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CALTRANS LAKE TAHOE STORM WATER SMALL-SCALE PILOT TREATMENT PROJECT

FIRST YEAR REPORT

AUGUST 2003

CALIFORNIA DEPARTMENT OF TRANSPORTATION
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Chapter 1

Executive Summary

Chapter 1 Executive Summary

The State of California Department of Transportation (Caltrans) is conducting the Lake Tahoe Small-Scale Storm Water Treatment Pilot Project to identify and evaluate storm water treatment technologies that may be capable of meeting the Tahoe Basin numeric surface water discharge limits for turbidity, total phosphorus, total nitrogen, total iron, and oil/grease. The project is being carried out at a small-scale pilot treatment facility constructed by Caltrans at its South Lake Tahoe Maintenance Station. A description and the results of the investigations completed during the first year of what is expected to be a multiple-year program are provided in this report and summarized below.

1.1 Project Activities

The first year of the project consisted of two parts: 1) laboratory-scale jar testing to select the most promising chemical coagulants and doses for Lake Tahoe storm water treatment, and 2) construction and operation of various small-scale pilot storm water treatment systems to test their efficacy in meeting the numeric limits for storm water discharges in the Lake Tahoe Basin. The jar testing procedures and results are described in a separate report (Caltrans, CTSW-RT-02-075).

Both “low technology” and “high technology” storm water treatment systems were tested. Low technology systems are those that have minimal or no power-driven mechanical equipment and controls and require minimal operation and maintenance labor. High technology systems, on the other hand, may include substantial power-driven mechanical equipment and controls and require significant operation and maintenance labor.

The low technology systems investigated included sedimentation (with and without chemical addition) and filtration (with and without prior sedimentation and/or chemical addition). Altogether, six sedimentation/filter combinations and nine filter-only treatment systems were developed and tested. Eight of these included chemical addition. The sedimentation/filter combinations were evaluated for the performance of the sedimentation step alone and for the performance of the combined systems. Six filter media were tested (selection based on literature review), including fine sand, coarse sand, concrete sand, activated alumina, aluminum oxide, and zeolite (clinoptilolite). Two chemicals were tested (identified by jar testing), PASS-C® (a liquid poly aluminum chloride) and granular polyacrylimide (PAM).

Two high technology treatment systems were tested. The first included a proprietary high-rate coagulation, flocculation, and sedimentation system (Actiflo®) followed by a proprietary synthetic media filter (Fuzzy Filter®) and ion exchange. The second high technology treatment system was the same as the first, except that a pressure sand filter was used in place of the Fuzzy Filter®. The performances of these high technology systems were evaluated after each successive step of treatment.

1.2 Summary of Findings

Findings related to the low technology and high technology systems are considered separately in the following paragraphs.

Low Technology Treatment Systems. Generally speaking, chemical coagulation and sedimentation were determined to be necessary for obtaining the best treatment results. The non-chemical systems provided insufficient treatment to meet the effluent standards. Adding chemical coagulation allowed at least some systems to meet some standards, particularly turbidity standards. However, direct chemical addition to filters, without sedimentation, generally resulted in filter blinding (clogging of media pores and high head losses).

More specific findings are summarized below:

- Sedimentation only, filtration only, and sedimentation coupled with filtration through concrete sand (all without chemicals) did not produce effluents that met the surface water discharge standards for any of the regulated constituents.
- Activated alumina removed phosphorus and iron better than the other filter media. It was particularly effective at removing the dissolved fractions of these constituents. Although activated alumina removed some total aluminum, the media leached substantial amounts of dissolved aluminum (0.2 – 1.1 mg/L) into the effluent. The same can be said for the aluminum oxide media.
- The low technology units that used a chemical coagulant were able to meet the turbidity and iron standards for surface water discharge in almost every case. The exceptions were the coarse sand filters. Systems with PASS-C® enhanced sedimentation (2 hour settling time) coupled with filtration were successful at meeting the turbidity standards for surface water discharge in every case.
- Although somewhat promising treatment results were obtained using granular PAM (e.g., Superfloc® A-836) as a filter aid, the "tea bag" dosing system tested in this study did not provide adequate control of chemical dose rates. As a consequence, subsequent filter blinding was a severe problem. Filter blinding was also a problem for fine sand filters with direct PASS-C® addition.

High Technology Treatment Systems. In general, the high technology systems exhibited the highest potential to meet all of the surface water discharge standards. Most of the treatment effects were obtained in the initial Actiflo® process. The Actiflo® process is a high-rate system that, compared to the low technology systems requires much less area to treat a given flow of storm water, but is equipment-intensive and chemical-intensive, using both a coagulant (PASS-C®) and polymer (LT25), as well as ballast sand ("micro-sand").

More specific findings are summarized below:

- Effluent from the Actiflo® process alone met the surface discharge standards for turbidity and iron and was close to meeting the phosphorus and oil and grease standards as well.

- When pressure sand filtration was added after the Actiflo® process, the effluent met the phosphorus standard and was closer to meeting the nitrogen standard for surface water discharge. The Fuzzy Filter® exhibited approximately the same degree of nitrogen removal but did not remove phosphorus quite as well as the pressure sand filter. In short, little difference in performance was observed between the pressure sand filter and the Fuzzy Filter® when each was used after Actiflo® treatment.
- Adding ion exchange after each of the filters improved phosphorus, nitrogen, and oil and grease treatment, but not to the level of consistently meeting the standard for surface water discharge. Operational problems such as plugging of ion exchange pre-filters and polymer carry-over from upstream units probably masked the full treatment potential of the ion exchange system tested in this study.

1.3 Potential Future Testing Activities

In this study, the only systems tested to date that came close to meeting the water quality standards were those that included chemical coagulation. However, because chemical storage and feed systems would substantially complicate the construction, operation, and maintenance of roadside storm water treatment systems, there is a strong incentive for Caltrans to focus further investigations on chemical-free low technology systems. Similarly, in situations where high technology systems might be most feasible (for example, where there may be large flows and limited land available for a treatment system), there is an incentive to develop nonproprietary treatment technologies to facilitate competitive bidding and hopefully result in lower project costs. With these objectives in mind, the following will be considered for future investigations:

1. Evaluate increased sedimentation times in the low technology systems as a possible means to improve treatment performance.
2. Determine if the treatment performance of the most promising low technology filtration systems tested to date can be improved by one or both of the following methods:
    a. Reducing hydraulic loading rates.
    b. Providing filter outlet configurations that force even flow distribution over the entire filter area and minimize flow velocities through the media.
3. Identify and test additional low technology filter media, particularly those with the capacity to adsorb dissolved pollutants (the concentrations of the dissolved fractions of several regulated constituents are nearly high enough to exceed the water quality standards).
4. Evaluate a fully nonproprietary high technology system consisting of a conventional coagulation, flocculation and sedimentation process (in place of the Actiflo® unit) followed by granular media filtration and ion exchange.

Chapter 2

Introduction

Chapter 2 Introduction

The Lake Tahoe Small-Scale Storm Water Treatment Pilot Project was implemented by the State of California Department of Transportation (Caltrans) to evaluate storm water treatment technologies that may be capable of meeting the Tahoe Basin numeric effluent limits. This chapter presents the background and conditions resulting in the need for this project. Previous work and reports leading up to the first year of operation of the Lake Tahoe small-scale storm water treatment pilot plant are discussed.

2.1 Introduction

Storm water discharge regulations adopted by the United States Environmental Protection Agency (USEPA) establish storm water permit requirements under the National Pollution Discharge Elimination System (NPDES) Program. The California Regional Water Quality Control Boards have implementing authority to issue NPDES permits to control discharges into the waters of the State. The Lahontan Regional Water Quality Control Board (LRWQCB) regulates storm water discharges in the Lake Tahoe Basin under the authority of the California State Water Resources Control Board (SWRCB).

Caltrans owns and operates highway systems, roadway maintenance facilities, snow storage facilities, and other properties within the Lake Tahoe Basin. These properties are typically impervious surfaces subject to intensive vehicular use. Contaminants present in storm water discharged from these roadways and facilities originate from motor vehicles, highway and bridge maintenance activities, winter snow and ice control activities, eroded cut and fill slopes, earthen roadside drainage, construction activities, illegal roadside dumping, spills, atmospheric deposition, and landscape maintenance activities. These contaminants can be described by seven categorical descriptions: (1) metals (e.g., copper, lead, zinc); (2) recalcitrant organic substances (e.g., petroleum products, paints, pesticides); (3) salts; (4) sediment; (5) nutrients (e.g., nitrogen, phosphorus); (6) litter, trash and debris; (7) other miscellaneous toxic contaminants.

In July 1999, the SWRCB issued a system-wide NPDES permit (No. CAS000003, Order No. 99-06-DWQ), which included requirements to both research and implement best management practices (BMPs) and comply with the basin plans of the various regional water quality control boards. The Basin Plan of the LRWQCB includes separate numeric effluent limits for surface discharges and runoff discharged to infiltration systems, as presented in Table 2-1 (LRWQCB, 1994). These values comprise the benchmark for treatment methodologies.

Table 2-1. Numeric Storm Water Discharge Limits

Constituent	Units	Maximum Effluent Concentration	
		Runoff Discharged to Infiltration Systems	Surface Discharges
Total Nitrogen as N	mg/L	5	0.5
Total Phosphate[(a)] as P	mg/L	1	0.1
Total Iron (Fe)	mg/L	4	0.5
Turbidity	NTU	200	20
Oil and Grease	mg/L	40	2.0

(a) Basin plan specifies that total phosphate is measured as "total phosphorus" (LRWQCB, 1994). Project measurements include both total and dissolved phosphorus (as mg-P/L) and total and dissolved orthophosphate (as mg-P/L).

Caltrans has constructed a research facility at the existing Caltrans South Lake Tahoe Maintenance Station and implemented a small-scale storm water treatment pilot project. This project is the first step in field-testing various filter medias and chemical treatment applications having the potential to improve storm water runoff quality from Caltrans properties within the Lake Tahoe Basin.

2.2 Purpose

The overall objective of the small-scale storm water treatment pilot project report is to evaluate the effectiveness of various storm water treatment methods for producing an effluent that complies with the numeric discharge limitations summarized in Table 2-1.

To achieve this objective, the first year of the small-scale pilot project was accomplished in two parts. Part A consisted of a laboratory-scale jar testing program for the selection of a chemical coagulant and dose for use in the pilot scale treatment facility (Part B). Part B consisted of construction and operation of a pilot scale treatment facility to test the efficacy of several treatment technologies. Storm water treatment technologies investigated in Part B included sedimentation and various gravity filters making use of both traditional and innovative filter media (hereinafter referred to as the "low technology" systems) and a high-rate mechanized system involving coagulation, flocculation, sedimentation, pressure filtration, and ion exchange (hereinafter referred to as the "high technology" system). The low technology sedimentation units were tested both with and without use of chemical coagulants/flocculants. The low technology filter units were tested with and without prior sedimentation and, in some cases, with and without chemical coagulants/flocculants. The overall pilot project was designed to allow for a comparative evaluation of coagulation, enhanced sedimentation, and granular media filtration for the removal of nitrogen, phosphorus, and other contaminants from Caltrans discharged storm water runoff.

2.3 Previous Reports

The development and implementation of the small-scale storm water treatment pilot project has included the preparation and distribution of four reports. The reports are entitled:

1. *Experimental Design: Pilot Study Jar Tests for Lake Tahoe Storm Water Treatment*, dated September 13, 2001.
2. *Draft Lake Tahoe Storm Water Treatment Pilot Project Monitoring and Operations Plan*, CTSW-RT-01-054D, dated October 10, 2001.
3. *Lake Tahoe Storm Water Treatment Pilot Project Monitoring and Operations Plan*, CTSW-RT-01-054, dated March 25, 2002.
4. *Lake Tahoe Storm Water Treatment Pilot Project Jar Test Results and Summary Report*, CTSW-RT-02-075, dated June, 2003.

Six experimental runs were conducted with the pilot facilities. The final *Operations and Maintenance Plan* (CTSW-RT-01-054) was issued after completion of Experimental Run 3. Therefore, Experimental Runs 1 through 3 were conducted in accordance to the *Draft Operations and Maintenance Plan* (CTSW-RT-01-054D). Only minor changes were made to the draft plan, thus no significant differences in operations and procedures were implemented.

The contents of the Jar Test Report and the Monitoring and Operations Plan are briefly presented in the following sections as background information.

2.3.1 Jar Test Report

The work plan entitled *Experimental Design: Pilot Study Jar Tests for Lake Tahoe Storm Water Treatment* (September, 2001) outlined the protocol for the chemical and dose selection process for use in the pilot facilities. Two sets of jar test experiments were proposed in the work plan; however, three sets of experiments were actually conducted: preliminary jar tests, temperature variable jar tests, and phosphate-spiked jar tests. These experiments were designed to evaluate thirteen chemical coagulant/flocculants (PASS-C®, ferric chloride, Sumaclear 700, Sumaclear 50, PAC-300, JC-1600, JC-1670, JC-1679, JC-1820, Westchlor 950S, alum, Superfloc A1849, and Superfloc C1598) for removing nitrogen, phosphorus, iron, and turbidity from actual storm water runoff collected in the Lake Tahoe Basin. The jar tests were conducted between October 30, 2001 and December 15, 2001 using four batches of storm water. The results are presented in the *Lake Tahoe Storm Water Treatment Pilot Project Jar Test Results and Summary Report* dated June, 2003. A brief overview and discussion of the findings from the jar test study follows.

The first set of jar test experiments was preliminary, intended to reduce the number of potential coagulants under evaluation from thirteen to six and to determine appropriate chemical doses. The preliminary experiments consisted of 120 jar tests, using the 13 coagulants, applied to two different batches of storm water obtained from storm water basins located at the Caltrans South Lake Tahoe Maintenance Station. The two batches of storm water exhibited significantly different turbidity. Based primarily on turbidity reduction, six coagulants and appropriate dosage ranges were selected for further study. The six selected coagulants were aluminum sulfate, ferric chloride, JC 1670, Westchlor 950S, PASS-C® and Superfloc A1849.

The second set of experiments was intended to determine the coagulant (and dose) with the greatest overall pollutant reduction potential under variable temperature conditions. The variable temperature experiments consisted of 56 jar tests, using the 6 coagulants and concentration ranges selected from the preliminary experimental data, at 4ºC and 15ºC, corresponding to winter and summer temperatures in the Upper Truckee River, respectively. The water under treatment was a mix of the two batches used in the preliminary experiments. Specific consideration was made of the need to add alkalinity to maintain chemical effectiveness. The need to add alkalinity would necessarily require the use of two chemicals for storm water treatment (i.e., a coagulant and a base) and thus vastly complicate the treatment process. Turbidity was not the sole determinant of chemical effectiveness as it was in the preliminary experiments. Analysis was conducted on a wide spectrum of potential contaminants, including metals and nutrients. After completion of the variable temperature experiments, PASS-C® at a dose of 100 mg/L (neat) was selected as the chemical and concentration with the greatest potential to improve overall storm water quality while not requiring alkalinity addition. Westchlor 950S and JC 1670 were the next two best performing chemicals.

The third set of experiments focused on storm water phosphate removal and involved spiking a high salt content storm water with phosphate stock solution, to yield a storm water sample containing at least 1 mg-P/L. The additional set of experiments was conducted because the storm water used in the variable temperature experiments did not contain adequate concentrations of phosphate to enable evaluation of removal performance. The results of these phosphate-spiked experiments supported the selection of PASS-C® at a dose of 100 mg/L (neat). Aluminum sulfate and ferric chloride facilitated removal of phosphate to a degree comparable to PASS-C®. However, both aluminum sulfate and ferric chloride consumed alkalinity and would therefore require addition of base to maintain pH and chemical effectiveness, an undesirable step in storm water treatment.

2.3.2 Small-Scale Pilot Project Monitoring and Operations Plan

The *Lake Tahoe Storm Water Treatment Pilot Project Monitoring and Operations Plan* (hereinafter referred to as the *Monitoring and Operations Plan*), dated March 25, 2002, presented discussions of pollutant forms, snowmelt dynamics and implications for nutrient loading. Also presented were contaminant removal mechanisms associated with coagulation, flocculation, sedimentation, filtration, and ion exchange. Based on the theoretical expectations, six low technology filter medias and two high technology filter medias were selected for pilot study. A brief summary of the operations is presented in Chapter 3. Also discussed in Chapter 3 are procedures and unexpected events that deviated from those described in the first year *Monitoring and Operations Plan*.

2.4 Scope of This Report

Presented in this report are the data and subsequent analyses associated with treating six batches of storm water through the pilot treatment technologies located at the South Lake Tahoe Maintenance Facility. In addition to data presentation, recommendations for operational enhancement and pilot study modifications are also presented.

This report is organized into seven chapters. Chapter 1 contains an Executive Summary. Chapter 2 includes an introduction and background information for the project. Chapter 3 contains an overview of the pilot facilities and operations including descriptions of the low and high technology treatment systems, storm water collection procedures, and the sampling and analysis plan. Chapter 4 contains information describing the six first year experimental runs. Chapter 5 contains project results, data analysis, and an assessment of the technologies tested. Chapter 6 presents a summary of findings and recommendations. Chapter 7 contains a list of references.

Chapter 3 Pilot Facilities and Operations

This chapter provides an overview of the Lake Tahoe Storm Water Treatment Pilot Plant facilities, operation, and changes to the *Monitoring and Operations Plan*. Maps, diagrams, and tables are presented to indicate how the plant and treatment units were constructed and the position and location of the units within the facility. Sample collection and handling procedures are presented for review. In response to issues and equipment problems, deviations from the original *Monitoring and Operations Plan* (March 25, 2002, CTSW-RT-01-054) were implemented and are discussed in this chapter.

3.1 Pilot Facilities

The Caltrans Small-Scale Storm Water Treatment Pilot Project began in 2001 with the design and construction of a new 2,040 square foot building to enclose equipment and test apparatus. Due to seasonal constraints, some elements (e.g., asphalt driveway, storm water swale) were not constructed until summer 2002. The building is located at the Caltrans South Lake Tahoe Maintenance Station site, near the junction of State Highway 89 and US Highway 50 (2243 Cornelian Drive, South Lake Tahoe, CA). A summary of the experimental treatments is presented in Table 3-1. The location of the pilot plant building, elevations, and drainage features of the property are illustrated in Figure 3-1.

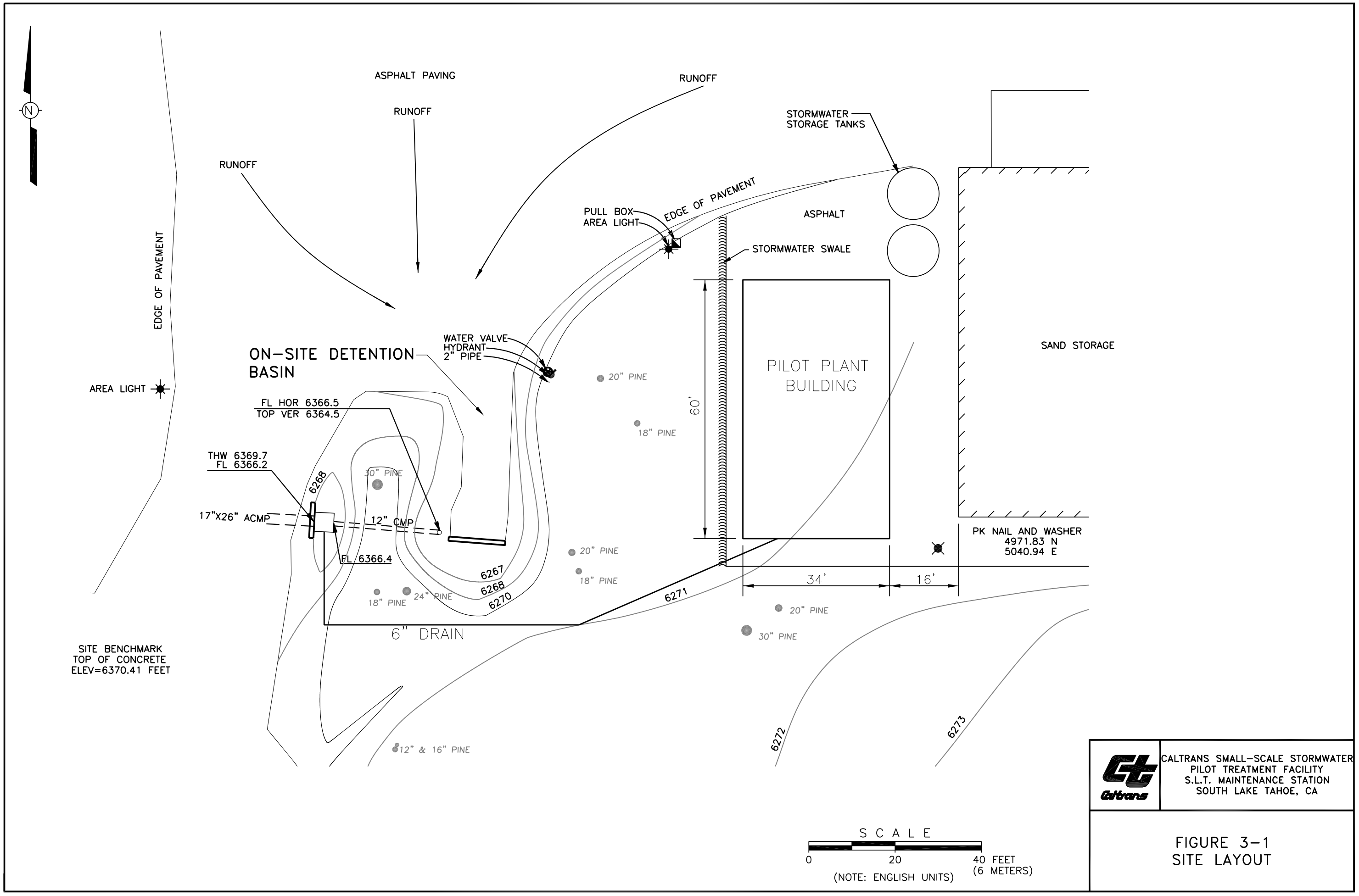
The Caltrans Small-Scale Storm Water Treatment Pilot Project was designed to evaluate the following treatment processes on storm water contaminant removal:

- sedimentation without chemical coagulation/flocculation,
- sedimentation with chemically enhanced coagulation/flocculation,
- filtration (various granular filter medias), with and without chemical coagulation and flocculation,
- filtration preceded by sedimentation, with and without chemical coagulation/flocculation,
- high rate, chemically enhanced, proprietary ballasted sand, coagulation, flocculation sedimentation, filtration (two types), and ion exchange.

To test these treatment processes, fifteen “low technology” and two “high technology” treatment systems were constructed between December 2001 and January 2002. Descriptive summaries of these treatment systems are presented in Table 3-1. A schematic diagram of treatment system components is presented in Figure 3-2. A layout of the treatment systems within the building is presented in Figure 3-3. A schematic diagram of the plant, showing the approximate position of valves and the sample points is presented in Figure 3-4. The following sections present descriptions of critical aspects of each system. More detailed descriptions of the pilot treatment facilities can be found in the project *Monitoring and Operations Plan* (Caltrans 2002a, CTSW-RT-01-054).

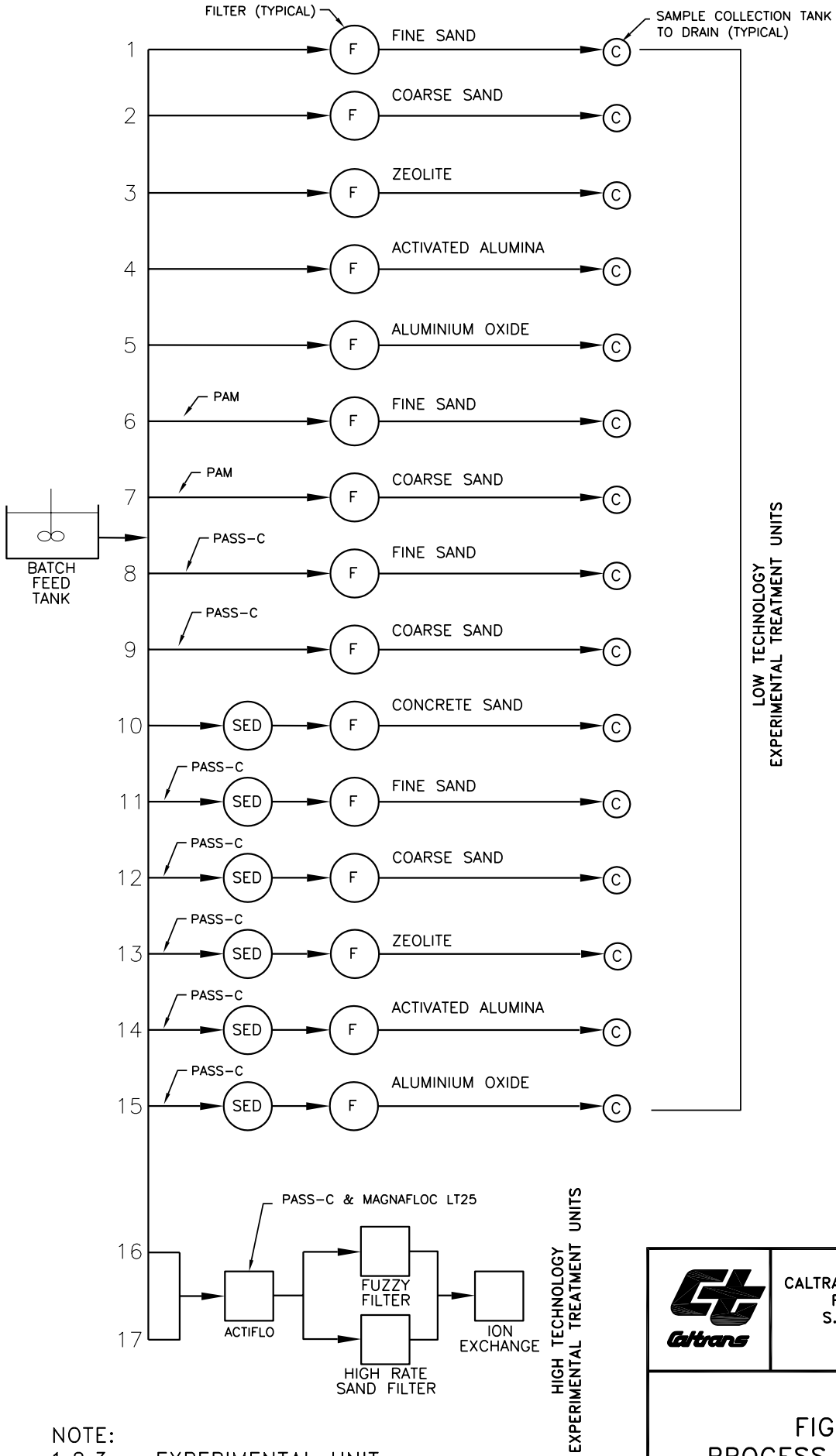
Chapter 3

Pilot Facilities and Operations



CALTRANS SMALL-SCALE STORMWATER
PILOT TREATMENT FACILITY
S.L.T. MAINTENANCE STATION
SOUTH LAKE TAHOE, CA

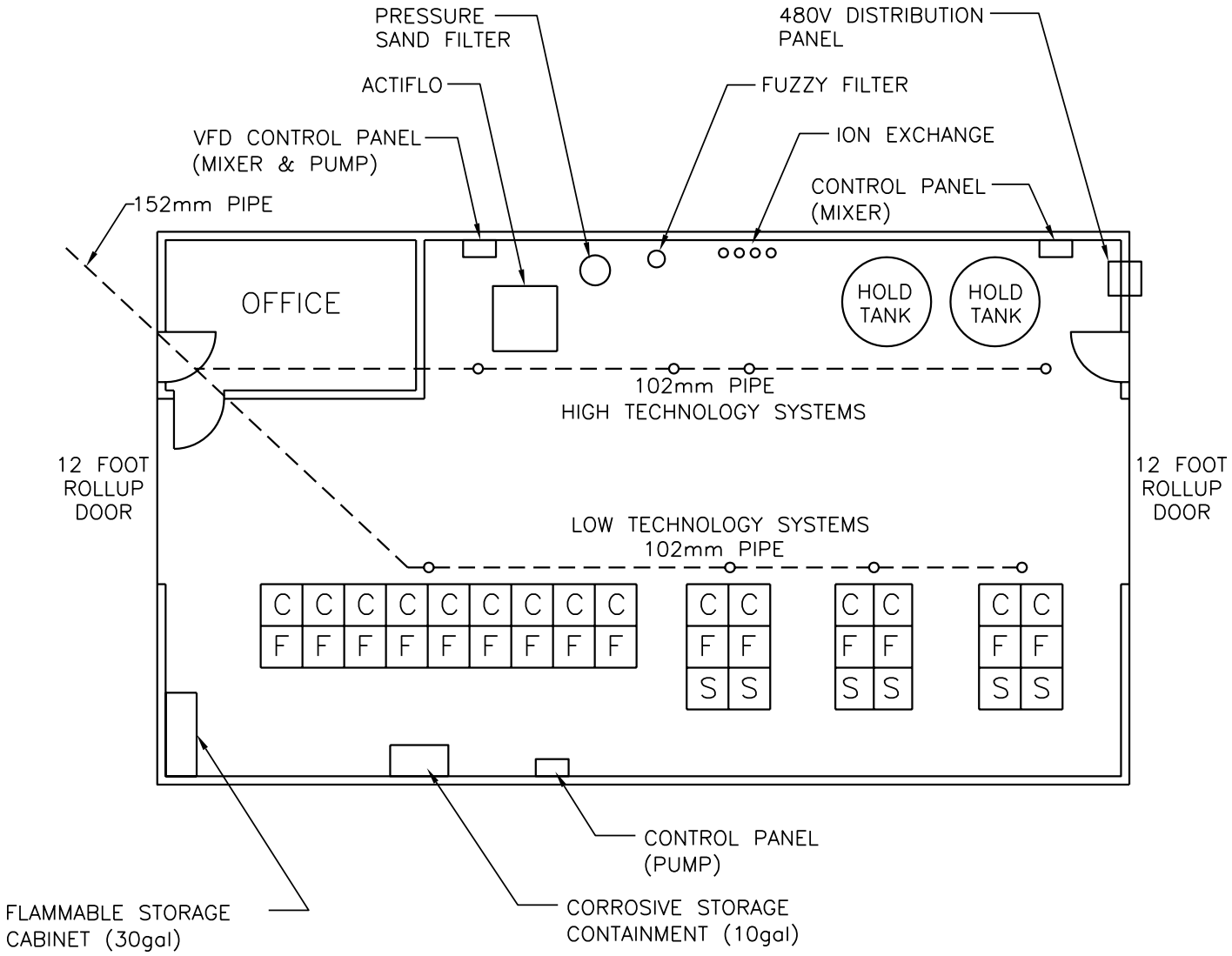
FIGURE 3-1
SITE LAYOUT



NOTE:
1,2,3 = EXPERIMENTAL UNIT
(REFERENCE **TABLE 3-1**)

CALTRANS SMALL-SCALE STORMWATER
PILOT TREATMENT FACILITY
S.L.T. MAINTENANCE STATION
SOUTH LAKE TAHOE, CA

FIGURE 3-2
PROCESS FLOW DIAGRAM



LEGEND

— —o— EFFLUENT LINE SUBFLOOR WITH FLOOR DRAIN

F – FILTER

S – SEDIMENTATION BASIN

C – COLLECTION TANK

SCALE

0 3 6 METERS

CALTRANS SMALL-SCALE STORMWATER
PILOT TREATMENT FACILITY
S.L.T. MAINTENANCE STATION
SOUTH LAKE TAHOE, CA

FIGURE 3-3
BUILDING LAYOUT

X:\Projects\Caltrans Stormwater Pilot Project\FINAL CT YR 1 Report (August 2003)\Cad Drawings\FIG 3-3 BUILDING LAYOUT.dwg
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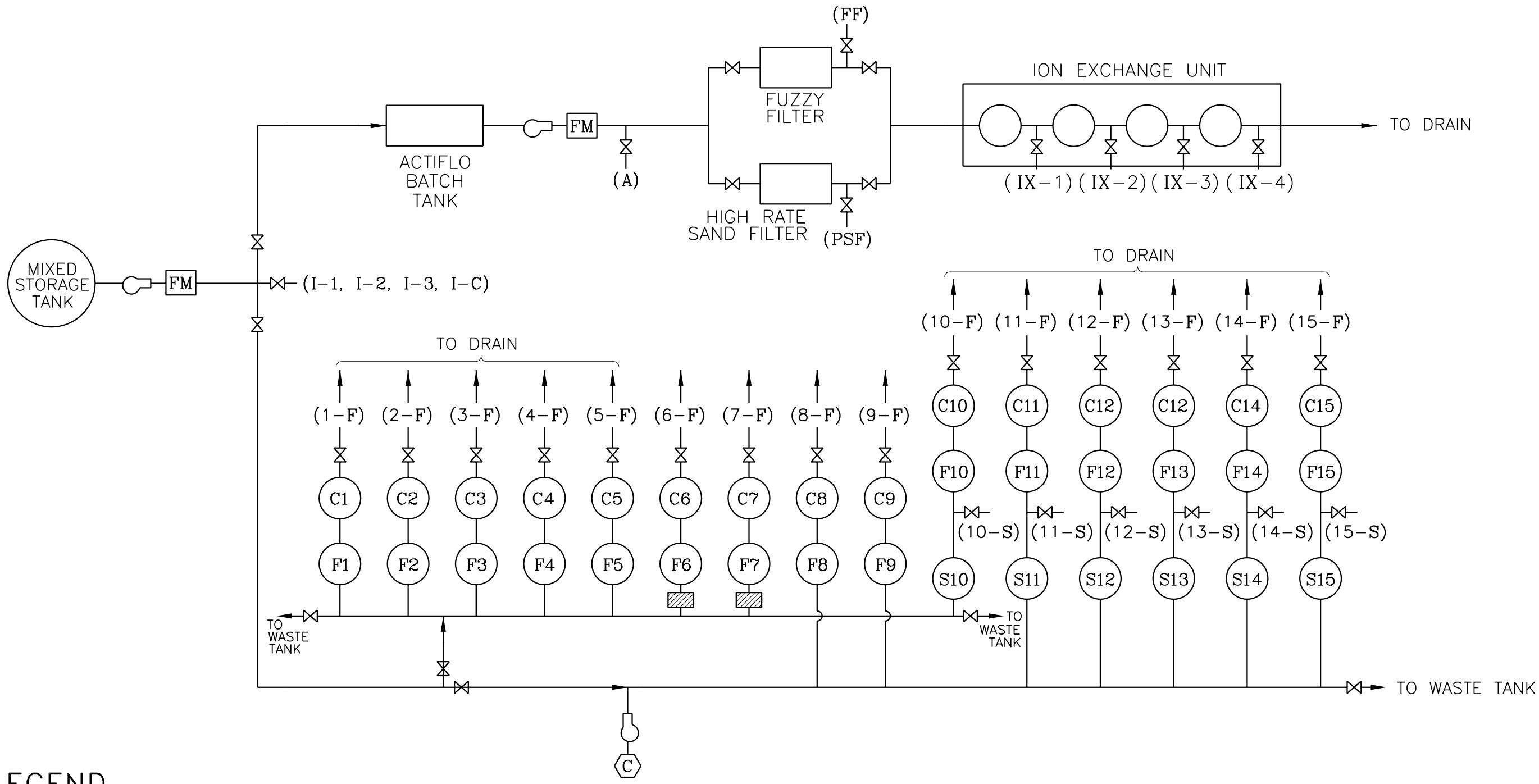


LEGEND

(I)– INFLUENT SAMPLING POINT
(F)– FILTER EFFLUENT SAMPLING POINT
(S)– SEDIMENTATION BASIN EFFLUENT SAMPLING POINT
(A)– ACTIFLO SYSTEM EFFLUENT SAMPLING POINT
(FF)– FUZZY FILTER EFFLUENT SAMPLING POINT
(PSF)– PRESSURE SAND FILTER EFFLUENT SAMPLING POINT
(IX)– ION EXCHANGE SAMPLING POINT

S# – SEDIMENTATION TANK ID NUMBER
F# – FILTRATION TANK ID NUMBER
C# – EFFLUENT COLLECTION TANK ID NUMBER
FM – FLOW METER
⟨C⟩ – PASS–C ADDITION PUMP
▨ – PASSIVE DOSING PAM BAGS

NOT DRAWN TO SCALE

CALTRANS SMALL–SCALE STORMWATER
PILOT TREATMENT FACILITY
S.L.T. MAINTENANCE STATION
SOUTH LAKE TAHOE, CA

FIGURE 3–4
PILOT PLANT SCHEMATIC

Table 3-1. Summary of Experimental Treatment Systems

Experimental System Identification	Filter Media or Treatment System	Sedimentation Provided	Coagulant	Filtration Aid
Low Technology Processes				
1	Fine Sand	No	None	None
2	Coarse Sand	No	None	None
3	Zeolite (clinoptilolite)	No	None	None
4	Activated Alumina	No	None	None
5	Aluminum Oxide Sand	No	None	None
6	Fine Sand	No	None	PAM[(a)]
7	Coarse Sand	No	None	PAM
8	Fine Sand	No	PASS-C®[(b)]	None
9	Coarse Sand	No	PASS-C®	None
10	Concrete Sand	Yes	None	None
11	Fine Sand	Yes	PASS-C®	None
12	Coarse Sand	Yes	PASS-C®	None
13	Zeolite (clinoptilolite)	Yes	PASS-C®	None
14	Activated Alumina	Yes	PASS-C®	None
15	Aluminum Oxide Sand	Yes	PASS-C®	None
High Technology Processes				
16	Actiflo®[(c)]+ Fuzzy Filter®[(d)] + Ion Exchange		PASS-C®	Magnafloc®LT25[(e)]
17	Actiflo® + High rate pressure sand filter + Ion Exchange		PASS-C®	Magnafloc® LT25

(a) "PAM" is a granular anionic polyacrylamide flocculation aid (Superfloc® A-836, Cytec Chemical).
(b) PASS-C® is a liquid poly-aluminum chloride coagulant (Eaglebrook Chemical).
(c) Actiflo® process a registered trademark of KRÜGER, inc., a division of US Filter.
(d) Fuzzy Filter® is a registered trademark of Schreiber® Wastewater Treatment Technologies.
(e) Magnafloc® LT25 is a granular water treatment polymer(Ciba Specialty Chemical Corporation).

3.1.1 Low Technology Systems

The fifteen low technology systems were designed to test the effectiveness of sedimentation and filtration (using six filter medias), alone and combined, both with and without chemical coagulation/flocculation. PASS-C® (a liquid poly aluminum chloride coagulant) and granular polyacrylamide (PAM, Superfloc® A-836; an anionic filter aid) were the only chemicals used in the low technology systems (see Sub-paragraph 3.2.2.1 that follows).

The six filter medias investigated were activated alumina, aluminum oxide sand, zeolite, well-sorted fine sand, well-sorted coarse sand, and concrete sand. A summary of the media particle size characteristics of these low technology filter medias is presented in Table 3-2 and is based on sieve analyses, which are included in Appendix B. Effective size and uniformity coefficient measurements presented in Table 3-2 are for the medias in the

unwashed, raw form, prior to conditioning, rinsing, and use. A discussion of the concrete sand gradation is included in Section 3.3.5 that follows.

Table 3-2. Summary of Low-Technology Filter Medias

Filter Media	Effective Size [D_{10} (mm)]	Uniformity Coefficient (D_{60}/D_{10})
Fine Sand	0.45	1.5
Coarse Sand	0.70	1.9
Concrete Sand	0.13	8.7
Aluminum Oxide Sand	0.45	1.4
Zeolite	0.45	1.4
Activated Alumina (Alcoa DD2)	0.26	1.9

3.1.2 Low Technology Filter Construction and Conditioning

Filters were constructed in January 2002 by placing approximately 61 cm (24 inches) of filter media on top of an underdrain system consisting of a 20.3 cm (8 inches) gravel layer and slotted PVC filtrate piping. A layer of geo-textile fabric was used to separate the granular media from the under-drain system. Filter unit designation, media type and source, and the approximate mass used to obtain a depth of 61 cm (24 inches) in each filter are listed in Table 3-3.

Table 3-3. Filter Media, Source and Amount Used to Construct the Filter Units

Unit	Media	Supplier and Product	Amount Used[a]
1	Fine Sand	Envirotrol/Loprest Water Treatment, Rodeo, CA, RMC Pacific Materials, Monterey Filter Sand	850 lbs (386 kg)
2	Coarse Sand	Envirotrol/Loprest Water Treatment, Rodeo, CA, Manufactures Mineral CO, 0.8 – 1.2 Sand	925 lbs (420 kg)
3	Zeolite	Ash Meadows Zeolite, LLC Donald Sims, Bakersfield, CA	550 lbs (250 kg)
4	Activated Alumina	Schoofs, Inc/Alcoa, Los Angeles, CA Calcined Alumina, DD-2	360 lbs (163 kg)
5	Aluminum Oxide	Industrial Supply, Loveland, CO White Aluminum Oxide, 30 grit	1000 lbs (454 kg)
6	Fine Sand	(See Above)	950 lbs (431 kg)
7	Coarse Sand	(See Above)	900 lbs (408 kg)
8	Fine Sand	(See Above)	900 lbs (408 kg)
9	Coarse Sand	(See Above)	900 lbs (408 kg)
10	Concrete Sand	Teichert Aggregates, Truckee, CA ASTM C-33	900 lbs (454 kg)
11	Fine Sand	(See Above)	850 lbs (386 kg)
12	Coarse Sand	(See Above)	950 lbs (431 kg)
13	Zeolite	Ash Meadows Zeolite, LLC	550 lbs (250 kg)
14	Activated Alumina	Schoofs, Inc/Alcoa	340 lbs (154 kg)
15	Aluminum Oxide	Industrial Supply	1000 lbs (454 kg)
All	Gravel (under-drain)	Envirotrol/Loprest Water Treatment ¼" x ⅜" Gravel	230 lbs (104 kg)

[a] Estimations, based on the number and size of bags or containers used.

Once constructed, each filter was conditioned. Filter conditioning consisted of thoroughly rinsing the media using a 2.4 m (8 ft) section of ¾ in (1.9 cm) PVC pipe connected to the potable water supply. The rinsing pipe was moved down through the profile dislodging any trapped air and dirt particles. Filters were rinsed until the effluent was visibly free of particles and color.

A series of wet runs were conducted in early February 2002 to collect background data on filtration rate and effluent turbidity arising from the media (i.e., filter impact). The wet runs consisted of filling the tanks with potable water and passing it through the systems without any chemical addition. Effluent turbidity results following the filter conditioning exercise are reported in Table 3-4. After the first wet run, all of the filters with an effluent turbidity exceeding 10 NTU were again rinsed until turbidity was less than 10 NTU.

Table 3-4. Final Filter Effluent Turbidity Values Following Conditioning

Filter	Media	Final Filter Turbidity Values After Conditioning (NTU)
Rinse Water Used (tap)		0.7
1	Fine Sand	1.2
2	Coarse Sand	2.9
3	Zeolite	2.9
4	Activated Alumina	1.1
5	Aluminum Oxide	1.0
6	Fine Sand	1.8
7	Coarse Sand	2.8
8	Fine Sand	1.7
9	Coarse Sand	4.6
10	Concrete Sand	1.3
11	Fine Sand	1.1
12	Coarse Sand	3.7
13	Zeolite	3.5
14	Activated Alumina	1.6
15	Aluminum Oxide	1.9

3.1.3 High Technology Systems

Each of the two high technology treatment trains included a batch test version of the Actiflo® process (sedimentation, enhanced by the addition of ballast sand, PASS-C®, and Magnafloc® LT25), followed by either high pressure sand filtration or Fuzzy Filter® filtration, followed by ion exchange. The ion exchange units were the same, regardless of the preceding filter type (Figure 3-2 and Figure 3-4). Initially, the ion exchange process was considered for possible use to treat storm water directly and therefore included four canisters: (1) pleated cellulose filter, (2) modified clay filter, (3) anion exchange resin, and (4) cation exchange resin. However, it was subsequently decided to test the ion exchange process only after

upstream filtration. Therefore, pretreatment canisters (Items 1 and 2) were not necessary and were eliminated (Figure 3-4).

3.2 Pilot Operations

Operations involved in running the storm water treatment pilot plant included storm water collection and storage, storm water treatment, and monitoring and sampling activities. Project operations were developed to obtain performance data of the highest possible quality. Operation activities are briefly described in the following sections.

3.2.1 Storm Water Collection Procedures

Storm water was collected for treatment from an on-site detention basin at the South Lake Tahoe Maintenance Station (the pilot project site) and from various other locations within the Lake Tahoe Basin (see Chapter 4). For collection from the on-site detention basin, a self-priming centrifugal pump was used to transfer water to the storage tanks that preceded the pilot treatment units. For off-site storm water collection, a contractor (Peter Nash, Carson City, NV) was engaged to haul water in a 14,380 liter (3,800 gallon) water truck to the pilot facility. An integral pump and associated hose with strainer were used to pump water from the off-site basins into the truck for transport. The transported storm water was then pumped into the storage tanks at the pilot project site.

All storm water collected for treatment underwent some form of sedimentation, either by temporary storage in a detention pond or by having passed through an in-line sand trap. Storm water was collected by placing the suction hose into the storm water at a sufficient depth to allow collection while minimizing the possibility of entraining settled material.

The storm water was stored outside of the plant building in one of two 25,000 liter (6,500 gallon) polyethylene storage tanks (Baker Tanks, Inc). The contents of each tank constituted a single batch of untreated storm water (although technically some sedimentation had already occurred). A submersible mixer in each tank operated continuously to avoid further sedimentation and to prevent freezing.

3.2.2 Pilot Treatment Operations

Two positive displacement pumps were used to transfer water from the storage tanks to the treatment systems. The piping was configured to allow the lines to be flushed to the waste tanks prior to treatment.

3.2.2.1 Chemical Addition

The chemical coagulant PASS-C® was added to both the low technology (selected units) and high technology treatment units. This chemical coagulant was selected for use based on its performance in the jar-testing phase of this study. Several other coagulants performed well in the jar testing and may function in an equivalent manner. PASS-C® is a liquid polyaluminum chloride (PAC) product made by Eaglebrook® Inc. (Matterson, IL). Product formulation is proprietary; however, the manufacturer lists the PAC content between 25 and

40 percent and a product specific gravity of 1.2. A technical data sheet for PASS-C® is provided in Appendix D.

PASS-C® was added to the low technology and high technology treatment units in different manners. A peristaltic pump was used to add neat PASS-C® to seven of the low technology treatment units upstream of Sedimentation Tanks 11 through 15 and at Filter Units 8 and 9 (Table 3-1). Calibration of the chemical metering pump was verified prior to each batch treatment of storm water, and recalibrated when required. A dedicated chemical feed line ensured that only those treatment units requiring chemical addition were dosed. All lines and pipes were flushed at the beginning of a run and drained at the end of a run. For the high technology systems, neat PASS-C® was measured using a graduated cylinder and added to the Actiflo® tank. A solution of Magnafloc® LT25 (a granular anionic polymer) and micro-sand were also added to the Actiflo® tank. The Actiflo® tank itself was cleaned after each run, with residuals transferred to two 5,700 L (1,500 gallon) holding tanks. These holding tanks, located inside the pilot treatment building, were used to store chemically dosed water and sludge generated during plant operation (Figure 3-3). When full, the holding tanks were chemically characterized and the storm water-sludge residue was hauled to the South Tahoe PUD Wastewater Treatment Plant.

Two other low technology treatment units (Filters 6 and 7) received granular anionic polyacrylamide (PAM; Superfloc® A-836, Cytec Chemical) via a passive dosing "tea bag" system. Mesh bags containing pre-measured amounts of PAM were placed into a storm water supply line tee assembly on the top of each filter. As storm water flowed past these bags, PAM was dissolved and released into solution. The PAM bags consisted of stitched geotextile fabric (Mirafi Filterweave® 401) with a nominal weave opening of 0.425 mm. Each side of the bag had approximately 32 square cm (5.08 x 6.35 cm) or 5 square inches (2.0 x 2.5 inches) of surface area. Each bag contained 30-35 g (0.066 – 0.077 lbs) of dry PAM. The passive dosing assembly held two bags and was constructed of 7.6 cm (3 inch) PVC pipe and fittings. A pre-weighed PAM bag was suspended into each of the tee assemblies prior to filling the filters. After the filters were filled with storm water (approximately 5 minutes), the bags were retrieved and the tee assembly drained. The dose of PAM was determined by gravimetric analysis of the bag [i.e., oven dried at 103 ºC (217 ºF) to a constant weight].

3.2.2.2 Batch Operations

The treatment units were operated in a batch mode, with the exception of the high technology filter and ion exchange units. Filters, sedimentation tanks, and the batch Actiflo® tank were filled by metering in the prescribed volume of storm water using a paddle wheel flow meter and totalizer. Calibration of the flow meter was verified by checking that the flow meter value matched a predetermined volumetric measure of water in the sedimentation basin .

Low-Technology Treatment Systems: For each test run, the amount of storm water treated through the filtration portion of each of the low-technology systems was equivalent to a depth of 183 cm (72 inches) over the filter area, or approximately 833 liters (220 gallons) (filter loading rates are discussed in Section 5.3.1). Each run was conducted in two treatment cycles, with half of the volume [416 L (110 gallons)] treated each time. For the six low-

technology treatment systems that included sedimentation tanks, an initial volume of 833 liters (220 gallons) was added to each sedimentation tank for the first part of the run. After 2 hours of sedimentation time, the upper half of the supernatant was released to the filters by opening a mid-depth valve and allowing half the water to drain directly on to the filter surface via the transfer piping and the filter inlet manifold. The rate of transfer was limited only by pipe constriction and the ability of the media to accept water. Typically, the time required to transfer water from the sedimentation tank to the filter was on the order of 5-7 minutes for new media (time required to filter was a recorded parameter and is listed as an entry in the database, Appendix A). Following the first sedimentation/filtration cycle, an additional 416 L was added to the sedimentation tank bringing the volume back up to 833 liters. After 2 hours, the upper 416 L (110 gal) was again released to the filter. Therefore, counting the 416 L (110 gallons) that remains in each of the six sedimentation tanks after release to the filters (i.e., static storage volume), a total of 15,000 liters (3,960 gallons) of storm water was required for each run of the low-technology systems. At the conclusion of each run, the remaining storm water in the sedimentation tanks and any accumulated sludge in the tank bottom was pumped to the inside holding tanks for eventual disposal.

High-Technology Treatment Systems: High-technology treatment systems consisted of a simulation of the Actiflo® high rate sedimentation process followed by effluent polishing using either Fuzzy Filter® (FF) filtration or a high rate pressure sand filtration (PSF). Effluent from either of the two polishing filters then went through both anion and cation exchange resin cartridges (Figures 3-2 and 3-4). Early in the project, two additional units (a 10 micron pleated filter and a modified clay filter) preceded the two ion exchange cartridges. After consultation with Caltrans project personnel it was deemed that these units were redundant to the filters and their use was discontinued after Run 1.

The Actiflo® simulation batch tank, a specially fabricated stainless steel tank, has a total volume of approximately 984 L (260 gallons). The tank provided approximately 757 L (200 gal) of settled storm water and approximately 227 L (60 gal) of dead volume for the particulates and solids. Mixing was accomplished using a mechanical mixer mounted on the top of the tank.

At the beginning of each high-technology run, the Actiflo® tank was filled to a depth of approximately 122 cm (48 inches) with storm water. After the tank was filled, 5 L (1.3 gal) of microsand (ballast sand) was introduced to the tank and mixed briefly prior to PASS-C® (coagulant) addition. Initially, PASS-C® was dosed to yield a concentration of 100 mg/L (neat) but later increased to 125 mg/L (see Section 3.3.9). The mixer was run at high speed for 3.5 minutes with micro-sand and coagulant. After the rapid mixing, pre-dissolved Magnafloc® LT25 polymer was dosed to achieve a final concentration of 1.0 mg/L. Rapid mixing was continued for an additional 30 seconds. A slow mix was then conducted for 1.5 minutes to allow the floc to mature. Mixing was then discontinued and the tank contents were allowed to settle for 3 to 20 minutes (see run notes, Chapter 4). After settling, the upper portion of the tank was pumped to either the Fuzzy Filter® or the high pressure sand filter. Approximately 379 L (100 gal) of the Actiflo® tank volume was pumped through the Fuzzy Filter® and subsequent ion exchange canisters at a flow rate of 9.8 Lpm (2.6 gpm). Following operation of the Fuzzy Filter® the valves were switched and the remainder of the

usable portion of the Actiflo® tank (100 gal) was sent to the pressure sand filter and subsequent ion exchange canisters at the same flow rate (2.6 gpm). Surface and volumetric loading rates for the high technology units are summarized in Table 3-5. Fuzzy Filter® media was periodically removed and cleaned (see run notes, Chapter 4). The pressure sand filter unit was not backwashed throughout the study (no appreciable pressure drop noted). After the high-technology run was complete, the remaining water in the Actiflo® tank was emptied through a floor drain. Accumulated sludge and sand was vacuumed out and sent to the holding tanks for eventual disposal prior to processing the next batch of storm water.

Table 3-5. Calculated Loading Rates for the High-Technology Treatment Units

Treatment Unit	Flow Rate (gpm)	Area (ft^2)	Volume (ft^3)	Calculated Loading Rates	
				Surface (gpm/ft^2)	Volumetric (gpm/ft^3)
Fuzzy Filter®	2.6	0.087	0.152	29.9	17.1
Pressure Sand Filter[a]	2.6	1.0	1.0	2.6	2.6
Ion Exchange Columns[b]	2.6	0.047[c]	0.066[d]	55.3	39.4

(a) Pressure sand filter unit, PEP Model CL-12 (Process Efficiency Products, Mooresville, NC.)
(b) Anion, cation exchange columns and housing obtained from American Filterworks, Los Angeles, CA. Housings are Ametek™ 20" Big Blue units. Cation cartridge part # PS-20-BB-1031. Anion cartridge part # SS-20-BB-1050.
(c) Area of the ion exchange cartridge itself.
(d) Volume of ion exchange resin.

3.2.3 Sampling and Lab Analyses

Physical and chemical data were collected during each experimental run for development of design parameters, performance benchmarks, and to assess treatment efficiencies. Monitored water quality parameters are listed in Table 3-6.

3.2.3.1 Influent Sampling

Samples of storm water used to feed the treatment systems were collected as 6-part grab samples composited into a single container. Samples were collected into a plastic 5-gallon (18.9 L) "composite" bucket graduated into 6 equal parts. Samples were collected by opening a valve located adjacent to the storm water feed pump and filling the sample collection bucket to the appropriate mark. For Experimental Runs 1 and 3, a single "running" influent composite sample was collected throughout the filling of the tanks. For Experimental Runs 4, 5, and 6, three composite influent samples were collected. One 6-part composite sample was collected during the beginning, middle and end of the process day (I-1, I-2, I-3, respectively). To assess influent sample variation, three composite samples (beginning, middle and end) as well as a running composite (I-C) sample were collected during Experimental Run 2.

Table 3-6. Water Quality Analytical Methods and Laboratory Reporting Limits

Analytes	Method[a]	Holding Time	Container Type	Filtration	Sample Preservation	Reporting Limit	Units
Conventionals							
Specific Conductance	120.1	24 hours	Plastic	Unfiltered	None	0.1	μmho/cm
pH	150.1	None	Plastic	Unfiltered	None	0.1	Units
Alkalinity – Total (as $CaCO_3$)	310.1	48 hours	Plastic	Unfiltered	None	1	mg/L
Alkalinity - Bicarbonate (as $CaCO_3$)	310.1	48 hours	Plastic	Unfiltered	None	1	mg/L
Hardness (as $CaCO_3$)	SM 2340B	6 months	Plastic	Unfiltered	Nitric Acid	1	mg/L
Total Dissolved Solids (TDS)	160.1	48 hours	Plastic	Unfiltered	None	1	mg/L
Total Suspended Solids (TSS)	160.2	48 hours	Plastic	Unfiltered	None	1	mg/L
Turbidity	180.1	48 hours	Plastic	Unfiltered	None	0.1	NTU
Oil and Grease	1664	28 days	Glass[b]	Unfiltered	Sulfuric Acid	2[c]	mg/L
Nutrients							
Nitrate (NO_3-N)	300.0	48 hours	Plastic	Unfiltered	None	0.1	mg-N/L
Ammonia (NH_3-N)	350.3	28 days	Plastic	Unfiltered	Sulfuric Acid	0.1	mg-N/L
Nitrite (NO_2-N)	300	48 hours	Plastic	Unfiltered	None	0.1	mg-N/L
Ortho Phosphate - Total	365.2	48 hours	Plastic	Unfiltered	None	0.03	mg-P/L
Ortho Phosphate – Dissolved	365.2[d]	48 hours	Plastic	Filtered	None	0.03	mg-P/L
Phosphorus – Total	365.2	28 days	Plastic	Unfiltered	Sulfuric Acid	0.03	mg-P/L
Phosphorus – Dissolved	365.2[d]	28 days	Plastic	Filtered	Sulfuric Acid	0.03	mg-P/L
Total Kjeldahl Nitrogen (TKN), Total	351.3	48 hours	Plastic	Unfiltered	Sulfuric Acid	0.1	mg-N/L
Total Kjeldahl Nitrogen (TKN), Dissolved	351.3[d]	48 hours	Plastic	Filtered	Sulfuric Acid	0.1	mg-N/L
Total Organic Carbon (TOC)	415.1	7 days	Glass	Unfiltered	Sulfuric Acid	1	mg/L
Dissolved Organic Carbon (DOC)	415.1[d]	7 days	Glass	Filtered	Sulfuric Acid	1	mg/L

Table 3-6. Water Quality Analytical Methods and Laboratory Reporting Limits

Analytes	Method[a]	Holding Time	Container Type	Filtration	Sample Preservation	Reporting Limit	Units
Minerals							
Calcium (Ca)	200.7	6 months	Plastic	Unfiltered	None	0.05	mg/L
Potassium (K)	200.7	6 months	Plastic	Unfiltered	None	0.5	mg/L
Sulfate (SO_4)	300	28 days	Plastic	Unfiltered	None	1	mg/L
Chloride (Cl)	300	28 days	Plastic	Unfiltered	None	1	mg/L
Magnesium (Mg)	200.7	6 months	Plastic	Unfiltered	None	0.05	mg/L
Sodium (Na)	200.7	6 months	Plastic	Unfiltered	None	0.5	mg/L
Boron (B)	200.7	6 months	Plastic	Unfiltered	None	0.02	mg/L
Silica (Si)	200.7	6 months	Plastic	Unfiltered	None	1	mg/L
Metals							
Aluminum (Al) Total and Dissolved	200.8[b]	6 months	Plastic	Filtered & Unfiltered	Nitric Acid	25	μg/L
Aluminum (Al) Acid Soluble	EPA 440/5-86-008	6 months	Plastic	Lab filtered after acidification/extraction step		25	μg/L
Cadmium (Cd) Total and Dissolved	200.8[d]	6 months	Plastic	Filtered & Unfiltered	Nitric Acid	0.2	μg/L
Chromium (Cr) Total and Dissolved	200.8[d]	6 months	Plastic	Filtered & Unfiltered	Nitric Acid	1	μg/L
Copper (Cu) Total and Dissolved	200.8[d]	6 months	Plastic	Filtered & Unfiltered	Nitric Acid	1	μg/L
Lead (Pb) Total and Dissolved	200.8[d]	6 months	Plastic	Filtered & Unfiltered	Nitric Acid	1	μg/L
Nickel (Ni) Total and Dissolved	200.8[d]	6 months	Plastic	Filtered & Unfiltered	Nitric Acid	2	μg/L
Zinc (Zn) Total and Dissolved	200.8[d]	6 months	Plastic	Filtered & Unfiltered	Nitric Acid	5	μg/L
Iron (Fe) Total and Dissolved	200.8[d]	6 months	Plastic	Filtered & Unfiltered	Nitric Acid	25	μg/L

Notes:
(a) If not indicated otherwise, method is EPA. SM refers to Standard Methods for the Examination of Water and Wastewater.
(b) Two, 1L amber glass bottles are filled for each oil and grease sample.
(c) Reporting limit for oil and grease (2 mg/L) is the same as that listed in Caltrans Storm Water Monitoring Protocols. Note: Required limit of 2 mg/L was not always attained by the laboratory (see Section 3.3.6).
(d) Dissolved samples are field filtered through a 0.45μm filter prior to any required sample preservation.

3.2.3.2 Low Technology Treatment System Samples

For the low-technology treatment systems, samples were collected from the sedimentation tanks and the filtrate (effluent) collection tanks. With the exception of samples for oil and grease, the sedimentation tank samples each consisted of six grab samples composited into one container. Each sedimentation tank was filled and allowed to settle twice for each batch of storm water being tested. After the first two-hour sedimentation cycle, the upper settled portion [416 L (110 gal)] of storm water was released to the filter by opening a valve. While the sedimentation tank was draining, a grab sample was drawn from the tap at the beginning, middle, and end of the drain period to characterize the water quality being loaded onto the filter. This sampling was repeated when the tank was draining the second time (two sedimentation tank fillings per run) to make a composite sedimentation tank sample that consisted of 6 grabs. Oil and grease samples were collected directly from the sampling tap into the laboratory bottles.

Sampling of the water after granular media filtration was accomplished by twice filling a sample bucket one-half full with water from the effluent collection tank. All of the water passing through the granular media filters was collected in individual collection tanks (416L [110 gal]). After mixing, a sample was drawn from the sample collection tank by opening a valve and collecting a sub-sample in a "composite" (5 gallon) sampling bucket. After sampling, the water in the effluent collection tank was sent to waste and the tank readied for the second filling. A sample of the filter effluent consisted of two parts, one collected during the first filling and one from the second filling. Again, oil and grease samples were collected directly from the sampling tap into the laboratory bottles.

3.2.3.3 High Technology Treatment System Samples

Sampling the various high-technology treatment units was accomplished by opening a valve and drawing process water into the appropriate "composite" sample collection bucket. Unlike the low-technology filter units, there was no effluent collection tank to capture the entire run volume for sampling.

A single batch Actiflo® run (260 gal, 984 L) was conducted for each Experimental Run and the water contained in the tank was used to evaluate both the Actiflo®- pressure sand filter - ion exchange treatment train as well as the Actiflo® - Fuzzy Filter® - ion exchange train. The Actiflo® composite sample itself consisted of a 6-part composite collected over approximately 1.3 hours. In a typical batch Actiflo® run, the first 379 L (100 gal) of clarified effluent was sent through the Fuzzy Filter® (and subsequent ion exchange units) and, after switching the valves, the next 379 L (100 gal) was sent through the pressure sand filter (and ion exchange units). One-sixth of the Actiflo® composite sample was collected at the beginning, middle, and end of each of both the Fuzzy Filter® and pressure sand filter runs to make up a single composite sample representative of the batch Actiflo® process effluent. To ensure equilibration, the system was allowed to run for approximately 12 minutes prior to collection of the first composite fraction.

Table 3-7 outlines the typical high technology run sequence of events and approximately when the composite sample fractions were collected.

Table 3-7. Typical High-Technology Sampling Event Sequence

Time (min.)	Event	Grab Sample Fraction (placed into a single composite container)				
		Actiflo®	Fuzzy Filter® & Ion Exchange		Pressure Sand Filter & Ion Exchange	
		(A)	(FF)	(IX-FF)	(PSF)	(IX-PSF)
0	Actiflo® settling time complete, feed pump turned on directing flow to the Fuzzy Filter® and IX units					
12	First Fuzzy Filter® sample fractions	1/6	1/3	1/3		
24	Second Fuzzy Filter® sample fractions	2/6	2/3	2/3		
36	Last Fuzzy Filter® sample fractions	3/6	3/3	3/3		
38.5	Pump turned off, valves redirected to send flow to the pressure sand filter					
40	Feed pump turned on					
52	First pressure sand filter sample fractions	4/6			1/3	1/3
64	First pressure sand filter sample fractions	5/6			2/3	2/3
76	First pressure sand filter sample fractions	6/6			3/3	3/3
77	High technology run terminated.					

The filters (Fuzzy® and pressure sand) received treated storm water only from the Actiflo® process. One filter at a time received flow from the Actiflo process. Piping was modified to isolate the first filter and bring on-line the second filter. Each filter – ion exchange train was run for approximately 38.5 minutes (treating approximately 379 L, 100 gal). Samples for both filters and ion exchange units were three-part composites. After equilibration of approximately 12 minutes, one-third of the sample was collected at the beginning, middle, and end of each run.

Depending on whether the Fuzzy Filter® or pressure sand filter was run first, the process water in the Actiflo® tank had a longer time to settle. An assessment of the significance of additional Actiflo® sedimentation time is presented in Section 5.3.3.

Though the results in Chapter 5 are presented similarly for all the experimental runs, there were differences among the six experimental runs with regard to how the ion-exchange process was monitored. During Experimental Run 1, the effluent from the ion exchange units was pooled as six-part composite samples with three parts (i.e., beginning, middle, end) from the pressure sand filter process line and three parts (i.e., beginning, middle, end) from the Fuzzy Filter® process line. The four ion-exchange canisters were sampled individually. During Experimental Run 2, no samples were collected due to hydraulic failure, as described in Chapter 5. For Experimental Run 3, the effluent from the Fuzzy Filter® process line and the pressure sand filter process line were collected separately (i.e., not combined as in

Experiment 1). For Experimental Runs 4 through 6, the pre-treatment canisters (pleated filter and clay) were removed and effluent samples from the Fuzzy Filter® process line and the pressure sand filter process line were collected separately as in Experiment 3.

A detailed description of the collection of oil and grease samples from the high technology treatment systems is presented in the *Lake Tahoe Storm Water Treatment Pilot Project Monitoring and Operations Plan* (Caltrans, 2002a).

3.2.3.4 Sample Processing

Field-conducted sample processing activities included splitting the sample into multiple sample containers for various contaminant analyses and filtering various samples for dissolved analyses. Some of the samples required specific container compositions, volumes, and preservatives. These requirements were met in accordance with the sampling and analytical requirements established by Caltrans for the monitoring of storm water and are summarized in Table 3-5.

Environmental contamination of the samples during processing was minimized by making use of "clean sampling techniques" as outlined in the *Caltrans Guidance Manual: Storm Water Monitoring Protocols* (Second Edition), CTSW-RT-00-005, Caltrans, 2000. Various degrees of rigor exist in so-called "clean" sampling protocols, culminating with the "clean hands/dirty hands" procedure as outlined in EPA Method 1669 and in Appendix F of the aforementioned *Storm Water Monitoring Protocols*. The clean hands/dirty hands procedure, as outlined in the project *Monitoring and Operations Plan*, was implemented for Experimental Run 3 and all subsequent runs. Prior to Run 3, while sampling activities involved less rigorous procedural techniques, they were consistent with those presented in the *Storm Water Monitoring Protocols* document.

After Experimental Run 3, the "clean hands/dirty hands" procedure presented in the project *Monitoring and Operations Plan* was modified for the remaining runs (Experimental Runs 4 through 6). Each treatment unit sample required 11 sample containers, some of which required field filtering, with 30 sampling locations. Using the standard "clean hands/dirty hands" procedure required 1.5 person-hours per sample for splitting and filtering alone. To reduce the labor requirement, a modified "clean hands/dirty hands" procedure was adopted which did not require a full time, two-person crew for each sample processed. This modified sampling procedure is presented in Appendix E.

3.2.3.5 Field Measurements of Samples Collected

A portion of the sample was collected from the composite buckets for field characterization. Temperature, pH, conductivity, and turbidity were measured on-site using portable meters. Operation, calibration and maintenance of these meters were performed according to manufacturer recommendations.

3.2.3.6 Sample Identification Numbers

The sample point and numbering designation associated with each treatment unit are presented in Table 3-3 and Figure 3-4. Log numbers used for sample tracking consisted of the run number (1 through 6) followed by the treatment unit designation. A complete list of sample collection points and samples collected during the first year of operation is presented in Chapter 5 (Table 5.1).

3.2.3.7 Quality Assurance and Control Samples

Quality Control (QC) samples collected throughout the project included field blanks, field duplicates, bottle blanks and lab QC samples. Quality control samples were not assigned the same log numbers each time they were collected (to decrease the possibility of laboratory bias). Quality control samples were collected and processed like other samples, labeled, recorded on the chain-of-custody forms, and transported to the laboratory along with the rest of the experimental run samples.

3.2.3.8 Sample Delivery and Chain-of-Custody

Samples were kept on ice from the time of collection until received by the laboratory. Samples shipped to the laboratory were placed inside coolers with ice and were well packaged (i.e. with bubble wrap, foam, etc. when necessary). The ice coolers were packed with sufficient ice to maintain a temperature near 4°C during transport. Cooler lids were secured with packaging tape. Samples were shipped to the laboratory via commercial delivery service.

3.2.3.9 Laboratory Analyses

Analytical methods, reporting limits, holding times, and sample container requirements are presented in Table 3-6. Total concentrations were determined for all of the constituents (except dissolved organic carbon) listed in Table 3-5 for all samples from the treatment systems. Dissolved concentrations were determined for the trace metals (Al, Cd, Cr, Cu, Pb, Ni, Zn, and Fe) and for the nutrients (TKN, Ortho-P, and P). Samples were field filtered using 0.45 µm cartridge filters. The monitoring of aluminum included the analysis of total, dissolved and acid-soluble.

3.3 Deviations From The Monitoring and Operations Plan

Treatment units were constructed and operated as outlined in the *Monitoring and Operations Plan* (Caltrans, 2002a), except for deviations required to address site-specific conditions. Deviations from the *Monitoring and Operations Plan* and issues encountered are discussed in the following section.

3.3.1 Flowrate Measurement

Two flowmeters were used to measure the pumping rate and total volume of storm water supplied to the treatment units. The flowmeters used a paddle wheel sensor that is typically suitable for most applications. However, the flowmeters only functioned on the high-

technology systems through Experimental Run 2 and on the low-technology systems during Experimental Runs 3 through 6.

Flowmeter failure apparently occurred due to failure of the paddle wheel to spin. Prior to each run the sensors were removed, cleaned, and inspected. On several occasions a buildup of solid particles was observed on the magnetic tips of the paddle wheel. Deposition of iron-containing particles from the storm water was believed to be a probable cause, though the composition of the particles was not tested. The storm water contained between 3 and 33 mg/L of total iron, less than 0.5 mg/L of which was in the dissolved form.

When flowmeter failure occurred on the low-technology systems, the Seepex™ positive displacement pumps were set at the desired flowrate and manual calibration used to ensure proper flow transfer. The 220-gallon mark on the storage tank was used to calibrate the desired flow rate (time-volume measurements). Error associated with this means of flow-control was calculated to be approximately 1% of the total transferred volume.

Flowmeter failure on the high technology systems was less common, presumably because of the higher quality storm water after Actiflo® sedimentation. However, flowmeter failure did occasionally occur, and was mitigated by setting the flowrate in a manner similar to that described above for the low-technology systems, with the exception that a bucket and stopwatch was used to calibrate the flowrate. The use of the so-called "bucket and stopwatch" method for flow rate calibration is listed in the *Caltrans Storm Water Monitoring Protocols* (Caltrans, 2000).

3.3.2 Filter Effluent Sampling

Sampling of the filter effluent was as outlined in the *Monitoring and Operations Plan*, with the following operational modification - prior to sampling the sedimentation tank effluent; the first 3.8 L (1 gallon) of water in the piping was discarded so that floc and sediment trapped in the piping did not bias the composite sample.

3.3.3 Target High Technology Flowrate

The high technology system was operated at a flow rate of 3 gpm for Experimental Run 1. This operational flowrate was in error because it resulted in a filtration rate in excess of the 30 gpm/ft^2 rate specified in the *Monitoring and Operations Plan*. Subsequent runs were operated at 2.6 gpm, which corresponded to the target polishing filter loading of approximately 30 gpm/ft^2.

3.3.4 Filtration Rate

The filtration rate of the granular media filters was monitored as specified in the Monitoring and Operations Plan. The filtration rate of the various low technology filter media was calculated by recording water drawdown as a function of time. Initial filtration rates are those determined using clean water at the time of construction. Final filtration rates are the latest determined using storm water during the course of study.

Filtration rate measurements were complicated by the different methods and rates at which flow was delivered to the filters compared to the rates at which water drained through the filters. Filter units that were not preceded by sedimentation basins were filled at a rate of 4.8 gpm/ft^2. Filter units that were preceded by sedimentation basins were filled by simply opening a valve and letting the water flow from the sedimentation basin. In this case the flow rate to the filter was variable, depending on the relative head of water in the filter and the sedimentation basin. Initially, when the sedimentation basin was full and the filter was empty, the rate was high, limited only by the capacity of the piping between the two units. As a head of water developed over the filter (for some units) and the water level in the sedimentation basin decreased, the transfer rate slowed. Any filter media that was capable of draining at a rate faster than its fill rate has its true filtration rate underestimated. For example, the drain rate was quicker than the fill rate for the coarse sand media filters (i.e., 2-F, 7-F, 9-F, and 12-F) and the zeolite media filter (i.e., 13-F) and therefore cannot be accurately compared to the filtration rate measurements for the fine sand, activated alumina, and aluminum oxide medias that did not drain quicker than their fill rates.

The filtration rates presented in Chapter 5 of this report are based on the total time taken to pass the total volume of water applied to the filter in each part of a run, expressed as a filter loading rate in gallons per minute per square foot of filter surface. They do not reflect the variability of filtration rates during a run.

In some instances the final filtration rate was described as "failure." Failure is defined as the inability of the media to pass within five hours the 110 gallons of storm water applied to it during each filling, due to clogging or blinding. Two filter runs were conducted for each experimental run. If a filter failed on the first filling of a run, no sample was collected. If a filter failed on the second filling, a sample was collected and results reported. Discussion pertaining to filter failure is provided in Chapter 5.

This filter loading procedure is different than that used as part of the Best Management Practice Retrofit Pilot Program conducted in southern California. In the Retrofit Pilot Program, the pilot systems were of a "full scale" size and the units were designed with an inlet feed system to apply water over a 24-hour period. The impact of these two different operational strategies is discussed in Chapter 5.

3.3.5 Concrete Sand

The concrete sand used in the pilot testing was selected to represent multipurpose, readily available sand material that is considerably less expensive than filter sand. Concrete sand was to meet ASTM C-33 concrete sand specifications. A comparison of the particle size distribution for the pilot plant sand to the ASTM C-33 specification is provided in Table 3-8.

Although a single sieve sample is not sufficient to fully characterize the material used owing to the fact that tolerances for errors in sieve analysis can be up to 10 percent, the tested concrete sand appeared to comply with the ASTM C-33 specifications.

Table 3-8. Comparison of Sieve Size for ASTM C-33 Sand and the Concrete Sand Used

USA Standard Sieve Size		Percent Finer by Weight	
Mesh	Millimeters	Target Values ASTM C-33	Pilot Plant Sand Used[(a)]
(3/8")	9.500	100 - 100	100
4	4.750	95 - 100	99
8	2.360	80 - 100	86
16	1.180	50 - 85	63
30	0.600	25 - 60	39
50	0.300	5- 30	23
100	0.150	0 - 10	4

(a) Estimated from sieve analysis with a slightly different sieve stack.

3.3.6 Oil and Grease Analytical Detection Limit

Samples collected during Experimental Runs 1 through 3 were processed by Pat-Chem Laboratories (Moorpark, California). Samples collected during the remainder of the first year of operation were processed by ToxScan/Soil Control Lab (Watsonville, California). In switching laboratories, the required detection limit for project oil and grease samples in Experimental Run 4 was not attained. A 2 mg/L detection limit is not standard, and the processing requires the extraction of double the analytical volume. Two 1 L bottles were shipped to the laboratory but only a single sample was extracted. Because Experimental Runs 4 and 5 were 20 days apart, the error was not corrected until Experimental Run 5.

3.3.7 Experimental Run 6 Operation

An abbreviated "low technology" experimental run was conducted during Experimental Run 6. The processes investigated included: (1) Activated aluminum direct filtration [4-F], (2) sedimentation followed by concrete sand filtration [10-S and 10-F], and (3) PASS-C® enhanced sedimentation followed by fine sand filtration [11-S and 11-F]. A new unit [101-S] was setup to evaluate PAM enhanced sedimentation.

Two different high technology runs were conducted. The first run consisted of the Actiflo® process followed by Fuzzy Filter® filtration and ion exchange. During the second run, the Actiflo® was operated in a non-proprietary manner by filling the tank with storm water, and dosing polymer and coagulant but no micro-sand. Filtration made use of the pressure sand filter only, followed by ion exchange. Further details are provided in Chapter 4, Table 4-6.

3.3.8 PAM and PAM Filter Units

As specified in the *Monitoring and Operations Plan*, the dose of PAM was to be determined by gravimetric analysis [i.e., oven dried at 103ºC to a constant weight]. After several attempts, the actual variation in measurement was too large to accurately determine the dose. Additionally, poor control over the passive dosing mechanism resulted in filter occlusion

starting with Experimental Run 1. While passive dosing of a filter aid is an attractive concept, considerable research must be done to develop better dosage control. As a result of filter blinding, PAM dosing to Experimental Units 6 and 7 (fine and coarse sand, respectively) was discontinued after the third run.

3.3.9 Altering Chemical Dose to the Actiflo® Process

Prior to any of the Experimental Runs, the operation of the batch Actiflo® process was tested and optimized by project personnel and a representative of Krüger – US Filter (Actiflo® license holder). Using storm water from the on-site basin, mixing times and paddle speeds were determined. At the same time, the optimal coagulant (PASS-C®), polymer (Magnafloc® LT25) and micro-sand dose (5 L/260 gal. storm water) was determined by running both jar test and actual batch runs. Results of this on-site optimization were that the process was generally very effective using a wide range of coagulant (50-150 mg/L) and polymer (0.3 – 1.5 mg/L) doses for this specific source water (on-site basin). However, using storm water collected from the Tahoe City wetland and the Snow Storage Yard (Experimental Runs 2 and 3) the process did not develop the classical robust floc typical of previous Actiflo® runs. After consultation with the Krüger representative, the coagulant dose was increased from approximately 100 mg/L to approximately 125 mg/L. At the same time, the polymer dose was increased from 0.8 mg/L to 1.0 mg/L.

3.3.10 Servicing of High Technology Units

It was anticipated that the ion exchange cartridges would last for the duration of the project and that exchange and resin loading calculations would be made. However, because of flow occlusion (see Section 5.3.4.3) attributed to an accumulation of either a small amount of floc or un-reacted polymer leaving the Actiflo® process, the ion-exchange units (anion and cation) were replaced with new cartridges for Experimental Runs 3 through 6. It should be noted that the cartridges were replaced for flow reasons and not because the resin was exhausted.

After Experimental Run 3, it was noted that the Fuzzy Filter® media was slightly discolored (see Section 5.3.4.2). The discoloration was attributed to either retained solids or internal biological growth resulting from stagnant water remaining within the filter between experimental runs. After experimental Run 3, the media was serviced or replaced between runs. Servicing involved draining residual storm water from the filter and re-filling with de-ionized water. Used media was removed and washed in hot-tap water, air dried and reused. Since the synthetic media used in the Fuzzy Filter® holds residual water even when drained, it is likely that a servicing regimen will be required if the filter is not in semi-continuous operation.

The pressure sand filter was drained between runs. Through operation of the pilot runs, no head loss through the pressure sand filter was observed. Therefore, the pressure sand filter was not backwashed at any time during the study.

Chapter 4

Pilot Project Experimental Runs

Chapter 4 Pilot Project Experimental Runs

This chapter presents specific information relating to the six experimental runs conducted during the first year of pilot project operations. Information about each run is summarized in tabular form. Additionally, the storm water collected and treated as part of this study is compared to water quality characteristics observed as part of the greater Tahoe Highway Runoff Characterization and Sand Trap Effectiveness Study to assess applicability of treatment results to storm water originating from other areas within the Lake Tahoe Basin.

4.1 Experimental Run Information

Field notes for each of the six experimental runs are summarized in Tables 4-1 through 4-6. Tabulated field notes include the run date, weather conditions, sample collection details, the analytical laboratory used, and field influent water quality measurements (pH, EC and turbidity). Also included are references to which treatment units were operated and any variations in operation.

Listed in the field notes (Tables 4-1 through 4-6) are values for filter "drain time". For units 1-9, this is the length of time between the end of filling (pump off) and when no standing water remained on the surface of the filter. For the sedimentation - filter units (units 10-15), drain time is the time required for the sedimentation tank to empty after opening the transfer valve. Time versus drawdown data were recorded in the field. Drain times of 9999 in Tables 4-1 through 4-6 indicate that no endpoint was recorded (i.e. filter hydraulic failure).

Additional run related information can be found in the database pages contained in Appendix A.

4.2 Pilot Project Influent Storm water

The primary objective of the small-scale storm water treatment pilot project is to evaluate the effectiveness of storm water treatment methods for producing an effluent that complies with the numeric discharge limitations summarized in Table 2-1. Collected storm water must, therefore, be representative of typical Lake Tahoe Basin storm water. The actual location of storm water collected as part of this study is not as important as whether the storm water was representative of Lake Tahoe Basin storm water. Limited monitoring shows that the mean and median values for several of the conventional parameters (e.g., EC, TSS, TDS, and hardness) and most of the total metals are higher in the Lake Tahoe Basin storm water than in the statewide storm water runoff averages (Caltrans 2002b, CTSW-RT-02-044). Comparisons of storm water collected for testing in this project to "typical" Lake Tahoe Basin storm water quality are made in the following section.

Table 4-1. Field Notes - Experimental Run Number 1

Run Number	1			
Date Run	February 20, 2002			
Water Source	Water collected from on-site basin (situated next to the facility). Water pumped from basin to Baker tank between 3 and 4 pm on 2/19/02			
Weather	Light rain.			
Storm Water Characteristics (influent)	**pH**	**Temp (ºC)**	**EC (µmhos/cm)**	**Turbidity (NTU)**
	7.5	14	2,357	904
	(On-site measurements)			
Laboratory Used	PatChem			

Operational Summary

Filter Units	**Filter Units**	**Operating Status**	**Drain Time (min.)**	
(Run 1)			**1st fill**	**2nd fill**
	Filter 1 (fine sand)	ok	3.1	3.7
	Filter 2 (coarse sand)	ok	0	0
	Filter 3 (zeolite)	ok	0.3	0.4
	Filter 4 (activated alumina)	ok	6.8	8.2
	Filter 5 (aluminum oxide)	ok	0.6	0.8
	Filter 6 (fine sand + PAM)	Failed on 1st filling, no sample collected	9999	9999
	Filter 7 (coarse sand + PAM)	ok	0.6	7.4
	Filter 8 (fine sand + 100 mg/L PASS-C)	ok	4.7	6.1
	Filter 9 (coarse sand + 100 mg/L PASS-C)	ok	0	1.0
	Field observations noted that the first 110-gals processed through the filters looked less turbid than the second 110-gallon batch processed. This was attributed to clear water remaining in the filter underdrains after initial conditioning (6 days earlier).			

Sedimentation Tank/Filter Units	**Sedimentation/Filter Units**	**Operating Status**	**Drain Time (min.)**	
			1st fill	**2nd fill**
Operating Status	Sed/Filt 10 (sed/no chem/concrete sand)	ok	18.0	21.5
	Sed/Filt 11 (sed/chem/fine sand)	ok	7.2	10.0
	Sed/Filt 12 (sed/chem/coarse sand)	ok	7.0	7.0
	Sed/Filt 13 (sed/chem/zeolite)	ok	7.0	7.0
	Sed/Filt 14 (sed/chem/activated alumina)	ok	9.8	13.0
	Sed/Filt 15 (sed/chem/aluminum oxide)	ok	7.0	7.0
	Two hour sedimentation time used, chemical dose (where used) = 100 mg/L (7.3 mL/min)			

Table 4-1. Field Notes - Experimental Run Number 1

High-Tech System (Run 1)

Initial Conditions:

Sand filter and Fuzzy Filter® pre-conditioned with tap water on 2/14/02. Ion exchange system consists of pleated filter (IX1), modified clay filter (IX2), anion resin (IX3) and cation resin (IX4). Pressure sand filter run first. Composite samples were collected from each sample port, with no separation between pressure sand filter and Fuzzy Filter® runs.

Actiflo® Run

Coagulant Dose (PASS-C®)	100 mg/L
Polymer Dose (Magnafloc® LT25)	0.8 mg/L
Micro-sand	5 L

	Step	Time	Process	Mixer Speed (HZ)
Operation:	0	0	Tank filled with 260 gal. storm water	0
	1	0	Dose with micro-sand and coagulant	60
	2	3.0	Dose with polymer	60
	3	3.5	Maturation, reduce speed	40
	4	5.0	Mixer off, begin sedimentation	0
	5	8.0*	End sedimentation, begin processing	-

* 3 minute sedimentation time

Fuzzy Filter® Run

Flow Rate:	3 gpm
Volume Treated:	90 gal
Media Condition:	New

Pressure Sand Filter Run

Flow Rate:	3 gpm
Volume Treated:	90 gal
Media Condition:	New

Ion Exchange Units

IX-1, Pleated Filter:	New
IX-2, Modified Clay:	New
IX-3, Anion Resin:	New
IX-4, Cation Resin:	New

Notes: Ion exchange samples collected at each sampling port (IX-1, IX-2, IX-3, IX-4) as multiple grab sample fractions composited into a single container. Composite sample fractions during pressure sand filter operation composited with fractions collected during Fuzzy Filter operation for all IX samples.

Sampling Notes (Run 1)

1-16-F = Field duplicate of 1-9-F
1-16-S = Equipment blank (using store bought DI water)
A single running composite influent sample collected.

Table 4-2. Field Notes - Experimental Run Number 2

Run Number	2			
Date Run	March 6, 2002			
Water Source	Water collected from the Placer County Wetlands Inlet (sand trap just below culvert) located on the west side of the Albertson's grocery store, intersection of SR 89 and SR 28, Tahoe City, California. Water hauled via truck (2 trips) in the afternoon of 3/5/02.			
Weather	Variable - rain and snow, sunny to cloudy			
Storm Water Characteristics (influent)	**pH**	**Temp (ºC)**	**EC (µmhos/cm)**	**Turbidity (NTU)**
	7.5	9	192	66
	(On-site measurements)			
Laboratory Used	PatChem			

Operational Summary

Filter Units	**Filter Units**	**Operating Status**	**Drain Time (min.)**	
(Run 2)			**1st fill**	**2nd fill**
	Filter 1 (fine sand)	ok	3.2	4.8
	Filter 2 (coarse sand)	ok	0	0.4
	Filter 3 (zeolite)	ok	0.6	1.1
	Filter 4 (activated alumina)	ok	8.1	9.8
	Filter 5 (aluminum oxide)	ok	0.8	1.5
	Filter 6 (fine sand + PAM)*	ok	4.8	7.6
	Filter 7 (coarse sand + PAM)	ok	1.5	4.2
	Filter 8 (fine sand + 100 mg/L PASS-C)	ok	5.6	8.9
	Filter 9 (coarse sand + 100 mg/L PASS-C)	ok	0	1.1

* Filter plugged during Run 1 and was reconditioned prior to Run 2. Reconditioning consisted of excavating the top layer (est. ¾ inch of fine sand/PAM gel), adding new media, and flushing with tap water.

Sedimentation Tank/Filter Units	**Sedimentation/Filter Units**	**Operating Status**	**Drain Time (min.)**	
			1st fill	**2nd fill**
(Run 2)	Sed/Filt 10 (sed/no chem/concrete sand)	ok	21.0[e]	24.0[e]
	Sed/Filt 11 (sed/chem/fine sand)	ok	8.0	9.5
	Sed/Filt 12 (sed/chem/coarse sand)	ok	5.2	8.8
	Sed/Filt 13 (sed/chem/zeolite)	ok	5.8	7.2
	Sed/Filt 14 (sed/chem/activated alumina)	ok	10.9[e]	12.5[e]
	Sed/Filt 15 (sed/chem/aluminum oxide)	ok	5.3[e]	6.5[e]

Two hour sedimentation time used, chemical dose (where used) = 100 mg/L (7.3 mL/min)
[e] indicates estimated value

Table 4-2. Field Notes - Experimental Run Number 2

High-Tech System (Run 2)

Initial Conditions:

System as is after Run 1 (14 days prior). Ion exchange system consists of pleated filter (IX1), modified clay filter (IX2), anion resin (IX3) and cation resin (IX4). Pressure sand filter operated first, followed by Fuzzy Filter.

Actiflo® Run

Coagulant Dose (PASS-C®)	100 mg/L
Polymer Dose (Magnafloc® LT25)	0.8 mg/L
Micro-sand	5 L

	Step	Time	Process	Mixer Speed (HZ)
Operation:	0	0	Tank filled with 260 gal storm water	0
	1	0	Dose with micro-sand and coagulant	60
	2	3.0	Dose with polymer	60
	3	3.5	Maturation, reduce speed	40
	4	5.0	Mixer off, begin sedimentation	0
	5	8.0	End sedimentation, begin processing	-

Fuzzy Filter® Run	Flow Rate:	2.6 gpm
	Volume Treated:	62 gal
	Media Condition:	Old, from Run 1
Pressure Sand Filter Run	Flow Rate:	2.6 gpm
	Volume Treated:	33 gal
	Media Condition:	Unchanged from Run 1
Ion Exchange Units	IX-1, Pleated Filter:	Old, from Run 1
	IX-2, Modified Clay:	Old, from Run 1
	IX-3, Anion Resin:	Old, from Run 1
	IX-4, Cation Resin:	Old, from Run 1

Notes: High-tech run problems evident within first few minutes of operation (Flow = 2.6 gal/min). Flow meter failure noted at time = 3 min (removed and serviced)

Pressure sand filter (PSF) operated first. Excessive back pressure (>55 psi) caused flow by-pass from the relief valve 52 gallons into the 100 gallon PSF run. Gauge readings indicate backpressure due to pleated filter failure (IX1). Pleated filter removed and the system was turned back on. Excessive pressure triggered relief near end of PSF run. Removed clay filter (IX2) and replaced original pleated filter (IX1). Pressure and flow ok.

At approximately 10 gal into the FF run (flow = 2.6 gpm) pressure reading 48 psi prior to IX cartridges. At 17.5 gal mark, flow down to 2 gpm and water flowing from relief valve. Removed both clay and pleated filter and continued run. At 33.3 gallon mark, relief valve again flowing and unable to maintain flow rate.

Because of overall inconsistencies in flow rates and unit processes, a decision was made to discontinue the high-tech run and concentrate on getting the system operational for the following run. No high-tech samples sent to the laboratory for Run 2.

Sampling Notes (Run 2)

2-16-S = Field duplicate of 2-14-S

2-16-F = Equipment blank (using store bought DI water)

Three grab influent samples were collected at the beginning (12:00 noon), middle (2:35 pm) and towards the end (4:10 pm) of the run. Additionally, a running composite influent sample was collected.

Table 4-3. Field Notes - Experimental Run Number 3

Run Number	3			
Date Run	March 7, 2002			
Water Source	Water collected from the snow storage yard at the point of runoff entry into the first pond. Snow Storage Yard is located at the end of Sierra Boulevard in the City of South Lake Tahoe, California (outside the City limits) Water hauled via truck (2 trips) in the morning of 3/5/02.			
Weather	Variable - rain and snow, sunny to cloudy			
Storm Water Characteristics (influent)	**pH**	**Temp (ºC)**	**EC (µmhos/cm)**	**Turbidity (NTU)**
	7.3	9	480	1038
	(On-site measurements)			
Laboratory Used	PatChem			

Operational Summary

Filter Units (Run 3)	**Filter Units**	**Operating Status**	**Drain Time (min.) 1st fill**	**2nd fill**
	Filter 1 (fine sand)	ok	4.6	5.1
	Filter 2 (coarse sand)	ok	0.3	0.7
	Filter 3 (zeolite)	ok	1.0	1.0
	Filter 4 (activated alumina)	ok	9.6	10.3
	Filter 5 (aluminum oxide)	ok	1.4	1.5
	Filter 6 (fine sand + PAM)	Failed on 2nd filling[1]	120	9999
	Filter 7 (coarse sand + PAM)	Failed on 2nd filling[2]	60.0	9999
	Filter 8 (fine sand + 100 mg/L PASS-C)	ok, slowing	15.5	65.0
	Filter 9 (coarse sand + 100 mg/L PASS-C)	ok	1.6	1.6

[1] Second filling drained approximately half way before blinding. Sample collected

[2] First filling drained in 1 hour, second filling drained only partially (1/3) before blinding. Sample collected

Sedimentation Tank/Filter Units	**Sedimentation/Filter Units**	**Operating Status**	**Drain Time (min.) 1st fill**	**2nd fill**
(Run 3)	Sed/Filt 10 (sed/no chem/concrete sand)	ok	24.0	26.5
	Sed/Filt 11 (sed/chem/fine sand)	ok	8.9	9.0
	Sed/Filt 12 (sed/chem/coarse sand)	ok	8.0	10.0
	Sed/Filt 13 (sed/chem/zeolite)	ok	5.8	5.7
	Sed/Filt 14 (sed/chem/activated alumina)	ok	12.1	12.4
	Sed/Filt 15 (sed/chem/aluminum oxide)	ok	6.0	4.0

Two hour sedimentation time used, chemical dose (where used) = 100 mg/L (7.3 mL/min)

Table 4-3. Field Notes - Experimental Run Number 3

High-Tech System (Run 3)

Initial Conditions:

After failure in Run 2 (previous day) all cartridges replaced and system flushed. Ion exchange system consists of pleated filter (IX1), modified clay filter (IX2), anion resin (IX3) and cation resin (IX4). Fuzzy filter® was run first. Composite samples were collected from each sample port, with no separation between PSF and FF runs.

Actiflo® Run

Coagulant Dose (PASS-C®)	100 mg/L
Polymer Dose (Magnafloc® LT25)	0.8 mg/L
Micro-sand	5 L

	Step	Time	Process	Mixer Speed (HZ)
Operation:	0	0	Tank filled with 260 gal storm water	0
	1	0	Dose with micro-sand and coagulant	60
	2	3.0	Dose with polymer	60
	3	3.5	Maturation, reduce speed	40
	4	5.0	Mixer off, begin sedimentation	0
	5	25.0*	End sedimentation, begin processing	-

* Somewhat poor settling of floc noted. Settling time extended to 20 minutes

Fuzzy Filter® Run	Flow Rate:	2.6 gpm
	Volume Treated:	100 gal
	Media Condition:	Old – same as used in Runs 1 & 2
Pressure Sand Filter Run	Flow Rate:	2.6 gpm
	Volume Treated:	100 gal
	Media Condition:	Old – same as used in Runs 1 & 2
Ion Exchange Units	IX-1, Pleated Filter:	New
	IX-2, Modified Clay:	New
	IX-3, Anion Resin:	New
	IX-4, Cation Resin:	New

Notes: No difficulties noted. Maximum system pressure noted was 24 psi.

Samples from the Fuzzy Filter® and pressure sand filter through the IX system sampled discreetly (i.e. FF, IX1-FF, IX2-FF, IX3-FF and IX4-FF samples collected as well as PSF, IX1-PSF, IX2-PSF, IX3-PSF and IX4-PSF).

Sampling Notes (Run 3)

3-16-F = Field duplicate of 3-11-F

No equipment blank sample collected because blank prepared the previous day (Run 2) was considered to be adequate for this Experimental Run.

