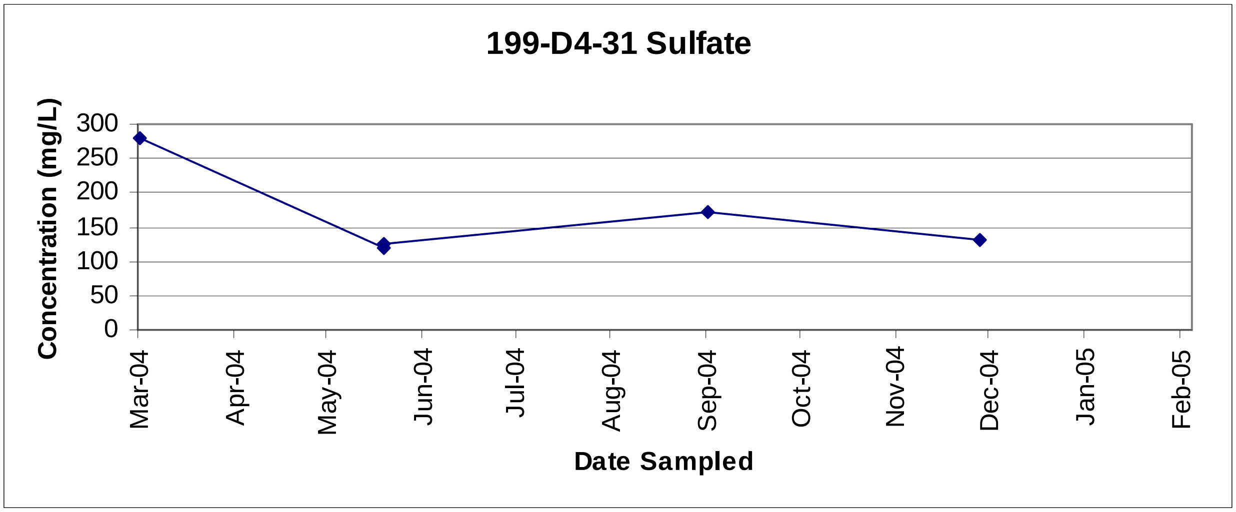
Dec-04
Jan-05
Feb-05
Date Sampled


199-D4-31 Sulfate
Concentration (mg/L)
300
250
200
150
100
50
0
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
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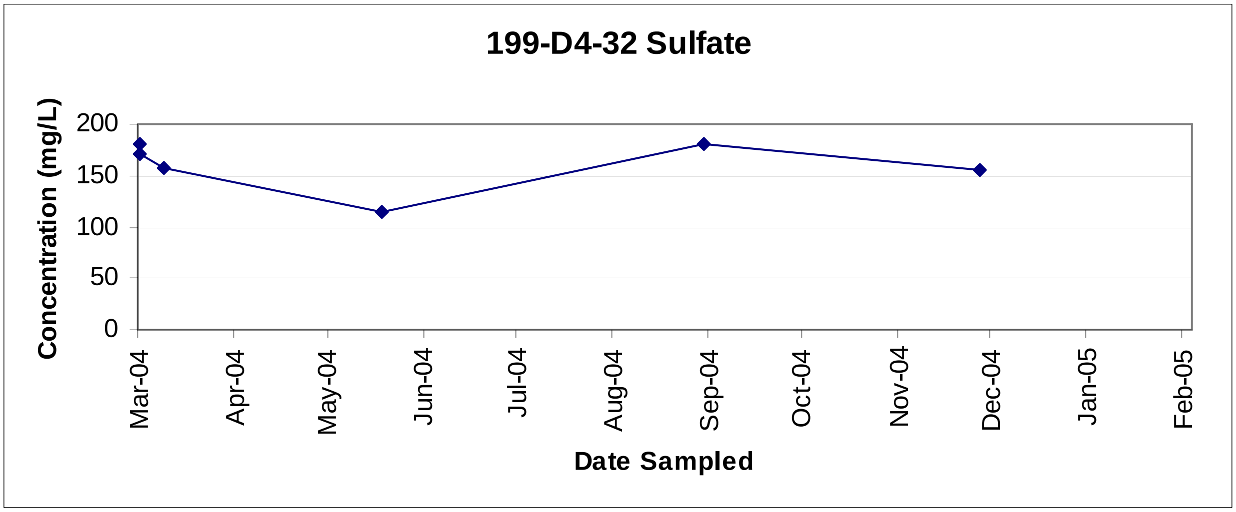
Jan-05
Feb-05
Date Sampled


199-D4-32 Sulfate
Concentration (mg/L)
200
150
100
50
0
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
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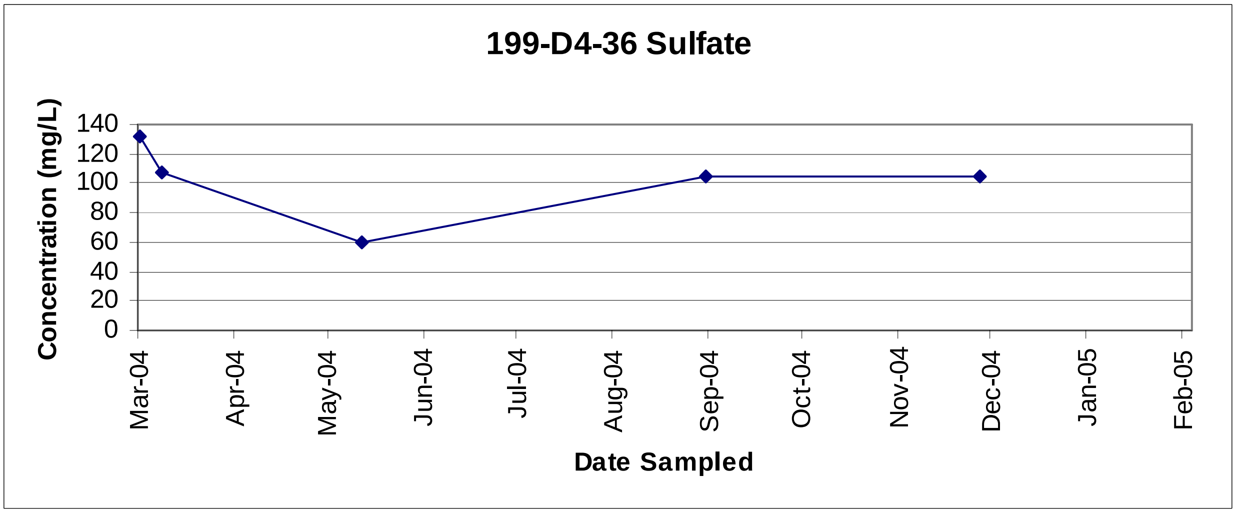
Jan-05
Feb-05
Date Sampled


199-D4-36 Sulfate
Concentration (mg/L)
140
120
100
80
60
40
20
0
Mar-04
Apr-04
May-04
Jun-04
Jul-04
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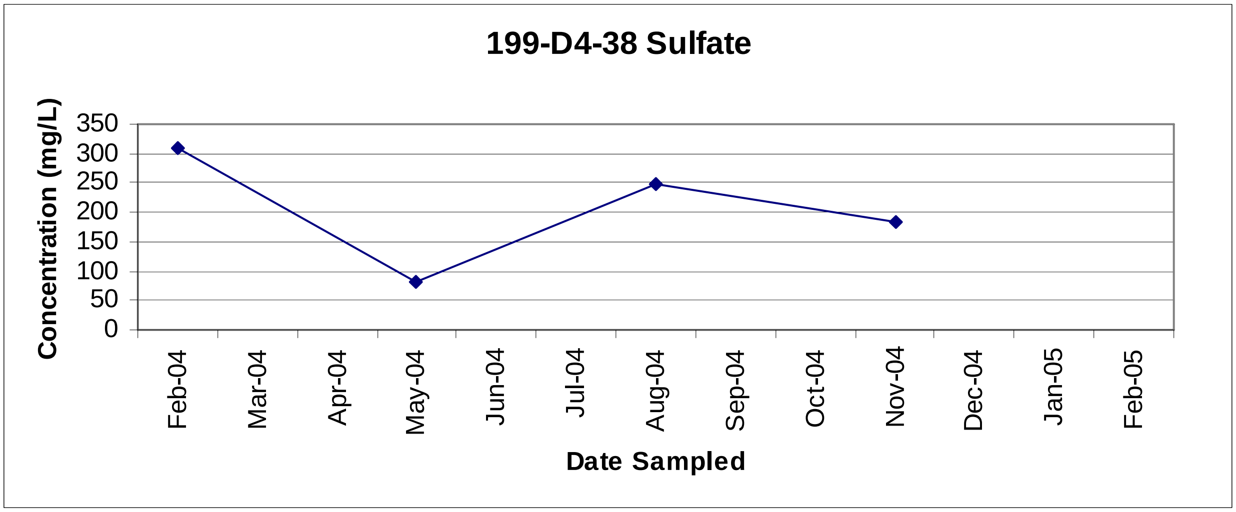
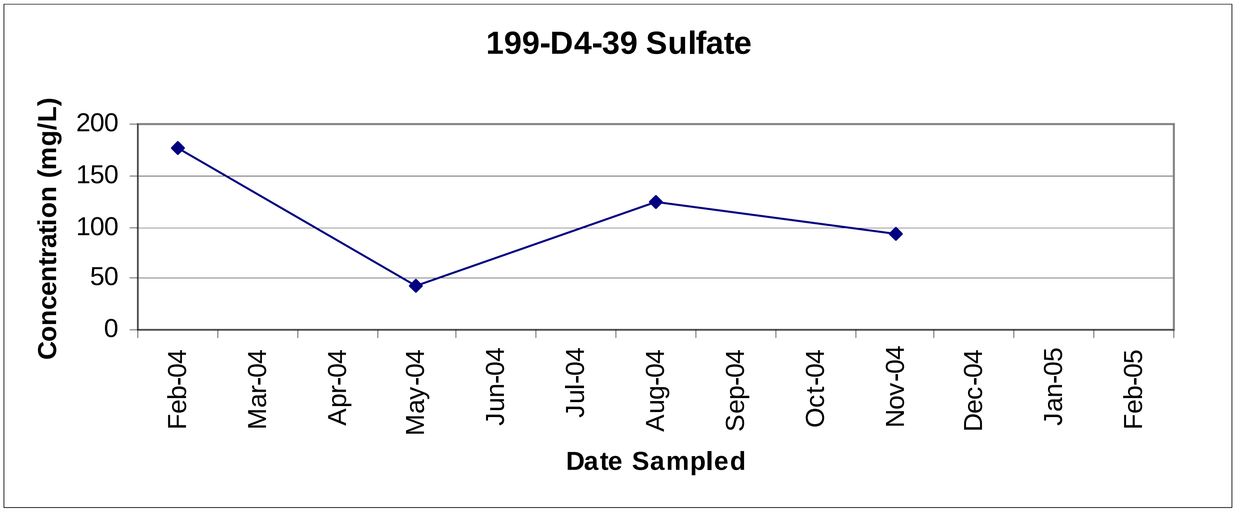
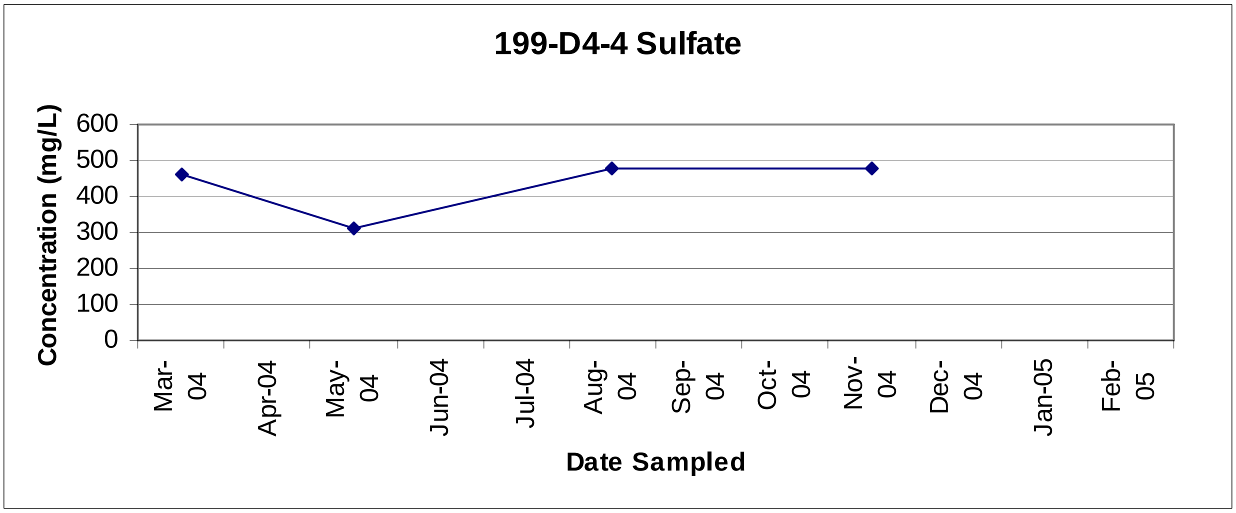
Jan-05
Feb-05
Date Sampled


199-D4-38 Sulfate
Concentration (mg/L)
350
300
250
200
150
100
50
0
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-D4-39 Sulfate
Concentration (mg/L)
200
150
100
50
0
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-D4-4 Sulfate
Concentration (mg/L)
600
500
400
300
200
100
0
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
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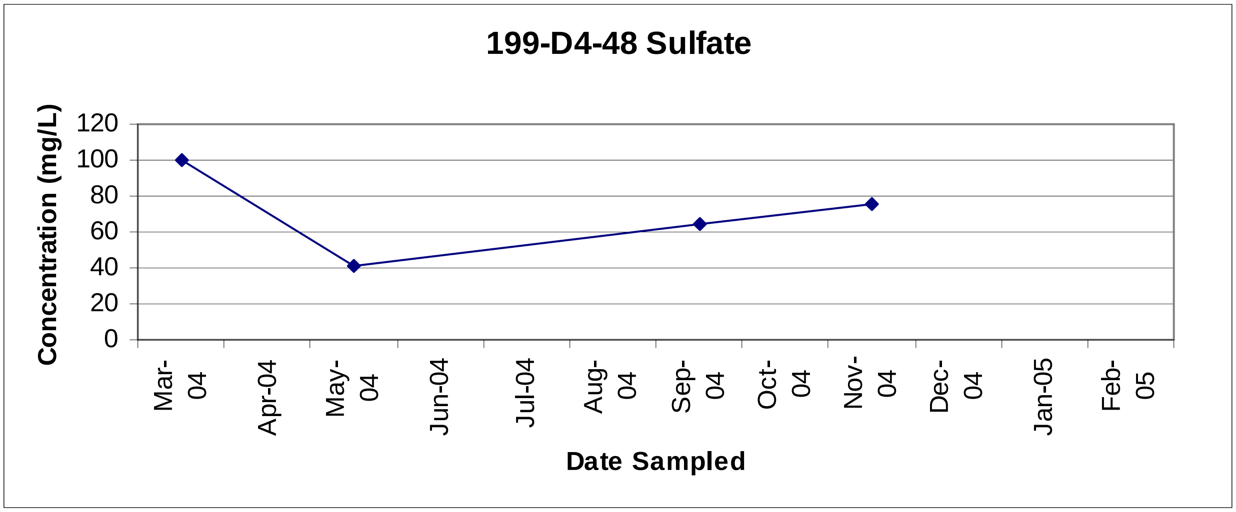
Date Sampled


199-D4-48 Sulfate
Concentration (mg/L)
120
100
80
60
40
20
0
Mar-04
Apr-04
May-04
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Jul-04
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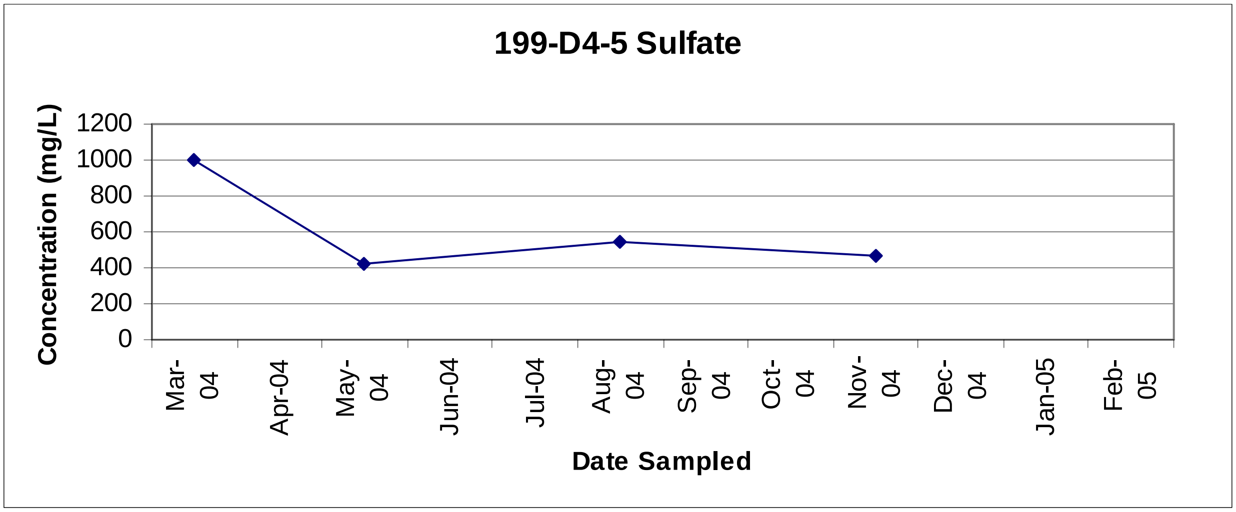
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-D4-5 Sulfate
Concentration (mg/L)
1200
1000
800
600
400
200
0
Mar-04
Apr-04
May-04
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Jul-04
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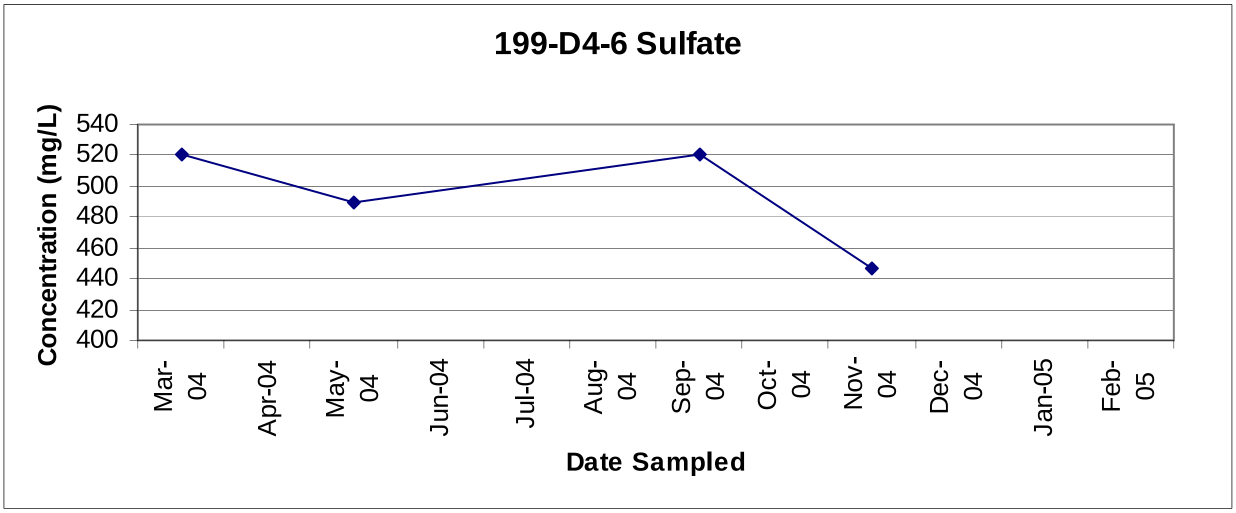
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-D4-6 Sulfate
Concentration (mg/L)
540
520
500
480
460
440
420
400
Mar-04
Apr-04
May-04
Jun-04
Jul-04
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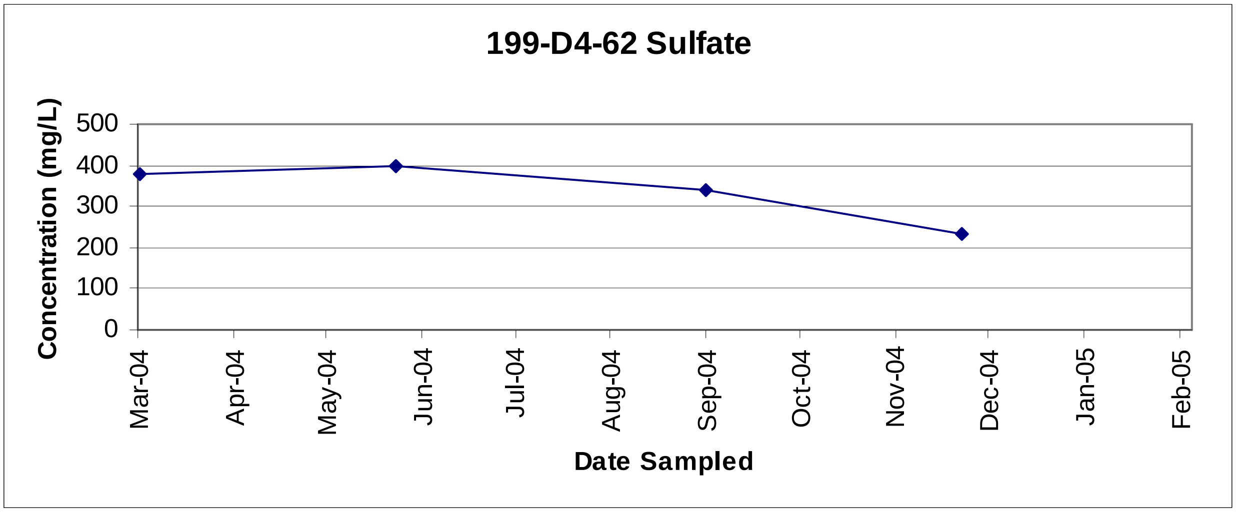
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-D4-62 Sulfate
Concentration (mg/L)
500
400
300
200
100
0
Mar-04
Apr-04
May-04
Jun-04
Jul-04
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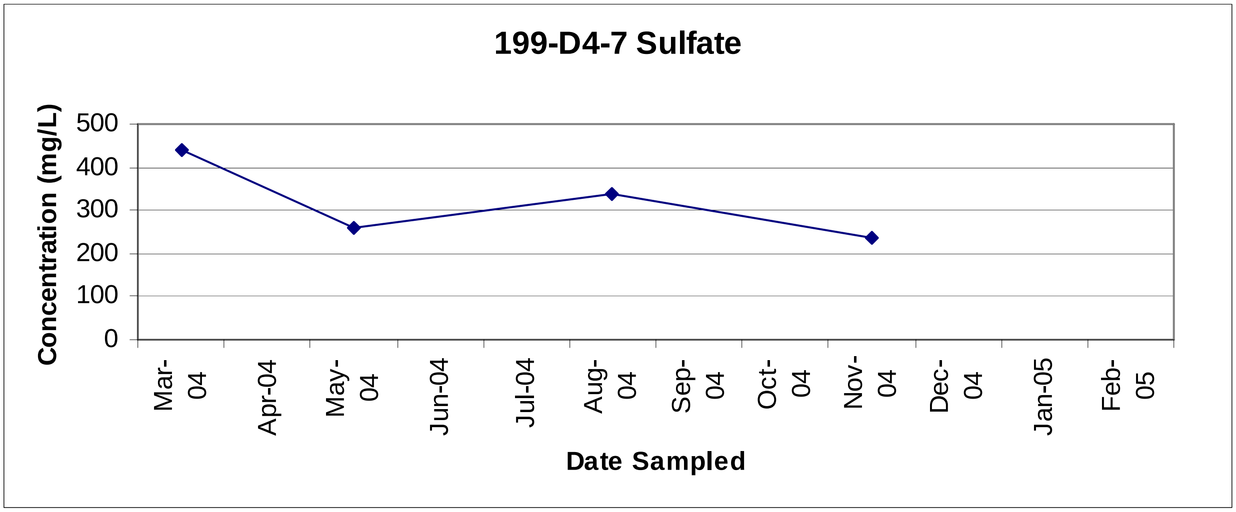
Dec-04
Jan-05
Feb-05
Date Sampled


199-D4-7 Sulfate
Concentration (mg/L)
500
400
300
200
100
0
Mar-04
Apr-04
May-04
Jun-04
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Aug-04
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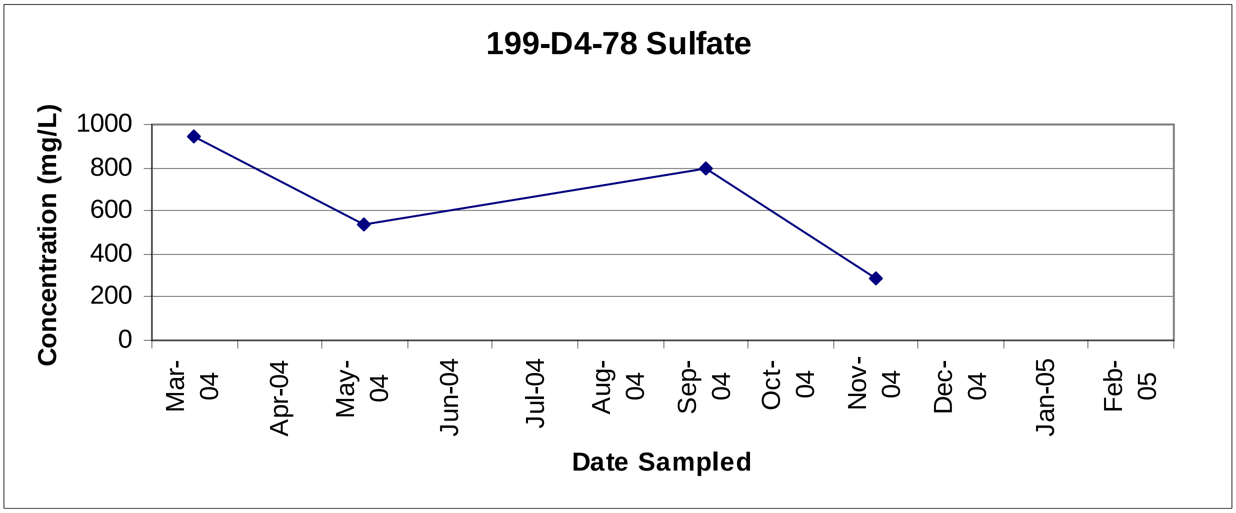
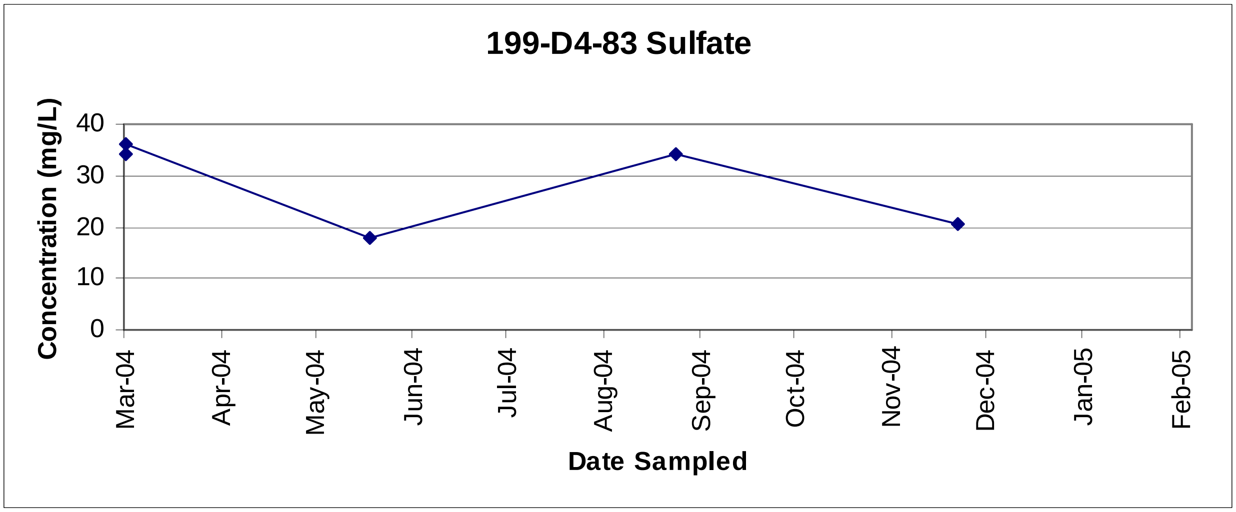
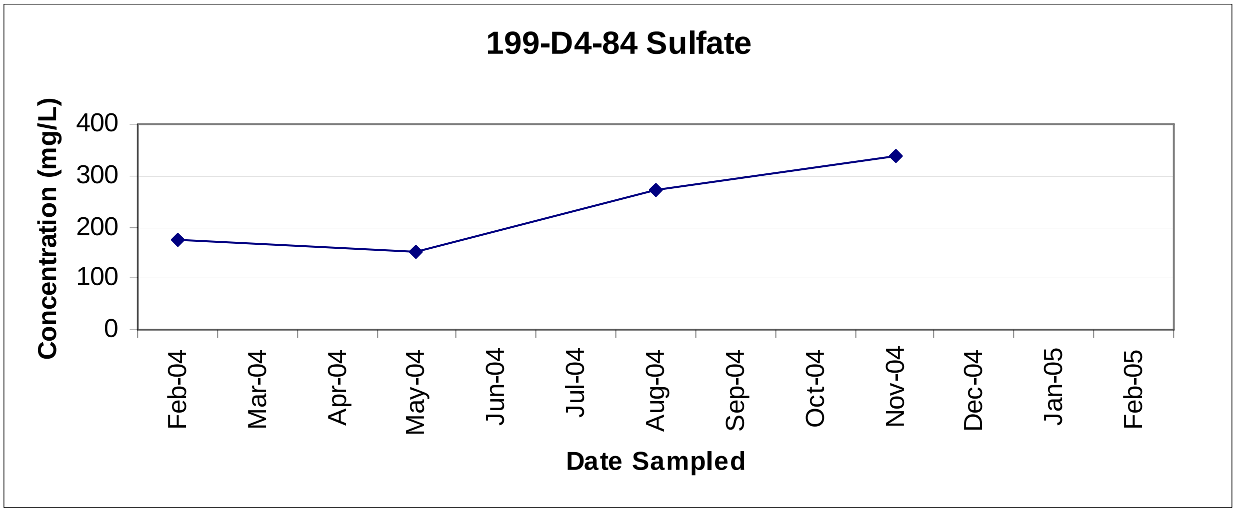
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-D4-78 Sulfate
Concentration (mg/L)
1000
800
600
400
200
0
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-D4-83 Sulfate
Concentration (mg/L)
40
30
20
10
0
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-D4-84 Sulfate
Concentration (mg/L)
400
300
200
100
0
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
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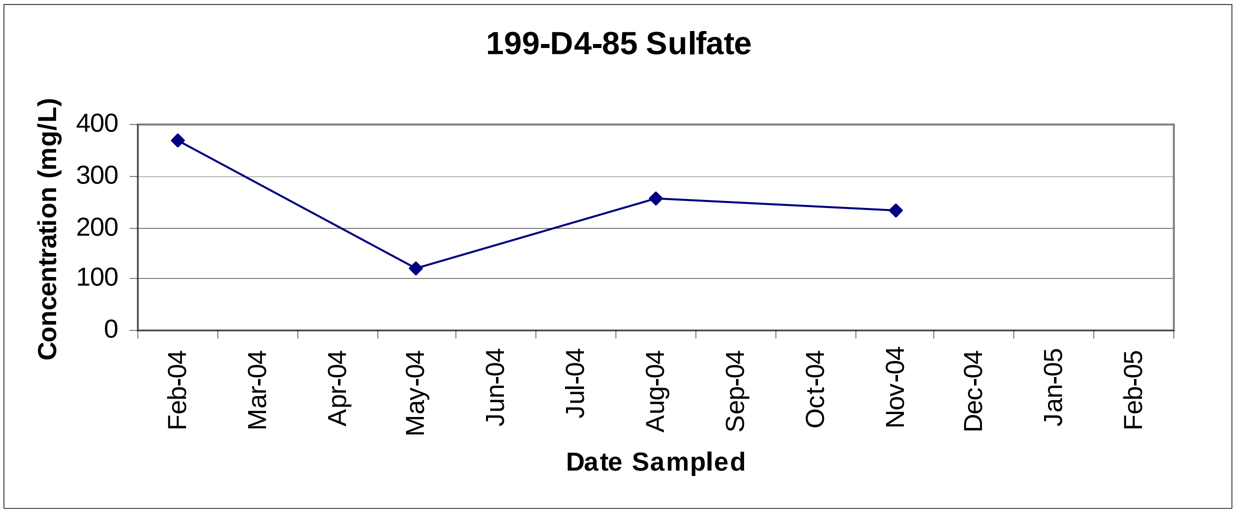
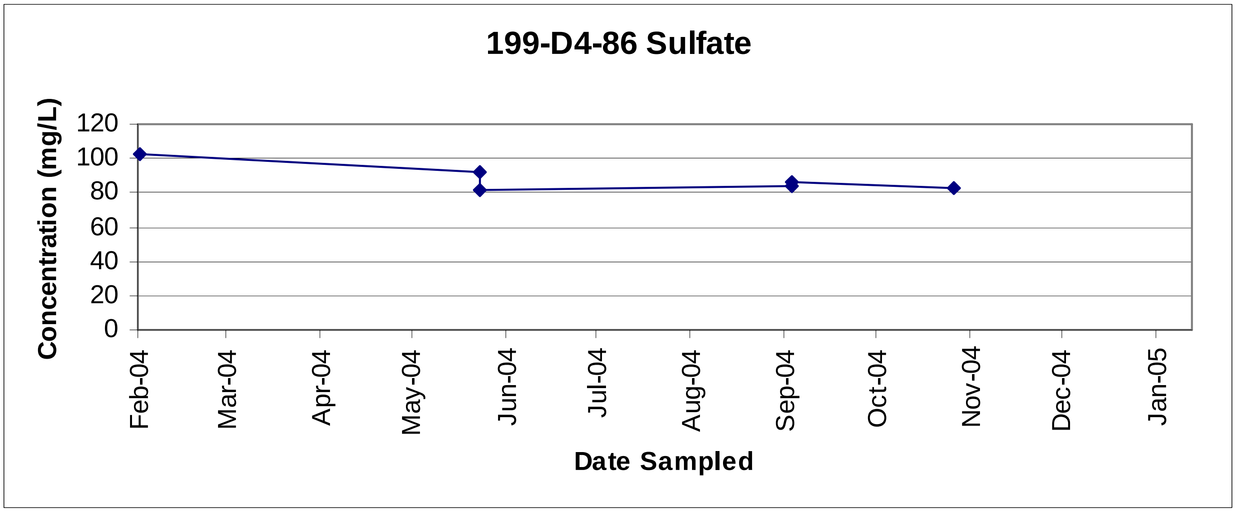
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-D4-85 Sulfate
Concentration (mg/L)
400
300
200
100
0
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-D4-86 Sulfate
Concentration (mg/L)
120
100
80
60
40
20
0
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

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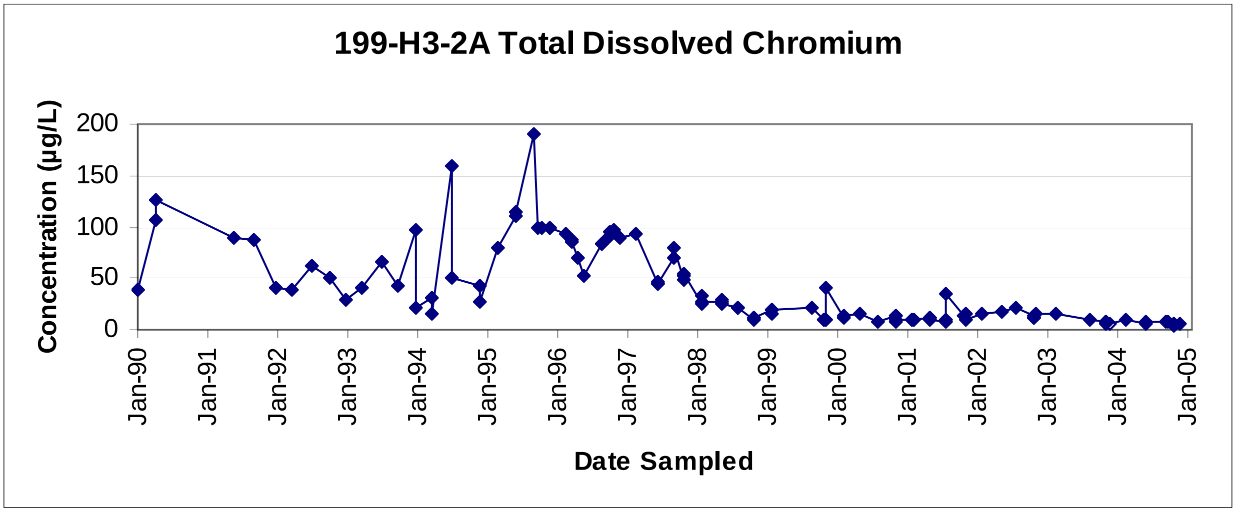
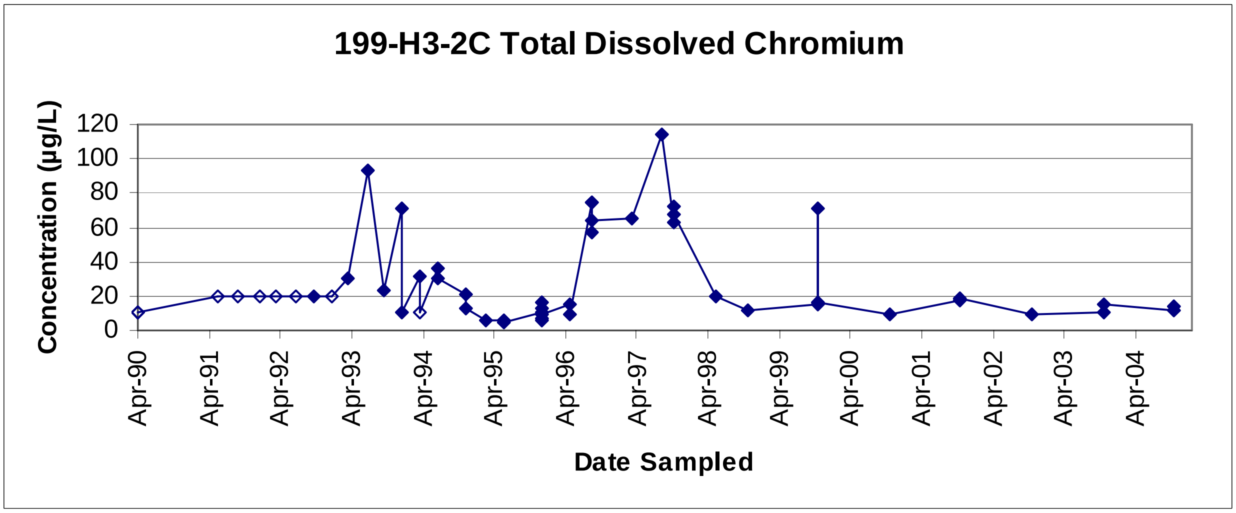
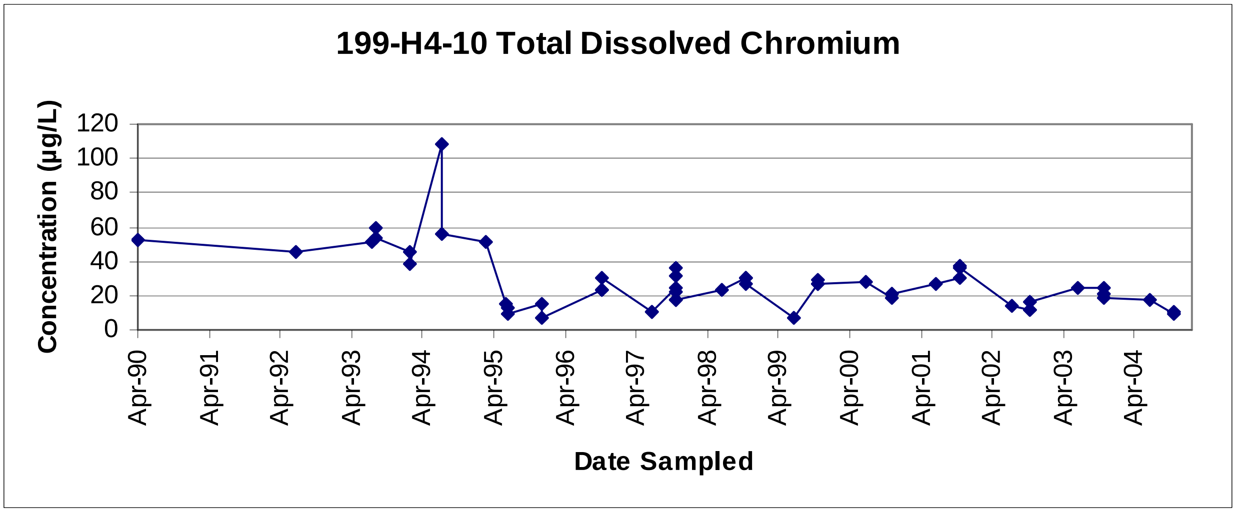
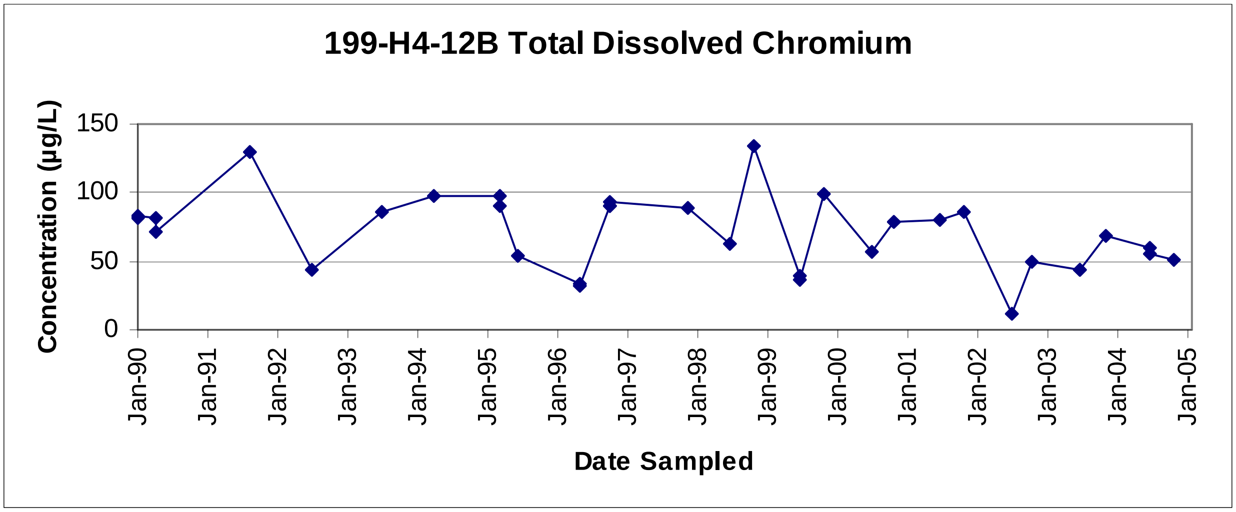
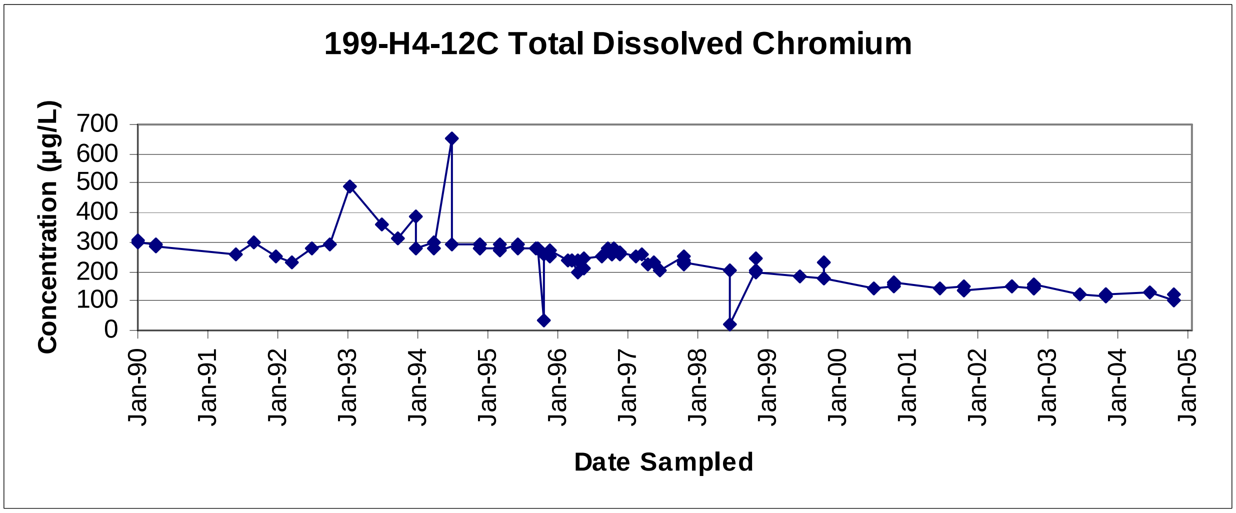
100-H AREA TREND PLOTS


199-H3-2A Total Dissolved Chromium
Concentration (µg/L)
200
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled


199-H3-2C Total Dissolved Chromium
Concentration (µg/L)
120
100
80
60
40
20
0
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled


199-H4-10 Total Dissolved Chromium
Concentration (µg/L)
120
100
80
60
40
20
0
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled


199-H4-12B Total Dissolved Chromium
Concentration (µg/L)
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled


199-H4-12C Total Dissolved Chromium
Concentration (µg/L)
700
600
500
400
300
200
100
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
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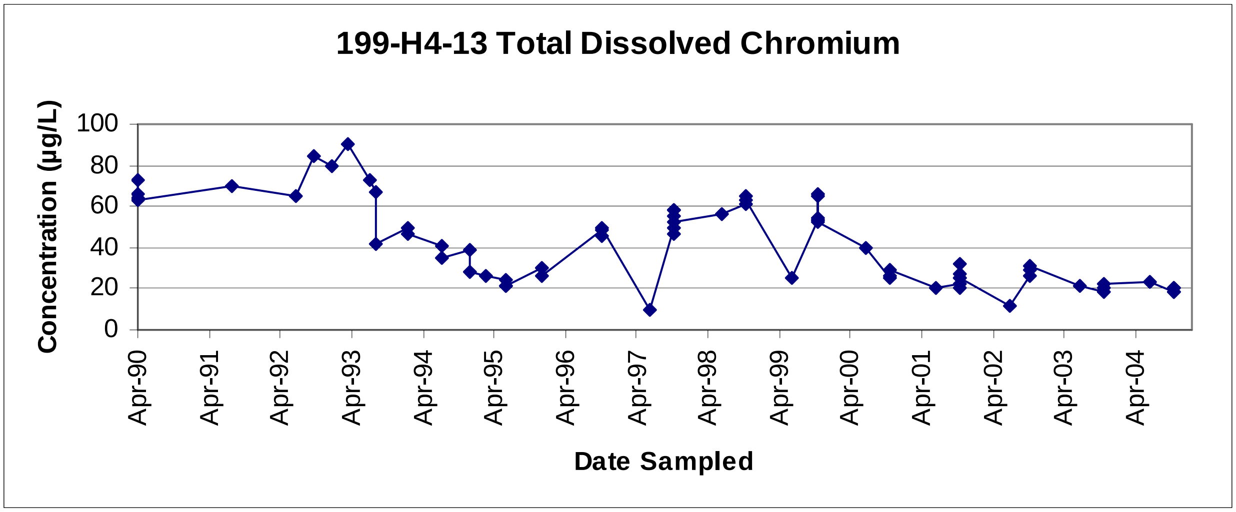
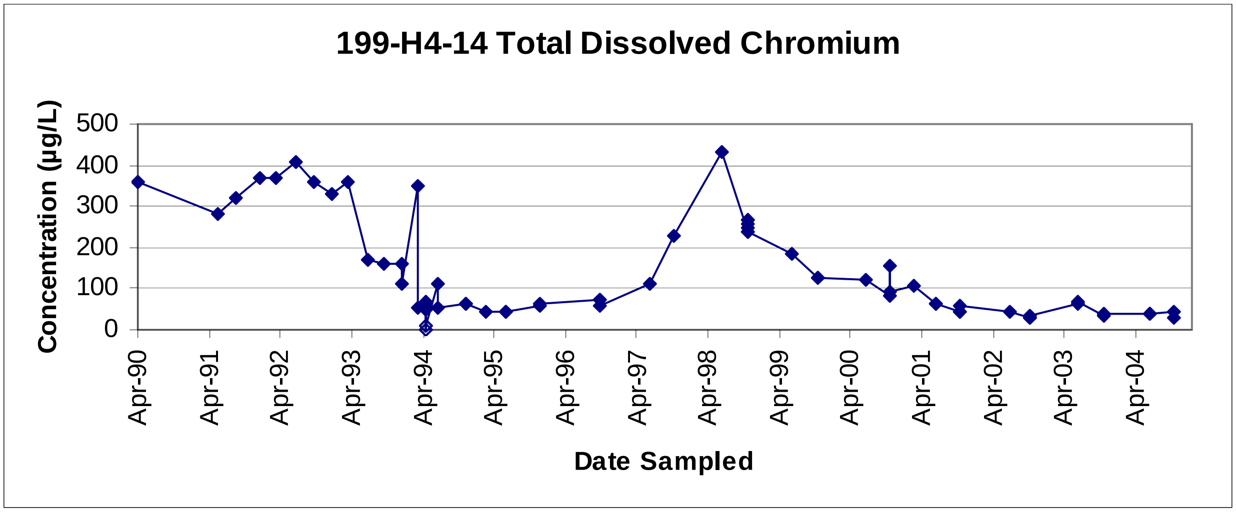
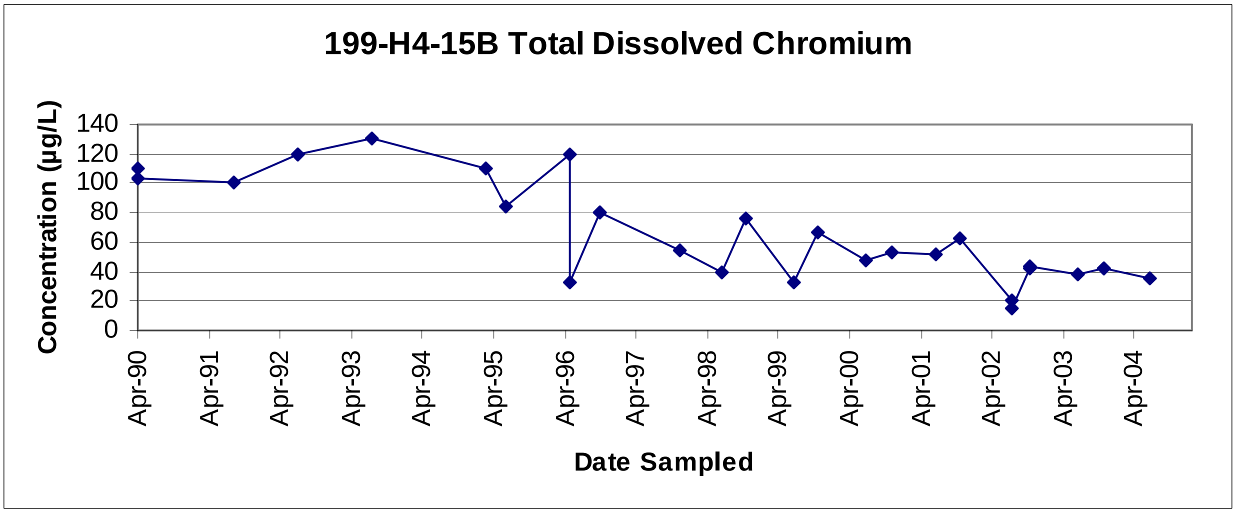
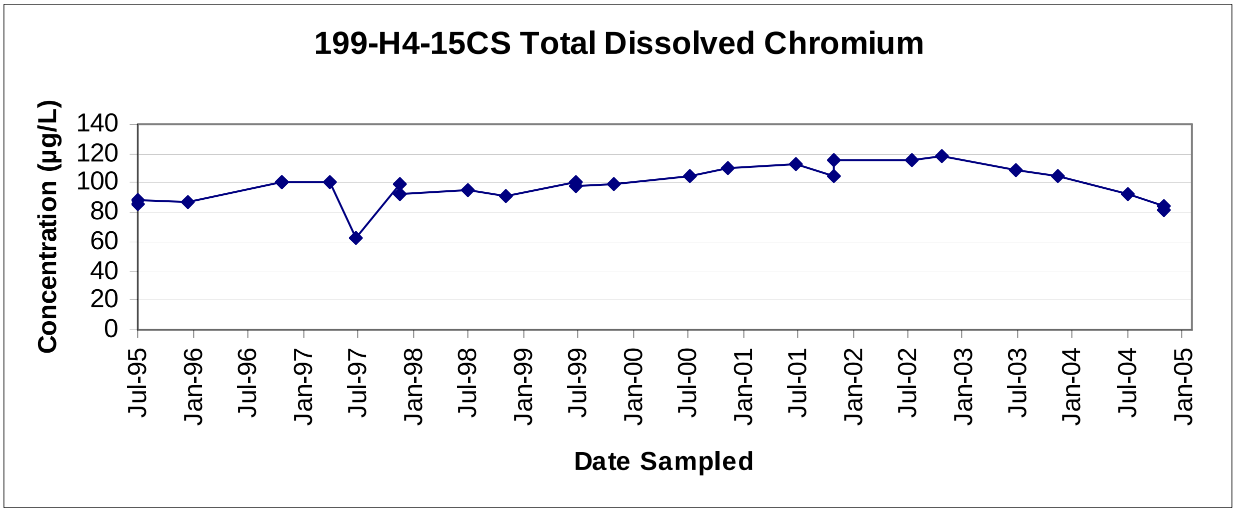
Jan-04
Jan-05
Date Sampled


199-H4-13 Total Dissolved Chromium
Concentration (µg/L)
100
80
60
40
20
0
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled


199-H4-14 Total Dissolved Chromium
Concentration (µg/L)
0
100
200
300
400
500
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled


199-H4-15B Total Dissolved Chromium
Concentration (µg/L)
0
20
40
60
80
100
120
140
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled


199-H4-15CS Total Dissolved Chromium
Concentration (µg/L)
0
20
40
60
80
100
120
140
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Jan-01
Jul-01
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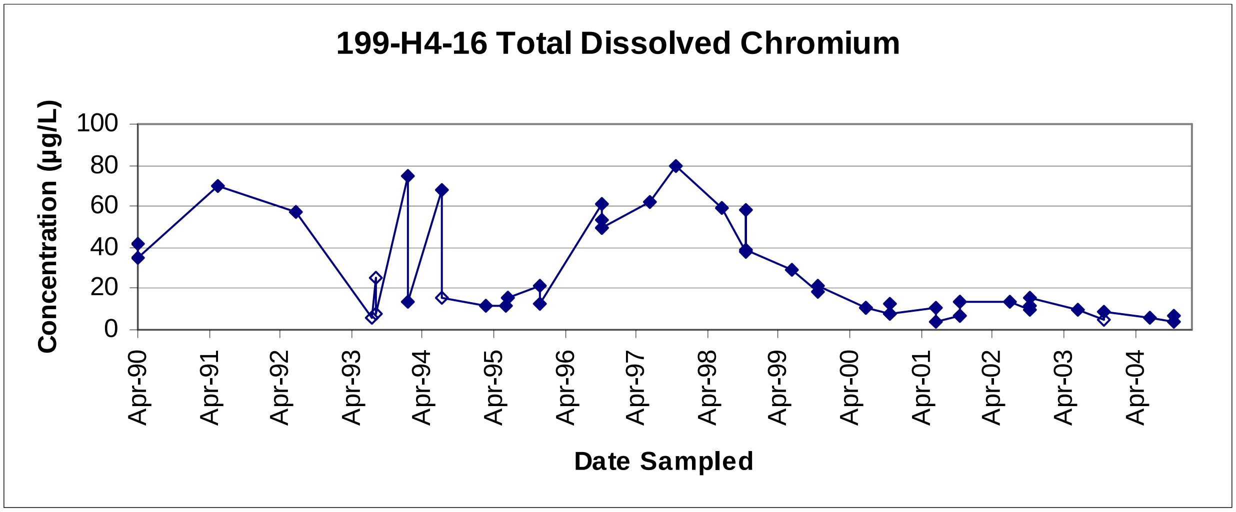
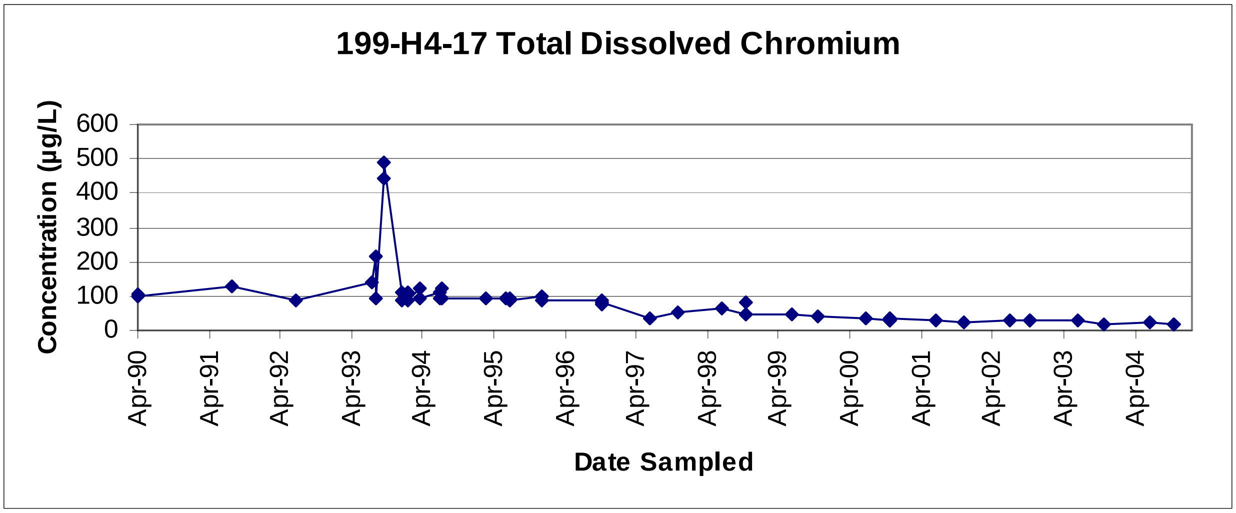
Jul-03
Jan-04
Jul-04
Jan-05
Date Sampled


199-H4-16 Total Dissolved Chromium
Concentration (µg/L)
0
20
40
60
80
100
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled


199-H4-17 Total Dissolved Chromium
Concentration (µg/L)
0
100
200
300
400
500
600
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
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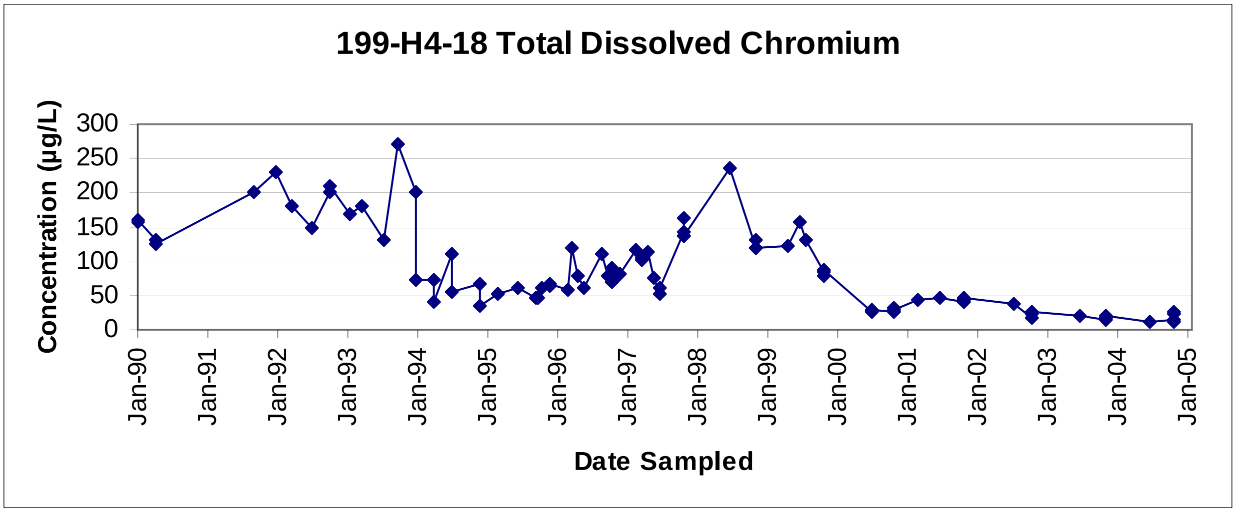
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled


199-H4-18 Total Dissolved Chromium
Concentration (µg/L)
0
50
100
150
200
250
300
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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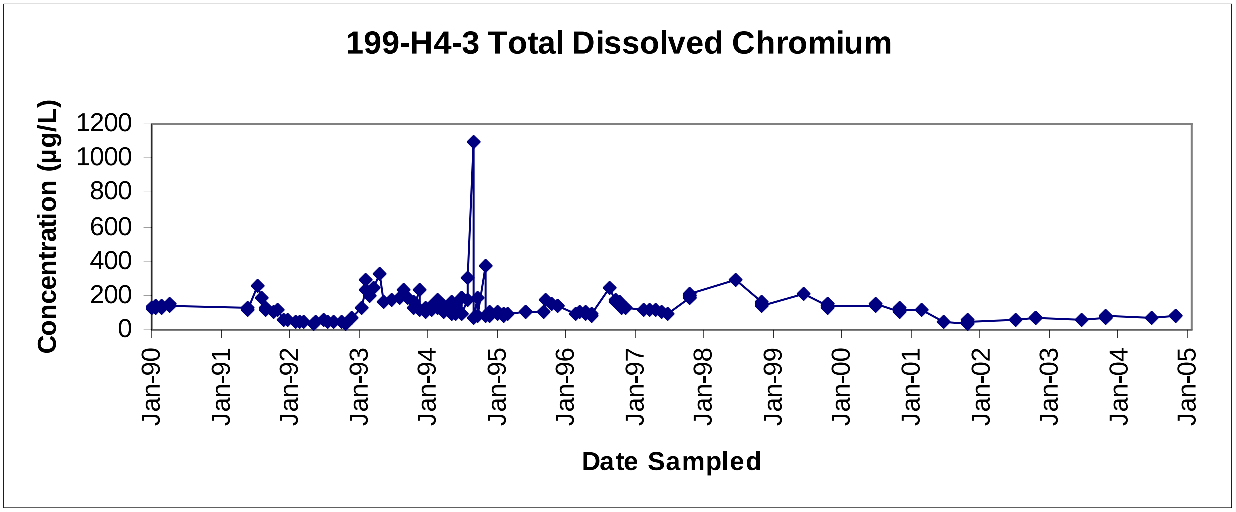
Jan-05
Date Sampled


199-H4-3 Total Dissolved Chromium
Concentration (µg/L)
1200
1000
800
600
400
200
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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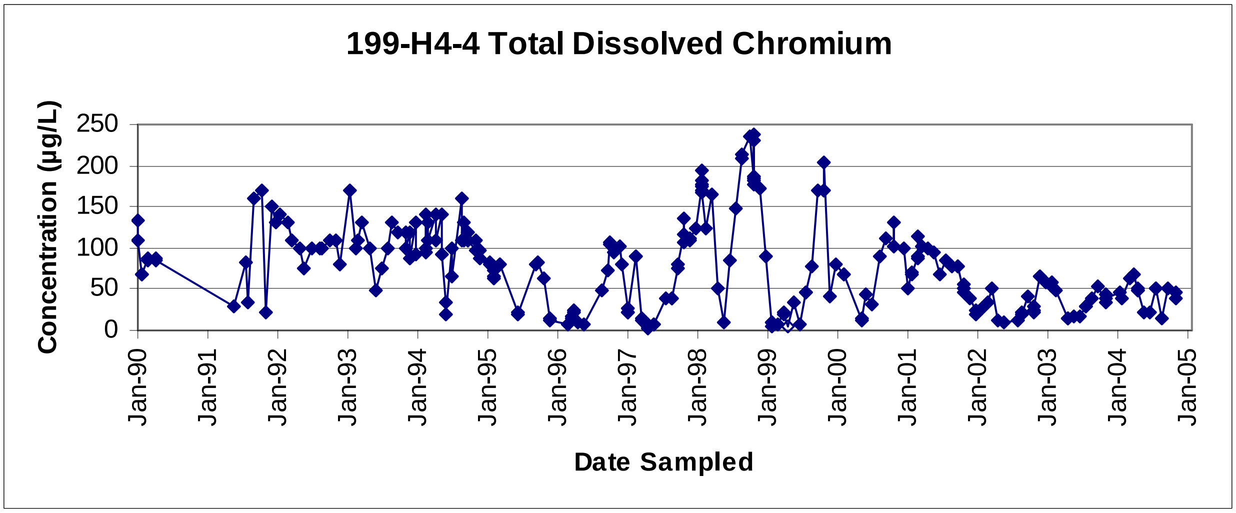
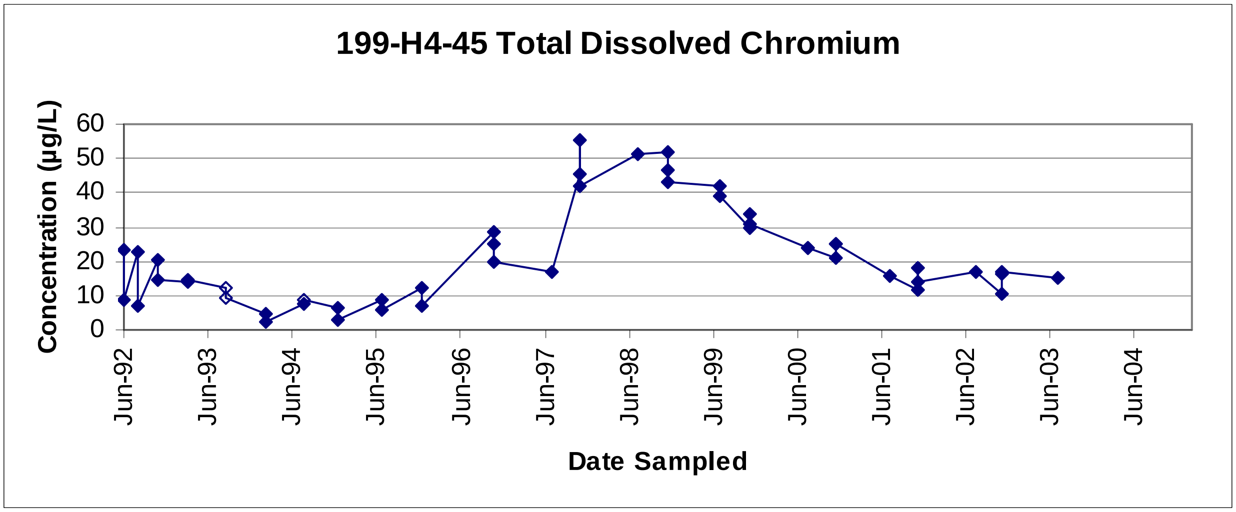
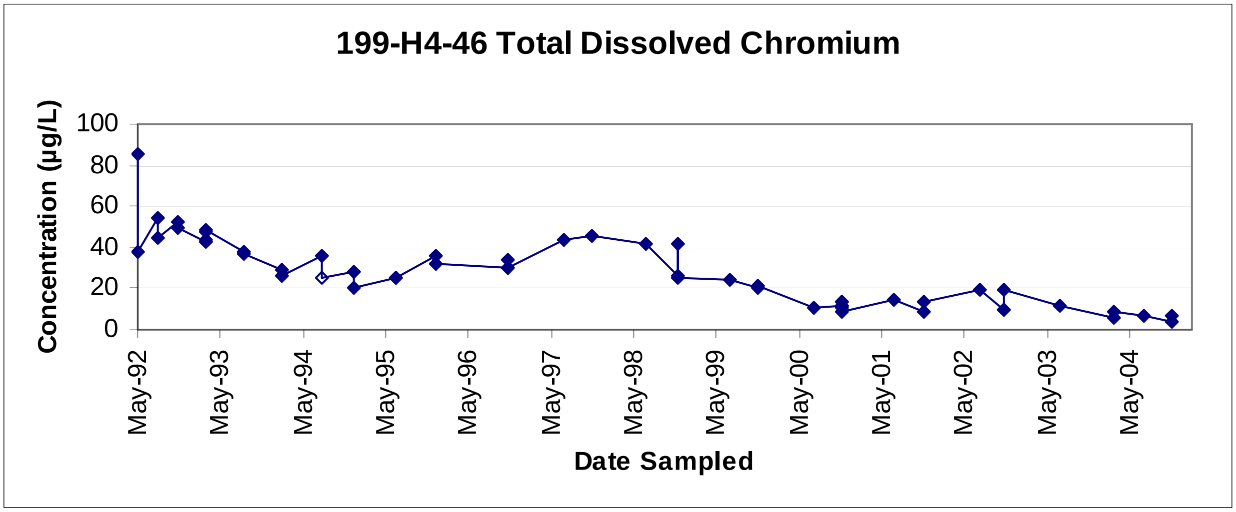
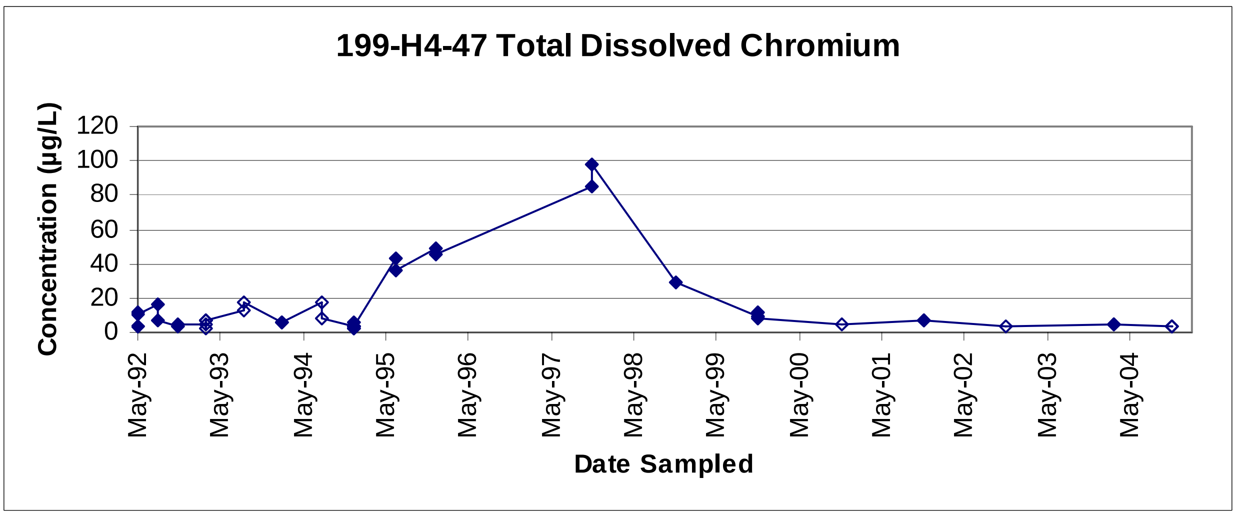
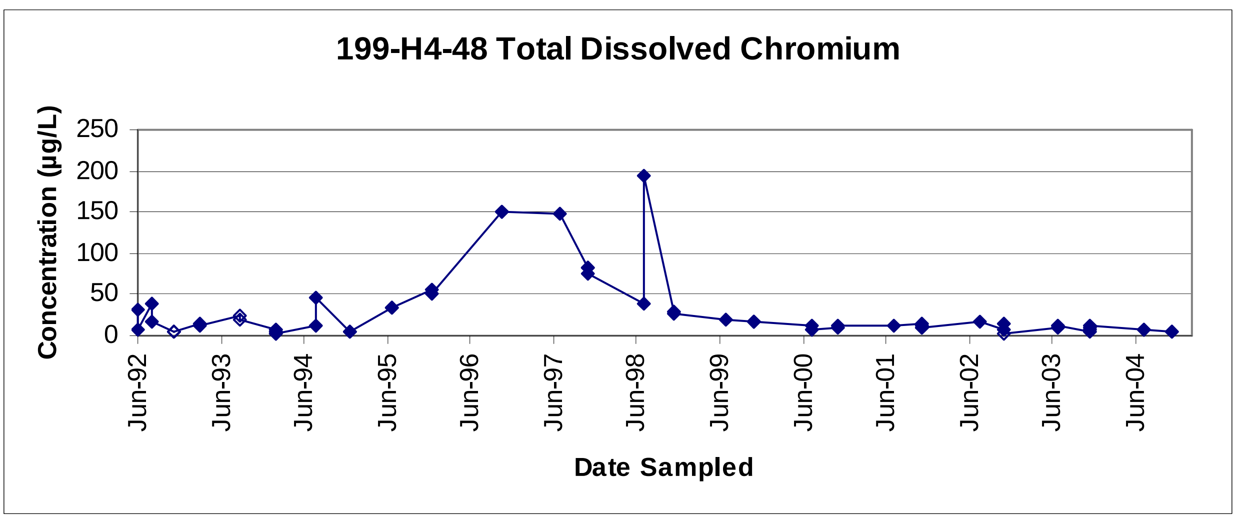
Jan-04
Jan-05
Date Sampled

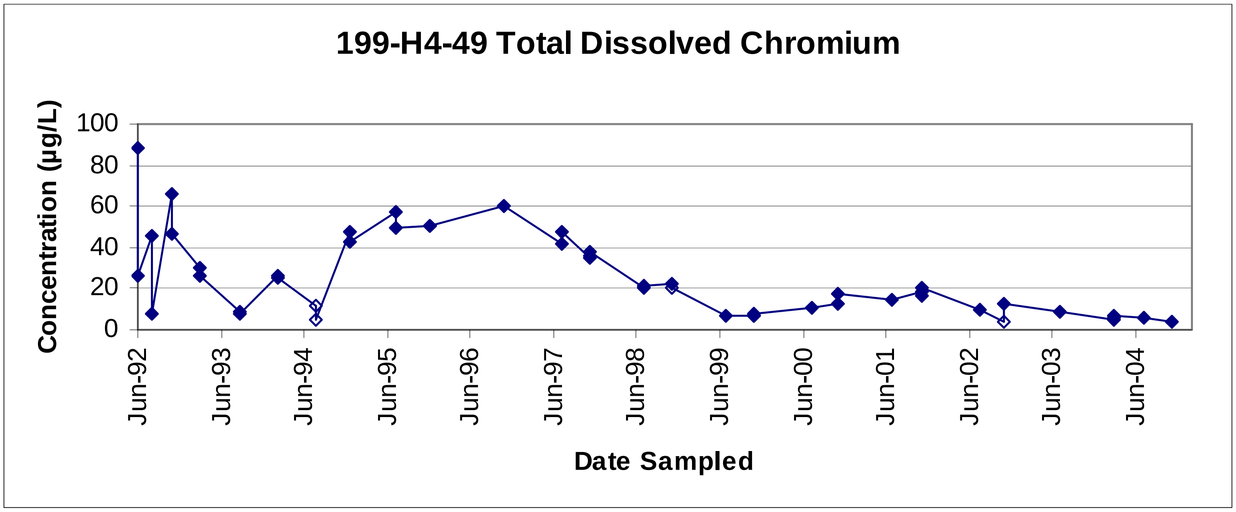

199-H4-4 Total Dissolved Chromium
Concentration (µg/L)
250
200
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

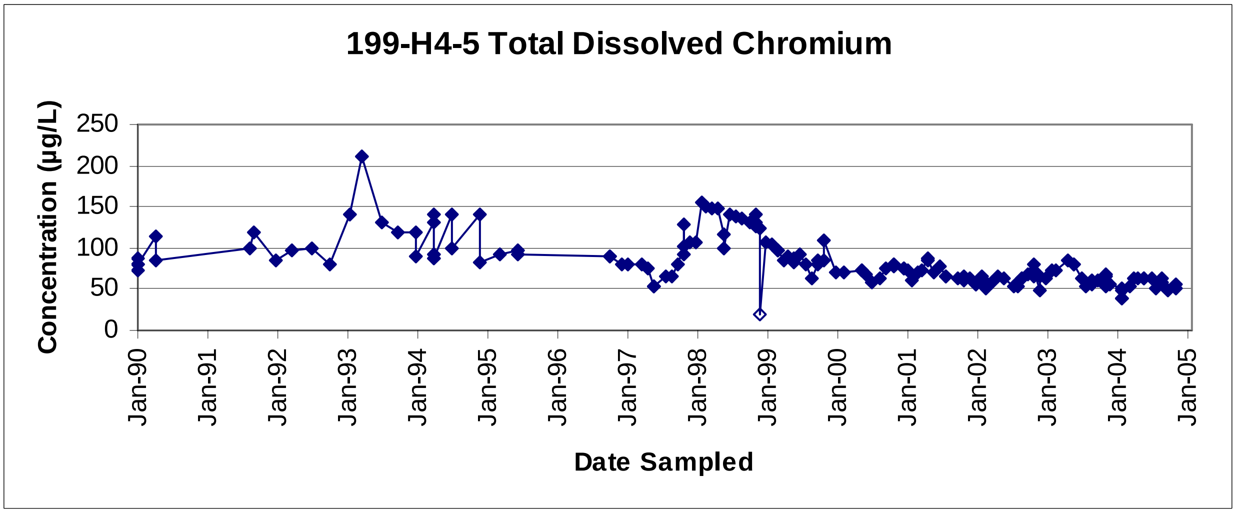

199-H4-45 Total Dissolved Chromium
Concentration (µg/L)
60
50
40
30
20
10
0
Jun-92
Jun-93
Jun-94
Jun-95
Jun-96
Jun-97
Jun-98
Jun-99
Jun-00
Jun-01
Jun-02
Jun-03
Jun-04
Date Sampled


199-H4-46 Total Dissolved Chromium
Concentration (µg/L)
100
80
60
40
20
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-H4-47 Total Dissolved Chromium
Concentration (µg/L)
120
100
80
60
40
20
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-H4-48 Total Dissolved Chromium
Concentration (µg/L)
250
200
150
100
50
0
Jun-92
Jun-93
Jun-94
Jun-95
Jun-96
Jun-97
Jun-98
Jun-99
Jun-00
Jun-01
Jun-02
Jun-03
Jun-04
Date Sampled


199-H4-49 Total Dissolved Chromium
Concentration (µg/L)
100
80
60
40
20
0
Jun-92
Jun-93
Jun-94
Jun-95
Jun-96
Jun-97
Jun-98
Jun-99
Jun-00
Jun-01
Jun-02
Jun-03
Jun-04
Date Sampled


199-H4-5 Total Dissolved Chromium
Concentration (µg/L)
250
200
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
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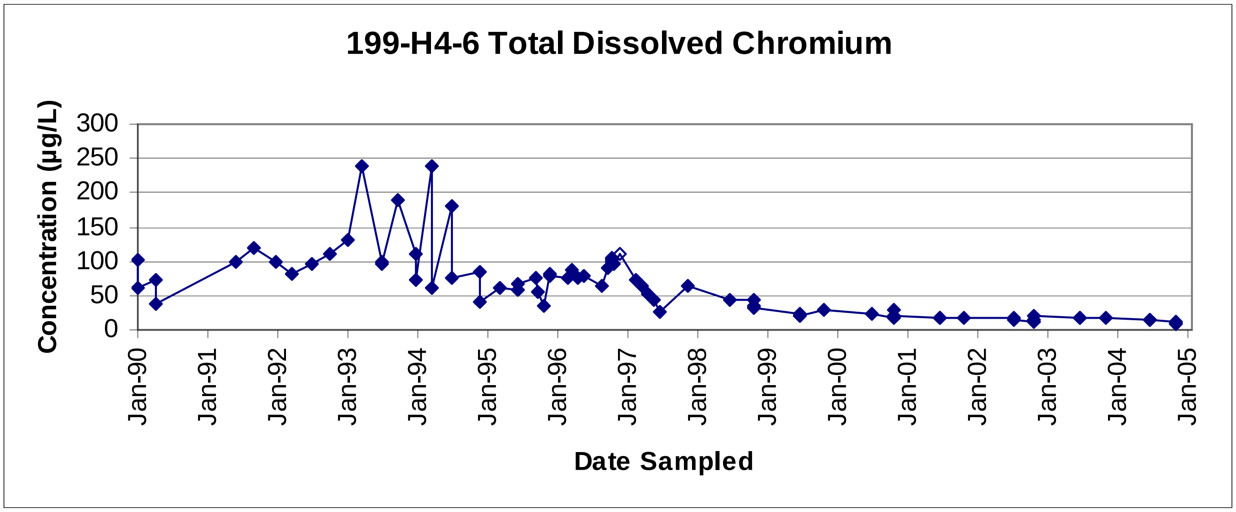
Jan-04
Jan-05
Date Sampled


199-H4-6 Total Dissolved Chromium
Concentration (µg/L)
300
250
200
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
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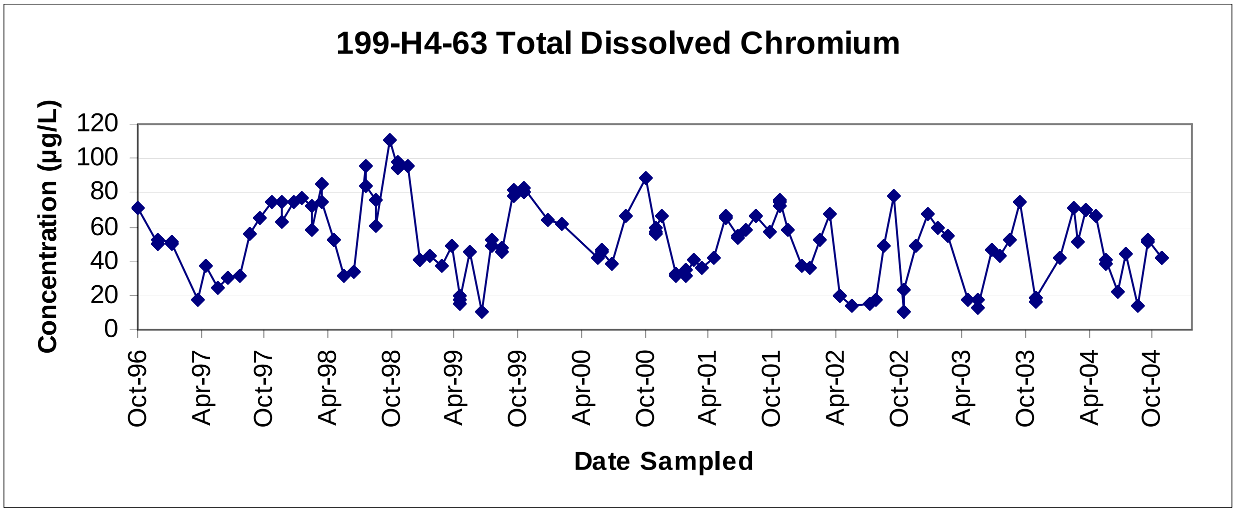
Jan-04
Jan-05
Date Sampled


199-H4-63 Total Dissolved Chromium
Concentration (µg/L)
120
100
80
60
40
20
0
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
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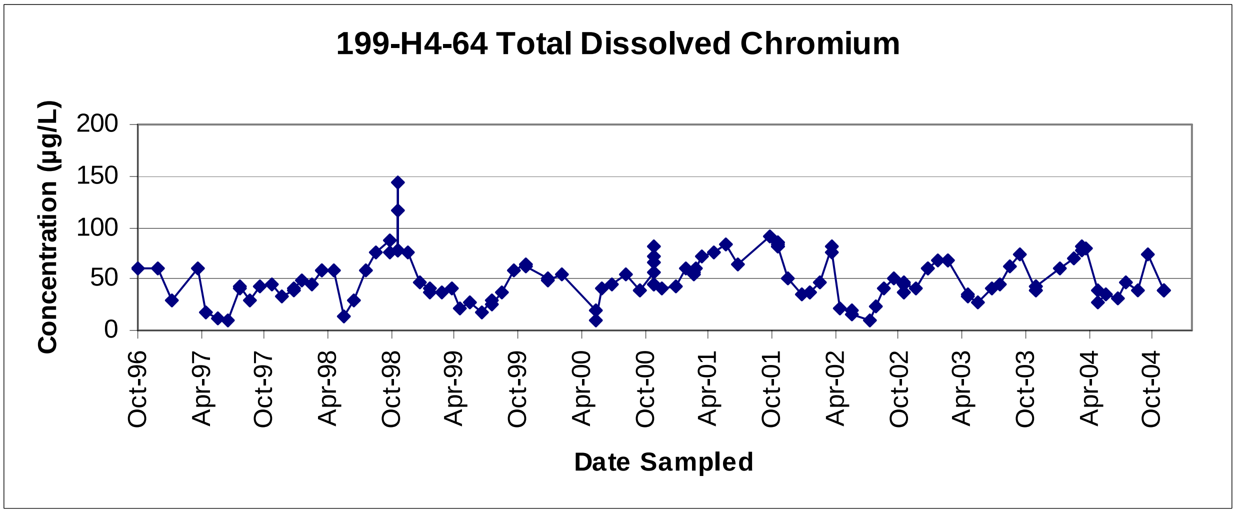
Apr-04
Oct-04
Date Sampled


199-H4-64 Total Dissolved Chromium
Concentration (µg/L)
200
150
100
50
0
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
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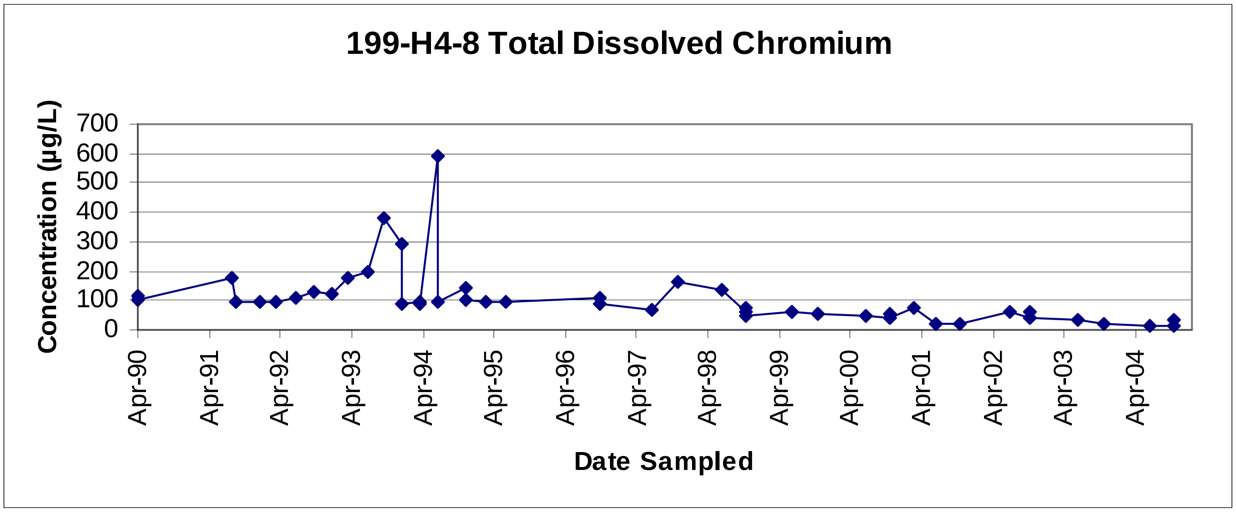
Oct-04
Date Sampled


199-H4-8 Total Dissolved Chromium
Concentration (µg/L)
700
600
500
400
300
200
100
0
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
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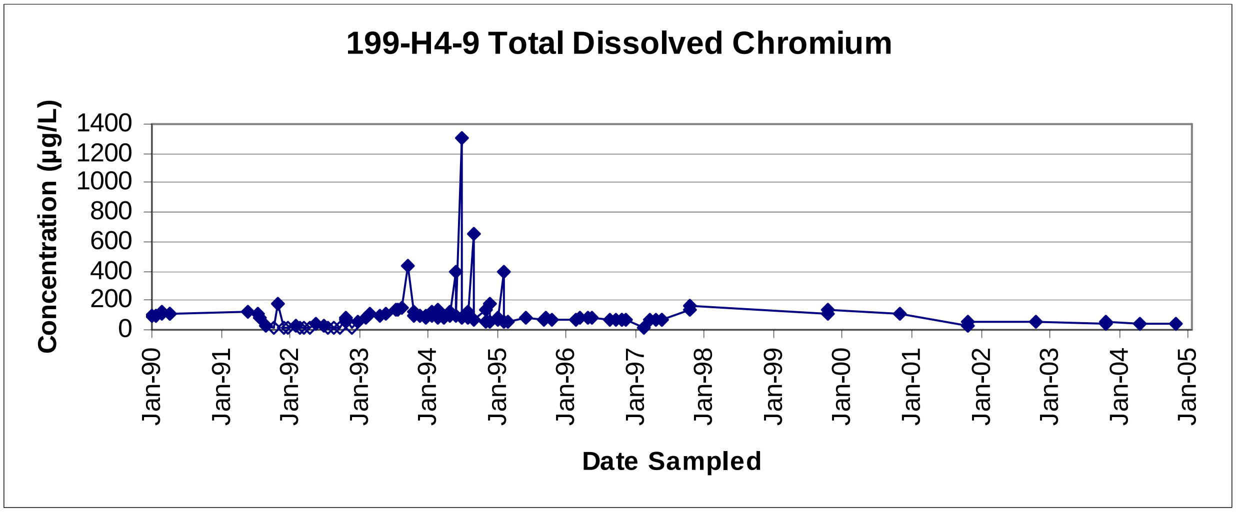
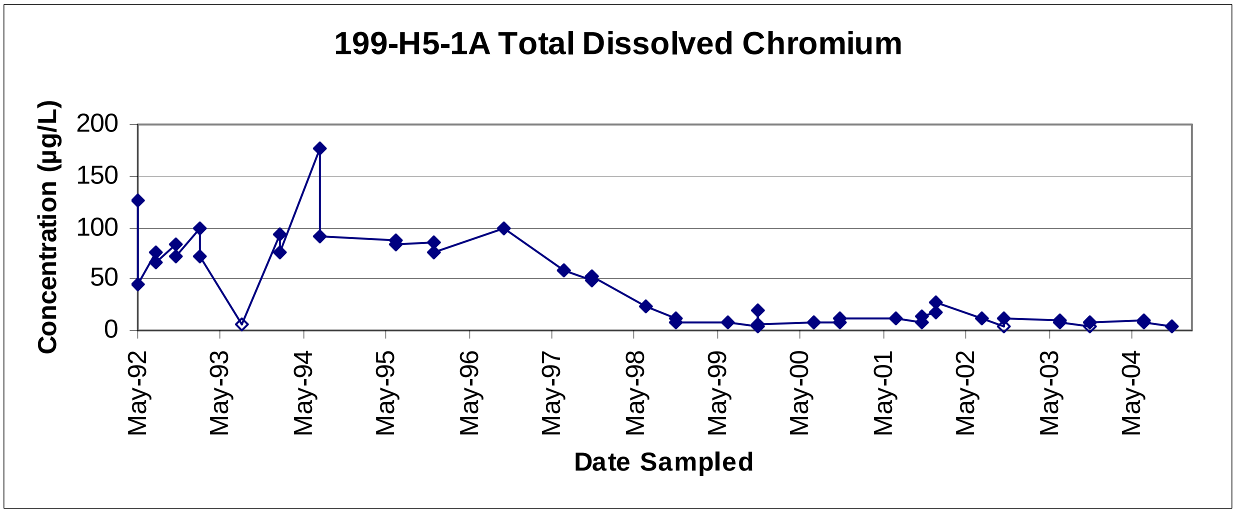
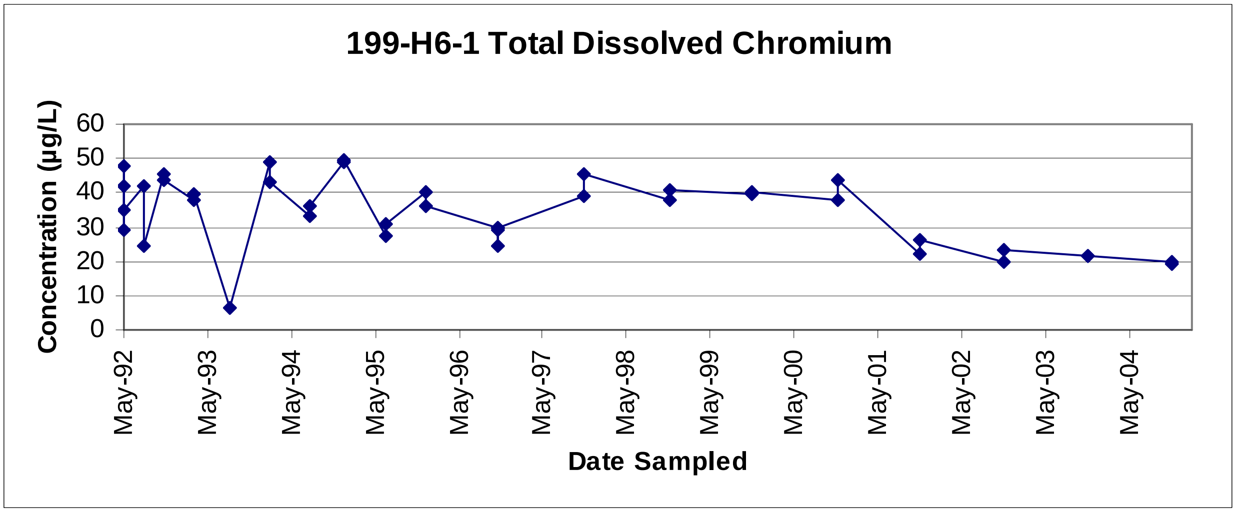
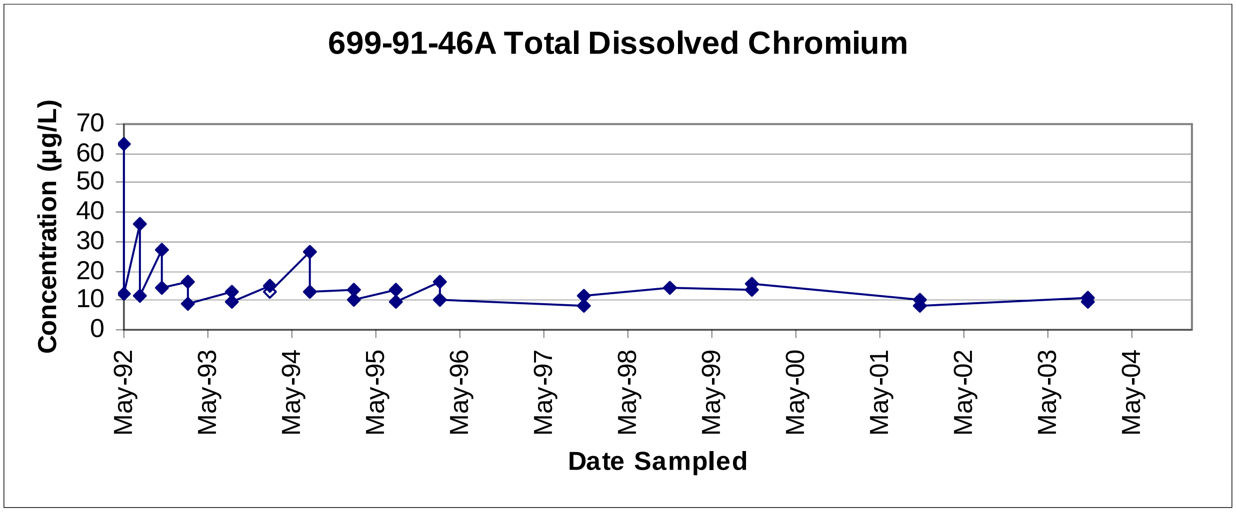
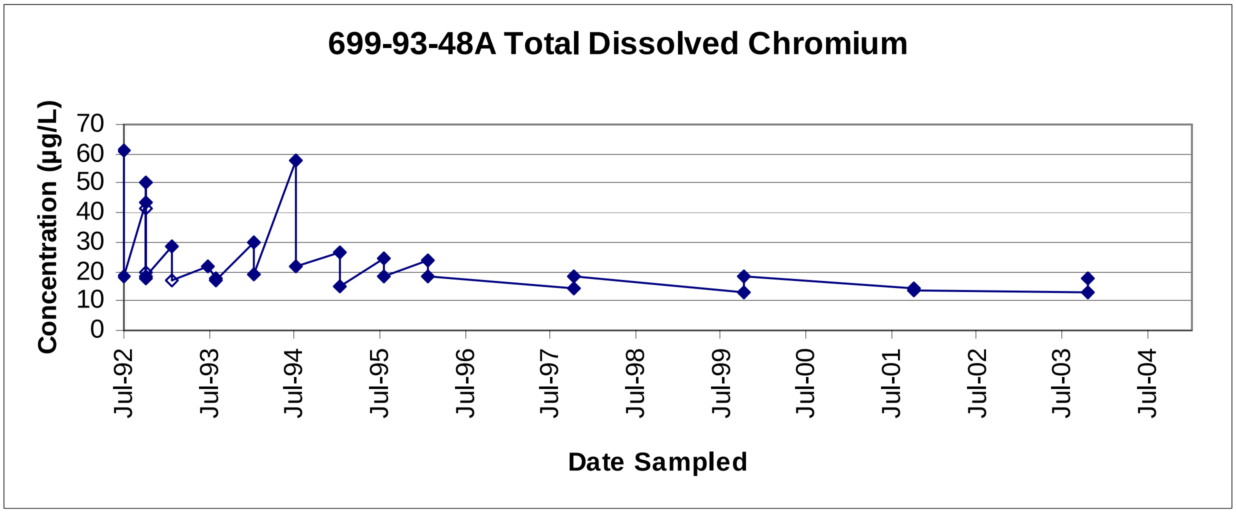
Apr-03
Apr-04
Date Sampled

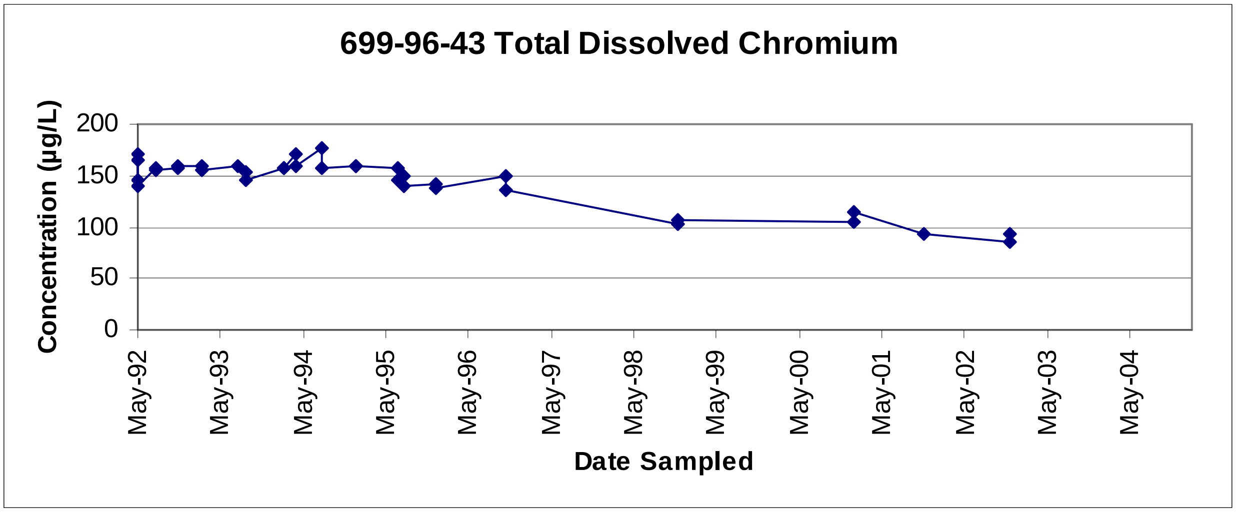

199-H4-9 Total Dissolved Chromium
Concentration (µg/L)
1400
1200
1000
800
600
400
200
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

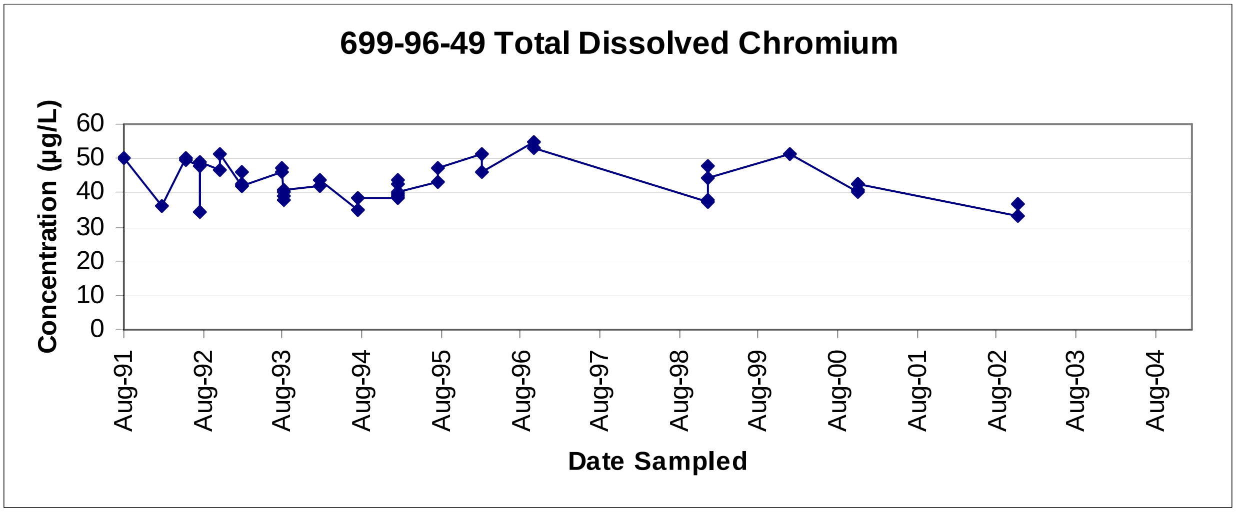

199-H5-1A Total Dissolved Chromium
Concentration (µg/L)
200
150
100
50
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

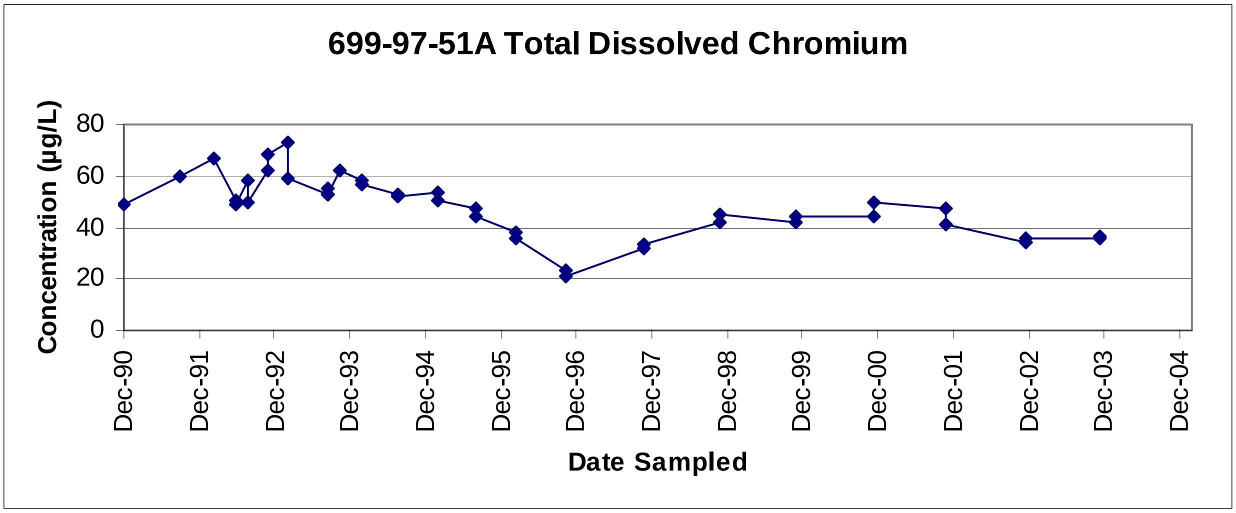

199-H6-1 Total Dissolved Chromium
Concentration (µg/L)
60
50
40
30
20
10
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

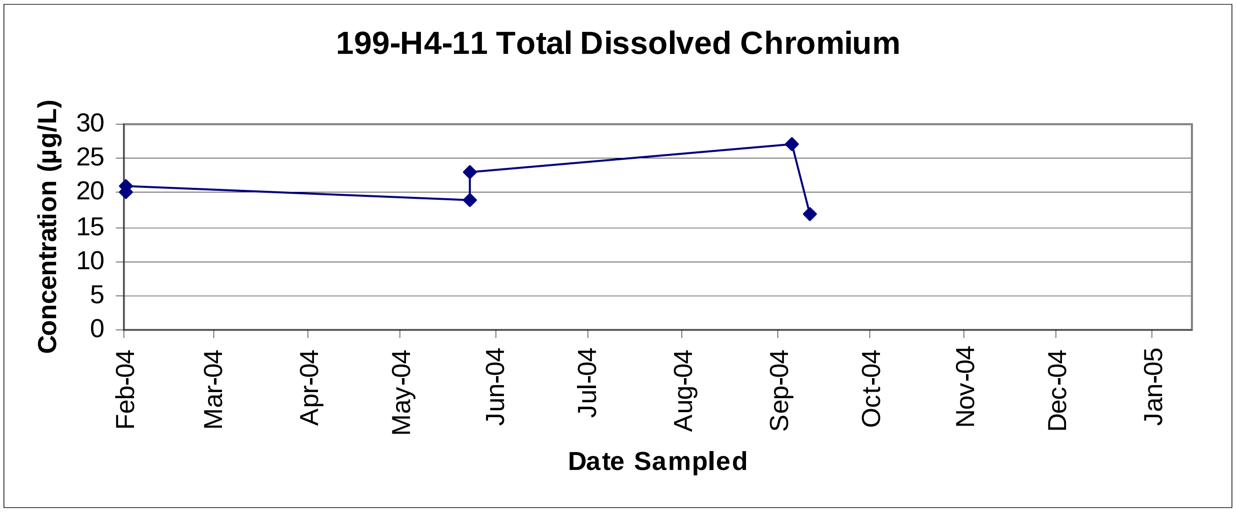

699-91-46A Total Dissolved Chromium
Concentration (µg/L)
70
60
50
40
30
20
10
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

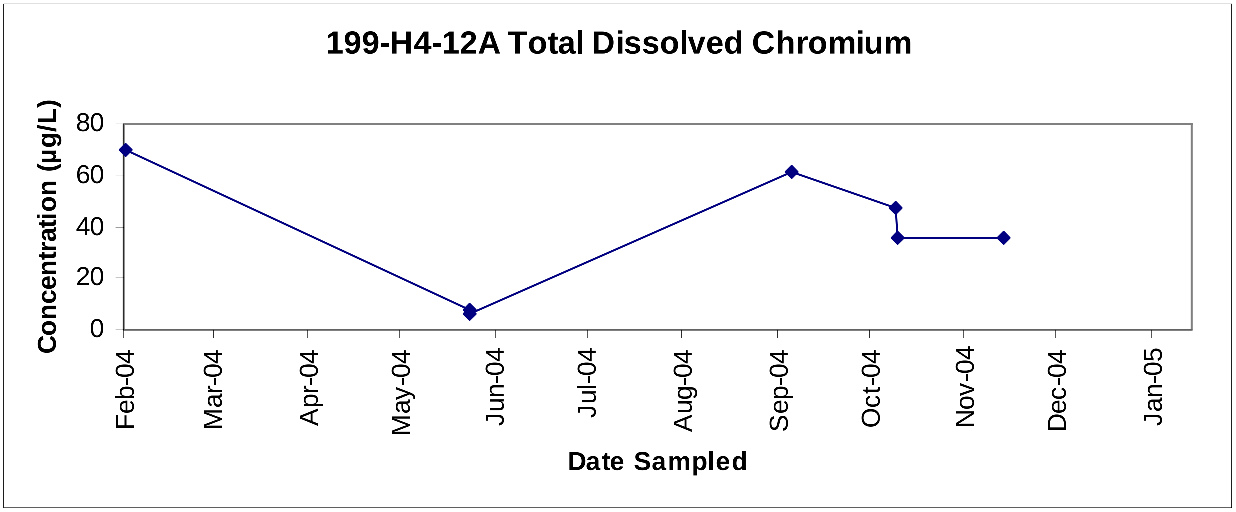

699-93-48A Total Dissolved Chromium
Concentration (µg/L)
70
60
50
40
30
20
10
0
Jul-92
Jul-93
Jul-94
Jul-95
Jul-96
Jul-97
Jul-98
Jul-99
Jul-00
Jul-01
Jul-02
Jul-03
Jul-04
Date Sampled

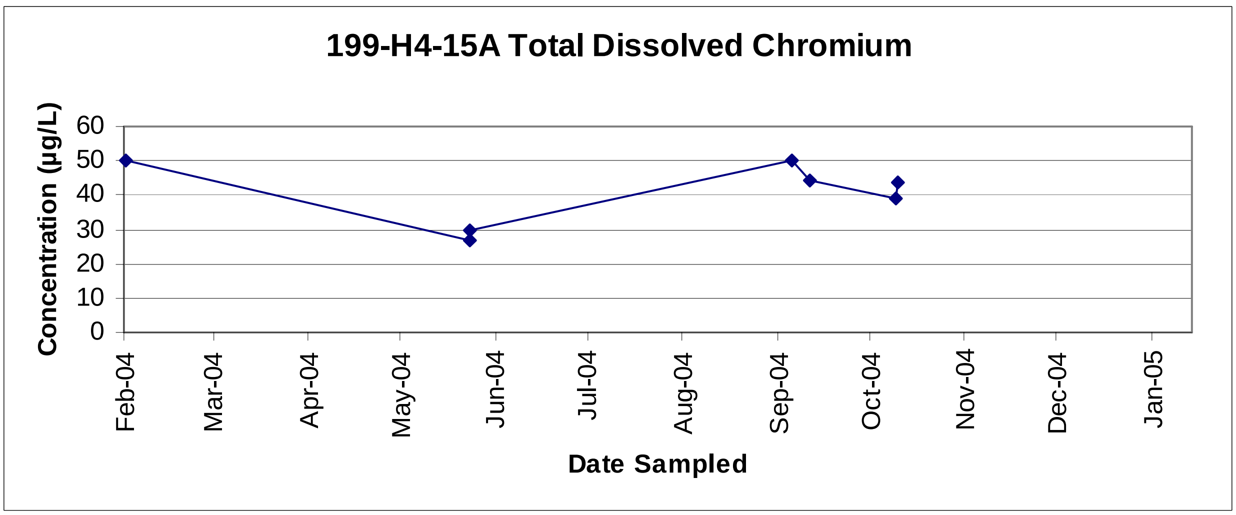

699-96-43 Total Dissolved Chromium
Concentration (µg/L)
200
150
100
50
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

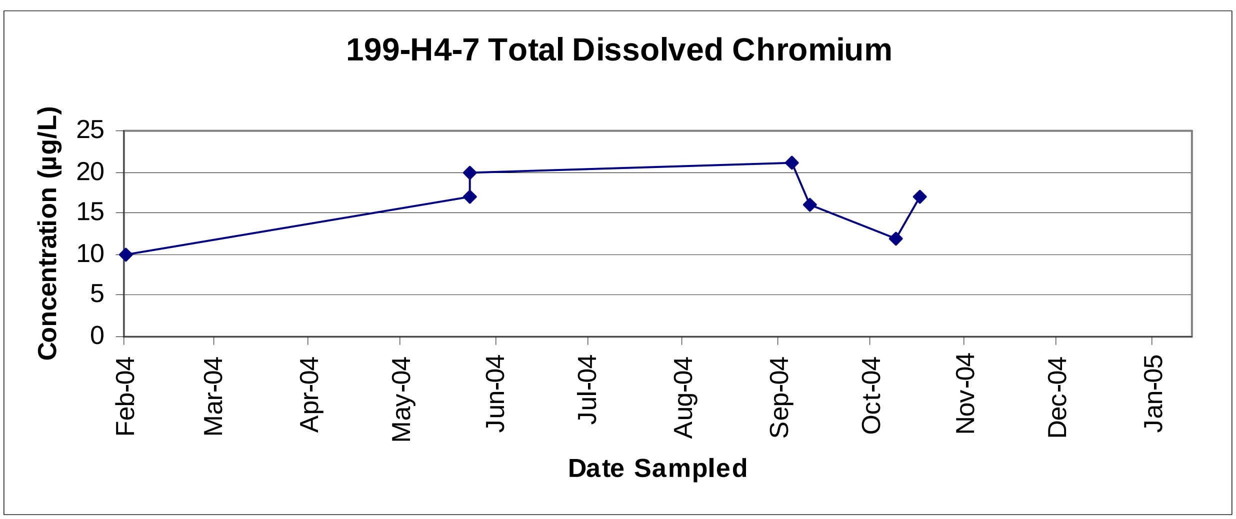

699-96-49 Total Dissolved Chromium
Concentration (µg/L)
0
10
20
30
40
50
60
Aug-91
Aug-92
Aug-93
Aug-94
Aug-95
Aug-96
Aug-97
Aug-98
Aug-99
Aug-00
Aug-01
Aug-02
Aug-03
Aug-04
Date Sampled

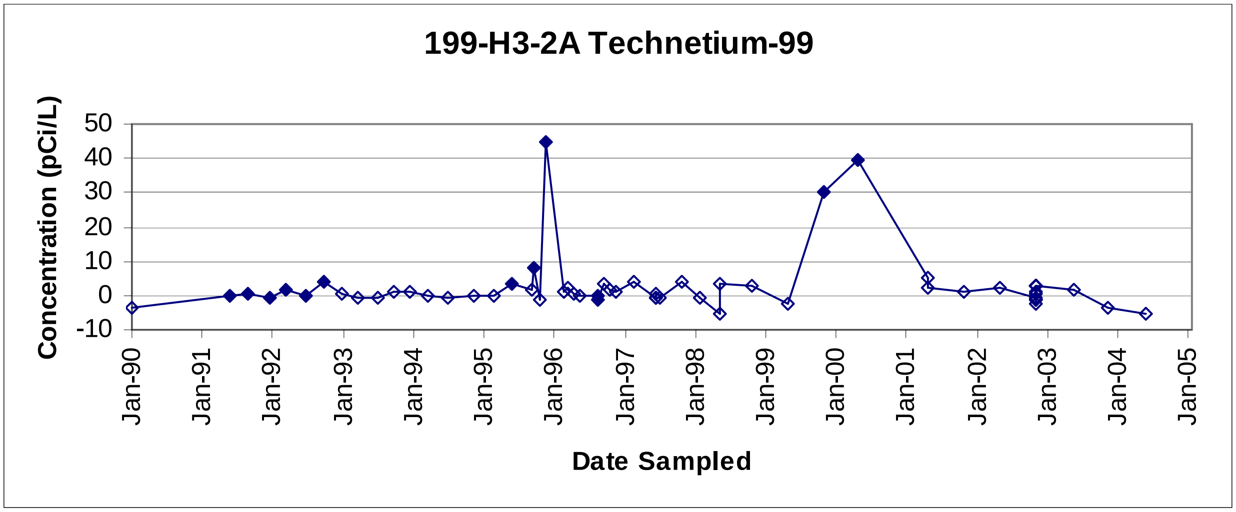

699-97-51A Total Dissolved Chromium
Concentration (µg/L)
0
20
40
60
80
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Date Sampled

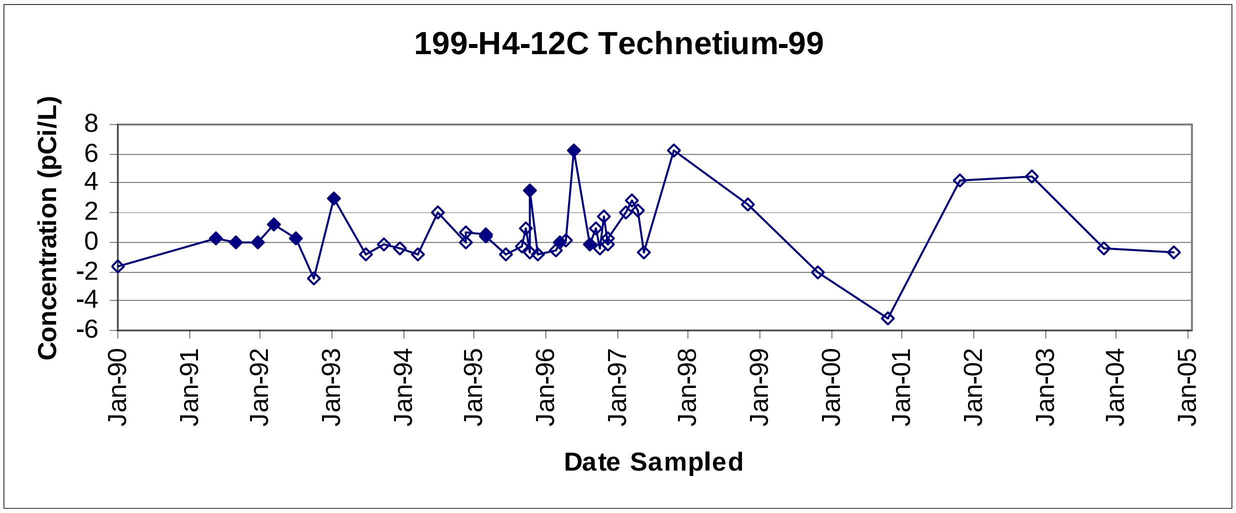

199-H4-11 Total Dissolved Chromium
Concentration (µg/L)
0
5
10
15
20
25
30
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

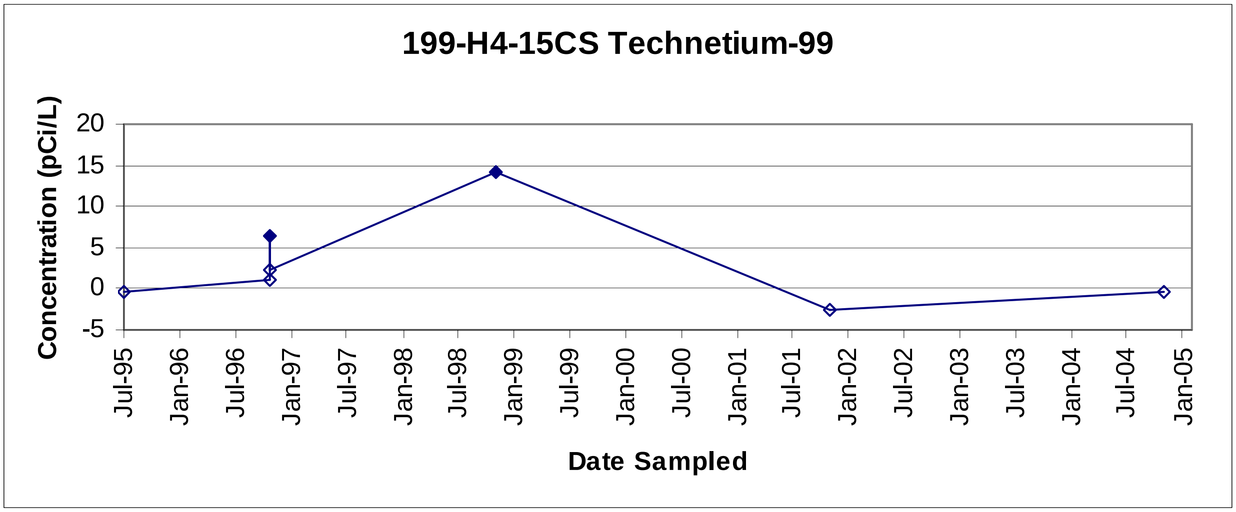

199-H4-12A Total Dissolved Chromium
Concentration (µg/L)
0
20
40
60
80
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled


199-H4-15A Total Dissolved Chromium
Concentration (µg/L)
0
10
20
30
40
50
60
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled


199-H4-7 Total Dissolved Chromium
Concentration (µg/L)
0
5
10
15
20
25
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled


199-H3-2A Technetium-99
Concentration (pCi/L)
50
40
30
20
10
0
-10
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled


199-H4-12C Technetium-99
Concentration (pCi/L)
8
6
4
2
0
-2
-4
-6
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled


199-H4-15CS Technetium-99
Concentration (pCi/L)
20
15
10
5
0
-5
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Jan-01
Jul-01
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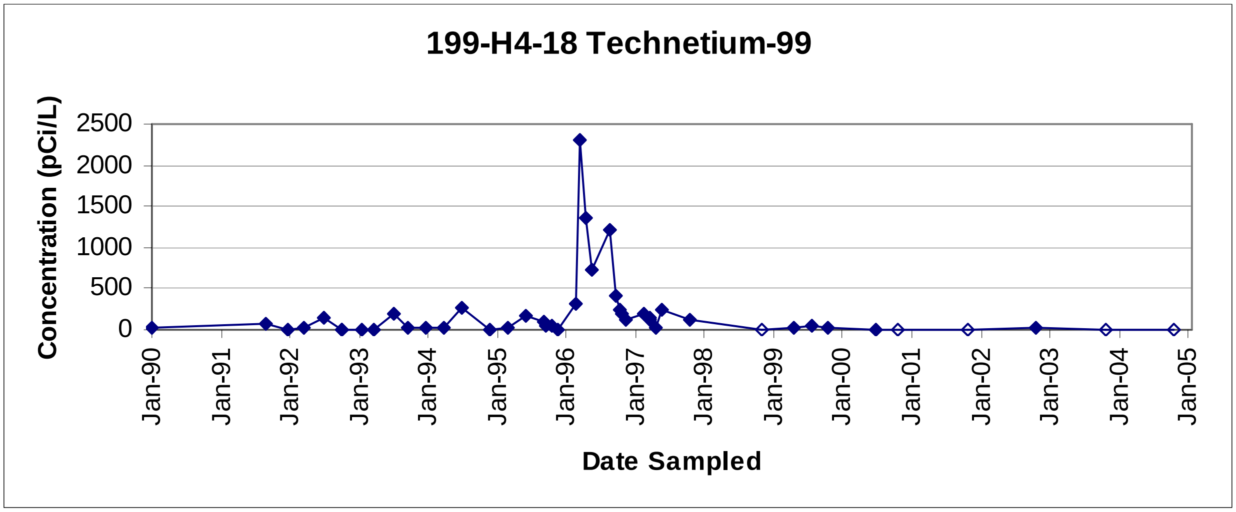
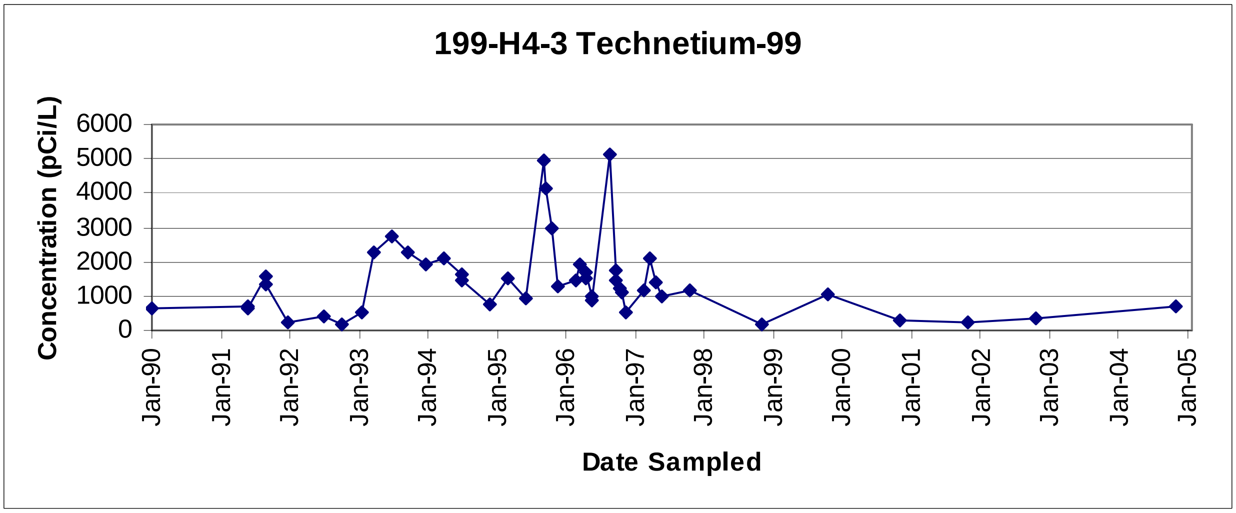
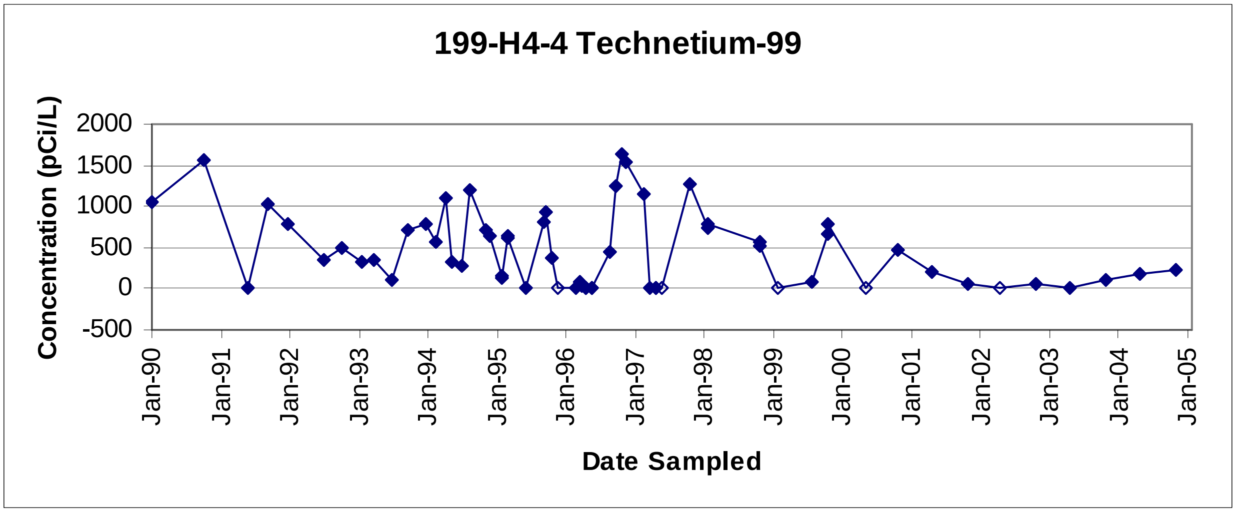
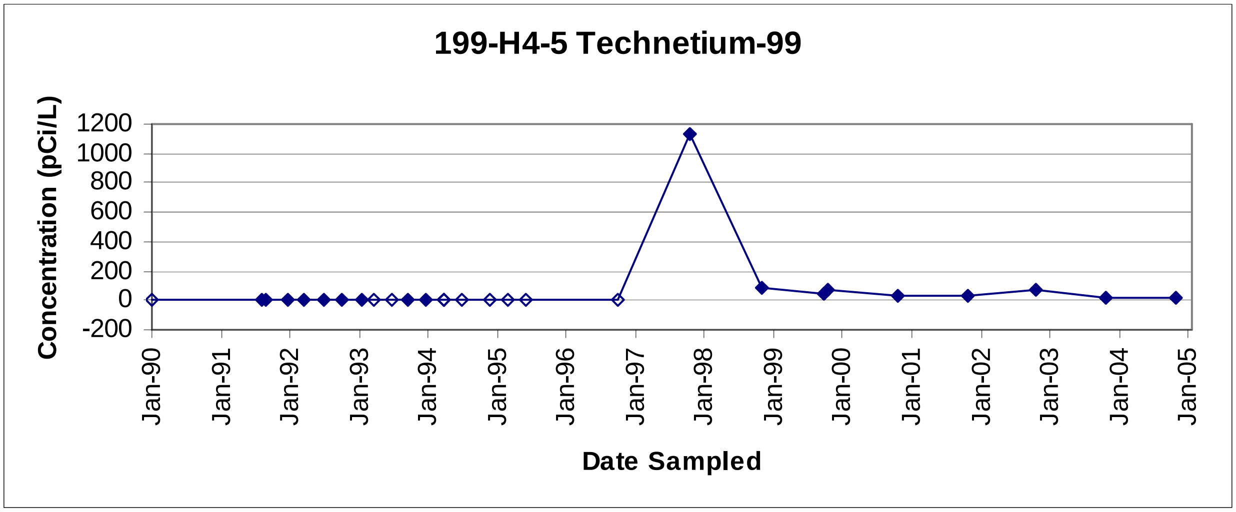
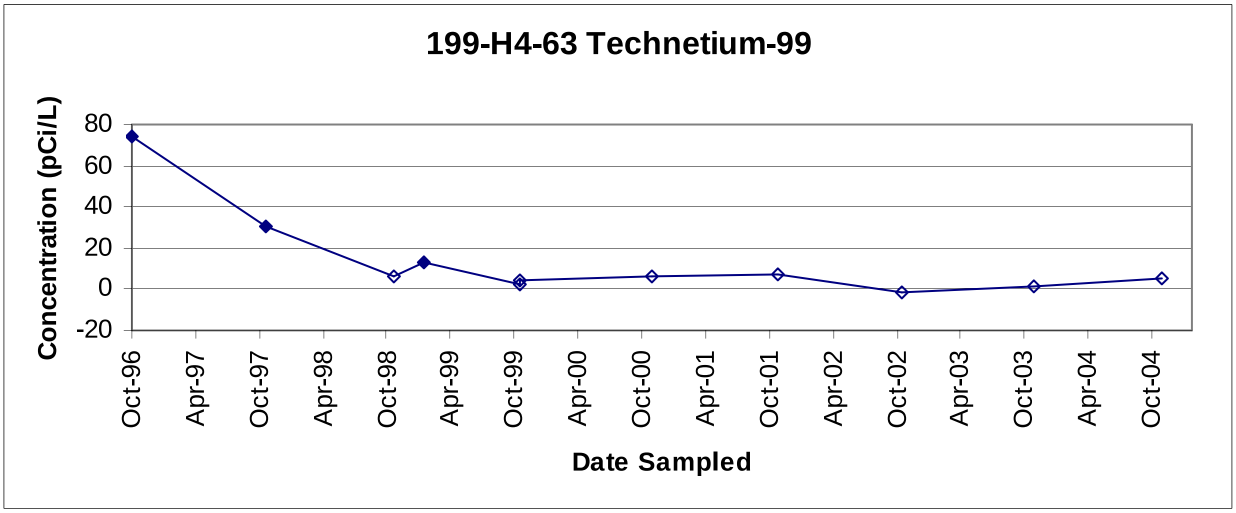
Jul-03
Jan-04
Jul-04
Jan-05
Date Sampled

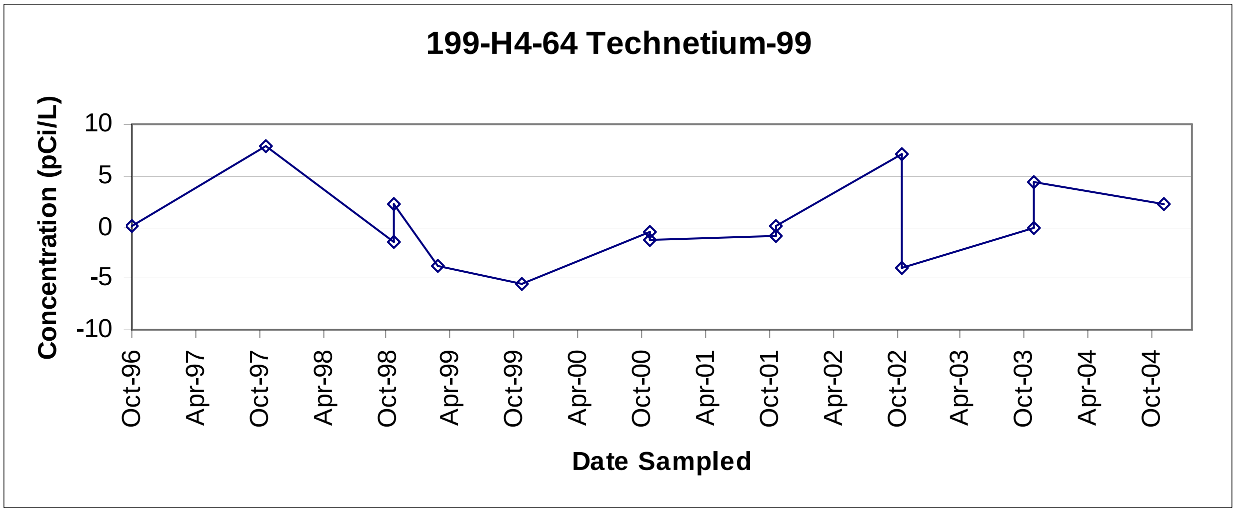

199-H4-18 Technetium-99
Concentration (pCi/L)
2500
2000
1500
1000
500
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

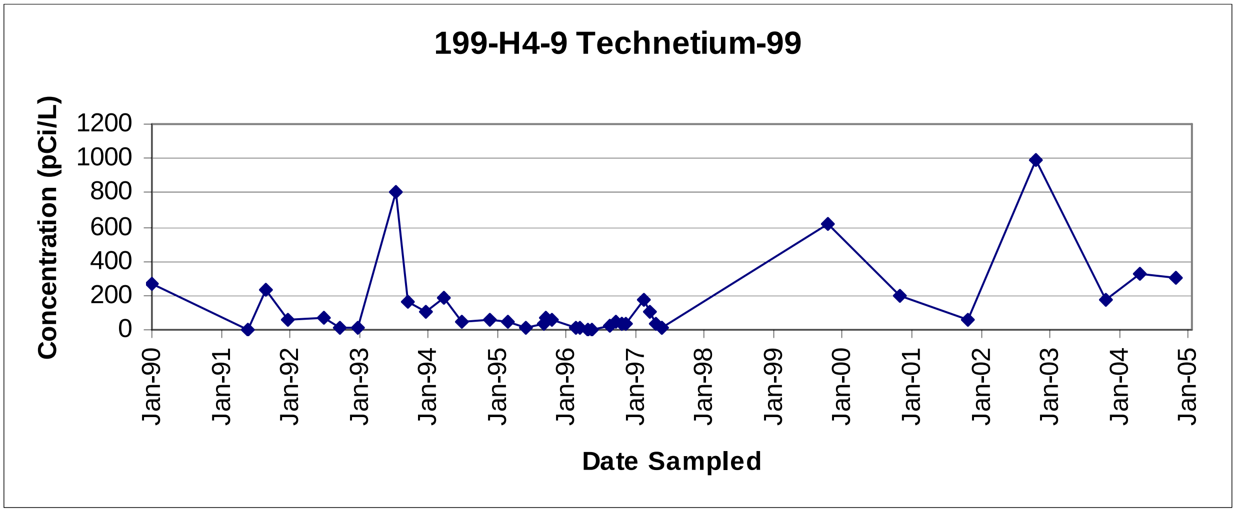

199-H4-3 Technetium-99
Concentration (pCi/L)
6000
5000
4000
3000
2000
1000
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

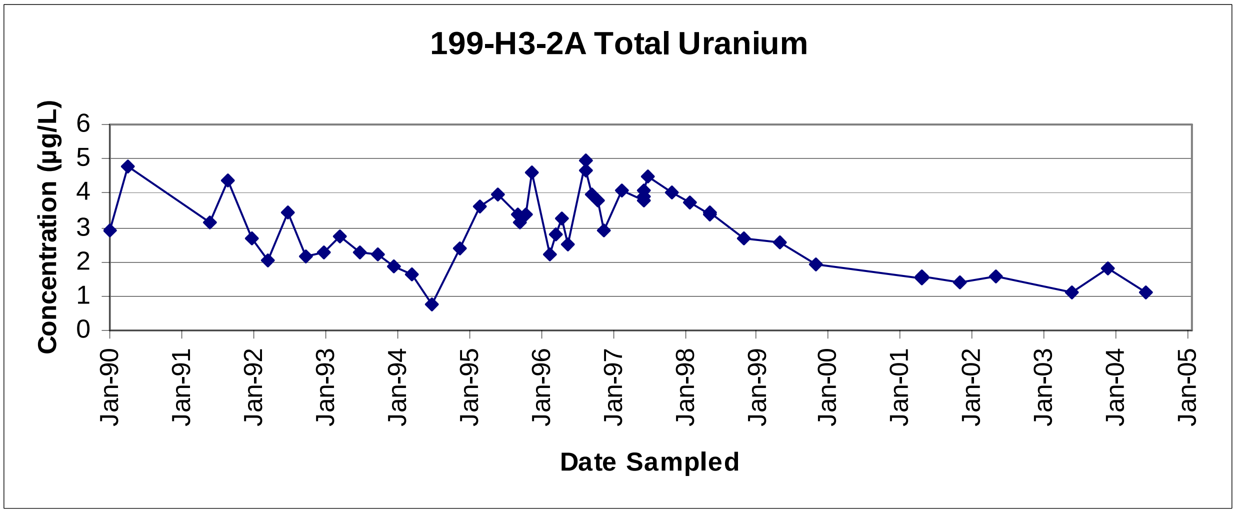

199-H4-4 Technetium-99
Concentration (pCi/L)
2000
1500
1000
500
0
-500
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

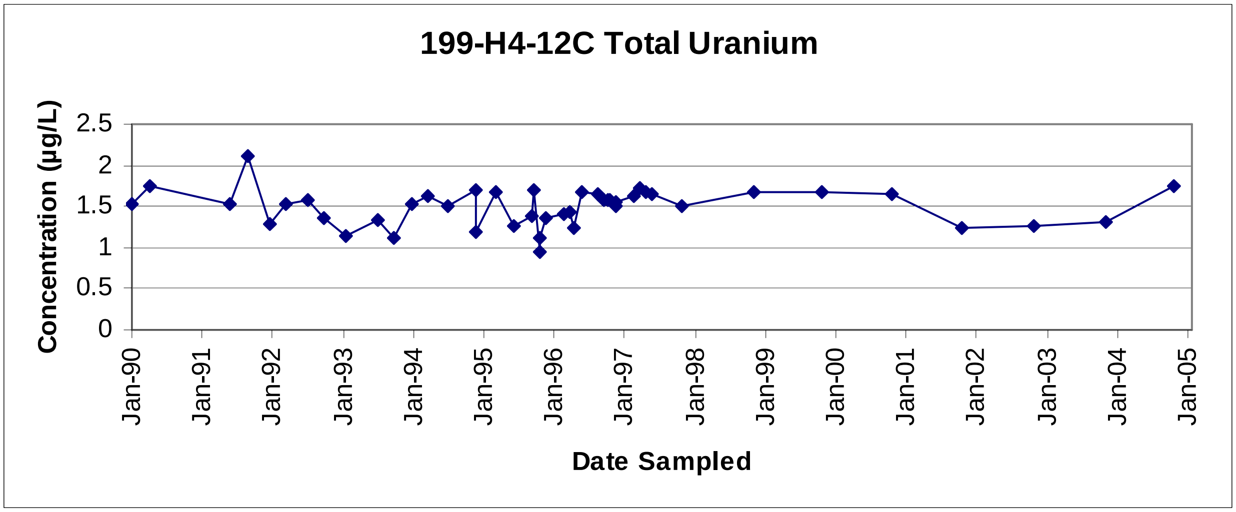

199-H4-5 Technetium-99
Concentration (pCi/L)
1200
1000
800
600
400
200
0
-200
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

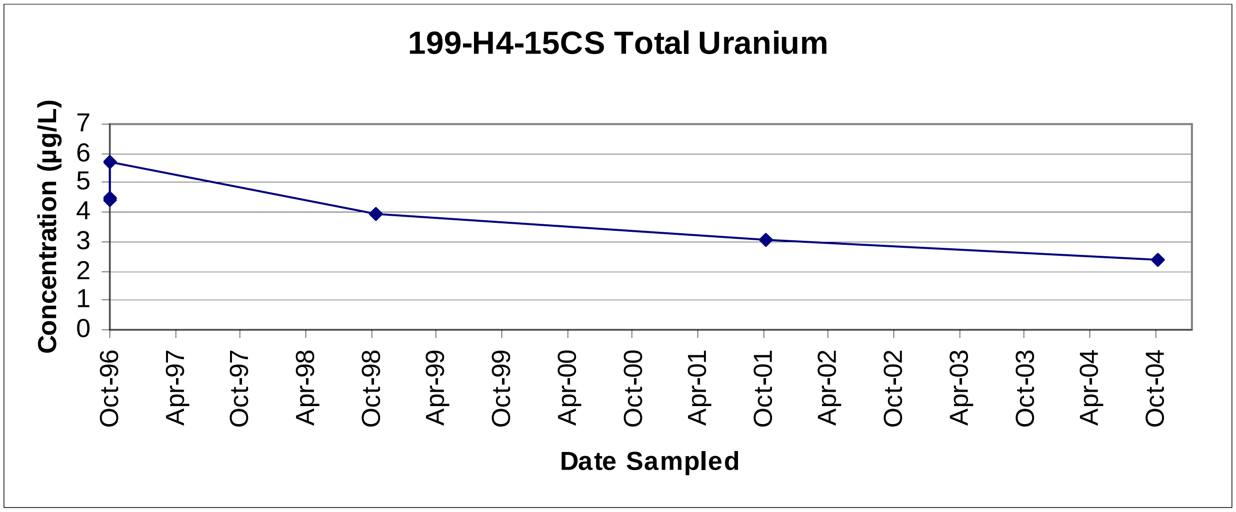

199-H4-63 Technetium-99
Concentration (pCi/L)
80
60
40
20
0
-20
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled

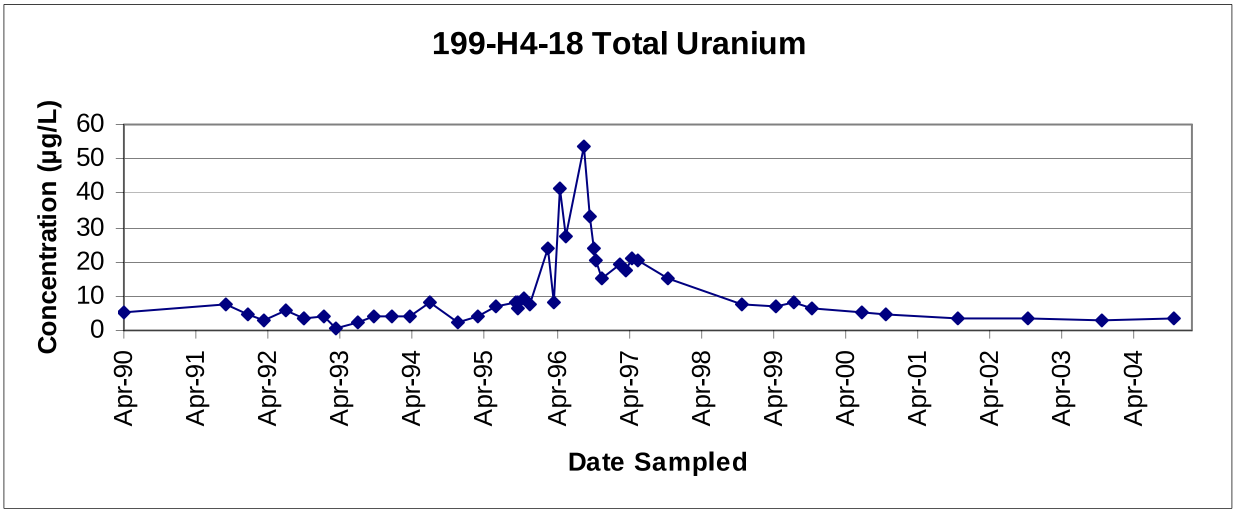

199-H4-64 Technetium-99
Concentration (pCi/L)
10
5
0
-5
-10
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled

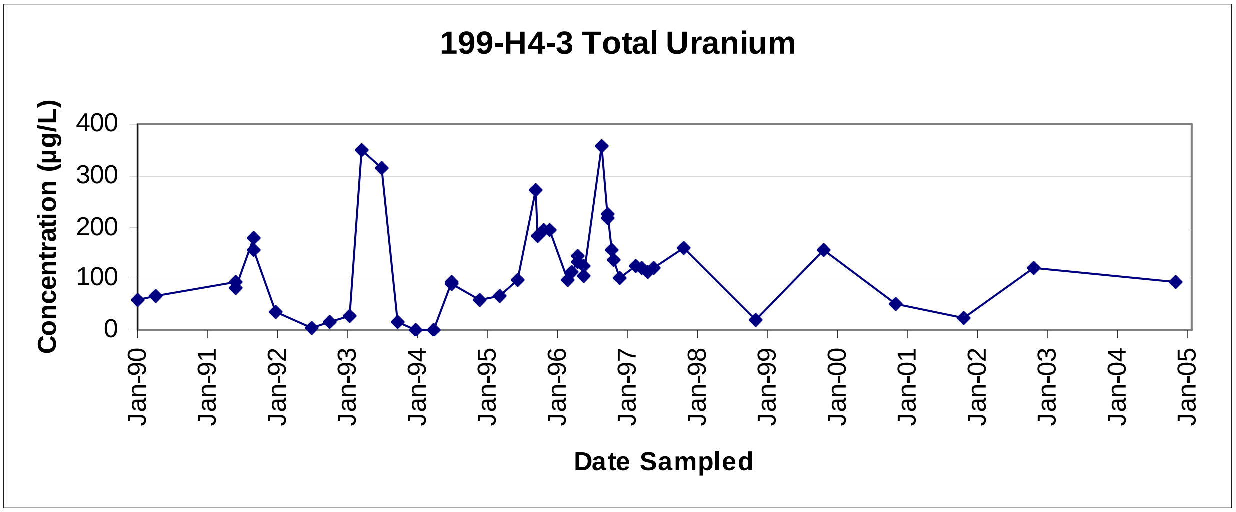

199-H4-9 Technetium-99
Concentration (pCi/L)
1200
1000
800
600
400
200
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

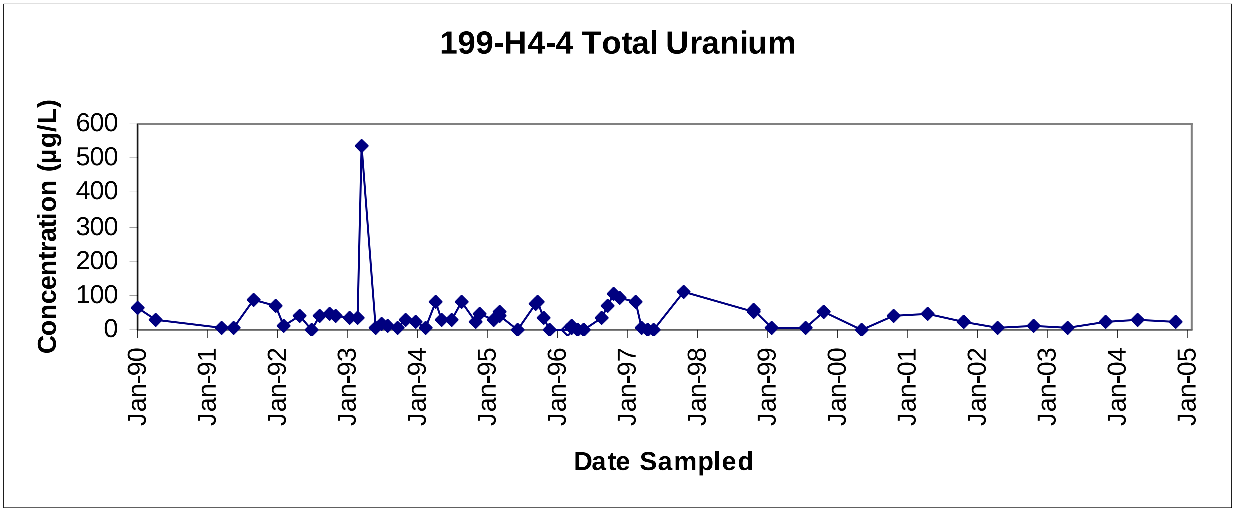

199-H3-2A Total Uranium
Concentration (µg/L)
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

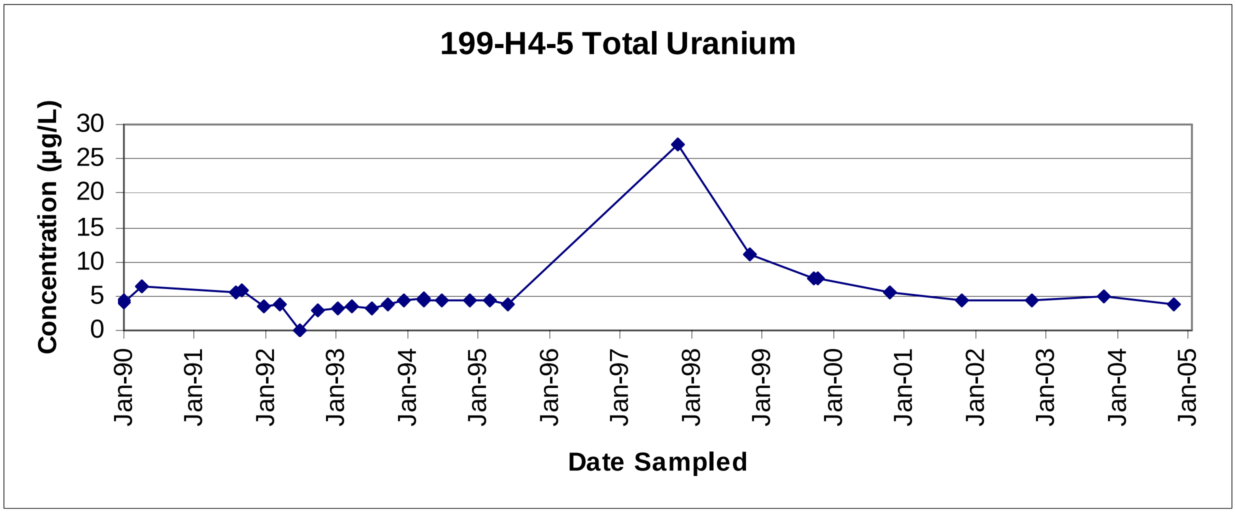

199-H4-12C Total Uranium
Concentration (µg/L)
2.5
2
1.5
1
0.5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

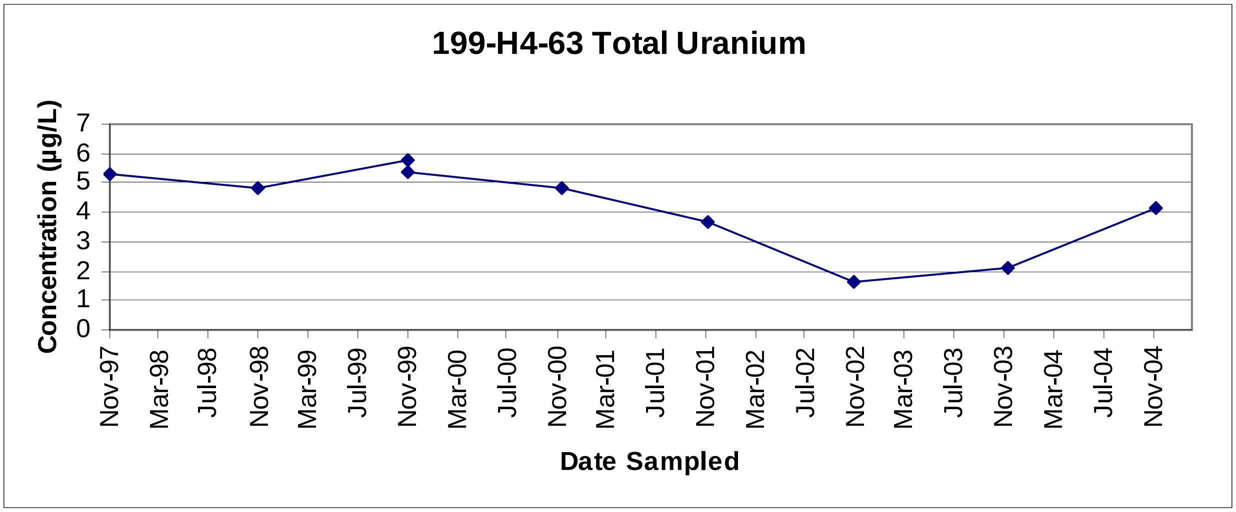

199-H4-15CS Total Uranium
Concentration (µg/L)
0
1
2
3
4
5
6
7
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled

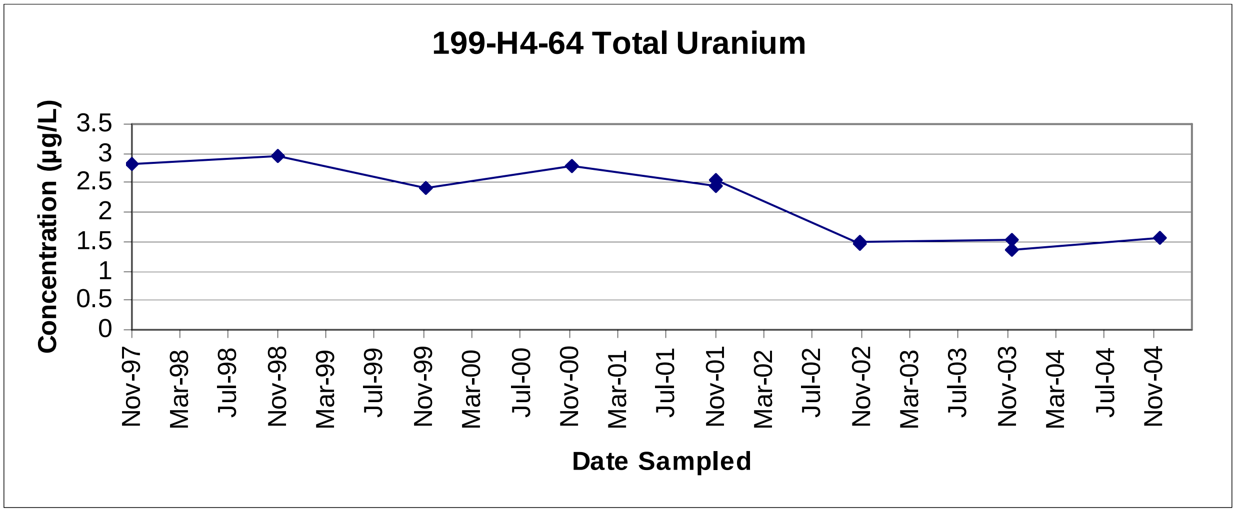

199-H4-18 Total Uranium
Concentration (µg/L)
0
10
20
30
40
50
60
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled

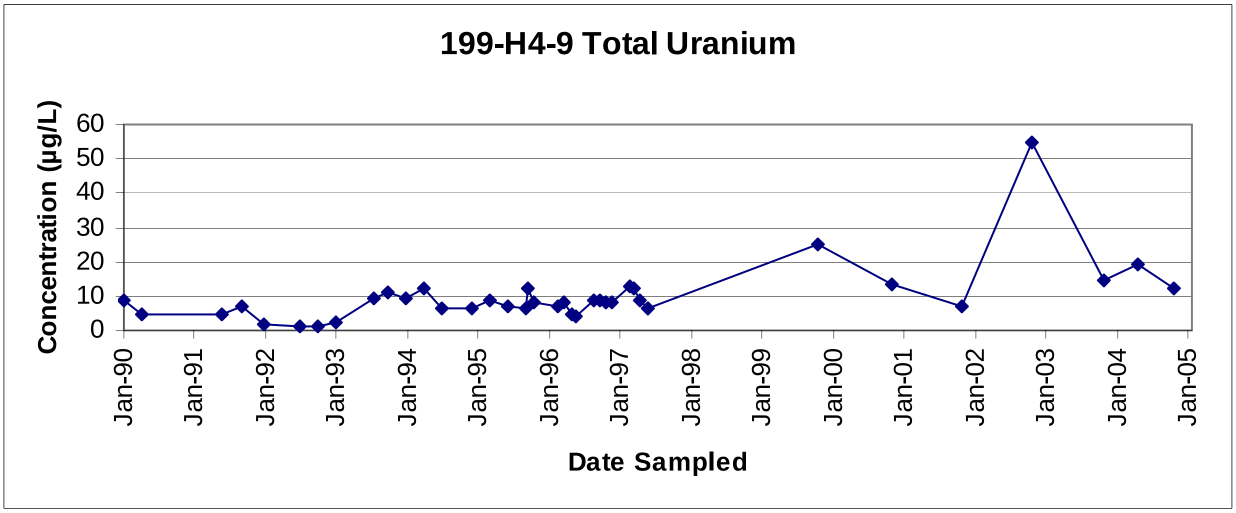

199-H4-3 Total Uranium
Concentration (µg/L)
0
100
200
300
400
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

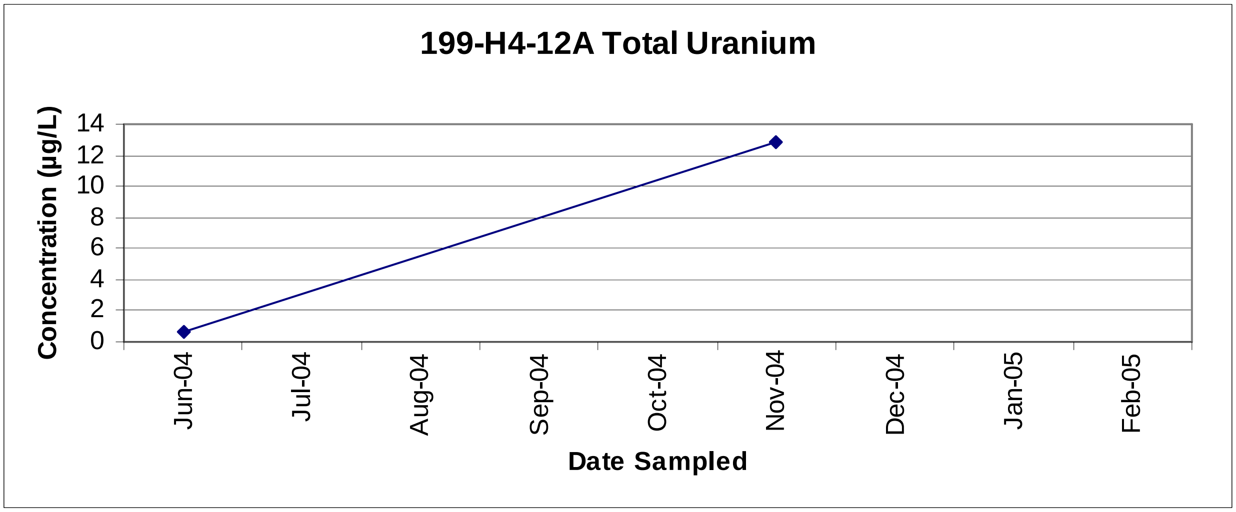

199-H4-4 Total Uranium
Concentration (µg/L)
600
500
400
300
200
100
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

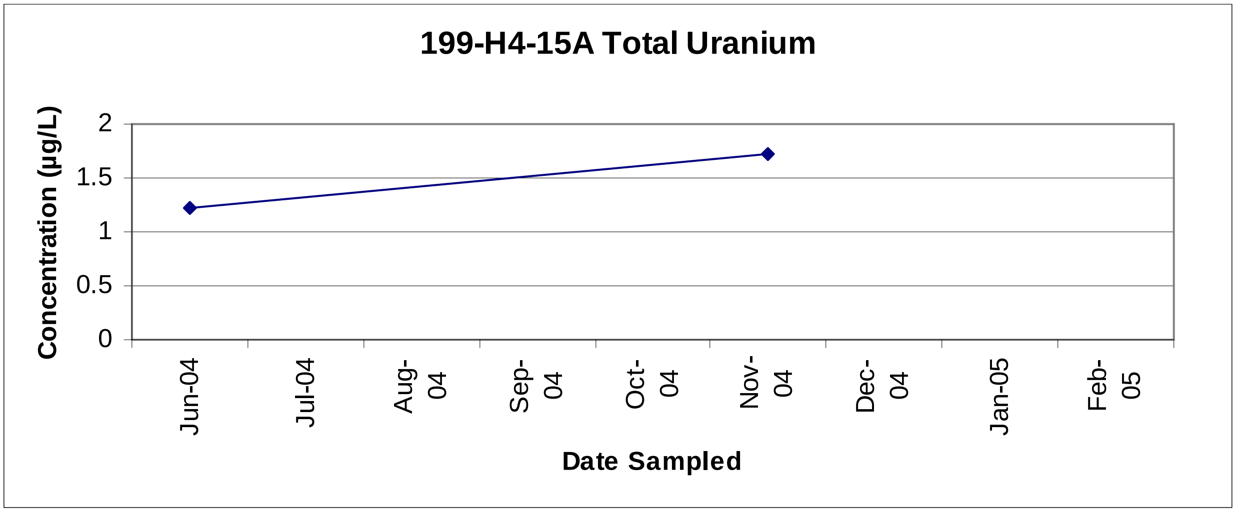

199-H4-5 Total Uranium
Concentration (µg/L)
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

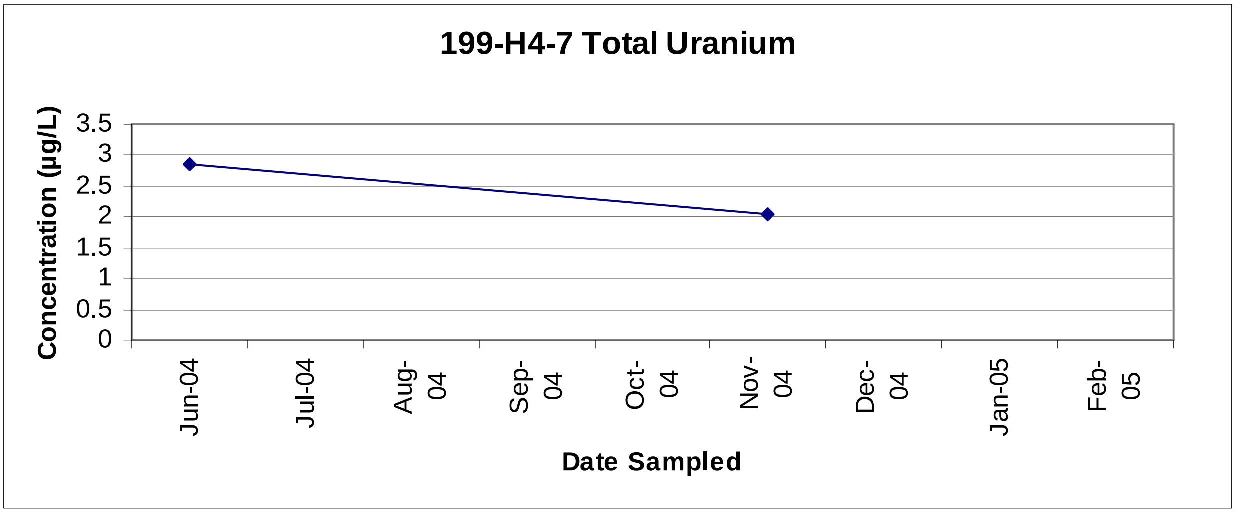

199-H4-63 Total Uranium
Concentration (µg/L)
7
6
5
4
3
2
1
0
Nov-97
Mar-98
Jul-98
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Date Sampled

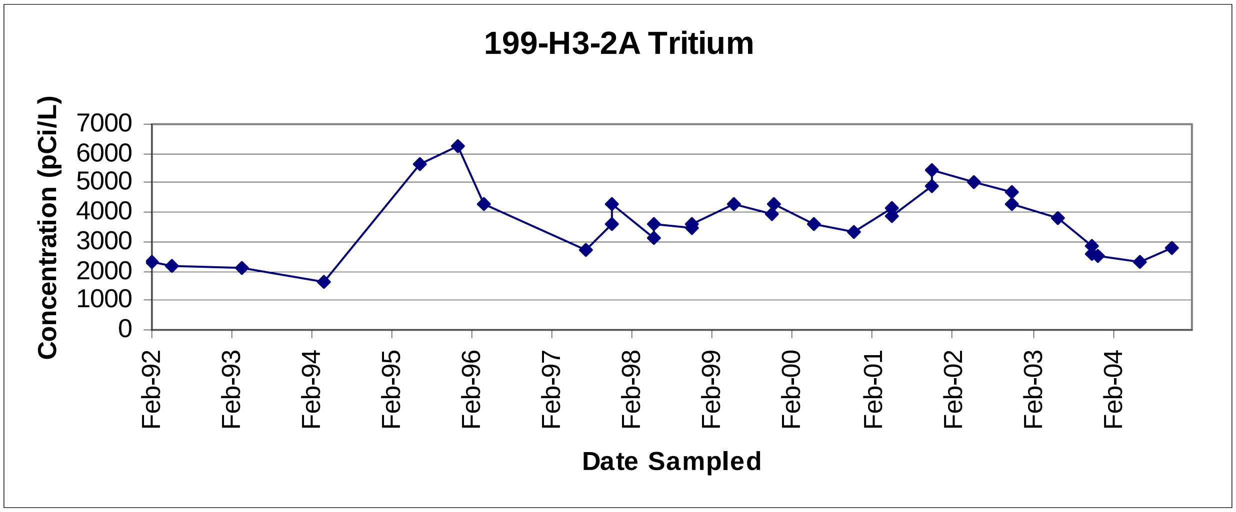

199-H4-64 Total Uranium
Concentration (µg/L)
3.5
3
2.5
2
1.5
1
0.5
0
Nov-97
Mar-98
Jul-98
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Date Sampled

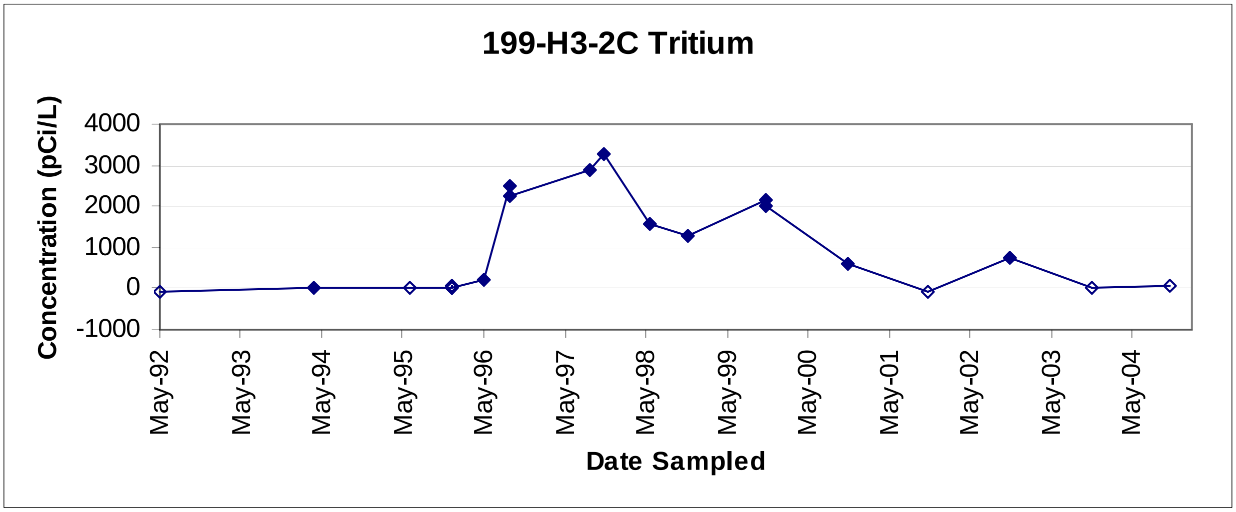

199-H4-9 Total Uranium
Concentration (µg/L)
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

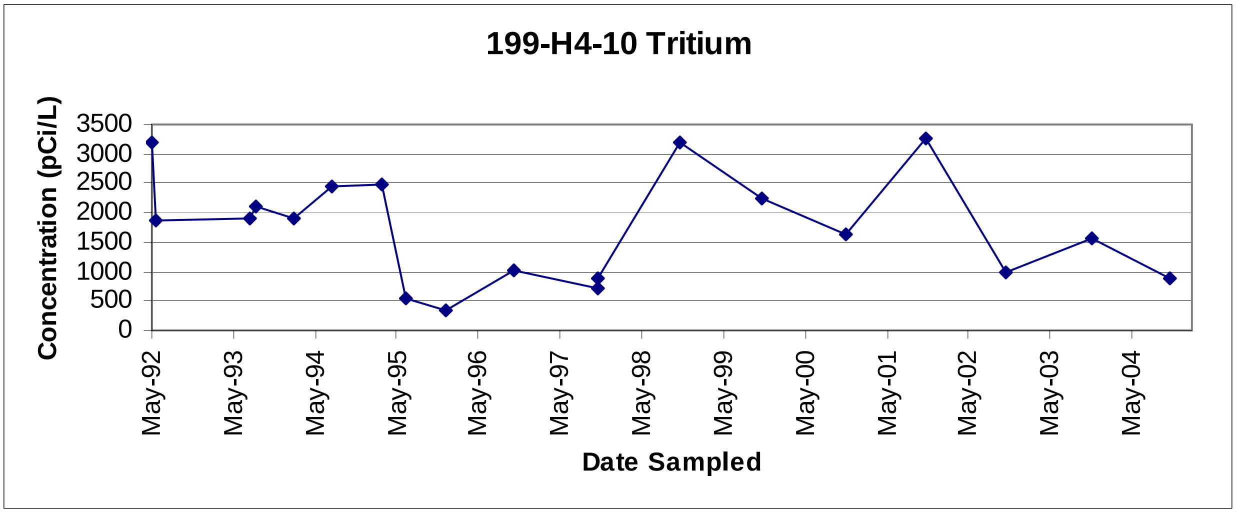

199-H4-12A Total Uranium
Concentration (µg/L)
14
12
10
8
6
4
2
0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-H4-15A Total Uranium
Concentration (µg/L)
2
1.5
1
0.5
0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-H4-7 Total Uranium
Concentration (µg/L)
3.5
3
2.5
2
1.5
1
0.5
0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-H3-2A Tritium
Concentration (pCi/L)
7000
6000
5000
4000
3000
2000
1000
0
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-H3-2C Tritium
Concentration (pCi/L)
4000
3000
2000
1000
0
-1000
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-H4-10 Tritium
Concentration (pCi/L)
3500
3000
2500
2000
1500
1000
500
0
May-92
May-93
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May-97
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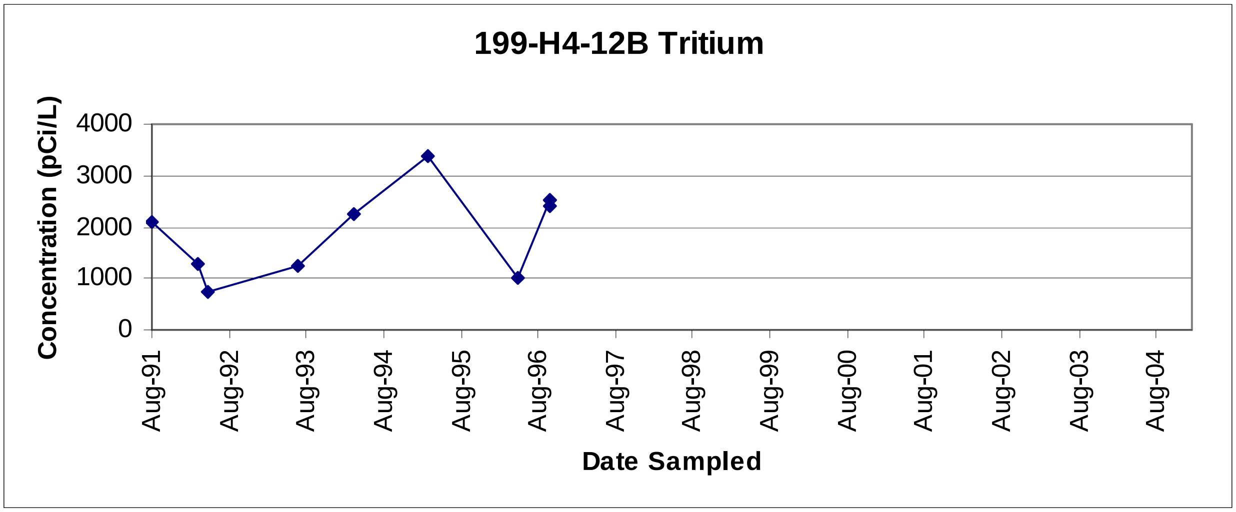
May-04
Date Sampled


199-H4-12B Tritium
Concentration (pCi/L)
4000
3000
2000
1000
0
Aug-91
Aug-92
Aug-93
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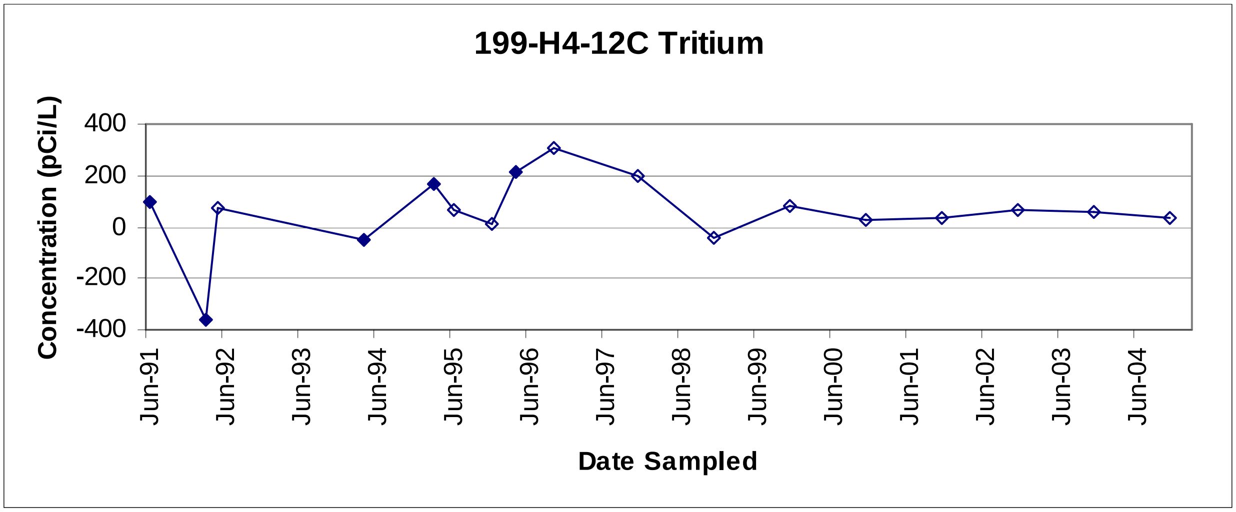
Date Sampled


199-H4-12C Tritium
Concentration (pCi/L)
400
200
0
-200
-400
Jun-91
Jun-92
Jun-93
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Jun-96
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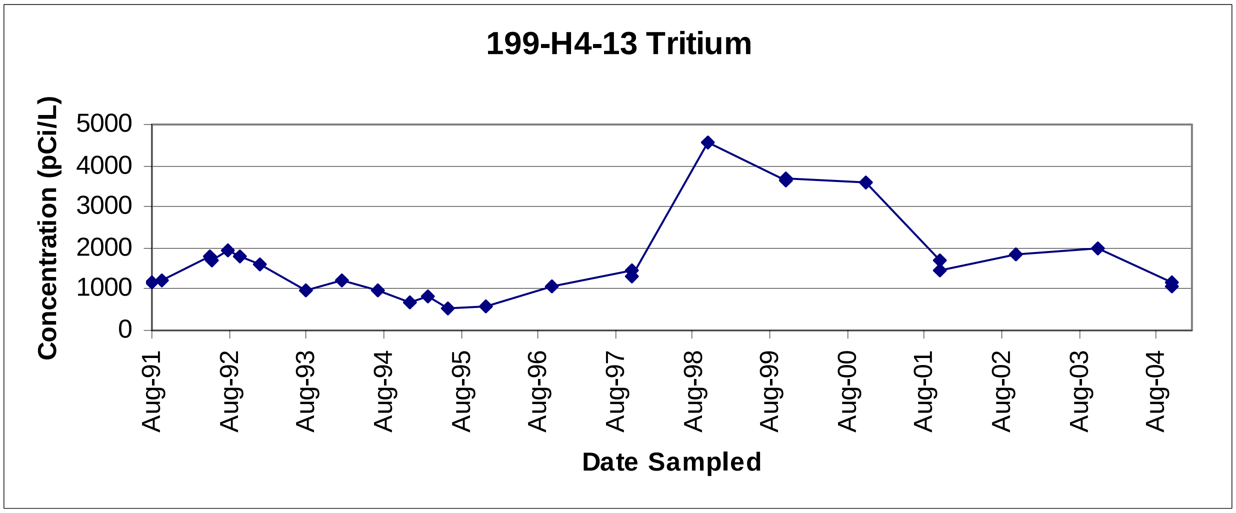
Date Sampled


199-H4-13 Tritium
Concentration (pCi/L)
5000
4000
3000
2000
1000
0
Aug-91
Aug-92
Aug-93
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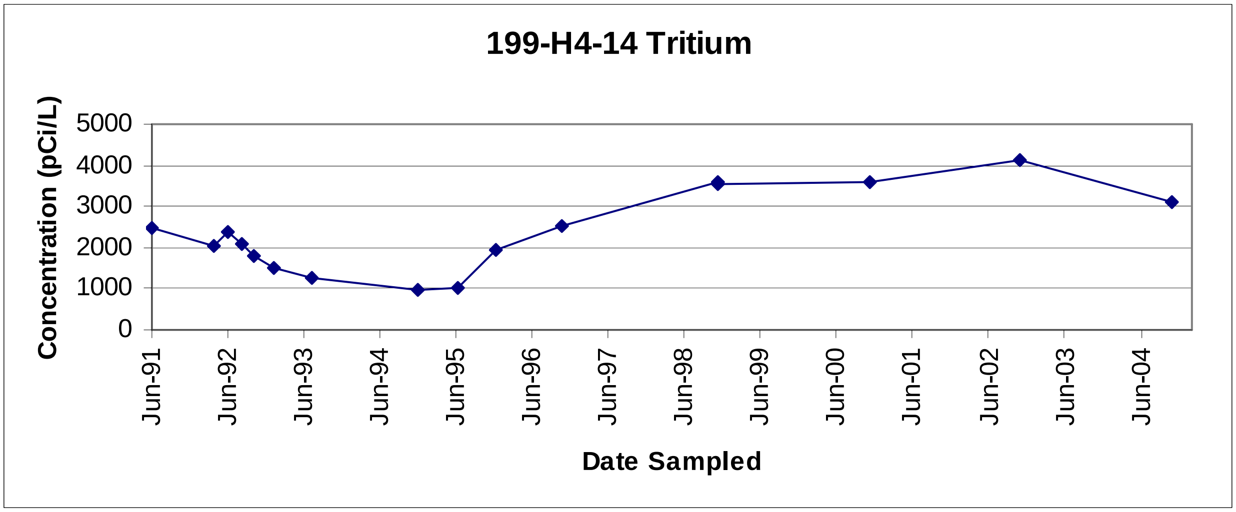
Aug-04
Date Sampled


199-H4-14 Tritium
Concentration (pCi/L)
5000
4000
3000
2000
1000
0
Jun-91
Jun-92
Jun-93
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Jun-03
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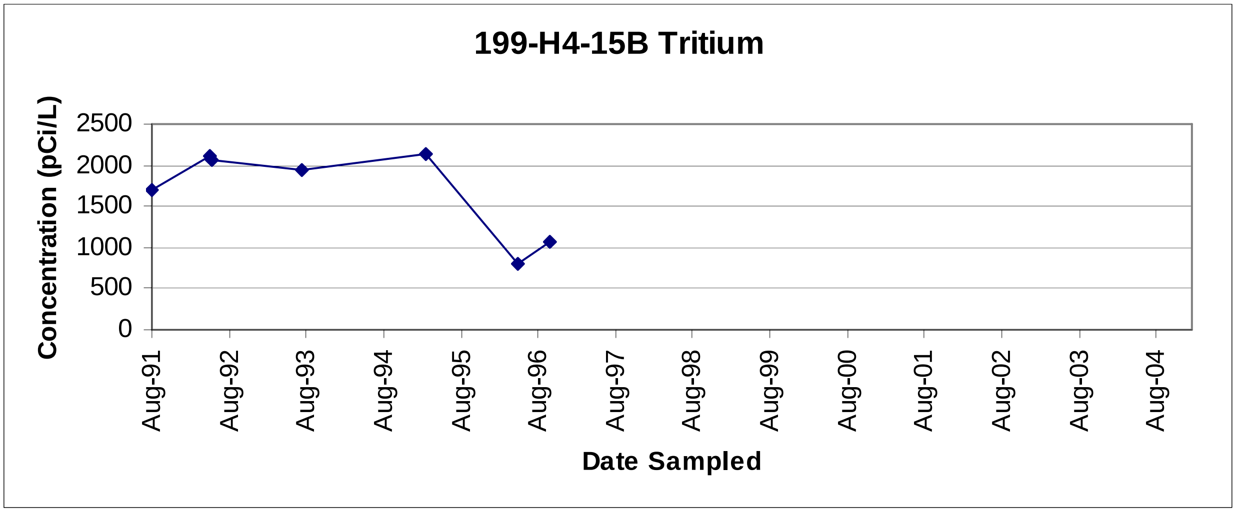
Date Sampled


199-H4-15B Tritium
Concentration (pCi/L)
2500
2000
1500
1000
500
0
Aug-91
Aug-92
Aug-93
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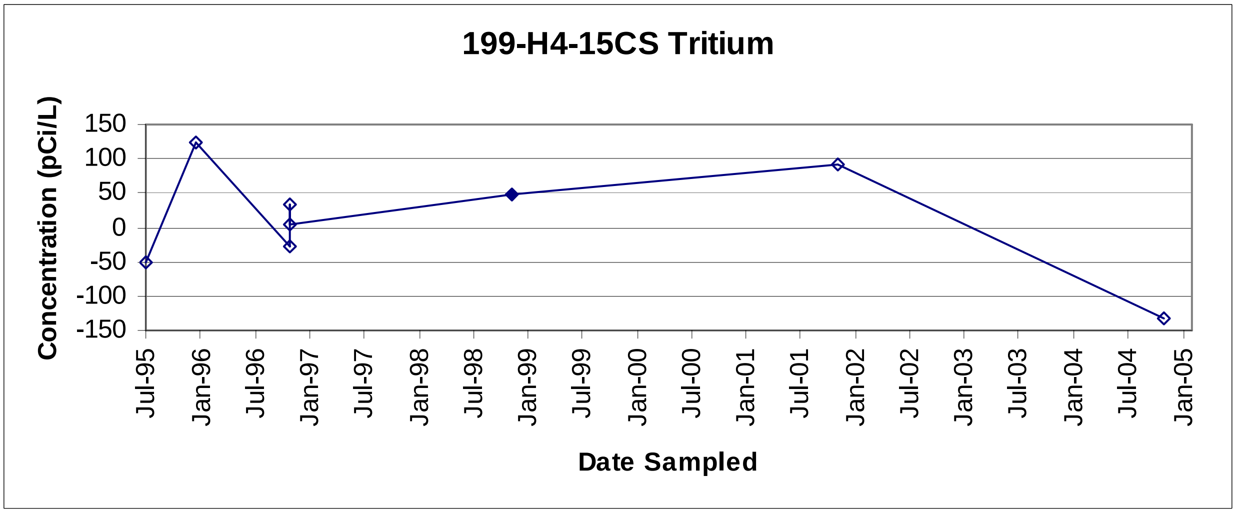
Date Sampled


199-H4-15CS Tritium
Concentration (pCi/L)
150
100
50
0
-50
-100
-150
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Jul-99
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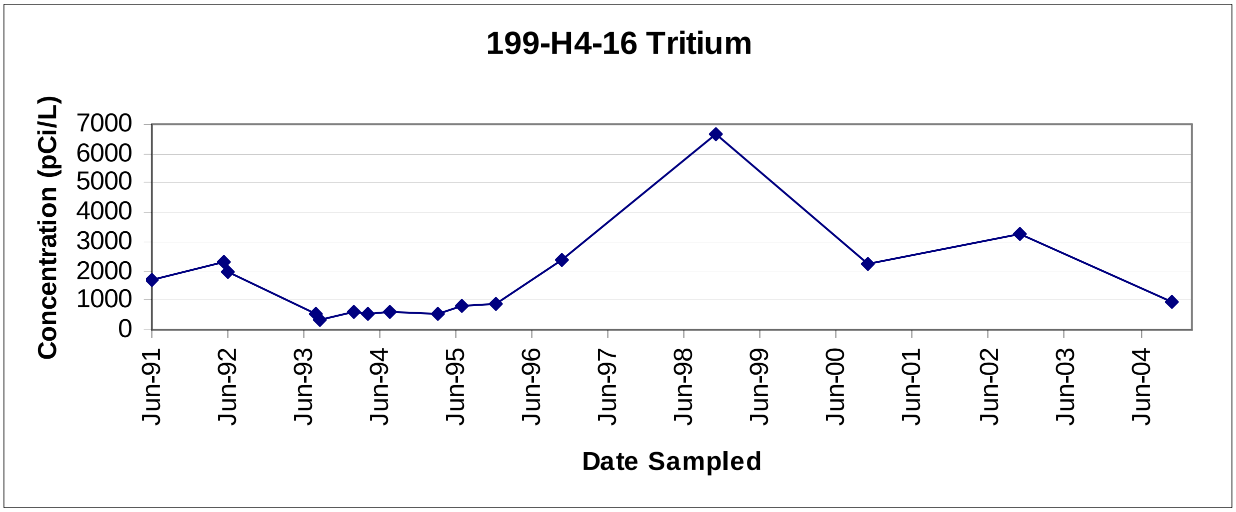
Jul-04
Jan-05
Date Sampled


199-H4-16 Tritium
Concentration (pCi/L)
7000
6000
5000
4000
3000
2000
1000
0
Jun-91
Jun-92
Jun-93
Jun-94
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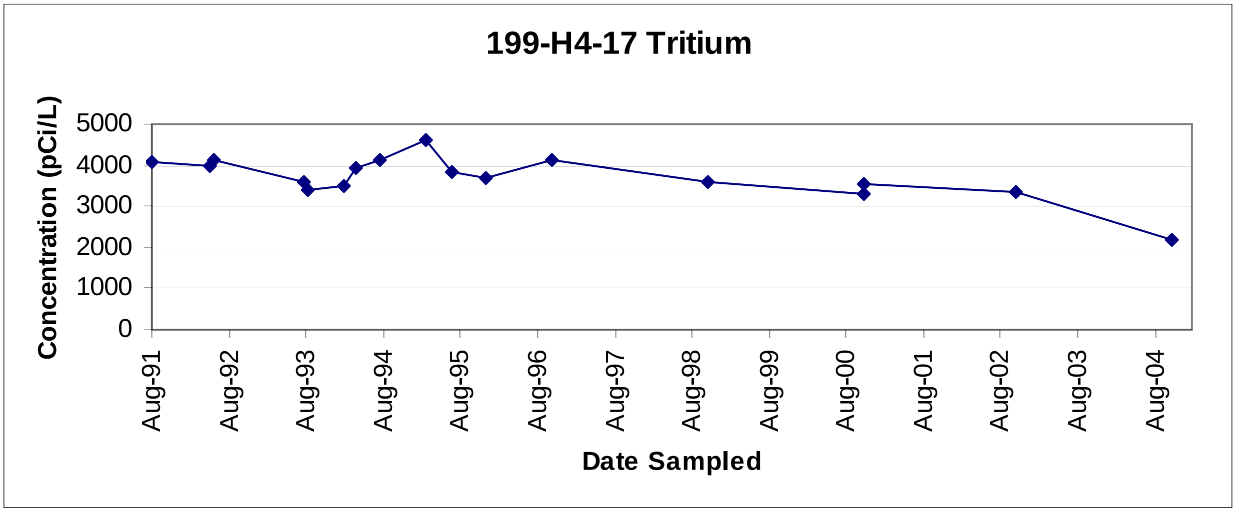
Jun-02
Jun-03
Jun-04
Date Sampled


199-H4-17 Tritium
Concentration (pCi/L)
5000
4000
3000
2000
1000
0
Aug-91
Aug-92
Aug-93
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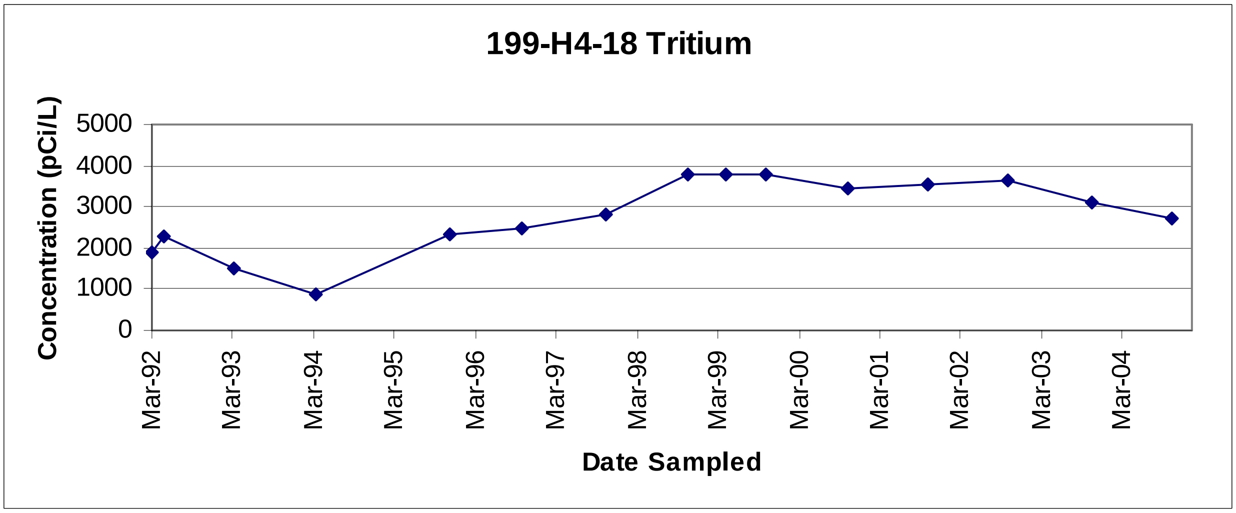
Aug-04
Date Sampled


199-H4-18 Tritium
Concentration (pCi/L)
5000
4000
3000
2000
1000
0
Mar-92
Mar-93
Mar-94
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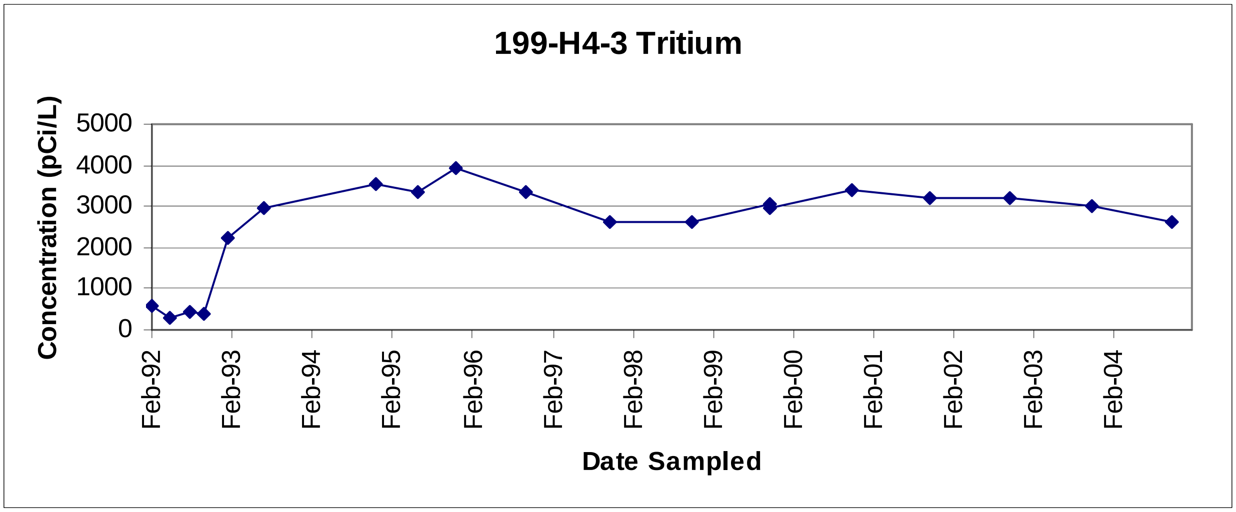
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled


199-H4-3 Tritium
Concentration (pCi/L)
5000
4000
3000
2000
1000
0
Feb-92
Feb-93
Feb-94
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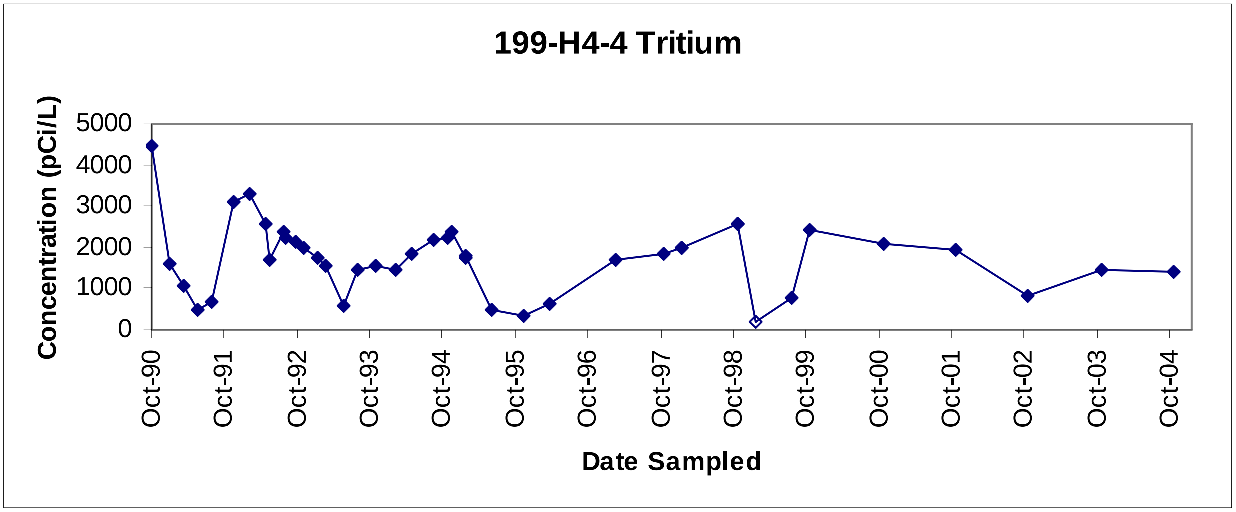
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-H4-4 Tritium
Concentration (pCi/L)
5000
4000
3000
2000
1000
0
Oct-90
Oct-91
Oct-92
Oct-93
Oct-94
Oct-95
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Oct-97
Oct-98
Oct-99
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Oct-01
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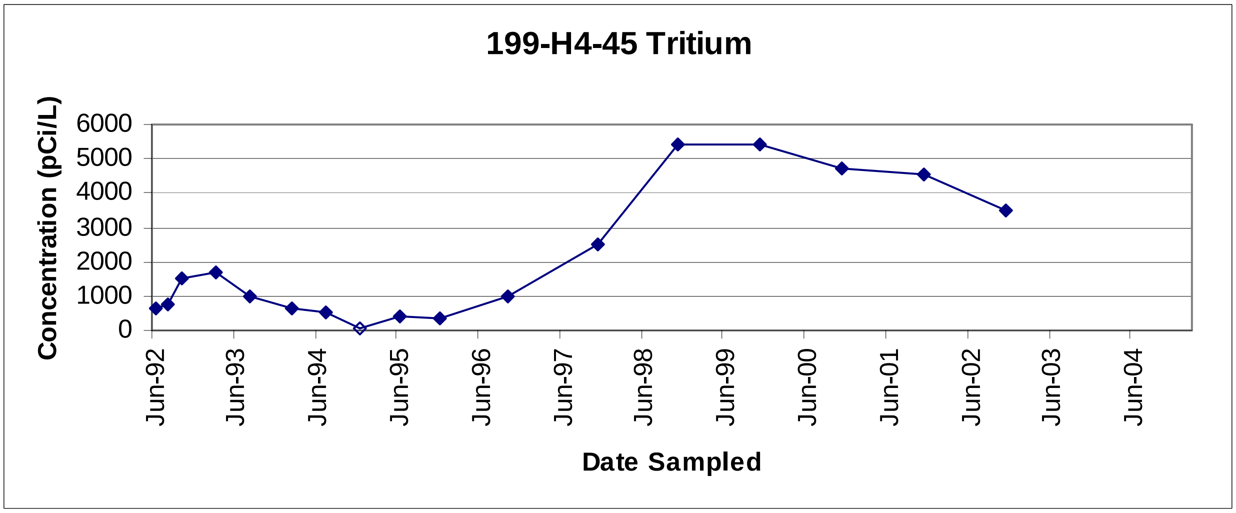
Oct-03
Oct-04
Date Sampled


199-H4-45 Tritium
Concentration (pCi/L)
6000
5000
4000
3000
2000
1000
0
Jun-92
Jun-93
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Jun-97
Jun-98
Jun-99
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Jun-01
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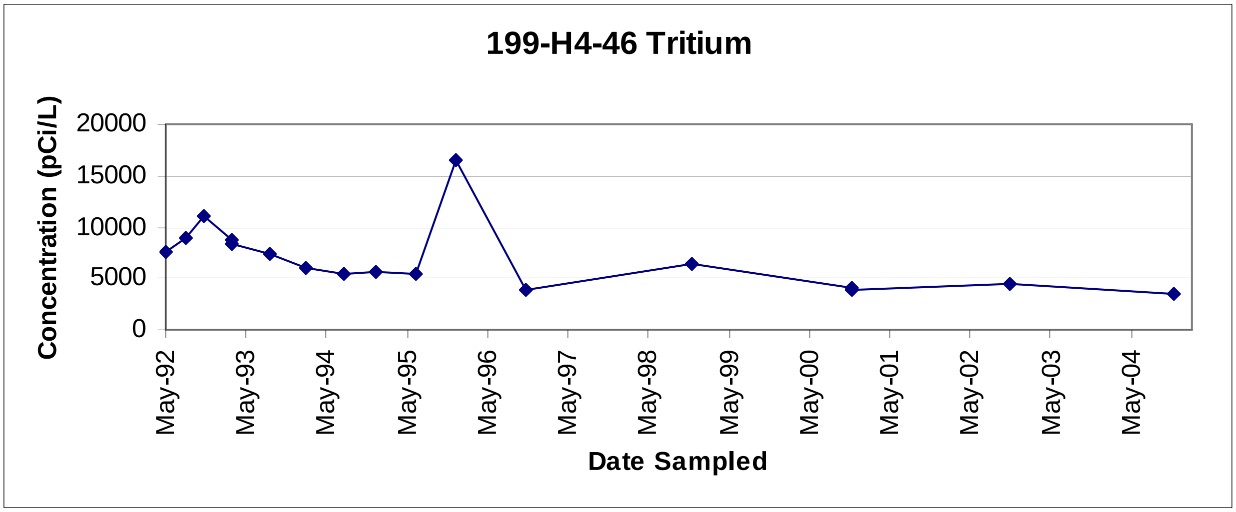
Jun-03
Jun-04
Date Sampled


199-H4-46 Tritium
Concentration (pCi/L)
20000
15000
10000
5000
0
May-92
May-93
May-94
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May-97
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May-99
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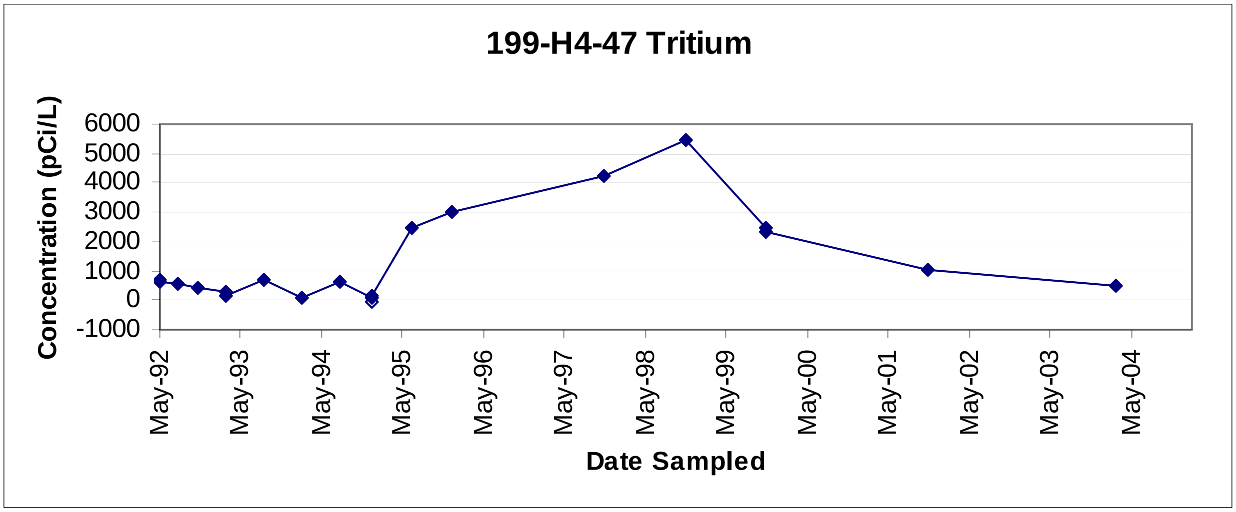
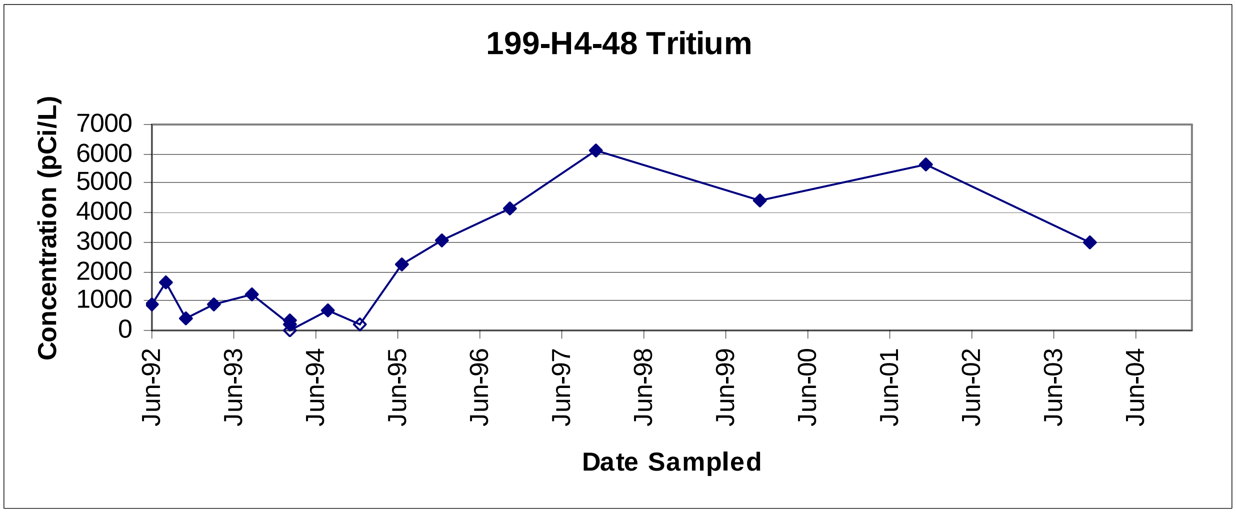
May-03
May-04
Date Sampled


199-H4-47 Tritium
Concentration (pCi/L)
6000
5000
4000
3000
2000
1000
0
-1000
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-H4-48 Tritium
Concentration (pCi/L)
7000
6000
5000
4000
3000
2000
1000
0
Jun-92
Jun-93
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Jun-97
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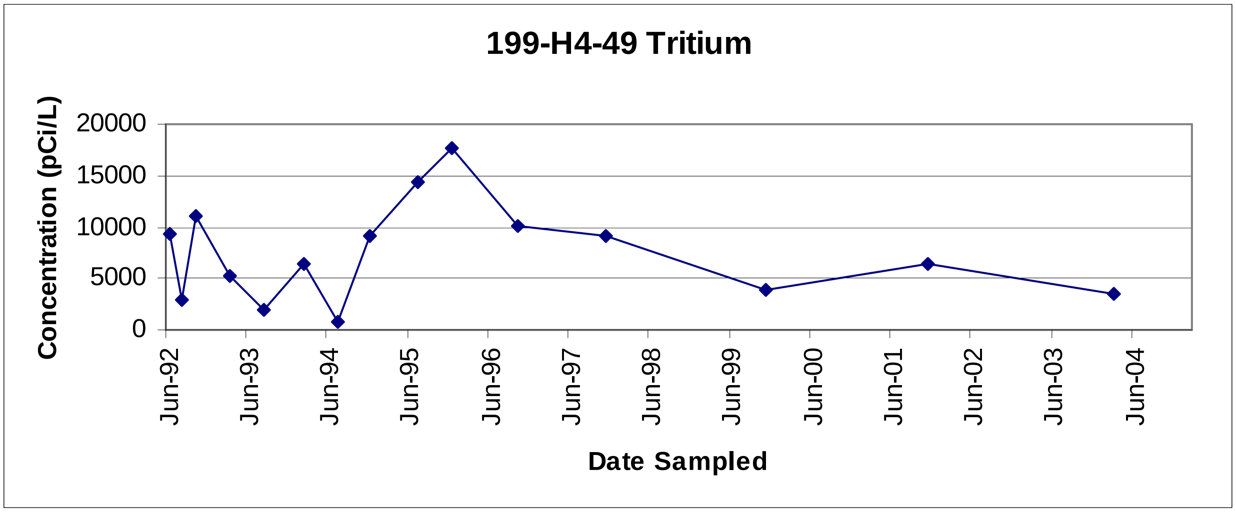
Jun-04
Date Sampled


199-H4-49 Tritium
Concentration (pCi/L)
20000
15000
10000
5000
0
Jun-92
Jun-93
Jun-94
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Jun-97
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Jun-01
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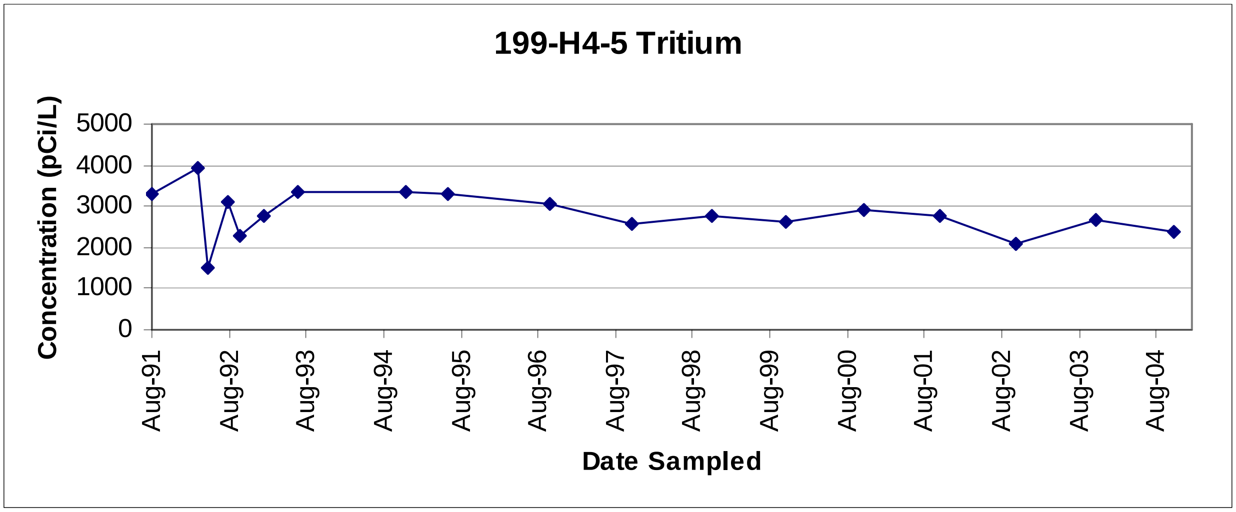
Jun-04
Date Sampled


199-H4-5 Tritium
Concentration (pCi/L)
5000
4000
3000
2000
1000
0
Aug-91
Aug-92
Aug-93
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Aug-97
Aug-98
Aug-99
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Aug-01
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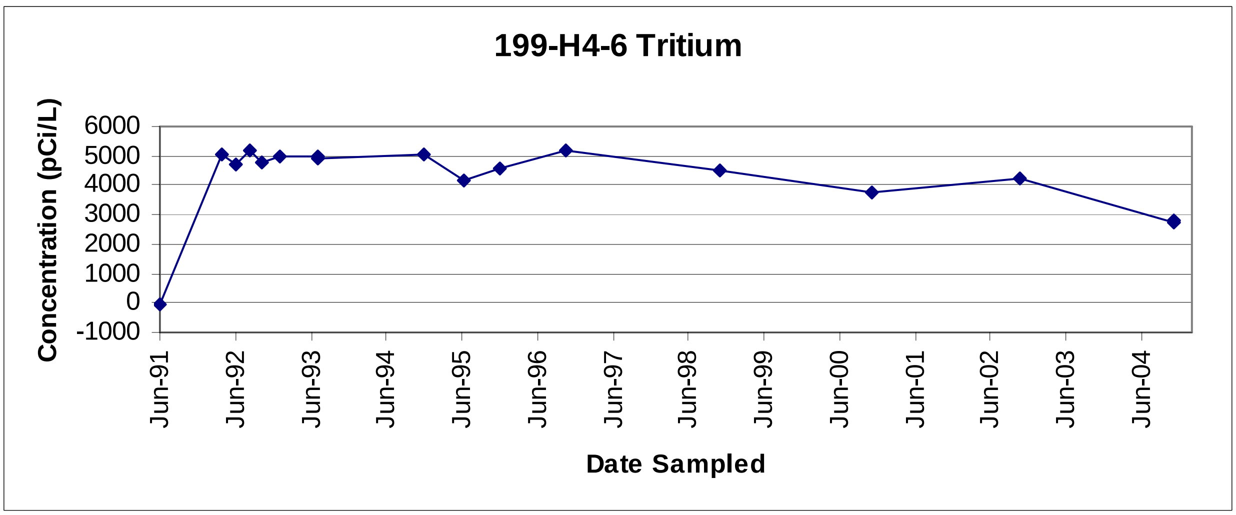
Aug-03
Aug-04
Date Sampled


199-H4-6 Tritium
Concentration (pCi/L)
6000
5000
4000
3000
2000
1000
0
-1000
Jun-91
Jun-92
Jun-93
Jun-94
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Jun-97
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Jun-01
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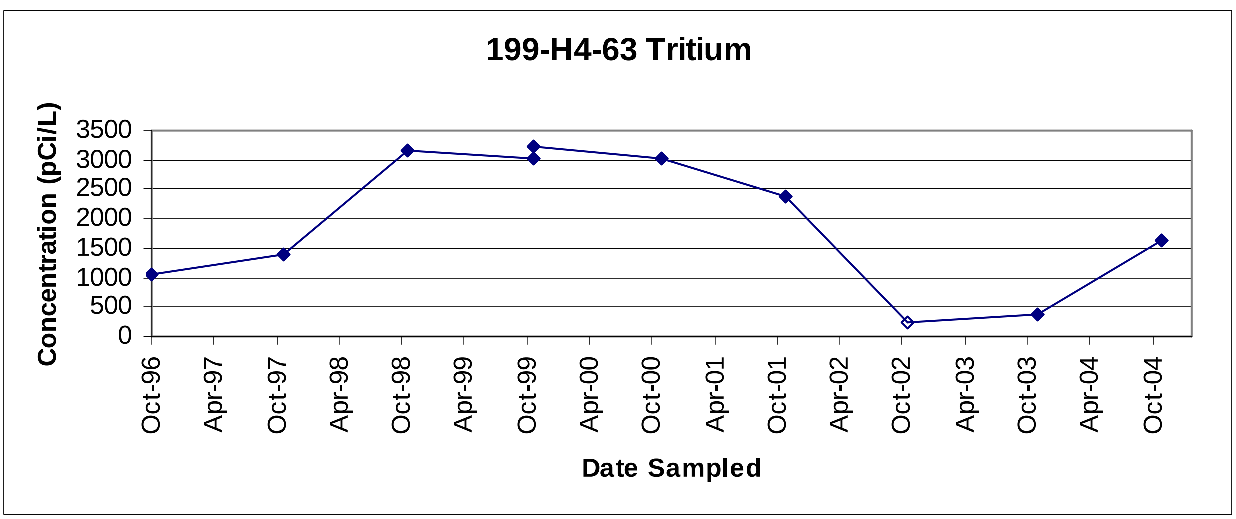
Jun-04
Date Sampled


199-H4-63 Tritium
Concentration (pCi/L)
3500
3000
2500
2000
1500
1000
500
0
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
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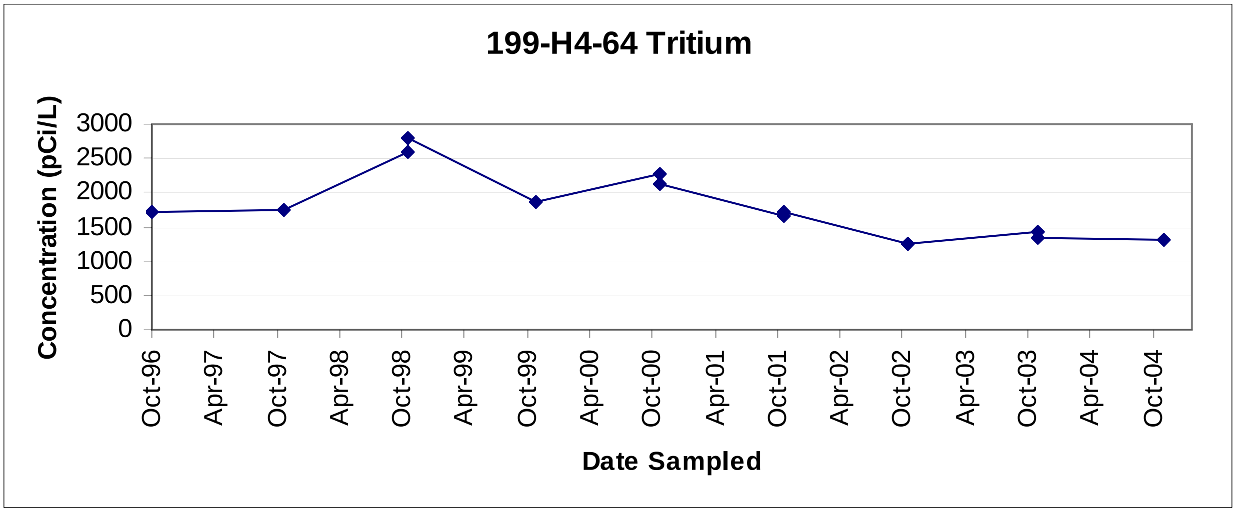
Apr-04
Oct-04
Date Sampled


199-H4-64 Tritium
Concentration (pCi/L)
3000
2500
2000
1500
1000
500
0
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
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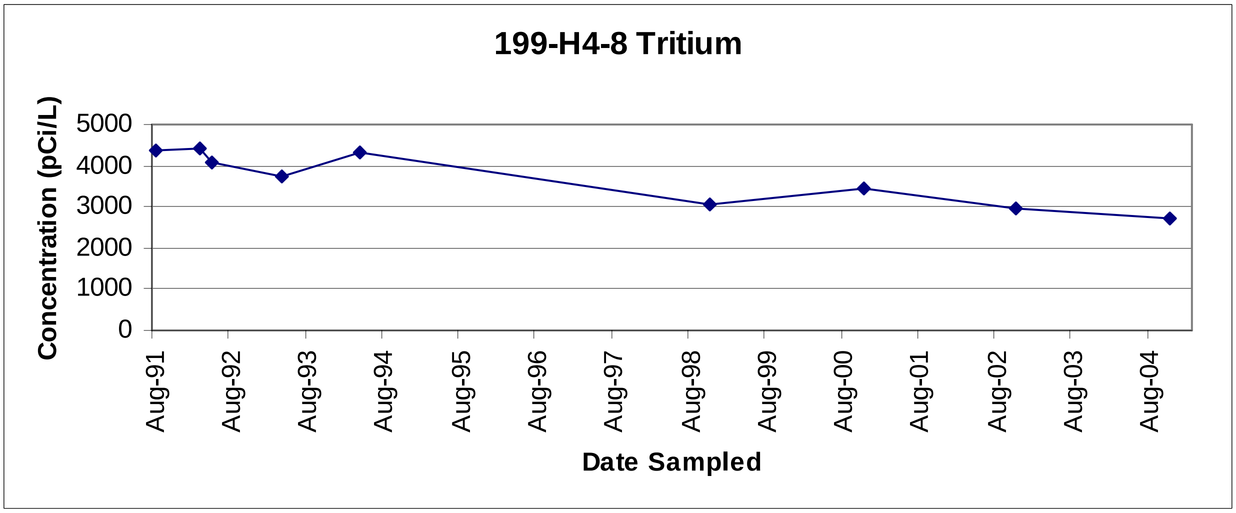
Oct-04
Date Sampled


199-H4-8 Tritium
Concentration (pCi/L)
5000
4000
3000
2000
1000
0
Aug-91
Aug-92
Aug-93
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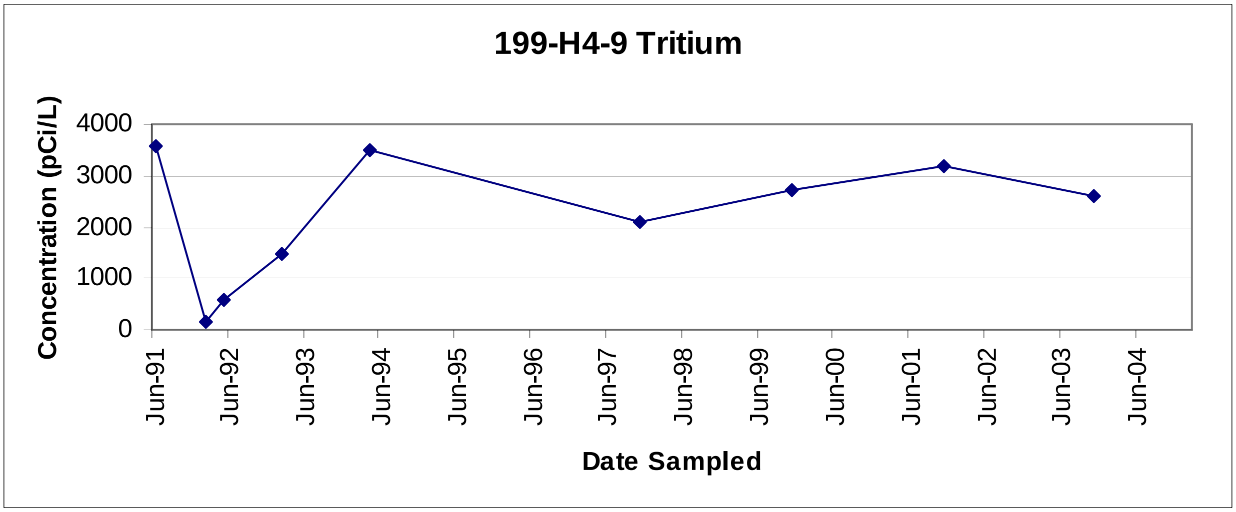
Date Sampled


199-H4-9 Tritium
Concentration (pCi/L)
4000
3000
2000
1000
0
Jun-91
Jun-92
Jun-93
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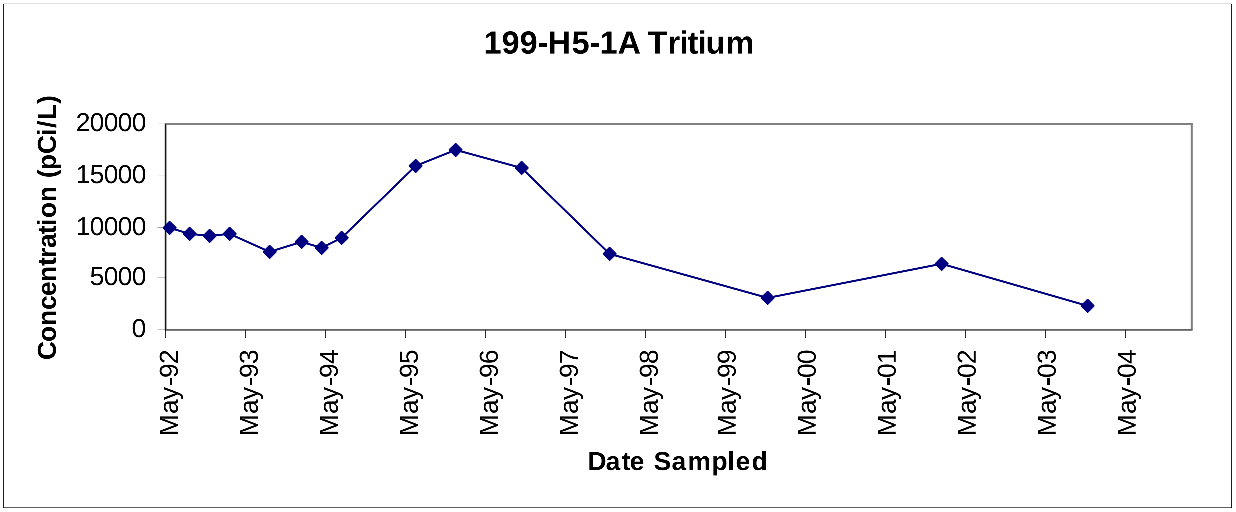
Jun-04
Date Sampled


199-H5-1A Tritium
Concentration (pCi/L)
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15000
10000
5000
0
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May-93
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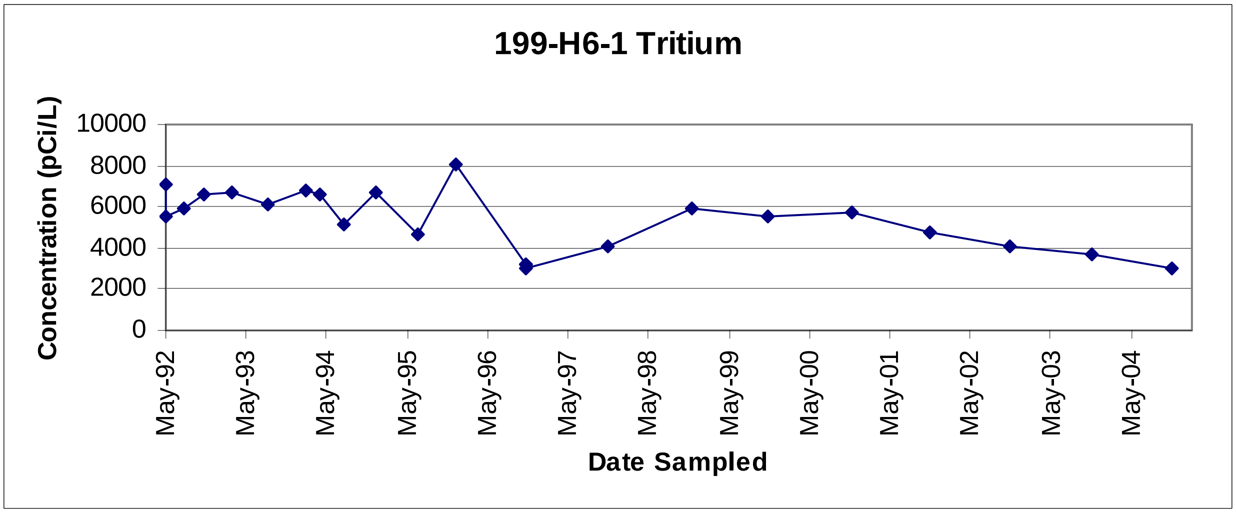
Date Sampled


199-H6-1 Tritium
Concentration (pCi/L)
10000
8000
6000
4000
2000
0
May-92
May-93
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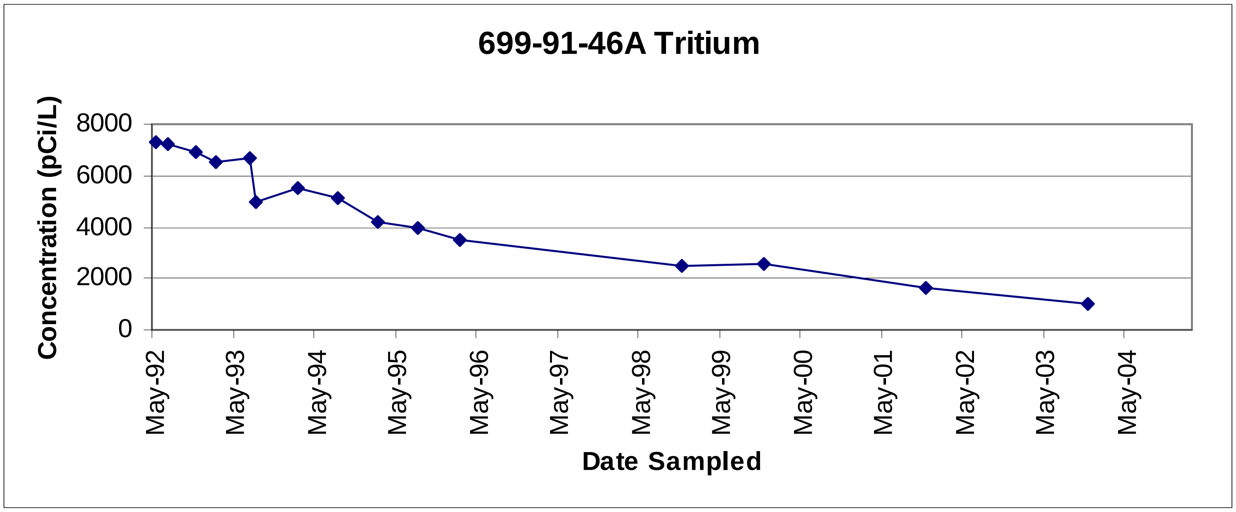
Date Sampled


699-91-46A Tritium
Concentration (pCi/L)
8000
6000
4000
2000
0
May-92
May-93
May-94
May-95
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May-97
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May-99
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May-01
May-02
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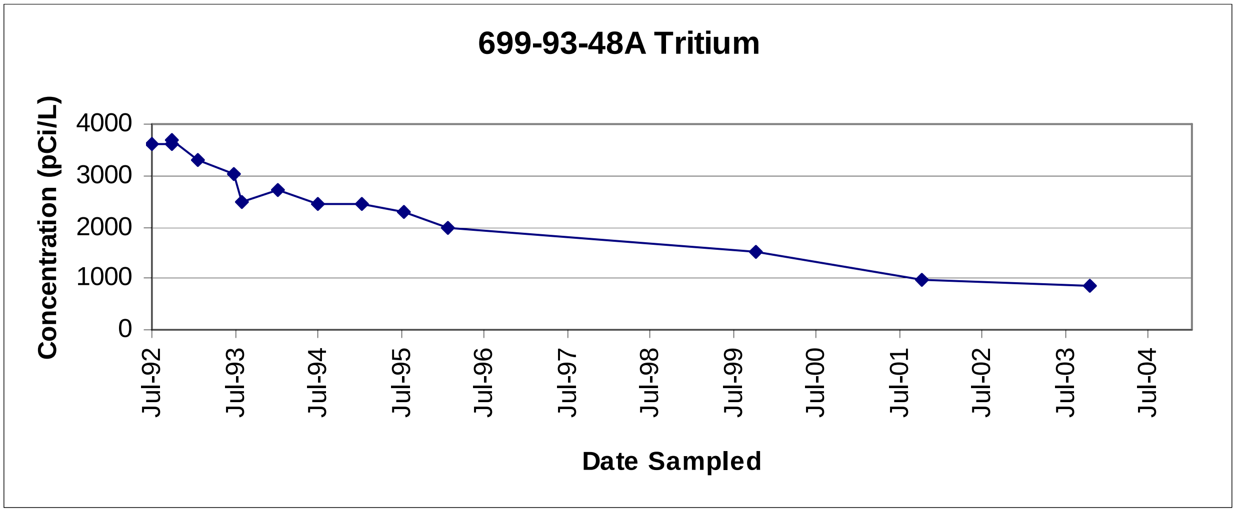
Date Sampled


699-93-48A Tritium
Concentration (pCi/L)
4000
3000
2000
1000
0
Jul-92
Jul-93
Jul-94
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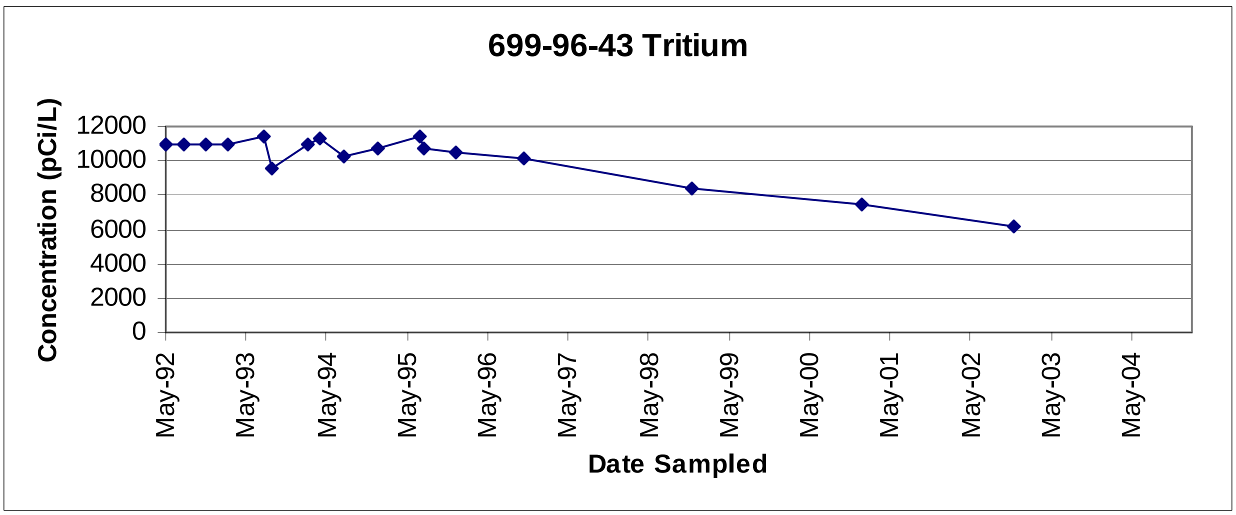
Date Sampled


699-96-43 Tritium
Concentration (pCi/L)
12000
10000
8000
6000
4000
2000
0
May-92
May-93
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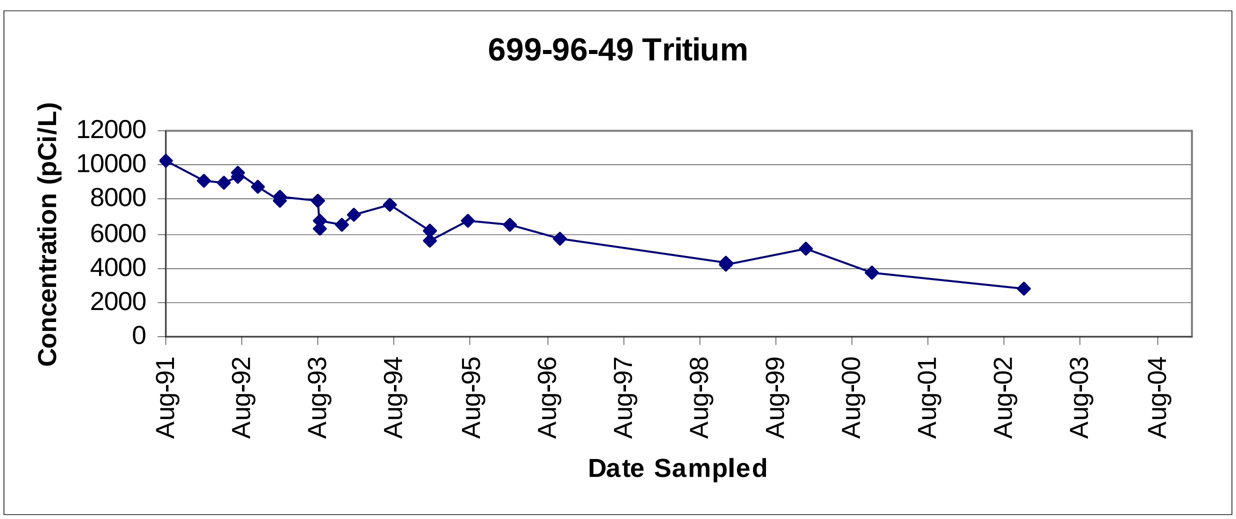
Date Sampled


699-96-49 Tritium
Concentration (pCi/L)
12000
10000
8000
6000
4000
2000
0
Aug-91
Aug-92
Aug-93
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Aug-95
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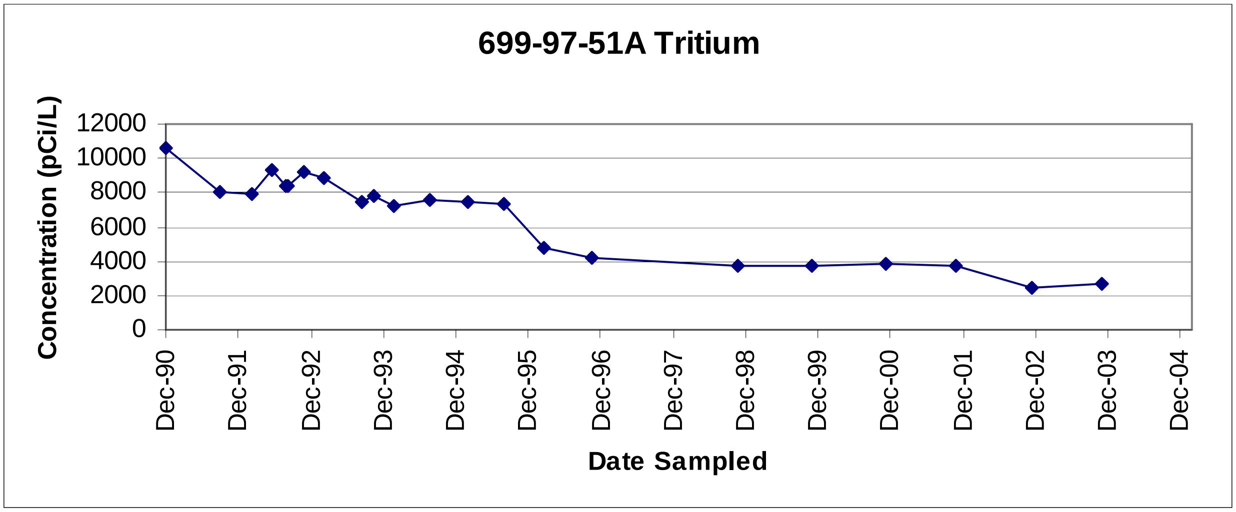
Date Sampled


699-97-51A Tritium
Concentration (pCi/L)
12000
10000
8000
6000
4000
2000
0
Dec-90
Dec-91
Dec-92
Dec-93
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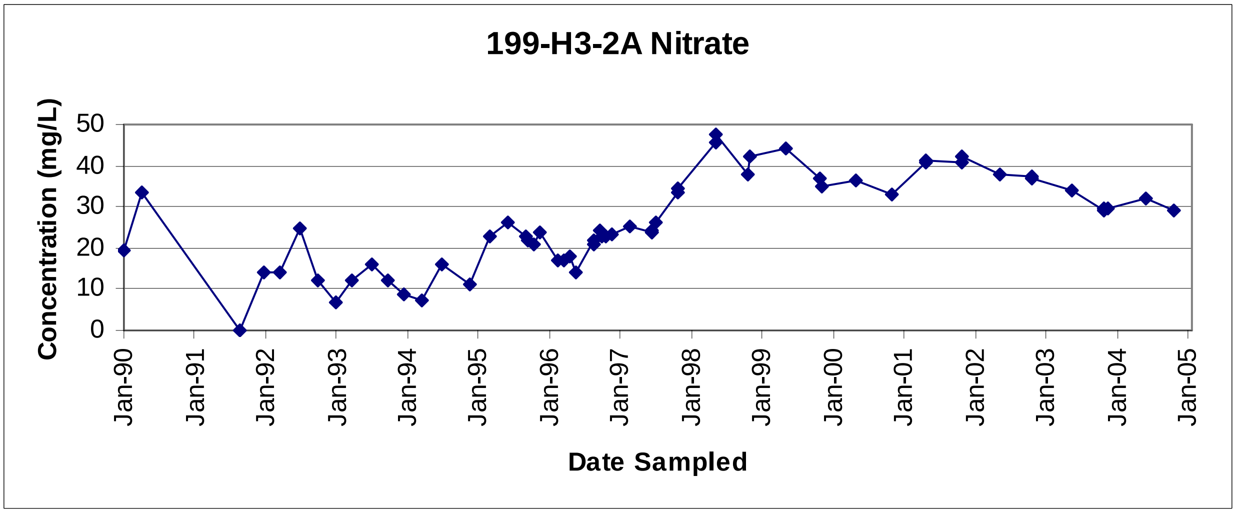
Date Sampled


199-H3-2A Nitrate
Concentration (mg/L)
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
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Jan-00
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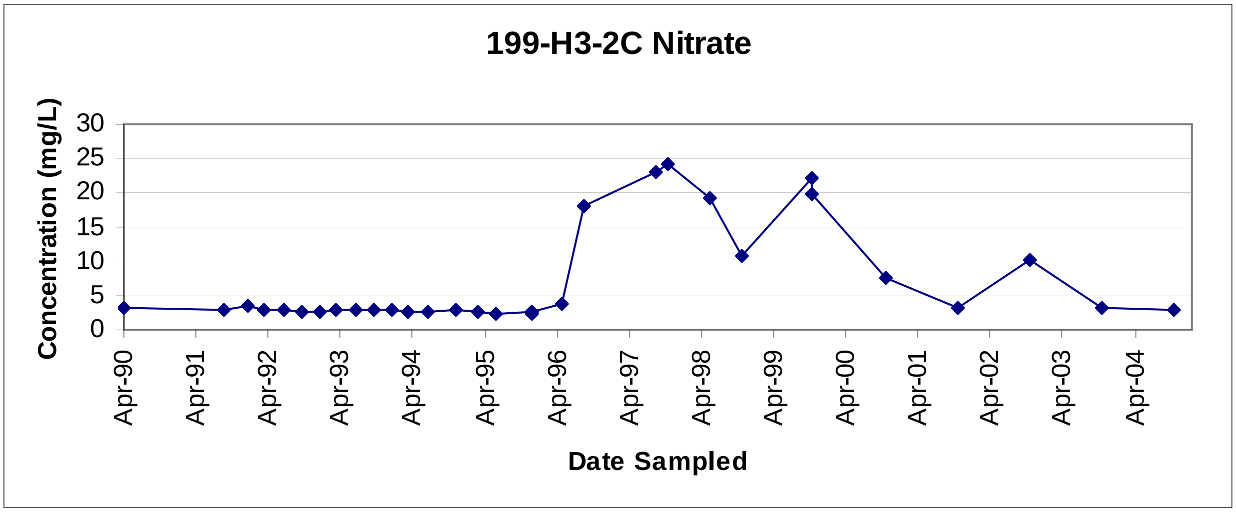
Jan-04
Jan-05
Date Sampled


199-H3-2C Nitrate
Concentration (mg/L)
30
25
20
15
10
5
0
Apr-90
Apr-91
Apr-92
Apr-93
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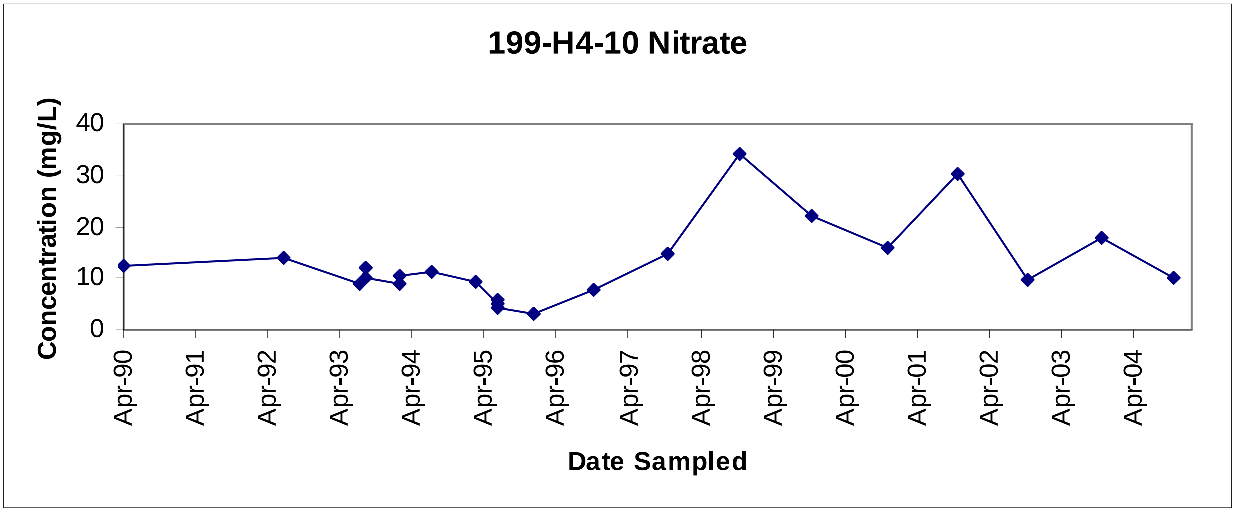
199-H4-10 Nitrate
Concentration (mg/L)
0
10
20
30
40
Apr-90
Apr-91
Apr-92
Apr-93
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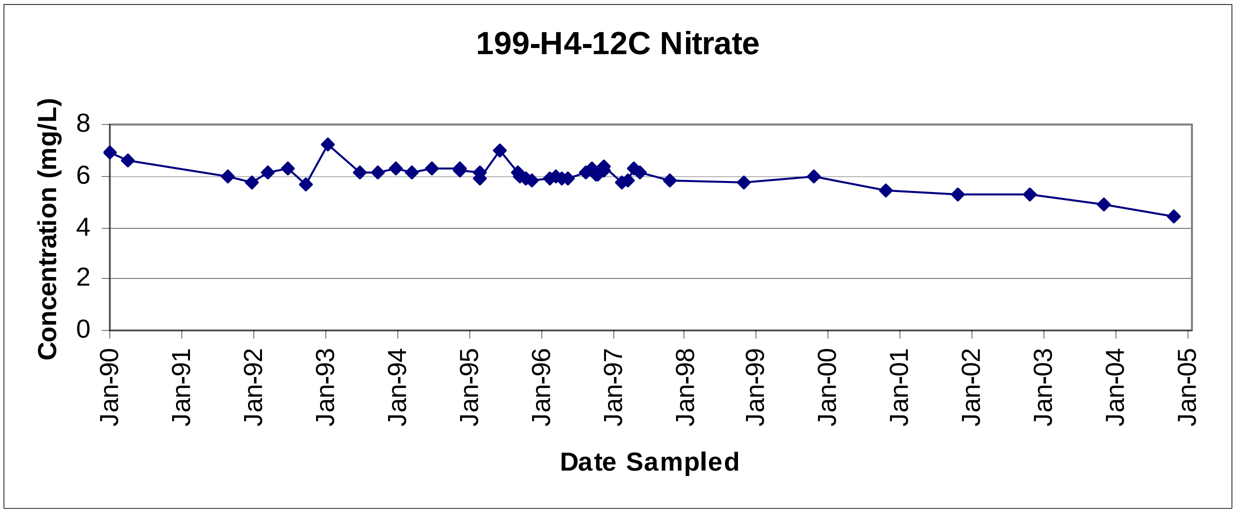
Date Sampled


199-H4-12C Nitrate
Concentration (mg/L)
0
2
4
6
8
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
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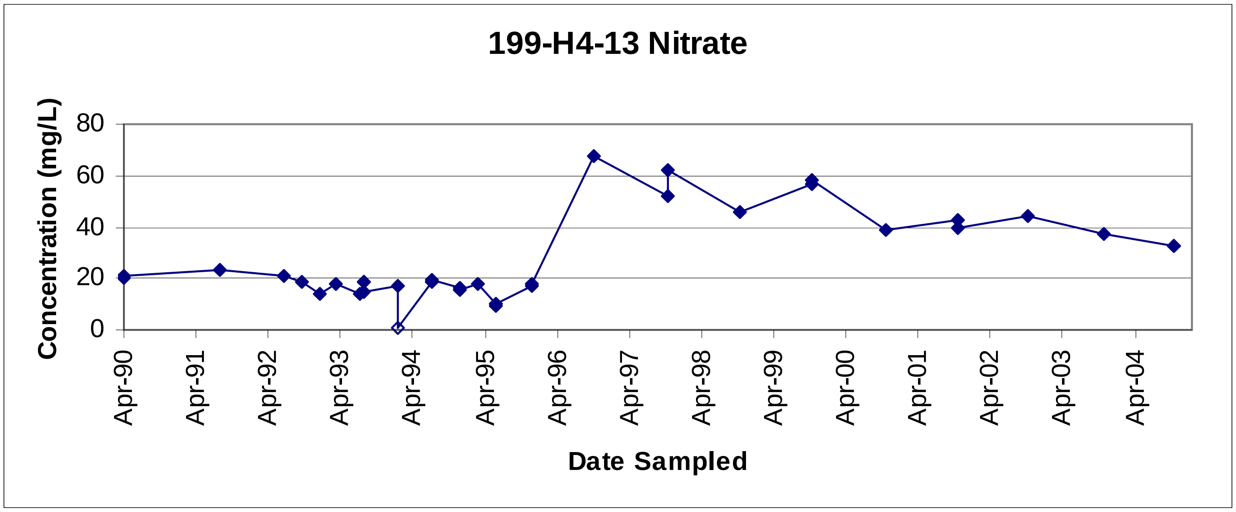
Date Sampled


199-H4-13 Nitrate
Concentration (mg/L)
0
20
40
60
80
Apr-90
Apr-91
Apr-92
Apr-93
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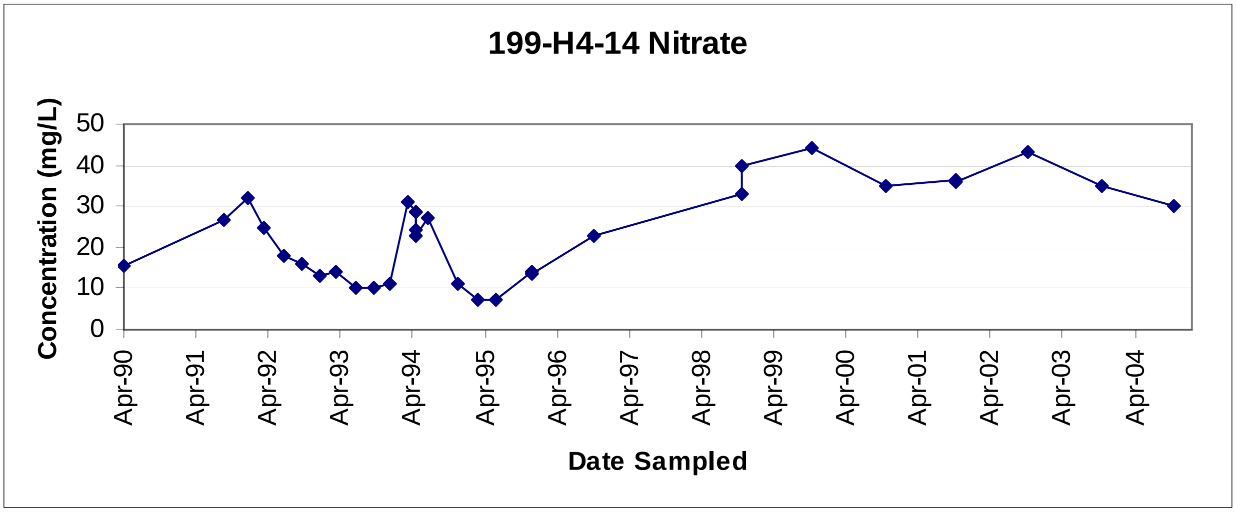
199-H4-14 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
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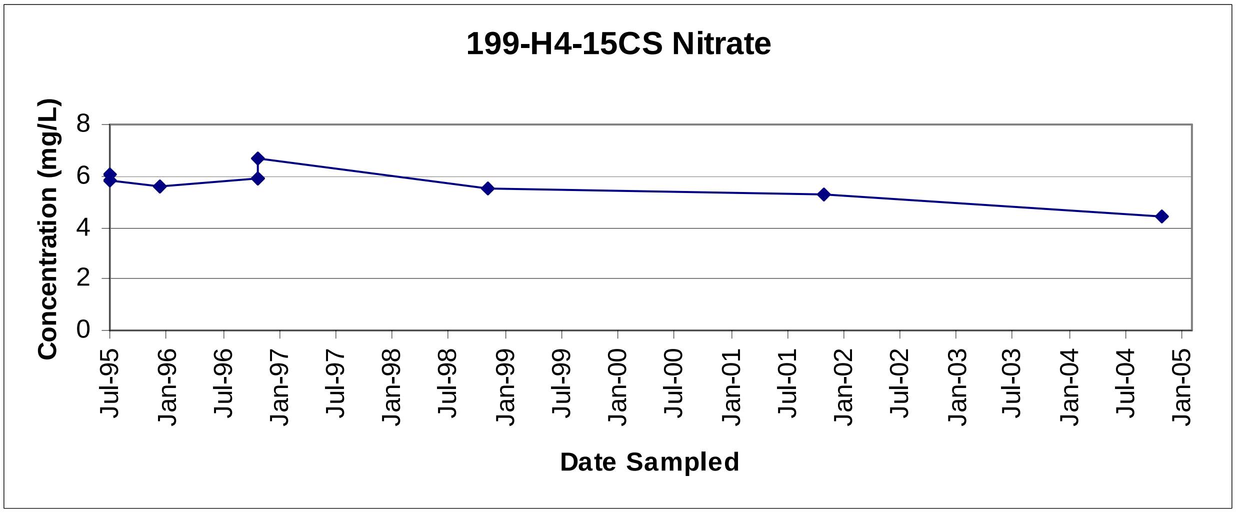
Date Sampled