Table 4-4. Field Notes Experimental Run Number 4

Run Number	4			
Date Run	May 1, 2002			
Water Source	Water collected from on-site basin. Water pumped from basin to Baker tank in the afternoon of 4/30/02			
Weather	Snowing			
Storm Water Characteristics (influent)	**pH**	**Temp (ºC)**	**EC (µmhos/cm)**	**Turbidity (NTU)**
	7.4	11	2,302	864
	(On-site measurements)			
Laboratory Used	ToxScan/UC Davis (metals)			

Operational Summary

Filter Units	**Filter Units**	**Operating Status**	**Drain Time (min.)**	
(Run 4)			**1st fill**	**2nd fill**
	Filter 1 (fine sand)	ok, rapidly slowing	4.0	92.0
	Filter 2 (coarse sand)	ok	0.1	0.6
	Filter 3 (zeolite)	ok, slowing	40.0	93.0
	Filter 4 (activated alumina)	Failed on 2nd filling[1]	15.3	9999
	Filter 5 (aluminum oxide)	ok	1.3	2.3
	Filter 6 (fine sand + PAM)	Not run	-	-
	Filter 7 (coarse sand + PAM)	Not run	-	-
	Filter 8 (fine sand + 100 mg/L PASS-C)	Failed on 2nd filling[2]	34.0	9999
	Filter 9 (coarse sand + 100 mg/L PASS-C)	ok	0	2.0

[1] Second filling drained approximately half way before blinding. Sample collected
[2] First filling drained in 34 minutes, second filling drained only partially (1/4) before blinding. Sample collected

Sedimentation Tank/Filter Units	**Sedimentation/Filter Units**	**Operating Status**	**Drain Time (min.)**	
			1st fill	**2nd fill**
(Run 4)	Sed/Filt 10 (sed/no chem/concrete sand)	ok, getting slow	6.3	77.0
	Sed/Filt 11 (sed/chem/fine sand)	ok	9.5	11.0
	Sed/Filt 12 (sed/chem/coarse sand)	ok	9.0	11.0
	Sed/Filt 13 (sed/chem/zeolite)	ok	6.0	8.0
	Sed/Filt 14 (sed/chem/activated alumina)	ok	16.5	18.5
	Sed/Filt 15 (sed/chem/aluminum oxide)	ok	7.0	8.5

Two hour sedimentation time used, chemical dose (where used) = 100 mg/L (7.3 mL/min)

Table 4-4. Field Notes Experimental Run Number 4

High-Tech System (Run 4)

Initial Conditions:

Ion exchange system re-plumbed to a two cartridge system prior to Run 4 (pleated filter (IX1), modified clay filter (IX2) removed, leaving the anion resin (IX3) and cation resin (IX4). New anion and cation cartridges installed. Fuzzy Filter® media was replaced prior to run. Pressure sand filter operated first.

Actiflo® Run

Coagulant Dose (PASS-C®)[1]	125 mg/L
Polymer Dose (Magnafloc® LT25) [1]	1.0 mg/L
Micro-sand	5 L

Operation:

Step	Time	Process	Mixer Speed (HZ)
0	0	Tank filled with 260 gal storm water	0
1	0	Dose with micro-sand and coagulant	60
2	3.0	Dose with polymer	60
3	3.5	Maturation, reduce speed	40
4	5.0	Mixer off, begin sedimentation	0
5	15.0[2]	End sedimentation, begin processing	-

[1] Because of somewhat poor settling of floc in previous runs, and, as the result of troubleshooting and consultation, coagulant and polymer dose increased.

[2] Actiflo settling time approximately 10 minutes.

Fuzzy Filter® Run

Flow Rate:	2.6 gpm[4]
Volume Treated:	100 gal
Media Condition:	New

Pressure Sand Filter Run

Flow Rate:	2.6 gpm[3]
Volume Treated:	100 gal
Media Condition:	Old – same as used in Runs 1-3

Ion Exchange Units

IX-1, Pleated Filter:	Removed
IX-2, Modified Clay:	Removed
IX-3, Anion Resin:	New
IX-4, Cation Resin:	New

Notes: [3] Pressure sand filter operated first at a at a flow rate of 2.6 gpm. Flow meter stopped incrementing so the run was continued for exactly 38.5 minutes (100 gallons) checking flow rate via bucket and stopwatch. Maximum system pressure noted was 24 psi at the end of the PSF run.

[4] Fuzzy Filter® operated at a flow rate of 2.6 gpm. Again, after cleaning, flow meter stopped incrementing so the run was continued by checking flow rate via bucket and stopwatch. At the 25 minute mark (65% complete) water from the relief started to flow and system flow rate dropped to 2 gpm. Run was continued for 38.5 min, approximating 100 gal of treated water.

Samples from the Fuzzy Filter® and pressure sand filter through the IX system sampled discreetly (i.e. FF, IX1-FF, IX2-FF, IX3-FF and IX4-FF samples collected as well as PSF, IX1-PSF, IX2-PSF, IX3-PSF and IX4-PSF).

Sampling Notes (Run 4)

4-16-F = Field duplicate of 4-12-F
4-16-S = Bottle blank (using Fisher Brand HPLC grade water)
4-17-F = Equipment blank (Fisher Brand HPLC grade water)
Three composite influent samples were collected representing the beginning, middle and latter portions of the run.

Table 4-5. Field Notes - Experimental Run Number 5

Run Number	5			
Date Run	May 21, 2002			
Water Source	Water collected from Jenson boxes and basins capturing primarily roadway runoff in the South Lake Tahoe area. Water collected and blended on 5/20/02. Water sources and proportion of final mix: Pioneer Trail at Al Tahoe Blvd., Jenson box, 35% 12th Street and Patricia, Jenson box, 30% End of 13th Street, Jenson box, 18% HY 89 at the 4 to 3 lane transition, roadside basin, 17%			
Weather	Rain on the evening of 5/19/02, sufficient to have visible water flowing into all of the above sample locations. Intermittent snow and sun on 5/20/02.			
Storm Water Characteristics (influent)	**pH**	**Temp (ºC)**	**EC (µmhos/cm)**	**Turbidity (NTU)**
	7.0	9	364	178
	(On-site measurements)			
Laboratory Used	ToxScan/UC Davis (metals)			

Operational Summary

Filter Units	**Filter Units**	**Operating Status**	**Drain Time (min.)**	
(Run 5)			**1st fill**	**2nd fill**
	Filter 1 (fine sand)	Failed on 1st filling[1]	9999	-
	Filter 2 (coarse sand)	ok	0.2	1.1
	Filter 3 (zeolite)	Failed on 2nd filling[2]	9.0	9999
	Filter 4 (activated alumina)	Not run (failed, Run 4)	-	-
	Filter 5 (aluminum oxide)	Failed on 2nd filling[2]	120	9999
	Filter 6 (fine sand + PAM)	Not run	-	-
	Filter 7 (coarse sand + PAM)	Not run	-	-
	Filter 8 (fine sand + 50 mg/L PASS-C)[3]	ok	4.1	6.2
	Filter 9 (coarse sand + 50 mg/L PASS-C) [3]	ok	0.1	0.3

[1] Blinded on first filling. No sample collected
[2] Blinded second filling. Sample collected
[3] Filter 8 blinded in Run 4. Both filters 8 and 9 reconditioned and PASS-C® dose reduced from 100 mg/L to 50 mg/L.

Sedimentation		**Operating Status**	**Drain Time (min.)**	
Tank/Filter Units	**Sedimentation/Filter Units**		**1st fill**	**2nd fill**
(Run 5)	Sed/Filt 10 (sed/no chem/concrete sand)	ok, quite slow	49.0	120
	Sed/Filt 11 (sed/chem/fine sand)	ok	28.0	10.7
	Sed/Filt 12 (sed/chem/coarse sand)	ok	6.0	6.5
	Sed/Filt 13 (sed/chem/zeolite)	ok	5.0	6.4
	Sed/Filt 14 (sed/chem/activated alumina)	ok	12.0	15.0
	Sed/Filt 15 (sed/chem/aluminum oxide)	ok	7.3	7.5
	Two hour sedimentation time used, chemical dose (where used) = 100 mg/L (7.3 mL/min)			

High-Tech System (Run 5)

Initial Conditions:

New ion exchange cartridges installed, Fuzzy Filter® media last washed prior to Run 4, pressure sand filter (PSF) never backwashed. New pressure gauges installed.

Actiflo® Run

Coagulant Dose (PASS-C®)[1]	125 mg/L
Polymer Dose (Magnafloc® LT25)[1]	1.0 mg/L
Micro-sand	5 L

Operation:

Step	Time	Process	Mixer Speed (HZ)
0	0	Tank filled with 260 gal storm water	0
1	0	Dose with micro-sand and coagulant	60
2	3.0	Dose with polymer	60
3	3.5	Maturation, reduce speed	40
4	5.0	Mixer off, begin sedimentation	0
5	15.0[2]	End sedimentation, begin processing	-

[1] Coagulant and polymer doses same as Run 4
[2] Actiflo settling time approximately 10 minutes.

Fuzzy Filter® Run

Flow Rate:	2.6 gpm[4]
Volume Treated:	100 gal
Media Condition:	Same as media used for Run 4 (Media was kept in DI since Run 3)

Pressure Sand Filter Run

Flow Rate:	2.6 gpm[3]
Volume Treated:	100 gal
Media Condition:	Old – same as used in all Runs

Ion Exchange Units

IX-1, Pleated Filter:	Removed
IX-2, Modified Clay:	Removed
IX-3, Anion Resin:	New
IX-4, Cation Resin:	New

Notes: [3] Pressure sand filter run first at 2.6 gal/min for 38.5 min. (100 gal). Pressure prior to anion cartridge = 40 psi at end of PSF run.

[4] Towards the end of the Fuzzy Filter® run (t=20 min) pressures reached >60 psi and approximately 1 L/min flow coming from the relief line. Run completed; however flow rate decreased to approximately 2.4 gal/min by the 38.5 minute mark.

Samples from the Fuzzy Filter® and pressure sand filter through the IX system sampled discreetly (i.e. FF, IX1-FF, IX2-FF, IX3-FF and IX4-FF samples collected as well as PSF, IX1-PSF, IX2-PSF, IX3-PSF and IX4-PSF).

Sampling Notes (Run 5)

5-17-F = run duplicate of 5-2-F
5-16-F = bottle blank (ESS bottles, Fisher HPLC water)
5-16-S = equipment blank
5-17-S = bottle blank (EP 500 mL bottle)
Three composite influent samples were collected representing the beginning, middle and latter portions of the run (5-I-1, 5-I-2, and 5-I-3).
A grab sample (5-I-G) for total and dissolved metals was collected at 4:00 pm on 5/20/03 to compare with values obtained 5/21/02 (run day).

Table 4-6. Field Notes - Experimental Run Number 6

Run Number	6 Note: Based on decisions made in a meeting with Caltrans on October 10, 2002, Run 6 was to include only a few of the treatment units normally run. Two high-tech runs and a test of PAM sedimentation were to be included.
Date Run	November 8, 2002
Water Source	Water collected from Jenson boxes and basins capturing primarily roadway runoff in the South Lake Tahoe area. Water collected and blended on 11/7/02. Storm water runoff blended from three locations. Water sources and proportion of final mix: 1) 12th Street and Patricia, Jenson box, 44% 2) End of 13th Street, Jenson box, 29% 3) HY 89 at the 4 to 3 lane transition, roadside basin, 27%
Weather	November 7 was the beginning of a large storm event that lasted several days (3). It is estimated that approximately 0.2-0.3 inches of rain had fallen in the South Lake Tahoe area by the late afternoon (11/7/02) when the sample collection was complete. This storm event was the first measurable precipitation in the area in 3 months. Temperatures recorded were in the low 40s (ºF). Storm water runoff was collected after the basin had filled and the boxes were flushed and actively draining.
Storm Water Characteristics (influent)	**pH**: 6.6; **Temp (ºC)**: 9; **EC (µmhos/cm)**: 129; **Turbidity (NTU)**: 184 (On-site measurements)
Laboratory Used	ToxScan/Soil Control Laboratory

Operational Summary

Filter Units (Run 6)	Filter Units	Operating Status	Drain Time (min.) 1st fill	Drain Time (min.) 2nd fill
	Filter 1 (fine sand)	Not run	-	-
	Filter 2 (coarse sand)	Not run	-	-
	Filter 3 (zeolite)	Not run	-	-
	Filter 4 (activated alumina)	ok[1]	4.7	9.6
	Filter 5 (aluminum oxide)	Not run	-	-
	Filter 6 (fine sand + PAM)	Not run	-	-
	Filter 7 (coarse sand + PAM)	Not run	-	-
	Filter 8 (fine sand + 50 mg/L PASS-C)	Not run	-	-
	Filter 9 (coarse sand + 50 mg/L PASS-C)	Not run	-	-

[1] Filter reconditioned prior to this run (blinded during Run 4)

Sedimentation Tank/Filter Units (Run 6)	Sedimentation/Filter Units	Operating Status	Drain Time (min.) 1st fill	Drain Time (min.) 2nd fill
	Sed/Filt 10 (sed/no chem/concrete sand)	very slow	105	198
	Sed/Filt 11 (sed/chem/fine sand)	ok[2]	8.0	8.55
	Sed/Filt 12 (sed/chem/coarse sand)	Not run	-	-
	Sed/Filt 13 (sed/chem/zeolite)	Not run	-	-
	Sed/Filt 14 (sed/chem/activated alumina)	Not run	-	-
	Sed/Filt 15 (sed/chem/aluminum oxide)	Not run	-	-

[2] Reconditioned prior to this run

Two hour sedimentation time used, chemical dose (where used) = 100 mg/L (7.3 mL/min)

Table 4-6. Field Notes - Experimental Run Number 6

High-Tech System (Run 6)

Initial Conditions:

Conditions: new ion exchange cartridges and Fuzzy Filter media. Two high tech runs performed:

Run 1 (A-1) – typical high-tech type run: units include Actiflo – Fuzzy Filter – IX3 & IX4 (no pressure sand filter run)

Run 2 (A-2) - "Conventional" non-proprietary tank run - pressure sand filter – IX3 & IX4

Actiflo® Run (Run 1)

Coagulant Dose (PASS-C®)[1]	125 mg/L
Polymer Dose (Magnafloc® LT25)[1]	1.0 mg/L
Micro-sand	5 L

	Step	Time	Process	Mixer Speed (HZ)
Operation:	0	0	Tank filled with 260 gal storm water	0
	1	0	Dose with micro-sand and coagulant	60
	2	3.0	Dose with polymer	60
	3	3.5	Maturation, reduce speed	40
	4	5.0	Mixer off, begin sedimentation	0
	5	10.0[2]	End sedimentation, begin processing	-

[1] Coagulant and polymer doses same as Run 4 & 5

[2] Actiflo settling time approximately 5 minutes.

Fuzzy Filter® Run

Flow Rate:	2.6 gpm[4]
Volume Treated:	130 gal
Media Condition:	New media

Pressure Sand Filter Run Not Run

Ion Exchange Units

IX-3, Anion Resin:	New
IX-4, Cation Resin:	New

Notes: Relatively poor coagulation noted. Fuzzy Filter run at 2.6 gal/min for 50 min. (130 gal). Pressure prior to anion cartridge = 14 psi at end of FF run. Samples collected included 6-A-1, 6-FF-1, 6-IX3-FF-1, 6-IX4-FF-1

Conventional Run (Run #2) (Using the Actiflo® Tank)

Coagulant Dose (PASS-C®)	125 mg/L
Polymer Dose (Magnafloc® LT25)	none
Micro-sand	none

	Step	Time	Process	Mixer Speed (HZ)
Operation:	0	0	Tank filled with 260 gal storm water	0
	1	0	Dose with coagulant	60
	2	1.0	Rapid Mix	60
	3	21	Slow mix	2
	4	51.0[1]	End sedimentation, begin processing	-

[1] Settling time approximately 30 minutes. Relatively poor sedimentation noted

Table 4-6. Field Notes - Experimental Run Number 6

	Pressure Sand Filter Run		
		Flow Rate:	2.6 gpm
		Volume Treated:	133 gal
		Media Condition:	Old – same as used in all Runs
	Fuzzy Filter® Run	Not Run	
	Ion Exchange Units	IX-1, Pleated Filter:	Removed
		IX-2, Modified Clay:	Removed
		IX-3, Anion Resin:	New
		IX-4, Cation Resin:	New
	Notes:	Pressure prior to anion cartridge = 14 psi at end of PSF run. Samples collected = 6-A-2, 6-PSF-2, 6-IX3-PSF-2, 6-IX4-PSF-2.	
Sampling Notes (Run 6)	6-16-S = run duplicate of 6-IX4-PSF-2 6-17-F = run duplicate of 6-I-3 6-16-F = bottle blank (ESS bottles, Fisher HPLC water) 6-18-S = equipment blank # 1 6-18-F = equipment blank # 2 6-19-S = equipment blank (rinse of 7-F) Three composite influent samples were collected representing the beginning, middle and latter portions of the run (6-I-1, 6-I-2, and 6-I-3).		

4.2.1 Experimental Run Storm Water Quality

Water quality data for storm water runoff collected as a part of this project as well as "typical" Lake Tahoe Basin storm water quality data are presented in Table 4-7. Monitored separately from this project, runoff water quality samples were collected and analyzed from six different sites during the 2001-2002 season (Caltrans, 2002b). Runoff samples were collected during storm events using automatic, flow-proportional samplers. Minimum, maximum and mean values listed in Table 4-7 (under the heading of Typical Lake Tahoe Basin Storm Water Quality) are the low, high and mean of "event mean concentration" (EMC) values. Pilot project influent storm water runoff quality is presented alongside "typical" values in Table 4-7. Values listed for each run are averages of all pilot project influent samples collected, and not EMC values.

Contaminants with regulated numerical limits (i.e., turbidity, oil and grease, total nitrogen, total phosphorus, and total iron) as listed in Table 2-1 are present in Lake Tahoe Basin storm water runoff in concentrations that exceed those limits. Of particular significance to the Winter/Spring 2001/2002 survey:

- Storm water runoff was found to have an mean EMC of approximately 531 NTU, while the effluent limit for surface water discharge is 20 NTU and the limit for infiltration systems is 200 NTU.
- The mean EMC for oil and grease was 22 mg/L, which is 10 times the limit of 2 mg/L for surface discharge, but below the limit of 40 for infiltration systems.
- Total nitrogen can be calculated from the sum of NO3, NO2, and TKN. Mean EMC total nitrogen was approximately 2.8 mg-N/L. This total nitrogen concentration is

approximately 5 times the surface discharge limit of 0.5 mg-N/L, but below the limit of 5 mg-N/L for infiltration systems.

- The median EMC total iron concentration was 16,884 µg/L (16.9 mg/L), which is over 30 times higher than the 500 µg/L (0.5 mg/L) regulatory limit for surface discharge and over three time the limit of 5000 µg/L (5 mg/L) for discharge to infiltration systems.
- It is uncertain exactly what form of phosphorus is to be regulated by the Lahontan Regional Water Quality Board. The Basin Plan lists a numerical storm water discharge limit of 0.1 mg/L of "total Phosphate as P" for surface discharges and a limit of 1 mg/L for discharges to infiltration systems. Additionally, the Basin plan specifies that total phosphate is measured as "total phosphorus" (LRWQCB, 1994). Assuming the intent is to regulate total phosphorus as P, the basin mean EMC for total phosphorus was 0.4 mg/L, four times the regulatory limit of 0.1 mg/L for surface discharge but below the limit for discharge to infiltration systems.

Storm water quality treated as part of this pilot project was generally similar to that reported in the 2001-2002 Tahoe Basin monitoring season report (Caltrans 2002b, CTSW-RT-02-044). Direct comparisons of the mean values are not appropriate, since the 2001-2002 Monitoring Season Report presents event-mean-concentration values. Storm water hauled and used in the pilot project was typically collected during the first period of significant runoff of a given storm event. However, most of the pilot project influent water quality parameters fell within the minimum and maximum EMC values reported in the basin monitoring report. Of particular importance:

- The concentrations of nitrogen compounds in the pilot project influent were similar to those reported in the 2001-2002 Basin Monitoring Report mean EMC values.
- Total phosphorus and ortho-phosphate concentrations were typically higher in the pilot project storm water than reported in the Basin Monitoring Report.
- Oil and grease concentrations were lower in the pilot project influent water than reported in the Basin Monitoring Repot. The collection of storm water from ponds and vaults was accomplished by lowering the water truck pump suction line into the pool. This procedure may have under represented oil and grease by missing any floating product. Additionally, oil and grease losses from the collected storm water may have transferred out of the water and stuck to the water truck hoses, tanks and piping.
- Total organic carbon concentration was higher in the pilot project influent than reported in the Basin Monitoring Report, especially water collected from the Jenson boxes (Experimental Runs 5 and 6).
- Overall, the storm water collected from the on-site detention pond (Experimental Runs 1 and 4) was the most similar the 2001-2002 Basin Monitoring Report mean EMC values.

Table 4-7. Storm Water Runoff Quality for the Tahoe Basin and the Six Experimental Runs

Parameter	Units of Measure	Typical Lake Tahoe Basin Storm Water Quality[a] (EMC)			Pilot Project Influent Quality[b] Run Average						
		Min.	Max	Mean	Mean	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Conventionals											
pH	pH units	5.9	9.6	7.3	7.2	7.5[c]	7.5	7.3	7.4	7.0	6.6
EC	µmhos/cm	25	21,000	2,735	971	2,357[c]	192	480	2,302	364	129
TSS	mg/L	36	2,500	761	239	372	46	260	430	153	173
TDS	mg/L	13	12,000	1,449	566	880	116	404	1,368	313	317
Hardness, as $CaCO_3$	mg/L	4	2,500	120	55	48	66	61	58	37	60
DOC	mg/L	2.4	160	21	13.3	3.9	9.3	5.7	6.8	41	NR
TOC	mg/L	2.6	180	27	42	7.6	10	6.9	6.3	40	183
Turbidity	NTU	25	1,500	531	539	904[c]	66	1,038	864	178	184
Chloride	mg/L	2	9,000	983	286	691	14	122	777	100	9
Oil and Grease	mg/L	6	45	22	4[d]	7	<2	<2	9	<5	6
Nutrients											
Nitrate - Nitrogen	mg-N/L	0.1	2	0.4	0.3[d]	<0.1	0.7	<0.1	<0.1	0.2	0.6
Nitrite – Nitrogen	mg-N/L	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
TKN – T	mg-N/L	0.6	14	2.4	2.3	4.1	0.8	1.1	1.0	2.1	4.4
Total Nitrogen, (Calc. as $TKN+NO_3+NO_2$)	mg-N/L	0.7	16	2.8	2.6	4.1	1.5	1.1	1.0	2.3	5.0
Phosphorus – T	mg-P/L	0.09	1.5	0.40	0.80	1.03	0.20	1.12	0.93	0.47	1.10
Phosphorus – D	mg-P/L	<0.03	1.1	0.11	0.20[d]	0.20	<0.03	0.11	0.09	0.09	0.68
Orthophosphate - T	mg-P/L	0.03	0.6	0.08	0.21[d]	0.17	0.08	<0.03	0.61	0.15	0.24
Aluminum - T	µg/L	*NR*	*NR*	*NR*	8,889	12,000	2,967	32,000	3,533	1,533	1,300
Aluminum - D	µg/L	*NR*	*NR*	*NR*	38[d]	<25	<25	<25	<25	50	128
Aluminum (Acid Sol)[e]	µg/L	*NR*	*NR*	*NR*	1,255	3,200	327	2,800	627	337	237
Cadmium - T	µg/L	<0.2	8	0.8	0.3[d]	0.4	<0.2	0.6	0.4	0.3	0.3

Table 4-7. Storm Water Runoff Quality for the Tahoe Basin and the Six Experimental Runs

Parameter	Units of Measure	Typical Lake Tahoe Basin Storm Water Quality[a] (EMC)			Pilot Project Influent Quality[b] Run Average						
		Min.	Max	Mean	Mean	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Cadmium - D	µg/L	<0.2	2.2	NA	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium - T	µg/L	2	73	17	14	9	5	23	26	12	8
Chromium - D	µg/L	<1	52	5	1[d]	<1	<1	<1	1	<1	5
Copper - T	µg/L	5.6	131	39	25	27	9	40	39	17	17
Copper - D	µg/L	<1	52	5	5[d]	<1	3	<1	12	3	9
Iron - T	µg/L	1,180	80,700	16,884	14,419	13,400	2,580	33,400	21,000	9,867	6,267
Iron - D	µg/L	32	4,460	499	133[d]	<25	64	<25	<25	467	227
Lead - T	µg/L	3	176	35	23	15	5	64	25	18	13
Lead - D	µg/L	<1	14	1.3	<1	<1	<1	<1	<1	<1	<1
Nickel - T	µg/L	3	39	15	9	10	3	13	15	6	5
Nickel - D	µg/L	2	11	2.9	2[d]	<2	<2	<2	<2	2	3
Zinc - T	µg/L	32	950	249	300	180	103	360	180	444	533
Zinc - D	µg/L	8	210	48	82	15	52	8	10	145	263

a Data from Caltrans Tahoe Highway Runoff Characterization and Sand Trap Effectiveness Studies, 2001-02 Monitoring Season,CSTW-RT-02-044
b Average of the pilot project storm water influent samples (see I-Avg, Table 5.1 for samples included in this average)
c Field measurements for pH, EC and Turbidity
d Averages calculated using ½ of reporting limit value for concentrations below reporting limit
e Acid soluble aluminum by EPA method 440/5-86-008 (unfiltered sample collected in the field, acidified and filtered in the laboratory)
NA = Not Available (statistics not reported in publication cited), NR = Not Run, T = Total, D = Dissolved

4.2.2 Location of Storm Water Collection Sites

Storm water was collected from four different sources. A map showing storm water sampling locations is provided in Figure 4-1. Listed in Table 4-8 are details relating to the sample collection locations, date collected and storm water source. Experimental Runs 5 and 6 used water collected from Jenson boxes located at various sites. A Jenson box is a sub-surface concrete vault, 3,000 to 5,000 gallons in total volume, with interior baffles, or cells, to detain runoff and allow sedimentation/treatment of runoff prior to discharge. The location of the Jenson boxes (and one roadside basin) used in Experimental Runs 5 and 6 are described in Table 4-9.

Storm water collected from the on-site detention basin (Experimental Runs 1 and 4) exhibited the highest concentrations of TSS, EC, TDS, turbidity, chloride, and oil and grease observed. The highest total iron measured in the influent project water was 33,400 µg/L in the sample collected from the snow storage yard basin (Run 3). The second and third highest total iron values measured were observed in water collected from the on-site basin. On-site storm water was not hauled in the tanker truck in which iron may be introduced but rather was pumped directly into the pilot plant storage tanks. Storm water collected from the inlet of the wetland in Tahoe City (Experimental Run 2) exhibited the lowest concentrations of total solids, turbidity, phosphorus and TKN, but the highest concentrations of nitrate observed (0.7 mg/L). Storm water collected from the Jenson boxes and the Highway 89 roadside basin exhibited the highest concentrations of organic carbon observed. Experimental Run 6 had a particularly high level of total organic carbon (183 mg/L). This sample represents the first rainfall of any significance after a period of approximately 5 months. While the turbidity, EC and solids were generally low, the nutrients were somewhat elevated, particularly nitrate and dissolved phosphorus.

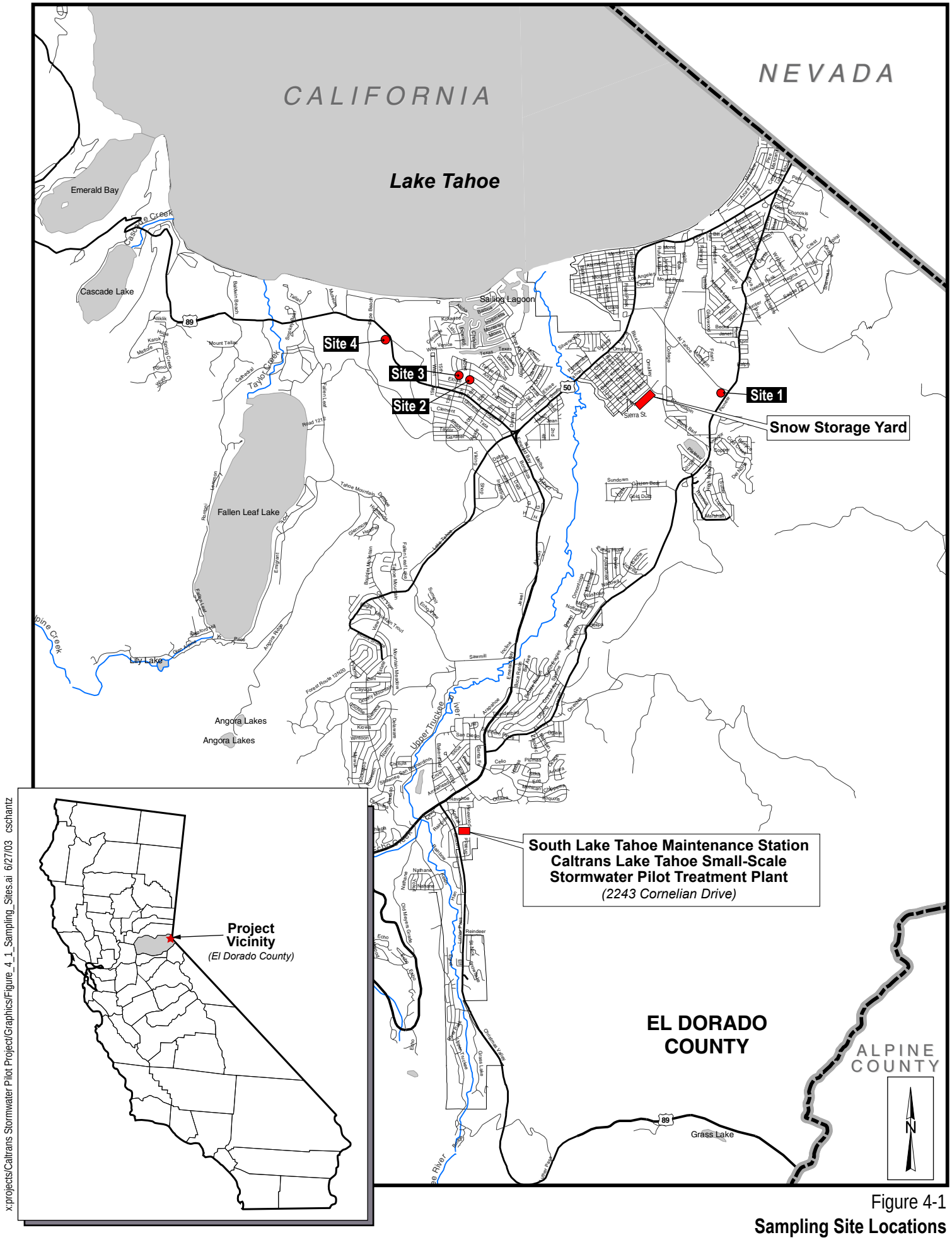


Figure 4-1
Sampling Site Locations

Table 4-8. Experimental Run Storm Water Runoff Sampling Information and Details

Run	Storm Water Collection Location	Date		Storm Water Source
		Collection	Experimental Run	
1	On-site detention basin (South Lake Tahoe Maintenance Station).	19-Feb-2002	20-Feb-2002	Precipitation (0.02 inches) was recorded on 2/16/02, 0.13 inches was recorded on 2/17/02, and 0.13 inches was recorded on 2/19/02. Precipitation was mixed rain and snow. The maximum daily temperature ranged between 33 and 46 ºF, with a minimum temperature of 30 ºF occurring on 2/19/02. Storm water resulted primarily from the rain events, and may have been influenced by some melting snow.
2	Inlet to Placer county wetlands, located at the intersection of SR 89 and SR 28 in Tahoe City, CA. The sample was collected at the inlet of the wetlands, located on the west side of the Albertson's grocery store. Water was hauled to the pilot project via a water truck (2 trips).	5-March-2002	6-March-2002	Precipitation (as rain; 0.04 inches) was recorded on 3/5/02. The maximum daily temperature was 50 ºF. Storm water resulted primarily from the rain event, and may have been influenced by some melting snow.
3	Snow storage yard, located at the end of Sierra Boulevard in South Lake Tahoe, CA. The sample was collected at the point of runoff entry into the first pond. Water was hauled to the pilot project via a water truck (2 trips).	5-March-2002	7-March-2002	Same as described for Run 2.
4	On-site detention basin (South Lake Tahoe Maintenance Station).	30-April-2002	1-May-2002	Mixed rain and snow (0.56 inches) was recorded on 4/29/02. The maximum daily temperature was 37 ºF, with a low temperature of 28 ºF. No precipitation was recorded on 4/30/02 (i.e., the day the sample was collected), but the daily high temperature was 69 ºF. Sample is believed to consist primarily of melting snow, and may have been influenced by rain-related runoff.
5	Mixture from four Jenson boxes/basins in the South Lake Tahoe, CA area. Detailed location description is provided in Table 4-9.	20-May-2002	21-May-2002	Mixed rain and snow (0.17 inches) was recorded on 5/19/02 and 5/20/02. Daily high temperature was 57 ºF on 5/19/02 and was 39 ºF on 5/20/02. Storm water source was rain and snowmelt that had accumulated in the Jenson boxes.
6	Water collected from Jenson Box at 12th and Patricia, 13th Street and the basin on HWY 89 (sites 2, 3, and 4, in proportions 0.44, 0.29, 0.27, respectively). See Table 4-9 for site descriptions.	07-Nov-2002	08-Nov-2002	November 7 was the beginning of a large rainstorm that lasted several days. It is estimated that approximately 0.2-0.3 inches of rain had fallen in the South Lake Tahoe area by the late afternoon when the sample collection was complete. Temperatures recorded were in the low 40s (ºF). Storm water runoff was collected after the basin had filled and the boxes were flushed and actively draining.

Table 4-9. Jenson Box/Basin Locations Sampled in Experimental Runs 5 and 6

Site	Location	Type of Collector	Drainage Area
1 (vault)	Pioneer Trail at Al Tahoe (1.5 miles from Lake Tahoe Boulevard), South Lake Tahoe, CA.	4-cell Jenson box Estimated volume is 6,000 gallons	Roadway runoff from Pioneer Trail and Al Tahoe Boulevard. The extent and area uncertain.
2 (vault)	12th Street at Patricia (approximately 35 feet from the intersection of Patricia, on the left hand side of 12th Street), South Lake Tahoe, CA.	4-cell Jenson box, estimated volume of 6,000 gallons.	Roadway runoff from 12th Street, with contributions from Highway 89.
3 (vault)	End of 13th Street, South Lake Tahoe, CA.	3-cell Jenson box, estimated volume of 3.000 gallons.	Roadway runoff from 13th Street, with contributions from Highway 89.
4 (basin)	Highway 89, at the four-lane to two-lane transition outside of South Lake Tahoe, CA.	Basin, estimated maximum volume is approximately 2.000 gallons.	Drainage directly from Highway 89. Highway drainage area is estimated to be several hundred feet long in extent. Some forest drainage and overland flow contributions (non-roadway) are possible.

Chapter 5

Project Results

Chapter 5 Project Results

A performance assessment of the treatment units during the first phase of operation is presented in this chapter. The assessment is based primarily on the ability to remove contaminants from Lake Tahoe Basin storm water to concentrations required by the Lahontan Regional Water Quality Control Board for discharge to ground or surface water. Initially, the assessment discussion herein addresses aspects relating to the data (e.g., data quality assurance assessments and data qualifiers). Treatment results are then presented sequentially by contaminant. Lastly, an overall assessment is presented for each treatment train that was investigated.

5.1 Presentation of Results

Included in the following section are discussions and a tabular summary of the treatment units that were operated during each experimental run. Not all treatment systems were operated for every batch of storm water collected. A summary of the quality assurance steps taken to ensure data accuracy and precision and an assessment of the qualified data are also presented. Approximately 10,000 individual data points were collected during the first year of pilot plant operation. A series of plot pages were devised to illustrate treatment unit performance for specific contaminants at a glance. This chapter presents the overall results of the first year monitoring on these plot pages. Sections provide detailed discussion as to the ability of each treatment train to remove specific contaminants (Section 5.2) and present overall assessments of each treatment train to achieve regulatory objectives (Section 5.3).

5.1.1 Data, Sampling Points, and Samples Collected

A complete tabular summary of the field and laboratory data generated in the first year of operation is compiled in Appendix A. Each appendix page represents a separate treatment unit or "sampling point". A list of project sampling point designations and the treatment units sampled during any particular experimental run is presented in Table 5-1.

There are some instances where the same unit process (i.e. sedimentation) was included in several different treatment trains. In some cases, the results from the common process were averaged and the mean values are included in the data presentation. For example, the point "I-Avg" in Table 5-1 and Appendix A refers to a mathematical average of all influent samples. Similarly, the sample point "Sed-Avg" refers to a mathematical average of all sedimentation tank effluent samples that all received PASS-C® chemical addition to aid in coagulation and sedimentation (e.g., average of 11-S, 12-S, 13-S, 14-S, and 15-S).

Table 5-1. Sample Point Designation, Process Description, Sample Collected and the Number of Points Plotted

Sample Point	Process Description	Sample collected at this sampling point/designation						No. of Plot Points[a]
		Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	
I-1	Influent storm water – First Composite Sample (6 grabs/sample)		X		X	X	X	NA
I-2	Influent storm water – Second Composite Sample (6 grabs/sample)		X		X	X	X	NA
I-3	Influent storm water – Third Composite Sample (6 grabs/sample)		X		X	X	X	NA
I-C	Influent storm water - Running Composite (6 grabs/sample)	X	X	X				NA
I-Avg	Influent storm water (mathematical average)	X	X	X	X	X	X	6[b]
1-F	Fine Sand Filter	X	X	X	X			4
2-F	Coarse Sand filter	X	X	X	X	X		5
3-F	Zeolite Filter	X	X	X	X	X		5
4-F	Activated Alumina Filter	X	X	X	X		X	5
5-F	Aluminum Oxide Filter	X	X	X	X	X		5
6-F	Fine Sand Filter + PAM		X	X				2
7-F	Coarse Sand Filter + PAM	X	X	X				3
8-F	Fine Sand Filter + PASS-C®	X	X	X	X	X		5
9-F	Coarse Sand Filter + PASS-C®	X	X	X	X	X		5
10-S	Sedimentation Tank Preceding Concrete Sand Filter	X	X	X	X	X	X	6
10-F	Concrete Sand Filter Following Sedimentation w/o Chemicals	X	X	X	X	X	X	6
11-S	Sedimentation Tank (w/PASS-C®) Preceding Fine Sand Filter	X	X	X	X	X	X	NA
11-F	Fine Sand Filter Following Sedimentation w/PASS-C®	X	X	X	X	X	X	6
12-S	Sedimentation Tank (w/PASS-C®) Preceding Coarse Sand Filter	X	X	X	X	X		NA
12-F	Coarse Sand Filter Following Sedimentation w/PASS-C®	X	X	X	X	X		5
13-S	Sedimentation Tank (w/PASS-C®) Preceding Zeolite Filter	X	X	X	X	X		NA
13-F	Zeolite Filter Following Sedimentation w/PASS-C®	X	X	X	X	X		5
14-S	Sedimentation Tank (w/PASS-C®) Preceding Activated Alumina	X	X	X	X	X		NA
14-F	Activated Alumina Filter Following Sedimentation w/PASS-C®	X	X	X	X	X		5
15-S	Sedimentation Tank (w/PASS-C®) Preceding Aluminum Oxide Filt.	X	X	X	X	X		NA
15-F	Aluminum Oxide Filter Following Sedimentation w/PASS-C®	X	X	X	X	X		5
101-S	PAM enhanced Sedimentation						X	NA
Sed-Avg	Calculated Average of all Sedimentation w/PASS-C	X	X	X	X	X	X	6

Table 5-1. Sample Point Designation, Process Description, Sample Collected and the Number of Points Plotted

Sample Point	Process Description	Sample collected at this sampling point/designation						No. of Plot Points[a]
		Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	
A	Actiflo® (micro-sand, PASS-C®, LT25)	X		X	X	X	X	5
PSF	Pressure Sand Filter (PSF) Following Actiflo® Treatment	X		X	X	X		4
FF	Fuzzy Filter® (FF) Following Actiflo® Treatment	X		X	X	X	X	5
IX-1	Pleated Filter Effluent (Actiflo®, composite of both PSF and FF)	X						NA
IX-2	Clay Filter Effluent (Actiflo®, composite of both PSF and FF)	X						NA
IX-3	Anion Resin Effluent (Actiflo®, composite of both PSF and FF)	X						NA
IX-4	Cation Resin Effluent (Actiflo®, composite of both PSF and FF)	X						5[c]
IX-1-PSF	Pleated Filter Effluent Following Actiflo® - PSF Filtration			X				NA
IX-2-PSF	Clay Filter Effluent Following Actiflo® - PSF Filtration			X				NA
IX-3-PSF	Anion Resin Effluent Following Actiflo® - PSF Filtration			X	X	X		NA
IX-4-PSF	Cation Resin Effluent Following Actiflo®, PSF, Anion			X	X	X		5[c]
IX-1-FF	Pleated Filter Effluent Following Actiflo® and FF Filtration			X				NA
IX-2-FF	Clay Filter Effluent Following Actiflo® and FF Filtration			X				NA
IX-3-FF	Anion Resin Effluent Following Actiflo® and FF Filtration			X	X	X	X	NA
IX-4-FF	Cation Resin Effluent Following Actiflo®, FF, Anion			X	X	X	X	5[c]
A-2	Conventional Run (PASS-C®, LT-25, W/O micro-sand)						X	NA
PSF-2	Pressure Sand Filter (PSF) Following Conventional Run						X	NA
IX-3-PSF-2	Anion Effluent Following Conventional Run and PSF Filtration						X	NA
IX-4-PSF-2	Cation Effluent Following Conventional, PSF and Anion						X	NA
16-S	QC Sample (duplicate, bottle or equipment blank, reference std.)	X	X		X	X	X	NA
16-F	QC Sample (duplicate, bottle or equipment blank, reference std.)	X	X	X	X	X	X	NA
17-S	QC Sample (duplicate, bottle or equipment blank, reference std.)					X		NA
17-F	QC Sample (duplicate, bottle or equipment blank, reference std.)				X	X	X	NA
18-S	QC Sample (duplicate, bottle or equipment blank, reference std.)						X	NA
18-F	QC Sample (duplicate, bottle or equipment blank, reference std.)						X	NA
19-S	QC Sample (duplicate, bottle or equipment blank, reference std.)						X	NA
19-F	QC Sample (duplicate, bottle or equipment blank, reference std.)							NA
20-S	QC Sample (duplicate, bottle or equipment blank, reference std.)						X	NA
20-F	QC Sample (duplicate, bottle or equipment blank, reference std.)						X	NA

a Refers to the expected number of data points (x,y pairs) on the plot pages, Figures 5-1 to 5-32.
b Data for this calculated point used on every plot (x-axis)
c Average of the terminal high tech effluent (IX-4) plotted for each run.
NA = Not applicable (sampling point not plotted)

5.1.2 Quality Assurance

Data received were reviewed with respect to the data quality objectives (DQOs) set forth in the *Monitoring and Operations Plan* and the procedures established in the *Caltrans Guidance Manual; Storm Water Monitoring Protocols*. Data review included electronic validation using the Caltrans *Laboratory Electronic Data Deliverable Error Checker and Automated Data Validation* (Version 2.0) processing tool. Data failing to meet the required quality objectives were issued a qualifier code preceding entry into the database. Detailed validation reports were prepared for Experimental Runs 4, 5, and 6 (Appendix C). Performance on individual DQOs is presented in the following section.

Completeness. Completeness can be measured and tracked several ways. Sample completeness can be determined by dividing the number of data points intended for collection by the number of data points actually received or recorded. For this project:

$$\text{Sample Completeness} = \frac{\text{Data Recorded}}{\text{Data Intended}} \text{x}100\% = \frac{9{,}685}{9{,}699} \text{x}100\% = 99.9\%$$

A very low percentage of sample-related data points intended for collection or analysis were actually missed. Missed data points were due to inadvertently failing to request specific analyses from the laboratory or due to the breakage of a sample bottle during transport. Certain sample data (e.g., dissolved hardness, sulfate, dissolved organic carbon) were not requested by intent and their lack of presence does not constitute sample incompleteness.

A second common definition of completeness is a calculation of the percentage of samples for which results are found to be valid following quality control assessments. For this project:

$$\text{Data Validity} = \frac{\text{Qualified Data}}{\text{All Data}} \text{x}100\% = \frac{9{,}230}{9{,}685} \text{x}100\% = 95.3\%$$

The reasons that may cause a data point to be disqualified are discussed in subsequent sections. However, a Data Validity in excess of 95 percent is a commonly accepted data quality objective.

Conformance with Analytical Methods. Analytical methods requested for project determinations were outlined in the project *Monitoring and Operations Plan* and printed on all sample chain-of-custody forms. Methods specified were consistent with those presented in the Caltrans *Guidance Manual; Storm Water Monitoring Protocols*. Analytical methods that deviated from the requested methods for any reason are listed in Table 5-2.

Table 5-2. Deviations from the Requested Analytical Methods

Parameter	Analytical Method		Experimental Runs	Notes
	Requested	Performed		
Total Kjeldahl Nitrogen (Total and Filtered)	EPA 351.3	EPA 351.1	4-6	EPA 351.3 is a titrimetric ammonia end-point determination. EPA 351.1 determines the end-point using an automated analyzer (automated phenate). Both methods are approved and acceptable.
Ammonia Nitrogen	EPA 350.3	EPA 350.2	4	EPA 350.3 determines aqueous ammonia by ion selective electrode. EPA 350.2 determines ammonia by distillation and titrimetric endpoint. Both methods are approved and acceptable.

Reporting Limits. Required project reporting limits were presented in Table 5-1 of the project *Monitoring and Operations Plan*. A copy of this table was furnished to both laboratories used during the course of the project. Required reporting limits were attained with two exceptions; (1) Experimental Run 6 silica values were reported as <1 mg/L, where <0.5 mg/L was required, and (2) Experimental Runs 4 and 5 oil and grease values were reported as <5 mg/L, where <2 mg/L was required. A higher reporting limit for silica is of no project consequence. The higher reporting limit for oil and grease prevents a full assessment of the treatment unit effectiveness to achieve the project objective (see Section 5.2.3).

Holding Times. Required sample analytical holding times were presented in Table 5-1 of the project *Monitoring and Operations Plan* and are consistent with those specified in the *Storm Water Monitoring Protocols*. Nitrate, Nitrite and ortho-phosphate have a holding time of 48 hours. Based on the logistics and timing of sample collection (e.g., nights and weekends) and sample transport time to laboratories (overnight courier services) some sample holding times were exceeded. After the first few runs new procedures (target experimental end times) were employed to minimize holding time violations. Violations were limited to Experimental Runs 1 through 3. Samples that exceeded holding times are flagged in the database (Appendix A).

Field Blanks. Both equipment and bottle field blanks were collected. Bottle blanks allow verification that bottles obtained from the contract laboratory are clean and free from contamination. Bottle blanks were prepared by pouring certified high performance liquid chromatography (HPLC) grade reagent water (de-ionized) directly into the clean sample bottles obtained from the laboratory. Equipment blanks typically are used to determine if a contaminant is introduced during field sampling or as an artifact of de-contamination of sampling equipment. Equipment blanks were prepared by rinsing randomly selected sample equipment (e.g., composite buckets, collection barrels) with HPLC grade reagent water. A bucket of this rinse water was then processed like any other sample. Blanks were sent to the laboratory with markings that did not indicate that the sample was a blank. Table 5-3 is a tabular summary of the project blank samples collected. Grey highlighted boxes in Table 5-3

are detected contaminant concentrations that received additional scrutiny (often leading to qualified results). Due to the presence of contaminants in Experimental Run 5 blank samples, additional blanks were incorporated into Run 6.

Experimental Runs 4 and 5 exhibited elevated total iron in both the bottle blanks collected but in only one of the equipment blanks. This contamination could have occurred in the sample containers or, more likely, was associated with the laboratory procedures. Similarly, Experimental Run 5 exhibited elevated phosphorus concentrations slightly above the reporting limit and Experimental Runs 4, 5, and 6 exhibited elevated total dissolved solids concentrations in both the equipment and bottle blanks. Contamination in both blanks indicates issues with the bottles or laboratory procedures. There is also some indication that the laboratory determinations are problematic with regards to background contamination with TKN.

Experimental runs having blank contamination were evaluated according to USEPA and Caltrans guidelines (Caltrans, 2000). These guidelines establish the levels at which contamination requires qualification of the data. For sample results that are less than five times the blank concentration, the data are qualified as anomalous (U) (see Section 5.1.3). After reviewing all data, qualifiers were added where necessary to the reported values in the database (Appendix C).

Field Duplicates. The collection and processing of duplicate samples in the field was used to assess precision (i.e., variability attributed to collection, handling, shipment, storage, and/or laboratory processing). Procedures for collecting and processing field duplicates were the same as for normal (non-replicate) samples. The acceptance (i.e., pass/fail) criterion was based on a calculated relative percent difference (RPD) of less than 50 percent (Caltrans, 2000). The RPD was calculated by dividing the difference between two measurements by the average of the two measurements. Of 580 individual determinations, 26 were rejected (i.e., 4.5 percent).

A complete tabular summary of all duplicate project samples is presented in Table 5-4. Generally, one field duplicate sample was collected for each run. After review of the laboratory Data from Experimental Runs 4 and 5 (ToxScan/Soil Control Labs), an additional replicate sample was collected for Experimental Run 6.

Duplicate pairs that have a RPD exceeding 50 percent are highlighted gray in Table 5-4. Many of the differences between replicate samples can be attributable to true sample variance. For example, for the metals determinations a 20 to 50 mL portion of sample is digested and analyzed. With small sub-samples, a larger variation exists in the metals content of small particles present in the sample. Many of the flagged duplicates with poor agreement are of little project concern, especially pertaining to the metals (e.g., Cd, Cr, Cu, Pb, Ni, Zn) and salt ions (e.g., Ca, Mg, hardness, alkalinity). Assessments of treatment performance are not based on these parameters because currently there are no effluent limitations associated with these contaminants. However, variations in the determination of solids content, nitrogen species, iron, and phosphorus are of concern. After reviewing all duplicate data, qualifiers were added where necessary to the reported values in the database (see Section 5.1.3 and Appendix C).

Table 5-3. Project Blank Sample Results

		1-16-S	2-16-F	4- 17-S	4-16-S	5-16-F	5-16-S	6-18-S	6-18-F	6-19-S	6-16-F
PARAMETER	**UNITS**	**EQ**	**EQ**	**Btl**	**EQ**	**EQ**	**Btl**	**EQ**	**EQ**	**EQ**	**Btl**
Nitrate as N	mg-N/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrite as N	mg-N/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1
Oil & Grease (HEM)	mg/L	<2	<2	<5	<5	<5	<5	<2	<2	<2	<2
Orthophosphate as P	mg-P/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Orthophosphate as P, Dis	mg-P/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Phosphorus, Dissolved as P	mg-P/L	<0.03	<0.03	<0.03	<0.03	0.04	0.04	<0.03	<0.03	<0.03	<0.03
Phosphorus, Total as P	mg-P/L	<0.03	<0.03	<0.03	<0.03	0.05	0.06	<0.03	<0.03	<0.03	<0.03
Potassium	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium	mg/L	1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulfate as SO_4	mg/L	<1.0	<1.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0
Total Alkalinity	mg-$CaCO_3$/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Dissolved Solids	mg/L	<1	<1	<1	2.0	12	16	6	<1	<1	6
Total Kjeldahl Nitrogen	mg-N/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1
Total Kjeldahl Nitrogen, Dis	mg-N/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.3	0.1	0.1
Total Organic Carbon	mg/L	1.9	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	1.0	1.4	1.2
Total Suspended Solids	mg/L	<1	<1	<1	<1	<1	2	<1	<1	<1	<1
Zinc	µg/L	<5	<5	<5	<5	<5	<5	6	<5	<5	<5
Zinc - Dissolved	µg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

EQ = equipment blank; Btl = bottle blank, Dis = Dissolved.

Table 5-3. Project Blank Sample Results

		1-16-S	2-16-F	4- 17-S	4-16-S	5-16-F	5-16-S	6-18-S	6-18-F	6-19-S	6-16-F
PARAMETER	**UNITS**	**EQ**	**EQ**	**Btl**	**EQ**	**EQ**	**Btl**	**EQ**	**EQ**	**EQ**	**Btl**
Acid Soluble Aluminum	µg/L	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
Aluminum	µg/L	<25	<25	<25	<25	<25	<25	<25	<25	<5	<25
Aluminum - Dissolved	µg/L	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
Ammonia as N	mg-N/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	mg/L	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cadmium	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cadmium - Dissolved	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Calcium	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.2	0.3	0.1
Carbonate Alkalinity	mg-$CaCO_3$/L	<1	<1	<1	<1	<1	<1				
Chloride	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chromium - Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Copper	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Copper - Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dissolved Organic Carbon	mg/L	1.2	<1.0	<1.0	<1.0	<1.0	<1.0				
Hardness	mg-$CaCO_3$/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Iron	µg/L	<25	<25	53	<25	47	27	<25	<25	<25	<25
Iron - Dissolved	µg/L	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
Lead	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Lead - Dissolved	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Magnesium	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Nickel - Dissolved	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0

Table 5-4. Project Field Duplicate Sample Results (Runs 1 through 3)

Parameter	Units	Run 4			Run 5			Run 6			Run 6		
		Dup[a]	Sample	RPD	Dup	Sample	RPD	Dup	Sample	RPD	Dup	Sample	RPD
Nitrite as N	mg-N/L	<0.1	<0.1	0.0	<0.1	<0.1	0.0	<0.1	<0.1	0.0	0.3	0.3	13.3
Oil & Grease (HEM)	mg/L	<5	<5	0.0	<5	<5	0.0	<2	<2	0.0	6	5	19.8
Orthophosphate as P	mg-P/L	0.05	0.04	12.8	0.08	0.08	2.5	0.36	0.36	0.0	0.22	0.21	4.7
Orthophosphate as P, Dis	mg-P/L	<0.03	<0.03	0.0	<0.03	0.03	6.5	0.03	0.03	0.0	0.52	0.47	10.1
Phosphorus, Dissolved as P	mg-P/L	<0.03	<0.03	0.0	0.09	0.13	39.6	0.07	0.06	18.2	0.66	0.69	4.4
Phosphorus, Total as P	mg-P/L	0.04	0.07	45.9	0.35	0.37	5.6	0.57	0.56	1.8	1.30	1.10	16.7
Potassium	mg/L	3.9	4.1	5.2	3.3	2.8	19.1	<0.5	<0.5	0.0	7.5	7.2	4.1
Silicon (as Si)	mg/L	2.9	2.7	5.0	9.8	7.8	21.8	10	9.9	1.0	27	20	29.8
Sodium	mg/L	314	319	1.6	127	108	15.9	40	39	2.5	17	17	0.0
Sulfate as SO4	mg/L	4.8	4.8	0.0	4.6	4.6	0.0	1.7	1.7	0.0	4.5	4.4	2.2
Total Alkalinity	mg-CaCO3/L	11	11	0.0	46	46	0.0	6	35	141.5	29	28	3.5
Total Dissolved Solids	mg/L	1300	1300	0.0	350	330	5.9	300	300	0.0	300	320	6.5
Total Kjeldahl Nitrogen	mg-N/L	0.3	0.3	6.9	1.5	1.4	6.9	1.5	1.6	6.5	4.4	4.3	2.3
Total Kjeldahl Nitrogen, Dis	mg-N/L	0.3	0.3	6.9	1.0	0.9	11.8	1.3	1.2	8.0	2.8	2.8	0.0
Total Organic Carbon	mg/L	5.1	4.9	4.0	38	44	14.6	160	150	6.5	190	190	0.0
Total Suspended Solids	mg/L	14	16	13.3	120	110	8.7	36	36	0.0	400	180	75.9
Turbidity (Lab)	NTU	23	22.0	4.4	130	140	7.4						
Zinc	µg/L	6	6	4.8	86	77	10.9	160	140	13.3	610	520	15.9
Zinc – Dissolved	µg/L	<5	<5	0.0	11	9	21.1	110	130	16.7	320	240	28.6

a Abbreviations: Dup= Duplicate, RPD = Relative Percent Difference.

Table 5-4. Project Field Duplicate Sample Results (Runs 1 through 3)

Parameter	Units	Run 4			Run 5			Run 6			Run 6		
		Dup[a]	Sample	RPD	Dup	Sample	RPD	Dup	Sample	RPD	Dup	Sample	RPD
Acid Soluble Aluminum	µg/L	120	140	15.4	210	190	10.0	2400	3400	34.5	530	220	82.7
Aluminum	µg/L	400	330	19.2	1400	1400	0.0	3700	550	148.2	2200	1200	58.8
Aluminum – Dissolved	µg/L	<25	<25	0.0	120	40	100.0	410	510	21.7	130	120	8.0
Ammonia as N	mg-N/L	<0.1	0.1	0.0	0.2	0.3	19.6	0.7	0.5	42.6	1.1	1.2	8.7
Ammonia as N, dissolved	mg-N/L							0.6	1.0	45.0	1.2	1.2	0.0
Boron	mg/L	<0.02	<0.02	0.0	0.03	0.08	90.4	0.04	0.04	2.4	0.05	0.05	0.0
Cadmium	µg/L	<0.2	<0.2	0.0	<0.2	<0.2	0.0	0.4	0.3	22.2	0.4	0.3	23.5
Cadmium – Dissolved	µg/L	<0.2	<0.2	0.0	<0.2	<0.2	0.0	<0.2	<0.2	0.0	<0.2	<0.2	0.0
Calcium	mg/L	29.1	30.5	4.7	6.4	5.4	17.1	0.7	0.7	0.0	9.7	8.8	9.7
Chloride	mg/L	760	800	5.1	110	130	16.7	53	53	0.0	9	9	0.0
Chromium	µg/L	2.4	2.3	4.3	10.3	8.4	20.3	5.0	2.5	66.7	9.3	8.2	12.6
Chromium – Dissolved	µg/L	1.6	1.6	0.0	<1.0	<1.0	3.1	1.9	1.7	11.1	5.4	4.9	9.7
Copper	µg/L	2.5	2.4	2.1	14	12	19.3	9.4	6.2	41.0	20	16	22.2
Copper – Dissolved	µg/L	1.8	1.6	11.8	4.7	4.5	3.7	4.5	5.3	16.3	11.0	9.3	16.7
Dissolved Organic Carbon	mg/L	5.7	4.4	25.7	36	43	17.7						
Iron	µg/L	1200	1200	0.0	6200	5700	8.4	1200	1200	0.0	6500	4900	28.1
Iron – Dissolved	µg/L	<25	<25	0.0	390	390	0.0	40	610	175.4	230	220	4.4
Lead	µg/L	<1.0	<1.0	0.0	7.4	7.4	0.1	3.1	<1.0	102.4	18	12	40.0
Lead – Dissolved	µg/L	<1.0	<1.0	0.0	<1.0	<1.0	0.0	<1.0	<1.0	0.0	<1.0	<1.0	0.0
Magnesium	mg/L	8.1	8.5	4.0	3.4	2.8	17.0	0.3	0.3	0.0	2.7	2.3	16.0
Nickel	µg/L	2.0	<2.0	1.5	5.2	4.4	15.2	<2.0	<2.0	0.0	5.5	4.6	17.8
Nickel – Dissolved	µg/L	<2.0	<2.0	0.0	1.7	<2.0	15.6	<2.0	<2.0	0.0	3.6	3.2	11.8
Nitrate as N	mg-N/L	0.1	<0.1	0.0	<0.1	<0.1	0.0	<0.1	<0.1	0.0	0.5	0.5	8.2

5.1.3 Data Qualifers

After quality control analysis, qualifier codes were entered into the database to identify apparent problems or concerns. The qualifier codes used were adapted from EPA guidelines and are recognized by Caltrans in the *Storm Water Monitoring Protocols, Guidance Manual*. The most common reasons for the addition of qualifier codes were:

1. Holding time violation
2. Blank contamination
3. Poor duplicate agreement
4. Dissolved fraction larger than total fraction

The two primary data qualifiers used were "J" and "U". The "J" qualifier indicates that the result should be considered approximate due to poor duplicate agreement, missed holding time, or a dissolved concentration reported at a greater concentration than the total concentration. The "U" qualifier signifies that the result should be considered to be below the quantification level for that run. The "U" qualifier was issued for samples with blank contamination. All samples with a reported concentration within five times the concentration detected in the blank were issued "U" qualifiers. Project data qualifiers used and reason code definitions are summarized in Table 5-5. Both qualifiers and reason codes are listed on the data pages prior to the qualified results (Appendix A).

Table 5-5. Project Data Qualifiers and Reason Codes

Data Qualifier Definitions			
U	The analyte was analyzed for, but was not detected above the calculated "sample quantitation limit".	J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".	NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.	R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
Reason Code Definitions			
a	Analytical sequence deficiency or omission.	c	Calibration failure; poor or unstable response.
d	Laboratory duplicate imprecision.	e	Laboratory duplicate control sample imprecision.
f	Field duplicate imprecision.	h	Holding time violation.
l	Laboratory control sample recovery failure.	m	Matrix spike/matrix spike duplicate recovery failure.
o	Calibration blank contamination (metals/inorganics)	p	Preparation blank contamination (metals/inorganics)
q	Quantitation outside of linear range.	r	Linearity failure in initial calibration.
x	Field or equipment blank contamination.	y	Trip blank contamination.
z	Method blank contamination.	D	Value exceeds quantitation limit.
		Q	Dissolved concentration significantly exceeded the total concentration.

5.1.4 Presentation of Treatment Unit Performance

Treatment unit performance with respect to water quality parameters was compiled graphically for presentation in Figures 5-1 through 5-32. Graphic plots on each figure are organized by water quality parameter. Each figure contains 21 individual plots, one for each treatment unit with a few exceptions. Each plot illustrates the treatment unit effluent concentration (ordinate) against the average influent concentration (abscissa) for a particular parameter. One (x,y) pair is plotted for each experimental run up to the six total. Because some treatment units were not operated for one or more runs, the plots have varying numbers of data points. The number of experimental runs for each treatment unit is indicated in Table 5-1. In addition, some data pairs are exactly equal or close enough to each other that they appear to be a single point. The data points that appear to be single data points are identified in the notes box on each of the figures.

Distinguishing characteristics of the data plots are discussed as follows:

Reporting Limit Lines. Reporting limit lines are shown on each plot as horizontal and vertical dotted lines. The lines are plotted on both axes because both the plant influent and treatment unit effluent samples are subject to the reporting limit. If a constituent was below the reporting limit, it is plotted on the reporting limit line. Some parameters with limits below the resolution of the plot are not shown (e.g., turbidity).

The reporting limit line on the ordinate is not shown for the oil and grease performance plots because the reporting limit is the same as the surface water discharge limit (2 mg/L). Because of laboratory error, a reporting limit of 5 mg/L was supplied for Experimental Runs 4 and 5. The data markers for the two experimental runs with the higher reporting limit are different than the data for the remaining experimental runs in which the 2 mg/L reporting limit was provided.

Discharge Limit Lines. For some parameters, a maximum surface water discharge limit line is shown as a dashed line. Maximum allowable concentrations for discharge to surface waters (Table 2-1) have been established for turbidity, total-iron, total-nitrogen, total-phosphate (as P) and oil and grease. For these parameters, a line is plotted parallel to the abscissa. If the sample point is plotted above this line, the effluent concentration is not in compliance with the discharge limit. Conversely, if the sample point is plotted below this line, the effluent complies with the regulatory criterion.

For the nitrogen compounds (e.g., nitrate, nitrite, total Kjeldahl nitrogen, and ammonia), the discharge permit line is plotted at the total nitrogen regulatory limit (i.e., 0.5 mg-N/L) even though this limit applies only to the total of the nitrogen compounds. Total nitrogen is presented in its own plot (Figure 5-9). Obviously, if any one individual species of nitrogen exceeds the regulatory limit, the effluent will not be in compliance with the regulatory objective.

In the Lake Tahoe Basin, phosphorus is regulated as “total phosphate as P” at a concentration of 0.1 mg-P/L. It is not clear what form of phosphorus is regulated. Therefore, the discharge permit line is plotted at 0.1 mg-P/L for all of the phosphorus forms. Obviously, if any one

individual species of phosphorus exceeds the regulatory limit, the effluent will not be in compliance with the regulatory objective.

One to One (1:1) Influent to Effluent Concentration Line. A solid line bisects each plot diagonally to illustrate equal influent and effluent concentrations (i.e., no increase or decrease in concentration through the treatment process). If the sample point is above this line, the concentration increased through the treatment process and, therefore, indicates deterioration in water quality. If the sample data point is below this line, the concentration decreased through the treatment process.

The high technology treatment processes were operated with several configurations and combinations. Common to all, the first process was the batch Actiflo® process. Effluent from the Actiflo® process was then passed through either the pressure sand filter (PSF) or the Fuzzy Filter® (FF). The effluent from the filters was then passed through a series of ion exchange cartridges. However, some runs had more cartridges in place than others. Additionally, some runs had only a single composite sample collected for the filters. Therefore, performance of only four of the high technology unit processes is plotted. These processes are:

- the Actiflo® process alone,
- the Actiflo® process followed by pressure sand filtration,
- the Actiflo® process followed by Fuzzy Filter® filtration, and
- the Actiflo® process followed by filtration and all ion exchange cartridges used.

All of the treatment unit effluent data are plotted against the pilot plant influent data, even though the pressure sand filter, the Fuzzy Filter®, and the ion exchange cartridges actually received partially treated storm water as influent (Actiflo® effluent).

5.2 Treatment Results

Results from the first year of operation are presented and discussed with regard to treatment performance and the ability to comply with surface water effluent discharge limits in the following sections. Performance plots for each treatment unit are presented by water quality parameter in Figures 5-1 through 5-32. The tabulated data are provided in Appendix A.

5.2.1 Turbidity

Turbidity is a measure of light scatter, and is attributed to suspended and colloidal particles. Sources of particles include clay and silt from erosion, organic detritus, atmospheric deposition of particulate emissions, etc. The Lake Tahoe Basin discharge limit for turbidity is 20 NTU for surface water discharge and 200 NTU for discharge to infiltration systems.

Because turbidity is an optical property of water, and the contaminant particle size distribution within a sample can change with time as fine particles coalesce into larger particles that reflect less light, turbidity is best measured in the field. For Experimental Runs 1 through 6, both field and laboratory turbidity measurements were conducted. As expected, the field turbidity measurements were consistently higher than those measured in the

laboratory. Therefore, turbidity results presented and discussed subsequently in this section relate to the field measurements only.

Sedimentation and filtration are expected to reduce turbidity because the processes directly remove the particles that are responsible for light scatter. Chemical addition is expected to increase turbidity removal because it aids in coagulating many small particles into fewer larger particles that either scatter less light or can be subsequently removed by sedimentation or filtration. Turbidity reduction through the various treatment processes is illustrated in Figure 5-1. Up through Experimental Run 5, nine of the twenty-five treatment systems were able to produce an effluent that complied with the surface water regulatory effluent limit of 20 NTU. Those systems were:

- PASS-C® addition, sedimentation, and fine sand filtration,
- PASS-C® addition, sedimentation, and activated alumina filtration,
- PASS-C® addition, sedimentation, and aluminum oxide filtration,
- PASS-C® addition, sedimentation, and zeolite filtration,
- Actiflo® sedimentation,
- Actiflo® sedimentation followed by Fuzzy Filter® filtration,
- Actiflo® sedimentation followed by pressure sand filtration,
- Actiflo® sedimentation followed by Fuzzy Filter® filtration and ion exchange,
- Actiflo® sedimentation followed by pressure sand filter filtration and ion exchange.

In addition, three systems were able to meet the less restrictive infiltration limit of 200 NTU:

- PASS-C® addition with sedimentation,
- PASS-C® addition with fine sand filtration,
- PASS-C® addition, sedimentation, and coarse sand filtration.

All of the low-technology systems that consistently complied with the surface water effluent limit for turbidity included chemical addition. The filters that did not make use of chemical addition did not perform well, in contrast to observations made during the Best Management Practice Retrofit Pilot Program conducted in Southern California. Without chemical addition both the fine sand and coarse sand filters exhibited essentially no meaningful TSS removal (TSS contributes to turbidity, see Figure 5-2) whereas the Retrofit Pilot Program observations were that such filters removed 80 to 90 percent of TSS, resulting in effluent concentrations of 10 to 20 mg/L. It is likely that the high filter loading rates used in this study contributed to the poorer performance observed as part of this study. Both projects passed similar amounts of water through a filter during storm events, but the Retrofit Pilot Program made use of an upstream sedimentation basin and provided for water application to the filter over a 24-hour period, whereas this project included much higher filter application rates (with and without prior sedimentation).

When chemicals were used, the coarse sand media (the only media with a larger effective size and uniformity coefficient) was unable to reduce turbidity to the surface water limit. The other medias were much more effective in solids removal. Therefore, it might be concluded that media particle size distribution is an important design consideration when attempting to remove turbidity. The alternative medias (e.g., zeolite, activated alumina and aluminum

oxide) that were also able to reduce turbidity to below the effluent limitation (when combined with PASS-C® enhanced sedimentation) had effective grain sizes (D_{10}) equal to or smaller than fine sand.

Sedimentation followed by concrete sand filtration was unable to meet either the surface water or infiltration discharge limits. Concrete sand filter media was not evaluated in conjunction with PASS-C® enhanced sedimentation. The concrete sand media had the smallest effective grain size (0.13 mm) but the largest uniformity coefficient (8.7) of any media (see Table 3-1). The concrete sand media required extensive initial flushing. It is likely that much of the finer particles were washed out during conditioning, leading to media with proportionally coarser grained material.

Of the high-technology treatment systems, most of the turbidity removal occurred in the Actiflo® high-rate sedimentation process and downstream filters did not have much observable effect. Experimental Run 6 differed from the other experimental runs because it was characterized by early season storm water after an extended dry summer period. It proved to be chemically dissimilar to the storm water treated during the other experimental runs [e.g., higher total organic carbon (TOC) content]. During Experimental Run 6, Actiflo® sedimentation was unable to produce an effluent with turbidity less than 20 NTU, even after polishing via Fuzzy Filter®. Final Actiflo® turbidity was approximately 30 NTU for Experimental Run 6, which is below the 200 NTU requirement for discharge to infiltration systems. The poor effluent quality in the Experimental Run 6 Actiflo® effluent suggests that a single pre-set chemical dose may not be appropriate for all storm events.

5.2.2 Total Suspended Solids

Total suspended solids (TSS) represents the concentration of solid material that is retained on a glass fiber filter (nominal pore size = 0.45 µm) after sample filtration and drying at 103°C. Sources of total suspended solids are similar to the sources of turbidity. In general, a fixed and precise correlation between turbidity and total suspended solids in storm water is not possible because the size, shape, and refractive index of particles are variable; however in general, TSS removal and turbidity removal somewhat correlates. Removal mechanisms for total suspended solids are similar to the removal mechanisms identified for turbidity.

The removal of TSS through the various treatment processes is illustrated in Figure 5-2. Total suspended solids do not have a specific numerical effluent limit listed in the Basin Plan. However, the Lahontan Basin Plan does list some general overall water quality standards for the Lake Tahoe Basin, one of which states that "*Suspended sediment concentrations in the streams tributary to Lake Tahoe shall not exceed a 90th percentile value of 60 mg/L*". Application of this standard would require consideration of the available dilution in receiving streams.

As stated above, it was expected that a reduction in turbidity would result in a corresponding reduction in the concentration of total suspended solids. This expectation was generally observed throughout the various treatment systems under study.

5.2.3 Oil and Grease

Oil and grease in storm water runoff can originate from a variety of sources, including hydrocarbons (non-volatile petroleum compounds) associated with vehicles and oils and waxy compounds extracted from plant and vegetable matter. Oil and grease can be removed from water by physical separation and adsorptive processes. Therefore, coagulation and filtration are expected to reduce concentrations of oil and grease in storm water, though not entirely eliminate their presence if they occur in relatively high concentrations.

The Tahoe Basin numeric storm water discharge limit for oil and grease is 2 mg/L for surface water discharge and 40 mg/L for discharge to infiltration systems. The average oil and grease concentration of the storm water used in the pilot plant was 5 mg/L. Experimental Runs 2, 3 and 5 had no detectable oil and grease in the influent (wetland, snow storage yard, roadside basins). Mean EMC Tahoe Basin storm water oil and grease (reported in the 2001-2002 basin survey) was 22 mg/L (Caltrans 2002b). In general, basin storm water may fall below the requirement of 40 mg/L for discharge to infiltration systems.

The removal of oil and grease through the various treatment processes is illustrated in Figure 5-3. There are two main factors that preclude drawing definitive conclusions about the treatment processes effectiveness with respect to oil and grease removal:

1. Oil and grease concentrations were lower than expected in the untreated storm water and are not typical of Lake Tahoe Basin storm water (Table 4-7). Oil and grease concentrations can be reduced via handling (e.g., pumping, transferring storm water from tank to tank) because oil and grease can adhere to surfaces. The small scale of the pilot systems (i.e., large internal surface areas) make it possible that oil and grease concentrations could be under-represented in the influent water collected and used for the experimental runs. An artificially low influent concentration would not allow for an accurate contaminant reduction assessment.

2. The project required a reporting limit for oil and grease at 2 mg/L, which is equivalent to the regulatory limit. This level of quantification was required to determine if a treatment process could be considered successful. In 2 of the 6 experimental runs, the laboratory failed to meet this limit, using instead a detection limit 5 mg/L. There were only three experimental runs available to evaluate treatment effectiveness and two of those runs exhibited influent concentrations of oil and grease less than the regulatory objective of 2 mg/L.

5.2.4 Phosphorus

Phosphorus can be present in storm water as orthophosphate, polyphosphate, or organically bound phosphorus. Phosphorus in water is typically complexed and bound with organic and inorganic particles, thus it is usually associated with sediment and biomass. Free “available” phosphate in natural waters is quickly bound or utilized by microorganisms and, therefore, typically is present at low concentrations. Sources of phosphorus include soils, fertilizers, wastes, and cleaners.

During the pilot project, monitoring was conducted for total phosphorus on unfiltered and filtered samples (resulting in measurements of total and dissolved phosphorus). Dissolved

phosphorus includes orthophosphate and dissolved forms of polyphosphate and organic phosphorus. True orthophosphate is always dissolved, so any differences between test results between unfiltered and filtered (total and dissolved) orthophosphate could represent particles containing phosphate precipitated with iron, for example. In the analytical test procedure for orthophosphate on unfiltered samples, these precipitates would dissolve and be measured as orthophosphate.

It is expected that treatment processes that remove particles (e.g., sedimentation, filtration) will remove particulate phosphorus. Chemical addition, too, is expected to enhance particulate phosphorus removal because it aids in coagulating many small particles into fewer larger particles that can subsequently be physically removed by sedimentation and/or filtration. Additionally, chemical addition can be used to remove dissolved phosphorus through complexation, sequestration and precipitation mechanisms. The chemical coagulant PASS-C® was specifically chosen for pilot project study due to its demonstrated ability to remove dissolved phosphorus during the Jar Test Study (Caltrans, 2003).

Total phosphorus reduction through the various treatment processes is illustrated in Figure 5-4. Dissolved phosphorus reduction is illustrated in Figure 5-5. The contribution of total and dissolved forms of phosphorus before and after treatment in each unit is illustrated in Figure 5-6. The reduction of total ortho-phosphate and dissolved ortho-phosphate through the various treatment processes is illustrated in Figures 5-7 and 5-8, respectively.

The majority of phosphorus in the Lake Tahoe Basin is particulate (see Table 4-7, Figure 5-6) and, therefore, subject to removal by solids/liquid separation processes (e.g., sedimentation and filtration). Therefore, chemical coagulation and/or flocculation can greatly improve particulate phosphorus removal.

None of the twenty-five treatment systems were able to produce an effluent that was less than the 0.1 mg-P/L limit for surface water discharge in the Tahoe Basin. However, potential laboratory or field contamination in Experimental Run 1 lead to the presence of a common data point (influent of 1 mg-P/L, effluent equal to 0.2 mg-P/L) in many of the total phosphorus plots in Figure 5-4. A similar anomalous point (influent = 0.2 mg-P/L, effluent = 0.2 mg-P/L) exists in most of Experimental Run 1 data for dissolved phosphorus (Figure 5-5 and the Run 1 plot in Figure 5-6). Additionally, the presence of phosphorus in the equipment and bottle blanks in Experimental Run 5 resulted in much of the data being qualified. Background contamination present in both equipment and bottle blanks indicates a potential laboratory issue. Although this contamination was below the surface water discharge limit, qualified data complicate the ability to ascertain process effectiveness for that standard.

Discounting Experimental Run 1 (possible erroneous data) and Run 6 (poor coagulation), seven of six of the twenty-five treatment systems are possibly able to produce an effluent that complied with the surface water regulatory effluent limit of 0.1 mg-P/L. Those systems were:

- PASS-C® addition, sedimentation, and activated alumina filtration,
- PASS-C® addition, sedimentation, and aluminum oxide filtration,
- Actiflo® sedimentation,

- Actiflo® sedimentation followed by Fuzzy Filter® filtration,
- Actiflo® sedimentation followed by pressure sand filtration,
- Actiflo® sedimentation followed by Fuzzy Filter® filtration and ion exchange,
- Actiflo® sedimentation followed by pressure sand filter filtration and ion exchange.

This single, potentially anomalous point prevents the definitive conclusion that the aluminum based medias with PASS-C® enhanced sedimentation produce an effluent that is compliant with the surface discharge standard. The aluminum based medias with chemical sedimentation were able to meet the surface water total phosphorus discharge limit of 0.10 mg-P/L in 4 of 5 pilot runs (Figure 5-4). Activated alumina filtration preceded by PASS-C® enhanced sedimentation was successful in treating the storm water in all runs except Run 1. Treating storm water with PASS-C® appears to be generally effective in reducing the concentration of total phosphorus. PASS-C® with sedimentation alone was fairly effective, complying with the surface discharge standard three times out of six.

As shown in Figure 5-5, influent dissolved phosphorus is often at or above the surface water discharge limit of 0.1 mg/L for total phosphorus ("total phosphate as P"). Therefore, to comply with the total phosphorus effluent limit, some dissolved phosphorus removal is required. The treatment systems that were expected to remove dissolved phosphorus were chemical precipitation (with PASS-C®), adsorptive filter medias (aluminum based medias), and ion exchange. PASS-C® and activated alumina were observed to remove substantial amounts of dissolved phosphorus whereas aluminum oxide was not effective by itself. Neither was tThe ion exchange unit used in this project was not effective at removing dissolved phosphorus every run (see Figure 5-6). Some medias showed an apparent production of orthophosphate (e.g., fine sand filter, zeolite filter, concrete sand filter, ion exchange) as shown by data points above the unit slope line. There is not an expectation that orthophosphate would be produced within a filter, and the results are likely due to variance in environmental analysis and sampling.

Most of the treatment schemes employed produced an effluent containing less than 1 mg-P/L total phosphorus (the discharge limit for infiltration systems within the basin). However, the storm water used in this study contained <1.0 mg-P/L in 3 of 6 Experimental Runs. Several of the treatment technologies may be able to attain this limit but the lack of influent phosphorus hinders making firm conclusions. Generally, sedimentation without chemical addition was ineffective in decreasing total phosphorus levels. Filtration without PASS-C® (except for activated alumina) was only marginally effective for meeting the infiltration standard. High technology treatment systems were able to produce an effluent that complies with the infiltration standard.

5.2.5 Nitrogen

Nitrogen is an essential nutrient for biological growth. Sources of inorganic nitrogen include fertilizers, animal and domestic wastes, household cleaners and the decay of organic matter. Organic nitrogen is typically in the form of biological material (plants, algae, animal wastes, etc.). Nitrogen can exist in storm water in various forms as set forth below:

Nitrogen Form	Particulate	Dissolved
Total Kjeldahl Nitrogen		
Organic	X	X
Ammonia		X
Nitrate		X
Nitrite		X

Monitoring was conducted for total and dissolved TKN, ammonia, nitrate, and nitrite (all expressed as N). Particulate organic nitrogen can be determined by subtracting dissolved TKN from total TKN. Dissolved organic nitrogen can be determined by subtracting ammonia from dissolved TKN.

Particulate organic nitrogen can be settled and filtered. Biodegradation of the captured particles can, however, produce dissolved nitrogen-containing constituents, particularly nitrate. Dissolved organic nitrogen and ammonia can be removed from storm water by adsorption. In the dry periods between storms, microorganisms will frequently convert these constituents to nitrate, which does not absorb onto most media. Thus, at least some of the nitrogen captured in one storm will be released in the next. Nitrate can be converted to nitrogen gas by biological denitrification, but conditions that promote this process are not usually present in settling basins and filters that dry out between storms.

Total nitrogen reduction through the various treatment processes is illustrated in Figure 5-9. The reduction of ammonia, nitrate, nitrite, total TKN, and dissolved TKN through the various treatment processes is illustrated in Figure 5-10, Figure 5-11, Figure 5-12, Figure 5-13, and Figure 5-14, respectively. Although some of the technologies appeared to produce total TKN, this mechanism is unlikely and the data probably indicate laboratory errors (e.g., method blank contamination).

As can be seen in Figure 5-9, none of the processes tested consistently met the total nitrogen surface water discharge standard of 0.5 mg-N/L. Systems that were effective at removing turbidity and phosphorus (i.e., PASS-C® enhanced sedimentation and filtration) were generally ineffective at removing total nitrogen. A few of the treatment systems were at best, marginally successful at reducing total nitrogen levels. Those treatments are:

- PASS-C® addition, sedimentation, and coarse sand filtration,
- PASS-C® addition, sedimentation, and zeolite filtration,
- PASS-C® addition, sedimentation, and activated alumina filtration,
- Actiflo® sedimentation followed by Fuzzy Filter® filtration and ion exchange,
- Actiflo® sedimentation followed by pressure sand filter filtration and ion exchange.

The various forms of nitrogen contributing to total nitrogen and the removal of each form during each experimental run are illustrated in Figure 5-15. It is clear from the data presented that to meet a 0.5 mg-N/L total nitrogen limit (surface discharge limit), it will be necessary to remove both dissolved and particulate nitrogen. Removing particulate nitrogen alone will not be adequate. Although for the pilot runs, ammonia, nitrate, and nitrite are generally low and below the regulatory effluent limit; nitrate alone exceeded the limit in

Experimental Run 2 and ammonia alone exceeded the limit in Experimental Runs 5 and 6. Average values for these dissolved contaminants, when added together, regularly exceed the regulatory limit. Soluble organic nitrogen (dissolved TKN minus ammonia) also exceeded the regulatory effluent limit in four experimental runs out of six.

Processes expected to remove dissolved constituents include ion exchange and zeolite filtration. The ion exchange process (IX) was selected because it can remove ionic compounds such as ammonia, nitrate, and nitrite. As shown in Figures 5-10, 5-11, and 5-12 the ion exchange process was effective in reducing ammonia and nitrate. The ability of the ion exchange process to remove nitrite is less clear because of the lack of nitrite in the influent storm water.

The zeolite filter media (3-F and 13-F) was selected because it can theoretically remove ammonia. PASS-C® addition, sedimentation, and zeolite filtration (13-F) was observed to be the most effective of the low technology treatment systems in reducing total nitrogen concentrations. Zeolite filtration alone (3-F) was observed to remove a significant amount of nitrogen in Experimental Run 1, only to release a substantial amount of nitrogen (mainly nitrate) in Experimental Run 2. Some incidental biological nitrification may have occurred in the filter units.

Considering that there are substantial quantities of particulate nitrogen in Lake Tahoe Basin storm water runoff, treatment technologies that effectively remove particulate material (including both low and high technology systems) can result in substantial nitrogen removal. However, due to the reported concentrations of the various dissolved nitrogen species, it is unlikely that any of the low technology treatment systems being tested can reliably meet the surface water regulatory effluent limit concentration of 0.5 mg/L of total nitrogen.

Most of the treatment schemes employed produced an effluent containing less than 5 mg-N/L of total nitrogen (the discharge limit for infiltration systems within the basin). However, the storm water used in this study contained ≤ 5 mg-N/L in all six Experimental Runs. Several of the treatment technologies may be able to attain this limit, but the lack of influent total nitrogen in excess of this level hinders making any firm conclusions.

5.2.6 Total and Dissolved Iron

Iron (Fe) is a metal found in various particulate and dissolved (soluble) forms. It is vital to plant and animal life. The proportion of dissolved iron present in water is dependent on the solubility, concentration, oxidation state, and presence of complexation agents. Iron is the fourth most abundant rock-forming element and occurs naturally in soils and water. Erosion of soils and dust deposition is therefore a common source of iron in storm water runoff. Vehicular sources can also be substantial, as lubricants, brake materials, tire-wear particulates and automotive body and frame parts all are known sources of iron in roadway runoff (FHA, 2000). The Lake Tahoe Basin total iron effluent limitations are 500 µg/L (0.5 mg/L) for surface waters and 4000 µg/L (4 mg/L) for discharges to infiltration systems (LRWQCB, 1994).

Of the various forms of iron, only total and dissolved irons were monitored. Total iron reduction through the various treatment processes is illustrated in Figure 5-16. Dissolved iron reduction is illustrated in Figure 5-17. For all of the experimental runs, dissolved iron was below the regulatory effluent limitation. Therefore, removal of particulate iron alone would allow compliance.

Of the low technology systems, PASS-C® addition with sedimentation alone exhibited substantial iron reduction, enough to meet the discharge limit of 4000 µg/L for discharge to infiltration systems, but not enough to meet the surface discharge limit (500 µg/L). There was a slight improvement in iron removal with the addition of filters, with the best reduction occurring when making use of the activated alumina filter following PASS-C® addition and sedimentation.

Of the high technology systems, Actiflo® sedimentation exhibited sufficient iron reduction to comply with the surface water discharge limit. The addition of filtration slightly increased iron removal, the magnitude likely influenced by the large amount of iron already removed within the Actiflo® process.

Six of the twenty-one treatment systems were able to produce an effluent that consistently complied with the permit regulatory limit of 500 µg/L. Those systems were:

- PASS-C® addition, sedimentation, and activated alumina filtration,
- Actiflo® sedimentation,
- Actiflo® sedimentation followed by Fuzzy Filter® filtration,
- Actiflo® sedimentation followed by pressure sand filtration,
- Actiflo® sedimentation followed by Fuzzy Filter® filtration and ion exchange,
- Actiflo® sedimentation followed by pressure sand filter filtration and ion exchange.

Five more treatment systems met the less stringent infiltration standard (4000 µg/L). They were:

- PASS-C® addition followed by fine sand filtration,
- PASS-C® addition followed by sedimentation,
- PASS-C® addition followed by sedimentation,
- PASS-C® addition followed by sedimentation and coarse sand filtration,
- PASS-C® addition followed by sedimentation and fine zeolite filtration.

5.2.7 Aluminum

There is not currently a regulatory requirement to remove aluminum from storm water in the Lake Tahoe Basin; however, the Environmental Protection Agency has stated that aluminum concentrations in excess of 87 µg/L have the potential to cause aquatic life toxicity (Brooke and Stephan, 1988). There is some controversy; however, regarding the state of aluminum that most contributes to aquatic life toxicity. Acid-soluble aluminum has been reported as being the best descriptor of aluminum toxicity (USEPA, 1988), but it has substantial deficiencies that preclude its universal use in setting regulations. Because two of the filter medias are aluminum based, three forms of aluminum (i.e., total, dissolved, and acid-soluble)

were monitored as an aid in determining the potential of the filter medias to contribute to aquatic life toxicity should they leach aluminum.

The removal of total, acid-soluble, and dissolved aluminum through the various treatment processes is illustrated in Figure 5-18, Figure 5-19, and Figure 5-20, respectively. Chemical addition and filtration (with the exception of concrete sand filtration) greatly reduced the concentration of total aluminum from Lake Tahoe Basin storm water runoff. All of the treatment processes were relatively ineffective in removing dissolved aluminum.

The activated alumina and aluminum oxide filters appeared to increase the concentration of dissolved aluminum, thus potentially increasing the toxicity of the effluent. Increased concentrations of dissolved aluminum could be due to re-partitioning of aluminum occurring within the filters, or the filter media itself contributing a leaching fraction of dissolved aluminum. Because the effluent concentration of acid-soluble aluminum was higher in the aluminum-based medias than it was in the other, non-aluminum based medias, the data lead to the suggestion of a leaching component. It is not yet known whether aluminum leaching is temporary and would stop with continued filter operation. Caution should, therefore, be taken when using either activated alumina or aluminum oxide filters to ensure that storm water treatment does not contribute to aquatic life toxicity.

5.2.8 Other Metals

No numerical limits for the discharge of metals (other than iron) are specifically listed in the Lake Tahoe, LRWQCB Basin Plan. However, the discharge of metals into streams and waterbodies within the State of California is regulated under the California Toxics Rule (CTR). Numerical limits for metals listed in the CTR are based on EPA aquatic life criteria (USEPA, 2000). Because metals are often trace chemical contaminants, and because the treatment processes have the potential to transform metals from the particulate form to the dissolved form (i.e., transform from a non-toxic form to a toxic form), the various metals were monitored to determine the potential for storm water treatment to decrease or contribute to aquatic life toxicity.

Many of the metallic aquatic life criteria are functions of water hardness. A typical Lake Tahoe Basin storm water hardness (not necessarily the most restrictive hardness) is 60 mg/L (as $CaCO_3$). For the sake of discussion, metals criteria based on a hardness of 60 mg/L (as $CaCO_3$) were used to discern aquatic toxicity impacts in the sections that follow.

Total and dissolved concentrations of the metals monitored during the course of study in the untreated storm water are reported in Table 5-6. Also reported in Table 5-6 are representative aquatic life criteria for assessing toxicity.

In the water quality objectives, the ratio of total concentration to the dissolved concentration (Table 5-6) provides an indication of the default partitioning of metals reported by EPA as expected in natural waters. In general, the particulate fraction of metals in the storm water exceeded that expected by EPA for natural waters, and therefore there exists the possibility that particulate metals can re-partition within the filters (leading to higher dissolved effluent concentrations than influent concentrations) or in downstream waters. In general, the

treatment processes were not selected to remove dissolved metals, so it could be expected that dissolved metals could pass through most of them (ion exchange being the exception). Fortunately, the concentrations of dissolved metals in untreated storm water were typically less than the aquatic toxicity criteria. Occasional exceptions occurred with copper and zinc.

Table 5-6. Comparison of Influent Concentrations of Metals to Aquatic Life Criteria

Metal	Observed Influent Concentration (µg/L) During Experimental Run:						Representative Concentration (µg/L) Capable of Exhibiting Aquatic Life Toxicity[a][b]
	1	2	3	4	5	6	
Cadmium							
Total	0.4	<0.2	0.6	0.4	0.3	0.3	1.7
Dissolved	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.5
Chromium							
Total	9.4	4.6	23	26	12	8.2	136
Dissolved	<1	<1	<1	1.4	<1	5.3	117
Copper							
Total	27	8.5	40	39	17	17	6.0
Dissolved	<1	3.4	<1	12	2.8	9.4	5.8
Lead							
Total	15	5.2	64	25	18	13	1.7
Dissolved	<1	<1	<1	<1	<1	<1	1.4
Nickel							
Total	10	2.9	13	15	6.1	4.6	34
Dissolved	<2	<2	<2	<2	2.4	3.2	34
Zinc							
Total	180	103	360	180	444	533	78
Dissolved	15	52	8	10	145	263	77

a USEPA (2000)
b 4-day average concentration, based on a hardness of 60 mg-$CaCO_3$/L and a water effect ratio of 1.0.

Solids separation processes (e.g., coagulation, sedimentation, filtration) are expected to remove particulate metals. Because dissolved metal concentrations were generally less than aquatic life criteria, removal of particulate metals is expected to be effective in reducing concentrations to those representative of the aquatic life criteria.

5.2.8.1 Cadmium

The removal of total and dissolved cadmium through different treatment processes is presented in Figure 5-21 and Figure 5-22, respectively. Based on a storm water hardness of 60 mg/L (as $CaCO_3$), the aquatic life criteria for total and dissolved cadmium are 1.7 and 1.5 µg/L, respectively.

Total and dissolved cadmium concentrations were always less than the aquatic life criteria in both the influent and effluent. Chemical addition always resulted in effluent concentrations at the detection limit of the analytical test, thus demonstrating cadmium removal occurs with the removal of other particulate contaminants. Aquatic toxicity due to cadmium arising from storm water treatment does not appear to be of concern.

5.2.8.2 Chromium

Removal of total and dissolved chromium through the different treatment processes is presented in Figure 5-23 and Figure 5-24, respectively. Based on a storm water hardness of 60 mg/L (as $CaCO_3$), the aquatic life criteria for total and dissolved chromium are 136 and 117 µg/L, respectively.

Total and dissolved chromium concentrations were always less than the aquatic life criteria in both the influent and effluent. There did not appear to be any removal of dissolved chromium (Figure 5-24) in any of the treatment systems (even ion-exchange); however, five of the six influent storm water batches contained ≤1 µg/L of dissolved chromium. The addition of PASS-C® generally resulted in low concentrations of total chromium in the effluents, demonstrating removal of particulate chromium with the removal of other particulate contaminants. Aquatic toxicity due to chromium from storm water treatment does not appear to be of concern.

5.2.8.3 Copper

Removal of total and dissolved copper through the different treatment processes is presented in Figure 5-25 and Figure 5-26, respectively. Based on a storm water hardness of 60 mg/L (as $CaCO_3$), the aquatic life criteria for total and dissolved copper are 6.0 and 5.8 µg/L, respectively.

The influent concentrations of copper always exceeded the aquatic life criteria. PASS-C® addition followed by sedimentation was very effective in reducing the concentration of both total and dissolved copper, with additional removal resulting after filtration. Effluent concentrations after filtration (with the exception of the concrete sand) were typically at or near the aquatic life criteria objective, suggesting that particulate copper removal occurs with the removal of other particulate contaminants. The Actiflo® process was also highly effective in reducing the concentrations of total copper.

Removal of metal was not a central purpose of this project. Aquatic life criteria for copper concentrations were not consistently achieved. The treatment processes did not leach copper from the medias; therefore, treating stormwater did not contribute to copper toxicity to aquatic life.

5.2.8.4 Lead

Removal of total and dissolved lead through the different treatment processes is presented in Figure 5-27 and Figure 5-28, respectively. Based on a storm water hardness of 60 mg/L (as

$CaCO_3$), the aquatic life criteria for total and dissolved lead are 1.7 and 1.4 µg/L, respectively.

The influent concentrations of lead always exceeded the aquatic life criteria. PASS-C® addition and sedimentation was very effective in reducing the concentration of particulate lead, but dissolved lead appeared unaffected by treatment in general. Effluent concentrations after filtration (with the exception of the concrete sand) were typically at or near the aquatic life criteria objective. The Actiflo® process was also highly effective in reducing the concentrations of particulate lead. Leaching of lead from the various medias was not observed. Therefore, the act of treating storm water does not appear to contribute to lead aquatic life toxicity.

5.2.8.5 Nickel

Removal of total and dissolved nickel through the different treatment processes is presented in Figure 5-29 and Figure 5-30, respectively. Based on a storm water hardness of 60 mg/L (as $CaCO_3$), the aquatic life criteria for both total and dissolved nickel is 34 µg/L.

Total and dissolved nickel concentrations were always less than the aquatic life criteria in both the influent and effluent. The combination of chemical addition, sedimentation, and filtration typically resulted in effluent total nickel concentrations at or near the detection limit (with the exception of the concrete sand). Systematic leaching of nickel from the various medias was not observed. Therefore, the act of treating storm water does not appear to contribute to nickel aquatic life toxicity.

5.2.8.6 Zinc

Removal of total and dissolved zinc through the different treatment processes is presented in Figure 5-31 and Figure 5-32, respectively. Based on a storm water hardness of 60 mg/L (as $CaCO_3$), the aquatic life criteria for total and dissolved zinc are 78 and 77 µg/L, respectively.

PASS-C® addition and sedimentation was somewhat effective in reducing zinc concentrations. The addition of filtration resulted in very effective zinc removal (with the exception of the concrete sand). The filter medias after chemical addition also appeared to remove dissolved zinc, perhaps by adsorption or precipitation in the filter.

Actiflo® was effective in reducing total zinc concentrations, but was ineffective in reducing dissolved zinc concentrations (as expected). The addition of ion exchange greatly increased the removal efficiency of both total and dissolved zinc in the high technology treatment processes. Systematic leaching of zinc from the various medias was not observed. Therefore, the act of treating storm water does not appear to contribute to zinc aquatic life toxicity.

5.3 Technology Assessments

The technology assessments are based on the overall contaminant removals described in Section 5.2. This section first presents the observed filtration performance and loading rates

for the various low technology systems, then presents overall assessments of the low technology and high technology systems.

5.3.1 Low Technology Filter Performance

Granular media filters failed (blinded) at different points throughout the study. Not all filters were operated each Experimental Run. A tabular summary of filter operation is presented in Table 5-7. During a run each filter was run twice. Blinding of a filter occurred when the surface layer became occluded to the point that flow through the media was all but halted. If the blinding occurred in the first fill, a sample for water quality analysis was not collected. If the filter blinded during the second fill a sample was collected. Some filter units were reconditioned between or prior to the next experimental run.

Table 5-7. Filter Operation, Failure and Reconditioning Notes for the First Year of Operation

Unit	Media	Filter Status					
		Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
1-F	Fine Sand	Ok	Ok	Ok	Ok	B-1st	NR
2-F	Coarse Sand	Ok	Ok	Ok	Ok	Ok	NR
3-F	Zeolite	Ok	Ok	Ok	Ok	B-2nd	NR
4-F	Activated Alumina	Ok	Ok	Ok	B-2nd	NR&Rec	Ok
5-F	Aluminum Oxide	Ok	Ok	Ok	Ok	B-2nd	NR
6-F	Fine Sand with PAM	B-1st	Ok	B-2nd	NR	NR	NR
7-F	Coarse Sand with PAM	Ok	Ok	B-1st	NR	NR	NR
8-F	Fine Sand with PASS-C®	Ok	Ok	Ok	B-2nd&Rec	Ok	NR
9-F	Coarse Sand with PASS-C®	Ok	Ok	Ok	Ok, Rec	Ok	NR
10-F	Concrete Sand, after Sed	Ok	Ok	Ok	Ok	Ok	Ok
11-F	Fine Sand, after PASS-C® Sed	Ok	Ok	Ok	Ok	Ok	Ok
12-F	Coarse Sand, after PASS-C® Sed	Ok	Ok	Ok	Ok	Ok	NR
13-F	Zeolite, after PASS-C® Sed	Ok	Ok	Ok	Ok	Ok	NR
14-F	Activated Alumina, after PASS-C® Sed	Ok	Ok	Ok	Ok	Ok	NR
15-F	Aluminum Oxide, after PASS-C® Sed	Ok	Ok	Ok	Ok	Ok	NR

Ok = Indicates that filter was in service for that run and operated without problem.
B-1st = Indicates that the filter blinded on the first filling cycle of the Experimental Run.
B-2nd = Indicates that the filter blinded on the second filling cycle of the Experimental Run.
Rec = Filter was reconditioned at the end of the Experimental Run.
NR = Not Run, Sed = Sedimentation.

Prior to the study, the initial filtration rate was measured using tap water for all of the low technology filter units. Initial filtration rates ranged between 1.5 and 5.0 gpm/ft^2 (typical water/wastewater sand filters operate 2-10 gpm/ft^2 and typical storm water sand filters are designed to operate between 0.01-2 gpm/ft^2). Summarized in Table 5-8 is the measured initial filtration rate for each of the filter units, along with media grain size information. Filter Units 1 through 9 were loaded directly by the storm water feed pump. Filtration rate

was estimated by recording the time required to drain the standing water from the filter surface. Filter Units 10 through 15 were loaded by opening a valve between the sedimentation tank and the filter unit and measuring the time required to transfer water from the sedimentation tank to the filter. Note: High technology filtration rates were fixed and did not vary throughout the study (see Table 3-5).

As can be seen from the initial filtration rate data in Table 5-8, there is a general correlation between effective size of the media and filtration rate. For the filter units loaded directly by pump, the coarse sand media has largest effective size and the highest measured initial filtration rate. Activated alumina has the smallest effective size and the lowest initial filtration rate. The remaining three medias (fine sand, zeolite and aluminum oxide) all have an effective size of 0.45 mm but have filtration rates ranging from 3 to 5 gpm/ft^2. For the filter units loaded by opening a valve on the filter–sedimentation tank transfer piping, the concrete sand has the smallest effective size and the slowest initial filtration rate. As expected, the next slowest filtration rate is that of the activated aluminum. The remaining three medias loaded by transfer all have an effective size of 0.45 mm but have filtration rates ranging from 2.2 to 3.3 gpm/ft^2. The zeolite media drains water faster than other media with an effective size of 0.45 mm.

Table 5-8. Initial Filtration Rates and Grain Size Information for the Low-Tech Filter Units

Unit	Media	Loading Method	Particle Size Information		Measured Initial Filtration Rate (gpm/ft^2)
			Effective Size [D_{10} (mm)]	Uniformity Coefficient [D_{60}/D_{10}]	
1	Fine Sand	Pump	0.45	1.50	3.1
2	Coarse Sand	Pump	0.70	1.90	5.0
3	Zeolite	Pump	0.45	1.40	5.0
4	Activated Alumina	Pump	0.26	1.90	2.3
5	Aluminum Oxide	Pump	0.45	1.40	4.2
6	Fine Sand with PAM	Pump	0.45	1.50	3.0
7	Coarse Sand with PAM	Pump	0.70	1.90	5.0
8	Fine Sand with PASS-C®	Pump	0.45	1.50	2.9
9	Coarse Sand with PASS-C®	Pump	0.70	1.90	5.0
10	Concrete Sand, after Sed	Transfer	0.13	8.70	1.5
11	Fine Sand, after PASS-C® Sed	Transfer	0.45	1.50	2.2
12	Coarse Sand, after PASS-C® Sed	Transfer	0.70	1.90	2.8
13	Zeolite, after PASS-C® Sed	Transfer	0.45	1.40	3.3
14	Activated Alumina, after PASS-C® Sed	Transfer	0.26	1.90	2.0
15	Aluminum Oxide, after PASS-C® Sed	Transfer	0.45	1.40	2.9

As the pilot experiments progressed, the filtration rate through the low technology granular media filters generally decreased with each run. Filtration rates measured for each filter for

each experimental run are presented graphically in Figure 5-33 (located at the end of this section). Initial filtration rate for each filter is shown on each of the individual plots within Figure 5-33 as "0-1". Subsequent filter rates are abbreviated on the individual plots by listing run–fill (Experimental Runs 1-6, first or second filling). For example, on any of the plots in Figure 5-33, the second filling for Experimental Run 2 is listed under each plot as "2-2". Blinding of the filter is evidenced by the filtration rate dropping to near zero (also see Table 5-7). When a filter was not run, no bars are shown on the plot for that Experimental Run.

As can be seen in Figure 5-33, there is generally a slight decrease in filtration rate with operation; however, many of the filter units operated at a relatively constant rate and then abruptly failed (1-F, 3-F, 5-F) . Direct filtration after chemical addition (6-F and 7-F, PAM or 8-F, PASS-C®) resulted in rapid failure with all the filter medias, with the exception of coarse sand with PASS-C® (9-F). Sedimentation was effective in preventing filter hydraulic failure for all the filter medias investigated; however, the filtration rate of the concrete sand media (10-F) was rapidly declining, indicating that failure was imminent.

5.3.2 Filter Loading

The maximum depth of storm water loaded to any one filter operated for all 6 runs was 11 m (36 ft). Hydraulic loading to the filters varied between 6.4 – 11 meters (21-36 ft). Of the directly loaded, no chemical filter units, the activated alumina media (smallest effective size, EC = 0.26 mm) was the first to fail, after filtering 6.4 m (21 ft) of storm water. The fine sand media (EC = 0.45 mm) was the next filter to fail, filtering 7.3 m (24 ft) of storm water. Aluminum oxide and zeolite medias, both with an EC = 0.45 mm, failed after processing 8.2 m (27 ft) of storm water. Hydraulic loading to the low-technology filter units is summarized in Table 5-9.

Filter failure typically results from the surface accumulation or entrainment of solids. Solids loading to the filter units varied from run to run, depending on the storm water used. Some of the filters retained much of the solids while other medias were less effective. Solids loading can be estimated by multiplying the concentration of suspended solids (as TSS) in the influent storm water (mg/L) by the total volume (L) used (applied to the filters) and dividing by the surface area of the filter (0.456 m^2, 4.91 ft^2). For a filter unit operated for all 6 runs, 4,997 L of storm water was filtered, containing 1.2 kg (2.6 lbs) of solids for a maximum loading of 2.62 kg per square meter of filter surface (0.53 lbs/ft^2).

Although dependent on the nature of the solid particles being filtered, the mass of solids retained by the filter may be used to predict filter failure. Mass retained by the filter units is calculated by subtracting the effluent total suspended solids from the influent suspended solids (mg/L), multiplying by the volume (L) of storm water filtered, and dividing by the area of the filter (m^2). Mass retained by each of the low technology filter units along with the hydraulic loading (expressed as total depth loaded) is presented in Table 5-9. For the filter units without sedimentation, mass retained at failure is presented. For the filter units preceded by sedimentation tanks, the mass retained to date is presented. For some of the filters during several of the Experimental Runs there was a measured increase in TSS in the filter effluent, which decreased the overall mass retained value.

For the filters receiving storm water directly, without chemical addition, activated aluminum with the smallest effective size removed the most TSS. The coarse sand media with the largest effective grain size removed the least mass of solids. Prior to blinding near the end of Experimental Run 4, the fine sand media receiving 100 mg/L PASS-C® had retained a relatively impressive amount of solids (1.95 kg TSS/m^2).

Table 5-9. Low Technology Filter Loadings

Unit	Filter Media	Media EC D_{10} (mm)	Filter Failure (Run, fill)	Total Depth m (feet)	Loading at Failure (Mass Retained, as TSS)	
					kg (lbs)	kg/m^2 (lbs/ft^2)
1	Fine Sand	0.45	5, 1	7.3 (24)	0.24 (0.53)	0.531 (0.109)
2	Coarse Sand	0.70	In-service	9.1 (30)	0.03 (0.06)	0.055 (0.011)
3	Zeolite	0.45	5, 2	8.2 (27)	0.35 (0.78)	0.773 (0.158)
4	Activated Alumina	0.26	4, 2	6.4 (21)	0.72 (1.60)	1.59 (0.327)
5	Aluminum Oxide	0.45	5, 2	8.2 (27)	0.40 (0.89)	0.882 (0.181)
6	Fine Sand with PAM	0.45	1, 1	NC[a]	NC	NC
7	Coarse Sand with PAM	0.70	2, 1	NC[a]	NC	NC
8	Fine Sand with PASS-C®	0.45	4, 2	6.4 (21)	0.89 (1.96)	1.95 (0.400)
9	Coarse Sand with PASS-C®	0.70	In-service[b]	NC	NC	NC
					Loading[c] (Mass Retained)	
10	Concrete Sand, after 2 hr. Sedimentation	0.13	In-service	11.0 (36)	0.56 (1.22)	1.22 (0.249)
11	Fine Sand, after PASS-C® 2 hr. Sedimentation	0.45	In-service	11.0 (36)	0.11 (0.25)	0.252 (0.052)
12	Coarse Sand, after PASS-C® 2 hr. Sedimentation	0.70	In-service	9.1 (30)	0.02 (0.05)	0.046 (0.006)
13	Zeolite, after PASS-C® 2 hr. Sedimentation	0.45	In-service	9.1 (30)	0.07 (0.15)	0.144 (0.030)
14	Activated Alumina, after PASS-C® 2 hr. Sed.	0.26	In-service	9.1 (30)	0.12 (0.27)	0.264 (0.054)
15	Aluminum Oxide, after PASS-C® 2 hr. Sed.	0.45	In-service	9.1 (30)	0.10 (0.23)	0.226 (0.046)

NC = Not Calculated.
a Operation of units discontinued after blinding and reconditioning.
b Filter reconditioned prior to failure (reconditioned at 100 to 50 mg/L PASS-C® change over).
c Filters still in-service, mass retained to date.

Filter units preceded by sedimentation (with PASS-C®) retained less mass and ultimately avoided hydraulic failure because a substantial amount of the TSS were removed by sedimentation. In the six experimental runs, sedimentation with PASS-C® removed 0.98 kg of the 1.2 kg contained in the storm water (82% removal of TSS). Correspondingly, sedimentation without the addition of PASS-C® removed 0.17 kg of the 1.2 kg contained in the storm water (14% removal of TSS).

5.3.3 Low Technology Systems

The low technology systems consisted of permutations of (1) presence or absence of sedimentation, (2) various types of granular media filtration, and (3) chemical enhancement. Discussion is provided in the sections below.

5.3.3.1 Effectiveness of Granular Media Filtration Alone

Referring to Table 5-7 and Figure 5-33, all of the filters that received storm water directly without chemical addition and/or sedimentation, with the exception of the coarse sand media, hydraulically failed during the course of study. Based on the storm water and loading rates used, full scale filters might be limited to a solids loading (as TSS) of about 0.5 to 1.5 kg/m^2 (0.10 to 0.31 lbs/ft^2) between reconditioning activities.

Granular media filtration alone, regardless of media, was ineffective in treating the contaminants to the levels required for surface discharge within the Lake Tahoe Basin. Little or no turbidity reduction was evident for any of the medias tested at the loading rates used. There was only minor phosphorus, nitrogen, and iron reduction, with the effluent always containing concentrations much higher than their respective surface water discharge regulatory limits. This observation contrasts with observations made during the Best Management Practice Retrofit Pilot Program conducted in Southern California (Caltrans, CTSW-RT-01-050, April 2002). It was observed over the course of the Southern California Retrofit Pilot Program that such filters removed approximately 80 to 90 percent of TSS, resulting in effluent concentrations of approximately 10 to 20 mg/L. It is speculated that the high filter-loading rate used in this study contributed to the poorer performance observed. Both projects passed similar amounts of water through a filter during storm events, but the Retrofit Pilot Program made use of an upstream sedimentation basin and provided for water application to the filter over a 24-hour period, whereas this project included much higher filter application rates (see Section 5.3.1). Additionally, the particle size of solids comprising TSS may be finer and inherently less filterable in the Tahoe storm water runoff.

The design intent for the zeolite filter media was to remove ammonia and soluble metals. Substantial ammonia removal was not observed through the zeolite filter, although influent concentrations were generally quite low. Use of the zeolite filter alone was effective in reducing the concentration of dissolved zinc and some of the dissolved copper in the storm water. The dissolved concentrations of the other metals were too low to allow meaningful comment regarding their removal through the zeolite filter.

The design intent of the aluminum-based filter media (i.e., aluminum oxide and activated alumina) was to remove orthophosphate. The activated alumina media exhibited substantial removal of dissolved and total (filtered and unfiltered) orthophosphate, while the aluminum oxide media did not. The levels of orthophosphate measured in the influent storm water were much lower than the total phosphorus levels. Although orthophosphate is a component of total phosphorus, the removal of orthophosphate alone will not allow permit compliance for the surface water discharge of total phosphorus. The aluminum-based medias were found to increase the concentration of dissolved aluminum, and their use could potentially contribute to aquatic toxicity.

As stated above, it is possible that the filters did not operate as efficiently as possible due to the manner in which they were hydraulically loaded. It is speculated that decreasing the loading rate to the filters may result in an increase in treatment effectiveness.

5.3.3.2 Effectiveness of Sedimentation

Sedimentation was very effective in preventing filter failure. Treatment units that made use of a sedimentation tank before filtration did not fail. However, with the exception of the coarse sand media all treatment units without sedimentation basins failed.

Sedimentation alone, for 2 hours, was not effective by itself in reducing the concentrations of any of the contaminants under study. Sedimentation alone should not be considered as a means of complying with the various regulatory restrictions.

Sedimentation for 2 hours following chemical addition was often very effective in reducing contaminant concentrations. With the aid of PASS-C®, sedimentation reduced turbidity to around 100 NTUs (from a high of 1038 NTUs), total phosphorus to around 0.4 mg-P/L (from a high of 1.1 mg-P/L), total nitrogen to around 2 mg-N/L (from a high of 4.5 mg-N/L), and total iron to around 1000 µg/L (from a high of 33,000 µg/L).

Sedimentation following PAM application (passive) as a treatment technology was only investigated during a single experimental run (Unit 101-S, Experimental Run 6). The effluent concentrations observed following 2-hour sedimentation, with PAM, PASS-C® (100 mg/L), and no-chemical sedimentation are presented in Table 5-10 alongside the average influent for Experimental Run 6. For the one experimental run conducted, none of the chemical treatments were particularly effective. However, no conclusions or generalizations can be made from data from one run.

5.3.3.3 Effectiveness of Chemical Coagulation

Two different chemicals were used to coagulate particles, PAM and PASS-C®. It was hoped that use of these chemicals would assist in meeting regulatory limits through removal of turbidity and particulate nitrogen and phosphorus. PASS-C® was also intended for the removal of dissolved phosphorus.

PAM. Filters 6 and 7 contained fine and coarse sand medias, respectively, and treated storm water that had been dosed with anionic polyacrylamide (PAM, Superfloc® A-836). Solid PAM was introduced into the storm water prior to filtration using a passive dosing “tea bag” system. For Experimental Run 1, the PAM bags were soaked overnight, blotted and weighed before and after being placed in the manifold. The fine sand filter (#6) plugged immediately. The plugging was attributed to overdosing of PAM due to the overnight soaking. No sample was collected because two volumes of water were not filtered.

Table 5-10. Chemical Addition Impacts on Sedimentation Performance for Run 6

Constituent	Influent (I-Avg)	Effluent Concentrations for 2-hr Sedimentation with Chemical Addition:		
		No Chemical (10-S)	PAM (101-S)	PASS-C® (11-S)
Turbidity - Field, NTU	184	164	148	155
Total Suspended Solids, mg/L	173	110	130	100
Aluminum, µg/L				
Total	1300	2200	1500	5100
Dissolved	128	370	550	760
Acid soluble	237	1300	490	3500
Ammonia, mg-N/L	1.2	1.2	1.2	1.1
Nitrate, mg-N/L	0.6	0.6	0.5	0.6
Nitrite, mg-N/L	0.2	0.2	0.3	0.1
TKN, mg-N/L				
Total	4.4	4.3	4.1	3.8
Dissolved	2.9	2.8	3.0	2.8
Oil and grease, mg/L	6	5	5	6
Phosphorus, mg-P/L				
Total	1.1	0.97	1.0	1.1
Dissolved	0.68	0.50	0.64	0.13
Orthophosphate, mg-P/L				
Total	0.51	0.46	0.42	0.36
Dissolved	0.24	0.19	0.18	0.07
Cadmium, µg/L				
Total	0.3	0.3	0.3	0.2
Dissolved	<0.2	<0.2	<0.2	<0.2
Chromium, µg/L				
Total	8.2	8.2	8.6	8.6
Dissolved	5.3	5.9	6.4	4.6
Copper, µg/L				
Total	17	15	17	15
Dissolved	9.4	10	11	8.6
Iron, µg/L				
Total	6267	3100	3300	2200
Dissolved	227	180	220	91
Lead, µg/L				
Total	13	10	11	7.8
Dissolved	<1.0	<1.0	<1.0	<1.0
Nickel, µg/L				
Total	4.6	4.5	4.9	4.5
Dissolved	3.2	3.3	3.2	3.0
Zinc, µg/L				
Total	533	510	470	450
Dissolved	263	310	320	290

Prior to Experimental Run 2, Filter #6 was reconstructed by removing the top 1.88 cm (0.75 inch) layer of clogged sand, rinsing the remaining media, then replacing the removed sand with new, rinsed, sand. The system was operated without pre-soaking the PAM bags to reduce the dosing. Two new PAM bags were placed in each manifold tee fitting. After the experimental run, the manifold was drained and PAM bags removed for gravimetric analysis. Both PAM filters (6 & 7) operated successfully during Experimental Run 2, but failed during Experimental Run 3 (the following day).

Because of the difficulty in handling hydrated PAM (i.e., its gelatinous and stringy consistency) and the difficulty of establishing an appropriate dose rate and measuring the actual dose rate (due to the small mass differences of the PAM "tea bags" observed before and after use), operation of these units was discontinued after consultation with Caltrans personnel until an alternative dosing method can be developed.

For those experimental runs where sample collection was possible, PAM appeared to effectively remove constituents. Turbidity, total phosphorus, total nitrogen, and total iron were reduced to varying degrees.

PASS-C®. Filters 8 and 9 contained fine and coarse sand media, respectively, and treated storm water that had been dosed with PASS-C® to obtain a concentration of 100 mg/L. Filter 8 failed during Experimental Run 4. After consulting with Caltrans personnel, it was decided to recondition both filters (i.e., both Filters 8 and 9) and decrease the PASS-C® dose to 50 mg/L. Both filters were reconditioned by removing the top few inches of media, rinsing with potable water, and then replacing the removed media with new, cleaned media. The chemical feed pump was adjusted to allow the application of the lower chemical feed rate.

The coagulant PASS-C® was very effective in the removal of particulate-associated contaminants. Use of PASS-C® substantially improved turbidity reduction, total phosphorus reduction, and total iron reduction. PASS-C® was also very effective in removing total metals from storm water. PASS-C® appeared to improve orthophosphate removal but not dissolved phosphorus removal. Dissolved iron removal may have been helped by PASS-C®, but the data are sketchy. PASS-C® didn't appear to aid removal of other dissolved metals. Finally, PASS-C® did improve total nitrogen removal somewhat, mostly by improving solids removal. PASS-C® did not substantially increase the removal of any dissolved nitrogen constituents.

5.3.4 High Technology Systems

The high technology systems consisted of Actiflo® sedimentation, pressure sand filtration, Fuzzy Filter® filtration, and ion exchange. There was a concern that the length of time required to pass the storm water through the two polishing filters and ion exchange units (i.e., about 1.5 hours) would result in different quality storm water over the experimental run time period (i.e., the last fluid elements to pass though the ion exchange system would undergo approximately 1.5 hours more sedimentation than the first fluid elements). During Experimental Run 3, the Actiflo® effluent was monitored as a function of time to assess the impact of extended sedimentation on water quality. The results are illustrated in Figure 5-34. Although it appears that additional sedimentation time does result in somewhat higher quality

effluent, the differences noted over the course of Experimental Run 3 are not sufficiently large to warrant a modification to the experimental plan.

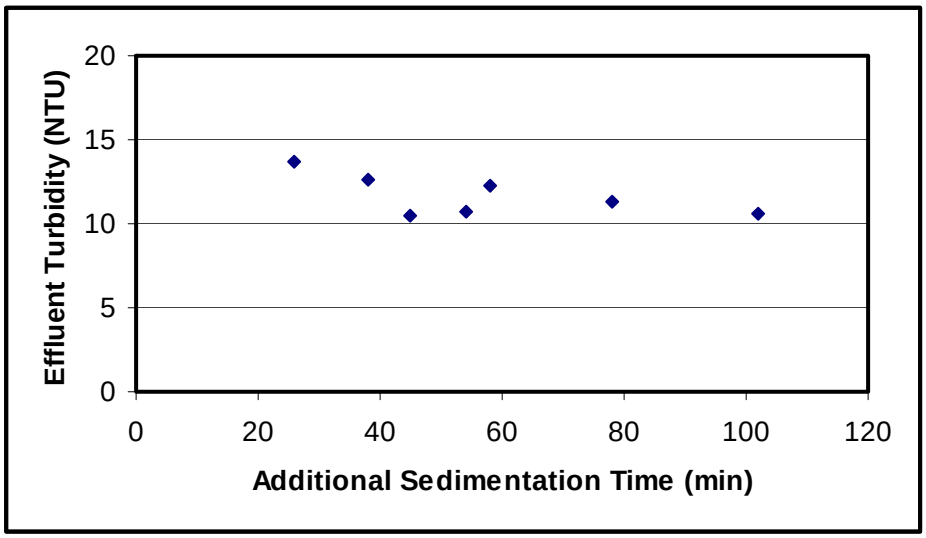


Figure 5-34. Impact of Additional Sedimentation on Run 3 Actiflo® Effluent Turbidity

5.3.4.1 Actiflo® Sedimentation

The Operations Plan stated that each Actiflo® batch would use of 100 mg/L (neat) of PASS-C® and 0.8 mg/L of polymer (Magnafloc® LT25). Following Experimental Run 3, the PASS-C® dosage was increased to 125 mg/L and the polymer dose to 1.0 mg/L (see Section 3.3.9).

Actiflo® sedimentation effectively removed many constituents from storm water. Turbidity was reduced to within the surface water regulatory limit (20 NTU), total phosphorus was greatly reduced in concentration (all but one occasion to below the surface water regulatory limit of 0.1 mg-P/L), and total iron was also reduced to below the surface water discharge limit of 0.5 mg/L. Actiflo® sedimentation was ineffective in reducing the concentration of any of the various forms of nitrogen. Comment cannot be made with regards to reduction in oil and grease due to low influent concentrations and elevated laboratory detection limits (Sections 3.3.6 and 5.2.3).

During Experimental Run 6, performance of the Actiflo® process without making use of the ballast sand and polymer was investigated in an attempt to develop a non-proprietary treatment process. Operational details for this so-called "conventional" run were presented in the field notes for Experimental Run 6, Table 4-6. Of note was that the conventional run utilized a 20 minute slow mix step and a 30 minute settling time (shorter than most water treatment plant settling times).

Final effluent concentrations for the Experimental Run 6 Actiflo® and "conventional" runs are presented in Table 5-11. Although one experimental run is insufficient for making any meaningful conclusions, the ballast sand and polymer appeared to increase the removal of

particulate contaminants (e.g., effluent total suspended solids were 12 mg/L with ballast sand and 150 mg/L without ballast sand).

Table 5-11. Experimental Run 6 Actiflo® and "Conventional" Run Performance

Constituent	Influent (I-Avg)	Effluent Concentration	
		"Conventional" (06-A-2)	Actiflo® (06-A-1)
Turbidity, NTU	184	187	30
Total Suspended Solids, mg/L	173	150	12
Aluminum, µg/L			
Total	1300	6800	4300
Dissolved	128	720	3000
Acid soluble	237	4500	3500
Ammonia, mg/L	1.2	1.2	1.1
Nitrate, mg/L	0.6	0.5	0.6
Nitrite, mg/L	0.2	0.3	0.2
TKN, mg/L			
Total	4.4	3.9	3.1
Dissolved	2.9	2.7	3.1
Oil and grease, mg/L	6	5	<2
Phosphorus, mg/L			
Total	1.1	1.1	0.65
Dissolved	0.68	0.1	0.34
Orthophosphate, mg/L			
Total	0.24	0.43	0.37
Dissolved	0.51	0.03	0.08
Cadmium, µg/L			
Total	0.3	0.2	<0.2
Dissolved	<0.2	<0.2	<0.2
Chromium, µg/L			
Total	8.2	8.9	7.6
Dissolved	5.3	4.1	5.8
Copper, µg/L			
Total	17	15	11
Dissolved	9.4	7.6	11
Iron, µg/L			
Total	6267	4100	810
Dissolved	227	82	350
Lead, µg/L			
Total	13	9.8	1.8
Dissolved	<1.0	<1.0	1.6
Nickel, µg/L			
Total	4.6	4.4	3.8
Dissolved	3.2	2.9	3.8
Zinc, µg/L			
Total	533	440	340
Dissolved	263	250	340

5.3.4.2 Pressure Sand Filter and Fuzzy Filter®

After Experimental Run 3, the lower 1/3 (up-flow column) of the Fuzzy Filter® media was slightly discolored (gray/brown). The discoloration was attributed to either retained solids or internal biological growth resulting from stagnant water remaining within the filter between experimental runs. Prior to Experimental Run 4, the Fuzzy Filter® media was replaced.

After completion of Experimental Run 4, residual treated storm water was drained from the Fuzzy Filter® column and the unit filled with de-ionized water. Prior to use in Experimental Run 5, the de-ionized water was drained. New media was used for Experimental Run 6. Observations made during this study indicate the need for an on-going maintenance, servicing and cleaning requirement for a Fuzzy Filter® unit placed in the field.

The pressure sand filter and Fuzzy Filter® were never operated in the absence of Actiflo® sedimentation. The pressure sand filter and Fuzzy Filter® did exhibit some additional TKN reduction over that realized by Actiflo® sedimentation, but did not produce substantially improved effluent for any other constituents. The Actiflo® process was very efficient in removing TSS from storm water, removing 1.333 kg of 1.365 kg loaded over 5 experimental runs (97.7% TSS removal efficiency). Because much of the contaminants of interest are associated with particulates, the Actiflo® process was also quite effective at reducing most contaminant concentrations. Because of the exceptional removal of particles in the Actiflo® process, there would not be the expectation of significant additional treatment with filtration. However, it is evident that TKN passed through the Actiflo® process and was somewhat more amenable to removal by filtration. It is implied that the particle size fraction associated with TKN was not removed in the Actiflo® (with the bulk of other solid particles) but are somewhat filterable. Characterizing particle size distributions of specific contaminants was beyond the scope of this study.

The effluents of the two filters (pressure sand filter or Fuzzy Filter®) generally were very similar in contaminant concentrations, and from a water quality standpoint, there isn't any reason to choose one over the other. The benefit associated with use of the pressure sand filter is that it is not a proprietary device. The benefit associated with the Fuzzy Filter® is that it has a much smaller footprint due to its higher surface loading rate.

5.3.4.3 Effectiveness of Ion Exchange

For the first three experimental runs, the ion exchange system consisted of a pleated filter cartridge, a modified clay filter cartridge, an anion exchange filter cartridge, and a cation-exchange filter cartridge. The ion exchange system failed on numerous occasions due to clogging or occlusion of flow. After discussions with the resin suppliers (American Filterworks and ResinTech) it was determined that failure of the cartridges was likely due to an accumulation of either a small amount of floc or un-reacted (unsettled) polymer leaving the Actiflo® process. Several plugged resin columns were cut open during the study and examined to determine the cause of hydraulic failure. All columns were free from visible solids, but the synthetic fiber plug preceding the first resin cartridge was noticeably slimy, supporting the hypothesis of polymer fouling. Because of the fouling, the ion-exchange

cartridges were replaced for Experimental Runs 3-6, with the pleated filter cartridge and the modified clay filter cartridge eliminated from the treatment train.

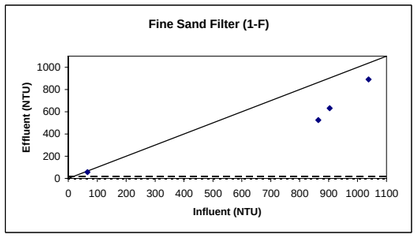
The ion exchange process was never operated in the absence of Actiflo® sedimentation and filter polishing (pressure sand filter or Fuzzy Filter®). Therefore, because Actiflo® sedimentation was generally able to produce an effluent that complied with all regulatory restrictions with the exception of nitrogen (Section 5.3.4.1), comments regarding contaminant removal effectiveness are limited to nitrogen.

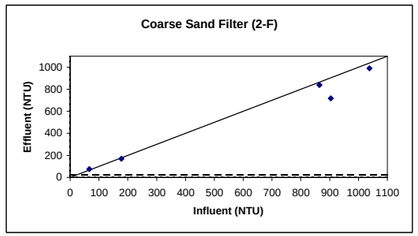
The ion exchange process was effective in reducing nitrogen concentrations, typically to near the surface water discharge regulatory limit of 0.5 mg-N/L. The greatest impact was on TKN (total and dissolved) removal, though the magnitude of the impact was not particularly large. Ammonia and nitrate, when present in the influent, were somewhat removed by ion exchange. Although not plotted, separate samples were collected for the anion and cation resin columns. Of note is that total lead, dissolved copper and both total and dissolved zinc were effectively removed by the cation column (IX4) to below levels of concern for aquatic toxicity.

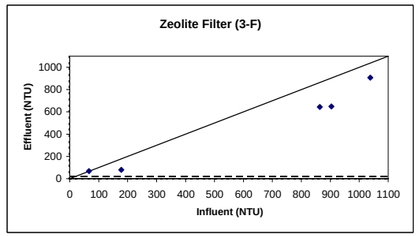
5.3.5 Low Technology versus High Technology

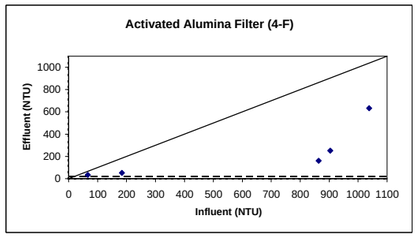
The high-technology system has the greatest potential for producing an effluent that is compliant with the surface water discharge requirements within the Tahoe Basin (Figures 5-1 through 5-32), with the possible exception of nitrogen. The Actiflo® process removed most of the contaminants. The filters contributed to a little more contaminant removal, and some added benefit was obtained with the ion exchange. However, the overall treatment system (i.e., Actiflo®, filtration, ion exchange) must be optimized to ensure its proper functioning without fouling of the ion exchange units, if used.

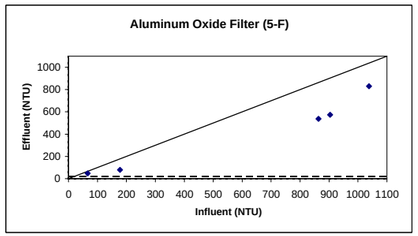
The low technology systems making use of PASS-C®, sedimentation, and filtration (except coarse sand filtration) were also effective in attaining substantial removals of most of the contaminants (except nitrogen) from Lake Tahoe Basin storm water. Like the high-technology systems, process enhancements (e.g., modification of filtration rates) should be directed toward increasing contaminant removal efficiencies.

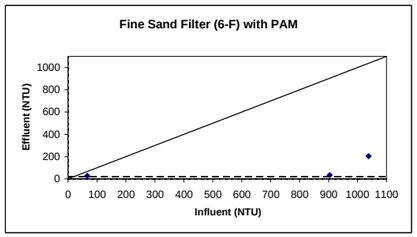


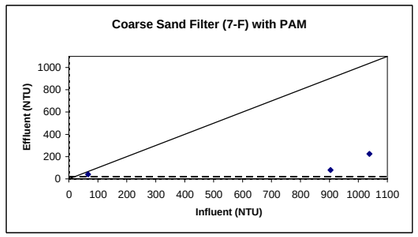


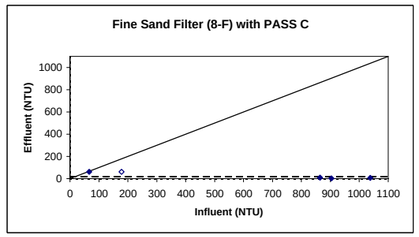


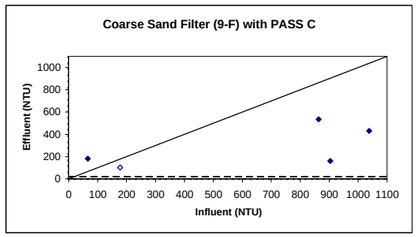


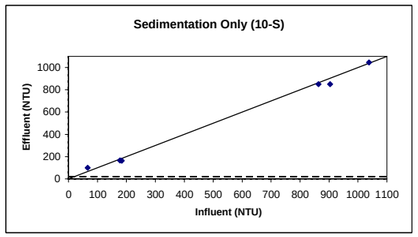


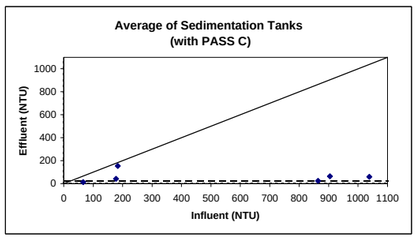


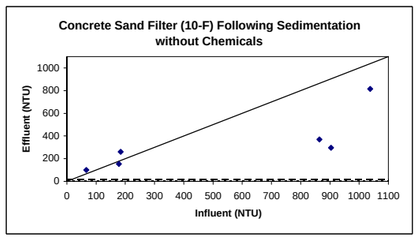


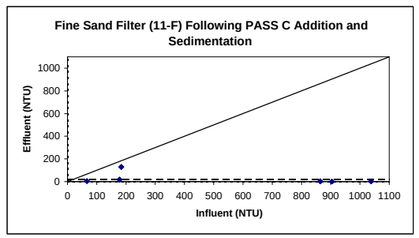


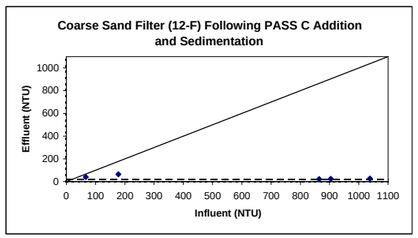


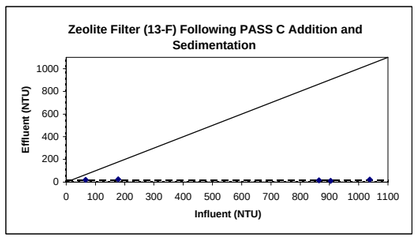


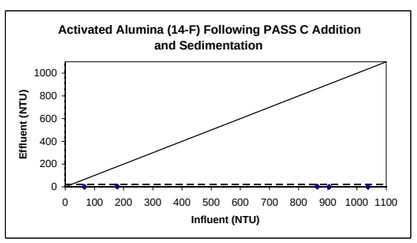


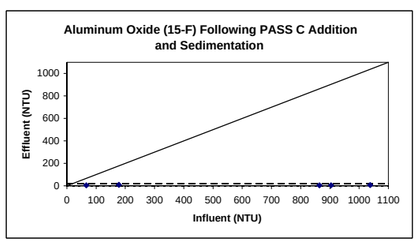












LEGEND

◆ Sample Points

◇ PASS C concentration was reduced from 100 mg/L to 50 mg/L

a PASS C concentration increased from 100 to 125 mg/L

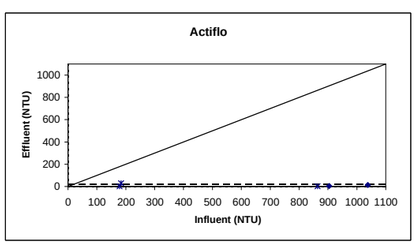
—— 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.

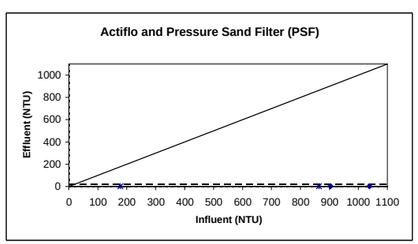
– – – Maximum Surface Water Discharge Turbidity (20 NTU).

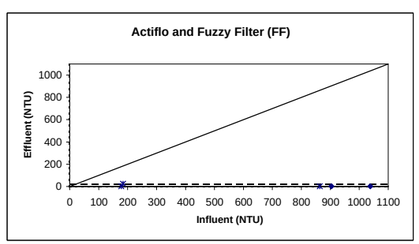
------ Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (0.1 NTU)

NOTES

1) The reporting limit for Turbidity is 0.1 NTU, because of the large scale of the plots the reporting limit line is so close to the x and y axis that it is difficult to distinguish.







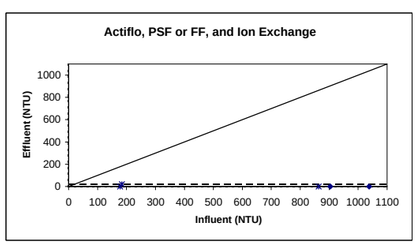
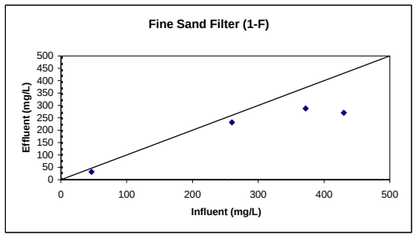
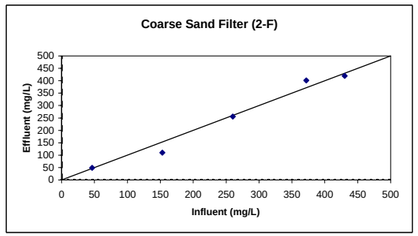
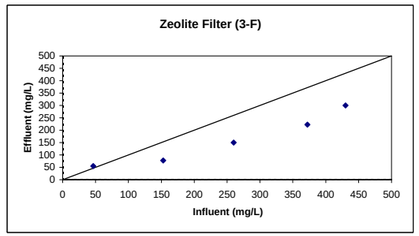
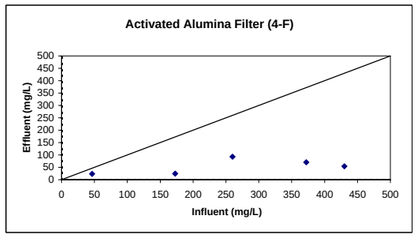


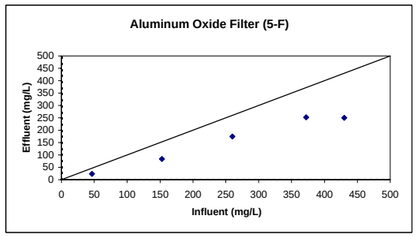
Figure 5-1.
Field Turbidity

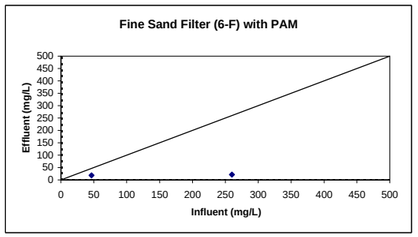


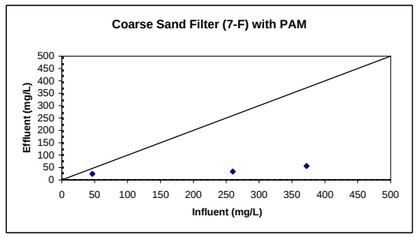


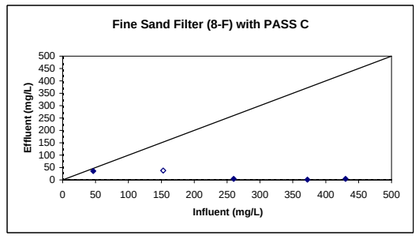


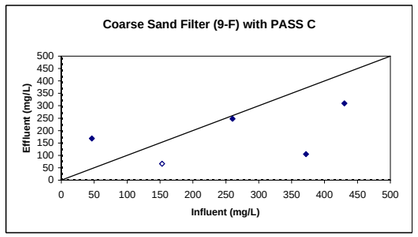


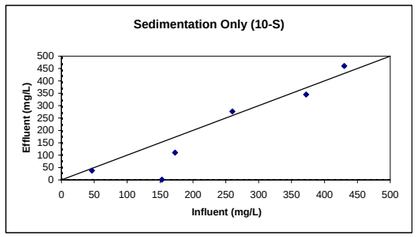


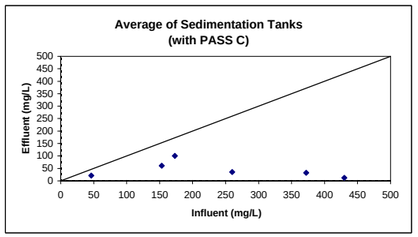


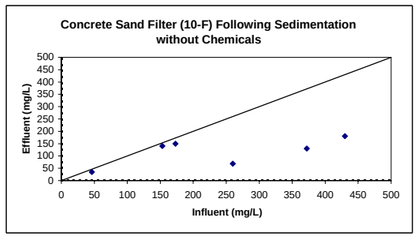


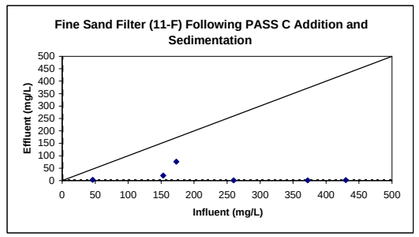


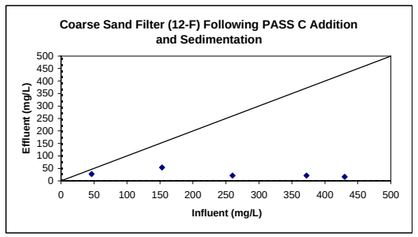


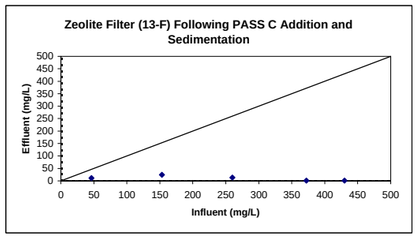


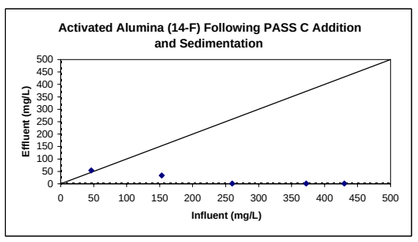


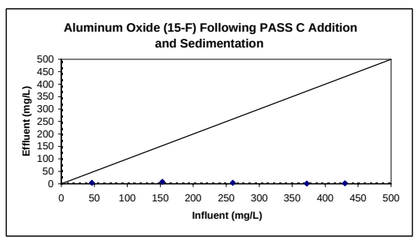










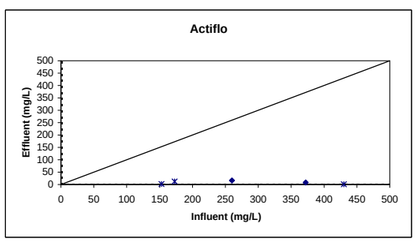


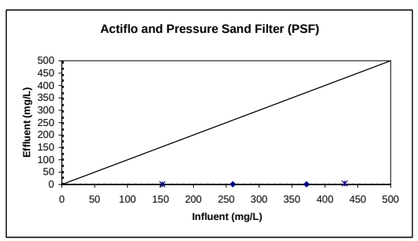
LEGEND

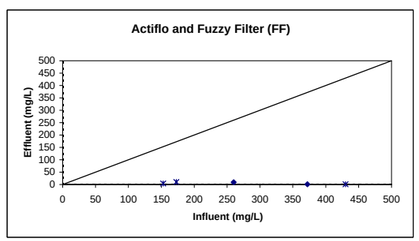
- ◆ Sample Points
- ◇ PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- —— 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.
- - - - - - Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (1 mg/L).

NOTES

1) The reporting limit for Total Suspended Solids is 1 mg/L, because of the large scale of the plots the reporting limit line is so close to the x and y axis that it is difficult to distinguish.







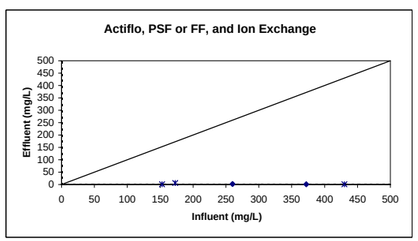
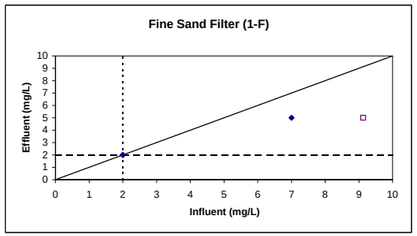
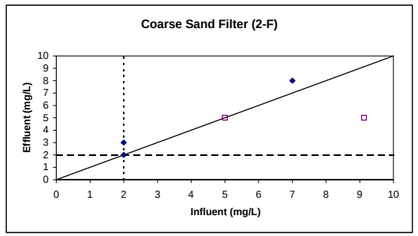
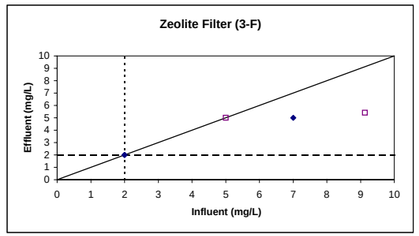
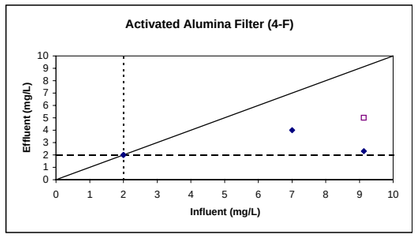


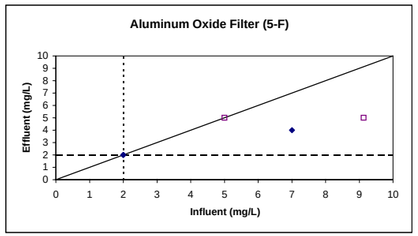
Figure 5-2.
Total Suspended Solids

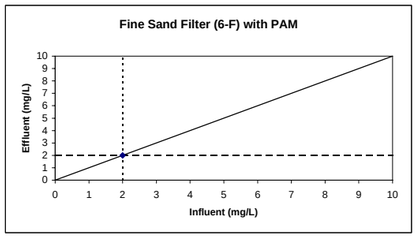


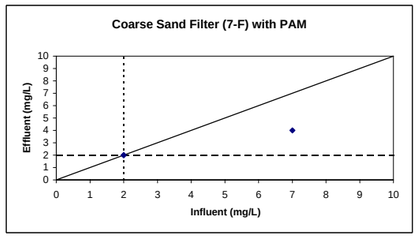


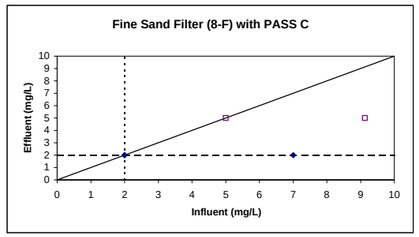


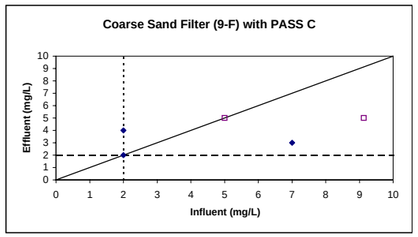


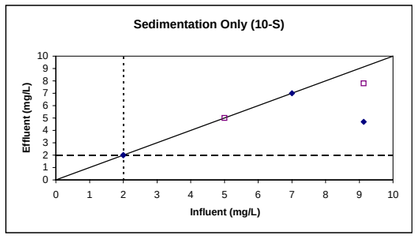


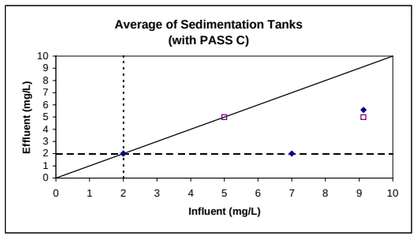


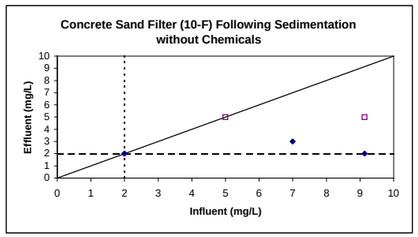


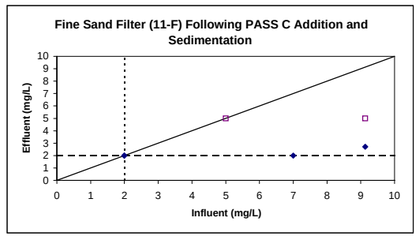


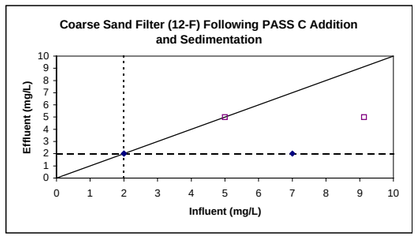


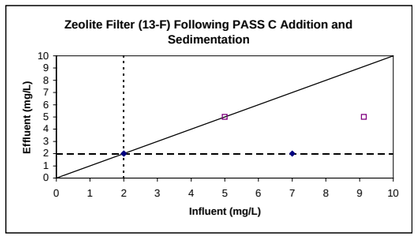


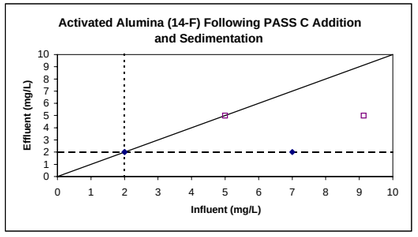


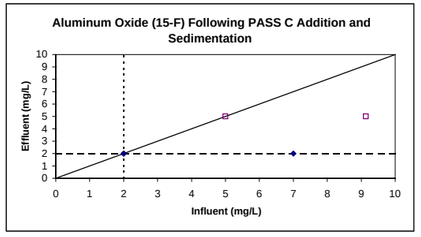












LEGEND

◆ Sample Points with Detection Limit of 2 mg/L

□ Sample Points with Detection Limit of 5 mg/L and PASS C concentration increased from 100 to 125 mg/L

a PASS C concentration increased from 100 to 125 mg/L

—— 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.

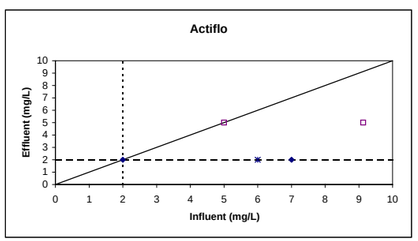
– – – Surface Water discharge standard for O&G is 2 mg/L. This level is also the laboratory reporting limit.

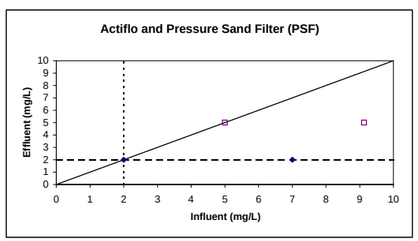
NOTES

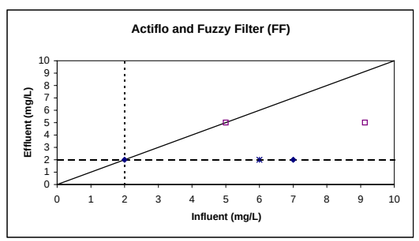
The dose of PASS C for the point at (5,5) in all of the plots was 50 mg/L instead of 100 mg/L for 8-F and 9-F.

The following list contains the data points that appear to be a single point in the plots.

-Fine Sand Filter (1-F) - 2 points at (2,2)
-Zeolite Filter (3-F) - 2 points at (2,2)
-Activated Alumina Filter (4-F) - 2 points at (2,2)
-Aluminum Oxide Filter (5-F) - 2 points at (2,2)
-Fine Sand Filter (6-F) with PAM - 2 points at (2,2)
-Coarse Sand Filter (7-F) with PAM - 2 points at (2,2)
-Fine Sand Filter (8-F) with PASS C - 2 points at (2,2)
-Sedimentation Only (10-S) - 2 points at (2,2)
-Average of Sedimentation Tanks (with PASS C) - 2 points at (2,2)
-Concrete Sand Filter (10-F) Following Gravity Sedimentation - 2 points at (2,2)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 2 points at (2,2)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 2 points at (2,2)
-Zeolite Filter (13-F) Following PASS C Addition and Sedimentation -2 points at (2,2)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation - 2 points at (2,2)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 2 points at (2,2)







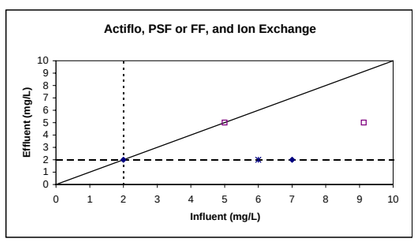
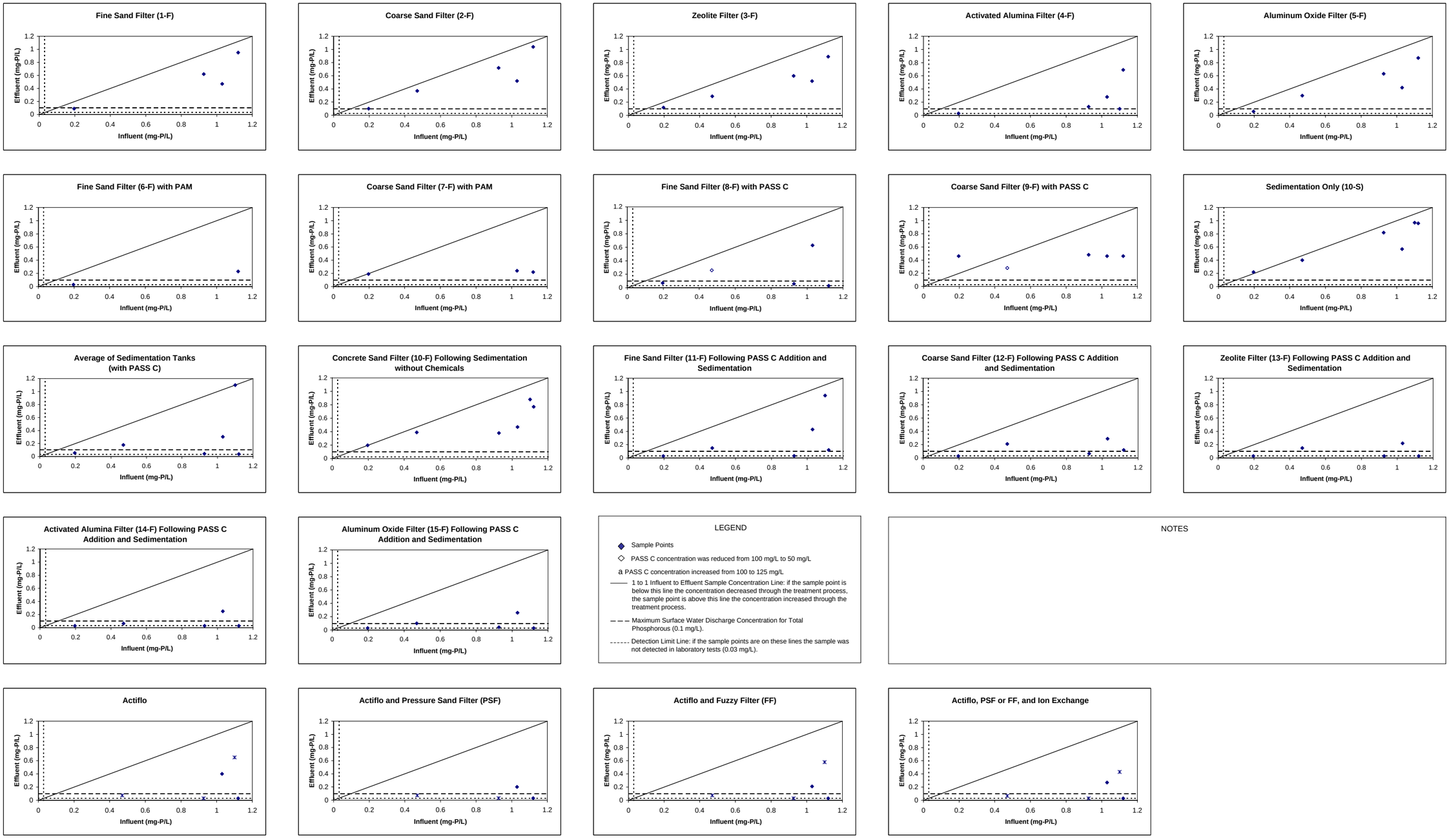


Figure 5-3.
Oil and Grease



LEGEND

- Sample Points
- PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.
- Maximum Surface Water Discharge Concentration for Total Phosphorous (0.1 mg/L).
- Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (0.03 mg/L).

NOTES

Figure 5-4.
Total Phosphorous

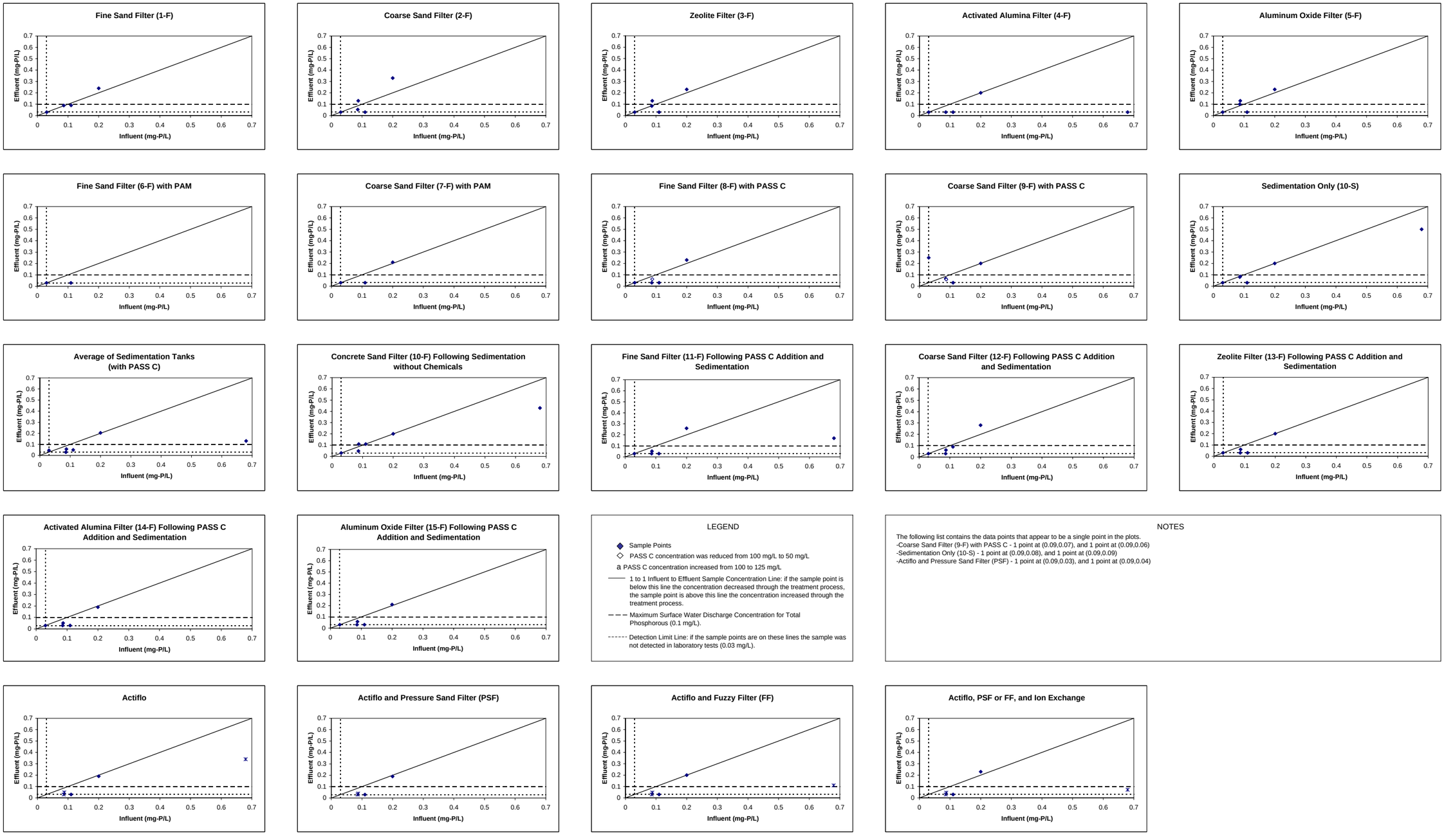


Figure 5-5.
Dissolved Phosphorous

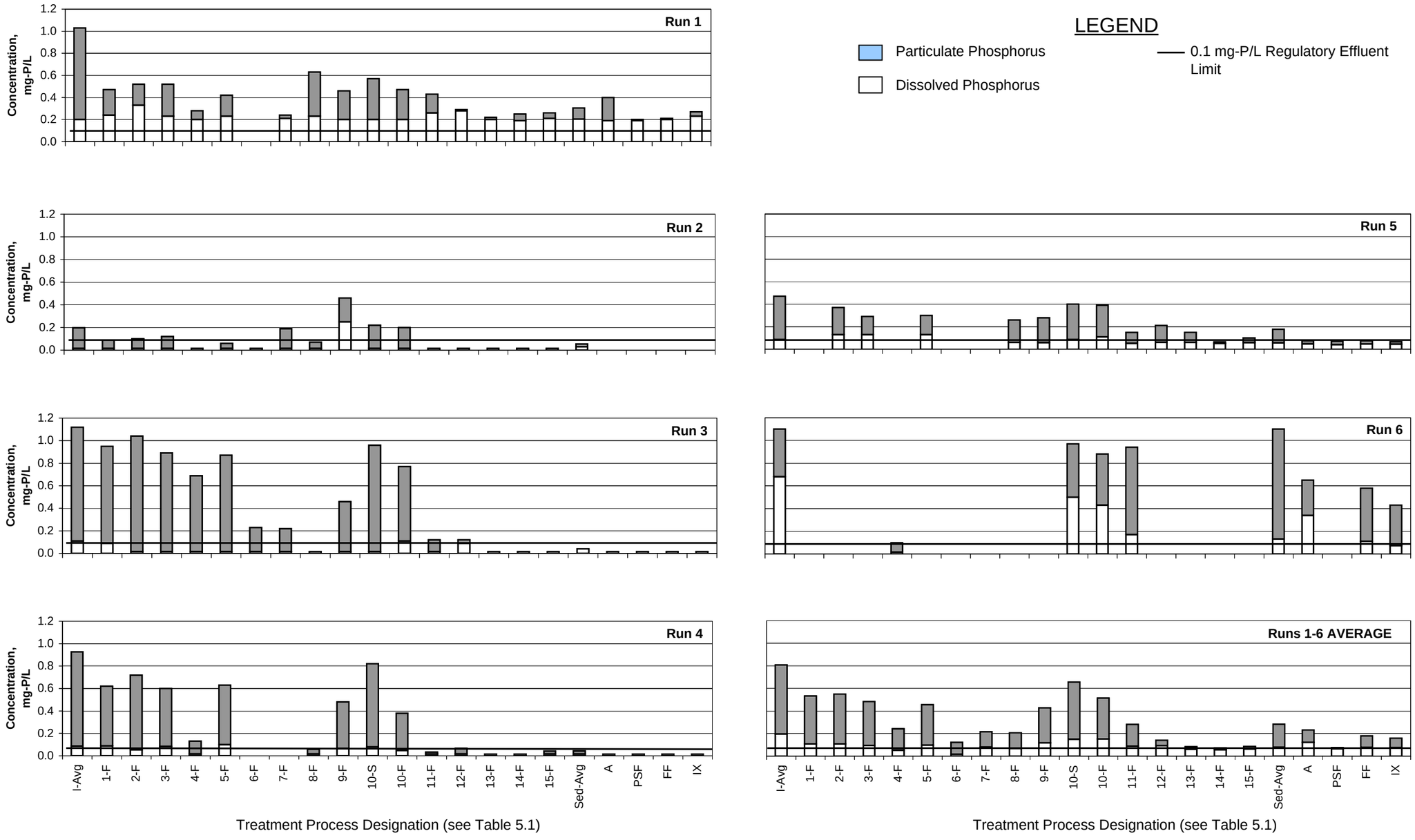


Figure 5-6.
Forms of Phosphorous Before and After Treatment

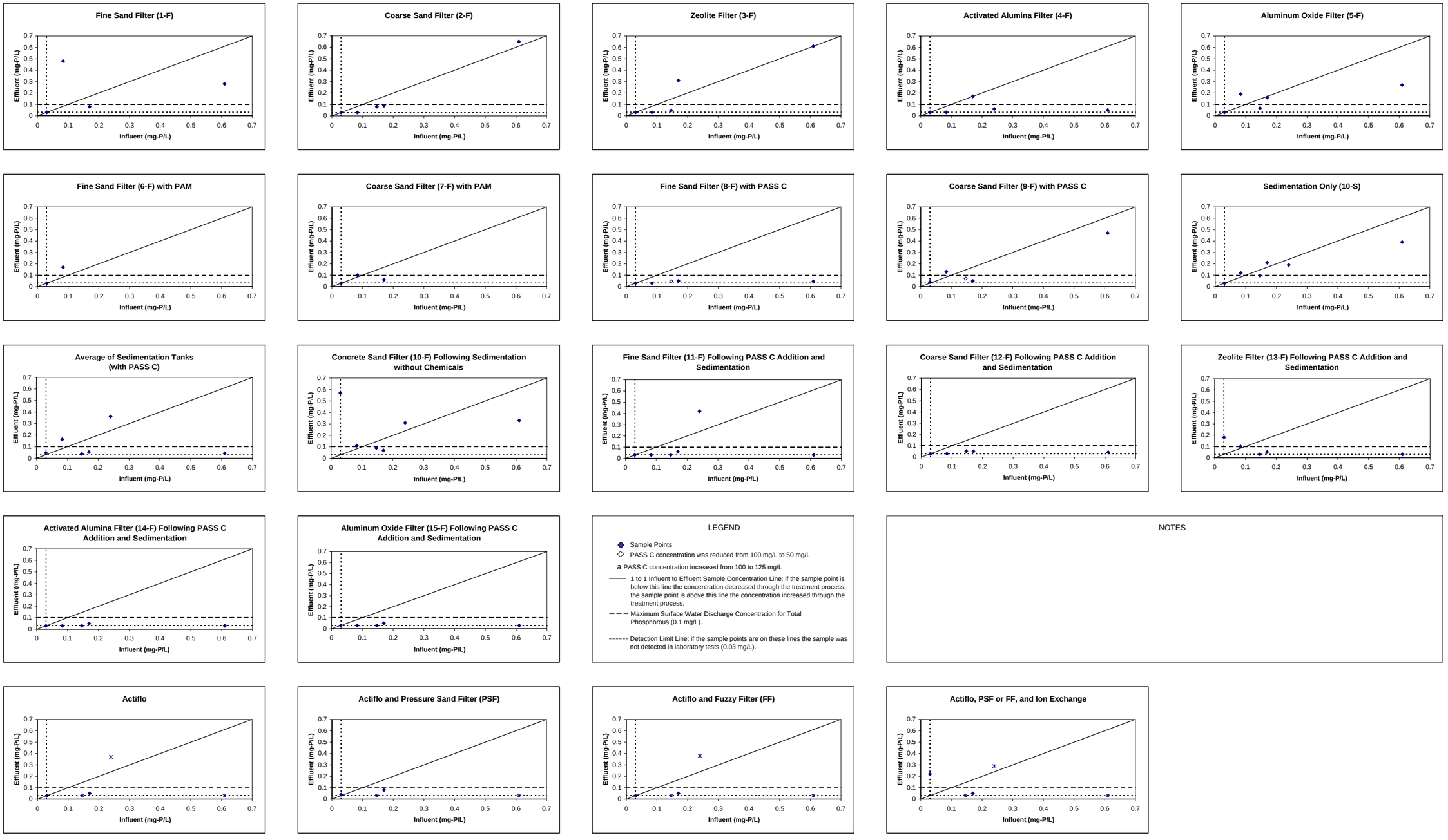
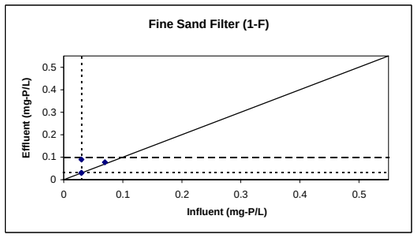
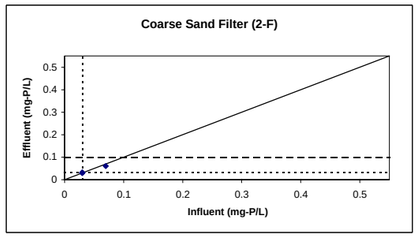
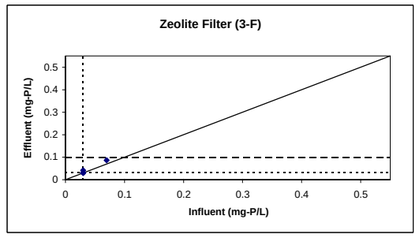
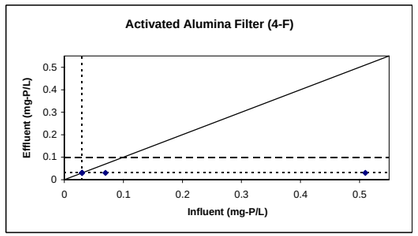


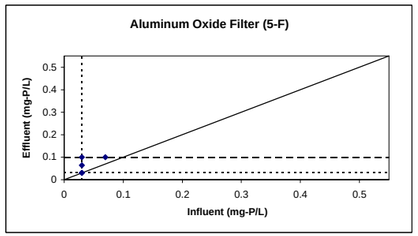
Figure 5-7.
Total Ortho - Phosphate

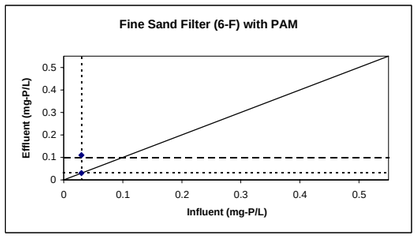


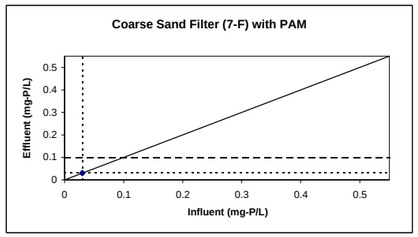


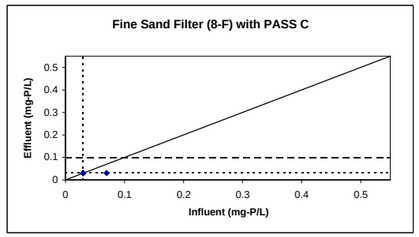


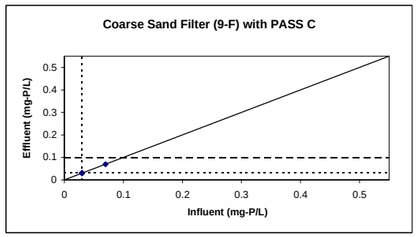


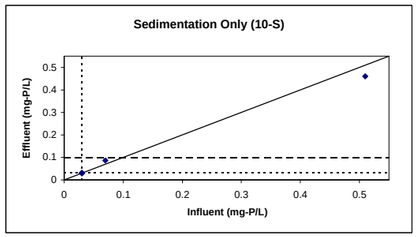


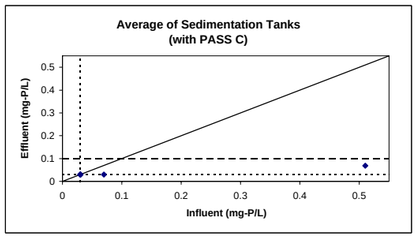


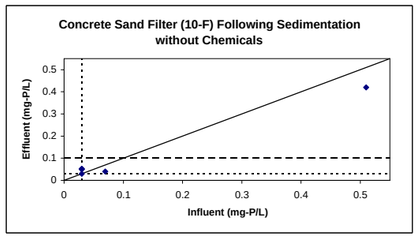


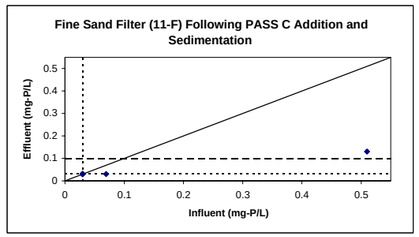


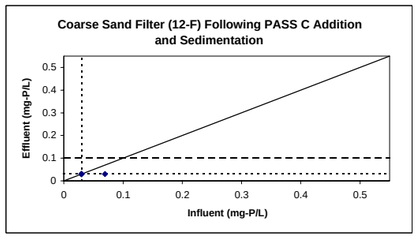


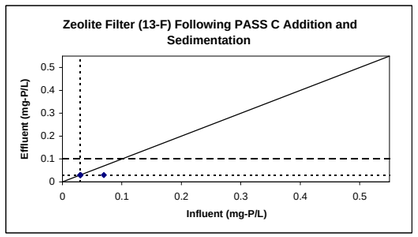


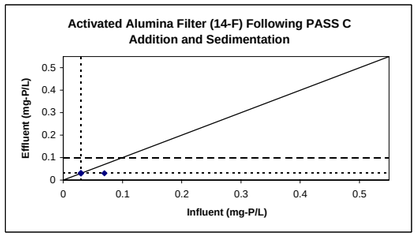


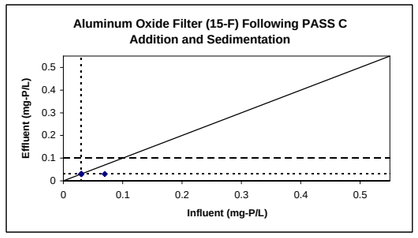












LEGEND

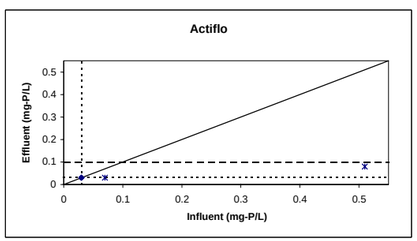
- Sample Points
- PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.
- Maximum Surface Water Discharge Concentration for Total Phosphorous (0.1 mg/L).
- Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (0.03 mg/L).

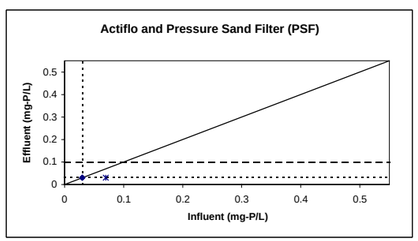
NOTES

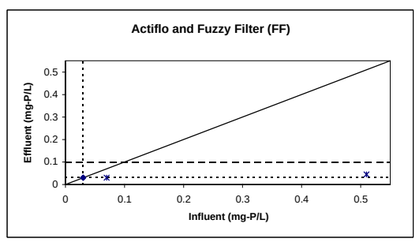
The dose of PASS C was 50 mg/L instead of 100 mg/L for 8-F and 9-F in Run 5. The open marker does not appear because it is directly in line with another data point.

The following list contains the data points that appear to be a single point in the plots.

-Fine Sand Filter (1-F) - 2 points at (0.3,0.3)
-Coarse Sand Filter (2-F) - 4 points at (0.3,0.3)
-Zeolite Filter (3-F) - 3 points at (0.3,0.3), and 1 point at (0.3,0.4)
-Activated Alumina Filter (4-F) - 3 points at (0.3,0.3)
-Aluminum Oxide Filter (5-F) - 2 points at (0.3,0.3)
-Coarse Sand Filter (7-F) with PAM - 3 points at (0.3,0.3)
-Fine Sand Filter (8-F) with PASS C -4 points at (0.3,0.3)
-Coarse Sand Filter (9-F) with PASS C - 4 points at (0.3,0.3)
-Sedimentation Only (10-S) - 4 points at (0.3,0.3)
-Average of Sedimentation Tanks (with PASS C) - 4 points at (0.3,0.3)
-Concrete Sand Filter (10-F) Following Gravity Sedimentation - 3 points at (0.3,0.5)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 4 points at (0.3,0.3)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation -4 points at (0.3,0.3)
-Zeolite Filter (13-F) Following PASS C Addition and Sedimentation -4 points at (0.3,0.3)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation - 4 points at (0.3,0.3)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 4 points at (0.3,0.3)
-Actiflo - 3 points at (0.3,0.3)
-Actiflo and Pressure Sand Filter (PSF) -3 points at (0.3,0.3)
-Actiflo and Fuzzy Filter (FF) -3 points at (0.3,0.3)
-Actiflo, PSF or FF, and Ion Exchange - 2 points at (0.3,0.3)







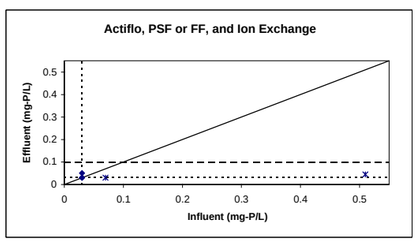
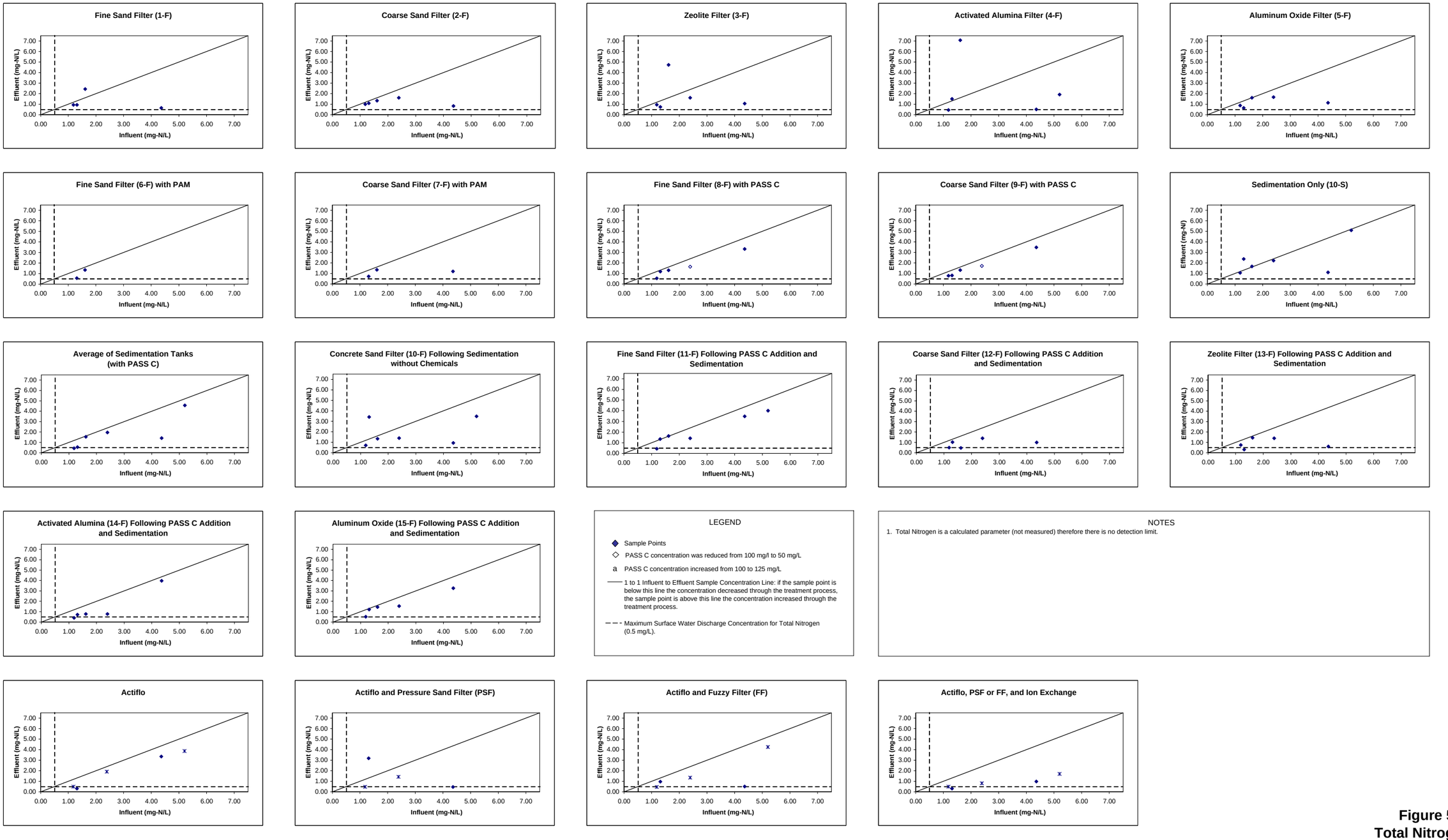


Figure 5-8.
Dissolved Ortho - Phosphate



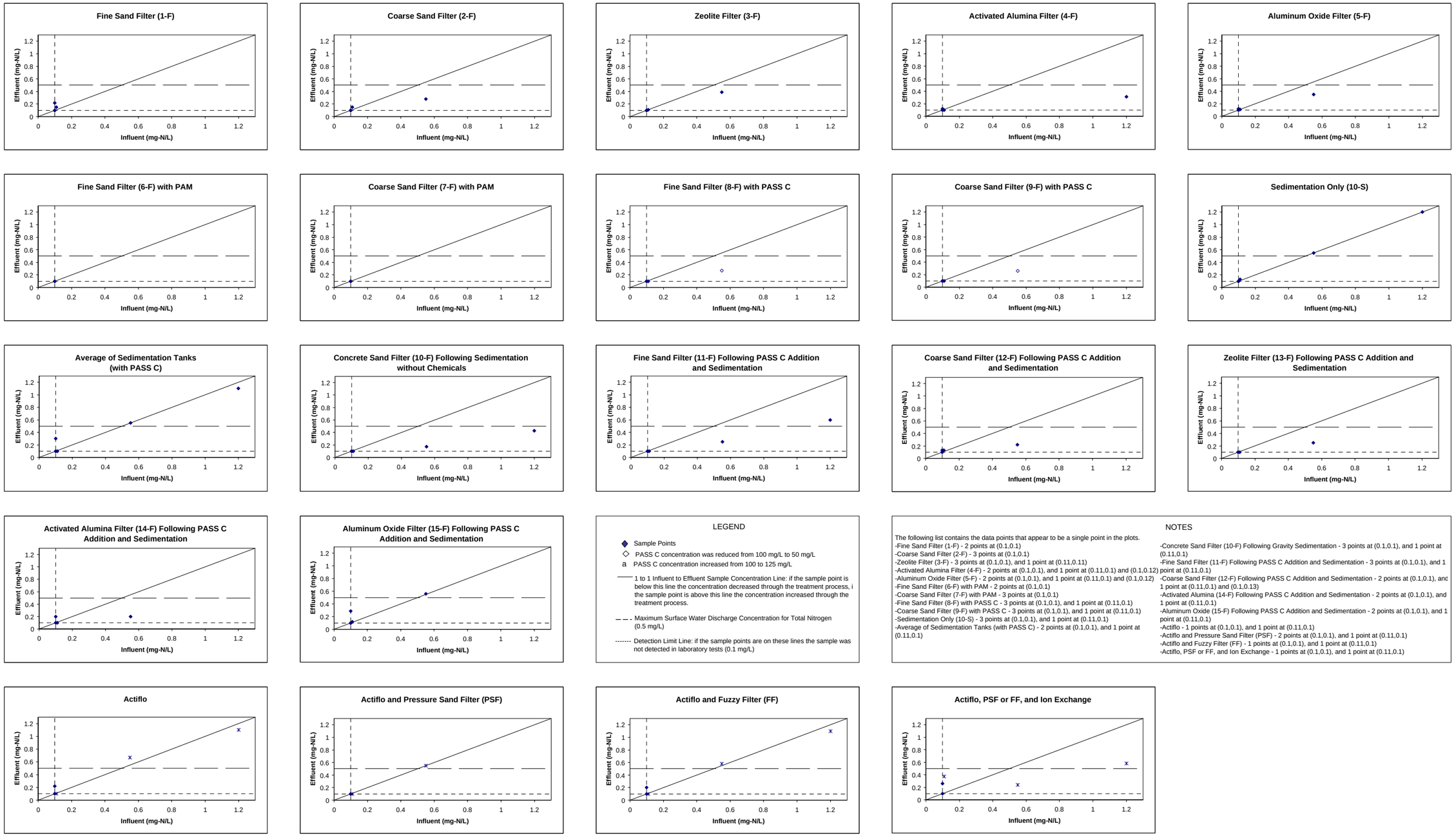
LEGEND

- Sample Points
- PASS C concentration was reduced from 100 mg/l to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.
- Maximum Surface Water Discharge Concentration for Total Nitrogen (0.5 mg/L).

NOTES

1. Total Nitrogen is a calculated parameter (not measured) therefore there is no detection limit.

Figure 5-9.
Total Nitrogen



LEGEND

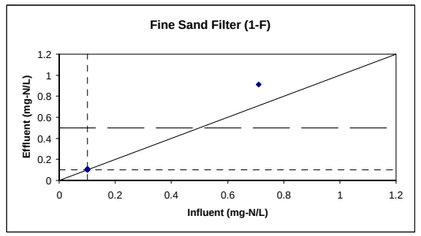
- ◆ Sample Points
- ◇ PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- —— 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, i the sample point is above this line the concentration increased through the treatment process.
- – – – Maximum Surface Water Discharge Concentration for Total Nitrogen (0.5 mg/L)
- ------- Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (0.1 mg/L)

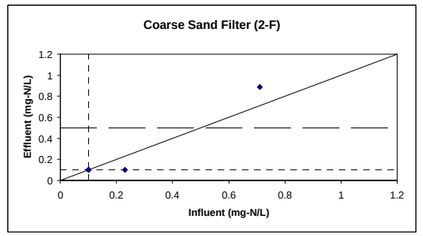
NOTES

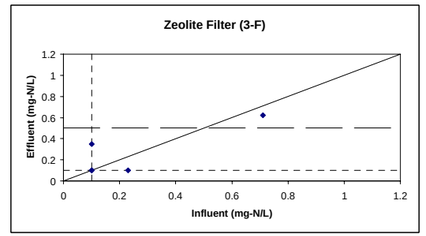
The following list contains the data points that appear to be a single point in the plots.

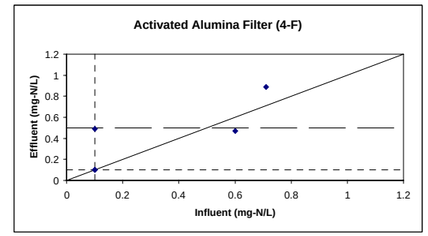
-Fine Sand Filter (1-F) - 2 points at (0.1,0.1)
-Coarse Sand Filter (2-F) - 3 points at (0.1,0.1)
-Zeolite Filter (3-F) - 3 points at (0.1,0.1), and 1 point at (0.11,0.11)
-Activated Alumina Filter (4-F) - 2 points at (0.1,0.1), and 1 point at (0.11,0.1) and (0.1,0.12)
-Aluminum Oxide Filter (5-F) - 2 points at (0.1,0.1), and 1 point at (0.11,0.1) and (0.1,0.12)
-Fine Sand Filter (6-F) with PAM - 2 points at (0.1,0.1)
-Coarse Sand Filter (7-F) with PAM - 3 points at (0.1,0.1)
-Fine Sand Filter (8-F) with PASS C - 3 points at (0.1,0.1), and 1 point at (0.11,0.1)
-Coarse Sand Filter (9-F) with PASS C - 3 points at (0.1,0.1), and 1 point at (0.11,0.1)
-Sedimentation Only (10-S) - 3 points at (0.1,0.1), and 1 point at (0.11,0.1)
-Average of Sedimentation Tanks (with PASS C) - 2 points at (0.1,0.1), and 1 point at (0.11,0.1)
-Concrete Sand Filter (10-F) Following Gravity Sedimentation - 3 points at (0.1,0.1), and 1 point at (0.11,0.1)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 3 points at (0.1,0.1), and 1 point at (0.11,0.1)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 2 points at (0.1,0.1), and 1 point at (0.11,0.1) and (0.1,0.13)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation - 2 points at (0.1,0.1), and 1 point at (0.11,0.1)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 2 points at (0.1,0.1), and 1 point at (0.11,0.1)
-Actiflo - 1 points at (0.1,0.1), and 1 point at (0.11,0.1)
-Actiflo and Pressure Sand Filter (PSF) - 2 points at (0.1,0.1), and 1 point at (0.11,0.1)
-Actiflo and Fuzzy Filter (FF) - 1 points at (0.1,0.1), and 1 point at (0.11,0.1)
-Actiflo, PSF or FF, and Ion Exchange - 1 points at (0.1,0.1), and 1 point at (0.11,0.1)

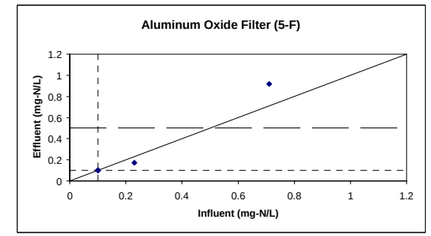
Figure 5-10.
Ammonia

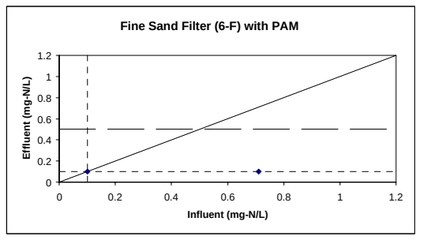


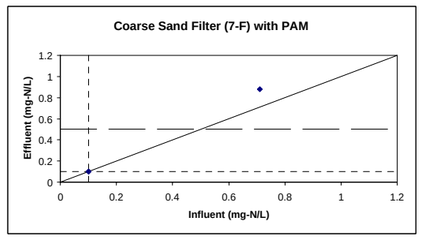


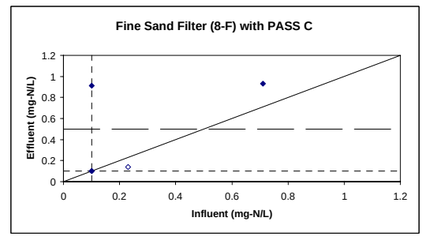


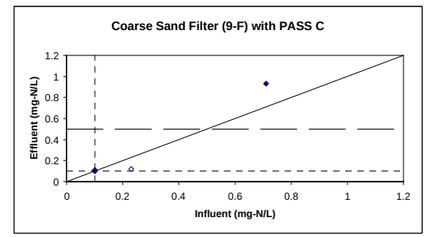


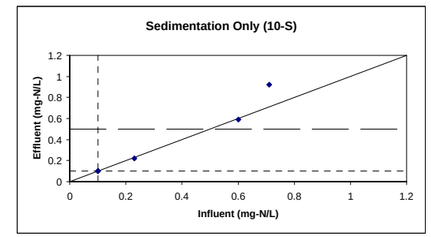


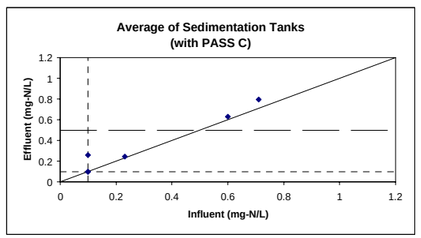


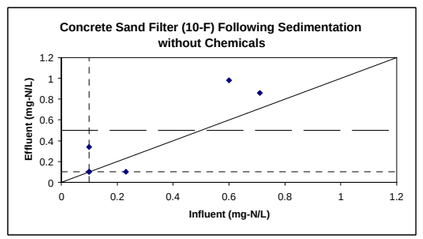


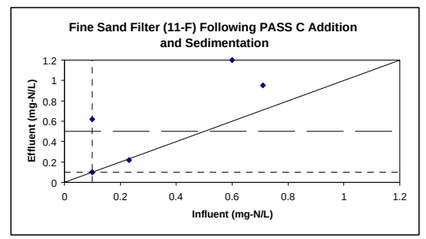


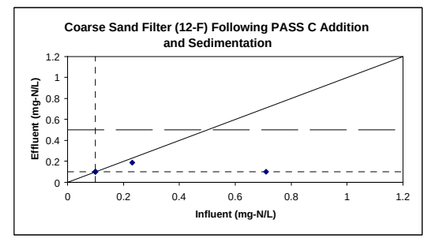


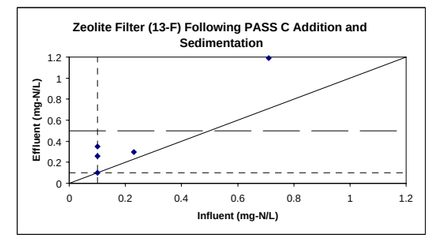


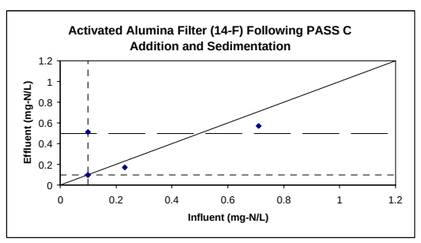


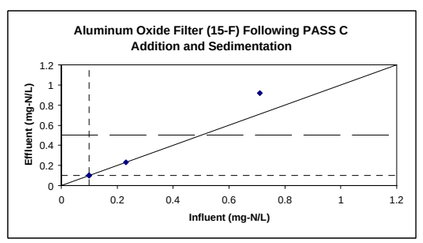












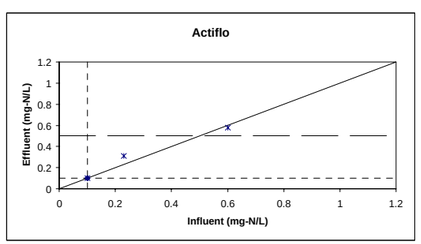
LEGEND

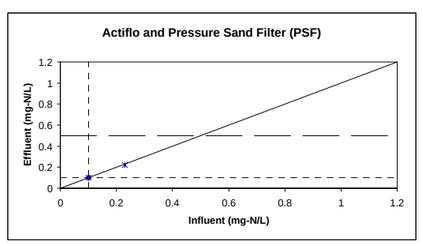
- Sample Points
- PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, i the sample point is above this line the concentration increased through the treatment process.
- Maximum Surface Water Discharge Concentration for Total Nitrogen (0.5 mg/L).
- Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (0.1 mg/L).