199-H4-15CS Nitrate
Concentration (mg/L)
0
2
4
6
8
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
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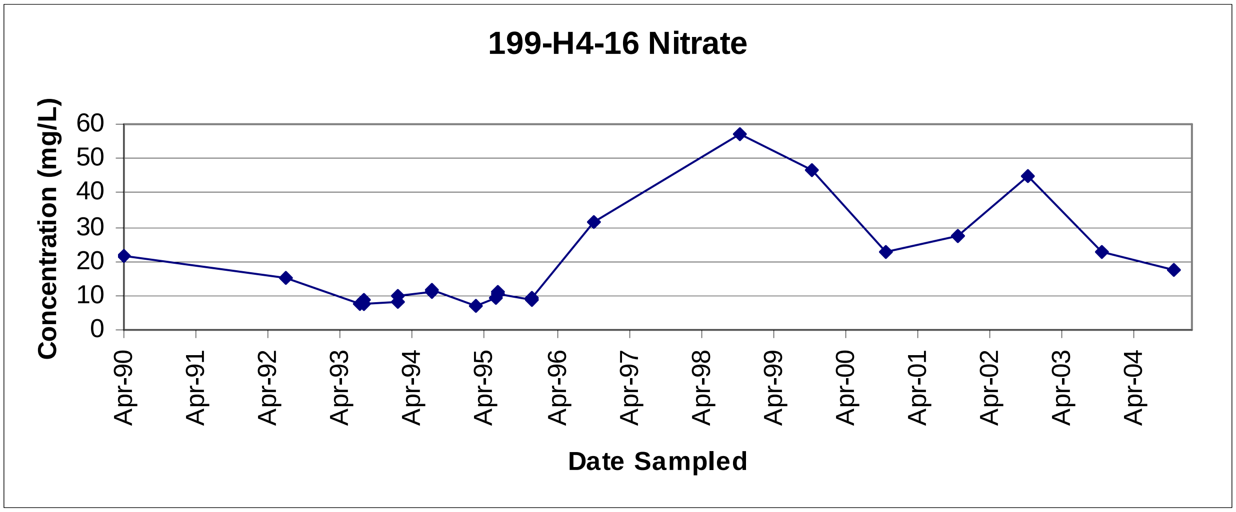
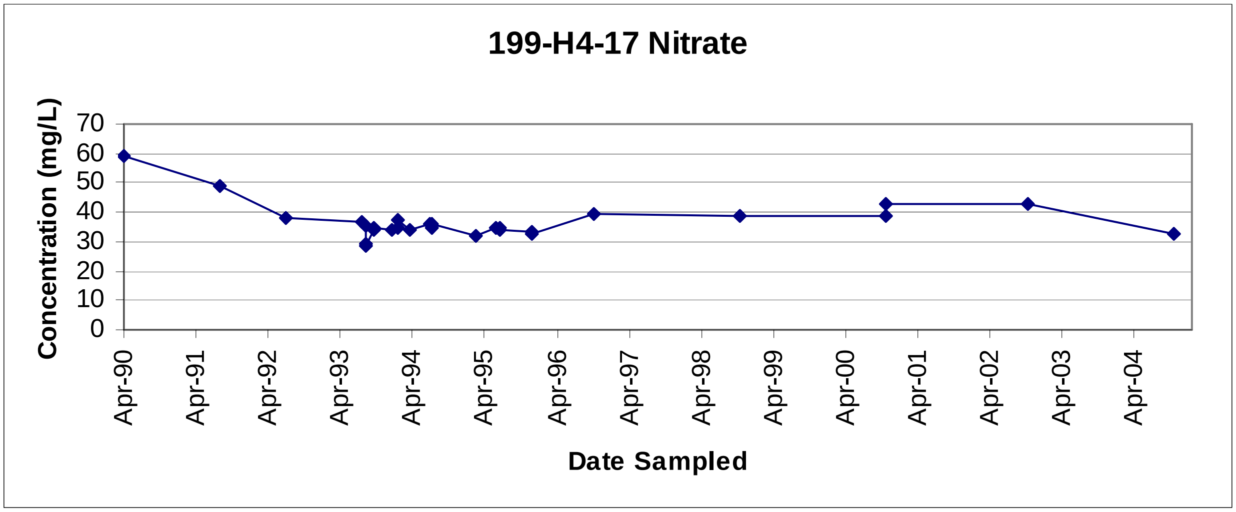
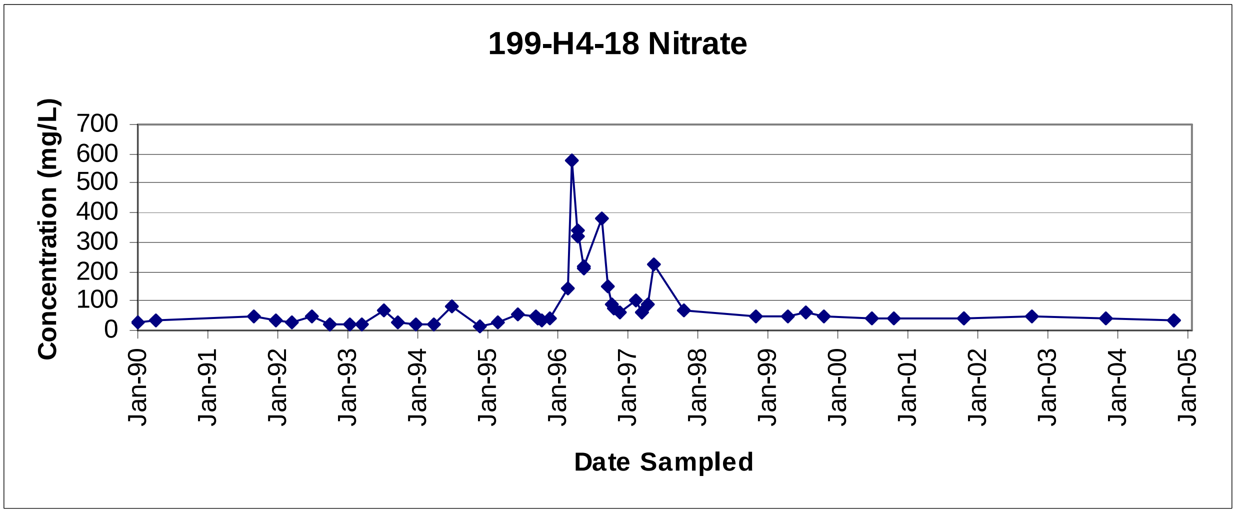
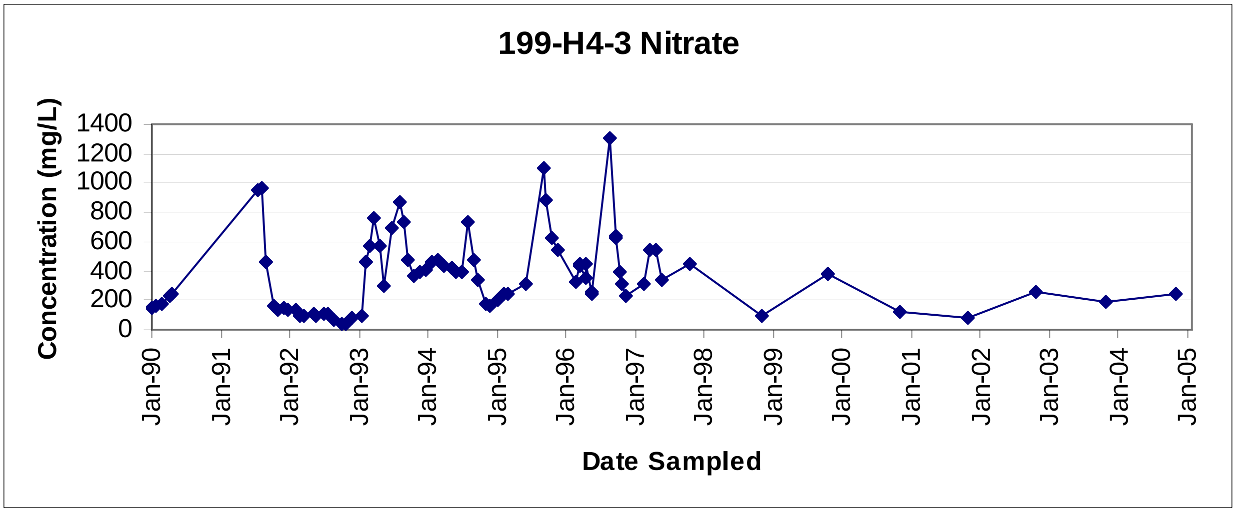
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Date Sampled


199-H4-16 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
60
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled


199-H4-17 Nitrate
Concentration (mg/L)
70
60
50
40
30
20
10
0
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled


199-H4-18 Nitrate
Concentration (mg/L)
700
600
500
400
300
200
100
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled


199-H4-3 Nitrate
Concentration (mg/L)
1400
1200
1000
800
600
400
200
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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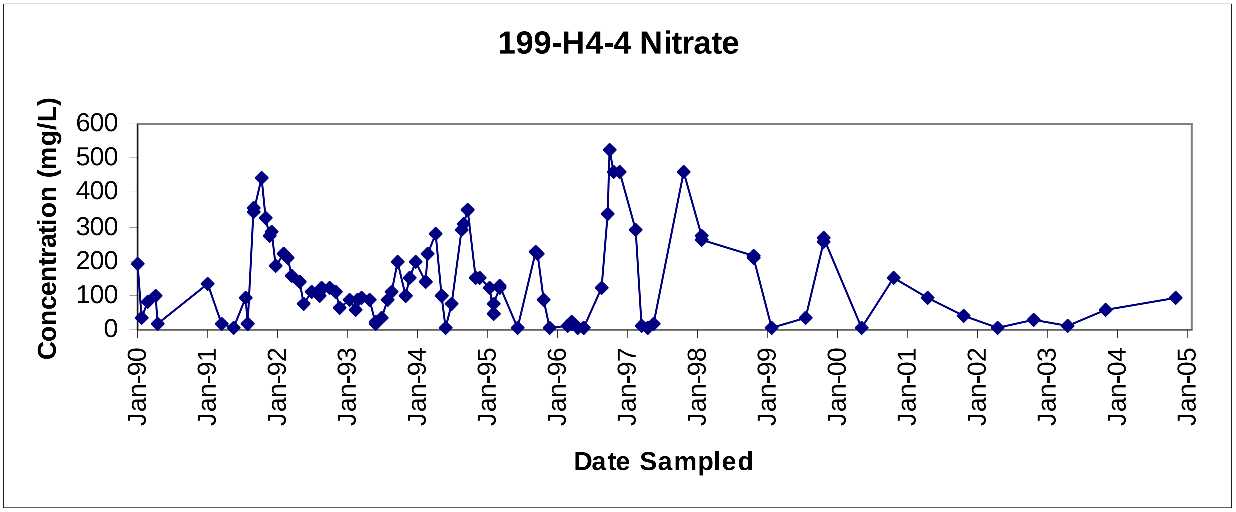
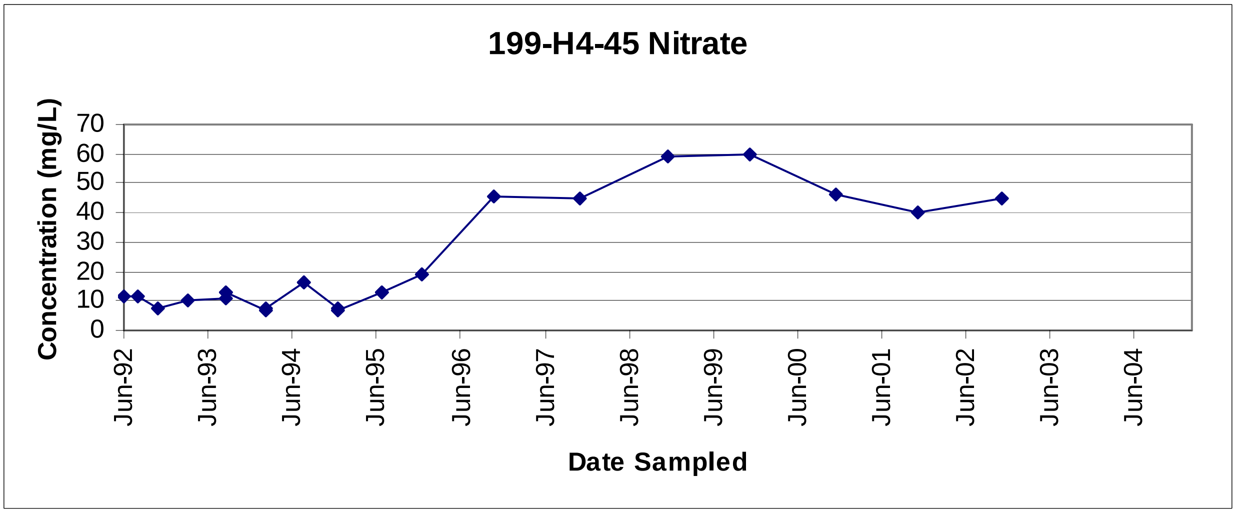
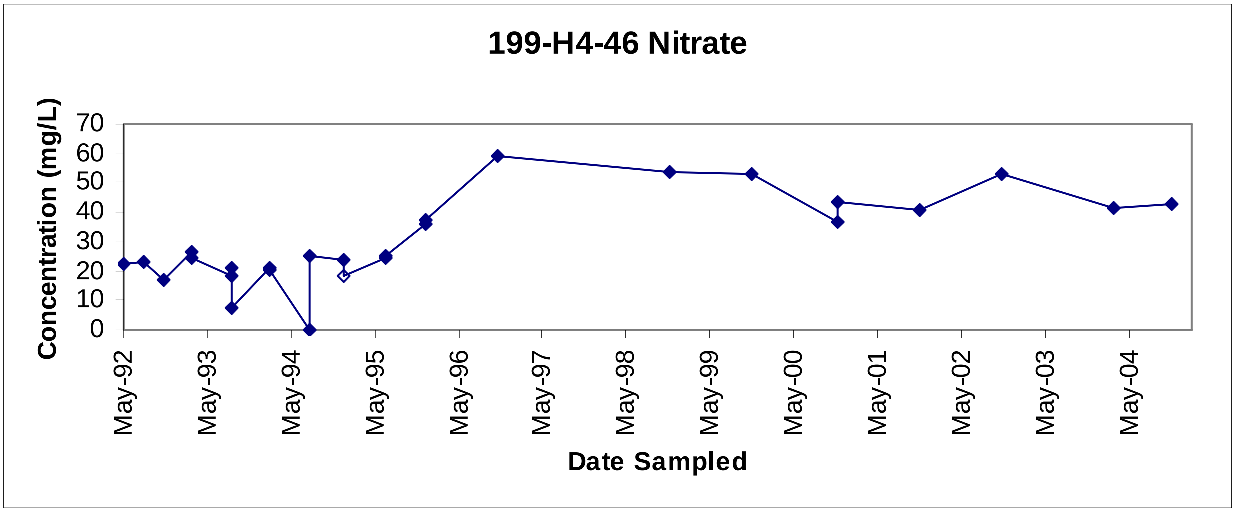
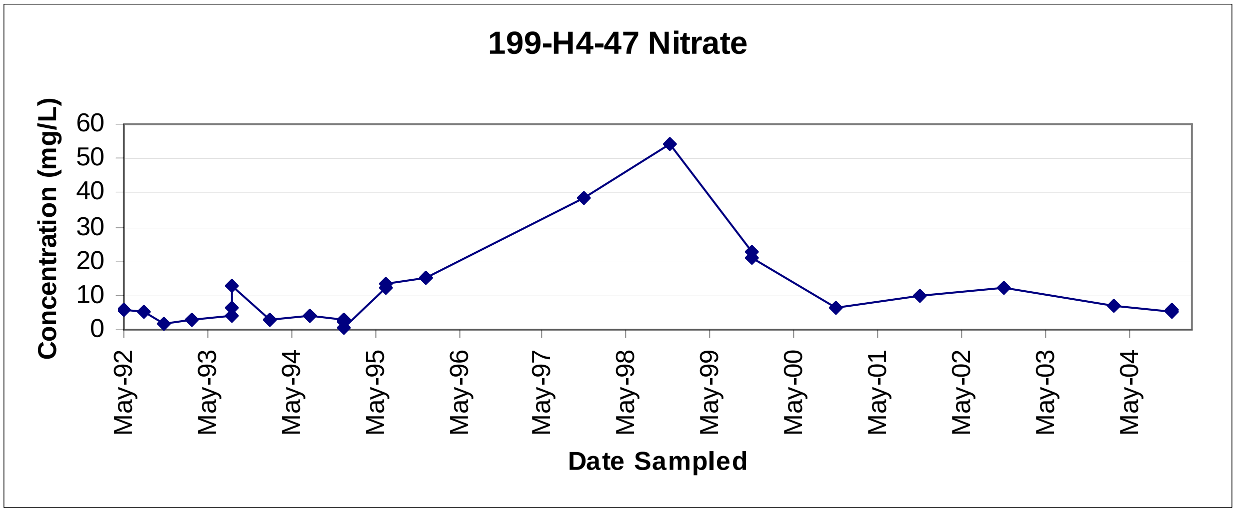
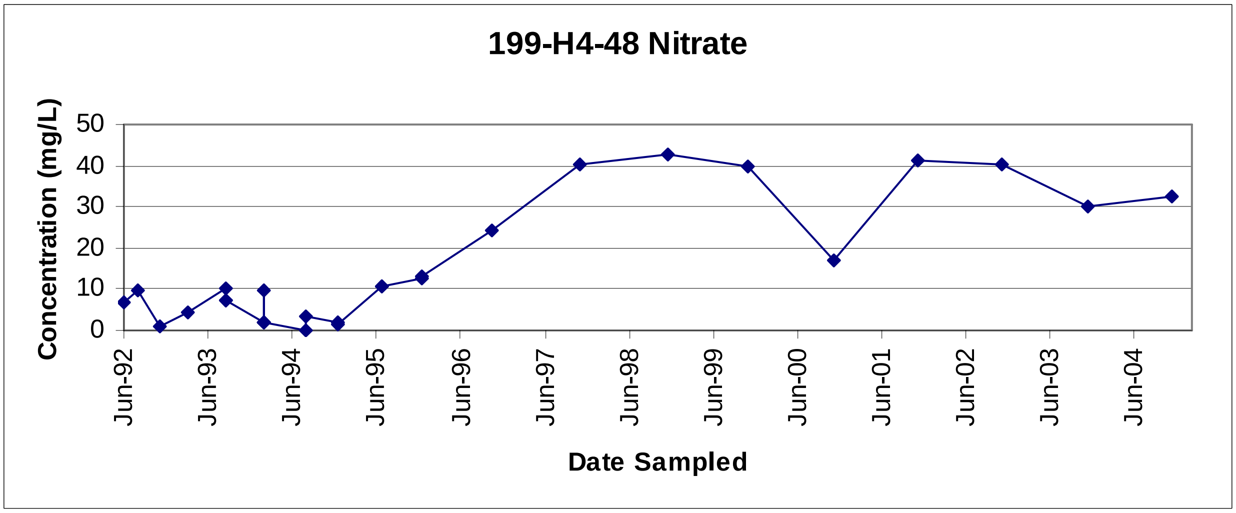
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

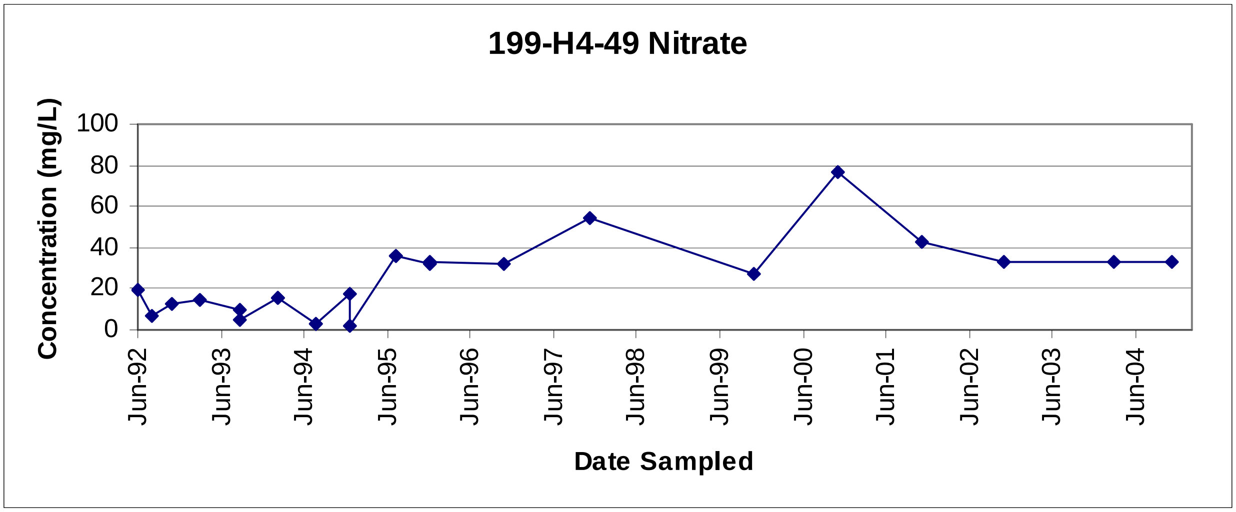

199-H4-4 Nitrate
Concentration (mg/L)
600
500
400
300
200
100
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

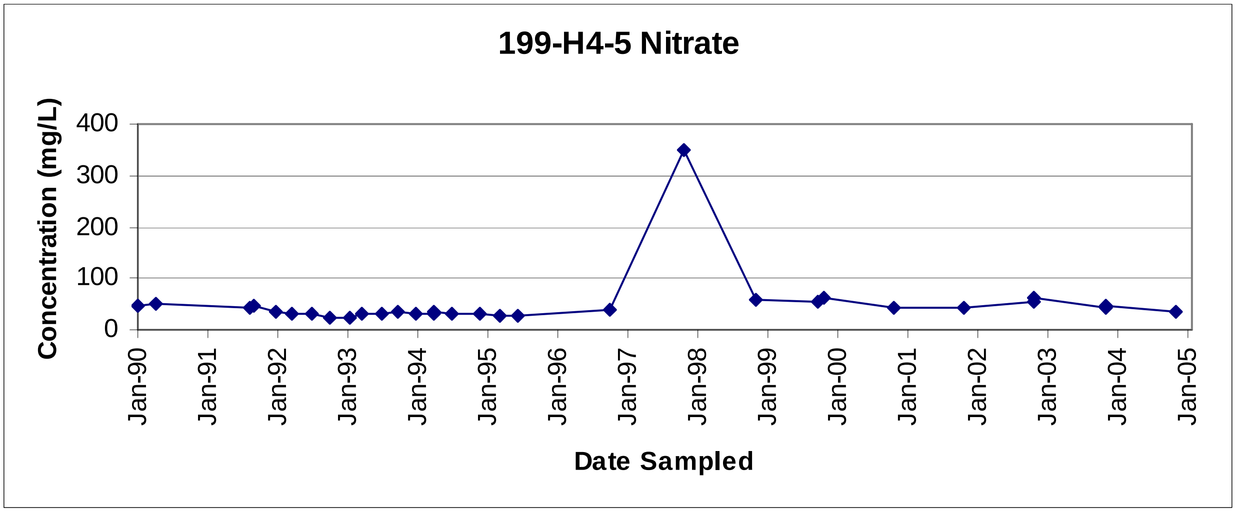

199-H4-45 Nitrate
Concentration (mg/L)
70
60
50
40
30
20
10
0
Jun-92
Jun-93
Jun-94
Jun-95
Jun-96
Jun-97
Jun-98
Jun-99
Jun-00
Jun-01
Jun-02
Jun-03
Jun-04
Date Sampled


199-H4-46 Nitrate
Concentration (mg/L)
70
60
50
40
30
20
10
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-H4-47 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
60
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-H4-48 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
Jun-92
Jun-93
Jun-94
Jun-95
Jun-96
Jun-97
Jun-98
Jun-99
Jun-00
Jun-01
Jun-02
Jun-03
Jun-04
Date Sampled


199-H4-49 Nitrate
Concentration (mg/L)
0
20
40
60
80
100
Jun-92
Jun-93
Jun-94
Jun-95
Jun-96
Jun-97
Jun-98
Jun-99
Jun-00
Jun-01
Jun-02
Jun-03
Jun-04
Date Sampled


199-H4-5 Nitrate
Concentration (mg/L)
400
300
200
100
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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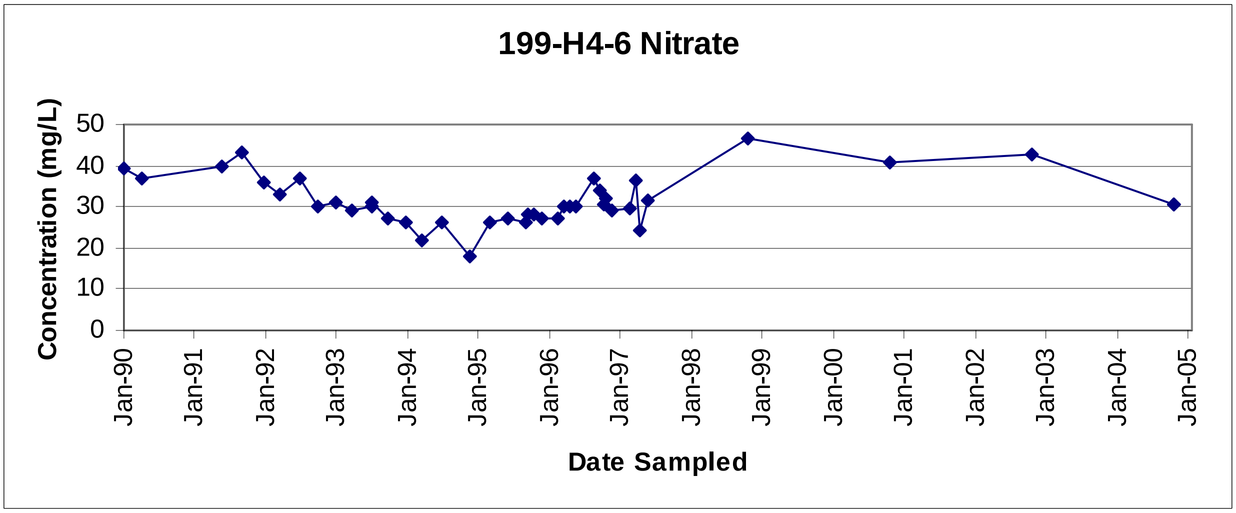
Jan-03
Jan-04
Jan-05
Date Sampled


199-H4-6 Nitrate
Concentration (mg/L)
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
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Jan-98
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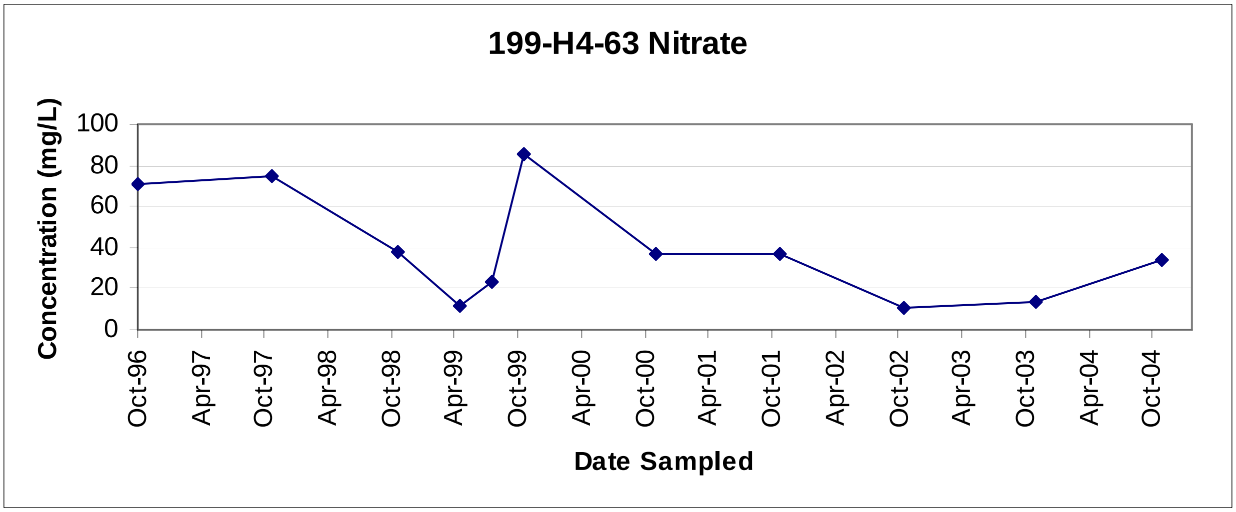
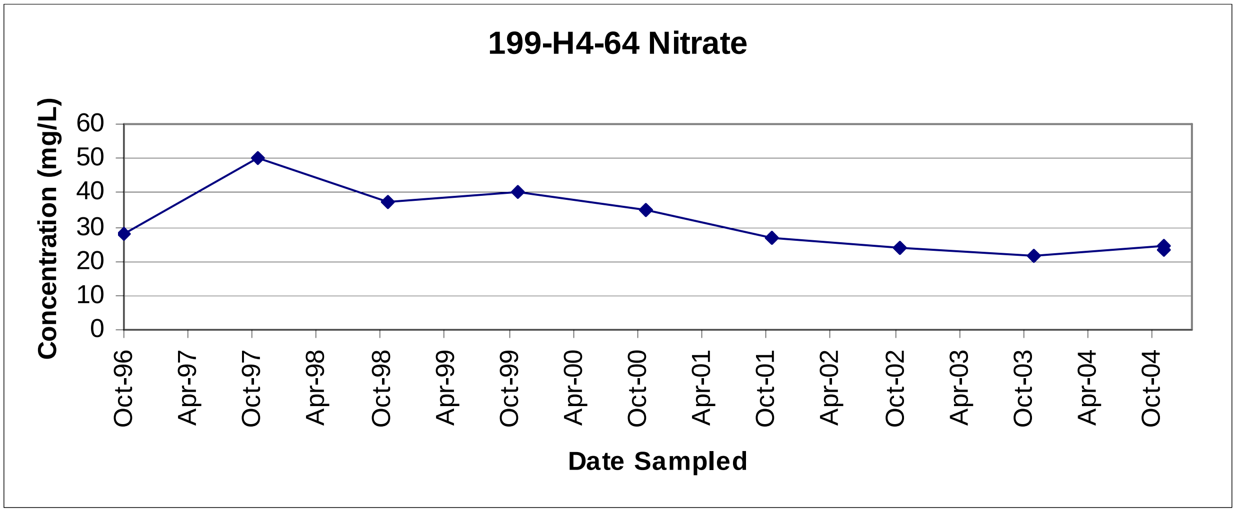
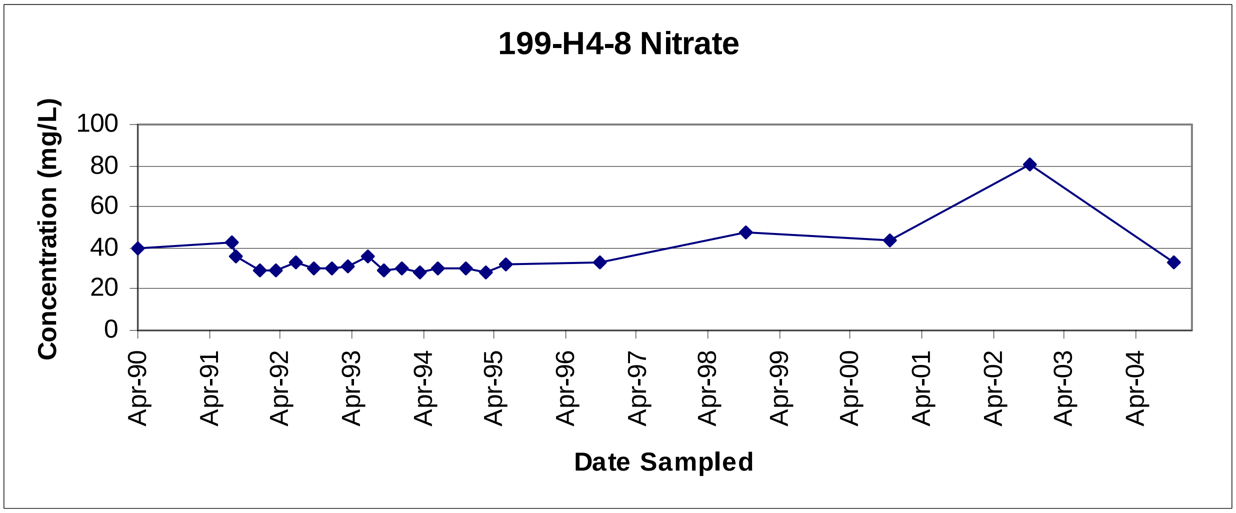
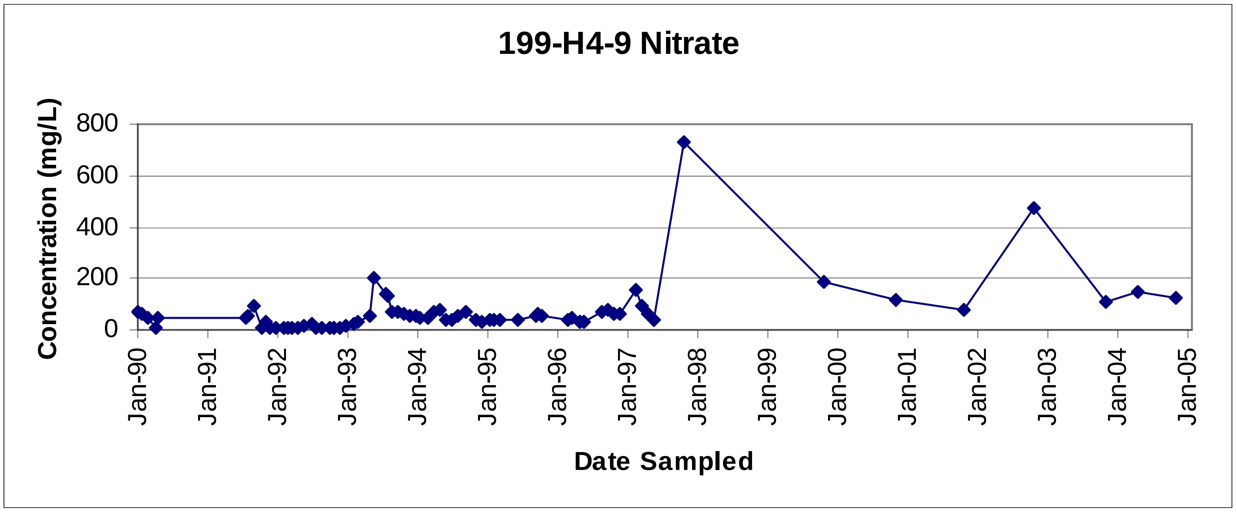
Jan-04
Jan-05
Date Sampled


199-H4-63 Nitrate
Concentration (mg/L)
100
80
60
40
20
0
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled


199-H4-64 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
60
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled


199-H4-8 Nitrate
Concentration (mg/L)
0
20
40
60
80
100
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled


199-H4-9 Nitrate
Concentration (mg/L)
0
200
400
600
800
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
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Jan-98
Jan-99
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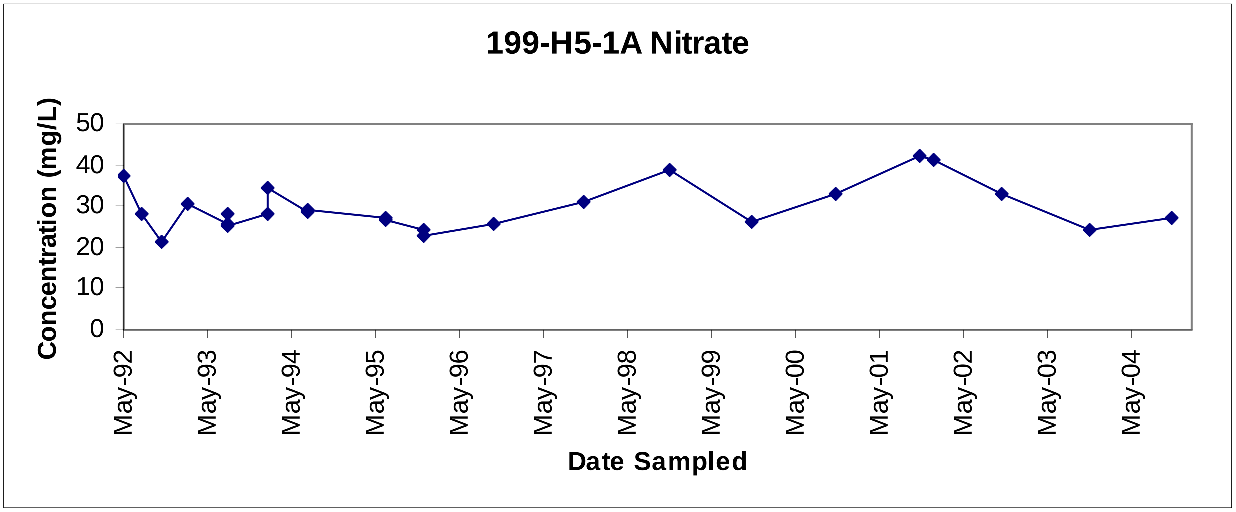
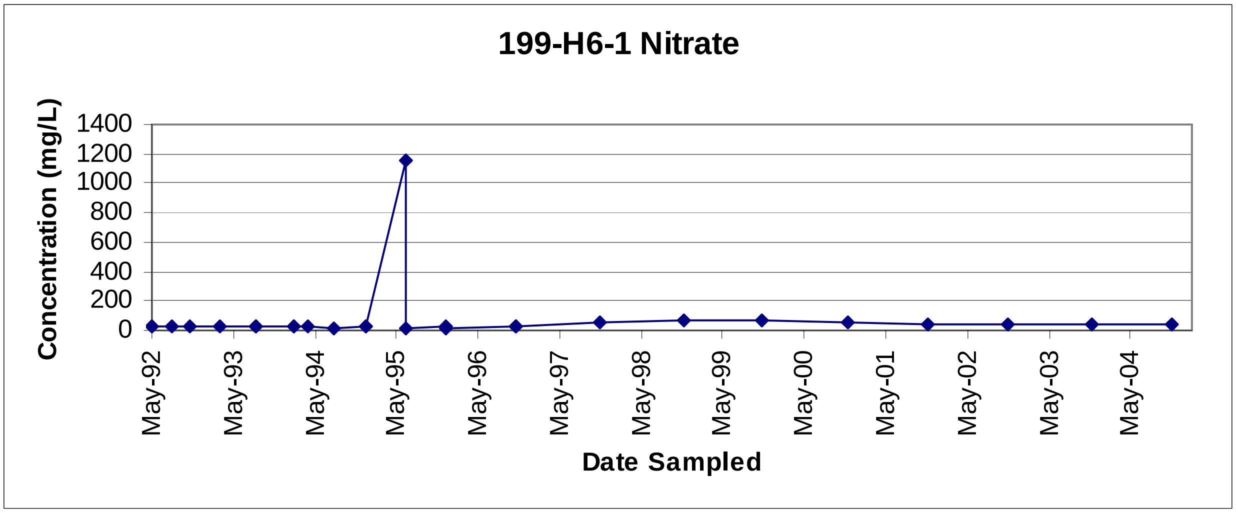
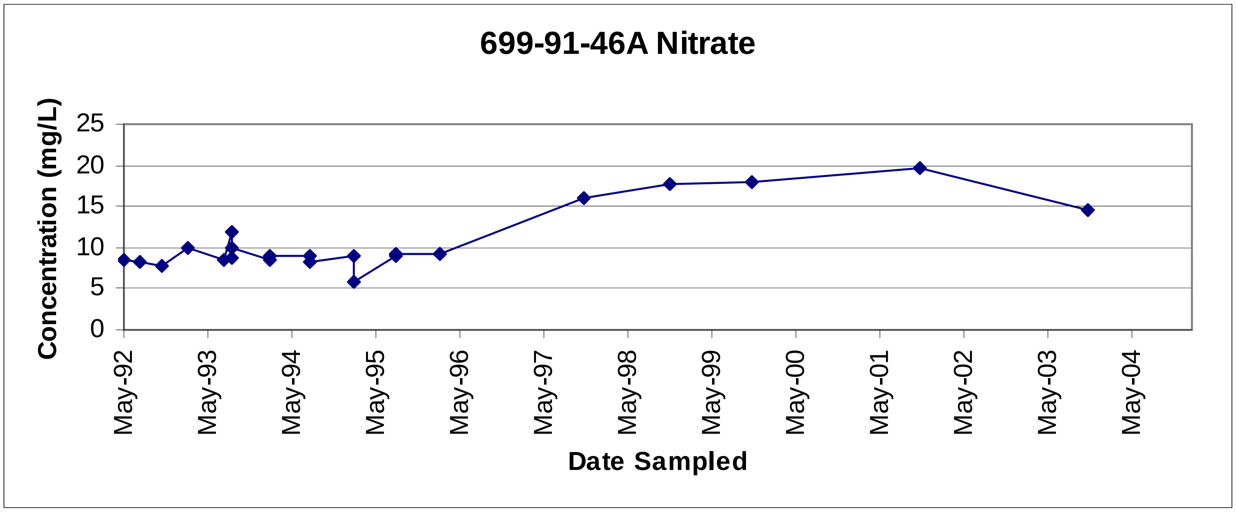
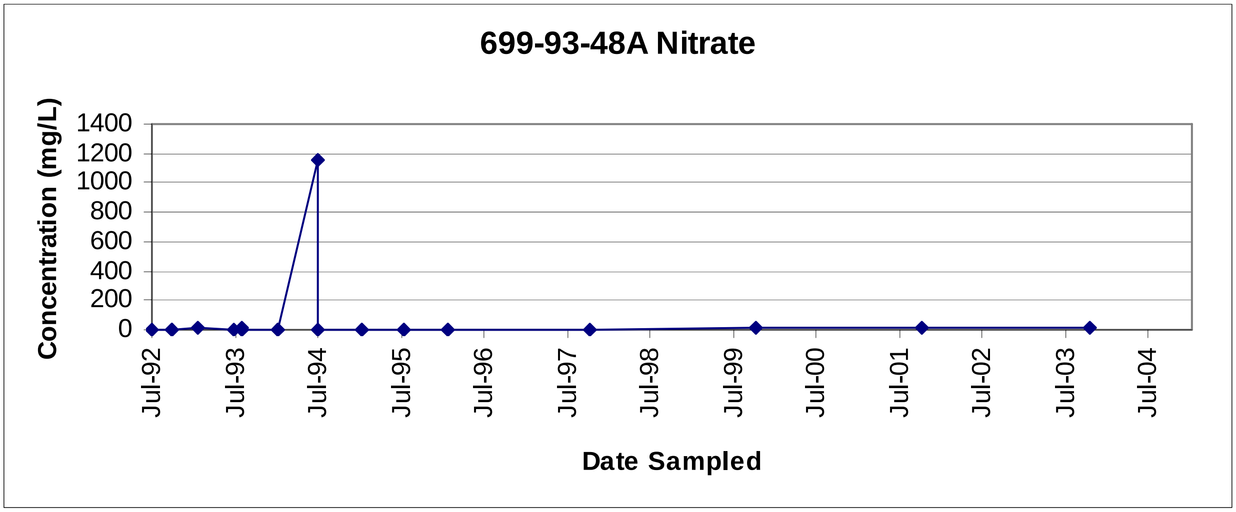
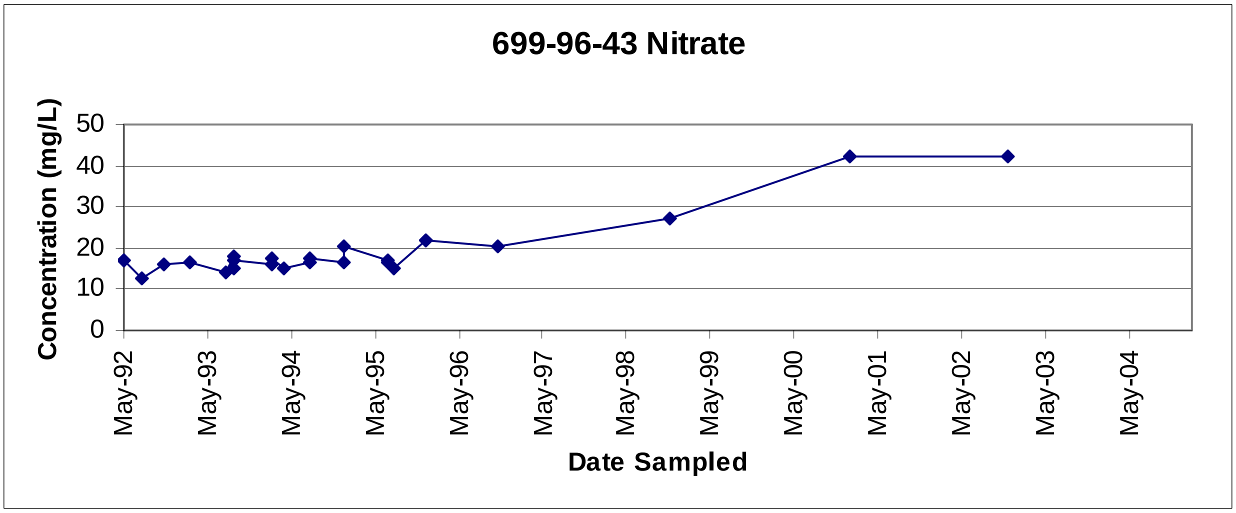
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

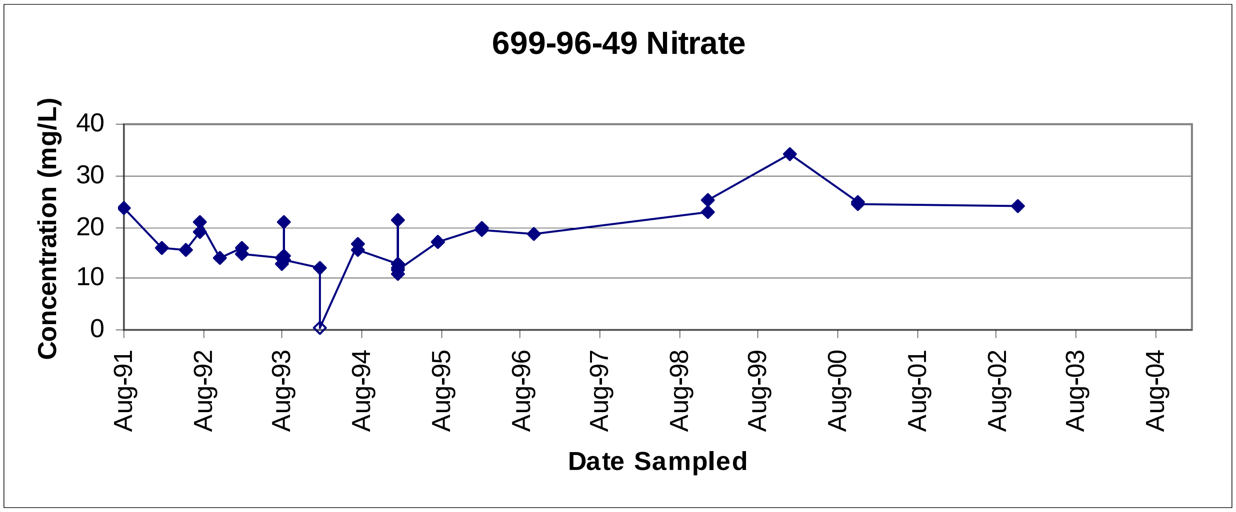

199-H5-1A Nitrate
Concentration (mg/L)
50
40
30
20
10
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

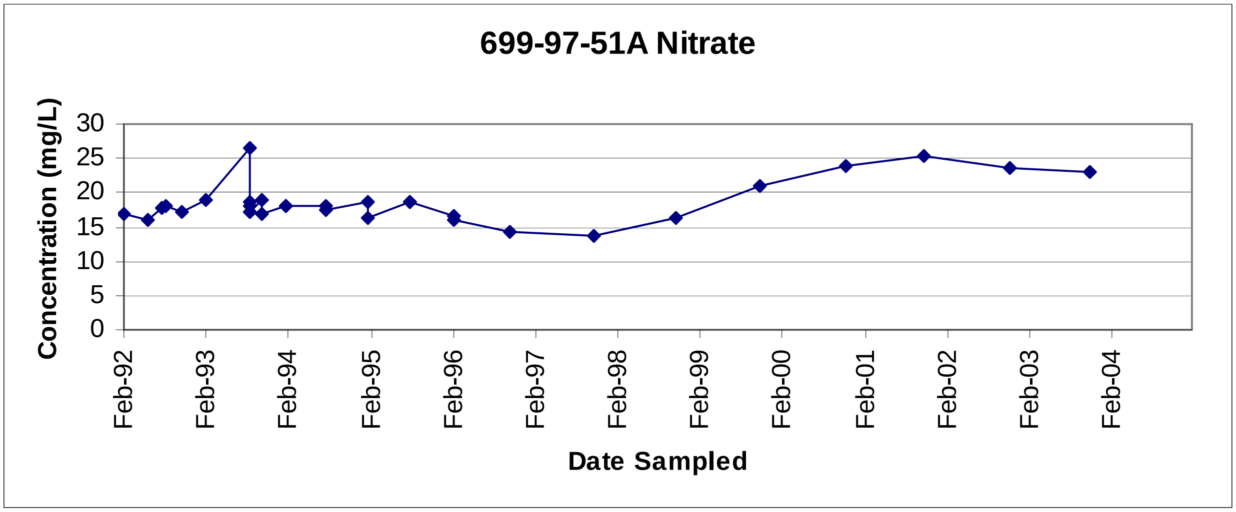

199-H6-1 Nitrate
Concentration (mg/L)
1400
1200
1000
800
600
400
200
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


699-91-46A Nitrate
Concentration (mg/L)
25
20
15
10
5
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


699-93-48A Nitrate
Concentration (mg/L)
1400
1200
1000
800
600
400
200
0
Jul-92
Jul-93
Jul-94
Jul-95
Jul-96
Jul-97
Jul-98
Jul-99
Jul-00
Jul-01
Jul-02
Jul-03
Jul-04
Date Sampled


699-96-43 Nitrate
Concentration (mg/L)
50
40
30
20
10
0
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


699-96-49 Nitrate
Concentration (mg/L)
40
30
20
10
0
Aug-91
Aug-92
Aug-93
Aug-94
Aug-95
Aug-96
Aug-97
Aug-98
Aug-99
Aug-00
Aug-01
Aug-02
Aug-03
Aug-04
Date Sampled


699-97-51A Nitrate
Concentration (mg/L)
30
25
20
15
10
5
0
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

APPENDIX I

QUALITY CONTROL

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CONTENTS

TABLES

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APPENDIX I

QUALITY CONTROL

The following tables present quality control data from the calendar year 2004 (CY04) sampling events at the 100-D, 100-H, 100-K, and 100-N Areas. The tables include field replicates, field/offsite laboratory splits, and offsite laboratory replicates. The tables included in this appendix are as follows:

- Table I-1, Quality Control Results, 100-D and 100-H Areas
- Table I-2, Quality Control Results, 100-K Area
- Table I-3, Quality Assurance/Control Results for 100-NR-2 Monitoring Data.

Table I-1. Quality Control Results, 100-D and 100-H Areas. (3 sheets)

Sample Number	Value	Sample Number	Value	RPD (%)	Sample Number	Value	Sample Number	Value	RPD (%)
100-D Area Contaminants of Concern									
Hexavalent Chromium (µg/L) (COLOR_TK_CR6_FLD), Field Duplicates, Filtered									
B19P18	91	B19P19	82	10.40	B18KJ5	97	B18KJ7	96.8	0.21
B18C69	5(U)	B18C87	5	N/A	B19NY0	62	B19NY1	62	0.00
B18DY4	7	B18DY6	7	0.00	B1B627	83	B1B628	83	0.00
B18Y32	7	B18Y34	6	15.38	B18KH1	135	B18KH3	134	0.74
B18KK3	41	B18KK5	42	2.41	B1B0W9	119	B1B0W8	120	0.84
B19637	75	B19639	71	5.48	B18KC9	530	B18KD0	540	1.87
B19PB1	124	B19P99	115	7.53	B19JL8	60	B19JL9	55	8.70
B1B0Y0	214	B1B0X8	208	2.84	B18XY7	49	B18XY8	50	2.02
B18PY8	690	B18R00	691	0.14	B19JN4	7	B19JN5	8	13.33
B18Y44	2,340	B18Y46	2,380	1.69	B18DT8	40	B18DT9	40	0.00
B18F14	10	B18F16	5(U)	N/A	B19603	62	B19604	63	1.60
B19HW1	39	B19HW0	39	0.00	B18PW0	70	B18PW1	70	0.00
B19JL2	8	B19JL3	7	13.33	B18KJ1	77	B18KJ3	81	5.06
B18C59	60	B18C58	60	0.00	--	--	--	--	--
Hexavalent Chromium (µg/L) (COLOR_TK_CR6_FLD/7196_CR6), Field/Laboratory Splits, Filtered									
B18DX7	109	B18DX8	118	7.93	B19JM2	39	B19JM3	40.5	3.77
B18Y26	1,360	B18Y27	1,400	2.90	B19NY3	50	B19NY4	49.9	0.20
B19K61	78	B19K63	81.6	4.51	B189V2	51.1	B18C62	49	4.20
B1B640	292	B1B642	290	0.69	B1B0X1	58	B1B0X2	62.7	7.79
B18KK9	508	B18KK7	497	2.19	B19JN8	16	B19JN9	14.8	7.79
B18F04	230	B18F05	240	4.26	B19605	39	B19606	40.8	4.51
B18TK1	1,110	B18TK3	1,270	13.45	B1B632	51	B1B633	52.2	2.33
B18Y52	17	B18Y53	9.3	58.56	B18Y02	26.5	B18Y01	38	35.66
B18DT4	70	B18DT5	85.4	19.82	B19JP4	9	B19JP5	7.7	15.57
B18PV6	12.9(Y)	B18PV5	142	N/A	--	--	--	--	--
Chromium (µg/L) (6010_METALS_ICP), Laboratory Duplicates, Filtered									
B1BK65	219	B1BK61	216	1.38	B1BKL2	18.6	B1BKK6	18.8	1.07
B1BK91	3.3(U)	B1BK87	3.3(U)	N/A	B1BKR5	8.6	B1BKP9	8.8	2.30

Table I-1. Quality Control Results, 100-D and 100-H Areas. (3 sheets)

Sample Number	Value	Sample Number	Value	RPD (%)	Sample Number	Value	Sample Number	Value	RPD (%)
Chromium (µg/L) (6010_METALS_ICP), Laboratory Duplicates, Not Filtered									
B1BK62	217	B1BK66	219	0.92	B1BKL3	20	B1BKK7	20.3	1.49
B1BK88	3.3(U)	B1BK92	3.3(U)	N/A	B1BKR0	10.9	B1BKR6	11.6	6.22
Chromium (µg/L) (6010_METALS_ICP), Laboratory Splits, Filtered									
B1BK93	348	B1BK99	341	2.03	B1BKM8	13.3	B1BKM6	13.1	1.52
B1BKD5	1,030	B1BKF1	1,010	1.96	B1BKC0	39.2	B1BKB7	38.9	0.77
Chromium (µg/L) (6010_METALS_ICP), Laboratory Splits, Not Filtered									
B1BKB0	346	B1BK41	350	1.15	B1BKB1	26.2	B1BKM9	23	13.01
B1BKF2	979	B1BK42	1050	7.00	B1BKB6	39.5	B1BKB9	38.7	2.05
100-H Area Contaminants of Concern									
Hexavalent Chromium (µg/L) (COLOR_TK_CR6_FLD), Field Duplicates, Filtered									
B18DT8	40	B18DT9	40	0.00	B19603	62	B19604	63	1.60
B18KJ1	77	B18KJ3	81	5.06	B19JL9	55	B19JL8	60	8.70
B18PW0	70	B18PW1	70	0.00	B19JN5	8	B19JN4	7	13.33
B18XY7	49	B18XY8	50	2.02	--	--	--	--	--
Hexavalent Chromium (µg/L) (COLOR_TK_CR6_FLD/7196_CR6), Field/Laboratory Splits, Filtered									
B189V2	51.1	B18C62	49	4.20	B19JP4	9	B19JP5	7.7	15.57
B18Y02	26.5	B18Y01	38	35.66	B19NY3	50	B19NY4	49.9	0.20
B19605	39	B19606	40.8	4.51	B1B0X1	58	B1B0X2	62.7	7.79
B19JM2	39	B19JM3	40.5	3.77	B1B632	51	B1B633	52.2	2.33
B19JN9	14.8	B19JN8	16	7.79	--	--	--	--	--
Chromium (µg/L) (6010_METALS_ICP), Laboratory Duplicates, Filtered									
B1BKK6	18.8	B1BKK7	20.3	7.67	B1BN98	3.3(U)	B1BNB2	3.3(U)	N/A
B1BKP9	8.8	B1BKR0	10.9	21.32	--	--	--	--	--
Chromium (µg/L) (6010_METALS_ICP), Laboratory Duplicates, Not Filtered									
B1BKK7	20.3	B1BKL2	20	1.49	B1BKR0	10.9	B1BKR5	11.6	6.22
Chromium (µg/L) (6010_METALS_ICP), Laboratory Split, Filtered									
B1BKB7	38.9	B1BKC0	39.2	0.77	B1BKM8	13.3	B1BKM6	13.1	1.52
Chromium (µg/L) (6010_METALS_ICP), Laboratory Split, Not Filtered									
B1BKM9	23	B1BKM8	26.2	13.01	B1BKB9	38.7	B1BKB7	39.5	2.05
100-D Area Co-Contaminants									
Strontium-90 (pCi/L) (SRISO_SEP_PRECIP_GPC / SRTOT_SEP_PRECIP_GPC), Laboratory Duplicates									
B19HR6	1.9(U)	B19HR7	5	N/A	B1BN46	5.01	B1BN47	4.85	3.25
B1BJW8	0.804	B1BJW9	0.793	1.38	B1BN59	3.38	B1BN60	3.97	16.05
Tritium (pCi/L) (906.0_H3_LSC / TRITIUM_DIST_LSC), Laboratory Duplicates									
B19HR6	1,200	B19HR7	1,200	0.00	B1BK14	12,800	B1BK15	13,100	2.32
B1BJW8	3,010	B1BJW9	3,210	6.43	B1BK34	476	B1BKV7	429	10.39
B1BN46	8,810	B1BN47	8,510	3.46	B1BK63	8,810	B1BK64	9,220	4.55
B1BK89	218(U)	B1BK90	48(U)	N/A	--	--	--	--	--
Sulfate (mg/L) (COLOR_TK_FLD), Field Duplicates									
B18DV7	132	B18DV9	132	0.00	B18Y79	120	B18Y81	125	4.08
B18DY5	20	B18DY7	20	0.00	B18Y94	92	B19H01	82	11.49
B18F15	18	B18F17	19	5.41	B18YB2	400	B18YB4	400	0.00
B18HK3	156	B18HK7	168	7.41	B190V0	64	B190V2	64	0.00
B18HM7	180	B18HN1	170	5.71	B19P53	132	B19P55	132	0.00
B18HV5	34	B18HV9	36	5.71	B19PB0	68	B19PB2	64	6.06

Table I-1. Quality Control Results, 100-D and 100-H Areas. (3 sheets)

Sample Number	Value	Sample Number	Value	RPD (%)	Sample Number	Value	Sample Number	Value	RPD (%)
B18KK4	102	B18KK6	104	1.94	B1B0X9	76	B1B0Y1	64	17.14
B18PY9	56	B18R01	56	0.00	B1B637	148	B1B639	144	2.74
B18Y33	9	B18Y35	10	10.53	B1BCF9	84	B1BCH1	86	2.35
Sulfate (mg/L) (300.0_ANIONS_IC), Laboratory Duplicates									
B1BK13	126	B1BK17	124	1.60	B1BK62	110	B1BK66	110	0.00
B1BK33	127	B1BKV6	124	2.39	B1BK88	16.4	B1BK92	16.4	0.00
Sulfate (mg/L) (COLOR_TK_FLD, 300.0_ANIONS_IC), Field/Laboratory Splits									
B18KK8	62	B18KL0	45.8	30.06	B19P00	136	B19P03	126	7.63
B18TK2	124	B18TK5	105	16.59	B19P29	68	B19P32	59.6	13.17
B19611	144	B19614	140	2.82	B1B0Y3	68	B1B0Y6	65.2	4.20
B19K62	68	B19K65	63.9	6.22	B1B641	92	B1B644	89.9	2.31
Sulfate (mg/L) (300.0_ANIONS_IC), Laboratory Splits									
B1BK40	133	B1BK45	124	7.00	B1BK42	112	B1BKF2	103	8.37
B1BK41	82.1	B1BKB0	71.9	13.25	--	--	--	--	--
Nitrate (mg/L) (300.0_ANIONS_IC), Laboratory Splits									
B1BK40	62.4	B1BK45	58.4	6.62	B1BK42	51	B1BKF2	42.9	17.25
B1BK41	39.8	B1BKB0	34.5	14.27	--	--	--	--	--
Nitrate (mg/L) (300.0_ANIONS_IC), Laboratory Duplicates									
B1BK17	25.2	B1BK13	26.1	3.51	B1BK92	3.72	B1BK88	3.76	1.07
B1BK33	60.6	B1BKV6	57.5	5.25	B19HR6	11.1	B19HR7	10.7	3.67
B1BK66	69.9	B1BK62	69.1	1.15	--	--	--	--	--
100-H Area Co-Contaminants									
Tritium(pCi/L) (906.0_H3-LSC), Laboratory Duplicates									
B1BKL0	1,180	B1BKL1	1,050	11.66	B1BKR3	2,760	B1BKR4	2,830	2.50
Strontium-90 (pCi/L) (SRISO_SEP_PRECIP_GPC), Laboratory Duplicates									
B1BNB1	0.00831(U)	B1BNB0	0.105(U)	N/A	--	--	--	--	--
Nitrate (mg/L) (300.0_ANIONS_IC), Laboratory Duplicates									
B1BKL3	32.8	B1BKK7	32.3	1.54	B1BNB3	5.75	B1BN99	5.31	7.96
B1BKR6	30.5	B1BKR0	30.5	0.00	--	--	--	--	--
Nitrate (mg/L) (300.0_ANIONS_IC), Laboratory Splits									
B1BKB6	23.5	B1BKB9	24.2	2.94	B1BKM9	33.2	B1BKB1	37.1	11.10

N/A = not applicable
RPD = relative percent difference
U = undetected
Y = rejected

Table I-2. Quality Control Results, 100-K Area. (2 sheets)

Sample Number	Value	Sample Number	Value	RPD (%)	Sample Number	Value	Sample Number	Value	RPD (%)
100-K Area Contaminants of Concern									
Hexavalent Chromium (µg/L) (COLOR_TK_CR6_FLD), Field Duplicates, Filtered									
B18CL6	75	B18CL7	75	0.00	B19JR9	26	B19JR8	26	0.00
B18DK7	129	B18DK8	128	0.78	B19JT5	17	B19JT6	11	42.86
B18KB5	39	B18KB6	38	2.60	B19P39	5	B19P40	6	18.18
B18KL3	6	B18KL2	6	0.00	B1B105	137	B1B106	139	1.45
B18PX4	54	B18PX5	55	1.83	B19629	9	B19630	8	11.76
B18Y60	102	B18Y59	101	0.99	B1B651	109	B1B652	107	1.85
Hexavalent Chromium (µg/L) (COLOR_TK_CR6_FLD), Field Duplicates, Not Filtered									
B1B416	101	B1B417	106	4.83	--	--	--	--	--
Hexavalent Chromium (µg/L) (COLOR_TK_CR6_FLD/7196_CR6), Field/Laboratory Splits, Filtered or Not Filtered									
B18CM1	50	B18CM2	20.6	83.29	B19JF1	28	B19JC9	23	19.61
B18CM5	565	B18CM4	516	9.07	B19JF2	62	B19JD0	54	13.79
B18DL0	69.4	B18DK9	70	0.86	B19JF4	66	B19JD2	57	14.63
B18KB7	97	B18KD7	84	14.36	B19JF5	35	B19JD3	30	15.38
B18KL5	132	B18KL7	138	4.44	B19JF7	34	B19JD5	28	19.35
B18PW8	45	B18PW9	39.3	13.52	B19JF9	53	B19JD7	45	16.33
B18Y56	10	B18Y57	3.3	100.75	B19JR4	135	B19JR3	133	1.49
B19634	59	B19635	57.5	2.58	B19P41	92	B19P42	95.9	4.15
B19JD1	57	B19JF3	66	14.63	B1B100	108	B1B101	106	1.87
B19JD4	65	B19JF6	74	12.95	B1B657	95	B1B658	92.8	2.34
B19JD6	79	B19JF8	90	13.02	B1B6J1	135	B1B660	130	3.77
B19JD8	35	B19JH0	41	15.79	--	--	--	--	--
Chromium (6010_METALS_ICP) Laboratory Duplicates, Filtered or Not Filtered									
B17MV5	27.5	B17MV6	33.4	19.38	B1B6C7	4.9	B1B6C6	5.1	4.00
B1B681	19	B1B684	14.2	28.92	B1B6D0	11.4	B1B6D1	13.1	13.88
B1B685	19	B1B680	14.2	28.92	B1B6D3	20.5	B1B6D4	25.2	20.57
B1B686	8.5	B1B687	18.8	75.46	B1B6D7	15	B1B6F1	17.8	17.07
B1B689	3.4	B1B690	3.4	0.00	B1B6F0	9.1	B1B6D6	8.5	6.82
B1B692	36.3	B1B693	39.3	7.94	B1B6F3	18	B1B6F2	12	40.00
B1B695	125	B1B696	139	10.61	B1B6F5	9.9	B1B6F6	16.2	48.28
B1B698	69.6	B1B699	73.5	5.45	B1B6F8	44.4	B1B6F9	77.5	54.31
B1B6B1	41.8	B1B6B2	45.2	7.82	B1B6H5	86.9	B1B6H4	83.1	4.47
B1B6B4	20.6	B1B6B5	31.7	42.45	B1B6H7	159	B1B6H8	124	24.73
B1B6C0	121	B1B6C1	126	4.05	B1B6H9	111	B1B6J0	30.8	113.12
100-K Area Co-Contaminants									
Nitrate (mg/L) (300.0_ANIONS_IC), Laboratory Duplicates, Not Filtered									
B1B685	81.5	B1B681	78.4	3.88	B1B6F1	8.85	B1B6D7	8.85	0.00
B1B6C7	74.4	B1B6H9	90	18.98	B1B6H7	98.2	B1B696	84.1	15.47
Nitrate (mg/L) (300.0_ANIONS_IC), Laboratory Splits, Not Filtered									
B1B6H7	98.2	B1B696	84.1	15.47	B1B6C7	74.4	B1B6H9	90	18.98

Table I-2. Quality Control Results, 100-K Area. (2 sheets)

Sample Number	Value	Sample Number	Value	RPD (%)	Sample Number	Value	Sample Number	Value	RPD (%)
Strontium-90 (pCi/L) (SRISO_SEP_PRECIP_GPC), Laboratory Duplicates, Not Filtered									
B18CN3	0.749	B18CN2	0.728	2.84	B19JD1	3.7	B19JD2	3	20.90
B18PY0	2380	B18PX9	2040	15.38	B1B654	19.3	B1B653	19	1.57
Strontium-90 (pCi/L) (SRISO_SEP_PRECIP_GPC), Laboratory Splits, Not Filtered									
B18PY2	0.025(U)	B18PY1	0.169	N/A	B1B6H9	0.36(U)	B1B6C8	3.3	N/A
B19NP4	-0.18(U)	B19JT1	4.68	N/A	B1BCK6	0.351	B1B659	0.033(U)	N/A
B1B662	-0.074(U)	B1B6H7	0.503(U)	N/A	--	--	--	--	--
Tritium (pCi/L) (906.0_H3_LSC), Laboratory Duplicates, Not Filtered									
B1B682	222(U)	B1B683	149(U)	N/A	B19JD1	940	B19JD2	980	4.17
B1B654	97.1(U)	B1B653	92.4(U)	N/A	B1B6D8	127(U)	B1B6D9	-75.5(U)	N/A
Tritium (pCi/L) (906.0_H3_LSC/TRITIUM_DIST_LSC), Laboratory Splits, Not Filtered									
B1B659	3,200	B1BCK6	4,010	22.47	B1B6C8	360,000	B1B6H9	470,000	26.51
B1B6H7	38,700	B1B662	31,000	22.09	--	--	--	--	--

(N) = not filtered
N/A = not applicable
RPD = relative percent difference
U = undetected

Table I-3. Quality Assurance/Quality Control Results for 100-NR-2 Monitoring Data. (2 sheets)

Sample Number	Value	Sample Number	Value	RPD (%)	Sample Number	Value	Sample Number	Value	RPD (%)
100-N Area Contaminants of Concern									
Strontium-90 (pCi/L) (SRISO_SEP_PRECIP_GPC), Laboratory Duplicates									
B18KN8	244	B18KN7	321	27.26	B1B184	4.83	B1B183	4.23	13.25
B1B111	971	B1B110	1020	4.92	B1BTD1	0.738	B1BTD2	1.04	33.97
Strontium-90 (pCi/L) (SRISO_SEP_PRECIP_GPC), Laboratory Splits									
B18KP4	164	B18KP5	177	7.62	B1B174	589	B1B173	565	4.16
B1B134	1,300	B1B133	1160	11.38	--	--	--	--	--
Manganese (µg/L) (6010_METALS_ICP), Laboratory Duplicates, Filtered									
B18KN9	1.4	B18KN5	2.6	60.00	B1B108	1.2	B1B112	1	18.18
B18KX8	8.3	B18KM3	7	16.99	B1B185	2.1	B1B181	3.2	41.51
B18MB7	860	B18MB5	876	1.84	--	--	--	--	--
Manganese (µg/L) (6010_METALS_ICP), Laboratory Splits, Filtered									
B18KP3	0.44	B18KP1	2.2	133.33	B1B170	1.6	B1B172	0.6	90.91
B1B130	2.6	B1B132	1.5	53.66	--	--	--	--	--
Nitrate (mg/L) (300.0_ANIONS_IC), Laboratory Duplicates									
B18KM4	66.4	B18KX9	66	0.60	B1B113	27.4	B1B109	27.4	0.00
B18KP0	32.8	B18KN6	34.1	3.89	B1B186	30.5	B1B182	32.3	5.73
B18MB6	12.8	B18MB8	12	6.45	--	--	--	--	--
Nitrate (mg/L) (300.0_ANIONS_IC), Laboratory Splits									
B18KP4	45.7	B18KP2	46.9	2.59	B1B173	31.8	B1B171	28.8	9.90
B1B131	63.7	B1B133	68.4	7.12	--	--	--	--	--

Table I-3. Quality Assurance/Quality Control Results for 100-NR-2 Monitoring Data. (2 sheets)

Sample Number	Value	Sample Number	Value	RPD (%)	Sample Number	Value	Sample Number	Value	RPD (%)
Sulfate (mg/L) (300.0_ANIONS_IC), Laboratory Duplicates									
B18KM4	201	B18KX9	194	3.54	B1B113	39.4	B1B109	39.6	0.51
B18KP0	45.9	B18KN6	46.6	1.51	B1B182	106	B1B186	104	1.90
B18MB8	68.2	B18MB6	69	1.17	--	--	--	--	--
Sulfate (mg/L) (300.0_ANIONS_IC), Laboratory Splits									
B18KP4	58.2	B18KP2	53.3	8.79	B1B171	67.8	B1B173	67.9	0.15
B1B131	190	B1B133	200	5.13	--	--	--	--	--
Tritium (pCi/L) (906.0_H3_LSC), Laboratory Duplicates, Not Filtered									
B18KN7	16,000	B18KN8	16,900	5.47	B1B184	2,690	B1B183	2,840	5.42
B1B110	23,800	B1B111	23,600	0.84	B1BTD2	1,710	B1BTD1	1,730	1.16
B1B146	9,130	B1B144	9,130	0.00	--	--	--	--	--
Tritium (pCi/L) (906.0_H3_LSC), Laboratory Splits, Not Filtered									
B18KP4	25,500	B18KP5	22,600	12.06	B1B173	19,000	B1B174	14,800	24.85
B1B133	3,560	B1B134	2,580	31.92	--	--	--	--	--
Total Petroleum Hydrocarbons - Diesel Range (µg/L) (WTPH_DIESEL) Laboratory Duplicates									
B18MB6	5,200	B18MB8	5,500	5.61	B18MV4	60,000(U)	B18MC0	150,000	N/A
B18MD5	60(U)	B18MD7	60(U)	N/A	B1B1X4	50(U)	B1B1X3	50(U)	N/A
Total Petroleum Hydrocarbons - Gasoline Range (µg/L) (TPH_GASOLINE) Laboratory Duplicates									
B18MB6	60(U)	B18MB8	60(U)	N/A	B18MD7	60(U)	B18MD5	60(U)	N/A
B18MC0	900(U)	B18MV4	450(J)	N/A	B1B1X3	200	B1B1X4	130	42.42
Total Chromium (µg/L) (6010_METALS_ICP), Laboratory Duplicates, Filtered									
B18KN9	4.4(U)	B18KN5	4.4(U)	N/A	B1B112	3.3(U)	B1B108	3.3(U)	N/A
B18KX8	4.4(U)	B18KM3	4.4(U)	N/A	B1B181	3.3(U)	B1B185	3.3(U)	N/A
B18MB7	4.4(U)	B18MB5	4.4(U)	N/A	--	--	--	--	--
Total Chromium (µg/L) (6010_METALS_ICP), Laboratory Split, Filtered									
B18KP3	2.8	B18KP1	4.4(U)	N/A	B1B170	3.3(U)	B1B172	9.5	N/A
B1B132	2.7	B1B130	3.3(U)	N/A	--	--	--	--	--

J = estimated
N/A = not applicable
RPD = relative percent difference
U = undetected

APPENDIX J

HYDROGRAPHS FOR THE 100-KR-4 OPERABLE UNIT

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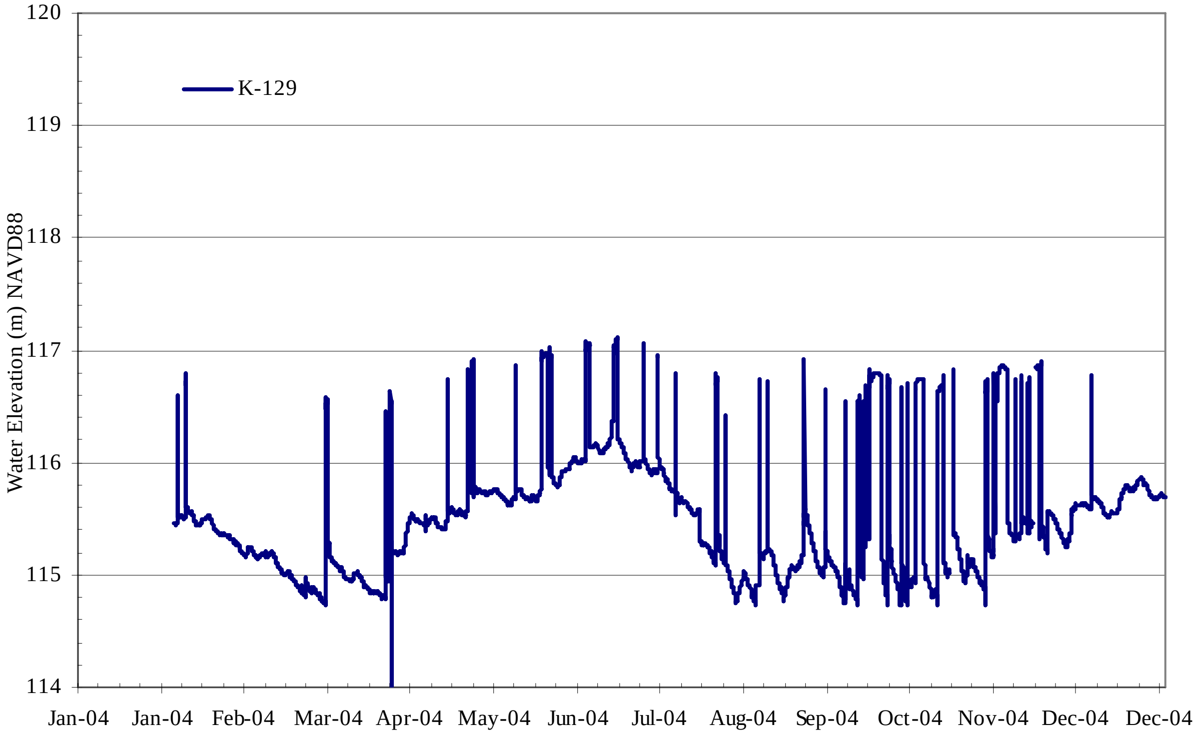

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119
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117
116
115
114
K-129
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Jan-04
Feb-04
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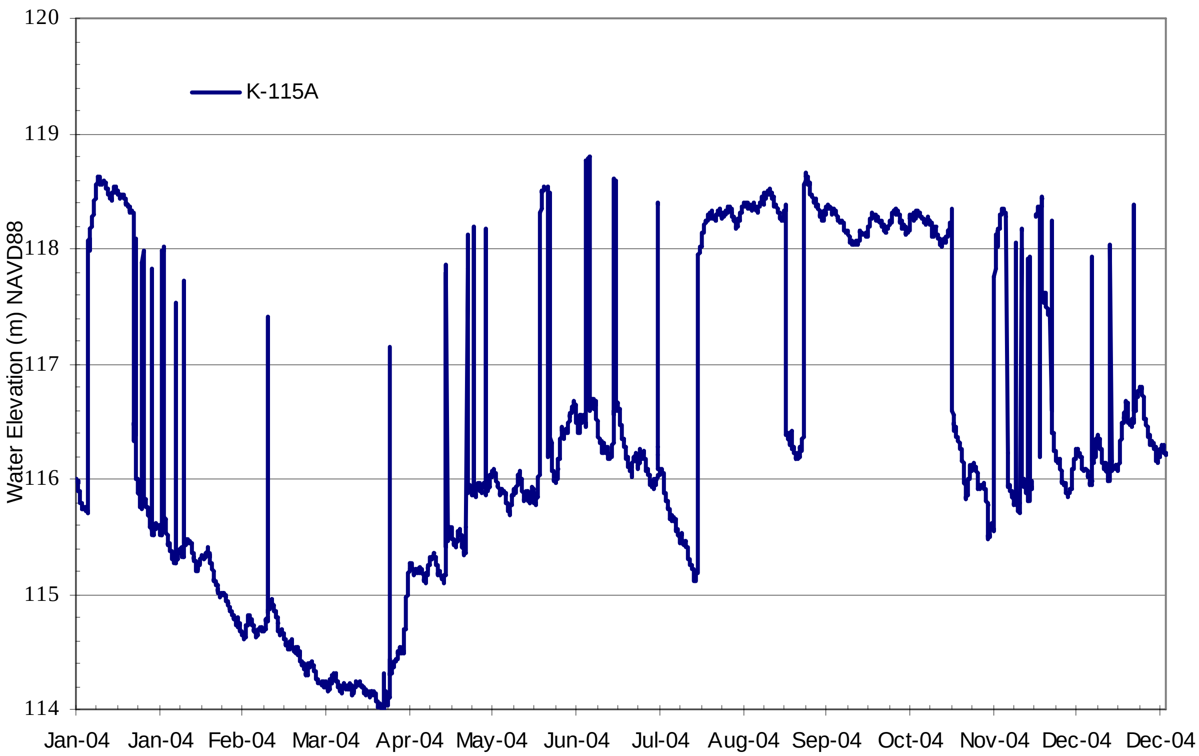
Nov-04
Dec-04
Dec-04



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K-115A
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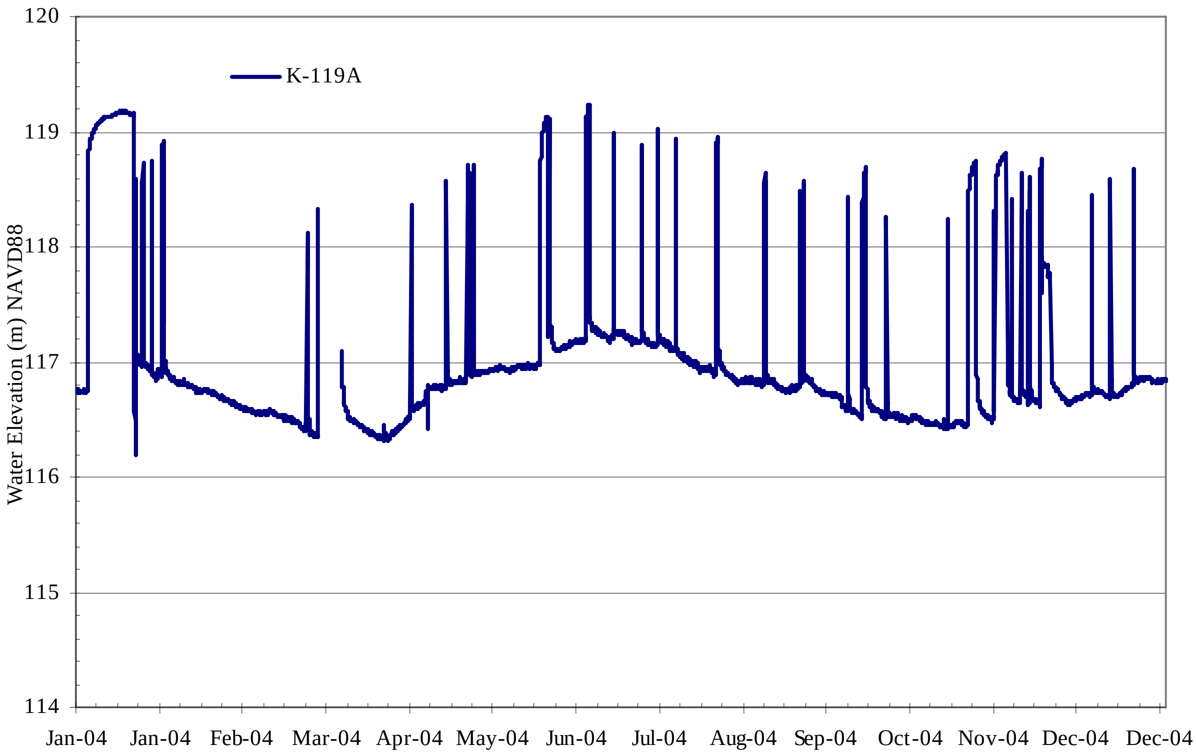
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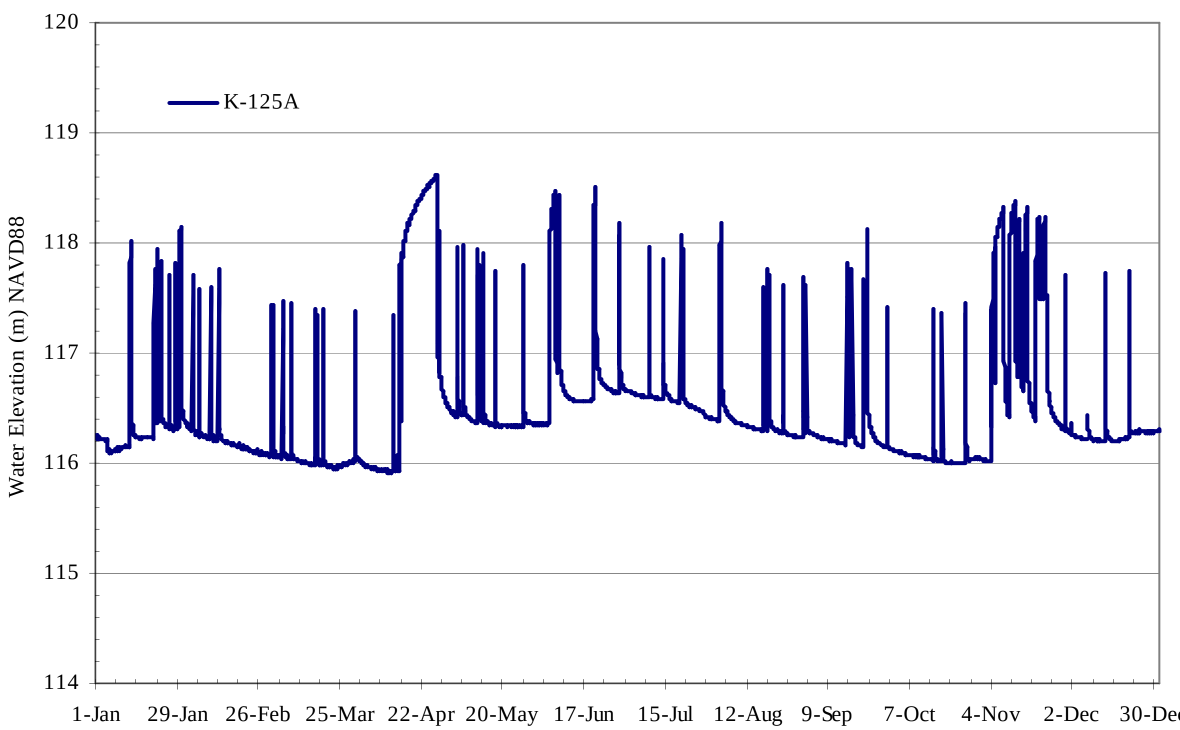
Dec-04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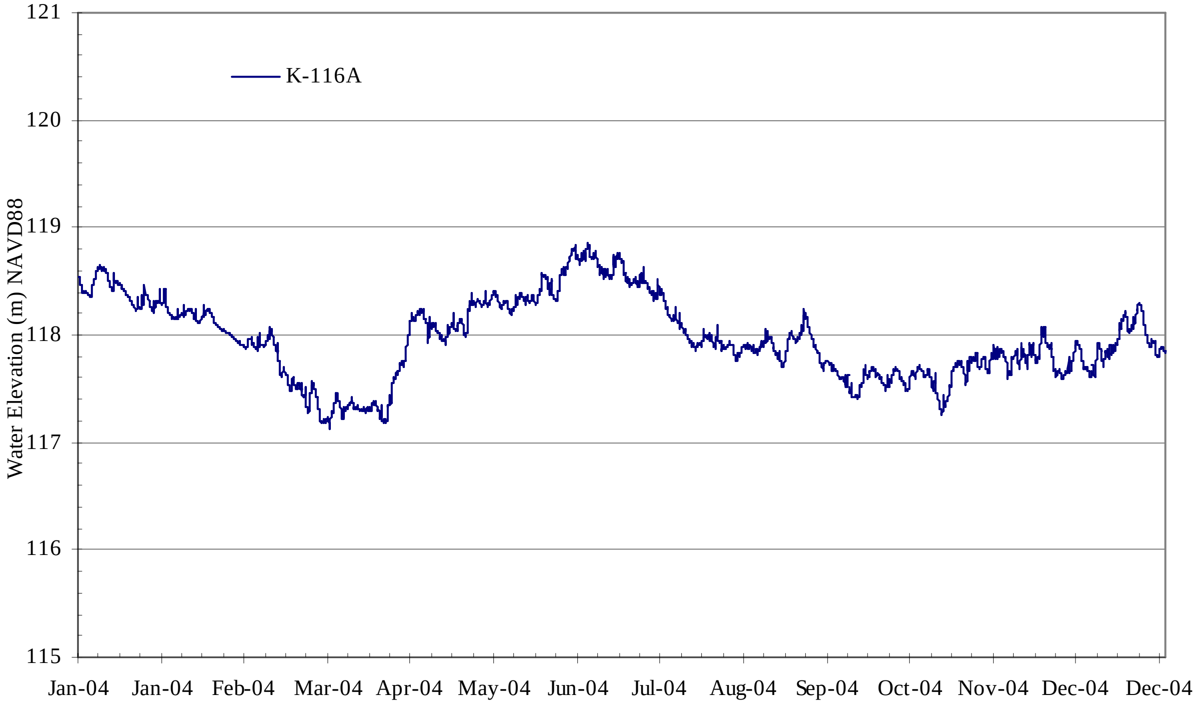
30-Dec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Water Elevation (m) NAVD88
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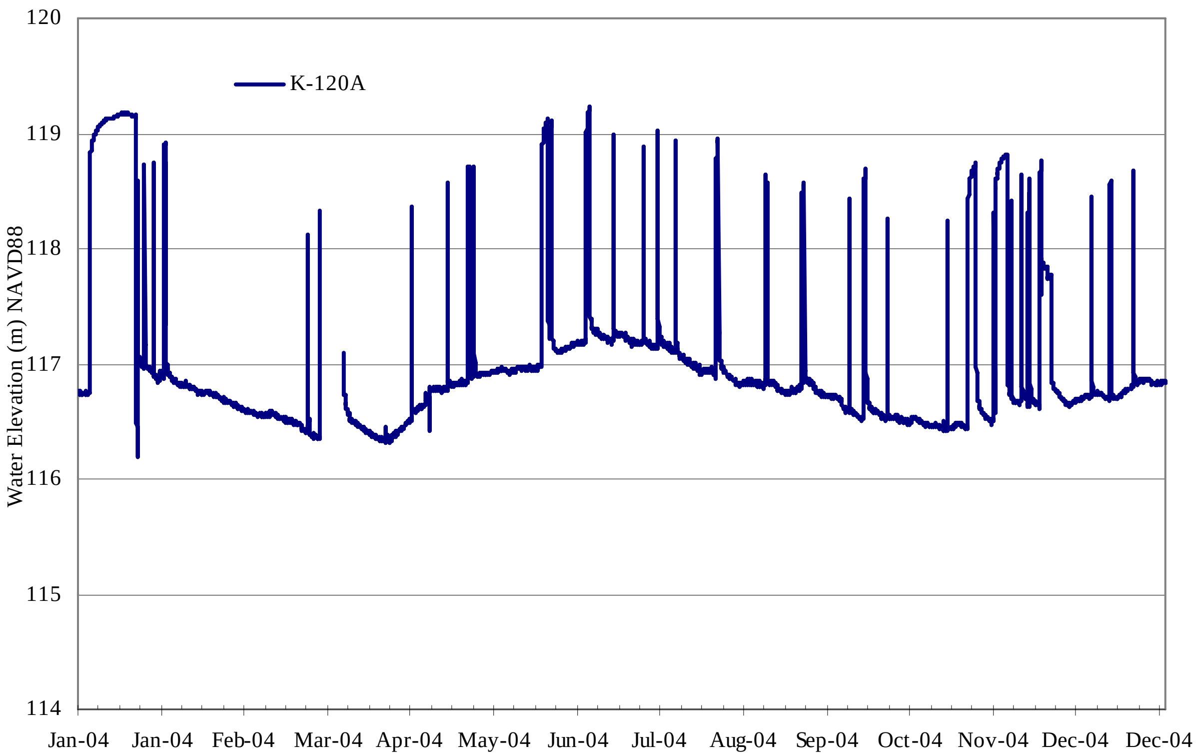
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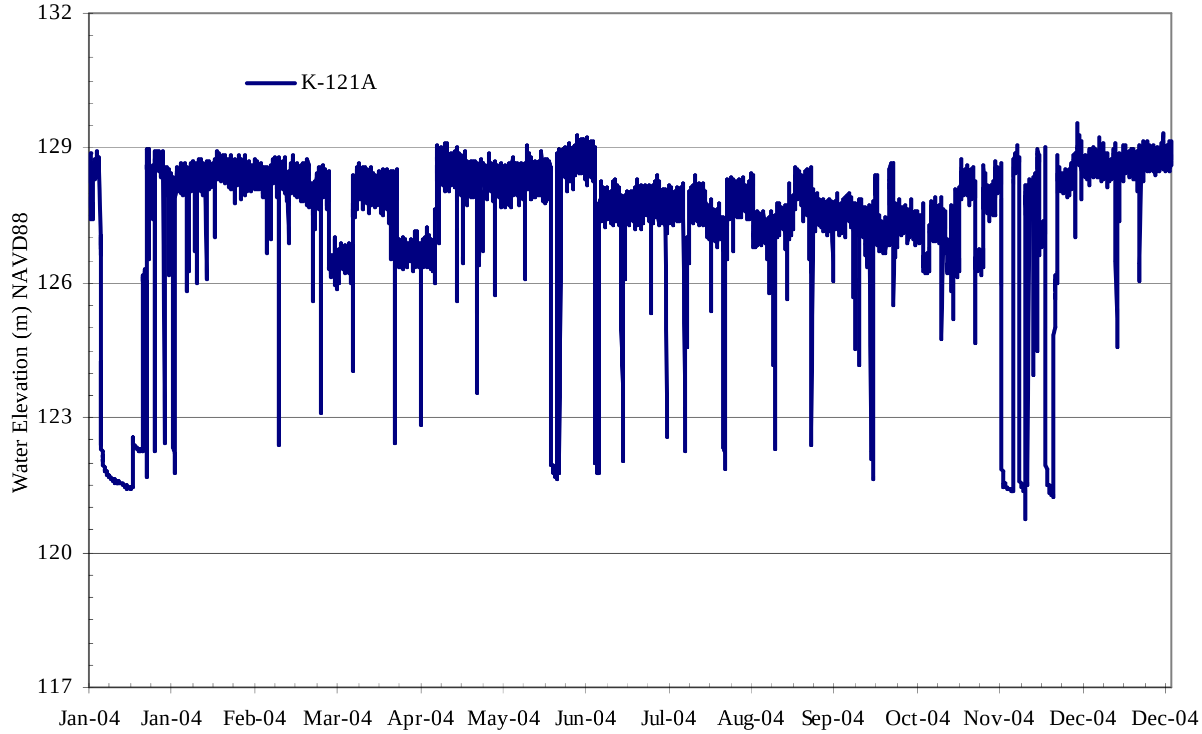
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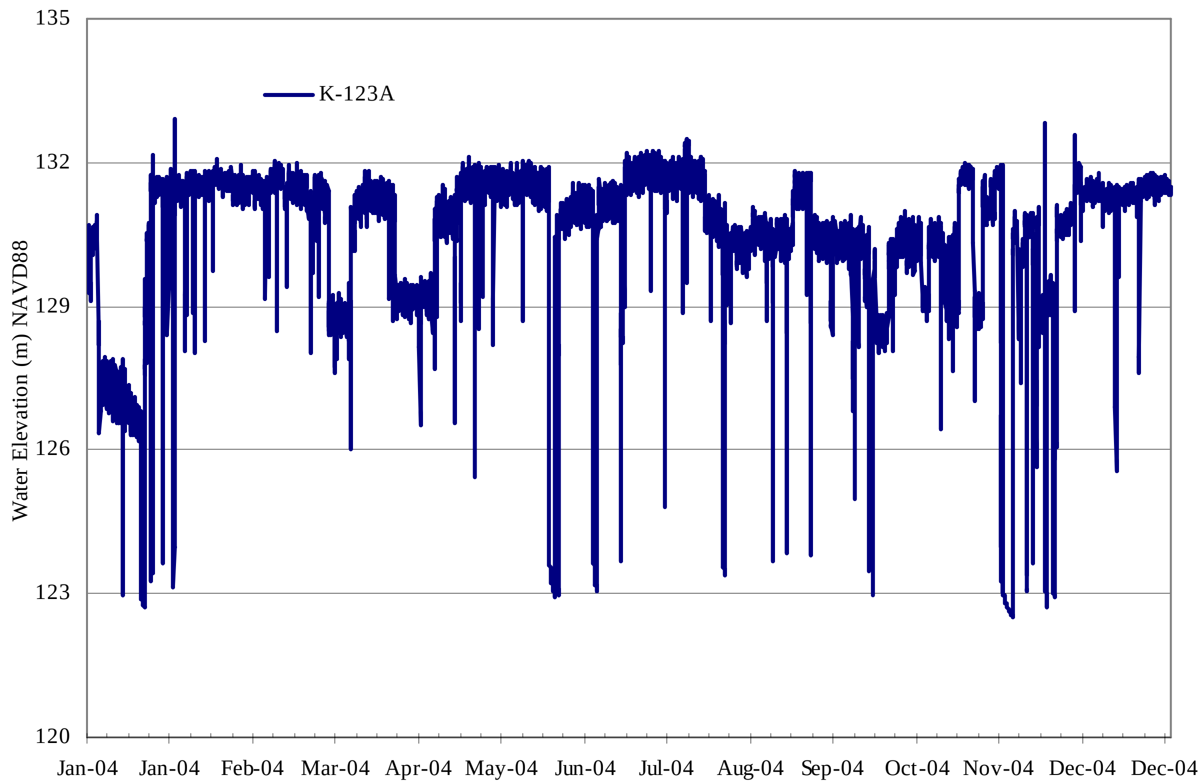
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Jan-04
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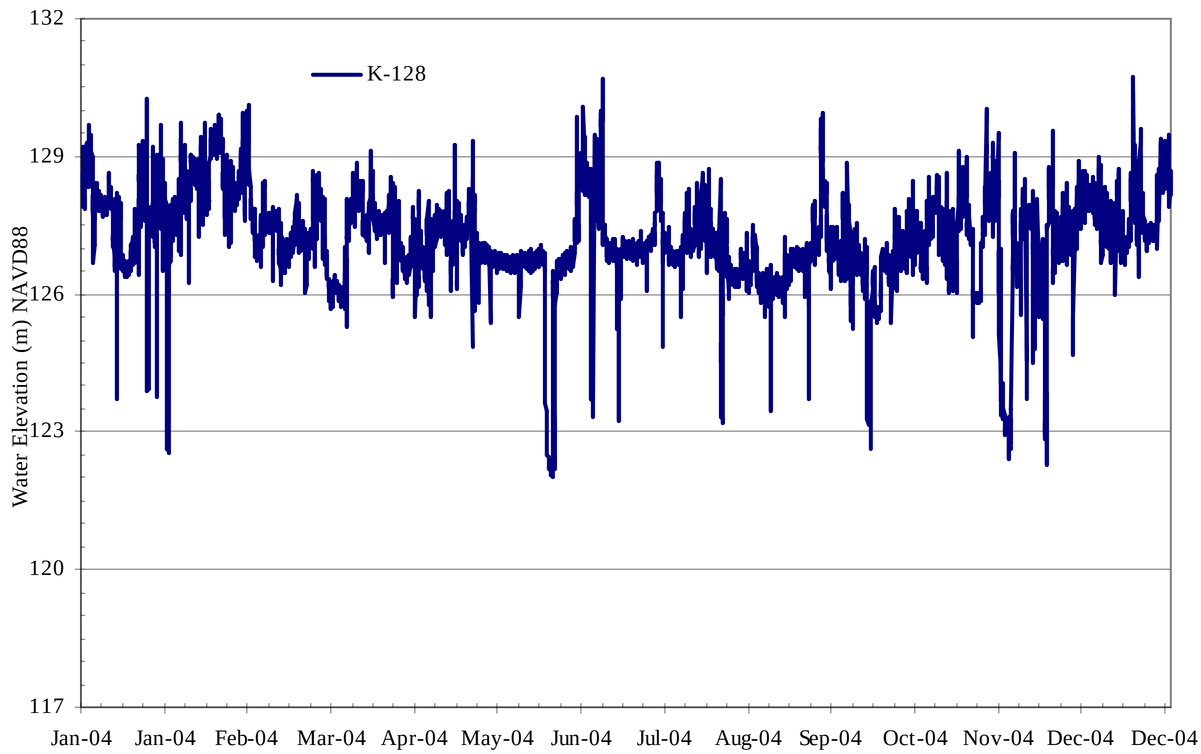
Dec-04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Water Elevation (m) NAVD88
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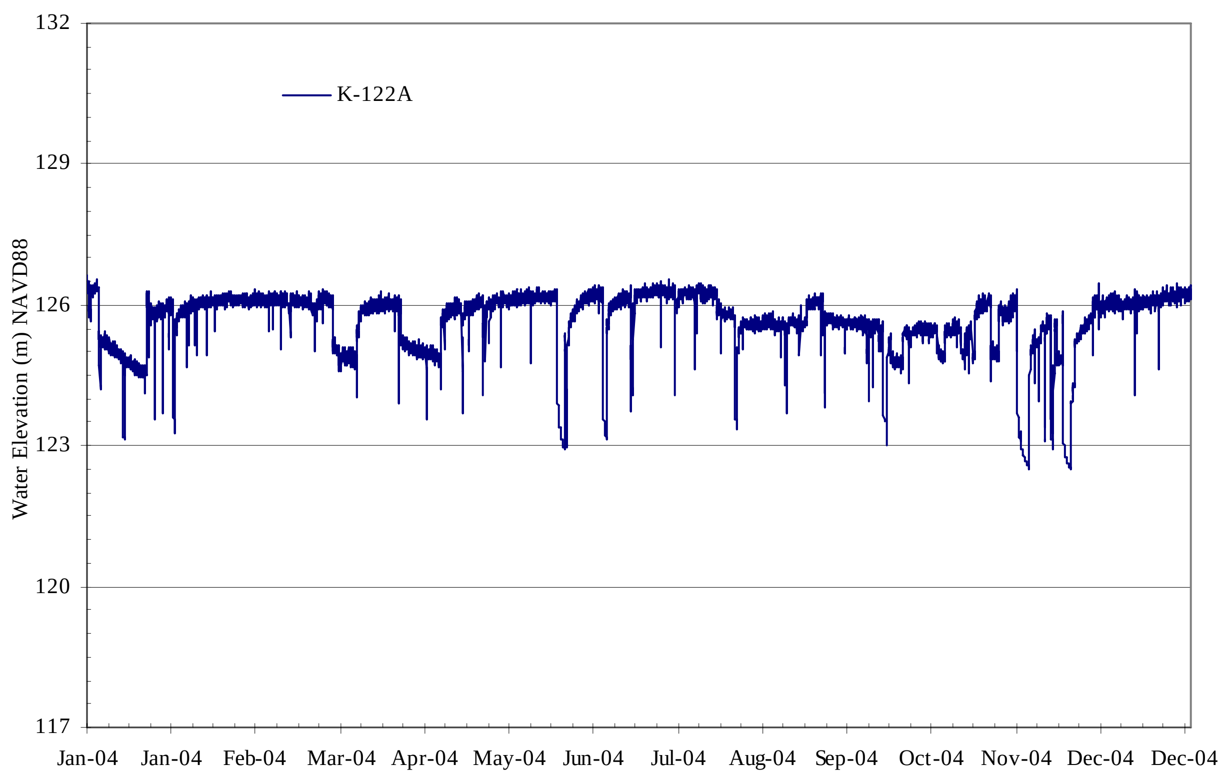
120
117
Jan-04 Jan-04 Feb-04 Mar-04 Apr-04 May-04 Jun-04 Jul-04 Aug-04 Sep-04 Oct-04 Nov-04 Dec-04 Dec-04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Water Elevation (m) NAVD88
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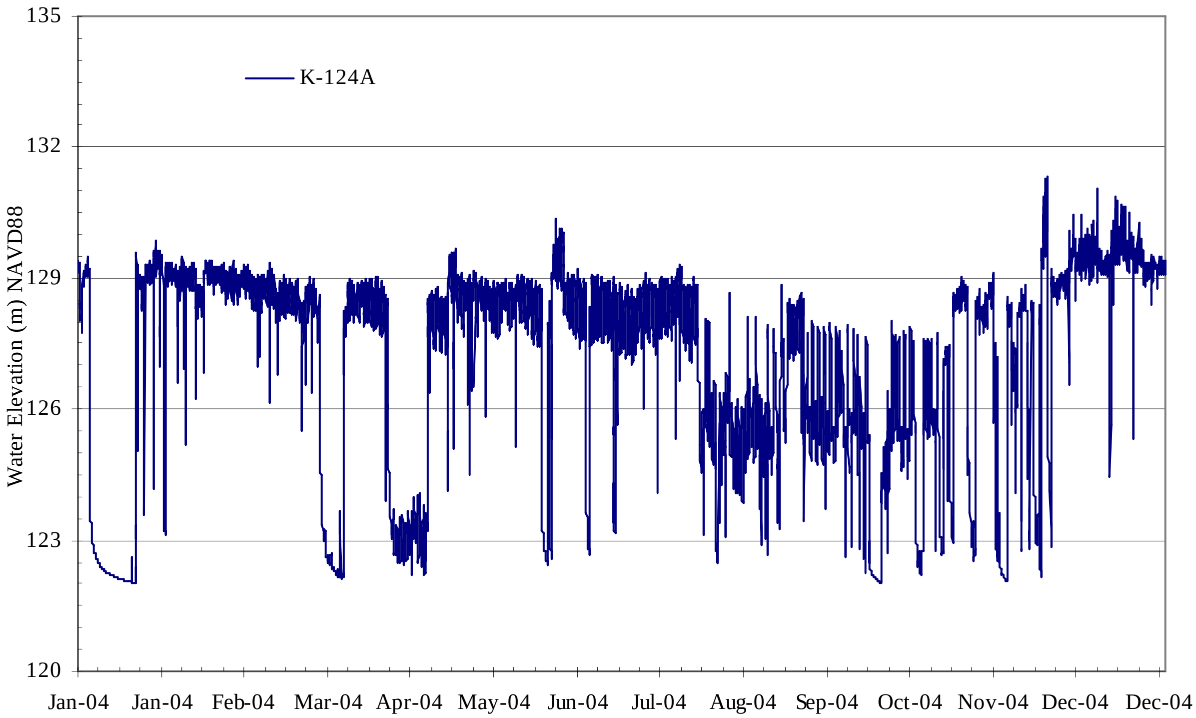
123
120
117
Jan-04 Jan-04 Feb-04 Mar-04 Apr-04 May-04 Jun-04 Jul-04 Aug-04 Sep-04 Oct-04 Nov-04 Dec-04 Dec-04



K-124A
Water Elevation (m) NAVD88
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126
123
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Jan-04
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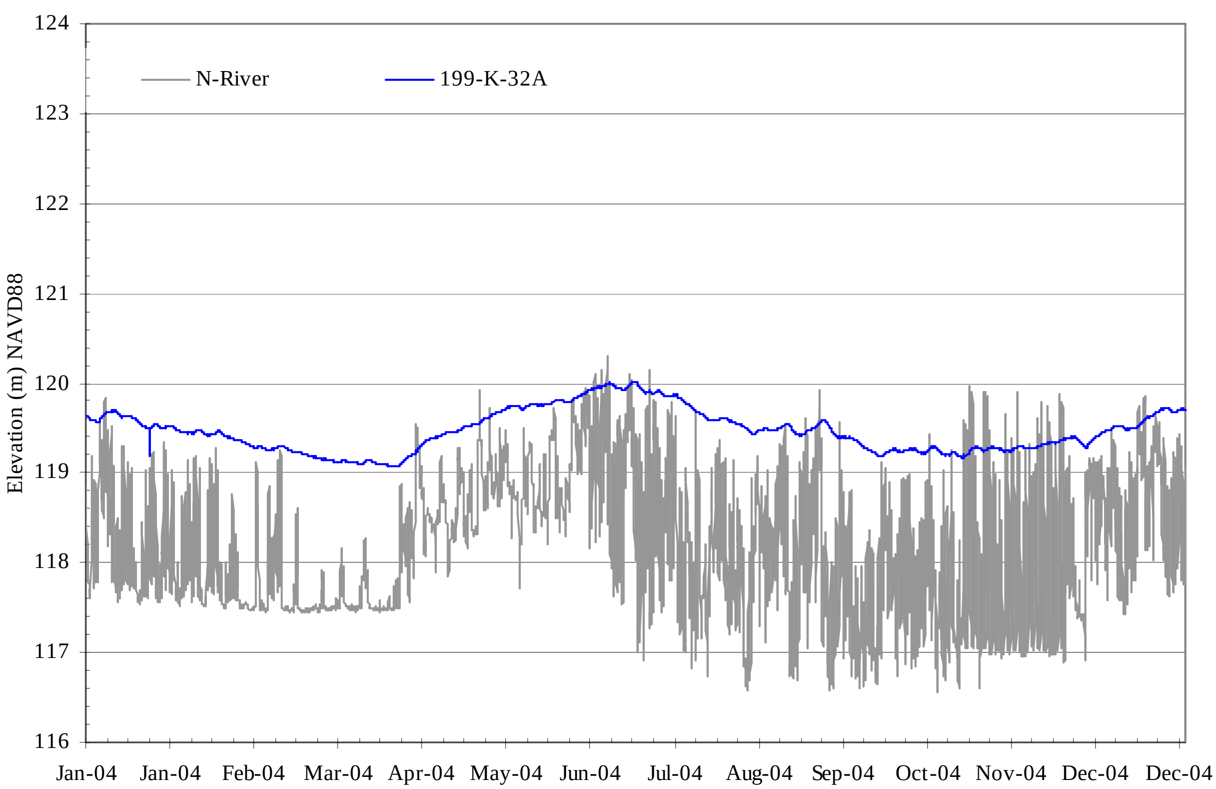
Dec-04



N-River
199-K-32A
Elevation (m) NAVD88
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122
121
120
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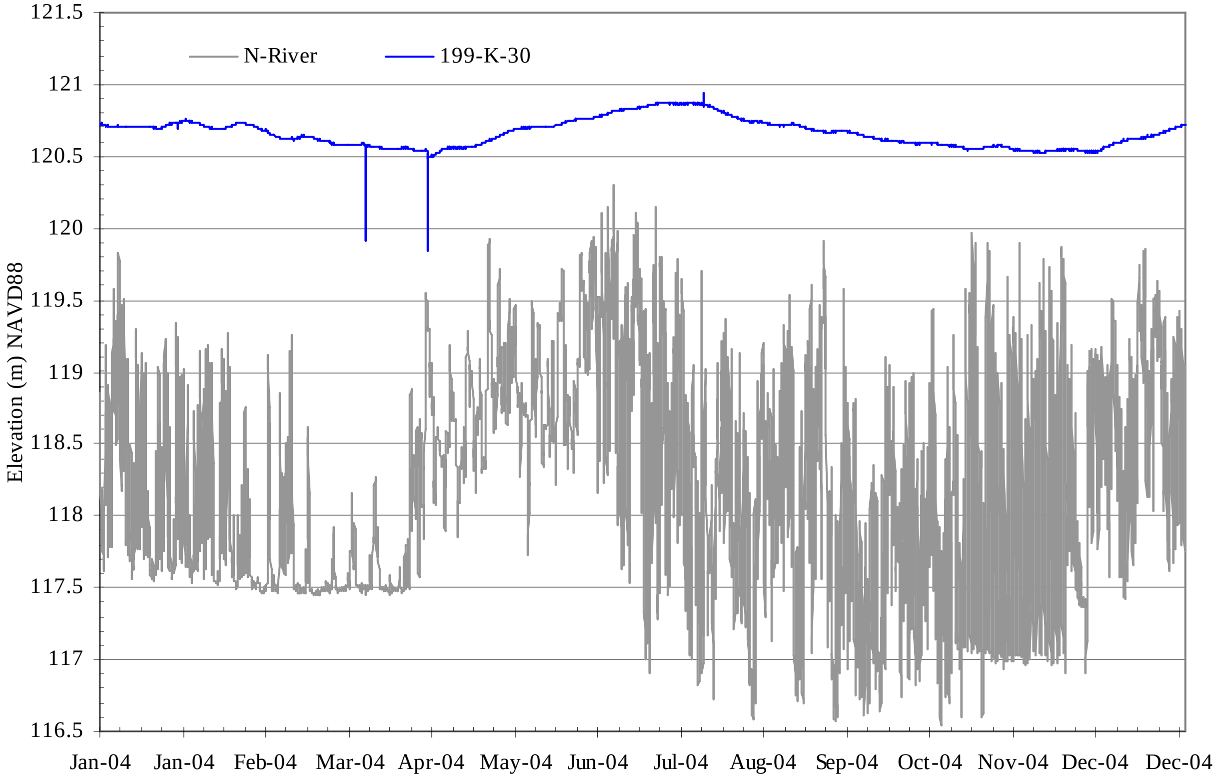
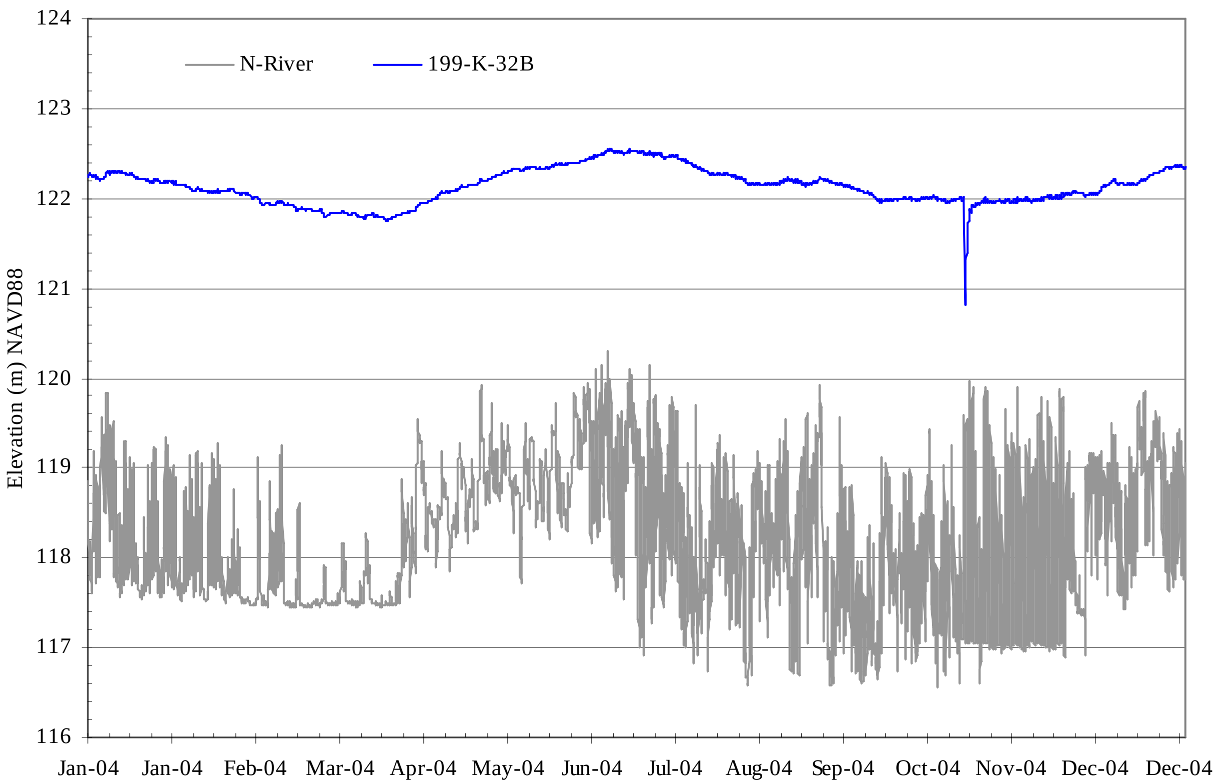
118
117
116
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04


N-River
199-K-30
Elevation (m) NAVD88
121.5
121
120.5
120
119.5
119
118.5
118
117.5
117
116.5
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04


N-River
199-K-32B
Elevation (m) NAVD88
124
123
122
121
120
119
118
117
116
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
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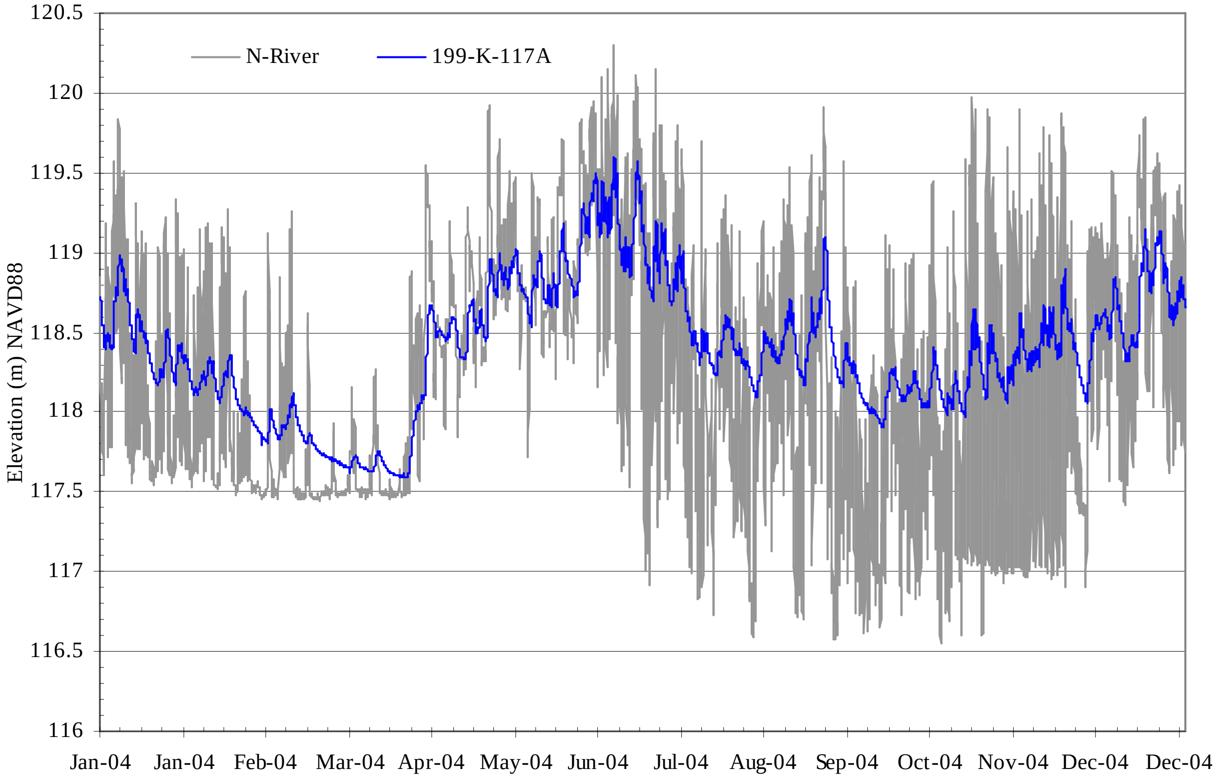
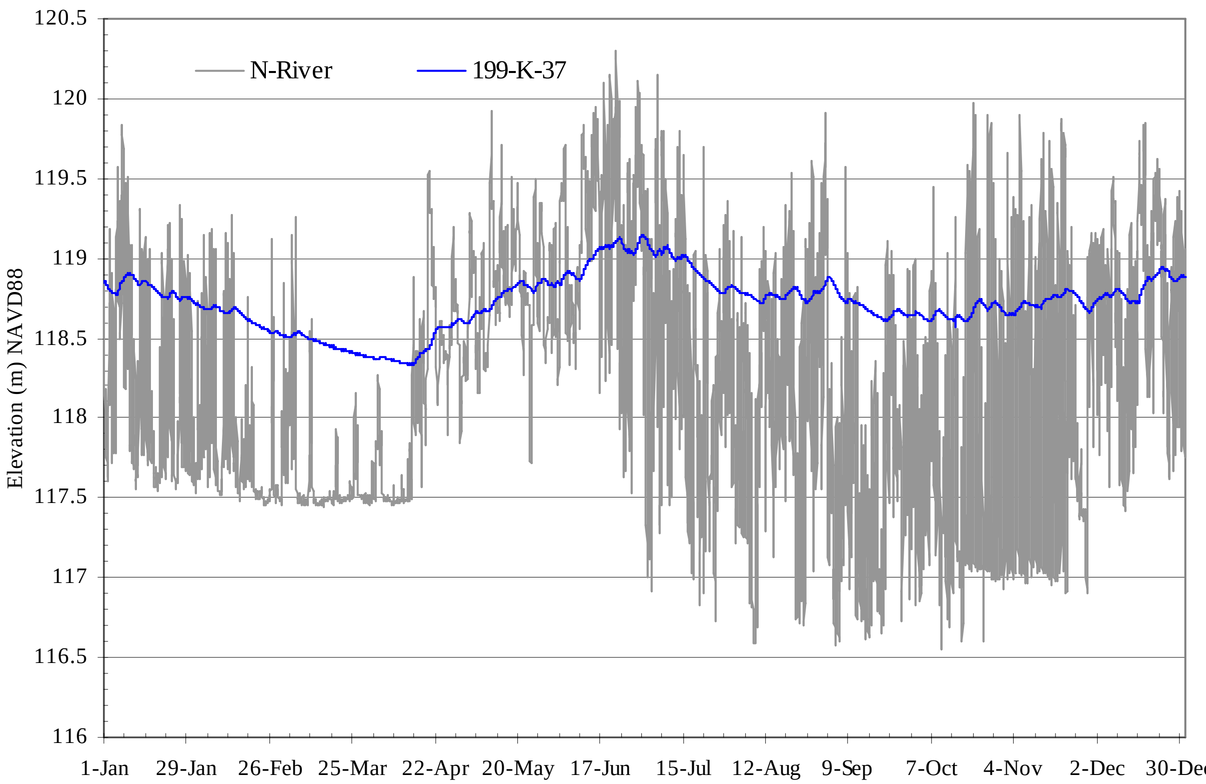
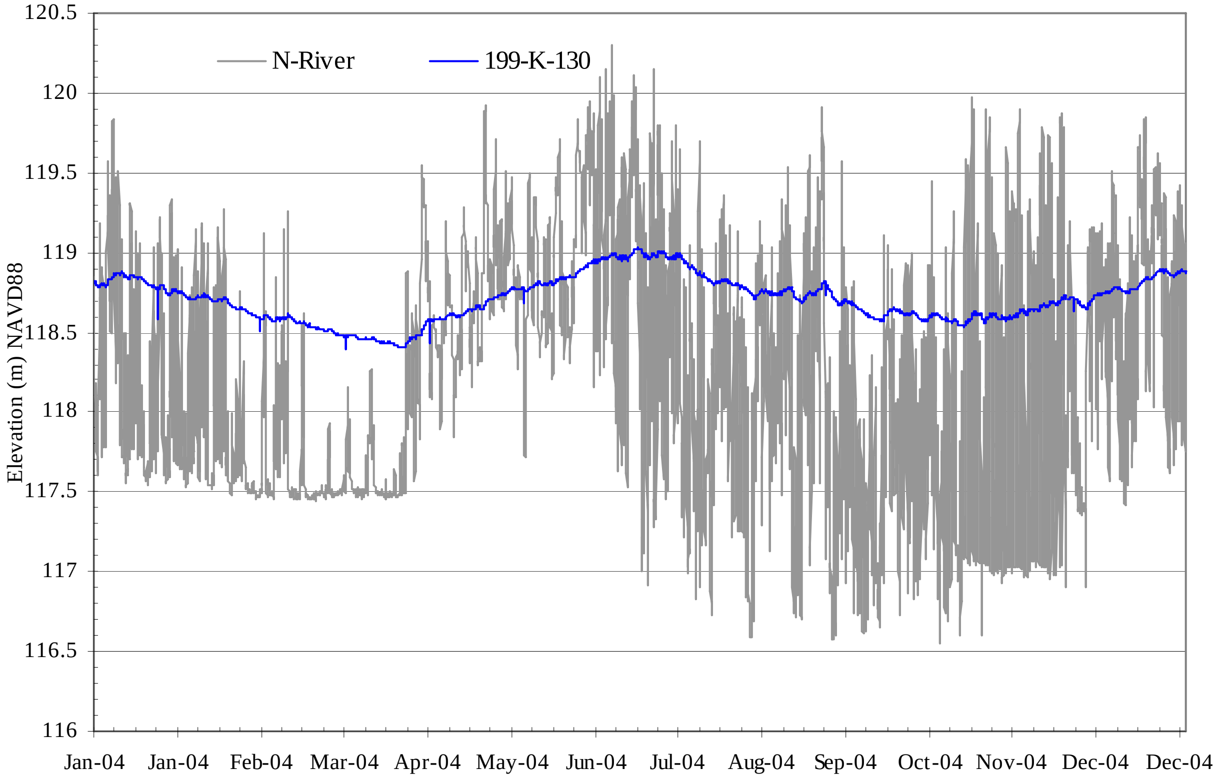
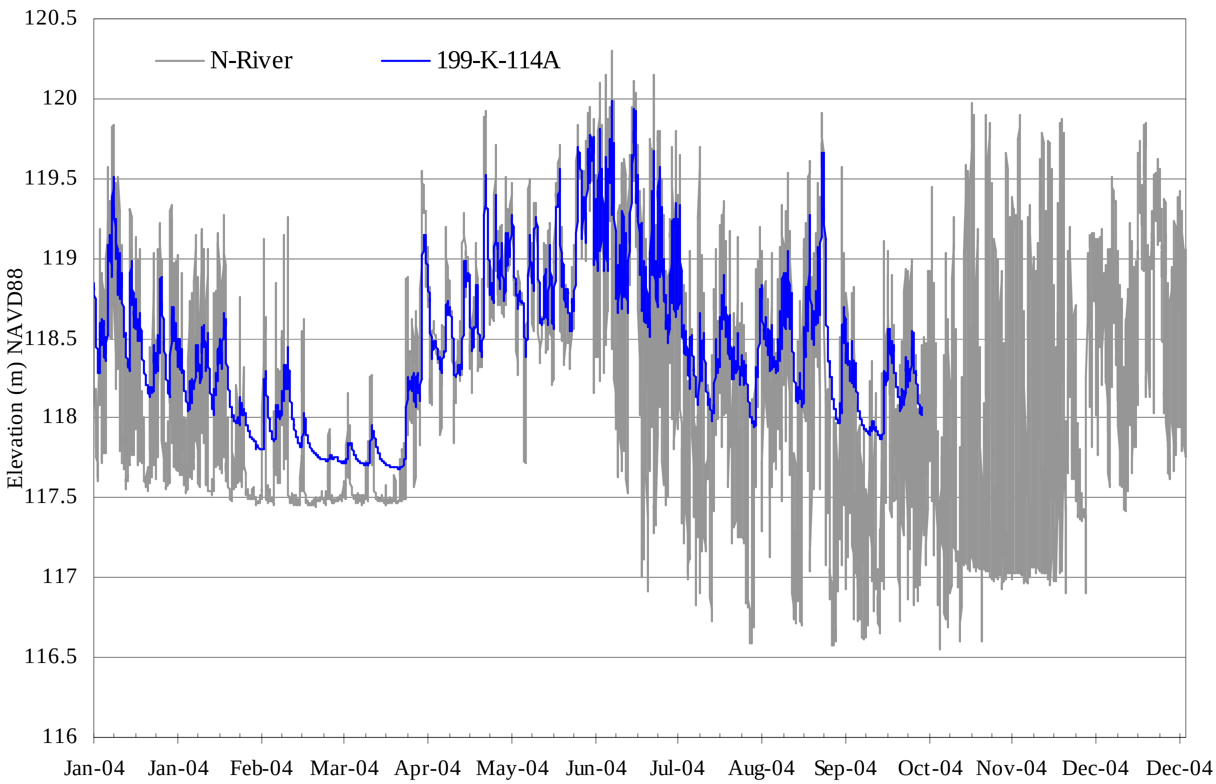
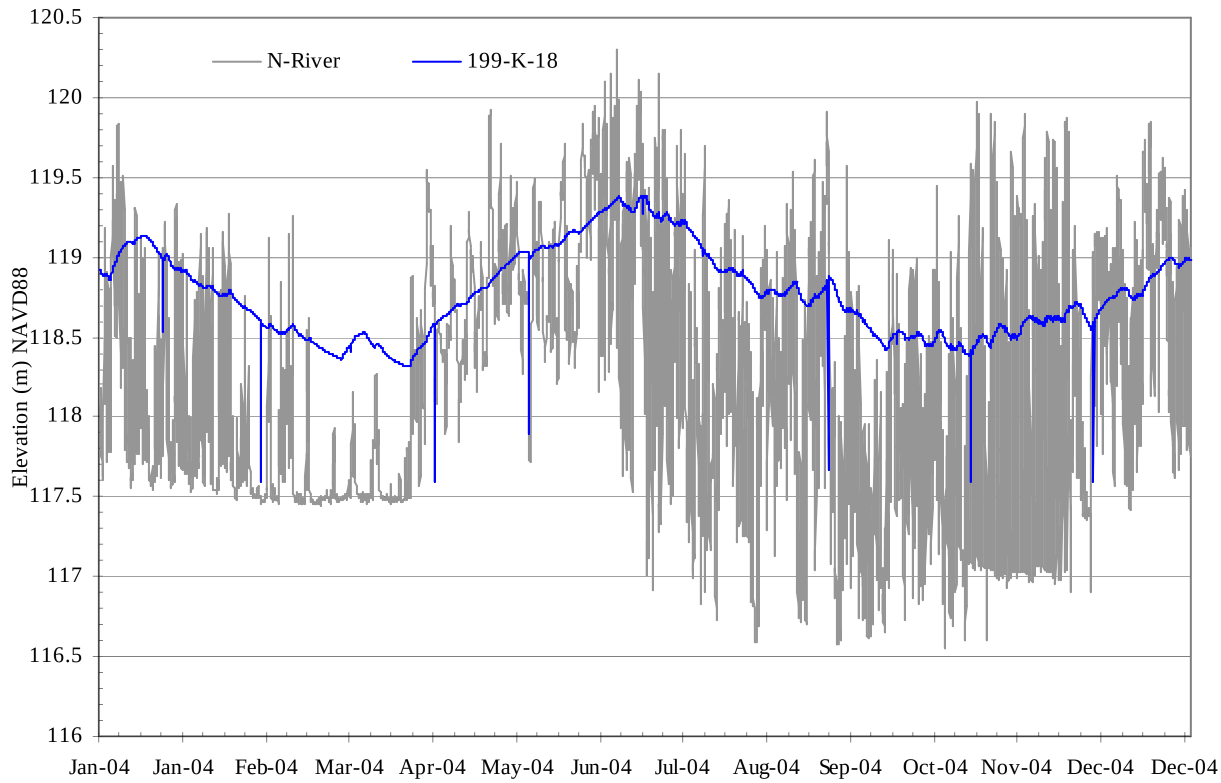
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04