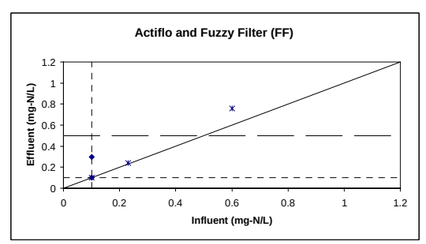
NOTES

The following list contains the data points that appear to be a single point in the plots.

-Fine Sand Filter (1-F) - 2 points at (0.1,0.1), and 1 point at (0.1,0.11)
-Coarse Sand Filter (2-F) - 3 points at (0.1,0.1)
-Zeolite Filter (3-F) - 2 points at (0.1,0.1)
-Activated Alumina Filter (4-F) - 2 points at (0.1,0.1)
-Aluminum Oxide Filter (5-F) - 3 points at (0.1,0.1)
-Coarse Sand Filter (7-F) with PAM - 2 points at (0.1,0.1)
-Fine Sand Filter (8-F) with PASS C - 2 points at (0.1,0.1)
-Coarse Sand Filter (9-F) with PASS C - 3 points at (0.1,0.1)
-Sedimentation Only (10-S) - 3 points at (0.1,0.1)
-Average of Sedimentation Tanks (with PASS C) - 2 points at (0.1,0.1)
-Concrete Sand Filter (10-F) Following Gravity Sedimentation - 2 points at (0.1,0.1)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 3 points at (0.1,0.1)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 3 points at (0.1,0.1)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation - 2 points at (0.1,0.1)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 3 points at (0.1,0.1)
-Actiflo - 3 points at (0.1,0.1)
-Actiflo and Pressure Sand Filter (PSF) - 3 points at (0.1,0.1)
-Actiflo and Fuzzy Filter (FF) - 2 points at (0.1,0.1)
-Actiflo, PSF or FF, and Ion Exchange - 3 points at (0.1,0.1)







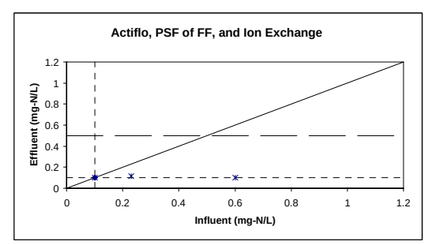
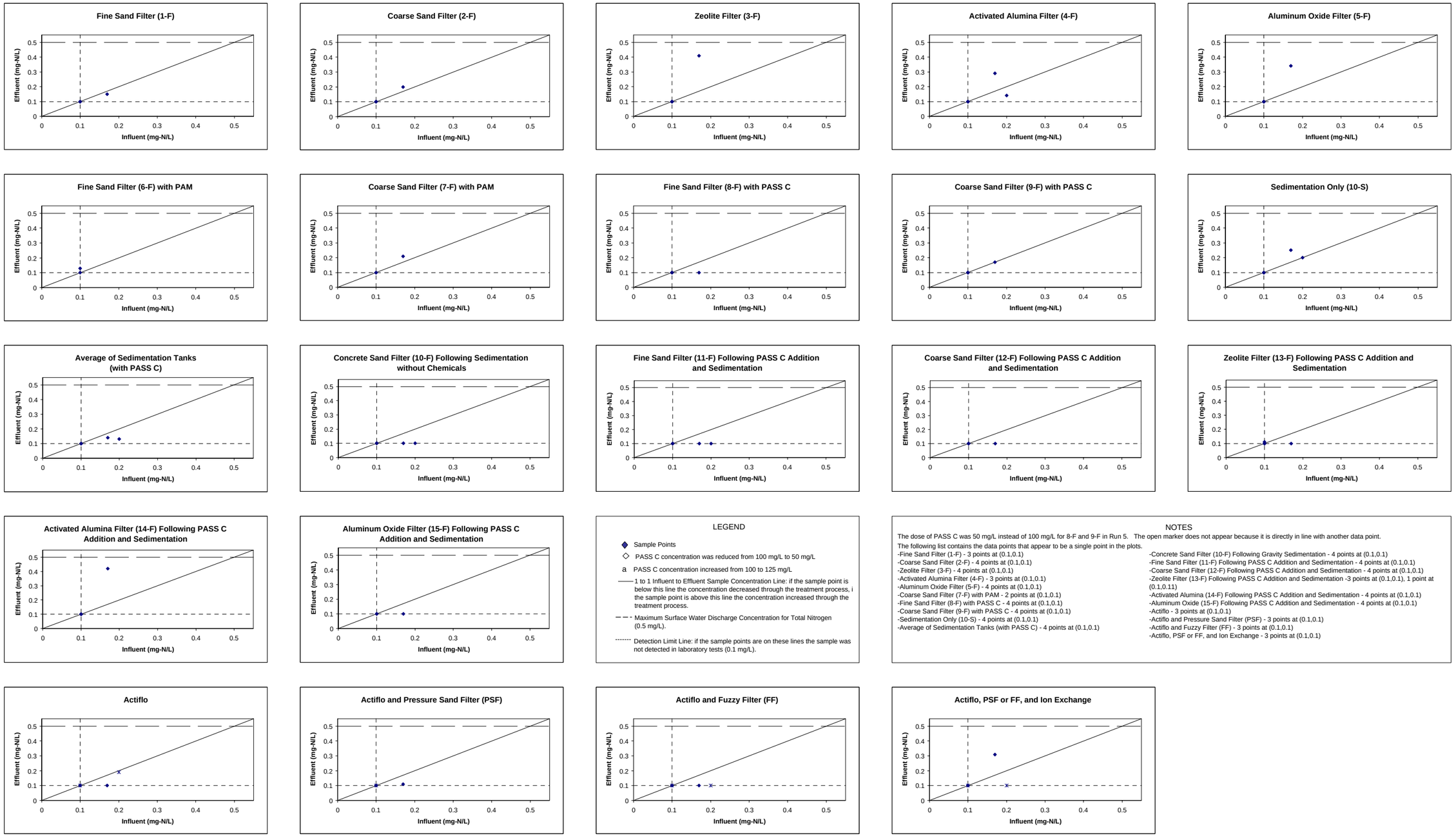


Figure 5-11.
Nitrate



LEGEND

◆ Sample Points

◇ PASS C concentration was reduced from 100 mg/L to 50 mg/L

a PASS C concentration increased from 100 to 125 mg/L

—— 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, i the sample point is above this line the concentration increased through the treatment process.

– – – Maximum Surface Water Discharge Concentration for Total Nitrogen (0.5 mg/L).

------- Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (0.1 mg/L).

NOTES

The dose of PASS C was 50 mg/L instead of 100 mg/L for 8-F and 9-F in Run 5. The open marker does not appear because it is directly in line with another data point.

The following list contains the data points that appear to be a single point in the plots.

-Fine Sand Filter (1-F) - 3 points at (0.1,0.1)
-Coarse Sand Filter (2-F) - 4 points at (0.1,0.1)
-Zeolite Filter (3-F) - 4 points at (0.1,0.1)
-Activated Alumina Filter (4-F) - 3 points at (0.1,0.1)
-Aluminum Oxide Filter (5-F) - 4 points at (0.1,0.1)
-Coarse Sand Filter (7-F) with PAM - 2 points at (0.1,0.1)
-Fine Sand Filter (8-F) with PASS C - 4 points at (0.1,0.1)
-Coarse Sand Filter (9-F) with PASS C - 4 points at (0.1,0.1)
-Sedimentation Only (10-S) - 4 points at (0.1,0.1)
-Average of Sedimentation Tanks (with PASS C) - 4 points at (0.1,0.1)
-Concrete Sand Filter (10-F) Following Gravity Sedimentation - 4 points at (0.1,0.1)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 4 points at (0.1,0.1)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 4 points at (0.1,0.1)
-Zeolite Filter (13-F) Following PASS C Addition and Sedimentation -3 points at (0.1,0.1), 1 point at (0.1,0.11)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation - 4 points at (0.1,0.1)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 4 points at (0.1,0.1)
-Actiflo - 3 points at (0.1,0.1)
-Actiflo and Pressure Sand Filter (PSF) - 3 points at (0.1,0.1)
-Actiflo and Fuzzy Filter (FF) - 3 points at (0.1,0.1)
-Actiflo, PSF or FF, and Ion Exchange - 3 points at (0.1,0.1)

Figure 5-12.
Nitrite

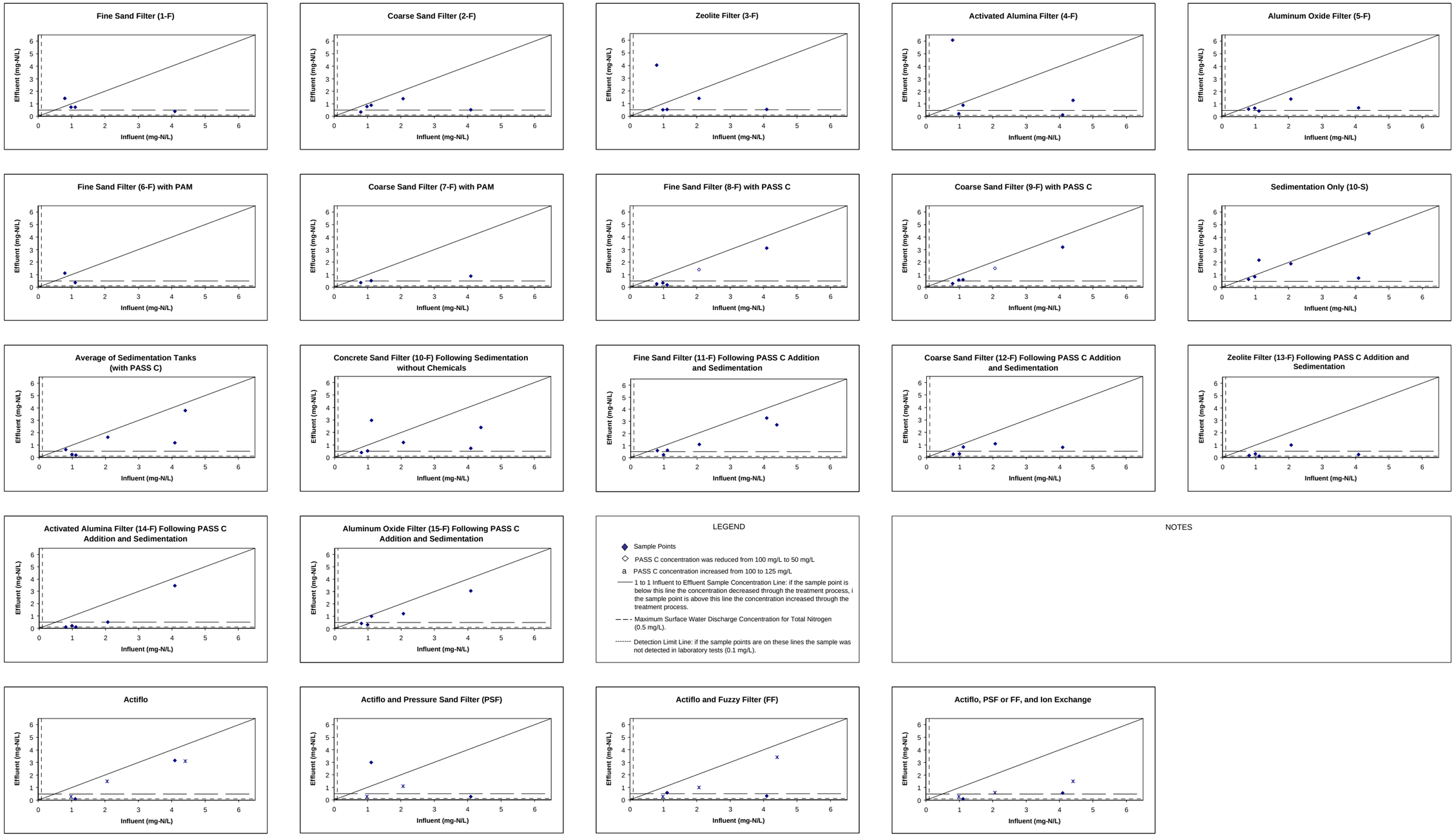
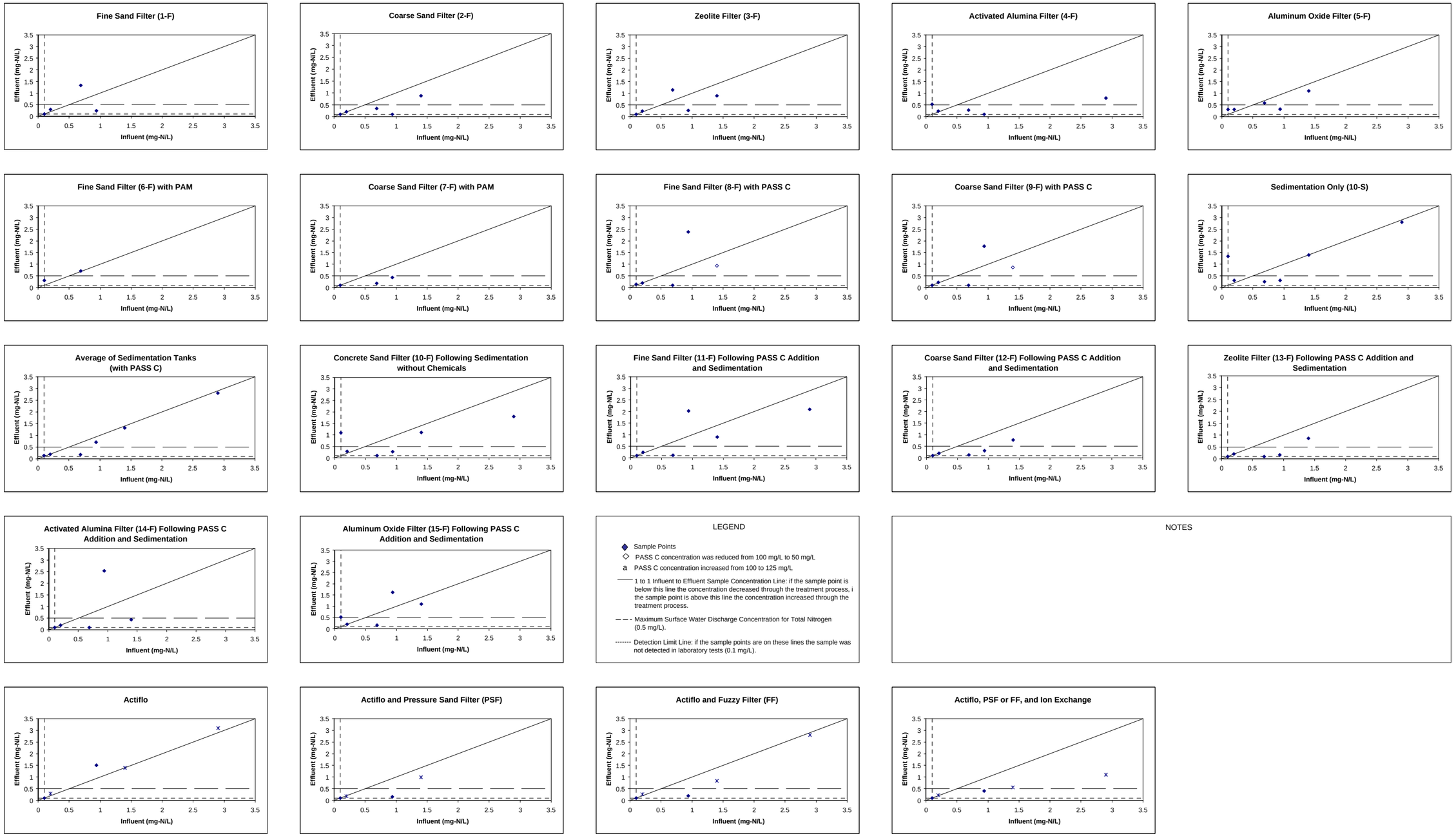


Figure 5-13.
Total Kjeldahl Nitrogen



LEGEND

- Sample Points
- PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, i the sample point is above this line the concentration increased through the treatment process.
- Maximum Surface Water Discharge Concentration for Total Nitrogen (0.5 mg/L).
- Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (0.1 mg/L).

NOTES

Figure 5-14.
Dissolved Kjeldahl Nitrogen

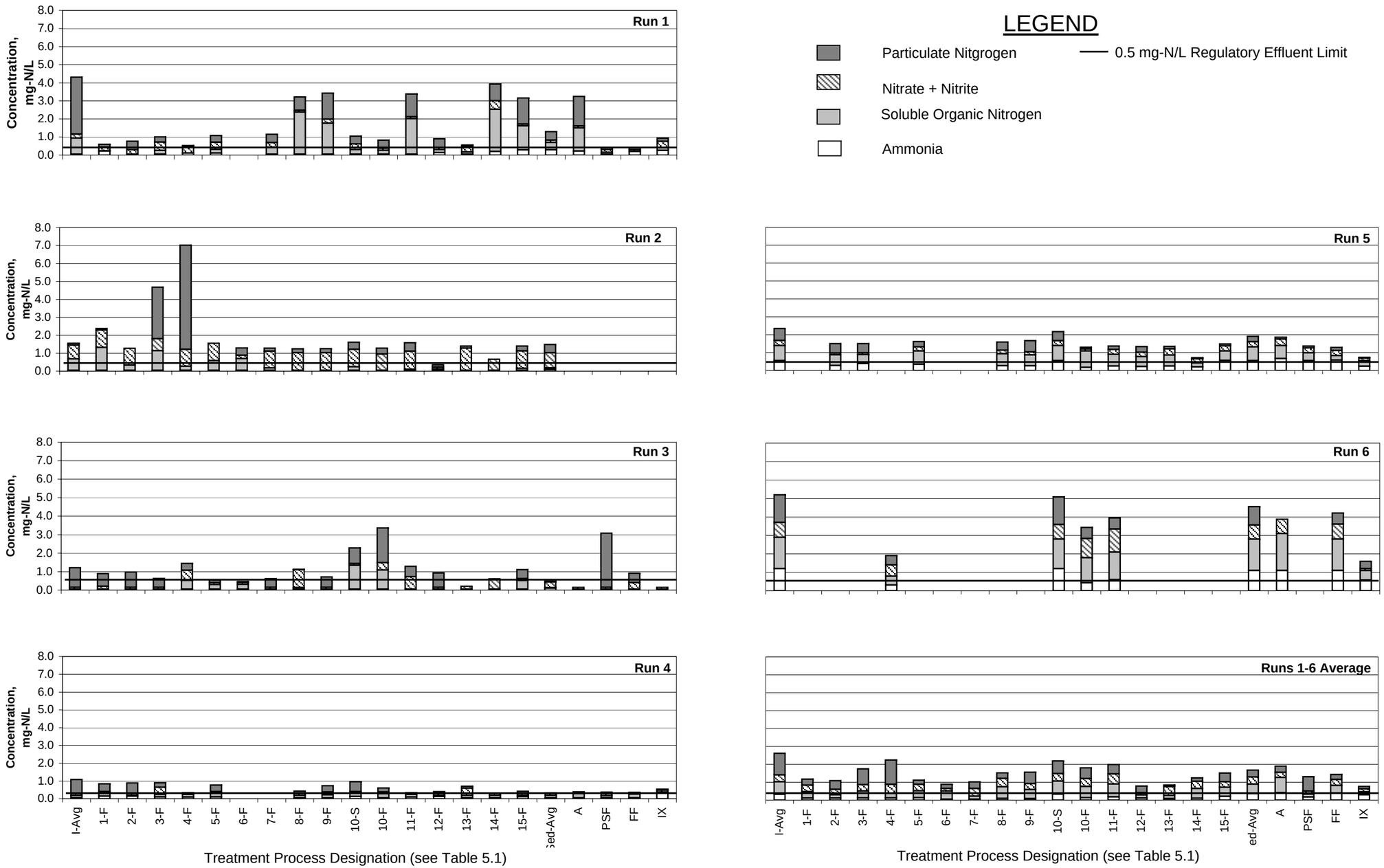
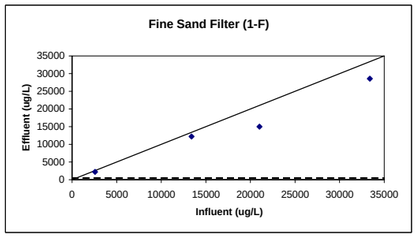
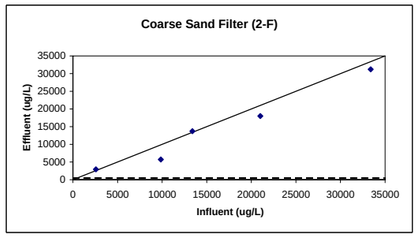
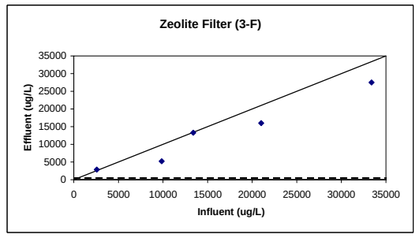
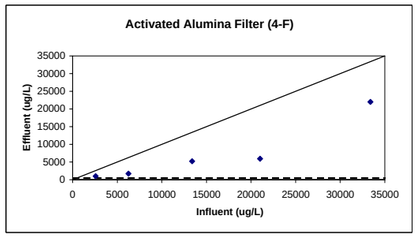


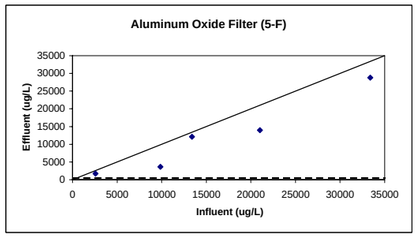
Figure 5-15.
Forms of Nitrogen Before and After Treatment

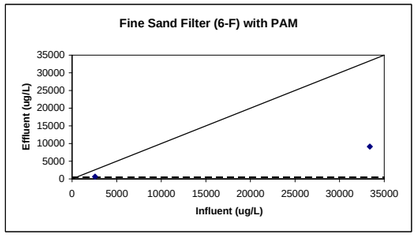


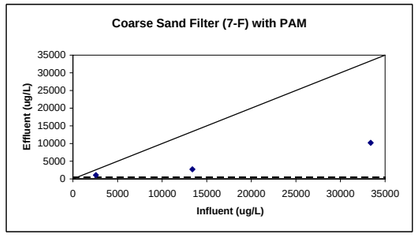


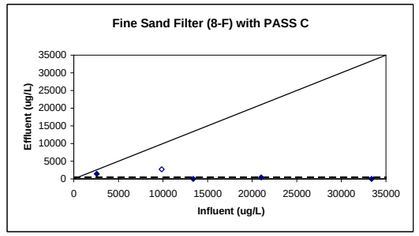


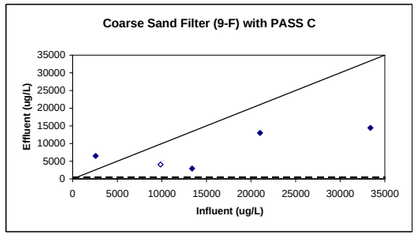


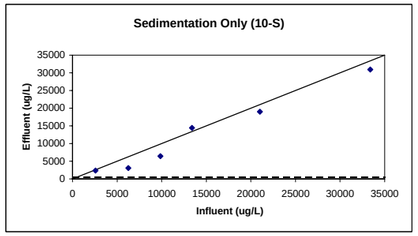


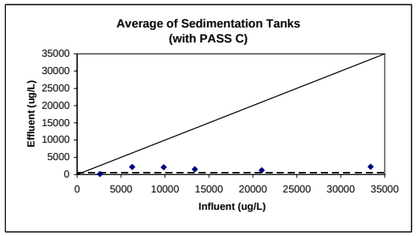


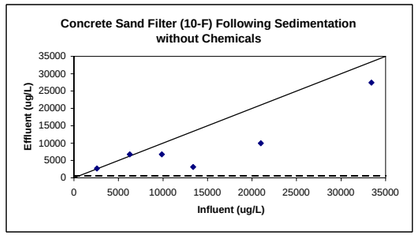


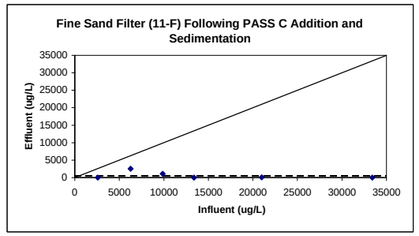


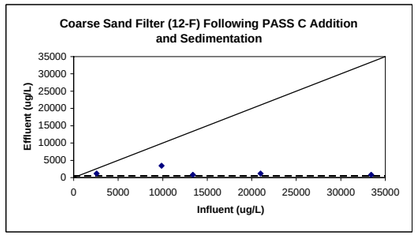


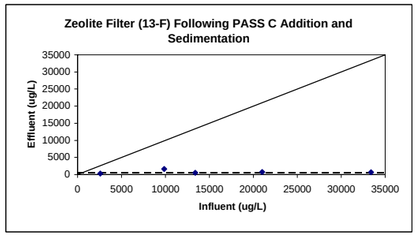


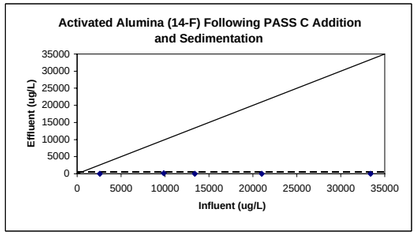


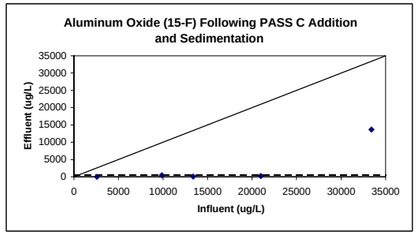










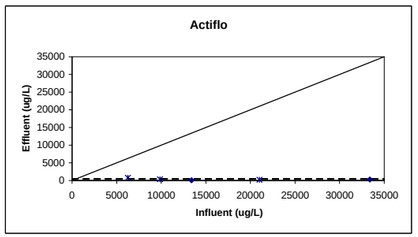


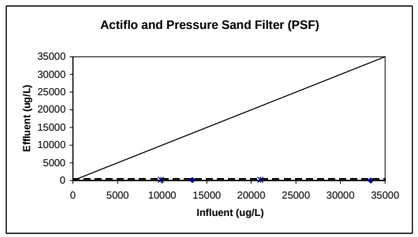
LEGEND

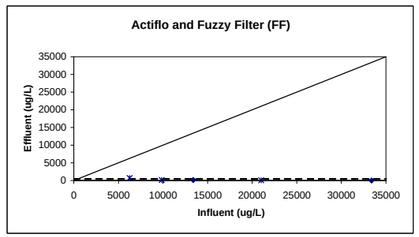
- Sample Points
- PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.
- Maximum Surface Water Discharge Concentration for Total Iron (500 µg/L).

NOTES

1) The reporting limit for total Iron is 25 µg/L, because of the large scale of the plots the method detection line is so close to the x and y axis that it is not visible.







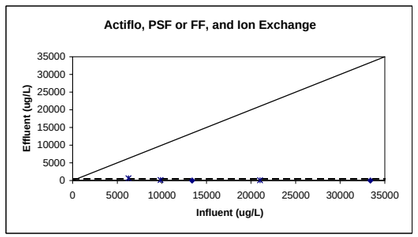
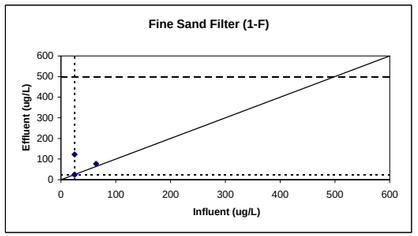
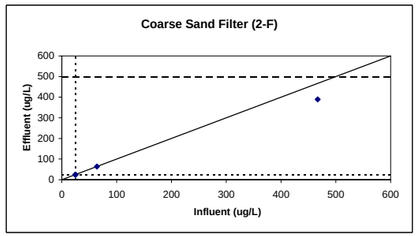
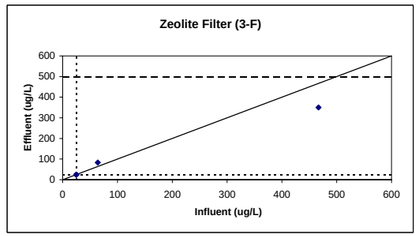
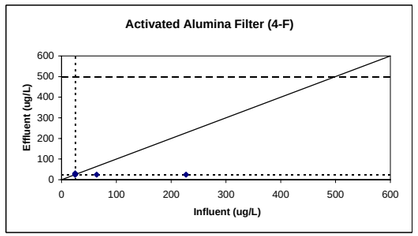


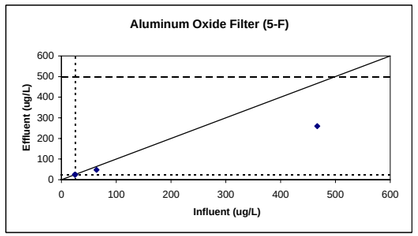
Figure 5-16.
Total Iron

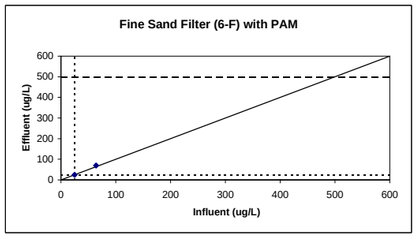


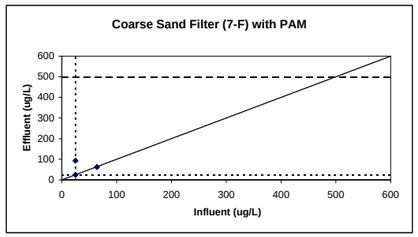


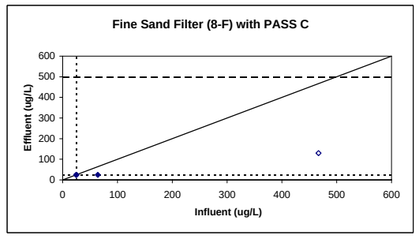


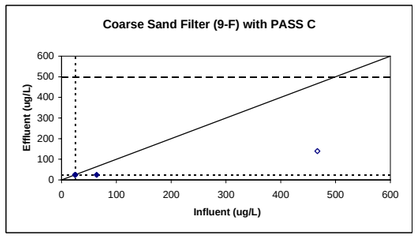


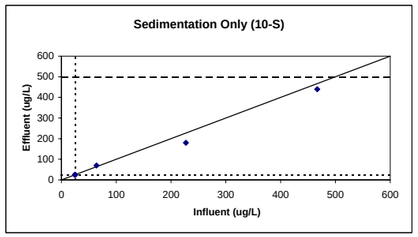


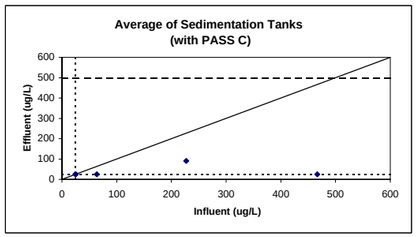


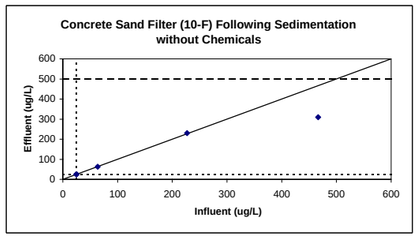


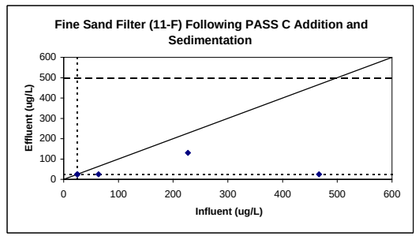


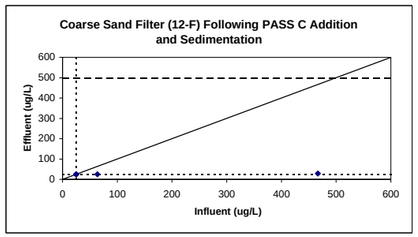


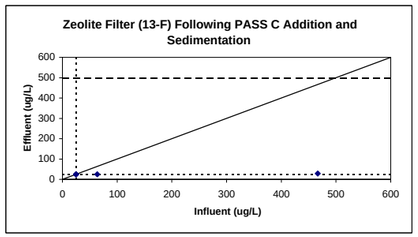


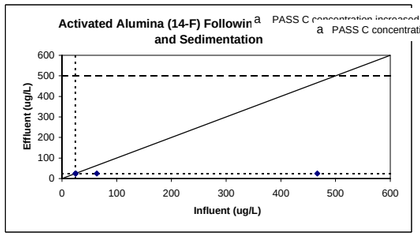




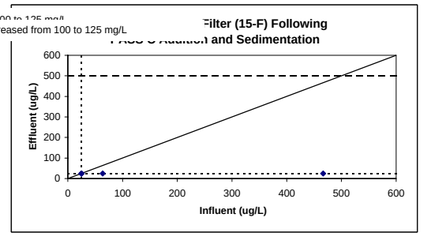








a PASS C concentration increased from 100 to 125 mg/L



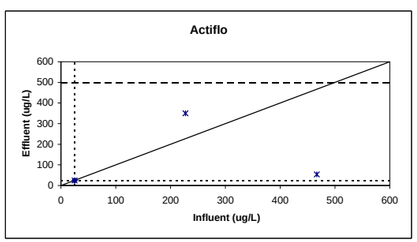
LEGEND

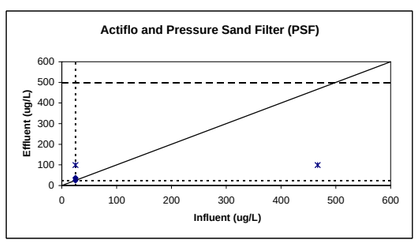
- Sample Points
- PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.
- Maximum Surface Water Discharge Concentration for Total Iron (500 µg/L)
- Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (25µg/L)

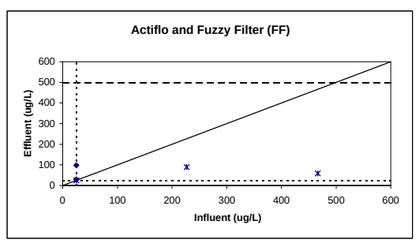
NOTES

The following list contains the data points that appear to be a single point in the plots.

-Fine Sand Filter (1-F) - 2 points at (25,25)
-Coarse Sand Filter (2-F) - 3 points at (25,25)
-Zeolite Filter (3-F) - 3 points at (25,25)
-Activated Alumina Filter (4-F) - 2 points at (25,25), and 1 point at (25,30.8)
-Aluminum Oxide Filter (5-F) - 3 points at (25,25)
-Fine Sand Filter (8-F) with PASS C - 3 points at (25,25)
-Coarse Sand Filter (9-F) with PASS C - 3 points at (25,25)
-Sedimentation Only (10-S) - 3 points at (25,25)
-Average of Sedimentation Tanks (with PASS C) - 3 points at (25,25)
-Concrete Sand Filter (10-F) Following Gravity Sedimentation - 3 points at (25,25)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 3 points at (25,25)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 3 points at (25,25)
-Zeolite Filter (13-F) Following PASS C Addition and Sedimentation - 3 points at (25,25)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation - 3 points at (25,25)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 3 points at (25,25)
-Actiflo - 3 points at (25,25)
-Actiflo and Pressure Sand Filter (PSF) - 1 point at (25,25), and 1 point at (25,37.3)
-Actiflo and Fuzzy Filter (FF) - 1 point at (25,25), and 1 point at (25,29)
-Actiflo, PSF or FF, and Ion Exchange - 3 points at (25,25)







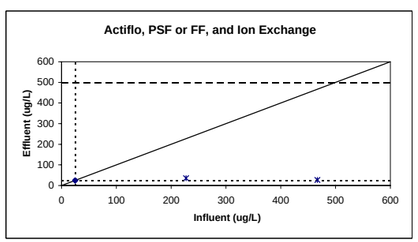
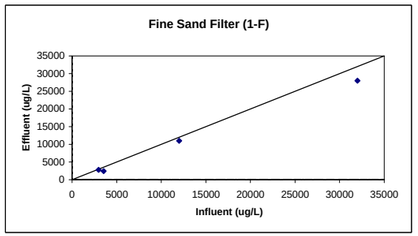
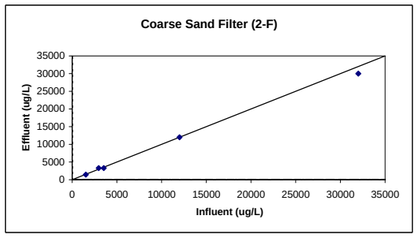
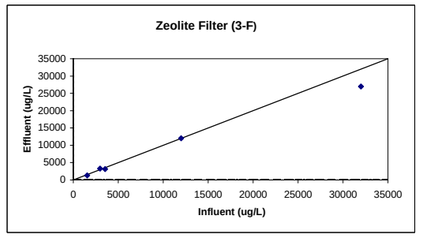
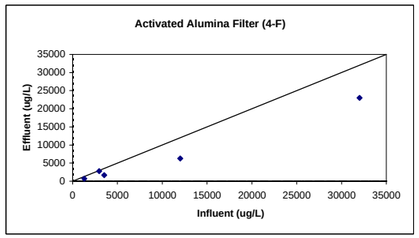


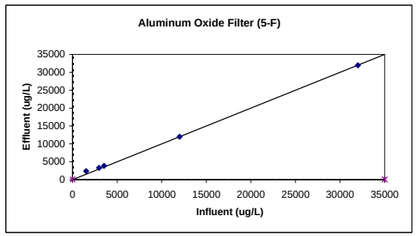
Figure 5-17.
Dissolved Iron

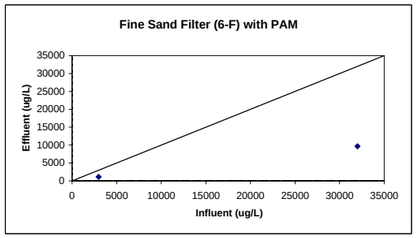


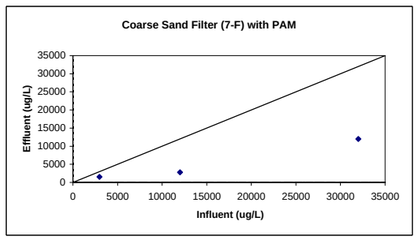


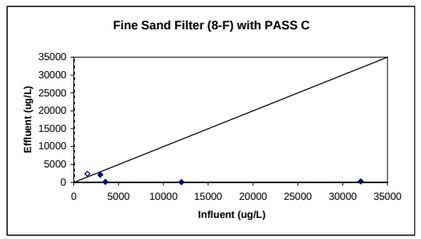


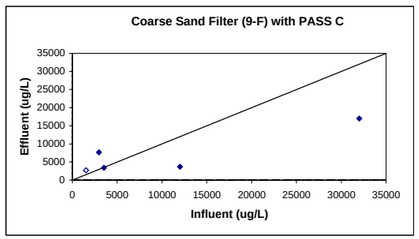


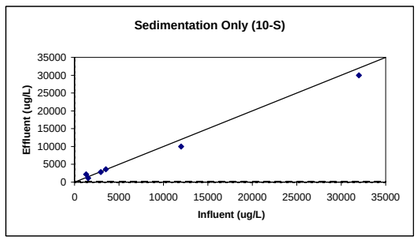


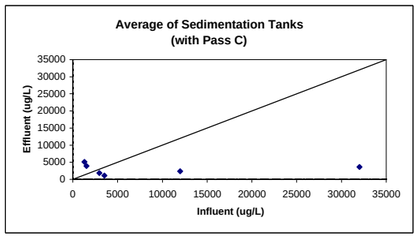


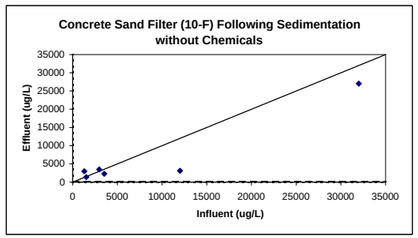


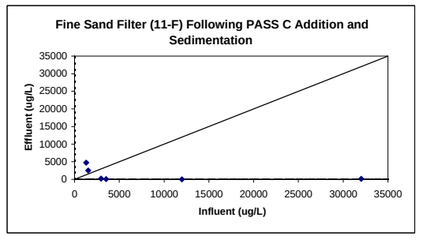


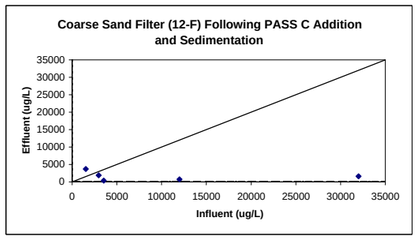


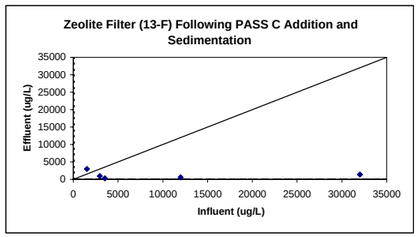


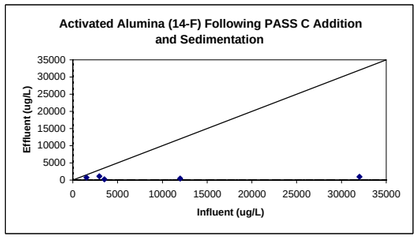


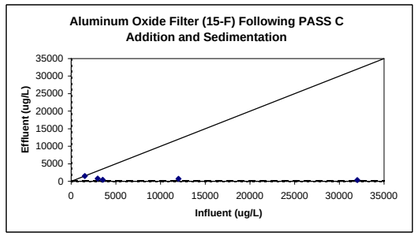










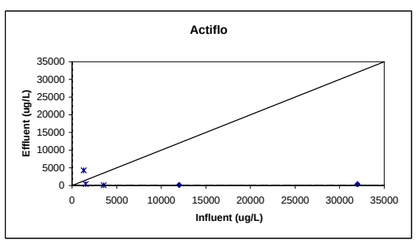


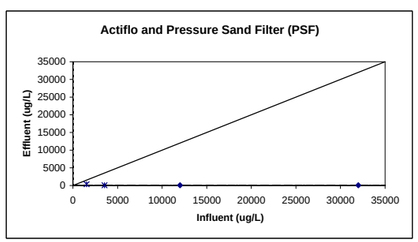
LEGEND

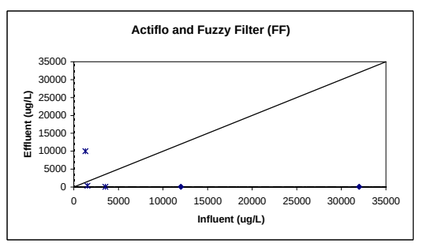
- Sample Points
- PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.
- EPA Water Quality Objective (87 µg/L)
- Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (25µg/L).

NOTES

1) The reporting limit for total Aluminum is 25µg/L, because of the large scale of the plots the method detection line is so close to the x and y axis that it does not appear.
2) The EPA water quality objective for total Aluminum is 87µg/L, because of the large scale of the plots the objective line is so close to the x axis that it is hard to distinguish.







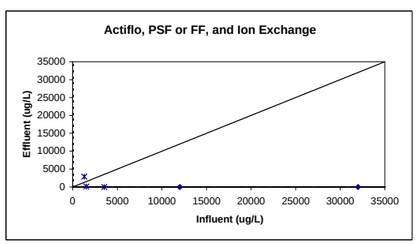


Figure 5-18.
Total Aluminum

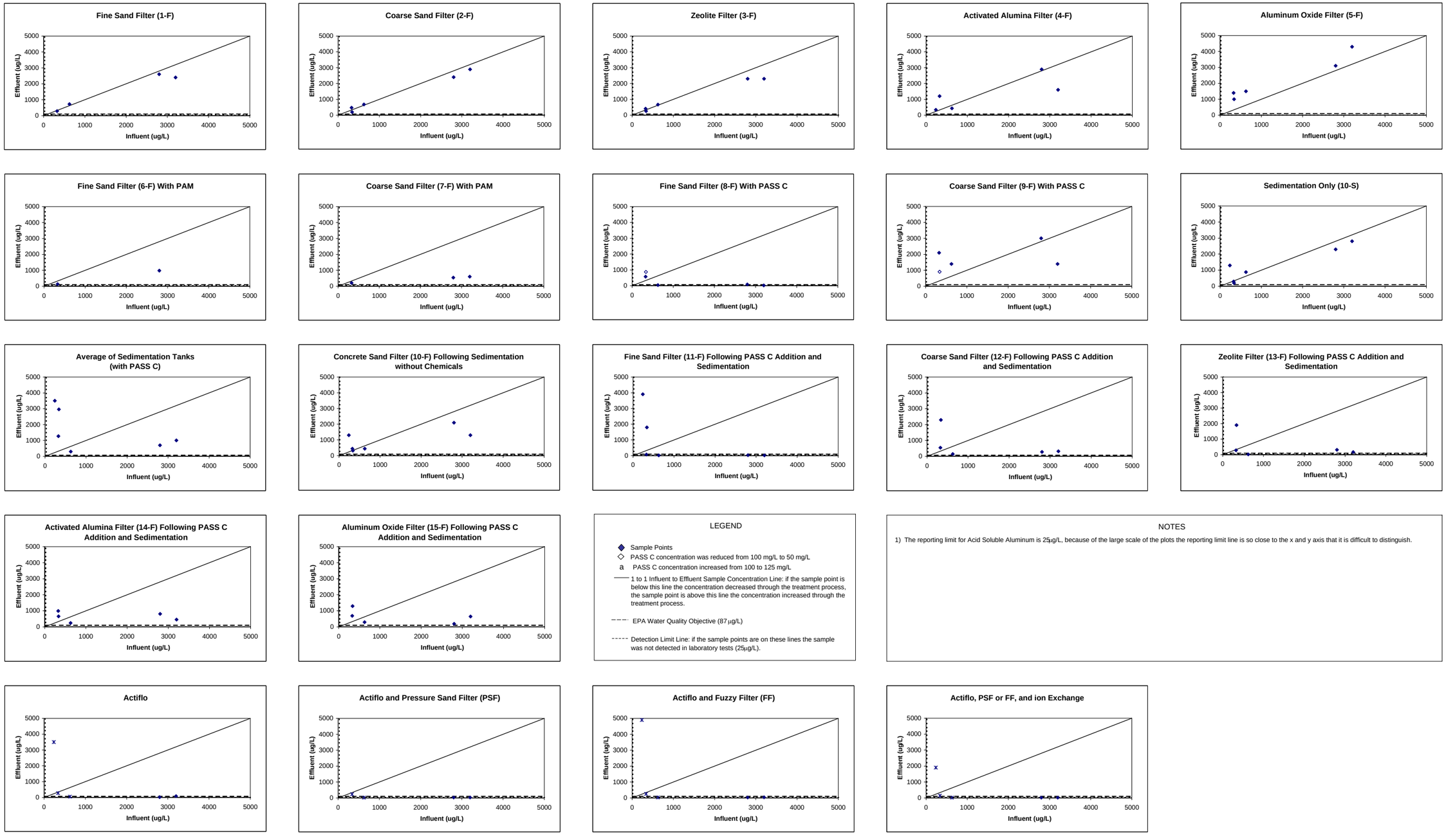
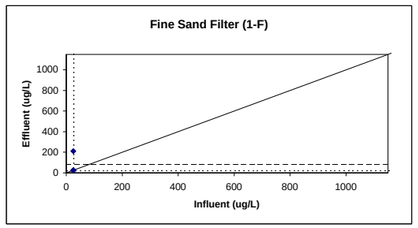
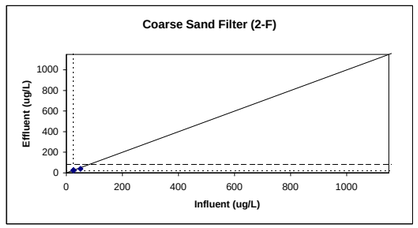
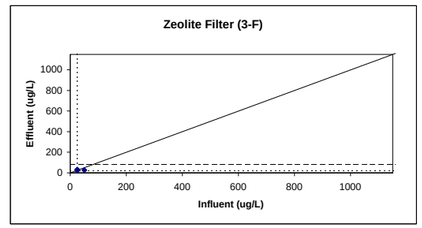
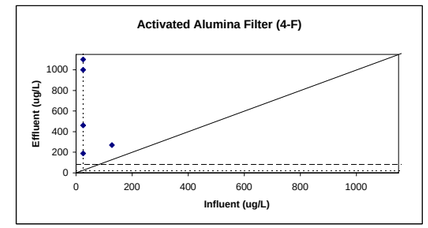


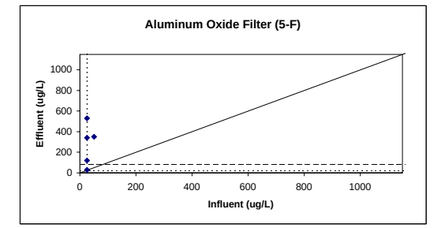
Figure 5-19.
Acid Soluble Aluminum

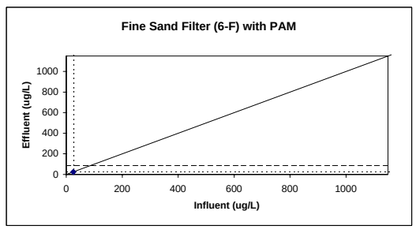


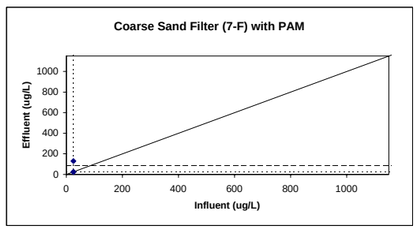


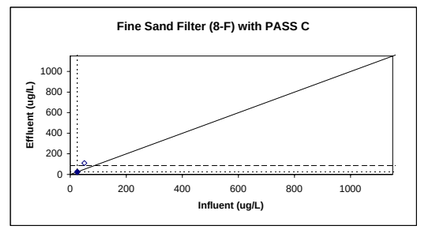


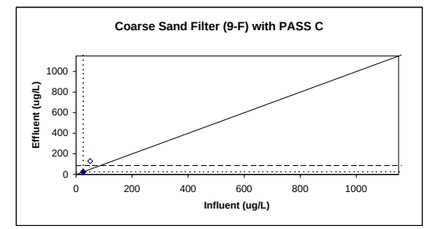


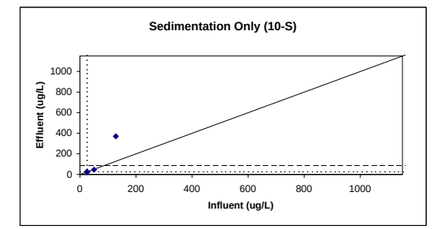


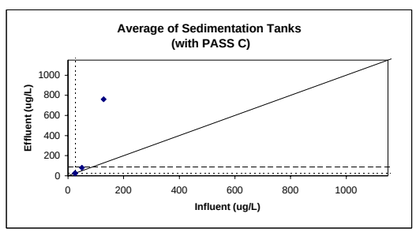


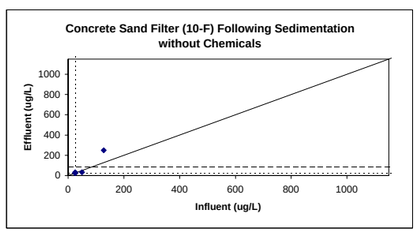


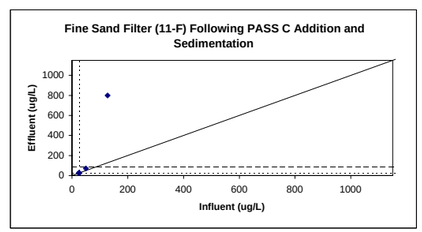


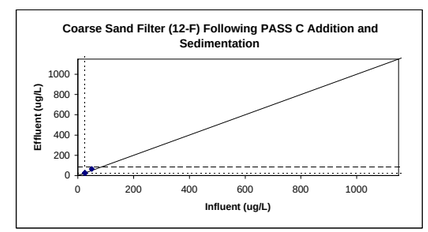


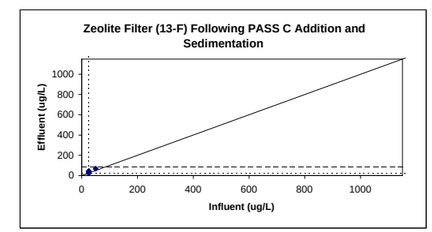


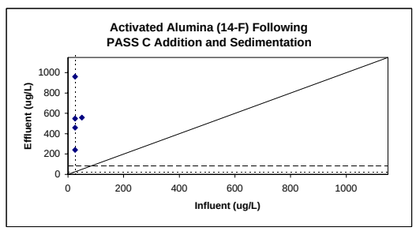


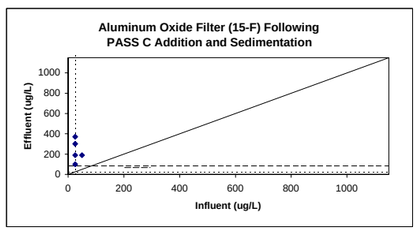












LEGEND

◆ Sample Points

◇ PASS C concentration was reduced from 100 mg/L to 50 mg/L

a PASS C concentration increased from 100 to 125 mg/L

—— 1 to 1 Influent to Effluent Sample Concentration Line: If the sample point is below this line the concentration decreased through the treatment process, if the sample point is above this line the concentration increased through the treatment process.

– – – – EPA Water Quality Objective (87 µg/L)

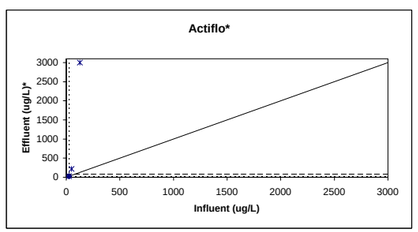
- - - - - Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (25 µg/L).

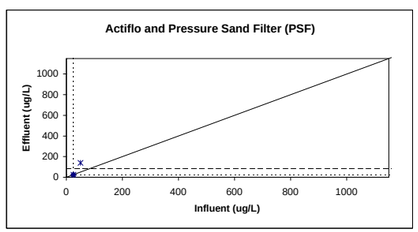
NOTES

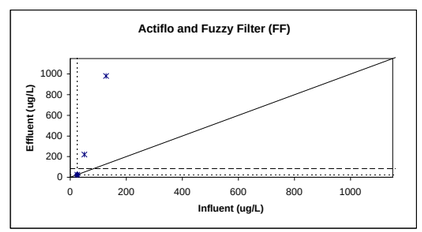
* Scale for Actiflo plot is different than the other plots.

The following list contains the data points that appear to be a single point in the plots.

-Fine Sand Filter (1-F) - 2 points at (25,25)
-Coarse Sand Filter (2-F) - 4 points at (25,25)
-Zeolite Filter (3-F) - 2 points at (25,25), and 1 point at (25,30) and (25,31)
-Fine Sand Filter (6-F) with PAM - 2 points at (25,25)
-Coarse Sand Filter (7-F) with PAM - 2 points at (25,25)
-Fine Sand Filter (8-F) with PASS C - 4 points at (25,25)
-Coarse Sand Filter (9-F) - 4 points at (25,25)
-Sedimentation Only (10-S) - 4 points at (25,25)
-Average of Sedimentation Tanks (with PASS C) - 4 points at (25,25)
-Concrete Sand Filter (10-F) Following Gravity Sedimentation - 3 points at (25,25) and 1 point at (25,33)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 4 points at (25,25)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 4 points at (25,25)
-Zeolite Filter (13-F) Following PASS C Addition and Sedimentation -2 points at (25,25), and 1 point at (25,45) and (25,38)
-Actiflo - 3 points at (25,25)
-Actiflo and Pressure Sand Filter (PSF)- 3 points at (25,25)
-Actiflo and Fuzzy Filter (FF) - 3 points at (25,25)
-Actiflo, PSF or FF, and Ion Exchange - 2 points at (25,25), and 1 point at (25,38)







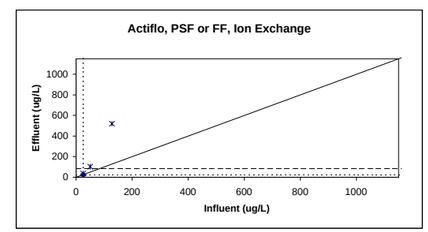
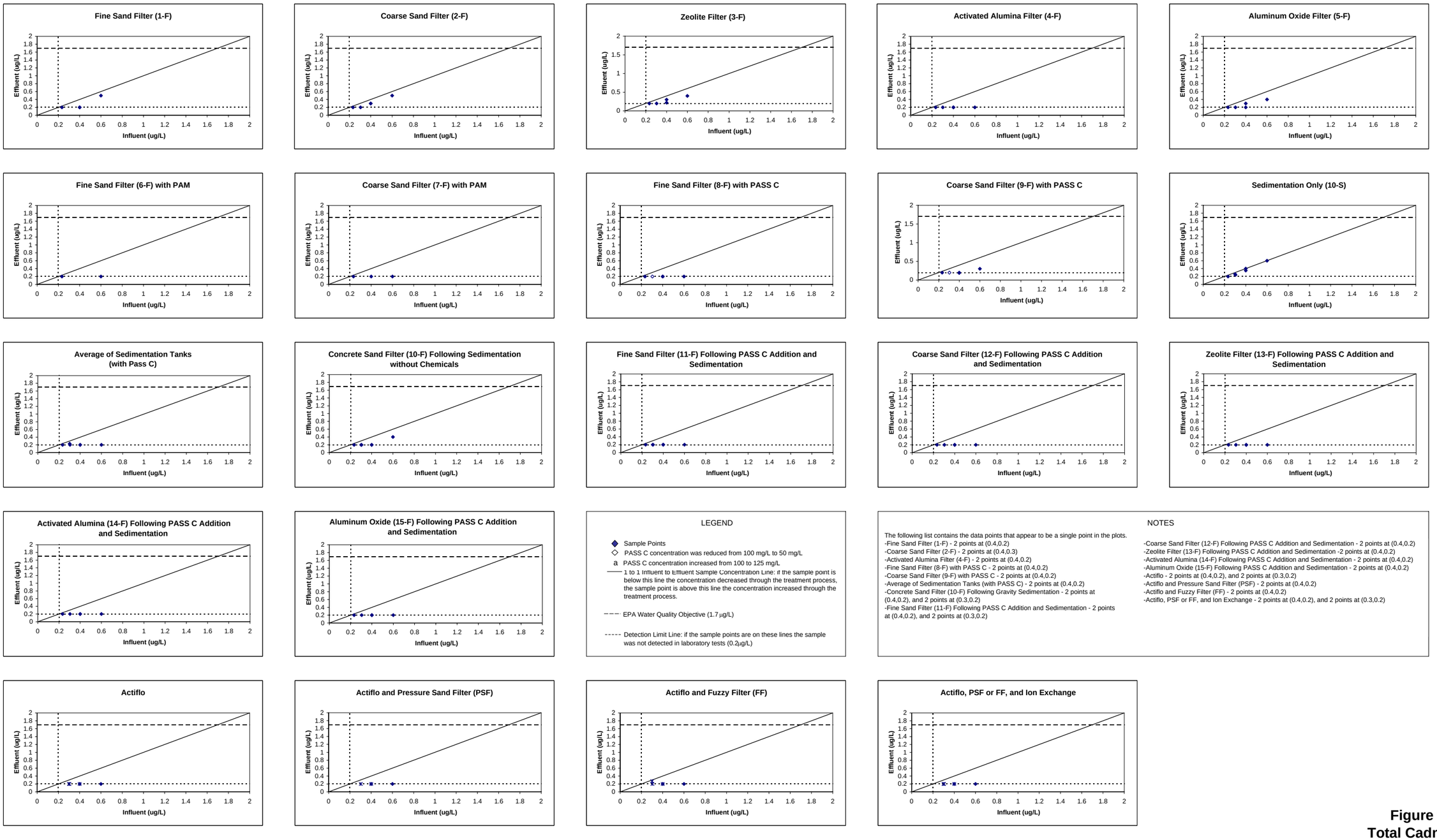


Figure 5-20.
Dissolved Aluminum



LEGEND

◆ Sample Points

◇ PASS C concentration was reduced from 100 mg/L to 50 mg/L

a PASS C concentration increased from 100 to 125 mg/L

—— 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.

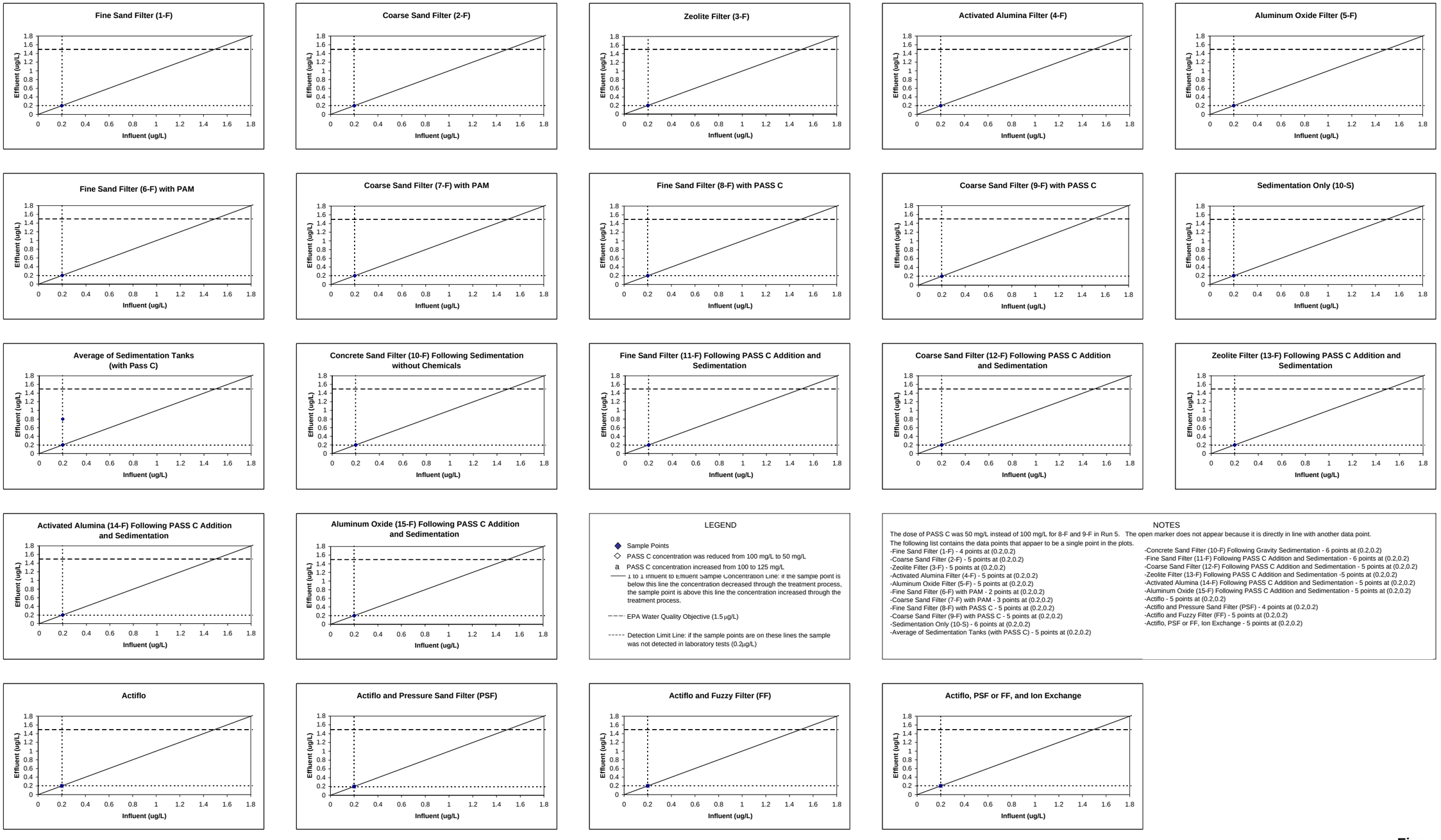
– – – EPA Water Quality Objective (1.7 µg/L)

- - - - Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (0.2µg/L)

NOTES

The following list contains the data points that appear to be a single point in the plots.
-Fine Sand Filter (1-F) - 2 points at (0.4,0.2)
-Coarse Sand Filter (2-F) - 2 points at (0.4,0.3)
-Activated Alumina Filter (4-F) - 2 points at (0.4,0.2)
-Fine Sand Filter (8-F) with PASS C - 2 points at (0.4,0.2)
-Coarse Sand Filter (9-F) with PASS C - 2 points at (0.4,0.2)
-Average of Sedimentation Tanks (with PASS C) - 2 points at (0.4,0.2)
-Concrete Sand Filter (10-F) Following Gravity Sedimentation - 2 points at (0.4,0.2), and 2 points at (0.3,0.2)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 2 points at (0.4,0.2), and 2 points at (0.3,0.2)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 2 points at (0.4,0.2)
-Zeolite Filter (13-F) Following PASS C Addition and Sedimentation -2 points at (0.4,0.2)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation - 2 points at (0.4,0.2)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 2 points at (0.4,0.2)
-Actiflo - 2 points at (0.4,0.2), and 2 points at (0.3,0.2)
-Actiflo and Pressure Sand Filter (PSF) - 2 points at (0.4,0.2)
-Actiflo and Fuzzy Filter (FF) - 2 points at (0.4,0.2)
-Actiflo, PSF or FF, and Ion Exchange - 2 points at (0.4,0.2), and 2 points at (0.3,0.2)

Figure 5-21.
Total Cadmium



LEGEND

- ◆ Sample Points
- ◇ PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- —— 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.
- – – – EPA Water Quality Objective (1.5 µg/L)
- - - - - Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (0.2µg/L)

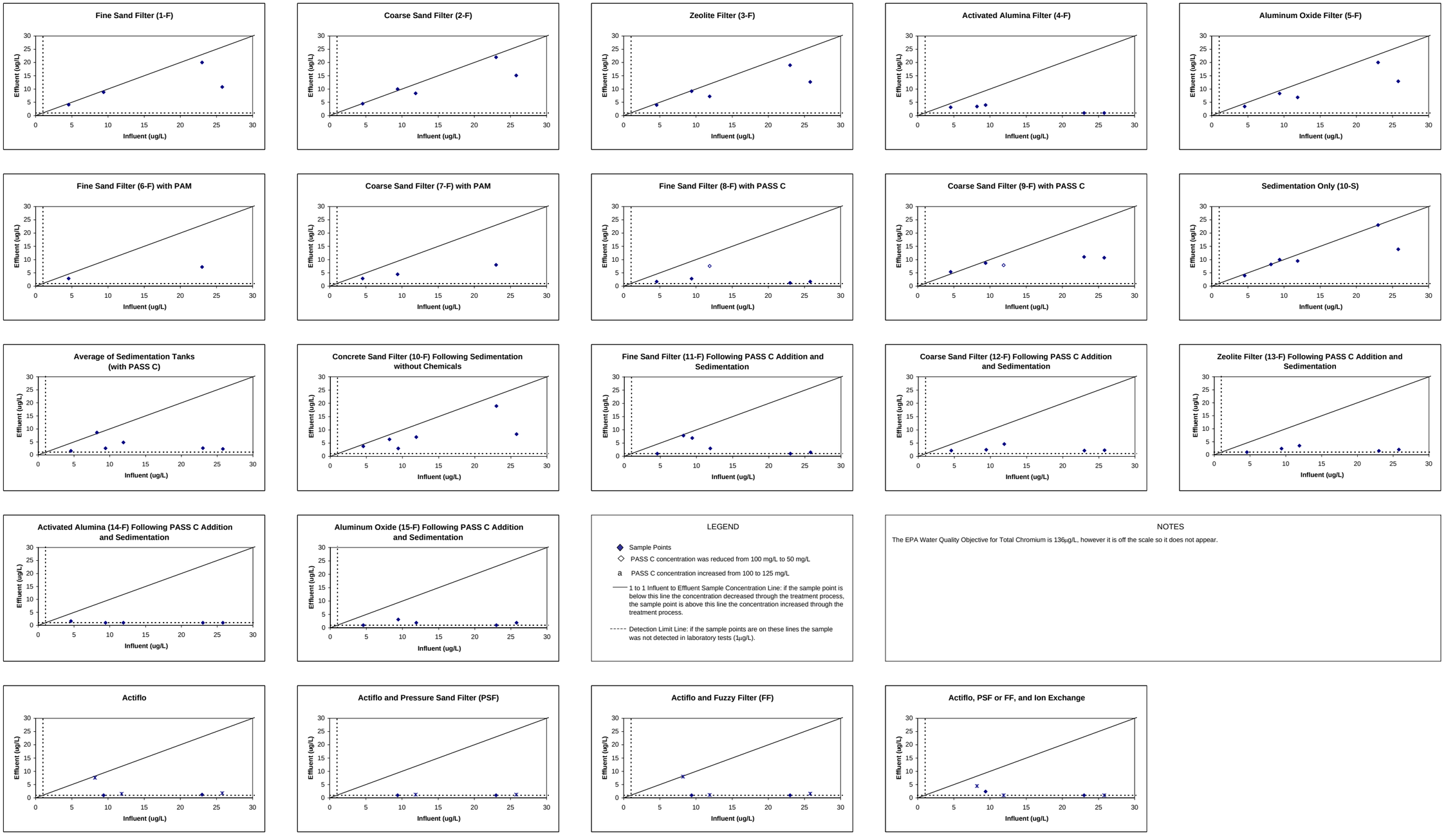
NOTES

The dose of PASS C was 50 mg/L instead of 100 mg/L for 8-F and 9-F in Run 5. The open marker does not appear because it is directly in line with another data point.

The following list contains the data points that appear to be a single point in the plots.

-Fine Sand Filter (1-F) - 4 points at (0.2,0.2)
-Coarse Sand Filter (2-F) - 5 points at (0.2,0.2)
-Zeolite Filter (3-F) - 5 points at (0.2,0.2)
-Activated Alumina Filter (4-F) - 5 points at (0.2,0.2)
-Aluminum Oxide Filter (5-F) - 5 points at (0.2,0.2)
-Fine Sand Filter (6-F) with PAM - 2 points at (0.2,0.2)
-Coarse Sand Filter (7-F) with PAM - 3 points at (0.2,0.2)
-Fine Sand Filter (8-F) with PASS C - 5 points at (0.2,0.2)
-Coarse Sand Filter (9-F) with PASS C - 5 points at (0.2,0.2)
-Sedimentation Only (10-S) - 6 points at (0.2,0.2)
-Average of Sedimentation Tanks (with PASS C) - 5 points at (0.2,0.2)
-Concrete Sand Filter (10-F) Following Gravity Sedimentation - 6 points at (0.2,0.2)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 6 points at (0.2,0.2)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 5 points at (0.2,0.2)
-Zeolite Filter (13-F) Following PASS C Addition and Sedimentation -5 points at (0.2,0.2)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation - 5 points at (0.2,0.2)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 5 points at (0.2,0.2)
-Actiflo - 5 points at (0.2,0.2)
-Actiflo and Pressure Sand Filter (PSF) - 4 points at (0.2,0.2)
-Actiflo and Fuzzy Filter (FF) - 5 points at (0.2,0.2)
-Actiflo, PSF or FF, Ion Exchange - 5 points at (0.2,0.2)

Figure 5-22.
Dissolved Cadmium



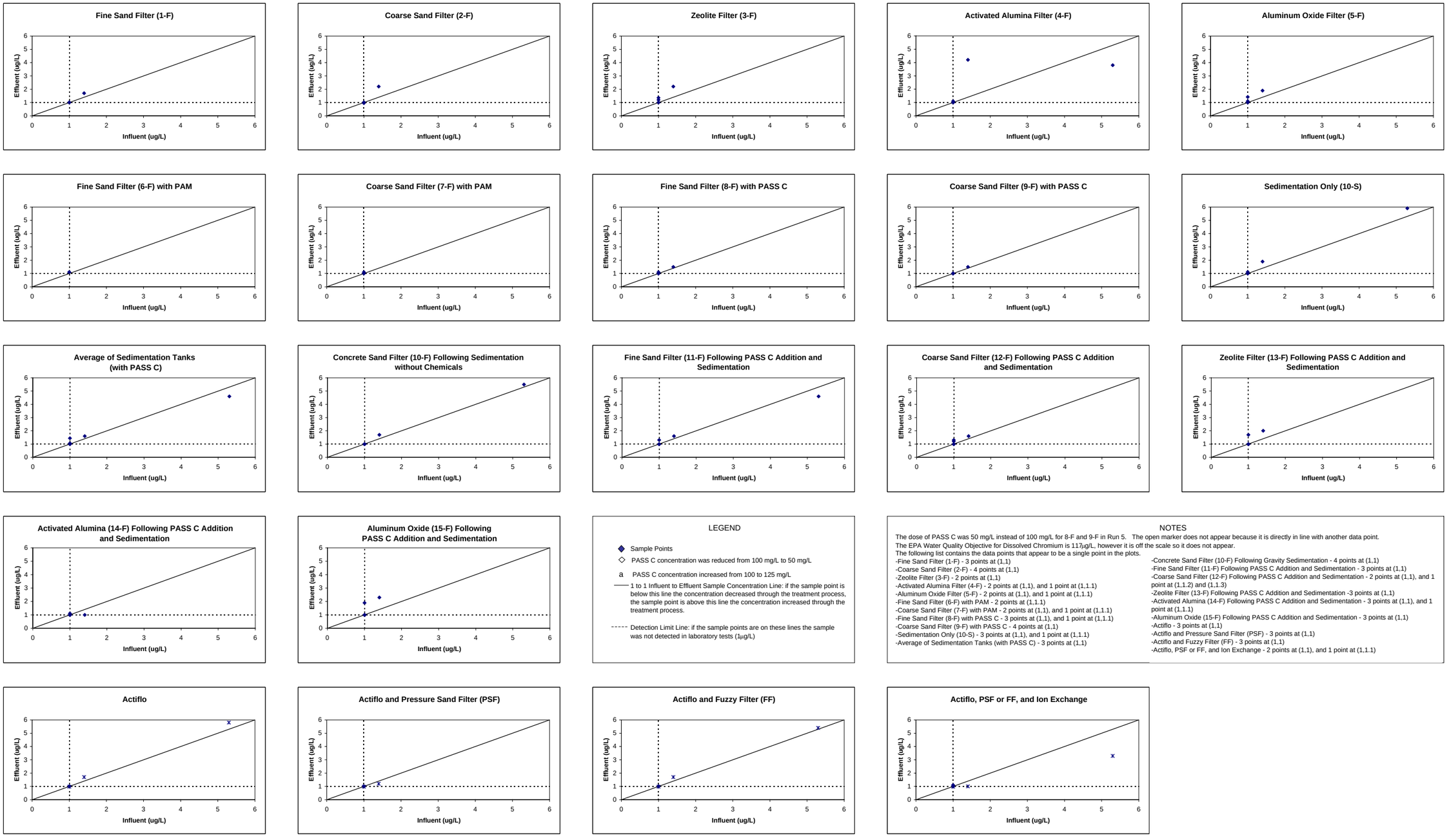
LEGEND

- ◆ Sample Points
- ◇ PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- —— 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.
- ----- Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (1µg/L).

NOTES

The EPA Water Quality Objective for Total Chromium is 136µg/L, however it is off the scale so it does not appear.

Figure 5-23.
Total Chromium



LEGEND

◆ Sample Points

◇ PASS C concentration was reduced from 100 mg/L to 50 mg/L

a PASS C concentration increased from 100 to 125 mg/L

—— 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.

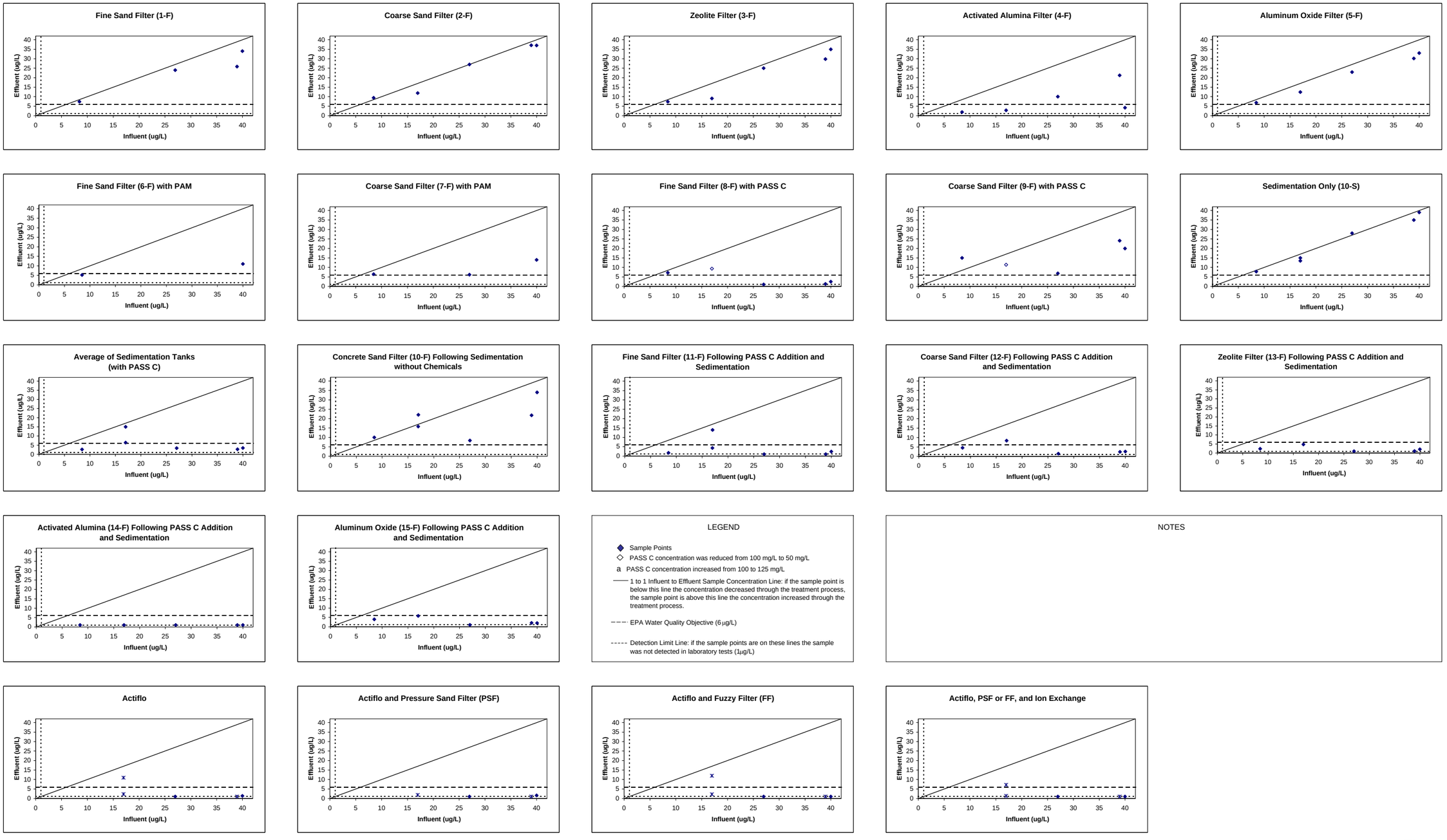
- - - - Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (1µg/L)

NOTES

The dose of PASS C was 50 mg/L instead of 100 mg/L for 8-F and 9-F in Run 5. The open marker does not appear because it is directly in line with another data point.
The EPA Water Quality Objective for Dissolved Chromium is 117µg/L, however it is off the scale so it does not appear.
The following list contains the data points that appear to be a single point in the plots.

-Fine Sand Filter (1-F) - 3 points at (1,1)
-Coarse Sand Filter (2-F) - 4 points at (1,1)
-Zeolite Filter (3-F) - 2 points at (1,1)
-Activated Alumina Filter (4-F) - 2 points at (1,1), and 1 point at (1,1.1)
-Aluminum Oxide Filter (5-F) - 2 points at (1,1), and 1 point at (1,1.1)
-Fine Sand Filter (6-F) with PAM - 2 points at (1,1.1)
-Coarse Sand Filter (7-F) with PAM - 2 points at (1,1), and 1 point at (1,1.1)
-Fine Sand Filter (8-F) with PASS C - 3 points at (1,1), and 1 point at (1,1.1)
-Coarse Sand Filter (9-F) with PASS C - 4 points at (1,1)
-Sedimentation Only (10-S) - 3 points at (1,1), and 1 point at (1,1.1)
-Average of Sedimentation Tanks (with PASS C) - 3 points at (1,1)
-Concrete Sand Filter (10-F) Following Gravity Sedimentation - 4 points at (1,1)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 3 points at (1,1)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 2 points at (1,1), and 1 point at (1,1.2) and (1,1.3)
-Zeolite Filter (13-F) Following PASS C Addition and Sedimentation -3 points at (1,1)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation - 3 points at (1,1), and 1 point at (1,1.1)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 3 points at (1,1)
-Actiflo - 3 points at (1,1)
-Actiflo and Pressure Sand Filter (PSF) - 3 points at (1,1)
-Actiflo and Fuzzy Filter (FF) - 3 points at (1,1)
-Actiflo, PSF or FF, and Ion Exchange - 2 points at (1,1), and 1 point at (1,1.1)

Figure 5-24.
Dissolved Chromium

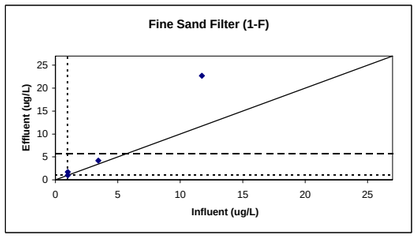


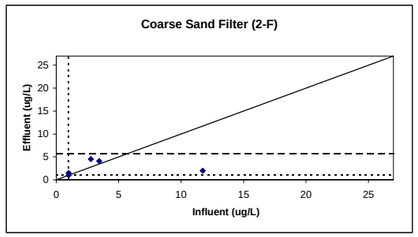
LEGEND

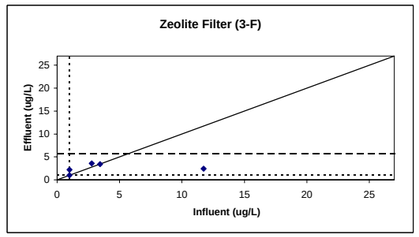
- Sample Points
- PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.
- EPA Water Quality Objective (6 µg/L)
- Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (1µg/L)

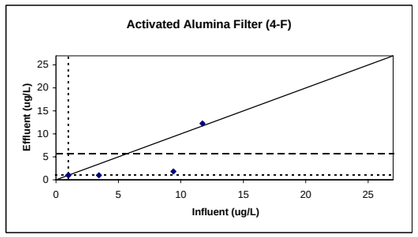
NOTES

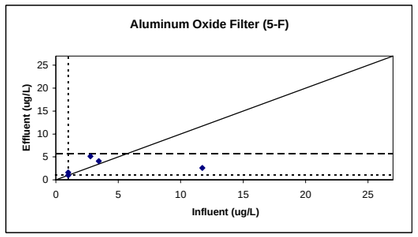
Figure 5-25.
Total Copper

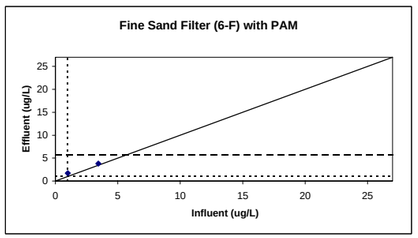


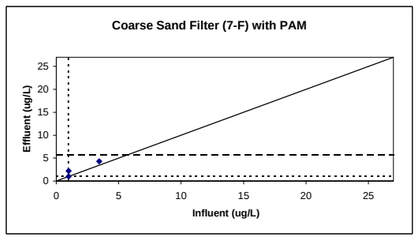


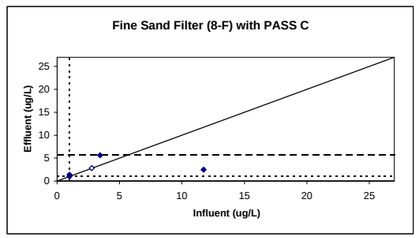


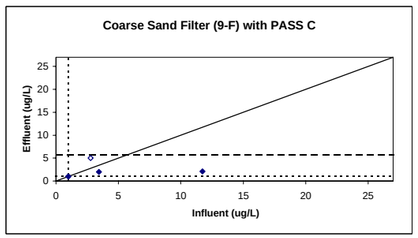


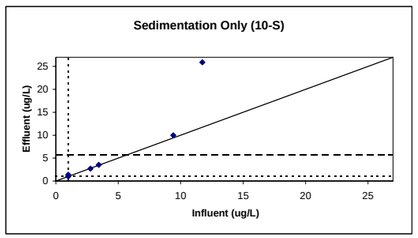


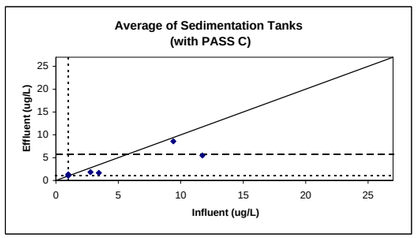


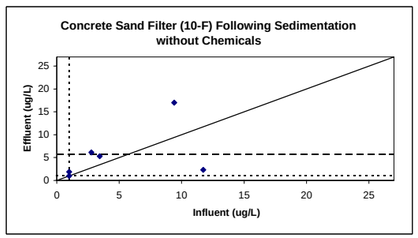


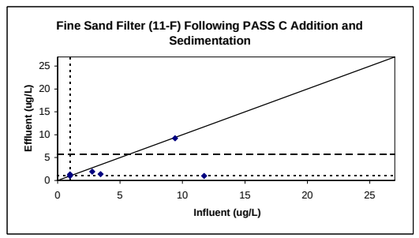


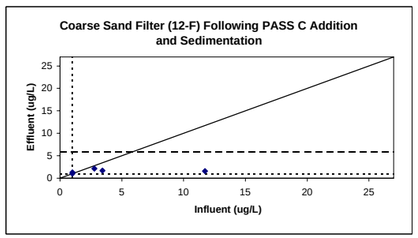


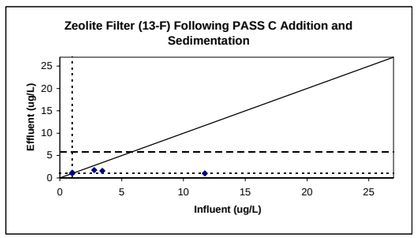


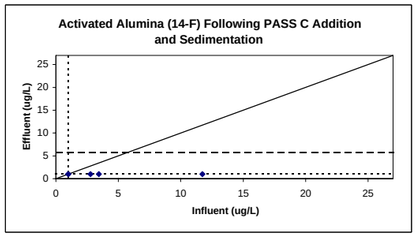


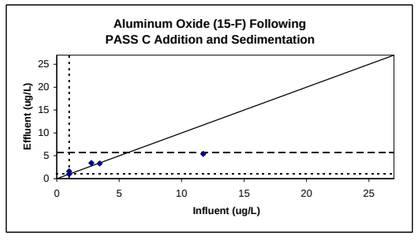












LEGEND

◆ Sample Points

◇ PASS C concentration was reduced from 100 mg/L to 50 mg/L

a PASS C concentration increased from 100 to 125 mg/L

—— 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.

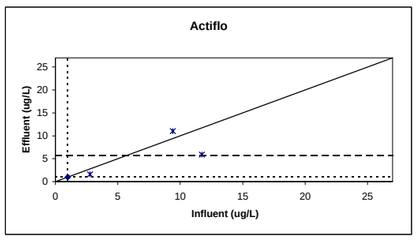
– – – EPA Water Quality Objective (5.8 µg/L)

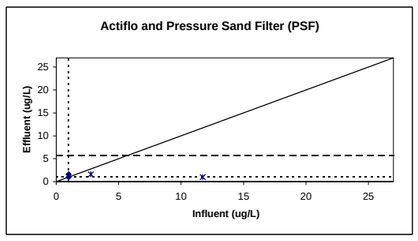
- - - - Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (1µg/L)

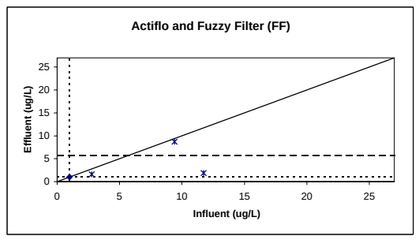
NOTES

The following list contains the data points that appaer to be a single point in the plots.

-Zeolite Filter (3-F) - 1 point at (1,1), and 1 point at (1,1.5)
-Activated Alumina Filter (4-F) - 2 points at (1,1)
-Aluminum Oxide Filter (5-F) - 1 point at (1,1), and 1 point at (1,1.6)
-Fine Sand Filter (8-F) with PASS C - 1 point at (1,1), and 1 point at (1,1.4)
-Coarse Sand Filter (9-F) with PASS C - 2 points at (1,1)
-Sedimentation Only (10-S) - 1 point at (1,1), and 1 point at (1,1.4)
-Average of Sedimentation Tanks (with PASS C) - 1 point at (1,1), and 1 point at (1,1.3)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 1 point at (1,1), and 1 point at (1,1.3)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 1 point at (1,1), an 1 point at (1,1.3)
-Zeolite Filter (13-F) Following PASS C Addition and Sedimentation -2 points at (1,1)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation - 2 points at (1,1)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 1 point at (1,1), and point at (1,1.6)
-Actiflo - 2 points at (1,1)
-Actiflo and Pressure Sand Filter (PSF) - 1 point at (1,1), and 1 point at (1,1.6)
- Actiflo and Fuzzy Filter (FF) - 2 points at (1,1)
-Actiflo, PSF or FF, and Ion Exchange - 2 points at (1,1)







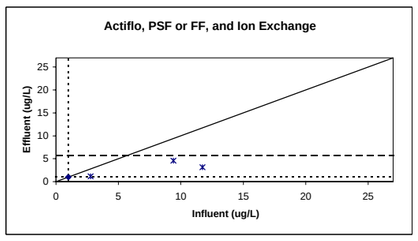


Figure 5-26.
Dissolved Copper

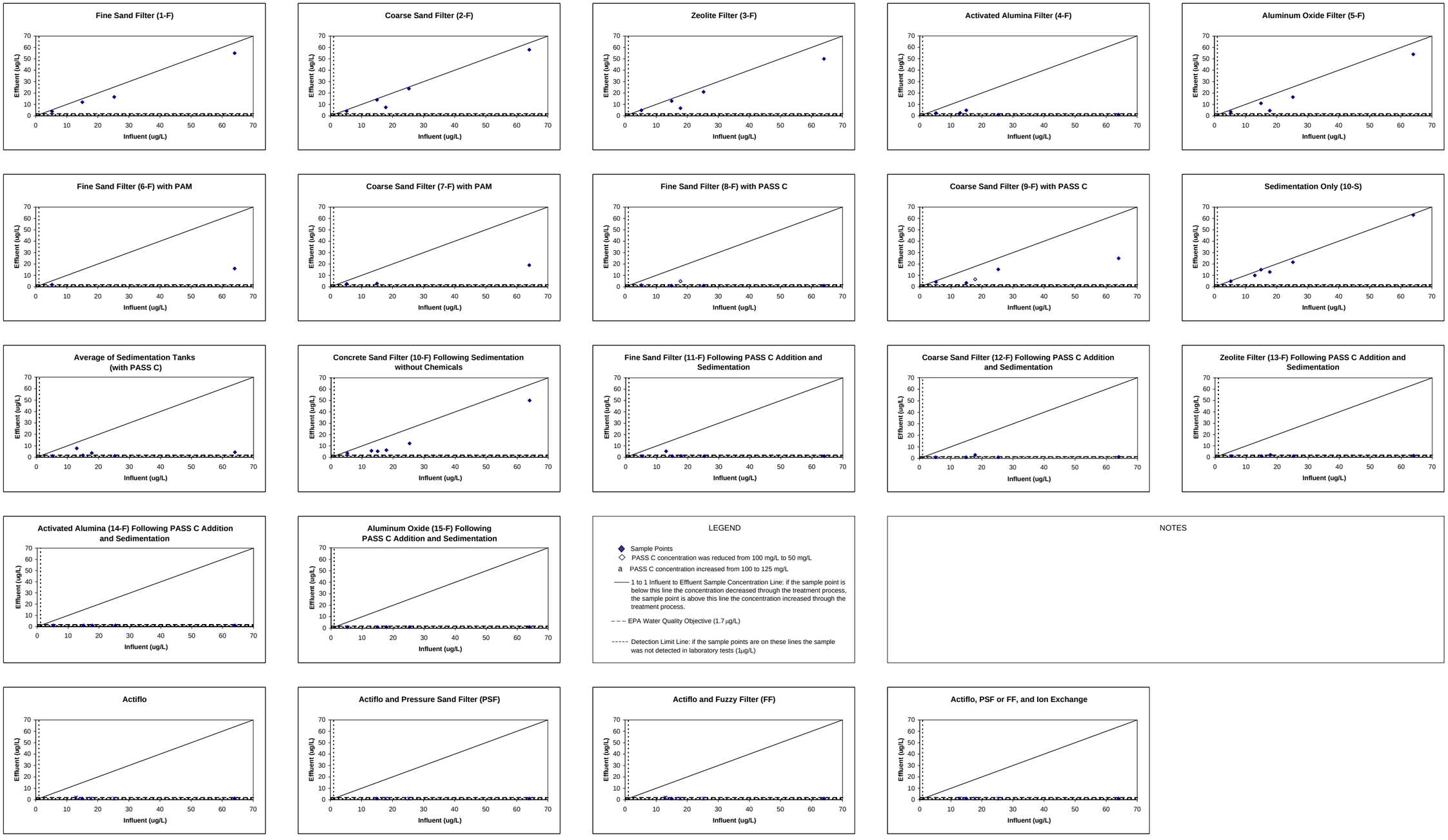
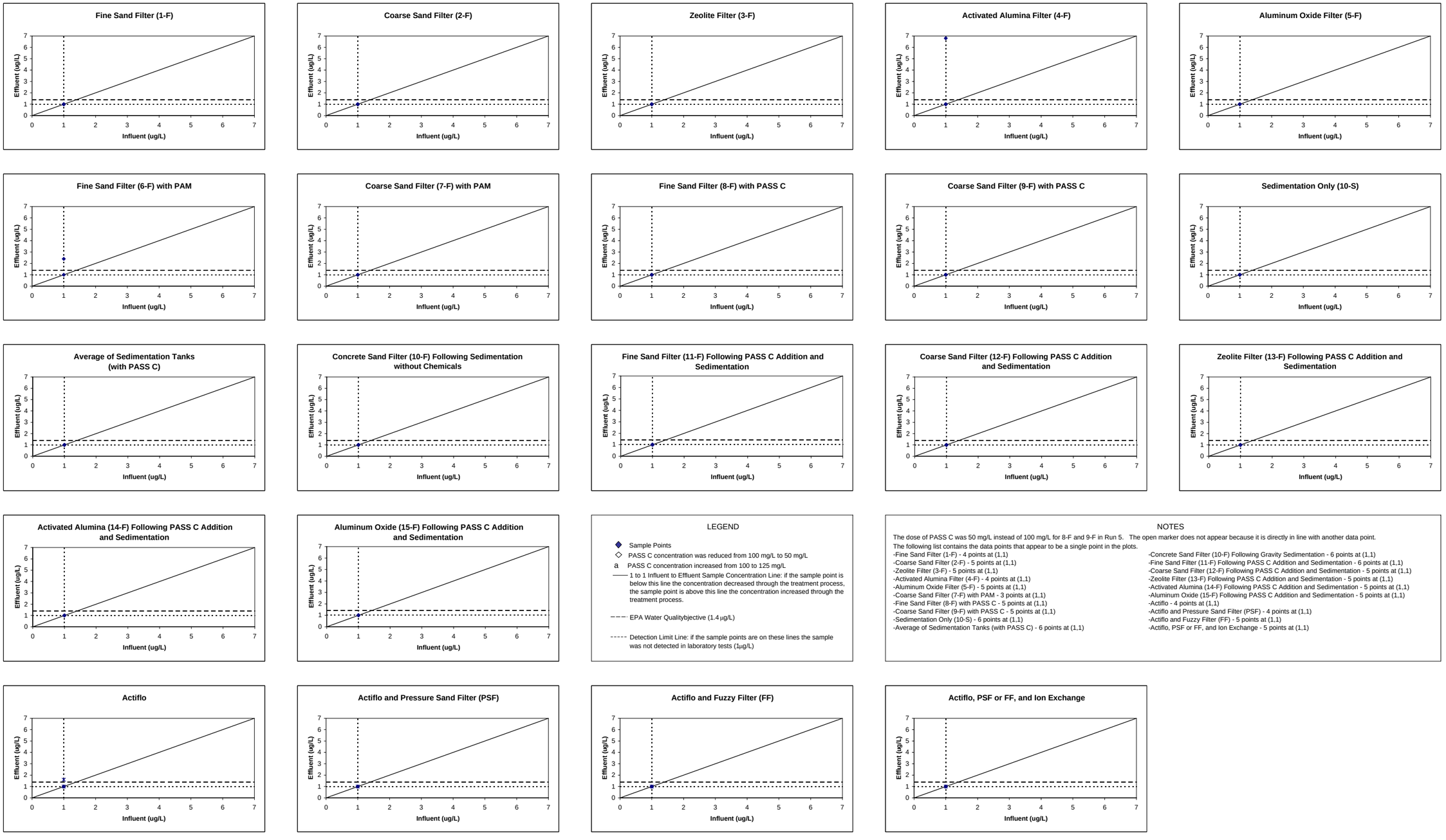


Figure 5-27.
Total Lead



LEGEND

- ◆ Sample Points
- ◇ PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- —— 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.
- – – – EPA Water Qualitybjective (1.4 µg/L)
- - - - - Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (1µg/L)

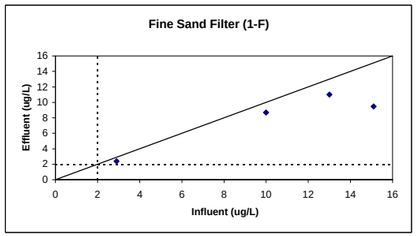
NOTES

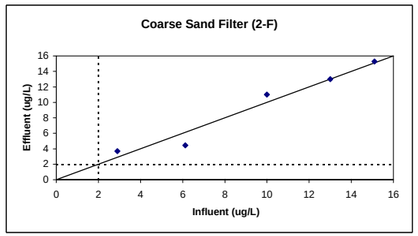
The dose of PASS C was 50 mg/L instead of 100 mg/L for 8-F and 9-F in Run 5. The open marker does not appear because it is directly in line with another data point.

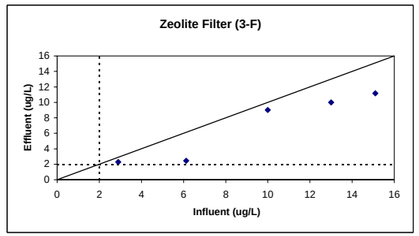
The following list contains the data points that appear to be a single point in the plots.

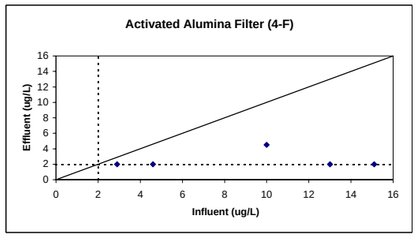
-Fine Sand Filter (1-F) - 4 points at (1,1)
-Coarse Sand Filter (2-F) - 5 points at (1,1)
-Zeolite Filter (3-F) - 5 points at (1,1)
-Activated Alumina Filter (4-F) - 4 points at (1,1)
-Aluminum Oxide Filter (5-F) - 5 points at (1,1)
-Coarse Sand Filter (7-F) with PAM - 3 points at (1,1)
-Fine Sand Filter (8-F) with PASS C - 5 points at (1,1)
-Coarse Sand Filter (9-F) with PASS C - 5 points at (1,1)
-Sedimentation Only (10-S) - 6 points at (1,1)
-Average of Sedimentation Tanks (with PASS C) - 6 points at (1,1)
-Concrete Sand Filter (10-F) Following Gravity Sedimentation - 6 points at (1,1)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 6 points at (1,1)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 5 points at (1,1)
-Zeolite Filter (13-F) Following PASS C Addition and Sedimentation - 5 points at (1,1)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation - 5 points at (1,1)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 5 points at (1,1)
-Actiflo - 4 points at (1,1)
-Actiflo and Pressure Sand Filter (PSF) - 4 points at (1,1)
-Actiflo and Fuzzy Filter (FF) - 5 points at (1,1)
-Actiflo, PSF or FF, and Ion Exchange - 5 points at (1,1)

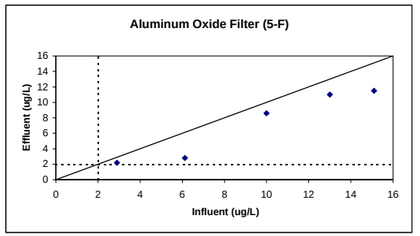
Figure 5-28.
Dissolved Lead

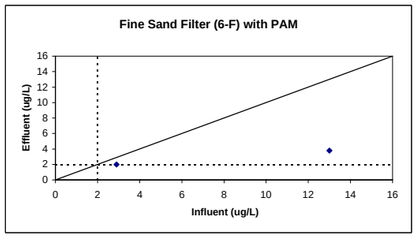


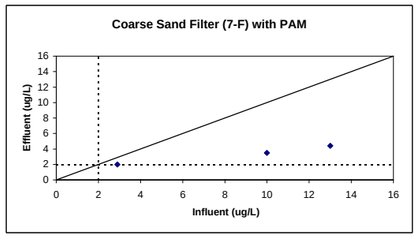


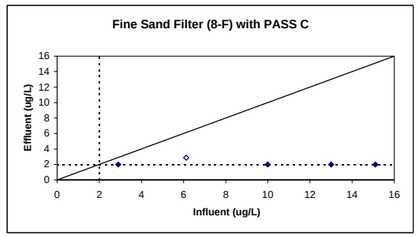


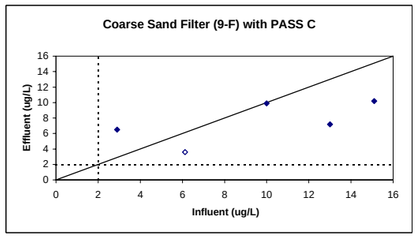


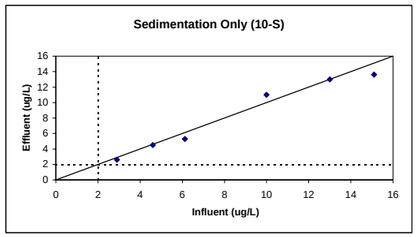


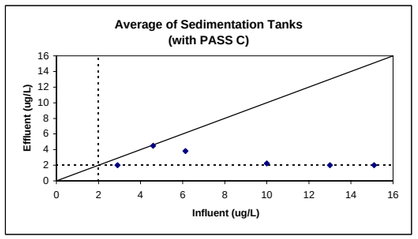


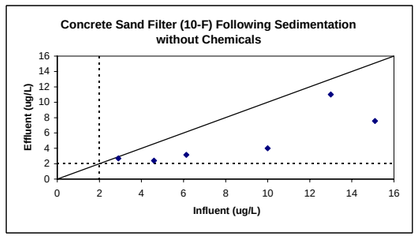


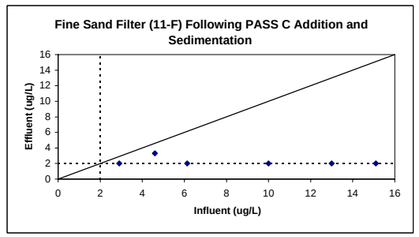


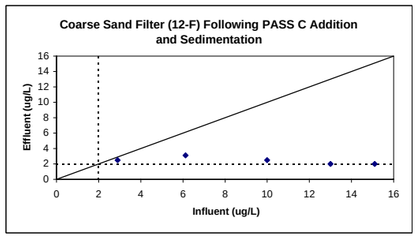


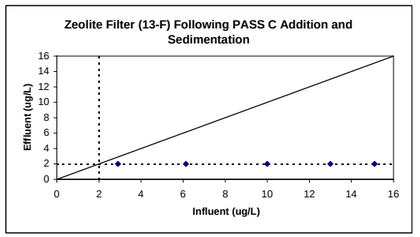


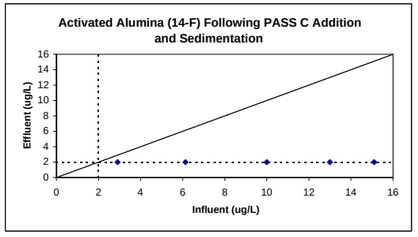


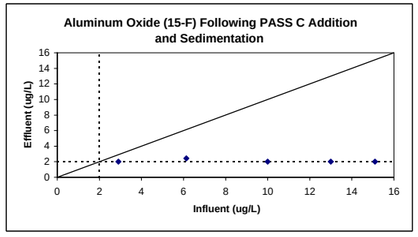










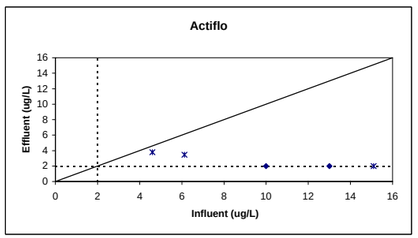


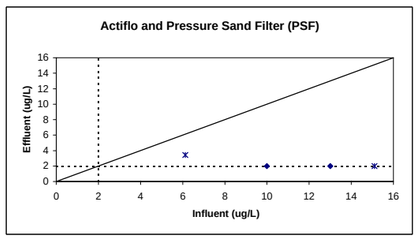
LEGEND

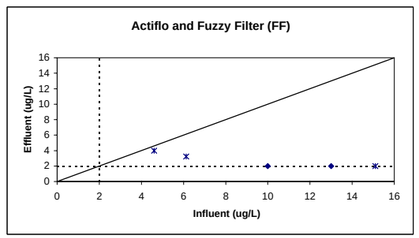
- Sample Points
- PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.
- Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (2µg/L).

NOTES

The EPA Water Quality Objective for Total Nickel is 34µg/L, however it is off the scale so it does not appear.







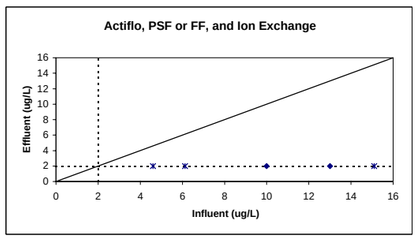
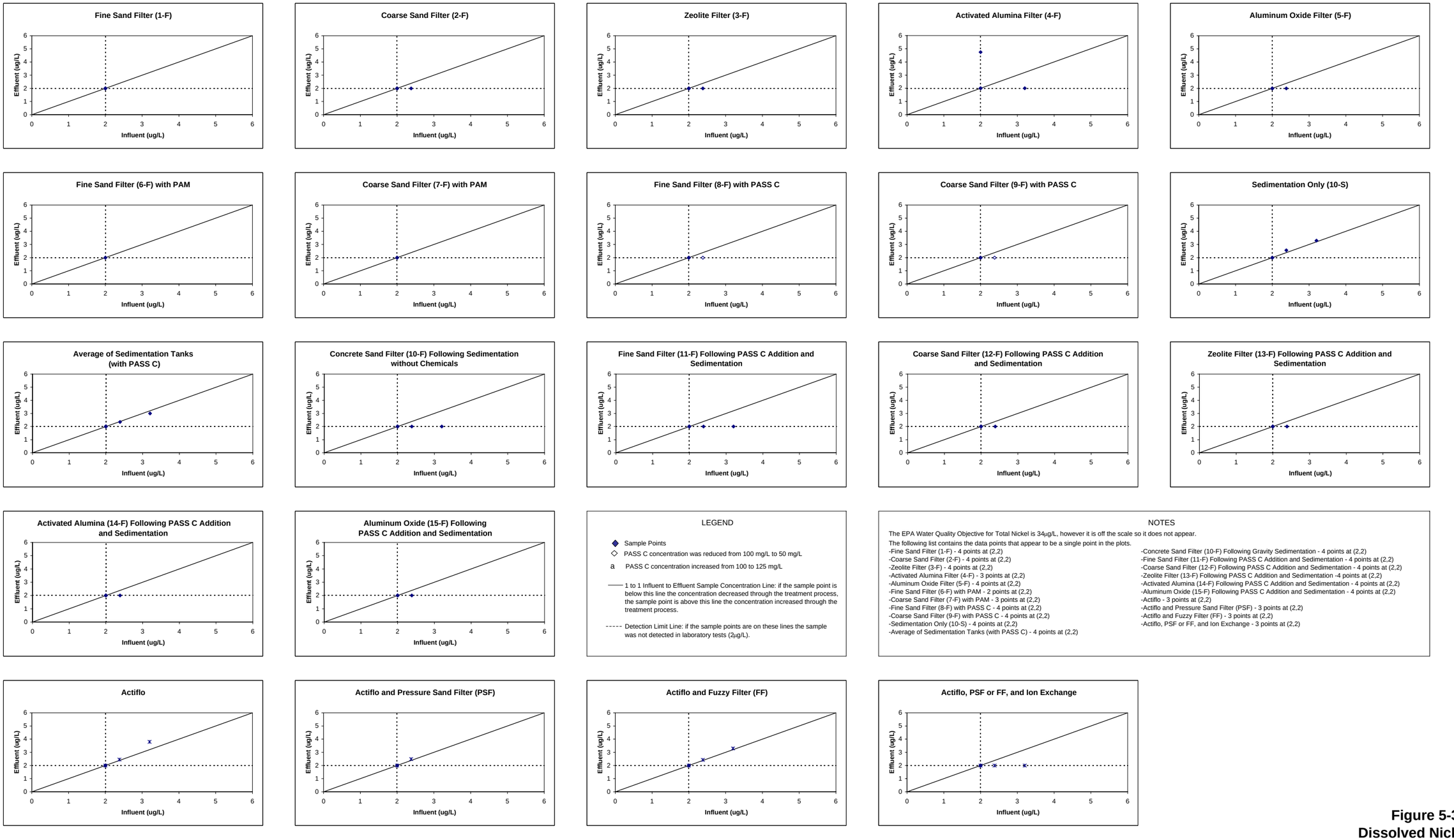


Figure 5-29.
Total Nickel



LEGEND

◆ Sample Points

◇ PASS C concentration was reduced from 100 mg/L to 50 mg/L

a PASS C concentration increased from 100 to 125 mg/L

—— 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, the sample point is above this line the concentration increased through the treatment process.

- - - - - Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (2µg/L).

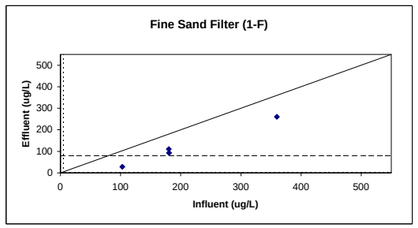
NOTES

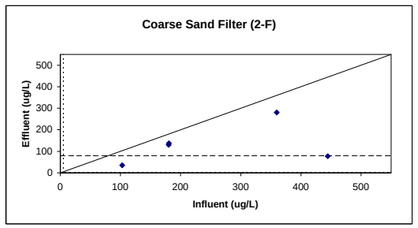
The EPA Water Quality Objective for Total Nickel is 34µg/L, however it is off the scale so it does not appear.

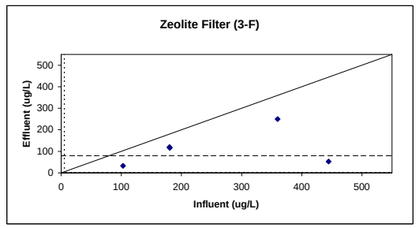
The following list contains the data points that appear to be a single point in the plots.

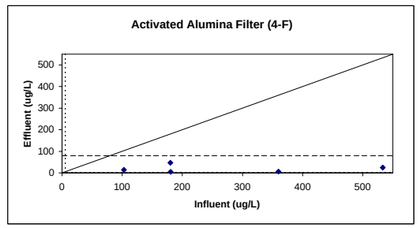
-Fine Sand Filter (1-F) - 4 points at (2,2)
-Coarse Sand Filter (2-F) - 4 points at (2,2)
-Zeolite Filter (3-F) - 4 points at (2,2)
-Activated Alumina Filter (4-F) - 3 points at (2,2)
-Aluminum Oxide Filter (5-F) - 4 points at (2,2)
-Fine Sand Filter (6-F) with PAM - 2 points at (2,2)
-Coarse Sand Filter (7-F) with PAM - 3 points at (2,2)
-Fine Sand Filter (8-F) with PASS C - 4 points at (2,2)
-Coarse Sand Filter (9-F) with PASS C - 4 points at (2,2)
-Sedimentation Only (10-S) - 4 points at (2,2)
-Average of Sedimentation Tanks (with PASS C) - 4 points at (2,2)
-Concrete Sand Filter (10-F) Following Gravity Sedimentation - 4 points at (2,2)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 4 points at (2,2)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 4 points at (2,2)
-Zeolite Filter (13-F) Following PASS C Addition and Sedimentation -4 points at (2,2)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation - 4 points at (2,2)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 4 points at (2,2)
-Actiflo - 3 points at (2,2)
-Actiflo and Pressure Sand Filter (PSF) - 3 points at (2,2)
-Actiflo and Fuzzy Filter (FF) - 3 points at (2,2)
-Actiflo, PSF or FF, and Ion Exchange - 3 points at (2,2)

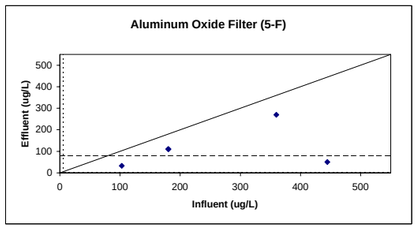
Figure 5-30.
Dissolved Nickel

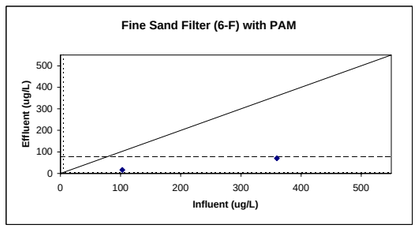


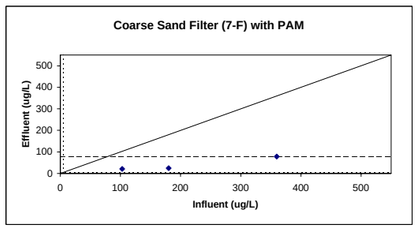


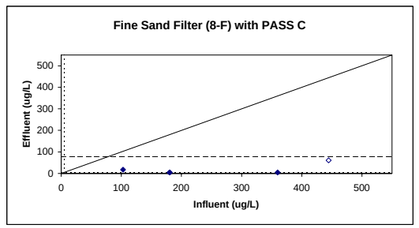


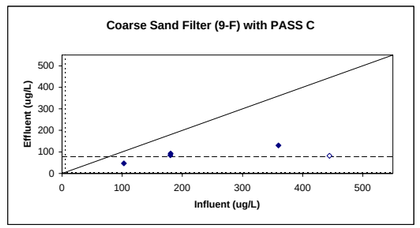


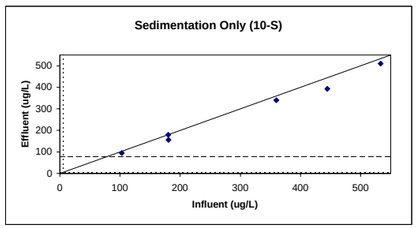


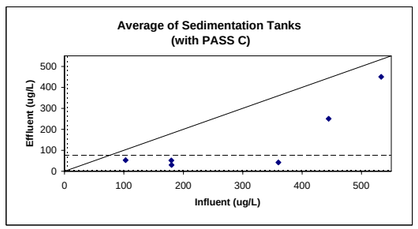


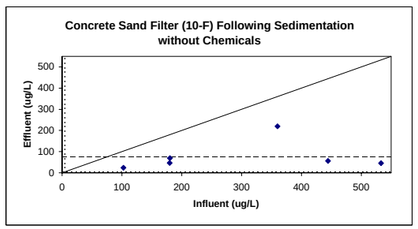


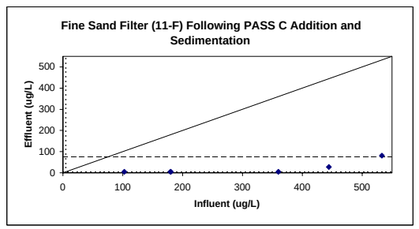


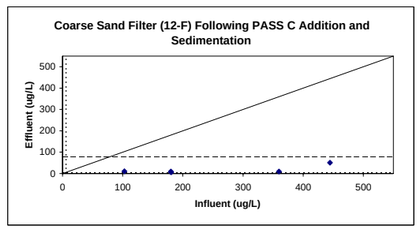


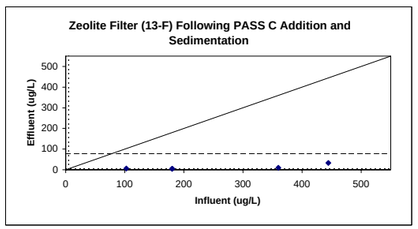


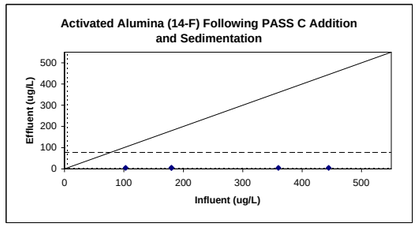


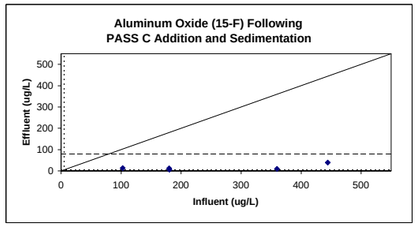










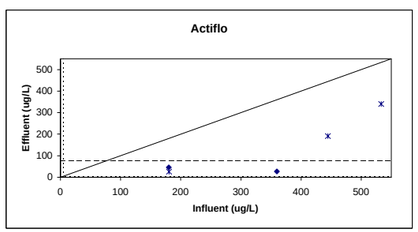


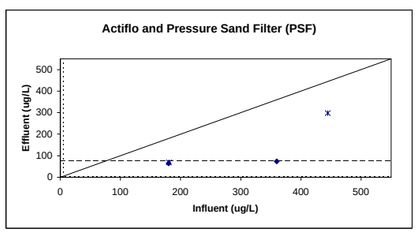
LEGEND

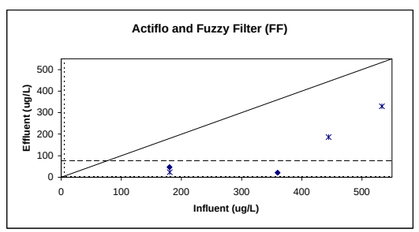
- Sample Points
- PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, if the sample point is above this line the concentration increased through the treatment process.
- EPA Water Quality Objective (78 µg/L)
- Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (5 µg/L).

NOTES

The following list contains the data points that appear to be a single point in the plots.
-Coarse Sand Filter (2-F) - 1 point at (180,130), and 1 point at (180,137)
-Zeolite Filter (3-F) -1 point at (180,120), and 1 point at (180,116)
-Aluminum Oxide Filter (5-F) - 2 points at (180,110)
-Fine Sand Filter (8-F) with PASS C - 2 points at (180,5)
-Coarse Sand Filter (9-F) with PASS C - 1 point at (180,85), and 1 point at (180,93)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 2 points at (180,5)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 1 point at (180,9.3), and 1 point at (180,6)
-Zeolite Filter (13-F) Following PASS C Addition and Sedimentation -2 points at (180,5)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation - 2 points at (180,5)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 1 point at (180,12), and 1 point at (180,6)
-Actiflo and Pressure Sand Filter (PSF) - 1 point at (180,65), and 1 point at (180,69)
-Actiflo, PSF or FF, and Ion Exchange - 1 point at (180,5)







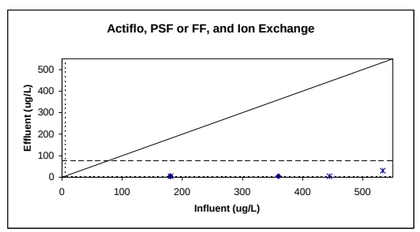
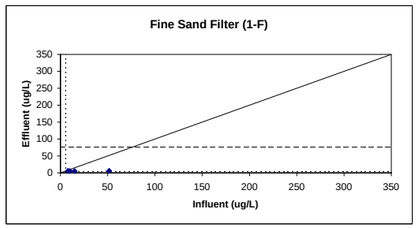
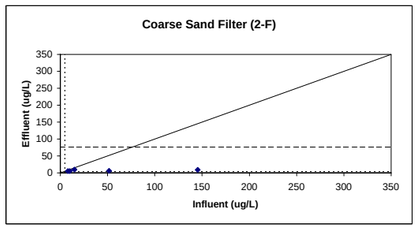
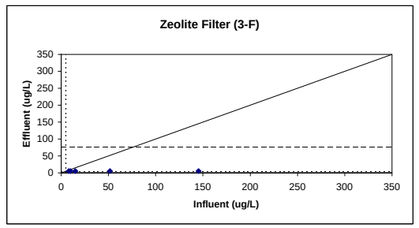
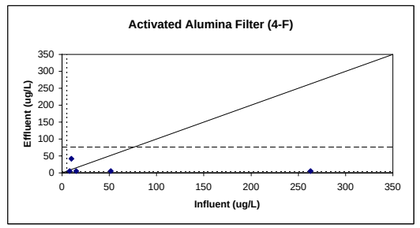


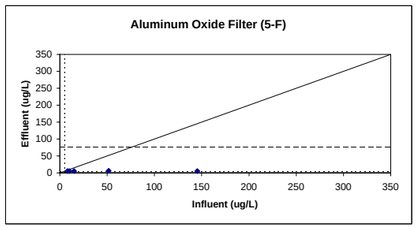
Figure 5-31.
Total Zinc

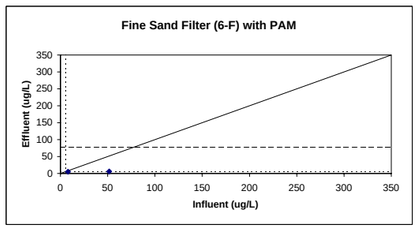


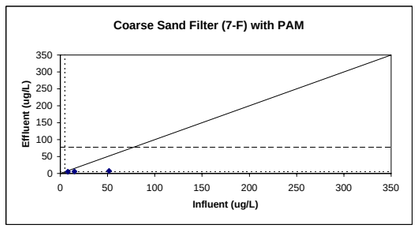


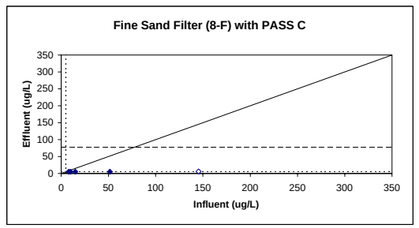


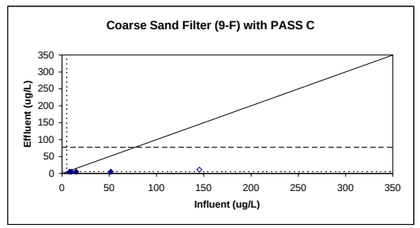


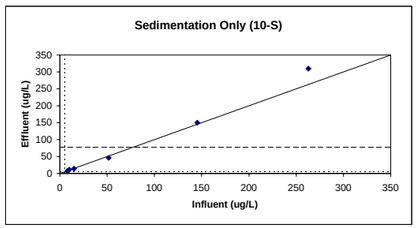


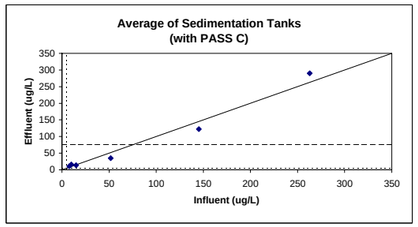


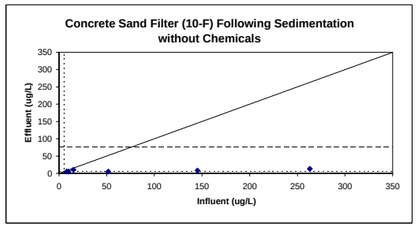


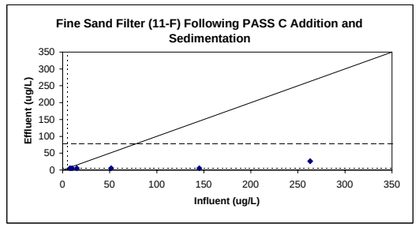


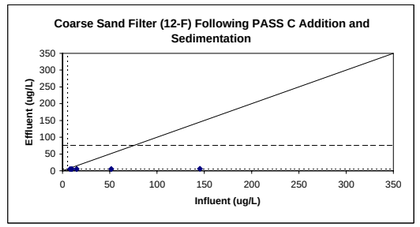


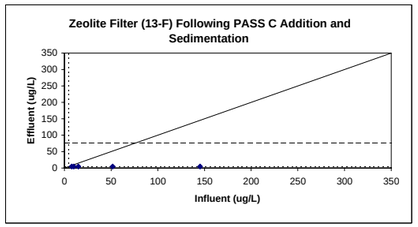


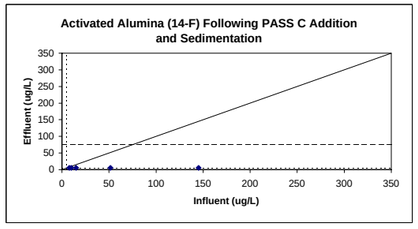


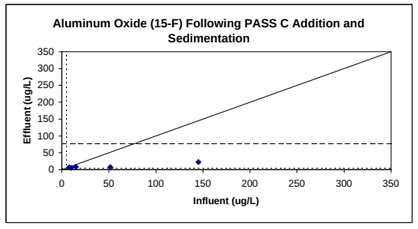










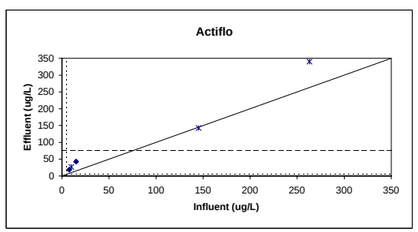


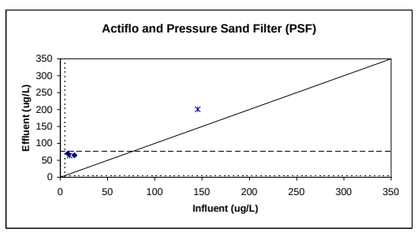
LEGEND

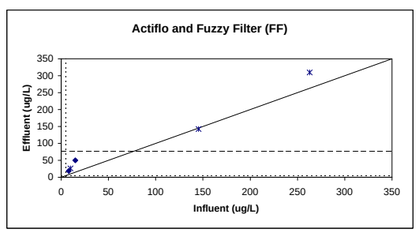
- Sample Points
- PASS C concentration was reduced from 100 mg/L to 50 mg/L
- a PASS C concentration increased from 100 to 125 mg/L
- 1 to 1 Influent to Effluent Sample Concentration Line: if the sample point is below this line the concentration decreased through the treatment process, if the sample point is above this line the concentration increased through the treatment process.
- EPA Water Quality Objective (77 µg/L)
- Detection Limit Line: if the sample points are on these lines the sample was not detected in laboratory tests (5 µg/L).

NOTES

The following list contains the data points that appear to be a single point in the plots.
-Fine Sand Filter (1-F) - 1 point at (7.9,5.7), and 1 point at (10,5.7)
-Coarse Sand Filter (2-F) - 1 point at (7.9,5), and 1 point at (10,6)
-Zeolite Filter (3-F) - 1 point at (7.9,5), and 1 point at (10,5)
-Aluminum Oxide Filter (5-F) - 1 point at (7.9,5), and 1 point at (10,5)
-Fine Sand Filter (8-F) with PASS C - 1 point at (7.9,5), and 1 point at (10,5)
-Coarse Sand Filter (9-F) with PASS C - 1 point at (7.9,5), and 1 point at (10,5)
-Sedimentation Only (10-S) - 1 point at (7.9,7.3), and 1 point at (10,11)
-Average of Sedimentation Tanks (with PASS C) - 1 point at (7.9,10.4), and 1 point at (10,16)
-Concrete Sand Filter (10-F) Following Gravity Sedimentation - 1 point at (7.9,5), and 1 point at (10,5)
-Fine Sand Filter (11-F) Following PASS C Addition and Sedimentation - 1 point at (7.9,5), and 1 point at (10,5)
-Coarse Sand Filter (12-F) Following PASS C Addition and Sedimentation - 1 point at (7.9,5), and 1 point at (10,5)
-Zeolite Filter (13-F) Following PASS C Addition and Sedimentation -1 point at (7.9,5), and 1 point at (10,5)
-Activated Alumina (14-F) Following PASS C Addition and Sedimentation -1 point at (7.9,5), and 1 point at (10,5)
-Aluminum Oxide (15-F) Following PASS C Addition and Sedimentation - 1 point at (7.9,6.8), and 1 point at (10,5)
-Actiflo - 1 point at (7.9,19), and 1 point at (10,27)
-Actiflo and Pressure Sand Filter (PSF) - 1 point at (7.9,70), and 1 point at (10,64)
-Actiflo and Fuzzy Filter (FF) - 1 point at (7.9,19), and 1 point at (10,26)
-Actiflo, PSF or FF, and Ion Exchange - 1 point at (7.9,5), and 1 point at (10,5)







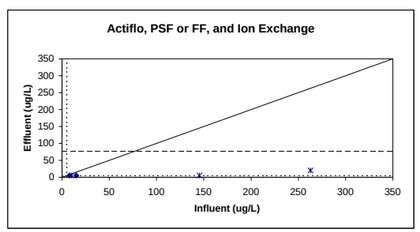


Figure 5-32.
Dissolved Zinc

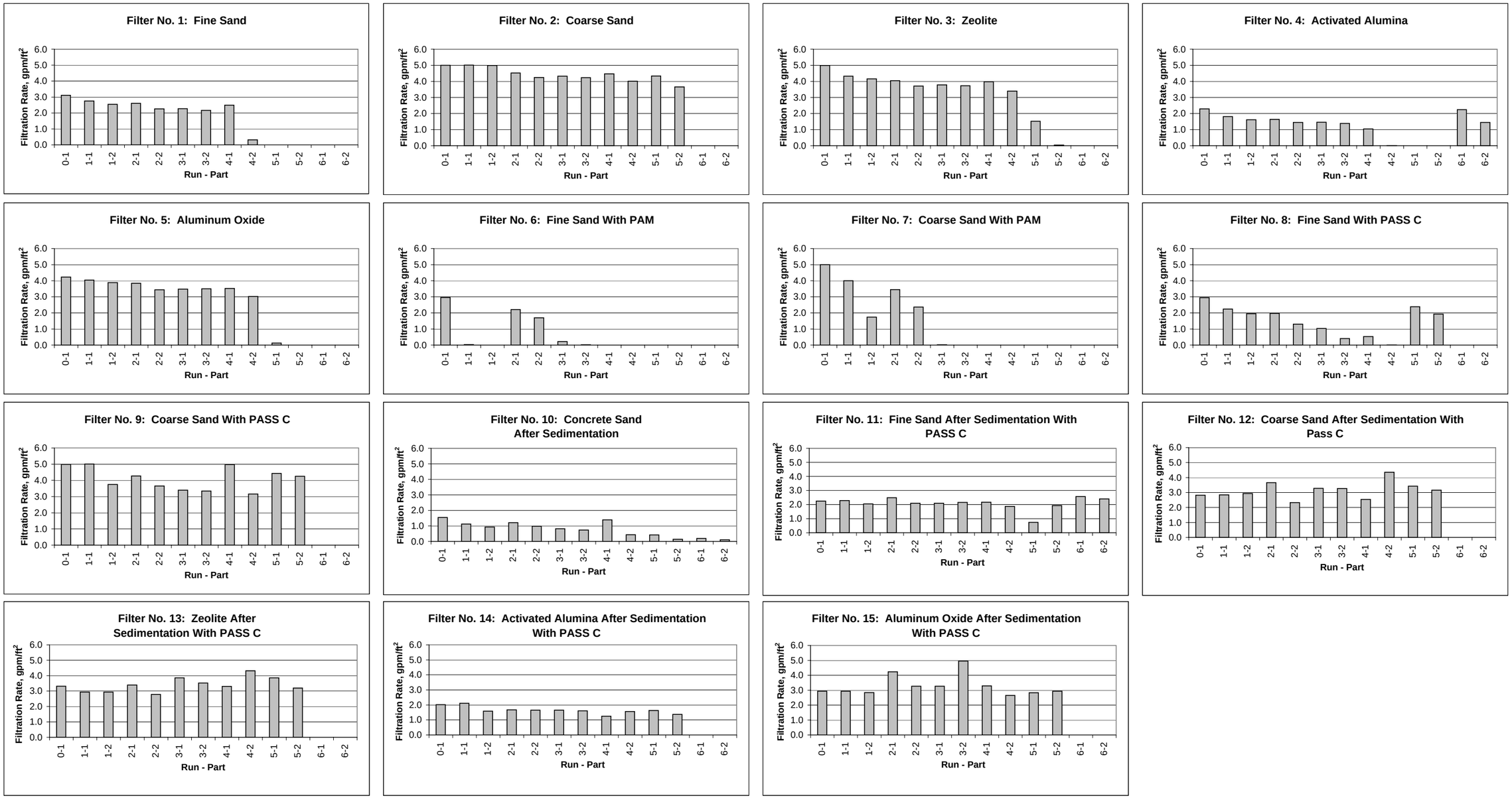


Figure 5-33.
FIltration Rates

Chapter 6

Summary of Findings

Chapter 6 Summary of Findings

Based on the pilot results, key findings as to the efficacy of the various treatment technologies are delineated below. Potential future testing activities are also presented.

6.1 Summary of Findings

As described in Chapter 2, the purpose of this project is to identify and develop storm water runoff treatment technologies that are appropriate for the Caltrans environment (i.e., the roadside) and that are capable of meeting the Tahoe Basin discharge limits for infiltration and surface water discharge. Based on an examination of the test results, preliminary evaluations of the various treatment systems were performed. These are summarized in Table 6-1. The nomenclature used in the table is explained below:

- "Y" (yes) means the effluent from the pilot system usually met the water quality standard. Systems that showed only one noncompliant result were also awarded a "Y".
- "Y+ and Y-" (yes, but) means that the effluent met the standard (like "Y") but also that the influent met the standard. In other words, treatment was not legally required for the constituent in question to meet one of the two standards (infiltration or surface discharge). If the treatment system further reduced the constituent concentration (i.e., provided treatment), it was assigned a "Y+". If it did not show any treatment, it was assigned a "Y-".
- "M" (maybe) was assigned to systems that showed potential but did not meet the standards during the pilot tests. This category was used when some individual test results met the standard and others did not, or when all or most of the test results were close to meeting the standard. The implication associated with an "M" rating is that further refinement of the process in question may lead to successful results.
- "N" (no) was assigned when the effluent rarely or never met the water quality standard.
- "?" (unknown) was used when the data were insufficient in number or quality to make a good evaluation. The most successful pilot systems produced six effluent results, which is a small number of samples to evaluate a technology. When the number of data points dropped below four, a "?" was assigned. The "?" was also assigned when the results could not be evaluated with respect to the standards. For instance, the oil and grease reporting limit for some of the test runs was higher than the surface water discharge standard, making it impossible to say whether or not the concentration met the standard. In other cases the reporting limit was the same as the standard and both the influent and effluent concentrations were reported to be less than the reporting limit.

In viewing Table 6-1, the reader should bear in mind that these evaluations involve a degree of judgment (especially the "Y+", "M", and "?" designations), and that they are based on six data points at most.

Table 6-1. Summary of Pilot Treatment Process Performance With Respect to Meeting the Tahoe Basin Discharge Regulations

	Meets INFILTRATION standard for:					Meets SURFACE WATER standard for:				
	Turb	P	N	O&G	Fe	Turb	P	N	O&G	Fe
Processes WITHOUT Chemical Coagulation										
Sedimentation (only)	N	Y-	Y-	Y-	N	N	N	N	N	N
Fine Sand filter (only)	N	Y+	Y+	Y+	N	N	N	N	?	N
Coarse sand filter (only)	N	Y+	Y+	Y-	N	N	N	N	N	N
Zeolite filter (only)	N	Y+	Y+	Y+	N	N	N	N	?	N
Activated alumina filter (only)	M	Y	Y+	Y+	M	M	M	M	M	N
Aluminum oxide (filter only)	N	Y	Y+	Y+	N	N	N	N	?	N
Concrete sand filter and settling	M	Y+	Y+	Y+	M	N	N	N	M	N
Processes WITH Chemical Coagulation										
Sedimentation + PASS-C®	Y	Y+	Y-	Y+	Y	M	M	N	M	N
Fine sand filter + PAM	Y	?	?	?	?	M	?	?	?	?
Coarse sand filter + PAM	Y	Y	Y+	?	M	N	N	N	?	N
Fine sand filter + PASS-C®	Y	Y+	Y-	Y+	Y	M	M	N	M	M
Coarse sand filter + PASS-C®	M	Y+	Y-	Y+	M	N	N	N	?	N
Fine sand filter + PASS-C® and settling	Y	Y+	Y-	Y+	Y	Y	M	N	M	M
Coarse sand filter + PASS-C® and settling	Y	Y+	Y+	Y+	Y	Y	M	M	M	N
Zeolite filter + PASS-C and settling	Y	Y+	Y+	Y+	Y	Y	M	M	M	M
Activated alumina filter + PASS-C® and settling	Y	Y+	Y+	Y+	Y	Y	Y	M	M	Y
Aluminum oxide filter + PASS-C® and settling	Y	Y+	Y-	Y+	Y	Y	Y	N	M	Y
"High Tech" Systems										
Actiflo® (PASS-C®+ LT25)	Y	Y+	Y-	Y+	Y	Y	M	N	M	Y
Actiflo® (PASS-C®+ LT25) and pressure sand filter	Y	Y+	Y+	Y+	Y	Y	Y	M	M	Y
Actiflo® (PASS-C®+ LT25) and Fuzzy filter	Y	Y+	Y+	Y+	Y	Y	M	M	M	Y
Actiflo® (PASS-C®+ LT25) with filtration and ion exchange	Y	Y	Y+	Y+	Y	Y	M	M	M	Y

Turb = turbidity, P = total phosphorus, N = total nitrogen, Fe = total iron, O&G = oil and grease
Y (yes) = Effluent usually met the standard (1 noncompliant result allowed).
Y+ (yes, but) = Effluent usually met the standard but the influent did also. Treatment was observed.
Y- (yes, but) = Effluent usually met the standard but the influent did also. Little or no treatment was observed.
M (maybe) = Treatment was observed but the effluent didn't consistently meet the standard. Refinement of the process may allow compliance.
N (no) = Effluent rarely or never met the standard.
? (unknown) = Data are insufficient in number or quality to make a judgment.

6.1.1 Processes Without Chemical Coagulation (Low-Technology Units)

As shown in Table 6-1, sedimentation only, filtration only, and sedimentation followed by filtration through concrete sand did not produce effluents that met the surface water discharge standards for any of the regulated constituents. For the less stringent infiltration standards, none of the processes produced effluents that met the turbidity and iron standards. Most processes did meet the phosphorus, nitrogen, and oil and grease standards mainly because the influent concentrations of these constituents were already below the standards. Treatment was observed in the pilot systems, but whether this degree of treatment is sufficient to meet the standard starting with a "dirtier" influent cannot be ascertained from the data available at this time.

The relatively poor performance of the filters in this study was unexpected. As seen in Figures 5-1 and 5-2, turbidity and TSS removal efficiencies were poor in most of the filters unaided by coagulants. In contrast, sand filters in previous Caltrans studies in the Retrofit Pilot Program in Southern California consistently produced effluents with TSS values less than 20 mg/L (turbidity was not measured in the Southern California studies). Three factors may be responsible for this disparity of results. First, the filter media in this study may not have been sufficiently cleaned prior to use. As noted earlier, the filter media were washed by hand in the field. If this cleaning was incomplete, fine materials washed out of the filter media could be contributing to the effluent turbidity and TSS; however, following this initial cleaning, the effluent of the filters ranged between 1 – 4.6 NTU (see table 3-4), implying that adequate rinsing had occurred. Second, the sizes of the particles in the Tahoe storm water influent may be smaller, and thus harder to filter, than those found in the storm water runoff used in the Southern California study. The rural environment around Lake Tahoe is quite different from the urban environment of Southern California, which may result in different kinds of particles being deposited on the roadways. Third, the filter loading methodologies of the Lake Tahoe small-scale pilots and the Southern California full-scale pilots were substantially different. The Southern California pilot sand filters collected storm water in a sedimentation basin and then loaded the granular medium filters slowly over a 24-hour period. The Lake Tahoe small-scale pilot filters were loaded at a higher rate by transferring all of the water for a given run to the filter in a short time and then allowing the water to drain through the filter as fast as possible. The resultant relatively high rate of storm water flow through the filters for the Lake Tahoe small-scale pilot units may have degraded treatment performance, as compared to a lower flow rate through the filters.

Activated alumina removed phosphorus and iron better than the other media (Figures 5-4 and 5-16). It was particularly effective at removing the dissolved fractions of these constituents (Figures 5-5 and 5-17). Although it removed some total aluminum, the activated alumina media leached substantial amounts (0.2 – 1.1 mg/L) of dissolved aluminum into the effluent (Figure 5-20). The same can be said for the aluminum oxide medium.

Zeolite (clinoptilolite) was chosen as a filter media for its ability to capture ammonia, which was thought to constitute a significant fraction of the storm water's dissolved nitrogen. Laboratory analyses showed, however, that the influent contained very little ammonia

(Figures 5-10 and 5-15). In the six storms studied, the largest component of the total nitrogen was usually organic-N and a significant fraction of this was dissolved (Figure 5-15).

6.1.2 Processes With Chemical Coagulation (Low-Technology Units)

As noted earlier, the influent concentrations for phosphorus, nitrogen, and oil and grease were lower than the water quality standards for infiltration. Consequently, almost all of the filter systems that included chemical coagulation met these standards. Some degree of treatment was observed in most cases, though whether or not this degree of treatment is sufficient to meet the standard starting with a "dirtier" influent cannot be ascertained from the data available. Unlike the chemical-free systems discussed above, pilot systems that used a chemical coagulant were able to meet the turbidity and iron standards for surface water discharge in almost every case. The exceptions were the coarse sand filters. Whether using PAM or PASS-C®, the effluents of coarse sand filters were not quite clean enough to meet the standards consistently.

Because of blinding problems, the fine sand filter with PAM was operated successfully for only a couple of runs, which did not generate enough information to make an evaluation.

The performance of the low technology systems with chemical addition might best be characterized as uncertain with respect to meeting the surface water discharge standards. As shown in Table 6-1, many of the systems tested earned "M" (maybe) evaluations. These systems provided treatment, but the strict surface water discharge standards for phosphorus, nitrogen, oil and grease, and iron were not met consistently. The turbidity standard was not met, or was met inconsistently, by filtration with direct chemical addition (no sedimentation) When PASS-C® enhanced sedimentation (2 hrs.) was coupled with filtration, however, these systems were uniformly successful at meeting the turbidity standard for surface water discharge.

Generally, chemical coagulation/sedimentation was a key element in determining whether or not a system met any of the surface water discharge standards in this study. The non-chemical systems provided insufficient treatment to meet these strict standards. Adding chemical coagulation allowed at least some systems to meet some standards, particularly turbidity standards. As a practical matter, chemical addition without settling was troublesome, at least at the chemical doses used in this study. Filters which received coagulants exhibited severe blinding problems. Adding a sedimentation step between the coagulant addition and the filter removed enough of the flocs that filter blinding was not a problem. In fact, coagulation and sedimentation alone was sufficient to meet the infiltration water quality standards.

The PASS-C® dose to the sedimentation tanks (100 mg/L neat) was chosen on the basis of jar testing and not varied throughout the study regardless of influent characteristics. Thus, coagulant optimization was not attempted and the potential to reduce chemical usage and/or increase coagulation performance is unknown.

Although somewhat promising treatment results were obtained using granular PAM (Superfloc® A-836) as a filter aid, the "tea bag" dosing system tested in this study did not

provide adequate control of chemical dose rates. As a consequence, subsequent filter blinding was a severe problem.

6.1.3 High-Technology Treatment Systems

The "high tech" treatment modules can be thought of as successive additions to the initial Actiflo® coagulation and settling unit. As can be seen in Table 6-1, the Actiflo® process (using PASS-C® and LT25 polymer) was by itself able to produce effluents that met the infiltration standards for all the regulated constituents. Not surprisingly, all the systems that included treatment processes downstream of the Actiflo® were also able to meet these standards. Effluent from the Actiflo® process alone met the surface discharge standards for turbidity and iron. It was close to meeting the phosphorus and oil and grease standards as well ("M" designation in Table 6-1), but not the nitrogen standard. When pressure sand filtration was added to the system, the effluent met the phosphorus standard and was closer to meeting the nitrogen standard ("M" designation). The Fuzzy Filter® exhibited approximately the same degree of nitrogen removal but did not remove phosphorus quite as well as the pressure sand filter. Adding ion exchange behind either of the filters improved phosphorus, nitrogen, and oil and grease treatment, but not to the level of consistently meeting the standards for surface water discharge ("M" designation).

Of all the systems studied, the "high tech" option exhibited the highest potential to meet all of the surface water standards. The Actiflo® process was very effective, but also equipment-intensive and chemical-intensive, using both a coagulant (PASS-C®) and polymer (LT25) and ballast sand (“micro-sand”). No efforts were made in this study to optimize chemical use or process performance (which might enhance the process's ability to meet standards at a lower cost). Little difference in performance was observed between the pressure sand filter and the Fuzzy Filter® used as polishing units following Actiflo® treatment. The filters did not significantly enhance turbidity removal, though they did reduce phosphorus and nitrogen concentrations somewhat. Ion exchange further reduced phosphorus and nitrogen concentrations. Operational problems in this study, such as plugging of pre-filters and polymer carry-over from upstream units probably masked the full treatment potential of ion exchange.

6.2 Potential Future Testing Activities

In this study, the only systems tested that came close to meeting the water quality standards were those that included chemical coagulation. In the field, however, the installation and operation of chemical feed systems would be a significant challenge for Caltrans maintenance staff. Before concluding that chemical addition is necessary to meet the standards, it would be prudent to investigate a wider variety of chemical-free systems. In addition, efforts to optimize some of the systems tested in this study would be warranted. The following is a list of potential pilot testing activities that would support these goals:

1. Sedimentation times might be increased in the low technology systems to maximize performance. The Austin-style sand filters tested in Southern California used a 24-hour detention time as opposed to the 2-hour times used here.

2. Hydraulic loading rates on the filters can be reduced. The loading rates in Austin-style sand filters are significantly lower than those used in this study. In the Austin filters the flow is regulated by an orifice between the upstream sedimentation chamber and the filter bed. Alternative arrangements, such as downstream flow control to assure even distribution of the flow over the whole media bed, might also be investigated.

3. Additional low technology filter media, particularly those with adsorptive capabilities, might be tested. The concentrations of the dissolved fractions of several regulated constituents are nearly high enough to exceed the water quality standards.

4. Passive chemical dosing systems such as that used to deliver PAM in this study might be investigated further. Both alternative delivery mechanisms and alternative chemicals (i.e., those which dissolve less easily) can be considered. If coagulants are necessary in field-scale installations, a passive dosing system would be easier than an active one for Caltrans personnel to maintain.

5. The PASS-C® dose can be optimized. Both lower fixed dosing and variable dosing based on storm water quality can be considered.

6. The effects of different coagulant and polymer doses in the Actiflo® system on the downstream ion exchange columns can be investigated. There is some evidence in this study that polymer carry-over from upstream units may have reduced the longevity (and potentially, the effectiveness) of the ion exchange units.

An alternative, nonproprietary "high tech" system can be assembled and tested. Such a system would include chemical dosing, filtration and ion exchange, but use conventional, nonproprietary processes such as sedimentation without ballast sand in place of the Actiflo® unit, and pressure sand filtration in place of the Fuzzy Filter®.

Chapter 7

References

Chapter 7 References

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Appendix A

Project Data

Caltrans Tahoe Small-Scale Plant First Year Data - KEY

Abbreviations	
NVR	No Value Recorded
LOSS	Sample Lost in Shipment
NA	Not Applicable to this Point
min	Minutes
mg/L	Milligrams per Liter
ug/L	Micrograms per Liter
NTU	Nephelometric Turbidity Units
umhos/cm	Micromhos per centimeter
mg-$CaCO_3$/L	Milligrams calcium carbonate/Liter
C	Degrees Celsius
T, -T or (T)	Total
D, -D, Diss, or (D)	Dissolved (filtered, 0.45 um)
L	Laboratory value
F	Field measurement

Data Qualifier Definitions	
U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identified" and the associated numerical value represents its approximate concentration.
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Data Qualifier Reason Code Definitions	
a	Analytical sequence deficiency or omission.
c	Calibration failure; poor or unstable response.
d	Laboratory duplicate imprecision.
e	Laboratory duplicate control sample imprecision.
f	Field duplicate imprecision.
h	Holding time violation.
l	Laboratory control sample recovery failure.
m	Matrix spike/matrix spike duplicate recovery failure.
o	Calibration blank contamination (metals/inorganics only).
p	Preparation blank contamination (metals/inorganics only).
q	Quantitation outside of linear range.
r	Linearity failure in initial calibration.
x	Field or equipment blank contamination.
y	Trip blank contamination.
z	Method blank contamination.
D	Value exceeds quantitation limit.
Q	Dissolved concentration significantly exceeded the total concentration.

CALTRANS TAHOE SMALL-SCALE STORMWATER TREATMENT PILOT PLANT - FIRST YEAR SAMPLE ID KEY

SAMPLING	DESIGNATION	SAMPLE DESCRIPTION	CHEMICAL	RUN 1 LOG #	RUN 2 LOG #	RUN 3 LOG #	RUN 4 LOG #	RUN 5 LOG #	RUN 6 LOG #
				2/20/2002	3/6/2002	3/7/2002	5/1/2002	5/21/2002	11/8/2002
I	-1	Influent Stormwater - First Sample	-	-	2-I-1	-	4-I-1	5-I-1	6-I-1
I	-2	Influent Stormwater - Second Sample	-	-	2-I-2	-	4-I-2	5-I-2	6-I-2
I	-3	Influent Stormwater - Third Sample	-	-	2-I-3	-	4-I-3	5-I-3	6-I-3
I	-C	Influent Stormwater - Running Composite	-	1-I-C	2-1-C	3-I-C	-	-	-
I	-Avg	Influent Stormwater (mathematical average)	-	(= 1-I-C)	(avg above)	(= 3-I-C)	(avg above)	(avg above)	(avg above)
1	-F	Fine Sand Filter	-	1-1-F	2-1-F	3-1-F	4-1-F	-	-
2	-F	Coarse Sand filter	-	1-2-F	2-2-F	3-2-F	4-2-F	5-2-F	-
3	-F	Zeolite Filter	-	1-3-F	2-3-F	3-3-F	4-3-F	5-3-F	-
4	-F	Activated Alumina Filter	-	1-4-F	2-4-F	3-4-F	4-4-F	-	6-4-F
5	-F	Aluminum Oxide Filter	-	1-5-F	2-5-F	3-5-F	4-5-F	5-5-F	-
6	-F	Fine Sand Filter	PAM	-	2-6-F	3-6-F	-	-	-
7	-F	Coarse Sand Filter	PAM	1-7-F	2-7-F	3-7-F	-	-	-
8	-F	Fine Sand Filter	Pass C	1-8-F	2-8-F	3-8-F	4-8-F	5-8-F	-
9	-F	Coarse Sand Filter	Pass C	1-9-F	2-9-F	3-9-F	4-9-F	5-9-F	-
10	-S	Sedimentation Tank Preceding Concrete Sand Filter	-	1-10-F	2-10-F	3-10-F	4-10-F	5-10-F	6-10-F
10	-F	Concrete Sand Filter	-	1-10-S	2-10-S	3-10-S	4-10-S	5-10-S	6-10-S
11	-S	Sedimentation Tank Preceding Fine Sand Filter	Pass C	1-11-F	2-11-F	3-11-F	4-11-F	5-11-F	6-11-F
11	-F	Fine Sand Filter Following Pass C Sedimentation	-	1-11-S	2-11-S	3-11-S	4-11-S	5-11-S	6-11-S
12	-S	Sedimentation Tank Preceding Coarse Sand Filter	Pass C	1-12-F	2-12-F	3-12-F	4-12-F	5-12-F	-
12	-F	Coarse Sand Filter Following Pass C Sedimentation	-	1-12-S	2-12-S	3-12-S	4-12-S	5-12-S	-
13	-S	Sedimentation Tank Preceding Zeolite Filter	Pass C	1-13-F	2-13-F	3-13-F	4-13-F	5-13-F	-
13	-F	Zeolite Filter Following Pass C Sedimentation	-	1-13-S	2-13-S	3-13-S	4-13-S	5-13-S	-
14	-S	Sedimentation Tank Preceding Activated Alumina	Pass C	1-14-F	2-14-F	3-14-F	4-14-F	5-14-F	-
14	-F	Activated Alumina Filter Following Pass C Sedimentation	-	1-14-S	2-14-S	3-14-S	4-14-S	5-14-S	-
15	-S	Sedimentation Tank Preceding Aluminum Oxide Filter	Pass C	1-15-F	2-15-F	3-15-F	4-15-F	5-15-F	-
15	-F	Aluminum Oxide Filter Following Pass C Sedimentation	-	1-15-S	2-15-S	3-15-S	4-15-S	5-15-S	-
S	-Avg	Calculated Average of all Pass C Sedimentation Tanks		Avg (n=5)	Avg (n=5)	Avg (n=5)	Avg (n=5)	Avg (n=5)	Avg (n=1)
101	-S	PAM Enhanced Sedimentation	PAM	-	-	-	-	-	6-101-S
A		Actiflo®	Sand, LT-25, Pass C	1-A	-	3-A	4-A	5-A	6-A-1
PSF		Sand Filter (PSF) Following Actiflo® Treatment	-	1-PSF	-	3-PSF	4-PSF	5-PSF	-
FF		Fuzzy Filter (FF) Following Actiflo® Treatment	-	1-FF	-	3-FF	4-FF	5-FF	6-FF-1
IX	-1	Pleated Filter Effluent (Actiflo with PSF and FF)	-	1-IX-1	-	-	-	-	-
IX	-2	Clay Filter Effluent (Actiflo with PSF and FF)	-	1-IX-2	-	-	-	-	-
IX	-3	Anion Resin Effluent (Actiflo with PSF and FF)	-	1-IX-3	-	-	-	-	-
IX	-4	Cation Resin Effluent (Actiflo with PSF and FF)	-	1-IX-4	-	-	-	-	-
IX	-1-PSF	Pleated Filter Effluent Following Actiflo® - PSF Filtration	-	-	-	3-IX-1-PSF	-	-	-
IX	-2-PSF	Clay Filter Effluent Following Actiflo® - PSF Filtration	-	-	-	3-IX-2-PSF	-	-	-
IX	-3-PSF	Anion Resin Effluent Following Actiflo® - PSF Filtration	-	-	-	3-IX-3-PSF	4-IX-3-PSF	5-IX-3-PSF	-
IX	-4-PSF	Cation Resin Effluent Following Actiflo®, PSF, Anion	-	-	-	3-IX-4-PSF	4-IX-4-PSF	5-IX-4-PSF	-
IX	-1-FF	Pleated Filter Effluent Following Actiflo® and FF Filtration	-	-	-	3-IX-1-FF	-	-	-
IX	-2-FF	Clay Filter Effluent following Actiflo® and FF Filtration	-	-	-	3-IX-2-FF	-	-	-
IX	-3-FF	Anion Resin Effluent Following Actiflo® and FF Filtration	-	-	-	3-IX-3-FF	4-IX-3-FF	5-IX-3-FF	6-IX-3-FF-1
IX	-4-FF	Cation Resin Effluent Following Actiflo®, FF, Anion	-	-	-	3-IX-4-FF	4-IX-4-FF	5-IX-4-FF	6-IX-4-FF-1
A	-2	Conventional Tank Run (W/O Sand and Polymer)	Pass C Only	-	-	-	-	-	6-A-2
PSF	-2	Sand Filter (PSF) Following Conventional Tank Run	-	-	-	-	-	-	6-PSF-2
IX	-3-PSF-2	Anion Effluent Following Conventional Run and PSF Filtration	-	-	-	-	-	-	6-IX-3-PSF-2
IX	-4-PSF-2	Cation Effluent Following Conventional, PSF and Anion	-	-	-	-	-	-	6-IX-4-PSF-2
QC	Sample	Field Duplicate Sample 1	-	1-16-F (dup of 1-9-F)	2-16-S (dup of 2-14-S)	3-16-F (dup of 3-11-F)	4-16-F (dup of 4-12-F)	5-17-F (dup of 5-2-F)	6-16-S (dup 0f 6-IX4-PSF-2)
QC	Sample	Field Duplicate Sample 2	-	-	-	-	-	-	6-17-F (Dup of 6-I-3)
QC	Sample	Equipment Blank # 1	-	1-16-S	2-16-F	-	4-16-S	5-16-S	6-18-S
QC	Sample	Equipment Blank # 2	-		-	-	-	-	6-18-F
QC	Sample	Equipment Bllank (Rinse of F-7 Collection Tank)	-		-	-	-	-	6-19-S
QC	Sample	Bottle Blank # 1	-	-	-	-	4-17-F	5-16-F	6-16-F
QC	Sample	Bottle Blank # 2	-	-	-	-	-	5-17-S	-
QC	Sample	Performance Evalation Sample							6-20-F
QC	Sample	Performance Evalation Sample Blank							6-20-S

CALTRANS TAHOE SMALL-SCALE STORMWATER TREATMENT PILOT PLANT - FIRST YEAR DATA

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
I-1	Run #	Run #	-			1			2			3			4			5			6
I-1	Date Sampled	Date	-						03/06/02						05/01/02			05/21/02			11/8/2002
I-1	Lab Name	Lab	-						PatChem						ToxScan/UCD			ToxScan/UCD			ToxScan
I-1	Water Source	Source	-						Wetland						On-Site			Roadside Basins			Roadside Basins
I-1	Pilot Plant ID #	Plant ID#	-			Not Collected			02-I-1G			Not Collected			04-I-01			05-I-01			06-I-01
I-1	Lab #	Lab #	-						0203265-01						T-20292-24			T-20333-29			T-20661-10
I-1	Turbidity - Field	Turb-F	NTU						66.6						808			180			174
I-1	Temp - Field	Temp-F	C						9.4						10.7			9.6			8.9
I-1	EC - Field	EC-F	umhos/cm						190						2298			360			114
I-1	pH - Field	pH-F	pH Units						7.5						7.4			6.9			6.6
I-1	Drain Time (first fill)	Drain 1	min						NA						NA			NA			NA
I-1	Drain Time (second fill)	Drain 2	min						NA						NA			NA			NA
I-1	Acid Soluble Aluminum	Al-AS	ug/L				J	h	310						690			290			230
I-1	Aluminum	Al-T	ug/L						2700						3500			1700			1500
I-1	Aluminum - Dissolved	Al-D	ug/L						< 25						< 25			45			180
I-1	Ammonia as N	NH4	mg-N/L						< 0.1						< 0.1			0.6			1.2
I-1	Ammonia as N, dissolved	NH4-D	mg-N/L						< 0.1												1.1
I-1	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L						39						21			45			
I-1	Boron	B	mg/L						< 0.02						< 0.02			0.16			0.07
I-1	Cadmium	Cd-T	ug/L						0.3						0.4			0.3			0.3
I-1	Cadmium - Dissolved	Cd-D	ug/L						< 0.2						< 0.2			< 0.2			< 0.2
I-1	Calcium	Ca	mg/L						15.0						9.4			10.9			13.0
I-1	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L						< 1						< 1			< 1			
I-1	Chloride	Cl	mg/L						14						770			100			9
I-1	Chromium	Cr-T	ug/L						4.2						17.7			10.6			8.2
I-1	Chromium - Dissolved	Cr-D	ug/L						< 1.0						1.6			< 1.0			4.7
I-1	Copper	Cu-T	ug/L						7.9						38			18			17
I-1	Copper - Dissolved	Cu-D	ug/L						3.5						12			2.7			9.0
I-1	Dissolved Organic Carbon	DOC	mg/L						9.4						7.3			40			
I-1	Hardness	Hard	mg-CaCO3/L						67						55			38			83
I-1	Hardness - Dissolved	Hard-D	mg-CaCO3/L						2												
I-1	Iron	Fe-T	ug/L						2290						18000			11000			8500
I-1	Iron - Dissolved	Fe-D	ug/L						< 25						< 25			470	J	Z	230
I-1	Lead	Pb-T	ug/L						5.0						25			19			13
I-1	Lead - Dissolved	Pb-D	ug/L						< 1.0						< 1.0			< 1.0			< 1.0
I-1	Magnesium	Mg	mg/L						7.2						7.7			2.6			3.6
I-1	Nickel	Ni-T	ug/L						2.8						14			6.4			4.7
I-1	Nickel - Dissolved	Ni-D	ug/L						< 2.0						< 2.0			2.4			3.0
I-1	Nitrate as N	NO3	mg-N/L				J	h	0.9						< 0.1			0.2	J	d	0.5
I-1	Nitrite as N	NO2	mg-N/L				J	h	< 0.1						< 0.1			< 0.1			0.3
I-1	Oil & Grease	O&G	mg/L						< 2						10			7			7
I-1	Orthophosphate as P	O-P (T)	mg-P/L				J	h	0.11						0.70			0.17	J	Q	0.24
I-1	Orthophosphate as P, Dis	O-P (D)	mg-P/L				J	h	< 0.03						0.09			< 0.03	J	Q	0.53
I-1	pH (Lab value)	pH-L	pH Units				J	h	6.8						7.1			6.9			
I-1	Phosphorus, Dissolved as P	Phos - D	mg-P/L						< 0.03						0.12	U	x	0.09			0.70
I-1	Phosphorus, Total as P	Phos - T	mg-P/L						0.21						0.81			0.51			1.10
I-1	Potassium	K	mg/L						2.7						3.3			2.7			10.0
I-1	Silicon (as Si)	Si	mg/L						11						30			8.5			35
I-1	Sodium	Na	mg/L						9.2						411			88			23
I-1	Specific Conductance (Lab)	EC-L	umhos/cm						165						2400			450			
I-1	Sulfate as SO4	SO4	mg/L						15.2						2.0			4.6			4.4
I-1	Total Alkalinity	Tot-Alk	mg-CaCO3/L						39						21			45			28
I-1	Total Dissolved Solids	TDS	mg/L						120						1400			310			310
I-1	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L						0.5						1.0			2.3			4.3
I-1	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L						0.3						0.2			1.5			3.1
I-1	Total Organic Carbon	TOC	mg/L						9.9						7.4			39			180
I-1	Total Suspended Solids	TSS	mg/L						38						380			200			170
I-1	Turbidity (Lab)	Turb-L	NTU				J	h	52.2						460			120			
I-1	Zinc	Zn-T	ug/L						98						167			459			560
I-1	Zinc - Dissolved	Zn-D	ug/L						51						10			145			240

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
I-2	Run #	Run #	-			1			2			3			4			5			6
I-2	Date Sampled	Date	-						03/06/02						05/01/02			05/21/02			11/8/2002
I-2	Lab Name	Lab	-						PatChem						ToxScan/UCD			ToxScan/UCD			ToxScan
I-2	Water Source	Source	-						Wetland						On-Site			Roadside Basins			Roadside Basins
I-2	Pilot Plant ID #	Plant ID#	-			Not Collected			02-I-2G			Not Collected			04-I-02			05-I-02			06-I-02
I-2	Lab #	Lab #	-						0203235-01						T-20292-23			T-20333-30			T-20661-15
I-2	Turbidity - Field	Turb-F	NTU						66.6						912			180			183
I-2	Temp - Field	Temp-F	C						9.5						10.7			9.0			8.7
I-2	EC - Field	EC-F	umhos/cm						194						2307			374			133
I-2	pH - Field	pH-F	pH Units						7.5						7.4			7.0			6.7
I-2	Drain Time (first fill)	Drain 1	min						NA						NA			NA			NA
I-2	Drain Time (second fill)	Drain 2	min						NA						NA			NA			NA
I-2	Acid Soluble Aluminum	Al-AS	ug/L				J	h	330						680			330			260
I-2	Aluminum	Al-T	ug/L						3200						3900			1800			1200
I-2	Aluminum - Dissolved	Al-D	ug/L						< 25						< 25			61			84
I-2	Ammonia as N	NH4	mg-N/L						< 0.1						< 0.1			0.6			1.1
I-2	Ammonia as N, dissolved	NH4-D	mg-N/L						< 0.1												1.1
I-2	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L						39						21			45			-
I-2	Boron	B	mg/L						< 0.02						< 0.02			0.13			0.07
I-2	Cadmium	Cd-T	ug/L						< 0.2						0.5			0.3			< 0.2
I-2	Cadmium - Dissolved	Cd-D	ug/L						< 0.2						< 0.2			< 0.2			< 0.2
I-2	Calcium	Ca	mg/L						14.1						11.2			10.9			11.0
I-2	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L						< 1						< 1			< 1			
I-2	Chloride	Cl	mg/L						14						770			100			9
I-2	Chromium	Cr-T	ug/L						4.6						24.6			11.0			8.1
I-2	Chromium - Dissolved	Cr-D	ug/L						< 1.0						1.6			< 1.0			6.2
I-2	Copper	Cu-T	ug/L						9.2						44			18			17
I-2	Copper - Dissolved	Cu-D	ug/L						3.5						21			2.6			10
I-2	Dissolved Organic Carbon	DOC	mg/L						8.7						7.7			44			
I-2	Hardness	Hard	mg-CaCO3/L						62						66			38			49
I-2	Hardness - Dissolved	Hard-D	mg-CaCO3/L						58												
I-2	Iron	Fe-T	ug/L						2790						23000			10000			5400
I-2	Iron - Dissolved	Fe-D	ug/L						87						< 25			460	J	Z	230
I-2	Lead	Pb-T	ug/L						5.5						29			19			13
I-2	Lead - Dissolved	Pb-D	ug/L						< 1.0						< 1.0			< 1.0			< 1.0
I-2	Magnesium	Mg	mg/L						6.5						9.3			2.7			2.9
I-2	Nickel	Ni-T	ug/L						3.0						17			6.5			4.5
I-2	Nickel - Dissolved	Ni-D	ug/L						< 2.0						< 2.0			2.3			3.3
I-2	Nitrate as N	NO3	mg-N/L				J	h	0.3						< 0.1			0.2	J	d	0.7
I-2	Nitrite as N	NO2	mg-N/L				J	h	< 0.1						< 0.1			< 0.1			< 0.1
I-2	Oil & Grease	O&G	mg/L						< 2						10			7			7
I-2	Orthophosphate as P	O-P (T)	mg-P/L				J	h	< 0.03						0.80			0.17	J	Q	0.26
I-2	Orthophosphate as P, Dis	O-P (D)	mg-P/L				J	h	< 0.03						0.07			< 0.03	J	Q	0.52
I-2	pH (Lab value)	pH-L	pH Units				J	h	6.8						7.1			6.9			
I-2	Phosphorus, Dissolved as P	Phos - D	mg-P/L						< 0.03						0.09	U	x	0.09			0.65
I-2	Phosphorus, Total as P	Phos - T	mg-P/L						0.13						1.10			0.50			1.10
I-2	Potassium	K	mg/L						2.9						3.8			2.8			9.3
I-2	Silicon (as Si)	Si	mg/L						11						34			8.4			26
I-2	Sodium	Na	mg/L						10						341			86			22
I-2	Specific Conductance (Lab)	EC-L	umhos/cm						146						2400			450			
I-2	Sulfate as SO4	SO4	mg/L						15.1						2.0			4.7			4.5
I-2	Total Alkalinity	Tot-Alk	mg-CaCO3/L						39						21			45			29
I-2	Total Dissolved Solids	TDS	mg/L						104						1400			320			320
I-2	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L						1.2						0.9			2.0			4.5
I-2	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L						1.1						0.2			1.4			2.9
I-2	Total Organic Carbon	TOC	mg/L						10						7.0			41			180
I-2	Total Suspended Solids	TSS	mg/L						53						510			210			170
I-2	Turbidity (Lab)	Turb-L	NTU				J	h	42.0						480			140			
I-2	Zinc	Zn-T	ug/L						100						205			462			520
I-2	Zinc - Dissolved	Zn-D	ug/L						51						11			144			310

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
I-3	Run #	Run #	-			1			2			3			4			5			6
I-3	Date Sampled	Date	-						03/06/02						05/01/02			05/21/02			11/8/2002
I-3	Lab Name	Lab	-						PatChem						ToxScan/UCD			ToxScan/UCD			ToxScan
I-3	Water Source	Source	-						Wetland						On-Site			Roadside Basins			Roadside Basins
I-3	Pilot Plant ID #	Plant ID#	-			Not Collected			02-I-3G			Not Collected			04-I-03			05-I-03			06-I-03
I-3	Lab #	Lab #	-						0203264-01						T-20292-17			T-20333-13			T-20661-8
I-3	Turbidity - Field	Turb-F	NTU						65.2						871			174			196
I-3	Temp - Field	Temp-F	C						9.3						10.8			9.1			9.4
I-3	EC - Field	EC-F	umhos/cm						192						2302			358			139
I-3	pH - Field	pH-F	pH Units						7.5						7.4			7.1			6.5
I-3	Drain Time (first fill)	Drain 1	min						NA						NA			NA			NA
I-3	Drain Time (second fill)	Drain 2	min						NA						NA			NA			NA
I-3	Acid Soluble Aluminum	Al-AS	ug/L				J	h	340						510			290			220
I-3	Aluminum	Al-T	ug/L						3000						3200			1100	J	f	1200
I-3	Aluminum - Dissolved	Al-D	ug/L						< 25						< 25			44			120
I-3	Ammonia as N	NH4	mg-N/L						< 0.1						0.1			0.5			1.2
I-3	Ammonia as N, dissolved	NH4-D	mg-N/L						< 0.1												1.2
I-3	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L						39						21			45			
I-3	Boron	B	mg/L						< 0.02						< 0.02			0.09			0.05
I-3	Cadmium	Cd-T	ug/L						< 0.2						0.3			0.3			0.3
I-3	Cadmium - Dissolved	Cd-D	ug/L						< 0.2						< 0.2			< 0.2			< 0.2
I-3	Calcium	Ca	mg/L						15.2						9.2			10.4			8.8
I-3	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L						< 1						< 1			< 1			
I-3	Chloride	Cl	mg/L						14						790			100			9
I-3	Chromium	Cr-T	ug/L						4.9						35.1			14.2			8.2
I-3	Chromium - Dissolved	Cr-D	ug/L						< 1.0						1.0			1.2			4.9
I-3	Copper	Cu-T	ug/L						8.3						35			15			16
I-3	Copper - Dissolved	Cu-D	ug/L						3.3						2.3			3.1			9.3
I-3	Dissolved Organic Carbon	DOC	mg/L						9.9						5.5			40			
I-3	Hardness	Hard	mg-CaCO3/L						68						54			35	J	f	47
I-3	Hardness - Dissolved	Hard-D	mg-CaCO3/L						50												
I-3	Iron	Fe-T	ug/L						2660						22000			8600			4900
I-3	Iron - Dissolved	Fe-D	ug/L						80						< 25			470	J	Z	220
I-3	Lead	Pb-T	ug/L						5.2						22			15			12
I-3	Lead - Dissolved	Pb-D	ug/L						< 1.0						< 1.0			< 1.0			< 1.0
I-3	Magnesium	Mg	mg/L						7.3						7.4			2.2			2.3
I-3	Nickel	Ni-T	ug/L						2.9						14			5.5			4.6
I-3	Nickel - Dissolved	Ni-D	ug/L						< 2.0						< 2.0			2.4			3.2
I-3	Nitrate as N	NO3	mg-N/L				J	h	0.9						< 0.1			0.2	J	d	0.5
I-3	Nitrite as N	NO2	mg-N/L				J	h	< 0.1						< 0.1			< 0.1			0.3
I-3	Oil & Grease	O&G	mg/L						< 2						8			5			5
I-3	Orthophosphate as P	O-P (T)	mg-P/L				J	h	0.11						0.33			0.10	J	Q	0.21
I-3	Orthophosphate as P, Dis	O-P (D)	mg-P/L				J	h	< 0.03						0.05			< 0.03	J	Q	0.47
I-3	pH (Lab value)	pH-L	pH Units				J	h	6.7						7.1			6.7			
I-3	Phosphorus, Dissolved as P	Phos - D	mg-P/L						< 0.03						0.05	U	x	0.09			0.69
I-3	Phosphorus, Total as P	Phos - T	mg-P/L						0.25						0.87			0.40			1.10
I-3	Potassium	K	mg/L						2.8						3.3			2.5			7.2
I-3	Silicon (as Si)	Si	mg/L						11						31			7.4			20
I-3	Sodium	Na	mg/L						9.3						367			89			17
I-3	Specific Conductance (Lab)	EC-L	umhos/cm						166						2400			450			
I-3	Sulfate as SO4	SO4	mg/L						15.2						2.1			4.5			4.4
I-3	Total Alkalinity	Tot-Alk	mg-CaCO3/L						39						21			45			28
I-3	Total Dissolved Solids	TDS	mg/L						124						1300			310			320
I-3	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L						0.7						1.1			1.9			4.3
I-3	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L						0.6						0.2			1.3			2.8
I-3	Total Organic Carbon	TOC	mg/L						10						4.5			40			190
I-3	Total Suspended Solids	TSS	mg/L						48						400			50	J	f	180
I-3	Turbidity (Lab)	Turb-L	NTU				J	h	50.2						430			110			
I-3	Zinc	Zn-T	ug/L						110						169			412			520
I-3	Zinc - Dissolved	Zn-D	ug/L						53						10			147			240

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
I-C	Run #	Run #	-			1			2			3			4			5			6
I-C	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02									
I-C	Lab Name	Lab	-			PatChem			PatChem			PatChem									
I-C	Water Source	Source	-			On-Site			Wetland			S-Yard									
I-C	Pilot Plant ID #	Plant ID#	-			01-I-C			02-I-C			03-I-C			Not Collected			Not Collected			Not Collected
I-C	Lab #	Lab #	-			0202530-01			0203267-01			0203274-01									
I-C	Turbidity - Field	Turb-F	NTU			904			64.3			1038									
I-C	Temp - Field	Temp-F	C			14.4			9.4			9.0									
I-C	EC - Field	EC-F	umhos/cm			2357			194			480									
I-C	pH - Field	pH-F	pH Units			7.5			7.5			7.3									
I-C	Drain Time (first fill)	Drain 1	min			NA			NA			NA									
I-C	Drain Time (second fill)	Drain 2	min			NA			NA			NA									
I-C	Acid Soluble Aluminum	Al-AS	ug/L			3200	J	h	360	J	h	2800									
I-C	Aluminum	Al-T	ug/L			12000			3200			32000									
I-C	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25									
I-C	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1			< 0.1									
I-C	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
I-C	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			19			39			29									
I-C	Boron	B	mg/L			0.08			< 0.02			< 0.02									
I-C	Cadmium	Cd-T	ug/L			0.4			< 0.2			0.6									
I-C	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2									
I-C	Calcium	Ca	mg/L			9.8			16.1			12.9									
I-C	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1									
I-C	Chloride	Cl	mg/L			691			15			122									
I-C	Chromium	Cr-T	ug/L			9.4			5.0			23.0									
I-C	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0			< 1.0									
I-C	Copper	Cu-T	ug/L			27			8.9			40									
I-C	Copper - Dissolved	Cu-D	ug/L			< 1.0			3.5			< 1.0									
I-C	Dissolved Organic Carbon	DOC	mg/L			3.9			10			5.7									
I-C	Hardness	Hard	mg-CaCO3/L			48			72			61									
I-C	Hardness - Dissolved	Hard-D	mg-CaCO3/L			22			51			18									
I-C	Iron	Fe-T	ug/L			13400			3010			33400									
I-C	Iron - Dissolved	Fe-D	ug/L			< 25			78			< 25									
I-C	Lead	Pb-T	ug/L			15			5.2			64									
I-C	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0									
I-C	Magnesium	Mg	mg/L			5.8			7.8			7.0									
I-C	Nickel	Ni-T	ug/L			10			3.2			13									
I-C	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0									
I-C	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			< 0.1									
I-C	Nitrite as N	NO2	mg-N/L			0.2	J	h	< 0.1			< 0.1									
I-C	Oil & Grease	O&G	mg/L			7			< 2			< 2									
I-C	Orthophosphate as P	O-P (T)	mg-P/L			0.17	J	h	0.11			< 0.03									
I-C	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03									
I-C	pH (Lab value)	pH-L	pH Units			6.9	J	h	6.8	J	h	7.1									
I-C	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.20			< 0.03			0.11									
I-C	Phosphorus, Total as P	Phos - T	mg-P/L			1.03			0.30			1.12									
I-C	Potassium	K	mg/L			3.5			3.0			3.2									
I-C	Silicon (as Si)	Si	mg/L			24			12			38									
I-C	Sodium	Na	mg/L			459			11			75									
I-C	Specific Conductance (Lab)	EC-L	umhos/cm			1890			168			412									
I-C	Sulfate as SO4	SO4	mg/L			1.4			15.2			2.4									
I-C	Total Alkalinity	Tot-Alk	mg-CaCO3/L			19			39			29									
I-C	Total Dissolved Solids	TDS	mg/L			880			96			404									
I-C	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			4.1			0.5			1.1									
I-C	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.9			0.4			< 0.1									
I-C	Total Organic Carbon	TOC	mg/L	U	x	7.6			10.3			6.9									
I-C	Total Suspended Solids	TSS	mg/L			372			52			260									
I-C	Turbidity (Lab)	Turb-L	NTU			507	J	h	51.5			971									
I-C	Zinc	Zn-T	ug/L			180			110			360									
I-C	Zinc - Dissolved	Zn-D	ug/L			15			53			8									

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
I-Avg	Run #	Run #	-			1			2			3			4			5			6
I-Avg	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			11/8/2002
I-Avg	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			ToxScan
I-Avg	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			Roadside Basins
I-Avg	Pilot Plant ID #	Plant ID#	-			NA			NA			NA			NA			NA			NA
I-Avg	Lab #	Lab #	-			NA			NA			NA			NA			NA			NA
I-Avg	Turbidity - Field	Turb-F	NTU			904			66.1			1038			864			178			184
I-Avg	Temp - Field	Temp-F	C			14.4			9.4			9.0			10.7			9.2			9.0
I-Avg	EC - Field	EC-F	umhos/cm			2357			192			480			2302			364			129
I-Avg	pH - Field	pH-F	pH Units			7.5			7.5			7.3			7.4			7.0			6.6
I-Avg	Drain Time (first fill)	Drain 1	min			NA			NA			NA			NA			NA			NA
I-Avg	Drain Time (second fill)	Drain 2	min			NA			NA			NA			NA			NA			NA
I-Avg	Acid Soluble Aluminum	Al-AS	ug/L			3200			327			2800			627			337			237
I-Avg	Aluminum	Al-T	ug/L			12000			2967			32000			3533			1533			1300
I-Avg	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25			< 25			50			128
I-Avg	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1			< 0.1			< 0.1			0.6			1.2
I-Avg	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									1.1
I-Avg	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			19			39			29			21			45			
I-Avg	Boron	B	mg/L			0.08			< 0.02			< 0.02			< 0.02			0.13			0.06
I-Avg	Cadmium	Cd-T	ug/L			0.4			< 0.2			0.6			0.4			0.3			0.3
I-Avg	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2
I-Avg	Calcium	Ca	mg/L			9.8			14.8			12.9			9.9			10.7			10.9
I-Avg	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
I-Avg	Chloride	Cl	mg/L			691			14			122			777			100			9
I-Avg	Chromium	Cr-T	ug/L			9.4			4.6			23.0			25.8			11.9			8.2
I-Avg	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0			< 1.0			1.4			< 1.0			5.3
I-Avg	Copper	Cu-T	ug/L			27			8.5			40			39			17			17
I-Avg	Copper - Dissolved	Cu-D	ug/L			< 1.0			3.4			< 1.0			12			2.8			9.4
I-Avg	Dissolved Organic Carbon	DOC	mg/L			3.9			9.3			5.7			6.8			41			
I-Avg	Hardness	Hard	mg-CaCO3/L			48			66			61			58			37			60
I-Avg	Hardness - Dissolved	Hard-D	mg-CaCO3/L			22			37			18									
I-Avg	Iron	Fe-T	ug/L			13400			2580			33400			21000			9867			6267
I-Avg	Iron - Dissolved	Fe-D	ug/L			< 25			64			< 25			< 25			467			227
I-Avg	Lead	Pb-T	ug/L			15			5.2			64			25			18			13
I-Avg	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0
I-Avg	Magnesium	Mg	mg/L			5.8			7.0			7.0			8.1			2.5			2.9
I-Avg	Nickel	Ni-T	ug/L			10			2.9			13			15			6.1			4.6
I-Avg	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			2.4			3.2
I-Avg	Nitrate as N	NO3	mg-N/L			< 0.1			0.7			< 0.1			< 0.1			0.2			0.6
I-Avg	Nitrite as N	NO2	mg-N/L			0.2			< 0.1			< 0.1			< 0.1			< 0.1			0.2
I-Avg	Oil & Grease	O&G	mg/L			7			< 2			< 2			9			< 5			6
I-Avg	Orthophosphate as P	O-P (T)	mg-P/L			0.17			0.08			< 0.03			0.61			0.15			0.24
I-Avg	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03			< 0.03			< 0.03			0.07			< 0.03			0.51
I-Avg	pH (Lab value)	pH-L	pH Units			6.9			6.8			7.1			7.1			6.8			
I-Avg	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.20			< 0.03			0.11			0.09			0.09			0.68
I-Avg	Phosphorus, Total as P	Phos - T	mg-P/L			1.03			0.20			1.12			0.93			0.47			1.10
I-Avg	Potassium	K	mg/L			3.5			2.8			3.2			3.5			2.7			8.8
I-Avg	Silicon (as Si)	Si	mg/L			24			11			38			32			8.1			27
I-Avg	Sodium	Na	mg/L			459			10			75			373			88			21
I-Avg	Specific Conductance (Lab)	EC-L	umhos/cm			1890			159			412			2400			450			
I-Avg	Sulfate as SO4	SO4	mg/L			1.4			15.2			2.4			2.0			4.6			4.4
I-Avg	Total Alkalinity	Tot-Alk	mg-CaCO3/L			19			39			29			21			45			28
I-Avg	Total Dissolved Solids	TDS	mg/L			880			116			404			1368			313			317
I-Avg	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			4.1			0.8			1.1			1.0			2.1			4.4
I-Avg	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.9			0.7			< 0.1			0.2			1.4			2.9
I-Avg	Total Organic Carbon	TOC	mg/L	U	x	7.6			10.0			6.9			6.3			40			183
I-Avg	Total Suspended Solids	TSS	mg/L			372			46			260			430			153			173
I-Avg	Turbidity (Lab)	Turb-L	NTU			507			48.1			971			457			123			
I-Avg	Zinc	Zn-T	ug/L			180			103			360			180			444			533
I-Avg	Zinc - Dissolved	Zn-D	ug/L			15			52			8			10			145			263

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
1-F	Run #	Run #	-			1			2			3			4			5			6
1-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
1-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
1-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
1-F	Pilot Plant ID #	Plant ID#	-			01-1-F			02-1-F			03-1-F			04-01-F			05-1-F			not run
1-F	Lab #	Lab #	-			0202519-1			0203236-01			0203278-01			T-20292-08						
1-F	Turbidity - Field	Turb-F	NTU			631			57.3			892			526						
1-F	Temp - Field	Temp-F	C			14.0			9.6			9.1			10.6						
1-F	EC - Field	EC-F	umhos/cm			2268			298			466			2196						
1-F	pH - Field	pH-F	pH Units			7.3			7.6			7.2			7.4						
1-F	Drain Time (first fill)	Drain 1	min			3.13			3.15			4.63			4.03			9999.00			
1-F	Drain Time (second fill)	Drain 2	min			3.73			4.83			5.07			92.00			NA			
1-F	Acid Soluble Aluminum	Al-AS	ug/L			2400	J	h	290	J	h	2600			720						
1-F	Aluminum	Al-T	ug/L			11000			2800			28000			2400						
1-F	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			210			< 25						
1-F	Ammonia as N	NH4	mg-N/L			0.2			< 0.1			< 0.1			0.2						
1-F	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
1-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			20			38			31			22						
1-F	Boron	B	mg/L			0.11			< 0.02			< 0.02			< 0.02						
1-F	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			0.5			< 0.2						
1-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2						
1-F	Calcium	Ca	mg/L			17.1			9.6			10.9			20.5						
1-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1						
1-F	Chloride	Cl	mg/L			699			50			107			750						
1-F	Chromium	Cr-T	ug/L			8.8			4.1			20.0			10.8						
1-F	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0			< 1.0			1.7						
1-F	Copper	Cu-T	ug/L			24			7.4			34			26						
1-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			4.2			1.7			23						
1-F	Dissolved Organic Carbon	DOC	mg/L			4.2			9.3			6.3			5.8						
1-F	Hardness	Hard	mg-CaCO3/L			77			42			62			88						
1-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			57			37			23									
1-F	Iron	Fe-T	ug/L			12200			2190			28600			15000						
1-F	Iron - Dissolved	Fe-D	ug/L			< 25			77			123			< 25						
1-F	Lead	Pb-T	ug/L			12			3.9			55			17						
1-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0						
1-F	Magnesium	Mg	mg/L			8.4			4.5			8.4			9.0						
1-F	Nickel	Ni-T	ug/L			8.7			2.4			11			9.5						
1-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0						
1-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			0.1			< 0.1						
1-F	Nitrite as N	NO2	mg-N/L			0.2	J	h	< 0.1			< 0.1			< 0.1						
1-F	Oil & Grease	O&G	mg/L			5			< 2			< 2			< 5						
1-F	Orthophosphate as P	O-P (T)	mg-P/L			0.08	J	h	0.48			< 0.03			0.28						
1-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	0.09			< 0.03			0.08						
1-F	pH (Lab value)	pH-L	pH Units			6.6	J	h	7.0	J	h	7.1			7.2						
1-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.24			< 0.03			0.09			0.09						
1-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.47			0.09			0.95			0.62						
1-F	Potassium	K	mg/L			6.3			2.5			4.0			5.1						
1-F	Silicon (as Si)	Si	mg/L			23			11			34			24						
1-F	Sodium	Na	mg/L			403			40			72			368						
1-F	Specific Conductance (Lab)	EC-L	umhos/cm			1730			229			383			2200						
1-F	Sulfate as SO4	SO4	mg/L			1.6			14.6			3.2			2.2						
1-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			20			38			31			22						
1-F	Total Dissolved Solids	TDS	mg/L			1202			176			432			1300						
1-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.4			1.4			0.7			0.7						
1-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.2			1.3			< 0.1			0.3						
1-F	Total Organic Carbon	TOC	mg/L	U	x	4.3			13.1			6.5			5.4						
1-F	Total Suspended Solids	TSS	mg/L			288			32			232			270						
1-F	Turbidity (Lab)	Turb-L	NTU			421	J	h	53.6			823			340						
1-F	Zinc	Zn-T	ug/L			110			28			260			92						
1-F	Zinc - Dissolved	Zn-D	ug/L			< 5			6			6			< 5						