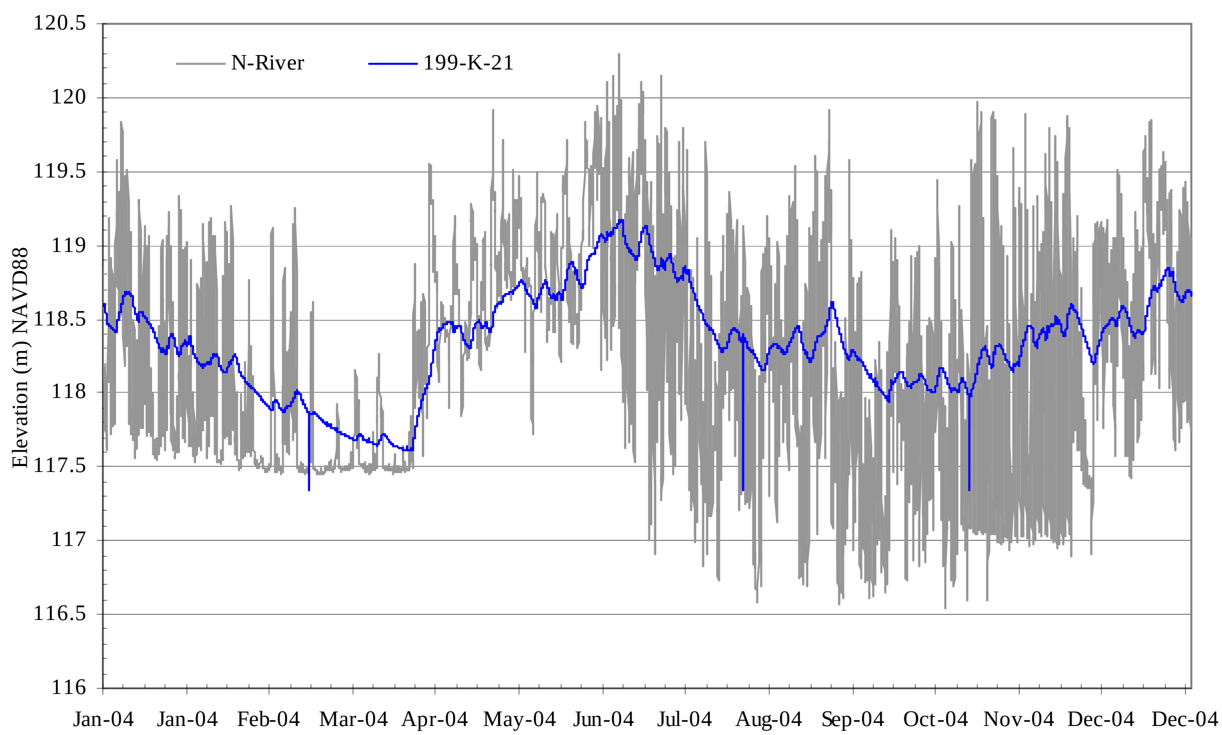

N-River
199-K-117A
Elevation (m) NAVD88
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04

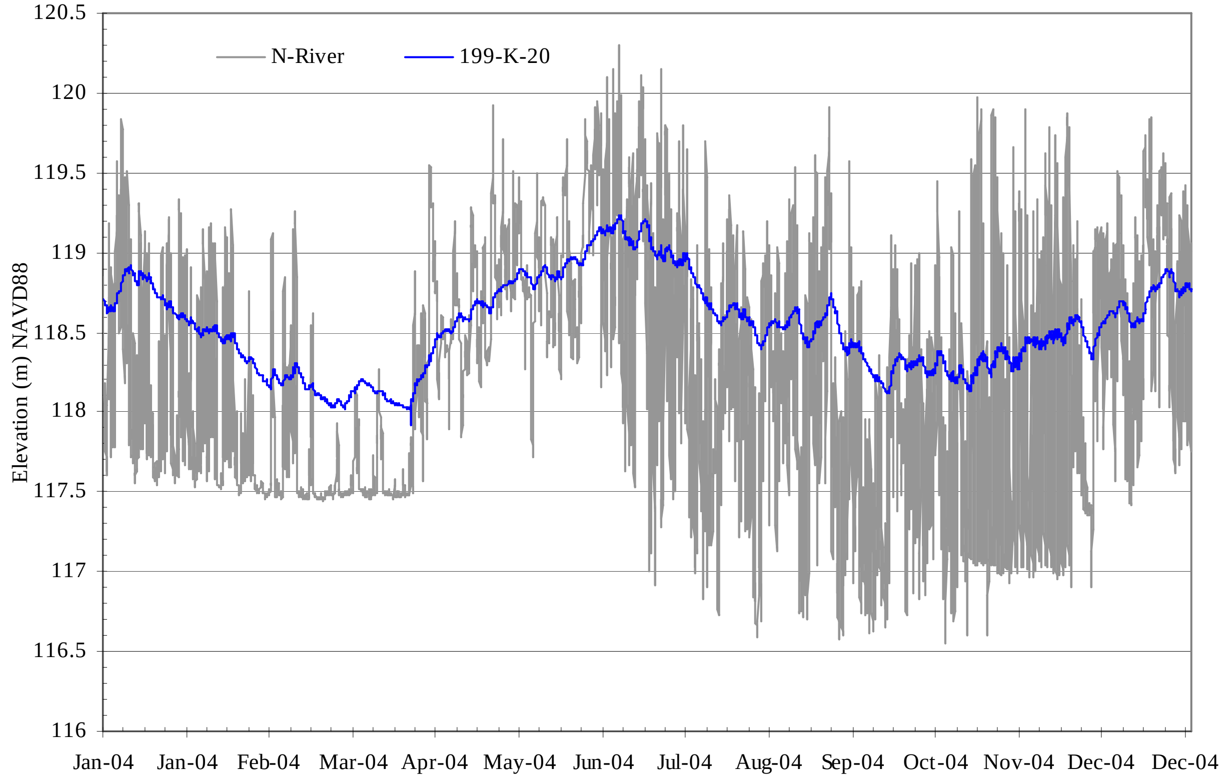

N-River
199-K-37
Elevation (m) NAVD88
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
1-Jan
29-Jan
26-Feb
25-Mar
22-Apr
20-May
17-Jun
15-Jul
12-Aug
9-Sep
7-Oct
4-Nov
2-Dec
30-Dec

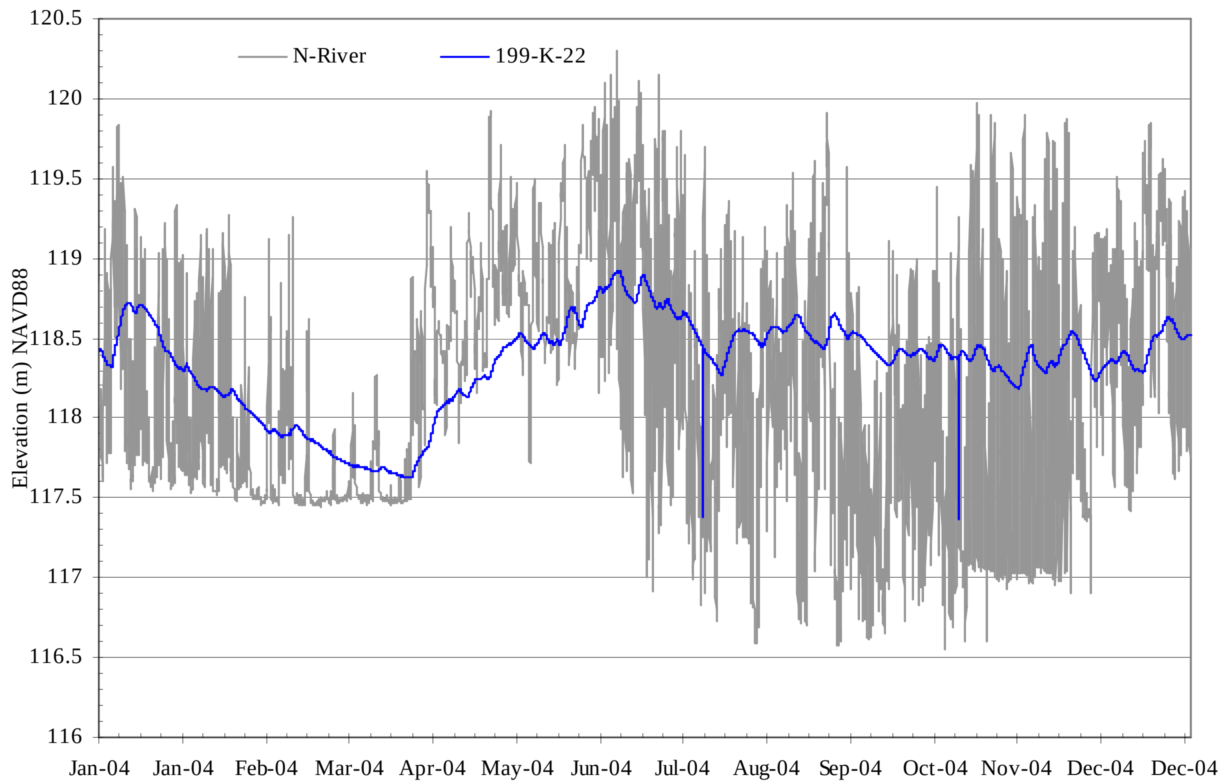

N-River
199-K-130
Elevation (m) NAVD88
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04


N-River
199-K-114A
Elevation (m) NAVD88
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04


N-River
199-K-18
Elevation (m) NAVD88
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04


N-River
199-K-21
Elevation (m) NAVD88
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04


N-River
199-K-20
Elevation (m) NAVD88
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04


N-River
199-K-22
Elevation (m) NAVD88
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04

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APPENDIX K

100-KR-4 CONTAMINANT TREND PLOTS

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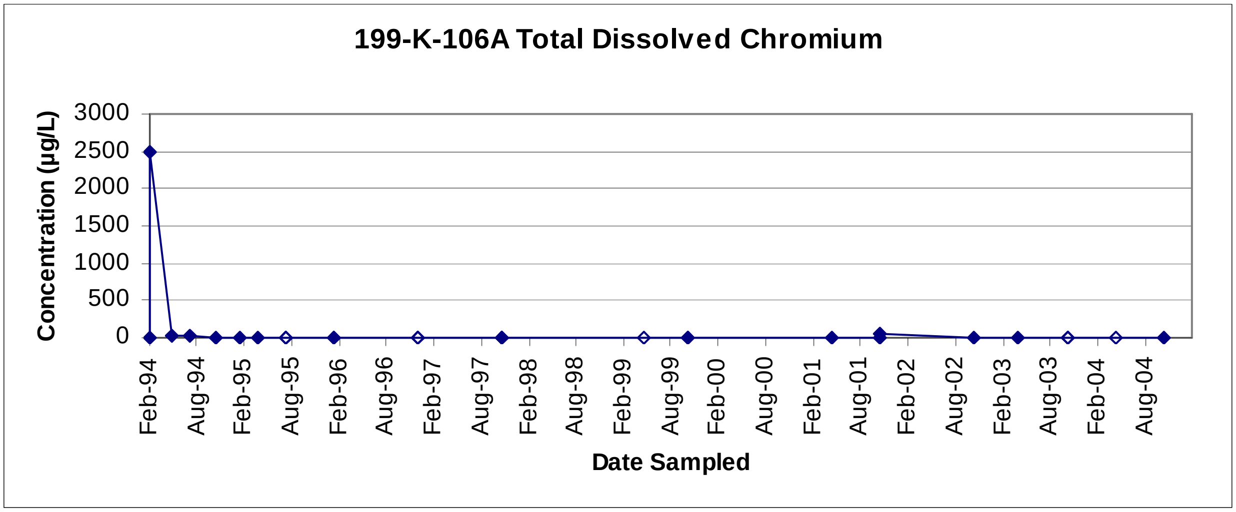
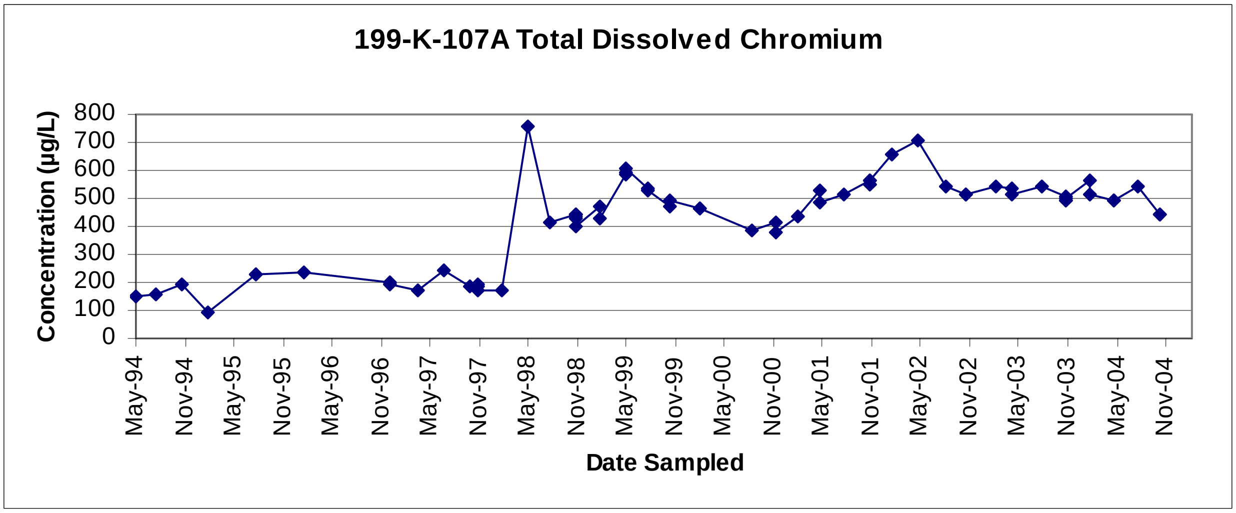
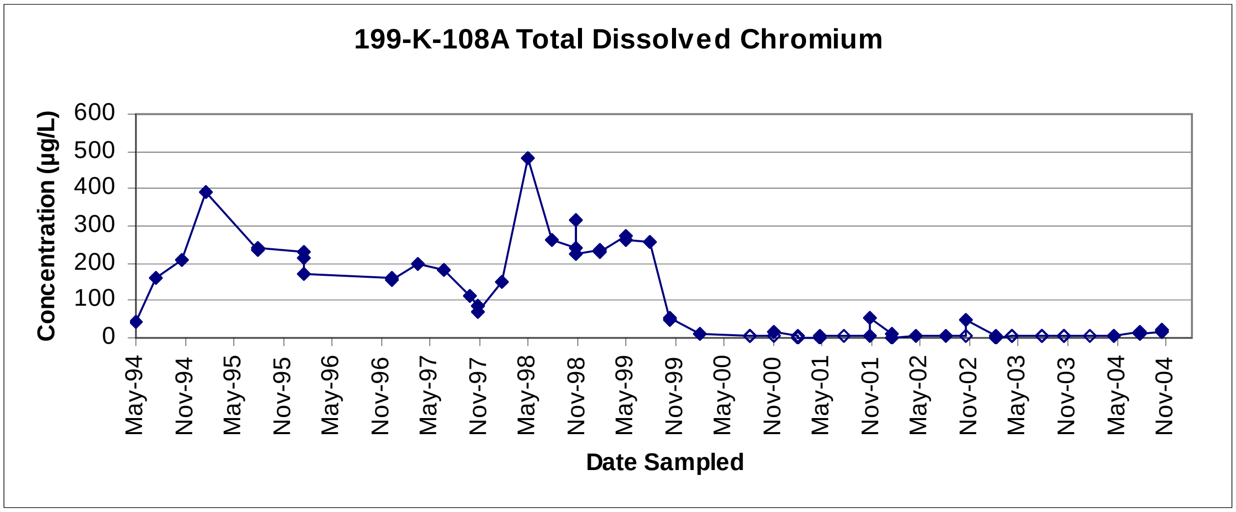
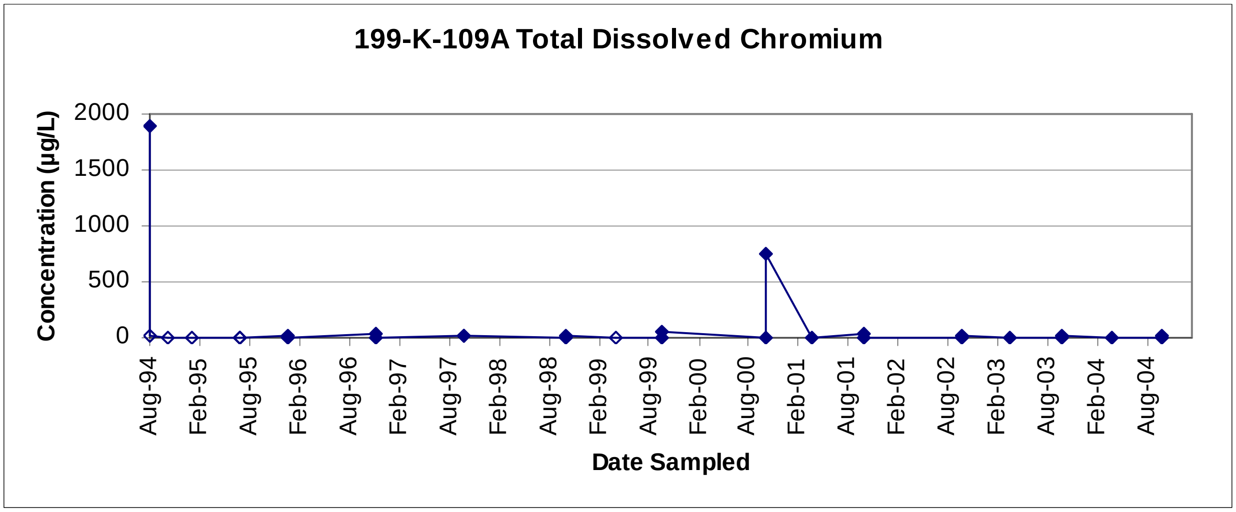
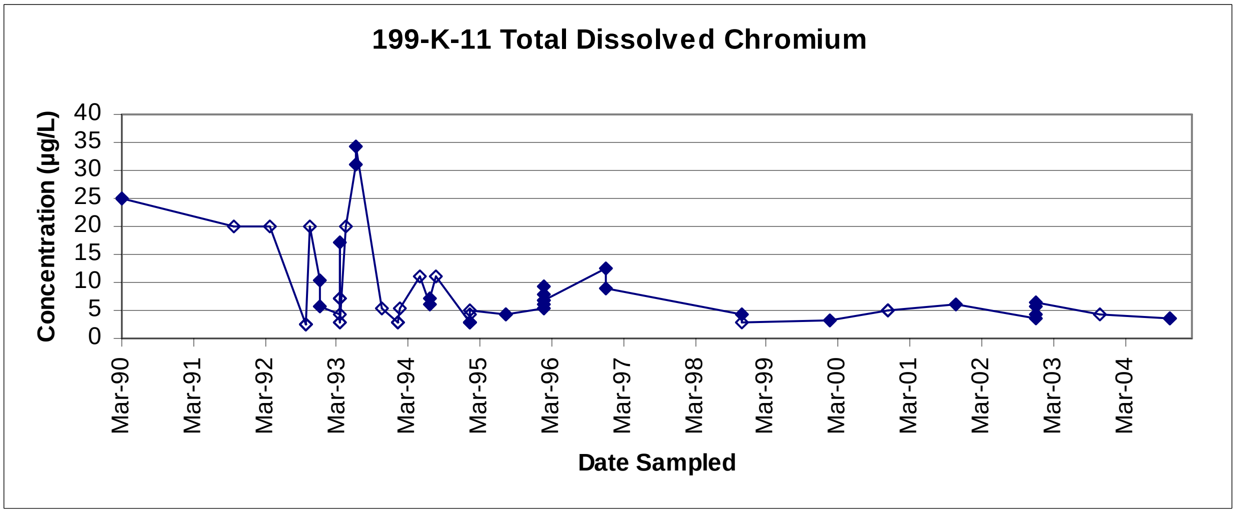
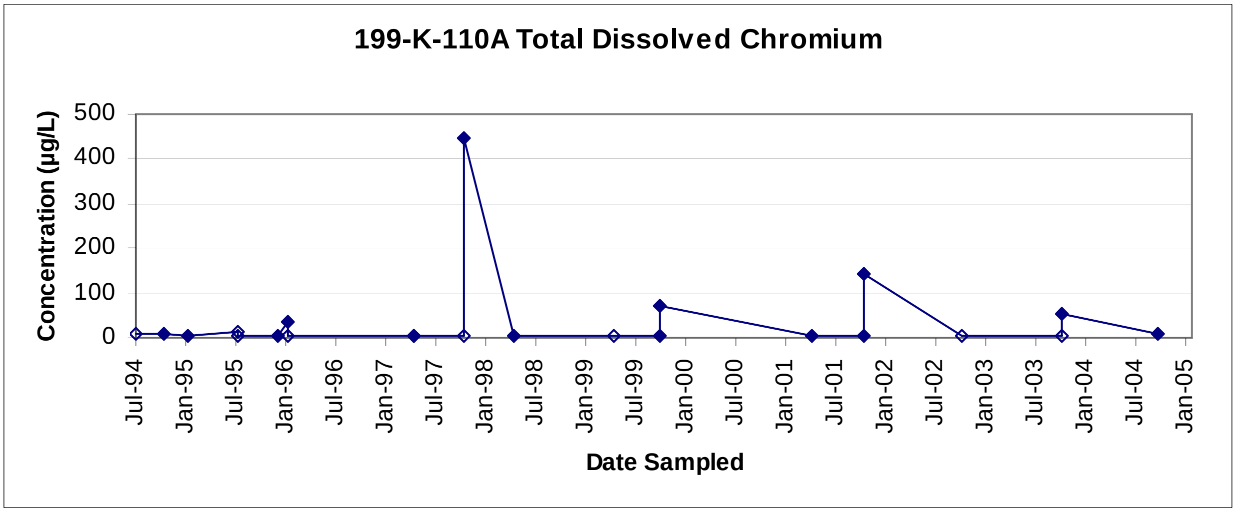

199-K-106A Total Dissolved Chromium
Concentration (µg/L)
3000
2500
2000
1500
1000
500
0
Feb-94
Aug-94
Feb-95
Aug-95
Feb-96
Aug-96
Feb-97
Aug-97
Feb-98
Aug-98
Feb-99
Aug-99
Feb-00
Aug-00
Feb-01
Aug-01
Feb-02
Aug-02
Feb-03
Aug-03
Feb-04
Aug-04
Date Sampled

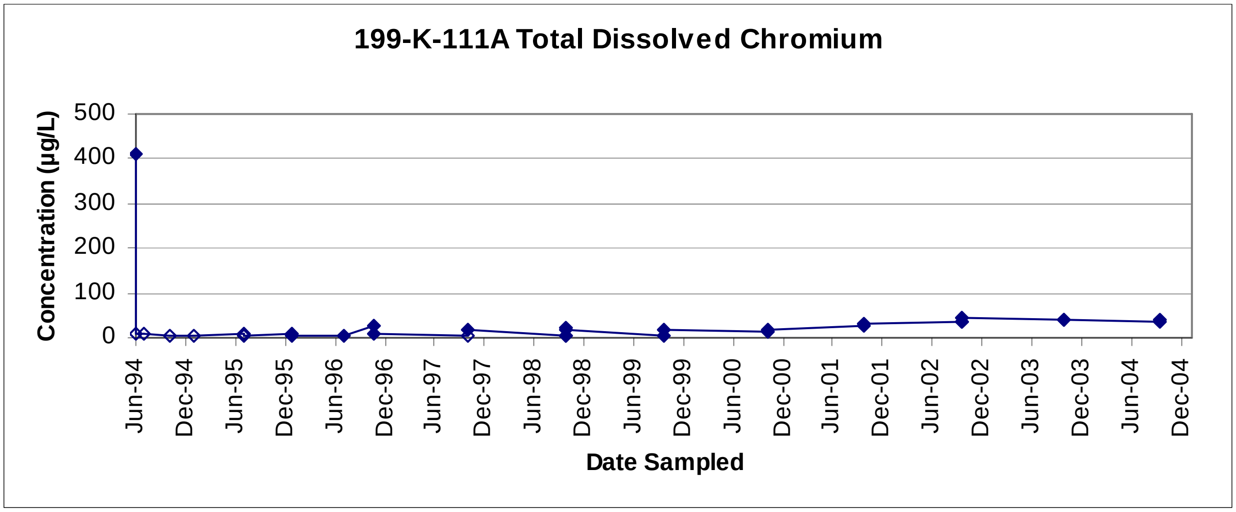

199-K-107A Total Dissolved Chromium
Concentration (µg/L)
800
700
600
500
400
300
200
100
0
May-94
Nov-94
May-95
Nov-95
May-96
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
Date Sampled


199-K-108A Total Dissolved Chromium
Concentration (µg/L)
600
500
400
300
200
100
0
May-94
Nov-94
May-95
Nov-95
May-96
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
Date Sampled

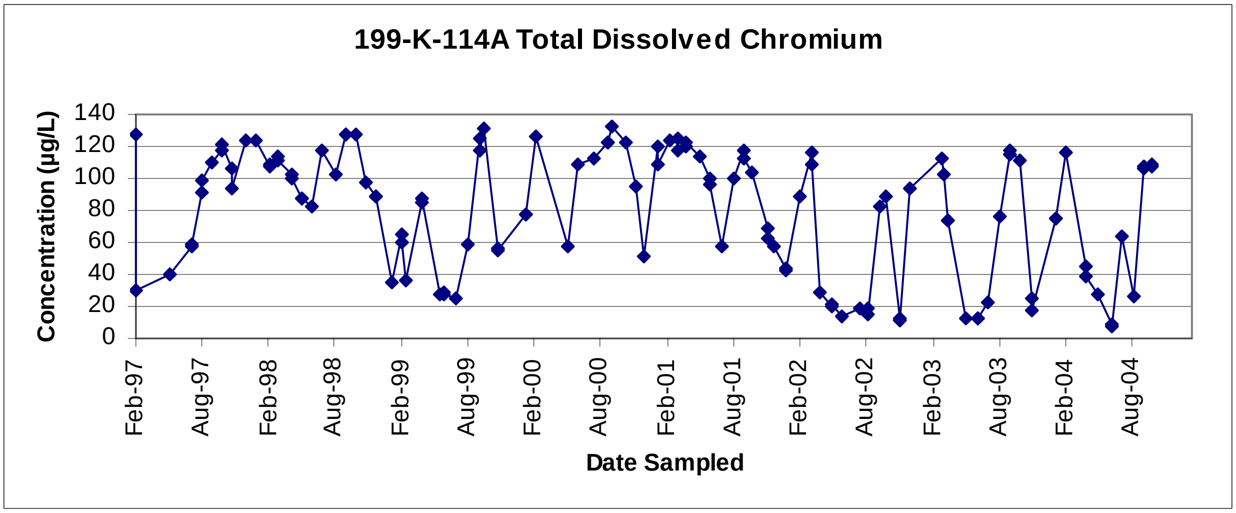

199-K-109A Total Dissolved Chromium
Concentration (µg/L)
2000
1500
1000
500
0
Aug-94
Feb-95
Aug-95
Feb-96
Aug-96
Feb-97
Aug-97
Feb-98
Aug-98
Feb-99
Aug-99
Feb-00
Aug-00
Feb-01
Aug-01
Feb-02
Aug-02
Feb-03
Aug-03
Feb-04
Aug-04
Date Sampled


199-K-11 Total Dissolved Chromium
Concentration (µg/L)
40
35
30
25
20
15
10
5
0
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

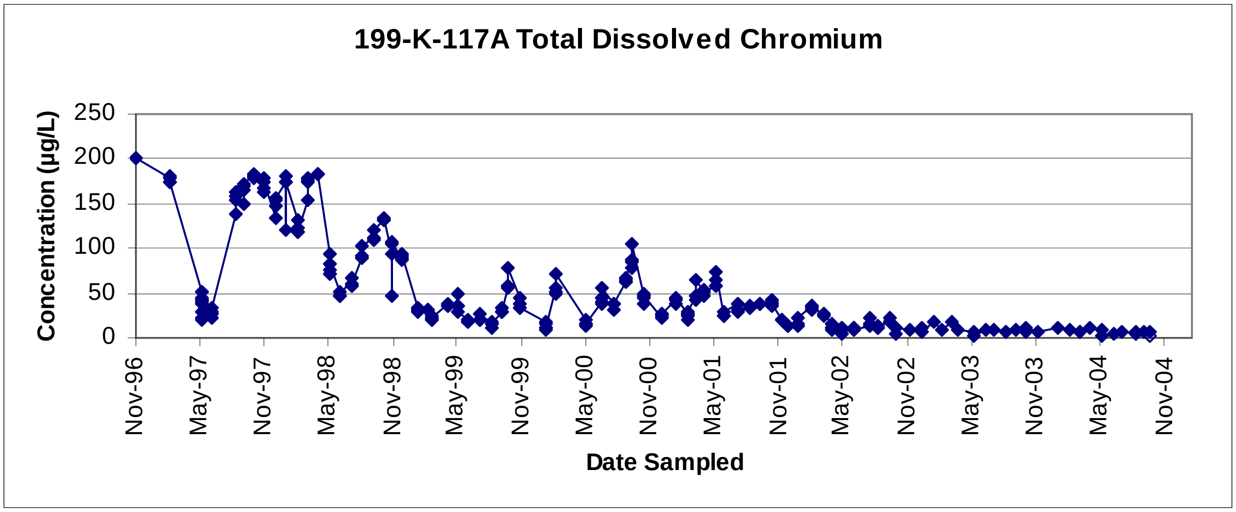

199-K-110A Total Dissolved Chromium
Concentration (µg/L)
500
400
300
200
100
0
Jul-94
Jan-95
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Date Sampled



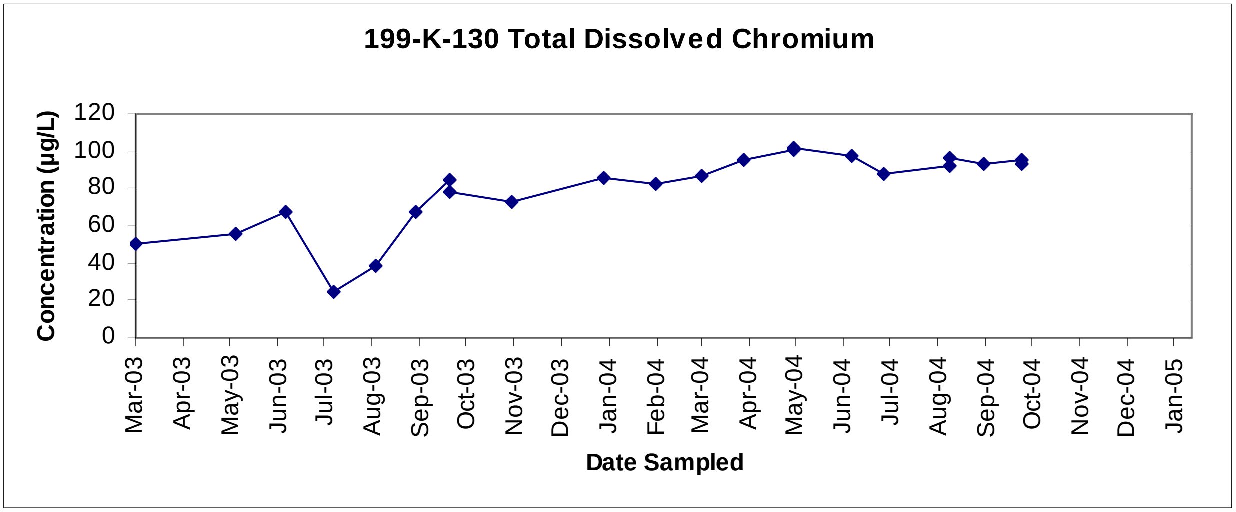
199-K-111A Total Dissolved Chromium
Concentration (µg/L)
500
400
300
200
100
0
Jun-94
Dec-94
Jun-95
Dec-95
Jun-96
Dec-96
Jun-97
Dec-97
Jun-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
Jun-02
Dec-02
Jun-03
Dec-03
Jun-04
Dec-04
Date Sampled

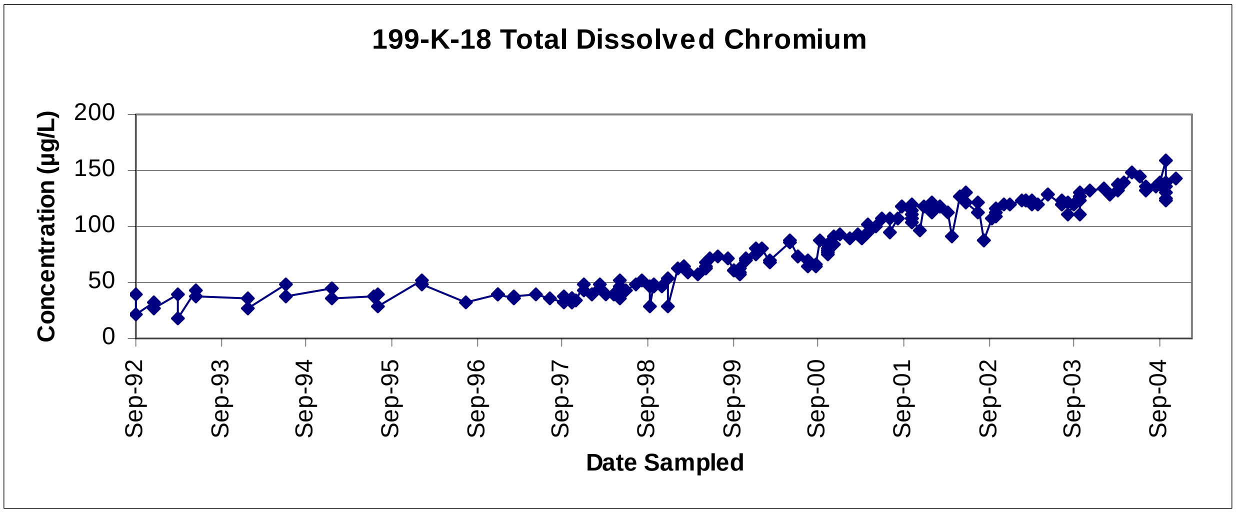


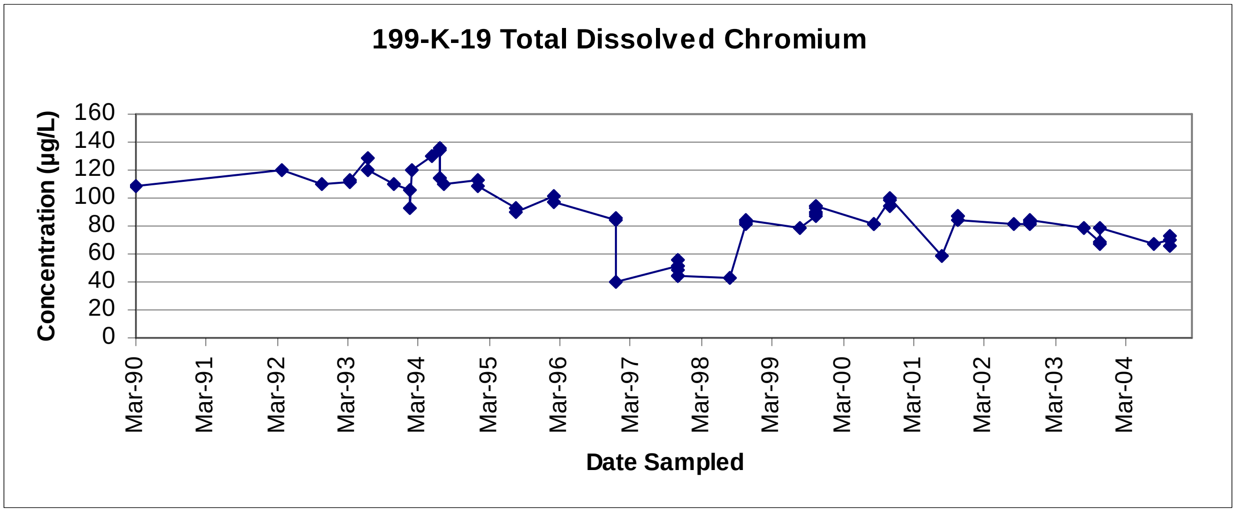
199-K-114A Total Dissolved Chromium
Concentration (µg/L)
140
120
100
80
60
40
20
0
Feb-97
Aug-97
Feb-98
Aug-98
Feb-99
Aug-99
Feb-00
Aug-00
Feb-01
Aug-01
Feb-02
Aug-02
Feb-03
Aug-03
Feb-04
Aug-04
Date Sampled

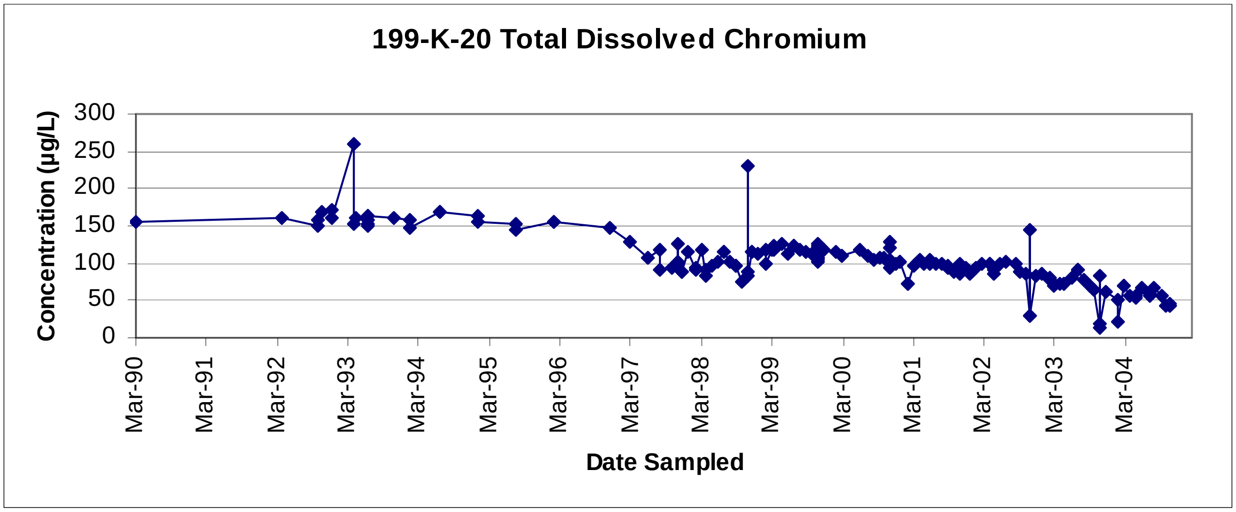


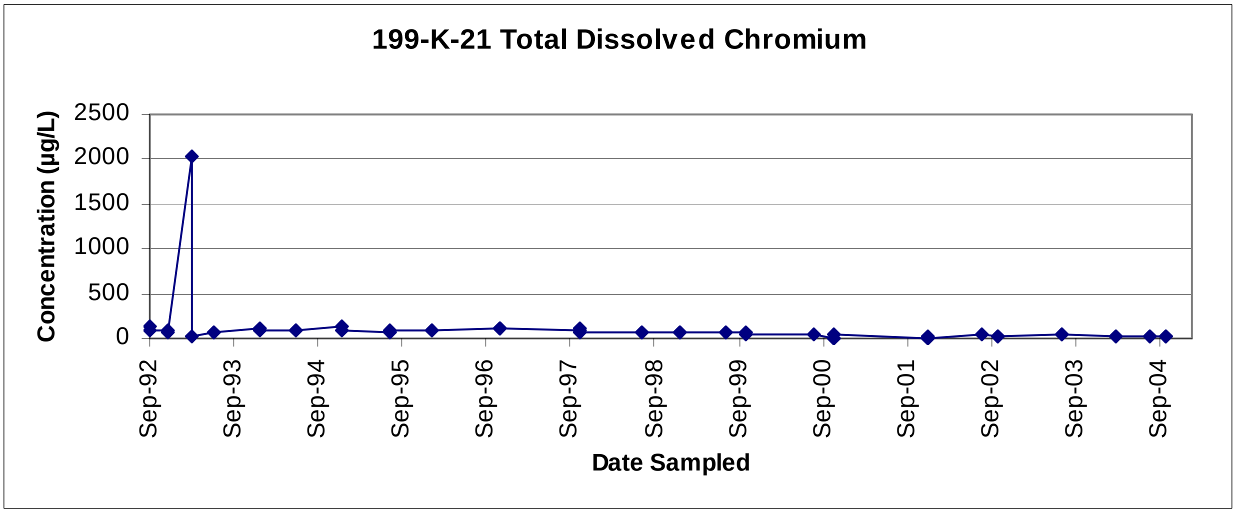
199-K-117A Total Dissolved Chromium
Concentration (µg/L)
250
200
150
100
50
0
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
Date Sampled

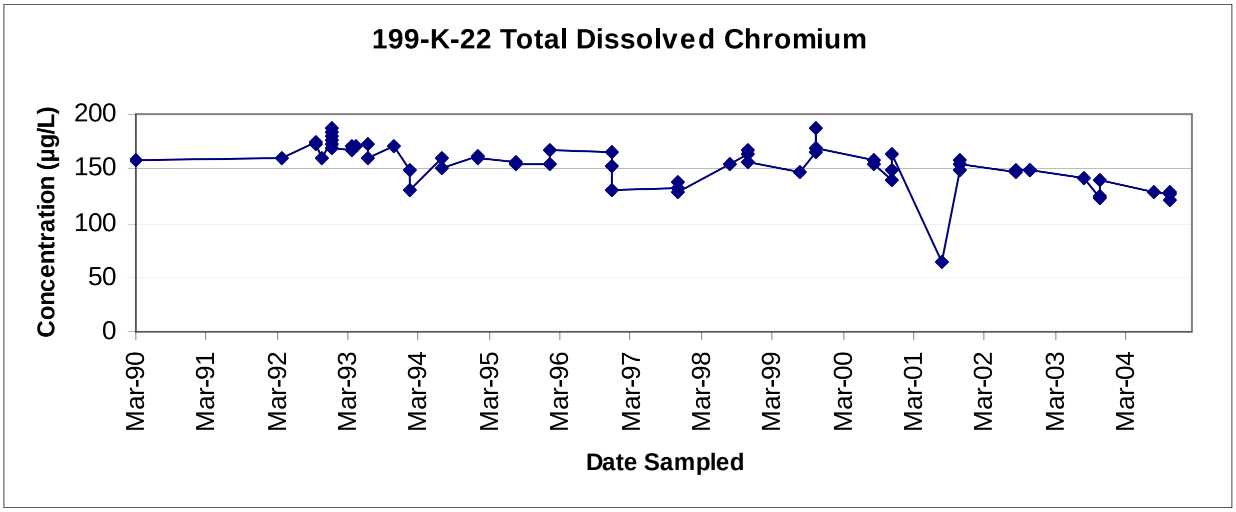

199-K-130 Total Dissolved Chromium
Concentration (µg/L)
0
20
40
60
80
100
120
Mar-03
Apr-03
May-03
Jun-03
Jul-03
Aug-03
Sep-03
Oct-03
Nov-03
Dec-03
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

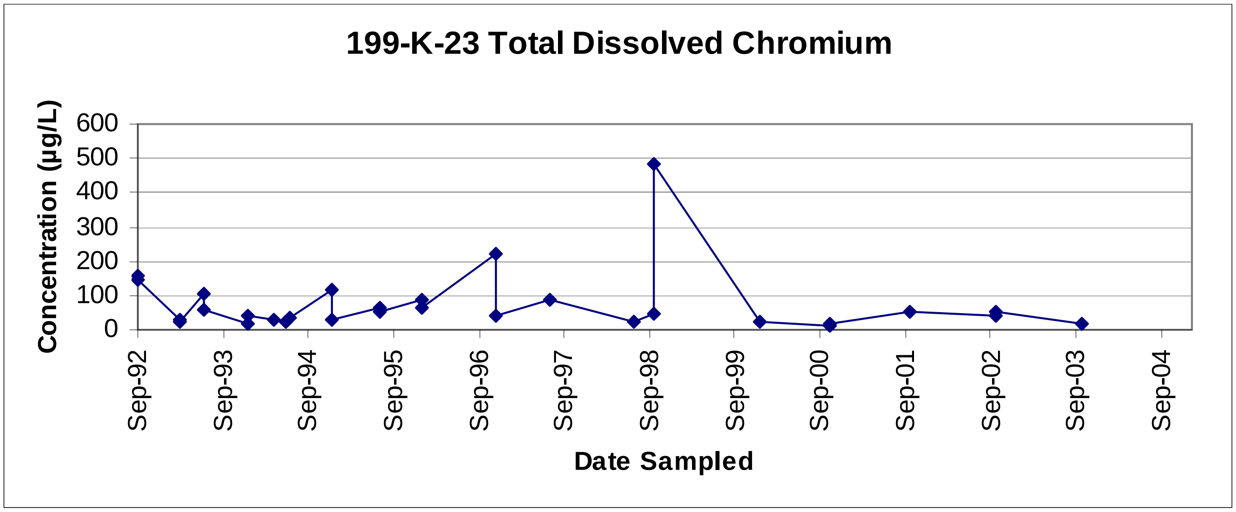

199-K-18 Total Dissolved Chromium
Concentration (µg/L)
0
50
100
150
200
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

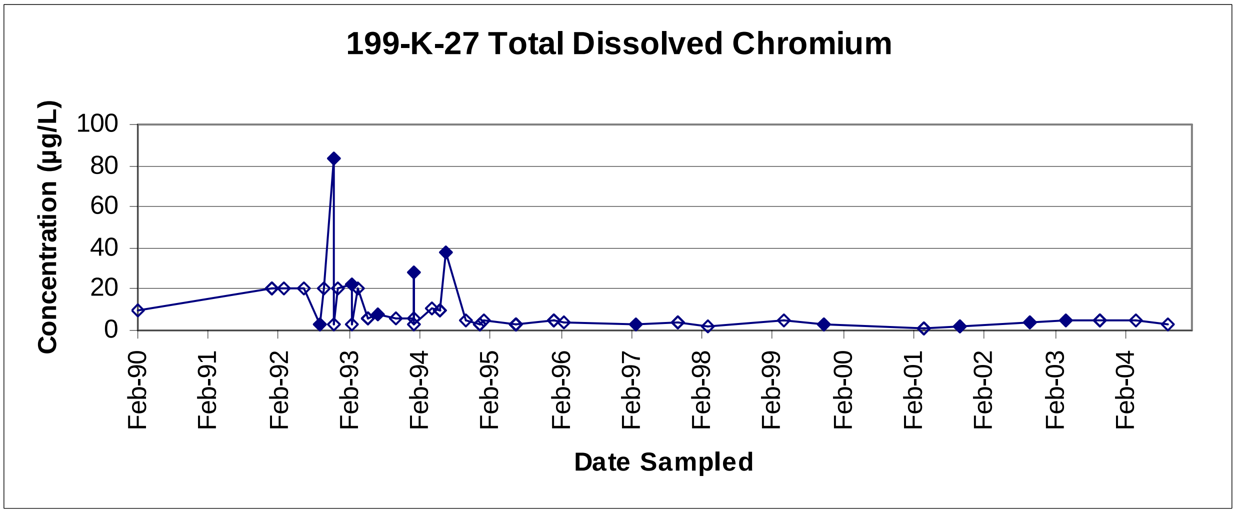

199-K-19 Total Dissolved Chromium
Concentration (µg/L)
0
20
40
60
80
100
120
140
160
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

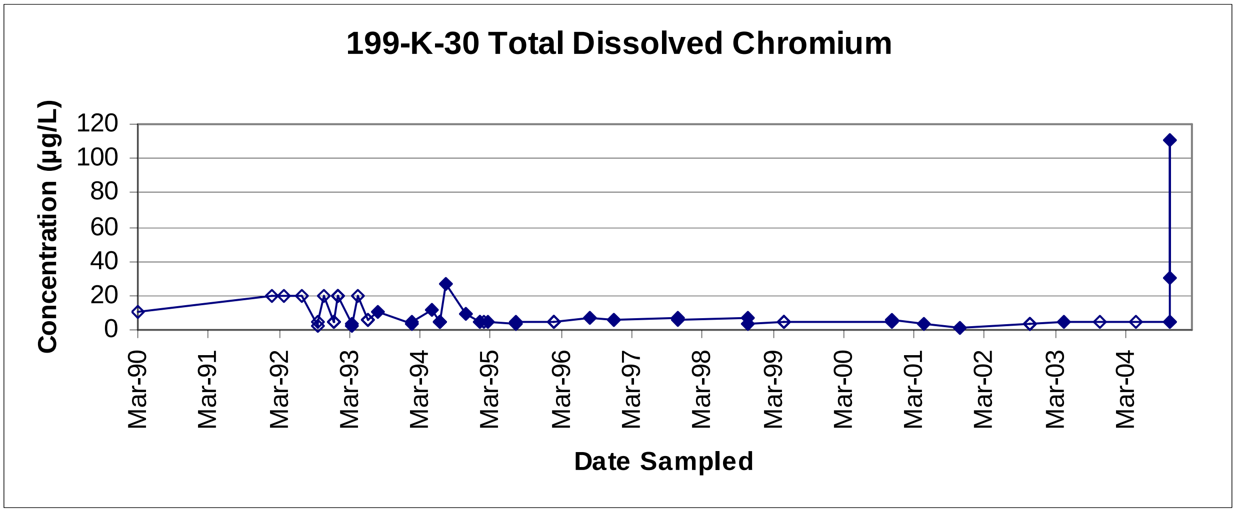

199-K-20 Total Dissolved Chromium
Concentration (µg/L)
300
250
200
150
100
50
0
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

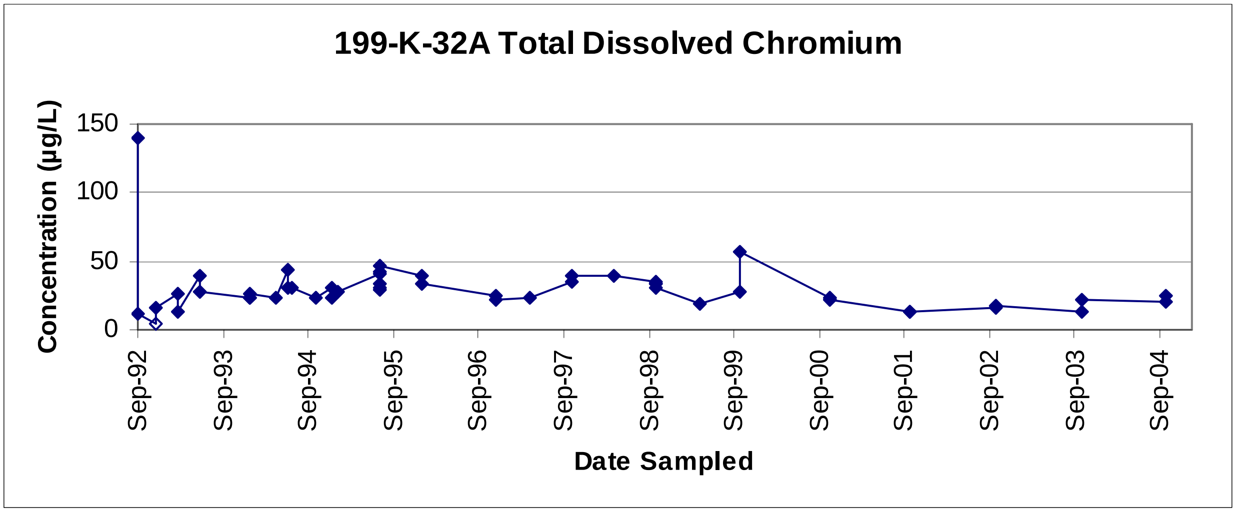

199-K-21 Total Dissolved Chromium
Concentration (µg/L)
2500
2000
1500
1000
500
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

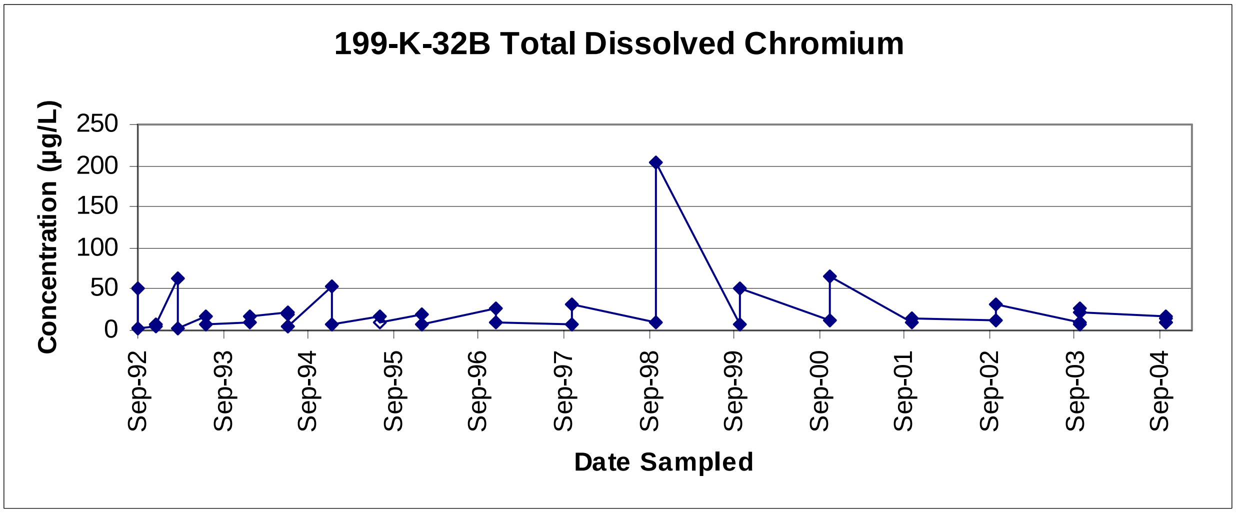

199-K-22 Total Dissolved Chromium
Concentration (µg/L)
200
150
100
50
0
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

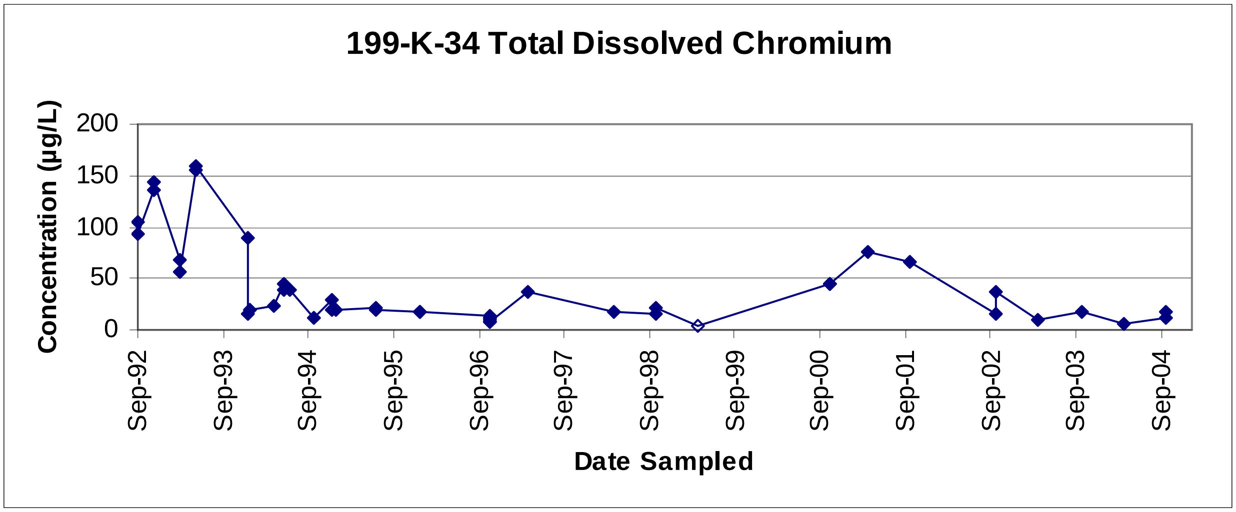

199-K-23 Total Dissolved Chromium
Concentration (µg/L)
0
100
200
300
400
500
600
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

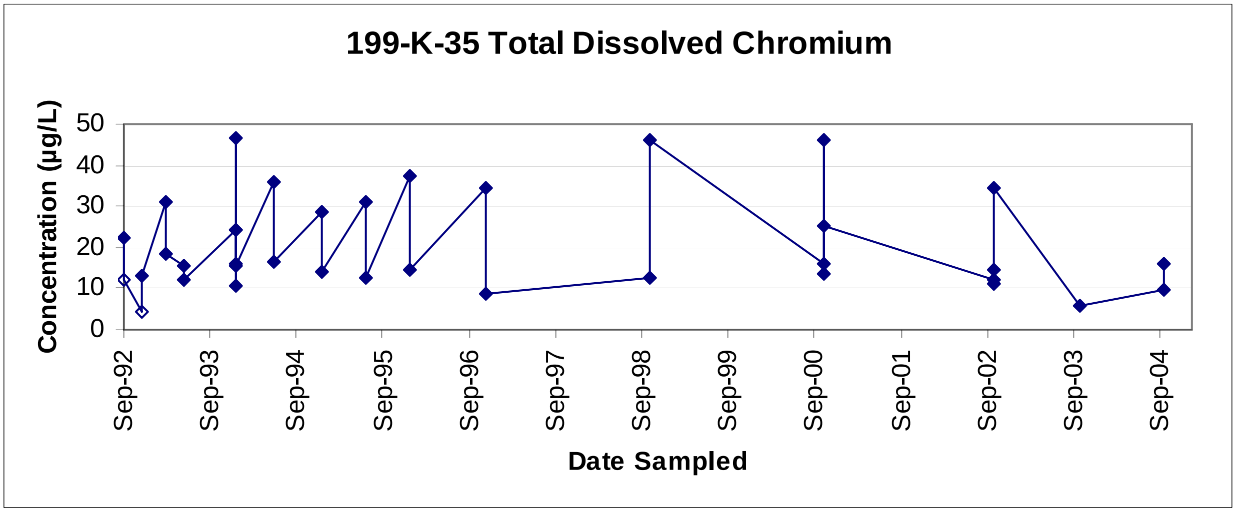

199-K-27 Total Dissolved Chromium
Concentration (µg/L)
0
20
40
60
80
100
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

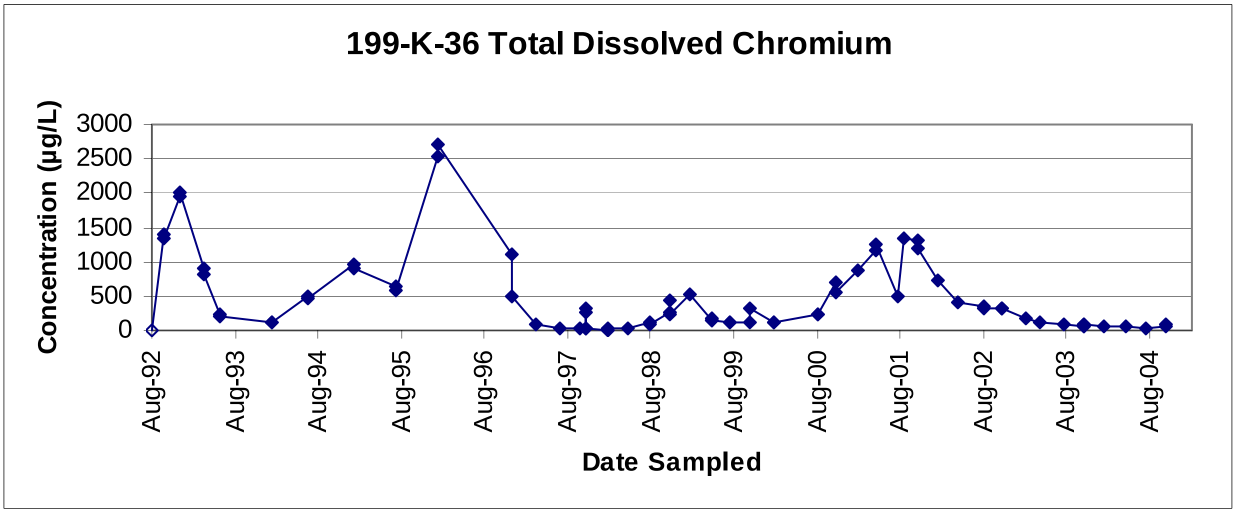

199-K-30 Total Dissolved Chromium
Concentration (µg/L)
0
20
40
60
80
100
120
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

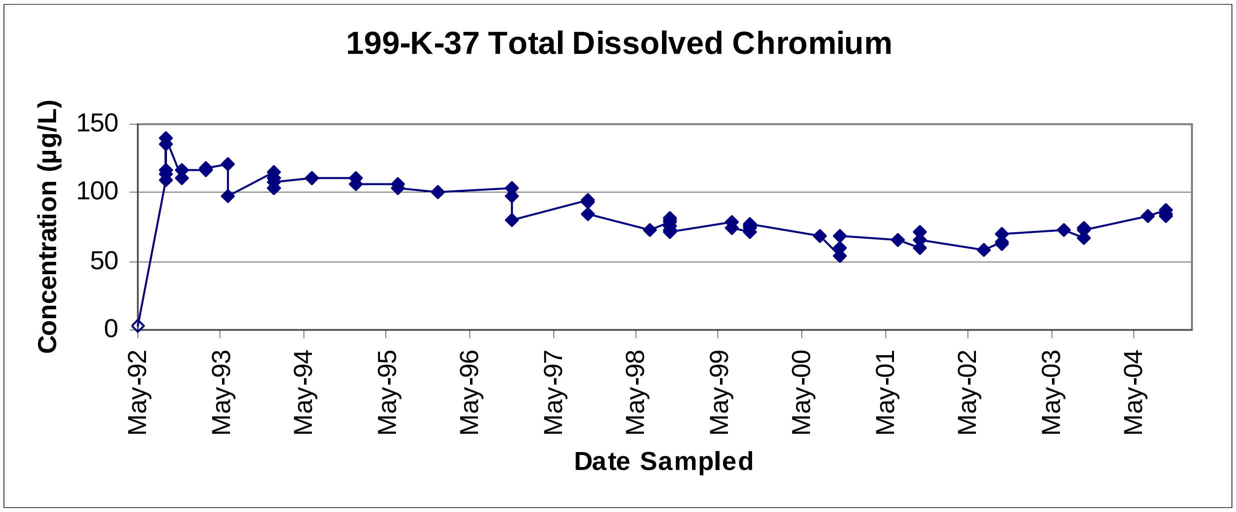

199-K-32A Total Dissolved Chromium
Concentration (µg/L)
150
100
50
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

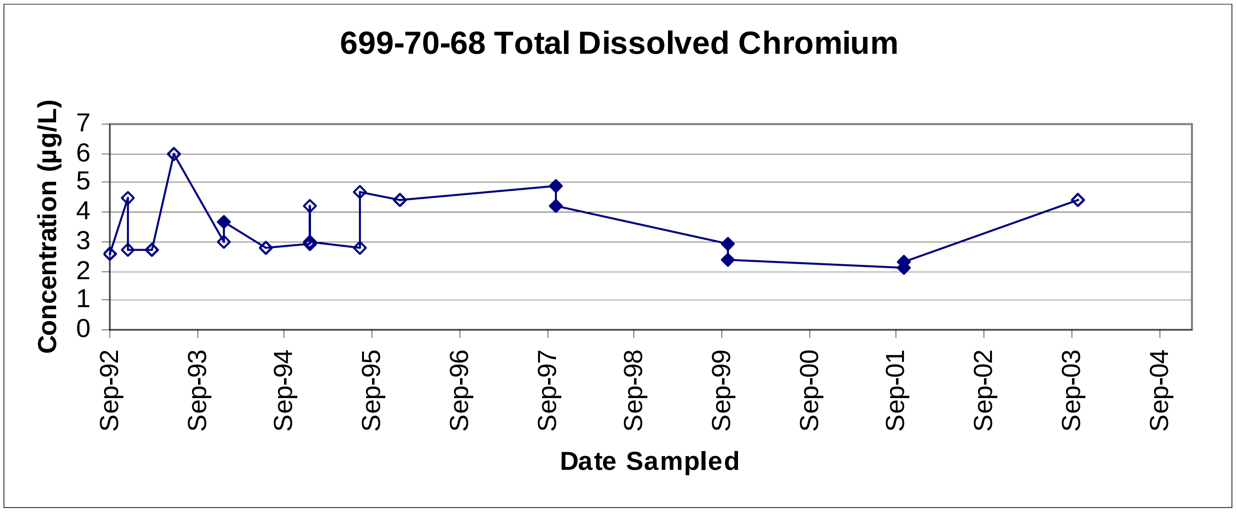

199-K-32B Total Dissolved Chromium
Concentration (µg/L)
250
200
150
100
50
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

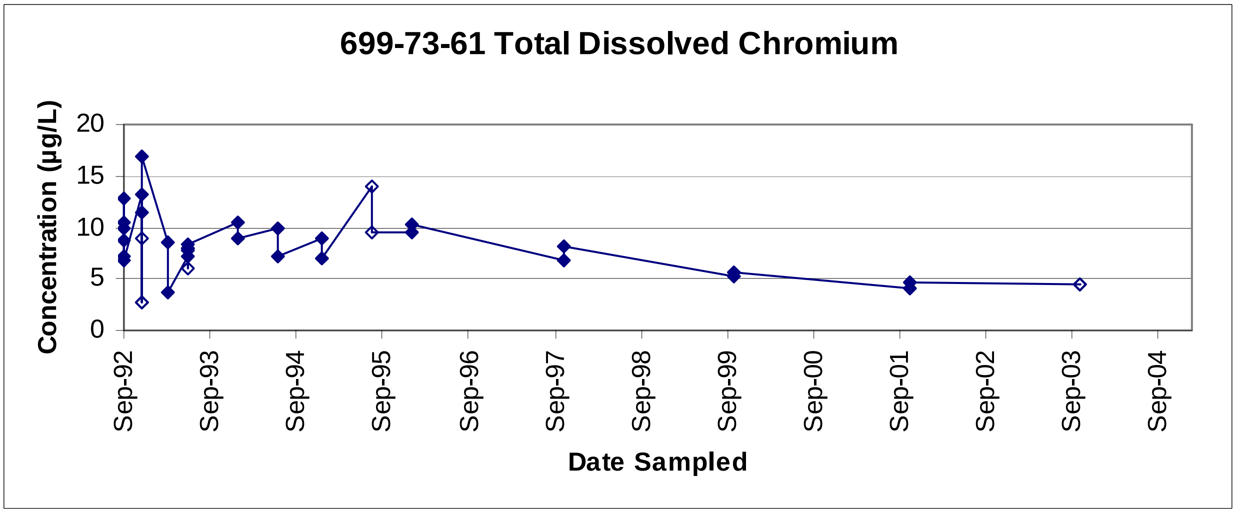

199-K-34 Total Dissolved Chromium
Concentration (µg/L)
200
150
100
50
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

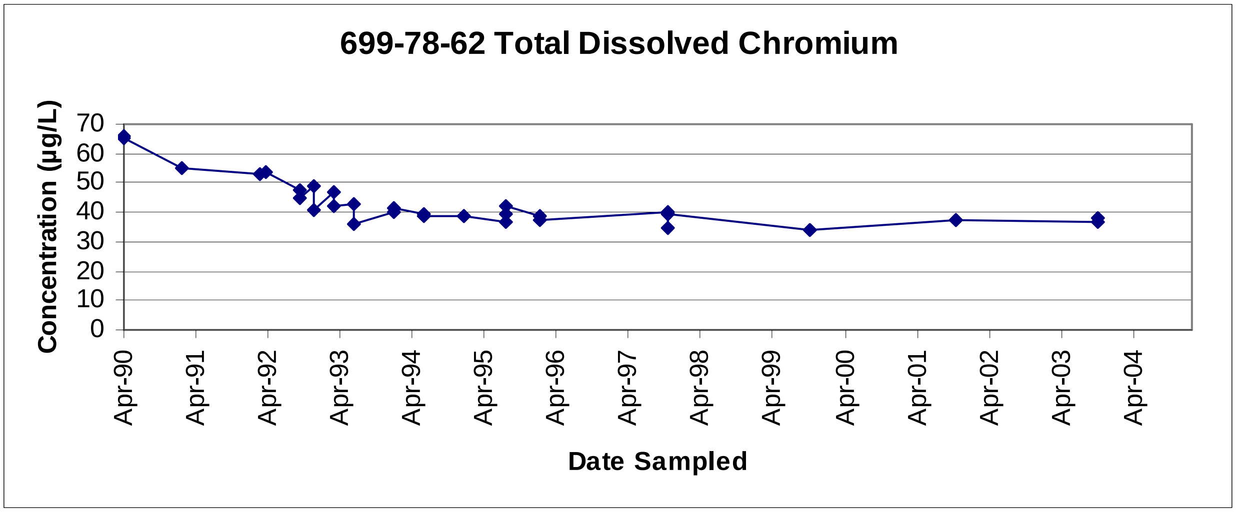

199-K-35 Total Dissolved Chromium
Concentration (µg/L)
0
10
20
30
40
50
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

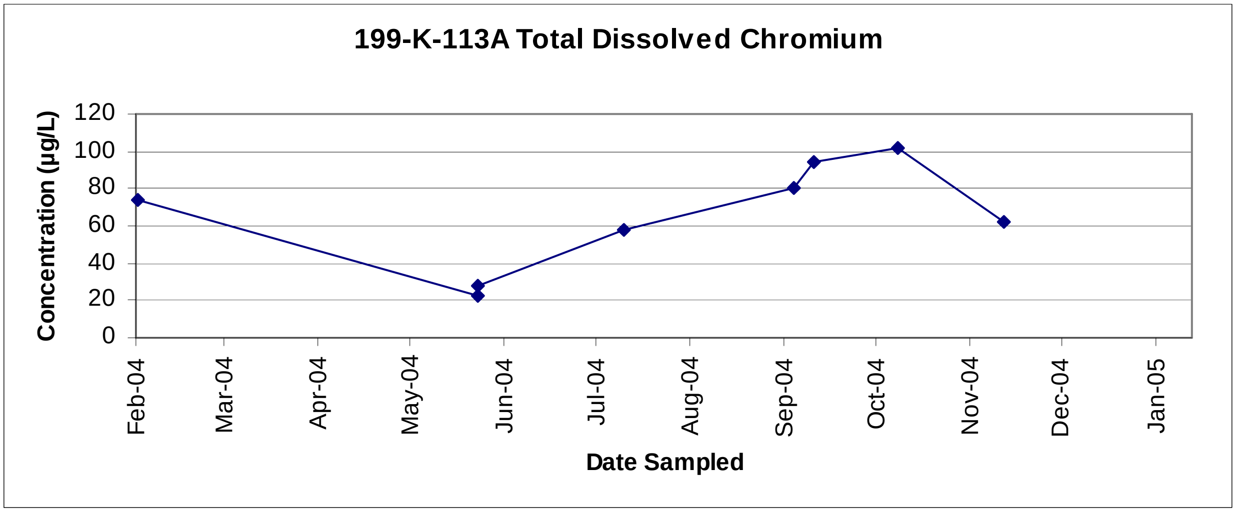

199-K-36 Total Dissolved Chromium
Concentration (µg/L)
0
500
1000
1500
2000
2500
3000
Aug-92
Aug-93
Aug-94
Aug-95
Aug-96
Aug-97
Aug-98
Aug-99
Aug-00
Aug-01
Aug-02
Aug-03
Aug-04
Date Sampled

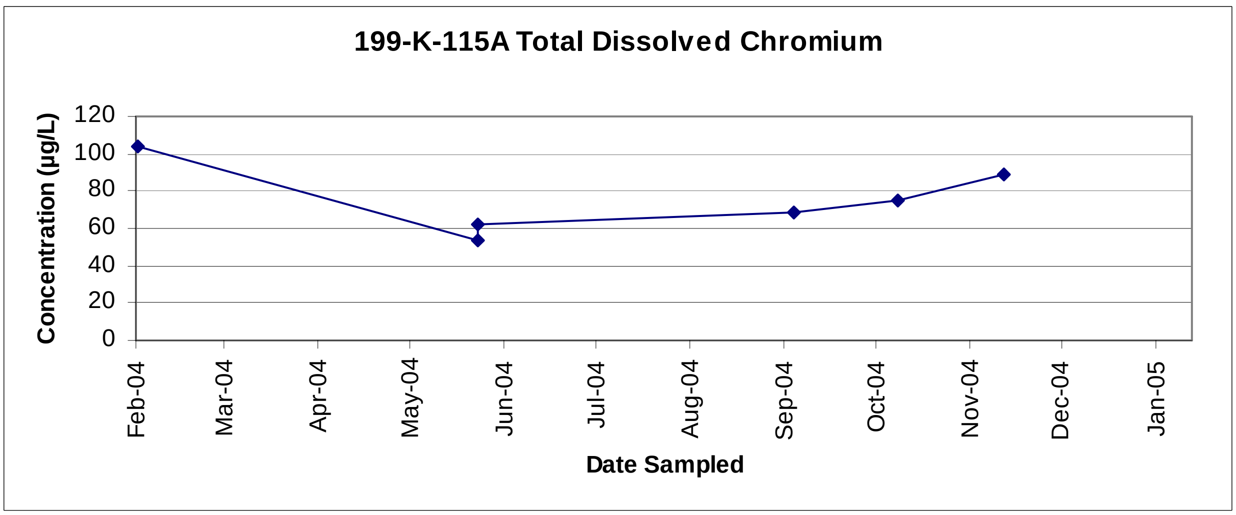

199-K-37 Total Dissolved Chromium
Concentration (µg/L)
0
50
100
150
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

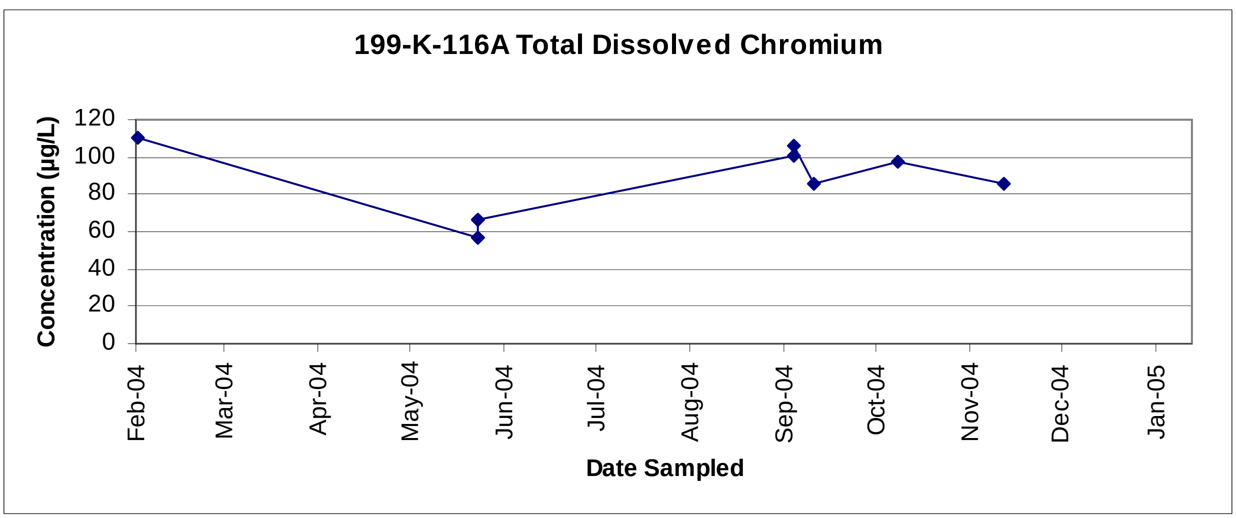

699-70-68 Total Dissolved Chromium
Concentration (µg/L)
7
6
5
4
3
2
1
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

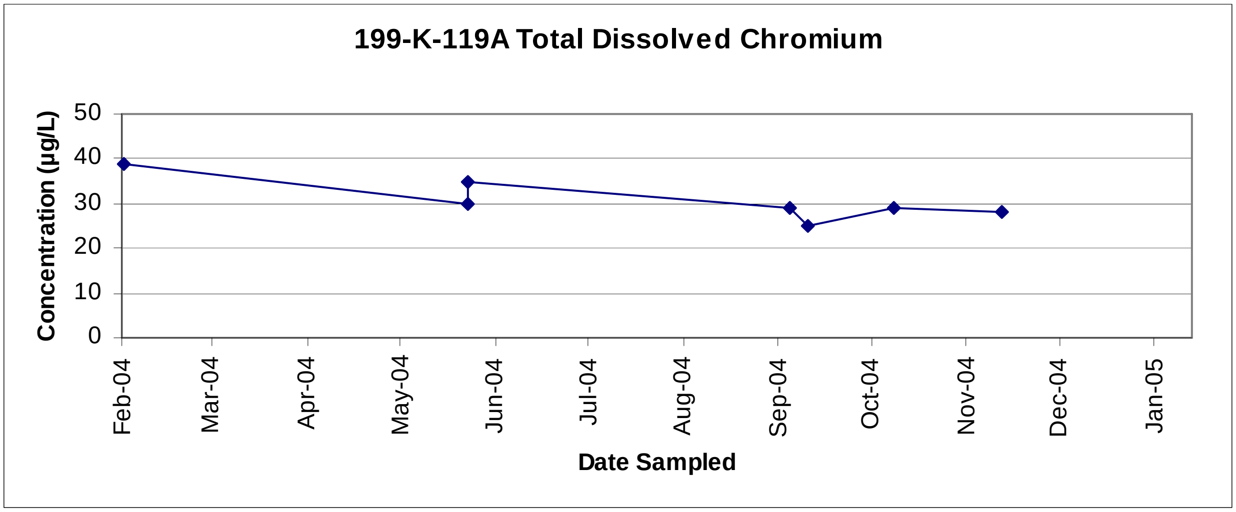

699-73-61 Total Dissolved Chromium
Concentration (µg/L)
20
15
10
5
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

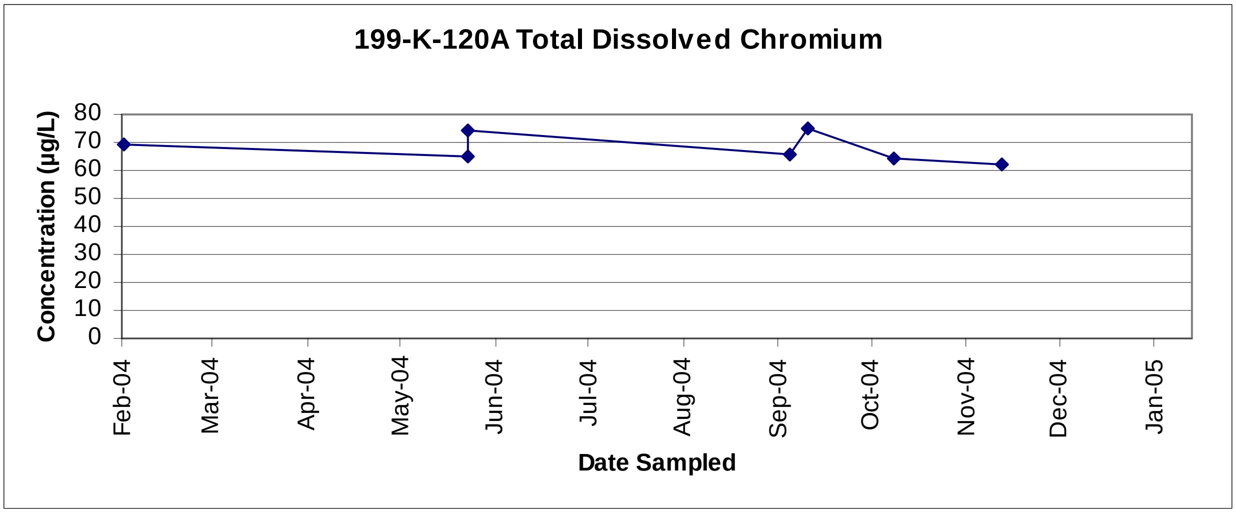

699-78-62 Total Dissolved Chromium
Concentration (µg/L)
70
60
50
40
30
20
10
0
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled

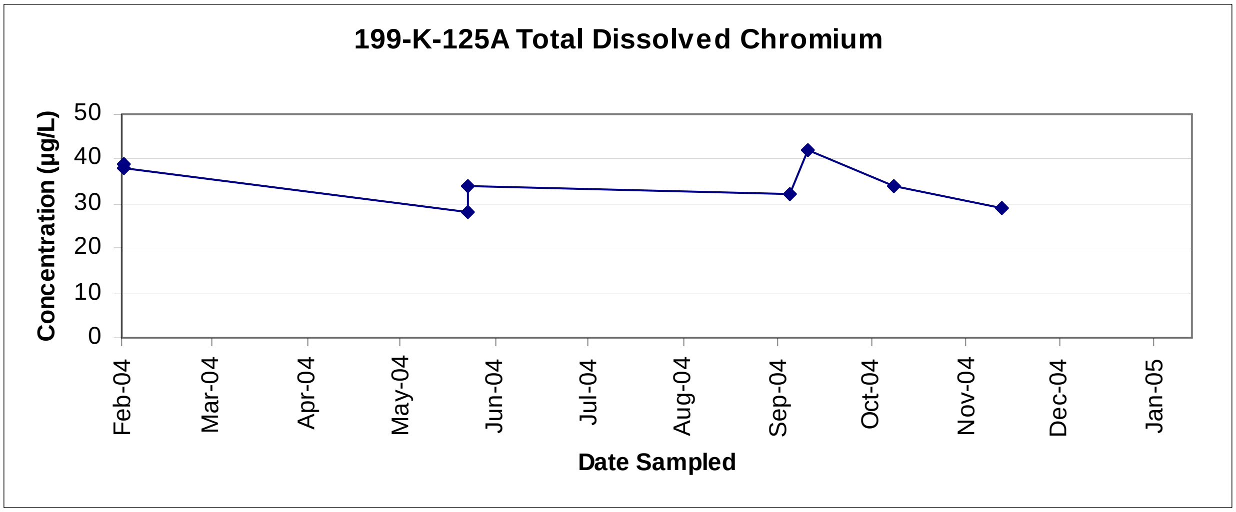

199-K-113A Total Dissolved Chromium
Concentration (µg/L)
0
20
40
60
80
100
120
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

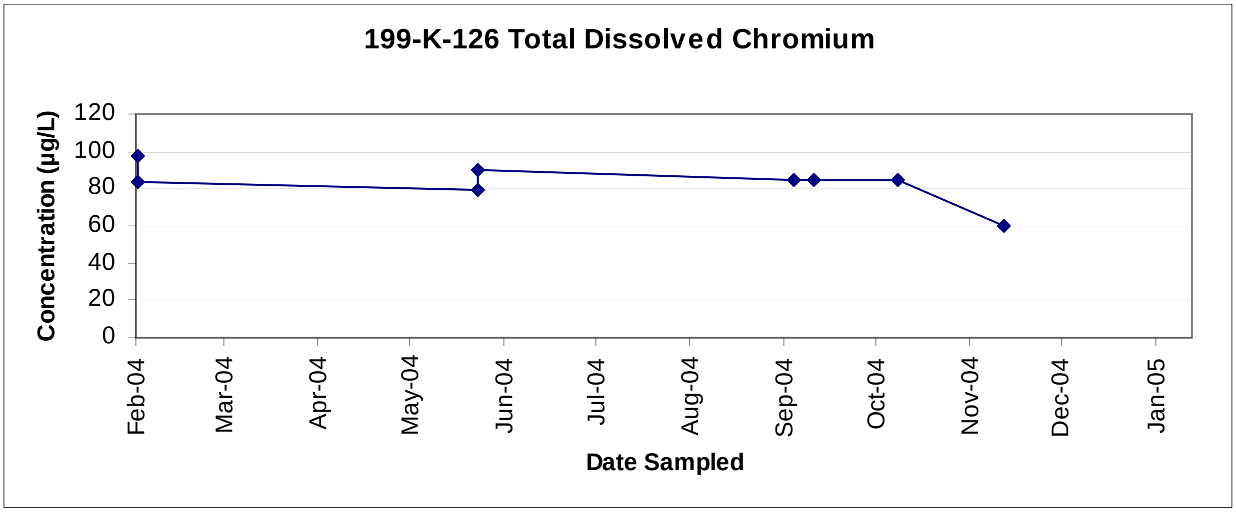

199-K-115A Total Dissolved Chromium
Concentration (µg/L)
0
20
40
60
80
100
120
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

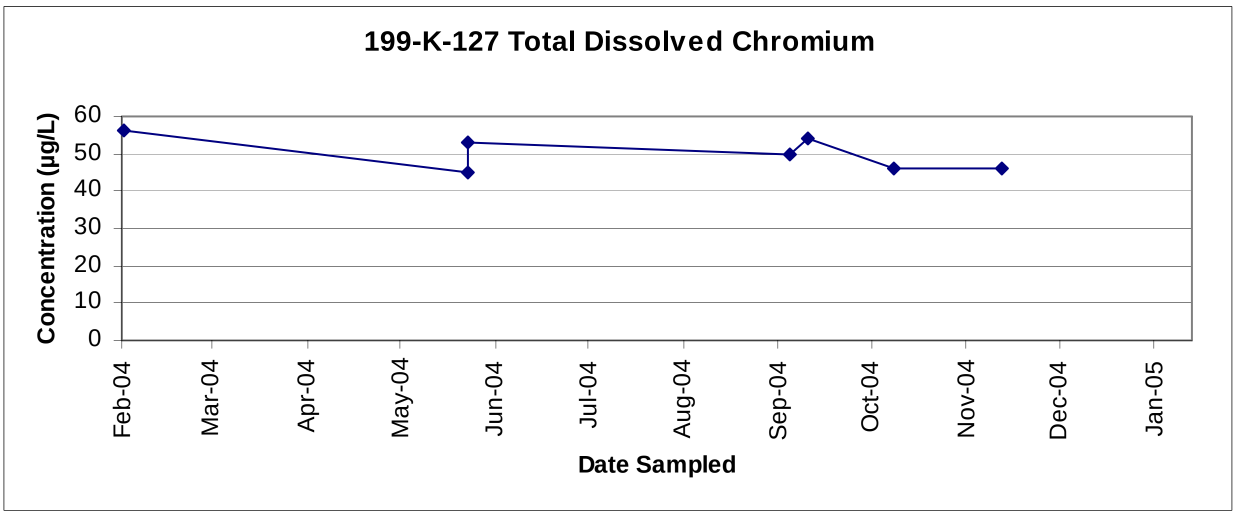

199-K-116A Total Dissolved Chromium
Concentration (µg/L)
0
20
40
60
80
100
120
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

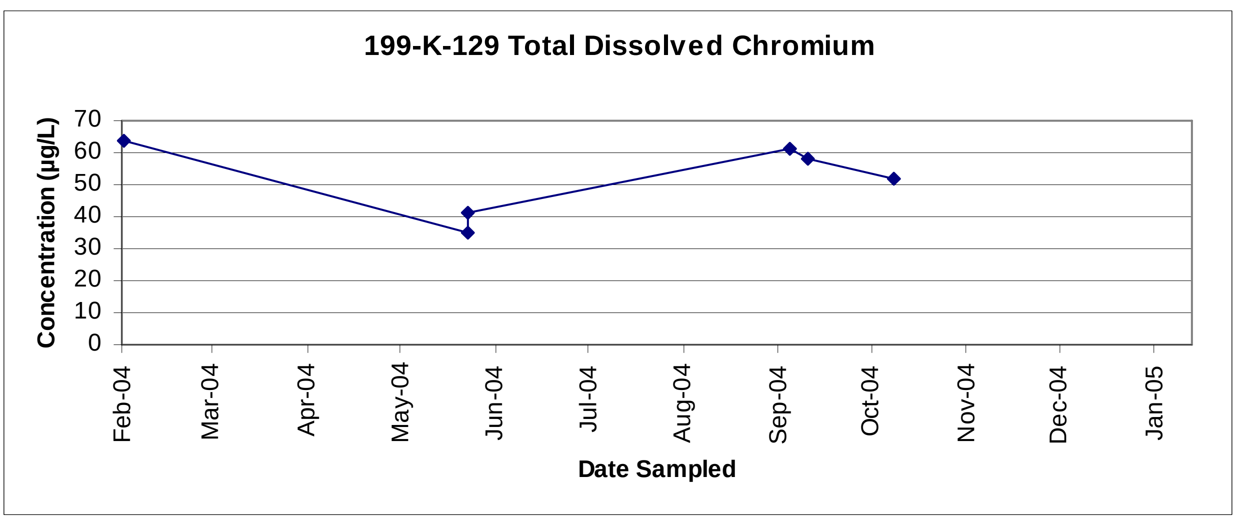

199-K-119A Total Dissolved Chromium
Concentration (µg/L)
0
10
20
30
40
50
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

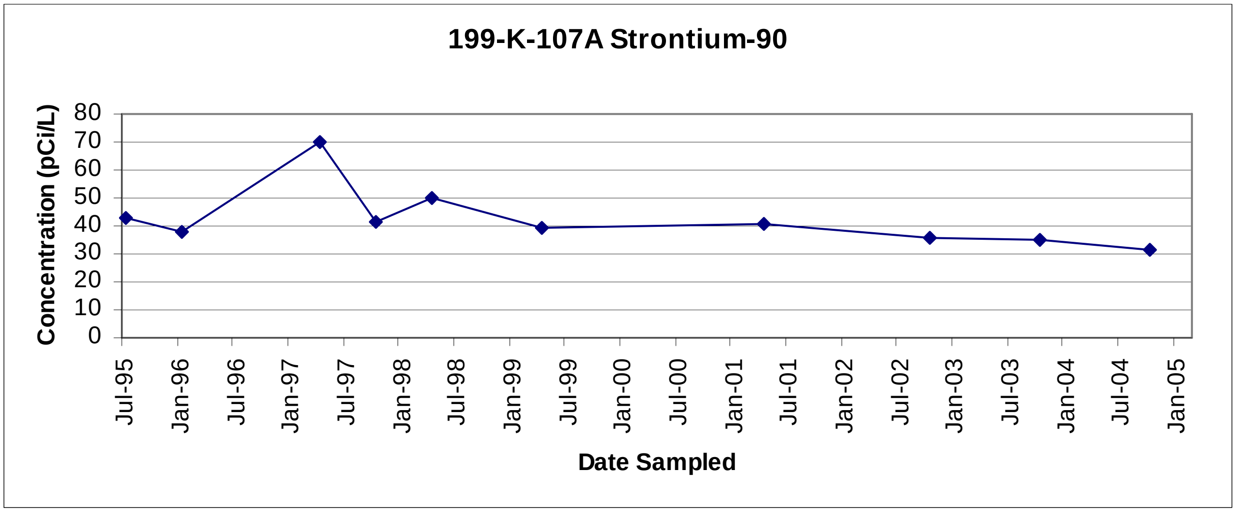

199-K-120A Total Dissolved Chromium
Concentration (µg/L)
0
10
20
30
40
50
60
70
80
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

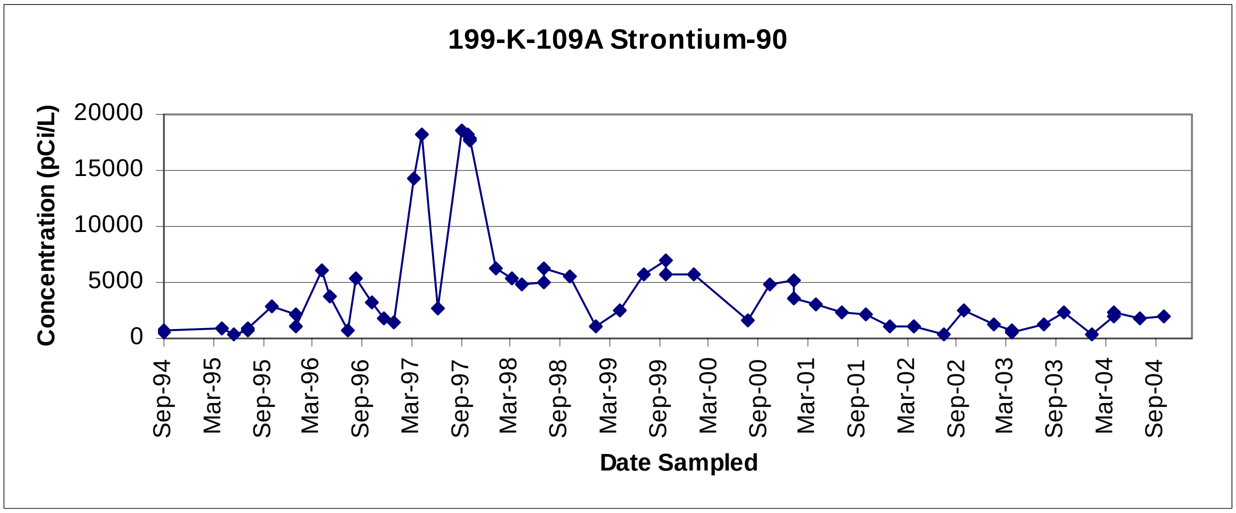

199-K-125A Total Dissolved Chromium
Concentration (µg/L)
0
10
20
30
40
50
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

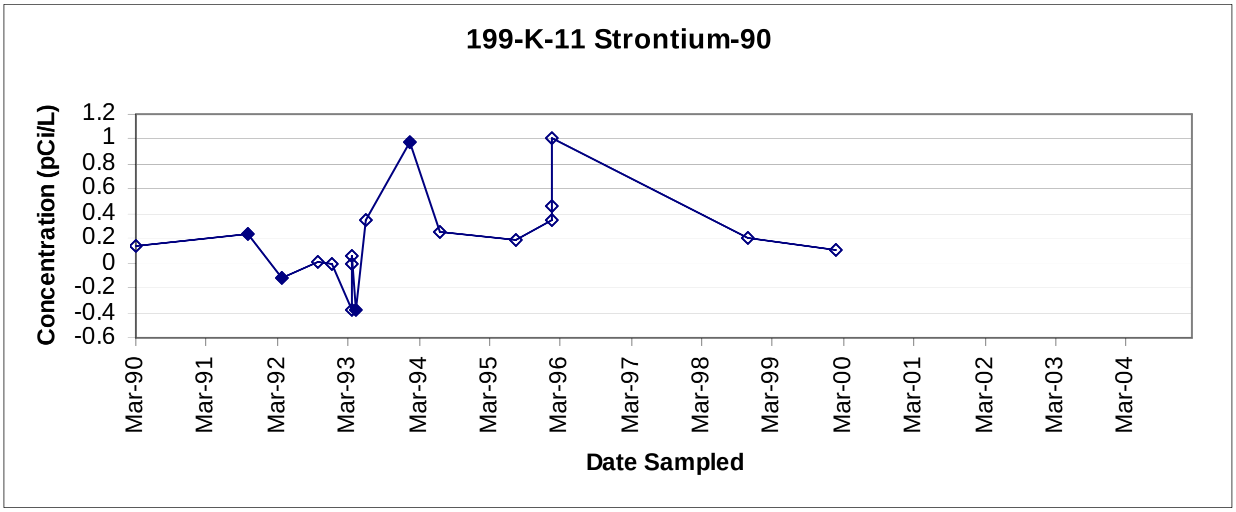

199-K-126 Total Dissolved Chromium
Concentration (µg/L)
0
20
40
60
80
100
120
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

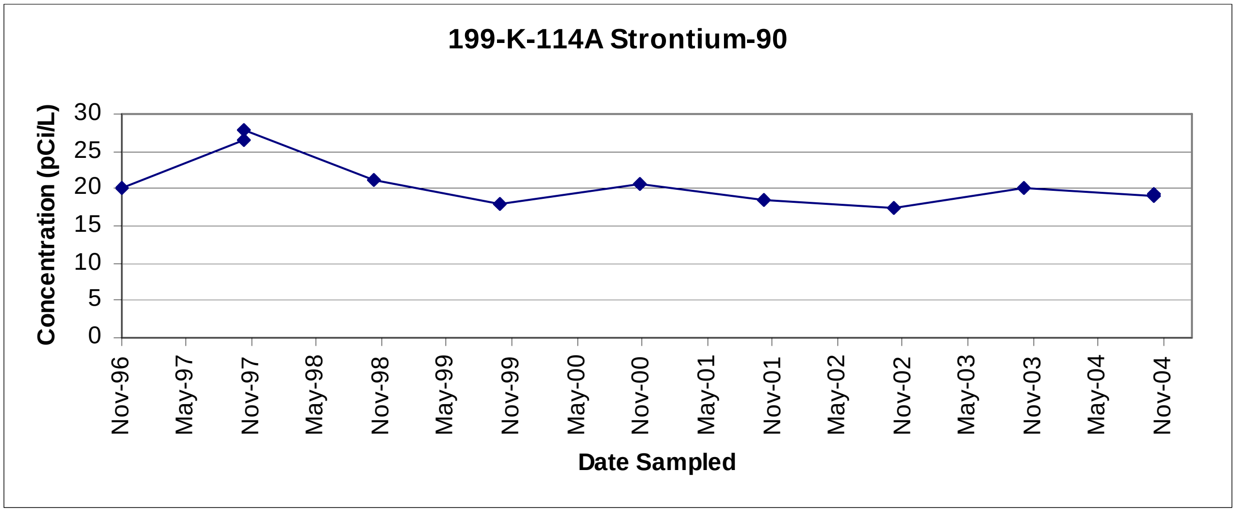

199-K-127 Total Dissolved Chromium
Concentration (µg/L)
0
10
20
30
40
50
60
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

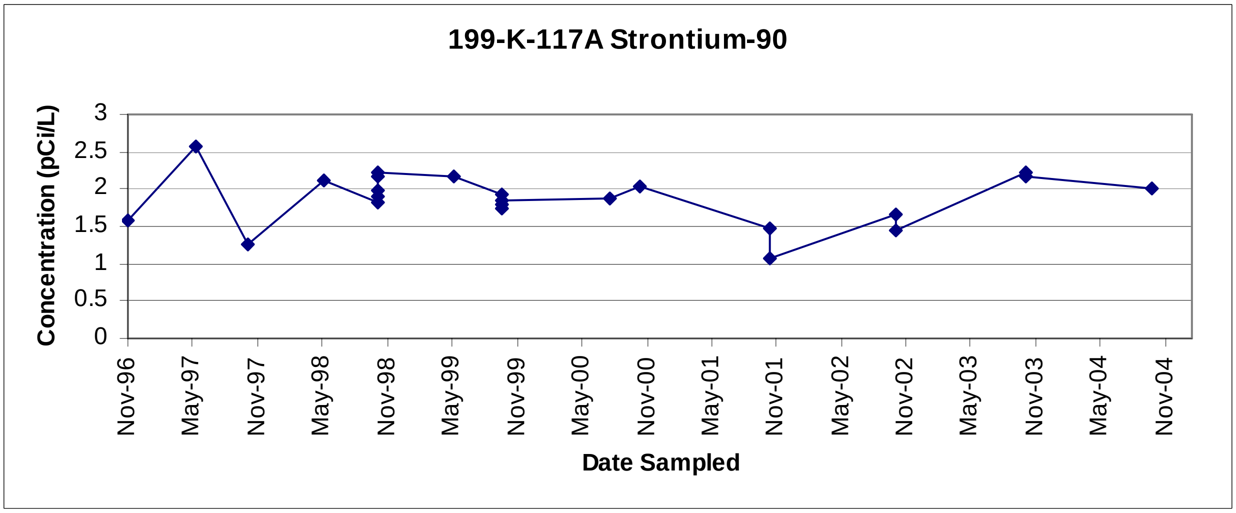

199-K-129 Total Dissolved Chromium
Concentration (µg/L)
0
10
20
30
40
50
60
70
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

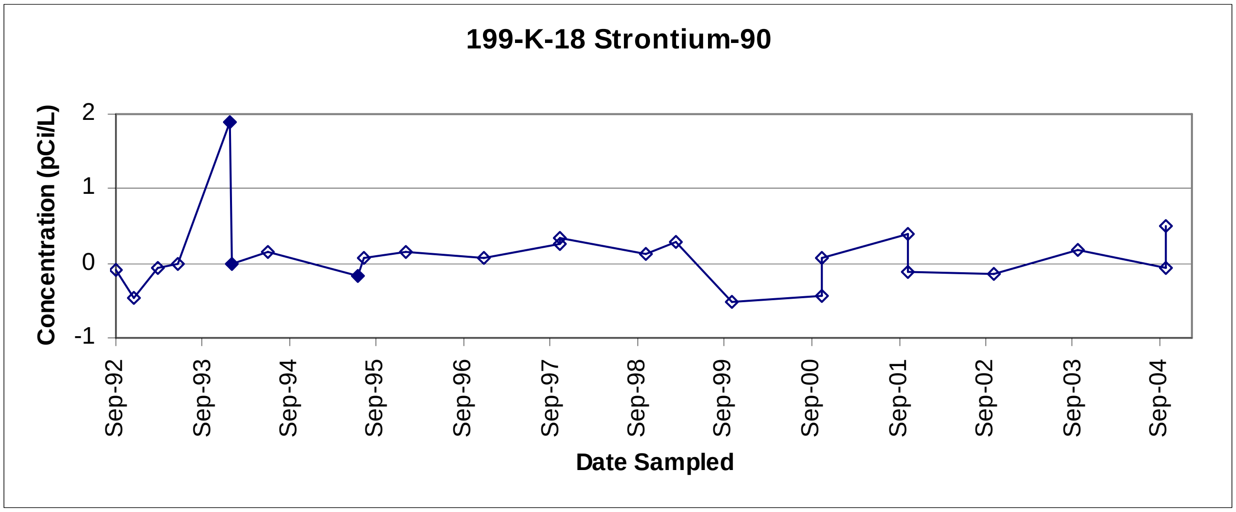

199-K-107A Strontium-90
Concentration (pCi/L)
80
70
60
50
40
30
20
10
0
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Date Sampled

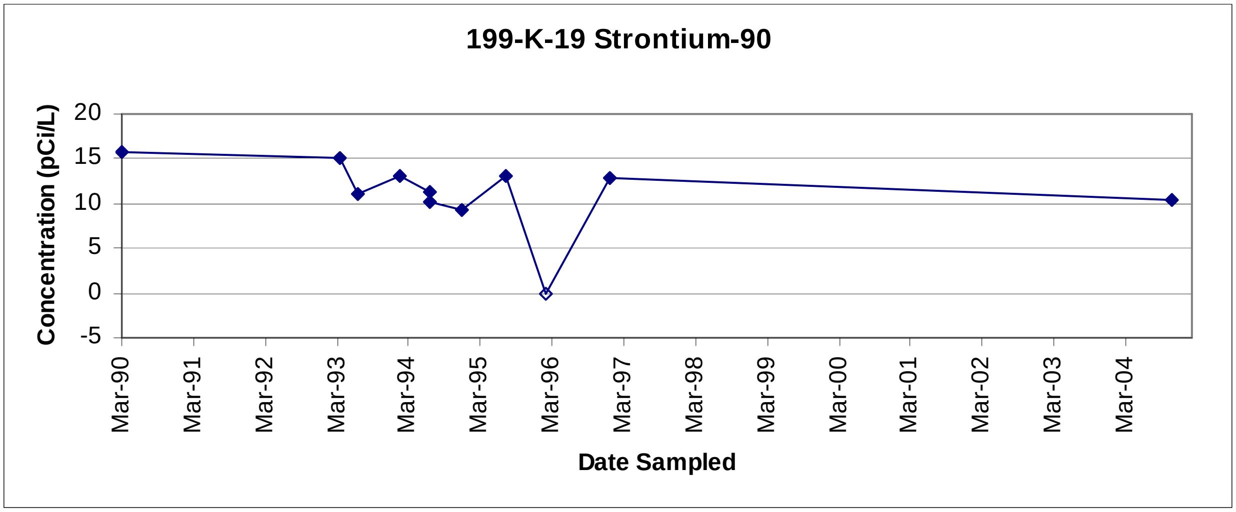

199-K-109A Strontium-90
Concentration (pCi/L)
20000
15000
10000
5000
0
Sep-94
Mar-95
Sep-95
Mar-96
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled

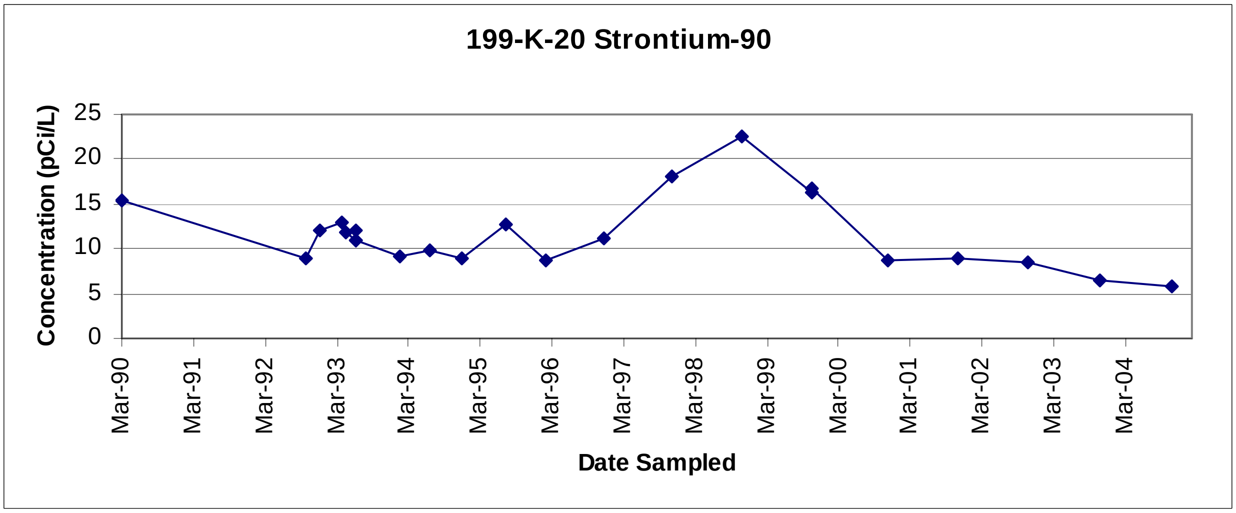

199-K-11 Strontium-90
Concentration (pCi/L)
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

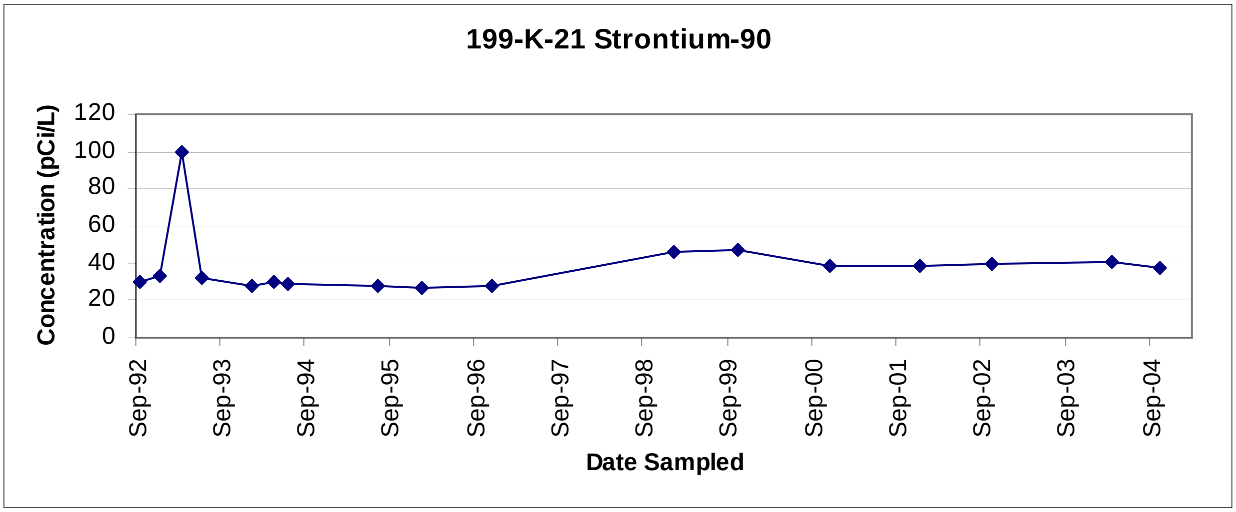

199-K-114A Strontium-90
Concentration (pCi/L)
30
25
20
15
10
5
0
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
Date Sampled

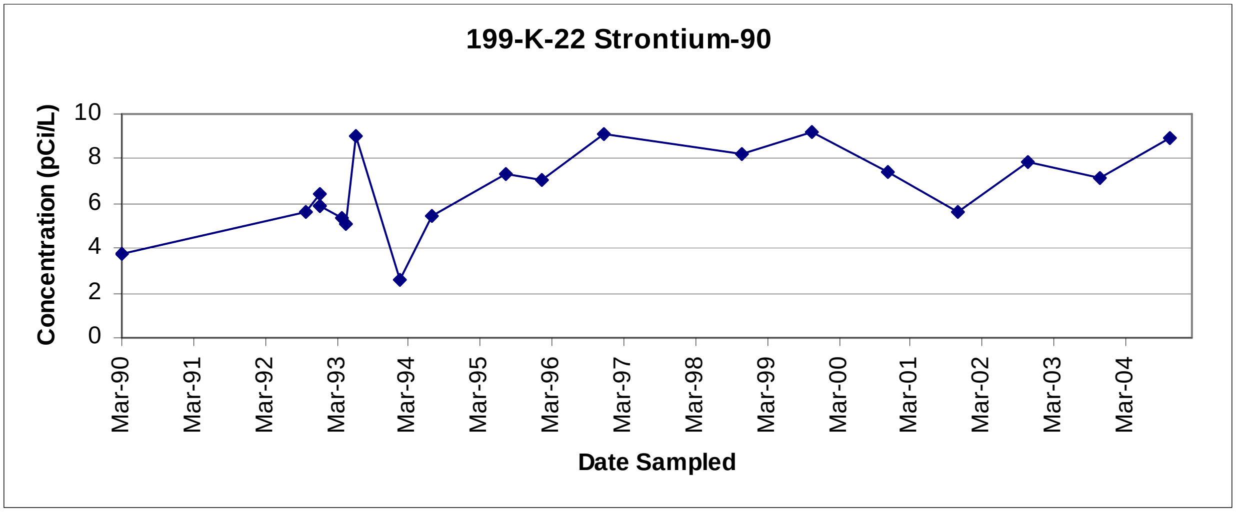

199-K-117A Strontium-90
Concentration (pCi/L)
3
2.5
2
1.5
1
0.5
0
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
Date Sampled

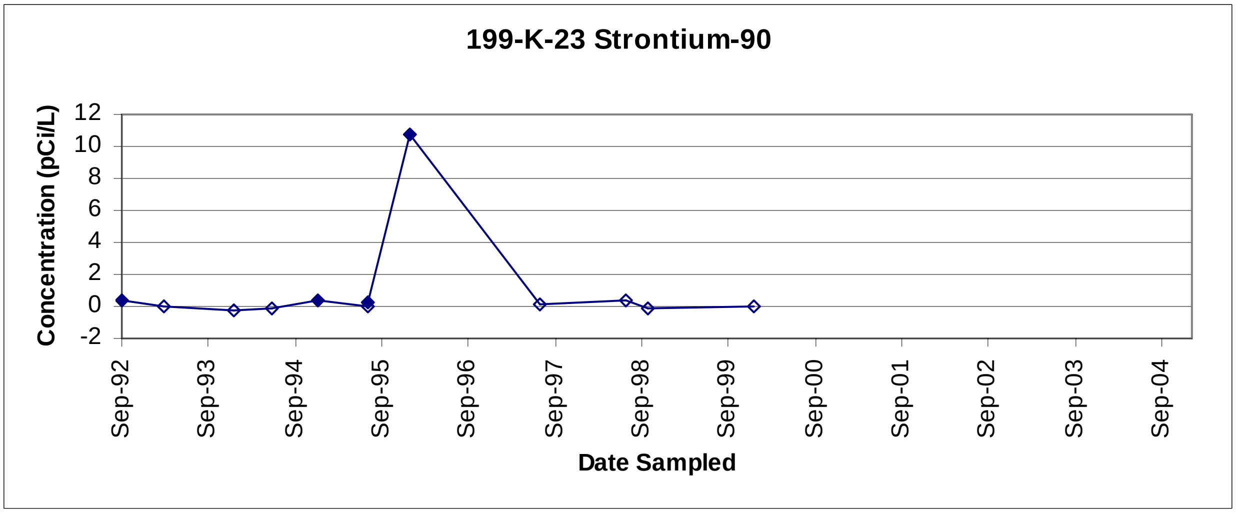

199-K-18 Strontium-90
Concentration (pCi/L)
2
1
0
-1
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

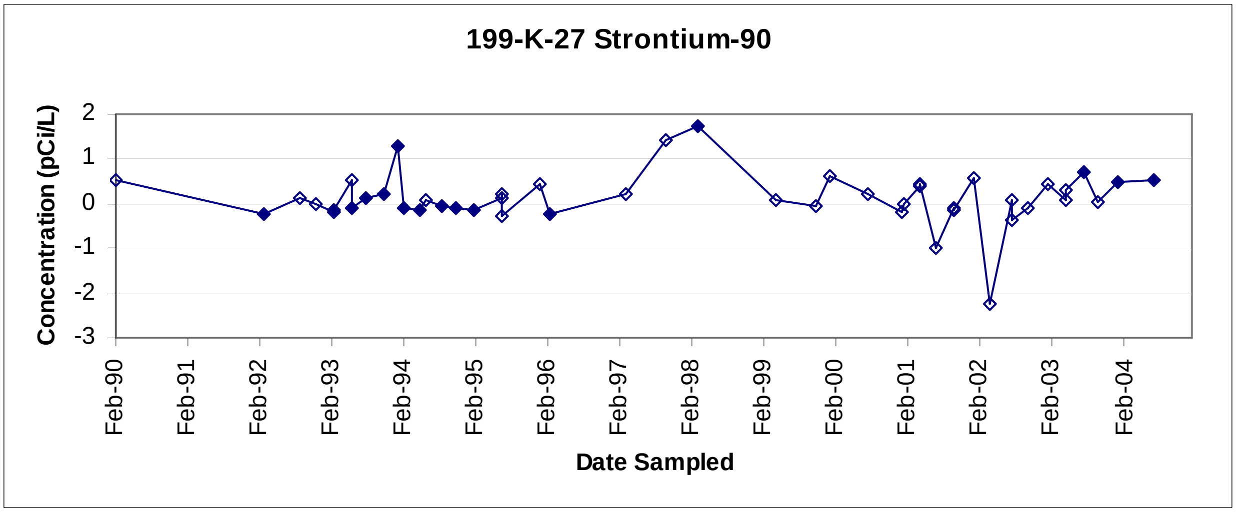

199-K-19 Strontium-90
Concentration (pCi/L)
20
15
10
5
0
-5
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

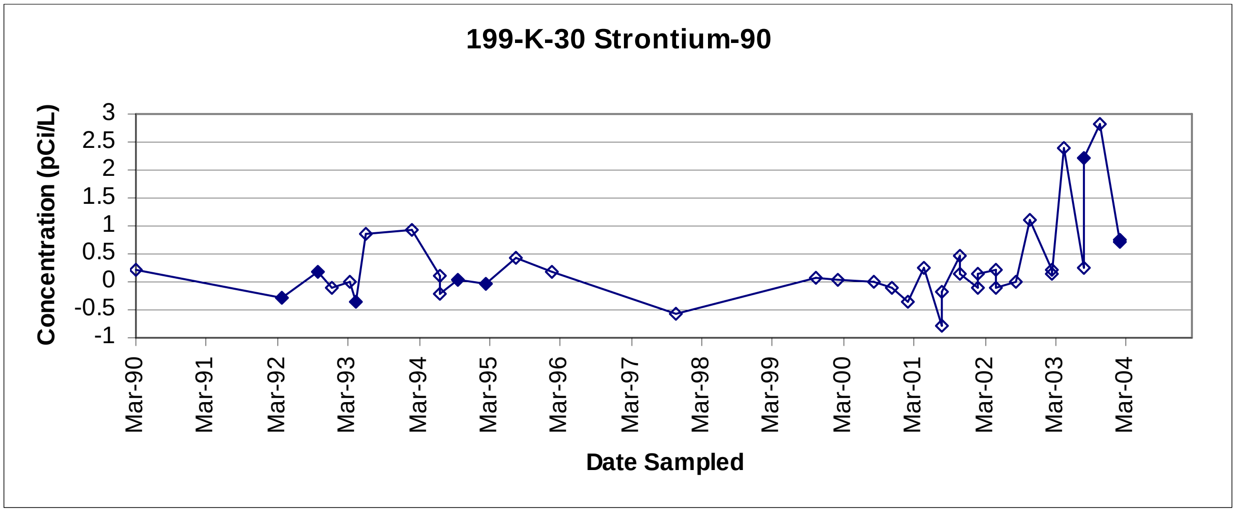

199-K-20 Strontium-90
Concentration (pCi/L)
25
20
15
10
5
0
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

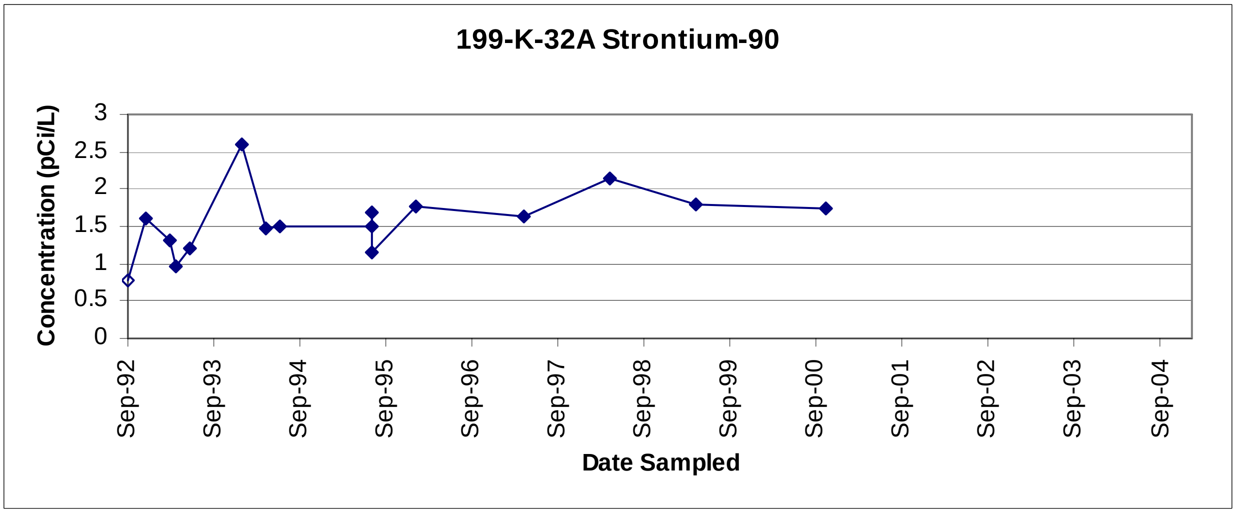

199-K-21 Strontium-90
Concentration (pCi/L)
120
100
80
60
40
20
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