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
2-F	Run #	Run #	-			1			2			3			4			5			6
2-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
2-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
2-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
2-F	Pilot Plant ID #	Plant ID#	-			01-2-F			02-2-F			03-2-F			04-02-F			05-2-F			not run
2-F	Lab #	Lab #	-			0202526-01			0203252-01			0203279-01			T-20292-26			T-20333-01			
2-F	Turbidity - Field	Turb-F	NTU			718			74.8			991			839			169			
2-F	Temp - Field	Temp-F	C			13.9			9.9			9.1			10.7			9.8			
2-F	EC - Field	EC-F	umhos/cm			2220			268			468			2196			398			
2-F	pH - Field	pH-F	pH Units			7.2			7.6			7.3			7.2			7.2			
2-F	Drain Time (first fill)	Drain 1	min			0.00			0.00			0.25			0.10			0.23			
2-F	Drain Time (second fill)	Drain 2	min			0.00			0.35			0.70			0.62			1.12			
2-F	Acid Soluble Aluminum	Al-AS	ug/L			2900	J	h	470			2400			680			190			
2-F	Aluminum	Al-T	ug/L			12000			3300			30000			3300			1400			
2-F	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25			< 25	J	f	40			
2-F	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1			< 0.1			0.2			0.3			
2-F	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
2-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			19			38			29			19			46			
2-F	Boron	B	mg/L			0.09			< 0.02			< 0.02			< 0.02			0.08			
2-F	Cadmium	Cd-T	ug/L			0.3			< 0.2			0.5			0.3			< 0.2			
2-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
2-F	Calcium	Ca	mg/L			35.5			7.4			11.0			36.8			5.4			
2-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
2-F	Chloride	Cl	mg/L			686			45			114			750			130			
2-F	Chromium	Cr-T	ug/L			10.0			4.5			22.0			15.1			8.4			
2-F	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0			< 1.0			2.2			< 1.0			
2-F	Copper	Cu-T	ug/L			27			9.4			37			37			12			
2-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			4.1			1.5			2.0			4.5			
2-F	Dissolved Organic Carbon	DOC	mg/L			3.5			8.6			6.1			6.2			43			
2-F	Hardness	Hard	mg-CaCO3/L			148			33			64			153			25			
2-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			123			23			25									
2-F	Iron	Fe-T	ug/L			13700			2940			31200			18000			5700			
2-F	Iron - Dissolved	Fe-D	ug/L			< 25			64			< 25			< 25			390			
2-F	Lead	Pb-T	ug/L			14			4.2			58			24			7.4			
2-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
2-F	Magnesium	Mg	mg/L			14.5			3.5			9.0			14.8			2.8			
2-F	Nickel	Ni-T	ug/L			11			3.7			13			15			4.4			
2-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			
2-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			< 0.1			< 0.1			< 0.1			
2-F	Nitrite as N	NO2	mg-N/L			0.2	J	h	< 0.1			< 0.1			< 0.1			< 0.1			
2-F	Oil & Grease	O&G	mg/L			8			< 2			3			< 5			< 5			
2-F	Orthophosphate as P	O-P (T)	mg-P/L			0.09	J	h	< 0.03			< 0.03			0.65			0.08			
2-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			0.06			0.03			
2-F	pH (Lab value)	pH-L	pH Units			7.1	J	h	7.0			7.1			7.1			6.8			
2-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.33			< 0.03			< 0.03			0.05	U	x	0.13			
2-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.52			0.10			1.04			0.72			0.37			
2-F	Potassium	K	mg/L			6.9			1.9			4.0			6.1			2.8			
2-F	Silicon (as Si)	Si	mg/L			25			12			37			28			7.8			
2-F	Sodium	Na	mg/L			400			39			70			331			108			
2-F	Specific Conductance (Lab)	EC-L	umhos/cm			1760			214			394			2300			500			
2-F	Sulfate as SO4	SO4	mg/L			1.8			14.6			3.8			2.3			4.6			
2-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			19			38			29			19			46			
2-F	Total Dissolved Solids	TDS	mg/L			1130			108			548			1300			330			
2-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.5			0.3			0.9			0.8			1.4			
2-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			< 0.1			0.3			< 0.1			0.2			0.9			
2-F	Total Organic Carbon	TOC	mg/L	U	x	6.8			9.1			6.4			5.5			44			
2-F	Total Suspended Solids	TSS	mg/L			401			49			256			420			110			
2-F	Turbidity (Lab)	Turb-L	NTU			450	J	h	66.4			916			440			140			
2-F	Zinc	Zn-T	ug/L			130			35			280			137			77			
2-F	Zinc - Dissolved	Zn-D	ug/L			10			6			< 5			6			9			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
3-F	Run #	Run #	-			1			2			3			4			5			6
3-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
3-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
3-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
3-F	Pilot Plant ID #	Plant ID#	-			01-3-F			02-3-F			03-3-F			04-03-F			05-3-F			not run
3-F	Lab #	Lab #	-			0202520-01			0203238-01			0203284-01			T-20292-30			T-20333-02			
3-F	Turbidity - Field	Turb-F	NTU			648			67.4			908			643			79.6			
3-F	Temp - Field	Temp-F	C			13.9			10.0			9.2			10.8			9.9			
3-F	EC - Field	EC-F	umhos/cm			2238			354			485			2226			498			
3-F	pH - Field	pH-F	pH Units			8.0			8.2			8.2			7.8			8.5			
3-F	Drain Time (first fill)	Drain 1	min			0.25			0.60			0.95			40.00			9.00			
3-F	Drain Time (second fill)	Drain 2	min			0.43			1.05			1.03			93.00			9999.00			
3-F	Acid Soluble Aluminum	Al-AS	ug/L			2300	J	h	410	J	h	2300			670			260			
3-F	Aluminum	Al-T	ug/L			12000			3300			27000			3100			1300			
3-F	Aluminum - Dissolved	Al-D	ug/L			< 25			30			31			< 25			28			
3-F	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1			< 0.1			0.1			0.4			
3-F	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
3-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			35			50			46			38			71			
3-F	Boron	B	mg/L			0.14			0.04			< 0.02			0.02			0.09			
3-F	Cadmium	Cd-T	ug/L			0.3			< 0.2			0.4			0.2			< 0.2			
3-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
3-F	Calcium	Ca	mg/L			8.4			1.5			4.1			9.5			2.8			
3-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
3-F	Chloride	Cl	mg/L			686			61			104			750			150			
3-F	Chromium	Cr-T	ug/L			9.2			4.0			19.0			12.7			7.2			
3-F	Chromium - Dissolved	Cr-D	ug/L			1.2			< 1.0			< 1.0			2.2			1.4			
3-F	Copper	Cu-T	ug/L			25			7.4			35			30			9.1			
3-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			3.4			2.2			2.4			3.6			
3-F	Dissolved Organic Carbon	DOC	mg/L			4.9			8.6			6.4	R	Q	9.4			44			
3-F	Hardness	Hard	mg-CaCO3/L			45			8			34			54			14			
3-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			21			4			< 1									
3-F	Iron	Fe-T	ug/L			13300			2840			27500			16000			5200			
3-F	Iron - Dissolved	Fe-D	ug/L			< 25			83			< 25			< 25			350			
3-F	Lead	Pb-T	ug/L			13			4.9			50			21			6.8			
3-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
3-F	Magnesium	Mg	mg/L			5.9			0.9			5.8			7.3			1.7			
3-F	Nickel	Ni-T	ug/L			9.0			2.3			10			11			2.4			
3-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			
3-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.6			< 0.1			0.4			< 0.1			
3-F	Nitrite as N	NO2	mg-N/L			0.4	J	h	< 0.1			< 0.1			< 0.1			< 0.1			
3-F	Oil & Grease	O&G	mg/L			5			< 2			< 2			5			< 5			
3-F	Orthophosphate as P	O-P (T)	mg-P/L			0.31	J	h	< 0.03			< 0.03			0.61			0.05			
3-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			0.09			0.04			
3-F	pH (Lab value)	pH-L	pH Units			6.8	J	h	7.9	J	h	8.1			7.6			7.4			
3-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.23			< 0.03			< 0.03			0.08	U	J	0.13			
3-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.52			0.12			0.89			0.60			0.29			
3-F	Potassium	K	mg/L			11			1.9			3.5			11			4.4			
3-F	Silicon (as Si)	Si	mg/L			27			14			35			32			12			
3-F	Sodium	Na	mg/L			464			67			82			344			148			
3-F	Specific Conductance (Lab)	EC-L	umhos/cm			1720			287			403			2200			630			
3-F	Sulfate as SO4	SO4	mg/L			2.5			15.3			3.7			3.6			5.1			
3-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			35			50			46			38			71			
3-F	Total Dissolved Solids	TDS	mg/L			1216			192			484			1300			420			
3-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.6			4.0			0.5			0.5			1.4			
3-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.3			1.1			< 0.1			0.2			0.9			
3-F	Total Organic Carbon	TOC	mg/L	U	x	6.6			9.3			7.3	R	Q	5.8			49			
3-F	Total Suspended Solids	TSS	mg/L			222			55			150			300			78			
3-F	Turbidity (Lab)	Turb-L	NTU			394	J	h	64.6			779			390			87.0			
3-F	Zinc	Zn-T	ug/L			120			33			250			116			52			
3-F	Zinc - Dissolved	Zn-D	ug/L			< 5			< 5			< 5			< 5			6			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
4-F	Run #	Run #	-			1			2			3			4			5			6
4-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02						11/8/2002
4-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD						ToxScan
4-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site						Roadside Basins
4-F	Pilot Plant ID #	Plant ID#	-			01-4-F			02-4-F			03-4-F			04-04-F			not run			06-4-F
4-F	Lab #	Lab #	-			0202546-01			0203237-01			0203283-01			T-20292-19						T-20661-16
4-F	Turbidity - Field	Turb-F	NTU			251			34.7			633			162						51.5
4-F	Temp - Field	Temp-F	C			14.4			10.5			9.2			10.8						10.3
4-F	EC - Field	EC-F	umhos/cm			1856			782			376			1837						217
4-F	pH - Field	pH-F	pH Units			9.4			10.0			9.9			8.8						9.1
4-F	Drain Time (first fill)	Drain 1	min			6.83			8.07			9.63			15.25						4.66
4-F	Drain Time (second fill)	Drain 2	min			8.21			9.75			10.35			9999.00						9.63
4-F	Acid Soluble Aluminum	Al-AS	ug/L			1600	J	h	1200	J	h	2900			430						340
4-F	Aluminum	Al-T	ug/L			6300			2800			23000			1700						710
4-F	Aluminum - Dissolved	Al-D	ug/L			460			1100			1000			190						270
4-F	Ammonia as N	NH4	mg-N/L			0.1			< 0.1			< 0.1			0.1						0.3
4-F	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
4-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			18			19			23			10						
4-F	Boron	B	mg/L			0.04			< 0.02			< 0.02			< 0.02						0.04
4-F	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2			< 0.2						< 0.2
4-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2						< 0.2
4-F	Calcium	Ca	mg/L			2.6			1.2			2.9			2.5				U	y, x	1.0
4-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			2			26			18			< 1						
4-F	Chloride	Cl	mg/L			549			181			84			620						27
4-F	Chromium	Cr-T	ug/L			4.0			3.1			< 1.0			< 1.0						3.4
4-F	Chromium - Dissolved	Cr-D	ug/L			< 1.0			1.1			< 1.0			4.2						3.8
4-F	Copper	Cu-T	ug/L			10			1.9			4.2			21						2.8
4-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			< 1.0			< 1.0			12						1.8
4-F	Dissolved Organic Carbon	DOC	mg/L			4.6			1.7			2.8	J	Q	4.6						
4-F	Hardness	Hard	mg-CaCO3/L			13			5			27			9						15
4-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			3			4			< 1									
4-F	Iron	Fe-T	ug/L			5190			1010			22000			5900						1700
4-F	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			31			< 25				UJ	Z	< 25
4-F	Lead	Pb-T	ug/L			4.8			2.4			< 1.0			< 1.0						2.5
4-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			6.8						< 1.0
4-F	Magnesium	Mg	mg/L			1.7			0.4			4.8			0.6						0.5
4-F	Nickel	Ni-T	ug/L			4.5			< 2.0			< 2.0			< 2.0						< 2.0
4-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			4.7						< 2.0
4-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			0.5			< 0.1				J	d	0.5
4-F	Nitrite as N	NO2	mg-N/L			0.3	J	h	< 0.1			< 0.1			< 0.1						0.1
4-F	Oil & Grease	O&G	mg/L			4			< 2			< 2			< 5						2
4-F	Orthophosphate as P	O-P (T)	mg-P/L			0.17	J	h	< 0.03			< 0.03			0.05						0.06
4-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			< 0.03						< 0.03
4-F	pH (Lab value)	pH-L	pH Units			9.2	J	h	9.7	J	h	9.7			7.8						
4-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.20			< 0.03			< 0.03			< 0.03						< 0.03
4-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.28			< 0.03			0.69			0.13						0.10
4-F	Potassium	K	mg/L			13			3.4			3.1			5.6						6.2
4-F	Silicon (as Si)	Si	mg/L			5.9			1.6			26			0.5						8.2
4-F	Sodium	Na	mg/L			363			137			65			274						68
4-F	Specific Conductance (Lab)	EC-L	umhos/cm			1520			639			304			1800						
4-F	Sulfate as SO4	SO4	mg/L			< 1.0			< 1.0			< 1.0			< 1.0						3.8
4-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			20			45			41			14						59
4-F	Total Dissolved Solids	TDS	mg/L			932			320			396			1100						220
4-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.1			6.1			0.9			0.2				U	y, x	1.3
4-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			< 0.1			0.3			0.5			0.2				U	y, x	0.8
4-F	Total Organic Carbon	TOC	mg/L	U	x	6.1			2.4			3.0	J	Q	3.1						89
4-F	Total Suspended Solids	TSS	mg/L			70			23			93			54						24
4-F	Turbidity (Lab)	Turb-L	NTU			166	J	h	34.7			597			130						
4-F	Zinc	Zn-T	ug/L			47			14			6			< 5						24
4-F	Zinc - Dissolved	Zn-D	ug/L			< 5			< 5			< 5			42						< 5

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
5-F	Run #	Run #	-			1			2			3			4			5			6
5-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
5-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
5-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
5-F	Pilot Plant ID #	Plant ID#	-			01-5-F			02-5-F			03-5-F			04-05-F			05-5-F			not run
5-F	Lab #	Lab #	-			0202540-01			0203253-01			0203285-01			T-20292-09			T-20333-14			
5-F	Turbidity - Field	Turb-F	NTU			573			47.8			830			538			79.6			
5-F	Temp - Field	Temp-F	C			14.2			10.4			9.1			10.8			10.3			
5-F	EC - Field	EC-F	umhos/cm			2235			370			473			2267			656			
5-F	pH - Field	pH-F	pH Units			8.3			8.1			7.5			8.7			8.8			
5-F	Drain Time (first fill)	Drain 1	min			0.58			0.81			1.40			1.33			120.08			
5-F	Drain Time (second fill)	Drain 2	min			0.80			1.48			1.45			2.30			9999.00			
5-F	Acid Soluble Aluminum	Al-AS	ug/L			4300	J	h	1400	J	h	3100			1500			1000			
5-F	Aluminum	Al-T	ug/L			12000			3300			32000			3900			2400			
5-F	Aluminum - Dissolved	Al-D	ug/L			340			530			29			120			350			
5-F	Ammonia as N	NH4	mg-N/L			0.1			< 0.1			< 0.1			0.1			0.4			
5-F	Ammonia as N, dissolved	NH4-D	mg-N/L			0.1			< 0.1			< 0.1									
5-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			38			56			34			55			97			
5-F	Boron	B	mg/L			0.10			< 0.02			< 0.02			< 0.02			0.06			
5-F	Cadmium	Cd-T	ug/L			0.3			< 0.2			0.4			0.2			< 0.2			
5-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
5-F	Calcium	Ca	mg/L			12.2			13.9			12.3			10.8			9.3			
5-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			7			< 1			
5-F	Chloride	Cl	mg/L			720			68			106			790			210			
5-F	Chromium	Cr-T	ug/L			8.3			3.4			20.0			12.9			6.9			
5-F	Chromium - Dissolved	Cr-D	ug/L			< 1.0			1.1			< 1.0			1.9			1.4			
5-F	Copper	Cu-T	ug/L			23			6.9			33			30			12			
5-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			4.1			1.6			2.6			5.1			
5-F	Dissolved Organic Carbon	DOC	mg/L			4.6			8.3			6.7			6.6			36			
5-F	Hardness	Hard	mg-CaCO3/L			56			60			60			56			37			
5-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			32			52			23									
5-F	Iron	Fe-T	ug/L			12100			1680			28800			14000			3600			
5-F	Iron - Dissolved	Fe-D	ug/L			< 25			48			< 25			< 25			260			
5-F	Lead	Pb-T	ug/L			11			3.4			54			16			4.5			
5-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
5-F	Magnesium	Mg	mg/L			6.2			6.2			7.1			7.0			3.3			
5-F	Nickel	Ni-T	ug/L			8.6			2.2			11			11			2.8			
5-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			
5-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			< 0.1			< 0.1			0.2			
5-F	Nitrite as N	NO2	mg-N/L			0.3	J	h	< 0.1			< 0.1			< 0.1			< 0.1			
5-F	Oil & Grease	O&G	mg/L			4			< 2			< 2			< 5			< 5			
5-F	Orthophosphate as P	O-P (T)	mg-P/L			0.16	J	h	0.19			< 0.03			0.27			0.07			
5-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	0.10			< 0.03			0.10			0.06			
5-F	pH (Lab value)	pH-L	pH Units			8.2	J	h	8.0	J	h	7.3			8.8			7.9			
5-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.23			< 0.03			< 0.03			0.10	U	x	0.13			
5-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.42			0.06			0.87			0.63			0.30			
5-F	Potassium	K	mg/L			3.6			2.4			2.9			3.0			2.6			
5-F	Silicon (as Si)	Si	mg/L			26			10			38			34			8.0			
5-F	Sodium	Na	mg/L			461			48			72			359			182			
5-F	Specific Conductance (Lab)	EC-L	umhos/cm			1840			301			400			2200			870			
5-F	Sulfate as SO4	SO4	mg/L			1.8			14.7			3.2			2.2			4.4			
5-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			38			56			34			61			97			
5-F	Total Dissolved Solids	TDS	mg/L			974			128			484			1400			540			
5-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.7			0.6			0.4			0.7			1.4			
5-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.3			0.6			0.3			0.3			1.1			
5-F	Total Organic Carbon	TOC	mg/L	U	x	6.5			8.6			6.8			6.9			36			
5-F	Total Suspended Solids	TSS	mg/L			252			23			174			250			84			
5-F	Turbidity (Lab)	Turb-L	NTU			355	J	h	45.9			805			360			68.0			
5-F	Zinc	Zn-T	ug/L			110			33			270			110			50			
5-F	Zinc - Dissolved	Zn-D	ug/L			< 5			6			< 5			< 5			< 5			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
6-F	Run #	Run #	-			1			2			3			4			5			6
6-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02									
6-F	Lab Name	Lab	-						PatChem			PatChem									
6-F	Water Source	Source	-			On-Site			Wetland			S-Yard									
6-F	Pilot Plant ID #	Plant ID#	-			01-6-F			02-6-F			03-6-F			not run			not run			not run
6-F	Lab #	Lab #	-						0203250-01			0203258-01									
6-F	Turbidity - Field	Turb-F	NTU			34.1			26.7			204									
6-F	Temp - Field	Temp-F	C			13.9			10.3			8.8									
6-F	EC - Field	EC-F	umhos/cm			2047			340			465									
6-F	pH - Field	pH-F	pH Units			7.2			7.6			7.3									
6-F	Drain Time (first fill)	Drain 1	min			1140.00			4.83			90.00									
6-F	Drain Time (second fill)	Drain 2	min			1140.00			7.58			1440.00									
6-F	Acid Soluble Aluminum	Al-AS	ug/L				J	h	130	J	h	980									
6-F	Aluminum	Al-T	ug/L						1100			9700									
6-F	Aluminum - Dissolved	Al-D	ug/L						< 25			< 25									
6-F	Ammonia as N	NH4	mg-N/L						< 0.1			< 0.1									
6-F	Ammonia as N, dissolved	NH4-D	mg-N/L						< 0.1			< 0.1									
6-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L						39			28									
6-F	Boron	B	mg/L						< 0.02			< 0.02									
6-F	Cadmium	Cd-T	ug/L						< 0.2			< 0.2									
6-F	Cadmium - Dissolved	Cd-D	ug/L						< 0.2			< 0.2									
6-F	Calcium	Ca	mg/L						9.2			8.2									
6-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L						< 1			< 1									
6-F	Chloride	Cl	mg/L						60			118									
6-F	Chromium	Cr-T	ug/L						2.9			7.2									
6-F	Chromium - Dissolved	Cr-D	ug/L						1.1			1.1									
6-F	Copper	Cu-T	ug/L						5.2			11									
6-F	Copper - Dissolved	Cu-D	ug/L						3.8			1.7									
6-F	Dissolved Organic Carbon	DOC	mg/L						8.8			5.6									
6-F	Hardness	Hard	mg-CaCO3/L						40			39									
6-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L						34			26									
6-F	Iron	Fe-T	ug/L						618			9140									
6-F	Iron - Dissolved	Fe-D	ug/L						70			< 25									
6-F	Lead	Pb-T	ug/L						1.9			16									
6-F	Lead - Dissolved	Pb-D	ug/L						< 1.0			2.4									
6-F	Magnesium	Mg	mg/L						4.3			4.5									
6-F	Nickel	Ni-T	ug/L						< 2.0			3.8									
6-F	Nickel - Dissolved	Ni-D	ug/L						< 2.0			< 2.0									
6-F	Nitrate as N	NO3	mg-N/L				J	h	< 0.1			< 0.1									
6-F	Nitrite as N	NO2	mg-N/L				J	h	0.1			< 0.1									
6-F	Oil & Grease	O&G	mg/L						< 2			< 2									
6-F	Orthophosphate as P	O-P (T)	mg-P/L				J	h	0.17			< 0.03									
6-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L				J	h	0.11			< 0.03									
6-F	pH (Lab value)	pH-L	pH Units				J	h	7.0	J	h	7.0									
6-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L						< 0.03			< 0.03									
6-F	Phosphorus, Total as P	Phos - T	mg-P/L						< 0.03			0.23									
6-F	Potassium	K	mg/L						2.5			3.1									
6-F	Silicon (as Si)	Si	mg/L						8.2			14									
6-F	Sodium	Na	mg/L						46			74									
6-F	Specific Conductance (Lab)	EC-L	umhos/cm						268			371									
6-F	Sulfate as SO4	SO4	mg/L						16.2			3.4									
6-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L						39			28									
6-F	Total Dissolved Solids	TDS	mg/L						172			316									
6-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L						1.1			0.4									
6-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L						0.7			0.3									
6-F	Total Organic Carbon	TOC	mg/L	U	x				9.5			6.0									
6-F	Total Suspended Solids	TSS	mg/L						18			21									
6-F	Turbidity (Lab)	Turb-L	NTU				J	h	27.4			262									
6-F	Zinc	Zn-T	ug/L						17			70									
6-F	Zinc - Dissolved	Zn-D	ug/L						6			< 5									

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
7-F	Run #	Run #	-			1			2			3			4			5			6
7-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02									
7-F	Lab Name	Lab	-			PatChem			PatChem			PatChem									
7-F	Water Source	Source	-			On-Site			Wetland			S-Yard									
7-F	Pilot Plant ID #	Plant ID#	-			01-7-F			02-7-F			03-7-F			not run			not run			not run
7-F	Lab #	Lab #	-			0202524-01			0203269-01			0203249-01									
7-F	Turbidity - Field	Turb-F	NTU			79.1			39.7			225									
7-F	Temp - Field	Temp-F	C			13.9			10.8			8.8									
7-F	EC - Field	EC-F	umhos/cm			2177			286			459									
7-F	pH - Field	pH-F	pH Units			7.2			7.6			7.4									
7-F	Drain Time (first fill)	Drain 1	min			0.63			1.45			60.00									
7-F	Drain Time (second fill)	Drain 2	min			7.35			4.18			1440.00									
7-F	Acid Soluble Aluminum	Al-AS	ug/L			600	J	h	200			540									
7-F	Aluminum	Al-T	ug/L			2800			1500			12000									
7-F	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			130									
7-F	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1			< 0.1									
7-F	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
7-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			17			40			26									
7-F	Boron	B	mg/L			0.09			< 0.02			< 0.02									
7-F	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2									
7-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2									
7-F	Calcium	Ca	mg/L			34.4			6.9			7.7									
7-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1									
7-F	Chloride	Cl	mg/L			702			160			106									
7-F	Chromium	Cr-T	ug/L			4.5			2.9			8.0									
7-F	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0			1.1									
7-F	Copper	Cu-T	ug/L			6.2			6.4			14									
7-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			4.3			2.2									
7-F	Dissolved Organic Carbon	DOC	mg/L			4.5			8.7			5.7									
7-F	Hardness	Hard	mg-CaCO3/L			131			30			36									
7-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			127			21			24									
7-F	Iron	Fe-T	ug/L			2730			1100			10200									
7-F	Iron - Dissolved	Fe-D	ug/L			< 25			62			93									
7-F	Lead	Pb-T	ug/L			2.9			2.6			19									
7-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0									
7-F	Magnesium	Mg	mg/L			11.0			3.2			4.0									
7-F	Nickel	Ni-T	ug/L			3.5			< 2.0			4.4									
7-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0									
7-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			< 0.1									
7-F	Nitrite as N	NO2	mg-N/L			0.2	J	h	< 0.1			< 0.1									
7-F	Oil & Grease	O&G	mg/L			4			< 2			< 2									
7-F	Orthophosphate as P	O-P (T)	mg-P/L			0.06	J	h	0.10			< 0.03									
7-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03									
7-F	pH (Lab value)	pH-L	pH Units			7.0	J	h	7.0	J	h	6.8									
7-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.21			< 0.03			< 0.03									
7-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.24			0.19			0.22									
7-F	Potassium	K	mg/L			5.7			1.6			2.7									
7-F	Silicon (as Si)	Si	mg/L			8.4			8.8			16									
7-F	Sodium	Na	mg/L			388			42			72									
7-F	Specific Conductance (Lab)	EC-L	umhos/cm			1680			245			366									
7-F	Sulfate as SO4	SO4	mg/L			1.8			14.8			3.4									
7-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			17			40			26									
7-F	Total Dissolved Solids	TDS	mg/L			1322			156			336									
7-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.9			0.4			0.5									
7-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.4			0.2			< 0.1									
7-F	Total Organic Carbon	TOC	mg/L	U	x	4.5			9.0			5.8									
7-F	Total Suspended Solids	TSS	mg/L			56			25			34									
7-F	Turbidity (Lab)	Turb-L	NTU			28.6	J	h	30.9			234									
7-F	Zinc	Zn-T	ug/L			25			21			79									
7-F	Zinc - Dissolved	Zn-D	ug/L			6			7			< 5									

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
8-F	Run #	Run #	-			1			2			3			4			5			6
8-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
8-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
8-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
8-F	Pilot Plant ID #	Plant ID#	-			01-8-F			02-8-F			03-8-F			04-08-F			05-8-F			not run
8-F	Lab #	Lab #	-			0202533-01			0203273-01			0203256-01			T-20292-20			T-20333-21			
8-F	Turbidity - Field	Turb-F	NTU			1.2			62.1			6.2			8.2			60.7			
8-F	Temp - Field	Temp-F	C			13.9			10.5			8.8			10.7			9.9			
8-F	EC - Field	EC-F	umhos/cm			2213			333			493			2235			394			
8-F	pH - Field	pH-F	pH Units			7.3			7.5			7.2			7.2			7.1			
8-F	Drain Time (first fill)	Drain 1	min			4.70			5.60			15.50			34.00			4.10			
8-F	Drain Time (second fill)	Drain 2	min			6.08			8.90			65.00			9999.00			6.17			
8-F	Acid Soluble Aluminum	Al-AS	ug/L			< 25	J	h	580	J	h	78			42			870			
8-F	Aluminum	Al-T	ug/L			52			2100			270			170			2400			
8-F	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25			< 25			110			
8-F	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1			< 0.1			< 0.1			0.3			
8-F	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
8-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			12			32			19			16			42			
8-F	Boron	B	mg/L			0.10			< 0.02			< 0.02			0.02			0.07			
8-F	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
8-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
8-F	Calcium	Ca	mg/L			16.3			9.8			8.5			24.9			9.7			
8-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
8-F	Chloride	Cl	mg/L			714			67			116			720			110			
8-F	Chromium	Cr-T	ug/L			2.8			1.7			1.2			1.7			7.6			
8-F	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0			1.1			1.5			< 1.0			
8-F	Copper	Cu-T	ug/L			< 1.0			7.2			2.5			1.3			9.3			
8-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			5.6			1.4			2.5			2.8			
8-F	Dissolved Organic Carbon	DOC	mg/L			3.5			4.9			4			4.9			36			
8-F	Hardness	Hard	mg-CaCO3/L			62			48			36			91			38			
8-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			61			32			29									
8-F	Iron	Fe-T	ug/L			< 25			1440			< 25			430			2700			
8-F	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			< 25			< 25			130			
8-F	Lead	Pb-T	ug/L			< 1.0			1.4			< 1.0			< 1.0			4.8			
8-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
8-F	Magnesium	Mg	mg/L			5.1			5.6			3.7			6.9			3.3			
8-F	Nickel	Ni-T	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			2.9			
8-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			
8-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			0.9			< 0.1			0.1			
8-F	Nitrite as N	NO2	mg-N/L			< 0.1	J	h	< 0.1			< 0.1			< 0.1			< 0.1			
8-F	Oil & Grease	O&G	mg/L			< 2			< 2			< 2			< 5			< 5			
8-F	Orthophosphate as P	O-P (T)	mg-P/L			0.05	J	h	< 0.03			< 0.03			0.05			0.05			
8-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			< 0.03			< 0.03			
8-F	pH (Lab value)	pH-L	pH Units			6.7	J	h	6.7	J	h	6.8			7.0			6.9			
8-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.23			< 0.03			< 0.03			< 0.03	U	x	0.06			
8-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.63			0.07			< 0.03			0.06	U	x	0.26			
8-F	Potassium	K	mg/L			5.1			2.4			2.3			4.9			3.8			
8-F	Silicon (as Si)	Si	mg/L			2.2			10			1.6			2.2			5.3			
8-F	Sodium	Na	mg/L			418			44			73			337			96			
8-F	Specific Conductance (Lab)	EC-L	umhos/cm			1830			286			402			2300			460			
8-F	Sulfate as SO4	SO4	mg/L			3.6			17.7			6.1			5.8			5.7			
8-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			12			32			19			16			42			
8-F	Total Dissolved Solids	TDS	mg/L			1220			108			200			1300			320			
8-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			3.1			0.3			0.2			0.3			1.4			
8-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			2.4			< 0.1			0.1			0.2			0.9			
8-F	Total Organic Carbon	TOC	mg/L	U	x	4.0			5.1			4.2			4.8			43			
8-F	Total Suspended Solids	TSS	mg/L			< 1			36			4			4			38			
8-F	Turbidity (Lab)	Turb-L	NTU			0.7	J	h	50.3			5.4			10.0			56.0			
8-F	Zinc	Zn-T	ug/L			< 5			18			< 5			< 5			60			
8-F	Zinc - Dissolved	Zn-D	ug/L			< 5			< 5			< 5			< 5			6			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
9-F	Run #	Run #	-			1			2			3			4			5			6
9-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
9-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
9-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
9-F	Pilot Plant ID #	Plant ID#	-			01-9-F			02-9-F			03-9-F			04-09-F			05-9-F			not run
9-F	Lab #	Lab #	-			0202532-01			0203251-01			0203272-01			T-20292-31			T-20333-22			
9-F	Turbidity - Field	Turb-F	NTU			162			182			430			535			101			
9-F	Temp - Field	Temp-F	C			14.2			10.4			9.0			10.8			9.3			
9-F	EC - Field	EC-F	umhos/cm			2206			286			493			2235			381			
9-F	pH - Field	pH-F	pH Units			7.1			7.4			7.2			6.9			7.0			
9-F	Drain Time (first fill)	Drain 1	min			0.00			0.00			1.56			0.00			0.13			
9-F	Drain Time (second fill)	Drain 2	min			1.00			1.13			1.61			2.00			0.33			
9-F	Acid Soluble Aluminum	Al-AS	ug/L			1400	J	h	2100	J	h	3000			1400			910			
9-F	Aluminum	Al-T	ug/L			3700			7700			17000			3400			2700			
9-F	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25			< 25			130			
9-F	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1			< 0.1			< 0.1			0.3			
9-F	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
9-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			13			29			18			12			42			
9-F	Boron	B	mg/L			0.08			< 0.02			< 0.02			< 0.02			0.05			
9-F	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			0.3			0.2			< 0.2			
9-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
9-F	Calcium	Ca	mg/L			33.9			8.6			9.9			33.5			9.3			
9-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
9-F	Chloride	Cl	mg/L			694			55			120			750			110			
9-F	Chromium	Cr-T	ug/L			8.7			5.4			11.0			10.7			7.9			
9-F	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0			< 1.0			1.5			< 1.0			
9-F	Copper	Cu-T	ug/L			6.9			15			20			24			11			
9-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			2.0			< 1.0			2.1			5.0			
9-F	Dissolved Organic Carbon	DOC	mg/L			5.1			4.6			4.8			5.2			38			
9-F	Hardness	Hard	mg-CaCO3/L			130			43			51			133			39			
9-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			128			25			25									
9-F	Iron	Fe-T	ug/L			2960			6510			14400			13000			4100			
9-F	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			< 25			< 25			140			
9-F	Lead	Pb-T	ug/L			3.4			4.3			25			15			6.6			
9-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
9-F	Magnesium	Mg	mg/L			10.9			5.2			6.5			12.1			4.0			
9-F	Nickel	Ni-T	ug/L			9.9			6.5			7.2			10			3.6			
9-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			
9-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			< 0.1			0.1			0.1			
9-F	Nitrite as N	NO2	mg-N/L			0.2	J	h	< 0.1			< 0.1			< 0.1			< 0.1			
9-F	Oil & Grease	O&G	mg/L			3			4			< 2			< 5			< 5			
9-F	Orthophosphate as P	O-P (T)	mg-P/L			0.05	J	h	0.13			0.04			0.47			0.07			
9-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			0.07			< 0.03			
9-F	pH (Lab value)	pH-L	pH Units			6.6	J	h	6.8	J	h	6.6			6.8			6.9			
9-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.20			0.25			< 0.03			0.07	U	x	0.06			
9-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.46			0.46			0.46			0.48	U	x	0.28			
9-F	Potassium	K	mg/L			5.5			2.9			3.2			5.4			3.6			
9-F	Silicon (as Si)	Si	mg/L			7.5			20			20			19			6.4			
9-F	Sodium	Na	mg/L			405			40			76			333			100			
9-F	Specific Conductance (Lab)	EC-L	umhos/cm			1850			224			439			2300			460			
9-F	Sulfate as SO4	SO4	mg/L			3.4			17.5			6.0			5.1			5.9			
9-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			13			29			18			12			42			
9-F	Total Dissolved Solids	TDS	mg/L			1228			108			200			1300			320			
9-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			3.2			0.3			0.6			0.6			1.5			
9-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			1.8			< 0.1			< 0.1			0.2			0.9			
9-F	Total Organic Carbon	TOC	mg/L	U	x	5.1			4.6			5.8			5.0			43			
9-F	Total Suspended Solids	TSS	mg/L			105			168			247			310			66			
9-F	Turbidity (Lab)	Turb-L	NTU			119	J	h	147			329			310			83			
9-F	Zinc	Zn-T	ug/L			85			47			130			93			82			
9-F	Zinc - Dissolved	Zn-D	ug/L			< 5			< 5			< 5			< 5			11			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
10-S	Run #	Run #	-			1			2			3			4			5			6
10-S	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			11/8/2002
10-S	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			ToxScan
10-S	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			Roadside Basins
10-S	Pilot Plant ID #	Plant ID#	-			01-10-S			02-10-S			03-10-S			04-10-S			05-10-S			06-10-S
10-S	Lab #	Lab #	-			0202517-01			0203271-01			0203242-01			T-20292-10			T-20333-16			T-20661-20
10-S	Turbidity - Field	Turb-F	NTU			850			99.5			1046			850			165			164
10-S	Temp - Field	Temp-F	C			14.3			10.3			9.0			10.4			9.7			10.2
10-S	EC - Field	EC-F	umhos/cm			2275			196			477			2282			359			135
10-S	pH - Field	pH-F	pH Units			7.5			7.4			7.3			7.3			7.2			6.4
10-S	Drain Time (first fill)	Drain 1	min			18.00			NA			24.00			NA			NA			NA
10-S	Drain Time (second fill)	Drain 2	min			21.50			NA			26.50			NA			NA			NA
10-S	Acid Soluble Aluminum	Al-AS	ug/L			2800	J	h	290			2300			880			190			1300
10-S	Aluminum	Al-T	ug/L			10000			2800			30000			3600			1100			2200
10-S	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25			< 25			46			370
10-S	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1			< 0.1			0.1			0.6			1.2
10-S	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
10-S	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			19			44			28			21			5			
10-S	Boron	B	mg/L			0.11			< 0.02			< 0.02			< 0.02			0.04			0.04
10-S	Cadmium	Cd-T	ug/L			0.4			< 0.2			0.6			0.4			0.2			0.3
10-S	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2
10-S	Calcium	Ca	mg/L			10.3			15.2			11.5			9.4			10.9			8.4
10-S	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
10-S	Chloride	Cl	mg/L			746			16			112			830			110			12
10-S	Chromium	Cr-T	ug/L			10.0			4.0			23.0			13.9			9.5			8.2
10-S	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0			< 1.0			1.9			1.1			5.9
10-S	Copper	Cu-T	ug/L			28			7.8			39			35			13			15
10-S	Copper - Dissolved	Cu-D	ug/L			< 1.0			3.5			1.4			26			2.7			10
10-S	Dissolved Organic Carbon	DOC	mg/L			4.2			9.2			5.6			5.8			38			
10-S	Hardness	Hard	mg-CaCO3/L			51			69			51			54			36			75
10-S	Hardness - Dissolved	Hard-D	mg-CaCO3/L			22			49			20									
10-S	Iron	Fe-T	ug/L			14400			2370			30900			19000			6400			3100
10-S	Iron - Dissolved	Fe-D	ug/L			< 25			69			< 25			< 25			440	J	Z	180
10-S	Lead	Pb-T	ug/L			15			4.9			63			22			13			10
10-S	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0
10-S	Magnesium	Mg	mg/L			6.2			7.5			5.4			7.4			2.2			2.0
10-S	Nickel	Ni-T	ug/L			11			2.6			13			14			5.3			4.5
10-S	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			2.6			3.3
10-S	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			< 0.1			< 0.1			0.2	J	d	0.6
10-S	Nitrite as N	NO2	mg-N/L			0.3	J	h	< 0.1			< 0.1			< 0.1			< 0.1			0.2
10-S	Oil & Grease	O&G	mg/L			7			< 2			< 2			8			< 5			5
10-S	Orthophosphate as P	O-P (T)	mg-P/L			0.21	J	h	0.12			< 0.03			0.39			0.10	J	Q	0.19
10-S	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			0.09			< 0.03	J	Q	0.46
10-S	pH (Lab value)	pH-L	pH Units			7.0	J	h	6.9	J	h	6.8			7.1			6.9			
10-S	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.20			< 0.03			< 0.03			0.08	U	x	0.09			0.50
10-S	Phosphorus, Total as P	Phos - T	mg-P/L			0.57			0.22			0.96			0.82			0.40			0.97
10-S	Potassium	K	mg/L			3.7			2.7			3.1			3.2			2.5			7.0
10-S	Silicon (as Si)	Si	mg/L			26			11			37			30			6.7			17
10-S	Sodium	Na	mg/L			470			10			75			360			95			17
10-S	Specific Conductance (Lab)	EC-L	umhos/cm			1740			169			383			2300			460			
10-S	Sulfate as SO4	SO4	mg/L			1.5			15.2			2.4			2.0			4.5			5.2
10-S	Total Alkalinity	Tot-Alk	mg-CaCO3/L			19			44			28			21			4.8			27
10-S	Total Dissolved Solids	TDS	mg/L			1158			112			456			1300			310			320
10-S	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.8			0.7			2.2			0.9			1.9			4.3
10-S	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.3			0.3			1.3			0.3			1.4			2.8
10-S	Total Organic Carbon	TOC	mg/L	U	x	4.4			11.8			6.6			5.5			42			190
10-S	Total Suspended Solids	TSS	mg/L			345			38			277			460			< 1			110
10-S	Turbidity (Lab)	Turb-L	NTU			524	J	h	47.2			985			460			110			
10-S	Zinc	Zn-T	ug/L			180			95			340			155			392			510
10-S	Zinc - Dissolved	Zn-D	ug/L			14			46			7			11			150			310

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
10-F	Run #	Run #	-			1			2			3			4			5			6
10-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			11/8/2002
10-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			ToxScan
10-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			Roadside Basins
10-F	Pilot Plant ID #	Plant ID#	-			01-10-F			02-10-F			03-10-F			04-10-F			05-10-F			06-10-F
10-F	Lab #	Lab #	-			0202531-01			0203266-01			0203231-01			T-20292-27			T-20333-15			T-20661-18
10-F	Turbidity - Field	Turb-F	NTU			297			99.5			816			370			153			260
10-F	Temp - Field	Temp-F	C			14.2			10.6			9.4			10.6			10.2			10.9
10-F	EC - Field	EC-F	umhos/cm			2127			353			467			2171			446			187
10-F	pH - Field	pH-F	pH Units			7.1			7.5			7.3			7.0			7.3			6.9
10-F	Drain Time (first fill)	Drain 1	min			18.00			NA			24.00			6.25			49.00			105.00
10-F	Drain Time (second fill)	Drain 2	min			21.50			NA			26.50			77.00			120.45			198.00
10-F	Acid Soluble Aluminum	Al-AS	ug/L			1300	J	h	440	J	h	2100			440			320			1300
10-F	Aluminum	Al-T	ug/L			3100			3500			27000			2300			1400			3000
10-F	Aluminum - Dissolved	Al-D	ug/L			< 25			33			< 25			< 25			33			250
10-F	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1			< 0.1			< 0.1			0.2			0.4
10-F	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
10-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			16			38			26			19			49			
10-F	Boron	B	mg/L			0.10			< 0.02			0.03			< 0.02			0.05			0.05
10-F	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			0.4			< 0.2			< 0.2			< 0.2
10-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2
10-F	Calcium	Ca	mg/L			65.1			6.2			6.1			47.9			6.7			2.9
10-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
10-F	Chloride	Cl	mg/L			663			71			105			740			140			19
10-F	Chromium	Cr-T	ug/L			3.0			3.8			19.0			8.4			7.3			6.4
10-F	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0			< 1.0			1.7			< 1.0			5.5
10-F	Copper	Cu-T	ug/L			8.4			10			34			22			16			22
10-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			5.3			1.9			2.3			6.1			17
10-F	Dissolved Organic Carbon	DOC	mg/L			4.3			8.5			13.8			6.2			37			
10-F	Hardness	Hard	mg-CaCO3/L			235			26			36			177			29			51
10-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			224			18			12									
10-F	Iron	Fe-T	ug/L			3140			2660			27400			10000			6800			6800
10-F	Iron - Dissolved	Fe-D	ug/L			< 25			63			< 25			< 25			310	J	Z	230
10-F	Lead	Pb-T	ug/L			5.3			3.6			50			12			6.2			5.8
10-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0
10-F	Magnesium	Mg	mg/L			17.6			2.7			5.0			13.9			3.0			1.8
10-F	Nickel	Ni-T	ug/L			4.0			2.7			11			7.6			3.2			2.4
10-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0
10-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			0.3			< 0.1			< 0.1	J	d	1.0
10-F	Nitrite as N	NO2	mg-N/L			< 0.1	J	h	< 0.1			< 0.1			< 0.1			< 0.1			< 0.1
10-F	Oil & Grease	O&G	mg/L			3			< 2			< 2			< 5			< 5			< 2
10-F	Orthophosphate as P	O-P (T)	mg-P/L			0.07	J	h	0.11			0.57			0.33			0.09	J	Q	0.31
10-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	0.05			0.05			0.04			0.05	J	Q	0.42
10-F	pH (Lab value)	pH-L	pH Units			6.9	J	h	7.1	J	h	6.7			7.2			7.1			
10-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.20			< 0.03			0.11			0.05	U	x	0.11			0.43
10-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.47			0.20			0.77			0.38			0.39			0.88
10-F	Potassium	K	mg/L			11.1			1.9			4.1			8.8			3.9			2.0
10-F	Silicon (as Si)	Si	mg/L			8.8			12			39			21			12			45
10-F	Sodium	Na	mg/L			360			54			77			305			120			40
10-F	Specific Conductance (Lab)	EC-L	umhos/cm			1830			314			373			2200			570			
10-F	Sulfate as SO4	SO4	mg/L			2.0			14.5			3.3			2.3			4.6			6.5
10-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			16			38			26			19			49			35
10-F	Total Dissolved Solids	TDS	mg/L			868			208			250			1300			390			380
10-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.7			0.4			3.0			0.5			1.2			2.4
10-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.3			< 0.1			1.1			0.3			1.1			1.8
10-F	Total Organic Carbon	TOC	mg/L	U	x	4.3			9.3			13.9			7.6			43			170
10-F	Total Suspended Solids	TSS	mg/L			130			35			69			180			140			150
10-F	Turbidity (Lab)	Turb-L	NTU			207	J	h	71.1			765			250			130			
10-F	Zinc	Zn-T	ug/L			47			24			220			69			56			45
10-F	Zinc - Dissolved	Zn-D	ug/L			10			< 5			< 5			< 5			8			13

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
11-S	Run #	Run #	-			1			2			3			4			5			6
11-S	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			11/8/2002
11-S	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			ToxScan
11-S	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			Roadside Basins
11-S	Pilot Plant ID #	Plant ID#	-			01-11-S			02-11-S			03-11-S			04-11-S			05-11-S			06-11-S
11-S	Lab #	Lab #	-			0202538-01			0203243-01			0203248-01			T-20292-13			T-20333-10			T-20661-2
11-S	Turbidity - Field	Turb-F	NTU			60.1			17.2			63.5			24.6			50.8			155
11-S	Temp - Field	Temp-F	C			14.2			10.3			8.9			10.5			9.4			9.5
11-S	EC - Field	EC-F	umhos/cm			2291			222			504			2342			391			161
11-S	pH - Field	pH-F	pH Units			7.1			7.3			7.1			6.8			6.9			6.3
11-S	Drain Time (first fill)	Drain 1	min			9.00			8.00			8.92			NA			NA			NA
11-S	Drain Time (second fill)	Drain 2	min			10.00			9.50			9.00			NA			NA			NA
11-S	Acid Soluble Aluminum	Al-AS	ug/L			1000	J	h	1300			640			390			3200			3500
11-S	Aluminum	Al-T	ug/L			2100			2100			3600			1400			4600			5100
11-S	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25			< 25			84			760
11-S	Ammonia as N	NH4	mg-N/L			0.2			< 0.1			< 0.1			< 0.1			0.5			1.1
11-S	Ammonia as N, dissolved	NH4-D	mg-N/L			0.1			< 0.1			< 0.1									
11-S	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			9			29			17			10			35			
11-S	Boron	B	mg/L			0.07			< 0.02			< 0.02			< 0.02			0.03			0.05
11-S	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			0.2
11-S	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2
11-S	Calcium	Ca	mg/L			8.1			13.9			9.4			5.8			10.5			7.9
11-S	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
11-S	Chloride	Cl	mg/L			712			124			125			790			110			19
11-S	Chromium	Cr-T	ug/L			3.2			1.4			2.7			2.5			6.0			8.6
11-S	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0			1.2			1.6			< 1.0			4.6
11-S	Copper	Cu-T	ug/L			3.0			3.0			3.5			3.0			7.3			15
11-S	Copper - Dissolved	Cu-D	ug/L			< 1.0			1.8			2.7			4.6			1.8			8.6
11-S	Dissolved Organic Carbon	DOC	mg/L			3.6			4.9			3.7			4.3			32			
11-S	Hardness	Hard	mg-CaCO3/L			28			60			28			21			32			91
11-S	Hardness - Dissolved	Hard-D	mg-CaCO3/L			23			53			24									
11-S	Iron	Fe-T	ug/L			1520			284			2140			1400			2400			2200
11-S	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			< 25			< 25			< 25	J	Z	91
11-S	Lead	Pb-T	ug/L			1.6			1.2			4.7			1.3			4.4			7.8
11-S	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0
11-S	Magnesium	Mg	mg/L			2.0			6.2			1.2			1.5			1.5			1.7
11-S	Nickel	Ni-T	ug/L			2.4			< 2.0			< 2.0			< 2.0			3.9			4.5
11-S	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			2.3			3.0
11-S	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.3			< 0.1			< 0.1			0.2	J	d	0.6
11-S	Nitrite as N	NO2	mg-N/L			< 0.1	J	h	< 0.1			< 0.1			< 0.1			< 0.1			0.1
11-S	Oil & Grease	O&G	mg/L			< 2			< 2			< 2			< 5			< 5			6
11-S	Orthophosphate as P	O-P (T)	mg-P/L			0.05	J	h	0.70			0.11			0.05			0.04			0.36
11-S	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			< 0.03			< 0.03			0.07
11-S	pH (Lab value)	pH-L	pH Units			6.6	J	h	6.6			6.5			6.7			6.6			
11-S	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.19			< 0.03			< 0.03			< 0.03	U	x	0.06			0.13
11-S	Phosphorus, Total as P	Phos - T	mg-P/L			0.43			< 0.03			< 0.03			0.05	U	x	0.19			1.10
11-S	Potassium	K	mg/L			1.9			2.6			1.1			1.2			2.3			6.7
11-S	Silicon (as Si)	Si	mg/L			4.6			7.8			4.1			3.3			4.5			13
11-S	Sodium	Na	mg/L			483			14			79			324			97			18
11-S	Specific Conductance (Lab)	EC-L	umhos/cm			1900			169			379			2300			460			
11-S	Sulfate as SO4	SO4	mg/L			3.2			17.7			5.0			4.6			7.2			6.7
11-S	Total Alkalinity	Tot-Alk	mg-CaCO3/L			9			29			17			10			35			20
11-S	Total Dissolved Solids	TDS	mg/L			1044			92			228			1300			310			320
11-S	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			3.3			0.5			< 0.1			0.2			1.6			3.8
11-S	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			2.0			0.1			< 0.1			0.2			1.2			2.8
11-S	Total Organic Carbon	TOC	mg/L	U	x	4.3			6.0			3.9			5.4			44			200
11-S	Total Suspended Solids	TSS	mg/L			25			24			31			10			50			100
11-S	Turbidity (Lab)	Turb-L	NTU			55.0	J	h	14.0			59.6			23.0			47.0			
11-S	Zinc	Zn-T	ug/L			50			57			42			31			267			450
11-S	Zinc - Dissolved	Zn-D	ug/L			14			34			13			15			121			290

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
11-F	Run #	Run #	-			1			2			3			4			5			6
11-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			11/8/2002
11-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			ToxScan
11-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			Roadside Basins
11-F	Pilot Plant ID #	Plant ID#	-			01-11-F			02-11-F			03-11-F			04-11-F			05-11-F			06-11-F
11-F	Lab #	Lab #	-			0202534-01			0203244-01			0203241-01			T-20292-05			T-20333-09			T-20661-1
11-F	Turbidity - Field	Turb-F	NTU			1.0			5.2			3.1			2.3			17.1			129
11-F	Temp - Field	Temp-F	C			14.3			10.8			9.2			10.7			9.9			9.6
11-F	EC - Field	EC-F	umhos/cm			2194			235			495			2251			459			184
11-F	pH - Field	pH-F	pH Units			7.3			7.3			7.1			7.1			6.9			6.5
11-F	Drain Time (first fill)	Drain 1	min			7.20			8.00			8.92			9.50			28.00			8.00
11-F	Drain Time (second fill)	Drain 2	min			10.00			9.50			9.00			11.00			10.67			8.55
11-F	Acid Soluble Aluminum	Al-AS	ug/L			< 25	J	h	72			32			< 25			1800			3900
11-F	Aluminum	Al-T	ug/L			26			220			140			58			2500			4700
11-F	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25			< 25			71			800
11-F	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1			< 0.1			0.1			0.3			0.6
11-F	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
11-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			14			29			20			10			37			
11-F	Boron	B	mg/L			0.09			< 0.02			< 0.02			< 0.02			0.04			0.06
11-F	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2
11-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2
11-F	Calcium	Ca	mg/L			16.1			9.0			7.7			15.9			5.1			5.4
11-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
11-F	Chloride	Cl	mg/L			724			59			116			760			140			= 24
11-F	Chromium	Cr-T	ug/L			6.9			< 1.0			< 1.0			1.5			3.0			7.8
11-F	Chromium - Dissolved	Cr-D	ug/L			1.3			< 1.0			< 1.0			1.6			< 1.0			4.6
11-F	Copper	Cu-T	ug/L			< 1.0			1.7			2.4			< 1.0			4.4			14
11-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			1.4			1.3			1.0			1.9			9.2
11-F	Dissolved Organic Carbon	DOC	mg/L			4.1			4.2			4.1			4.6			30			
11-F	Hardness	Hard	mg-CaCO3/L			61			39			31			57			21			110
11-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			60			35			29									
11-F	Iron	Fe-T	ug/L			< 25			< 25			< 25	U	x	97			1100			2500
11-F	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			< 25			< 25			< 25	J	Z	130
11-F	Lead	Pb-T	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			1.2			5.3
11-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0
11-F	Magnesium	Mg	mg/L			5.1			4.1			2.9			4.1			2.0			2.2
11-F	Nickel	Ni-T	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			3.3
11-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0
11-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	1.0			0.6			< 0.1			0.2	J	d	1.2
11-F	Nitrite as N	NO2	mg-N/L			< 0.1	J	h	< 0.1			< 0.1			< 0.1			< 0.1			< 0.1
11-F	Oil & Grease	O&G	mg/L			< 2			< 2			< 2			< 5			< 5			3
11-F	Orthophosphate as P	O-P (T)	mg-P/L			0.06	J	h	< 0.03			< 0.03			< 0.03			< 0.03			0.42
11-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			< 0.03			< 0.03			0.13
11-F	pH (Lab value)	pH-L	pH Units			6.8	J	h	6.7	J	h	6.9			6.8			6.8			
11-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.26			< 0.03			< 0.03			< 0.03	U	x	0.05			0.17
11-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.43			< 0.03			0.12			0.03	U	x	0.15			0.94
11-F	Potassium	K	mg/L			5.0			2.2			2.2			3.4			2.7			3.1
11-F	Silicon (as Si)	Si	mg/L			2.2			6.9			1.6			1.4			3.8			17
11-F	Sodium	Na	mg/L			420			42			76			326			118			30
11-F	Specific Conductance (Lab)	EC-L	umhos/cm			1830			248			406			2200			570			
11-F	Sulfate as SO4	SO4	mg/L			3.5			17.2			5.7			4.7			7.1			7.5
11-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			14			29			20			13			37			24
11-F	Total Dissolved Solids	TDS	mg/L			1208			140			184			1300			360			340
11-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			3.3			0.6			0.6			0.2			1.1	J	Z	2.7
11-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			2.0			0.1			< 0.1			0.2			0.9	J	Z	2.1
11-F	Total Organic Carbon	TOC	mg/L	U	x	4.3			4.3			4.0			4.0			37			180
11-F	Total Suspended Solids	TSS	mg/L			< 1			3			< 1			2			20			76
11-F	Turbidity (Lab)	Turb-L	NTU			0.6	J	h	3.6			2.3			2.1			19.0			
11-F	Zinc	Zn-T	ug/L			< 5			< 5			< 5			< 5			27			81
11-F	Zinc - Dissolved	Zn-D	ug/L			< 5			< 5			< 5			< 5			< 5			26

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
12-S	Run #	Run #	-			1			2			3			4			5			6
12-S	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
12-S	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
12-S	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
12-S	Pilot Plant ID #	Plant ID#	-			01-12-S			02-12-S			03-12-S			04-12-S			05-12-S			not run
12-S	Lab #	Lab #	-			0202515-01			0203261-01			0203254-01			T-20292-25			T-20333-04			
12-S	Turbidity - Field	Turb-F	NTU			57.2			17.6			57.8			28.8			45.4			
12-S	Temp - Field	Temp-F	C			14.2			10.4			8.9			10.3			10.0			
12-S	EC - Field	EC-F	umhos/cm			2293			222			506			2350			378			
12-S	pH - Field	pH-F	pH Units			7.1			7.3			7.1			6.8			6.7			
12-S	Drain Time (first fill)	Drain 1	min			7.00			5.20			8.00			NA			NA			
12-S	Drain Time (second fill)	Drain 2	min			7.00			8.82			10.00			NA			NA			
12-S	Acid Soluble Aluminum	Al-AS	ug/L			980	J	h	1700	J	h	600			280			3100			
12-S	Aluminum	Al-T	ug/L			2400			2500			3700			1200			4000			
12-S	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25			< 25			78			
12-S	Ammonia as N	NH4	mg-N/L			1.0			< 0.1			< 0.1			< 0.1			0.6			
12-S	Ammonia as N, dissolved	NH4-D	mg-N/L			0.1			< 0.1			< 0.1									
12-S	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			10			28			16			11			35			
12-S	Boron	B	mg/L			< 0.02			< 0.02			< 0.02			< 0.02			0.03			
12-S	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
12-S	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
12-S	Calcium	Ca	mg/L			11.7			14.4			9.4			5.8			10.0			
12-S	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
12-S	Chloride	Cl	mg/L			756			38			127			780			110			
12-S	Chromium	Cr-T	ug/L			2.0			1.5			2.9			2.5			4.6			
12-S	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0			< 1.0			1.6			< 1.0			
12-S	Copper	Cu-T	ug/L			3.8			3.1			3.5			3.2			6.3			
12-S	Copper - Dissolved	Cu-D	ug/L			< 1.0			1.5			< 1.0			1.7			1.5			
12-S	Dissolved Organic Carbon	DOC	mg/L			3.8			4.6			4.1	J	Q	5.7			36			
12-S	Hardness	Hard	mg-CaCO3/L			73			63			29			21			31			
12-S	Hardness - Dissolved	Hard-D	mg-CaCO3/L			25			49			22									
12-S	Iron	Fe-T	ug/L			944			329			2250			1600			2400			
12-S	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			< 25			< 25			31			
12-S	Lead	Pb-T	ug/L			1.7			1.2			4.6			1.6			3.8			
12-S	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
12-S	Magnesium	Mg	mg/L			10.3			6.6			1.3			1.6			1.4			
12-S	Nickel	Ni-T	ug/L			2.3			< 2.0			< 2.0			< 2.0			3.7			
12-S	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			2.2			
12-S	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			0.9			< 0.1			0.3			
12-S	Nitrite as N	NO2	mg-N/L			< 0.1	J	h	< 0.1			< 0.1			< 0.1			< 0.1			
12-S	Oil & Grease	O&G	mg/L			< 2			< 2			< 2			< 5			< 5			
12-S	Orthophosphate as P	O-P (T)	mg-P/L			0.05	J	h	< 0.03			< 0.03			0.06			0.04			
12-S	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			< 0.03			< 0.03			
12-S	pH (Lab value)	pH-L	pH Units			6.5	J	h	6.6	J	h	6.6			6.6			6.6			
12-S	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.19			< 0.03			0.13			< 0.03	U	x	0.06			
12-S	Phosphorus, Total as P	Phos - T	mg-P/L			0.37			0.06			< 0.03			0.06	U	x	0.19			
12-S	Potassium	K	mg/L			24			2.6			1.1			1.2			2.2			
12-S	Silicon (as Si)	Si	mg/L			< 0.5			7.8			4.1			3.2			3.9			
12-S	Sodium	Na	mg/L			381			13			79			359			93			
12-S	Specific Conductance (Lab)	EC-L	umhos/cm			1840			398			402			2300			480			
12-S	Sulfate as SO4	SO4	mg/L			3.3			17.9			5.0			4.6			7.2			
12-S	Total Alkalinity	Tot-Alk	mg-CaCO3/L			10			28			16			11			35			
12-S	Total Dissolved Solids	TDS	mg/L			1054			312			204			1300			310			
12-S	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			1.5			0.2			0.2			0.2			1.6			
12-S	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.8			0.2			< 0.1			0.1			1.5			
12-S	Total Organic Carbon	TOC	mg/L	U	x	6.9			5.5			4.1	J	Q	4.6			46			
12-S	Total Suspended Solids	TSS	mg/L			39			29			36			16			44			
12-S	Turbidity (Lab)	Turb-L	NTU			46.1	J	h	14.5			52.6			26.0			44.0			
12-S	Zinc	Zn-T	ug/L			51			58			44			31			243			
12-S	Zinc - Dissolved	Zn-D	ug/L			14			34			9			15			120			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
12-F	Run #	Run #	-			1			2			3			4			5			6
12-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
12-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
12-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
12-F	Pilot Plant ID #	Plant ID#	-			01-12-F			02-12-F			03-12-F			04-12-F			05-12-F			not run
12-F	Lab #	Lab #	-			0202516-01			0203255-01			0203247-01			T-20292-11			T-20333-03			
12-F	Turbidity - Field	Turb-F	NTU			23.9			41.0			27.7			21.2			64.7			
12-F	Temp - Field	Temp-F	C			14.3			10.8			9.1			10.9			9.9			
12-F	EC - Field	EC-F	umhos/cm			2212			303			496			2231			443			
12-F	pH - Field	pH-F	pH Units			6.9			7.3			7.1			7.0			7.1			
12-F	Drain Time (first fill)	Drain 1	min			7.00			5.20			8.00			9.00			6.00			
12-F	Drain Time (second fill)	Drain 2	min			7.00			8.82			10.00			11.00			6.50			
12-F	Acid Soluble Aluminum	Al-AS	ug/L			320	J	h	540	J	h	280			140			2300			
12-F	Aluminum	Al-T	ug/L			760			1900			1600			330			3700			
12-F	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25			< 25			65			
12-F	Ammonia as N	NH4	mg-N/L			0.1			< 0.1			< 0.1			0.1			0.2			
12-F	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
12-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			11			29			18			11			35			
12-F	Boron	B	mg/L			0.14			< 0.02			< 0.02			< 0.02			0.03			
12-F	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
12-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
12-F	Calcium	Ca	mg/L			34.2			7.6			7.0			30.5			6.1			
12-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
12-F	Chloride	Cl	mg/L			744			67			204			800			150			
12-F	Chromium	Cr-T	ug/L			2.5			2.2			2.2			2.3			4.7			
12-F	Chromium - Dissolved	Cr-D	ug/L			1.2			< 1.0			1.3			1.6			< 1.0			
12-F	Copper	Cu-T	ug/L			1.5			4.6			2.6			2.4			8.4			
12-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			1.7			1.3			1.6			2.2			
12-F	Dissolved Organic Carbon	DOC	mg/L			4.4			4.0			3.8	J	f	4.4			36			
12-F	Hardness	Hard	mg-CaCO3/L			129			34			29			111			27			
12-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			52			24			27									
12-F	Iron	Fe-T	ug/L			793			1140			812			1200			3400			
12-F	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			< 25			< 25			28			
12-F	Lead	Pb-T	ug/L			< 1.0			< 1.0			1.3			< 1.0			3.0			
12-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
12-F	Magnesium	Mg	mg/L			10.6			3.6			2.9			8.5			2.8			
12-F	Nickel	Ni-T	ug/L			2.5			2.5			< 2.0			< 2.0			3.1			
12-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			
12-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	< 0.1			< 0.1			< 0.1			0.2			
12-F	Nitrite as N	NO2	mg-N/L			< 0.1	J	h	< 0.1			< 0.1			< 0.1			< 0.1			
12-F	Oil & Grease	O&G	mg/L			< 2			< 2			< 2			< 5			< 5			
12-F	Orthophosphate as P	O-P (T)	mg-P/L			0.05	J	h	< 0.03			< 0.03			0.04			0.05			
12-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			< 0.03			< 0.03			
12-F	pH (Lab value)	pH-L	pH Units			6.6	J	h	6.8	J	h	6.4			6.7			6.7			
12-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.28			< 0.03			0.09			< 0.03	U	x	0.06			
12-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.29			< 0.03			0.12			0.07	U	x	0.21			
12-F	Potassium	K	mg/L			5.0			1.9			1.9			4.1			2.9			
12-F	Silicon (as Si)	Si	mg/L			3.7			10			3.1			2.7			6.0			
12-F	Sodium	Na	mg/L			417			46			72			319			120			
12-F	Specific Conductance (Lab)	EC-L	umhos/cm			1730			245			372			2300			560			
12-F	Sulfate as SO4	SO4	mg/L			3.5			17.4			5.6			4.8			7.2			
12-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			11			29			18			11			35			
12-F	Total Dissolved Solids	TDS	mg/L			1184			120			200			1300			350			
12-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.8			0.3			0.8			0.3			1.1			
12-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.3			0.1			< 0.1			0.2			0.8			
12-F	Total Organic Carbon	TOC	mg/L	U	x	8.3			4.2			4.1			4.9			44			
12-F	Total Suspended Solids	TSS	mg/L			21			27			21			16			54			
12-F	Turbidity (Lab)	Turb-L	NTU			20.8	J	h	32.1			25.6			22.0			61.0			
12-F	Zinc	Zn-T	ug/L			9			11			9			6			50			
12-F	Zinc - Dissolved	Zn-D	ug/L			< 5			< 5			< 5			< 5			6			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
13-S	Run #	Run #	-			1			2			3			4			5			6
13-S	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
13-S	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
13-S	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
13-S	Pilot Plant ID #	Plant ID#	-			01-13-S			02-13-S			03-13-S			04-13-S			05-13-S			not run
13-S	Lab #	Lab #	-			0202525-01			0203270-01			0203281-01			T-20292-18			T-20333-06			
13-S	Turbidity - Field	Turb-F	NTU			58			10.9			54.9			22.1			41.5			
13-S	Temp - Field	Temp-F	C			13.5			10.4			8.9			10.3			9.6			
13-S	EC - Field	EC-F	umhos/cm			2296			228			503			2350			375			
13-S	pH - Field	pH-F	pH Units			7.1			7.3			7.1			6.8			6.8			
13-S	Drain Time (first fill)	Drain 1	min			7.00			5.78			5.78			NA			NA			
13-S	Drain Time (second fill)	Drain 2	min			7.00			7.17			5.67			NA			NA			
13-S	Acid Soluble Aluminum	Al-AS	ug/L			980			1200	J	h	680			240			2900			
13-S	Aluminum	Al-T	ug/L			3000			1700			3700			1000			3900			
13-S	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25			< 25			75			
13-S	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1			< 0.1			< 0.1			0.6			
13-S	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
13-S	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			11			32			19			11			34			
13-S	Boron	B	mg/L			0.08			< 0.02			< 0.02			< 0.02			0.03			
13-S	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
13-S	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
13-S	Calcium	Ca	mg/L			7.6			14.6			10.4			5.8			10.2			
13-S	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
13-S	Chloride	Cl	mg/L			758			39			138			780			120			
13-S	Chromium	Cr-T	ug/L			2.0			1.1			2.5			2.2			4.9			
13-S	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0			< 1.0			1.6			< 1.0			
13-S	Copper	Cu-T	ug/L			3.9			2.3			3.3			2.5			6.5			
13-S	Copper - Dissolved	Cu-D	ug/L			< 1.0			1.5			< 1.0			1.2			1.5			
13-S	Dissolved Organic Carbon	DOC	mg/L			4.0			6.8			4.6	J	Q	4.3			35			
13-S	Hardness	Hard	mg-CaCO3/L			27			65			36			21			32			
13-S	Hardness - Dissolved	Hard-D	mg-CaCO3/L			25			48			22									
13-S	Iron	Fe-T	ug/L			1920			85			2540			1100			2100			
13-S	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			< 25			< 25			< 25			
13-S	Lead	Pb-T	ug/L			1.8			< 1.0			4.3			1.2			3.8			
13-S	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
13-S	Magnesium	Mg	mg/L			1.9			6.9			2.4			1.4			1.5			
13-S	Nickel	Ni-T	ug/L			2.3			< 2.0			< 2.0			< 2.0			3.8			
13-S	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			2.3			
13-S	Nitrate as N	NO3	mg-N/L			< 0.1			1.0			< 0.1			< 0.1			0.3			
13-S	Nitrite as N	NO2	mg-N/L			< 0.1			< 0.1			< 0.1			< 0.1			< 0.1			
13-S	Oil & Grease	O&G	mg/L			< 2			< 2			< 2			< 5			< 5			
13-S	Orthophosphate as P	O-P (T)	mg-P/L			0.05			< 0.03			< 0.03			0.03			0.04			
13-S	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03			< 0.03			< 0.03			< 0.03			< 0.03			
13-S	pH (Lab value)	pH-L	pH Units			6.6			6.6	J	h	6.6			6.6			6.6			
13-S	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.22			< 0.03			< 0.03			< 0.03	U	x	0.06			
13-S	Phosphorus, Total as P	Phos - T	mg-P/L			0.26			< 0.03			< 0.03			0.03	U	x	0.18			
13-S	Potassium	K	mg/L			1.8			2.5			1.0			1.2			2.2			
13-S	Silicon (as Si)	Si	mg/L			5.9			7.3			4.5			2.6			4.3			
13-S	Sodium	Na	mg/L			475			14			78			340			96			
13-S	Specific Conductance (Lab)	EC-L	umhos/cm			1780			198			419			2400			480			
13-S	Sulfate as SO4	SO4	mg/L			3.3			17.9			5.1			4.7			7.2			
13-S	Total Alkalinity	Tot-Alk	mg-CaCO3/L			11			32			19			11			34			
13-S	Total Dissolved Solids	TDS	mg/L			1160			52			144			1300			310			
13-S	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.2			0.6			< 0.1			0.2			1.6			
13-S	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			< 0.1			0.2			< 0.1			0.2			1.2			
13-S	Total Organic Carbon	TOC	mg/L	U	x	4.6			7.2			4.9	J	Q	3.1			46			
13-S	Total Suspended Solids	TSS	mg/L			24			16			30			14			44			
13-S	Turbidity (Lab)	Turb-L	NTU			46.9			16.3			56.2			19.0			41.0			
13-S	Zinc	Zn-T	ug/L			51			52			45			29			248			
13-S	Zinc - Dissolved	Zn-D	ug/L			13			35			10			15			121			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
13-F	Run #	Run #	-			1			2			3			4			5			6
13-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
13-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
13-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
13-F	Pilot Plant ID #	Plant ID#	-			01-13-F			02-13-F			03-13-F			04-13-F			05-13-F			not run
13-F	Lab #	Lab #	-			0202527-01			0203268-01			0203259-01			T-20292-04			T-20333-05			
13-F	Turbidity - Field	Turb-F	NTU			10.5			21.1			21.5			15.3			25.4			
13-F	Temp - Field	Temp-F	C			14.4			10.9			9.2			10.5			9.9			
13-F	EC - Field	EC-F	umhos/cm			2269			372			523			2282			477			
13-F	pH - Field	pH-F	pH Units			7.8			7.9			7.8			7.6			7.3			
13-F	Drain Time (first fill)	Drain 1	min			7.00			5.78			5.78			6.02			5.00			
13-F	Drain Time (second fill)	Drain 2	min			7.00			7.17			5.67			8.00			6.42			
13-F	Acid Soluble Aluminum	Al-AS	ug/L			170	J	h	280	J	h	310			< 25			1900			
13-F	Aluminum	Al-T	ug/L			550			920			1400			290			3000			
13-F	Aluminum - Dissolved	Al-D	ug/L			< 25			45			38			< 25			68			
13-F	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1			< 0.1			< 0.1			0.3			
13-F	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									
13-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			26			42			32			28			48			
13-F	Boron	B	mg/L			0.13			0.03			< 0.02			0.02			0.04			
13-F	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
13-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
13-F	Calcium	Ca	mg/L			4.8			1.6			0.9			5.7			1.8			
13-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
13-F	Chloride	Cl	mg/L			678			154			120			750			150			
13-F	Chromium	Cr-T	ug/L			2.4			< 1.0			1.5			2.0			3.5			
13-F	Chromium - Dissolved	Cr-D	ug/L			1.7			< 1.0			< 1.0			2.0			< 1.0			
13-F	Copper	Cu-T	ug/L			< 1.0			2.3			2.1			1.1			4.8			
13-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			1.6			1.2			1.0			1.7			
13-F	Dissolved Organic Carbon	DOC	mg/L			4.1			4.6			4.6			3.8			37			
13-F	Hardness	Hard	mg-CaCO3/L			17			8			5			22			8			
13-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			17			3			2									
13-F	Iron	Fe-T	ug/L			499			318			661			740			1600			
13-F	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			< 25			< 25			29			
13-F	Lead	Pb-T	ug/L			< 1.0			< 1.0			1.5			1.0			2.2			
13-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
13-F	Magnesium	Mg	mg/L			1.3			1.1			0.6			1.8			0.9			
13-F	Nickel	Ni-T	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			
13-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			
13-F	Nitrate as N	NO3	mg-N/L			0.3	J	h	1.2			< 0.1			0.4			0.3			
13-F	Nitrite as N	NO2	mg-N/L			< 0.1	J	h	< 0.1			0.1			< 0.1			< 0.1			
13-F	Oil & Grease	O&G	mg/L			< 2			< 2			< 2			< 5			< 5			
13-F	Orthophosphate as P	O-P (T)	mg-P/L			0.05	J	h	0.10			0.18			< 0.03			< 0.03			
13-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			< 0.03			< 0.03			
13-F	pH (Lab value)	pH-L	pH Units			7.2	J	h	7.1	J	h	7.2			7.3			6.9			
13-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.20			< 0.03			< 0.03			< 0.03	U	x	0.06			
13-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.22			< 0.03			< 0.03			< 0.03	U	x	0.15			
13-F	Potassium	K	mg/L			8.2			1.3			1.7			8.1			3.8			
13-F	Silicon (as Si)	Si	mg/L			5.0			9.4			4.9			3.8			6.2			
13-F	Sodium	Na	mg/L			426			70			96			338			139			
13-F	Specific Conductance (Lab)	EC-L	umhos/cm			1830			328			434			2200			590			
13-F	Sulfate as SO4	SO4	mg/L			4.4			18.2			6.1			6.0			7.6			
13-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			26			42			32			28			48			
13-F	Total Dissolved Solids	TDS	mg/L			1168			196			170			1300			400			
13-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.3			0.2			< 0.1			0.3			1.0			
13-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.2			< 0.1			< 0.1			0.2			0.9			
13-F	Total Organic Carbon	TOC	mg/L	U	x	4.7			5.1			5.8			4.6			39			
13-F	Total Suspended Solids	TSS	mg/L			< 1			11			13			< 1			24			
13-F	Turbidity (Lab)	Turb-L	NTU			8.5	J	h	12.6			19.5			14.0			25.0			
13-F	Zinc	Zn-T	ug/L			< 5			6			10			5			32			
13-F	Zinc - Dissolved	Zn-D	ug/L			< 5			< 5			< 5			< 5			< 5			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
14-S	Run #	Run #	-			1			2			3			4			5			6
14-S	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
14-S	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
14-S	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
14-S	Pilot Plant ID #	Plant ID#	-			01-14-S			02-14-S			03-14-S			04-14-S			05-14-S			not run
14-S	Lab #	Lab #	-			0202541-01			0203245-01			0203260-01			T-20292-14			T-20333-12			
14-S	Turbidity - Field	Turb-F	NTU			66.2			8.6			67.9			22.9			37.0			
14-S	Temp - Field	Temp-F	C			14.2			10.5			8.9			10.3			10.1			
14-S	EC - Field	EC-F	umhos/cm			2294			220			506			2348			388			
14-S	pH - Field	pH-F	pH Units			7.1			7.3			7.1			6.8			6.8			
14-S	Drain Time (first fill)	Drain 1	min			9.75			NA			12.07			NA			NA			
14-S	Drain Time (second fill)	Drain 2	min			13.00			NA			12.43			NA			NA			
14-S	Acid Soluble Aluminum	Al-AS	ug/L			1100	J	h	960	J	h	900			310			3100			
14-S	Aluminum	Al-T	ug/L			2500			1200			4000			1000			4000			
14-S	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25			< 25			81			
14-S	Ammonia as N	NH4	mg-N/L			0.1			< 0.1			< 0.1			< 0.1			0.6			
14-S	Ammonia as N, dissolved	NH4-D	mg-N/L			0.1			< 0.1			< 0.1									
14-S	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			11			30			16			11			34			
14-S	Boron	B	mg/L			0.07			< 0.02			< 0.02			< 0.02			0.03			
14-S	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
14-S	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			4.2			< 0.2			
14-S	Calcium	Ca	mg/L			7.9			13.0			9.0			5.7			10.1			
14-S	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
14-S	Chloride	Cl	mg/L			730			37			124			760			120			
14-S	Chromium	Cr-T	ug/L			4.1			< 1.0			2.8			2.2			4.3			
14-S	Chromium - Dissolved	Cr-D	ug/L			3.0			< 1.0			1.1			1.6			< 1.0			
14-S	Copper	Cu-T	ug/L			3.7			2.3			3.9			2.7			6.1			
14-S	Copper - Dissolved	Cu-D	ug/L			< 1.0			1.6			< 1.0			13			1.9			
14-S	Dissolved Organic Carbon	DOC	mg/L			3.7			5.1			3.7			5.0	J	Q	32			
14-S	Hardness	Hard	mg-CaCO3/L			28			56			28			20			31			
14-S	Hardness - Dissolved	Hard-D	mg-CaCO3/L			25			52			23									
14-S	Iron	Fe-T	ug/L			2010			< 25			2470			1200			1900			
14-S	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			< 25			< 25			< 25			
14-S	Lead	Pb-T	ug/L			1.8			< 1.0			4.8			1.2			3.5			
14-S	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
14-S	Magnesium	Mg	mg/L			2.1			5.8			1.3			1.4			1.4			
14-S	Nickel	Ni-T	ug/L			2.1			< 2.0			< 2.0			< 2.0			3.8			
14-S	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			2.3			
14-S	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			< 0.1			< 0.1			0.2			
14-S	Nitrite as N	NO2	mg-N/L			< 0.1	J	h	< 0.1			< 0.1			< 0.1			< 0.1			
14-S	Oil & Grease	O&G	mg/L			< 2			< 2			< 2			< 5			< 5			
14-S	Orthophosphate as P	O-P (T)	mg-P/L			0.07	J	h	< 0.03			< 0.03			< 0.03			0.04			
14-S	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			< 0.03			< 0.03			
14-S	pH (Lab value)	pH-L	pH Units			7.0	J	h	6.6	J	h	6.6			6.7			6.7			
14-S	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.20			0.11			< 0.03			< 0.03	U	x	0.05			
14-S	Phosphorus, Total as P	Phos - T	mg-P/L			0.23			0.12			< 0.03			0.03	U	x	0.17			
14-S	Potassium	K	mg/L			1.8			2.4			1.1			1.2			2.2			
14-S	Silicon (as Si)	Si	mg/L			5.7			6.8			4.4			2.6			4.1			
14-S	Sodium	Na	mg/L			484			12			75			344			98			
14-S	Specific Conductance (Lab)	EC-L	umhos/cm			1900			179			421			2300			480			
14-S	Sulfate as SO4	SO4	mg/L			3.2			17.7			5.0			4.6			7.3			
14-S	Total Alkalinity	Tot-Alk	mg-CaCO3/L			11			30			16			11			34			
14-S	Total Dissolved Solids	TDS	mg/L			1022			72			220			1300			320			
14-S	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.5			1.8			0.4			0.3			1.5			
14-S	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.4			0.3			0.3			0.2			1.4			
14-S	Total Organic Carbon	TOC	mg/L	U	x	4.1			5.2			4.1			6.0	J	Q	36			
14-S	Total Suspended Solids	TSS	mg/L			36			16			44			8			130			
14-S	Turbidity (Lab)	Turb-L	NTU			67.2	J	h	7.6			74.6			20.0			36.0			
14-S	Zinc	Zn-T	ug/L			50			46			44			29			248			
14-S	Zinc - Dissolved	Zn-D	ug/L			14			35			10			20			121			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
14-F	Run #	Run #	-			1			2			3			4			5			6
14-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
14-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
14-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
14-F	Pilot Plant ID #	Plant ID#	-			01-14-F			02-14-F			03-14-F			04-14-F			05-14-F			not run
14-F	Lab #	Lab #	-			0202539-01			0203262-01			0203280-01			T-20292-01			T-20333-11			
14-F	Turbidity - Field	Turb-F	NTU			0.7			0.6			0.6			2.0			2.0			
14-F	Temp - Field	Temp-F	C			14.2			10.9			8.9			10.7			9.5			
14-F	EC - Field	EC-F	umhos/cm			1865			774			407			1905			684			
14-F	pH - Field	pH-F	pH Units			9.3			10.0			9.8			8.5			9.3			
14-F	Drain Time (first fill)	Drain 1	min			9.75			NA			12.07			16.50			12.00			
14-F	Drain Time (second fill)	Drain 2	min			13.00			NA			12.43			18.50			15.00			
14-F	Acid Soluble Aluminum	Al-AS	ug/L			460	J	h	990	J	h	810			240			660			
14-F	Aluminum	Al-T	ug/L			460			1100			940			210			770			
14-F	Aluminum - Dissolved	Al-D	ug/L			460			960			550			240			560			
14-F	Ammonia as N	NH4	mg-N/L			0.2			< 0.1			< 0.1			< 0.1			0.2			
14-F	Ammonia as N, dissolved	NH4-D	mg-N/L			0.2			< 0.1			< 0.1									
14-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			11			13			9			11			19			
14-F	Boron	B	mg/L			0.04			< 0.02			< 0.02			< 0.02			< 0.02			
14-F	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
14-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
14-F	Calcium	Ca	mg/L			1.6			1.3			1.2			1.5			1.5			
14-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			4			24			16			< 1			3			
14-F	Chloride	Cl	mg/L			557			174			96			660			280			
14-F	Chromium	Cr-T	ug/L			< 1.0			1.6			< 1.0			< 1.0			< 1.0			
14-F	Chromium - Dissolved	Cr-D	ug/L			< 1.0			1.1			< 1.0			< 1.0			< 1.0			
14-F	Copper	Cu-T	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
14-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
14-F	Dissolved Organic Carbon	DOC	mg/L			2.6			1.1			2.4			3.4			13			
14-F	Hardness	Hard	mg-CaCO3/L			5			5			9			5			6			
14-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			4			4			< 1									
14-F	Iron	Fe-T	ug/L			< 25			< 25			< 25			< 25	U	x	120			
14-F	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			< 25			< 25			< 25			
14-F	Lead	Pb-T	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
14-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
14-F	Magnesium	Mg	mg/L			0.2			0.5			1.3			0.4			0.5			
14-F	Nickel	Ni-T	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			
14-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			
14-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.6			0.5			< 0.1			0.2			
14-F	Nitrite as N	NO2	mg-N/L			0.4	J	h	< 0.1			< 0.1			< 0.1			< 0.1			
14-F	Oil & Grease	O&G	mg/L			< 2			< 2			< 2			< 5			< 5			
14-F	Orthophosphate as P	O-P (T)	mg-P/L			0.05	J	h	< 0.03			< 0.03			< 0.03			< 0.03			
14-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			< 0.03			< 0.03			
14-F	pH (Lab value)	pH-L	pH Units			9.2	J	h	9.8	J	h	9.6			8.0			8.5			
14-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.19			< 0.03			< 0.03			< 0.03	U	x	0.05			
14-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.25			< 0.03			< 0.03			< 0.03	U	x	0.07			
14-F	Potassium	K	mg/L			12			2.6			1.3			5.1			2.7			
14-F	Silicon (as Si)	Si	mg/L			< 0.5			< 0.5			< 0.5			< 0.5			< 0.5			
14-F	Sodium	Na	mg/L			358			128			69			260			222			
14-F	Specific Conductance (Lab)	EC-L	umhos/cm			1510			625			346			1900			910			
14-F	Sulfate as SO4	SO4	mg/L			< 1.0			< 1.0			20.0			< 1.0			< 1.0			
14-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			15			37			25			11			22			
14-F	Total Dissolved Solids	TDS	mg/L			850			316			88			1000			490			
14-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			3.5			< 0.1			< 0.1			0.2	U	x	0.5			
14-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			2.5			< 0.1			< 0.1			0.2			0.4			
14-F	Total Organic Carbon	TOC	mg/L	U	x	4.7			1.2			2.8			3.8			12			
14-F	Total Suspended Solids	TSS	mg/L			< 1			54			< 1			< 1			34			
14-F	Turbidity (Lab)	Turb-L	NTU			< 0.5	J	h	< 0.5			0.9			1.5			1.7			
14-F	Zinc	Zn-T	ug/L			< 5			< 5			< 5			< 5			< 5			
14-F	Zinc - Dissolved	Zn-D	ug/L			< 5			< 5			< 5			< 5			(T<5) 5			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
15-S	Run #	Run #	-			1			2			3			4			5			6
15-S	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
15-S	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
15-S	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
15-S	Pilot Plant ID #	Plant ID#	-			01-15-S			02-15-S			03-15-S			04-15-S			05-15-S			not run
15-S	Lab #	Lab #	-			0202542-01			0203263-01			0203282-01			T-20292-28			T-20333-08			
15-S	Turbidity - Field	Turb-F	NTU			73.6			9.8			50.2			19.9			30.9			
15-S	Temp - Field	Temp-F	C			14.2			10.4			8.8			10.5			9.5			
15-S	EC - Field	EC-F	umhos/cm			2285			229			503			2341			387			
15-S	pH - Field	pH-F	pH Units			7.1			7.2			7.1			6.8			6.9			
15-S	Drain Time (first fill)	Drain 1	min			7.00			4.70			6.00			NA			NA			
15-S	Drain Time (second fill)	Drain 2	min			7.00			6.08			4.00			NA			NA			
15-S	Acid Soluble Aluminum	Al-AS	ug/L			980	J	h	1200	J	h	670			270			2500			
15-S	Aluminum	Al-T	ug/L			1900			1700			3000			1100			2900			
15-S	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25			< 25			84			
15-S	Ammonia as N	NH4	mg-N/L			0.2			< 0.1			< 0.1			< 0.1			0.5			
15-S	Ammonia as N, dissolved	NH4-D	mg-N/L			0.1			< 0.1			< 0.1									
15-S	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			11			29			18			11			33			
15-S	Boron	B	mg/L			0.07			< 0.02			< 0.02			< 0.02			0.03			
15-S	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
15-S	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
15-S	Calcium	Ca	mg/L			7.6			14.0			10.4			5.5			10.8			
15-S	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
15-S	Chloride	Cl	mg/L			768			43			148			790			120			
15-S	Chromium	Cr-T	ug/L			1.5			2.9			2.2			2.1			4.3			
15-S	Chromium - Dissolved	Cr-D	ug/L			1.2			1.2			< 1.0			1.6			< 1.0			
15-S	Copper	Cu-T	ug/L			2.6			2.4			2.9			2.5			5.8			
15-S	Copper - Dissolved	Cu-D	ug/L			1.2			2.0			< 1.0			7.4			2.6			
15-S	Dissolved Organic Carbon	DOC	mg/L			3.5			7.3			4.2			5.4			37			
15-S	Hardness	Hard	mg-CaCO3/L			26			62			36			19			33			
15-S	Hardness - Dissolved	Hard-D	mg-CaCO3/L			24			52			24									
15-S	Iron	Fe-T	ug/L			1390			45			1920			1000			2000			
15-S	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			< 25			< 25			< 25			
15-S	Lead	Pb-T	ug/L			1.4			< 1.0			3.7			1.1			3.1			
15-S	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
15-S	Magnesium	Mg	mg/L			1.8			6.5			2.5			1.4			1.6			
15-S	Nickel	Ni-T	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			3.9			
15-S	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			2.6			
15-S	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			< 0.1			< 0.1			0.2			
15-S	Nitrite as N	NO2	mg-N/L			0.3	J	h	< 0.1			< 0.1			< 0.1			< 0.1			
15-S	Oil & Grease	O&G	mg/L			< 2			< 2			< 2			< 5			< 5			
15-S	Orthophosphate as P	O-P (T)	mg-P/L			0.05	J	h	< 0.03			< 0.03			0.04			0.03			
15-S	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			< 0.03			< 0.03			
15-S	pH (Lab value)	pH-L	pH Units			6.8	J	h	7.2	J	h	6.6			6.7			6.7			
15-S	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.22			< 0.03			< 0.03			< 0.03	U	x	0.06			
15-S	Phosphorus, Total as P	Phos - T	mg-P/L			0.23			< 0.03			0.07			0.04	U	x	0.16			
15-S	Potassium	K	mg/L			1.7			2.5			0.9			1.1			2.3			
15-S	Silicon (as Si)	Si	mg/L			4.3			7.4			3.1			2.7			4.4			
15-S	Sodium	Na	mg/L			469			14			74			339			104			
15-S	Specific Conductance (Lab)	EC-L	umhos/cm			1890			187			416			2400			480			
15-S	Sulfate as SO4	SO4	mg/L			3.3			18.0			5.2			4.6			7.4			
15-S	Total Alkalinity	Tot-Alk	mg-CaCO3/L			11			29			18			11			33			
15-S	Total Dissolved Solids	TDS	mg/L			1044			88			76			1300			310			
15-S	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.4			< 0.1			< 0.1			0.2			1.8			
15-S	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.2			< 0.1			< 0.1			0.2			1.3			
15-S	Total Organic Carbon	TOC	mg/L	U	x	4.1			11			5.0			5.9			31			
15-S	Total Suspended Solids	TSS	mg/L			39			19			34			14			36			
15-S	Turbidity (Lab)	Turb-L	NTU			43.4	J	h	12.7			54.3			18.0			31.0			
15-S	Zinc	Zn-T	ug/L			59			52			38			28			244			
15-S	Zinc - Dissolved	Zn-D	ug/L			15			36			11			15			129			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
15-F	Run #	Run #	-			1			2			3			4			5			6
15-F	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			
15-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			
15-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			
15-F	Pilot Plant ID #	Plant ID#	-			01-15-F			02-15-F			03-15-F			04-15-F			05-15-F			not run
15-F	Lab #	Lab #	-			0202537-01			0203240-01			0203230-01			T-20292-03			T-20333-07			
15-F	Turbidity - Field	Turb-F	NTU			3.7			3.5			5.7			5.2			8.0			
15-F	Temp - Field	Temp-F	C			14.0			10.6			9.4			10.5			9.5			
15-F	EC - Field	EC-F	umhos/cm			2260			435			507			2341			500			
15-F	pH - Field	pH-F	pH Units			8.2			8.0			7.4			6.8			7.4			
15-F	Drain Time (first fill)	Drain 1	min			7.00			5.30			6.00			7.00			7.25			
15-F	Drain Time (second fill)	Drain 2	min			7.00			6.50			4.00			8.50			7.50			
15-F	Acid Soluble Aluminum	Al-AS	ug/L			650	J	h	690	J	h	190			290			1300			
15-F	Aluminum	Al-T	ug/L			700			810			380			450			1500			
15-F	Aluminum - Dissolved	Al-D	ug/L			370			300			100			190			190			
15-F	Ammonia as N	NH4	mg-N/L			0.3			< 0.1			< 0.1			0.1			0.6			
15-F	Ammonia as N, dissolved	NH4-D	mg-N/L			0.2			< 0.1			< 0.1									
15-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			30			49			26			46			55			
15-F	Boron	B	mg/L			0.09			< 0.02			0.04			< 0.02			0.04			
15-F	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
15-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			
15-F	Calcium	Ca	mg/L			9.8			13.6			7.8			7.8			10.8			
15-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			2			< 1			
15-F	Chloride	Cl	mg/L			725			84			130			770			150			
15-F	Chromium	Cr-T	ug/L			3.1			< 1.0			< 1.0			1.9			1.9			
15-F	Chromium - Dissolved	Cr-D	ug/L			1.9			< 1.0			< 1.0			2.3			< 1.0			
15-F	Copper	Cu-T	ug/L			< 1.0			4.0			2.0			2.1			5.8			
15-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			3.3			1.6			5.4			3.4			
15-F	Dissolved Organic Carbon	DOC	mg/L			3.2			4.1			4.1			5.7			34			
15-F	Hardness	Hard	mg-CaCO3/L			34			57			33			26			36			
15-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			34			54			26									
15-F	Iron	Fe-T	ug/L			69			< 25			13700	U	x	220			450			
15-F	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			< 25			< 25			< 25			
15-F	Lead	Pb-T	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
15-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			
15-F	Magnesium	Mg	mg/L			2.3			5.7			3.2			1.7			2.1			
15-F	Nickel	Ni-T	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			2.5			
15-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			
15-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	0.9			< 0.1			< 0.1			0.2			
15-F	Nitrite as N	NO2	mg-N/L			< 0.1	J	h	< 0.1			< 0.1			< 0.1			< 0.1			
15-F	Oil & Grease	O&G	mg/L			< 2			< 2			< 2			< 5			< 5			
15-F	Orthophosphate as P	O-P (T)	mg-P/L			0.05	J	h	< 0.03			< 0.03			< 0.03			< 0.03			
15-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			< 0.03			< 0.03			
15-F	pH (Lab value)	pH-L	pH Units			7.6	J	h	7.3	J	h	6.5			8.4			7.0			
15-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.21			< 0.03			< 0.03			< 0.03	U	x	0.06			
15-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.26			< 0.03			< 0.03			0.04	U	x	0.10			
15-F	Potassium	K	mg/L			1.9			2.3			2.7			1.2			2.4			
15-F	Silicon (as Si)	Si	mg/L			2.1			6.5			20			1.6			3.9			
15-F	Sodium	Na	mg/L			463			58			81			335			142			
15-F	Specific Conductance (Lab)	EC-L	umhos/cm			1860			347			432			2300			640			
15-F	Sulfate as SO4	SO4	mg/L			3.5			17.6			6.0			4.8			7.4			
15-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			30			49			26			48			55			
15-F	Total Dissolved Solids	TDS	mg/L			1178			204			228			1300			380			
15-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			3.1			0.4			1.0			0.3			1.2			
15-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			1.6			0.2			0.5			0.2			1.1			
15-F	Total Organic Carbon	TOC	mg/L	U	x	3.3			4.9			4.3			6.4			35			
15-F	Total Suspended Solids	TSS	mg/L			< 1			4			4			2	U	x	8			
15-F	Turbidity (Lab)	Turb-L	NTU			3.1	J	h	3.2			3.2			4.7			9.2			
15-F	Zinc	Zn-T	ug/L			12			13			10			6			39			
15-F	Zinc - Dissolved	Zn-D	ug/L			8			8			7			< 5			23			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
Sed-Avg	Run #	Run #	-			1			2			3			4			5			6
Sed-Avg	Date Sampled	Date	-			02/20/02			03/06/02			03/07/02			05/01/02			05/21/02			11/8/2002
Sed-Avg	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			ToxScan
Sed-Avg	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			Roadside Basins
Sed-Avg	Pilot Plant ID #	Plant ID#	-			NA			NA			NA			NA			NA			Only (06-11-S)
Sed-Avg	Lab #	Lab #	-			NA			NA			NA			NA			NA			Average of 1
Sed-Avg	Turbidity - Field	Turb-F	NTU			63.0			12.8			58.9			23.7			41.1			155
Sed-Avg	Temp - Field	Temp-F	C			14.1			10.4			8.9			10.4			9.7			9.5
Sed-Avg	EC - Field	EC-F	umhos/cm			2292			224			504			2346			384			161
Sed-Avg	pH - Field	pH-F	pH Units			7.1			7.3			7.1			6.8			6.8			6.3
Sed-Avg	Drain Time (first fill)	Drain 1	min			7.95			5.92			7.18			7.70			NA			NA
Sed-Avg	Drain Time (second fill)	Drain 2	min			NA			NA			NA			NA			NA			NA
Sed-Avg	Acid Soluble Aluminum	Al-AS	ug/L			1008			1272			698			298			2960			3500
Sed-Avg	Aluminum	Al-T	ug/L			2380			1840			3600			1140			3880			5100
Sed-Avg	Aluminum - Dissolved	Al-D	ug/L			25			25			25			< 25			80			760
Sed-Avg	Ammonia as N	NH4	mg-N/L			0.3			0.1			0.1			< 0.1			0.6			1.1
Sed-Avg	Ammonia as N, dissolved	NH4-D	mg-N/L			0.1			0.1			0.1									
Sed-Avg	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			10			30			17			11			34			
Sed-Avg	Boron	B	mg/L			0.06			0.02			0.02			< 0.02			0.03			0.05
Sed-Avg	Cadmium	Cd-T	ug/L			0.2			0.2			0.2			< 0.2			0.2			0.2
Sed-Avg	Cadmium - Dissolved	Cd-D	ug/L			0.2			0.2			0.2			0.8			0.2			< 0.2
Sed-Avg	Calcium	Ca	mg/L			8.6			14.0			9.7			5.8			10.3			7.9
Sed-Avg	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
Sed-Avg	Chloride	Cl	mg/L			745			56			132			780			116			19
Sed-Avg	Chromium	Cr-T	ug/L			2.6			1.6			2.6			2.3			4.8			8.6
Sed-Avg	Chromium - Dissolved	Cr-D	ug/L			1.4			1.0			1.1			1.6			< 1.0			4.6
Sed-Avg	Copper	Cu-T	ug/L			3.4			2.6			3.4			2.8			6.4			15
Sed-Avg	Copper - Dissolved	Cu-D	ug/L			1.0			1.7			1.3			5.5			1.8			8.6
Sed-Avg	Dissolved Organic Carbon	DOC	mg/L			3.7			5.7			4.1			4.9			34			
Sed-Avg	Hardness	Hard	mg-CaCO3/L			36			61			31			20			32			91
Sed-Avg	Hardness - Dissolved	Hard-D	mg-CaCO3/L			24			51			23									
Sed-Avg	Iron	Fe-T	ug/L			1557			153			2264			1260			2160			2200
Sed-Avg	Iron - Dissolved	Fe-D	ug/L			25			25			25			< 25			< 25			91
Sed-Avg	Lead	Pb-T	ug/L			1.7			< 1.0			4.4			1.3			3.7			7.8
Sed-Avg	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0
Sed-Avg	Magnesium	Mg	mg/L			3.6			6.4			1.7			1.5			1.5			1.7
Sed-Avg	Nickel	Ni-T	ug/L			2.2			< 2.0			< 2.0			< 2.0			3.8			4.5
Sed-Avg	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			2.4			3.0
Sed-Avg	Nitrate as N	NO3	mg-N/L			< 0.1			0.8			0.3			< 0.1			0.2			0.6
Sed-Avg	Nitrite as N	NO2	mg-N/L			< 0.1			< 0.1			< 0.1			< 0.1			< 0.1			0.1
Sed-Avg	Oil & Grease	O&G	mg/L			< 2			< 2			< 2			< 5			< 5			6
Sed-Avg	Orthophosphate as P	O-P (T)	mg-P/L			0.05			0.14			< 0.03			0.04			0.04			0.36
Sed-Avg	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03			< 0.03			< 0.03			< 0.03			< 0.03			0.07
Sed-Avg	pH (Lab value)	pH-L	pH Units			6.7			6.7			6.6			6.7			6.6			
Sed-Avg	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.20			0.03			0.04			< 0.03			0.06			0.13
Sed-Avg	Phosphorus, Total as P	Phos - T	mg-P/L			0.30			0.05			< 0.03			0.04			0.18			1.10
Sed-Avg	Potassium	K	mg/L			6.2			2.5			1.0			1.2			2.2			6.7
Sed-Avg	Silicon (as Si)	Si	mg/L			4.1			7.4			4.0			2.9			4.3			13
Sed-Avg	Sodium	Na	mg/L			458			13			77			341			97			18
Sed-Avg	Specific Conductance (Lab)	EC-L	umhos/cm			1862			226			407			2340			476			
Sed-Avg	Sulfate as SO4	SO4	mg/L			3.3			17.8			5.1			4.6			7.3			6.7
Sed-Avg	Total Alkalinity	Tot-Alk	mg-CaCO3/L			10			30			17			11			34			20
Sed-Avg	Total Dissolved Solids	TDS	mg/L			1065			123			174			1300			312			320
Sed-Avg	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			1.2			0.6			0.2			0.2			1.6			3.8
Sed-Avg	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.7			0.2			0.1			0.2			1.3			2.8
Sed-Avg	Total Organic Carbon	TOC	mg/L	U	x	4.8			7.1			4.4			5.0			41			200
Sed-Avg	Total Suspended Solids	TSS	mg/L			33			21			35			12			61			100
Sed-Avg	Turbidity (Lab)	Turb-L	NTU			136			13.0			59.5			21.2			39.8			
Sed-Avg	Zinc	Zn-T	ug/L			52			53			43			30			250			450
Sed-Avg	Zinc - Dissolved	Zn-D	ug/L			14			35			10			16			122			290

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
A	Run #	Run #	-			1			2			3			4			5			6
A	Date Sampled	Date	-			02/21/02						03/07/02			05/01/02			05/21/02			11/8/2002
A	Lab Name	Lab	-			PatChem						PatChem			ToxScan/UCD			ToxScan/UCD			ToxScan
A	Water Source	Source	-			On-Site						S-Yard			On-Site			Roadside Basins			Roadside Basins
A	Pilot Plant ID #	Plant ID#	-			01-A			not run			03-A			04-A			05-A			06-A-1
A	Lab #	Lab #	-			0202536-01						0203299-01			T-20292-06			T-20333-20			T-20661-04
A	Turbidity - Field	Turb-F	NTU			3.8						13.1			3.3			3.1			29.6
A	Temp - Field	Temp-F	C			13.4						8.8			10.3			9.3			8.3
A	EC - Field	EC-F	umhos/cm			2303						518			2323			385			178
A	pH - Field	pH-F	pH Units			7.0						6.8			6.7			6.6			6.2
A	Drain Time (first fill)	Drain 1	min			NA						NA			NA			NA			NA
A	Drain Time (second fill)	Drain 2	min			NA						NA			NA			NA			NA
A	Acid Soluble Aluminum	Al-AS	ug/L			80	J	h				< 25			53			280			3500
A	Aluminum	Al-T	ug/L			150						390			77			400			4300
A	Aluminum - Dissolved	Al-D	ug/L			< 25						< 25			< 25			220			3000
A	Ammonia as N	NH4	mg-N/L			0.2						< 0.1			< 0.1			0.7			1.1
A	Ammonia as N, dissolved	NH4-D	mg-N/L			0.2						< 0.1									
A	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			9						18			10			32			
A	Boron	B	mg/L			0.07						< 0.02			< 0.02			0.03			0.05
A	Cadmium	Cd-T	ug/L			< 0.2						< 0.2			< 0.2			< 0.2			< 0.2
A	Cadmium - Dissolved	Cd-D	ug/L			< 0.2						< 0.2			< 0.2			< 0.2			< 0.2
A	Calcium	Ca	mg/L			7.8						7.7			6.0			11.3			7.2
A	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1						< 1			< 1			< 1			
A	Chloride	Cl	mg/L			759						134			800			120			23
A	Chromium	Cr-T	ug/L			< 1.0						1.2			1.8			1.5			7.6
A	Chromium - Dissolved	Cr-D	ug/L			< 1.0						< 1.0			1.7			< 1.0			5.8
A	Copper	Cu-T	ug/L			< 1.0						1.4			1.0			2.4			11
A	Copper - Dissolved	Cu-D	ug/L			< 1.0						< 1.0			5.9			1.6			11
A	Dissolved Organic Carbon	DOC	mg/L			3.7						4.4			3.9			28			
A	Hardness	Hard	mg-CaCO3/L			26						23			20			34			75
A	Hardness - Dissolved	Hard-D	mg-CaCO3/L			24						22									
A	Iron	Fe-T	ug/L			101						311	U	x	180			350			810
A	Iron - Dissolved	Fe-D	ug/L			< 25						< 25			< 25			54	J	Z	350
A	Lead	Pb-T	ug/L			< 1.0						1.2			< 1.0			< 1.0			1.8
A	Lead - Dissolved	Pb-D	ug/L			< 1.0						< 1.0			< 1.0			< 1.0			1.6
A	Magnesium	Mg	mg/L			1.5						0.8			1.2			1.5			1.4
A	Nickel	Ni-T	ug/L			< 2.0						< 2.0			< 2.0			3.5			3.8
A	Nickel - Dissolved	Ni-D	ug/L			< 2.0						< 2.0			< 2.0			2.5			3.8
A	Nitrate as N	NO3	mg-N/L			< 0.1	J	h				< 0.1			< 0.1			0.3	J	d	0.6
A	Nitrite as N	NO2	mg-N/L			< 0.1	J	h				< 0.1			< 0.1			< 0.1			0.2
A	Oil & Grease	O&G	mg/L			< 2						< 2			< 5			< 5			< 2
A	Orthophosphate as P	O-P (T)	mg-P/L			0.05	J	h				< 0.03			< 0.03			< 0.03			0.37
A	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h				< 0.03			< 0.03			< 0.03			0.08
A	pH (Lab value)	pH-L	pH Units			6.4	J	h				6.1			6.5			6.7			
A	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.19						< 0.03			< 0.03	U	x	0.05			0.34
A	Phosphorus, Total as P	Phos - T	mg-P/L			0.40						< 0.03			< 0.03	U	x	0.08			0.65
A	Potassium	K	mg/L			1.6						1.0			1.1			2.4			6.5
A	Silicon (as Si)	Si	mg/L			1.7						1.4			1.2			3.5			7.1
A	Sodium	Na	mg/L			491						69			331			109			19
A	Specific Conductance (Lab)	EC-L	umhos/cm			1910						433			2200			490			
A	Sulfate as SO4	SO4	mg/L			3.4						5.2			5.0			7.7			7.5
A	Total Alkalinity	Tot-Alk	mg-CaCO3/L			9						18			9.6			32			18
A	Total Dissolved Solids	TDS	mg/L			1218						232			1300			310			310
A	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			3.2						< 0.1			0.3			1.5	U	x	3.1
A	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			1.5						< 0.1			0.3			1.4	U	x	3.1
A	Total Organic Carbon	TOC	mg/L	U	x	3.8						4.5			3.3			30			180
A	Total Suspended Solids	TSS	mg/L			8						16			< 1	U	x	2			12
A	Turbidity (Lab)	Turb-L	NTU			3.4	J	h				4.2			3.0			4.6			
A	Zinc	Zn-T	ug/L			46						27			26			191			340
A	Zinc - Dissolved	Zn-D	ug/L			43						19			27			143			340

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
PSF	Run #	Run #	-			1			2			3			4			5			6
PSF	Date Sampled	Date	-			02/21/02						03/07/02			05/01/02			05/21/02			
PSF	Lab Name	Lab	-			PatChem						PatChem			ToxScan/UCD			ToxScan/UCD			
PSF	Water Source	Source	-			On-Site						S-Yard			On-Site			Roadside Basins			
PSF	Pilot Plant ID #	Plant ID#	-			01-PSF			not run			03-PSF			04-PSF			05-PSF			not run
PSF	Lab #	Lab #	-			0202528-01						0203234-01			T-20292-32			T-20333-28			
PSF	Turbidity - Field	Turb-F	NTU			1.9						2.1			1.6			1.9			
PSF	Temp - Field	Temp-F	C			13.5						8.6			10.0			9.5			
PSF	EC - Field	EC-F	umhos/cm			2272						432			2207			626			
PSF	pH - Field	pH-F	pH Units			7.0						6.8			6.7			6.8			
PSF	Drain Time (first fill)	Drain 1	min			NA						NA			NA			NA			
PSF	Drain Time (second fill)	Drain 2	min			NA						NA			NA			NA			
PSF	Acid Soluble Aluminum	Al-AS	ug/L			31	J	h				33			< 25			230			
PSF	Aluminum	Al-T	ug/L			65						78			37			330			
PSF	Aluminum - Dissolved	Al-D	ug/L			< 25						< 25			< 25			140			
PSF	Ammonia as N	NH4	mg-N/L			< 0.1						< 0.1			< 0.1			0.6			
PSF	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1						< 0.1									
PSF	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			14						28			15			34			
PSF	Boron	B	mg/L			0.08						< 0.02			< 0.02			0.03			
PSF	Cadmium	Cd-T	ug/L			< 0.2						< 0.2			< 0.2			< 0.2			
PSF	Cadmium - Dissolved	Cd-D	ug/L			< 0.2						< 0.2			< 0.2			< 0.2			
PSF	Calcium	Ca	mg/L			9.0						14.5			7.8			11.9			
PSF	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1						< 1			< 1			< 1			
PSF	Chloride	Cl	mg/L			698						90			720			130			
PSF	Chromium	Cr-T	ug/L			< 1.0						< 1.0			1.2			1.2			
PSF	Chromium - Dissolved	Cr-D	ug/L			< 1.0						< 1.0			1.2			< 1.0			
PSF	Copper	Cu-T	ug/L			< 1.0						1.6			< 1.0			1.9			
PSF	Copper - Dissolved	Cu-D	ug/L			< 1.0						1.6			< 1.0			1.6			
PSF	Dissolved Organic Carbon	DOC	mg/L			3.9						4.8			5.4			29			
PSF	Hardness	Hard	mg-CaCO3/L			29						47			24			36			
PSF	Hardness - Dissolved	Hard-D	mg-CaCO3/L			28						43									
PSF	Iron	Fe-T	ug/L			116						< 25	U	x	220	U	x	220			
PSF	Iron - Dissolved	Fe-D	ug/L			37						< 25			99			99			
PSF	Lead	Pb-T	ug/L			< 1.0						< 1.0			< 1.0			< 1.0			
PSF	Lead - Dissolved	Pb-D	ug/L			< 1.0						< 1.0			< 1.0			< 1.0			
PSF	Magnesium	Mg	mg/L			1.5						2.7			1.2			1.5			
PSF	Nickel	Ni-T	ug/L			< 2.0						< 2.0			< 2.0			3.4			
PSF	Nickel - Dissolved	Ni-D	ug/L			< 2.0						< 2.0			< 2.0			2.5			
PSF	Nitrate as N	NO3	mg-N/L			< 0.1						< 0.1			< 0.1			0.2			
PSF	Nitrite as N	NO2	mg-N/L			0.1						< 0.1			< 0.1			< 0.1			
PSF	Oil & Grease	O&G	mg/L			< 2						< 2			< 5			< 5			
PSF	Orthophosphate as P	O-P (T)	mg-P/L			0.08						0.04			< 0.03			< 0.03			
PSF	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03						< 0.03			< 0.03			< 0.03			
PSF	pH (Lab value)	pH-L	pH Units			6.6	J	h				6.6			6.9			6.8			
PSF	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.19						< 0.03			< 0.03	U	x	0.04			
PSF	Phosphorus, Total as P	Phos - T	mg-P/L			0.20						< 0.03			< 0.03	U	x	0.07			
PSF	Potassium	K	mg/L			1.5						1.6			1.1			2.4			
PSF	Silicon (as Si)	Si	mg/L			2.2						3.5			1.2			3.5			
PSF	Sodium	Na	mg/L			462						60			325			121			
PSF	Specific Conductance (Lab)	EC-L	umhos/cm			1820						340			2200			540			
PSF	Sulfate as SO4	SO4	mg/L			3.4						9.4			5.1			7.5			
PSF	Total Alkalinity	Tot-Alk	mg-CaCO3/L			14						28			15			34			
PSF	Total Dissolved Solids	TDS	mg/L			1224						192			1200			350			
PSF	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.3						3.0			0.3			1.1			
PSF	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.2						< 0.1			0.2			1.0			
PSF	Total Organic Carbon	TOC	mg/L	U	x	5.2						5.5			5.0			29			
PSF	Total Suspended Solids	TSS	mg/L			< 1						< 1			4			< 1			
PSF	Turbidity (Lab)	Turb-L	NTU			1.5						1.3			1.5			2.4			
PSF	Zinc	Zn-T	ug/L			65						74			69			297			
PSF	Zinc - Dissolved	Zn-D	ug/L			65						70			64			201			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
FF	Run #	Run #	-			1			2			3			4			5			6
FF	Date Sampled	Date	-			02/21/02						03/07/02			05/01/02			05/21/02			11/8/2002
FF	Lab Name	Lab	-			PatChem						PatChem			ToxScan/UCD			ToxScan/UCD			ToxScan
FF	Water Source	Source	-			On-Site						S-Yard			On-Site			Roadside Basins			Roadside Basins
FF	Pilot Plant ID #	Plant ID#	-			01-FF			not run			03-FF			04-FF			05-FF			06-FF-1
FF	Lab #	Lab #	-			0202544-01						0203275-01			T-20292-02			T-20333-19			T-20661-23
FF	Turbidity - Field	Turb-F	NTU			1.6						2.5			2.2			2.14			24.8
FF	Temp - Field	Temp-F	C			13.5						8.4			10.3			9.8			9.1
FF	EC - Field	EC-F	umhos/cm			2196						504			2337			382			218
FF	pH - Field	pH-F	pH Units			7.0						6.8			6.6			6.6			6.3
FF	Drain Time (first fill)	Drain 1	min			NA						NA			NA			NA			NA
FF	Drain Time (second fill)	Drain 2	min			NA						NA			NA			NA			NA
FF	Acid Soluble Aluminum	Al-AS	ug/L			37	J	h				32			33			260			4900
FF	Aluminum	Al-T	ug/L			61						100			44			380			10000
FF	Aluminum - Dissolved	Al-D	ug/L			< 25						< 25			< 25			220			980
FF	Ammonia as N	NH4	mg-N/L			0.2						< 0.1			< 0.1			0.6			1.1
FF	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1						< 0.1									1.2
FF	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			12						24			10			32			
FF	Boron	B	mg/L			0.08						< 0.02			< 0.02			0.03			0.03
FF	Cadmium	Cd-T	ug/L			< 0.2						< 0.2			< 0.2			< 0.2			0.3
FF	Cadmium - Dissolved	Cd-D	ug/L			< 0.2						< 0.2			< 0.2			< 0.2			< 0.2
FF	Calcium	Ca	mg/L			7.7						10.7			5.8			11.0			7.2
FF	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1						< 1			< 1			< 1			
FF	Chloride	Cl	mg/L			699						124			780			120			23
FF	Chromium	Cr-T	ug/L			< 1.0						< 1.0			1.6			1.1			8.0
FF	Chromium - Dissolved	Cr-D	ug/L			< 1.0						< 1.0			1.7			< 1.0			5.4
FF	Copper	Cu-T	ug/L			< 1.0						< 1.0			< 1.0			2.2			12
FF	Copper - Dissolved	Cu-D	ug/L			< 1.0						< 1.0			1.9			1.6			8.7
FF	Dissolved Organic Carbon	DOC	mg/L			4.7						4.6			3.0			29			
FF	Hardness	Hard	mg-CaCO3/L			26						37			19			33			23
FF	Hardness - Dissolved	Hard-D	mg-CaCO3/L			26						23									
FF	Iron	Fe-T	ug/L			154						< 25	U	x	63	U	x	170			720
FF	Iron - Dissolved	Fe-D	ug/L			98						29			< 25			59	J	Z	90
FF	Lead	Pb-T	ug/L			< 1.0						< 1.0			< 1.0			< 1.0			1.8
FF	Lead - Dissolved	Pb-D	ug/L			< 1.0						< 1.0			< 1.0			< 1.0			< 1.0
FF	Magnesium	Mg	mg/L			1.7						2.5			1.2			1.4			1.3
FF	Nickel	Ni-T	ug/L			< 2.0						< 2.0			< 2.0			3.2			4.0
FF	Nickel - Dissolved	Ni-D	ug/L			< 2.0						< 2.0			< 2.0			2.4			3.3
FF	Nitrate as N	NO3	mg-N/L			< 0.1						0.3			< 0.1			0.2	J	d	0.8
FF	Nitrite as N	NO2	mg-N/L			< 0.1						< 0.1			< 0.1			< 0.1			< 0.1
FF	Oil & Grease	O&G	mg/L			< 2						< 2			< 5			< 5			< 2
FF	Orthophosphate as P	O-P (T)	mg-P/L			0.05						< 0.03			< 0.03			< 0.03			0.38
FF	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03						< 0.03			< 0.03			< 0.03			0.05
FF	pH (Lab value)	pH-L	pH Units			6.7	J	h				6.6			6.5			6.7			
FF	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.20						< 0.03			< 0.03	U	x	0.05			0.11
FF	Phosphorus, Total as P	Phos - T	mg-P/L			0.21						< 0.03			< 0.03	U	x	0.08			0.58
FF	Potassium	K	mg/L			1.7						1.0			1.1			2.3			6.3
FF	Silicon (as Si)	Si	mg/L			2.4						1.0			1.0			3.3			6.8
FF	Sodium	Na	mg/L			452						78			332			103			19
FF	Specific Conductance (Lab)	EC-L	umhos/cm			1820						402			2200			490			
FF	Sulfate as SO4	SO4	mg/L			3.5						5.9			5.0			7.7			7.5
FF	Total Alkalinity	Tot-Alk	mg-CaCO3/L			12						24			10			32			17
FF	Total Dissolved Solids	TDS	mg/L			1100						96			1300			310			330
FF	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.3						0.6			0.3			1.0			3.4
FF	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.2						< 0.1			0.3			0.8			2.8
FF	Total Organic Carbon	TOC	mg/L	U	x	7.8						5.5			5.4			29			170
FF	Total Suspended Solids	TSS	mg/L			< 1						9			< 1	U	x	4			10
FF	Turbidity (Lab)	Turb-L	NTU			1.5	J	h				4.4			1.4			3.0			
FF	Zinc	Zn-T	ug/L			47						21			24			186			330
FF	Zinc - Dissolved	Zn-D	ug/L			50						19			26			142			310

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-1	Run #	Run #	-			1			2			3			4			5			6
IX-1	Date Sampled	Date	-			02/21/02															
IX-1	Lab Name	Lab	-			PatChem															
IX-1	Water Source	Source	-			On-Site															
IX-1	Pilot Plant ID #	Plant ID#	-			01-IX-1			not run			not run			not run			not run			not run
IX-1	Lab #	Lab #	-			0202535-01															
IX-1	Turbidity - Field	Turb-F	NTU			1.8															
IX-1	Temp - Field	Temp-F	C			13.5															
IX-1	EC - Field	EC-F	umhos/cm			2285															
IX-1	pH - Field	pH-F	pH Units			7.0															
IX-1	Drain Time (first fill)	Drain 1	min			NA															
IX-1	Drain Time (second fill)	Drain 2	min			NA															
IX-1	Acid Soluble Aluminum	Al-AS	ug/L			30															
IX-1	Aluminum	Al-T	ug/L			58															
IX-1	Aluminum - Dissolved	Al-D	ug/L			< 25															
IX-1	Ammonia as N	NH4	mg-N/L			0.3															
IX-1	Ammonia as N, dissolved	NH4-D	mg-N/L			0.2															
IX-1	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			11															
IX-1	Boron	B	mg/L			0.08															
IX-1	Cadmium	Cd-T	ug/L			< 0.2															
IX-1	Cadmium - Dissolved	Cd-D	ug/L			< 0.2															
IX-1	Calcium	Ca	mg/L			9.0															
IX-1	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1															
IX-1	Chloride	Cl	mg/L			822															
IX-1	Chromium	Cr-T	ug/L			< 1.0															
IX-1	Chromium - Dissolved	Cr-D	ug/L			< 1.0															
IX-1	Copper	Cu-T	ug/L			< 1.0															
IX-1	Copper - Dissolved	Cu-D	ug/L			< 1.0															
IX-1	Dissolved Organic Carbon	DOC	mg/L			3.9															
IX-1	Hardness	Hard	mg-CaCO3/L			29															
IX-1	Hardness - Dissolved	Hard-D	mg-CaCO3/L			27															
IX-1	Iron	Fe-T	ug/L			77															
IX-1	Iron - Dissolved	Fe-D	ug/L			25															
IX-1	Lead	Pb-T	ug/L			< 1.0															
IX-1	Lead - Dissolved	Pb-D	ug/L			< 1.0															
IX-1	Magnesium	Mg	mg/L			1.6															
IX-1	Nickel	Ni-T	ug/L			< 2.0															
IX-1	Nickel - Dissolved	Ni-D	ug/L			< 2.0															
IX-1	Nitrate as N	NO3	mg-N/L			< 0.1															
IX-1	Nitrite as N	NO2	mg-N/L			< 0.1															
IX-1	Oil & Grease	O&G	mg/L			< 2															
IX-1	Orthophosphate as P	O-P (T)	mg-P/L			0.05															
IX-1	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03															
IX-1	pH (Lab value)	pH-L	pH Units			6.6															
IX-1	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.20															
IX-1	Phosphorus, Total as P	Phos - T	mg-P/L			0.21															
IX-1	Potassium	K	mg/L			3.5															
IX-1	Silicon (as Si)	Si	mg/L			2.0															
IX-1	Sodium	Na	mg/L			483															
IX-1	Specific Conductance (Lab)	EC-L	umhos/cm			1890															
IX-1	Sulfate as SO4	SO4	mg/L			3.5															
IX-1	Total Alkalinity	Tot-Alk	mg-CaCO3/L			11															
IX-1	Total Dissolved Solids	TDS	mg/L			1068															
IX-1	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			3.9															
IX-1	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			1.5															
IX-1	Total Organic Carbon	TOC	mg/L	U	x	4.6															
IX-1	Total Suspended Solids	TSS	mg/L			< 1															
IX-1	Turbidity (Lab)	Turb-L	NTU			1.2															
IX-1	Zinc	Zn-T	ug/L			57															
IX-1	Zinc - Dissolved	Zn-D	ug/L			54															

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-2	Run #	Run #	-			1			2			3			4			5			6
IX-2	Date Sampled	Date	-			02/21/02															
IX-2	Lab Name	Lab	-			PatChem															
IX-2	Water Source	Source	-			On-Site															
IX-2	Pilot Plant ID #	Plant ID#	-			01-IX-2			not run			not run			not run			not run			not run
IX-2	Lab #	Lab #	-			0202521-01															
IX-2	Turbidity - Field	Turb-F	NTU			0.9															
IX-2	Temp - Field	Temp-F	C			13.5															
IX-2	EC - Field	EC-F	umhos/cm			2265															
IX-2	pH - Field	pH-F	pH Units			7.0															
IX-2	Drain Time (first fill)	Drain 1	min			NA															
IX-2	Drain Time (second fill)	Drain 2	min			NA															
IX-2	Acid Soluble Aluminum	Al-AS	ug/L			< 25															
IX-2	Aluminum	Al-T	ug/L			32															
IX-2	Aluminum - Dissolved	Al-D	ug/L			< 25															
IX-2	Ammonia as N	NH4	mg-N/L			< 0.1															
IX-2	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1															
IX-2	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			14															
IX-2	Boron	B	mg/L			0.09															
IX-2	Cadmium	Cd-T	ug/L			< 0.2															
IX-2	Cadmium - Dissolved	Cd-D	ug/L			< 0.2															
IX-2	Calcium	Ca	mg/L			9.1															
IX-2	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1															
IX-2	Chloride	Cl	mg/L			729															
IX-2	Chromium	Cr-T	ug/L			< 1.0															
IX-2	Chromium - Dissolved	Cr-D	ug/L			< 1.0															
IX-2	Copper	Cu-T	ug/L			< 1.0															
IX-2	Copper - Dissolved	Cu-D	ug/L			< 1.0															
IX-2	Dissolved Organic Carbon	DOC	mg/L			4.1															
IX-2	Hardness	Hard	mg-CaCO3/L			30															
IX-2	Hardness - Dissolved	Hard-D	mg-CaCO3/L			28															
IX-2	Iron	Fe-T	ug/L			38															
IX-2	Iron - Dissolved	Fe-D	ug/L			< 25															
IX-2	Lead	Pb-T	ug/L			< 1.0															
IX-2	Lead - Dissolved	Pb-D	ug/L			< 1.0															
IX-2	Magnesium	Mg	mg/L			1.7															
IX-2	Nickel	Ni-T	ug/L			< 2.0															
IX-2	Nickel - Dissolved	Ni-D	ug/L			< 2.0															
IX-2	Nitrate as N	NO3	mg-N/L			0.2															
IX-2	Nitrite as N	NO2	mg-N/L			< 0.1															
IX-2	Oil & Grease	O&G	mg/L			< 2															
IX-2	Orthophosphate as P	O-P (T)	mg-P/L			0.05															
IX-2	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03															
IX-2	pH (Lab value)	pH-L	pH Units			6.6															
IX-2	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.18															
IX-2	Phosphorus, Total as P	Phos - T	mg-P/L			0.22															
IX-2	Potassium	K	mg/L			1.5															
IX-2	Silicon (as Si)	Si	mg/L			2.2															
IX-2	Sodium	Na	mg/L			455															
IX-2	Specific Conductance (Lab)	EC-L	umhos/cm			1730															
IX-2	Sulfate as SO4	SO4	mg/L			3.8															
IX-2	Total Alkalinity	Tot-Alk	mg-CaCO3/L			14															
IX-2	Total Dissolved Solids	TDS	mg/L			1172															
IX-2	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.7															
IX-2	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.2															
IX-2	Total Organic Carbon	TOC	mg/L	U	x	5.3															
IX-2	Total Suspended Solids	TSS	mg/L			< 1															
IX-2	Turbidity (Lab)	Turb-L	NTU			1.1															
IX-2	Zinc	Zn-T	ug/L			61															
IX-2	Zinc - Dissolved	Zn-D	ug/L			60															

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-3	Run #	Run #	-			1			2			3			4			5			6
IX-3	Date Sampled	Date	-			02/21/02															
IX-3	Lab Name	Lab	-			PatChem															
IX-3	Water Source	Source	-			On-Site															
IX-3	Pilot Plant ID #	Plant ID#	-			01-IX-3			not run			not run			not run			not run			not run
IX-3	Lab #	Lab #	-			0202522-01															
IX-3	Turbidity - Field	Turb-F	NTU			0.7															
IX-3	Temp - Field	Temp-F	C			13.5															
IX-3	EC - Field	EC-F	umhos/cm			2257															
IX-3	pH - Field	pH-F	pH Units			7.0															
IX-3	Drain Time (first fill)	Drain 1	min			NA															
IX-3	Drain Time (second fill)	Drain 2	min			NA															
IX-3	Acid Soluble Aluminum	Al-AS	ug/L			30															
IX-3	Aluminum	Al-T	ug/L			30															
IX-3	Aluminum - Dissolved	Al-D	ug/L			< 25															
IX-3	Ammonia as N	NH4	mg-N/L			< 0.1															
IX-3	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1															
IX-3	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			16															
IX-3	Boron	B	mg/L			0.09															
IX-3	Cadmium	Cd-T	ug/L			< 0.2															
IX-3	Cadmium - Dissolved	Cd-D	ug/L			< 0.2															
IX-3	Calcium	Ca	mg/L			8.8															
IX-3	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1															
IX-3	Chloride	Cl	mg/L			722															
IX-3	Chromium	Cr-T	ug/L			< 1.0															
IX-3	Chromium - Dissolved	Cr-D	ug/L			< 1.0															
IX-3	Copper	Cu-T	ug/L			< 1.0															
IX-3	Copper - Dissolved	Cu-D	ug/L			< 1.0															
IX-3	Dissolved Organic Carbon	DOC	mg/L			4.3															
IX-3	Hardness	Hard	mg-CaCO3/L			29															
IX-3	Hardness - Dissolved	Hard-D	mg-CaCO3/L			29															
IX-3	Iron	Fe-T	ug/L			41															
IX-3	Iron - Dissolved	Fe-D	ug/L			< 25															
IX-3	Lead	Pb-T	ug/L			< 1.0															
IX-3	Lead - Dissolved	Pb-D	ug/L			< 1.0															
IX-3	Magnesium	Mg	mg/L			1.7															
IX-3	Nickel	Ni-T	ug/L			< 2.0															
IX-3	Nickel - Dissolved	Ni-D	ug/L			< 2.0															
IX-3	Nitrate as N	NO3	mg-N/L			< 0.1															
IX-3	Nitrite as N	NO2	mg-N/L			< 0.1															
IX-3	Oil & Grease	O&G	mg/L			< 2															
IX-3	Orthophosphate as P	O-P (T)	mg-P/L			0.07															
IX-3	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03															
IX-3	pH (Lab value)	pH-L	pH Units			6.8															
IX-3	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.19															
IX-3	Phosphorus, Total as P	Phos - T	mg-P/L			0.30															
IX-3	Potassium	K	mg/L			1.5															
IX-3	Silicon (as Si)	Si	mg/L			2.2															
IX-3	Sodium	Na	mg/L			439															
IX-3	Specific Conductance (Lab)	EC-L	umhos/cm			1790															
IX-3	Sulfate as SO4	SO4	mg/L			< 1.0															
IX-3	Total Alkalinity	Tot-Alk	mg-CaCO3/L			16															
IX-3	Total Dissolved Solids	TDS	mg/L			1186															
IX-3	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.7															
IX-3	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.2															
IX-3	Total Organic Carbon	TOC	mg/L	U	x	5.7															
IX-3	Total Suspended Solids	TSS	mg/L			< 1															
IX-3	Turbidity (Lab)	Turb-L	NTU			< 0.5															
IX-3	Zinc	Zn-T	ug/L			60															
IX-3	Zinc - Dissolved	Zn-D	ug/L			60															

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-4	Run #	Run #	-			1			2			3			4			5			6
IX-4	Date Sampled	Date	-			02/21/02															
IX-4	Lab Name	Lab	-			PatChem															
IX-4	Water Source	Source	-			On-Site															
IX-4	Pilot Plant ID #	Plant ID#	-			01-IX-4			not run			not run			not run			not run			not run
IX-4	Lab #	Lab #	-			0202518-01															
IX-4	Turbidity - Field	Turb-F	NTU			0.8															
IX-4	Temp - Field	Temp-F	C			13.6															
IX-4	EC - Field	EC-F	umhos/cm			2252															
IX-4	pH - Field	pH-F	pH Units			7.4															
IX-4	Drain Time (first fill)	Drain 1	min			NA															
IX-4	Drain Time (second fill)	Drain 2	min			NA															
IX-4	Acid Soluble Aluminum	Al-AS	ug/L			< 25															
IX-4	Aluminum	Al-T	ug/L			< 25															
IX-4	Aluminum - Dissolved	Al-D	ug/L			< 25															
IX-4	Ammonia as N	NH4	mg-N/L			0.3															
IX-4	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1															
IX-4	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			19															
IX-4	Boron	B	mg/L			0.12															
IX-4	Cadmium	Cd-T	ug/L			< 0.2															
IX-4	Cadmium - Dissolved	Cd-D	ug/L			< 0.2															
IX-4	Calcium	Ca	mg/L			< 0.05															
IX-4	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1															
IX-4	Chloride	Cl	mg/L			705															
IX-4	Chromium	Cr-T	ug/L			2.4															
IX-4	Chromium - Dissolved	Cr-D	ug/L			1.1															
IX-4	Copper	Cu-T	ug/L			< 1.0															
IX-4	Copper - Dissolved	Cu-D	ug/L			< 1.0															
IX-4	Dissolved Organic Carbon	DOC	mg/L			4.2															
IX-4	Hardness	Hard	mg-CaCO3/L			< 1															
IX-4	Hardness - Dissolved	Hard-D	mg-CaCO3/L			< 1															
IX-4	Iron	Fe-T	ug/L			< 25															
IX-4	Iron - Dissolved	Fe-D	ug/L			< 25															
IX-4	Lead	Pb-T	ug/L			< 1.0															
IX-4	Lead - Dissolved	Pb-D	ug/L			< 1.0															
IX-4	Magnesium	Mg	mg/L			< 0.05															
IX-4	Nickel	Ni-T	ug/L			< 2.0															
IX-4	Nickel - Dissolved	Ni-D	ug/L			< 2.0															
IX-4	Nitrate as N	NO3	mg-N/L			< 0.1															
IX-4	Nitrite as N	NO2	mg-N/L			0.3															
IX-4	Oil & Grease	O&G	mg/L			< 2															
IX-4	Orthophosphate as P	O-P (T)	mg-P/L			0.05															
IX-4	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03															
IX-4	pH (Lab value)	pH-L	pH Units			6.2															
IX-4	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.23															
IX-4	Phosphorus, Total as P	Phos - T	mg-P/L			0.27															
IX-4	Potassium	K	mg/L			1.6															
IX-4	Silicon (as Si)	Si	mg/L			2.5															
IX-4	Sodium	Na	mg/L			447															
IX-4	Specific Conductance (Lab)	EC-L	umhos/cm			1770															
IX-4	Sulfate as SO4	SO4	mg/L			< 1.0															
IX-4	Total Alkalinity	Tot-Alk	mg-CaCO3/L			19															
IX-4	Total Dissolved Solids	TDS	mg/L			836															
IX-4	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			0.6															
IX-4	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.4															
IX-4	Total Organic Carbon	TOC	mg/L	U	x	4.4															
IX-4	Total Suspended Solids	TSS	mg/L			< 1															
IX-4	Turbidity (Lab)	Turb-L	NTU			0.8															
IX-4	Zinc	Zn-T	ug/L			< 5															
IX-4	Zinc - Dissolved	Zn-D	ug/L			< 5															

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-1-PSF	Run #	Run #	-			1			2			3			4			5			6
IX-1-PSF	Date Sampled	Date	-									03/07/02									
IX-1-PSF	Lab Name	Lab	-									PatChem									
IX-1-PSF	Water Source	Source	-									S-Yard									
IX-1-PSF	Pilot Plant ID #	Plant ID#	-			not run			not run			3-IX1-PSF			not run			not run			not run
IX-1-PSF	Lab #	Lab #	-									0203277-01									
IX-1-PSF	Turbidity - Field	Turb-F	NTU									1.6									
IX-1-PSF	Temp - Field	Temp-F	C									8.7									
IX-1-PSF	EC - Field	EC-F	umhos/cm									459									
IX-1-PSF	pH - Field	pH-F	pH Units									6.8									
IX-1-PSF	Drain Time (first fill)	Drain 1	min									NA									
IX-1-PSF	Drain Time (second fill)	Drain 2	min									NA									
IX-1-PSF	Acid Soluble Aluminum	Al-AS	ug/L							J	h	27									
IX-1-PSF	Aluminum	Al-T	ug/L									64									
IX-1-PSF	Aluminum - Dissolved	Al-D	ug/L									< 25									
IX-1-PSF	Ammonia as N	NH4	mg-N/L									< 0.1									
IX-1-PSF	Ammonia as N, dissolved	NH4-D	mg-N/L									< 0.1									
IX-1-PSF	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L									21									
IX-1-PSF	Boron	B	mg/L									< 0.02									
IX-1-PSF	Cadmium	Cd-T	ug/L									< 0.2									
IX-1-PSF	Cadmium - Dissolved	Cd-D	ug/L									< 0.2									
IX-1-PSF	Calcium	Ca	mg/L									10.6									
IX-1-PSF	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L									< 1									
IX-1-PSF	Chloride	Cl	mg/L									106									
IX-1-PSF	Chromium	Cr-T	ug/L									< 1.0									
IX-1-PSF	Chromium - Dissolved	Cr-D	ug/L									< 1.0									
IX-1-PSF	Copper	Cu-T	ug/L									< 1.0									
IX-1-PSF	Copper - Dissolved	Cu-D	ug/L									< 1.0									
IX-1-PSF	Dissolved Organic Carbon	DOC	mg/L									4.8									
IX-1-PSF	Hardness	Hard	mg-CaCO3/L									39									
IX-1-PSF	Hardness - Dissolved	Hard-D	mg-CaCO3/L									25									
IX-1-PSF	Iron	Fe-T	ug/L									< 25									
IX-1-PSF	Iron - Dissolved	Fe-D	ug/L									< 25									
IX-1-PSF	Lead	Pb-T	ug/L									< 1.0									
IX-1-PSF	Lead - Dissolved	Pb-D	ug/L									< 1.0									
IX-1-PSF	Magnesium	Mg	mg/L									3.0									
IX-1-PSF	Nickel	Ni-T	ug/L									< 2.0									
IX-1-PSF	Nickel - Dissolved	Ni-D	ug/L									< 2.0									
IX-1-PSF	Nitrate as N	NO3	mg-N/L									0.2									
IX-1-PSF	Nitrite as N	NO2	mg-N/L									< 0.1									
IX-1-PSF	Oil & Grease	O&G	mg/L									< 2									
IX-1-PSF	Orthophosphate as P	O-P (T)	mg-P/L									< 0.03									
IX-1-PSF	Orthophosphate as P, Dis	O-P (D)	mg-P/L									< 0.03									
IX-1-PSF	pH (Lab value)	pH-L	pH Units							J	h	6.6									
IX-1-PSF	Phosphorus, Dissolved as P	Phos - D	mg-P/L									< 0.03									
IX-1-PSF	Phosphorus, Total as P	Phos - T	mg-P/L									< 0.03									
IX-1-PSF	Potassium	K	mg/L									1.1									
IX-1-PSF	Silicon (as Si)	Si	mg/L									1.4									
IX-1-PSF	Sodium	Na	mg/L									65									
IX-1-PSF	Specific Conductance (Lab)	EC-L	umhos/cm									370									
IX-1-PSF	Sulfate as SO4	SO4	mg/L									7.3									
IX-1-PSF	Total Alkalinity	Tot-Alk	mg-CaCO3/L									21									
IX-1-PSF	Total Dissolved Solids	TDS	mg/L									172									
IX-1-PSF	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L									< 0.1									
IX-1-PSF	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L									< 0.1									
IX-1-PSF	Total Organic Carbon	TOC	mg/L									5.7									
IX-1-PSF	Total Suspended Solids	TSS	mg/L									2									
IX-1-PSF	Turbidity (Lab)	Turb-L	NTU							J	h	1.4									
IX-1-PSF	Zinc	Zn-T	ug/L									39									
IX-1-PSF	Zinc - Dissolved	Zn-D	ug/L									36									

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-2-PSF	Run #	Run #	-			1			2			3			4			5			6
IX-2-PSF	Date Sampled	Date	-									03/07/02									
IX-2-PSF	Lab Name	Lab	-									PatChem									
IX-2-PSF	Water Source	Source	-									S-Yard									
IX-2-PSF	Pilot Plant ID #	Plant ID#	-			not run			not run			3-IX2-PSF			not run			not run			not run
IX-2-PSF	Lab #	Lab #	-									0203276-01									
IX-2-PSF	Turbidity - Field	Turb-F	NTU									1.3									
IX-2-PSF	Temp - Field	Temp-F	C									8.9									
IX-2-PSF	EC - Field	EC-F	umhos/cm									485									
IX-2-PSF	pH - Field	pH-F	pH Units									6.8									
IX-2-PSF	Drain Time (first fill)	Drain 1	min									NA									
IX-2-PSF	Drain Time (second fill)	Drain 2	min									NA									
IX-2-PSF	Acid Soluble Aluminum	Al-AS	ug/L							J	h	< 25									
IX-2-PSF	Aluminum	Al-T	ug/L									46									
IX-2-PSF	Aluminum - Dissolved	Al-D	ug/L									< 25									
IX-2-PSF	Ammonia as N	NH4	mg-N/L									< 0.1									
IX-2-PSF	Ammonia as N, dissolved	NH4-D	mg-N/L									< 0.1									
IX-2-PSF	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L									22									
IX-2-PSF	Boron	B	mg/L									< 0.02									
IX-2-PSF	Cadmium	Cd-T	ug/L									< 0.2									
IX-2-PSF	Cadmium - Dissolved	Cd-D	ug/L									< 0.2									
IX-2-PSF	Calcium	Ca	mg/L									10.4									
IX-2-PSF	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L									< 1									
IX-2-PSF	Chloride	Cl	mg/L									2									
IX-2-PSF	Chromium	Cr-T	ug/L									< 1.0									
IX-2-PSF	Chromium - Dissolved	Cr-D	ug/L									< 1.0									
IX-2-PSF	Copper	Cu-T	ug/L									< 1.0									
IX-2-PSF	Copper - Dissolved	Cu-D	ug/L									< 1.0									
IX-2-PSF	Dissolved Organic Carbon	DOC	mg/L									4.2									
IX-2-PSF	Hardness	Hard	mg-CaCO3/L									39									
IX-2-PSF	Hardness - Dissolved	Hard-D	mg-CaCO3/L									29									
IX-2-PSF	Iron	Fe-T	ug/L									< 25									
IX-2-PSF	Iron - Dissolved	Fe-D	ug/L									< 25									
IX-2-PSF	Lead	Pb-T	ug/L									< 1.0									
IX-2-PSF	Lead - Dissolved	Pb-D	ug/L									< 1.0									
IX-2-PSF	Magnesium	Mg	mg/L									3.3									
IX-2-PSF	Nickel	Ni-T	ug/L									< 2.0									
IX-2-PSF	Nickel - Dissolved	Ni-D	ug/L									< 2.0									
IX-2-PSF	Nitrate as N	NO3	mg-N/L									0.2									
IX-2-PSF	Nitrite as N	NO2	mg-N/L									< 0.1									
IX-2-PSF	Oil & Grease	O&G	mg/L									< 2									
IX-2-PSF	Orthophosphate as P	O-P (T)	mg-P/L									0.04									
IX-2-PSF	Orthophosphate as P, Dis	O-P (D)	mg-P/L									< 0.03									
IX-2-PSF	pH (Lab value)	pH-L	pH Units							J	h	6.6									
IX-2-PSF	Phosphorus, Dissolved as P	Phos - D	mg-P/L									< 0.03									
IX-2-PSF	Phosphorus, Total as P	Phos - T	mg-P/L									< 0.03									
IX-2-PSF	Potassium	K	mg/L									1.2									
IX-2-PSF	Silicon (as Si)	Si	mg/L									1.5									
IX-2-PSF	Sodium	Na	mg/L									60									
IX-2-PSF	Specific Conductance (Lab)	EC-L	umhos/cm									367									
IX-2-PSF	Sulfate as SO4	SO4	mg/L									< 1.0									
IX-2-PSF	Total Alkalinity	Tot-Alk	mg-CaCO3/L									22									
IX-2-PSF	Total Dissolved Solids	TDS	mg/L									196									
IX-2-PSF	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L									< 0.1									
IX-2-PSF	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L									< 0.1									
IX-2-PSF	Total Organic Carbon	TOC	mg/L									5.5									
IX-2-PSF	Total Suspended Solids	TSS	mg/L									2									
IX-2-PSF	Turbidity (Lab)	Turb-L	NTU							J	h	1.8									
IX-2-PSF	Zinc	Zn-T	ug/L									52									
IX-2-PSF	Zinc - Dissolved	Zn-D	ug/L									52									

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-3-PSF	Run #	Run #	-			1			2			3			4			5			6
IX-3-PSF	Date Sampled	Date	-									03/07/02			05/01/02			05/21/02			
IX-3-PSF	Lab Name	Lab	-									PatChem			ToxScan/UCD			ToxScan/UCD			
IX-3-PSF	Water Source	Source	-									S-Yard			On-Site			Roadside Basins			
IX-3-PSF	Pilot Plant ID #	Plant ID#	-			not run			not run			3-IX3-PSF			04-IX3-PSF			05-IX3-PSF			not run
IX-3-PSF	Lab #	Lab #	-									0203297-01			T-20292-07			T-20333-27			
IX-3-PSF	Turbidity - Field	Turb-F	NTU									1.0			0.7			1.4			
IX-3-PSF	Temp - Field	Temp-F	C									8.6			10.2			9.9			
IX-3-PSF	EC - Field	EC-F	umhos/cm									477			2259			443			
IX-3-PSF	pH - Field	pH-F	pH Units									6.8			6.7			6.2			
IX-3-PSF	Drain Time (first fill)	Drain 1	min									NA			NA			NA			
IX-3-PSF	Drain Time (second fill)	Drain 2	min									NA			NA			NA			
IX-3-PSF	Acid Soluble Aluminum	Al-AS	ug/L							J	h	< 25			< 25			150			
IX-3-PSF	Aluminum	Al-T	ug/L									33			< 25			220			
IX-3-PSF	Aluminum - Dissolved	Al-D	ug/L									< 25			< 25			120			
IX-3-PSF	Ammonia as N	NH4	mg-N/L									< 0.1			0.2			0.6			
IX-3-PSF	Ammonia as N, dissolved	NH4-D	mg-N/L									< 0.1									
IX-3-PSF	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L									9			12			13			
IX-3-PSF	Boron	B	mg/L									< 0.02			< 0.02			0.03			
IX-3-PSF	Cadmium	Cd-T	ug/L									< 0.2			0.2			0.3			
IX-3-PSF	Cadmium - Dissolved	Cd-D	ug/L									< 0.2			loss			0.2			
IX-3-PSF	Calcium	Ca	mg/L									7.8			7.4			12.6			
IX-3-PSF	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L									< 1			< 1			< 1			
IX-3-PSF	Chloride	Cl	mg/L									128			770			150			
IX-3-PSF	Chromium	Cr-T	ug/L									< 1.0			< 1.0			< 1.0			
IX-3-PSF	Chromium - Dissolved	Cr-D	ug/L									< 1.0			loss			< 1.0			
IX-3-PSF	Copper	Cu-T	ug/L									< 1.0			< 1.0			1.2			
IX-3-PSF	Copper - Dissolved	Cu-D	ug/L									2.1			loss			< 1.0			
IX-3-PSF	Dissolved Organic Carbon	DOC	mg/L									2.2			2.8			15			
IX-3-PSF	Hardness	Hard	mg-CaCO3/L									25			23			38			
IX-3-PSF	Hardness - Dissolved	Hard-D	mg-CaCO3/L									24									
IX-3-PSF	Iron	Fe-T	ug/L									< 25	U	x	120	U	x	140			
IX-3-PSF	Iron - Dissolved	Fe-D	ug/L									< 25			74			85			
IX-3-PSF	Lead	Pb-T	ug/L									< 1.0			< 1.0			< 1.0			
IX-3-PSF	Lead - Dissolved	Pb-D	ug/L									< 1.0			loss			< 1.0			
IX-3-PSF	Magnesium	Mg	mg/L									1.3			1.2			1.6			
IX-3-PSF	Nickel	Ni-T	ug/L									< 2.0			< 2.0			3.1			
IX-3-PSF	Nickel - Dissolved	Ni-D	ug/L									< 2.0			loss			2.4			
IX-3-PSF	Nitrate as N	NO3	mg-N/L							J	h	< 0.1			< 0.1			< 0.1			
IX-3-PSF	Nitrite as N	NO2	mg-N/L							J	h	< 0.1			< 0.1			< 0.1			
IX-3-PSF	Oil & Grease	O&G	mg/L									< 2			< 5			< 5			
IX-3-PSF	Orthophosphate as P	O-P (T)	mg-P/L							J	h	0.07			< 0.03			< 0.03			
IX-3-PSF	Orthophosphate as P, Dis	O-P (D)	mg-P/L							J	h	< 0.03			< 0.03			< 0.03			
IX-3-PSF	pH (Lab value)	pH-L	pH Units							J	h	5.9			6.6			6.4			
IX-3-PSF	Phosphorus, Dissolved as P	Phos - D	mg-P/L									< 0.03			< 0.03	U	x	0.04			
IX-3-PSF	Phosphorus, Total as P	Phos - T	mg-P/L									< 0.03			< 0.03	U	x	0.06			
IX-3-PSF	Potassium	K	mg/L									1.0			1.1			2.5			
IX-3-PSF	Silicon (as Si)	Si	mg/L									1.6			1.2			3.5			
IX-3-PSF	Sodium	Na	mg/L									62			337			126			
IX-3-PSF	Specific Conductance (Lab)	EC-L	umhos/cm									426			2200			540			
IX-3-PSF	Sulfate as SO4	SO4	mg/L									< 1.0			< 1.0			< 1.0			
IX-3-PSF	Total Alkalinity	Tot-Alk	mg-CaCO3/L									9			12			13			
IX-3-PSF	Total Dissolved Solids	TDS	mg/L									248			1200			340			
IX-3-PSF	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L									< 0.1			0.3			0.9			
IX-3-PSF	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L									< 0.1			0.3			0.8			
IX-3-PSF	Total Organic Carbon	TOC	mg/L									3.3			2.2			17			
IX-3-PSF	Total Suspended Solids	TSS	mg/L									2			< 1			< 1			
IX-3-PSF	Turbidity (Lab)	Turb-L	NTU							J	h	1.6			0.7			2.3			
IX-3-PSF	Zinc	Zn-T	ug/L									45			58			253			
IX-3-PSF	Zinc - Dissolved	Zn-D	ug/L									41			loss			201			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-4-PSF	Run #	Run #	-			1			2			3			4			5			6
IX-4-PSF	Date Sampled	Date	-									03/07/02			05/01/02			05/21/02			
IX-4-PSF	Lab Name	Lab	-									PatChem			ToxScan/UCD			ToxScan/UCD			
IX-4-PSF	Water Source	Source	-									S-Yard			On-Site			Roadside Basins			
IX-4-PSF	Pilot Plant ID #	Plant ID#	-			not run			not run			3-IX4-PSF			04-IX4-PSF			05-IX4-PSF			not run
IX-4-PSF	Lab #	Lab #	-									0203298-01			T-20292-15			T-20333-17			
IX-4-PSF	Turbidity - Field	Turb-F	NTU									0.7			0.6			0.8			
IX-4-PSF	Temp - Field	Temp-F	C									8.6			10.3			9.5			
IX-4-PSF	EC - Field	EC-F	umhos/cm									475			2228			455			
IX-4-PSF	pH - Field	pH-F	pH Units									7.3			6.6			6.0			
IX-4-PSF	Drain Time (first fill)	Drain 1	min									NA			NA			NA			
IX-4-PSF	Drain Time (second fill)	Drain 2	min									NA			NA			NA			
IX-4-PSF	Acid Soluble Aluminum	Al-AS	ug/L							J	h	< 25			< 25			170			
IX-4-PSF	Aluminum	Al-T	ug/L									< 25			< 25			150			
IX-4-PSF	Aluminum - Dissolved	Al-D	ug/L									< 25			< 25			97			
IX-4-PSF	Ammonia as N	NH4	mg-N/L									< 0.1			0.6			0.3			
IX-4-PSF	Ammonia as N, dissolved	NH4-D	mg-N/L									< 0.1									
IX-4-PSF	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L									7			9			10			
IX-4-PSF	Boron	B	mg/L									< 0.02			< 0.02			0.03			
IX-4-PSF	Cadmium	Cd-T	ug/L									< 0.2			< 0.2			< 0.2			
IX-4-PSF	Cadmium - Dissolved	Cd-D	ug/L									< 0.2			< 0.2			< 0.2			
IX-4-PSF	Calcium	Ca	mg/L									< 0.05			< 0.05			0.06			
IX-4-PSF	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L									< 1			< 1			< 1			
IX-4-PSF	Chloride	Cl	mg/L									138			700			160			
IX-4-PSF	Chromium	Cr-T	ug/L									< 1.0			< 1.0			< 1.0			
IX-4-PSF	Chromium - Dissolved	Cr-D	ug/L									< 1.0			< 1.0			< 1.0			
IX-4-PSF	Copper	Cu-T	ug/L									< 1.0			< 1.0			1.2			
IX-4-PSF	Copper - Dissolved	Cu-D	ug/L									< 1.0			5.0			< 1.0			
IX-4-PSF	Dissolved Organic Carbon	DOC	mg/L									2.3			4.9			17			
IX-4-PSF	Hardness	Hard	mg-CaCO3/L									< 1			< 1			< 1			
IX-4-PSF	Hardness - Dissolved	Hard-D	mg-CaCO3/L									< 1									
IX-4-PSF	Iron	Fe-T	ug/L									< 25	U	x	50	U	x	88			
IX-4-PSF	Iron - Dissolved	Fe-D	ug/L									< 25			< 25			< 25			
IX-4-PSF	Lead	Pb-T	ug/L									< 1.0			< 1.0			< 1.0			
IX-4-PSF	Lead - Dissolved	Pb-D	ug/L									< 1.0			< 1.0			< 1.0			
IX-4-PSF	Magnesium	Mg	mg/L									< 0.05			< 0.05			< 0.05			
IX-4-PSF	Nickel	Ni-T	ug/L									< 2.0			< 2.0			< 2.0			
IX-4-PSF	Nickel - Dissolved	Ni-D	ug/L									< 2.0			< 2.0			< 2.0			
IX-4-PSF	Nitrate as N	NO3	mg-N/L							J	h	< 0.1			< 0.1			0.1			
IX-4-PSF	Nitrite as N	NO2	mg-N/L							J	h	< 0.1			< 0.1			< 0.1			
IX-4-PSF	Oil & Grease	O&G	mg/L									< 2			< 5			< 5			
IX-4-PSF	Orthophosphate as P	O-P (T)	mg-P/L							J	h	0.22			< 0.03			< 0.03			
IX-4-PSF	Orthophosphate as P, Dis	O-P (D)	mg-P/L							J	h	0.05			< 0.03			< 0.03			
IX-4-PSF	pH (Lab value)	pH-L	pH Units							J	h	5.6			6.4			6.1			
IX-4-PSF	Phosphorus, Dissolved as P	Phos - D	mg-P/L									< 0.03			< 0.03	U	x	0.05			
IX-4-PSF	Phosphorus, Total as P	Phos - T	mg-P/L									< 0.03			< 0.03	U	x	0.07			
IX-4-PSF	Potassium	K	mg/L									< 0.5			< 0.5			< 0.5			
IX-4-PSF	Silicon (as Si)	Si	mg/L									1.4			1.2			3.6			
IX-4-PSF	Sodium	Na	mg/L									67			325			141			
IX-4-PSF	Specific Conductance (Lab)	EC-L	umhos/cm									407			2200			550			
IX-4-PSF	Sulfate as SO4	SO4	mg/L									< 1.0			< 1.0			< 1.0			
IX-4-PSF	Total Alkalinity	Tot-Alk	mg-CaCO3/L									7			8.7			10			
IX-4-PSF	Total Dissolved Solids	TDS	mg/L									164			1200			320			
IX-4-PSF	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L									< 0.1			0.3	U	x	0.5			
IX-4-PSF	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L									< 0.1			0.2			0.4			
IX-4-PSF	Total Organic Carbon	TOC	mg/L									2.8			4.9			18			
IX-4-PSF	Total Suspended Solids	TSS	mg/L									2			< 1			< 1			
IX-4-PSF	Turbidity (Lab)	Turb-L	NTU							J	h	0.9			1.0			1.9			
IX-4-PSF	Zinc	Zn-T	ug/L									< 5			< 5			< 5			
IX-4-PSF	Zinc - Dissolved	Zn-D	ug/L									< 5			< 5			< 5			

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-1-FF	Run #	Run #	-			1			2			3			4			5			6
IX-1-FF	Date Sampled	Date	-									03/07/02									
IX-1-FF	Lab Name	Lab	-									PatChem									
IX-1-FF	Water Source	Source	-									S-Yard									
IX-1-FF	Pilot Plant ID #	Plant ID#	-			not run			not run			3-IX1-FF			not run			not run			not run
IX-1-FF	Lab #	Lab #	-									0203232-01									
IX-1-FF	Turbidity - Field	Turb-F	NTU									1.8									
IX-1-FF	Temp - Field	Temp-F	C									8.6									
IX-1-FF	EC - Field	EC-F	umhos/cm									471									
IX-1-FF	pH - Field	pH-F	pH Units									6.8									
IX-1-FF	Drain Time (first fill)	Drain 1	min									NA									
IX-1-FF	Drain Time (second fill)	Drain 2	min									NA									
IX-1-FF	Acid Soluble Aluminum	Al-AS	ug/L							J	h	< 25									
IX-1-FF	Aluminum	Al-T	ug/L									69									
IX-1-FF	Aluminum - Dissolved	Al-D	ug/L									< 25									
IX-1-FF	Ammonia as N	NH4	mg-N/L									< 0.1									
IX-1-FF	Ammonia as N, dissolved	NH4-D	mg-N/L									< 0.1									
IX-1-FF	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L									28									
IX-1-FF	Boron	B	mg/L									< 0.02									
IX-1-FF	Cadmium	Cd-T	ug/L									< 0.2									
IX-1-FF	Cadmium - Dissolved	Cd-D	ug/L									< 0.2									
IX-1-FF	Calcium	Ca	mg/L									12.8									
IX-1-FF	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L									< 1									
IX-1-FF	Chloride	Cl	mg/L									90									
IX-1-FF	Chromium	Cr-T	ug/L									< 1.0									
IX-1-FF	Chromium - Dissolved	Cr-D	ug/L									< 1.0									
IX-1-FF	Copper	Cu-T	ug/L									1.4									
IX-1-FF	Copper - Dissolved	Cu-D	ug/L									1.4									
IX-1-FF	Dissolved Organic Carbon	DOC	mg/L									4.5									
IX-1-FF	Hardness	Hard	mg-CaCO3/L									41									
IX-1-FF	Hardness - Dissolved	Hard-D	mg-CaCO3/L									37									
IX-1-FF	Iron	Fe-T	ug/L									< 25									
IX-1-FF	Iron - Dissolved	Fe-D	ug/L									< 25									
IX-1-FF	Lead	Pb-T	ug/L									< 1.0									
IX-1-FF	Lead - Dissolved	Pb-D	ug/L									< 1.0									
IX-1-FF	Magnesium	Mg	mg/L									2.2									
IX-1-FF	Nickel	Ni-T	ug/L									< 2.0									
IX-1-FF	Nickel - Dissolved	Ni-D	ug/L									< 2.0									
IX-1-FF	Nitrate as N	NO3	mg-N/L							J	h	0.2									
IX-1-FF	Nitrite as N	NO2	mg-N/L							J	h	< 0.1									
IX-1-FF	Oil & Grease	O&G	mg/L									< 2									
IX-1-FF	Orthophosphate as P	O-P (T)	mg-P/L							J	h	< 0.03									
IX-1-FF	Orthophosphate as P, Dis	O-P (D)	mg-P/L							J	h	< 0.03									
IX-1-FF	pH (Lab value)	pH-L	pH Units							J	h	6.5									
IX-1-FF	Phosphorus, Dissolved as P	Phos - D	mg-P/L									< 0.03									
IX-1-FF	Phosphorus, Total as P	Phos - T	mg-P/L									< 0.03									
IX-1-FF	Potassium	K	mg/L									1.5									
IX-1-FF	Silicon (as Si)	Si	mg/L									2.9									
IX-1-FF	Sodium	Na	mg/L									68									
IX-1-FF	Specific Conductance (Lab)	EC-L	umhos/cm									359									
IX-1-FF	Sulfate as SO4	SO4	mg/L									8.0									
IX-1-FF	Total Alkalinity	Tot-Alk	mg-CaCO3/L									28									
IX-1-FF	Total Dissolved Solids	TDS	mg/L									156									
IX-1-FF	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L									4.1									
IX-1-FF	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L									< 0.1									
IX-1-FF	Total Organic Carbon	TOC	mg/L									6.4									
IX-1-FF	Total Suspended Solids	TSS	mg/L									< 1									
IX-1-FF	Turbidity (Lab)	Turb-L	NTU							J	h	2.2									
IX-1-FF	Zinc	Zn-T	ug/L									120									
IX-1-FF	Zinc - Dissolved	Zn-D	ug/L									110									

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-2-FF	Run #	Run #	-			1			2			3			4			5			6
IX-2-FF	Date Sampled	Date	-									03/07/02									
IX-2-FF	Lab Name	Lab	-									PatChem									
IX-2-FF	Water Source	Source	-									S-Yard									
IX-2-FF	Pilot Plant ID #	Plant ID#	-			not run			not run			3-IX2-FF			not run			not run			not run
IX-2-FF	Lab #	Lab #	-									0203233-01									
IX-2-FF	Turbidity - Field	Turb-F	NTU									1.2									
IX-2-FF	Temp - Field	Temp-F	C									8.7									
IX-2-FF	EC - Field	EC-F	umhos/cm									458									
IX-2-FF	pH - Field	pH-F	pH Units									6.9									
IX-2-FF	Drain Time (first fill)	Drain 1	min									NA									
IX-2-FF	Drain Time (second fill)	Drain 2	min									NA									
IX-2-FF	Acid Soluble Aluminum	Al-AS	ug/L							J	h	< 25									
IX-2-FF	Aluminum	Al-T	ug/L									45									
IX-2-FF	Aluminum - Dissolved	Al-D	ug/L									< 25									
IX-2-FF	Ammonia as N	NH4	mg-N/L									< 0.1									
IX-2-FF	Ammonia as N, dissolved	NH4-D	mg-N/L									< 0.1									
IX-2-FF	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L									16									
IX-2-FF	Boron	B	mg/L									< 0.02									
IX-2-FF	Cadmium	Cd-T	ug/L									< 0.2									
IX-2-FF	Cadmium - Dissolved	Cd-D	ug/L									< 0.2									
IX-2-FF	Calcium	Ca	mg/L									10.9									
IX-2-FF	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L									< 1									
IX-2-FF	Chloride	Cl	mg/L									111									
IX-2-FF	Chromium	Cr-T	ug/L									< 1.0									
IX-2-FF	Chromium - Dissolved	Cr-D	ug/L									< 1.0									
IX-2-FF	Copper	Cu-T	ug/L									2.4									
IX-2-FF	Copper - Dissolved	Cu-D	ug/L									1.1									
IX-2-FF	Dissolved Organic Carbon	DOC	mg/L									3.9									
IX-2-FF	Hardness	Hard	mg-CaCO3/L									33									
IX-2-FF	Hardness - Dissolved	Hard-D	mg-CaCO3/L									31									
IX-2-FF	Iron	Fe-T	ug/L									< 25									
IX-2-FF	Iron - Dissolved	Fe-D	ug/L									< 25									
IX-2-FF	Lead	Pb-T	ug/L									< 1.0									
IX-2-FF	Lead - Dissolved	Pb-D	ug/L									< 1.0									
IX-2-FF	Magnesium	Mg	mg/L									1.4									
IX-2-FF	Nickel	Ni-T	ug/L									< 2.0									
IX-2-FF	Nickel - Dissolved	Ni-D	ug/L									< 2.0									
IX-2-FF	Nitrate as N	NO3	mg-N/L							J	h	0.2									
IX-2-FF	Nitrite as N	NO2	mg-N/L							J	h	< 0.1									
IX-2-FF	Oil & Grease	O&G	mg/L									< 2									
IX-2-FF	Orthophosphate as P	O-P (T)	mg-P/L							J	h	< 0.03									
IX-2-FF	Orthophosphate as P, Dis	O-P (D)	mg-P/L							J	h	< 0.03									
IX-2-FF	pH (Lab value)	pH-L	pH Units							J	h	6.5									
IX-2-FF	Phosphorus, Dissolved as P	Phos - D	mg-P/L									< 0.03									
IX-2-FF	Phosphorus, Total as P	Phos - T	mg-P/L									< 0.03									
IX-2-FF	Potassium	K	mg/L									1.2									
IX-2-FF	Silicon (as Si)	Si	mg/L									2.0									
IX-2-FF	Sodium	Na	mg/L									75									
IX-2-FF	Specific Conductance (Lab)	EC-L	umhos/cm									395									
IX-2-FF	Sulfate as SO4	SO4	mg/L									6.5									
IX-2-FF	Total Alkalinity	Tot-Alk	mg-CaCO3/L									16									
IX-2-FF	Total Dissolved Solids	TDS	mg/L									228									
IX-2-FF	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L									1.8									
IX-2-FF	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L									< 0.1									
IX-2-FF	Total Organic Carbon	TOC	mg/L									4.4									
IX-2-FF	Total Suspended Solids	TSS	mg/L									< 1									
IX-2-FF	Turbidity (Lab)	Turb-L	NTU							J	h	0.9									
IX-2-FF	Zinc	Zn-T	ug/L									51									
IX-2-FF	Zinc - Dissolved	Zn-D	ug/L									48									

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-3-FF	Run #	Run #	-			1			2			3			4			5			6
IX-3-FF	Date Sampled	Date	-									03/07/02			05/01/02			05/21/02			11/8/2002
IX-3-FF	Lab Name	Lab	-									PatChem			ToxScan/UCD			ToxScan/UCD			ToxScan
IX-3-FF	Water Source	Source	-									S-Yard			On-Site			Roadside Basins			Roadside Basins
IX-3-FF	Pilot Plant ID #	Plant ID#	-			not run			not run			3-IX3-FF			04-IX3-FF			05-IX3-FF			06-IX3-FF-1
IX-3-FF	Lab #	Lab #	-									0203300-01			T-20292-16			T-20333-18			T-20661-12
IX-3-FF	Turbidity - Field	Turb-F	NTU									1.0			0.5			1.3			23.5
IX-3-FF	Temp - Field	Temp-F	C									8.6			10.2			9.3			9.1
IX-3-FF	EC - Field	EC-F	umhos/cm									500			2341			408			202
IX-3-FF	pH - Field	pH-F	pH Units									6.8			6.6			6.6			5.4
IX-3-FF	Drain Time (first fill)	Drain 1	min									NA			NA			NA			NA
IX-3-FF	Drain Time (second fill)	Drain 2	min									NA			NA			NA			NA
IX-3-FF	Acid Soluble Aluminum	Al-AS	ug/L							J	h	< 25			< 25			130			2900
IX-3-FF	Aluminum	Al-T	ug/L									33			< 25			450			3800
IX-3-FF	Aluminum - Dissolved	Al-D	ug/L									< 25			< 25			130			600
IX-3-FF	Ammonia as N	NH4	mg-N/L									< 0.1			< 0.1			0.6			1.2
IX-3-FF	Ammonia as N, dissolved	NH4-D	mg-N/L									< 0.1									1.2
IX-3-FF	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L									17			10			24			
IX-3-FF	Boron	B	mg/L									< 0.02			< 0.02			0.04			0.05
IX-3-FF	Cadmium	Cd-T	ug/L									< 0.2			< 0.2			0.2			4.7
IX-3-FF	Cadmium - Dissolved	Cd-D	ug/L									< 0.2			< 0.2			< 0.2			4.4
IX-3-FF	Calcium	Ca	mg/L									9.1			5.8			12.4	U	y, x	8.9
IX-3-FF	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L									< 1			< 1			< 1			
IX-3-FF	Chloride	Cl	mg/L									122			780			140			48
IX-3-FF	Chromium	Cr-T	ug/L									< 1.0			< 1.0			< 1.0			5.6
IX-3-FF	Chromium - Dissolved	Cr-D	ug/L									< 1.0			< 1.0			< 1.0			3.3
IX-3-FF	Copper	Cu-T	ug/L									< 1.0			4.3			1.5			11
IX-3-FF	Copper - Dissolved	Cu-D	ug/L									< 1.0			< 1.0			>T 2.7			7.4
IX-3-FF	Dissolved Organic Carbon	DOC	mg/L									2.1			1.9			19			
IX-3-FF	Hardness	Hard	mg-CaCO3/L									29			19			38			41
IX-3-FF	Hardness - Dissolved	Hard-D	mg-CaCO3/L									26									
IX-3-FF	Iron	Fe-T	ug/L									< 25			< 25	U	x	93			62
IX-3-FF	Iron - Dissolved	Fe-D	ug/L									< 25			< 25			44	J	Z	45
IX-3-FF	Lead	Pb-T	ug/L									4.3			< 1.0			< 1.0			1.7
IX-3-FF	Lead - Dissolved	Pb-D	ug/L									< 1.0			< 1.0			< 1.0			< 1.0
IX-3-FF	Magnesium	Mg	mg/L									1.5			1.2			1.6			1.5
IX-3-FF	Nickel	Ni-T	ug/L									< 2.0			< 2.0			3.2			3.6
IX-3-FF	Nickel - Dissolved	Ni-D	ug/L									< 2.0			< 2.0			2.5			2.7
IX-3-FF	Nitrate as N	NO3	mg-N/L							J	h	< 0.1			< 0.1			< 0.1			< 0.1
IX-3-FF	Nitrite as N	NO2	mg-N/L							J	h	< 0.1			< 0.1			< 0.1			< 0.1
IX-3-FF	Oil & Grease	O&G	mg/L									< 2			< 5			< 5			< 2
IX-3-FF	Orthophosphate as P	O-P (T)	mg-P/L							J	h	0.05			< 0.03			< 0.03			0.32
IX-3-FF	Orthophosphate as P, Dis	O-P (D)	mg-P/L							J	h	0.05			< 0.03			< 0.03			< 0.03
IX-3-FF	pH (Lab value)	pH-L	pH Units							J	h	6.2			6.6			6.6			
IX-3-FF	Phosphorus, Dissolved as P	Phos - D	mg-P/L									< 0.03			< 0.03	U	x	0.05			0.06
IX-3-FF	Phosphorus, Total as P	Phos - T	mg-P/L									< 0.03			< 0.03	U	x	0.07			0.51
IX-3-FF	Potassium	K	mg/L									1.1			1.0			2.6			7.9
IX-3-FF	Silicon (as Si)	Si	mg/L									1.9			1.1			3.6			6.1
IX-3-FF	Sodium	Na	mg/L									58			340			121			24
IX-3-FF	Specific Conductance (Lab)	EC-L	umhos/cm									401			2300			510			
IX-3-FF	Sulfate as SO4	SO4	mg/L									< 1.0			< 1.0			< 1.0			1.6
IX-3-FF	Total Alkalinity	Tot-Alk	mg-CaCO3/L									17			10			24			6
IX-3-FF	Total Dissolved Solids	TDS	mg/L									218			1300			300			320
IX-3-FF	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L									0.5			0.3			1.1	U	y, x	2.4
IX-3-FF	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L									< 0.1			0.2			1.0			2.3
IX-3-FF	Total Organic Carbon	TOC	mg/L									2.5			3.2			19	U	y, x	150
IX-3-FF	Total Suspended Solids	TSS	mg/L									< 1			< 1	U	x	4			26
IX-3-FF	Turbidity (Lab)	Turb-L	NTU							J	h	4.4			0.7			4.0			
IX-3-FF	Zinc	Zn-T	ug/L									52			28			204			1700
IX-3-FF	Zinc - Dissolved	Zn-D	ug/L									45			30			155			1500

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-4-FF	Run #	Run #	-			1			2			3			4			5			6
IX-4-FF	Date Sampled	Date	-									03/07/02			05/01/02			05/21/02			11/8/2002
IX-4-FF	Lab Name	Lab	-									PatChem			ToxScan/UCD			ToxScan/UCD			ToxScan
IX-4-FF	Water Source	Source	-									S-Yard			On-Site			Roadside Basins			Roadside Basins
IX-4-FF	Pilot Plant ID #	Plant ID#	-			not run			not run			3-IX4-FF			04-IX4-FF			05-IX4-PSF			06-IX4-FF-1
IX-4-FF	Lab #	Lab #	-									0203301-01			T-20292-29			T-20333-25			T-20661-11
IX-4-FF	Turbidity - Field	Turb-F	NTU									0.7			0.5			0.8			19.3
IX-4-FF	Temp - Field	Temp-F	C									8.7			10.5			9.3			9.3
IX-4-FF	EC - Field	EC-F	umhos/cm									488			2346			414			193
IX-4-FF	pH - Field	pH-F	pH Units									7.1			6.7			6.7			5.3
IX-4-FF	Drain Time (first fill)	Drain 1	min									NA			NA			NA			NA
IX-4-FF	Drain Time (second fill)	Drain 2	min									NA			NA			NA			NA
IX-4-FF	Acid Soluble Aluminum	Al-AS	ug/L							J	h	< 25			< 25			120			1900
IX-4-FF	Aluminum	Al-T	ug/L									< 25			< 25			190			2900
IX-4-FF	Aluminum - Dissolved	Al-D	ug/L									< 25			51			110			520
IX-4-FF	Ammonia as N	NH4	mg-N/L									< 0.1			0.1			0.2	J	Q	0.6
IX-4-FF	Ammonia as N, dissolved	NH4-D	mg-N/L									< 0.1							J	Q	1.6
IX-4-FF	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L									16			10			26			
IX-4-FF	Boron	B	mg/L									< 0.02			< 0.02			0.04			0.05
IX-4-FF	Cadmium	Cd-T	ug/L									< 0.2			< 0.2			< 0.2			< 0.2
IX-4-FF	Cadmium - Dissolved	Cd-D	ug/L									< 0.2			< 0.2			< 0.2			< 0.2
IX-4-FF	Calcium	Ca	mg/L									< 0.05			< 0.05			< 0.05	U	x	0.2
IX-4-FF	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L									< 1			< 1			< 1			
IX-4-FF	Chloride	Cl	mg/L									237			800			130			47
IX-4-FF	Chromium	Cr-T	ug/L									< 1.0			< 1.0			< 1.0			4.5
IX-4-FF	Chromium - Dissolved	Cr-D	ug/L									< 1.0			< 1.0			< 1.0			3.3
IX-4-FF	Copper	Cu-T	ug/L									< 1.0			< 1.0			1.6			7.2
IX-4-FF	Copper - Dissolved	Cu-D	ug/L									< 1.0			1.3			1.3			4.6
IX-4-FF	Dissolved Organic Carbon	DOC	mg/L									2.2			3.7			20			
IX-4-FF	Hardness	Hard	mg-CaCO3/L									< 1			< 1			< 1			43
IX-4-FF	Hardness - Dissolved	Hard-D	mg-CaCO3/L									< 1									
IX-4-FF	Iron	Fe-T	ug/L									< 25			< 25	U	x	200			610
IX-4-FF	Iron - Dissolved	Fe-D	ug/L									< 25			< 25			29	J	Z	36
IX-4-FF	Lead	Pb-T	ug/L									< 1.0			< 1.0			< 1.0			1.1
IX-4-FF	Lead - Dissolved	Pb-D	ug/L									< 1.0			< 1.0			< 1.0			< 1.0
IX-4-FF	Magnesium	Mg	mg/L									< 0.05			< 0.05			< 0.05			0.1
IX-4-FF	Nickel	Ni-T	ug/L									< 2.0			< 2.0			< 2.0			< 2.0
IX-4-FF	Nickel - Dissolved	Ni-D	ug/L									< 2.0			< 2.0			< 2.0			< 2.0
IX-4-FF	Nitrate as N	NO3	mg-N/L							J	h	< 0.1			< 0.1			< 0.1			< 0.1
IX-4-FF	Nitrite as N	NO2	mg-N/L							J	h	< 0.1			< 0.1			< 0.1			< 0.1
IX-4-FF	Oil & Grease	O&G	mg/L									< 2			< 5			< 5			< 2
IX-4-FF	Orthophosphate as P	O-P (T)	mg-P/L							J	h	0.20			< 0.03			< 0.03			0.29
IX-4-FF	Orthophosphate as P, Dis	O-P (D)	mg-P/L							J	h	0.19			< 0.03			< 0.03			0.05
IX-4-FF	pH (Lab value)	pH-L	pH Units							J	h	6.2			6.6			6.7			
IX-4-FF	Phosphorus, Dissolved as P	Phos - D	mg-P/L									< 0.03			< 0.03	U	x	0.04			0.07
IX-4-FF	Phosphorus, Total as P	Phos - T	mg-P/L									< 0.03			< 0.03	U	x	0.07			0.43
IX-4-FF	Potassium	K	mg/L									< 0.5			< 0.5			< 0.5			< 0.5
IX-4-FF	Silicon (as Si)	Si	mg/L									1.7			1.0			3.7			8.6
IX-4-FF	Sodium	Na	mg/L									69			343			142			47
IX-4-FF	Specific Conductance (Lab)	EC-L	umhos/cm									398			2300			510			
IX-4-FF	Sulfate as SO4	SO4	mg/L									< 1.0			< 1.0			< 1.0			1.5
IX-4-FF	Total Alkalinity	Tot-Alk	mg-CaCO3/L									16			10			26			6
IX-4-FF	Total Dissolved Solids	TDS	mg/L									192			1300			310			300
IX-4-FF	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L									< 0.1			0.3	U	x	0.7			1.5
IX-4-FF	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L									< 0.1			0.3			0.7	U	x	1.1
IX-4-FF	Total Organic Carbon	TOC	mg/L									3.3			2.9			20			150
IX-4-FF	Total Suspended Solids	TSS	mg/L									2			< 1			< 1			6
IX-4-FF	Turbidity (Lab)	Turb-L	NTU							J	h	1.6			0.4			1.7			
IX-4-FF	Zinc	Zn-T	ug/L									< 5			< 5			< 5			30
IX-4-FF	Zinc - Dissolved	Zn-D	ug/L									< 5			< 5			< 5			20

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
16-S	Run #	Run #	-			1			2			3			4			5			6
16-S	Date Sampled	Date	-			02/21/02			03/06/02						05/01/02			05/21/02			11/8/2002
16-S	Lab Name	Lab	-			PatChem			PatChem						ToxScan/UCD			ToxScan/UCD			ToxScan
16-S	Water Source	Source	-			On-Site			Wetland						On-Site			Roadside Basins			Roadside Basins
16-S	Pilot Plant ID #	Plant ID#	-			Equip Blk			2-14-S dup			not run			Equip Blk			Equip Blk (16-S)			6-IX4-PSF-2 Dup
16-S	Lab #	Lab #	-			0202529-01			0203239-01						T-20292-21			T-20333-23			T-20661-11
16-S	Turbidity - Field	Turb-F	NTU			0.3			8.9						0.4			0.5			52.8
16-S	Temp - Field	Temp-F	C						10.5						10.3			11.3			10.7
16-S	EC - Field	EC-F	umhos/cm						223						3			< 1			217
16-S	pH - Field	pH-F	pH Units						7.3						5.2			6.9			5.5
16-S	Drain Time (first fill)	Drain 1	min			NA			NA						NA			NA			NA
16-S	Drain Time (second fill)	Drain 2	min			NA			NA						NA			NA			NA
16-S	Acid Soluble Aluminum	Al-AS	ug/L			< 25	J	h	990						< 25			< 25			2400
16-S	Aluminum	Al-T	ug/L			< 25			1300						< 25			< 25			3700
16-S	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25						< 25			< 25			410
16-S	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1						< 0.1			< 0.1			0.7
16-S	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1												0.6
16-S	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			< 1			29						< 1			< 1			
16-S	Boron	B	mg/L			0.03			< 0.02						< 0.02			< 0.02			0.04
16-S	Cadmium	Cd-T	ug/L			< 0.2			< 0.2						< 0.2			< 0.2			0.4
16-S	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2						< 0.2			< 0.2			< 0.2
16-S	Calcium	Ca	mg/L			< 0.05			14.0						< 0.05			< 0.05	U	x	0.7
16-S	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1						< 1			< 1			
16-S	Chloride	Cl	mg/L			< 1			47						< 1			< 1			53
16-S	Chromium	Cr-T	ug/L			< 1.0			< 1.0						< 1.0			< 1.0			5.0
16-S	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0						< 1.0			< 1.0			1.9
16-S	Copper	Cu-T	ug/L			< 1.0			2.5						< 1.0			< 1.0			9.4
16-S	Copper - Dissolved	Cu-D	ug/L			< 1.0			1.6						< 1.0			< 1.0			4.5
16-S	Dissolved Organic Carbon	DOC	mg/L			1.2			5.0						< 1.0			< 1.0			
16-S	Hardness	Hard	mg-CaCO3/L			< 1			60						< 1			< 1	J	f	65
16-S	Hardness - Dissolved	Hard-D	mg-CaCO3/L			< 1			59												
16-S	Iron	Fe-T	ug/L			< 25			61						< 25			27			1200
16-S	Iron - Dissolved	Fe-D	ug/L			< 25			< 25						< 25			< 25	J	f, Z	40
16-S	Lead	Pb-T	ug/L			< 1.0			< 1.0						< 1.0			< 1.0			3.1
16-S	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0						< 1.0			< 1.0			< 1.0
16-S	Magnesium	Mg	mg/L			< 0.05			6.1						< 0.05			< 0.05			0.3
16-S	Nickel	Ni-T	ug/L			< 2.0			< 2.0						< 2.0			< 2.0			< 2.0
16-S	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0						< 2.0			< 2.0			< 2.0
16-S	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	1.1						< 0.1			< 0.1			< 0.1
16-S	Nitrite as N	NO2	mg-N/L			< 0.1	J	h	< 0.1						< 0.1			< 0.1			< 0.1
16-S	Oil & Grease	O&G	mg/L			< 2			< 2						< 5			< 5			< 2
16-S	Orthophosphate as P	O-P (T)	mg-P/L			< 0.03	J	h	0.23						< 0.03			< 0.03			0.36
16-S	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03			< 0.03						< 0.03			< 0.03			0.03
16-S	pH (Lab value)	pH-L	pH Units			5.1	J	h	6.7						6.2			5.0			
16-S	Phosphorus, Dissolved as P	Phos - D	mg-P/L			< 0.03			< 0.03						< 0.03			0.04			0.07
16-S	Phosphorus, Total as P	Phos - T	mg-P/L			< 0.03			< 0.03						< 0.03			0.06			0.57
16-S	Potassium	K	mg/L			< 0.5			2.6						< 0.5			< 0.5			< 0.5
16-S	Silicon (as Si)	Si	mg/L			< 0.5			7.6						< 0.5			< 0.5			10
16-S	Sodium	Na	mg/L			1.0			14						< 0.5			< 0.5			40
16-S	Specific Conductance (Lab)	EC-L	umhos/cm			< 1			169						1.2			< 1			
16-S	Sulfate as SO4	SO4	mg/L			< 1.0			17.9						< 1.0			< 1.0			1.7
16-S	Total Alkalinity	Tot-Alk	mg-CaCO3/L			< 1			29						< 1			< 1	J	f	6
16-S	Total Dissolved Solids	TDS	mg/L			< 1			106						2.0			16			300
16-S	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			< 0.1			4.9						< 0.1			< 0.1			1.5
16-S	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			< 0.1			< 0.1						< 0.1			< 0.1			1.3
16-S	Total Organic Carbon	TOC	mg/L	U	x	1.9			5.7						< 1.0			< 1.0			160
16-S	Total Suspended Solids	TSS	mg/L			< 1			15						< 1			2			36
16-S	Turbidity (Lab)	Turb-L	NTU			< 0.5	J	h	8.5						< 0.1			< 1			
16-S	Zinc	Zn-T	ug/L			< 5			51						< 5			< 5			160
16-S	Zinc - Dissolved	Zn-D	ug/L			< 5			37						< 5			< 5			110

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
16-F	Run #	Run #	-			1			2			3			4			5			6
16-F	Date Sampled	Date	-			02/21/02			03/06/02			03/07/02			05/01/02			05/21/02			11/8/2002
16-F	Lab Name	Lab	-			PatChem			PatChem			PatChem			ToxScan/UCD			ToxScan/UCD			ToxScan
16-F	Water Source	Source	-			On-Site			Wetland			S-Yard			On-Site			Roadside Basins			Roadside Basins
16-F	Pilot Plant ID #	Plant ID#	-			1-9-F Dup			Equip Blk			3-11-F Dup			04-12-F Dup			Bottle Blk (16-F)			Bottle Blk (16-F)
16-F	Lab #	Lab #	-			0202523-01			0203246-01			0203257-01			T-20292-12			T-20333-26			T-20661-17
16-F	Turbidity - Field	Turb-F	NTU						0.3			3.0			21.4			0.5			NA
16-F	Temp - Field	Temp-F	C						10.3			9.1			10.8			11.3			NA
16-F	EC - Field	EC-F	umhos/cm						< 1			496			2227			< 1			NA
16-F	pH - Field	pH-F	pH Units						7.1			7.1			7.0			6.9			NA
16-F	Drain Time (first fill)	Drain 1	min			NA			NA			NA			NA			NA			NA
16-F	Drain Time (second fill)	Drain 2	min			NA			NA			NA			NA			NA			NA
16-F	Acid Soluble Aluminum	Al-AS	ug/L			1400	J	h	< 25			36			120			< 25			< 25
16-F	Aluminum	Al-T	ug/L			4000			< 25			130			400			< 25			< 25
16-F	Aluminum - Dissolved	Al-D	ug/L			< 25			< 25			< 25			< 25			< 25			< 25
16-F	Ammonia as N	NH4	mg-N/L			< 0.1			< 0.1			< 0.1			< 0.1			< 0.1			< 0.1
16-F	Ammonia as N, dissolved	NH4-D	mg-N/L			< 0.1			< 0.1			< 0.1									< 0.1
16-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L			11			< 1			19			11			< 1			
16-F	Boron	B	mg/L			0.09			< 0.02			< 0.02			< 0.02			< 0.02			< 0.02
16-F	Cadmium	Cd-T	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2
16-F	Cadmium - Dissolved	Cd-D	ug/L			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2			< 0.2
16-F	Calcium	Ca	mg/L			35.4			< 0.05			7.5			29.1			< 0.05			0.1
16-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L			< 1			< 1			< 1			< 1			< 1			
16-F	Chloride	Cl	mg/L			700			< 1			117			760			< 1			< 1
16-F	Chromium	Cr-T	ug/L			2.8			< 1.0			1.6			2.4			< 1.0			< 1.0
16-F	Chromium - Dissolved	Cr-D	ug/L			< 1.0			< 1.0			< 1.0			1.6			< 1.0			< 1.0
16-F	Copper	Cu-T	ug/L			7.5			< 1.0			< 1.0			2.5			< 1.0			< 1.0
16-F	Copper - Dissolved	Cu-D	ug/L			< 1.0			< 1.0			< 1.0			1.8			< 1.0			< 1.0
16-F	Dissolved Organic Carbon	DOC	mg/L			5.5			< 1.0			4.2	J	f	5.7			< 1.0			
16-F	Hardness	Hard	mg-CaCO3/L			136			< 1			31			106			< 1			< 1
16-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L			109			< 1			26									
16-F	Iron	Fe-T	ug/L			3470			< 25			< 25			1200			47			< 25
16-F	Iron - Dissolved	Fe-D	ug/L			< 25			< 25			< 25			< 25			< 25	UJ	Z	< 25
16-F	Lead	Pb-T	ug/L			3.6			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0
16-F	Lead - Dissolved	Pb-D	ug/L			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			< 1.0
16-F	Magnesium	Mg	mg/L			11.6			< 0.05			3.0			8.1			< 0.05			< 0.05
16-F	Nickel	Ni-T	ug/L			3.8			< 2.0			< 2.0			2.0			< 2.0			< 2.0
16-F	Nickel - Dissolved	Ni-D	ug/L			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0			< 2.0
16-F	Nitrate as N	NO3	mg-N/L			< 0.1	J	h	< 0.1			< 0.1			0.1			< 0.1			< 0.1
16-F	Nitrite as N	NO2	mg-N/L			0.2	J	h	< 0.1			< 0.1			< 0.1			< 0.1			< 0.1
16-F	Oil & Grease	O&G	mg/L			5			< 2			< 2			< 5			< 5			< 2
16-F	Orthophosphate as P	O-P (T)	mg-P/L			0.07	J	h	< 0.03			< 0.03			0.05			< 0.03			< 0.03
16-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L			< 0.03	J	h	< 0.03			< 0.03			< 0.03			< 0.03			< 0.03
16-F	pH (Lab value)	pH-L	pH Units			6.6	J	h	5.6	J	h	6.6			6.8			4.9			
16-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L			0.27			< 0.03			< 0.03			< 0.03			0.04			< 0.03
16-F	Phosphorus, Total as P	Phos - T	mg-P/L			0.55			< 0.03			< 0.03			0.04			0.05			< 0.03
16-F	Potassium	K	mg/L			5.7			< 0.5			2.0			3.9			< 0.5			< 0.5
16-F	Silicon (as Si)	Si	mg/L			8.5			< 0.5			1.2			2.9			< 0.5			< 1
16-F	Sodium	Na	mg/L			422			< 0.5			72			314			< 0.5			< 0.5
16-F	Specific Conductance (Lab)	EC-L	umhos/cm			1780			< 1			398			2200			< 1			
16-F	Sulfate as SO4	SO4	mg/L			3.9			< 1.0			5.7			4.8			< 1.0			< 1.0
16-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L			11			< 1			19			11			< 1			< 1
16-F	Total Dissolved Solids	TDS	mg/L			1244			< 1			204			1300			12			6
16-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L			1.0			< 0.1			0.8			0.3			< 0.1			0.1
16-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L			0.6			< 0.1			< 0.1			0.2			< 0.1			0.1
16-F	Total Organic Carbon	TOC	mg/L	U	x	5.9			< 1.0			4.4			5.1			< 1.0			1.2
16-F	Total Suspended Solids	TSS	mg/L			< 1			< 1			5			14			< 1			< 1
16-F	Turbidity (Lab)	Turb-L	NTU			113	J	h	< 0.5			2.2			23			< 1			
16-F	Zinc	Zn-T	ug/L			33			< 5			< 5			6			< 5			< 5
16-F	Zinc - Dissolved	Zn-D	ug/L			< 5			< 5			< 5			< 5			< 5			< 5

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
17-S	Run #	Run #	-			1			2			3			4			5			6
17-S	Date Sampled	Date	-															05/21/02			
17-S	Lab Name	Lab	-															ToxScan/UCD			
17-S	Water Source	Source	-															Roadside Basins			
17-S	Pilot Plant ID #	Plant ID#	-			No Sample			No Sample			No Sample			No Sample			Make-up H2SO4 Btl Blk			Not Collected
17-S	Lab #	Lab #	-															T-20335-01			
17-S	Turbidity - Field	Turb-F	NTU															NA			
17-S	Temp - Field	Temp-F	C															NA			
17-S	EC - Field	EC-F	umhos/cm															NA			
17-S	pH - Field	pH-F	pH Units															NA			
17-S	Drain Time (first fill)	Drain 1	min															NA			
17-S	Drain Time (second fill)	Drain 2	min															NA			
17-S	Acid Soluble Aluminum	Al-AS	ug/L																		
17-S	Aluminum	Al-T	ug/L																		
17-S	Aluminum - Dissolved	Al-D	ug/L																		
17-S	Ammonia as N	NH4	mg-N/L																		
17-S	Ammonia as N, dissolved	NH4-D	mg-N/L																		
17-S	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L																		
17-S	Boron	B	mg/L																		
17-S	Cadmium	Cd-T	ug/L																		
17-S	Cadmium - Dissolved	Cd-D	ug/L																		
17-S	Calcium	Ca	mg/L																		
17-S	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L																		
17-S	Chloride	Cl	mg/L																		
17-S	Chromium	Cr-T	ug/L																		
17-S	Chromium - Dissolved	Cr-D	ug/L																		
17-S	Copper	Cu-T	ug/L																		
17-S	Copper - Dissolved	Cu-D	ug/L																		
17-S	Dissolved Organic Carbon	DOC	mg/L																		
17-S	Hardness	Hard	mg-CaCO3/L																		
17-S	Hardness - Dissolved	Hard-D	mg-CaCO3/L																		
17-S	Iron	Fe-T	ug/L																		
17-S	Iron - Dissolved	Fe-D	ug/L																		
17-S	Lead	Pb-T	ug/L																		
17-S	Lead - Dissolved	Pb-D	ug/L																		
17-S	Magnesium	Mg	mg/L																		
17-S	Nickel	Ni-T	ug/L																		
17-S	Nickel - Dissolved	Ni-D	ug/L																		
17-S	Nitrate as N	NO3	mg-N/L																		
17-S	Nitrite as N	NO2	mg-N/L																		
17-S	Oil & Grease	O&G	mg/L																		
17-S	Orthophosphate as P	O-P (T)	mg-P/L																		
17-S	Orthophosphate as P, Dis	O-P (D)	mg-P/L																		
17-S	pH (Lab value)	pH-L	pH Units																		
17-S	Phosphorus, Dissolved as P	Phos - D	mg-P/L															0.07			
17-S	Phosphorus, Total as P	Phos - T	mg-P/L															0.06			
17-S	Potassium	K	mg/L																		
17-S	Silicon (as Si)	Si	mg/L																		
17-S	Sodium	Na	mg/L																		
17-S	Specific Conductance (Lab)	EC-L	umhos/cm																		
17-S	Sulfate as SO4	SO4	mg/L																		
17-S	Total Alkalinity	Tot-Alk	mg-CaCO3/L																		
17-S	Total Dissolved Solids	TDS	mg/L																		
17-S	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L															0.2			
17-S	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L															< 0.1			
17-S	Total Organic Carbon	TOC	mg/L																		
17-S	Total Suspended Solids	TSS	mg/L																		
17-S	Turbidity (Lab)	Turb-L	NTU																		
17-S	Zinc	Zn-T	ug/L																		
17-S	Zinc - Dissolved	Zn-D	ug/L																		