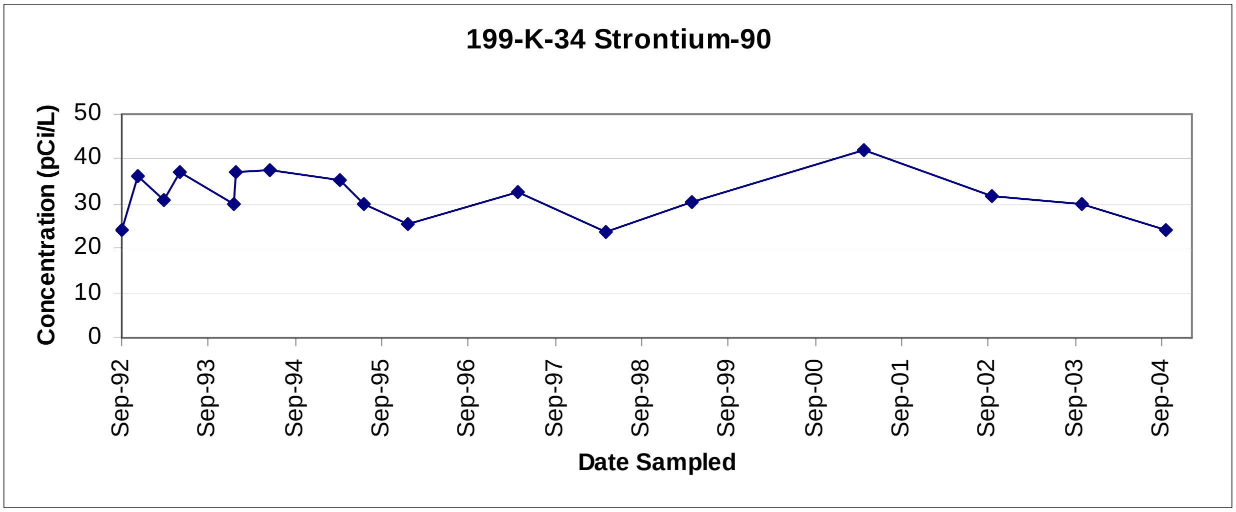

199-K-22 Strontium-90
Concentration (pCi/L)
10
8
6
4
2
0
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

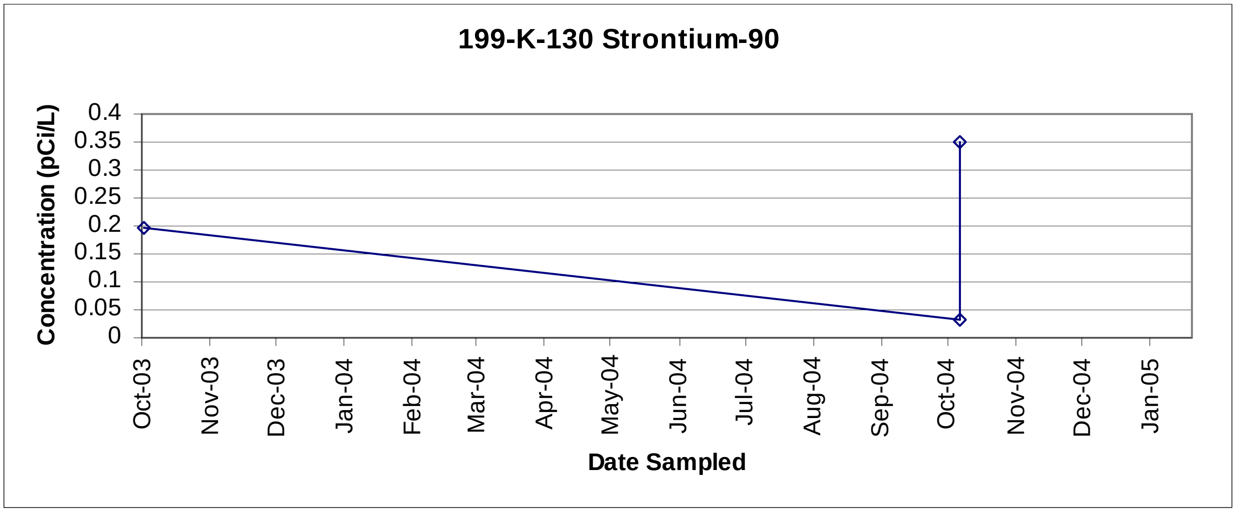

199-K-23 Strontium-90
Concentration (pCi/L)
12
10
8
6
4
2
0
-2
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

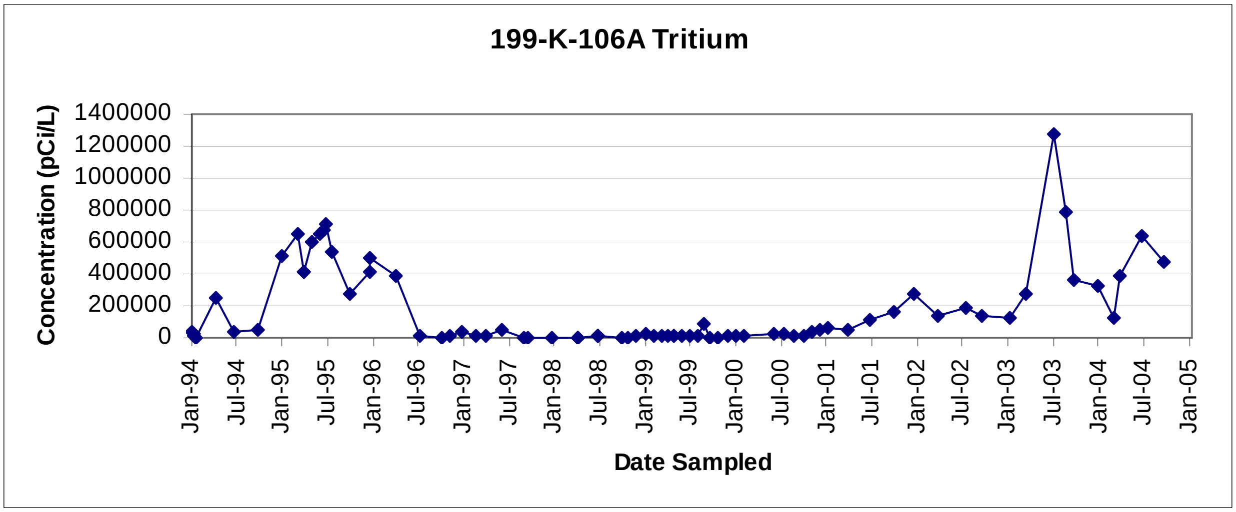

199-K-27 Strontium-90
Concentration (pCi/L)
2
1
0
-1
-2
-3
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-K-30 Strontium-90
Concentration (pCi/L)
3
2.5
2
1.5
1
0.5
0
-0.5
-1
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled


199-K-32A Strontium-90
Concentration (pCi/L)
3
2.5
2
1.5
1
0.5
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled


199-K-34 Strontium-90
Concentration (pCi/L)
50
40
30
20
10
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled


199-K-130 Strontium-90
Concentration (pCi/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Oct-03
Nov-03
Dec-03
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled


199-K-106A Tritium
Concentration (pCi/L)
1400000
1200000
1000000
800000
600000
400000
200000
0
Jan-94
Jul-94
Jan-95
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
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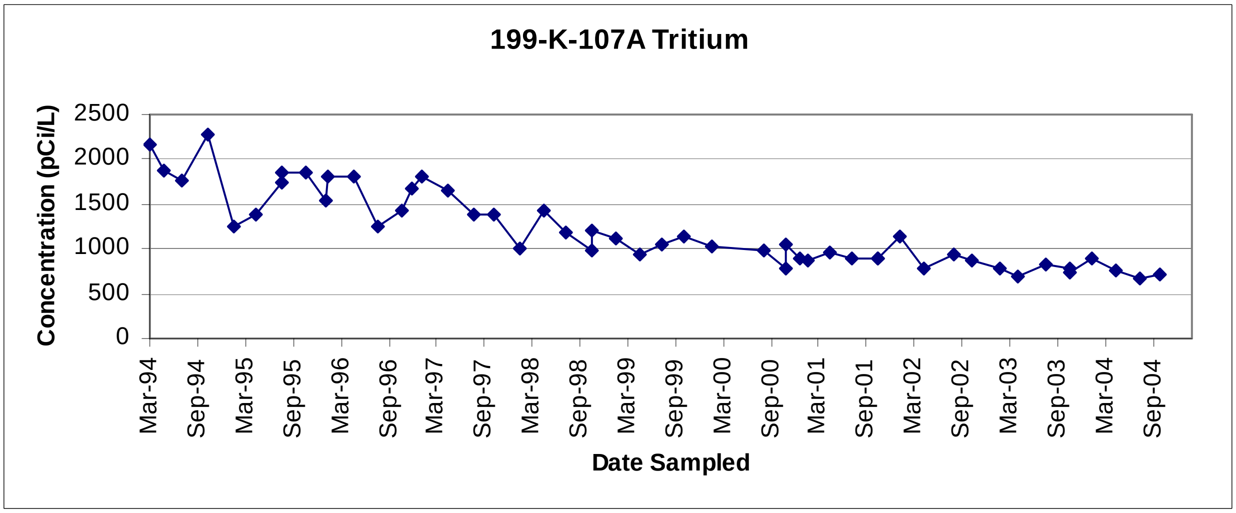
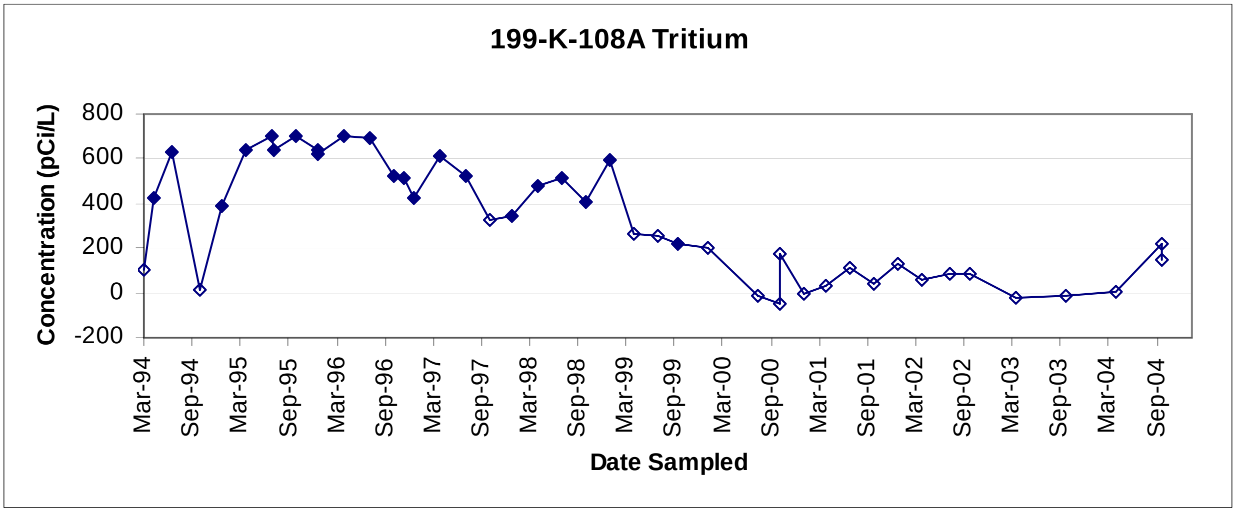
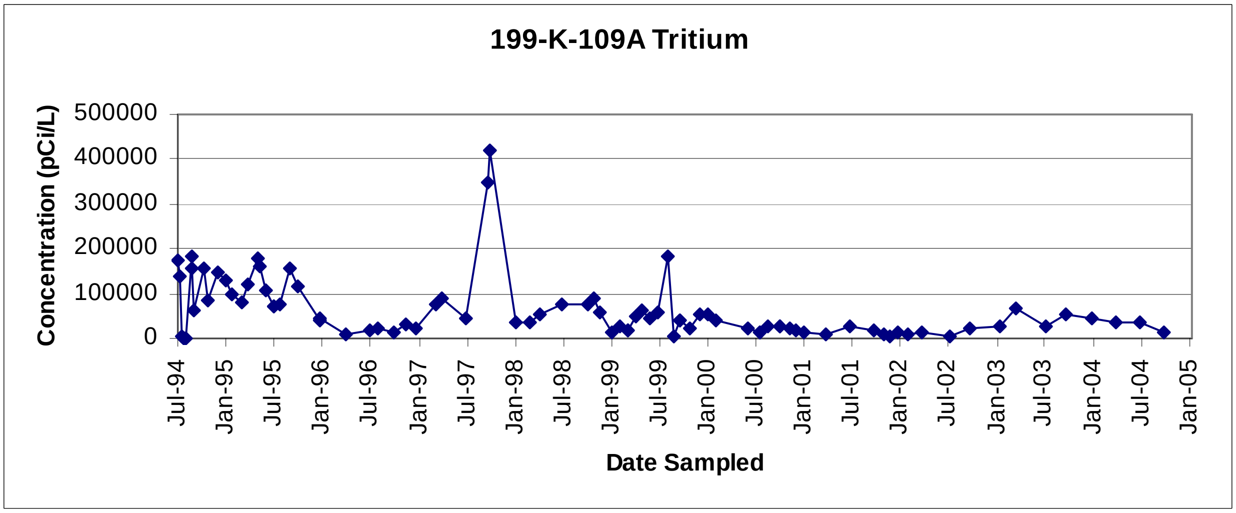
Jan-04
Jul-04
Jan-05
Date Sampled


199-K-107A Tritium
Concentration (pCi/L)
2500
2000
1500
1000
500
0
Mar-94
Sep-94
Mar-95
Sep-95
Mar-96
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled


199-K-108A Tritium
Concentration (pCi/L)
800
600
400
200
0
-200
Mar-94
Sep-94
Mar-95
Sep-95
Mar-96
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled


199-K-109A Tritium
Concentration (pCi/L)
500000
400000
300000
200000
100000
0
Jul-94
Jan-95
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
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Jul-01
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Jul-02
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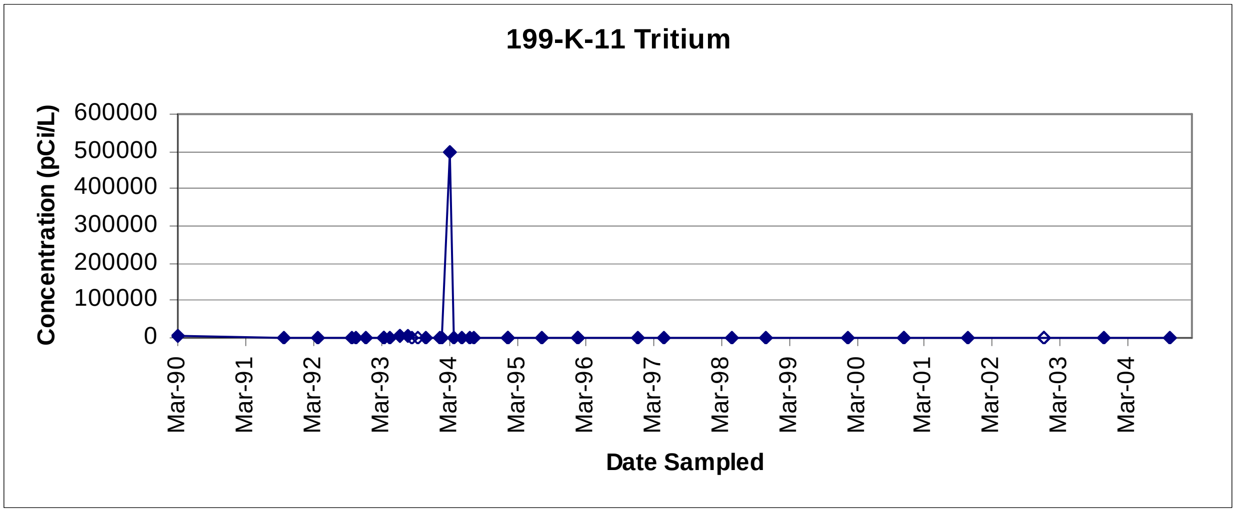
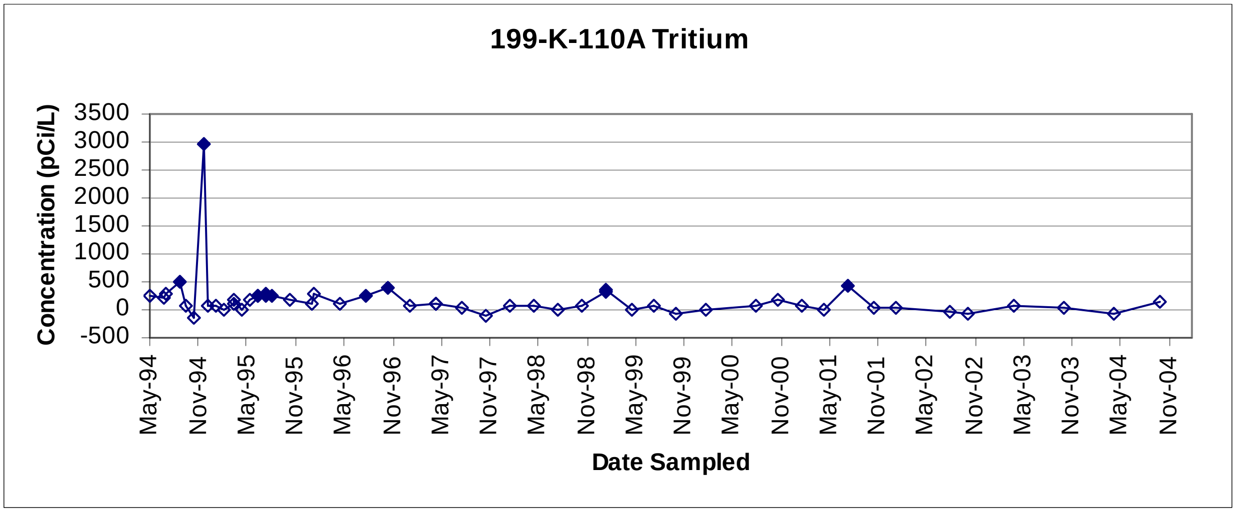
Jan-04
Jul-04
Jan-05
Date Sampled


199-K-11 Tritium
Concentration (pCi/L)
600000
500000
400000
300000
200000
100000
0
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled


199-K-110A Tritium
Concentration (pCi/L)
3500
3000
2500
2000
1500
1000
500
0
-500
May-94
Nov-94
May-95
Nov-95
May-96
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
May-00
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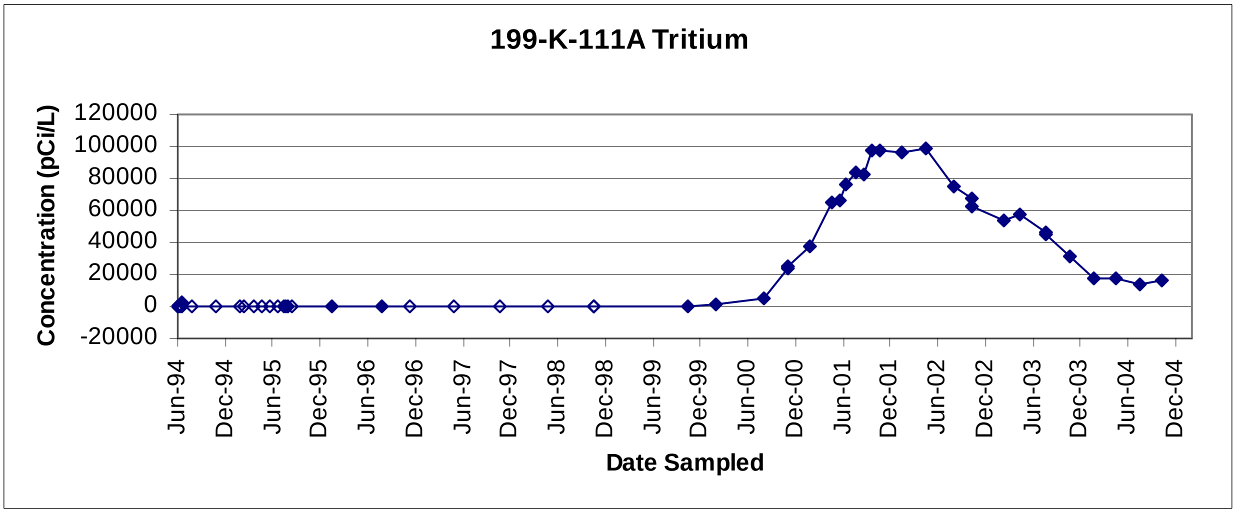
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
Date Sampled


199-K-111A Tritium
Concentration (pCi/L)
120000
100000
80000
60000
40000
20000
0
-20000
Jun-94
Dec-94
Jun-95
Dec-95
Jun-96
Dec-96
Jun-97
Dec-97
Jun-98
Dec-98
Jun-99
Dec-99
Jun-00
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Dec-02
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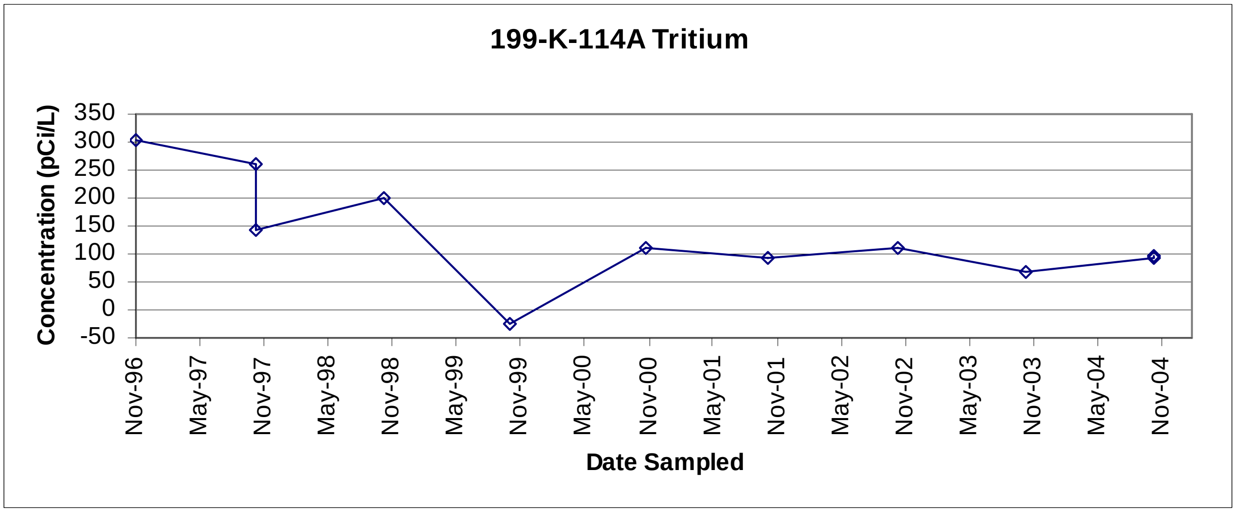
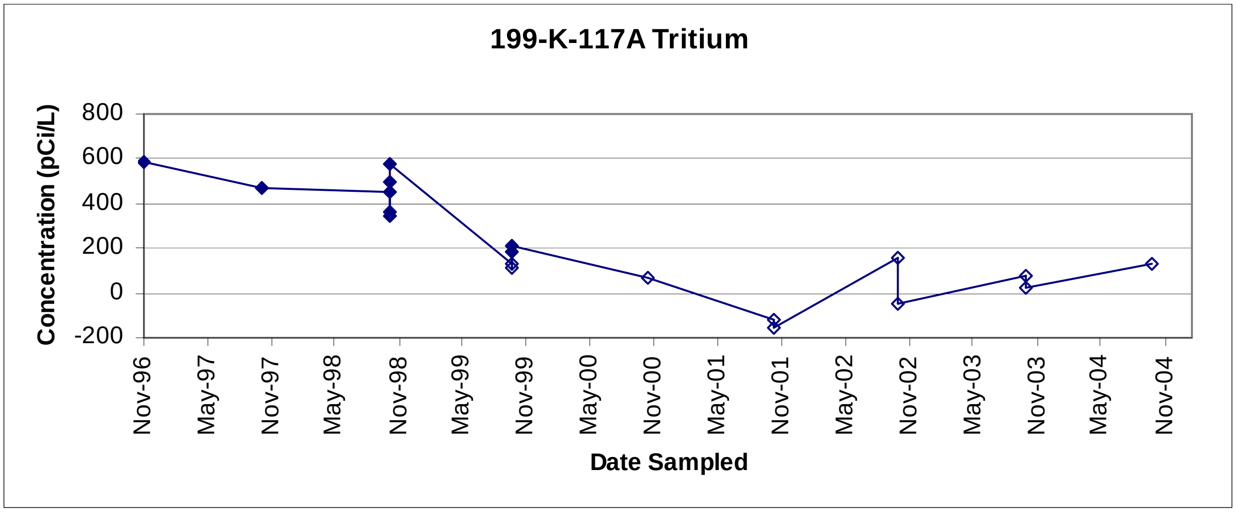
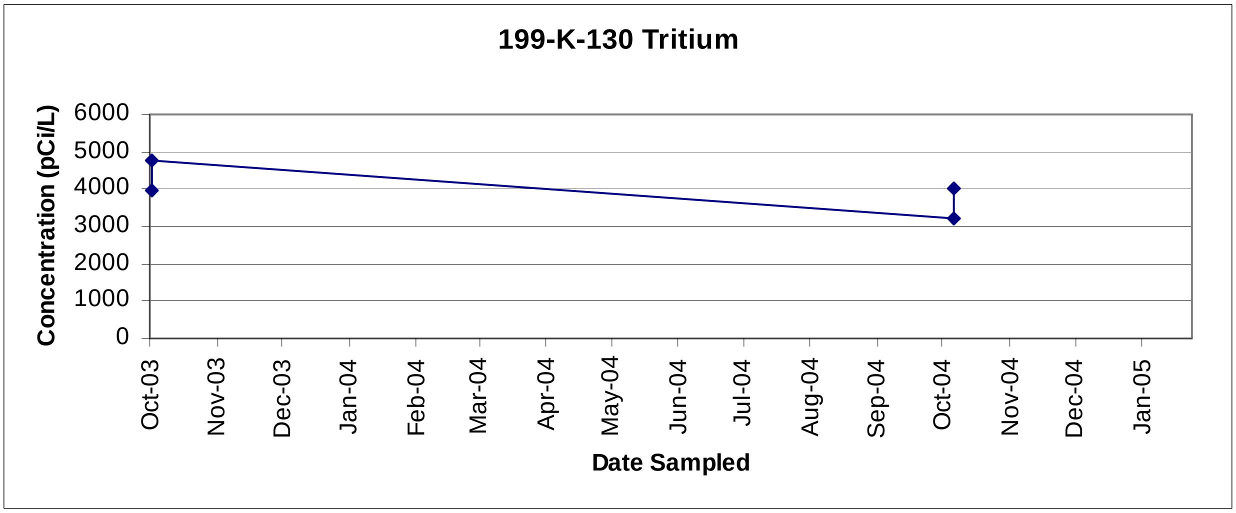
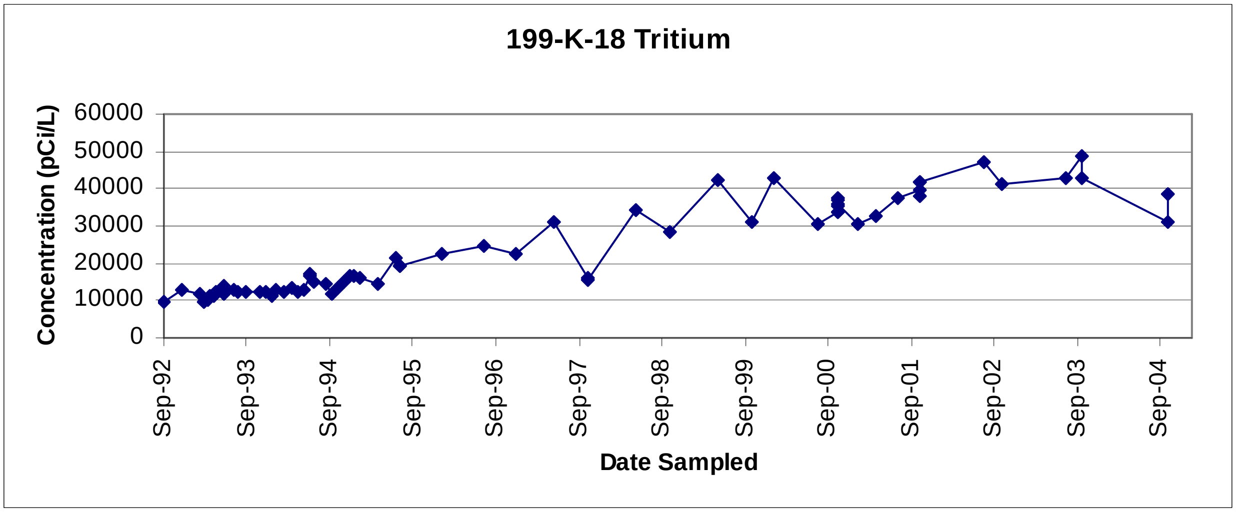
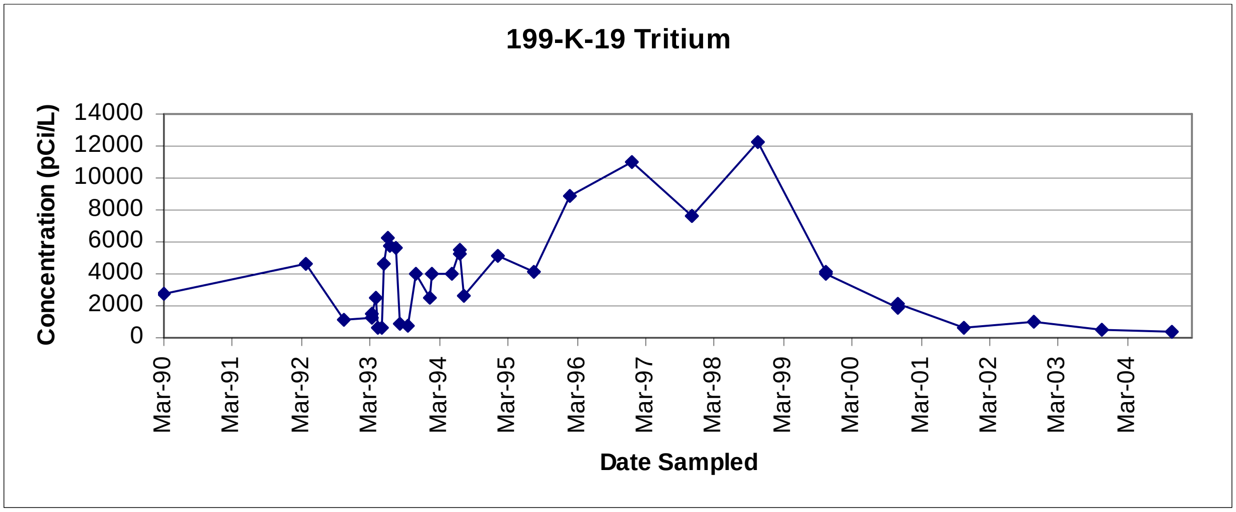
Dec-03
Jun-04
Dec-04
Date Sampled

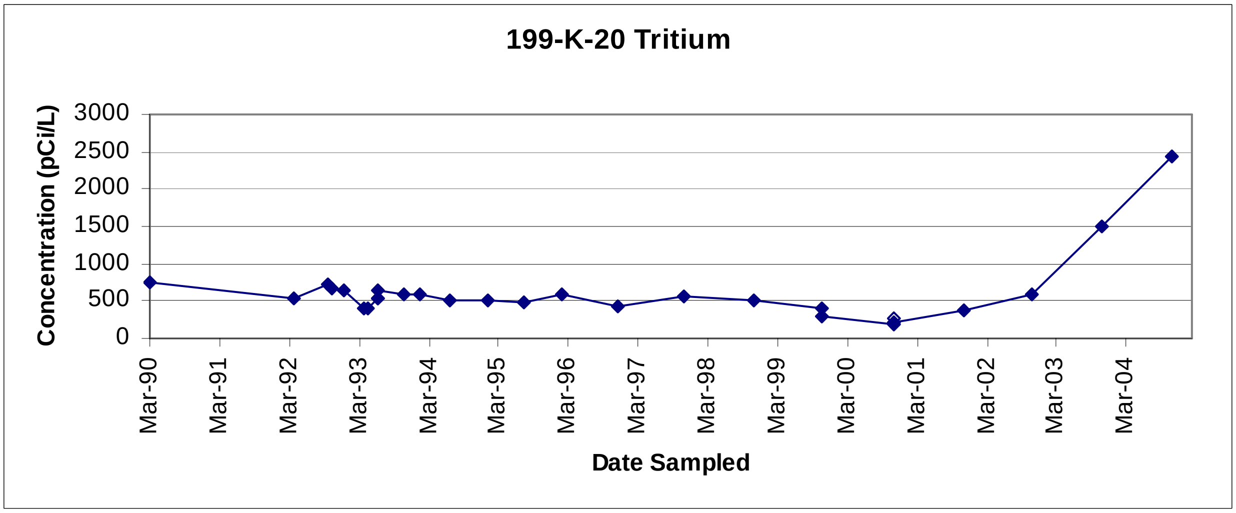

199-K-114A Tritium
Concentration (pCi/L)
350
300
250
200
150
100
50
0
-50
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
Date Sampled

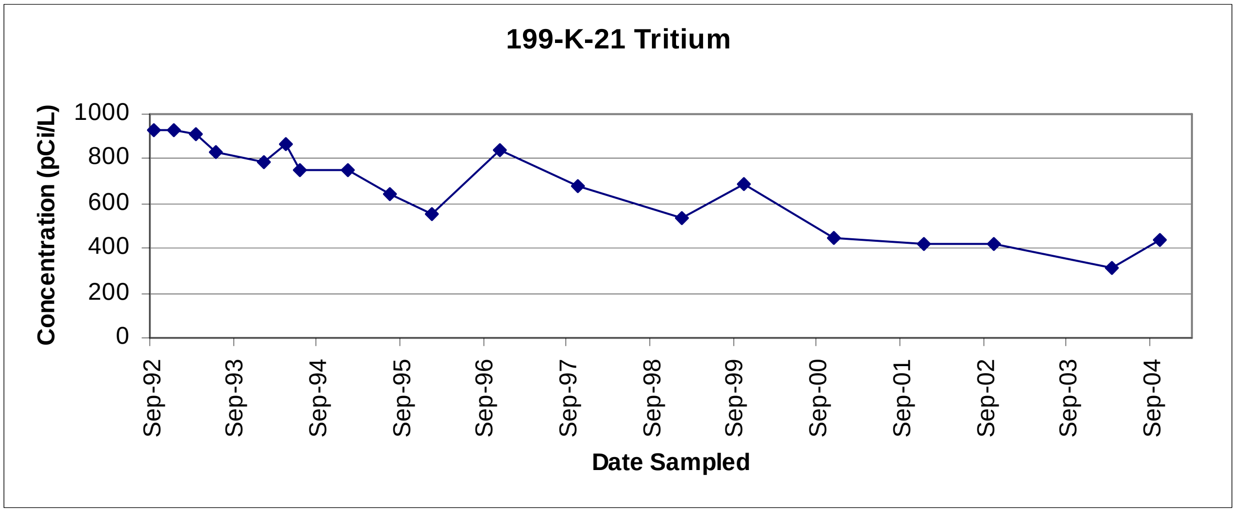

199-K-117A Tritium
Concentration (pCi/L)
800
600
400
200
0
-200
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
Date Sampled

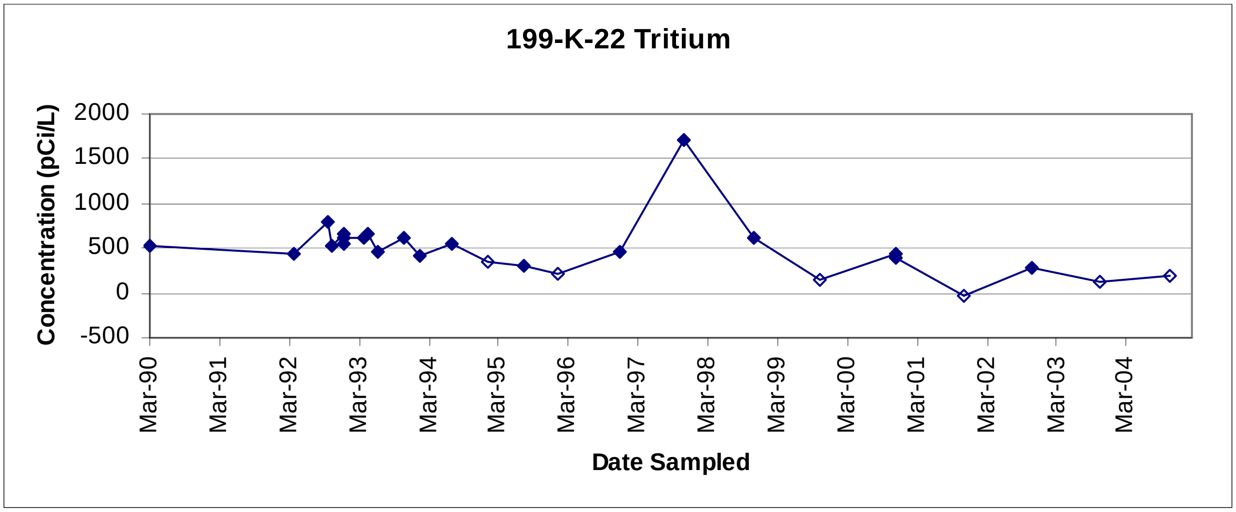

199-K-130 Tritium
Concentration (pCi/L)
6000
5000
4000
3000
2000
1000
0
Oct-03
Nov-03
Dec-03
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

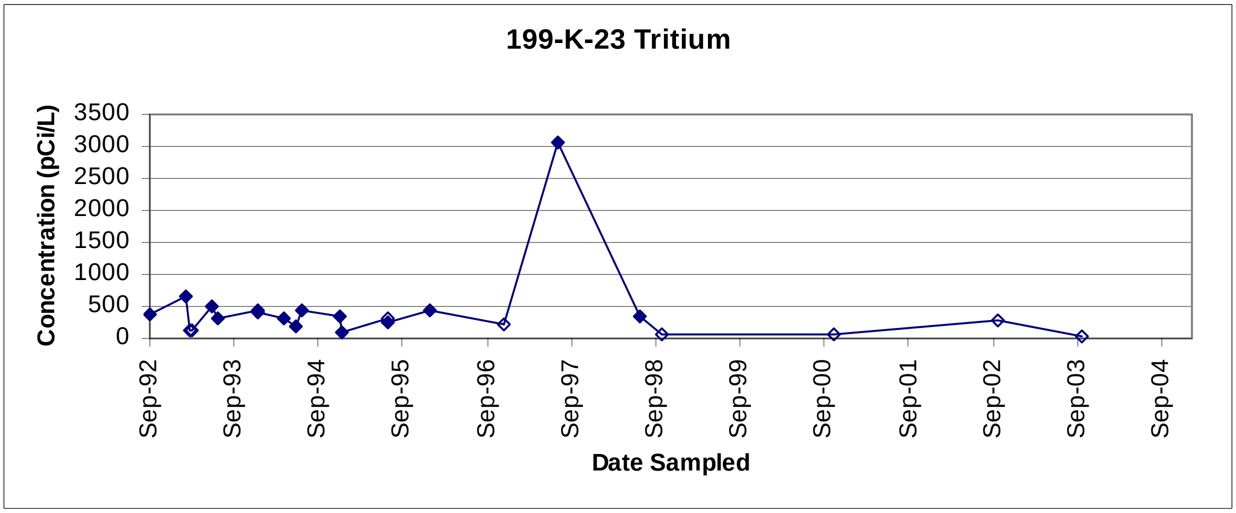

199-K-18 Tritium
Concentration (pCi/L)
60000
50000
40000
30000
20000
10000
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

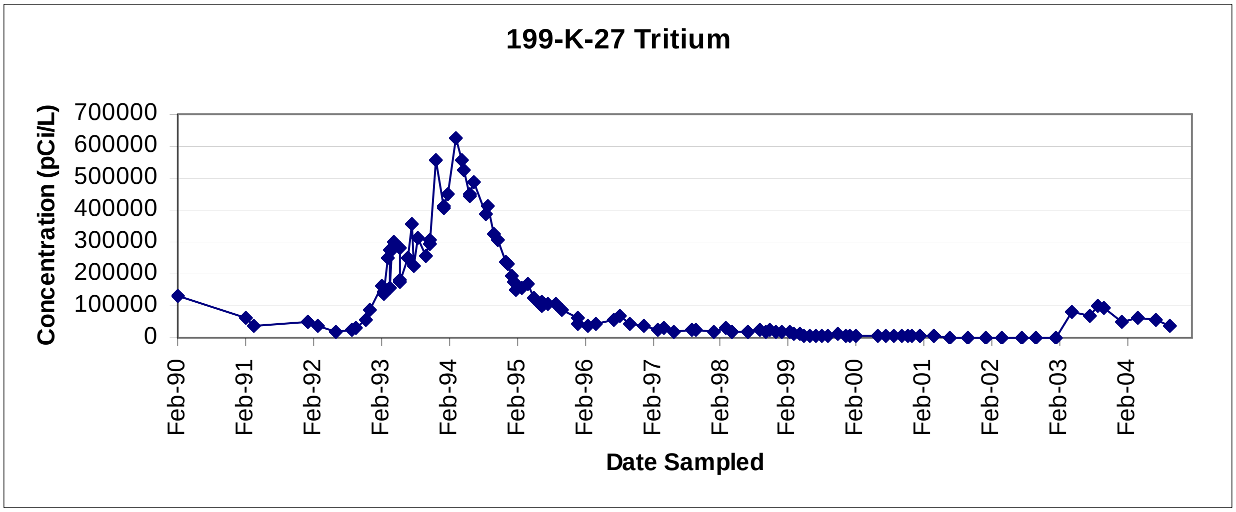

199-K-19 Tritium
Concentration (pCi/L)
14000
12000
10000
8000
6000
4000
2000
0
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

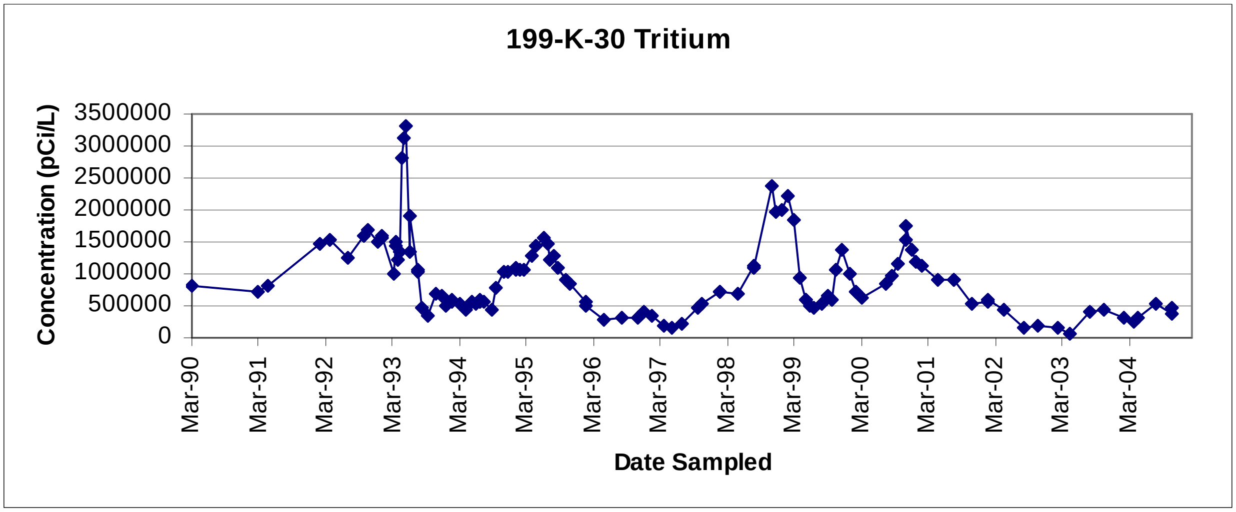

199-K-20 Tritium
Concentration (pCi/L)
3000
2500
2000
1500
1000
500
0
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

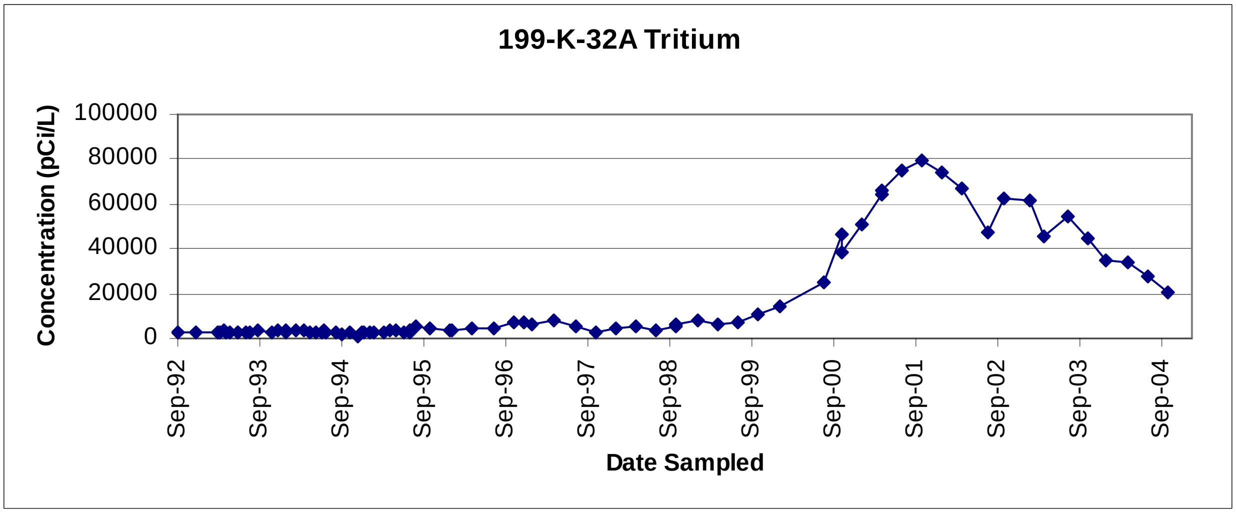

199-K-21 Tritium
Concentration (pCi/L)
1000
800
600
400
200
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

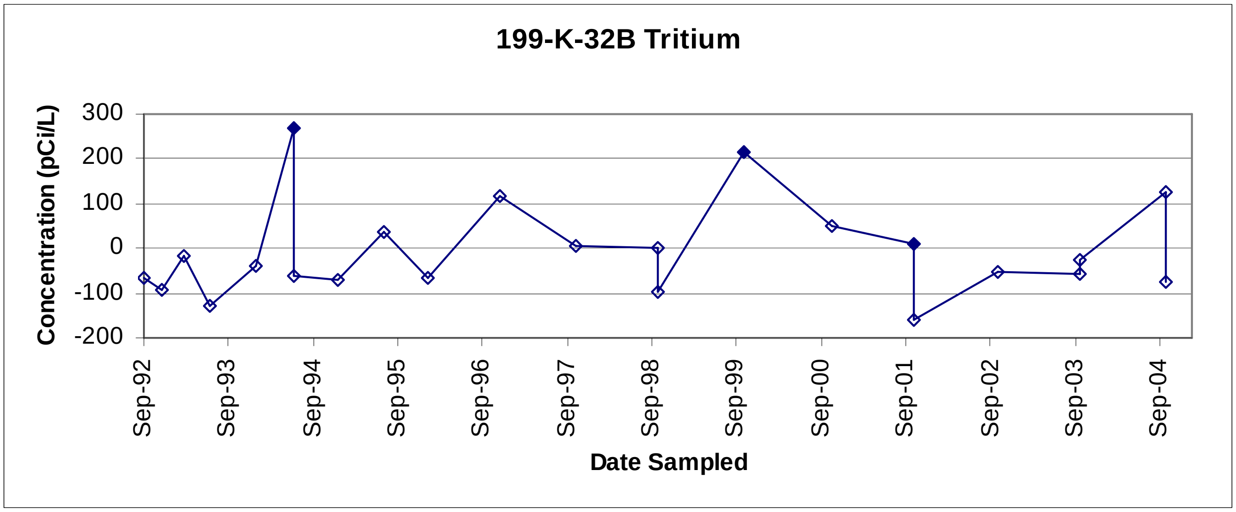

199-K-22 Tritium
Concentration (pCi/L)
2000
1500
1000
500
0
-500
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

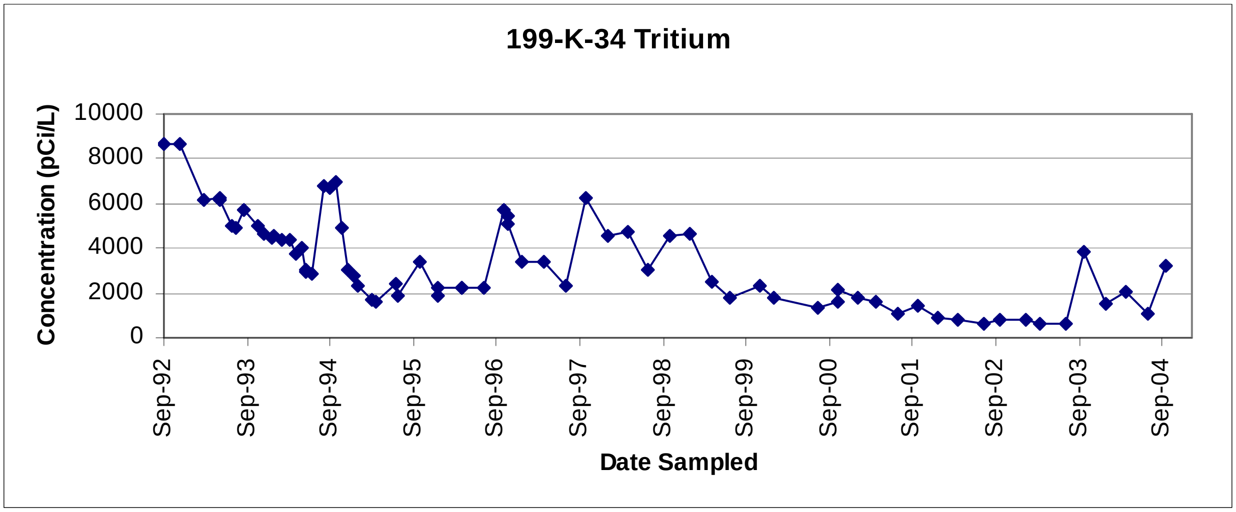

199-K-23 Tritium
Concentration (pCi/L)
3500
3000
2500
2000
1500
1000
500
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

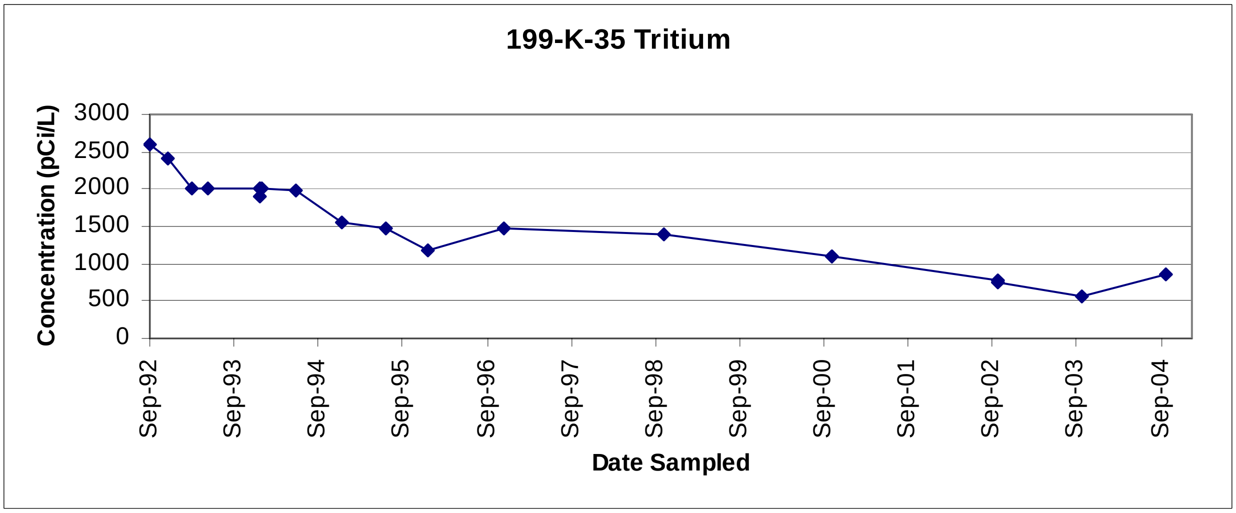

199-K-27 Tritium
Concentration (pCi/L)
700000
600000
500000
400000
300000
200000
100000
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

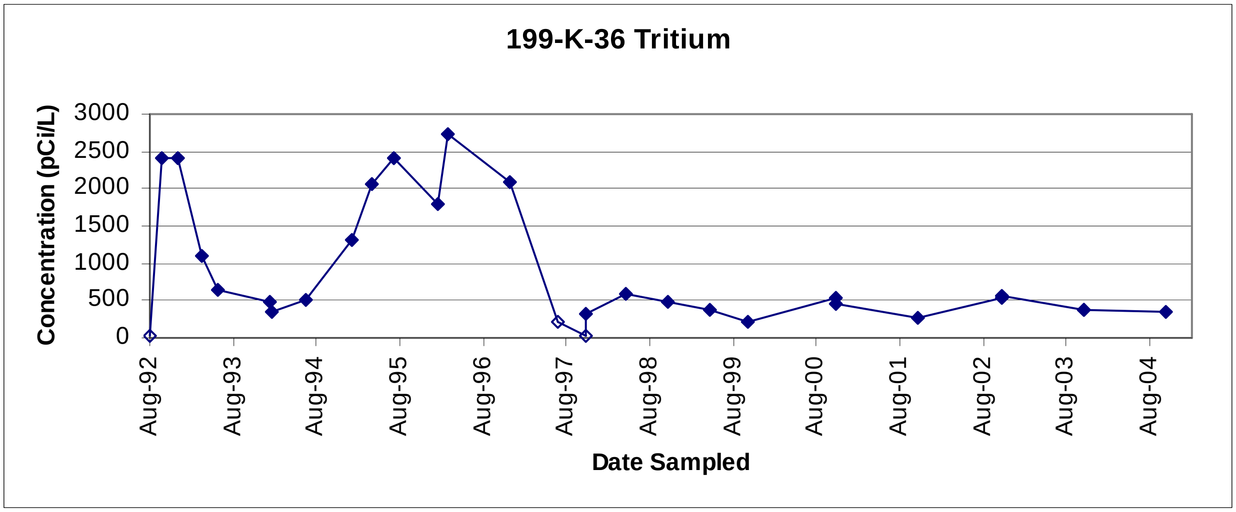

199-K-30 Tritium
Concentration (pCi/L)
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

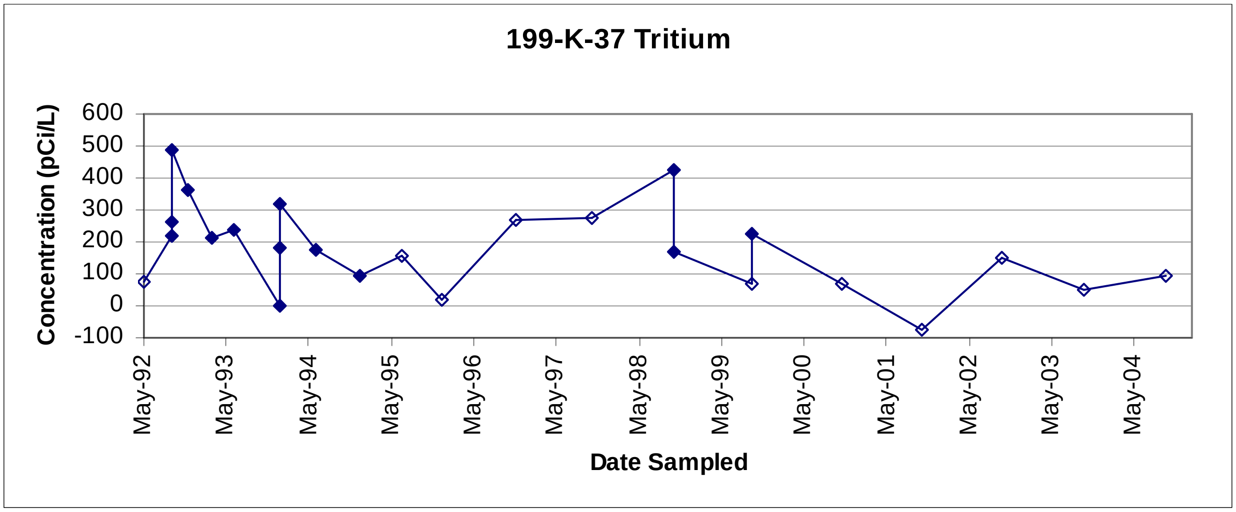

199-K-32A Tritium
Concentration (pCi/L)
100000
80000
60000
40000
20000
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

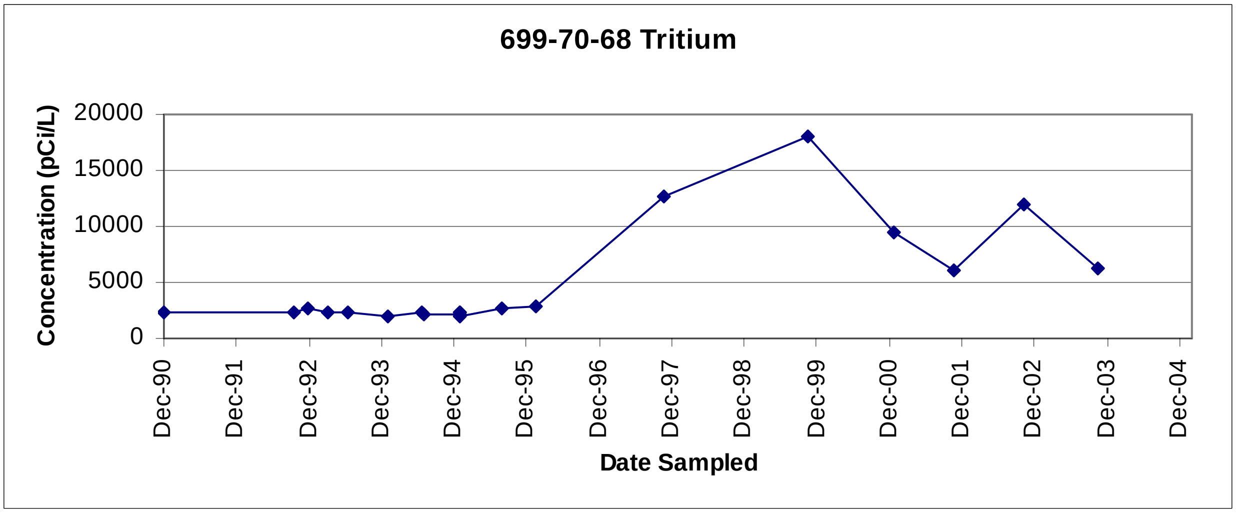

199-K-32B Tritium
Concentration (pCi/L)
300
200
100
0
-100
-200
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

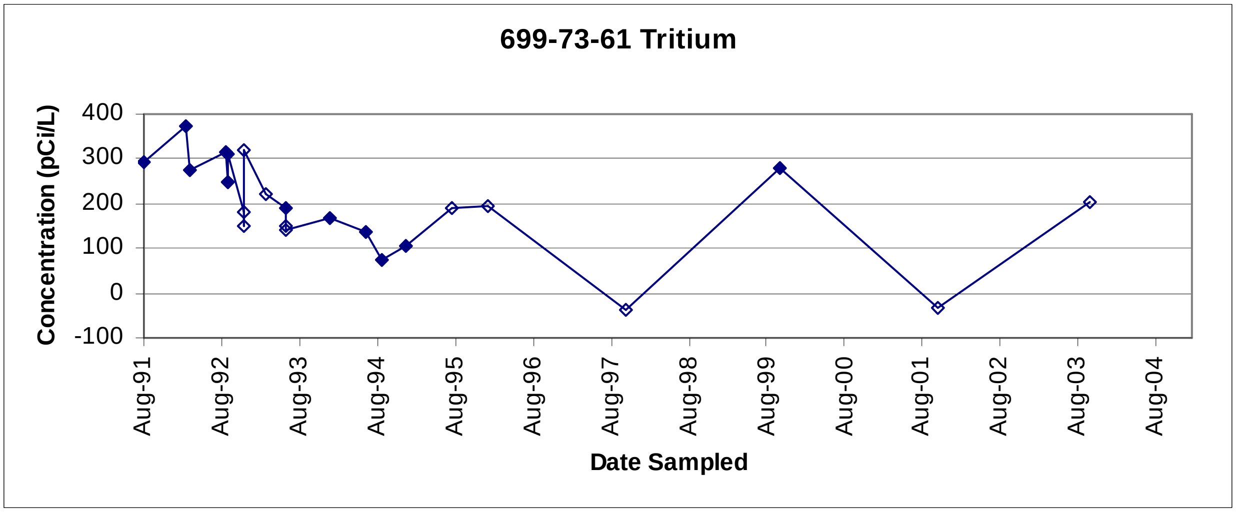

199-K-34 Tritium
Concentration (pCi/L)
10000
8000
6000
4000
2000
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

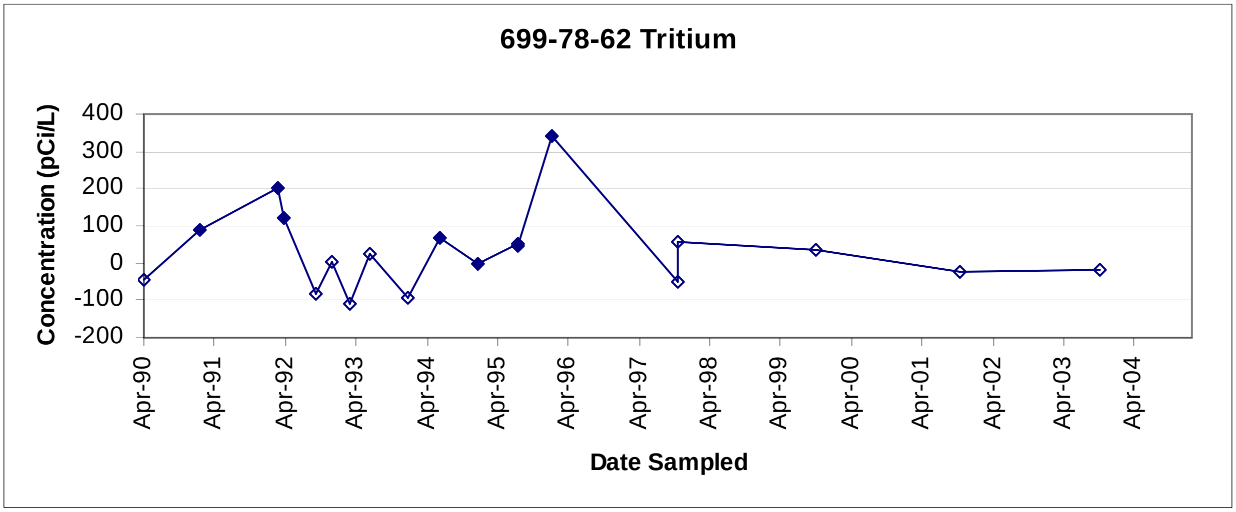

199-K-35 Tritium
Concentration (pCi/L)
3000
2500
2000
1500
1000
500
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

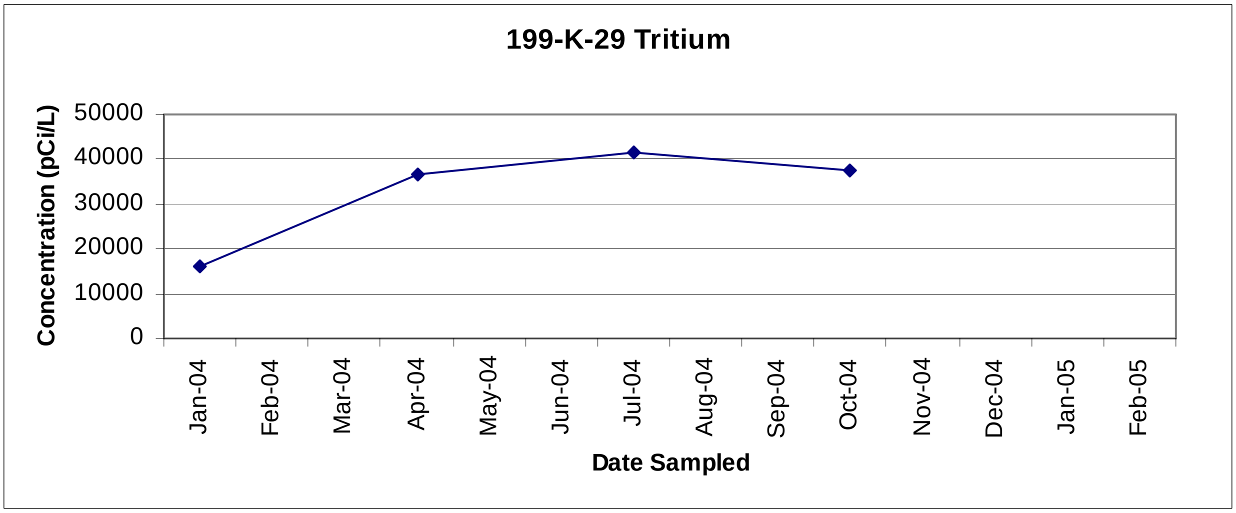

199-K-36 Tritium
Concentration (pCi/L)
3000
2500
2000
1500
1000
500
0
Aug-92
Aug-93
Aug-94
Aug-95
Aug-96
Aug-97
Aug-98
Aug-99
Aug-00
Aug-01
Aug-02
Aug-03
Aug-04
Date Sampled

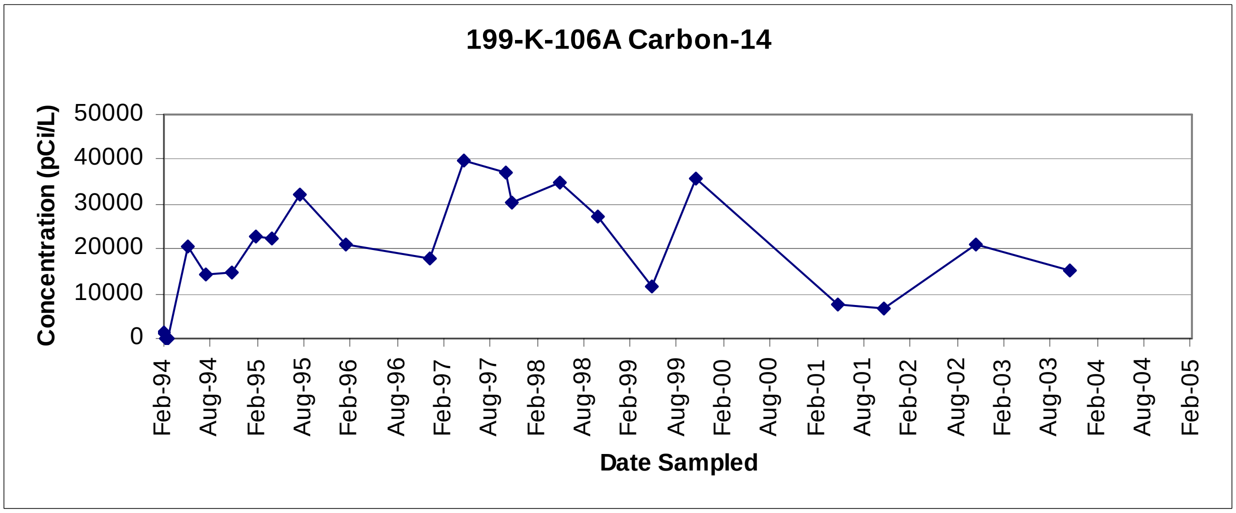

199-K-37 Tritium
Concentration (pCi/L)
600
500
400
300
200
100
0
-100
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


699-70-68 Tritium
Concentration (pCi/L)
20000
15000
10000
5000
0
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Date Sampled


699-73-61 Tritium
Concentration (pCi/L)
400
300
200
100
0
-100
Aug-91
Aug-92
Aug-93
Aug-94
Aug-95
Aug-96
Aug-97
Aug-98
Aug-99
Aug-00
Aug-01
Aug-02
Aug-03
Aug-04
Date Sampled


699-78-62 Tritium
Concentration (pCi/L)
400
300
200
100
0
-100
-200
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled


199-K-29 Tritium
Concentration (pCi/L)
50000
40000
30000
20000
10000
0
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-K-106A Carbon-14
Concentration (pCi/L)
50000
40000
30000
20000
10000
0
Feb-94
Aug-94
Feb-95
Aug-95
Feb-96
Aug-96
Feb-97
Aug-97
Feb-98
Aug-98
Feb-99
Aug-99
Feb-00
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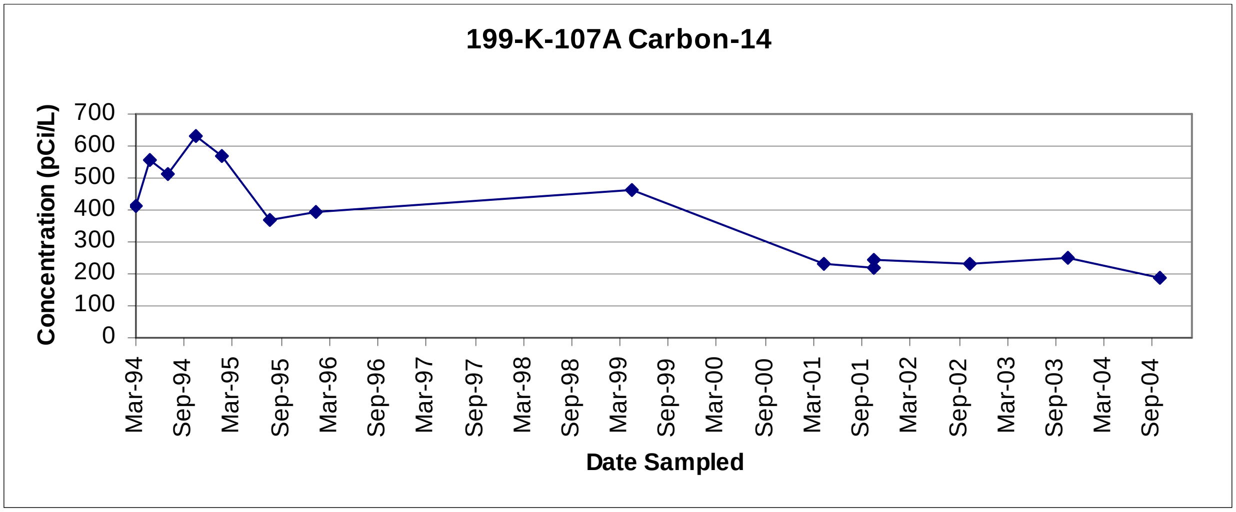
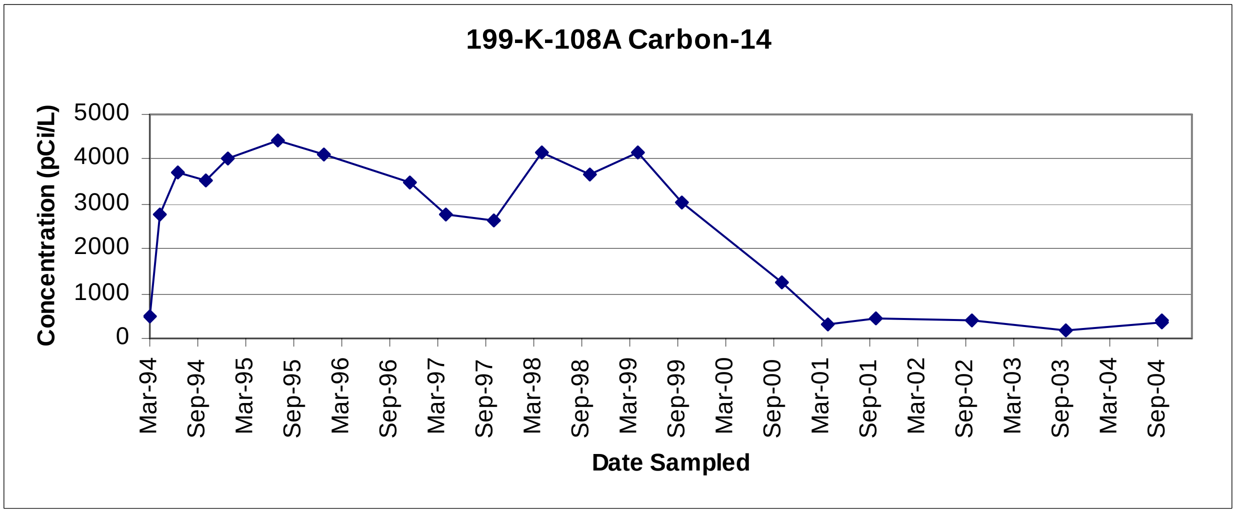
Aug-04
Feb-05
Date Sampled


199-K-107A Carbon-14
Concentration (pCi/L)
700
600
500
400
300
200
100
0
Mar-94
Sep-94
Mar-95
Sep-95
Mar-96
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled


199-K-108A Carbon-14
Concentration (pCi/L)
5000
4000
3000
2000
1000
0
Mar-94
Sep-94
Mar-95
Sep-95
Mar-96
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
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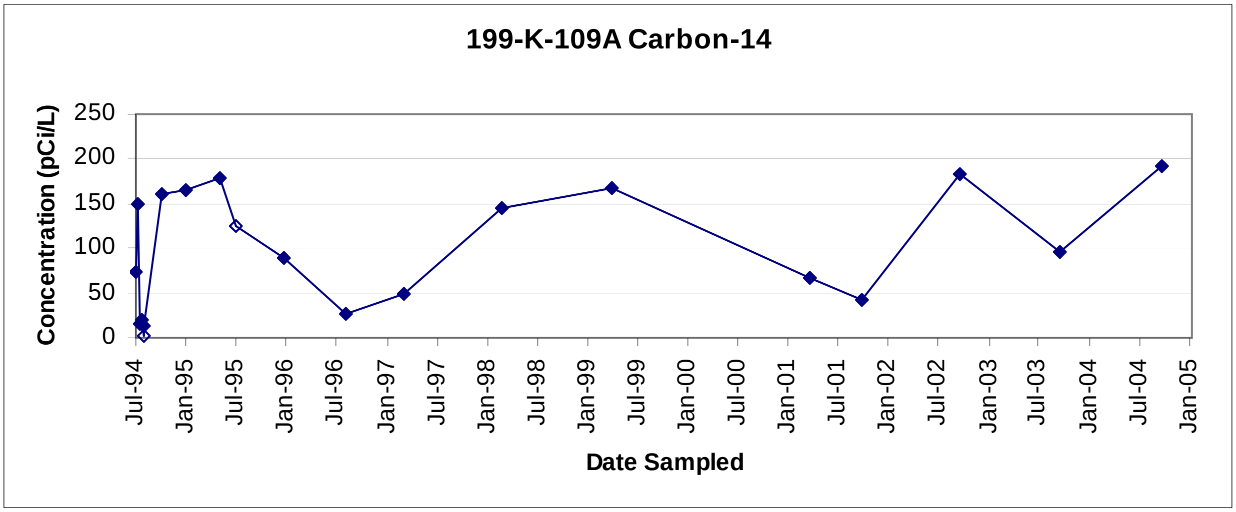
Mar-04
Sep-04
Date Sampled


199-K-109A Carbon-14
Concentration (pCi/L)
250
200
150
100
50
0
Jul-94
Jan-95
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Jan-01
Jul-01
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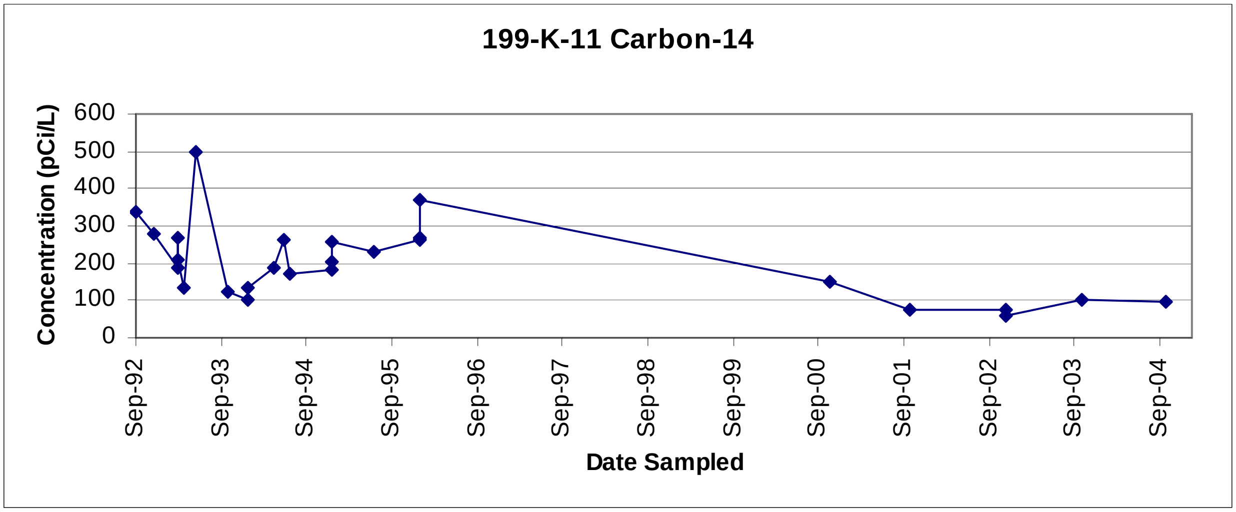
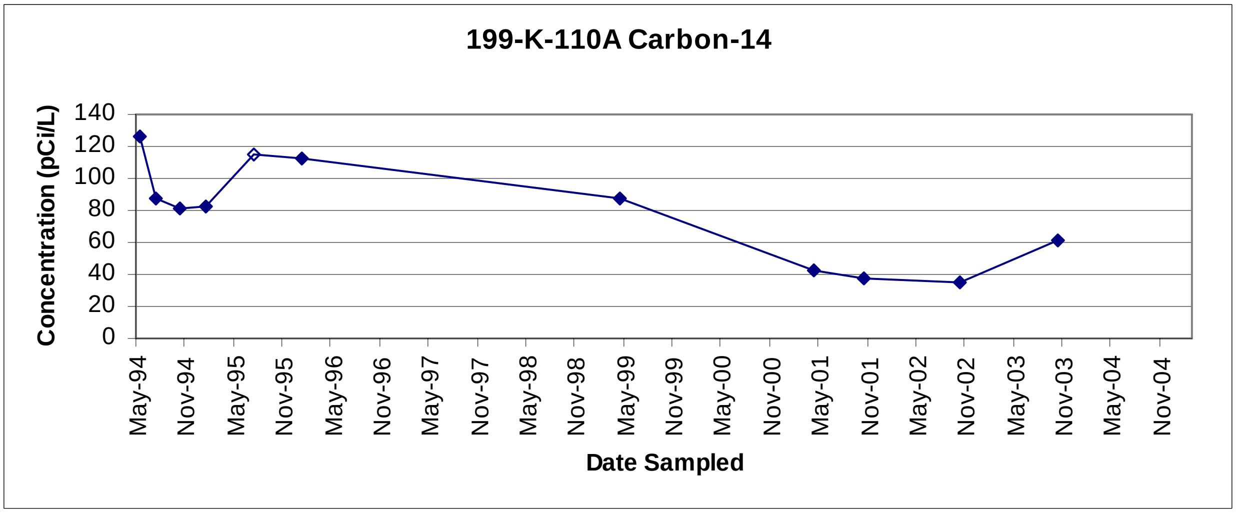
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Date Sampled


199-K-11 Carbon-14
Concentration (pCi/L)
600
500
400
300
200
100
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled


199-K-110A Carbon-14
Concentration (pCi/L)
140
120
100
80
60
40
20
0
May-94
Nov-94
May-95
Nov-95
May-96
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
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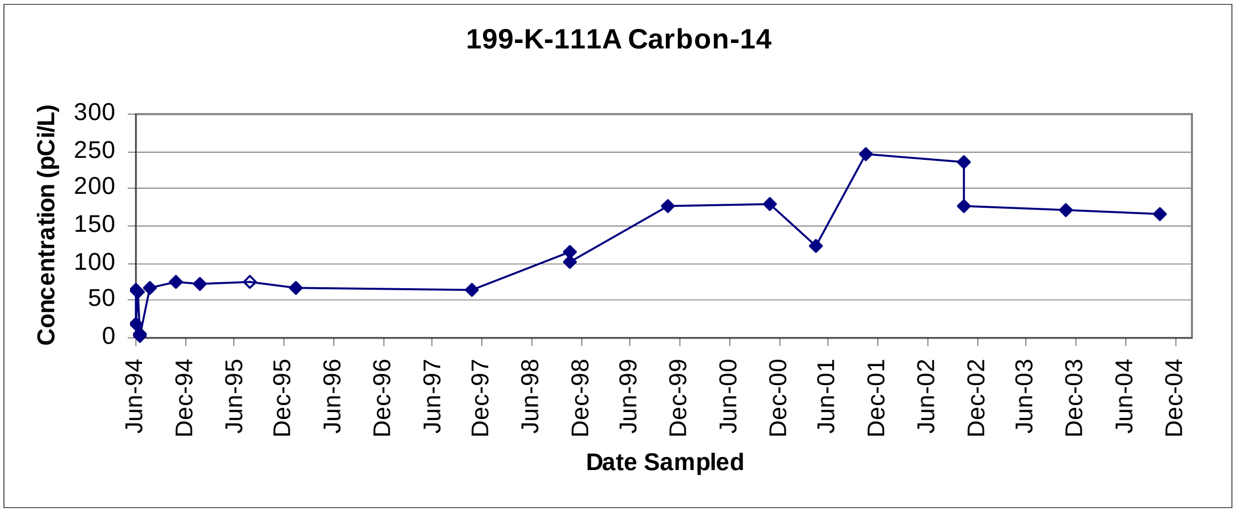
May-04
Nov-04
Date Sampled


199-K-111A Carbon-14
Concentration (pCi/L)
300
250
200
150
100
50
0
Jun-94
Dec-94
Jun-95
Dec-95
Jun-96
Dec-96
Jun-97
Dec-97
Jun-98
Dec-98
Jun-99
Dec-99
Jun-00
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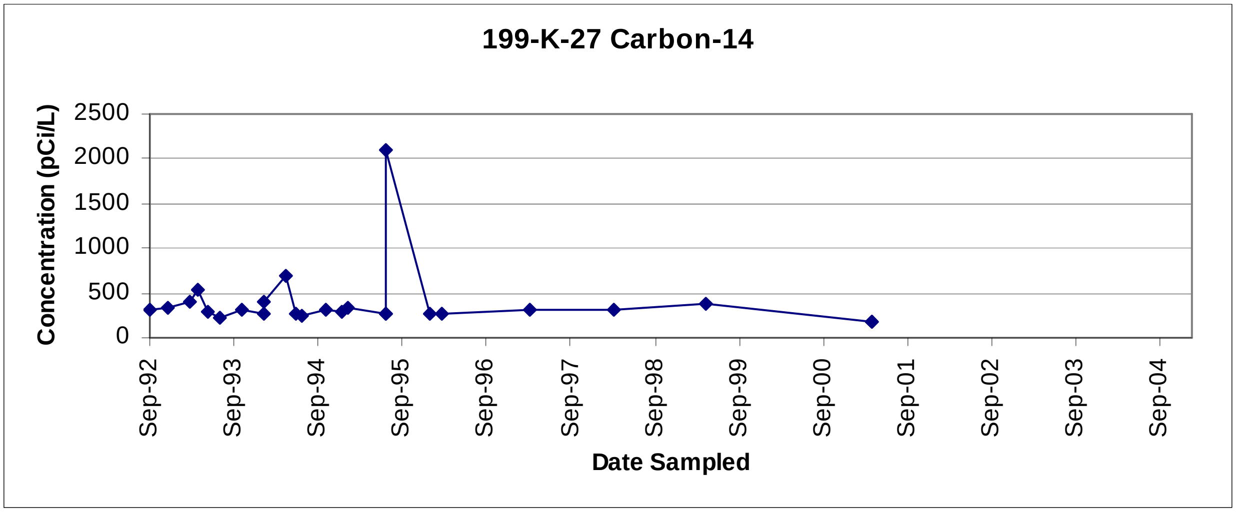
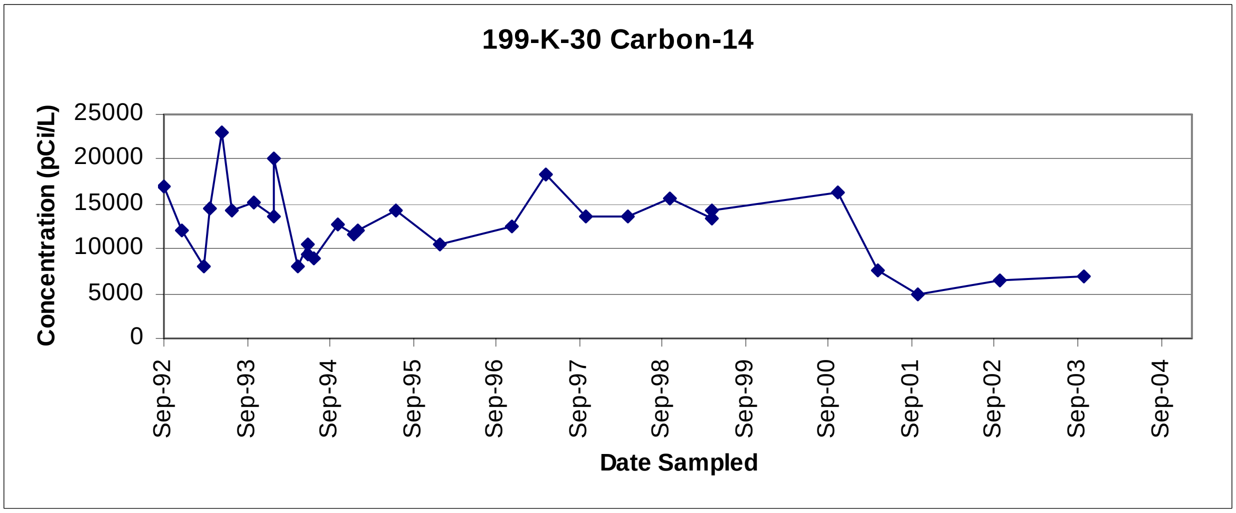
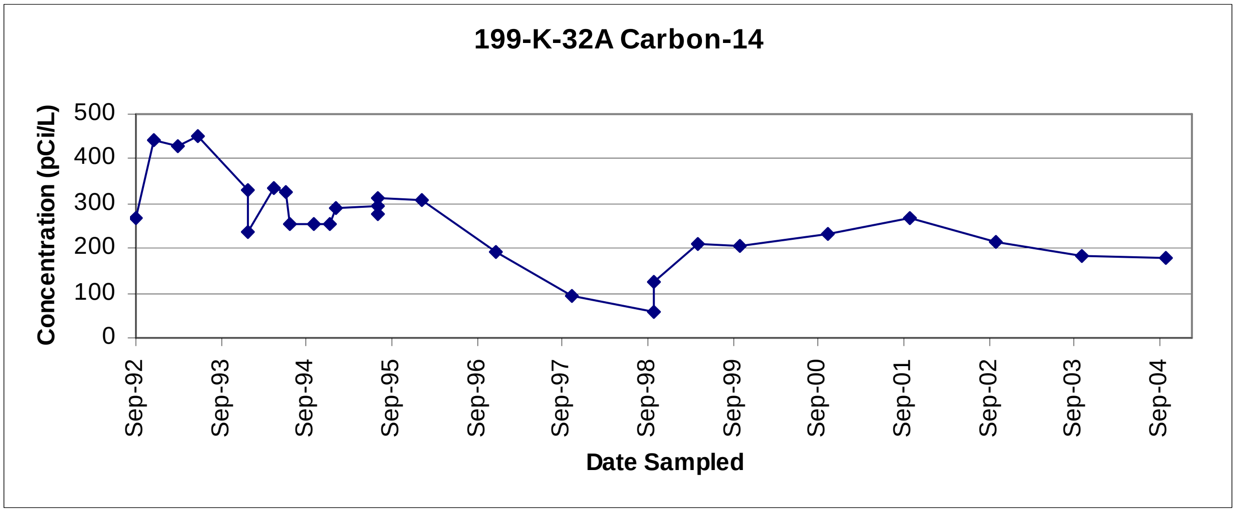
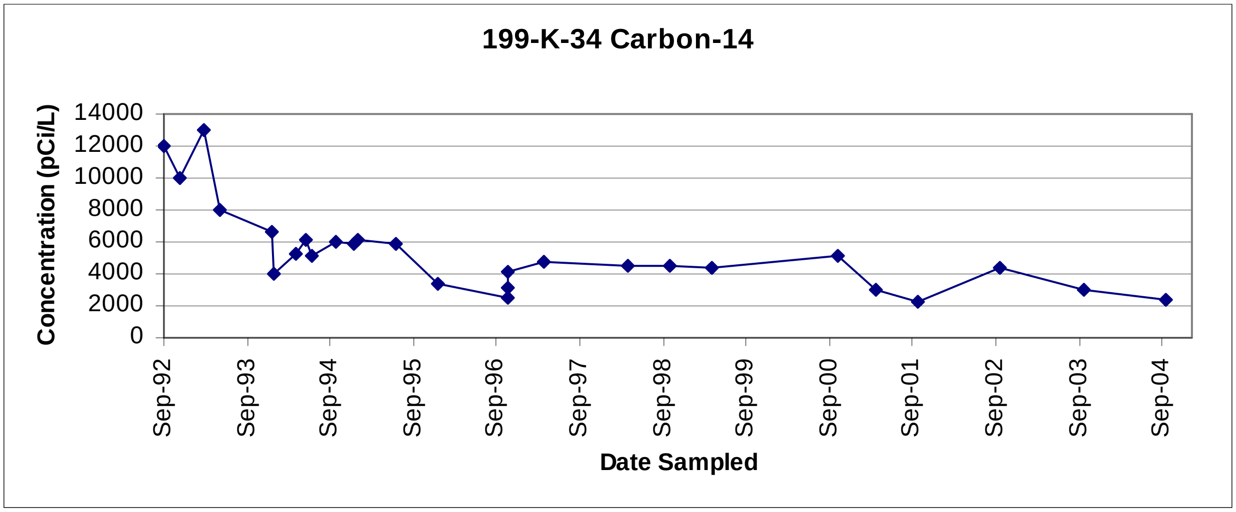
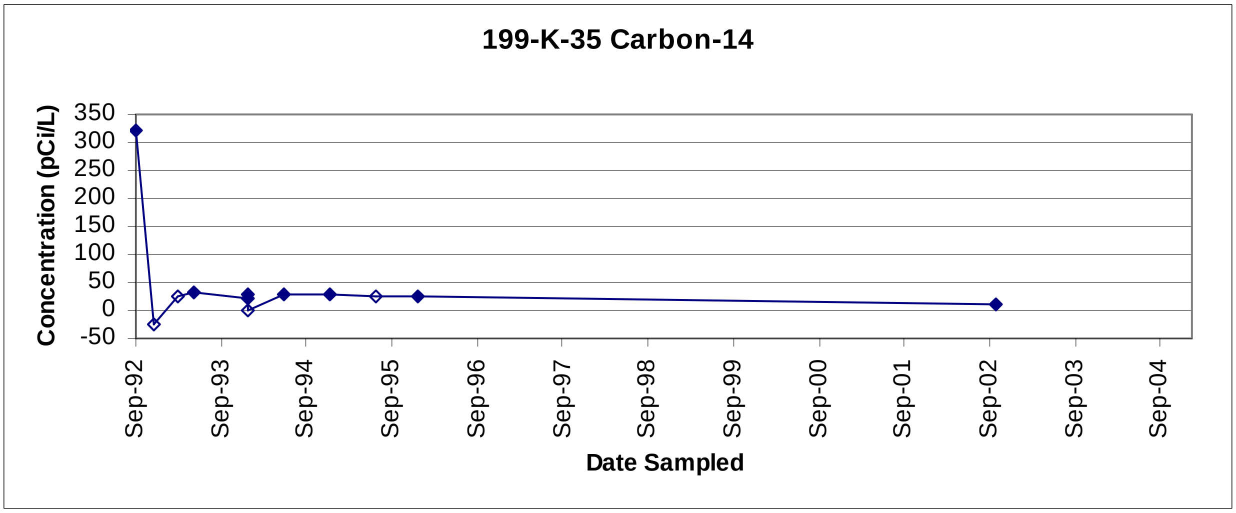
Jun-04
Dec-04
Date Sampled

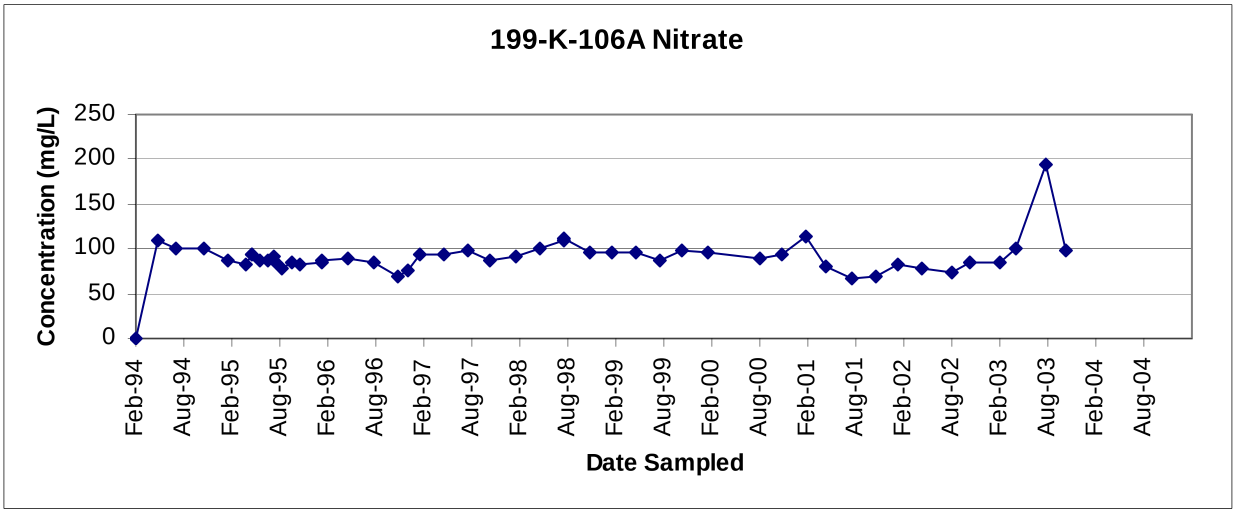

199-K-27 Carbon-14
Concentration (pCi/L)
2500
2000
1500
1000
500
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled


199-K-30 Carbon-14
Concentration (pCi/L)
25000
20000
15000
10000
5000
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled


199-K-32A Carbon-14
Concentration (pCi/L)
500
400
300
200
100
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled


199-K-34 Carbon-14
Concentration (pCi/L)
14000
12000
10000
8000
6000
4000
2000
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled


199-K-35 Carbon-14
Concentration (pCi/L)
350
300
250
200
150
100
50
0
-50
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled


199-K-106A Nitrate
Concentration (mg/L)
250
200
150
100
50
0
Feb-94
Aug-94
Feb-95
Aug-95
Feb-96
Aug-96
Feb-97
Aug-97
Feb-98
Aug-98
Feb-99
Aug-99
Feb-00
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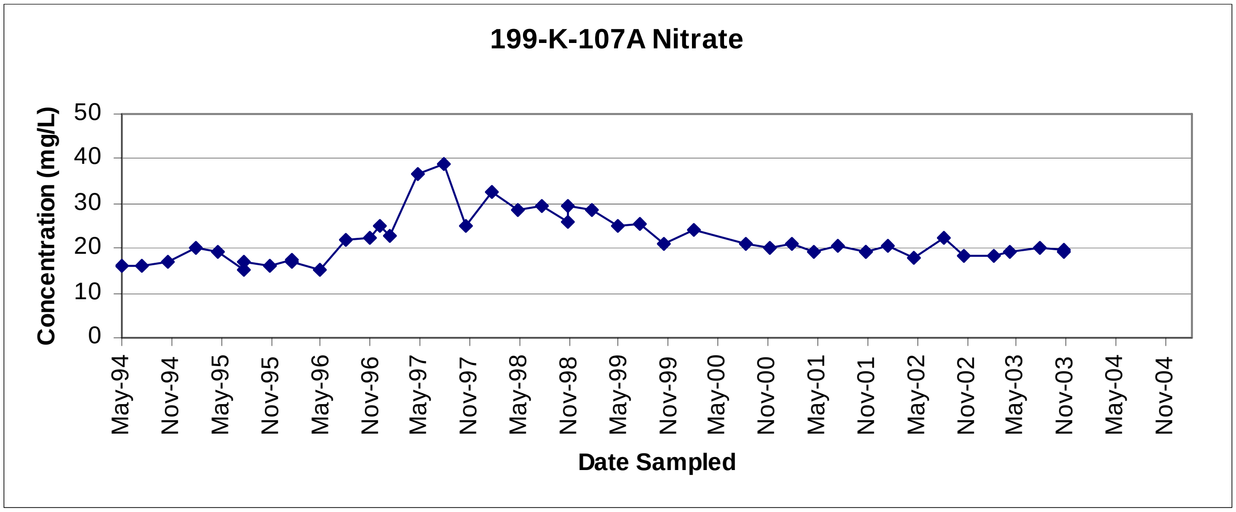
Feb-02
Aug-02
Feb-03
Aug-03
Feb-04
Aug-04
Date Sampled


199-K-107A Nitrate
Concentration (mg/L)
0
10
20
30
40
50
May-94
Nov-94
May-95
Nov-95
May-96
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
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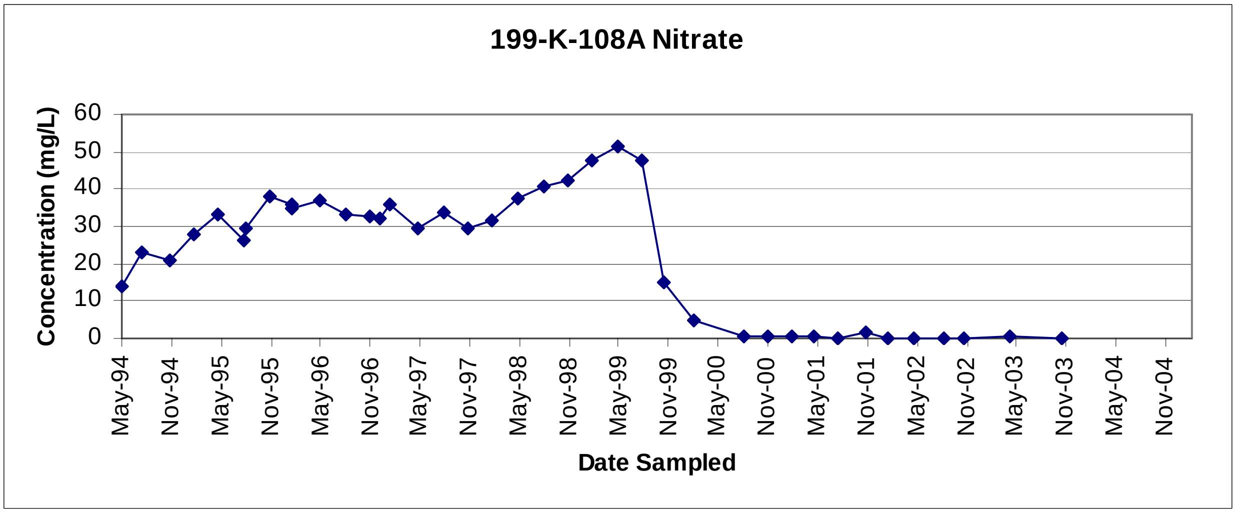
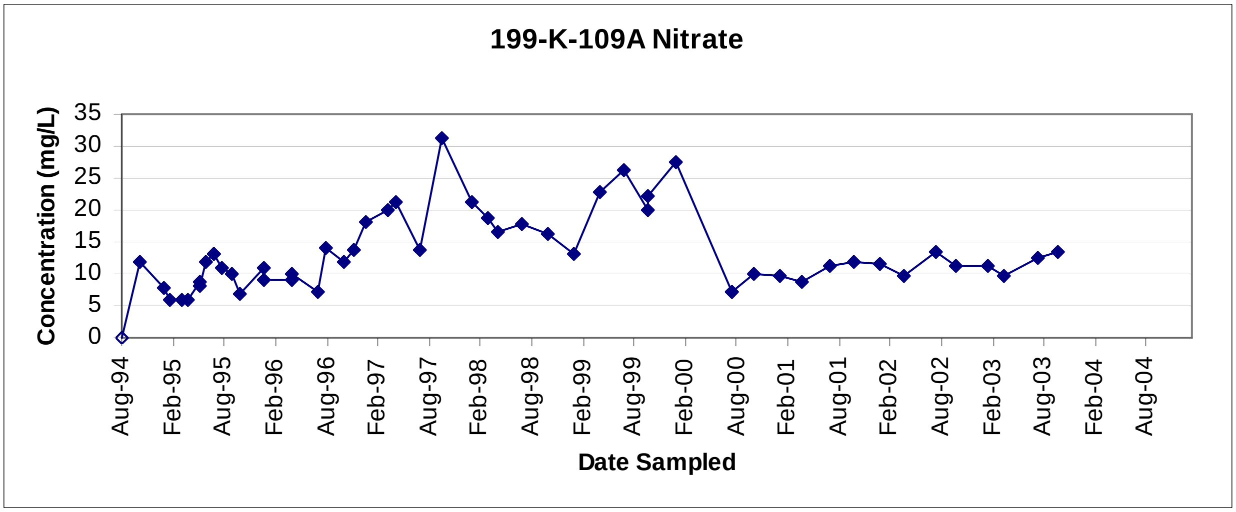
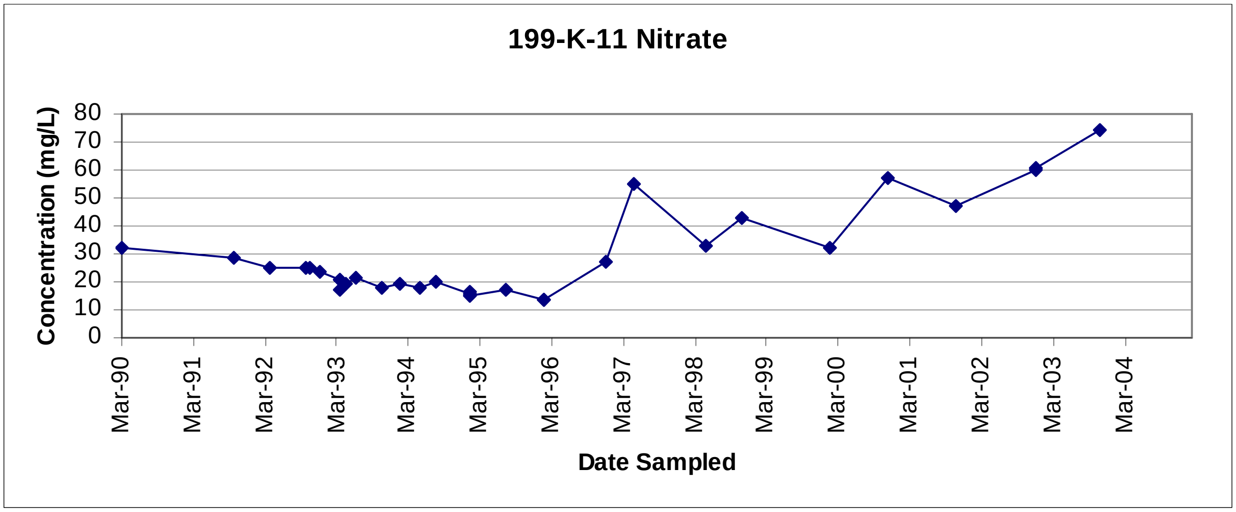
May-04
Nov-04
Date Sampled


199-K-108A Nitrate
Concentration (mg/L)
0
10
20
30
40
50
60
May-94
Nov-94
May-95
Nov-95
May-96
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
Date Sampled


199-K-109A Nitrate
Concentration (mg/L)
0
5
10
15
20
25
30
35
Aug-94
Feb-95
Aug-95
Feb-96
Aug-96
Feb-97
Aug-97
Feb-98
Aug-98
Feb-99
Aug-99
Feb-00
Aug-00
Feb-01
Aug-01
Feb-02
Aug-02
Feb-03
Aug-03
Feb-04
Aug-04
Date Sampled


199-K-11 Nitrate
Concentration (mg/L)
80
70
60
50
40
30
20
10
0
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
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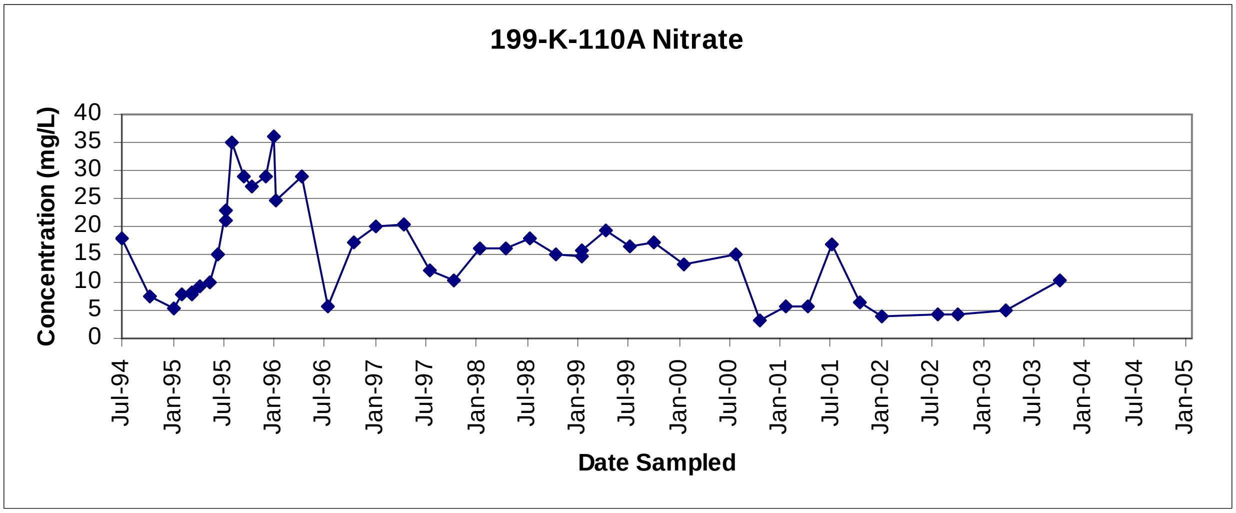
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled


199-K-110A Nitrate
Concentration (mg/L)
40
35
30
25
20
15
10
5
0
Jul-94
Jan-95
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
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Jan-01
Jul-01
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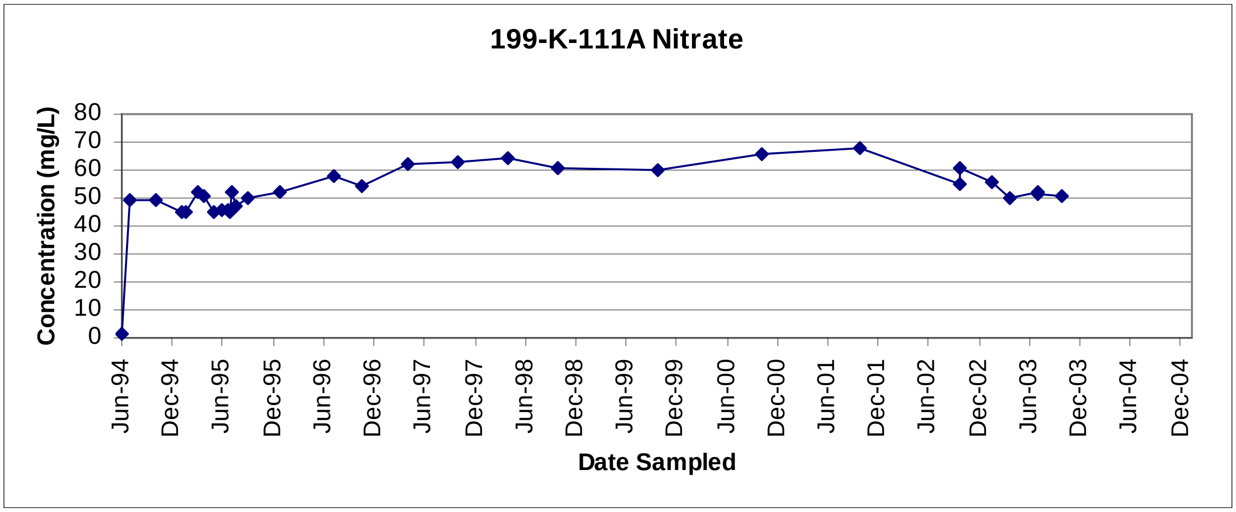
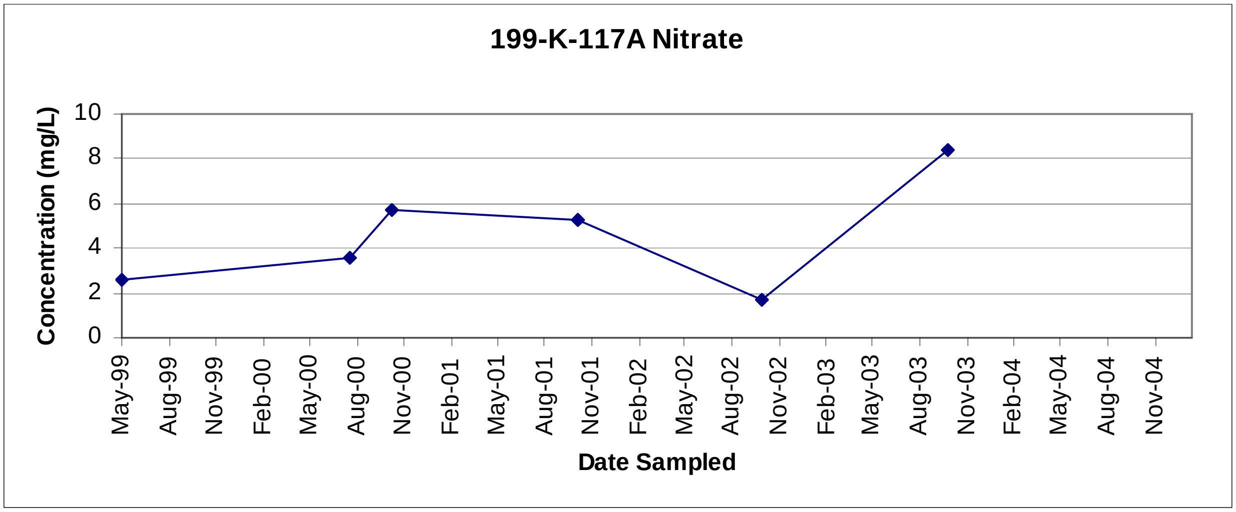
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Date Sampled


199-K-111A Nitrate
Concentration (mg/L)
80
70
60
50
40
30
20
10
0
Jun-94
Dec-94
Jun-95
Dec-95
Jun-96
Dec-96
Jun-97
Dec-97
Jun-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
Jun-02
Dec-02
Jun-03
Dec-03
Jun-04
Dec-04
Date Sampled


199-K-117A Nitrate
Concentration (mg/L)
0
2
4
6
8
10
May-99
Aug-99
Nov-99
Feb-00
May-00
Aug-00
Nov-00
Feb-01
May-01
Aug-01
Nov-01
Feb-02
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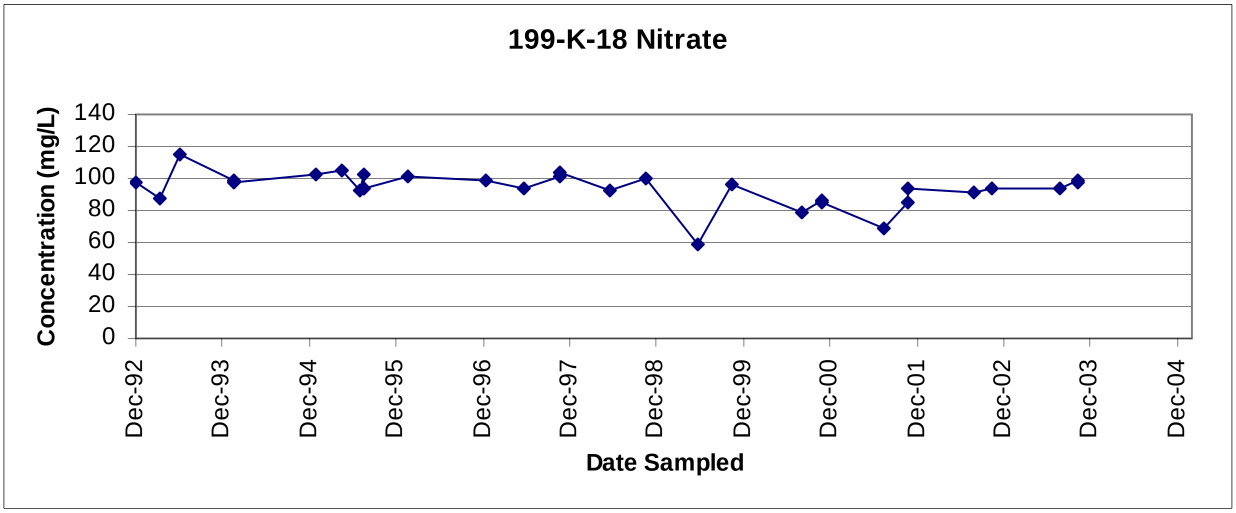
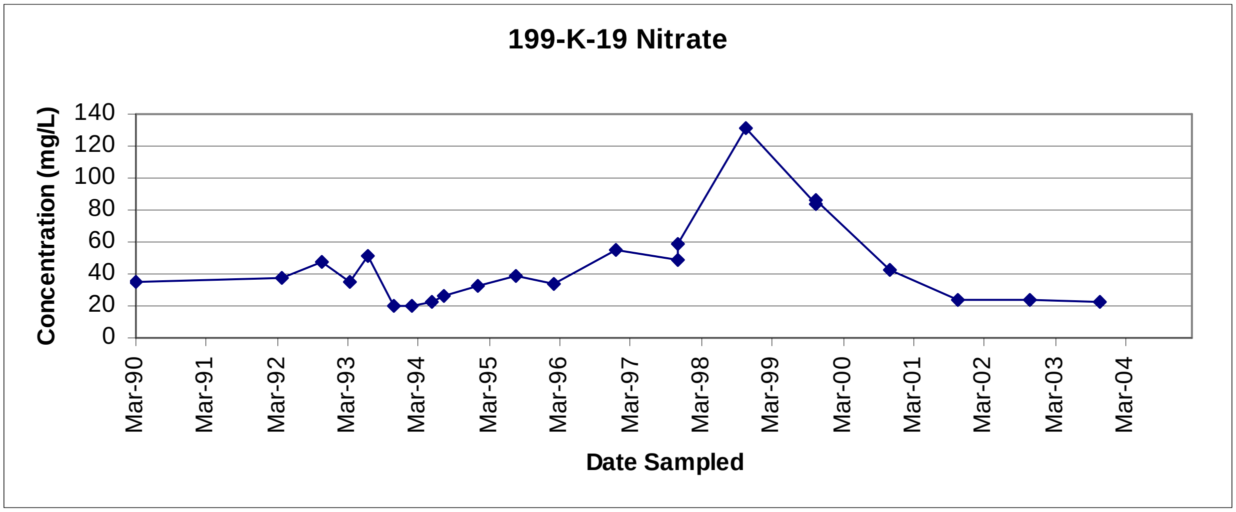
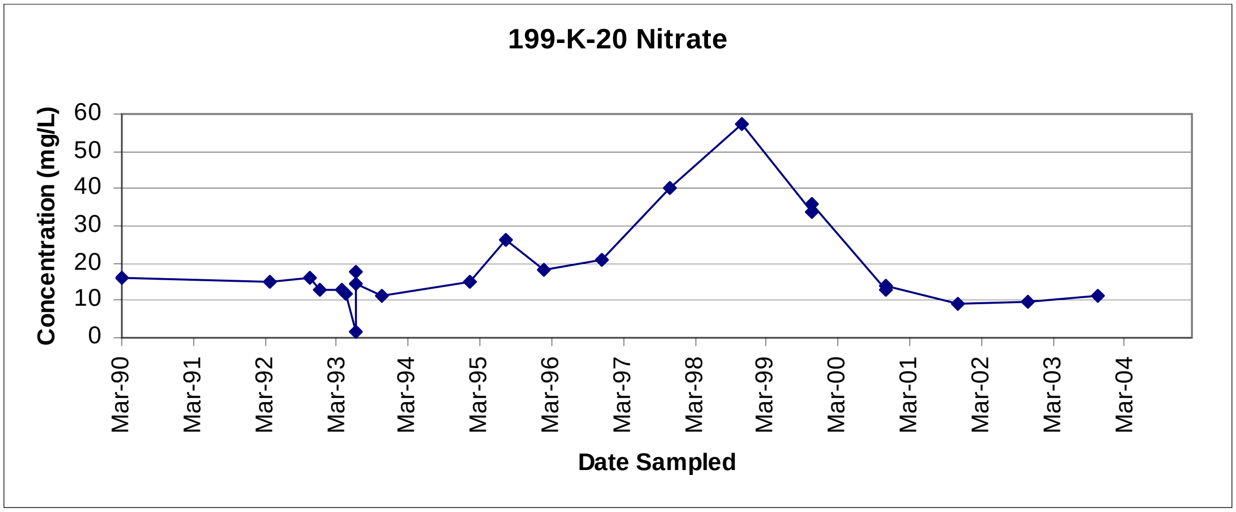
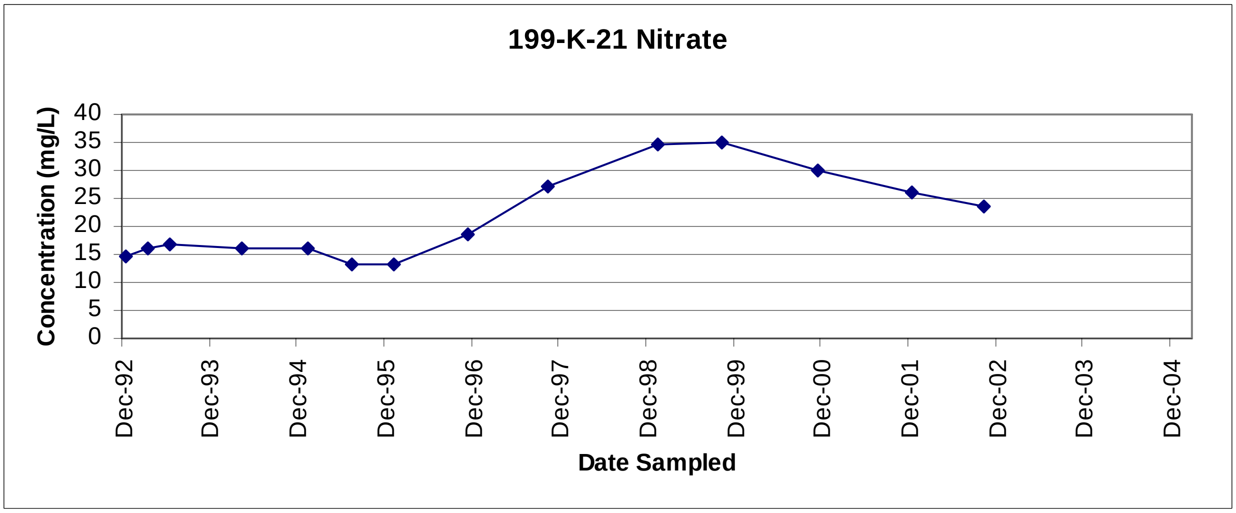
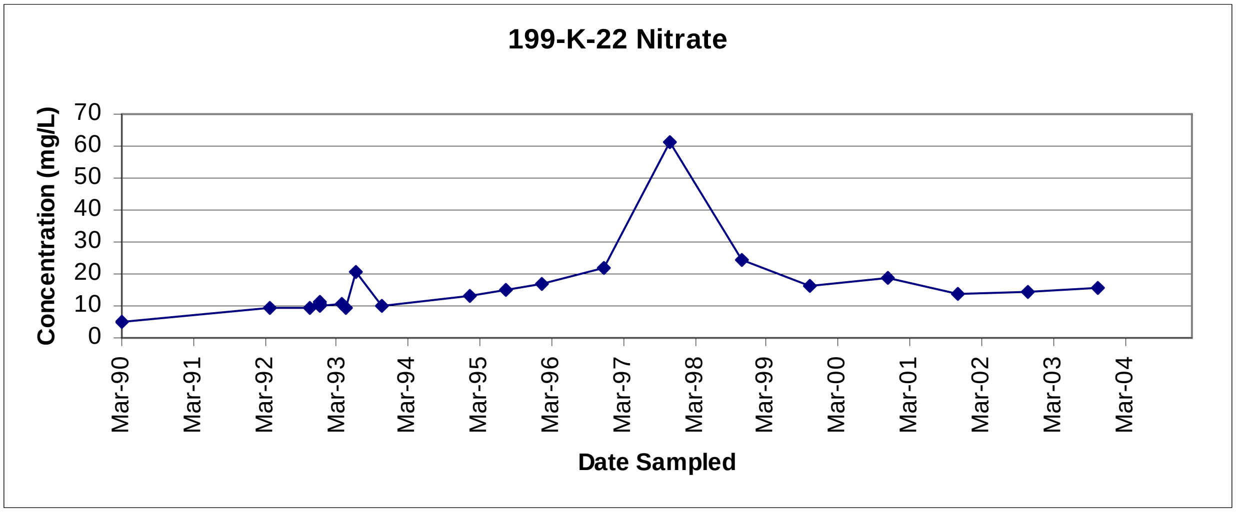
Aug-04
Nov-04
Date Sampled

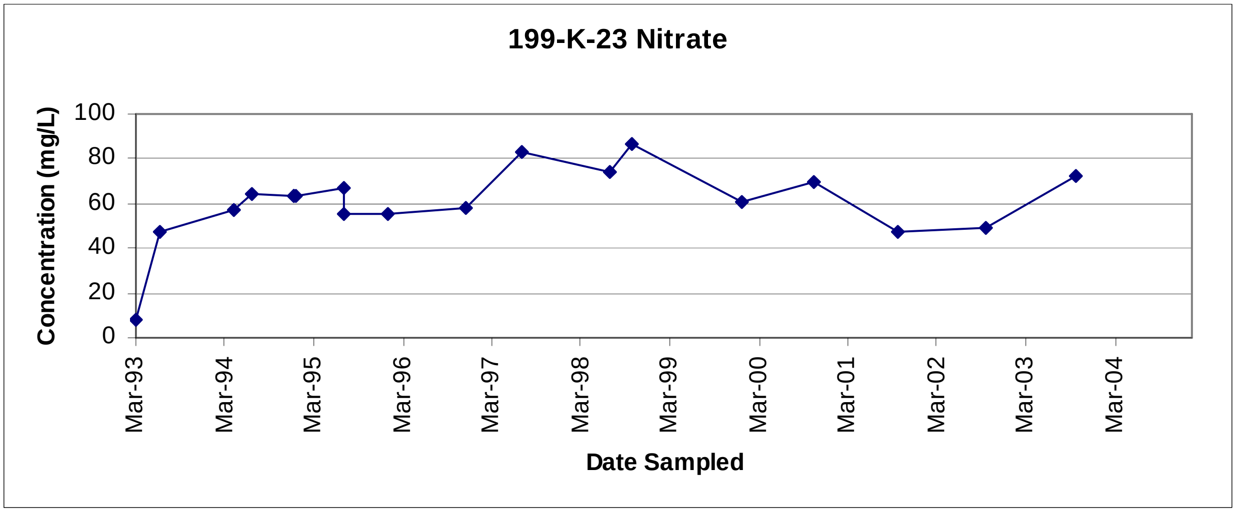

199-K-18 Nitrate
Concentration (mg/L)
0
20
40
60
80
100
120
140
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Date Sampled

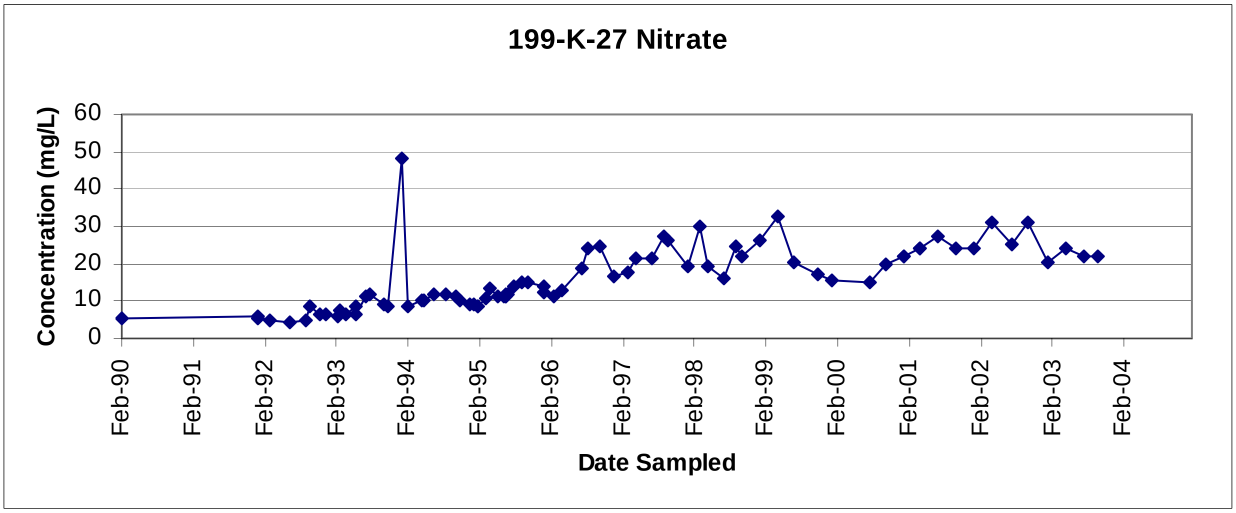

199-K-19 Nitrate
Concentration (mg/L)
0
20
40
60
80
100
120
140
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

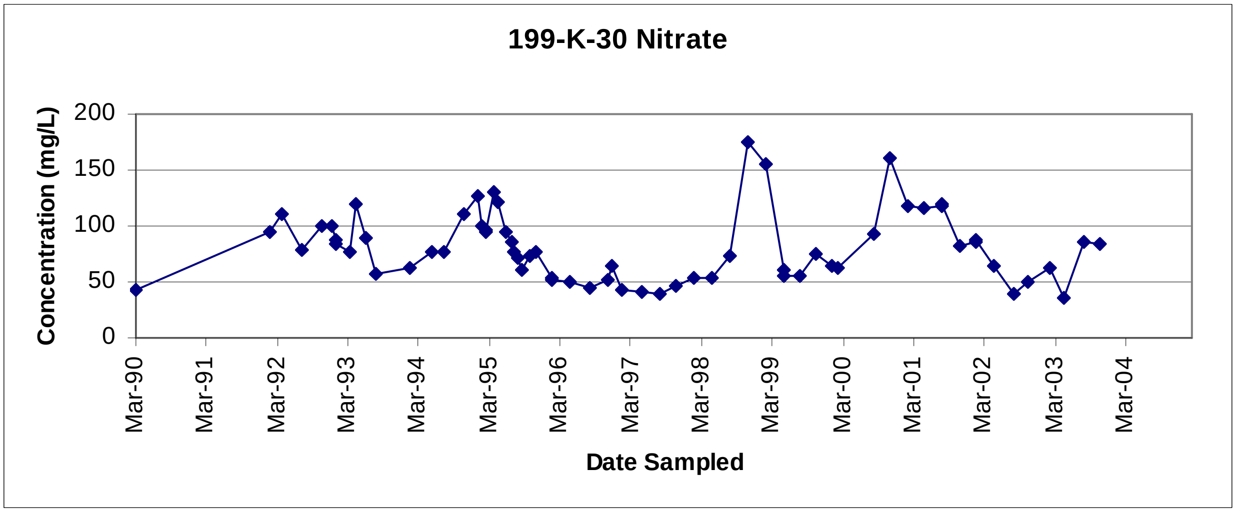

199-K-20 Nitrate
Concentration (mg/L)
60
50
40
30
20
10
0
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

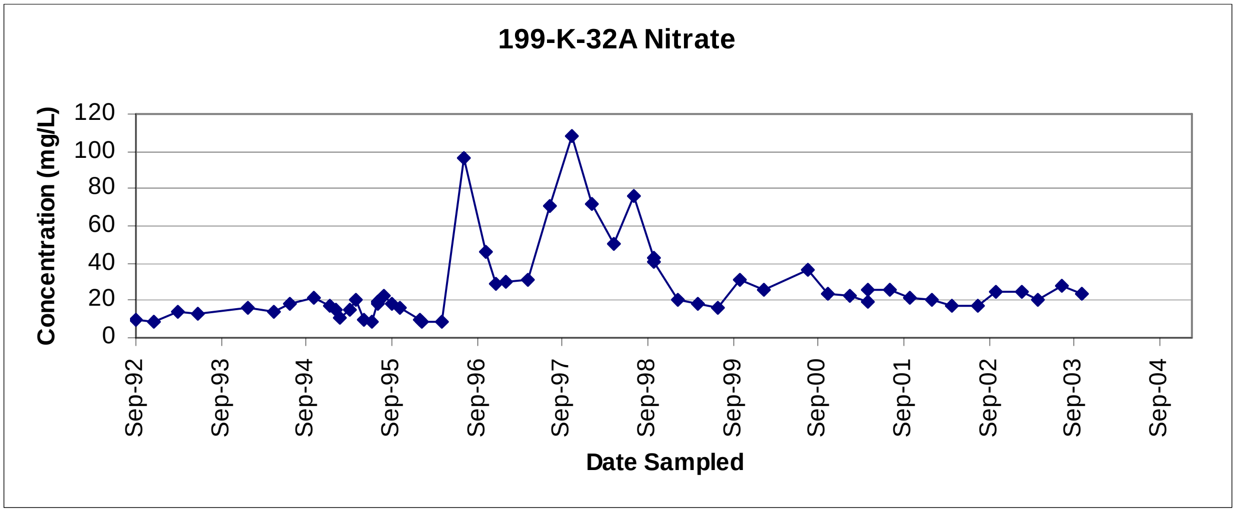

199-K-21 Nitrate
Concentration (mg/L)
40
35
30
25
20
15
10
5
0
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Date Sampled

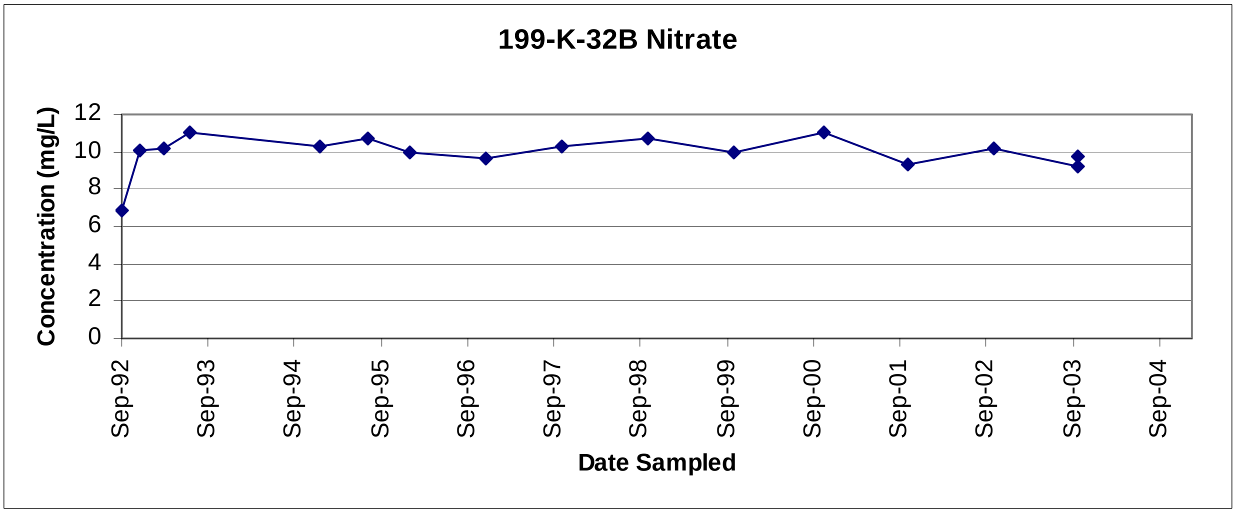

199-K-22 Nitrate
Concentration (mg/L)
70
60
50
40
30
20
10
0
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

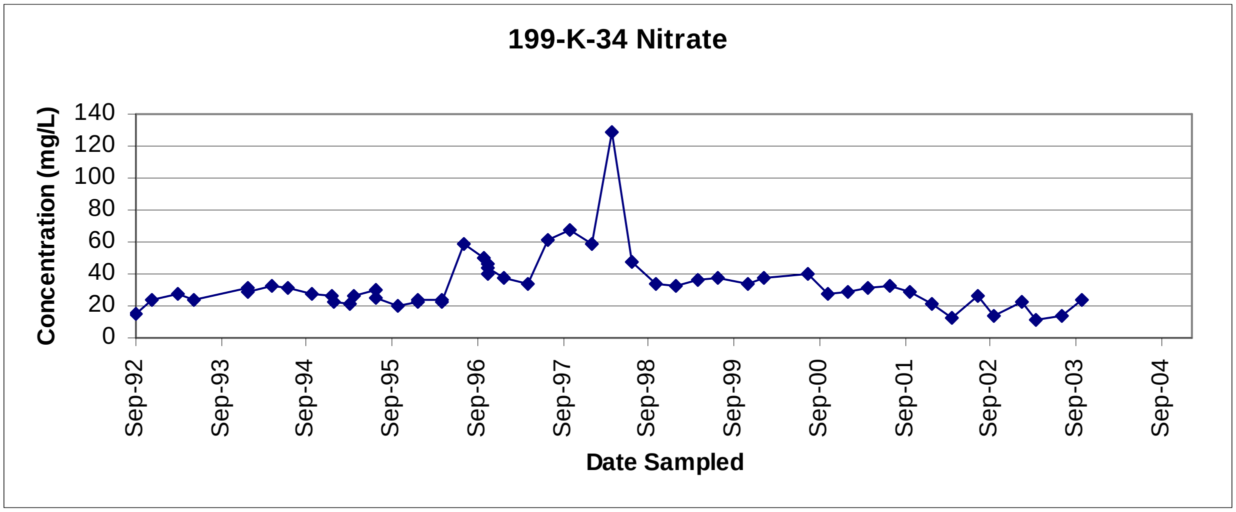

199-K-23 Nitrate
Concentration (mg/L)
0
20
40
60
80
100
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

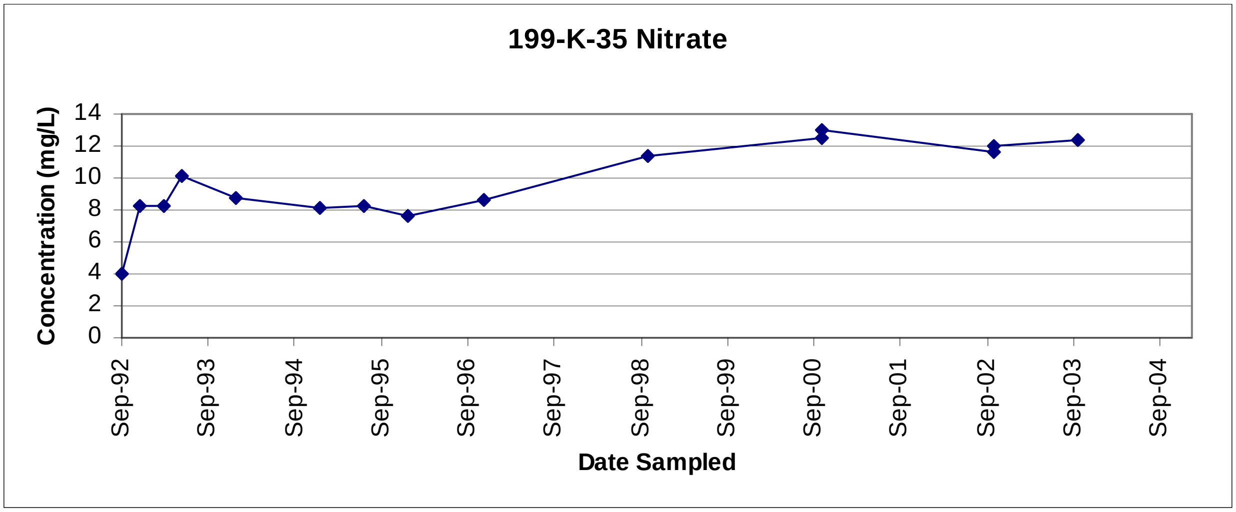

199-K-27 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
60
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

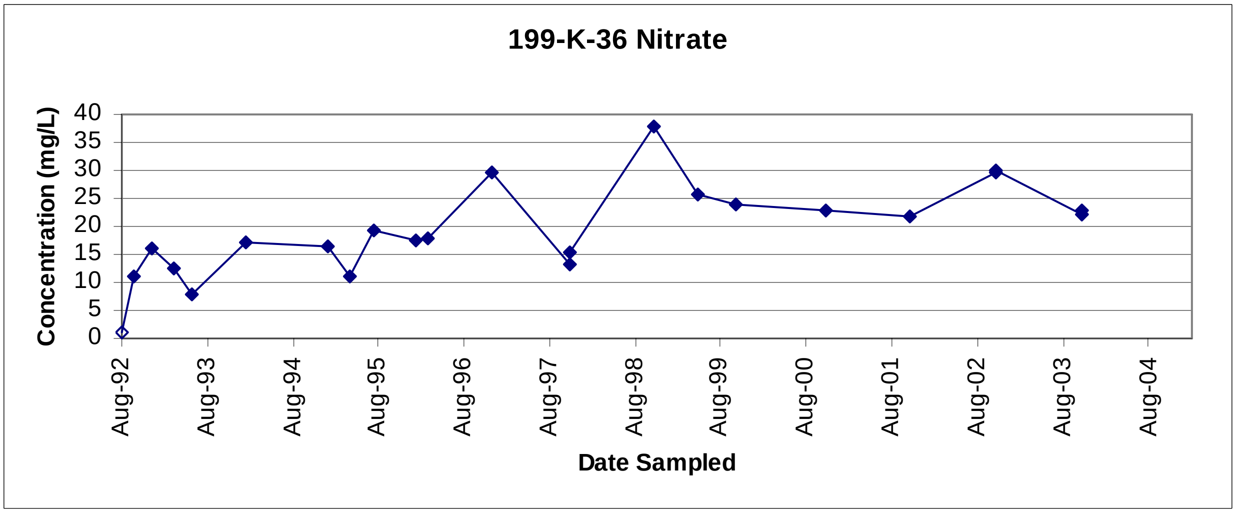

199-K-30 Nitrate
Concentration (mg/L)
0
50
100
150
200
Mar-90
Mar-91
Mar-92
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

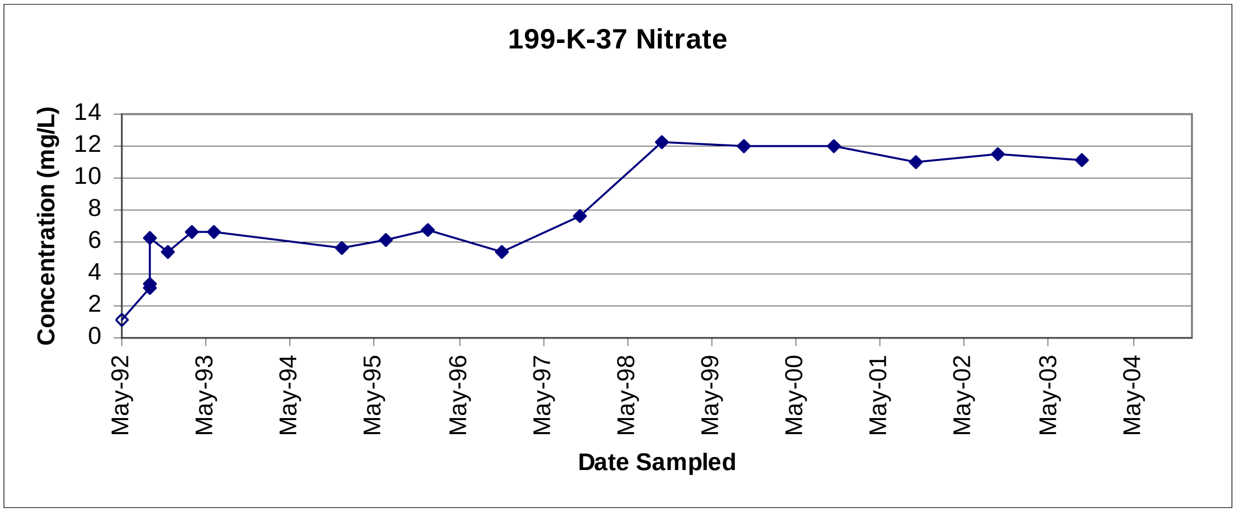

199-K-32A Nitrate
Concentration (mg/L)
0
20
40
60
80
100
120
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

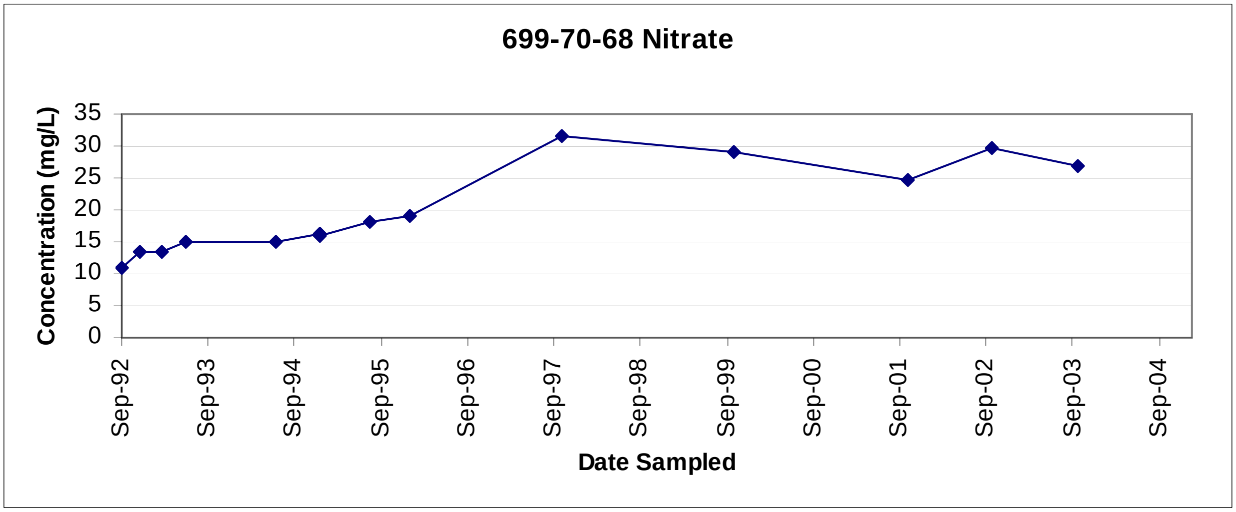

199-K-32B Nitrate
Concentration (mg/L)
0
2
4
6
8
10
12
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled


199-K-34 Nitrate
Concentration (mg/L)
0
20
40
60
80
100
120
140
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled

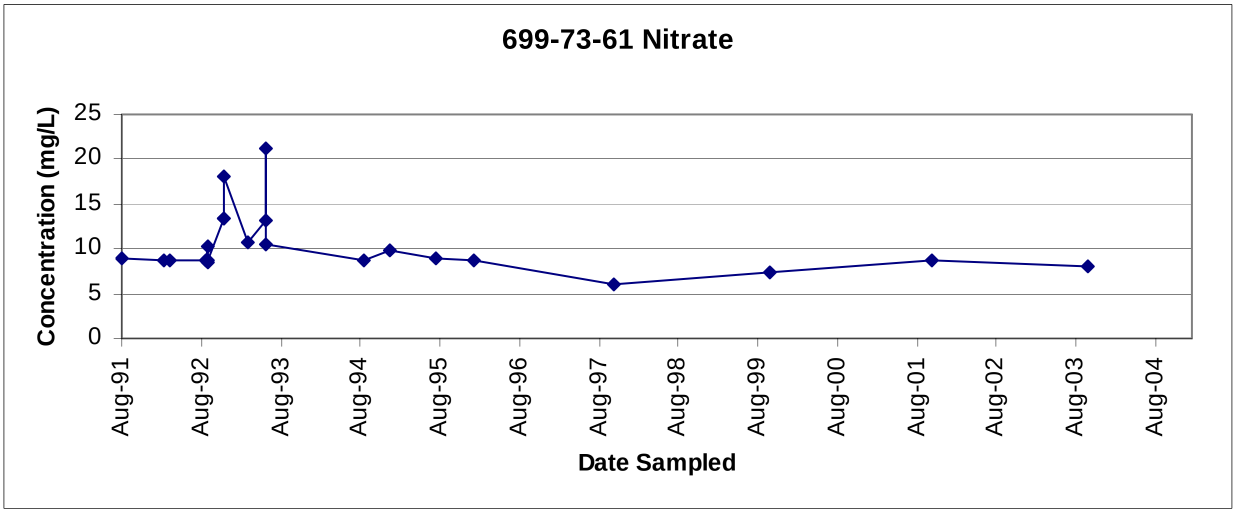

199-K-35 Nitrate
Concentration (mg/L)
0
2
4
6
8
10
12
14
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled


199-K-36 Nitrate
Concentration (mg/L)
0
5
10
15
20
25
30
35
40
Aug-92
Aug-93
Aug-94
Aug-95
Aug-96
Aug-97
Aug-98
Aug-99
Aug-00
Aug-01
Aug-02
Aug-03
Aug-04
Date Sampled

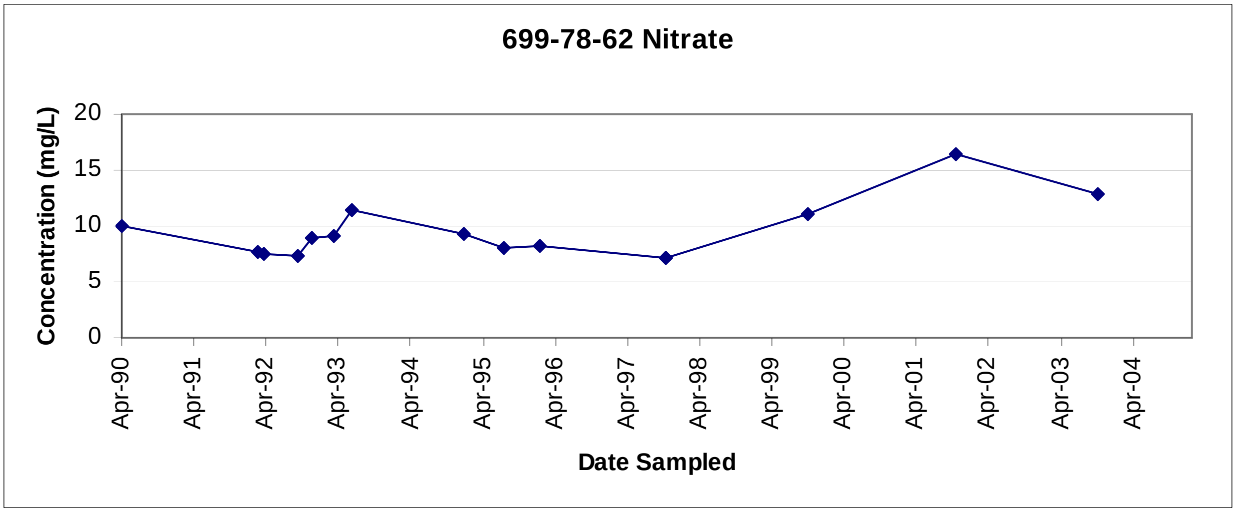

199-K-37 Nitrate
Concentration (mg/L)
0
2
4
6
8
10
12
14
May-92
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled



699-70-68 Nitrate
Concentration (mg/L)
35
30
25
20
15
10
5
0
Sep-92
Sep-93
Sep-94
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Date Sampled



699-73-61 Nitrate
Concentration (mg/L)
25
20
15
10
5
0
Aug-91
Aug-92
Aug-93
Aug-94
Aug-95
Aug-96
Aug-97
Aug-98
Aug-99
Aug-00
Aug-01
Aug-02
Aug-03
Aug-04
Date Sampled



699-78-62 Nitrate
Concentration (mg/L)
20
15
10
5
0
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Date Sampled

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APPENDIX L

HYDROGRAPHS FOR THE 100-NR-2 OPERABLE UNIT

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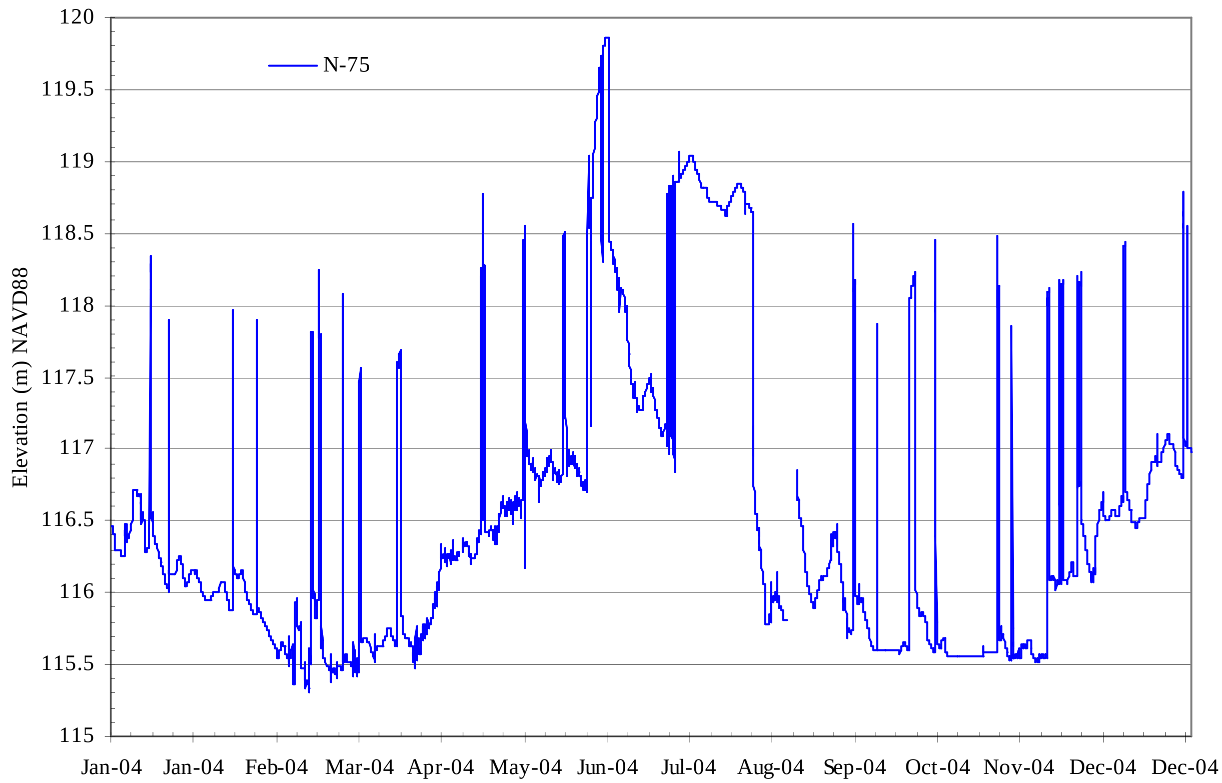
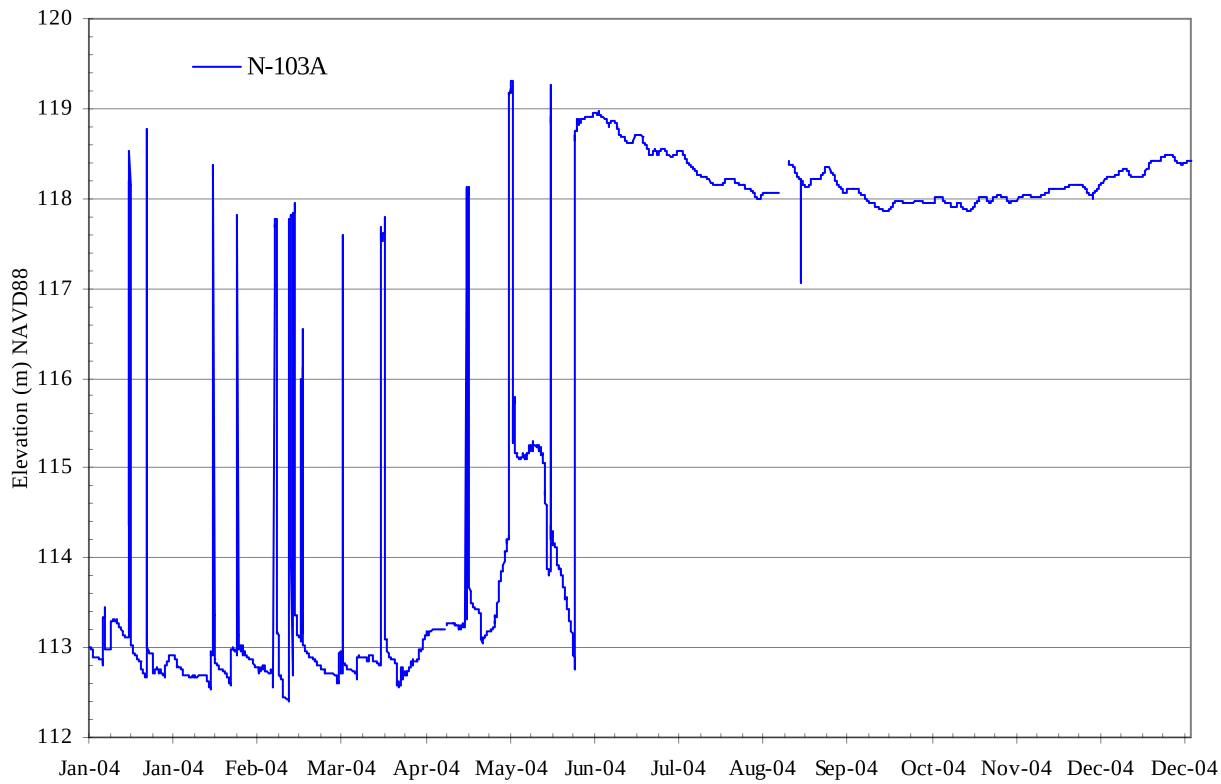

N-75
Elevation (m) NAVD88
120
119.5
119
118.5
118
117.5
117
116.5
116
115.5
115
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04


N-103A
Elevation (m) NAVD88
120
119
118
117
116
115
114
113
112
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
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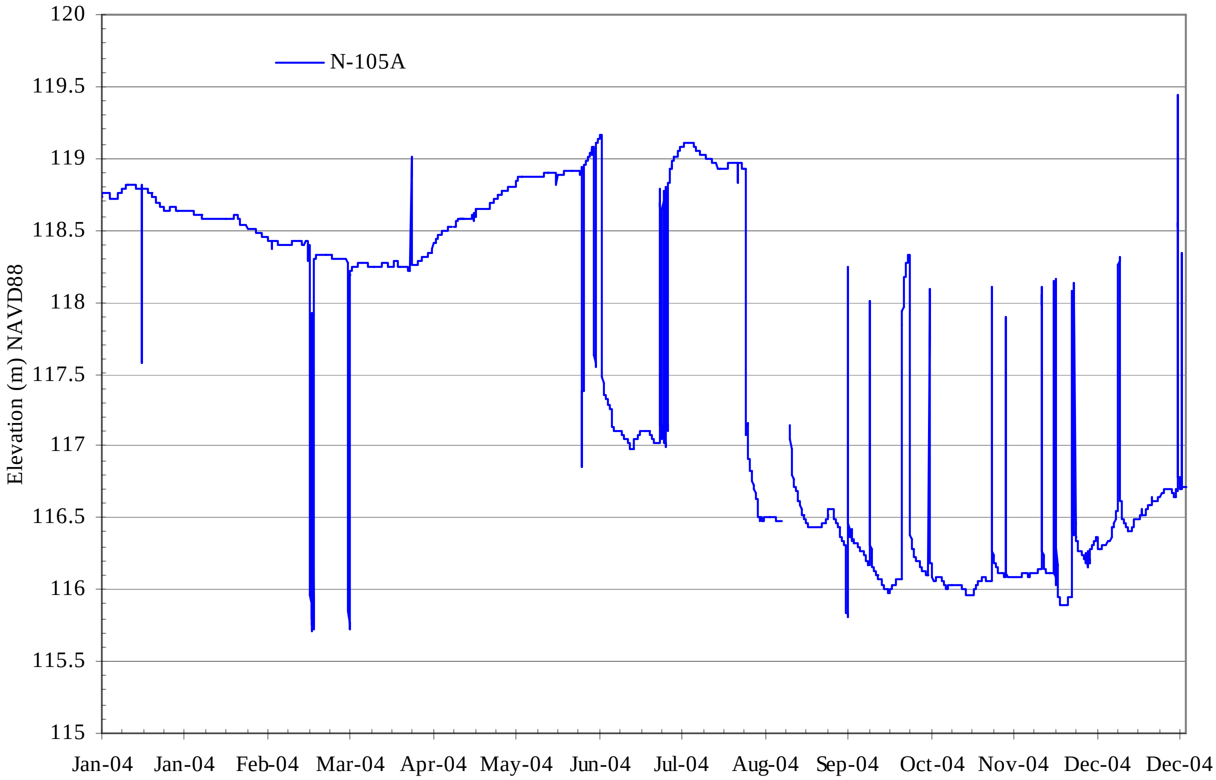
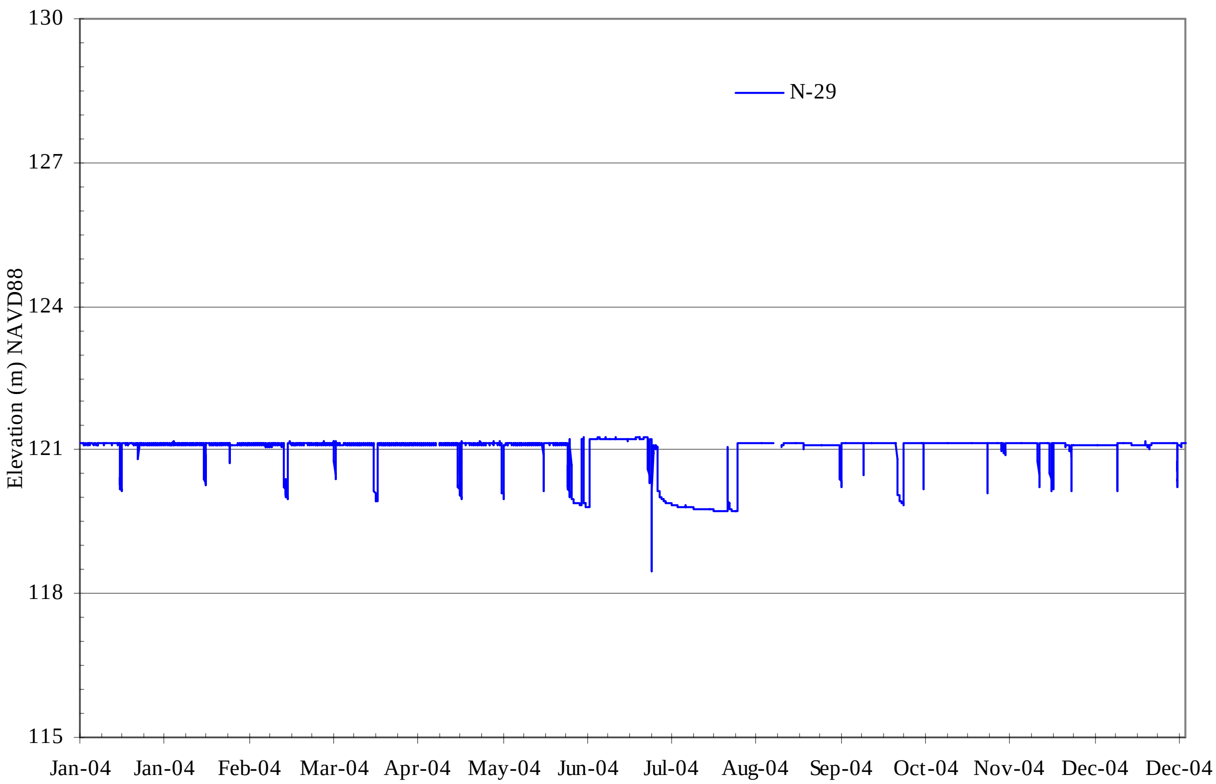
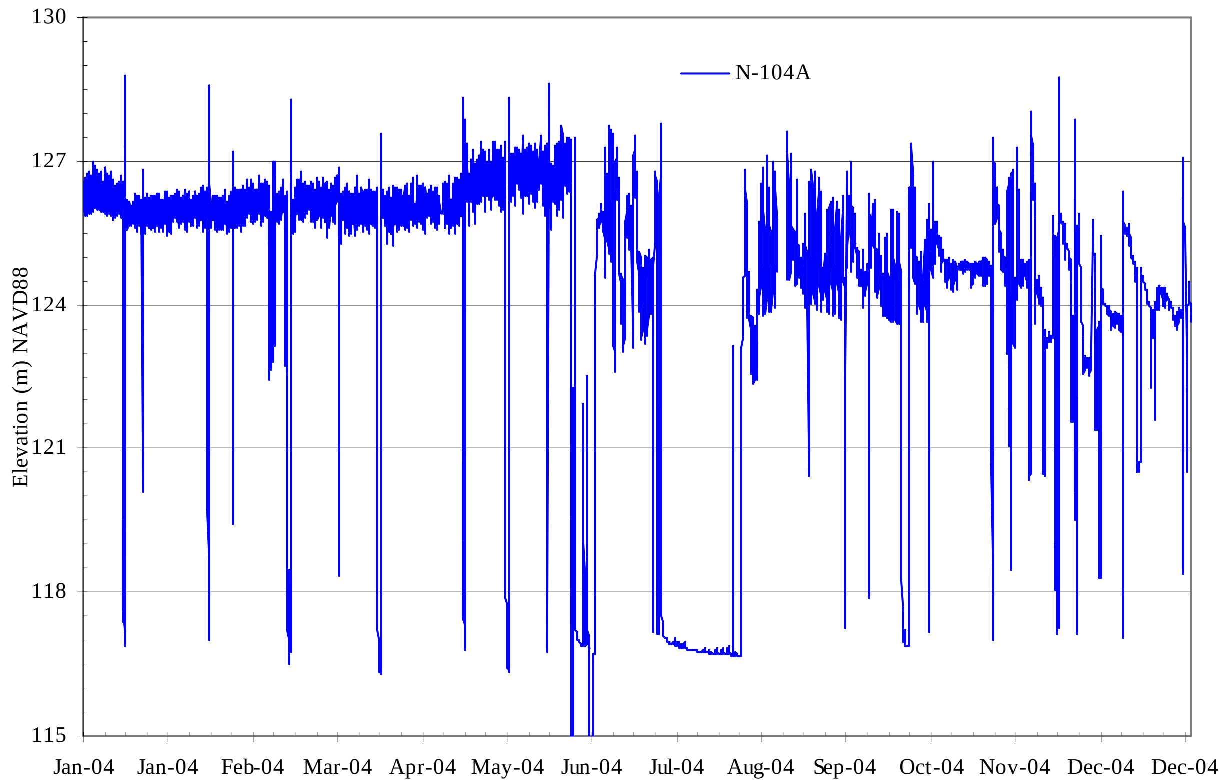
Nov-04
Dec-04
Dec-04

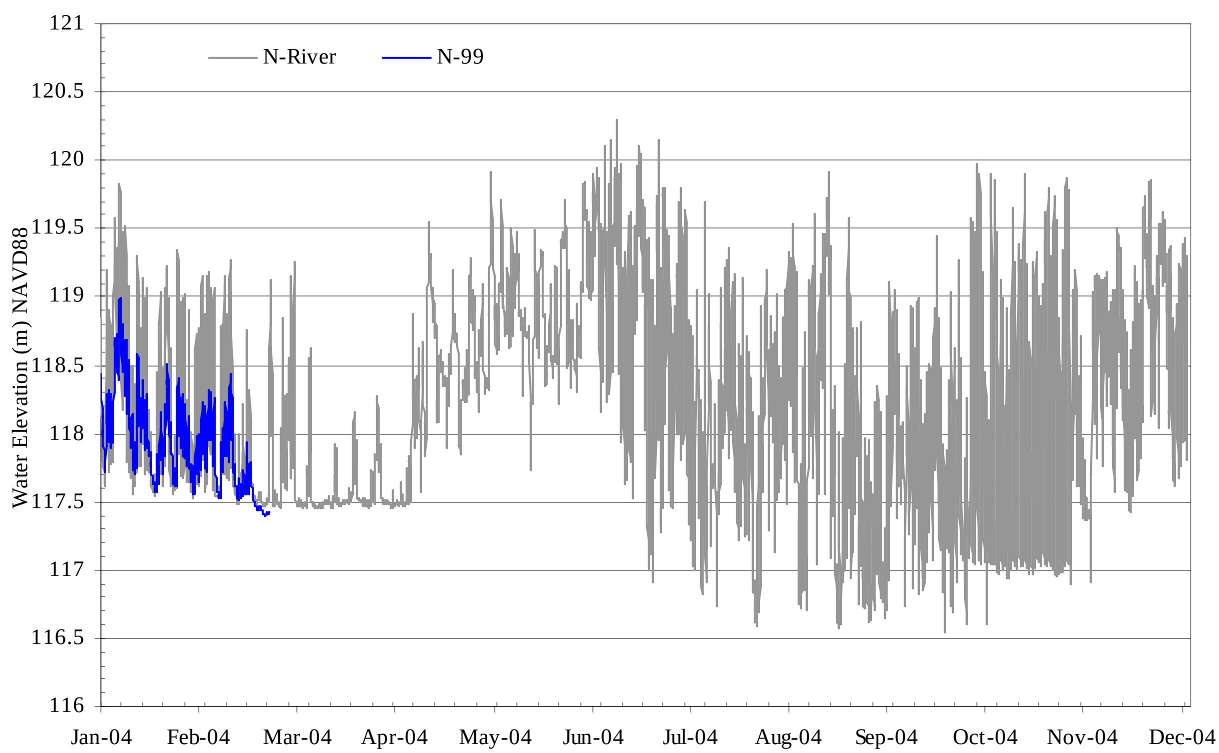


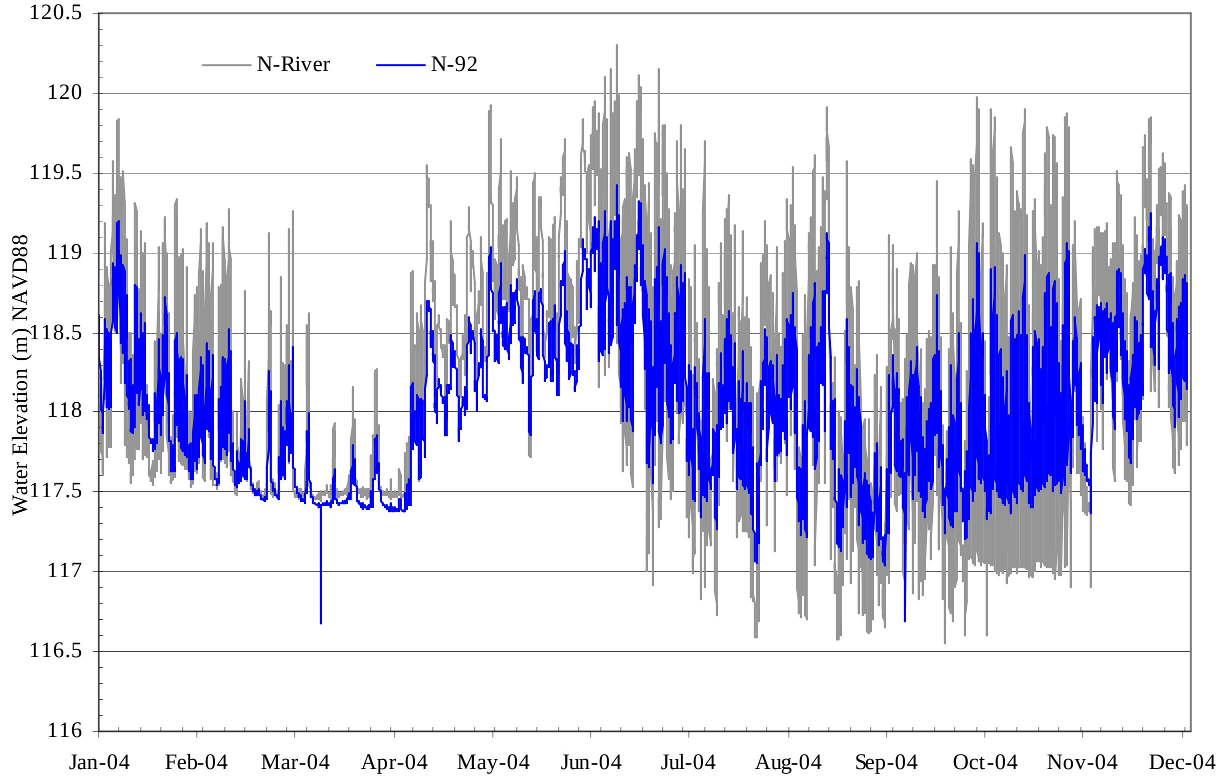
N-105A
Elevation (m) NAVD88
120
119.5
119
118.5
118
117.5
117
116.5
116
115.5
115
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04

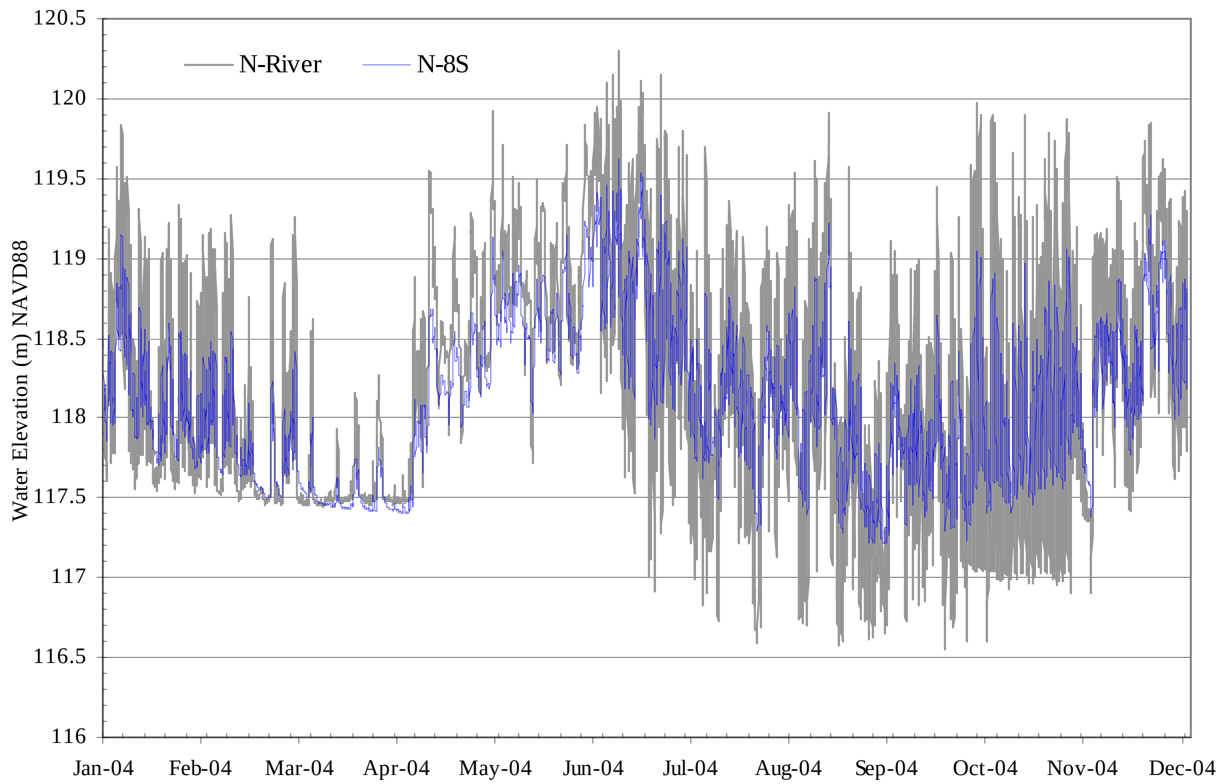


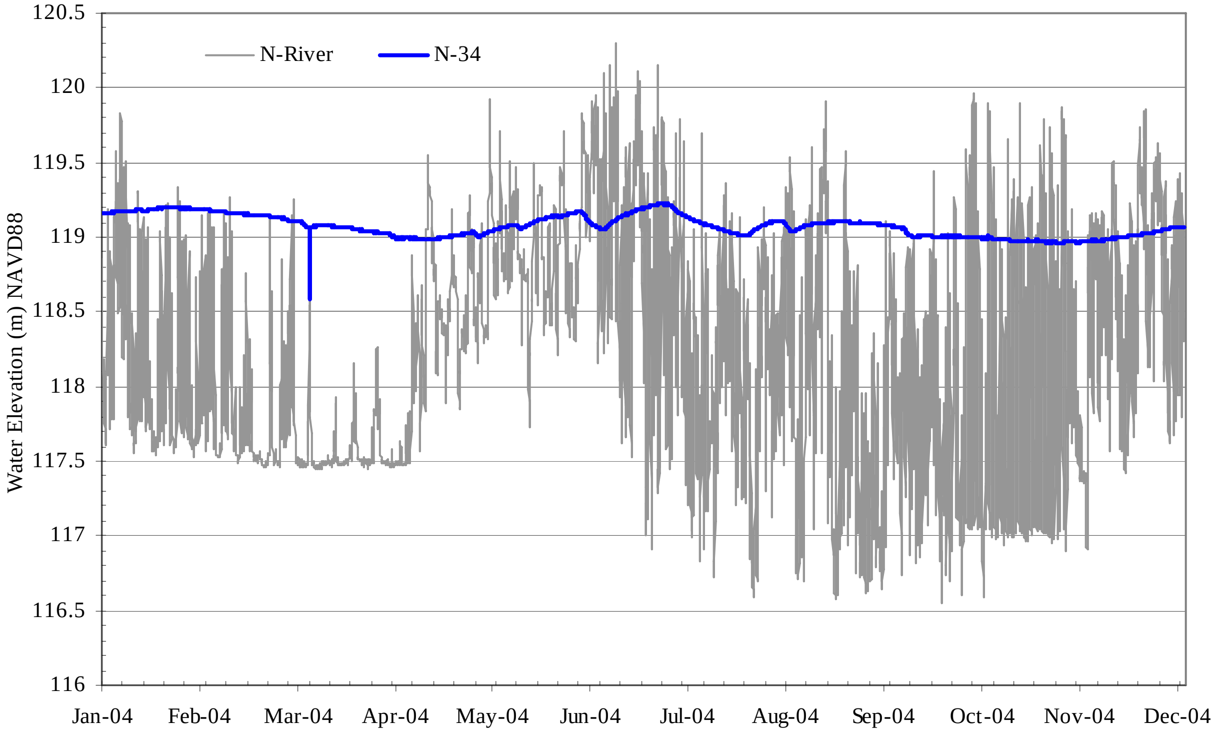
N-29
Elevation (m) NAVD88
130
127
124
121
118
115
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04

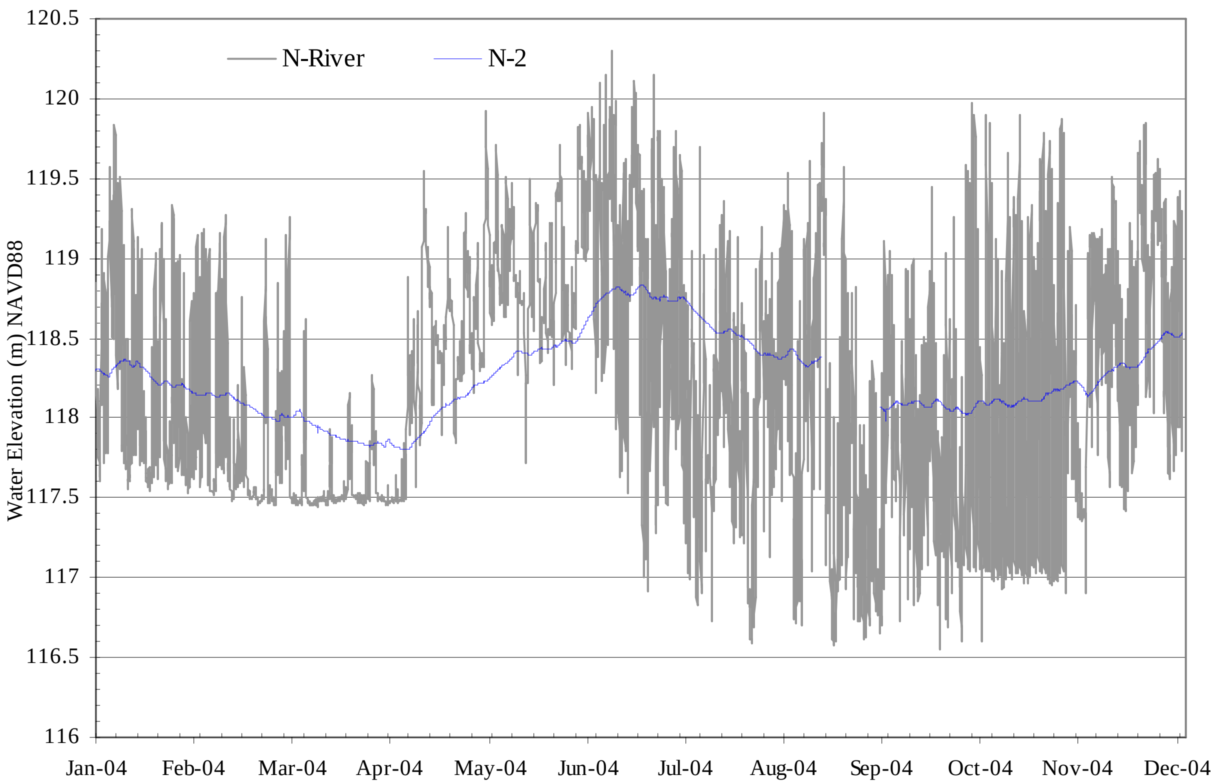

130
127
124
121
118
115
Elevation (m) NAVD88
N-104A
Jan-04
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Dec-04

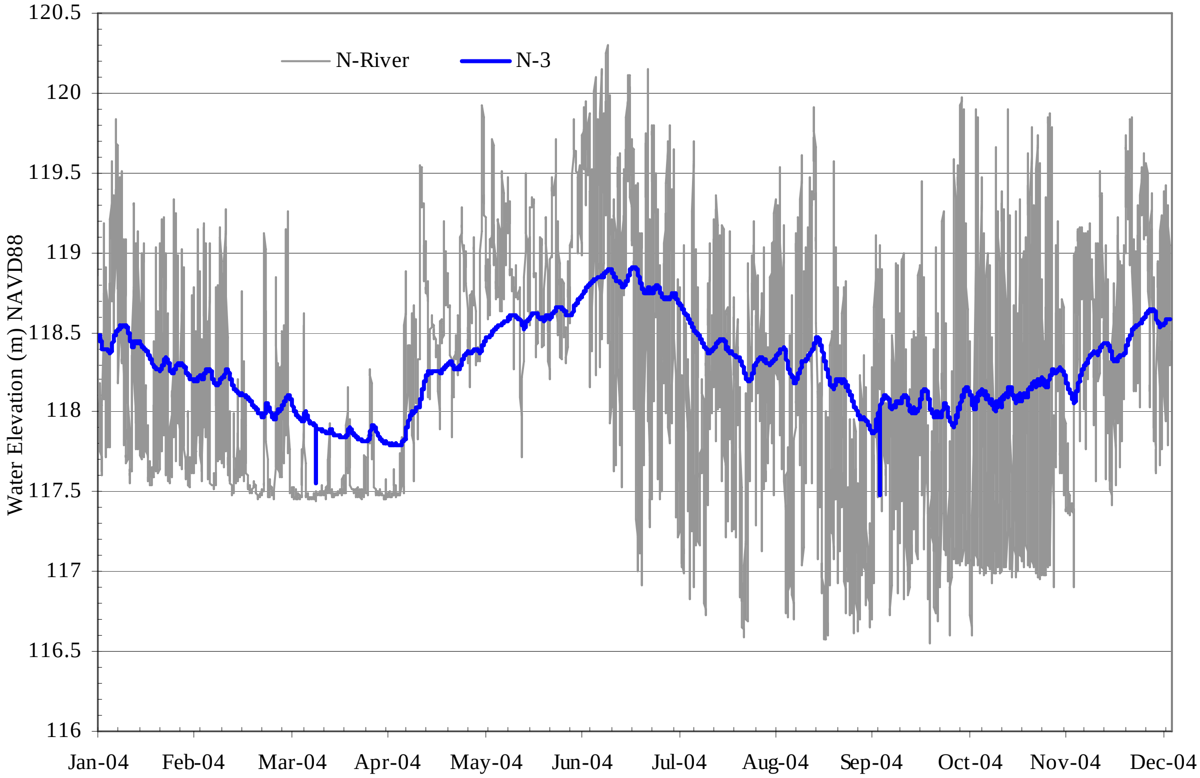

121
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Water Elevation (m) NAVD88
N-River
N-99
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04

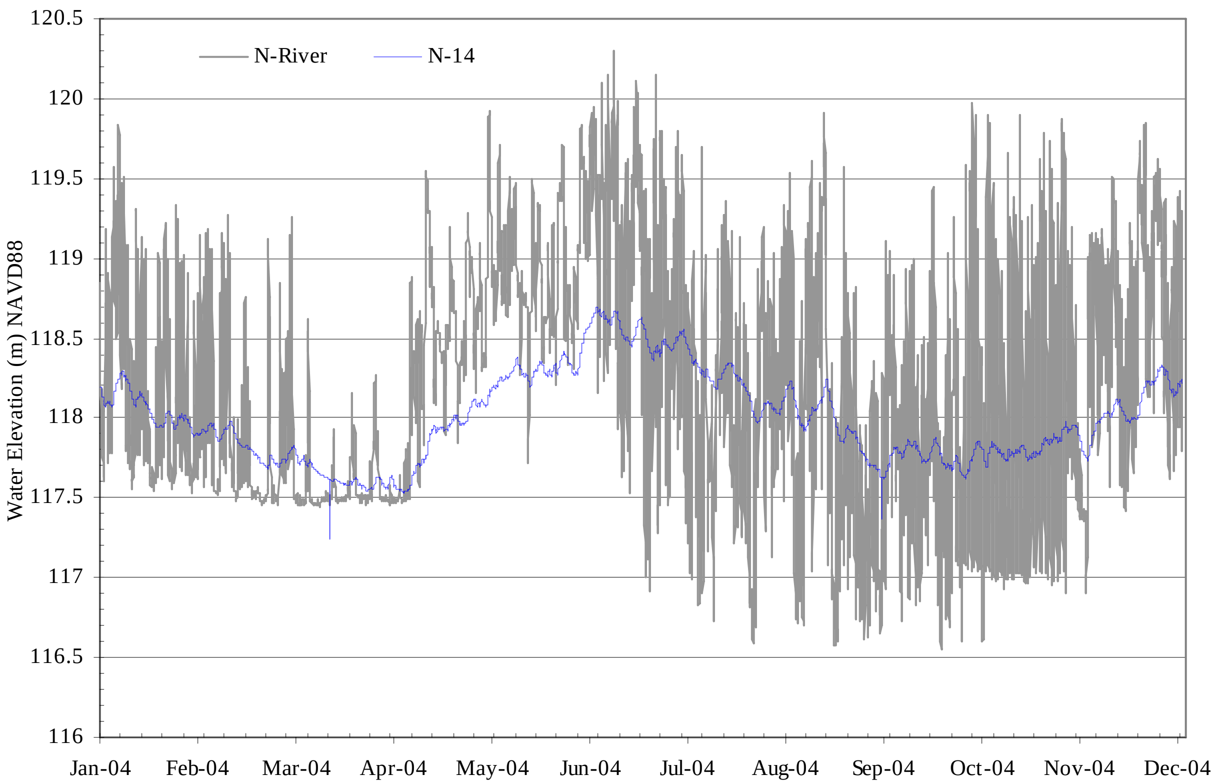

120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Water Elevation (m) NAVD88
N-River
N-92
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04

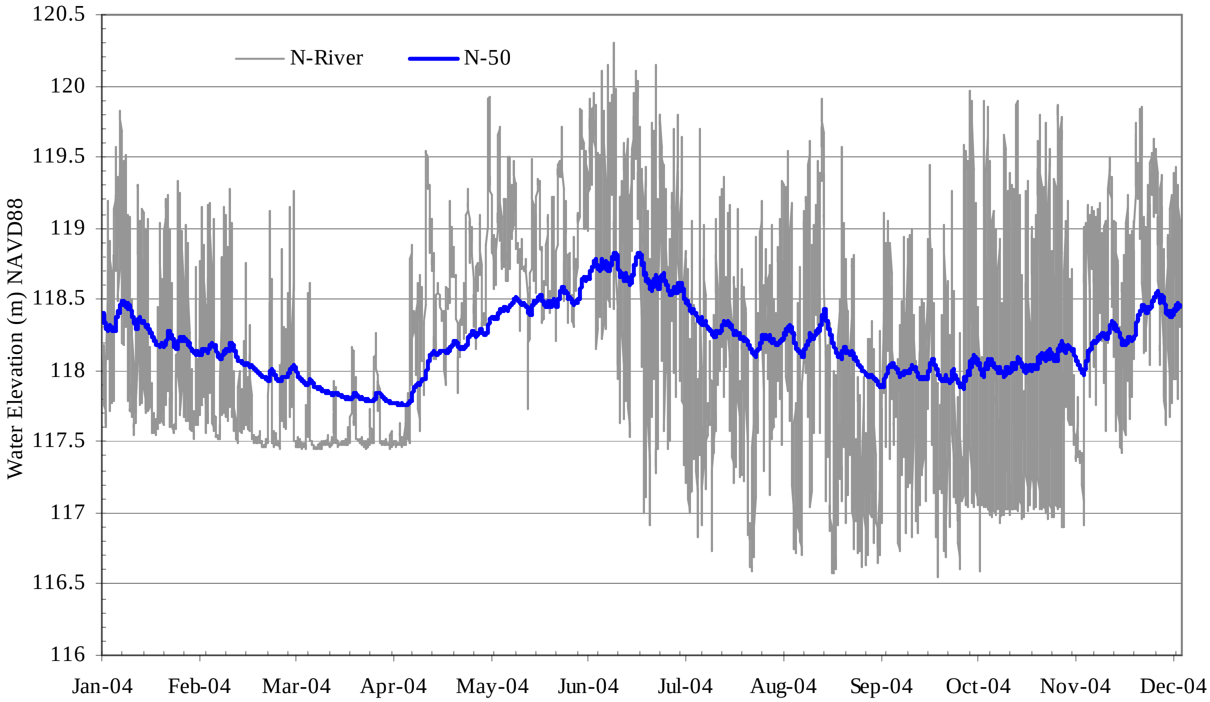

120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Water Elevation (m) NAVD88
N-River
N-8S
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04

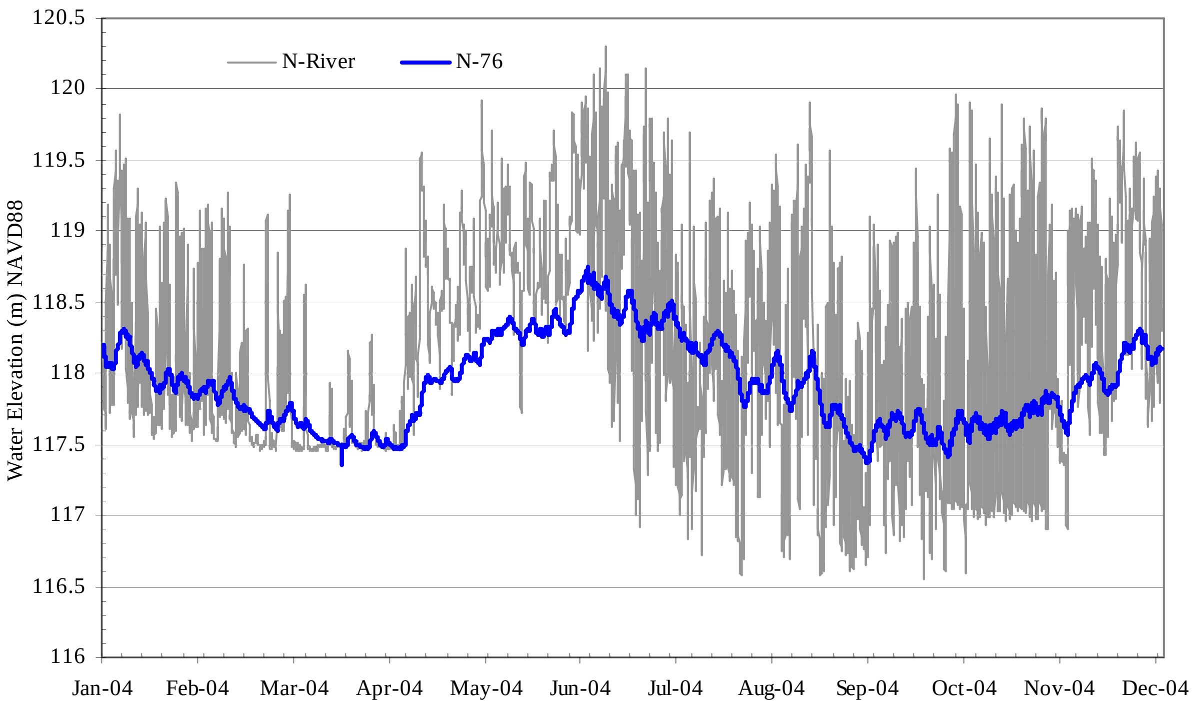

N-River
N-34
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Water Elevation (m) NAVD88
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04

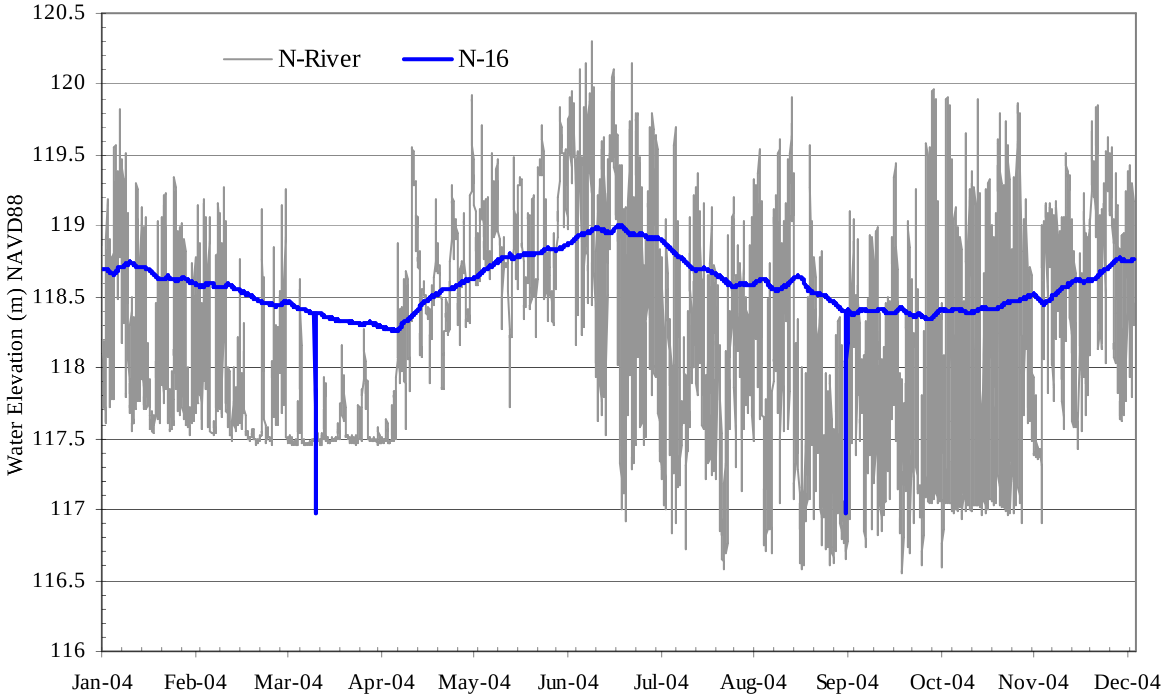

N-River
N-2
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Water Elevation (m) NAVD88
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04


N-River
N-3
Water Elevation (m) NAVD88
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04


N-River
N-14
Water Elevation (m) NAVD88
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04


N-River
N-50
Water Elevation (m) NAVD88
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04


N-River
N-76
Water Elevation (m) NAVD88
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04



N-River
N-16
Water Elevation (m) NAVD88
120.5
120
119.5
119
118.5
118
117.5
117
116.5
116
Jan-04
Feb-04
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04

APPENDIX M

100-NR-2 CONTAMINANT TREND PLOTS

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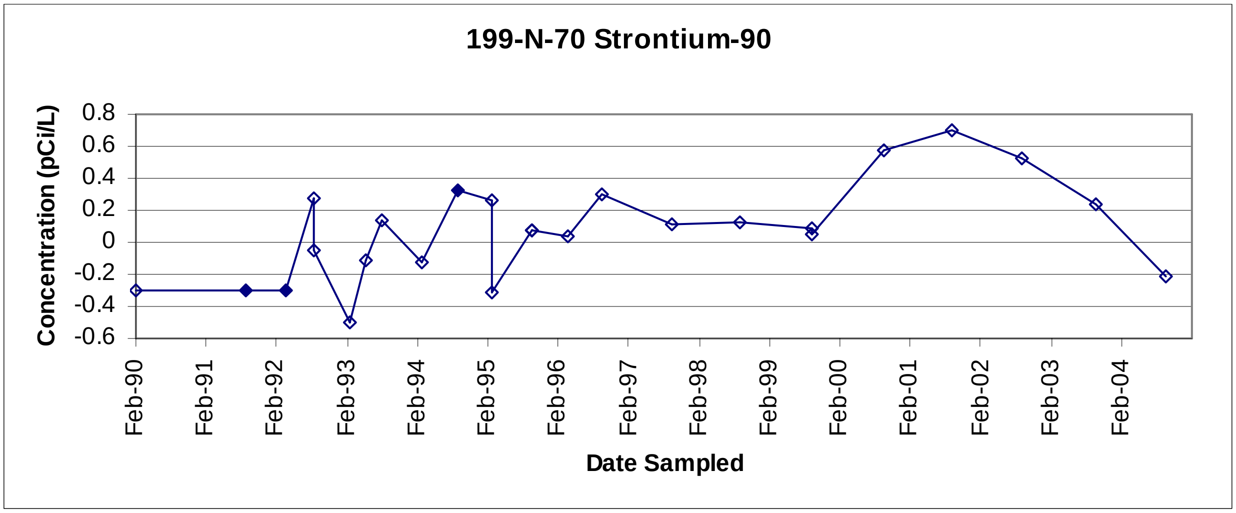
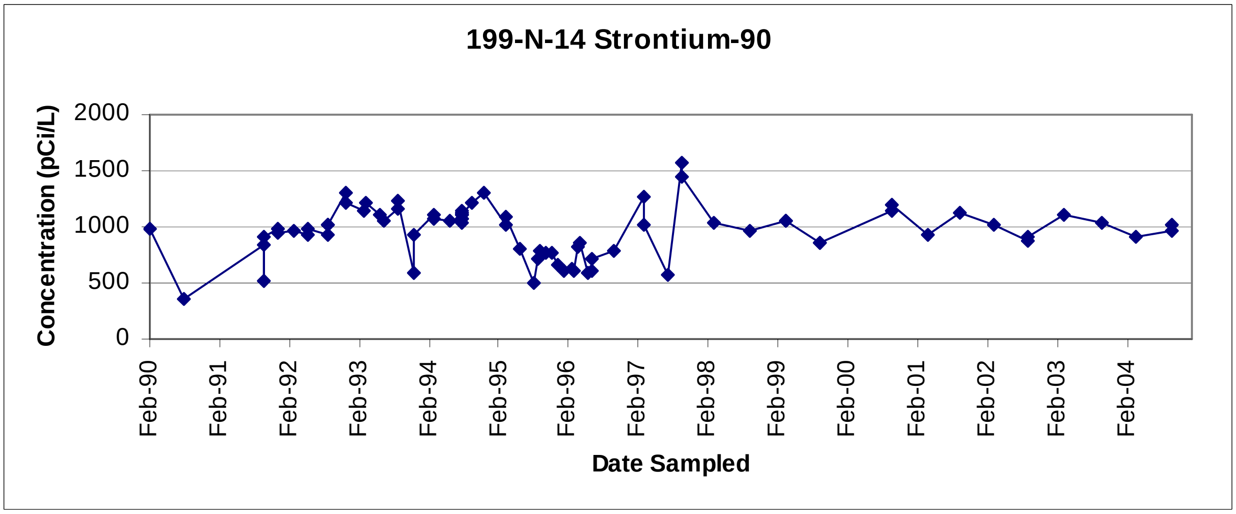
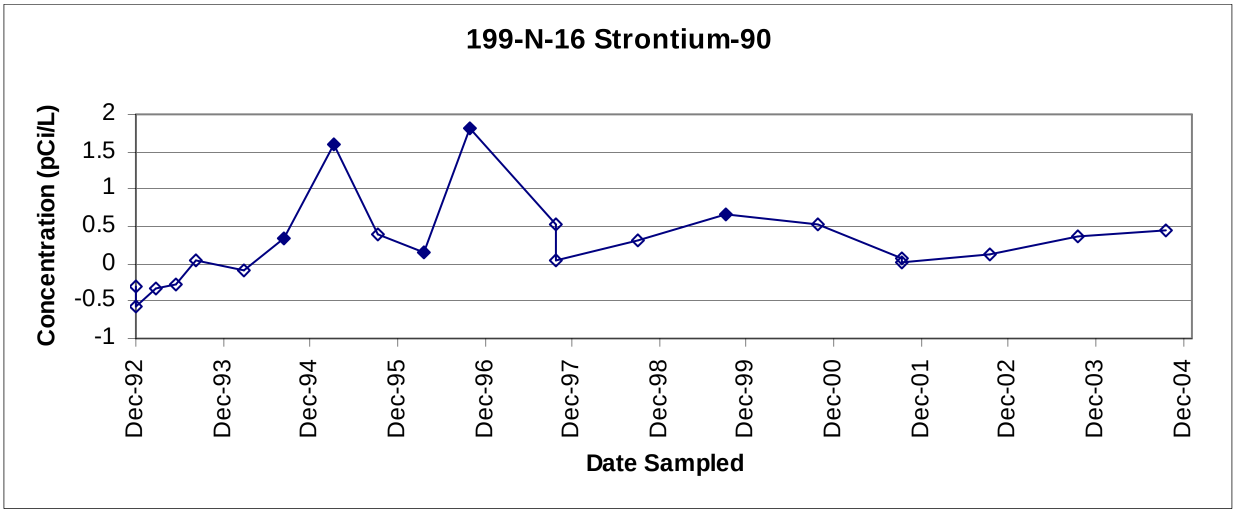
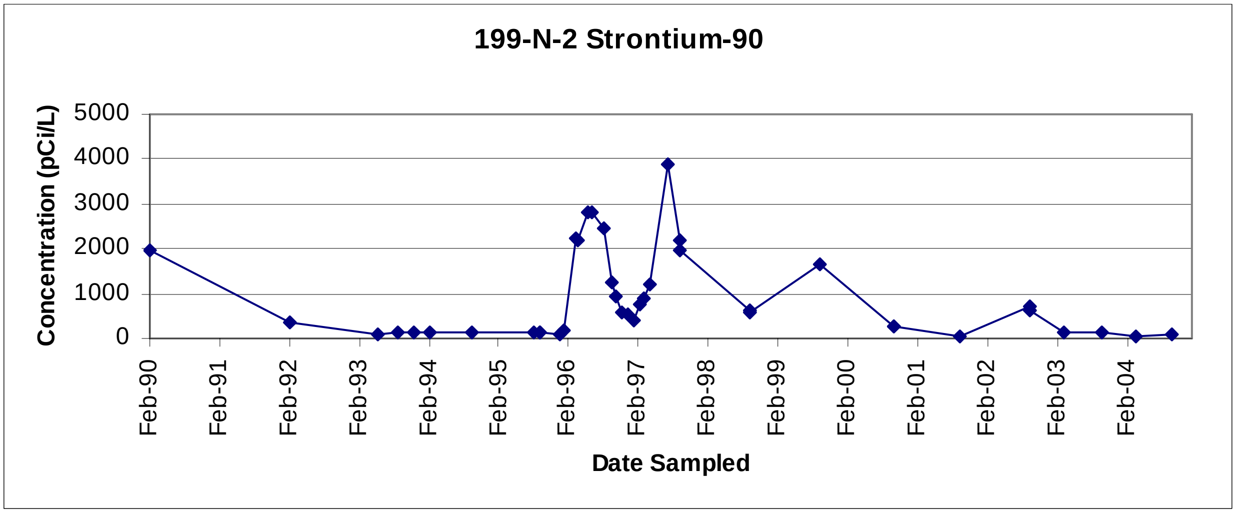
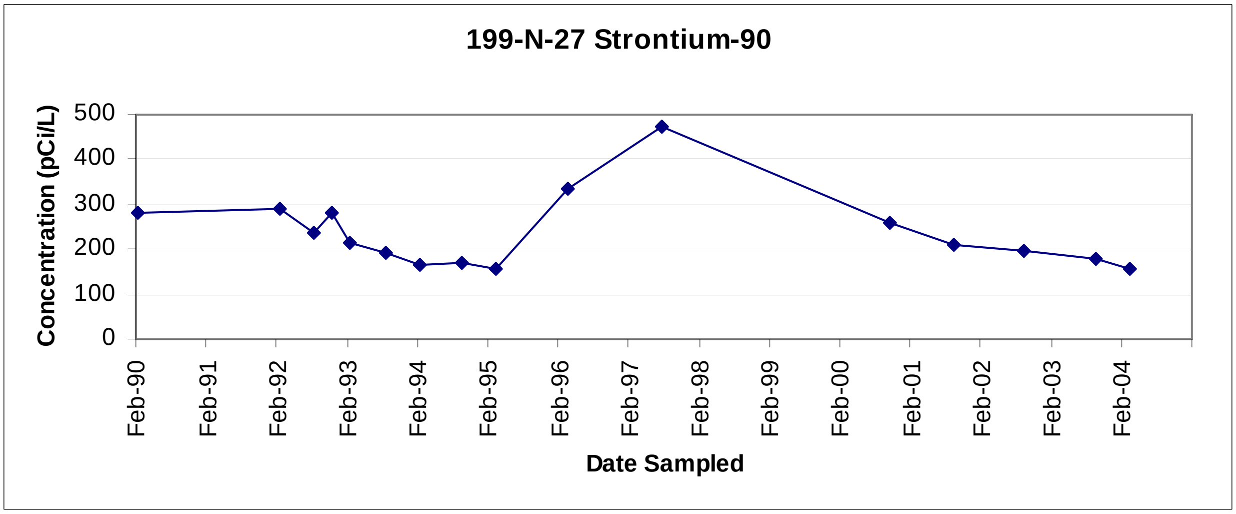
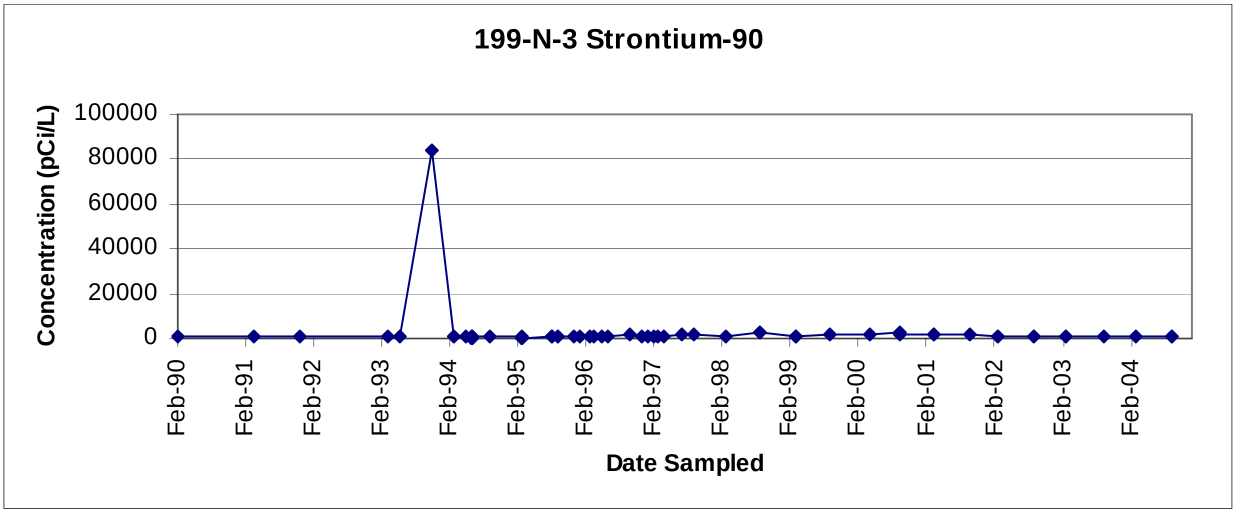

199-N-70 Strontium-90
Concentration (pCi/L)
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-14 Strontium-90
Concentration (pCi/L)
2000
1500
1000
500
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-16 Strontium-90
Concentration (pCi/L)
2
1.5
1
0.5
0
-0.5
-1
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Date Sampled


199-N-2 Strontium-90
Concentration (pCi/L)
5000
4000
3000
2000
1000
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-27 Strontium-90
Concentration (pCi/L)
500
400
300
200
100
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-3 Strontium-90
Concentration (pCi/L)
100000
80000
60000
40000
20000
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
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Feb-02
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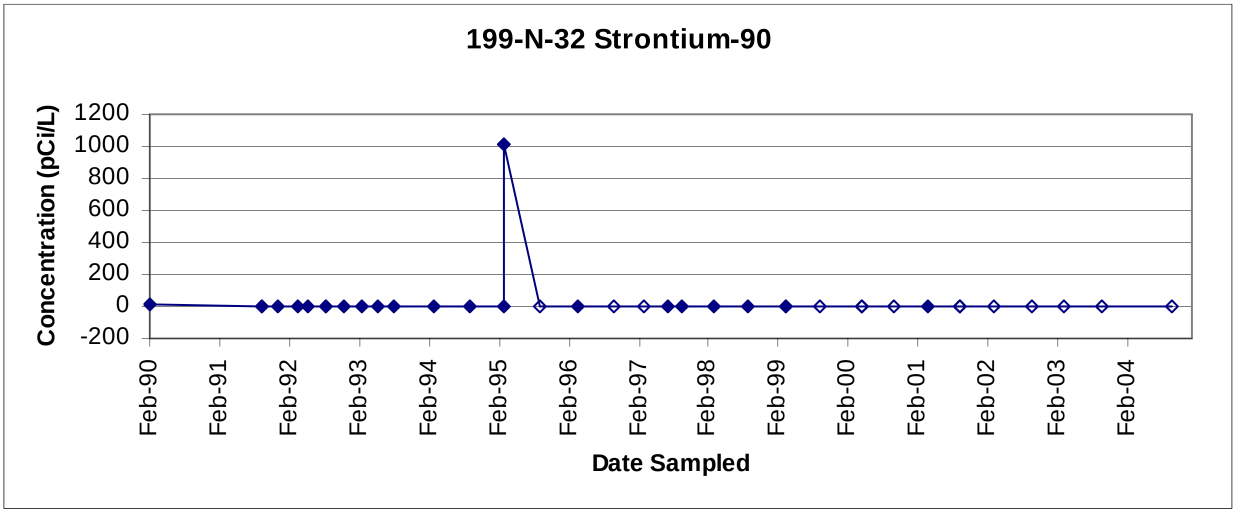
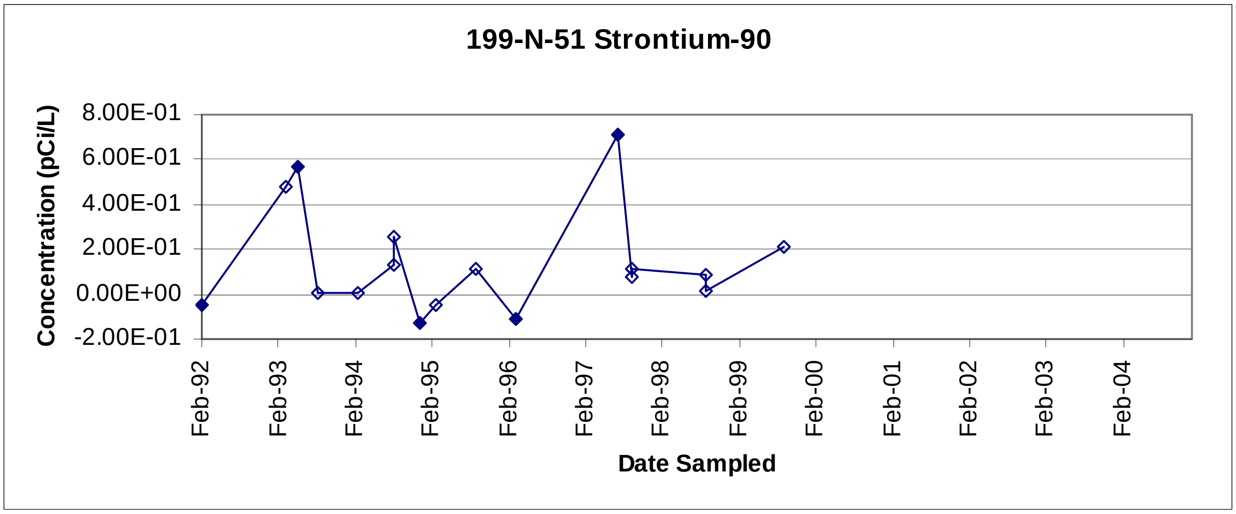
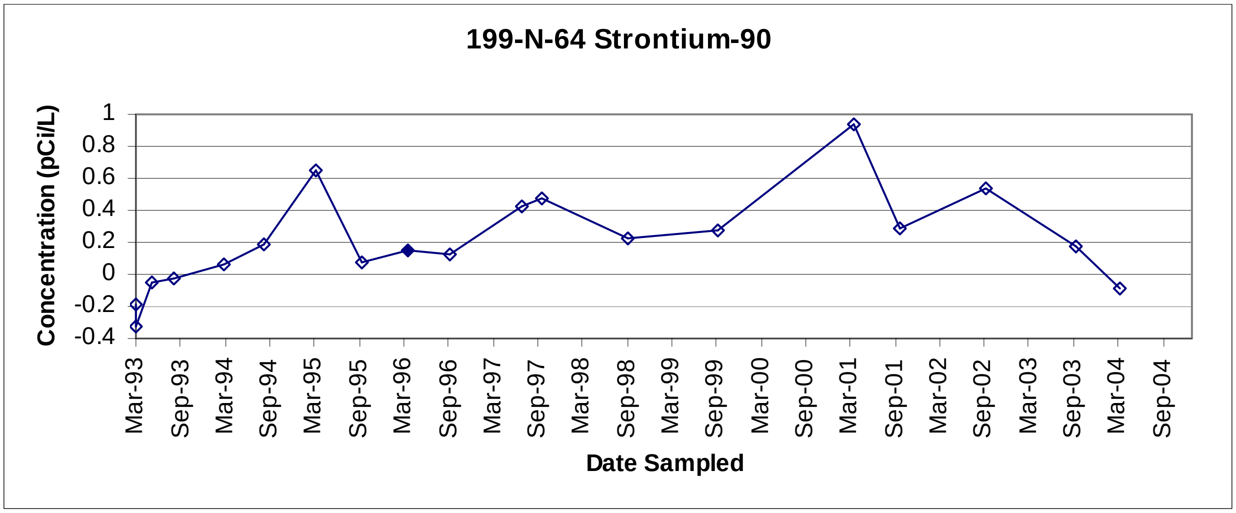
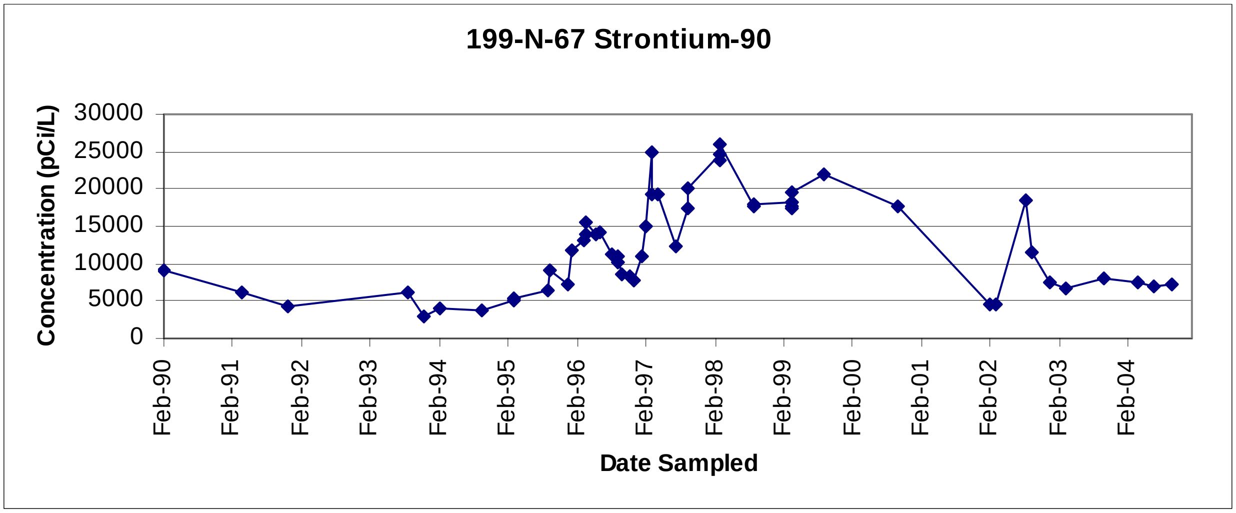
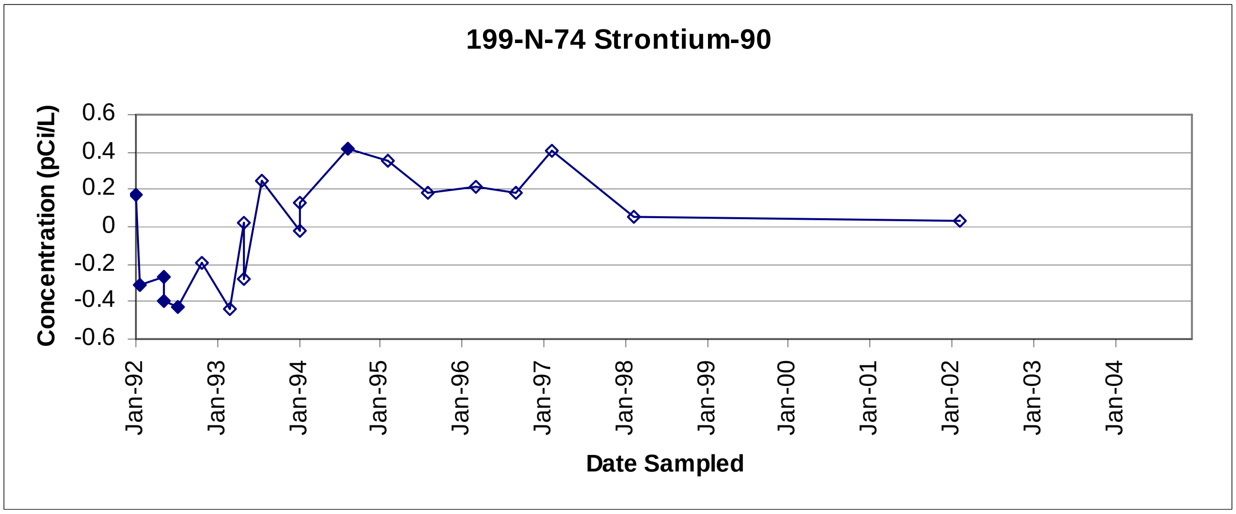
Feb-04
Date Sampled

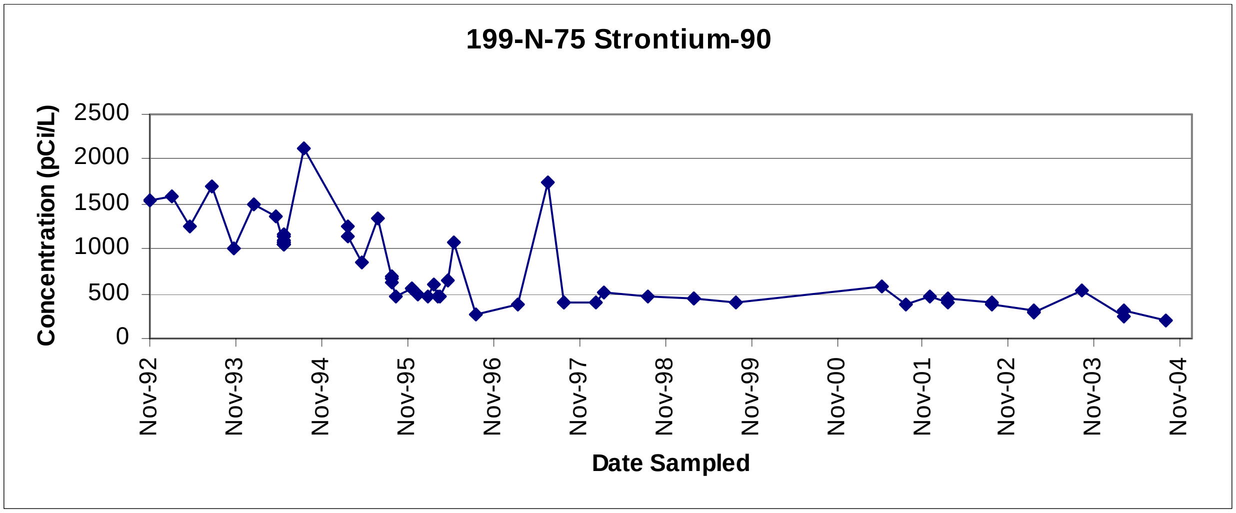

199-N-32 Strontium-90
Concentration (pCi/L)
1200
1000
800
600
400
200
0
-200
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

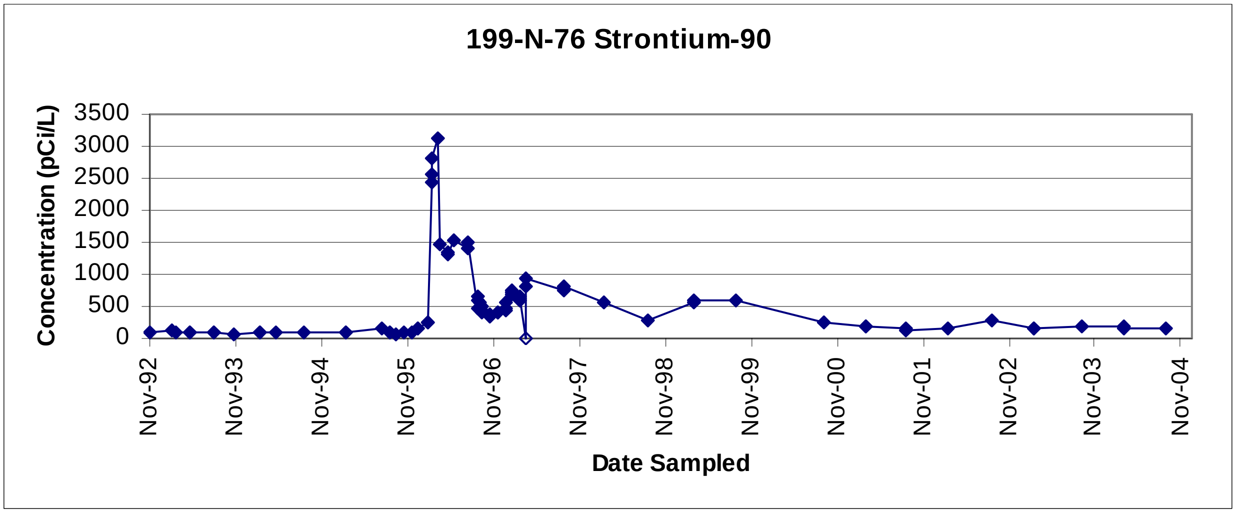

199-N-51 Strontium-90
Concentration (pCi/L)
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
-2.00E-01
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

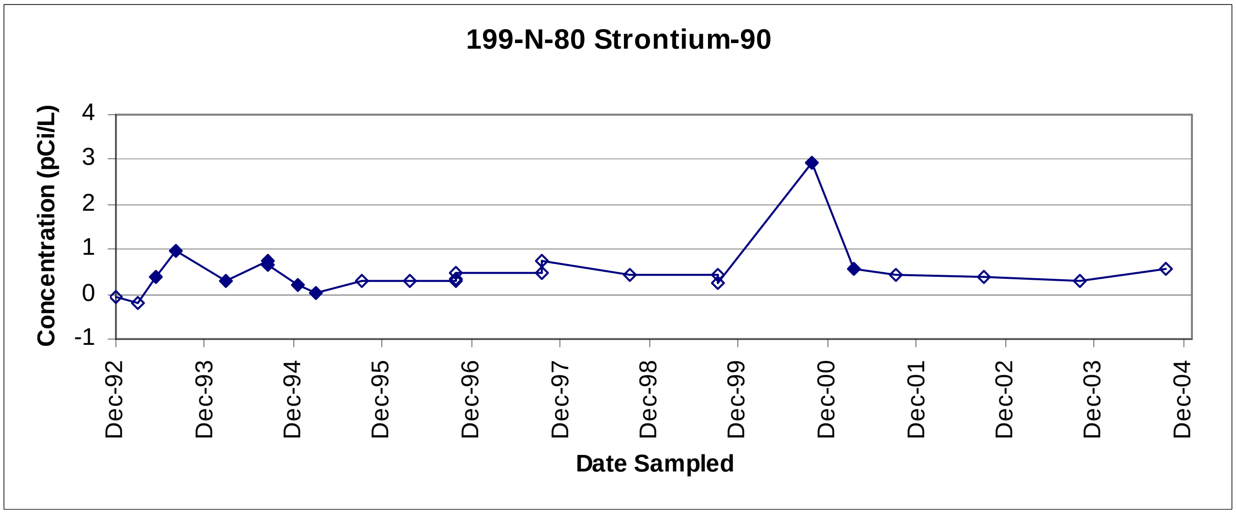

199-N-64 Strontium-90
Concentration (pCi/L)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
Mar-93
Sep-93
Mar-94
Sep-94
Mar-95
Sep-95
Mar-96
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled

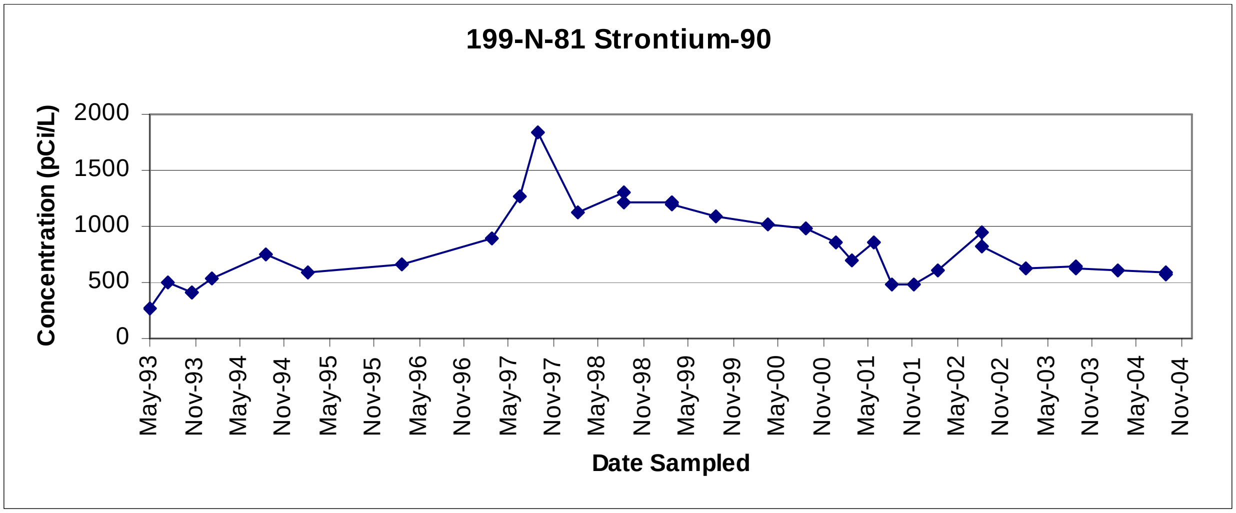

199-N-67 Strontium-90
Concentration (pCi/L)
30000
25000
20000
15000
10000
5000
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

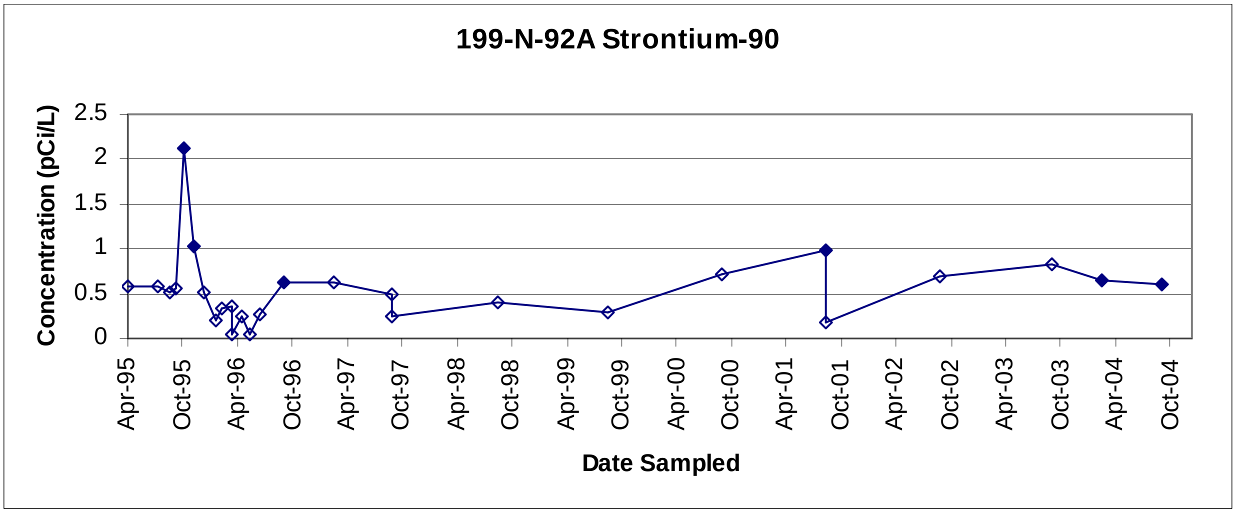

199-N-74 Strontium-90
Concentration (pCi/L)
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Date Sampled

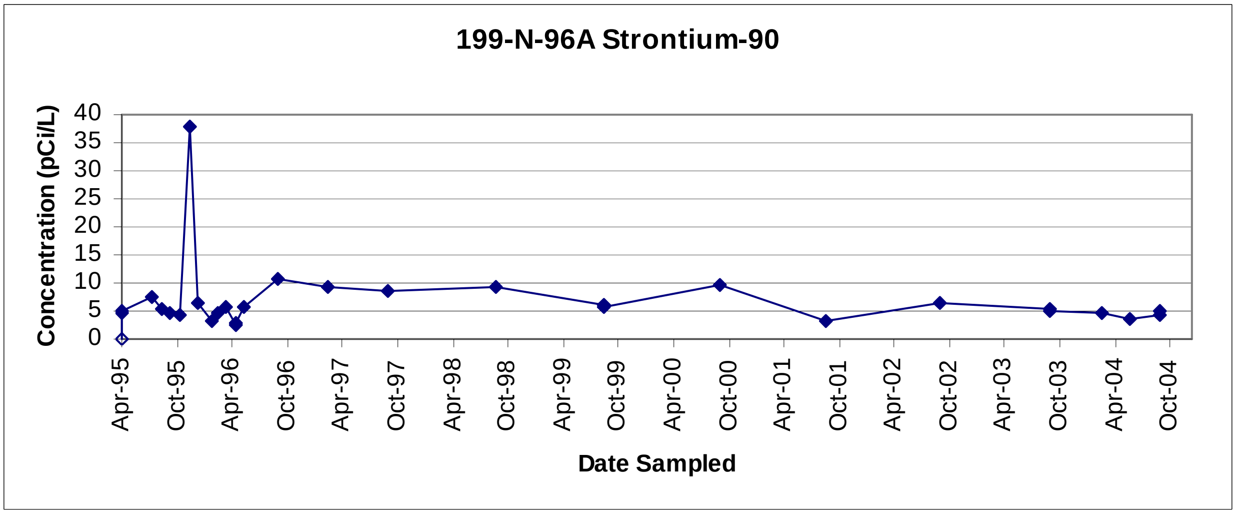

199-N-75 Strontium-90
Concentration (pCi/L)
2500
2000
1500
1000
500
0
Nov-92
Nov-93
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00
Nov-01
Nov-02
Nov-03
Nov-04
Date Sampled

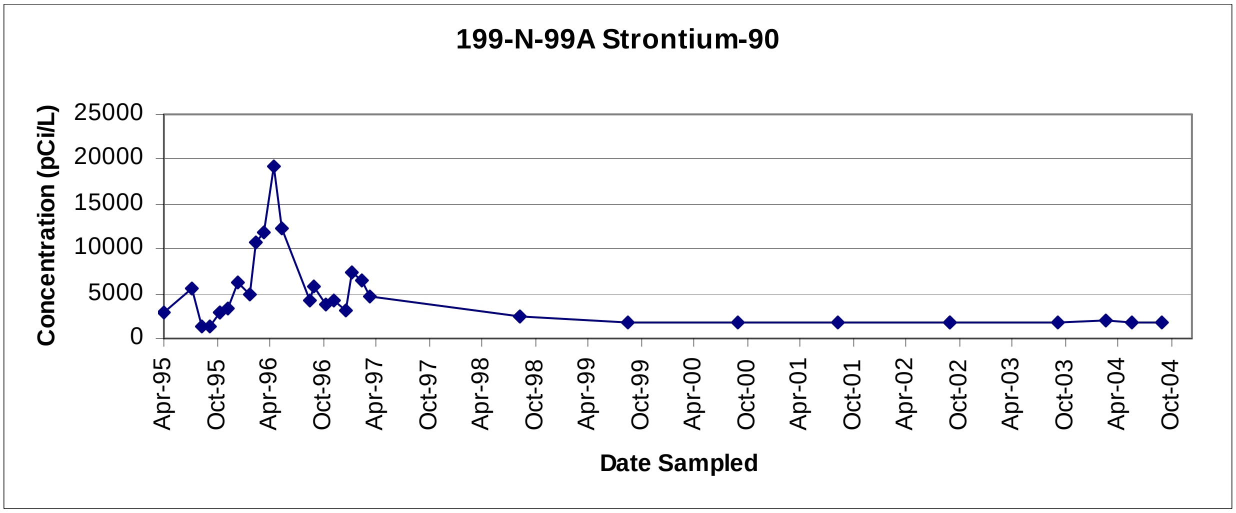

199-N-76 Strontium-90
Concentration (pCi/L)
3500
3000
2500
2000
1500
1000
500
0
Nov-92
Nov-93
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00
Nov-01
Nov-02
Nov-03
Nov-04
Date Sampled

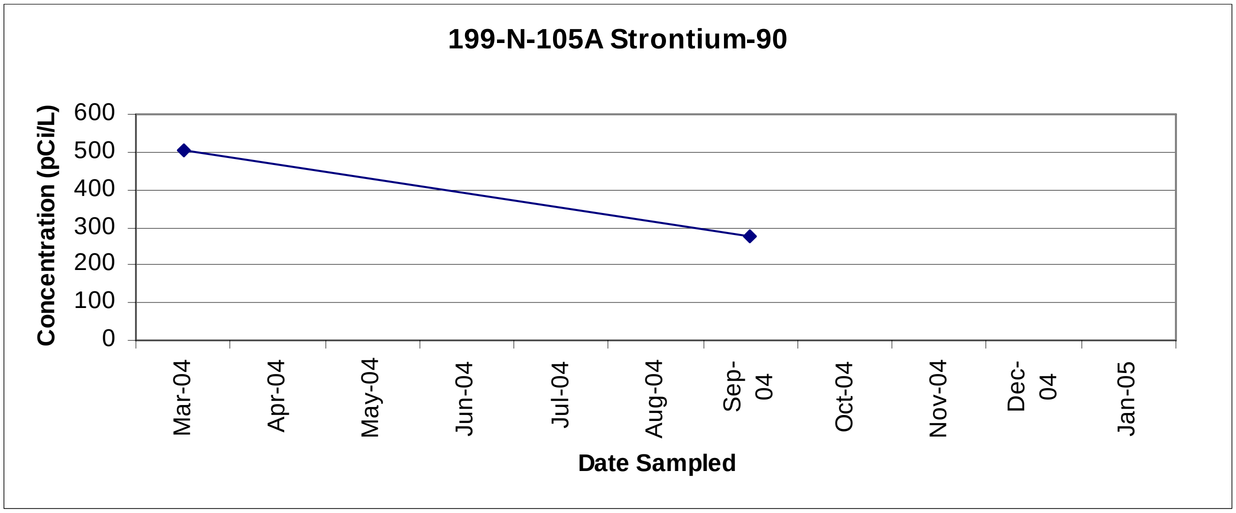

199-N-80 Strontium-90
Concentration (pCi/L)
4
3
2
1
0
-1
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Date Sampled

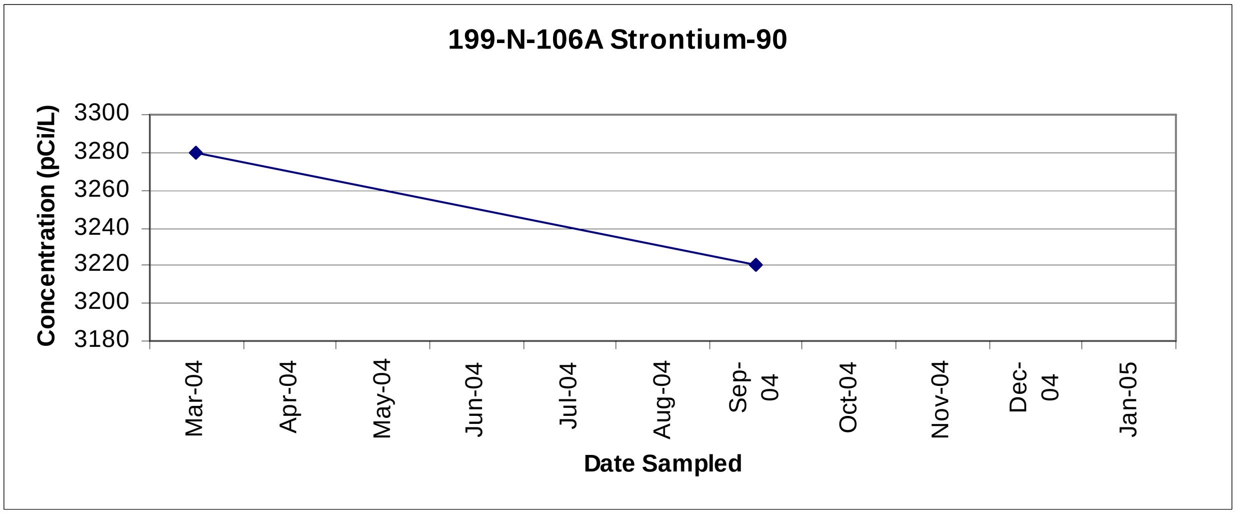

199-N-81 Strontium-90
Concentration (pCi/L)
2000
1500
1000
500
0
May-93
Nov-93
May-94
Nov-94
May-95
Nov-95
May-96
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
Date Sampled

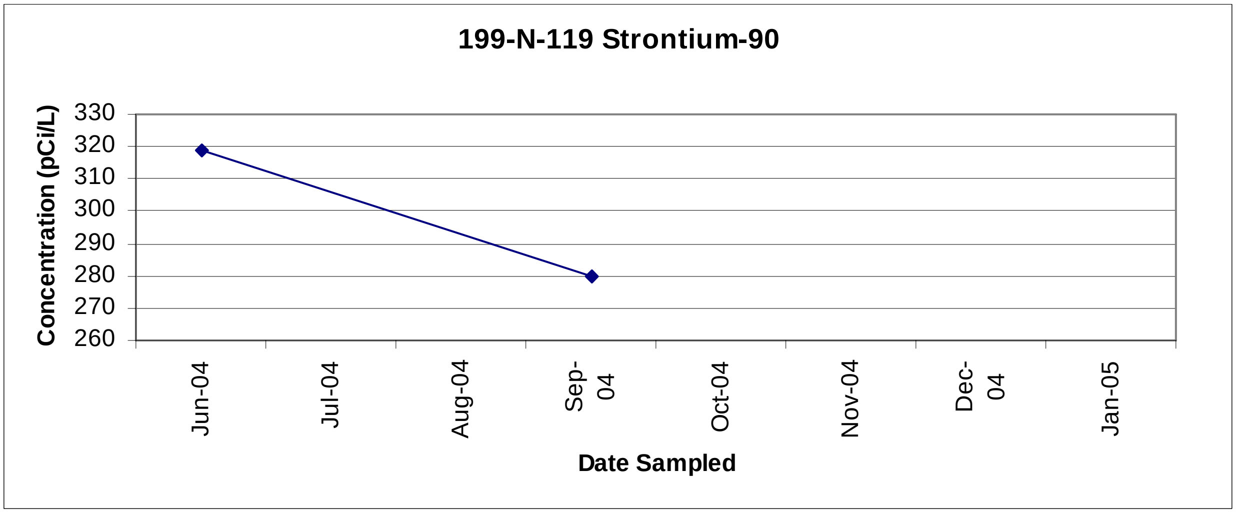

199-N-92A Strontium-90
Concentration (pCi/L)
2.5
2
1.5
1
0.5
0
Apr-95
Oct-95
Apr-96
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled

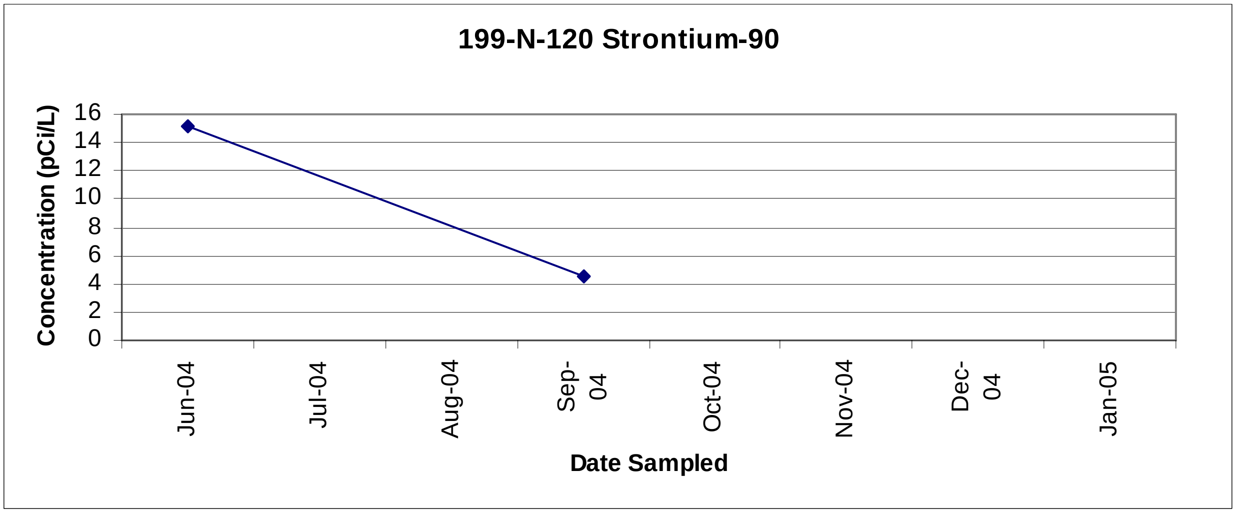

199-N-96A Strontium-90
Concentration (pCi/L)
40
35
30
25
20
15
10
5
0
Apr-95
Oct-95
Apr-96
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled

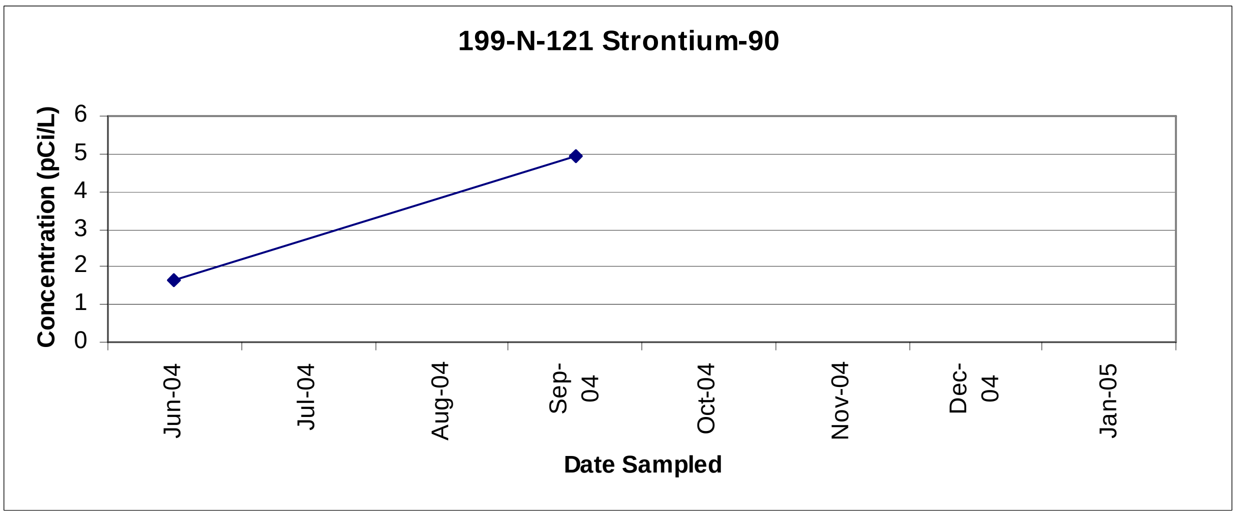

199-N-99A Strontium-90
Concentration (pCi/L)
25000
20000
15000
10000
5000
0
Apr-95
Oct-95
Apr-96
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled

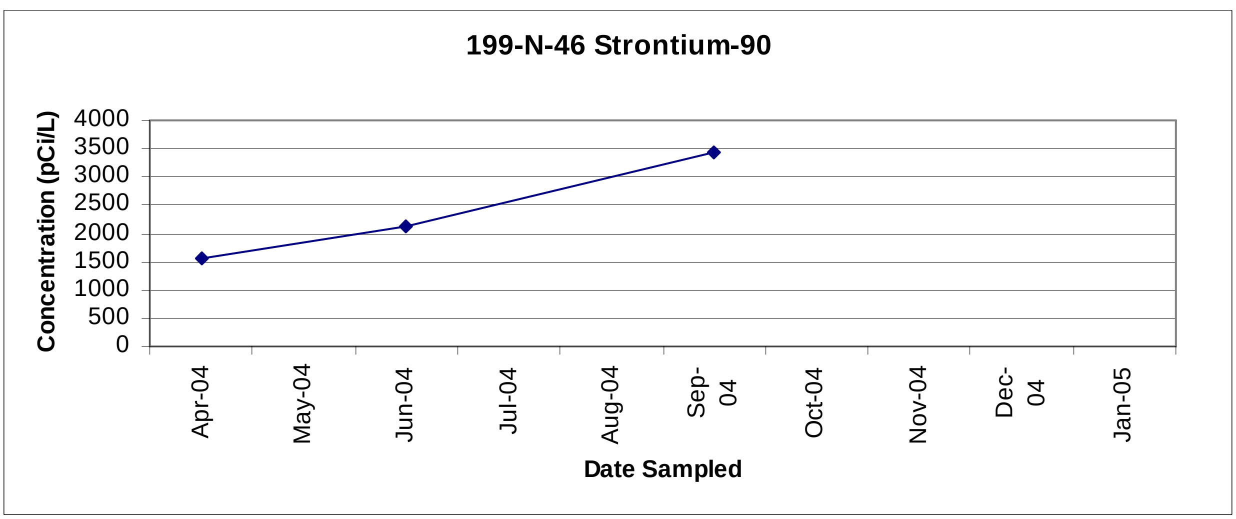

199-N-105A Strontium-90
Concentration (pCi/L)
600
500
400
300
200
100
0
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

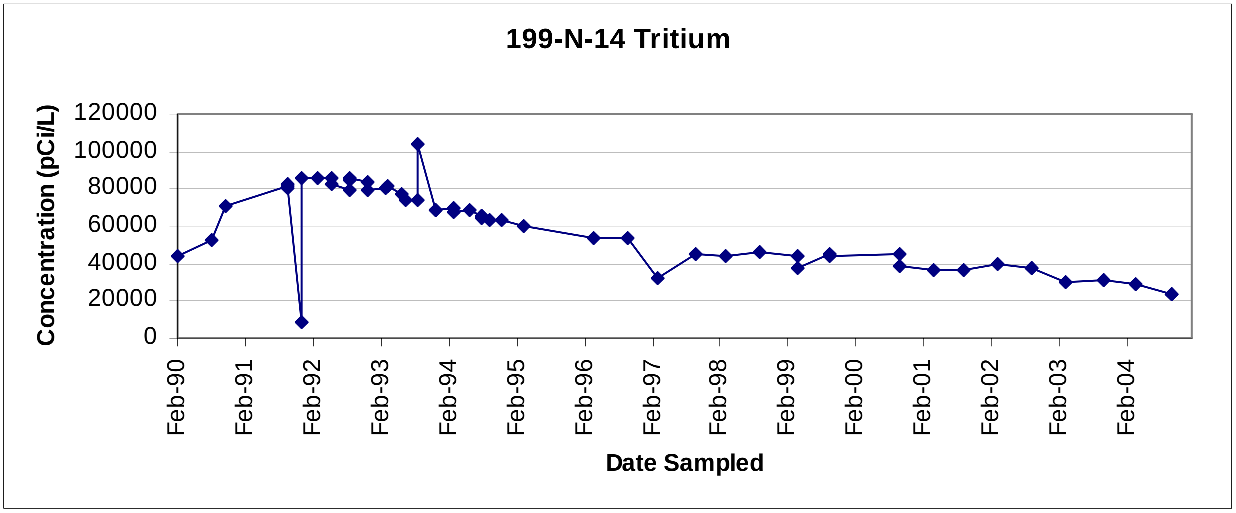

199-N-106A Strontium-90
Concentration (pCi/L)
3300
3280
3260
3240
3220
3200
3180
Mar-04
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

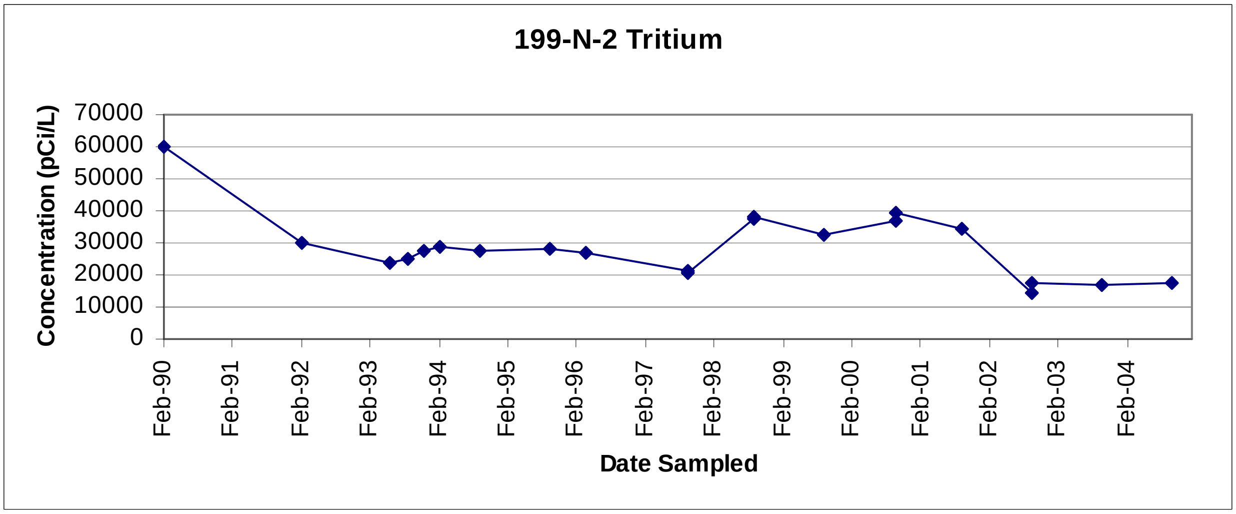

199-N-119 Strontium-90
Concentration (pCi/L)
330
320
310
300
290
280
270
260
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

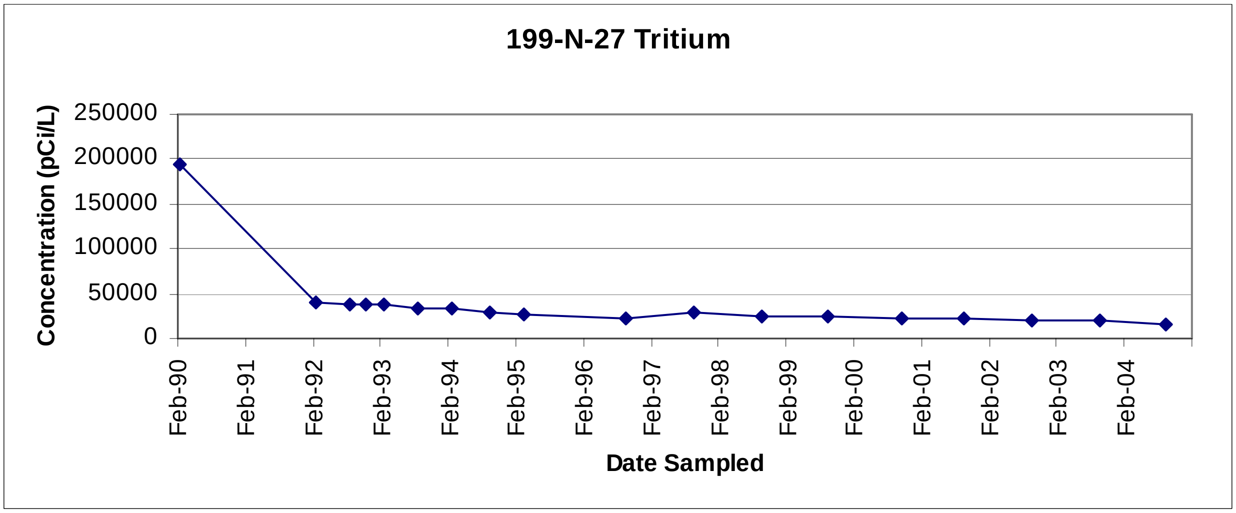

199-N-120 Strontium-90
Concentration (pCi/L)
16
14
12
10
8
6
4
2
0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

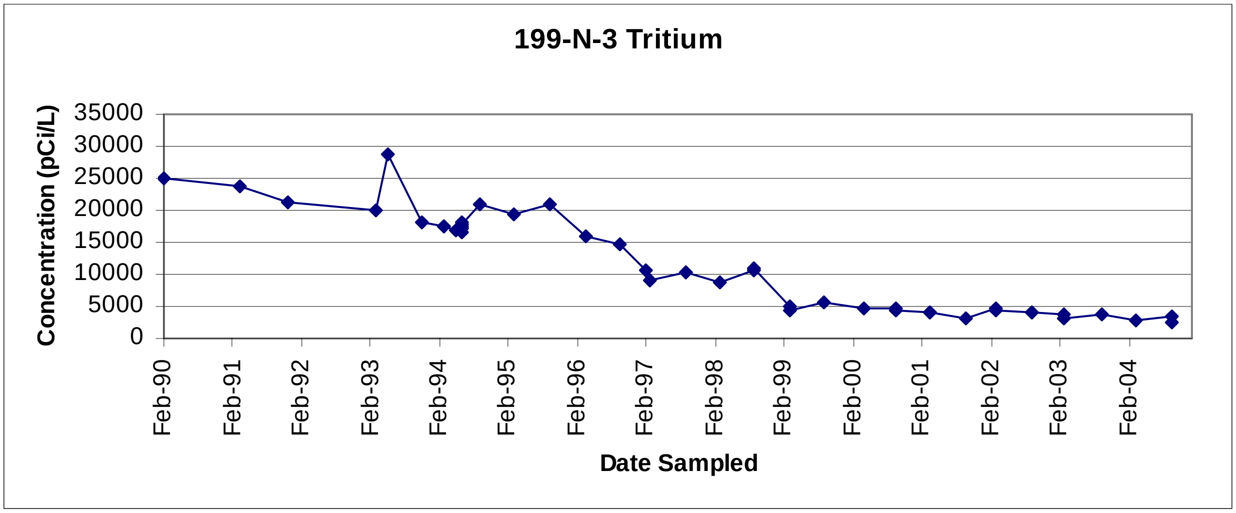

199-N-121 Strontium-90
Concentration (pCi/L)
6
5
4
3
2
1
0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

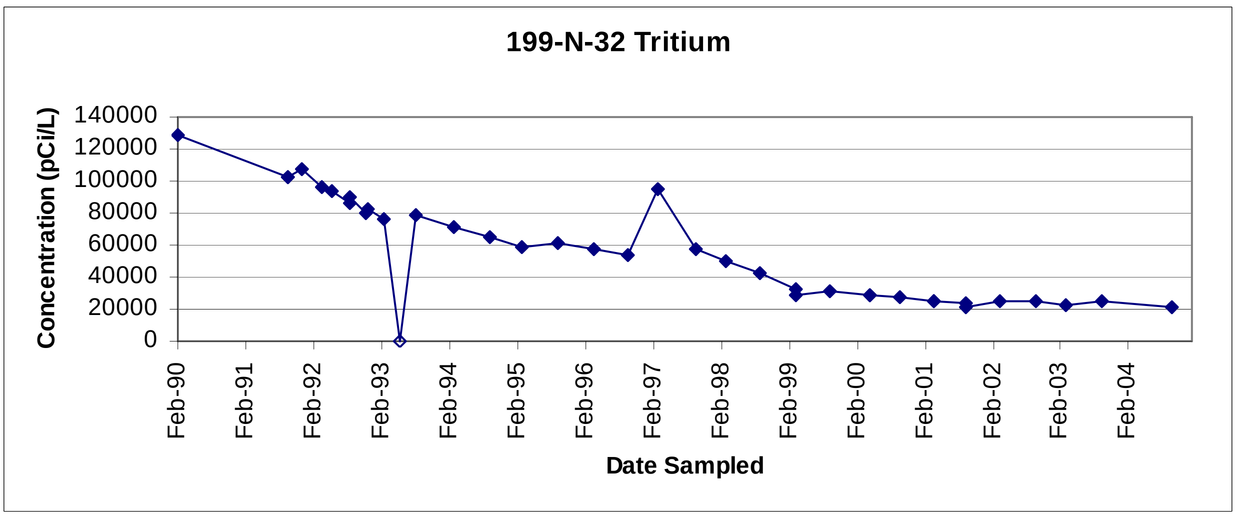

199-N-46 Strontium-90
Concentration (pCi/L)
4000
3500
3000
2500
2000
1500
1000
500
0
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

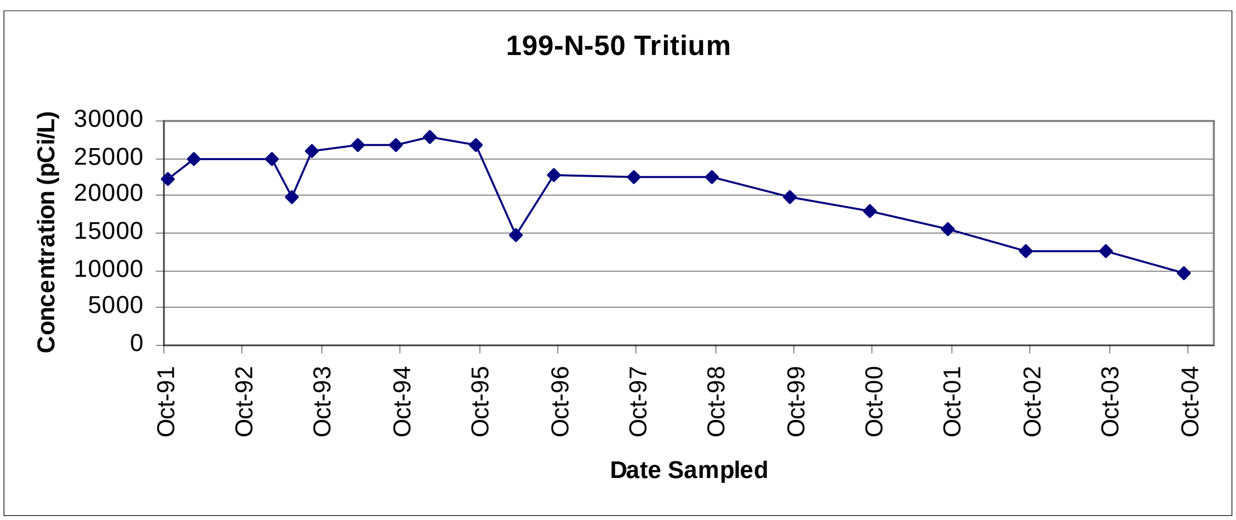

199-N-14 Tritium
Concentration (pCi/L)
120000
100000
80000
60000
40000
20000
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

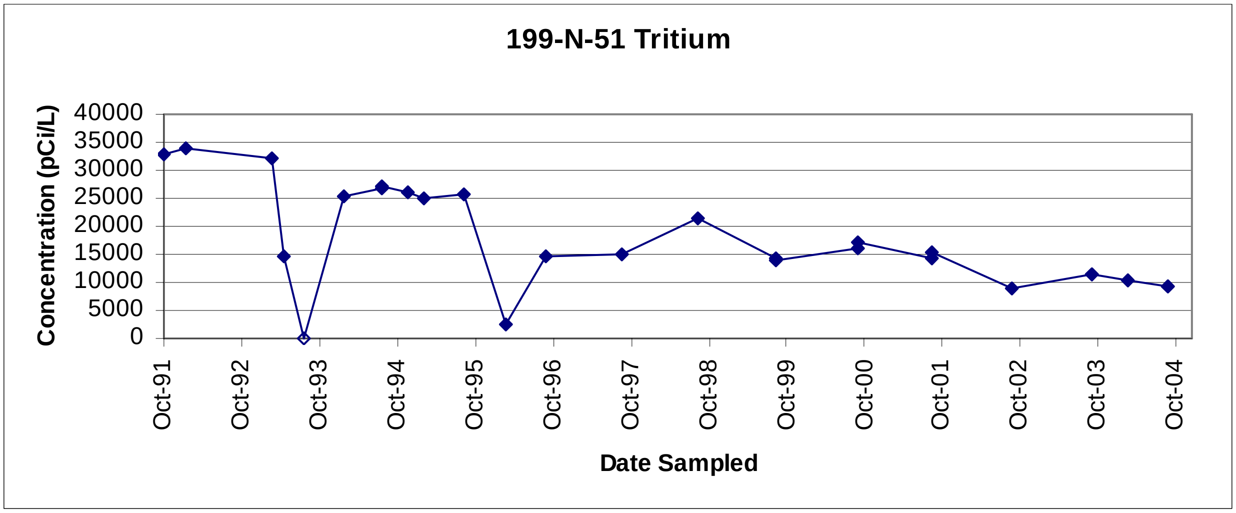

199-N-2 Tritium
Concentration (pCi/L)
70000
60000
50000
40000
30000
20000
10000
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

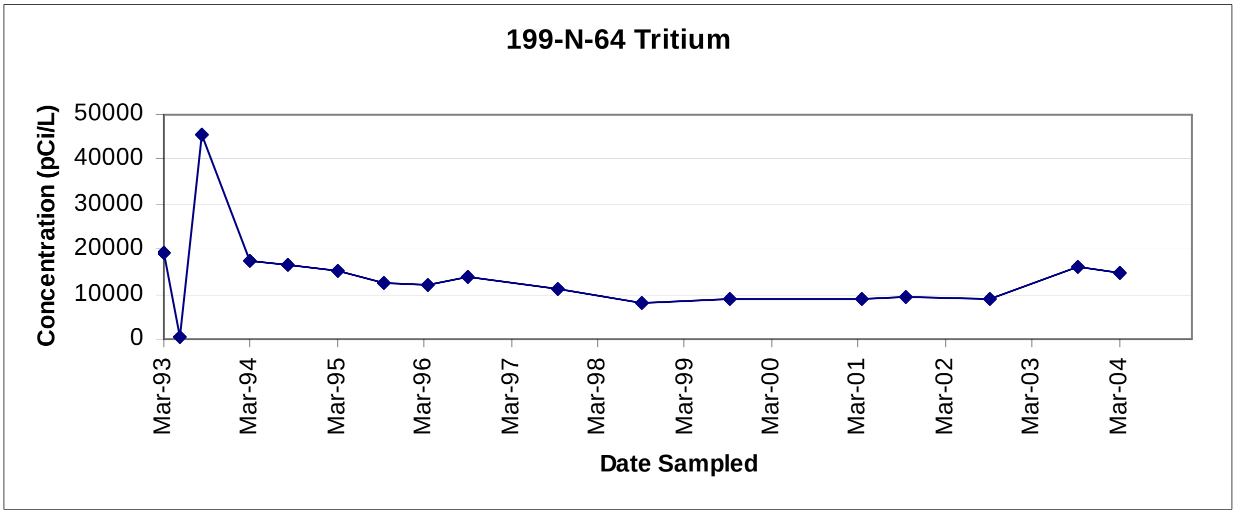

199-N-27 Tritium
Concentration (pCi/L)
250000
200000
150000
100000
50000
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

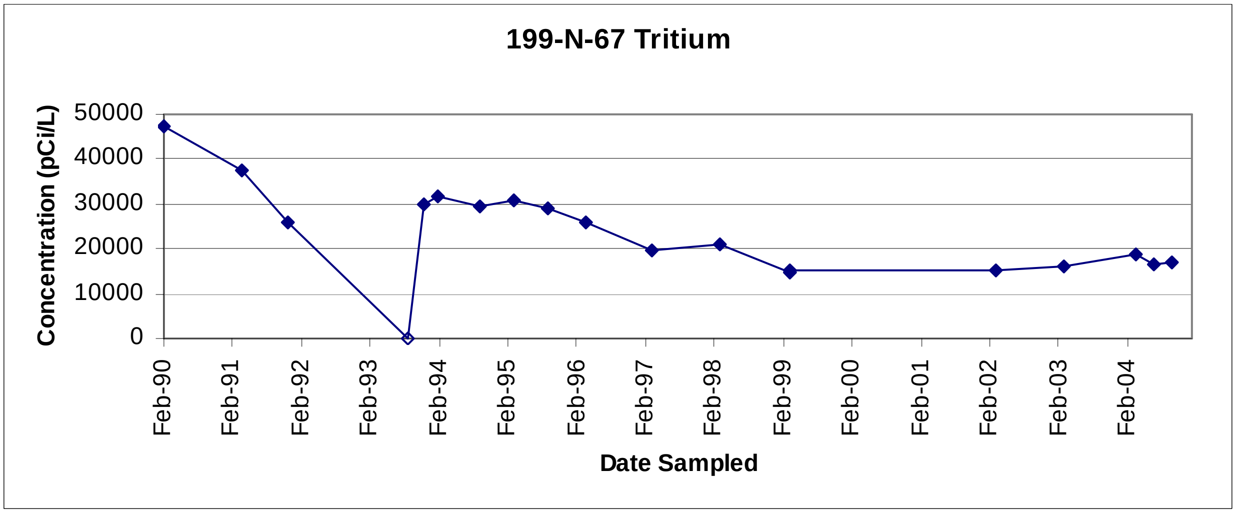

199-N-3 Tritium
Concentration (pCi/L)
35000
30000
25000
20000
15000
10000
5000
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

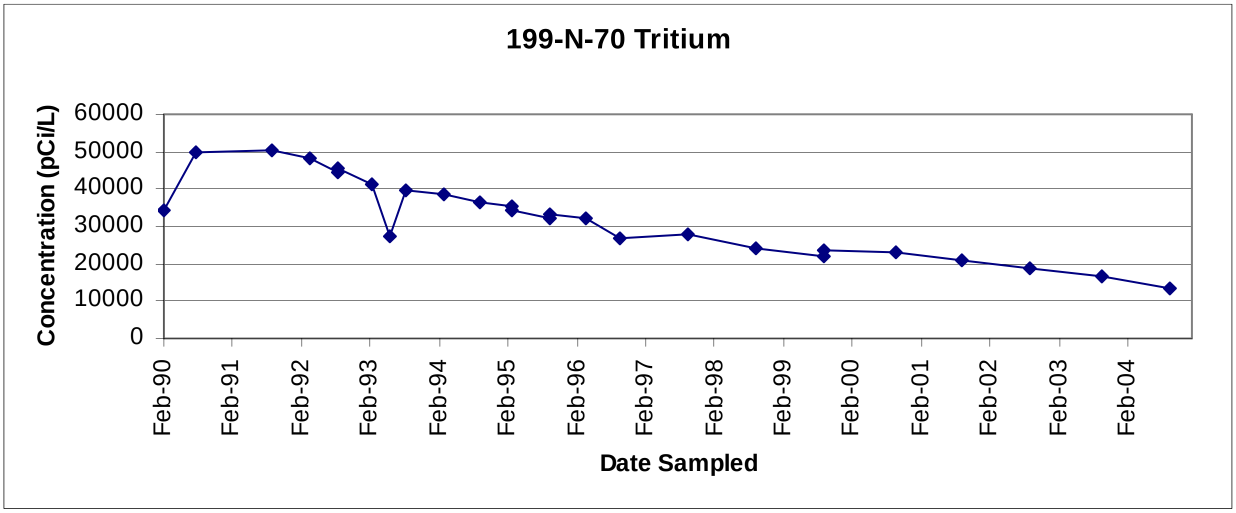

199-N-32 Tritium
Concentration (pCi/L)
140000
120000
100000
80000
60000
40000
20000
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

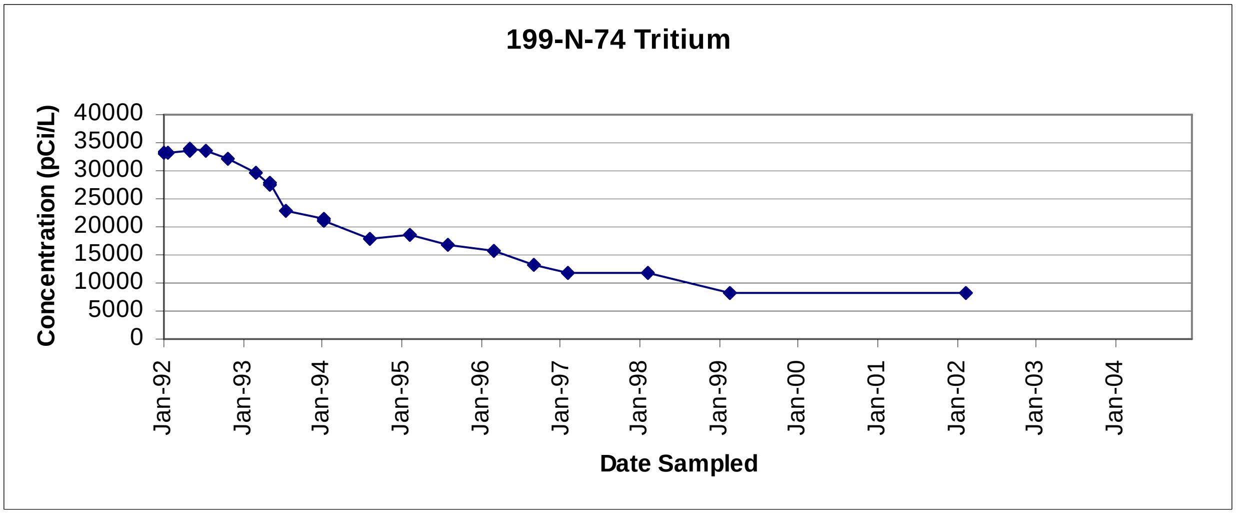

199-N-50 Tritium
Concentration (pCi/L)
30000
25000
20000
15000
10000
5000
0
Oct-91
Oct-92
Oct-93
Oct-94
Oct-95
Oct-96
Oct-97
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
Oct-03
Oct-04
Date Sampled

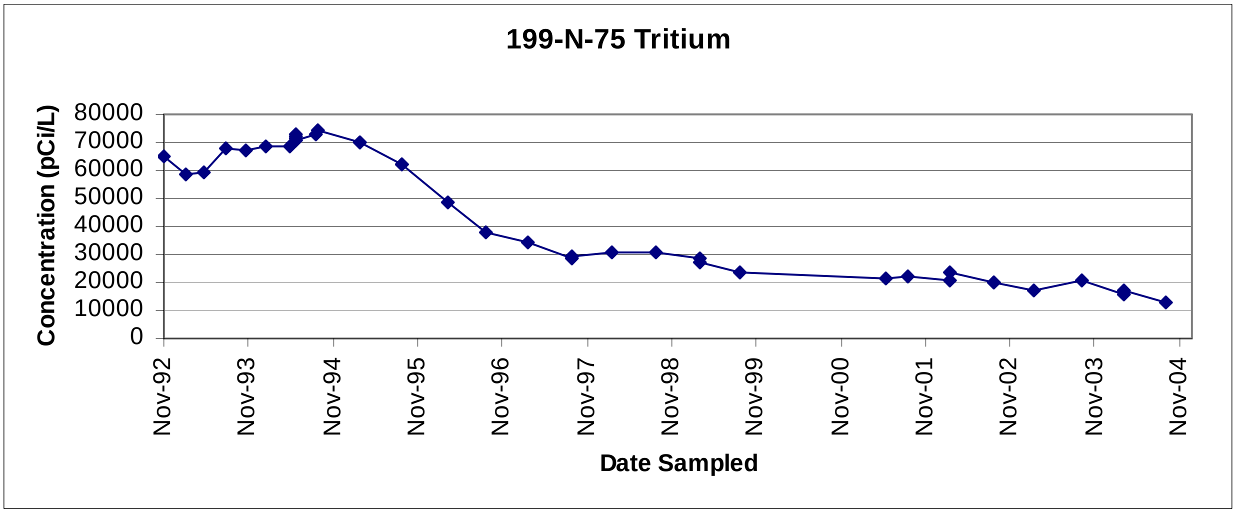

199-N-51 Tritium
Concentration (pCi/L)
40000
35000
30000
25000
20000
15000
10000
5000
0
Oct-91
Oct-92
Oct-93
Oct-94
Oct-95
Oct-96
Oct-97
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
Oct-03
Oct-04
Date Sampled

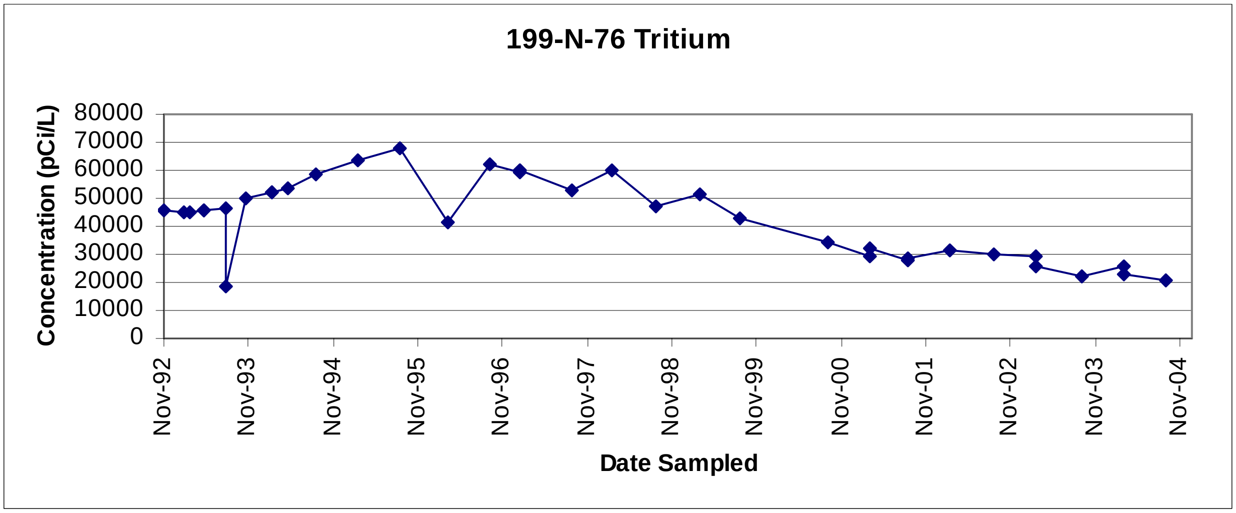

199-N-64 Tritium
Concentration (pCi/L)
50000
40000
30000
20000
10000
0
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled

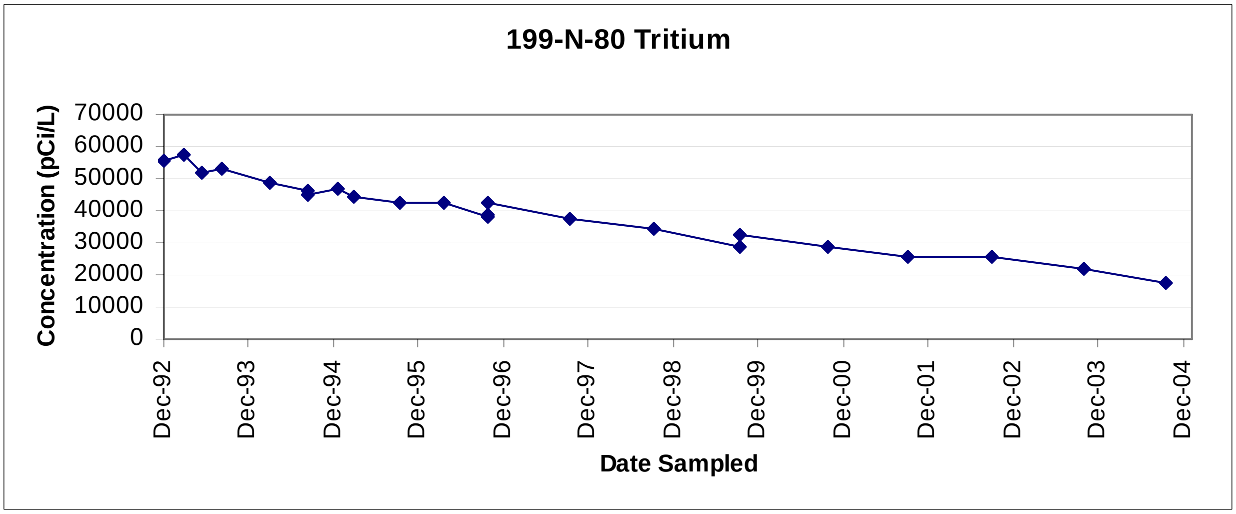

199-N-67 Tritium
Concentration (pCi/L)
50000
40000
30000
20000
10000
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

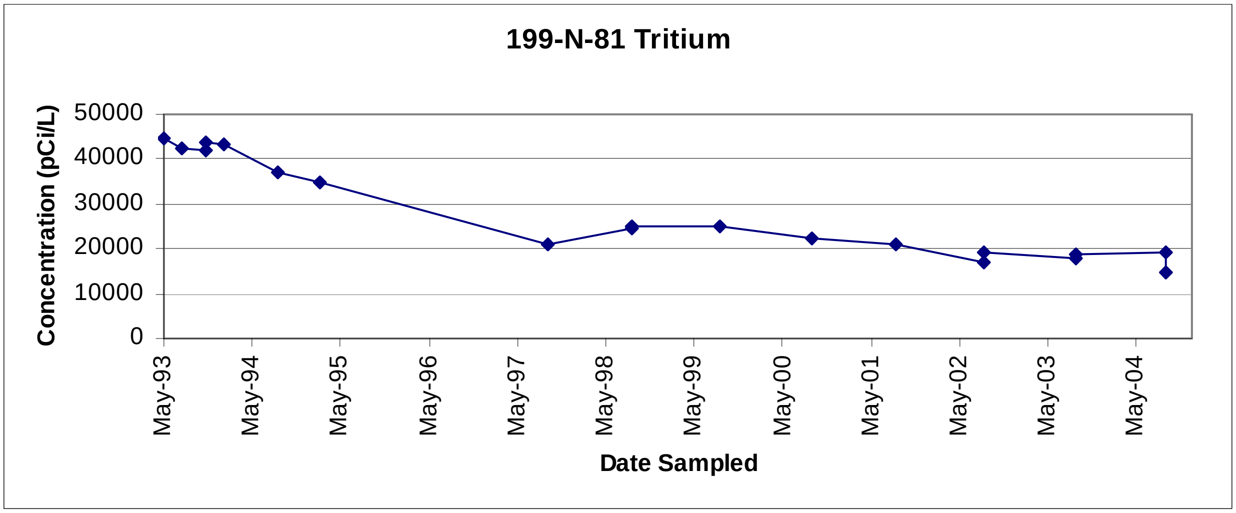

199-N-70 Tritium
Concentration (pCi/L)
60000
50000
40000
30000
20000
10000
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

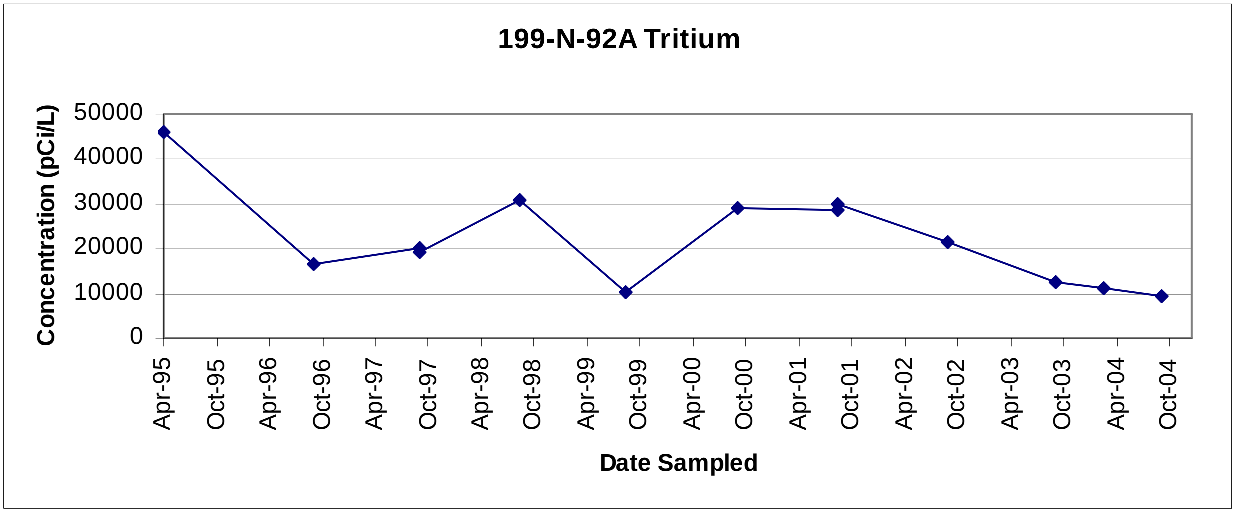

199-N-74 Tritium
Concentration (pCi/L)
40000
35000
30000
25000
20000
15000
10000
5000
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Date Sampled

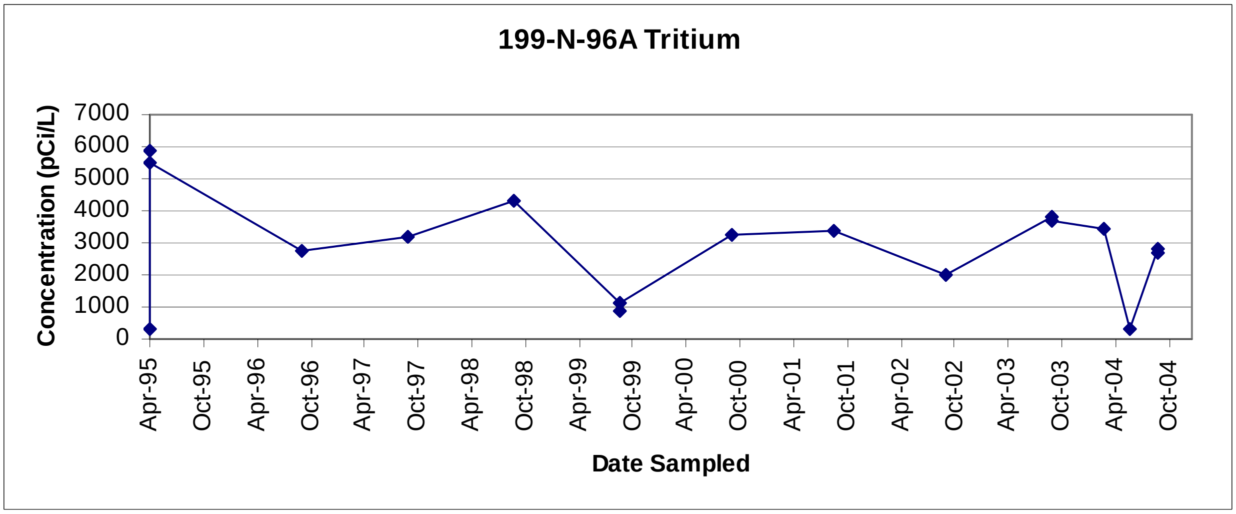

199-N-75 Tritium
Concentration (pCi/L)
80000
70000
60000
50000
40000
30000
20000
10000
0
Nov-92
Nov-93
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00
Nov-01
Nov-02
Nov-03
Nov-04
Date Sampled

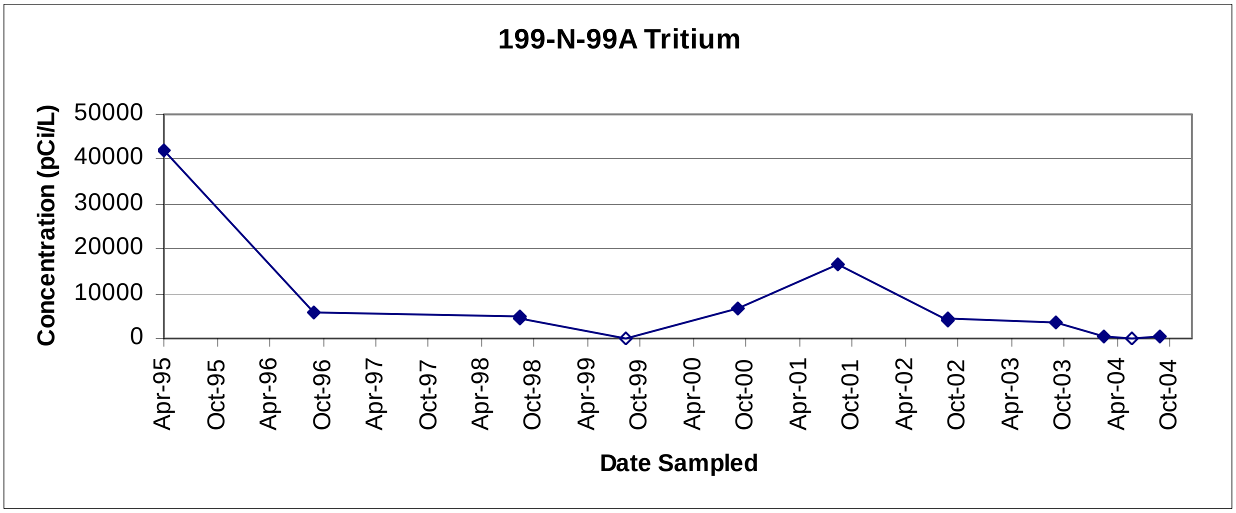

199-N-76 Tritium
Concentration (pCi/L)
80000
70000
60000
50000
40000
30000
20000
10000
0
Nov-92
Nov-93
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00
Nov-01
Nov-02
Nov-03
Nov-04
Date Sampled

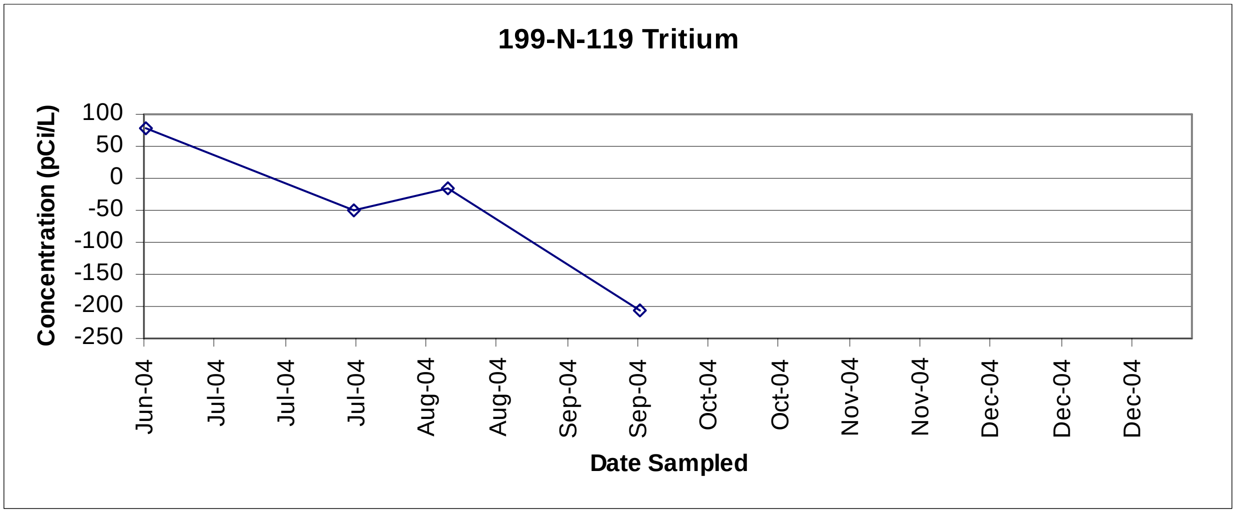

199-N-80 Tritium
Concentration (pCi/L)
70000
60000
50000
40000
30000
20000
10000
0
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Date Sampled


199-N-81 Tritium
Concentration (pCi/L)
50000
40000
30000
20000
10000
0
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled


199-N-92A Tritium
Concentration (pCi/L)
50000
40000
30000
20000
10000
0
Apr-95
Oct-95
Apr-96
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled


199-N-96A Tritium
Concentration (pCi/L)
7000
6000
5000
4000
3000
2000
1000
0
Apr-95
Oct-95
Apr-96
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled


199-N-99A Tritium
Concentration (pCi/L)
50000
40000
30000
20000
10000
0
Apr-95
Oct-95
Apr-96
Oct-96
Apr-97
Oct-97
Apr-98
Oct-98
Apr-99
Oct-99
Apr-00
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Apr-04
Oct-04
Date Sampled


199-N-119 Tritium
Concentration (pCi/L)
100
50
0
-50
-100
-150
-200
-250
Jun-04
Jul-04
Jul-04
Jul-04
Aug-04
Aug-04
Sep-04
Sep-04
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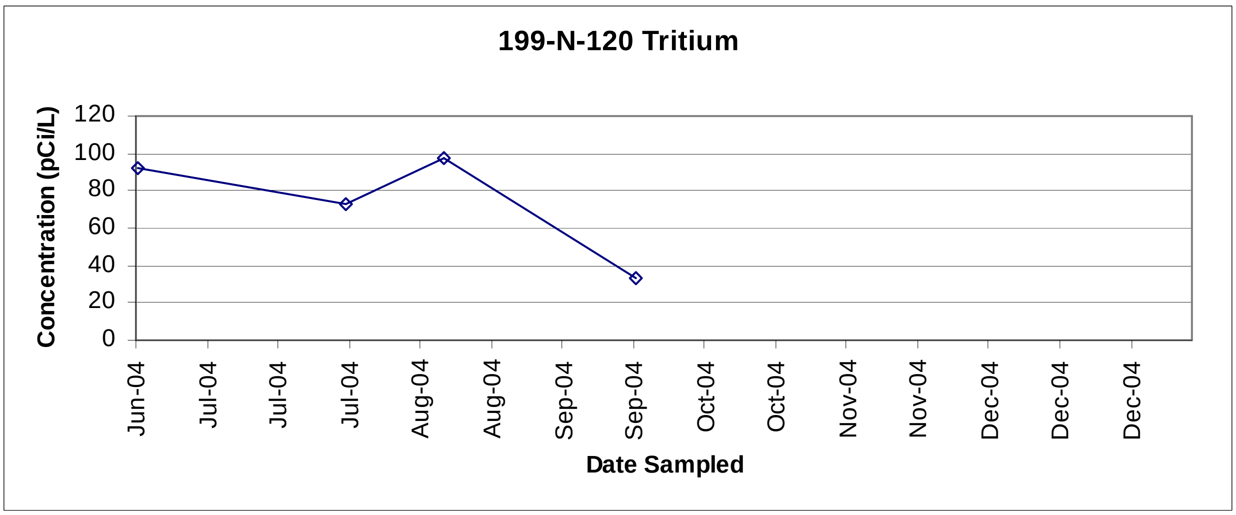
Oct-04
Nov-04
Nov-04
Dec-04
Dec-04
Dec-04
Date Sampled


199-N-120 Tritium
Concentration (pCi/L)
120
100
80
60
40
20
0
Jun-04
Jul-04
Jul-04
Jul-04
Aug-04
Aug-04
Sep-04
Sep-04
Oct-04
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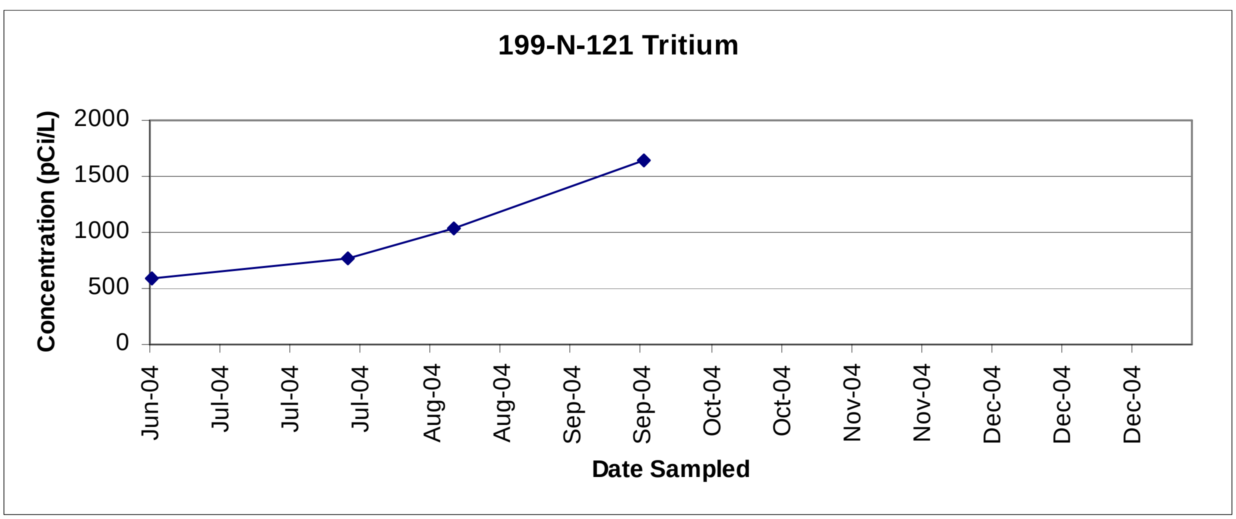
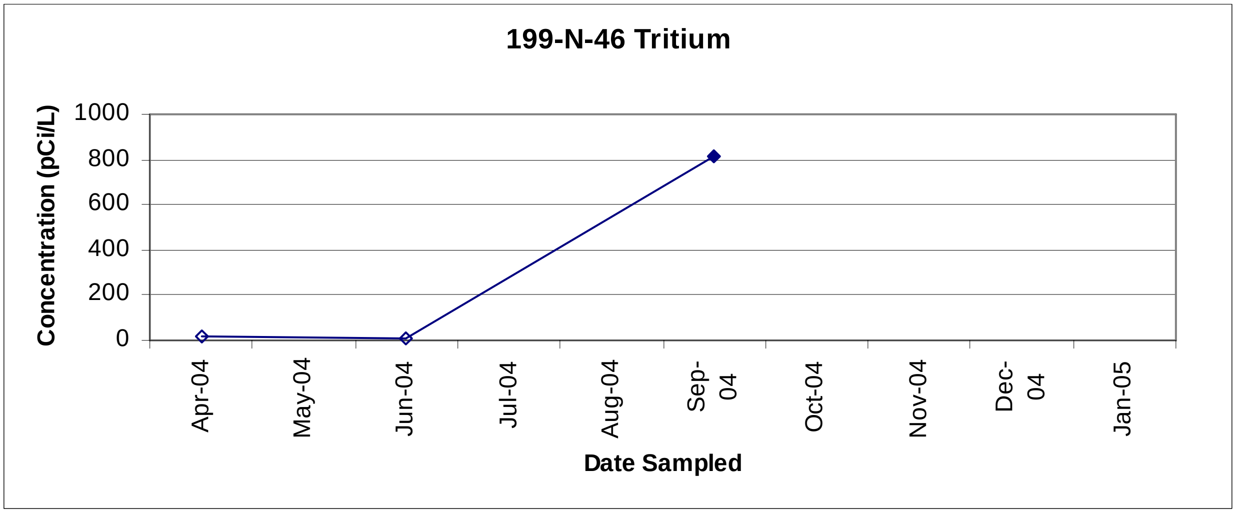
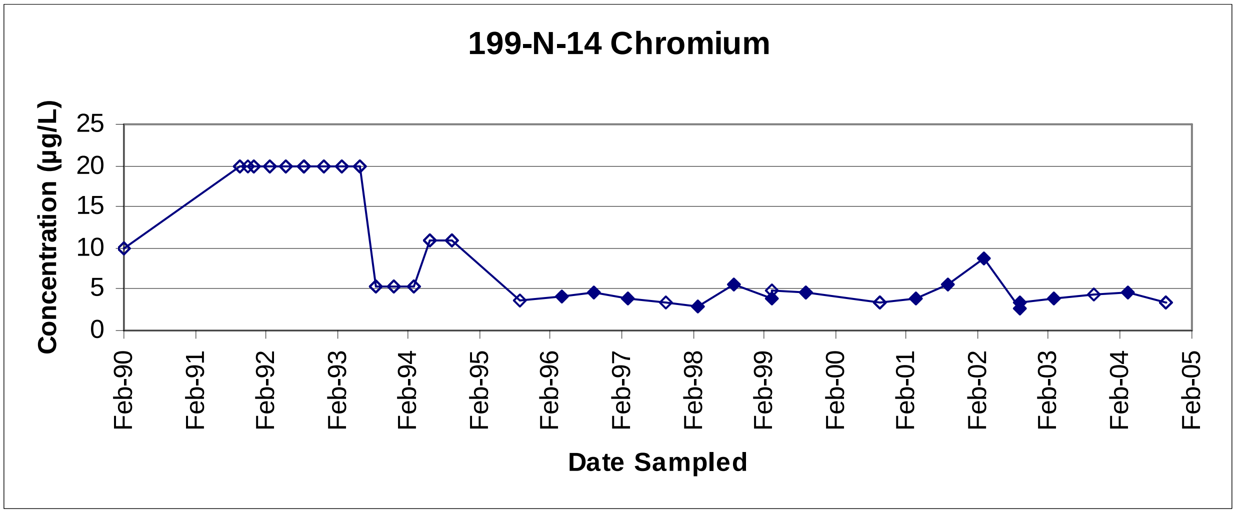
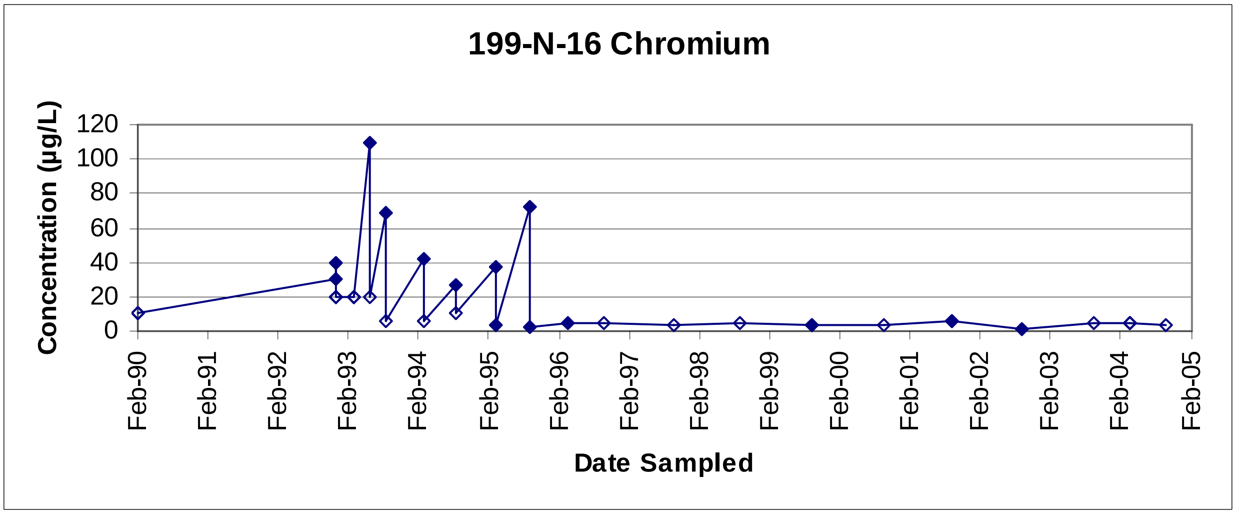
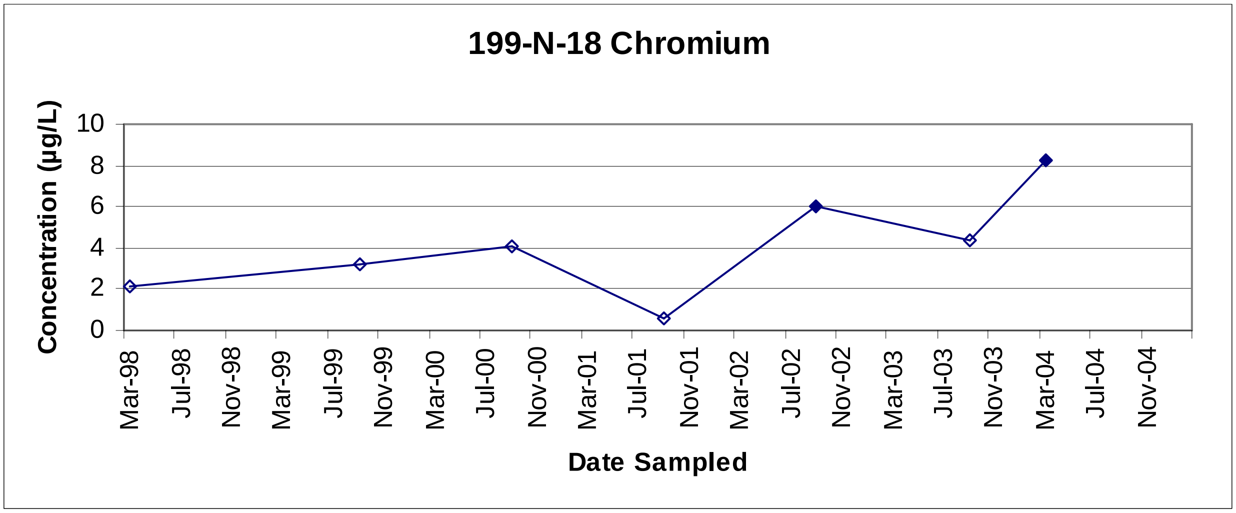
Nov-04
Dec-04
Dec-04
Dec-04
Date Sampled

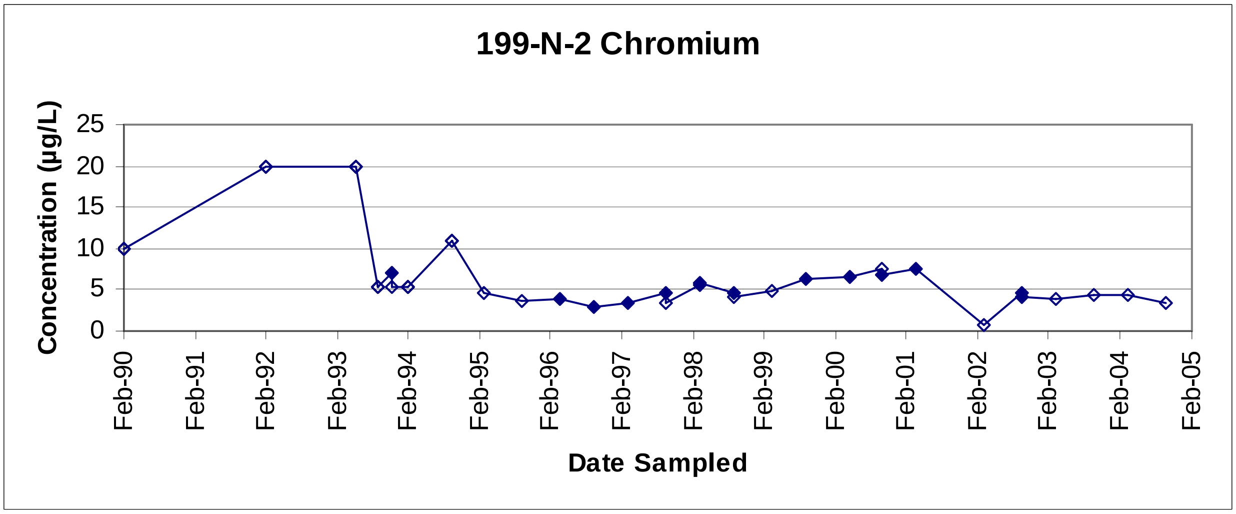

199-N-121 Tritium
Concentration (pCi/L)
2000
1500
1000
500
0
Jun-04
Jul-04
Jul-04
Jul-04
Aug-04
Aug-04
Sep-04
Sep-04
Oct-04
Oct-04
Nov-04
Nov-04
Dec-04
Dec-04
Dec-04
Date Sampled

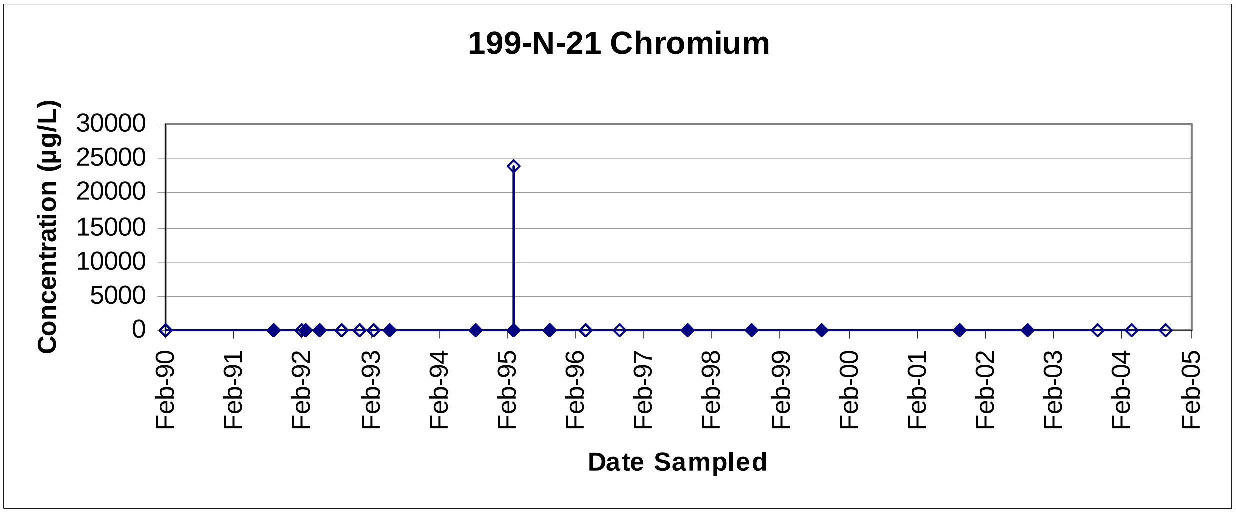

199-N-46 Tritium
Concentration (pCi/L)
1000
800
600
400
200
0
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

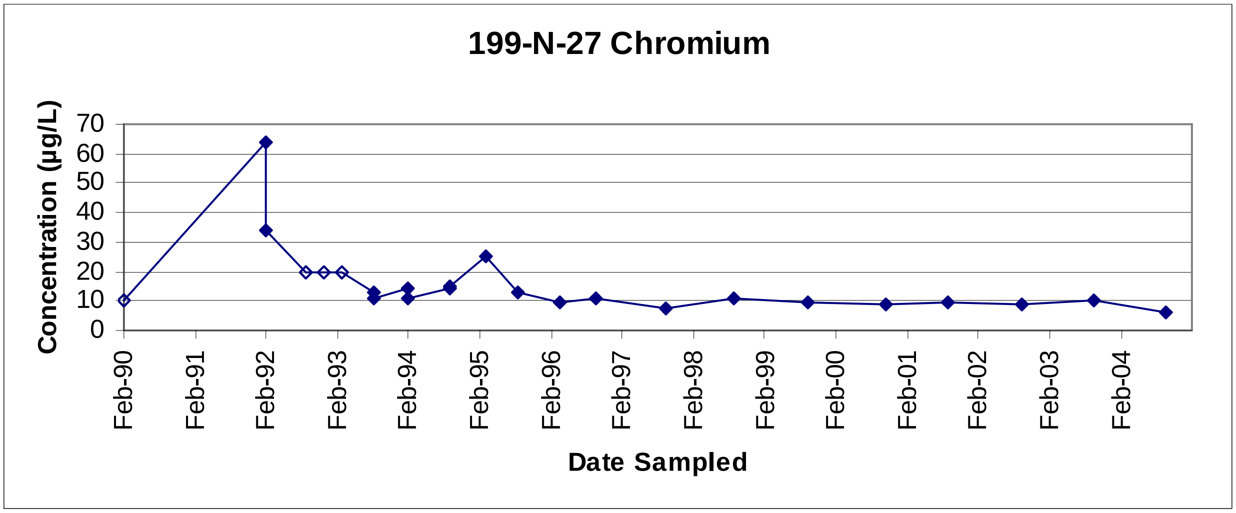

199-N-14 Chromium
Concentration (µg/L)
25
20
15
10
5
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Date Sampled

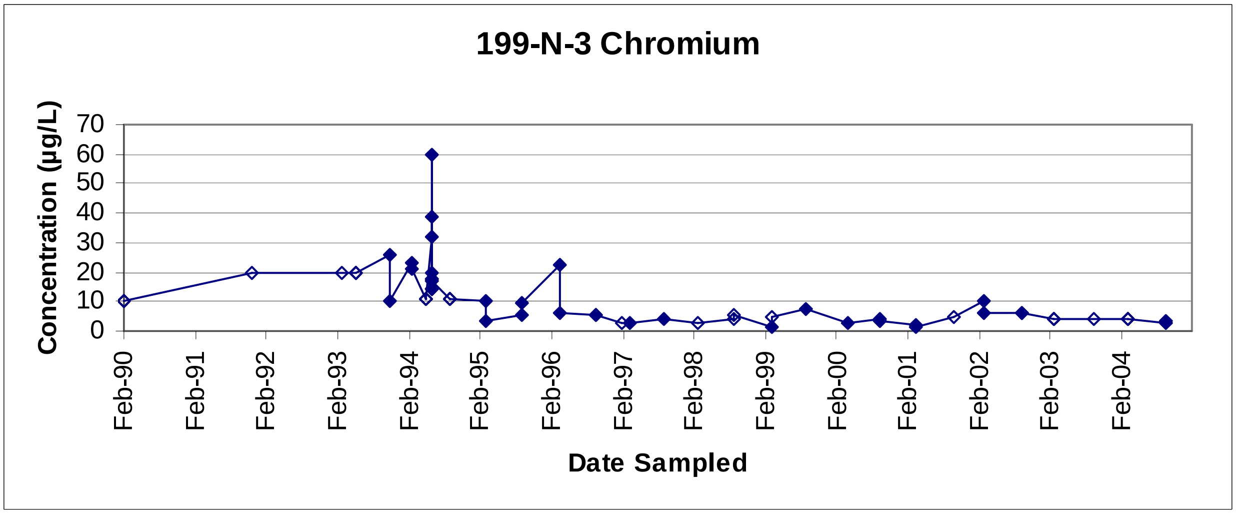

199-N-16 Chromium
Concentration (µg/L)
120
100
80
60
40
20
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Date Sampled

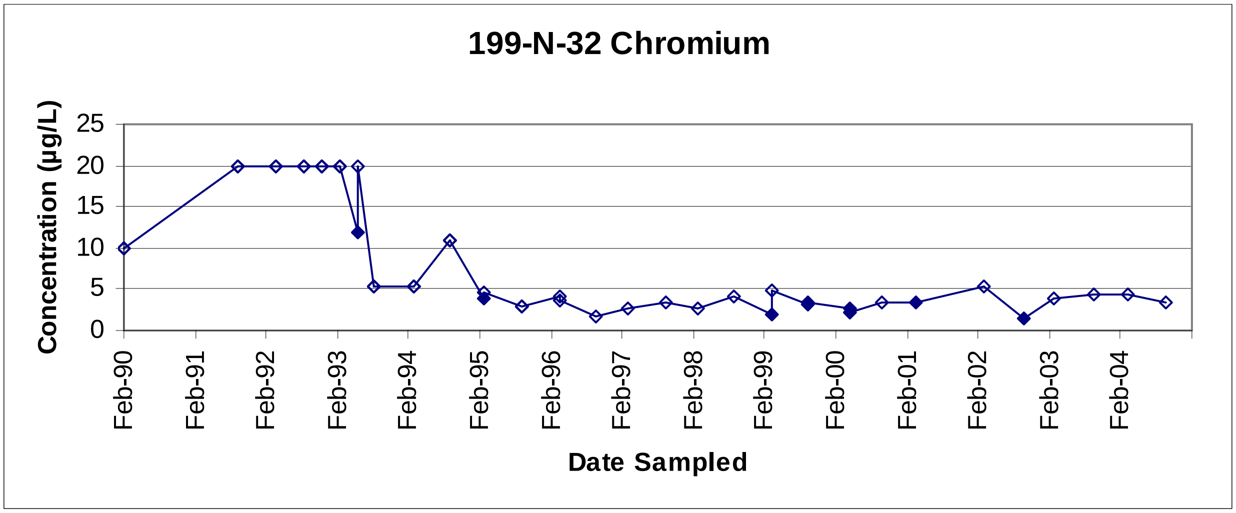

199-N-18 Chromium
Concentration (µg/L)
10
8
6
4
2
0
Mar-98
Jul-98
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Date Sampled

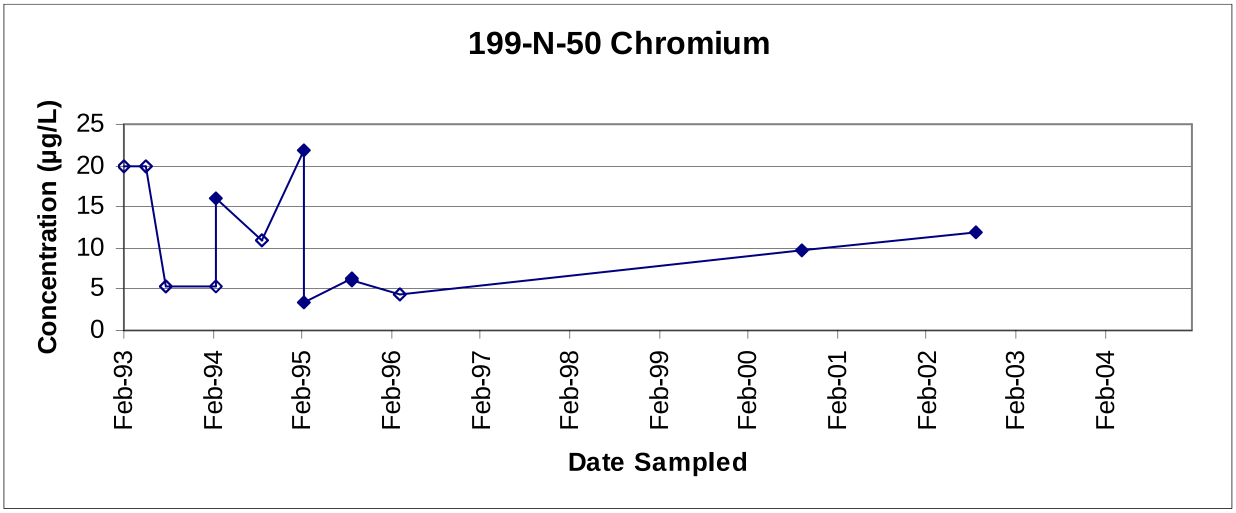

199-N-2 Chromium
Concentration (µg/L)
25
20
15
10
5
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Date Sampled

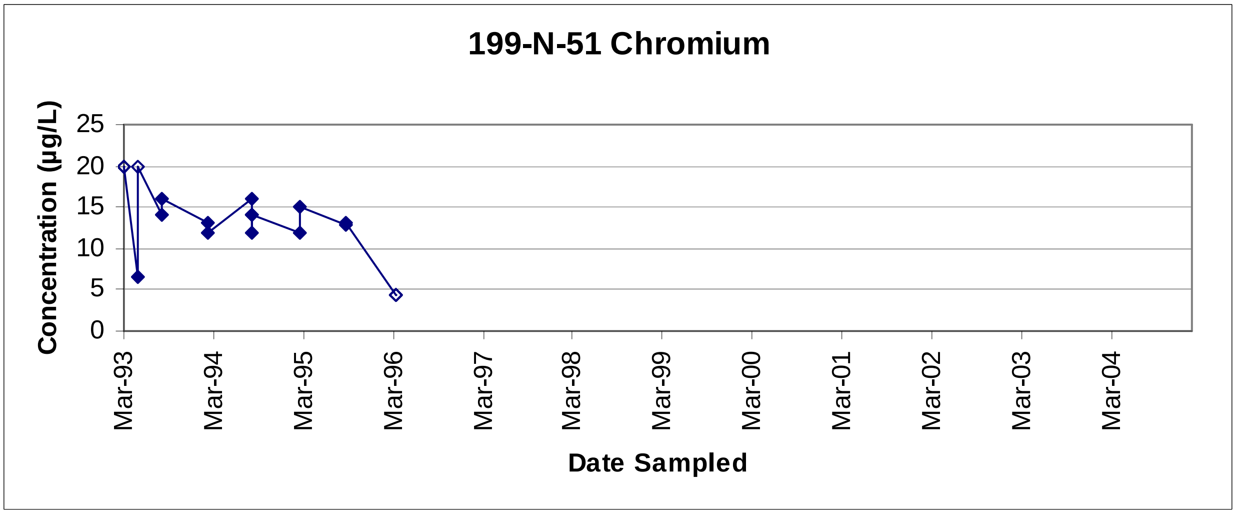

199-N-21 Chromium
Concentration (µg/L)
30000
25000
20000
15000
10000
5000
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Date Sampled

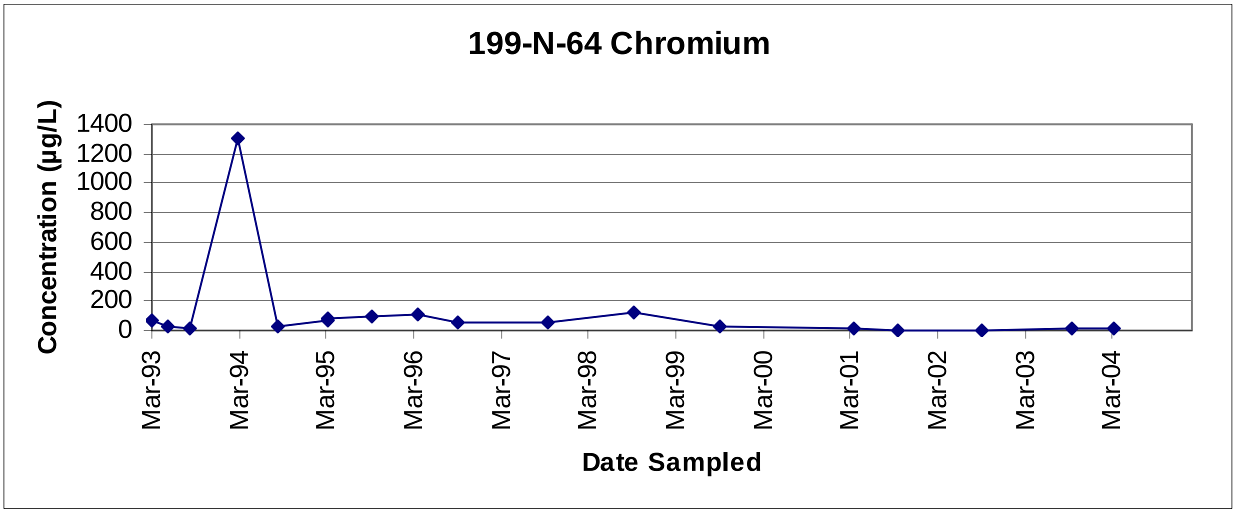

199-N-27 Chromium
Concentration (µg/L)
0
10
20
30
40
50
60
70
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

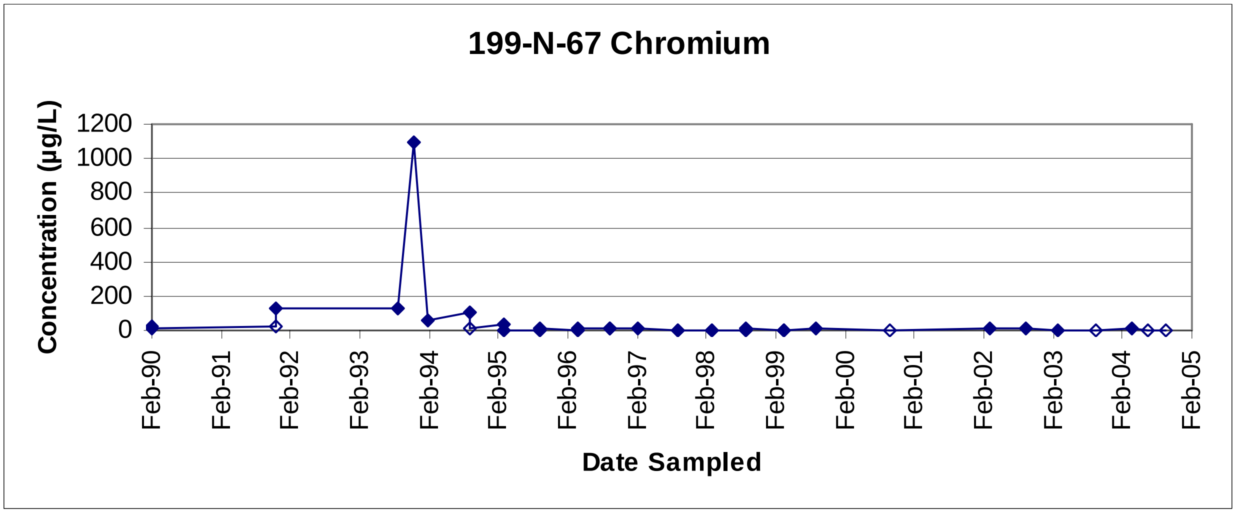

199-N-3 Chromium
Concentration (µg/L)
0
10
20
30
40
50
60
70
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-32 Chromium
Concentration (µg/L)
0
5
10
15
20
25
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-50 Chromium
Concentration (µg/L)
25
20
15
10
5
0
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-51 Chromium
Concentration (µg/L)
25
20
15
10
5
0
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled


199-N-64 Chromium
Concentration (µg/L)
1400
1200
1000
800
600
400
200
0
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled


199-N-67 Chromium
Concentration (µg/L)
1200
1000
800
600
400
200
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
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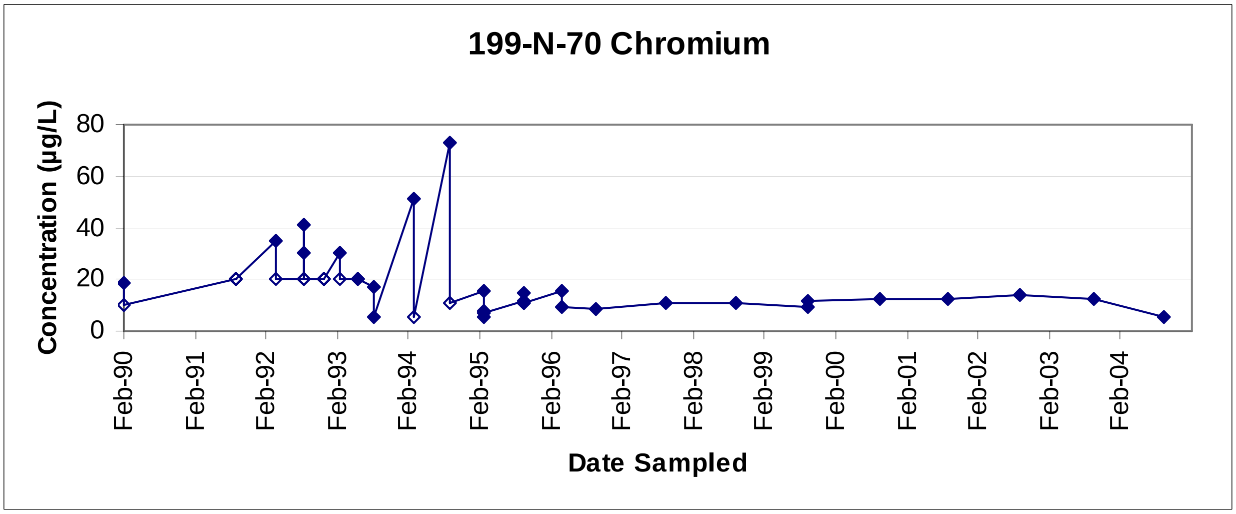
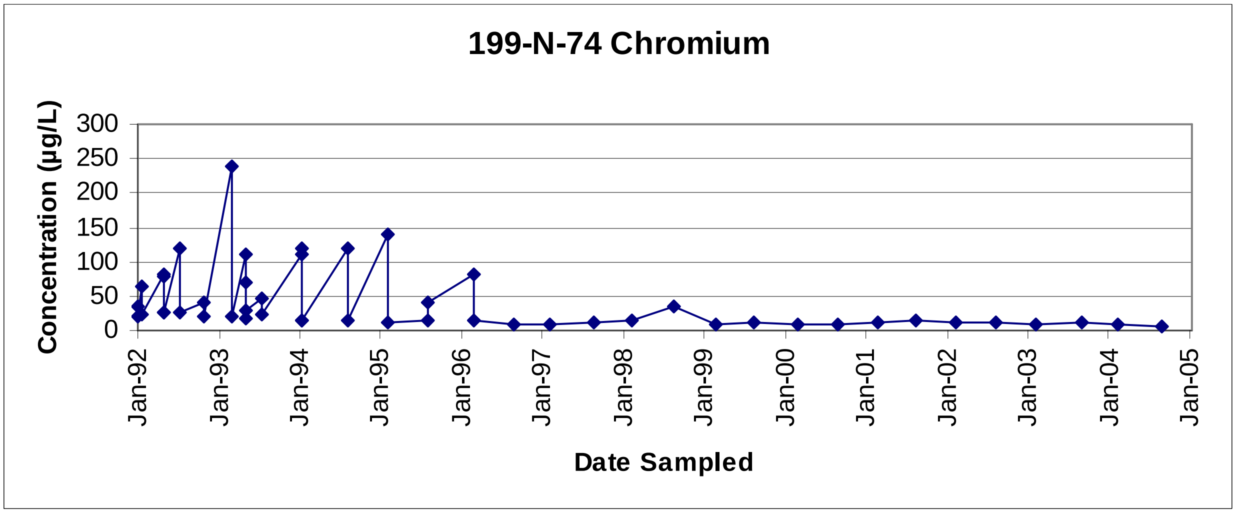
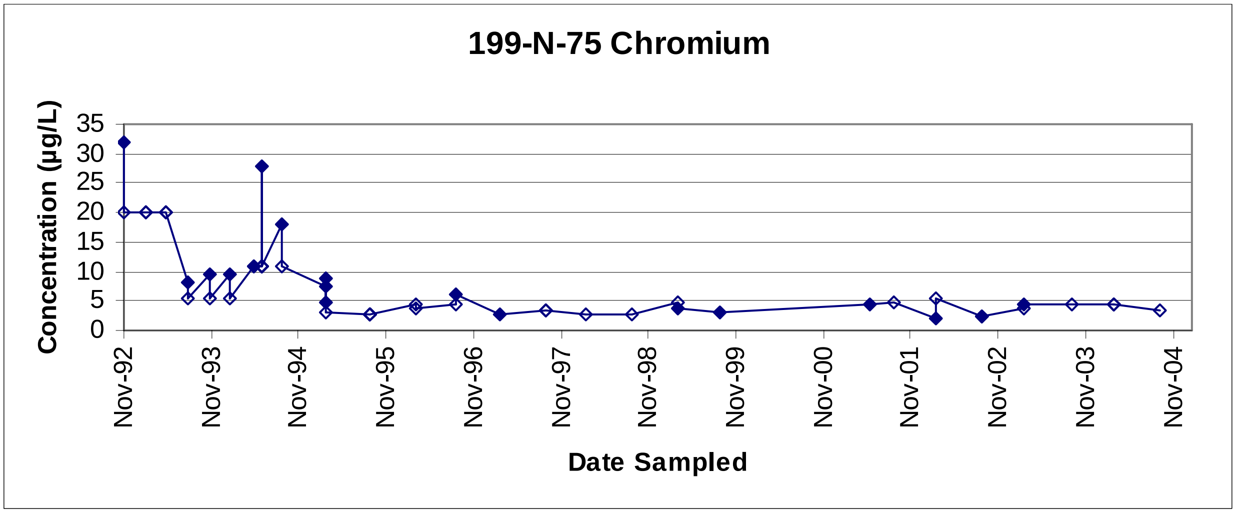
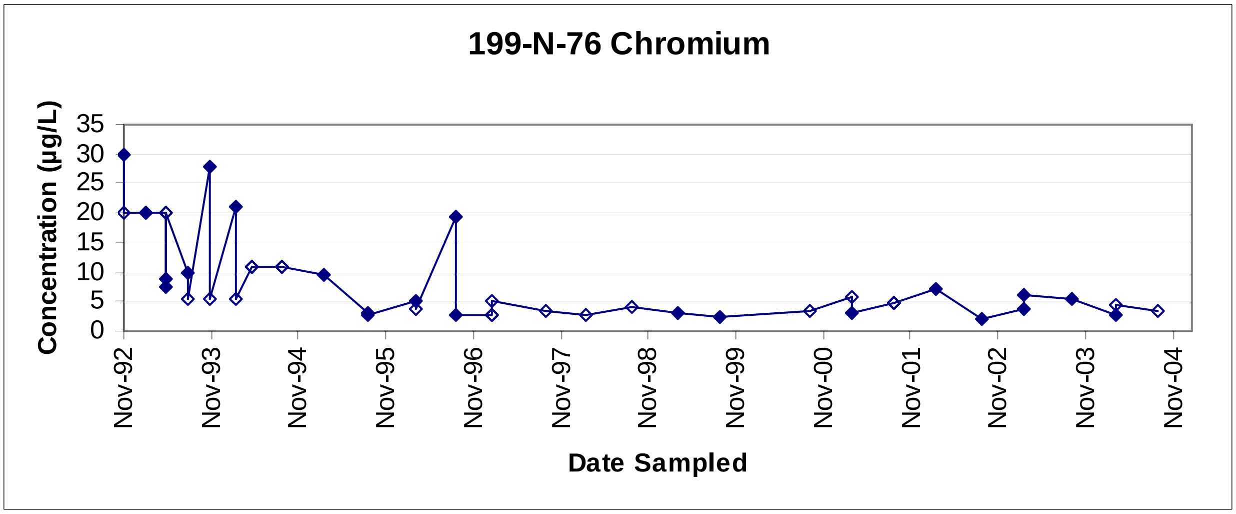
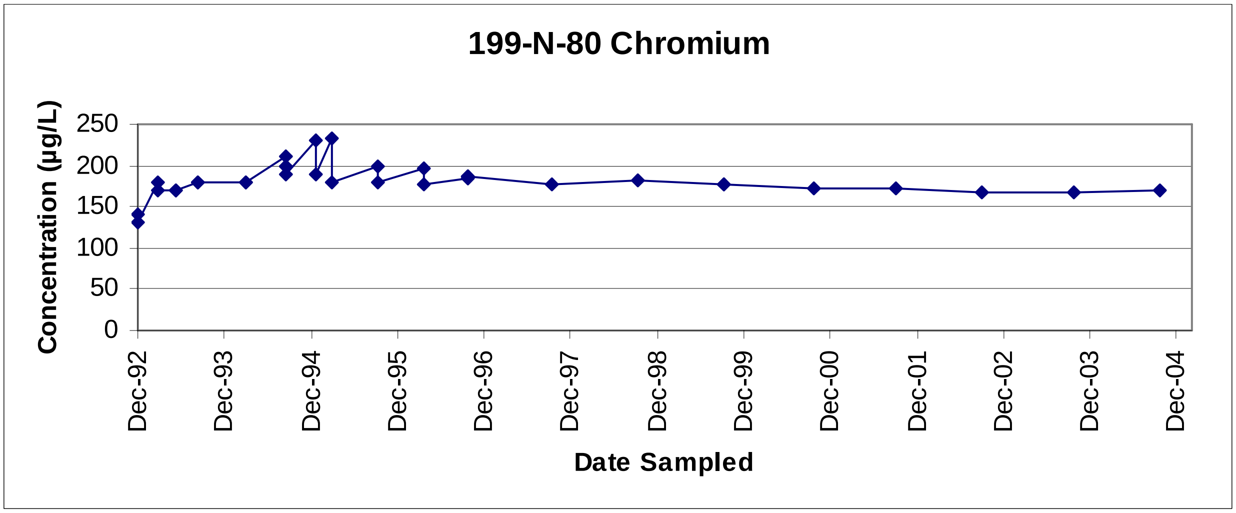
Feb-04
Feb-05
Date Sampled

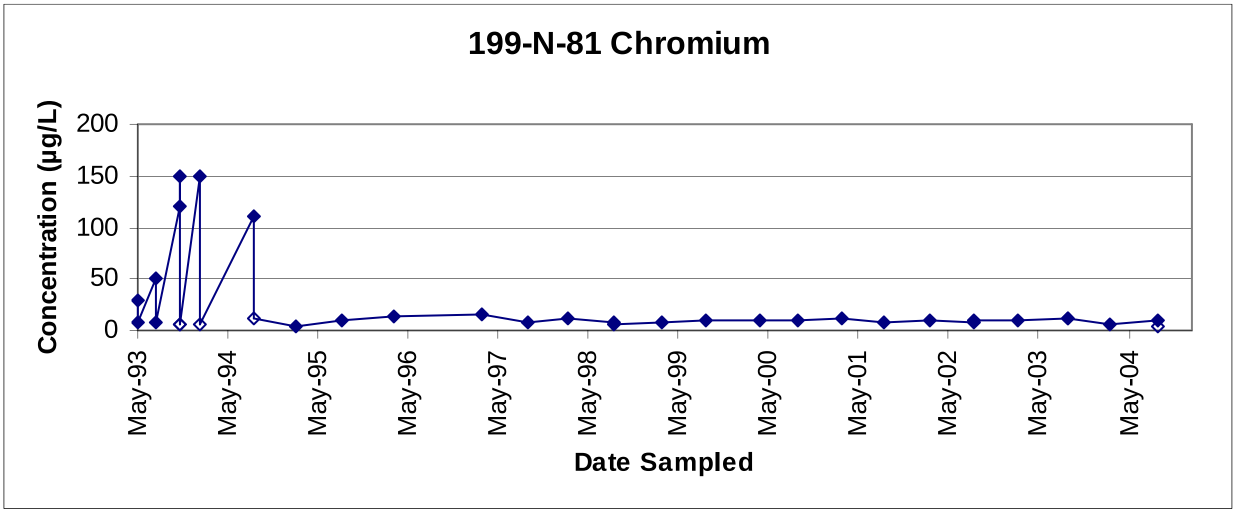

199-N-70 Chromium
Concentration (µg/L)
80
60
40
20
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

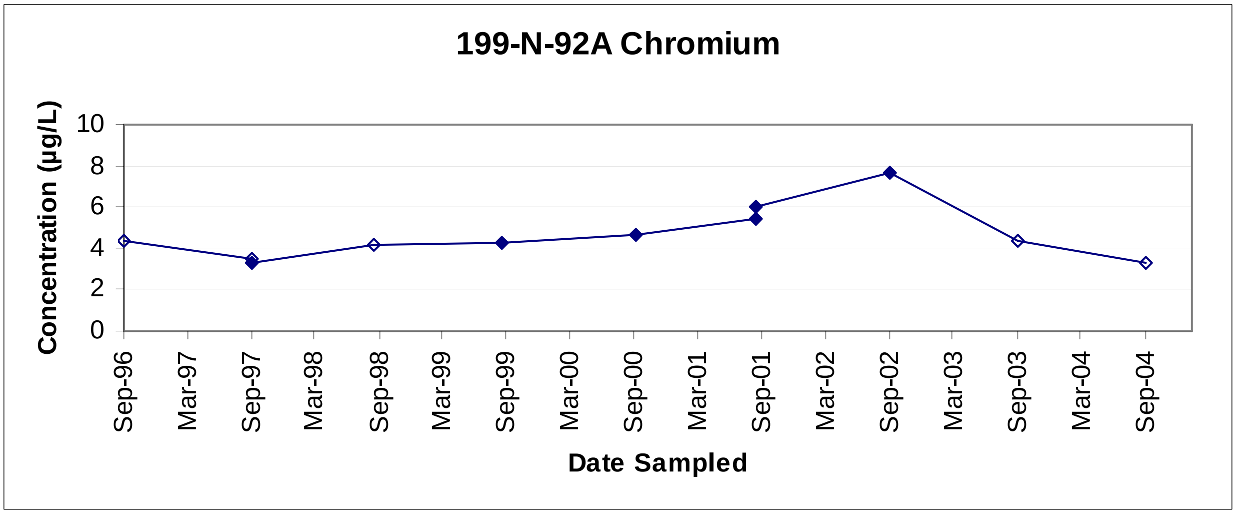

199-N-74 Chromium
Concentration (µg/L)
300
250
200
150
100
50
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

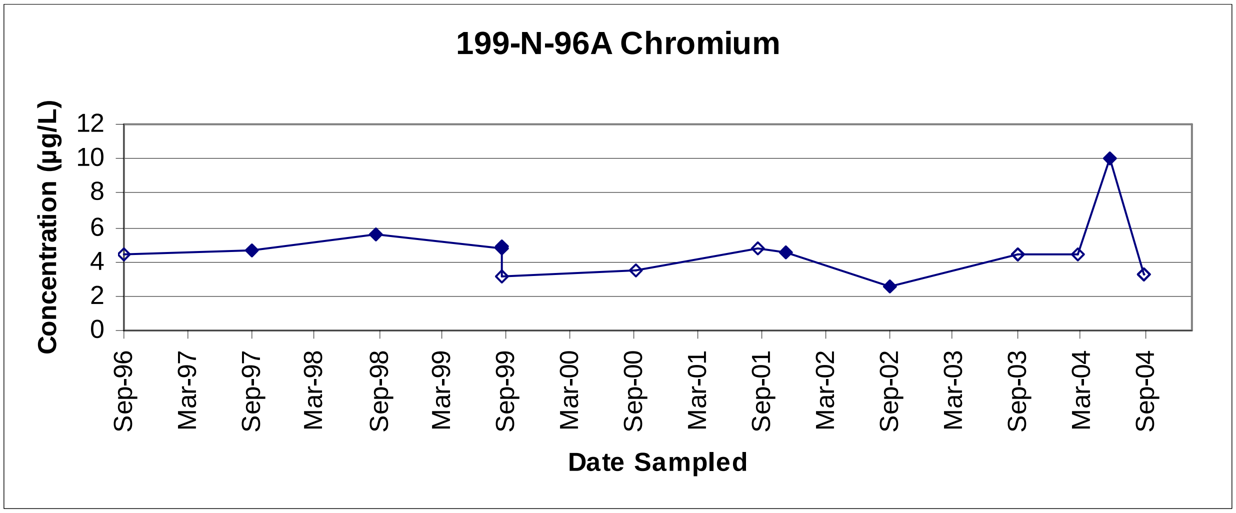

199-N-75 Chromium
Concentration (µg/L)
35
30
25
20
15
10
5
0
Nov-92
Nov-93
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00
Nov-01
Nov-02
Nov-03
Nov-04
Date Sampled

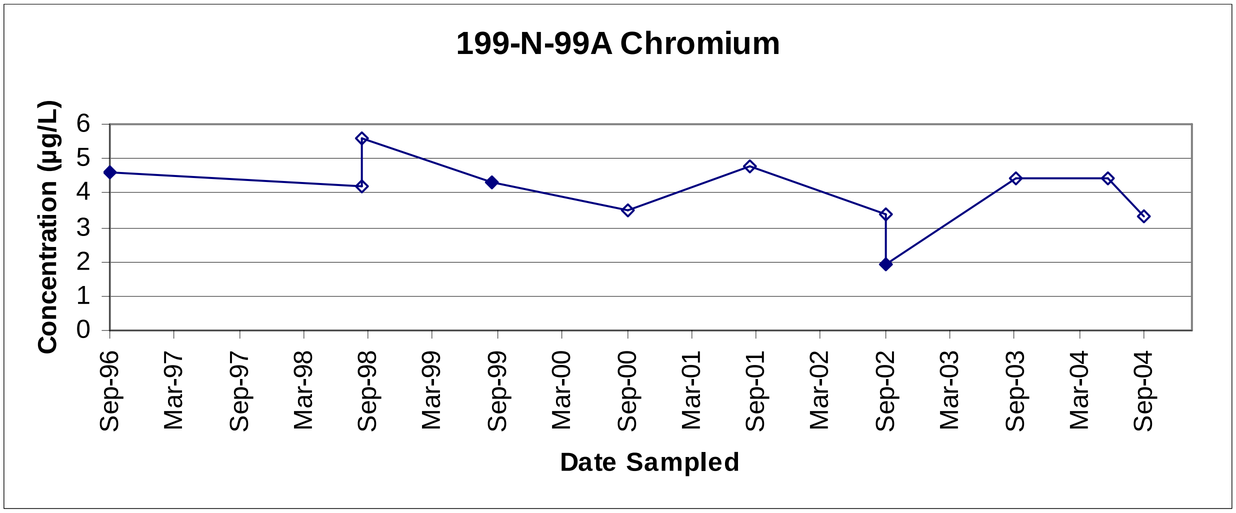

199-N-76 Chromium
Concentration (µg/L)
35
30
25
20
15
10
5
0
Nov-92
Nov-93
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00
Nov-01
Nov-02
Nov-03
Nov-04
Date Sampled

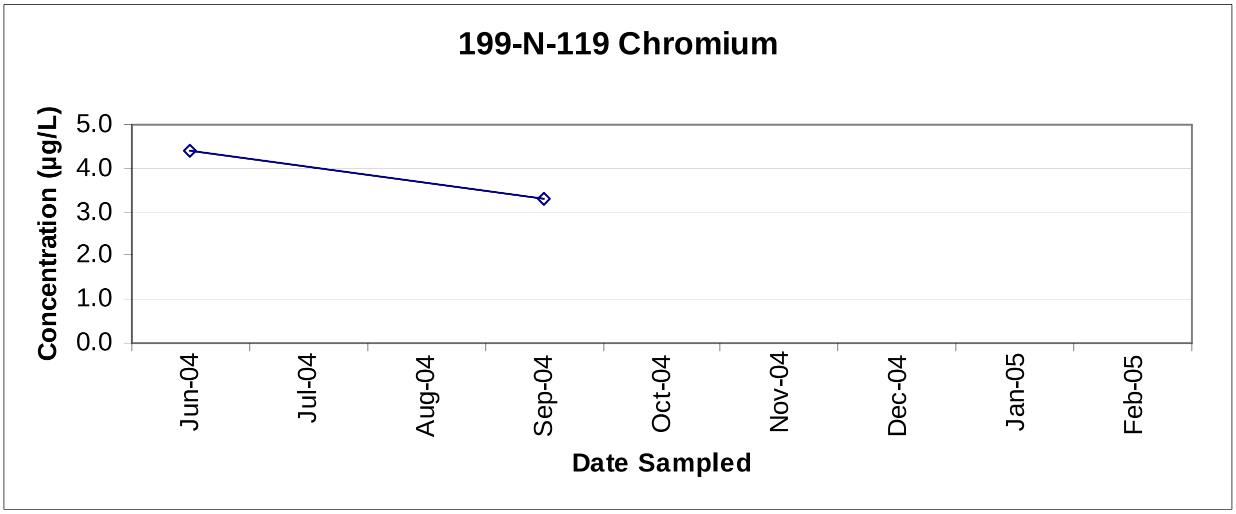

199-N-80 Chromium
Concentration (µg/L)
250
200
150
100
50
0
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Date Sampled

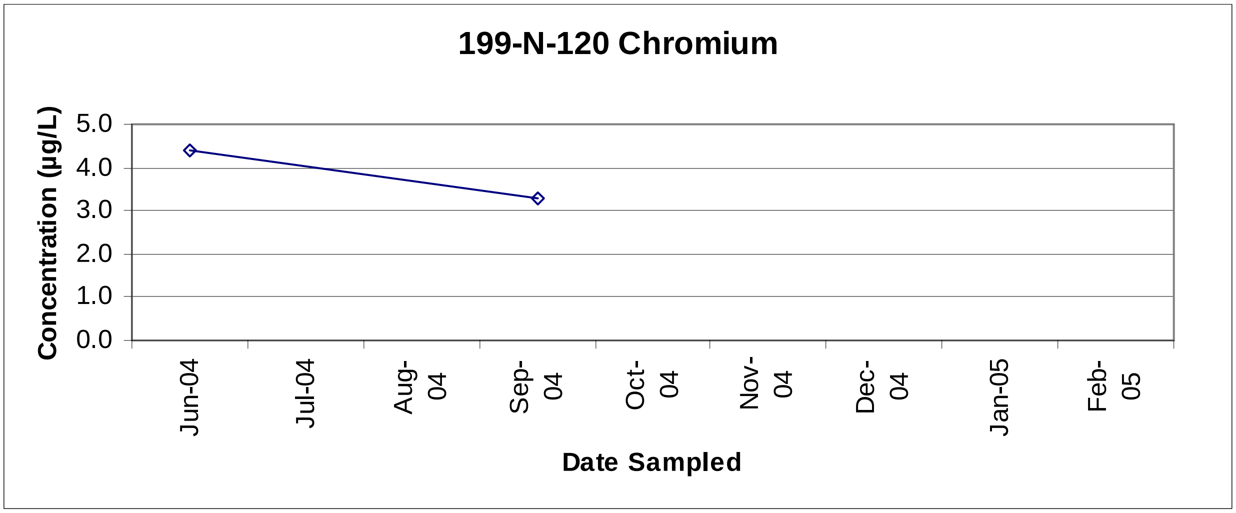

199-N-81 Chromium
Concentration (µg/L)
200
150
100
50
0
May-93
May-94
May-95
May-96
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
Date Sampled

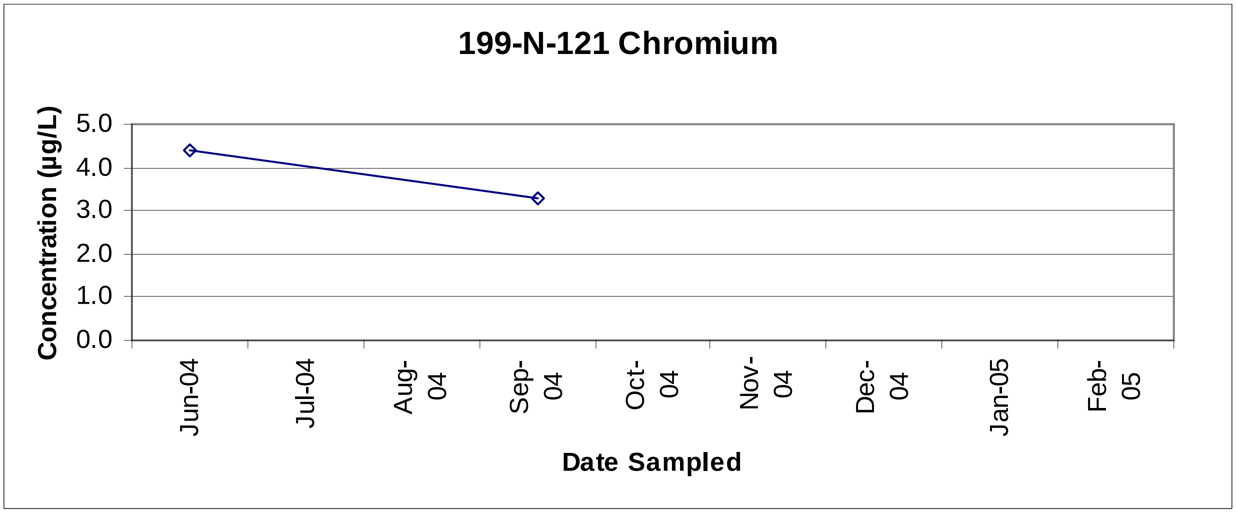

199-N-92A Chromium
Concentration (µg/L)
10
8
6
4
2
0
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled

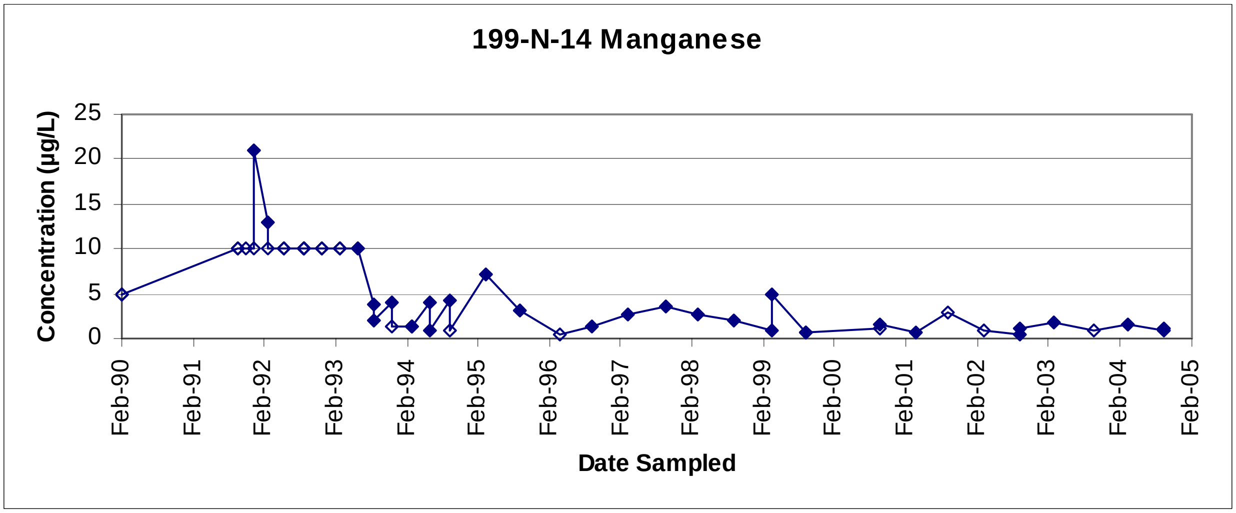

199-N-96A Chromium
Concentration (µg/L)
12
10
8
6
4
2
0
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled

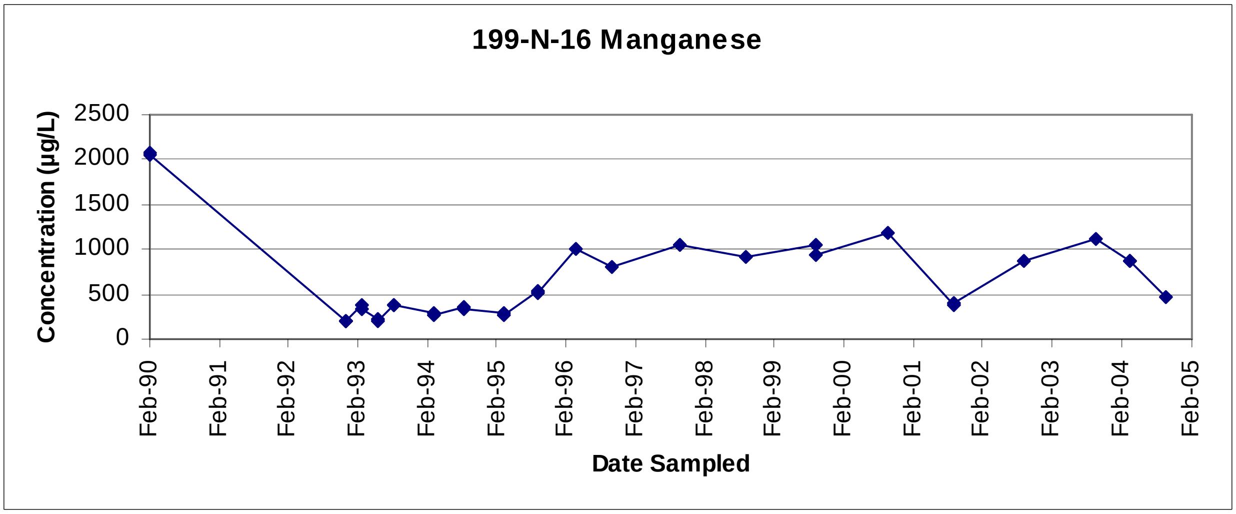

199-N-99A Chromium
Concentration (µg/L)
0
1
2
3
4
5
6
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled

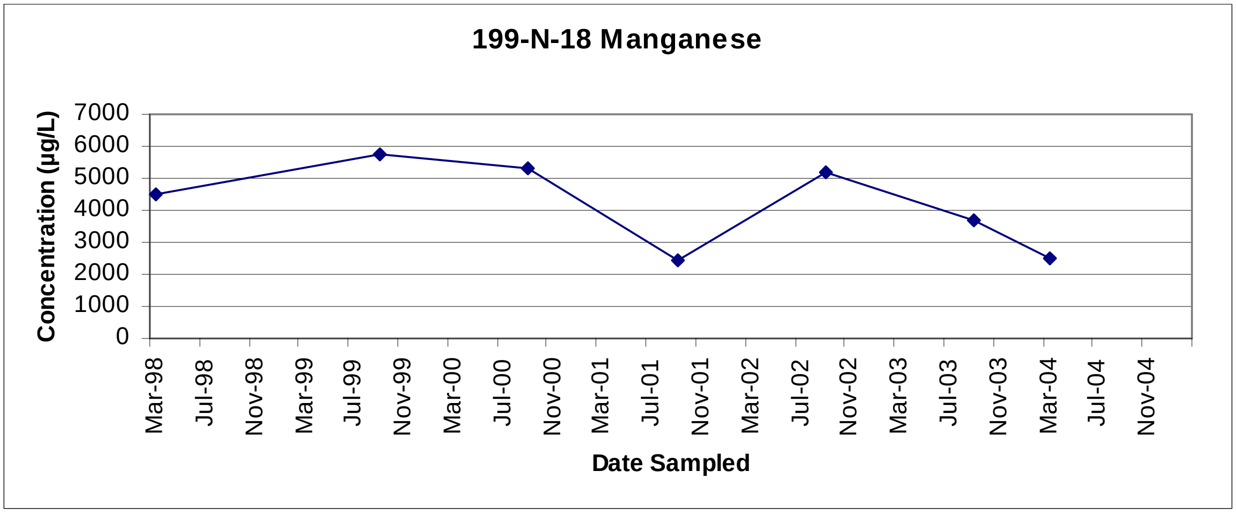

199-N-119 Chromium
Concentration (µg/L)
0.0
1.0
2.0
3.0
4.0
5.0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-N-120 Chromium
Concentration (µg/L)
0.0
1.0
2.0
3.0
4.0
5.0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-N-121 Chromium
Concentration (µg/L)
5.0
4.0
3.0
2.0
1.0
0.0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-N-14 Manganese
Concentration (µg/L)
25
20
15
10
5
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Date Sampled


199-N-16 Manganese
Concentration (µg/L)
2500
2000
1500
1000
500
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Date Sampled


199-N-18 Manganese
Concentration (µg/L)
7000
6000
5000
4000
3000
2000
1000
0
Mar-98
Jul-98
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
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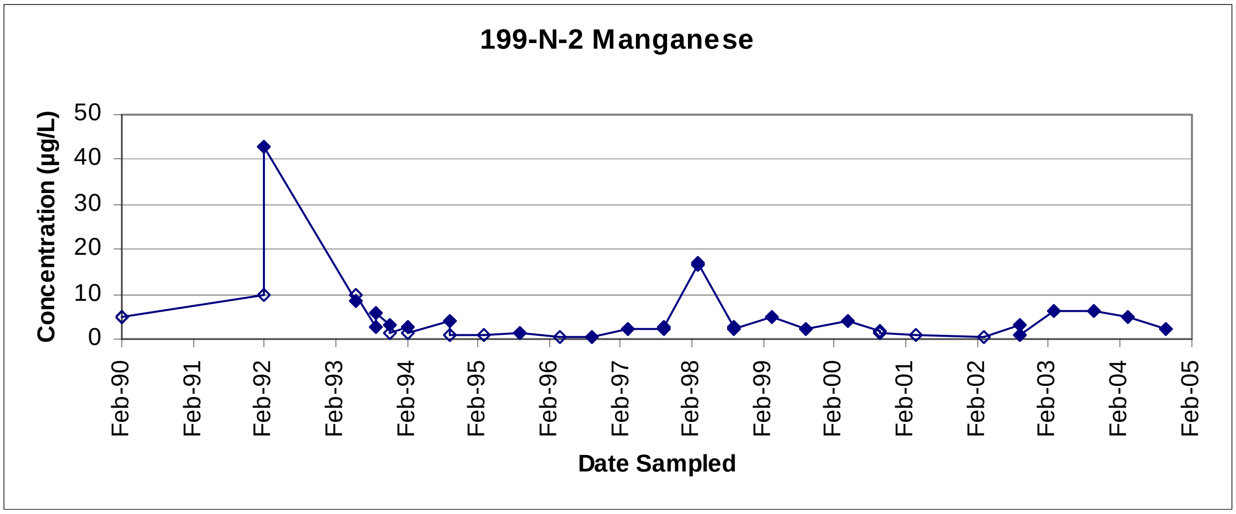
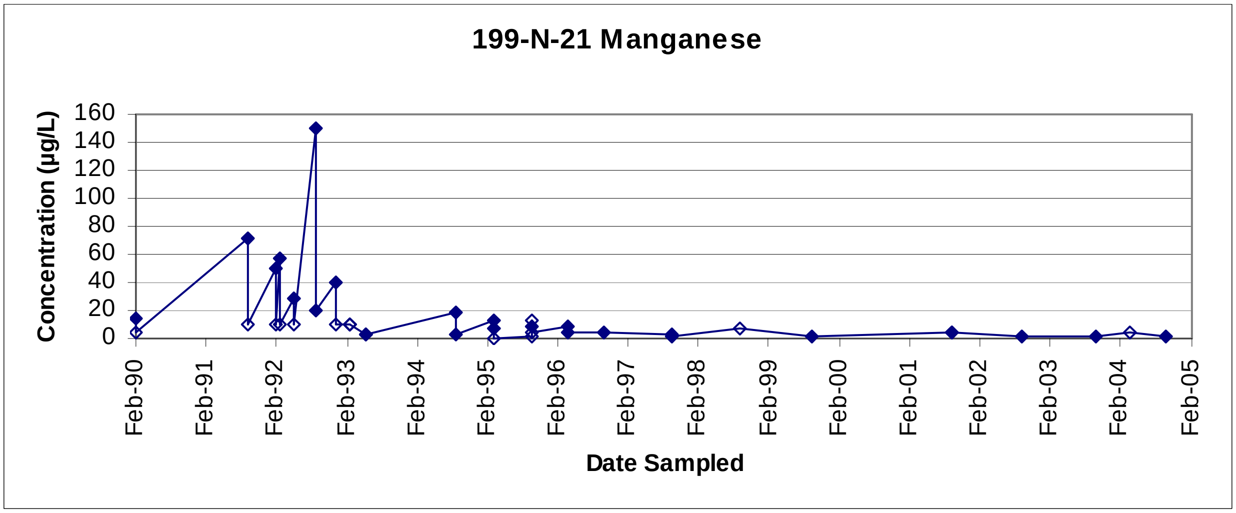
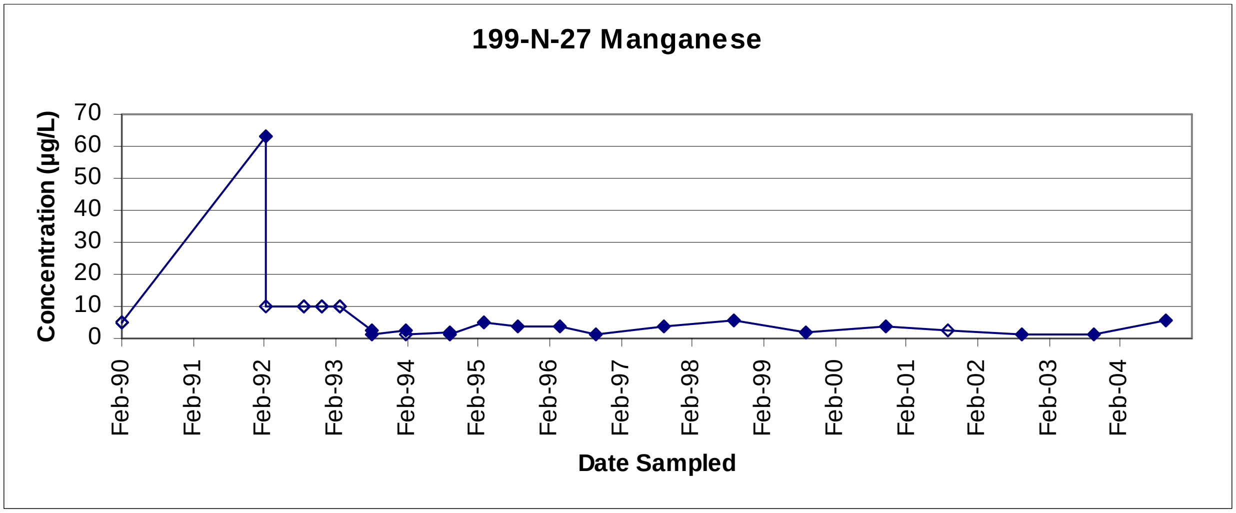
Nov-03
Mar-04
Jul-04
Nov-04
Date Sampled


199-N-2 Manganese
Concentration (µg/L)
50
40
30
20
10
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Date Sampled


199-N-21 Manganese
Concentration (µg/L)
160
140
120
100
80
60
40
20
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Date Sampled


199-N-27 Manganese
Concentration (µg/L)
70
60
50
40
30
20
10
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
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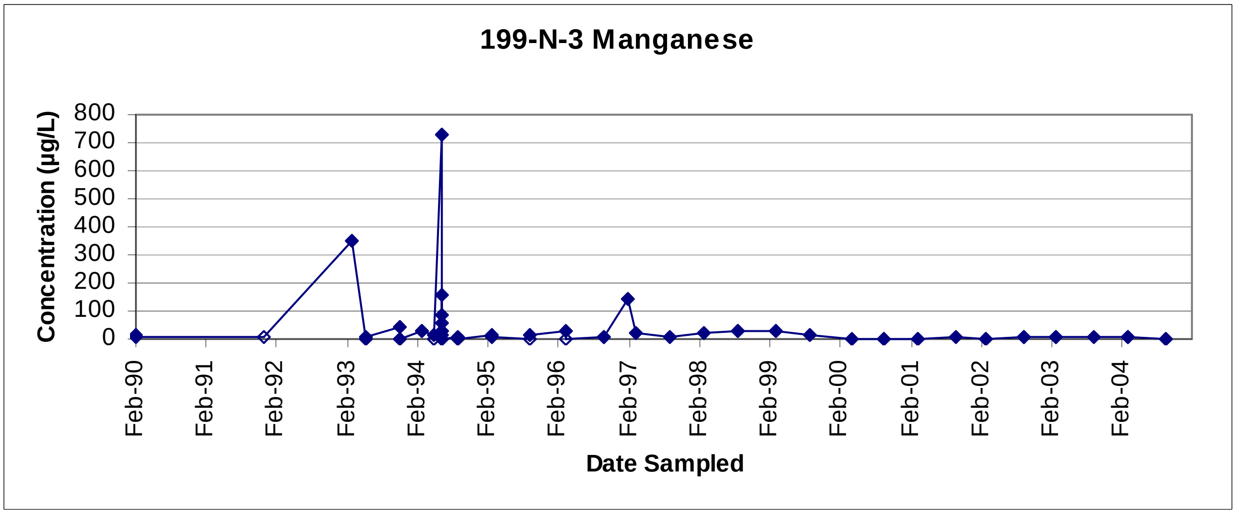
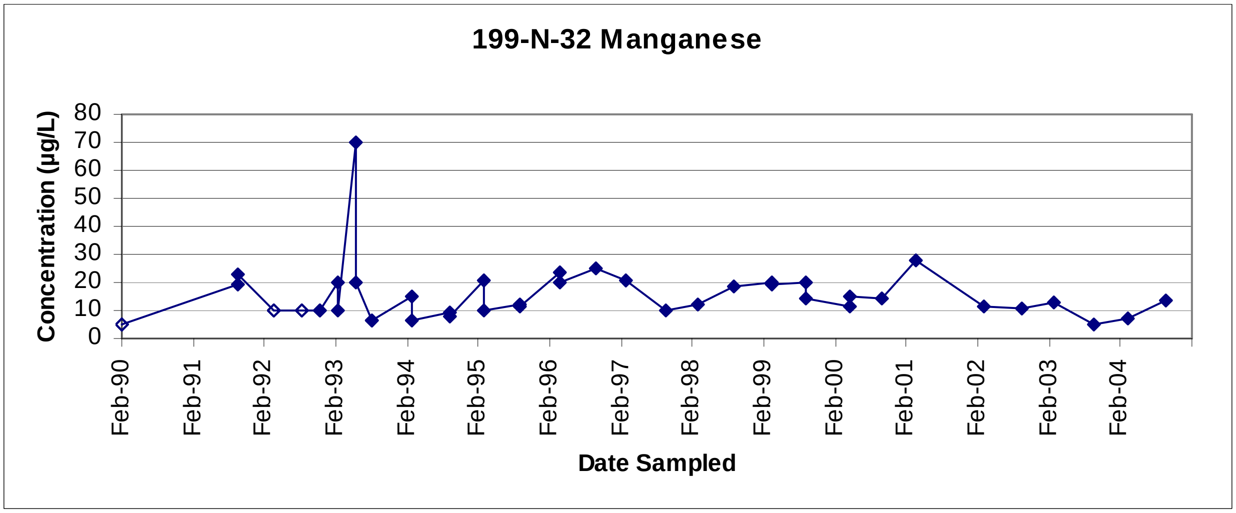
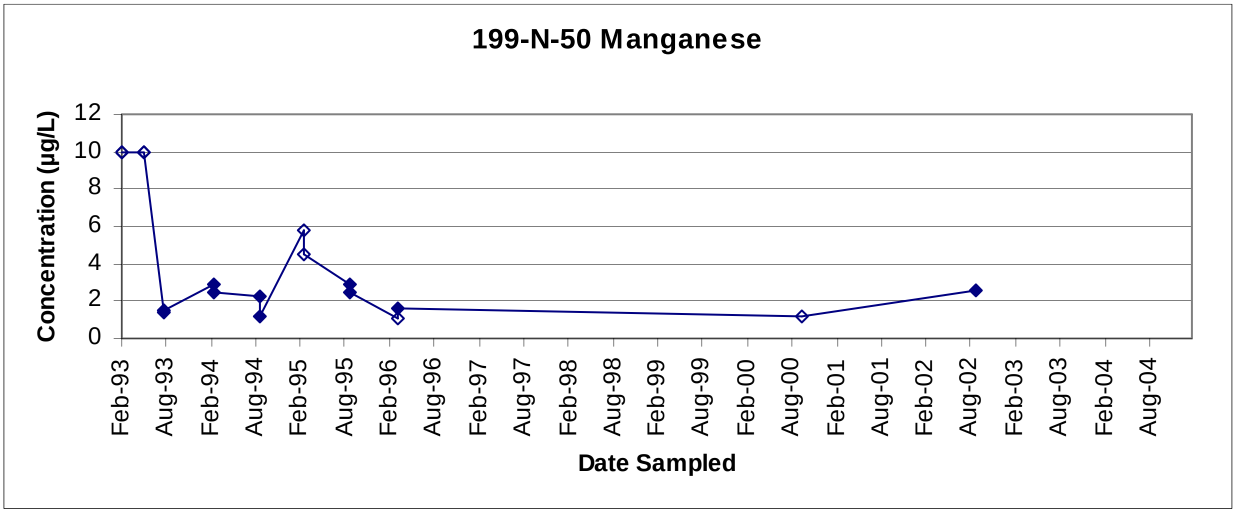
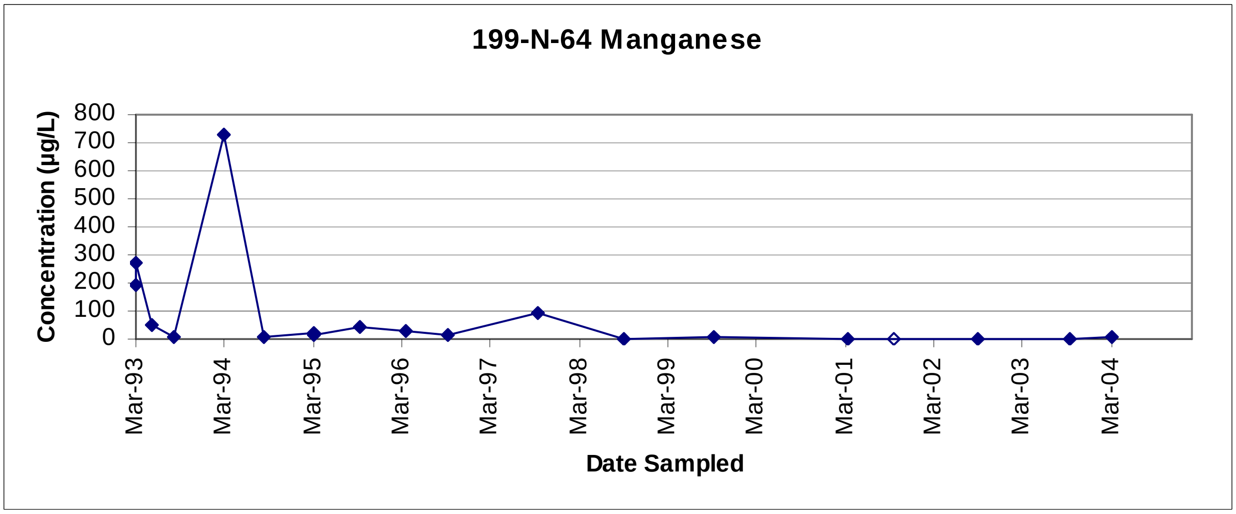
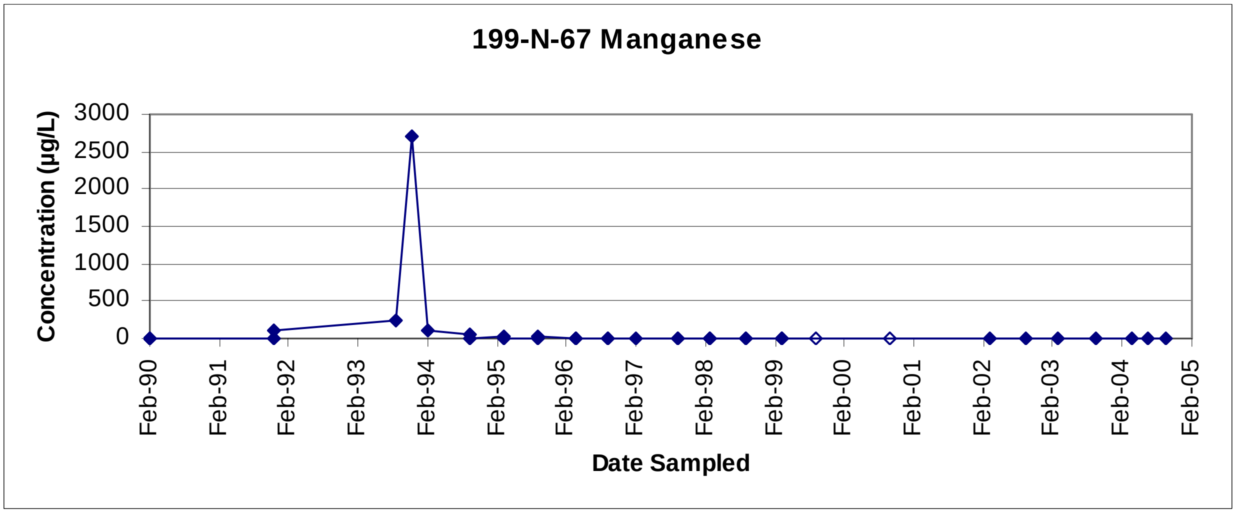
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-3 Manganese
Concentration (µg/L)
800
700
600
500
400
300
200
100
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-32 Manganese
Concentration (µg/L)
80
70
60
50
40
30
20
10
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-50 Manganese
Concentration (µg/L)
0
2
4
6
8
10
12
Feb-93
Aug-93
Feb-94
Aug-94
Feb-95
Aug-95
Feb-96
Aug-96
Feb-97
Aug-97
Feb-98
Aug-98
Feb-99
Aug-99
Feb-00
Aug-00
Feb-01
Aug-01
Feb-02
Aug-02
Feb-03
Aug-03
Feb-04
Aug-04
Date Sampled


199-N-64 Manganese
Concentration (µg/L)
0
100
200
300
400
500
600
700
800
Mar-93
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Date Sampled


199-N-67 Manganese
Concentration (µg/L)
0
500
1000
1500
2000
2500
3000
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
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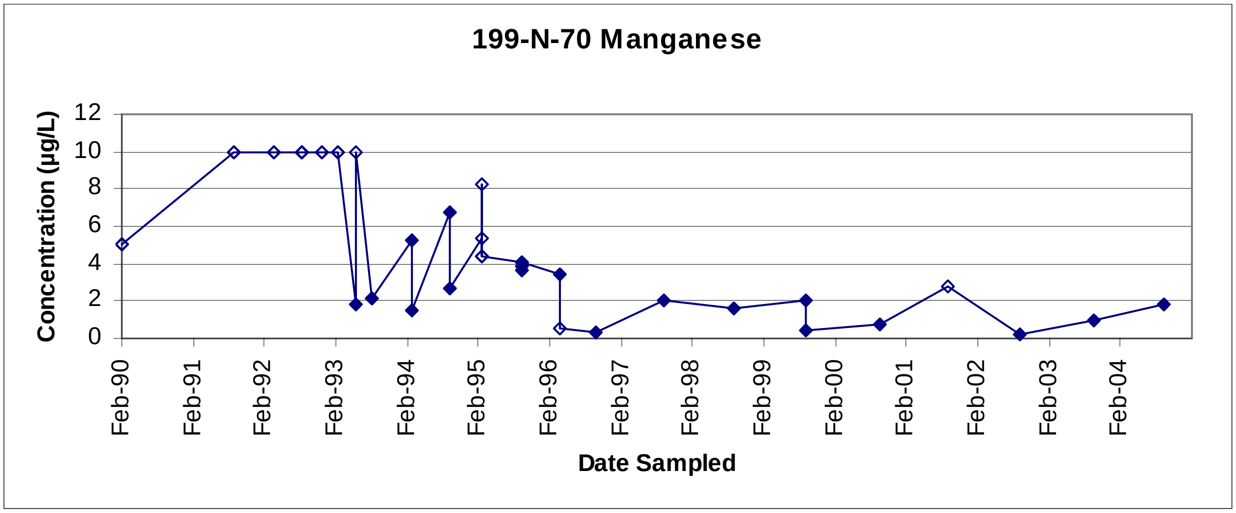
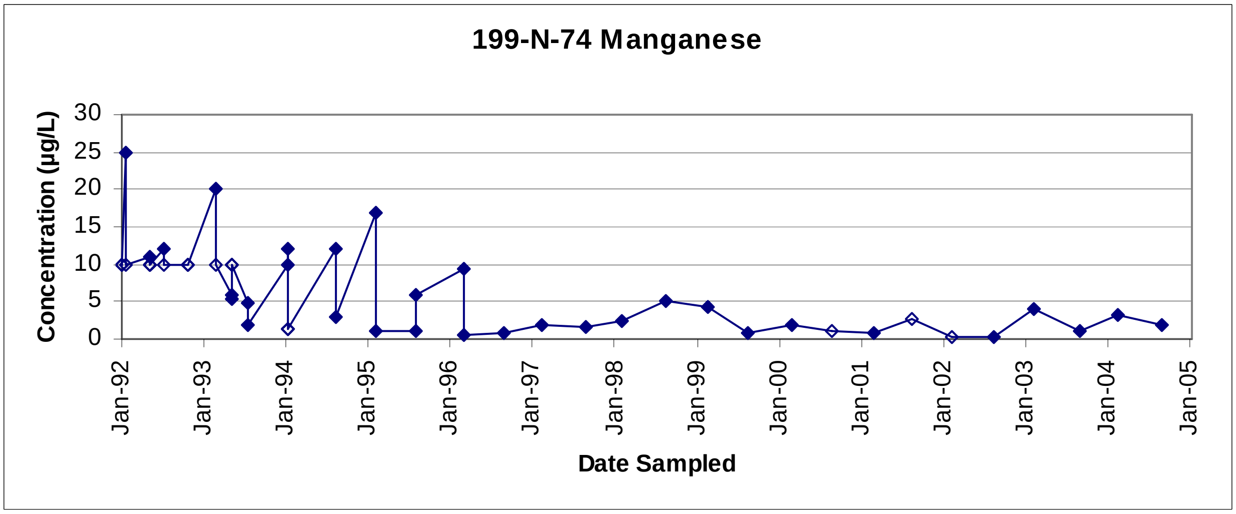
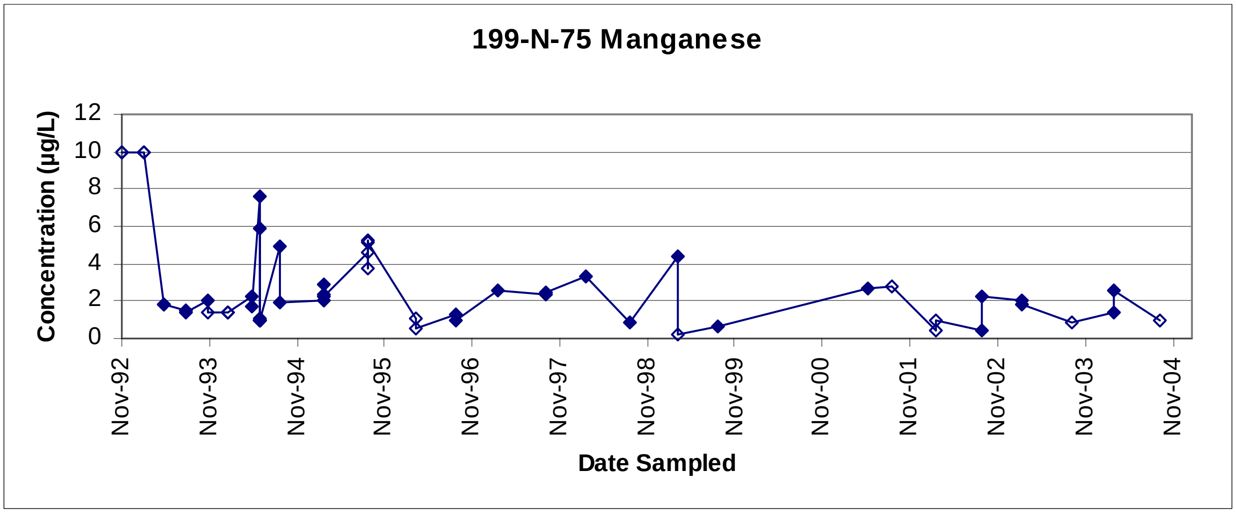
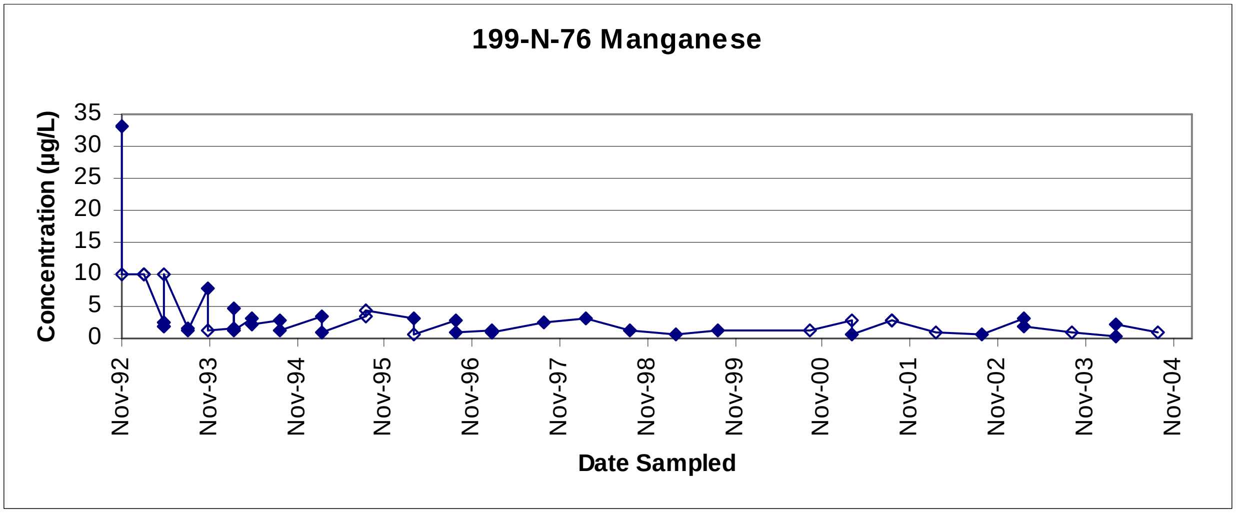
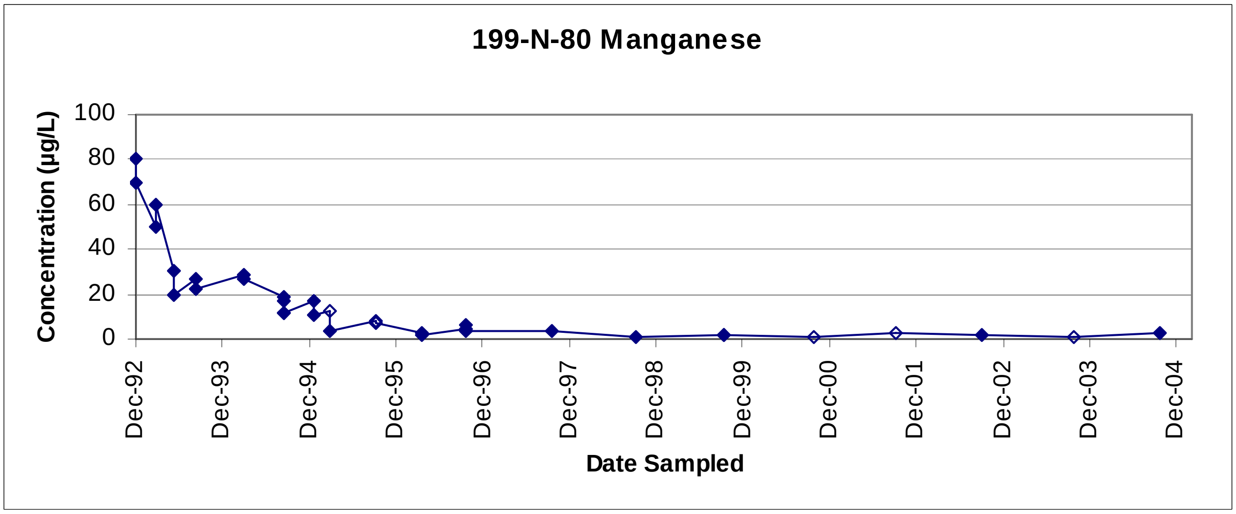
Feb-02
Feb-03
Feb-04
Feb-05
Date Sampled

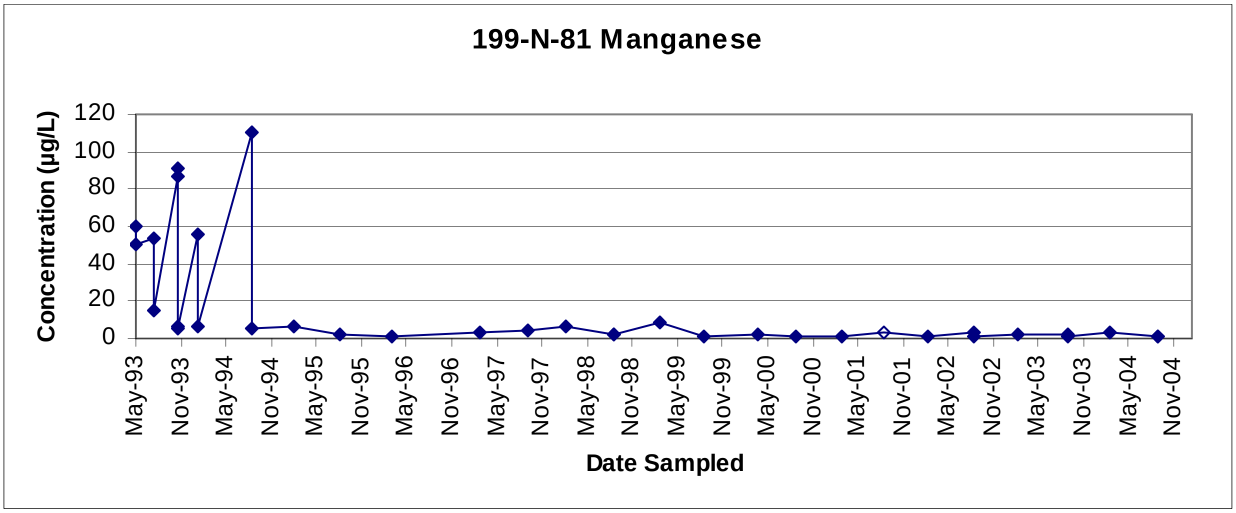

199-N-70 Manganese
Concentration (µg/L)
12
10
8
6
4
2
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

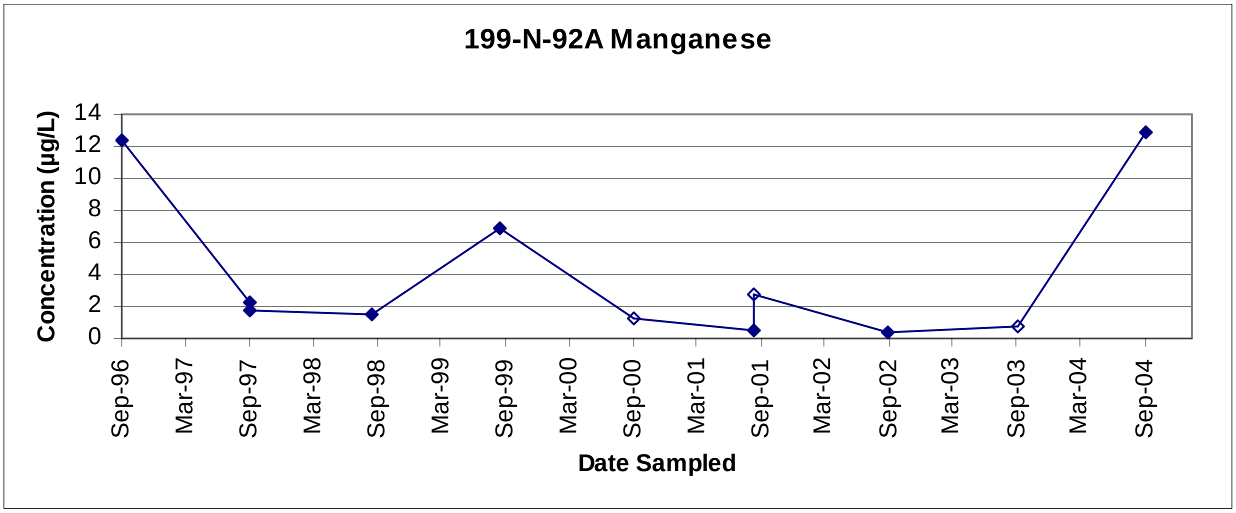

199-N-74 Manganese
Concentration (µg/L)
30
25
20
15
10
5
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Date Sampled

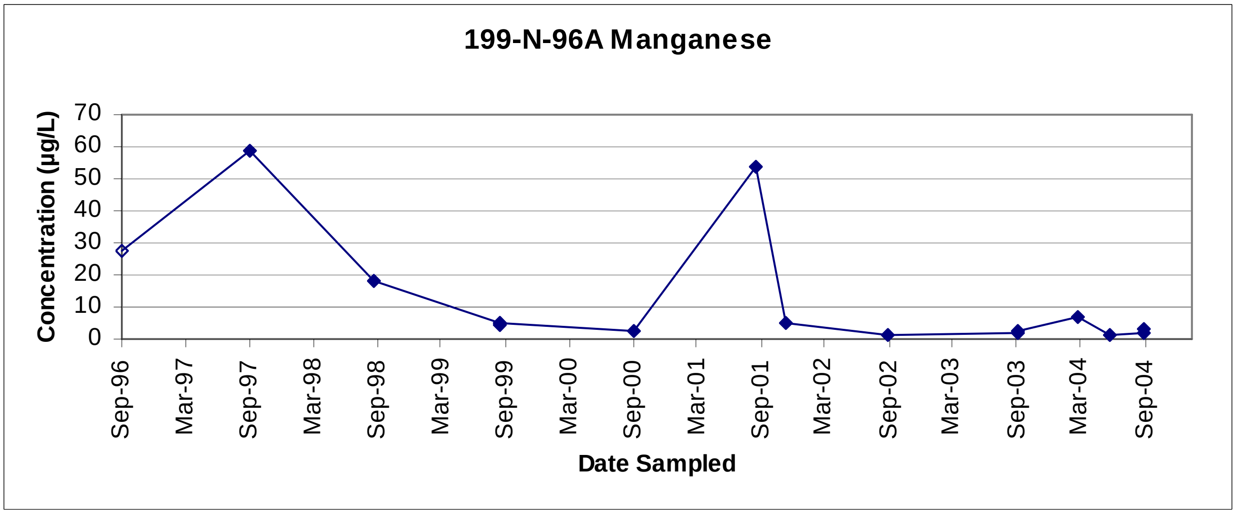

199-N-75 Manganese
Concentration (µg/L)
12
10
8
6
4
2
0
Nov-92
Nov-93
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00
Nov-01
Nov-02
Nov-03
Nov-04
Date Sampled

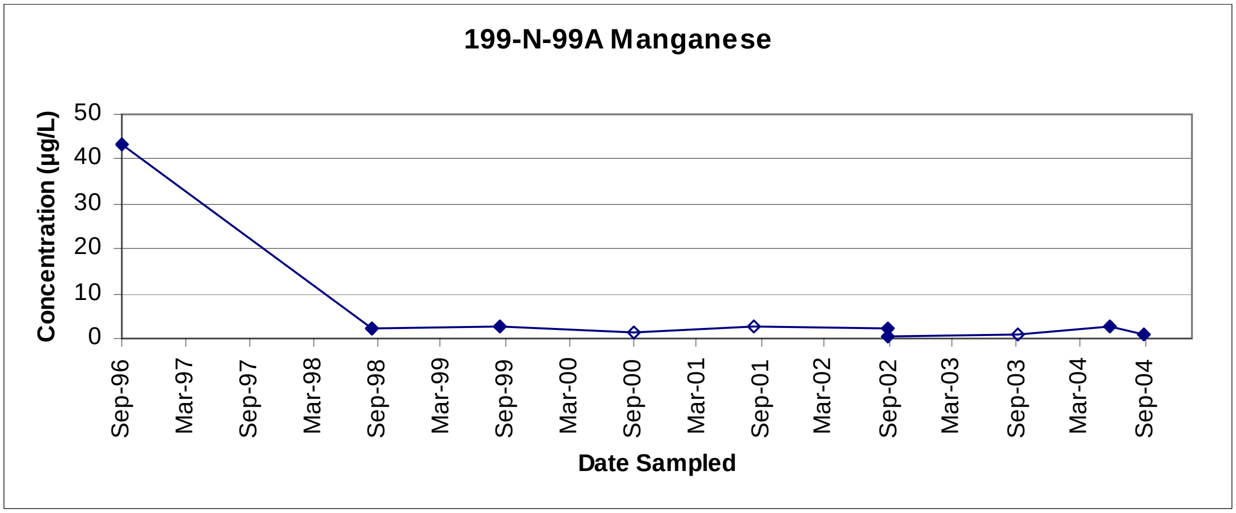

199-N-76 Manganese
Concentration (µg/L)
0
5
10
15
20
25
30
35
Nov-92
Nov-93
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00
Nov-01
Nov-02
Nov-03
Nov-04
Date Sampled

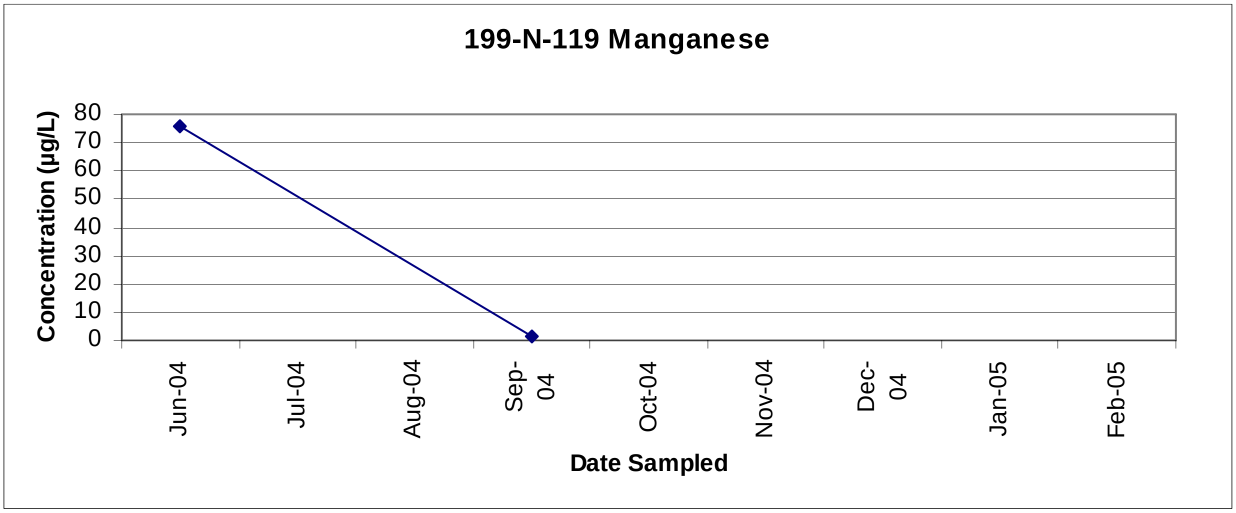

199-N-80 Manganese
Concentration (µg/L)
0
20
40
60
80
100
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Date Sampled

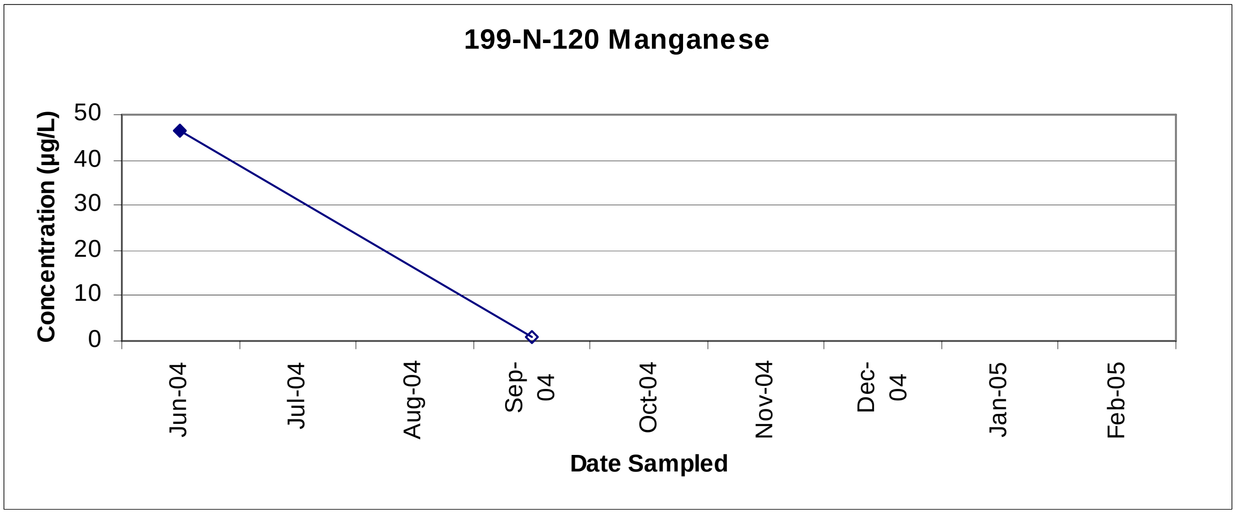

199-N-81 Manganese
Concentration (µg/L)
0
20
40
60
80
100
120
May-93
Nov-93
May-94
Nov-94
May-95
Nov-95
May-96
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
Date Sampled

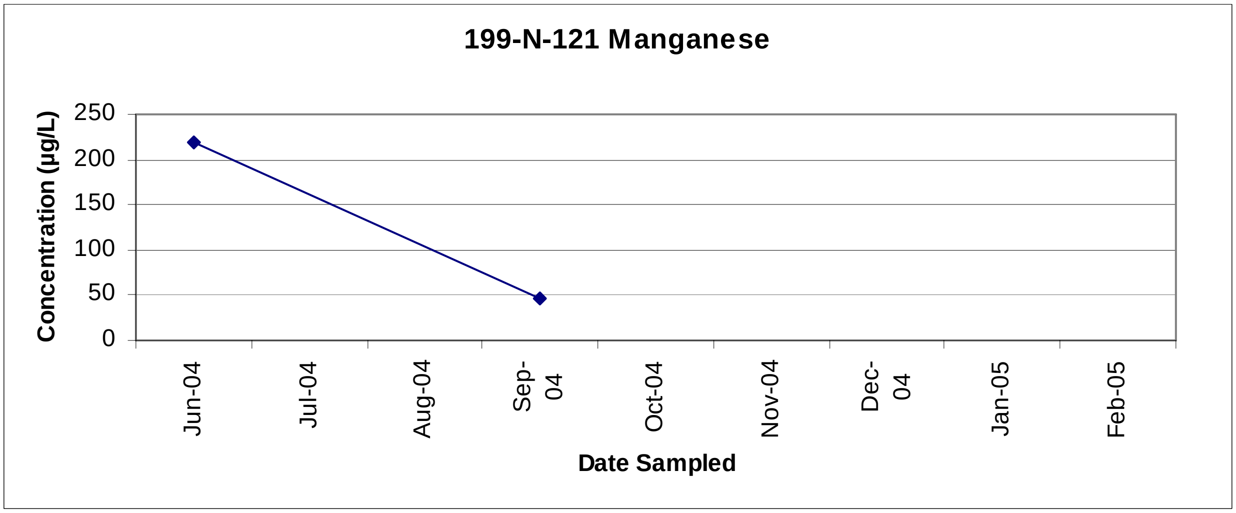

199-N-92A Manganese
Concentration (µg/L)
0
2
4
6
8
10
12
14
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled

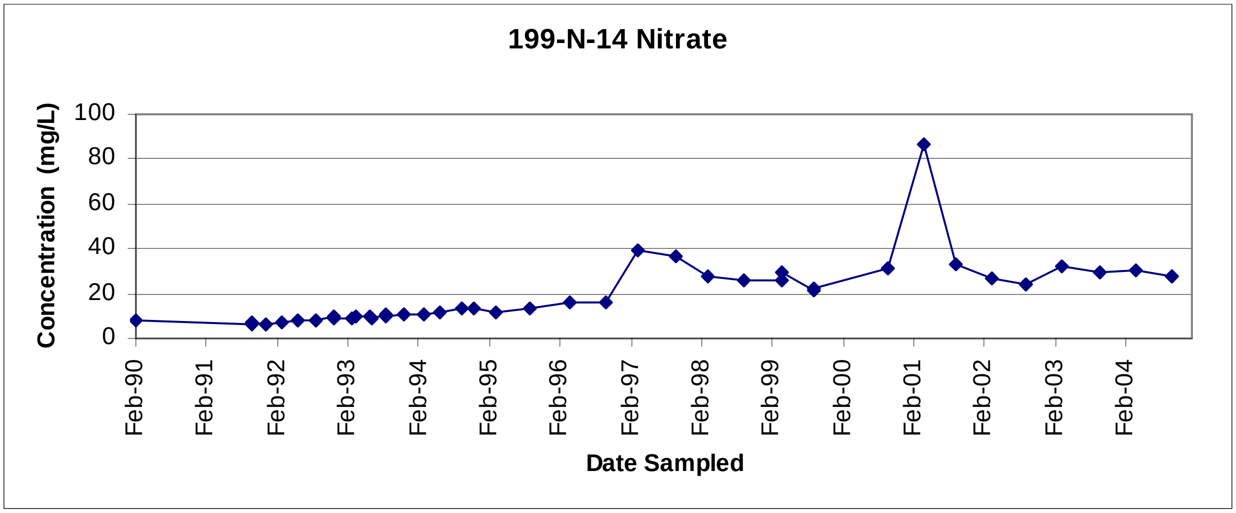

199-N-96A Manganese
Concentration (µg/L)
0
10
20
30
40
50
60
70
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled


199-N-99A Manganese
Concentration (µg/L)
0
10
20
30
40
50
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled


199-N-119 Manganese
Concentration (µg/L)
80
70
60
50
40
30
20
10
0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-N-120 Manganese
Concentration (µg/L)
50
40
30
20
10
0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-N-121 Manganese
Concentration (µg/L)
250
200
150
100
50
0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Date Sampled


199-N-14 Nitrate
Concentration (mg/L)
0
20
40
60
80
100
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
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Feb-04
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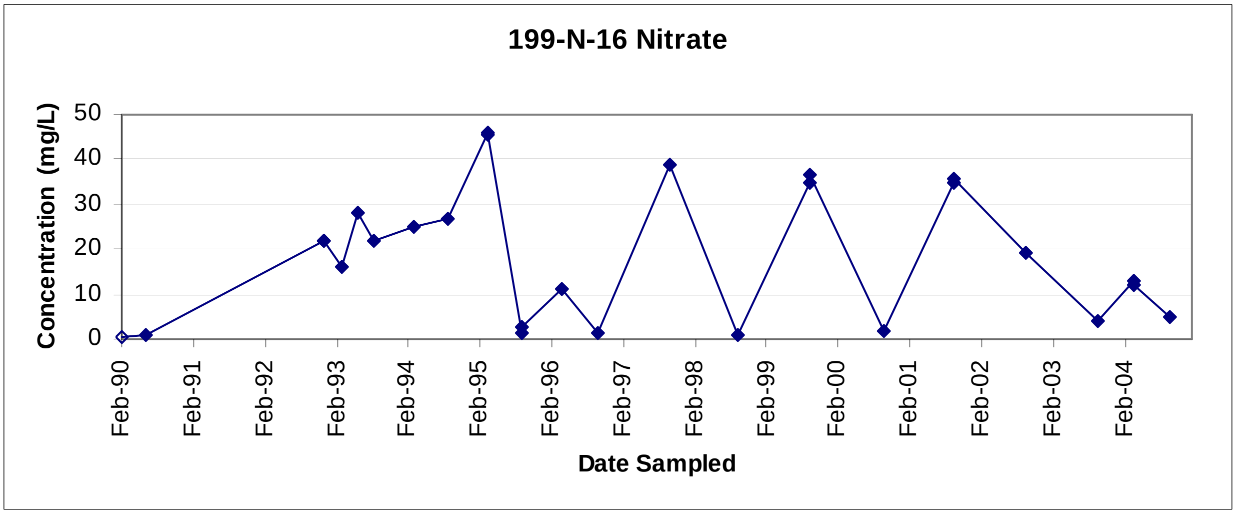
199-N-16 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
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Feb-01
Feb-02
Feb-03
Feb-04
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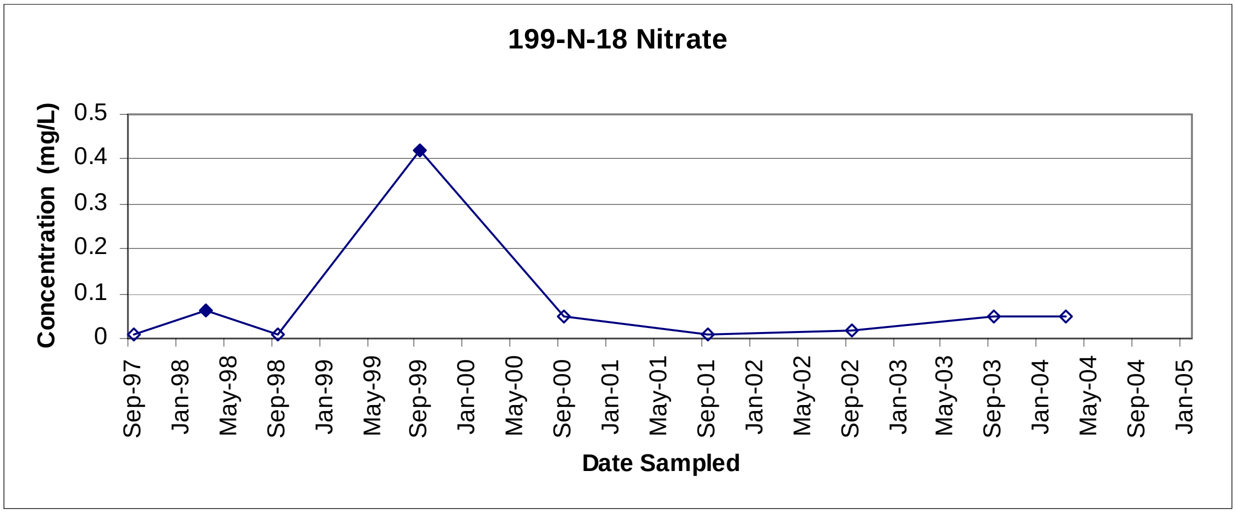
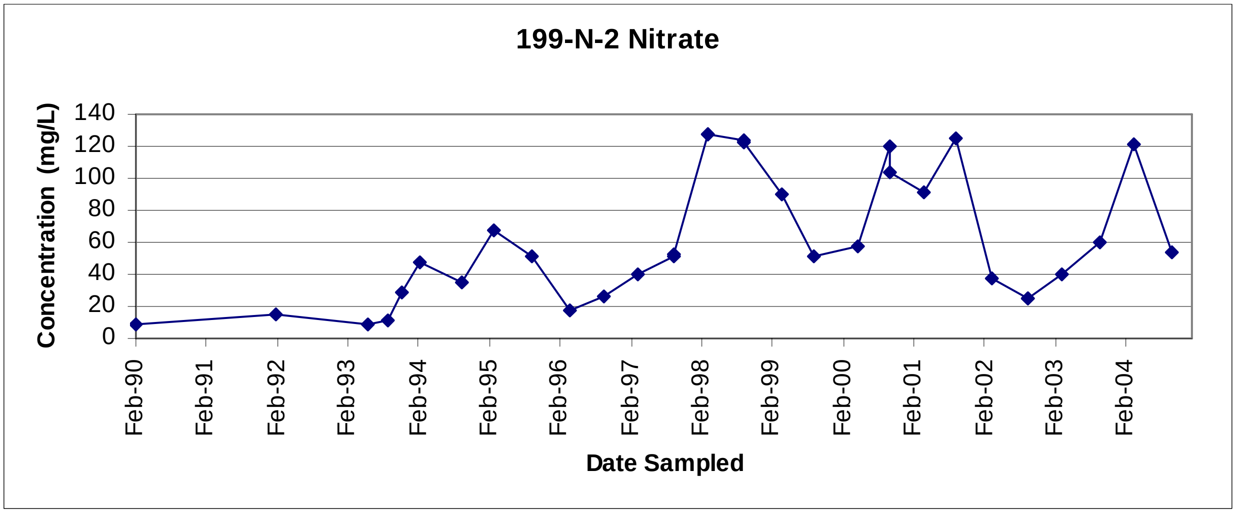

199-N-18 Nitrate
Concentration (mg/L)
0
0.1
0.2
0.3
0.4
0.5
Sep-97
Jan-98
May-98
Sep-98
Jan-99
May-99
Sep-99
Jan-00
May-00
Sep-00
Jan-01
May-01
Sep-01
Jan-02
May-02
Sep-02
Jan-03
May-03
Sep-03
Jan-04
May-04
Sep-04
Jan-05
Date Sampled


199-N-2 Nitrate
Concentration (mg/L)
0
20
40
60
80
100
120
140
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
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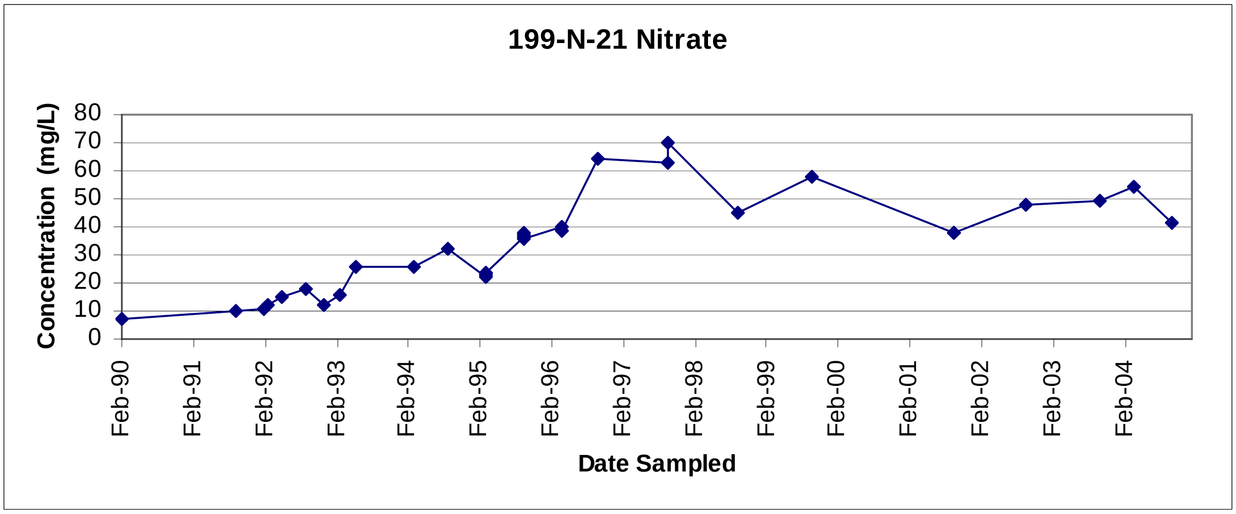
Feb-04
Date Sampled


199-N-21 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
60
70
80
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
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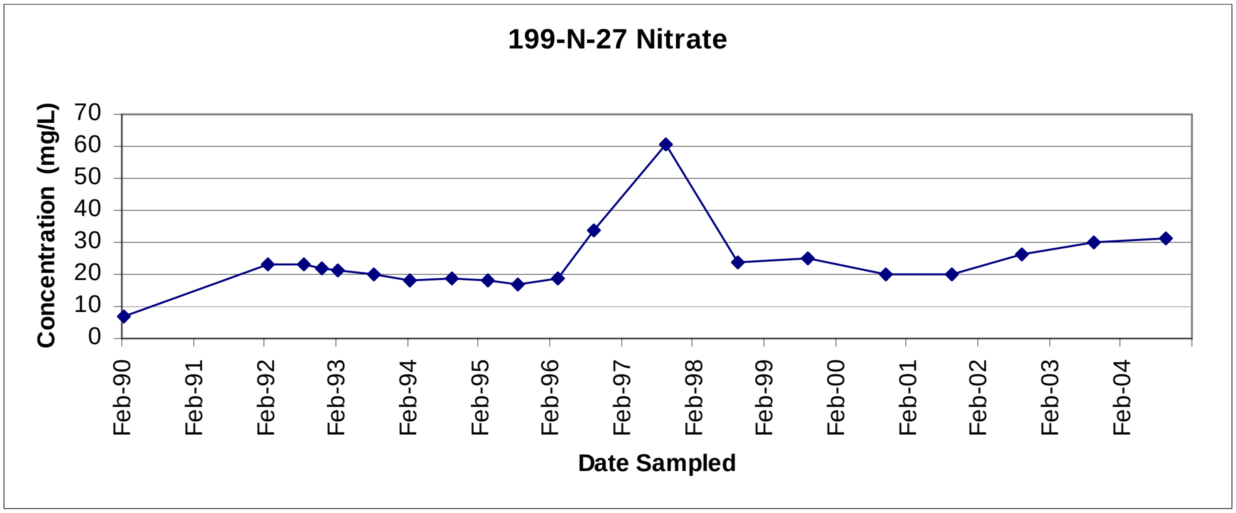
199-N-27 Nitrate
Concentration (mg/L)
0
10
20
30
40
50
60
70
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
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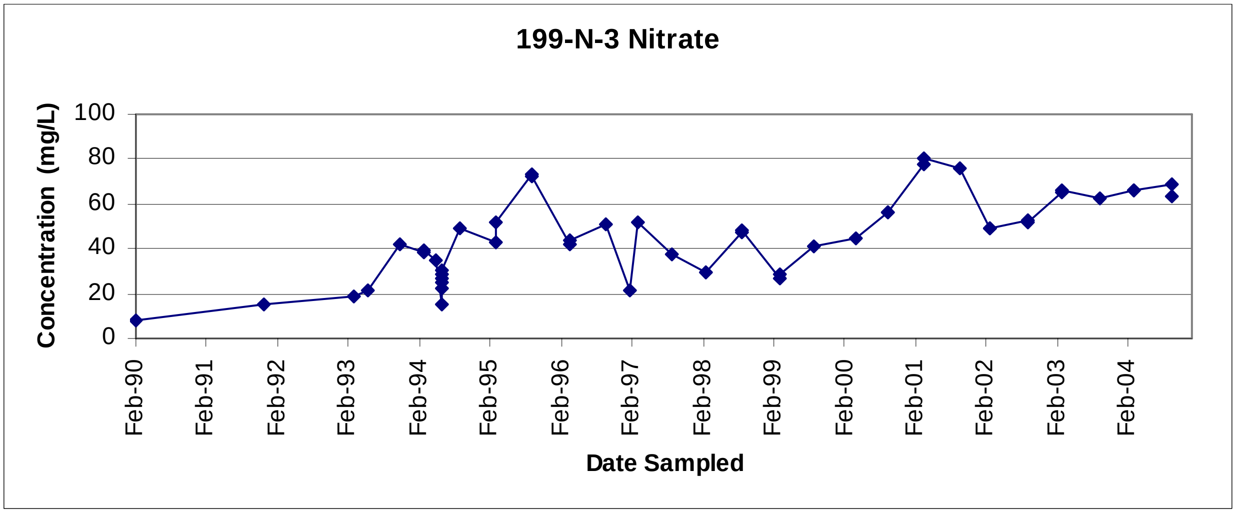
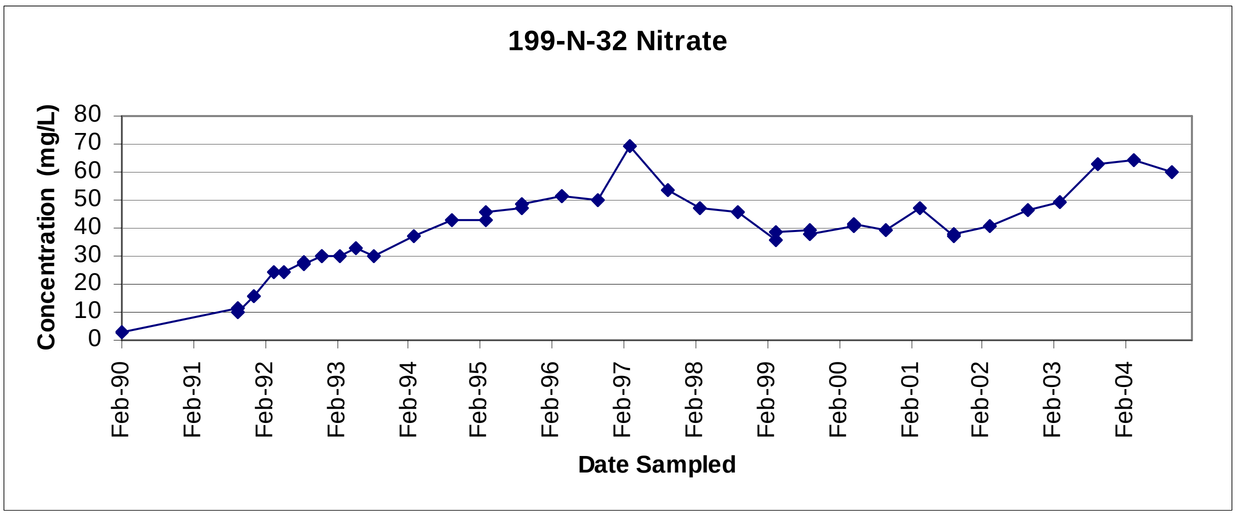
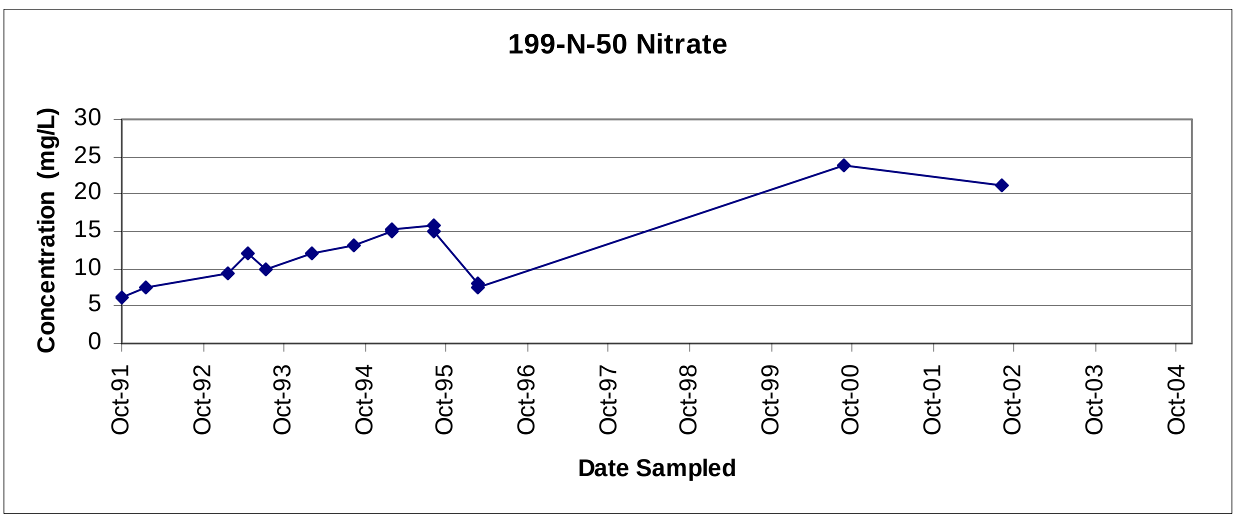
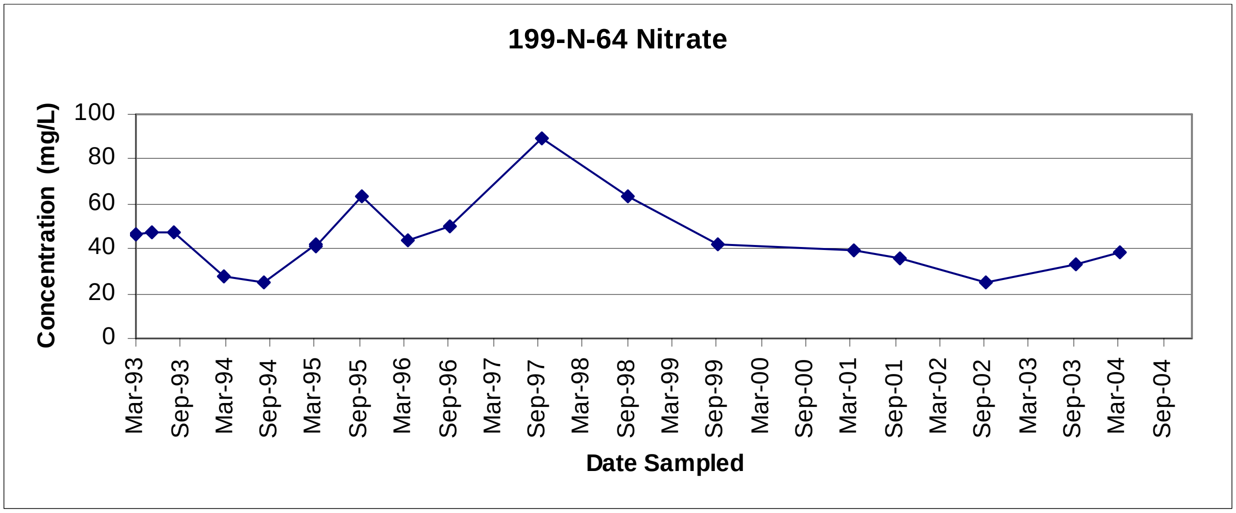
Feb-03
Feb-04
Date Sampled


199-N-3 Nitrate
Concentration (mg/L)
100
80
60
40
20
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-32 Nitrate
Concentration (mg/L)
80
70
60
50
40
30
20
10
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-50 Nitrate
Concentration (mg/L)
30
25
20
15
10
5
0
Oct-91
Oct-92
Oct-93
Oct-94
Oct-95
Oct-96
Oct-97
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
Oct-03
Oct-04
Date Sampled


199-N-64 Nitrate
Concentration (mg/L)
100
80
60
40
20
0
Mar-93
Sep-93
Mar-94
Sep-94
Mar-95
Sep-95
Mar-96
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
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Mar-02
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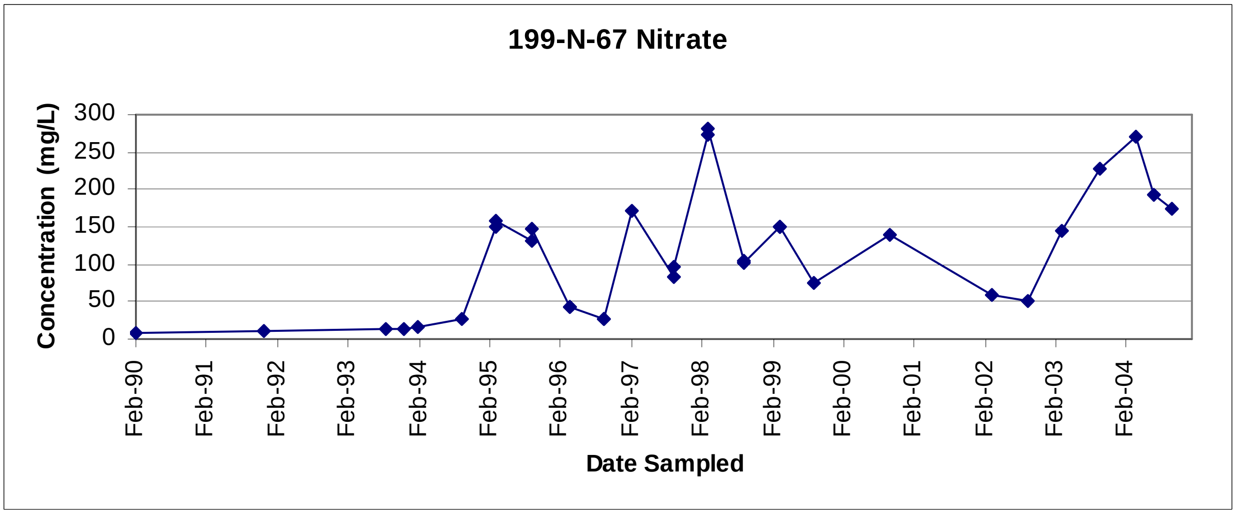
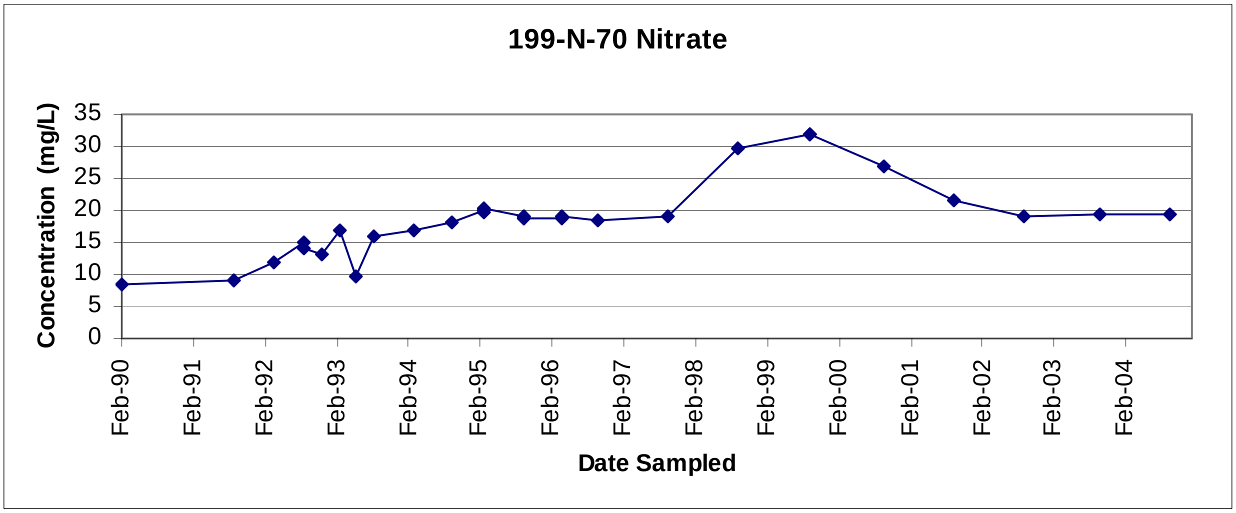
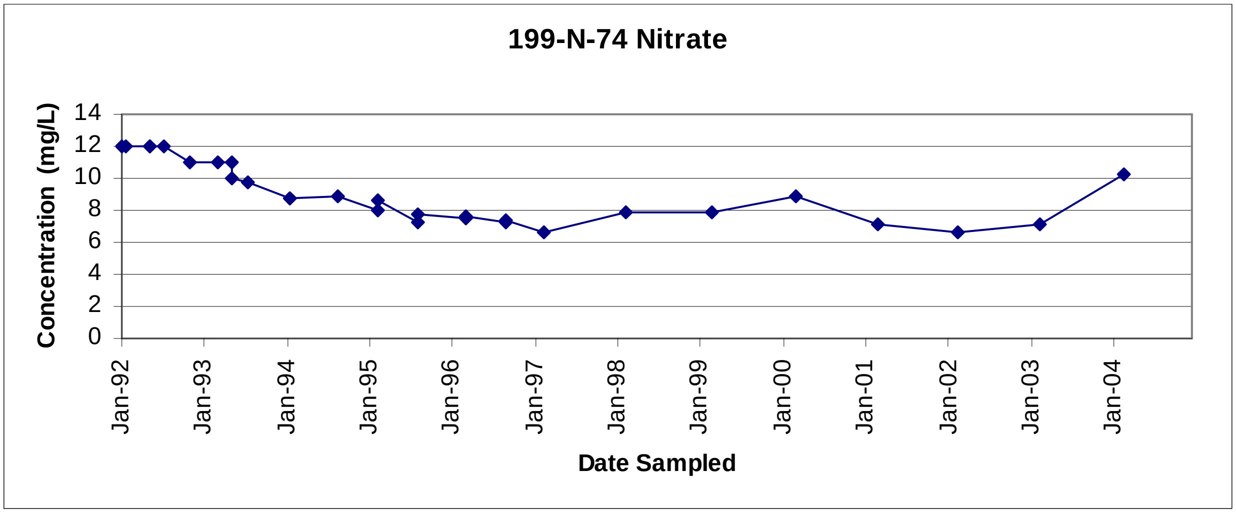
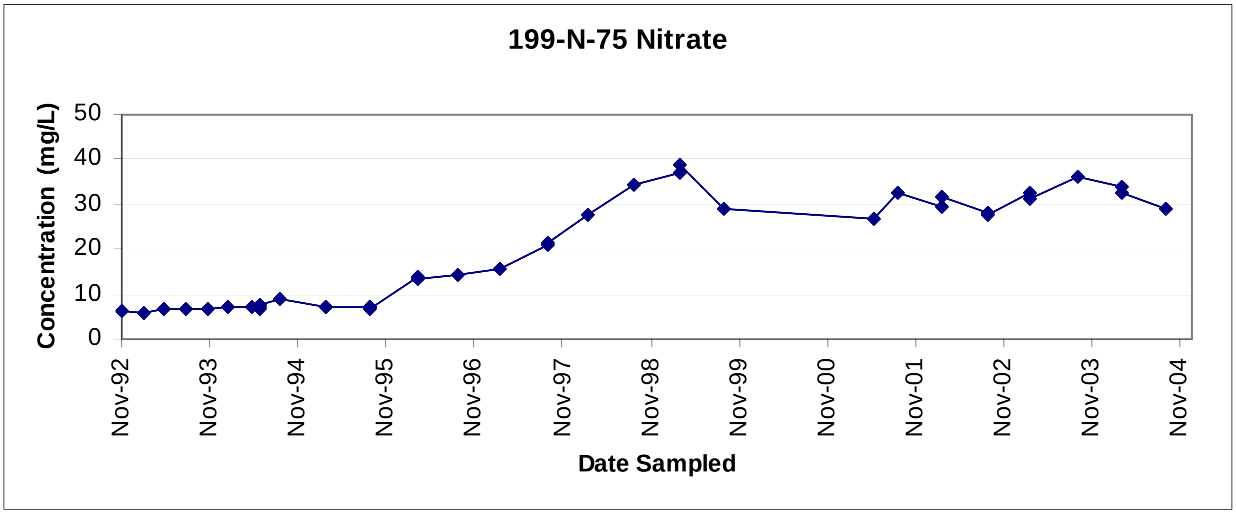
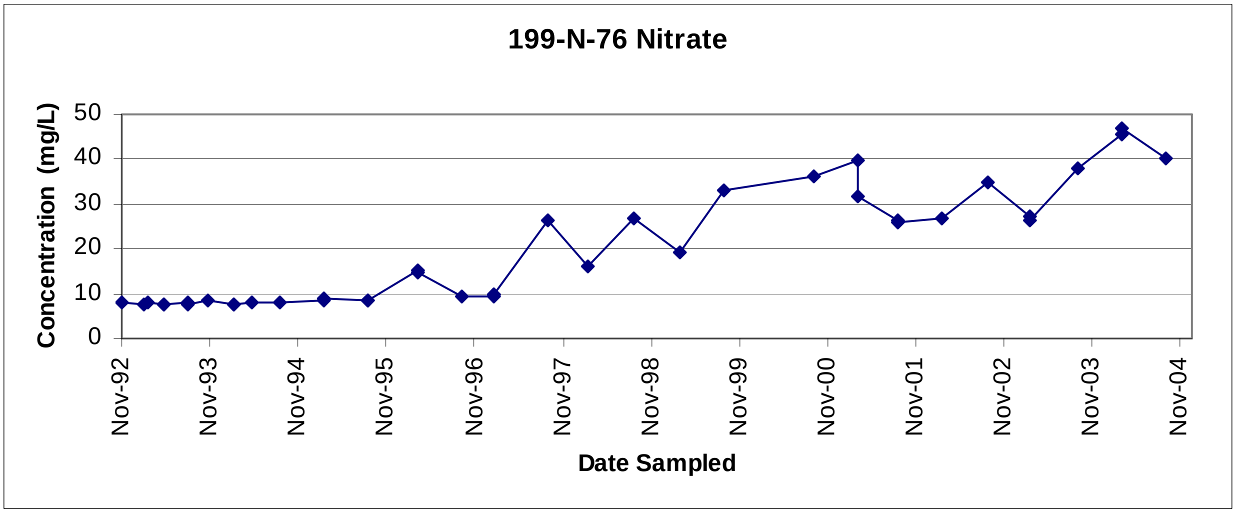
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled

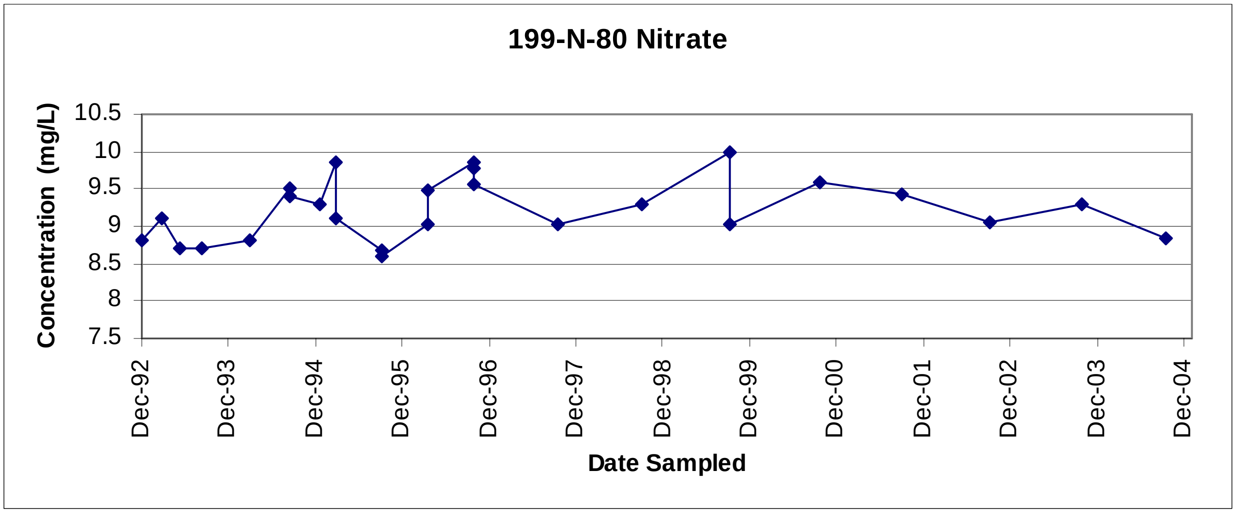

199-N-67 Nitrate
Concentration (mg/L)
300
250
200
150
100
50
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-70 Nitrate
Concentration (mg/L)
35
30
25
20
15
10
5
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-74 Nitrate
Concentration (mg/L)
14
12
10
8
6
4
2
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Date Sampled


199-N-75 Nitrate
Concentration (mg/L)
50
40
30
20
10
0
Nov-92
Nov-93
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00
Nov-01
Nov-02
Nov-03
Nov-04
Date Sampled


199-N-76 Nitrate
Concentration (mg/L)
50
40
30
20
10
0
Nov-92
Nov-93
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00
Nov-01
Nov-02
Nov-03
Nov-04
Date Sampled


199-N-80 Nitrate
Concentration (mg/L)
10.5
10
9.5
9
8.5
8
7.5
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
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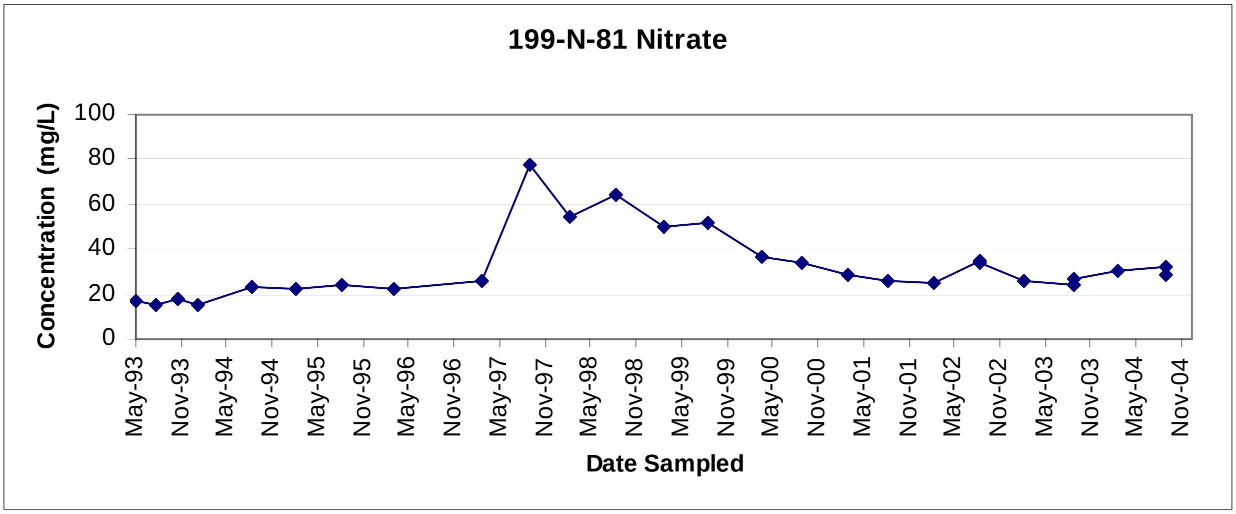
Dec-02
Dec-03
Dec-04
Date Sampled


199-N-81 Nitrate
Concentration (mg/L)
100
80
60
40
20
0
May-93
Nov-93
May-94
Nov-94
May-95
Nov-95
May-96
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
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Nov-00
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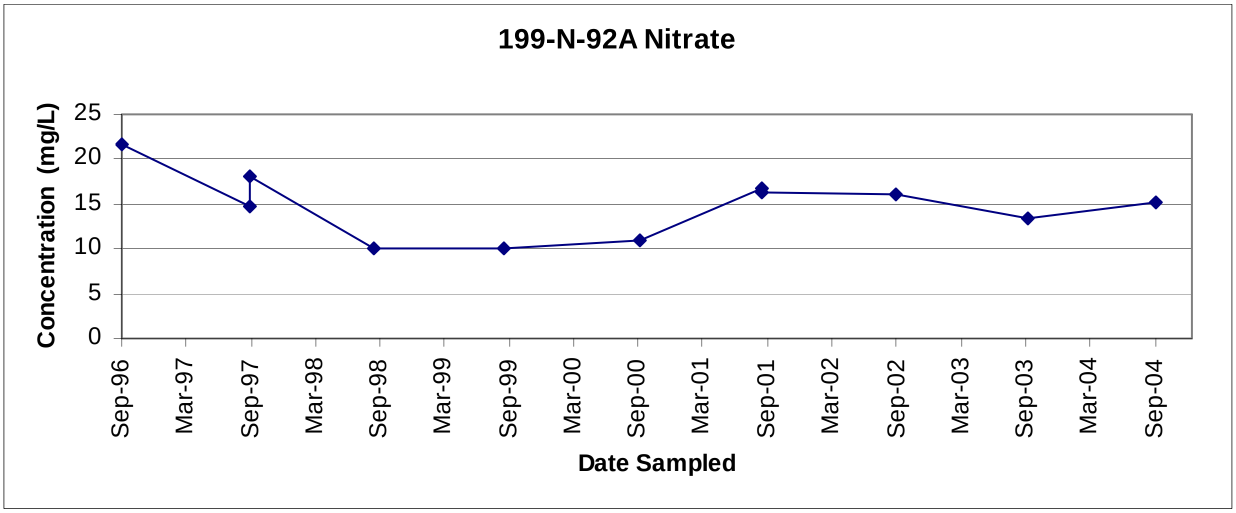
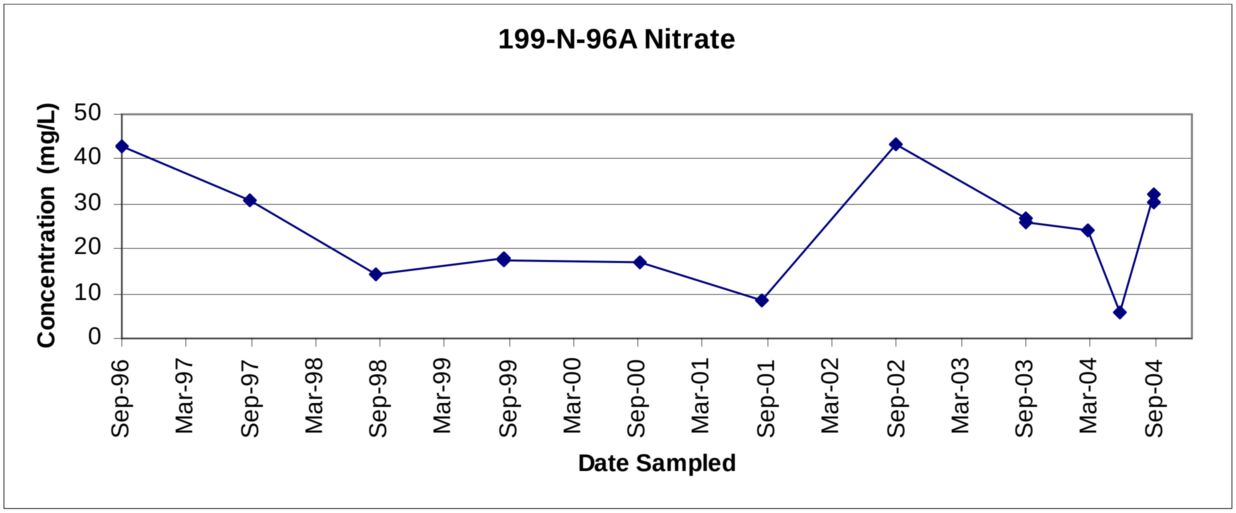
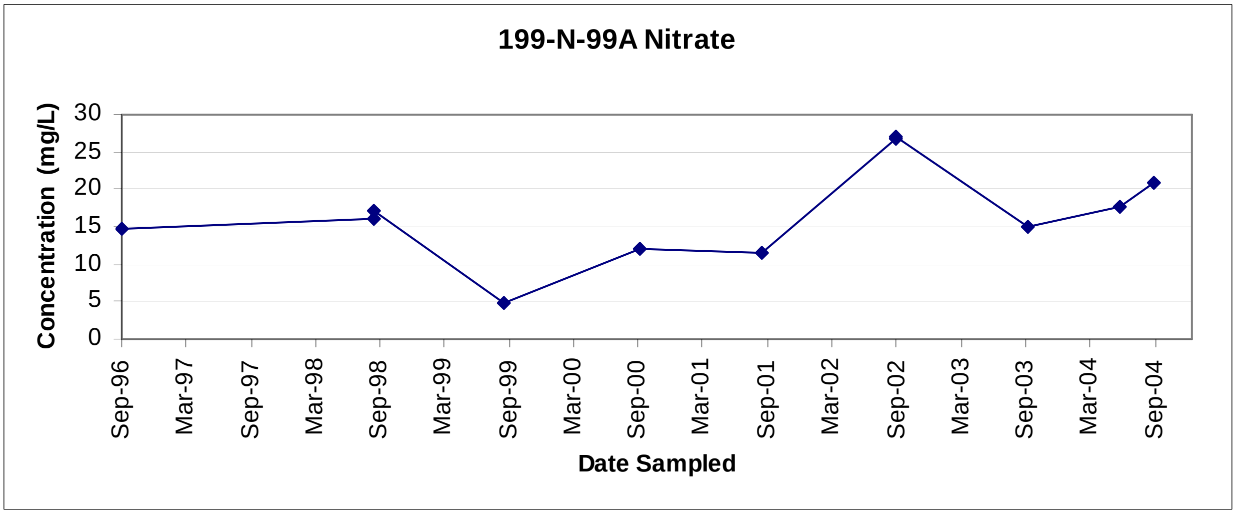
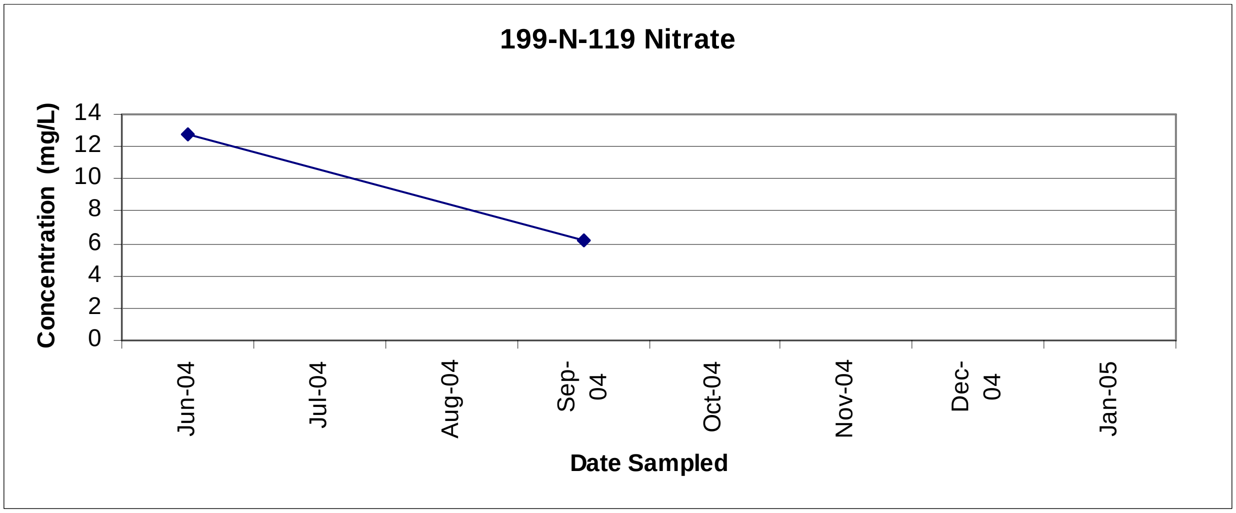
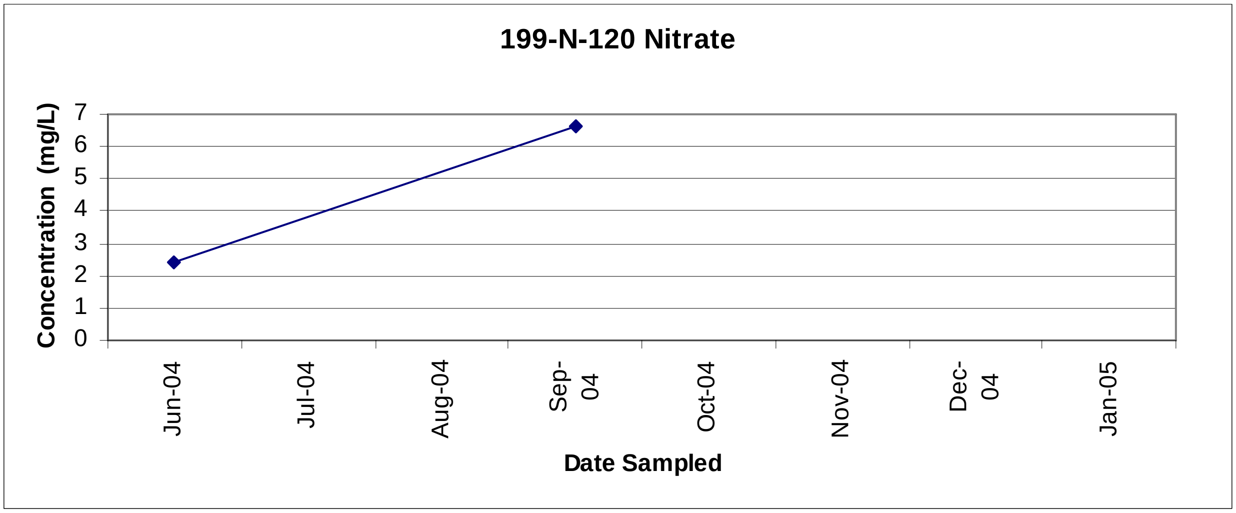
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
Date Sampled

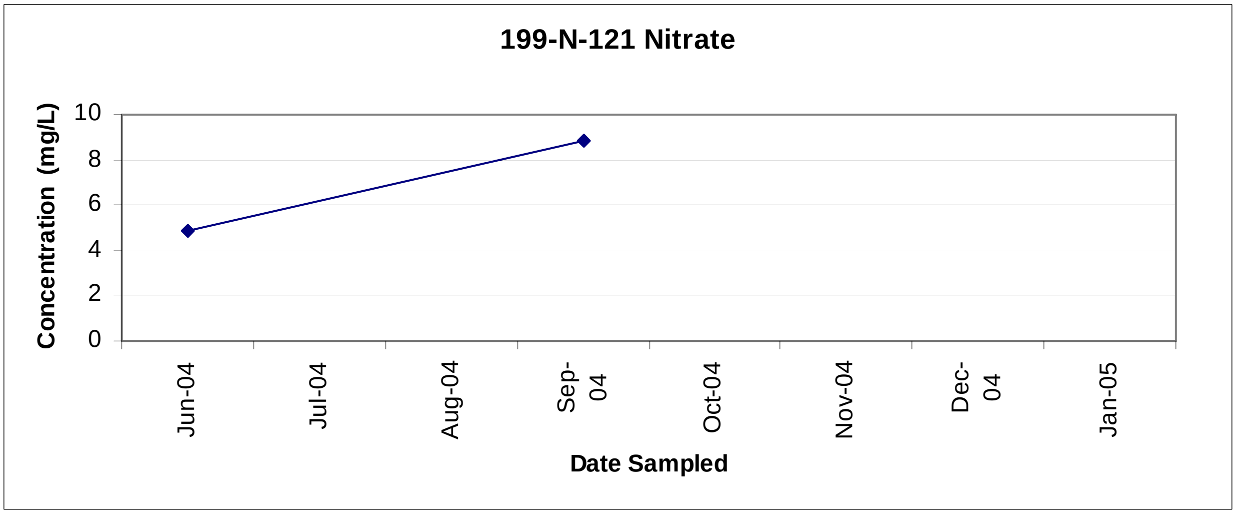

199-N-92A Nitrate
Concentration (mg/L)
25
20
15
10
5
0
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled

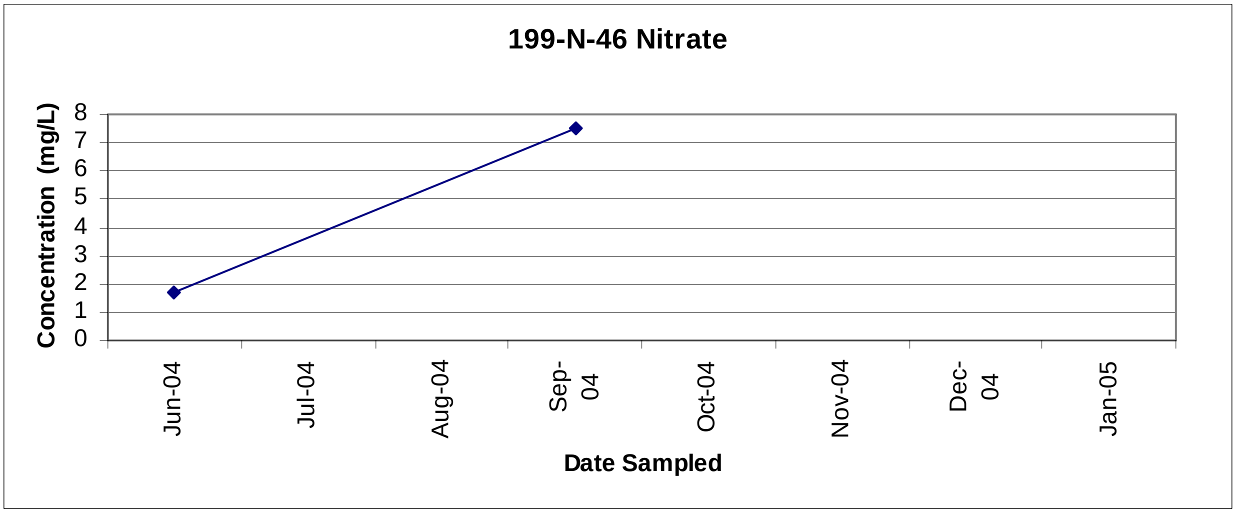

199-N-96A Nitrate
Concentration (mg/L)
50
40
30
20
10
0
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled

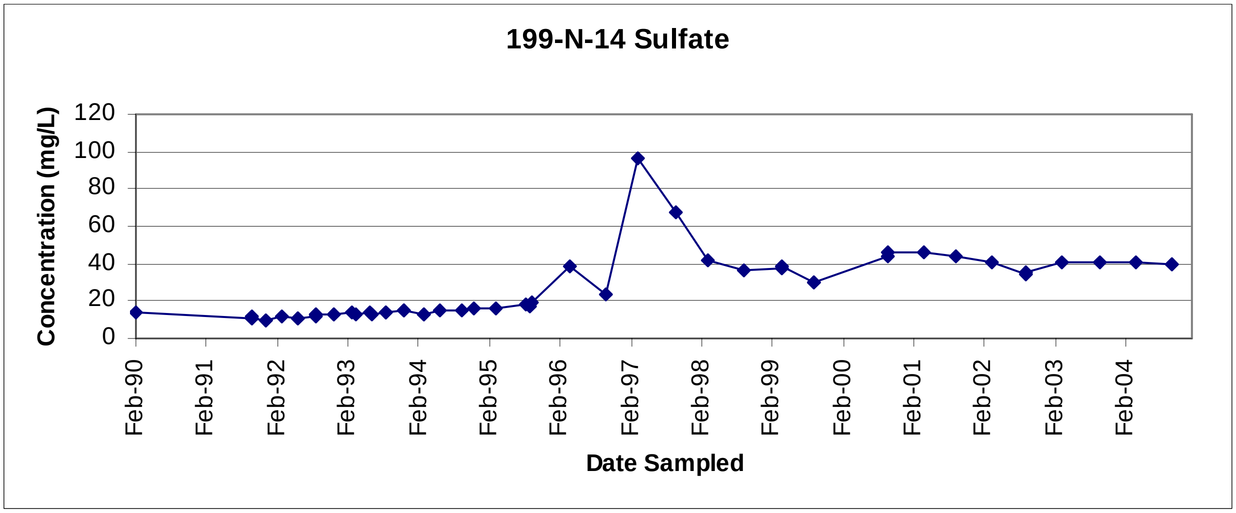

199-N-99A Nitrate
Concentration (mg/L)
30
25
20
15
10
5
0
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled

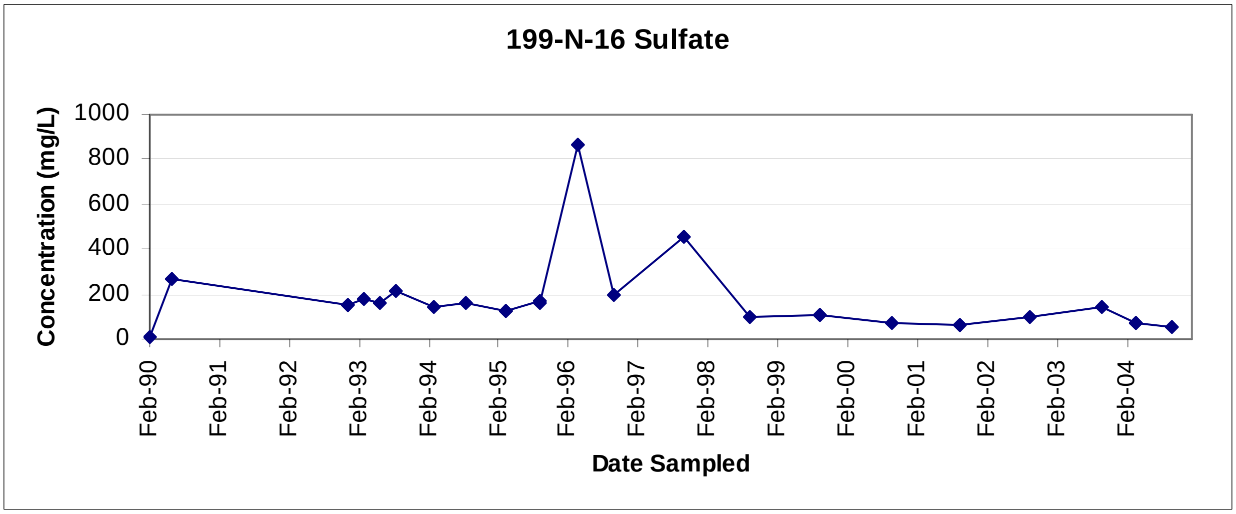

199-N-119 Nitrate
Concentration (mg/L)
14
12
10
8
6
4
2
0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

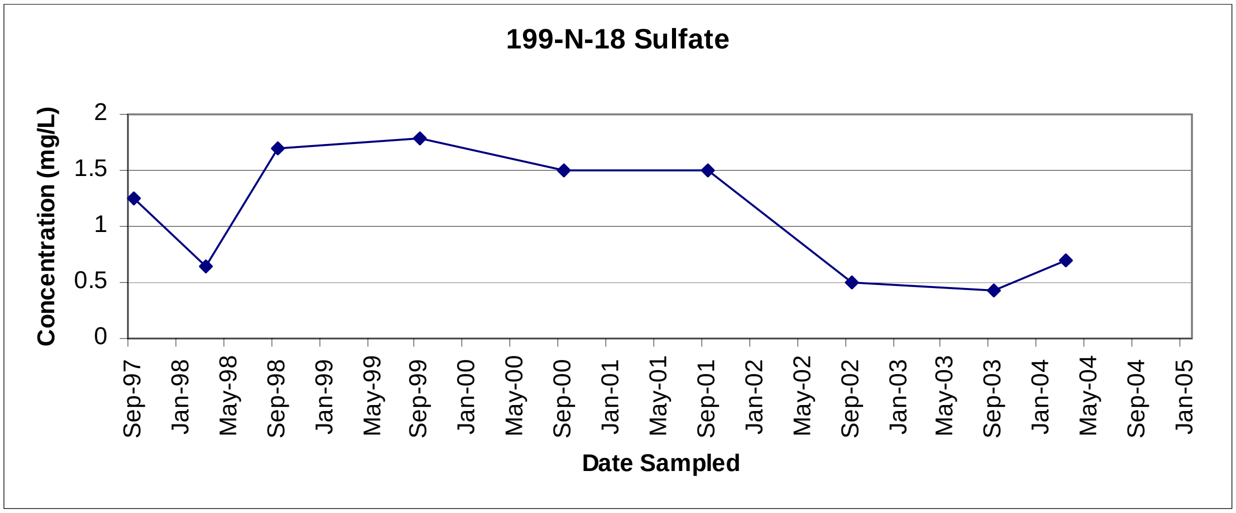

199-N-120 Nitrate
Concentration (mg/L)
7
6
5
4
3
2
1
0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled


199-N-121 Nitrate
Concentration (mg/L)
10
8
6
4
2
0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled


199-N-46 Nitrate
Concentration (mg/L)
8
7
6
5
4
3
2
1
0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled


199-N-14 Sulfate
Concentration (mg/L)
0
20
40
60
80
100
120
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-16 Sulfate
Concentration (mg/L)
0
200
400
600
800
1000
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-18 Sulfate
Concentration (mg/L)
0
0.5
1
1.5
2
Sep-97
Jan-98
May-98
Sep-98
Jan-99
May-99
Sep-99
Jan-00
May-00
Sep-00
Jan-01
May-01
Sep-01
Jan-02
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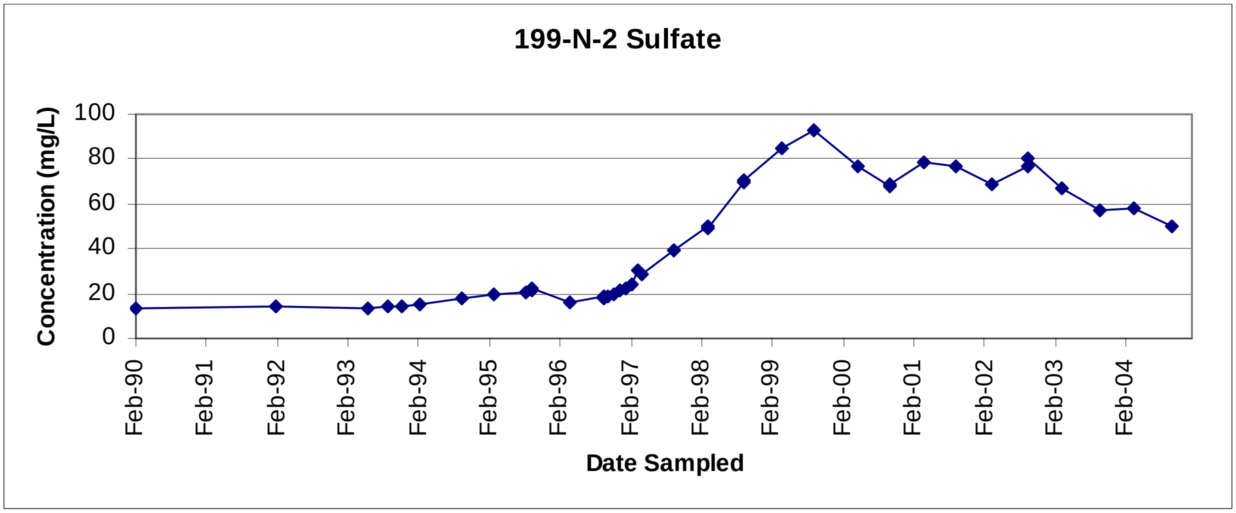
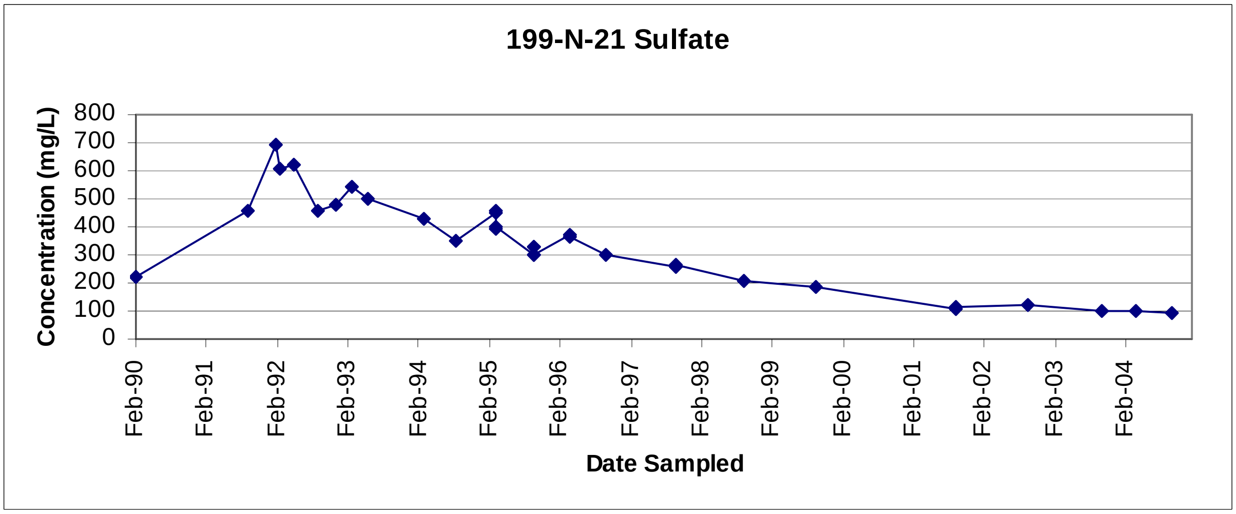
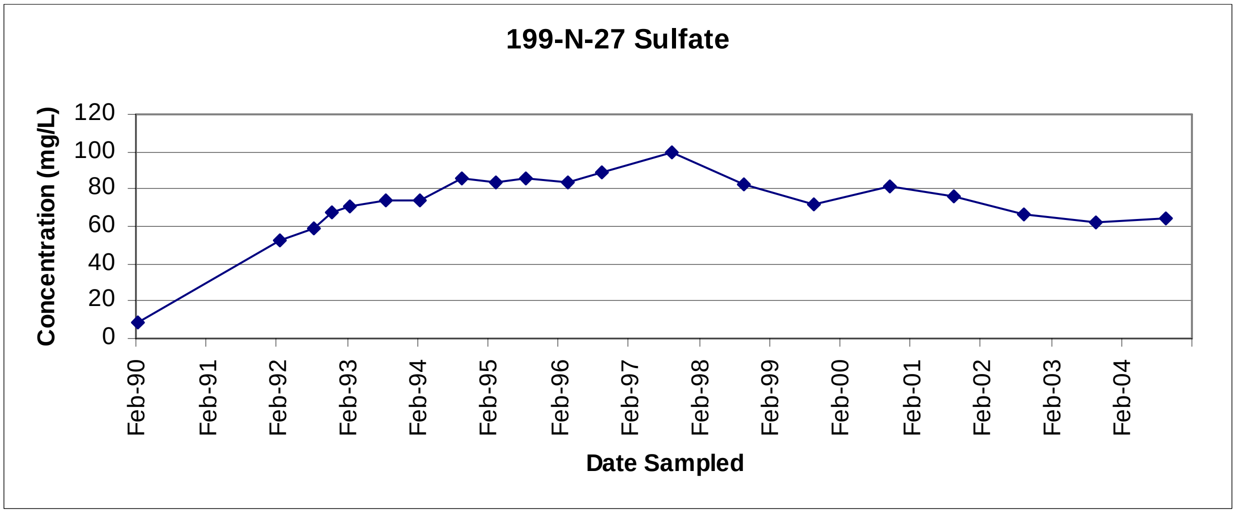
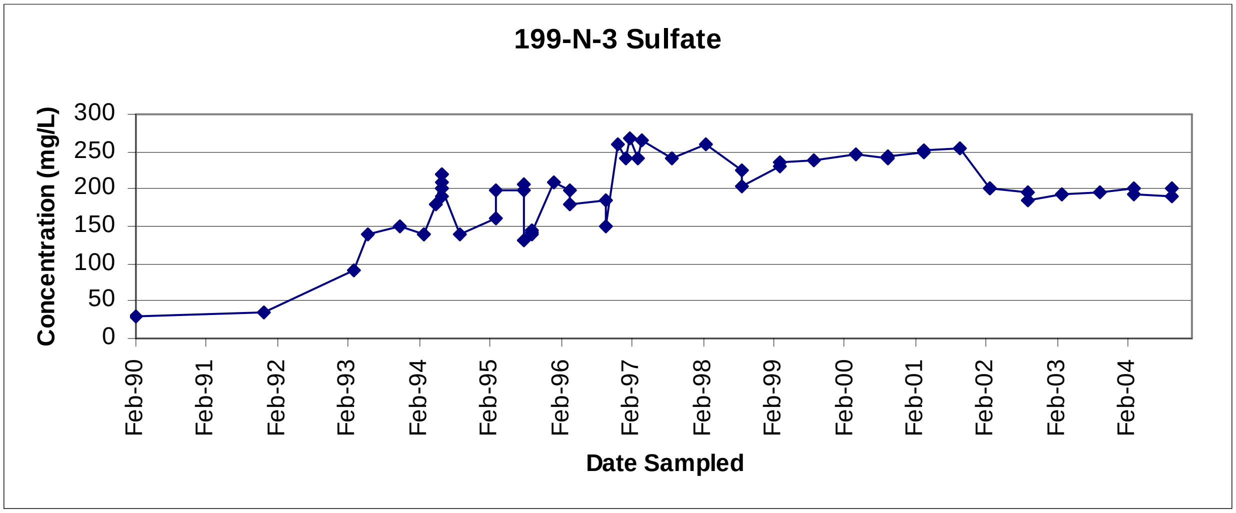
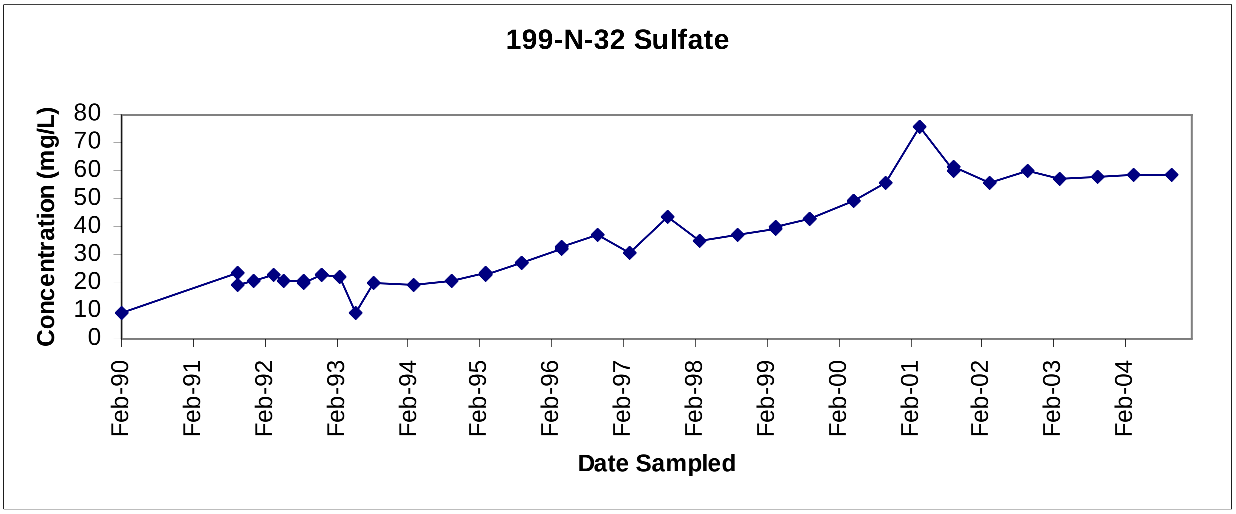
Sep-02
Jan-03
May-03
Sep-03
Jan-04
May-04
Sep-04
Jan-05
Date Sampled

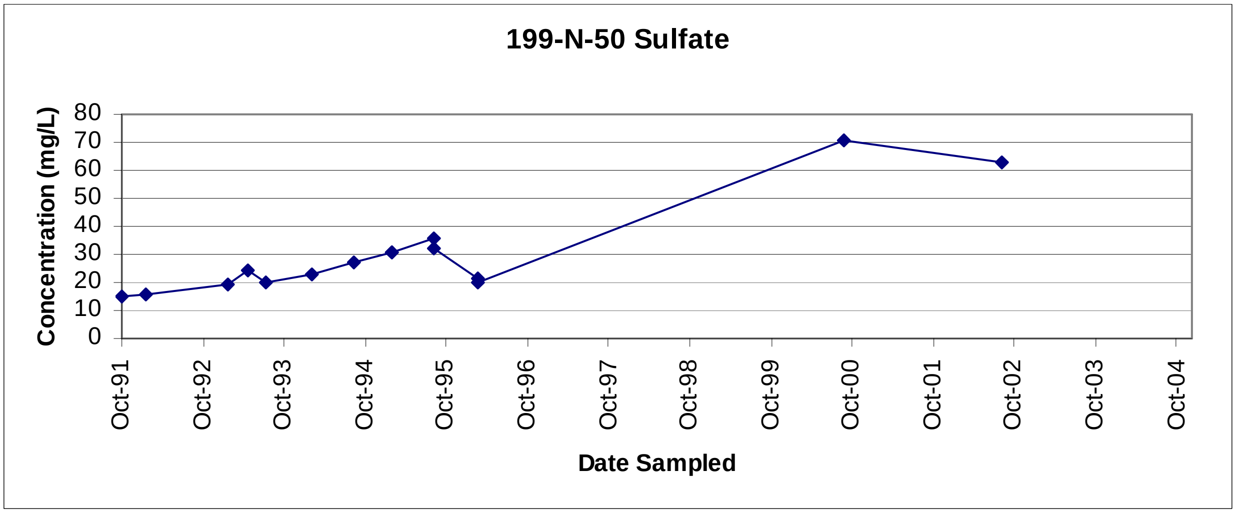

199-N-2 Sulfate
Concentration (mg/L)
0
20
40
60
80
100
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled

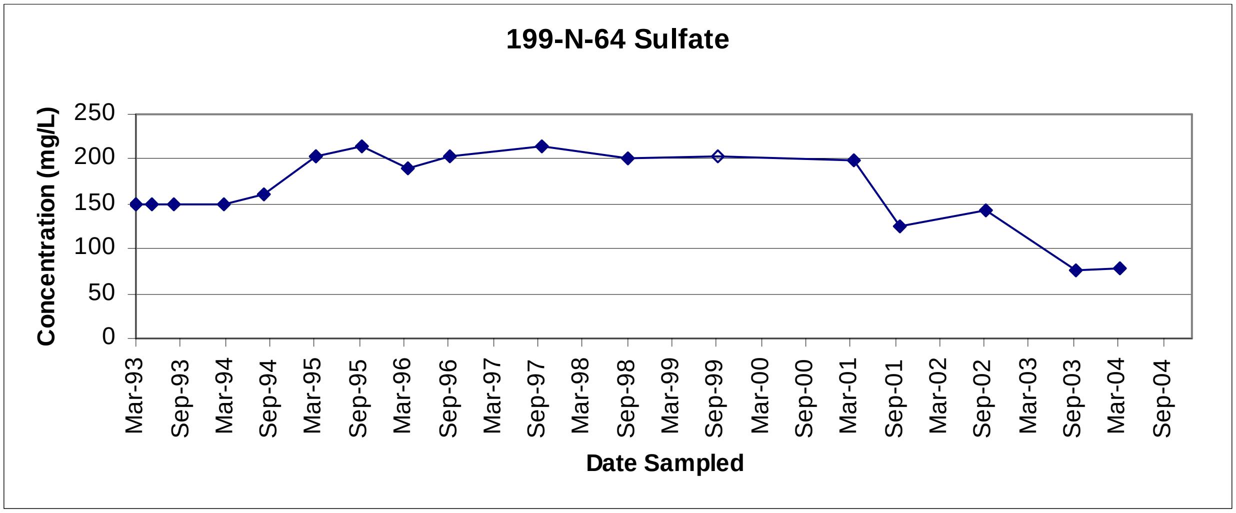

199-N-21 Sulfate
Concentration (mg/L)
0
100
200
300
400
500
600
700
800
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-27 Sulfate
Concentration (mg/L)
0
20
40
60
80
100
120
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-3 Sulfate
Concentration (mg/L)
300
250
200
150
100
50
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-32 Sulfate
Concentration (mg/L)
80
70
60
50
40
30
20
10
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-50 Sulfate
Concentration (mg/L)
80
70
60
50
40
30
20
10
0
Oct-91
Oct-92
Oct-93
Oct-94
Oct-95
Oct-96
Oct-97
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
Oct-03
Oct-04
Date Sampled


199-N-64 Sulfate
Concentration (mg/L)
250
200
150
100
50
0
Mar-93
Sep-93
Mar-94
Sep-94
Mar-95
Sep-95
Mar-96
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
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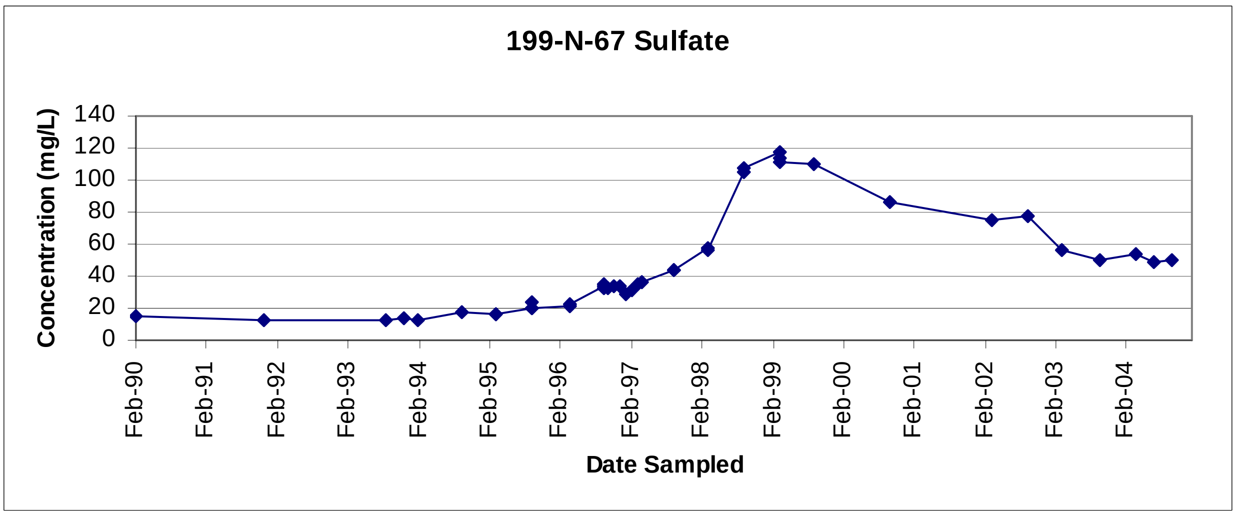
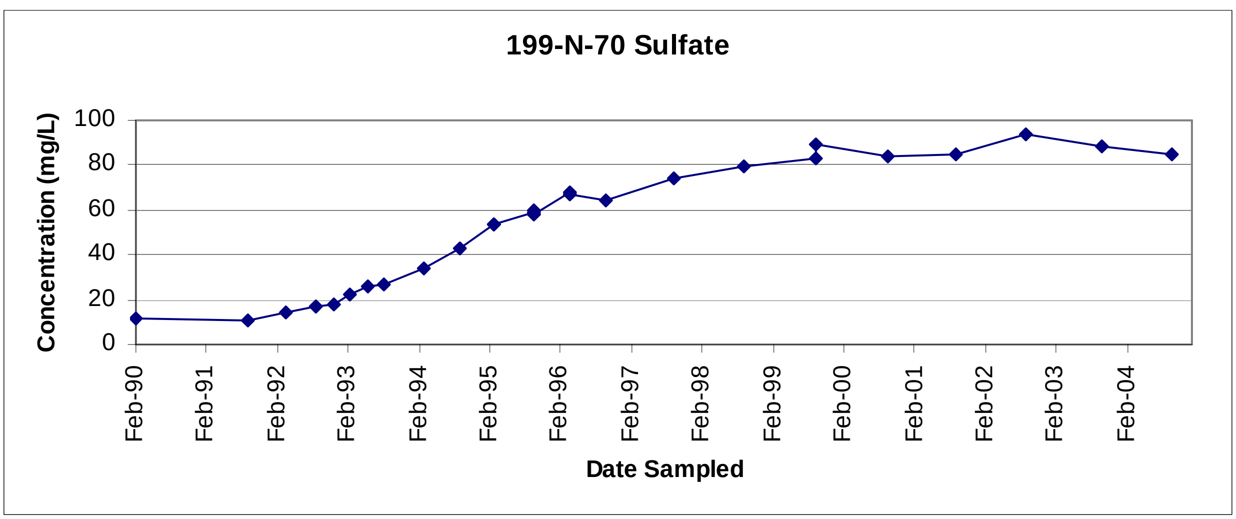
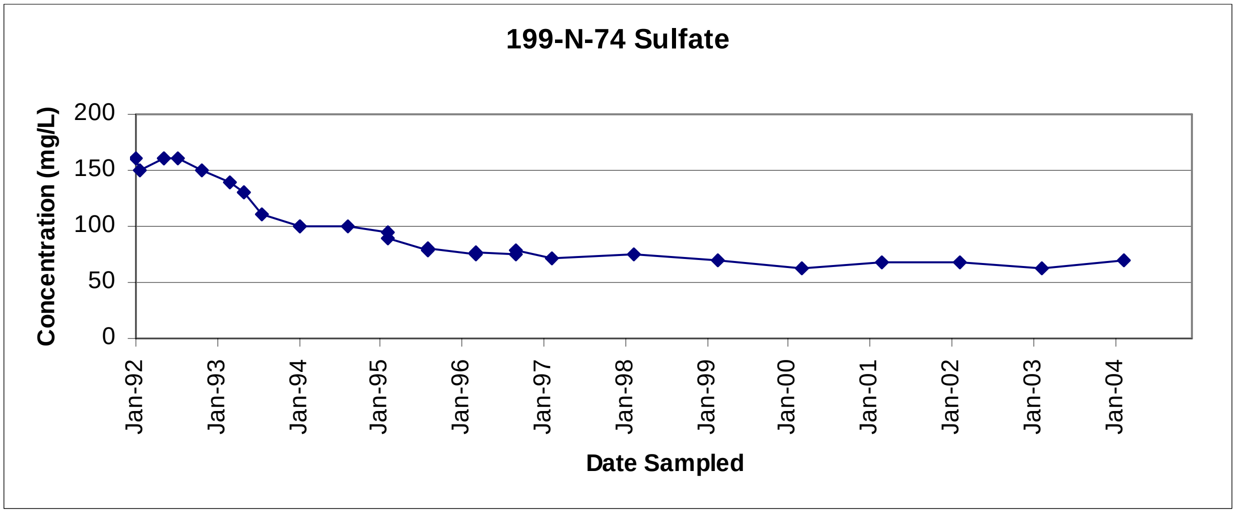
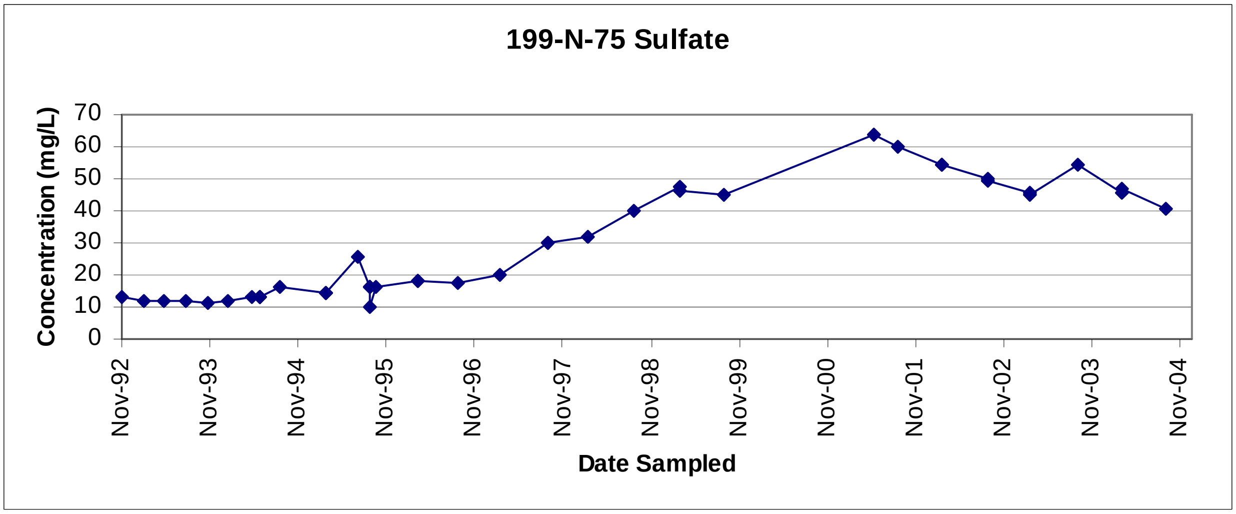
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled


199-N-67 Sulfate
Concentration (mg/L)
140
120
100
80
60
40
20
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-70 Sulfate
Concentration (mg/L)
100
80
60
40
20
0
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Date Sampled


199-N-74 Sulfate
Concentration (mg/L)
200
150
100
50
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Date Sampled


199-N-75 Sulfate
Concentration (mg/L)
70
60
50
40
30
20
10
0
Nov-92
Nov-93
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00
Nov-01
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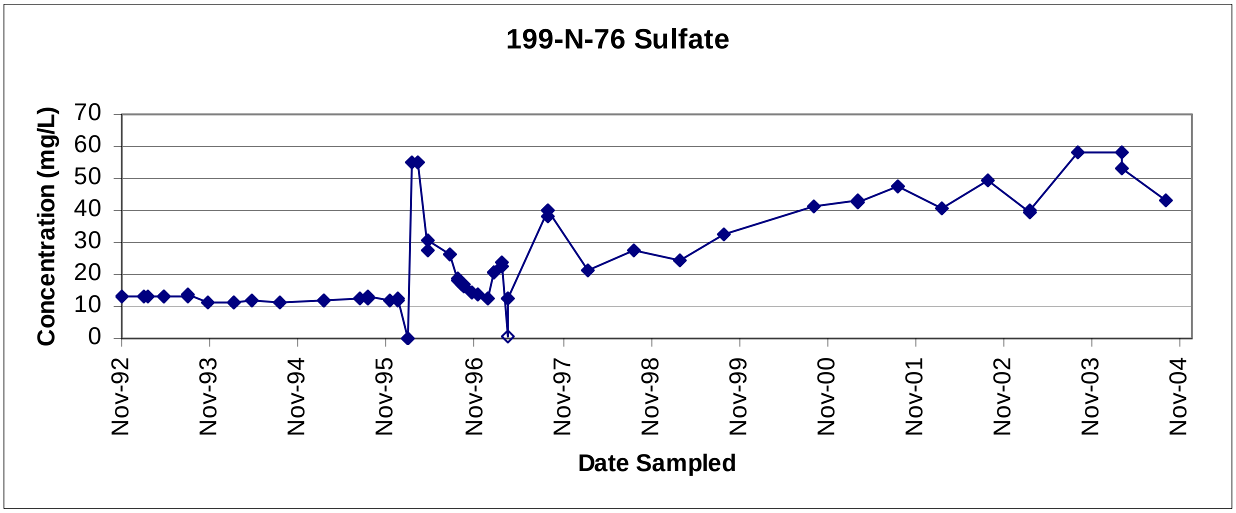
Nov-04
Date Sampled


199-N-76 Sulfate
Concentration (mg/L)
70
60
50
40
30
20
10
0
Nov-92
Nov-93
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00
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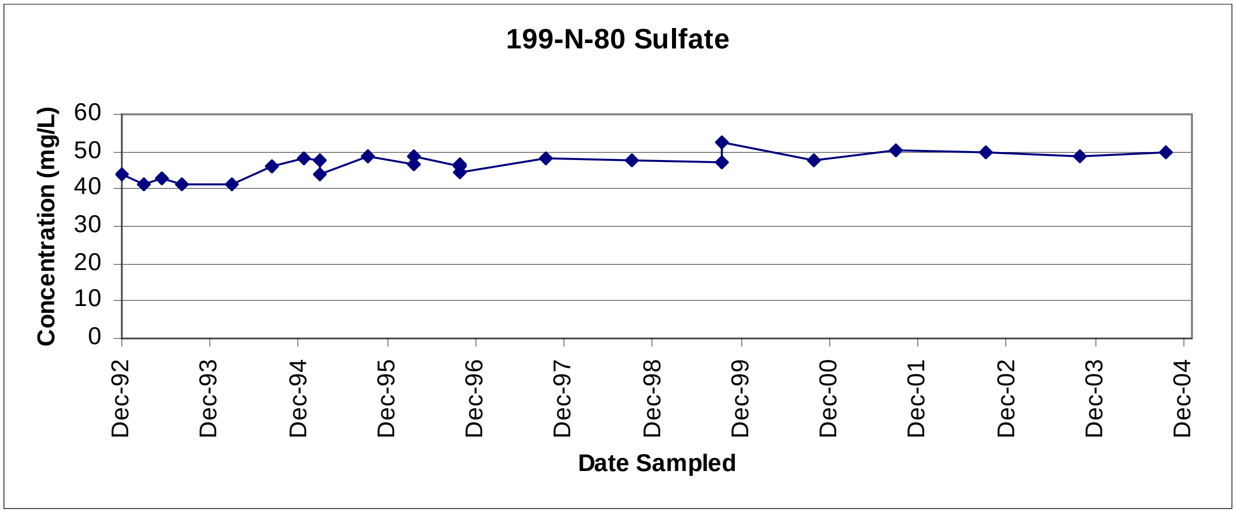
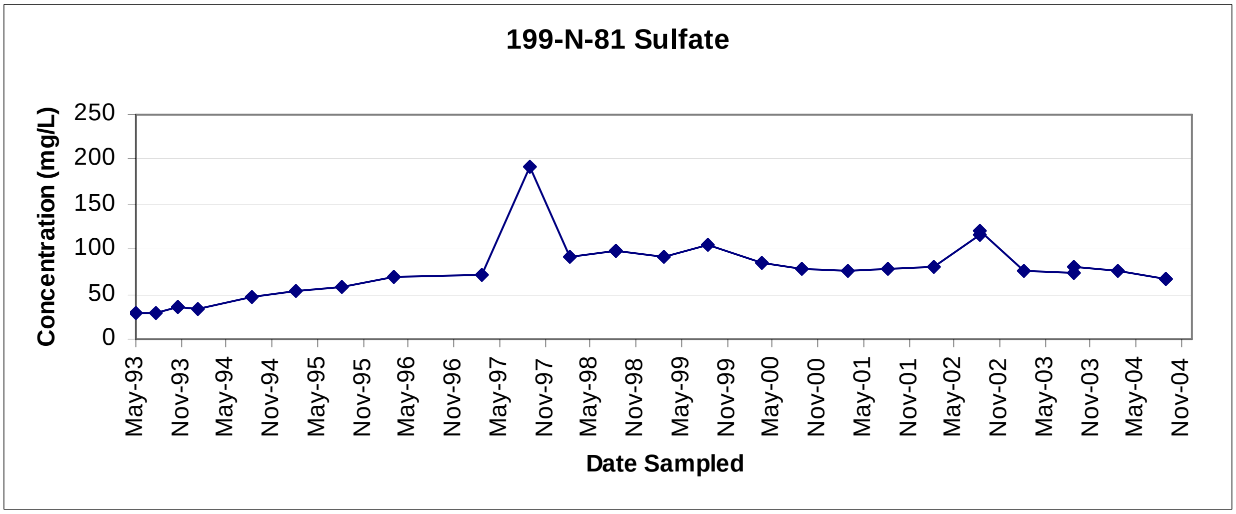
Nov-02
Nov-03
Nov-04
Date Sampled


199-N-80 Sulfate
Concentration (mg/L)
60
50
40
30
20
10
0
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Date Sampled


199-N-81 Sulfate
Concentration (mg/L)
250
200
150
100
50
0
May-93
Nov-93
May-94
Nov-94
May-95
Nov-95
May-96
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
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Nov-00
May-01
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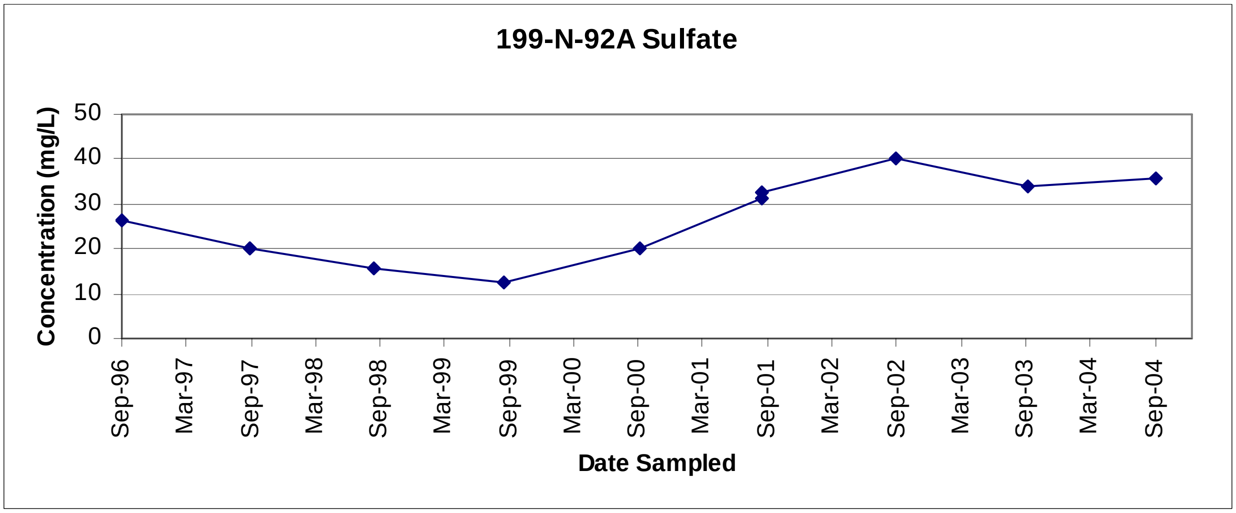
May-03
Nov-03
May-04
Nov-04
Date Sampled


199-N-92A Sulfate
Concentration (mg/L)
50
40
30
20
10
0
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
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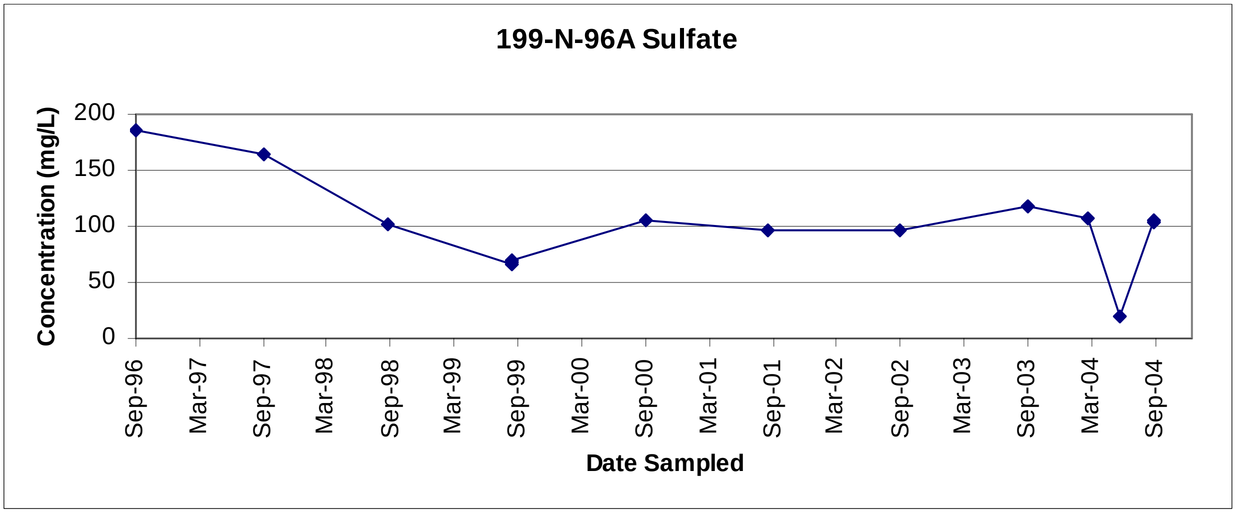
Sep-03
Mar-04
Sep-04
Date Sampled


199-N-96A Sulfate
Concentration (mg/L)
200
150
100
50
0
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
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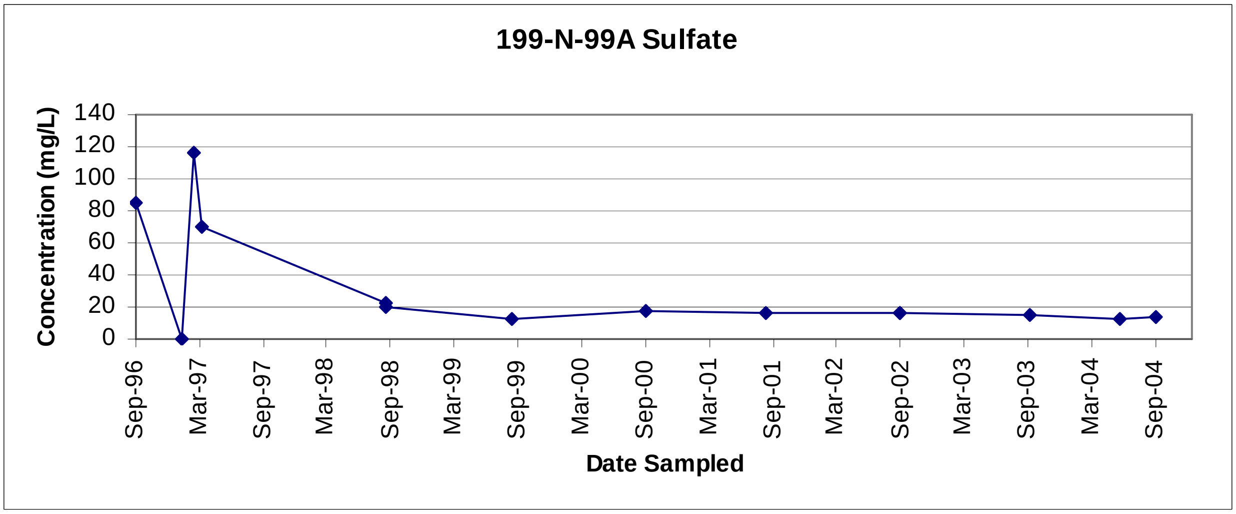
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled


199-N-99A Sulfate
Concentration (mg/L)
140
120
100
80
60
40
20
0
Sep-96
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
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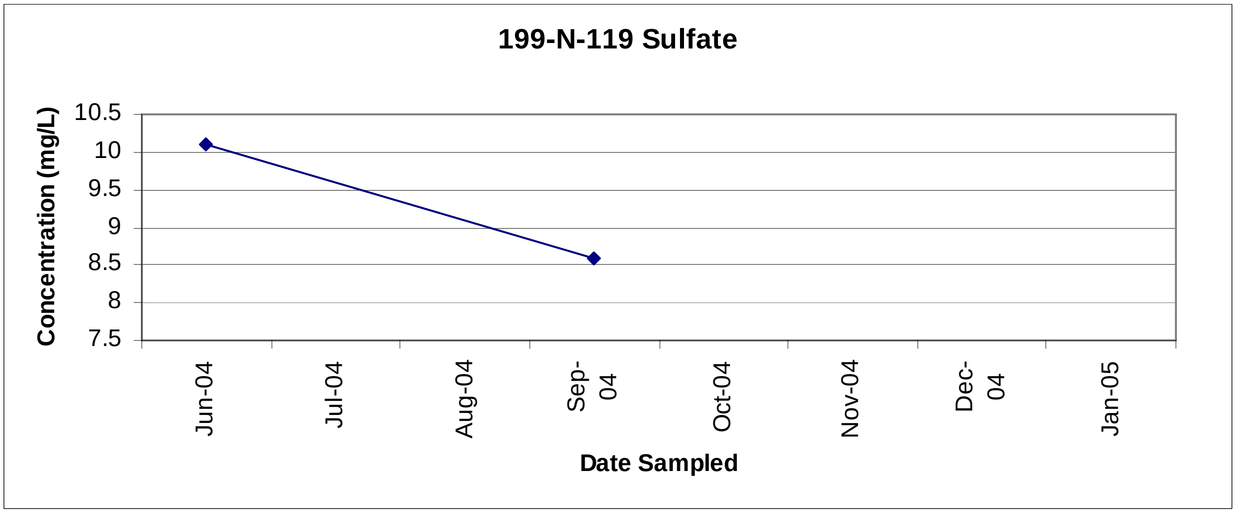
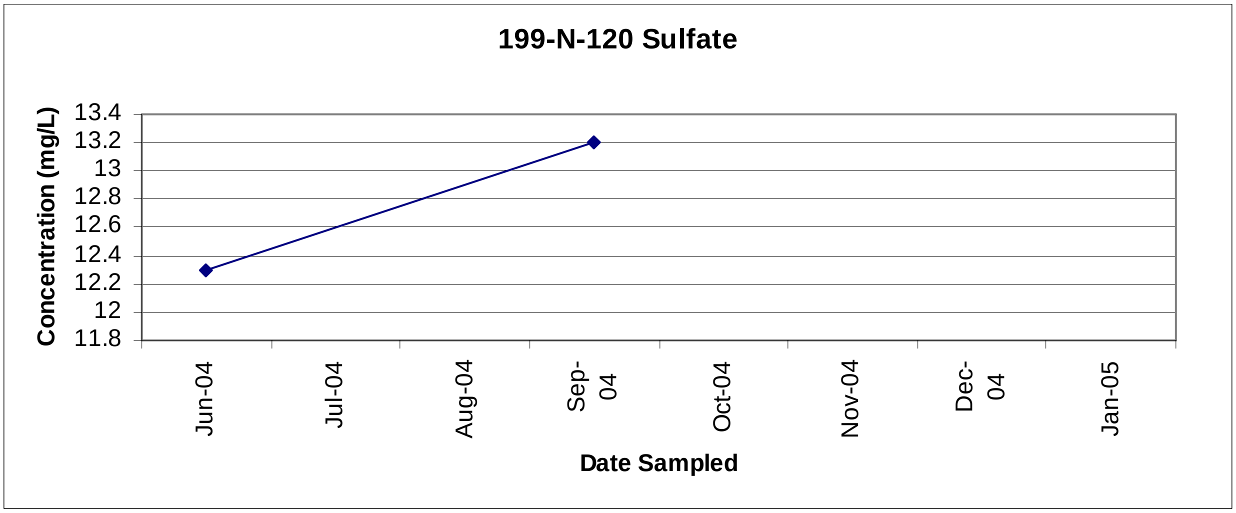
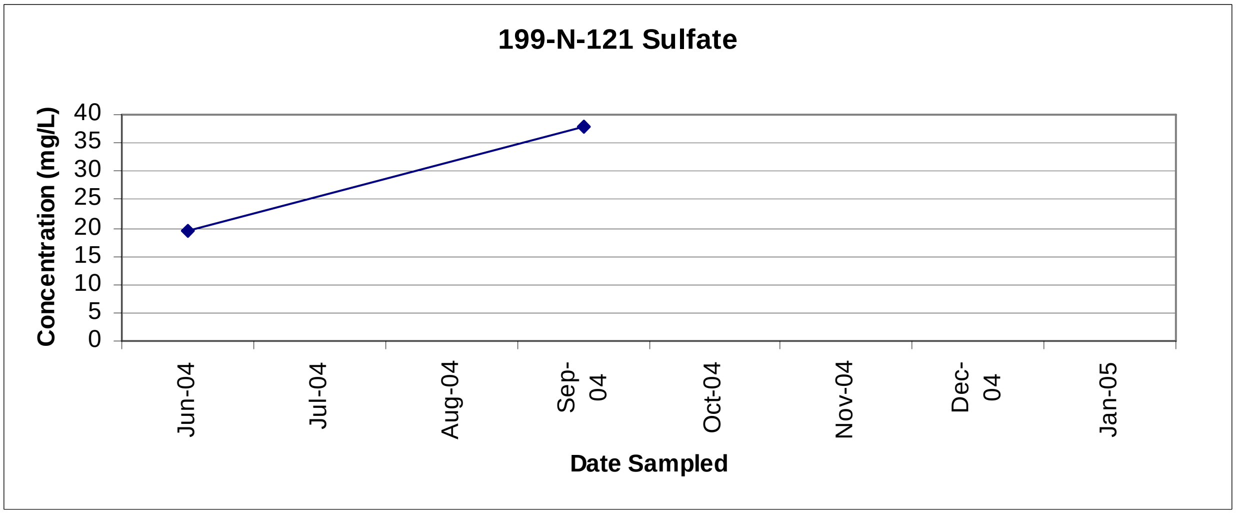
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Date Sampled


199-N-119 Sulfate
Concentration (mg/L)
10.5
10
9.5
9
8.5
8
7.5
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled


199-N-120 Sulfate
Concentration (mg/L)
13.4
13.2
13
12.8
12.6
12.4
12.2
12
11.8
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled


199-N-121 Sulfate
Concentration (mg/L)
40
35
30
25
20
15
10
5
0
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Date Sampled

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