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
17-F	Run #	Run #	-			1			2			3			4			5			6
17-F	Date Sampled	Date	-												05/01/02			05/21/02			11/8/2002
17-F	Lab Name	Lab	-												ToxScan/UCD			ToxScan/UCD			ToxScan
17-F	Water Source	Source	-												On-Site			Roadside Basins			Roadside Basins
17-F	Pilot Plant ID #	Plant ID#	-			No Sample			No Sample			No Sample			Bottle Blk			05-2-F Dup (17-F)			06-I-3 Dup
17-F	Lab #	Lab #	-												T-20292-22			T-20333-24			T-20661-6
17-F	Turbidity - Field	Turb-F	NTU												0.4			169			NVR
17-F	Temp - Field	Temp-F	C												9.8			9.8			NVR
17-F	EC - Field	EC-F	umhos/cm												4			398			NVR
17-F	pH - Field	pH-F	pH Units												5.5			7.2			NVR
17-F	Drain Time (first fill)	Drain 1	min												NA			NA			NA
17-F	Drain Time (second fill)	Drain 2	min												NA			NA			NA
17-F	Acid Soluble Aluminum	Al-AS	ug/L												< 25			210			530
17-F	Aluminum	Al-T	ug/L												< 25			1400	J	f	2200
17-F	Aluminum - Dissolved	Al-D	ug/L												< 25	J	f	120			130
17-F	Ammonia as N	NH4	mg-N/L												< 0.1			0.2			1.1
17-F	Ammonia as N, dissolved	NH4-D	mg-N/L																		1.2
17-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L												< 1			46			
17-F	Boron	B	mg/L												< 0.02			0.03			0.05
17-F	Cadmium	Cd-T	ug/L												< 0.2			< 0.2			0.4
17-F	Cadmium - Dissolved	Cd-D	ug/L												< 0.2			< 0.2			< 0.2
17-F	Calcium	Ca	mg/L												< 0.05			6.4			9.7
17-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L												< 1			< 1			
17-F	Chloride	Cl	mg/L												< 1			110			9
17-F	Chromium	Cr-T	ug/L												< 1.0			10.3			9.3
17-F	Chromium - Dissolved	Cr-D	ug/L												< 1.0			< 1.0			5.4
17-F	Copper	Cu-T	ug/L												< 1.0			14			20
17-F	Copper - Dissolved	Cu-D	ug/L												< 1.0			4.7			11.0
17-F	Dissolved Organic Carbon	DOC	mg/L												< 1.0			36			
17-F	Hardness	Hard	mg-CaCO3/L												< 1			30	J	f	100
17-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L																		
17-F	Iron	Fe-T	ug/L												53			6200			6500
17-F	Iron - Dissolved	Fe-D	ug/L												< 25			390	J	Z	230
17-F	Lead	Pb-T	ug/L												< 1.0			7.4			18
17-F	Lead - Dissolved	Pb-D	ug/L												< 1.0			< 1.0			< 1.0
17-F	Magnesium	Mg	mg/L												< 0.05			3.4			2.7
17-F	Nickel	Ni-T	ug/L												< 2.0			5.2			5.5
17-F	Nickel - Dissolved	Ni-D	ug/L												< 2.0			1.7			3.6
17-F	Nitrate as N	NO3	mg-N/L												< 0.1			< 0.1	J	d	0.5
17-F	Nitrite as N	NO2	mg-N/L												< 0.1			< 0.1			0.3
17-F	Oil & Grease	O&G	mg/L												< 5			< 5			6
17-F	Orthophosphate as P	O-P (T)	mg-P/L												< 0.03			0.08	J	Q	0.22
17-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L												< 0.03			< 0.03	J	Q	0.52
17-F	pH (Lab value)	pH-L	pH Units												5.4			6.9			
17-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L												< 0.03	U	x	0.09			0.66
17-F	Phosphorus, Total as P	Phos - T	mg-P/L												< 0.03			0.35			1.30
17-F	Potassium	K	mg/L												< 0.5			3.3			7.5
17-F	Silicon (as Si)	Si	mg/L												< 0.5			9.8			27
17-F	Sodium	Na	mg/L												< 0.5			127			17
17-F	Specific Conductance (Lab)	EC-L	umhos/cm												1.2			510			
17-F	Sulfate as SO4	SO4	mg/L												< 1.0			4.6			4.5
17-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L												< 1			46			29
17-F	Total Dissolved Solids	TDS	mg/L												< 1			350			300
17-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L												< 0.1			1.5			4.4
17-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L												< 0.1			1.0			2.8
17-F	Total Organic Carbon	TOC	mg/L												< 1.0			38			190
17-F	Total Suspended Solids	TSS	mg/L												< 1			120			400
17-F	Turbidity (Lab)	Turb-L	NTU												< 0.1			130			
17-F	Zinc	Zn-T	ug/L												< 5			86			610
17-F	Zinc - Dissolved	Zn-D	ug/L												< 5			11			320

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
18-S	Run #	Run #	-			1			2			3			4			5			6
18-S	Date Sampled	Date	-																		11/8/2002
18-S	Lab Name	Lab	-																		ToxScan
18-S	Water Source	Source	-																		Roadside Basins
18-S	Pilot Plant ID #	Plant ID#	-			No Sample			No Sample			No Sample			No Sample			No Sample			Equip Blk #1 (18-S)
18-S	Lab #	Lab #	-																		T-20661-14
18-S	Turbidity - Field	Turb-F	NTU																		0.15
18-S	Temp - Field	Temp-F	C																		10.7
18-S	EC - Field	EC-F	umhos/cm																		14
18-S	pH - Field	pH-F	pH Units																		4.6
18-S	Drain Time (first fill)	Drain 1	min																		NA
18-S	Drain Time (second fill)	Drain 2	min																		NA
18-S	Acid Soluble Aluminum	Al-AS	ug/L																		< 25
18-S	Aluminum	Al-T	ug/L																		< 25
18-S	Aluminum - Dissolved	Al-D	ug/L																		< 25
18-S	Ammonia as N	NH4	mg-N/L																		< 0.1
18-S	Ammonia as N, dissolved	NH4-D	mg-N/L																		< 0.1
18-S	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L																		
18-S	Boron	B	mg/L																		< 0.02
18-S	Cadmium	Cd-T	ug/L																		< 0.2
18-S	Cadmium - Dissolved	Cd-D	ug/L																		< 0.2
18-S	Calcium	Ca	mg/L																		< 0.05
18-S	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L																		
18-S	Chloride	Cl	mg/L																		< 1
18-S	Chromium	Cr-T	ug/L																		< 1.0
18-S	Chromium - Dissolved	Cr-D	ug/L																		< 1.0
18-S	Copper	Cu-T	ug/L																		< 1.0
18-S	Copper - Dissolved	Cu-D	ug/L																		< 1.0
18-S	Dissolved Organic Carbon	DOC	mg/L																		
18-S	Hardness	Hard	mg-CaCO3/L																		< 1
18-S	Hardness - Dissolved	Hard-D	mg-CaCO3/L																		
18-S	Iron	Fe-T	ug/L																		< 25
18-S	Iron - Dissolved	Fe-D	ug/L																UJ	Z	< 25
18-S	Lead	Pb-T	ug/L																		< 1.0
18-S	Lead - Dissolved	Pb-D	ug/L																		< 1.0
18-S	Magnesium	Mg	mg/L																		< 0.05
18-S	Nickel	Ni-T	ug/L																		< 2.0
18-S	Nickel - Dissolved	Ni-D	ug/L																		< 2.0
18-S	Nitrate as N	NO3	mg-N/L																		< 0.1
18-S	Nitrite as N	NO2	mg-N/L																		< 0.1
18-S	Oil & Grease	O&G	mg/L																		< 2
18-S	Orthophosphate as P	O-P (T)	mg-P/L																J	Q	< 0.03
18-S	Orthophosphate as P, Dis	O-P (D)	mg-P/L																J	Q	< 0.03
18-S	pH (Lab value)	pH-L	pH Units																		
18-S	Phosphorus, Dissolved as P	Phos - D	mg-P/L																		< 0.03
18-S	Phosphorus, Total as P	Phos - T	mg-P/L																		< 0.03
18-S	Potassium	K	mg/L																		< 0.5
18-S	Silicon (as Si)	Si	mg/L																		< 1
18-S	Sodium	Na	mg/L																		< 0.5
18-S	Specific Conductance (Lab)	EC-L	umhos/cm																		
18-S	Sulfate as SO4	SO4	mg/L																		< 1.0
18-S	Total Alkalinity	Tot-Alk	mg-CaCO3/L																		< 1
18-S	Total Dissolved Solids	TDS	mg/L																		6
18-S	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L																		< 0.1
18-S	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L																		0.2
18-S	Total Organic Carbon	TOC	mg/L																		1.0
18-S	Total Suspended Solids	TSS	mg/L																		< 1
18-S	Turbidity (Lab)	Turb-L	NTU																		
18-S	Zinc	Zn-T	ug/L																		6
18-S	Zinc - Dissolved	Zn-D	ug/L																		< 5

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
18-F	Run #	Run #	-			1			2			3			4			5			6
18-F	Date Sampled	Date	-																		11/8/2002
18-F	Lab Name	Lab	-																		ToxScan
18-F	Water Source	Source	-																		Roadside Basins
18-F	Pilot Plant ID #	Plant ID#	-			No Sample			No Sample			No Sample			No Sample			No Sample			Equip Blk #2 (18-F)
18-F	Lab #	Lab #	-																		T-20661-21
18-F	Turbidity - Field	Turb-F	NTU																		0.31
18-F	Temp - Field	Temp-F	C																		11.6
18-F	EC - Field	EC-F	umhos/cm																		< 1
18-F	pH - Field	pH-F	pH Units																		5.0
18-F	Drain Time (first fill)	Drain 1	min																		NA
18-F	Drain Time (second fill)	Drain 2	min																		NA
18-F	Acid Soluble Aluminum	Al-AS	ug/L																		< 25
18-F	Aluminum	Al-T	ug/L																		< 25
18-F	Aluminum - Dissolved	Al-D	ug/L																		< 25
18-F	Ammonia as N	NH4	mg-N/L																		< 0.1
18-F	Ammonia as N, dissolved	NH4-D	mg-N/L																		< 0.1
18-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L																		
18-F	Boron	B	mg/L																		< 0.02
18-F	Cadmium	Cd-T	ug/L																		< 0.2
18-F	Cadmium - Dissolved	Cd-D	ug/L																		< 0.2
18-F	Calcium	Ca	mg/L																U	y, x	0.2
18-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L																		
18-F	Chloride	Cl	mg/L																		< 1
18-F	Chromium	Cr-T	ug/L																		< 1.0
18-F	Chromium - Dissolved	Cr-D	ug/L																		< 1.0
18-F	Copper	Cu-T	ug/L																		< 1.0
18-F	Copper - Dissolved	Cu-D	ug/L																		< 1.0
18-F	Dissolved Organic Carbon	DOC	mg/L																		
18-F	Hardness	Hard	mg-CaCO3/L																		< 1
18-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L																		
18-F	Iron	Fe-T	ug/L																		< 25
18-F	Iron - Dissolved	Fe-D	ug/L																UJ	Z	< 25
18-F	Lead	Pb-T	ug/L																		< 1.0
18-F	Lead - Dissolved	Pb-D	ug/L																		< 1.0
18-F	Magnesium	Mg	mg/L																		< 0.05
18-F	Nickel	Ni-T	ug/L																		< 2.0
18-F	Nickel - Dissolved	Ni-D	ug/L																		< 2.0
18-F	Nitrate as N	NO3	mg-N/L																		< 0.1
18-F	Nitrite as N	NO2	mg-N/L																		< 0.1
18-F	Oil & Grease	O&G	mg/L																		< 2
18-F	Orthophosphate as P	O-P (T)	mg-P/L																U	y, x	< 0.03
18-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L																U	y, x	< 0.03
18-F	pH (Lab value)	pH-L	pH Units																		
18-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L																		< 0.03
18-F	Phosphorus, Total as P	Phos - T	mg-P/L																		< 0.03
18-F	Potassium	K	mg/L																		< 0.5
18-F	Silicon (as Si)	Si	mg/L																		< 1
18-F	Sodium	Na	mg/L																		< 0.5
18-F	Specific Conductance (Lab)	EC-L	umhos/cm																		
18-F	Sulfate as SO4	SO4	mg/L																		< 1.0
18-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L																		< 1
18-F	Total Dissolved Solids	TDS	mg/L																		< 1
18-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L																		0.1
18-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L																		0.3
18-F	Total Organic Carbon	TOC	mg/L																		1.0
18-F	Total Suspended Solids	TSS	mg/L																		< 1
18-F	Turbidity (Lab)	Turb-L	NTU																		
18-F	Zinc	Zn-T	ug/L																		< 5
18-F	Zinc - Dissolved	Zn-D	ug/L																		< 5

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
19-S	Run #	Run #	-			1			2			3			4			5			6
19-S	Date Sampled	Date	-																		11/8/2002
19-S	Lab Name	Lab	-																		ToxScan
19-S	Water Source	Source	-																		Roadside Basins
19-S	Pilot Plant ID #	Plant ID#	-			No Sample			No Sample			No Sample			No Sample			No Sample			Equip Blk (tank7 rinse)
19-S	Lab #	Lab #	-																		T-20661-22
19-S	Turbidity - Field	Turb-F	NTU																		0.31
19-S	Temp - Field	Temp-F	C																		8.9
19-S	EC - Field	EC-F	umhos/cm																		< 1
19-S	pH - Field	pH-F	pH Units																		6.2
19-S	Drain Time (first fill)	Drain 1	min																		NA
19-S	Drain Time (second fill)	Drain 2	min																		NA
19-S	Acid Soluble Aluminum	Al-AS	ug/L																		< 25
19-S	Aluminum	Al-T	ug/L																		< 25
19-S	Aluminum - Dissolved	Al-D	ug/L																		< 25
19-S	Ammonia as N	NH4	mg-N/L																		< 0.1
19-S	Ammonia as N, dissolved	NH4-D	mg-N/L																		< 0.1
19-S	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L																		
19-S	Boron	B	mg/L																		< 0.02
19-S	Cadmium	Cd-T	ug/L																		< 0.2
19-S	Cadmium - Dissolved	Cd-D	ug/L																		< 0.2
19-S	Calcium	Ca	mg/L																		0.3
19-S	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L																		
19-S	Chloride	Cl	mg/L																		< 1
19-S	Chromium	Cr-T	ug/L																		< 1.0
19-S	Chromium - Dissolved	Cr-D	ug/L																		< 1.0
19-S	Copper	Cu-T	ug/L																		< 1.0
19-S	Copper - Dissolved	Cu-D	ug/L																		< 1.0
19-S	Dissolved Organic Carbon	DOC	mg/L																		
19-S	Hardness	Hard	mg-CaCO3/L																		< 1
19-S	Hardness - Dissolved	Hard-D	mg-CaCO3/L																		
19-S	Iron	Fe-T	ug/L																		< 25
19-S	Iron - Dissolved	Fe-D	ug/L																UJ	Z	< 25
19-S	Lead	Pb-T	ug/L																		< 1.0
19-S	Lead - Dissolved	Pb-D	ug/L																		< 1.0
19-S	Magnesium	Mg	mg/L																		< 0.05
19-S	Nickel	Ni-T	ug/L																		< 2.0
19-S	Nickel - Dissolved	Ni-D	ug/L																		< 2.0
19-S	Nitrate as N	NO3	mg-N/L																		< 0.1
19-S	Nitrite as N	NO2	mg-N/L																		< 0.1
19-S	Oil & Grease	O&G	mg/L																		< 2
19-S	Orthophosphate as P	O-P (T)	mg-P/L																		< 0.03
19-S	Orthophosphate as P, Dis	O-P (D)	mg-P/L																		< 0.03
19-S	pH (Lab value)	pH-L	pH Units																		
19-S	Phosphorus, Dissolved as P	Phos - D	mg-P/L																		< 0.03
19-S	Phosphorus, Total as P	Phos - T	mg-P/L																		< 0.03
19-S	Potassium	K	mg/L																		< 0.5
19-S	Silicon (as Si)	Si	mg/L																		< 1
19-S	Sodium	Na	mg/L																		< 0.5
19-S	Specific Conductance (Lab)	EC-L	umhos/cm																		
19-S	Sulfate as SO4	SO4	mg/L																		< 1.0
19-S	Total Alkalinity	Tot-Alk	mg-CaCO3/L																		< 1
19-S	Total Dissolved Solids	TDS	mg/L																		< 1
19-S	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L																		0.1
19-S	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L																		0.1
19-S	Total Organic Carbon	TOC	mg/L																		1.4
19-S	Total Suspended Solids	TSS	mg/L																		< 1
19-S	Turbidity (Lab)	Turb-L	NTU																		
19-S	Zinc	Zn-T	ug/L																		< 5
19-S	Zinc - Dissolved	Zn-D	ug/L																		< 5

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
19-F	Run #	Run #	-			1			2			3			4			5			6
19-F	Date Sampled	Date	-																		
19-F	Lab Name	Lab	-																		
19-F	Water Source	Source	-																		
19-F	Pilot Plant ID #	Plant ID#	-			No Sample			No Sample			No Sample			No Sample			No Sample			Not Collected
19-F	Lab #	Lab #	-																		
19-F	Turbidity - Field	Turb-F	NTU																		
19-F	Temp - Field	Temp-F	C																		
19-F	EC - Field	EC-F	umhos/cm																		
19-F	pH - Field	pH-F	pH Units																		
19-F	Drain Time (first fill)	Drain 1	min																		
19-F	Drain Time (second fill)	Drain 2	min																		
19-F	Acid Soluble Aluminum	Al-AS	ug/L																		
19-F	Aluminum	Al-T	ug/L																		
19-F	Aluminum - Dissolved	Al-D	ug/L																		
19-F	Ammonia as N	NH4	mg-N/L																		
19-F	Ammonia as N, dissolved	NH4-D	mg-N/L																		
19-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L																		
19-F	Boron	B	mg/L																		
19-F	Cadmium	Cd-T	ug/L																		
19-F	Cadmium - Dissolved	Cd-D	ug/L																		
19-F	Calcium	Ca	mg/L																		
19-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L																		
19-F	Chloride	Cl	mg/L																		
19-F	Chromium	Cr-T	ug/L																		
19-F	Chromium - Dissolved	Cr-D	ug/L																		
19-F	Copper	Cu-T	ug/L																		
19-F	Copper - Dissolved	Cu-D	ug/L																		
19-F	Dissolved Organic Carbon	DOC	mg/L																		
19-F	Hardness	Hard	mg-CaCO3/L																		
19-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L																		
19-F	Iron	Fe-T	ug/L																		
19-F	Iron - Dissolved	Fe-D	ug/L																		
19-F	Lead	Pb-T	ug/L																		
19-F	Lead - Dissolved	Pb-D	ug/L																		
19-F	Magnesium	Mg	mg/L																		
19-F	Nickel	Ni-T	ug/L																		
19-F	Nickel - Dissolved	Ni-D	ug/L																		
19-F	Nitrate as N	NO3	mg-N/L																		
19-F	Nitrite as N	NO2	mg-N/L																		
19-F	Oil & Grease	O&G	mg/L																		
19-F	Orthophosphate as P	O-P (T)	mg-P/L																		
19-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L																		
19-F	pH (Lab value)	pH-L	pH Units																		
19-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L																		
19-F	Phosphorus, Total as P	Phos - T	mg-P/L																		
19-F	Potassium	K	mg/L																		
19-F	Silicon (as Si)	Si	mg/L																		
19-F	Sodium	Na	mg/L																		
19-F	Specific Conductance (Lab)	EC-L	umhos/cm																		
19-F	Sulfate as SO4	SO4	mg/L																		
19-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L																		
19-F	Total Dissolved Solids	TDS	mg/L																		
19-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L																		
19-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L																		
19-F	Total Organic Carbon	TOC	mg/L																		
19-F	Total Suspended Solids	TSS	mg/L																		
19-F	Turbidity (Lab)	Turb-L	NTU																		
19-F	Zinc	Zn-T	ug/L																		
19-F	Zinc - Dissolved	Zn-D	ug/L																		

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
20-S	Run #	Run #	-			1			2			3			4			5			6
20-S	Date Sampled	Date	-																		11/8/2002
20-S	Lab Name	Lab	-																		ToxScan
20-S	Water Source	Source	-																		URS
20-S	Pilot Plant ID #	Plant ID#	-			No Sample			No Sample			No Sample			No Sample			No Sample			PE Blank
20-S	Lab #	Lab #	-																		T-20661-25
20-S	Turbidity - Field	Turb-F	NTU																		NA
20-S	Temp - Field	Temp-F	C																		NA
20-S	EC - Field	EC-F	umhos/cm																		NA
20-S	pH - Field	pH-F	pH Units																		NA
20-S	Drain Time (first fill)	Drain 1	min																		NA
20-S	Drain Time (second fill)	Drain 2	min																		NA
20-S	Acid Soluble Aluminum	Al-AS	ug/L																		
20-S	Aluminum	Al-T	ug/L																		
20-S	Aluminum - Dissolved	Al-D	ug/L																		
20-S	Ammonia as N	NH4	mg-N/L																		
20-S	Ammonia as N, dissolved	NH4-D	mg-N/L																		
20-S	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L																		
20-S	Boron	B	mg/L																		
20-S	Cadmium	Cd-T	ug/L																		
20-S	Cadmium - Dissolved	Cd-D	ug/L																		
20-S	Calcium	Ca	mg/L																		
20-S	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L																		
20-S	Chloride	Cl	mg/L																		
20-S	Chromium	Cr-T	ug/L																		
20-S	Chromium - Dissolved	Cr-D	ug/L																		
20-S	Copper	Cu-T	ug/L																		
20-S	Copper - Dissolved	Cu-D	ug/L																		
20-S	Dissolved Organic Carbon	DOC	mg/L																		
20-S	Hardness	Hard	mg-CaCO3/L																		
20-S	Hardness - Dissolved	Hard-D	mg-CaCO3/L																		
20-S	Iron	Fe-T	ug/L																		< 25
20-S	Iron - Dissolved	Fe-D	ug/L																UJ	Z	< 25
20-S	Lead	Pb-T	ug/L																		
20-S	Lead - Dissolved	Pb-D	ug/L																		
20-S	Magnesium	Mg	mg/L																		
20-S	Nickel	Ni-T	ug/L																		
20-S	Nickel - Dissolved	Ni-D	ug/L																		
20-S	Nitrate as N	NO3	mg-N/L																		
20-S	Nitrite as N	NO2	mg-N/L																		
20-S	Oil & Grease	O&G	mg/L																		
20-S	Orthophosphate as P	O-P (T)	mg-P/L																		
20-S	Orthophosphate as P, Dis	O-P (D)	mg-P/L																		
20-S	pH (Lab value)	pH-L	pH Units																		
20-S	Phosphorus, Dissolved as P	Phos - D	mg-P/L																		< 0.03
20-S	Phosphorus, Total as P	Phos - T	mg-P/L																		< 0.03
20-S	Potassium	K	mg/L																		
20-S	Silicon (as Si)	Si	mg/L																		
20-S	Sodium	Na	mg/L																		
20-S	Specific Conductance (Lab)	EC-L	umhos/cm																		
20-S	Sulfate as SO4	SO4	mg/L																		
20-S	Total Alkalinity	Tot-Alk	mg-CaCO3/L																		
20-S	Total Dissolved Solids	TDS	mg/L																		
20-S	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L																		< 0.1
20-S	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L																		0.1
20-S	Total Organic Carbon	TOC	mg/L																		1.1
20-S	Total Suspended Solids	TSS	mg/L																		
20-S	Turbidity (Lab)	Turb-L	NTU																		
20-S	Zinc	Zn-T	ug/L																		
20-S	Zinc - Dissolved	Zn-D	ug/L																		

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
20-F	Run #	Run #	-			1			2			3			4			5			6
20-F	Date Sampled	Date	-																		11/8/2002
20-F	Lab Name	Lab	-																		ToxScan
20-F	Water Source	Source	-																		URS
20-F	Pilot Plant ID #	Plant ID#	-			No Sample			No Sample			No Sample			No Sample			No Sample			PE Sample
20-F	Lab #	Lab #	-																		20661-24
20-F	Turbidity - Field	Turb-F	NTU																		NA
20-F	Temp - Field	Temp-F	C																		NA
20-F	EC - Field	EC-F	umhos/cm																		NA
20-F	pH - Field	pH-F	pH Units																		NA
20-F	Drain Time (first fill)	Drain 1	min																		NA
20-F	Drain Time (second fill)	Drain 2	min																		NA
20-F	Acid Soluble Aluminum	Al-AS	ug/L																		
20-F	Aluminum	Al-T	ug/L																		
20-F	Aluminum - Dissolved	Al-D	ug/L																		
20-F	Ammonia as N	NH4	mg-N/L																		
20-F	Ammonia as N, dissolved	NH4-D	mg-N/L																		
20-F	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L																		
20-F	Boron	B	mg/L																		
20-F	Cadmium	Cd-T	ug/L																		
20-F	Cadmium - Dissolved	Cd-D	ug/L																		
20-F	Calcium	Ca	mg/L																		
20-F	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L																		
20-F	Chloride	Cl	mg/L																		
20-F	Chromium	Cr-T	ug/L																		
20-F	Chromium - Dissolved	Cr-D	ug/L																		
20-F	Copper	Cu-T	ug/L																		
20-F	Copper - Dissolved	Cu-D	ug/L																		
20-F	Dissolved Organic Carbon	DOC	mg/L																		
20-F	Hardness	Hard	mg-CaCO3/L																		
20-F	Hardness - Dissolved	Hard-D	mg-CaCO3/L																		
20-F	Iron	Fe-T	ug/L																		65
20-F	Iron - Dissolved	Fe-D	ug/L																J	Z	44
20-F	Lead	Pb-T	ug/L																		
20-F	Lead - Dissolved	Pb-D	ug/L																		
20-F	Magnesium	Mg	mg/L																		
20-F	Nickel	Ni-T	ug/L																		
20-F	Nickel - Dissolved	Ni-D	ug/L																		
20-F	Nitrate as N	NO3	mg-N/L																		
20-F	Nitrite as N	NO2	mg-N/L																		
20-F	Oil & Grease	O&G	mg/L																		
20-F	Orthophosphate as P	O-P (T)	mg-P/L																		
20-F	Orthophosphate as P, Dis	O-P (D)	mg-P/L																		
20-F	pH (Lab value)	pH-L	pH Units																		
20-F	Phosphorus, Dissolved as P	Phos - D	mg-P/L																		0.25
20-F	Phosphorus, Total as P	Phos - T	mg-P/L																		0.23
20-F	Potassium	K	mg/L																		
20-F	Silicon (as Si)	Si	mg/L																		
20-F	Sodium	Na	mg/L																		
20-F	Specific Conductance (Lab)	EC-L	umhos/cm																		
20-F	Sulfate as SO4	SO4	mg/L																		
20-F	Total Alkalinity	Tot-Alk	mg-CaCO3/L																		
20-F	Total Dissolved Solids	TDS	mg/L																		
20-F	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L																U	y, x	0.3
20-F	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L																U	y, x	0.3
20-F	Total Organic Carbon	TOC	mg/L																		17
20-F	Total Suspended Solids	TSS	mg/L																		
20-F	Turbidity (Lab)	Turb-L	NTU																		
20-F	Zinc	Zn-T	ug/L																		
20-F	Zinc - Dissolved	Zn-D	ug/L																		

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
A-2	Run #	Run #	-			1			2			3			4			5			6
A-2	Date Sampled	Date	-																		11/8/2002
A-2	Lab Name	Lab	-																		ToxScan
A-2	Water Source	Source	-																		Roadside Basins
A-2	Pilot Plant ID #	Plant ID#	-			No Sample			No Sample			No Sample			No Sample			No Sample			06-A-2
A-2	Lab #	Lab #	-																		T-20661-9
A-2	Turbidity - Field	Turb-F	NTU																		187
A-2	Temp - Field	Temp-F	C																		8.4
A-2	EC - Field	EC-F	umhos/cm																		187
A-2	pH - Field	pH-F	pH Units																		6.1
A-2	Drain Time (first fill)	Drain 1	min																		NA
A-2	Drain Time (second fill)	Drain 2	min																		NA
A-2	Acid Soluble Aluminum	Al-AS	ug/L																		4500
A-2	Aluminum	Al-T	ug/L																		6800
A-2	Aluminum - Dissolved	Al-D	ug/L																		720
A-2	Ammonia as N	NH4	mg-N/L																		1.2
A-2	Ammonia as N, dissolved	NH4-D	mg-N/L																		
A-2	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L																		
A-2	Boron	B	mg/L																		0.07
A-2	Cadmium	Cd-T	ug/L																		0.2
A-2	Cadmium - Dissolved	Cd-D	ug/L																		< 0.2
A-2	Calcium	Ca	mg/L																		12.0
A-2	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L																		
A-2	Chloride	Cl	mg/L																		23
A-2	Chromium	Cr-T	ug/L																		8.9
A-2	Chromium - Dissolved	Cr-D	ug/L																		4.1
A-2	Copper	Cu-T	ug/L																		15
A-2	Copper - Dissolved	Cu-D	ug/L																		7.6
A-2	Dissolved Organic Carbon	DOC	mg/L																		
A-2	Hardness	Hard	mg-CaCO3/L																		85
A-2	Hardness - Dissolved	Hard-D	mg-CaCO3/L																		
A-2	Iron	Fe-T	ug/L																		4100
A-2	Iron - Dissolved	Fe-D	ug/L																J	Z	82
A-2	Lead	Pb-T	ug/L																		9.8
A-2	Lead - Dissolved	Pb-D	ug/L																		< 1.0
A-2	Magnesium	Mg	mg/L																		2.7
A-2	Nickel	Ni-T	ug/L																		4.4
A-2	Nickel - Dissolved	Ni-D	ug/L																		2.9
A-2	Nitrate as N	NO3	mg-N/L																J	d	0.5
A-2	Nitrite as N	NO2	mg-N/L																		0.3
A-2	Oil & Grease	O&G	mg/L																		5
A-2	Orthophosphate as P	O-P (T)	mg-P/L																		0.43
A-2	Orthophosphate as P, Dis	O-P (D)	mg-P/L																		0.03
A-2	pH (Lab value)	pH-L	pH Units																		
A-2	Phosphorus, Dissolved as P	Phos - D	mg-P/L																		0.10
A-2	Phosphorus, Total as P	Phos - T	mg-P/L																		1.10
A-2	Potassium	K	mg/L																		9.9
A-2	Silicon (as Si)	Si	mg/L																		24
A-2	Sodium	Na	mg/L																		28
A-2	Specific Conductance (Lab)	EC-L	umhos/cm																		
A-2	Sulfate as SO4	SO4	mg/L																		8.3
A-2	Total Alkalinity	Tot-Alk	mg-CaCO3/L																		18
A-2	Total Dissolved Solids	TDS	mg/L																		300
A-2	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L																U	x	3.9
A-2	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L																U	y, x	2.7
A-2	Total Organic Carbon	TOC	mg/L																		200
A-2	Total Suspended Solids	TSS	mg/L																		150
A-2	Turbidity (Lab)	Turb-L	NTU																		
A-2	Zinc	Zn-T	ug/L																		440
A-2	Zinc - Dissolved	Zn-D	ug/L																		250

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
A-2-PSF	Run #	Run #	-			1			2			3			4			5			6
A-2-PSF	Date Sampled	Date	-																		11/8/2002
A-2-PSF	Lab Name	Lab	-																		ToxScan
A-2-PSF	Water Source	Source	-																		Roadside Basins
A-2-PSF	Pilot Plant ID #	Plant ID#	-			No Sample			No Sample			No Sample			No Sample			No Sample			06-PSF-2
A-2-PSF	Lab #	Lab #	-																		T-20661-5
A-2-PSF	Turbidity - Field	Turb-F	NTU																		86.0
A-2-PSF	Temp - Field	Temp-F	C																		9.1
A-2-PSF	EC - Field	EC-F	umhos/cm																		86
A-2-PSF	pH - Field	pH-F	pH Units																		6.4
A-2-PSF	Drain Time (first fill)	Drain 1	min																		NA
A-2-PSF	Drain Time (second fill)	Drain 2	min																		NA
A-2-PSF	Acid Soluble Aluminum	Al-AS	ug/L																		3800
A-2-PSF	Aluminum	Al-T	ug/L																		6300
A-2-PSF	Aluminum - Dissolved	Al-D	ug/L																		660
A-2-PSF	Ammonia as N	NH4	mg-N/L																J	Q	1.1
A-2-PSF	Ammonia as N, dissolved	NH4-D	mg-N/L																J	Q	1.3
A-2-PSF	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L																		
A-2-PSF	Boron	B	mg/L																		0.05
A-2-PSF	Cadmium	Cd-T	ug/L																		< 0.2
A-2-PSF	Cadmium - Dissolved	Cd-D	ug/L																		< 0.2
A-2-PSF	Calcium	Ca	mg/L																		10.0
A-2-PSF	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L																		
A-2-PSF	Chloride	Cl	mg/L																		33
A-2-PSF	Chromium	Cr-T	ug/L																		8.9
A-2-PSF	Chromium - Dissolved	Cr-D	ug/L																		4.3
A-2-PSF	Copper	Cu-T	ug/L																		14
A-2-PSF	Copper - Dissolved	Cu-D	ug/L																		7.0
A-2-PSF	Dissolved Organic Carbon	DOC	mg/L																		
A-2-PSF	Hardness	Hard	mg-CaCO3/L																		55
A-2-PSF	Hardness - Dissolved	Hard-D	mg-CaCO3/L																		
A-2-PSF	Iron	Fe-T	ug/L																		2100
A-2-PSF	Iron - Dissolved	Fe-D	ug/L																J	Z	150
A-2-PSF	Lead	Pb-T	ug/L																		5.9
A-2-PSF	Lead - Dissolved	Pb-D	ug/L																		< 1.0
A-2-PSF	Magnesium	Mg	mg/L																		1.6
A-2-PSF	Nickel	Ni-T	ug/L																		5.3
A-2-PSF	Nickel - Dissolved	Ni-D	ug/L																		3.7
A-2-PSF	Nitrate as N	NO3	mg-N/L																J	d	0.5
A-2-PSF	Nitrite as N	NO2	mg-N/L																		0.3
A-2-PSF	Oil & Grease	O&G	mg/L																		2
A-2-PSF	Orthophosphate as P	O-P (T)	mg-P/L																		0.43
A-2-PSF	Orthophosphate as P, Dis	O-P (D)	mg-P/L																		< 0.03
A-2-PSF	pH (Lab value)	pH-L	pH Units																		
A-2-PSF	Phosphorus, Dissolved as P	Phos - D	mg-P/L																		0.08
A-2-PSF	Phosphorus, Total as P	Phos - T	mg-P/L																		0.82
A-2-PSF	Potassium	K	mg/L																		6.2
A-2-PSF	Silicon (as Si)	Si	mg/L																		13
A-2-PSF	Sodium	Na	mg/L																		26
A-2-PSF	Specific Conductance (Lab)	EC-L	umhos/cm																		
A-2-PSF	Sulfate as SO4	SO4	mg/L																		7.2
A-2-PSF	Total Alkalinity	Tot-Alk	mg-CaCO3/L																		25
A-2-PSF	Total Dissolved Solids	TDS	mg/L																		320
A-2-PSF	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L																		3.5
A-2-PSF	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L																		2.6
A-2-PSF	Total Organic Carbon	TOC	mg/L																		170
A-2-PSF	Total Suspended Solids	TSS	mg/L																		62
A-2-PSF	Turbidity (Lab)	Turb-L	NTU																		
A-2-PSF	Zinc	Zn-T	ug/L																		330
A-2-PSF	Zinc - Dissolved	Zn-D	ug/L																		470

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-3-PSF-2	Run #	Run #	-			1			2			3			4			5			6
IX-3-PSF-2	Date Sampled	Date	-																		11/8/2002
IX-3-PSF-2	Lab Name	Lab	-																		ToxScan
IX-3-PSF-2	Water Source	Source	-																		Roadside Basins
IX-3-PSF-2	Pilot Plant ID #	Plant ID#	-			No Sample			No Sample			No Sample			No Sample			No Sample			06-IX3-PSF-2
IX-3-PSF-2	Lab #	Lab #	-																		T-20661-19
IX-3-PSF-2	Turbidity - Field	Turb-F	NTU																		NVR
IX-3-PSF-2	Temp - Field	Temp-F	C																		NVR
IX-3-PSF-2	EC - Field	EC-F	umhos/cm																		NVR
IX-3-PSF-2	pH - Field	pH-F	pH Units																		NVR
IX-3-PSF-2	Drain Time (first fill)	Drain 1	min																		NA
IX-3-PSF-2	Drain Time (second fill)	Drain 2	min																		NA
IX-3-PSF-2	Acid Soluble Aluminum	Al-AS	ug/L																		3900
IX-3-PSF-2	Aluminum	Al-T	ug/L																		4600
IX-3-PSF-2	Aluminum - Dissolved	Al-D	ug/L																		560
IX-3-PSF-2	Ammonia as N	NH4	mg-N/L																		1.1
IX-3-PSF-2	Ammonia as N, dissolved	NH4-D	mg-N/L																		1.1
IX-3-PSF-2	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L																		
IX-3-PSF-2	Boron	B	mg/L																		0.04
IX-3-PSF-2	Cadmium	Cd-T	ug/L																		5.7
IX-3-PSF-2	Cadmium - Dissolved	Cd-D	ug/L																		5.0
IX-3-PSF-2	Calcium	Ca	mg/L																		9.8
IX-3-PSF-2	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L																		
IX-3-PSF-2	Chloride	Cl	mg/L																		55
IX-3-PSF-2	Chromium	Cr-T	ug/L																		6.1
IX-3-PSF-2	Chromium - Dissolved	Cr-D	ug/L																		3.1
IX-3-PSF-2	Copper	Cu-T	ug/L																		18
IX-3-PSF-2	Copper - Dissolved	Cu-D	ug/L																		9.6
IX-3-PSF-2	Dissolved Organic Carbon	DOC	mg/L																		
IX-3-PSF-2	Hardness	Hard	mg-CaCO3/L																		51
IX-3-PSF-2	Hardness - Dissolved	Hard-D	mg-CaCO3/L																		
IX-3-PSF-2	Iron	Fe-T	ug/L																		1600
IX-3-PSF-2	Iron - Dissolved	Fe-D	ug/L																J	Z	77
IX-3-PSF-2	Lead	Pb-T	ug/L																		4.2
IX-3-PSF-2	Lead - Dissolved	Pb-D	ug/L																		< 1.0
IX-3-PSF-2	Magnesium	Mg	mg/L																		1.6
IX-3-PSF-2	Nickel	Ni-T	ug/L																		4.4
IX-3-PSF-2	Nickel - Dissolved	Ni-D	ug/L																		2.9
IX-3-PSF-2	Nitrate as N	NO3	mg-N/L																		< 0.1
IX-3-PSF-2	Nitrite as N	NO2	mg-N/L																		< 0.1
IX-3-PSF-2	Oil & Grease	O&G	mg/L																		< 2
IX-3-PSF-2	Orthophosphate as P	O-P (T)	mg-P/L																		0.36
IX-3-PSF-2	Orthophosphate as P, Dis	O-P (D)	mg-P/L																		< 0.03
IX-3-PSF-2	pH (Lab value)	pH-L	pH Units																		
IX-3-PSF-2	Phosphorus, Dissolved as P	Phos - D	mg-P/L																		0.04
IX-3-PSF-2	Phosphorus, Total as P	Phos - T	mg-P/L																		0.64
IX-3-PSF-2	Potassium	K	mg/L																		6.4
IX-3-PSF-2	Silicon (as Si)	Si	mg/L																		12
IX-3-PSF-2	Sodium	Na	mg/L																		25
IX-3-PSF-2	Specific Conductance (Lab)	EC-L	umhos/cm																		
IX-3-PSF-2	Sulfate as SO4	SO4	mg/L																		1.8
IX-3-PSF-2	Total Alkalinity	Tot-Alk	mg-CaCO3/L																		8
IX-3-PSF-2	Total Dissolved Solids	TDS	mg/L																		360
IX-3-PSF-2	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L																		2.8
IX-3-PSF-2	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L																		2.1
IX-3-PSF-2	Total Organic Carbon	TOC	mg/L																		140
IX-3-PSF-2	Total Suspended Solids	TSS	mg/L																		56
IX-3-PSF-2	Turbidity (Lab)	Turb-L	NTU																		
IX-3-PSF-2	Zinc	Zn-T	ug/L																		2500
IX-3-PSF-2	Zinc - Dissolved	Zn-D	ug/L																		2600

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
IX-4-PSF-2	Run #	Run #	-			1			2			3			4			5			6
IX-4-PSF-2	Date Sampled	Date	-																		11/8/2002
IX-4-PSF-2	Lab Name	Lab	-																		ToxScan
IX-4-PSF-2	Water Source	Source	-																		Roadside Basins
IX-4-PSF-2	Pilot Plant ID #	Plant ID#	-			No Sample			No Sample			No Sample			No Sample			No Sample			06-IX4-PSF-2
IX-4-PSF-2	Lab #	Lab #	-																		T-20661-3
IX-4-PSF-2	Turbidity - Field	Turb-F	NTU																		86.0
IX-4-PSF-2	Temp - Field	Temp-F	C																		10.0
IX-4-PSF-2	EC - Field	EC-F	umhos/cm																		219
IX-4-PSF-2	pH - Field	pH-F	pH Units																		5.4
IX-4-PSF-2	Drain Time (first fill)	Drain 1	min																		NA
IX-4-PSF-2	Drain Time (second fill)	Drain 2	min																		NA
IX-4-PSF-2	Acid Soluble Aluminum	Al-AS	ug/L																		3400
IX-4-PSF-2	Aluminum	Al-T	ug/L																		550
IX-4-PSF-2	Aluminum - Dissolved	Al-D	ug/L																		510
IX-4-PSF-2	Ammonia as N	NH4	mg-N/L																J	Q	0.5
IX-4-PSF-2	Ammonia as N, dissolved	NH4-D	mg-N/L																J	Q	1.0
IX-4-PSF-2	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L																		
IX-4-PSF-2	Boron	B	mg/L																		0.04
IX-4-PSF-2	Cadmium	Cd-T	ug/L																		0.3
IX-4-PSF-2	Cadmium - Dissolved	Cd-D	ug/L																		< 0.2
IX-4-PSF-2	Calcium	Ca	mg/L																U	x	0.7
IX-4-PSF-2	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L																		
IX-4-PSF-2	Chloride	Cl	mg/L																		53
IX-4-PSF-2	Chromium	Cr-T	ug/L																		2.5
IX-4-PSF-2	Chromium - Dissolved	Cr-D	ug/L																		1.7
IX-4-PSF-2	Copper	Cu-T	ug/L																		6.2
IX-4-PSF-2	Copper - Dissolved	Cu-D	ug/L																		5.3
IX-4-PSF-2	Dissolved Organic Carbon	DOC	mg/L																		
IX-4-PSF-2	Hardness	Hard	mg-CaCO3/L																J	f	25
IX-4-PSF-2	Hardness - Dissolved	Hard-D	mg-CaCO3/L																		
IX-4-PSF-2	Iron	Fe-T	ug/L																		1200
IX-4-PSF-2	Iron - Dissolved	Fe-D	ug/L																J	f, Z	610
IX-4-PSF-2	Lead	Pb-T	ug/L																		< 1.0
IX-4-PSF-2	Lead - Dissolved	Pb-D	ug/L																		< 1.0
IX-4-PSF-2	Magnesium	Mg	mg/L																		0.3
IX-4-PSF-2	Nickel	Ni-T	ug/L																		< 2.0
IX-4-PSF-2	Nickel - Dissolved	Ni-D	ug/L																		< 2.0
IX-4-PSF-2	Nitrate as N	NO3	mg-N/L																		< 0.1
IX-4-PSF-2	Nitrite as N	NO2	mg-N/L																		< 0.1
IX-4-PSF-2	Oil & Grease	O&G	mg/L																		< 2
IX-4-PSF-2	Orthophosphate as P	O-P (T)	mg-P/L																		0.36
IX-4-PSF-2	Orthophosphate as P, Dis	O-P (D)	mg-P/L																		0.03
IX-4-PSF-2	pH (Lab value)	pH-L	pH Units																		
IX-4-PSF-2	Phosphorus, Dissolved as P	Phos - D	mg-P/L																		0.06
IX-4-PSF-2	Phosphorus, Total as P	Phos - T	mg-P/L																		0.56
IX-4-PSF-2	Potassium	K	mg/L																		< 0.5
IX-4-PSF-2	Silicon (as Si)	Si	mg/L																		9.9
IX-4-PSF-2	Sodium	Na	mg/L																		39
IX-4-PSF-2	Specific Conductance (Lab)	EC-L	umhos/cm																		
IX-4-PSF-2	Sulfate as SO4	SO4	mg/L																		1.7
IX-4-PSF-2	Total Alkalinity	Tot-Alk	mg-CaCO3/L																J	f	35
IX-4-PSF-2	Total Dissolved Solids	TDS	mg/L																		300
IX-4-PSF-2	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L																		1.6
IX-4-PSF-2	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L																U	y, x	1.2
IX-4-PSF-2	Total Organic Carbon	TOC	mg/L																		150
IX-4-PSF-2	Total Suspended Solids	TSS	mg/L																		36
IX-4-PSF-2	Turbidity (Lab)	Turb-L	NTU																		
IX-4-PSF-2	Zinc	Zn-T	ug/L																		140
IX-4-PSF-2	Zinc - Dissolved	Zn-D	ug/L																		130

SAMPLE Point	PARAMETER	ABV.	UNITS	DATA FLAG	REASON CODE	RUN 1	DATA FLAG	REASON CODE	RUN 2	DATA FLAG	REASON CODE	RUN 3	DATA FLAG	REASON CODE	RUN 4	DATA FLAG	REASON CODE	RUN 5	DATA FLAG	REASON CODE	RUN 6
101-S	Run #	Run #	-			1			2			3			4			5			6
101-S	Date Sampled	Date	-																		11/8/2002
101-S	Lab Name	Lab	-																		ToxScan
101-S	Water Source	Source	-																		Roadside Basins
101-S	Pilot Plant ID #	Plant ID#	-			No Sample			No Sample			No Sample			No Sample			No Sample			06-101-S (PAM Sed)
101-S	Lab #	Lab #	-																		T-20661-16
101-S	Turbidity - Field	Turb-F	NTU																		148
101-S	Temp - Field	Temp-F	C																		9.8
101-S	EC - Field	EC-F	umhos/cm																		145
101-S	pH - Field	pH-F	pH Units																		6.6
101-S	Drain Time (first fill)	Drain 1	min																		NA
101-S	Drain Time (second fill)	Drain 2	min																		NA
101-S	Acid Soluble Aluminum	Al-AS	ug/L																J	Q	490
101-S	Aluminum	Al-T	ug/L																		1500
101-S	Aluminum - Dissolved	Al-D	ug/L																J	Q	550
101-S	Ammonia as N	NH4	mg-N/L																		1.2
101-S	Ammonia as N, dissolved	NH4-D	mg-N/L																		
101-S	Bicarbonate Alkalinity	Bicarb-Alk	mg-CaCO3/L																		
101-S	Boron	B	mg/L																		0.04
101-S	Cadmium	Cd-T	ug/L																		0.3
101-S	Cadmium - Dissolved	Cd-D	ug/L																		< 0.2
101-S	Calcium	Ca	mg/L																		8.2
101-S	Carbonate Alkalinity	Carb-Alk	mg-CaCO3/L																		
101-S	Chloride	Cl	mg/L																		10
101-S	Chromium	Cr-T	ug/L																		8.6
101-S	Chromium - Dissolved	Cr-D	ug/L																		6.4
101-S	Copper	Cu-T	ug/L																		17
101-S	Copper - Dissolved	Cu-D	ug/L																		11
101-S	Dissolved Organic Carbon	DOC	mg/L																		
101-S	Hardness	Hard	mg-CaCO3/L																		43
101-S	Hardness - Dissolved	Hard-D	mg-CaCO3/L																		
101-S	Iron	Fe-T	ug/L																		3300
101-S	Iron - Dissolved	Fe-D	ug/L																J	Z	220
101-S	Lead	Pb-T	ug/L																		11
101-S	Lead - Dissolved	Pb-D	ug/L																		< 1.0
101-S	Magnesium	Mg	mg/L																		2.0
101-S	Nickel	Ni-T	ug/L																		4.9
101-S	Nickel - Dissolved	Ni-D	ug/L																		3.2
101-S	Nitrate as N	NO3	mg-N/L																J	d	0.5
101-S	Nitrite as N	NO2	mg-N/L																		0.3
101-S	Oil & Grease	O&G	mg/L																		5
101-S	Orthophosphate as P	O-P (T)	mg-P/L																J	Q	0.18
101-S	Orthophosphate as P, Dis	O-P (D)	mg-P/L																J	Q	0.42
101-S	pH (Lab value)	pH-L	pH Units																		
101-S	Phosphorus, Dissolved as P	Phos - D	mg-P/L																		0.64
101-S	Phosphorus, Total as P	Phos - T	mg-P/L																		1.00
101-S	Potassium	K	mg/L																		7.0
101-S	Silicon (as Si)	Si	mg/L																		17
101-S	Sodium	Na	mg/L																		17
101-S	Specific Conductance (Lab)	EC-L	umhos/cm																		
101-S	Sulfate as SO4	SO4	mg/L																		4.6
101-S	Total Alkalinity	Tot-Alk	mg-CaCO3/L																		27
101-S	Total Dissolved Solids	TDS	mg/L																		320
101-S	Total Kjeldahl Nitrogen	TKN (T)	mg-N/L																		4.1
101-S	Total Kjeldahl Nitrogen, Dis	TKN (D)	mg-N/L																		3.0
101-S	Total Organic Carbon	TOC	mg/L																		180
101-S	Total Suspended Solids	TSS	mg/L																		130
101-S	Turbidity (Lab)	Turb-L	NTU																		
101-S	Zinc	Zn-T	ug/L																		470
101-S	Zinc - Dissolved	Zn-D	ug/L																		320

Appendix B

Filter Media Sieve Analyses

KLEINFELDER
An employee owned company

June 20, 2002
File: 17926.01

ECO:LOGIC Consulting Engineers
6490 S. McCarran Blvd., Suite #1
Reno, NV 89509

Attn: Mr. Jeffry Curtis

SUBJECT: Laboratory Test Results

SAMPLE DATA

PROJECT:	Information Only
LABORATORY NO & SAMPLE DESCRIPTION:	5870 A - Coarse Sand - 1/18/02 5870 B - Fine Sand - 1/18/02 5870 C - Aluminum Oxide Sand - 1/18/02 5870 D - Concrete Sand #10 Tank - 1/18/02 5870 E - Activated Alumina - 1/18/02 5870 F - Zeolite - 1/18/02
PROPOSED FOR:	Filter Sand
SOURCE:	Unknown
SAMPLED BY & DATE RECEIVED:	Others, 6/13/02
LOCATION SAMPLED:	Unknown

TEST RESULTS

Grading Analysis - Percent Passing by Dry Weight (ASTM C136)

U.S. Standard Sieve Size	Coarse Sand 5870A
#4	100
#10	99.3
#20	13.3
#40	1.3
#60	0.4
#100	0.4
#200	0.3

U.S. Standard Sieve Size	Fine Sand 5870B
#4	100
#10	100
#20	93.4
#40	1.7
#60	0.5
#100	0.5
#200	0.4

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KLEINFELDER 4875 Longley Lane, Suite 100, Reno, NV 89502-5953 (775) 689-7800 (775) 689-7810 fax

U.S. Standard Sieve Size	Aluminum Oxide Sand 5870C
#4	100
#10	100
#20	99.9
#40	0.8
#60	0.4
#100	0.3
#200	0.2

U.S. Standard Sieve Size	Concrete Sand #10 Tank 5870D
3/8"	100
#4	99.8
#10	82.0
#20	50.9
#40	30.0
#60	19.1
#100	11.4
#200	5.9

U.S. Standard Sieve Size	Activated Alumina 5870E
#4	100
#10	99.9
#20	99.8
#40	49.0
#60	6.8
#100	3.5
#200	3.0

U.S. Standard Sieve Size	Zeolite 5870F
#4	100
#10	100
#20	98.0
#40	2.6
#60	1.7
#100	1.4
#200	1.0

Please find enclosed Grain Size Analyses Diagrams.

If you have any questions or need additional information, please feel free to contact the undersigned.

Very truly yours,

KLEINFELDER, INC.

Elaine Freeman, CET
Laboratory Manager

K.C. Weulfing, P.E.
Operations Manager

PROFESSIONAL ENGINEER-STATE OF NEVADA
KRISTOPHER C. WUELFING
6-20-02
CIVIL
No 15393

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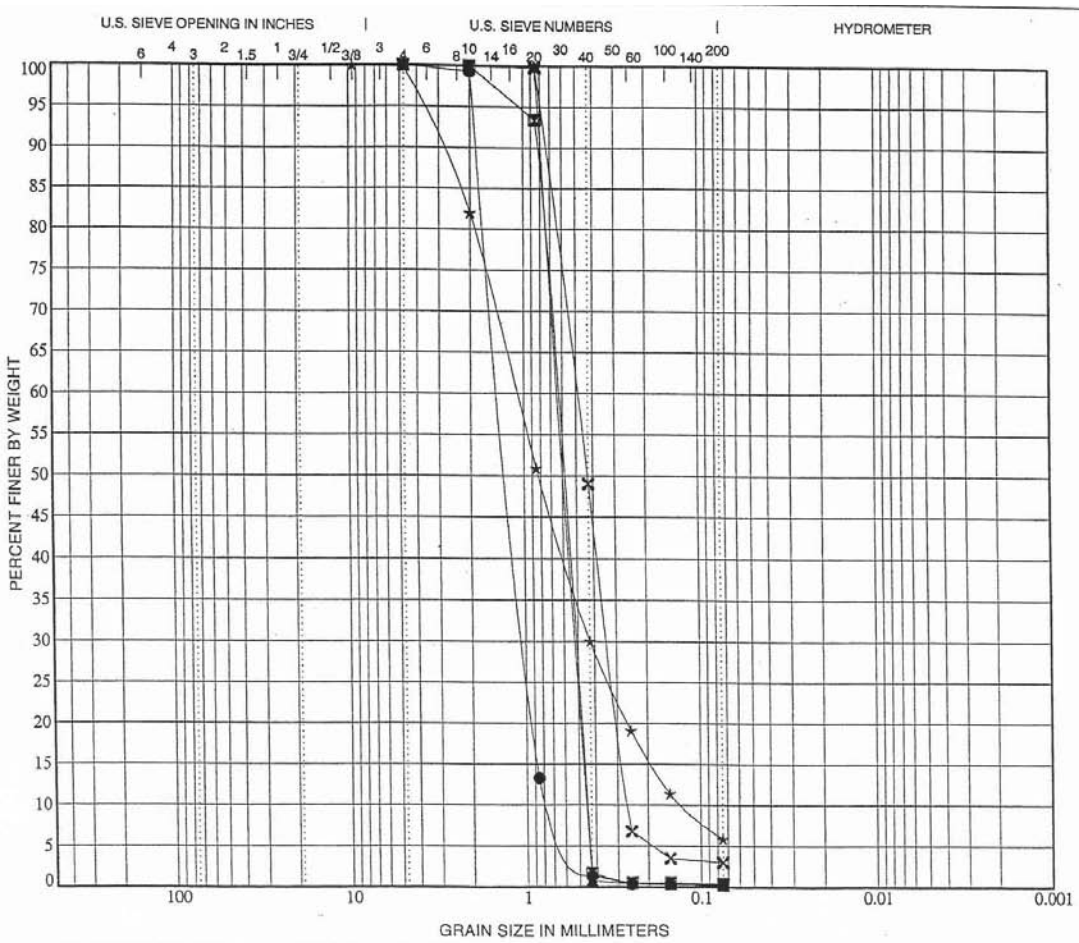


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth (ft.)	Description - ASTM Classification	LL	PL	PI	Cc	Cu
●	5870A	0.0	Coarse Sand - 1/18/02				1.06	1.93
⊠	5870B	0.0	Fine Sand - 1/18/02				0.93	1.46
▲	5870C	0.0	Aluminum Oxide Sand - 1/18/02				0.93	1.42
★	5870D	0.0	Concrete Sand #10 Tank - 1/18/02				1.32	8.68
✕	5870E	0.0	Activated Alumina - 1/18/02				0.87	1.90

	Sample	Depth (ft.)	D100	D60	D30	D10	% Gravel	% Sand	% Silt	% Clay
●	5870A	0.0	4.75	1.353	1.004	0.702	0.0	99.7	0.3	
⊠	5870B	0.0	2	0.66	0.526	0.453	0.0	99.6	0.4	
▲	5870C	0.0	2	0.643	0.521	0.453	0.0	99.8	0.2	
★	5870D	0.0	9.5	1.092	0.425	0.126	0.2	93.9	5.9	
✕	5870E	0.0	4.75	0.494	0.335	0.26	0.0	97.0	3.0	

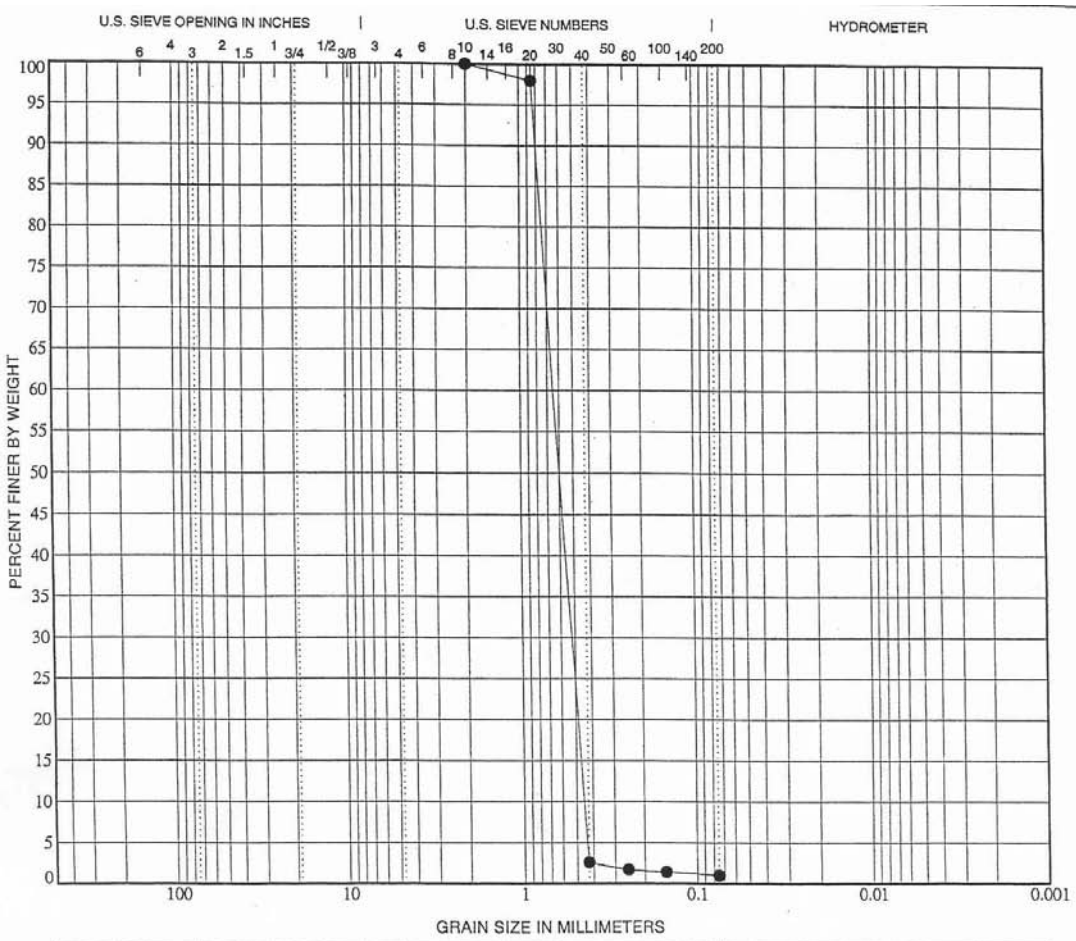
KLEINFELDER

ECO:LOGIC Consulting Engineers
Filter Sand Gradations

PLATE

PROJECT NUMBER: 17926.01

GRAIN SIZE ANALYSES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth (ft.)	Description - ASTM Classification	LL	PL	PI	Cc	Cu
●	5870F	0.0	Zeolite - 1/18/02				0.93	1.44

	Sample	Depth (ft.)	D100	D60	D30	D10	% Gravel	% Sand	% Silt	% Clay
●	5870F	0.0	2	0.645	0.519	0.448	0.0	99.0	1.0	

KLEINFELDER

ECO:LOGIC Consulting Engineers
Filter Sand Gradations

PLATE

PROJECT NUMBER: 17926.01

GRAIN SIZE ANALYSES

Appendix C

Quality Control Summary Reports

DATA VALIDATION SUMMARY

URS
2870 Gateway Oaks Drive, Suite 300
Sacramento, CA 95833
Telephone - (916) 679-2000
Fax - (916) 679-2900

TO: David Balgobin

FROM: Sacramento Project Chemistry Group **FILE:** 27644063.0T001

DATE: October 22, 2002 **SITE:** Caltrans: Lake Tahoe Pilot Project

SUBJECT: **Caltrans: Lake Tahoe Pilot Project – Run 4**
ToxScan Report No.: T-20292

A limited data review (including electronic validation by Caltrans Laboratory EDD Processing Tool) was performed by the Sacramento Project Chemistry Group on ToxScan Report No.: T-20292 in support of the Caltrans: Lake Tahoe Pilot Project. The report contains analytical data for 32 aqueous samples (including one field duplicate pair, one equipment blank, and one bottle blank). Sample IDs are listed in Table 1. Samples represent a field duplicate pair. The samples were collected on May 1, 2002 and submitted to ToxScan, Inc. in Watsonville, California for analysis of Ammonia (EPA Method 350.3), Chloride (EPA Method 300.0), Hardness (EPA Method 130.2), Nitrate (EPA Method 300.0), Nitrate (EPA Method 300.0), Oil and Grease (EPA Method 1664), pH (EPA Method 150.1), Sulfate (EPA Method 300.0), Specific Conductance (EPA Method 120.1), Total Alkalinity, Carbonate Alkalinity, and Bicarbonate Alkalinity (EPA Method 310.1), Total and Dissolved Aluminum (EPA Method 200.8), Acid Soluble Aluminum (EPA Method 440/ 5-86-008), Total and Dissolved Iron (EPA Method 200.7), Total and Dissolved Ortho-Phosphate (EPA Method 365.2), Total and Dissolved Kjeldahl Nitrogen (EPA Method 351.3), Total and Dissolved Organic Carbon (EPA Method 415.1), Total and Dissolved Phosphorous (EPA Method 365.2), Total Dissolved Solids (TDS; EPA Method 160.1), Total Suspended Solids (TSS; EPA Method 160.2), and Turbidity (EPA Method 180.1).

The data were reviewed in accordance with analytical methods outlined in EPA SW-846 and Analysis of Water and Wastewater. The following presents an overview of the limited data review: The areas reviewed are listed below. A check mark ( ) indicates an area of review in which all data were acceptable without qualification; a crossed circle (⊗) signifies areas where issues raised during validation impacted data quality and/or usability.

- ✓ Data Completeness
- ✓ Holding Times
- ⊗ Blanks
- ✓ Laboratory Control Samples
- ✓ Matrix Spike/Matrix Spike Duplicates
- ✓ Laboratory Duplicates
- ⊗ Field Duplicates
- ⊗ Total/Dissolved Comparison
- ✓ Compound Quantification

Data Completeness

The sample analyses were performed as requested on the chain-of-custody records with the exceptions summarized in the following table.

Analyte	Analysis Requested	Analysis Performed
Ammonia	EPA Method 350.3	EPA Method 350.2

Analyte	Analysis Requested	Analysis Performed
Total Kjeldahl Nitrogen	EPA Method 351.3	EPA Method 351.1
Dissolved Kjeldahl Nitrogen	EPA Method 351.3	EPA Method 351.1

Holding Time and Preservation

Although the samples were not analyzed within the project-specified holding times, the samples were analyzed within the holding times specified in the Caltrans: Guidance Manual: Storm Water Monitoring Protocols; consequently, qualification of the data was not warranted.

Blanks

The preparation blanks with target compound contamination and the associated qualified sample data are listed in the following table. Samples were qualified as anomalous (U) if the on-column sample concentration were within five-times the blank concentration.

Blank	Contaminant	Concentration	Qualifier	Samples Qualified
04-16-S (Equipment Blank)	Chloride	4.4 mg/L	NA	**None**
	TDS	2.0 mg/L	NA	**None**
04-17-F (Bottle Blank)	Total Iron	53 µg/L	U	**04-A, 04-FF, 04-IX3-PSF, 04-IX4-PSF, 04-PSF, 04-11-F, 04-15-F**

Laboratory Control Samples

The LCS recoveries for all analytes were within acceptance limits.

Matrix Spike and Matrix Spike Duplicate

The following table lists the project samples utilized for the Matrix Spike/Matrix Spike Duplicate analyses. Recoveries and Relative percent differences (where applicable) were within the QAPP-specified acceptance criteria.

Analyte	Project Sample(s) Utilized
Dissolved Iron	**04-10-S and 04-02-F**
TOC and Total Phosphate	**04-10-S and 04-PSF**
DOC	**04-08-F and 04-02-F**
Total Kjeldahl Nitrogen	**04-04-F and 04-IX4-FF**
Total Phosphorus	**04-08-F and 04-03-F**
Chloride, Dissolved Kjeldahl Nitrogen, Dissolved Phosphorus, Nitrate, Nitrite, Sulfate, Total Iron, and Total Ortho-Phosphate	**04-08-F and 04-PSF**
Acid Soluble Aluminum	**04-14-F[1]**
Total Aluminum	**04-14-F[1] and 04-16-S[1]**
Dissolved Aluminum	**04-FF, 04-16-F, and 04-17-F**

Note:
1. The native concentration was greater than 4-times the spike level, consequently, an assessment of matrix effects cannot be made.

Laboratory Duplicates

The following table lists the project samples utilized for the Laboratory Duplicate analyses. Relative percent differences were within the QAPP-specified acceptance criteria.

Analyte	Project Sample(s) Utilized
Ammonia	**Non-Project Sample[1]**
Chloride, Conductivity, Dissolved Kjeldahl Nitrogen, Dissolved Phosphorus, Nitrate, Nitrite, Oil & Grease, pH, Sulfate, Total Alkalinity, Bicarbonate Alkalinity, Carbonate Alkalinity, Total Iron, Total Ortho-Phosphate, and Turbidity	**04-08-F and 04-PSF**
Dissolved Iron	**04-10-S and 04-02-F**
DOC	**04-08-F and 04-02-F**
Hardness	**04-IX4-PSF**
TDS and TSS	**04-05-F and 04-I-02**
TOC and Total Phosphate	**04-10-S and 04-PSF**
Total Kjeldahl Nitrogen	**04-13-S and 04-15-S**
Dissolved Ortho-Phosphate	**04-08-F and 04-03-F**

Note:
1. Since a non-project sample was utilized for the laboratory duplicate analysis, an assessment of laboratory precision cannot be made.

Field Duplicates

The field duplicate pair, **04-12-F/04-16-F**, demonstrated acceptable field and laboratory precision for all analytes except those listed in the following table.

Analyte	Primary Sample Result	Field Duplicate Result	Qualifier
DOC	4.4 mg/L	5.7 mg/L	**J[1]**

Note:
1. The primary and duplicate results differ by more than the reporting limit, therefore, the data was considered estimated (J).

Total/Dissolved Comparison

For all samples, a comparison of the total and dissolved data demonstrated acceptable results for all analytes except those listed in the following table.

Sample	Analyte	Total Result	Dissolved Result	Qualifier
04-03-F	TOC/DOC	5.8 mg/L	9.4 mg/L	**R[1]**
04-04-F	TOC/DOC	3.1 mg/L	4.6 mg/L	**J[2]**
04-12-S	TOC/DOC	4.6 mg/L	5.7 mg/L	**J[2]**
04-13-S	TOC/DOC	3.1 mg/L	4.3 mg/L	**J[2]**

Note:
1. The dissolved concentration exceeded the total concentration by more 2-times reporting limit or 20%. The data was rejected.
2. The dissolved concentration exceeded the total concentration by more 1-times reporting limit or 10%. The data was estimated (J).

Compound Quantification

The project-specific reporting limits were met for analytes except for Oil & Grease. Due to a laboratory error, only one liter of sample was extracted instead of the full two liters. As a result, the reporting limits for this analysis was 5 mg/L and not the project-specific reporting limit of 2 mg/L.

Table 1
Lake Tahoe Pilot Project Samples

Sample	SDG	Date Sampled
Project Samples		
04-01-F	20292	05/01/2002
04-02-F	20292	05/01/2002
04-03-F	20292	05/01/2002
04-04-F	20292	05/01/2002
04-05-F	20292	05/01/2002
04-08-F	20292	05/01/2002
04-09-F	20292	05/01/2002
04-10-F	20292	05/01/2002
04-10-S	20292	05/01/2002
04-11-F	20292	05/01/2002
04-11-S	20292	05/01/2002
04-12-F	20292	05/01/2002
04-12-S	20292	05/01/2002
04-13-F	20292	05/01/2002
04-13-S	20292	05/01/2002
04-14-F	20292	05/01/2002
04-14-S	20292	05/01/2002
04-15-F	20292	05/01/2002
04-15-S	20292	05/01/2002
04-16-F (Field Duplicate of 04-12-F)	20292	05/01/2002
04-A	20292	05/01/2002
04-FF	20292	05/01/2002
04-I-01	20292	05/01/2002
04-I-02	20292	05/01/2002
04-I-03	20292	05/01/2002
04-IX3-FF	20292	05/01/2002
04-IX3-PSF	20292	05/01/2002
04-IX4-FF	20292	05/01/2002
04-IX4-PSF	20292	05/01/2002
04-PSF	20292	05/01/2002
Equipment Blank		
04-16-S	20292	05/01/2002
Bottle Blank		
04-17-F	20292	05/01/2002

ATTACHMENT A
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by the URS Data Review Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
NJ The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

DATA QUALIFIER REASON CODE DEFINITIONS

a Analytical sequence deficiency or omission.
b Gross compound breakdown (4,4'-DDT/Endrin).
c Calibration failure; poor or unstable response.
d Laboratory duplicate imprecision.
e Laboratory duplicate control sample imprecision.
f Field duplicate imprecision.
g Poor chromatography.
h Holding time violation.
i Internal standard failure.
j Poor mass spectrographic performance.
k Serial dilution imprecision.
l Laboratory control sample recovery failure.
m Matrix spike/matrix spike duplicate recovery failure.
n Interference check sample recovery failure.
o Calibration blank contamination (metals/inorganics only).
p Preparation blank contamination (metals/inorganics only).
q Quantitation outside of linear range.
r Linearity failure in initial calibration.
s Surrogate spike recovery failure (GC organics and GC/MS organics only).
t Instrument tuning failure.
u No confirmation column present (GC Organics only).
v Value is estimated below the MDA (Rads only).
w Retention time (RT) outside of RT window.
x Field or equipment blank contamination.
y Trip blank contamination.
z Method blank contamination.
D Value exceeds quantitation limit.
Q Dissolved concentration significantly exceeded the total concentration.

DATA VALIDATION SUMMARY

URS
2870 Gateway Oaks Drive, Suite 300
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Telephone - (916) 679-2000
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TO: David Balgobin

FROM: Sacramento Project Chemistry Group **FILE:** 27644063.0T001

DATE: October 22, 2002 **SITE:** Caltrans: Lake Tahoe Pilot Project

SUBJECT: **Caltrans: Lake Tahoe Pilot Project – Run 5**
ToxScan Report Nos.: T-20333 and T-20335

A limited data review (including electronic validation by Caltrans Laboratory EDD Processing Tool) was performed by the Sacramento Project Chemistry Group on ToxScan Report No s.: T-20333 and T-20335 in support of the Caltrans: Lake Tahoe Pilot Project. The report contains analytical data for 32 aqueous samples (including one field duplicate pair, one equipment blank, and one bottle blank). Sample IDs are listed in Table 1. Samples represent a field duplicate pair. The samples were collected on May 1, 2002 and submitted to ToxScan, Inc. in Watsonville, California for analysis of Ammonia (EPA Method 350.3), Chloride (EPA Method 300.0), Hardness (EPA Method 130.2), Nitrate (EPA Method 300.0), Nitrate (EPA Method 300.0), Oil and Grease (EPA Method 1664), pH (EPA Method 150.1), Sulfate (EPA Method 300.0), Specific Conductance (EPA Method 120.1), Total Alkalinity, Carbonate Alkalinity, and Bicarbonate Alkalinity (EPA Method 310.1), Total and Dissolved Aluminum (EPA Method 200.8), Acid Soluble Aluminum (EPA Method 440/ 5-86-008), Total and Dissolved Iron (EPA Method 200.7), Total and Dissolved Ortho-Phosphate (EPA Method 365.2), Total and Dissolved Kjeldahl Nitrogen (EPA Method 351.3), Total and Dissolved Organic Carbon (EPA Method 415.1), Total and Dissolved Phosphorous (EPA Method 365.2), Total Dissolved Solids (TDS; EPA Method 160.1), Total Suspended Solids (TSS; EPA Method 160.2), and Turbidity (EPA Method 180.1).

The data were reviewed in accordance with analytical methods outlined in EPA SW-846 and Analysis of Water and Wastewater. The following presents an overview of the limited data review: The areas reviewed are listed below. A check mark ( ) indicates an area of review in which all data were acceptable without qualification; a crossed circle (⊗) signifies areas where issues raised during validation impacted data quality and/or usability.

- ✓ Data Completeness
- ✓ Holding Times
- ⊗ Blanks
- ⊗ Laboratory Control Samples
- ✓ Matrix Spike/Matrix Spike Duplicates
- ✓ Laboratory Duplicates
- ⊗ Field Duplicates
- ⊗ Total/Dissolved Comparison
- ✓ Compound Identification and Quantification

Data Completeness

The sample analyses were performed as requested on the chain-of-custody records with the exceptions summarized in the following table.

Analyte	Analysis Requested	Analysis Performed
Ammonia	EPA Method 350.3	EPA Method 350.2

Analyte	Analysis Requested	Analysis Performed
Total Kjeldahl Nitrogen	EPA Method 351.3	EPA Method 351.1
Dissolved Kjeldahl Nitrogen	EPA Method 351.3	EPA Method 351.1

Holding Time and Preservation

Although the samples were not analyzed within the project-specified holding times, the samples were analyzed within the holding times specified in the Caltrans: Guidance Manual: Storm Water Monitoring Protocols; consequently, qualification of the data was not warranted.

Blanks

The preparation blanks with target compound contamination and the associated qualified sample data are listed in the following table. Samples were qualified as anomalous (U) if on-column sample concentrations were within five-times the blank concentration for uncommon laboratory contaminants or ten-times the blank concentration for common laboratory contaminants.

Blank	Contaminant	Concentration	Qualifier	Samples Qualified
05-16-S (Equipment Blank)	Total Iron	27 µg/L	U	**05-14-F, 05-IX3-FF, 05-IX4-PSF**
	Dissolved Phosphorus	0.039 mg/L	U	**05-02-F, 05-03-F, 05-05-F, 05-08-F, 05-09-F, 05-10-F, 05-10-S, 05-11-F, 05-11-S, 05-12-F, 05-12-S, 05-13-F, 05-13-S, 05-14-F, 05-14-S, 05-15-F, 05-15-S, 05-17-F, 05-A, 05-FF, 05-I-01, 05-I-02, 05-I-03, 05-IX3-FF, 05-IX3-PSF, 05-IX4-FF, 05-IX4-PSF, 05-PSF**
	Total Phosphorus	0.056 mg/L	U	**05-08-F, 05-09-F, 05-11-F, 05-11-S, 05-12-F, 05-12-S, 05-13-F, 05-13-S, 05-14-F, 05-14-S, 05-15-F, 05-15-S, 05-A, 05-FF, 05-IX3-FF, 05-IX3-PSF, 05-IX4-FF, 05-IX4-PSF, 05-PSF**
	TDS	16 mg/L	NA	**None**
	TSS	2 mg/L	U	**05-15-F, 05-A 05-FF, 05-IX3-FF**
05-16-F (Bottle Blank)	Total Iron	47 µg/L	U	**05-14-F, 05-FF, 05-IX3-FF, 05-IX3-PSF, 05-IX4-FF, 05-IX4-PSF, 05-PSF**

Blank	Contaminant	Concentration	Qualifier	Samples Qualified
05-16-F (Bottle Blank) cont.	Dissolved Phosphorus	0.038 mg/L	U	**05-02-F, 05-03-F, 05-05-F, 05-08-F, 05-09-F, 05-10-F, 05-10-S, 05-11-F, 05-11-S, 05-12-F, 05-12-S, 05-13-F, 05-13-S, 05-14-F, 05-14-S, 05-15-F, 05-15-S, 05-17-F, 05-A, 05-FF, 05-I-01, 05-I-02, 05-I-03, 05-IX3-FF, 05-IX3-PSF, 05-IX4-FF, 05-IX4-PSF, 05-PSF**
	Total Phosphorus	0.052 mg/L	U	**05-08-F, 05-11-F, 05-11-S, 05-12-F, 05-12-S, 05-13-F, 05-13-S, 05-14-F, 05-14-S, 05-15-F, 05-15-S, 05-A, 05-FF, 05-IX3-FF, 05-IX3-PSF, 05-IX4-FF, 05-IX4-PSF, 05-PSF**
	TDS	12 mg/L	NA	**None**
05-17-S (Bottle Blank)	Dissolved Phosphorus	0.070 mg/L	U	**05-02-F, 05-03-F, 05-05-F, 05-08-F, 05-09-F, 05-10-F, 05-10-S, 05-11-F, 05-11-S, 05-12-F, 05-12-S, 05-13-F, 05-13-S, 05-14-F, 05-14-S, 05-15-F, 05-15-S, 05-17-F, 05-A, 05-FF, 05-I-01, 05-I-02, 05-I-03, 05-IX3-FF, 05-IX3-PSF, 05-IX4-FF, 05-IX4-PSF, 05-PSF**
	Total Phosphorus	0.057 mg/L	U	**05-08-F, 05-09-F, 05-11-F, 05-11-S, 05-12-F, 05-12-S, 05-13-F, 05-13-S, 05-14-F, 05-14-S, 05-15-F, 05-15-S, 05-A, 05-FF, 05-IX3-FF, 05-IX3-PSF, 05-IX4-FF, 05-IX4-PSF, 05-PSF**
	Total Kjeldahl Nitrogen	0.17 mg/L	U	**05-14-F, 05-IX4-FF, 05-IX4-PSF**

Laboratory Control Samples

The LCS recoveries for all analytes were within acceptance limits except those listed in the following table.

LCS (Date)	Analyte	Percent Recovery	Qualifier	Sample(s) Qualified
060302B	DOC	116%	**J**	**05-08-F, 05-09-F, 05-16-F, 05-16-S, 05-17-F, 05-I-01, 05-I-02, 05-IX3-PSF, 05-IX4-FF, 05-PSF**

Matrix Spike and Matrix Spike Duplicate

The following table lists the project samples utilized for the Matrix Spike/Matrix Spike Duplicate analyses. Recoveries and Relative percent differences (where applicable) were within the QAPP-specified acceptance criteria.

Analyte	Project Sample(s) Utilized
Acid Soluble Aluminum, Dissolved Aluminum, and Total Aluminum	**05-02-F** and **05-08-F**
TOC	**05-11-S** and **05-IX4-FF**
Chloride, Dissolved Iron, Dissolved Kjeldahl Nitrogen, Dissolved Ortho-Phosphate, Dissolved Phosphorus, DOC, Hardness, Nitrate, Sulfate, Total Iron, Total Ortho-Phosphate, and Total Phosphorus	**05-A** and **05-I-02**
Total Kjeldahl Nitrogen	**05-A** and **05-17-S**

Laboratory Duplicates

The following table lists the project samples utilized for the Laboratory Duplicate analyses. Relative percent differences were within the QAPP-specified acceptance criteria.

Analyte	Project Sample(s) Utilized
TOC	**05-11-S** and **05-IX4-FF**
Total Kjeldahl Nitrogen	**05-A** and **05-17-S**
Bicarbonate Alkalinity, Carbonate Alkalinity, Chloride, Conductivity, Dissolved Iron, Dissolved Kjeldahl Nitrogen, Dissolved Ortho-Phosphate, Dissolved Phosphorus, DOC, Hardness, Nitrate, Nitrite, Oil & Grease, pH, Sulfate, TDS, Total Alkalinity, Total Iron, Total Ortho-Phosphate, Total Phosphorus, TSS, and Turbidity	**05-A** and **05-I-02**

Field Duplicates

The field duplicate pair, **05-2-F/05-17-F**, demonstrated acceptable field and laboratory precision for all analytes except those listed in the following table.

Analyte	Primary Sample Result	Field Duplicate Result	Qualifier
Dissolved Aluminum	40 µg/L	120 µg/L	**J**[1]

Note:
1. The primary and duplicate results differ by more than the 20%, therefore, the data was considered estimated (J).

Total/Dissolved Comparison

For all samples, a comparison of the total and dissolved data demonstrated acceptable results for all analytes except those listed in the following table.

Sample	Analyte	Total Result	Dissolved Result	Qualifier
05-15-S	TOC/DOC	31 mg/L	37 mg/L	**J**[1]

Note:
1. The dissolved concentration exceeded the total concentration by more 1-times reporting limit or 10%. The data was estimated (J).

Compound Quantification

The project-specific reporting limits were met for analytes except for Oil & Grease. Due to a laboratory error, only one liter of sample was extracted instead of the full two liters. As a result, the reporting limits for this analysis was 5 mg/L and not the project-specific reporting limit of 2 mg/L.

Table 1
Lake Tahoe Pilot Project Samples

Sample	SDG	Date Sampled
Project Samples		
05-02-F	20333	05/21/2002
05-03-F	20333	05/21/2002
05-05-F	20333	05/21/2002
05-08-F	20333	05/21/2002
05-09-F	20333	05/21/2002
05-10-F	20333	05/21/2002
05-10-S	20333	05/21/2002
05-11-F	20333	05/21/2002
05-11-S	20333	05/21/2002
05-12-F	20333	05/21/2002
05-12-S	20333	05/21/2002
05-13-F	20333	05/21/2002
05-13-S	20333	05/21/2002
05-14-F	20333	05/21/2002
05-14-S	20333	05/21/2002
05-15-F	20333	05/21/2002
05-15-S	20333	05/21/2002
05-17-F (Field Duplicate of 05-02-F)	20333	05/21/2002
05-A	20333	05/21/2002
05-FF	20333	05/21/2002
05-I-01	20333	05/21/2002
05-I-02	20333	05/21/2002
05-I-03	20333	05/21/2002
05-IX3-FF	20333	05/21/2002
05-IX3-PSF	20333	05/21/2002
05-IX4-FF	20333	05/21/2002
05-IX4-PSF	20333	05/21/2002
05-PSF	20333	05/21/2002
Equipment Blank		
05-16-S	20333	05/21/2002
Bottle Blanks		
05-16-F	20333	05/21/2002
05-17-S	20335	05/21/2002

ATTACHMENT A
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by the URS Data Review Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
NJ The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

DATA QUALIFIER REASON CODE DEFINITIONS

a Analytical sequence deficiency or omission.
b Gross compound breakdown (4,4'-DDT/Endrin).
c Calibration failure; poor or unstable response.
d Laboratory duplicate imprecision.
e Laboratory duplicate control sample imprecision.
f Field duplicate imprecision.
g Poor chromatography.
h Holding time violation.
i Internal standard failure.
j Poor mass spectrographic performance.
k Serial dilution imprecision.
l Laboratory control sample recovery failure.
m Matrix spike/matrix spike duplicate recovery failure.
n Interference check sample recovery failure.
o Calibration blank contamination (metals/inorganics only).
p Preparation blank contamination (metals/inorganics only).
q Quantitation outside of linear range.
r Linearity failure in initial calibration.
s Surrogate spike recovery failure (GC organics and GC/MS organics only).
t Instrument tuning failure.
u No confirmation column present (GC Organics only).
v Value is estimated below the MDA (Rads only).
w Retention time (RT) outside of RT window.
x Field or equipment blank contamination.
y Trip blank contamination.
z Method blank contamination.
D Value exceeds quantitation limit.
Q Dissolved concentration significantly exceeded the total concentration.

DATA VALIDATION SUMMARY

URS
2870 Gateway Oaks Drive, Suite 300
Sacramento, CA 95833
Telephone - (916) 679-2000
Fax - (916) 679-2900

TO: David Balgobin

FROM: Sacramento Project Chemistry Group **FILE:** 27644063.0T001

DATE: March 14, 2003 **SITE:** Caltrans: Lake Tahoe Pilot Project

SUBJECT: **Caltrans: Lake Tahoe Pilot Project – Run 6**
ToxScan Report Nos.: T-20661 and T-211027

A limited data review (including electronic validation by Caltrans Laboratory EDD Processing Tool) was performed by the Sacramento Project Chemistry Group on ToxScan Report Nos.: T-20661 and T-211027 in support of the Caltrans: Lake Tahoe Pilot Project. The report contains analytical data for 25 aqueous samples (including two field duplicate pairs, one performance evaluation sample, two field blanks, one bottle blank, one equipment blank, and one performance evaluation blank). Sample IDs are listed in Table 1. Samples **06-IX4-PSF-2/06-16-S** and **06-I-03/06-17-F** represent field duplicate pairs. The samples were collected on November 8, 2002 and submitted to ToxScan, Inc. in Watsonville, California for analysis of Total and Dissolved Ammonia (EPA Method 350.3), Chloride (EPA Method 300.0), Hardness (EPA Method 130.2), Nitrate (EPA Method 300.0), Nitrite (EPA Method 300.0), Oil and Grease (EPA Method 1664), Sulfate (EPA Method 300.0), Total Alkalinity (EPA Method 310.1), Total and Dissolved Metals (Al, Cd, Cr, Cu, Pb, Ni, and Zn by EPA Method 200.8), Acid Soluble Aluminum (EPA Method 440/ 5-86-008), Total and Dissolved Cations (B, Ca, Fe, K, Mg, and Si by EPA Method 200.7), Total and Dissolved Ortho-Phosphate (EPA Method 365.2), Total and Dissolved Kjeldahl Nitrogen (EPA Method 351.3), Total Organic Carbon (EPA Method 415.1), Total and Dissolved Phosphorous (EPA Method 365.2), Total Dissolved Solids (TDS; EPA Method 160.1), and Total Suspended Solids (TSS; EPA Method 160.2). The laboratory report was issued on December 6, 2002 and revised on February 18, 2003 based on questions and comments generated in response to the original package provided.

The data were reviewed in accordance with analytical methods outlined in EPA SW-846 and Analysis of Water and Wastewater. The following presents an overview of the limited data validation. The areas reviewed are listed below. A check mark ( ) indicates an area of review in which all data were acceptable without qualification; a crossed circle (⊗) signifies areas where issues raised during validation impacted data quality and/or usability.

- ✓ Data Completeness
- ✓ Holding Times
- ⊗ Blanks
- ✓ Laboratory Control Samples
- ✓ Matrix Spike/Matrix Spike Duplicates
- ⊗ Laboratory Duplicates
- ⊗ Field Duplicates
- ✓ Total/Dissolved Comparison
- ⊗ Performance Evaluation Sample
- ✓ Analyte Quantification

Data Completeness

The sample analyses were performed as requested on the chain-of-custody records with the exceptions summarized in the following table.

Analyte	Analysis Requested	Analysis Performed
Total Kjeldahl Nitrogen	EPA Method 351.3	EPA Method 351.1
Dissolved Kjeldahl Nitrogen	EPA Method 351.3	EPA Method 351.1

Although not requested in the associated chain-of-custody records, samples **06-04-F**, **06-10-S**, **06-10-F**, **06-11-F**, **06-A-1**, and **06-A-2** were analyzed and the data reported for chloride, sulfate, dissolved and total boron, dissolved and total calcium, dissolved and total potassium, dissolved and total magnesium, and dissolved and total silicon.

In response to a review of the original data for the total metals fraction of sample **06-IX4-PSF-2**, the laboratory redigested and reanalyzed the sample. Based on the results of the reanalysis, it was determined that the original analysis was performed on a filtered aliquot of the sample (i.e., dissolved metals) and not on an unfiltered aliquot of the sample. The results have been revised to reflect the data from the reanalysis.

Holding Time and Preservation

The samples were analyzed within the holding times specified in the Caltrans: Guidance Manual: Storm Water Monitoring Protocols.

Blanks

The blanks with target analyte contamination are listed in the following table.

Blank	Contaminant	Concentration
Laboratory Method Blank (TKN_120202a)	Total Kjeldahl Nitrogen	0.10 mg/L
06-16-F (Bottle Blank)	Total Dissolved Solids	6 mg/L
	Dissolved Kjeldahl Nitrogen	0.12 mg/L
	Total Kjeldahl Nitrogen	0.10 mg/L
	Total Organic Carbon	1.2 mg/L
	Dissolved Calcium	0.054 mg/L
06-18-F (Field Blank)	Dissolved Kjeldahl Nitrogen	0.25 mg/L
	Total Kjeldahl Nitrogen	0.11 mg/L
	Total Organic Carbon	1.0 mg/L
	Total Calcium	0.15 mg/L
06-18-S (Field Blank)	Total Dissolved Solids	6 mg/L
	Total Zinc	6.1 µg/L
	Dissolved Kjeldahl Nitrogen	0.23 mg/L
	Total Organic Carbon	1.0 mg/L
06-19-S (Equipment Blank)	Dissolved Kjeldahl Nitrogen	0.11 mg/L
	Total Kjeldahl Nitrogen	0.14 mg/L
	Total Organic Carbon	1.4 mg/L
	Dissolved Calcium	0.21 mg/L

Blank	Contaminant	Concentration
06-19-S (Equipment Blank) (cont.)	Total Calcium	0.28 mg/L
06-20-S (PE Blank)	Dissolved Kjeldahl Nitrogen	0.10 mg/L
	Total Organic Carbon	1.1 mg/L

A sample result was qualified as anomalous (U) if instrument concentration of the sample was within five-times the instrument concentration of an associated blank. The qualified data are summarized in the following table.

Analyte	Qualifier	Samples Qualified	Concentration (mg/L)
Dissolved Calcium	U	**06-IX4-PSF-2** **06-16-S** **06-04-F** **06-10-F**	0.60 0.56 0.099 0.90
Dissolved Kjeldahl Nitrogen	U	**06-IX4-PSF-2** **06-IX4-FF-1** **06-04-F** **06-20-F**	1.2 1.1 0.79 0.33
Total Calcium	U	**06-IX4-PSF-2** **06-16-S** **06-IX4-FF-1** **06-04-F**	0.70 0.72 0.17 1.0
Total Dissolved Solids	U	**None**	NA
Total Kjeldahl Nitrogen	U	**06-20-F**	0.34
Total Organic Carbon	U	**None**	NA
Total Zinc	U	**None**	NA

Laboratory Control Samples

The LCS recoveries for all analytes were within acceptance limits.

Matrix Spike and Matrix Spike Duplicate

The following table lists the project samples utilized for the Matrix Spike/Matrix Spike Duplicate analyses. The recoveries and relative percent differences were within the acceptance criteria.

Analyte	Project Sample(s) Utilized
Acid Soluble Aluminum	**06-11-F**
Dissolved (Al, Cd, Cr, Cu, Pb, Ni, Zn) Total (Al, Cd, Cr, Cu, Pb, Ni, Zn)	**06-IX4-PSF-2**
Dissolved and Total Silica	**06-IX3-FF-1 and 06-FF-1**
Total Phosphorus	**06-IX3-FF-1 and 06-20-F**
Chloride, Dissolved and Total Iron, Dissolved and Total Ortho-Phosphate, Dissolved and Total Phosphorus, Nitrate, Sulfate, Dissolved and Total Metals (B, Ca, Mg, Na)	**06-101-S and 06-FF-1**
TOC	**06-101-S, 06-FF-1, and 06-20-S**

Analyte	Project Sample(s) Utilized
Dissolved and Total Kjeldahl Nitrogen	**06-101-S and 06-20-S**
Nitrite	**06-18-S and 06-19-S**

It should be noted that a high relative percent difference (21%) was observed between the zinc MS and MSD recoveries for the matrix spike analysis of sample **06-IX4-PSF-2**. However, the relative percent difference observed between the reported zinc concentrations in the MS (182 µg/L) and MSD (173 µg/L) was acceptable (5%). Consequently, qualification of the data was not warranted on this basis.

Laboratory Duplicates

The following table lists the project samples utilized for the Laboratory Duplicate analyses.

Analyte	Project Sample(s) Utilized
Oil & Grease	**06-11-S and 06-A-1**
Acid Soluble Aluminum	**06-11-F**
Dissolved and Total (Al, Cd, Cr, Cu, Pb, Ni, Zn)	**06-IX4-PSF-2**
Dissolved and Total Ammonia	**06-FF-1**
Total Phosphorus	**06-IX3-FF-1 and 06-20-F**
Chloride, Dissolved and Total Iron, Dissolved and Total Ortho-Phosphate, Dissolved and Total Phosphorus, Nitrate, Sulfate, Total Alkalinity, Dissolved and Total (B, Ca, Mg, Na),and Dissolved and Total Silica	**06-101-S and 06-FF-1**
Nitrite	**06-18-S and 06-19-S**
Dissolved and Total Kjeldahl Nitrogen	**06-101-S and 06-20-S**
Hardness, Total Dissolved Solids, and Total Suspended Solids	**06-10-S and 06-FF-1**
TOC	**06-101-S, 06-FF-1, and 06-20-S**

The relative percent differences were within the acceptance criteria except for those listed in the following table. The relative percent differences were within the acceptance criteria except for the analytes listed in the following table.

Analyte	Spike Sample	RPD	Qualifier	Samples Qualified
Nitrate	**06-101-S**	43.8%	**J[1]**	**06-I-01, 06-I-03, 06-11-S, 06-11-F, 06-A-1, 06-A-2, 06-PSF-2, 06-17-F, and 06-101-S**
	06-FF-1	35.9%	**J[1]**	**06-I-02, 06-04-F, 06-10-F, 06-10-S, and 06-FF-1**

Note:
1. The relative percent difference between the primary and duplicate results was greater than 20%, therefore, the data were considered estimated (J). It should be noted that these samples displayed biological activity during analysis (i.e., nitrate was converting to nitrite).

Field Duplicates

The field duplicate pairs, **06-IX4-PSF-2/06-16-S** and **06-I-03/06-17-F**, demonstrated acceptable field and laboratory precision for all analytes except those listed in the following table.

Analyte	Primary Sample Result	Field Duplicate Result	Qualifier
Field Duplicate Pair 06-IX4-PSF-2/06-16-S			
Dissolved Iron	610 µg/L	40 µg/L	**J[1]**
Dissolved Magnesium	140 µg/L	76 µg/L	**J[1]**
Hardness	25 mg/L	65 mg/L	**J[1]**
Total Alkalinity	35 mg/L	6 mg/L	**J[1]**
Field Duplicate Pair 06-I-03/06-17-F			
Hardness	47 mg/L	100 mg/L	**J[1]**
Total Aluminum	1200 µg/L	2200 µg/L	**J[1]**
Total Suspended Solids	180 mg/L	400 mg/L	**J[1]**

Note:
1. The relative percent difference between the primary and duplicate results was greater than 50%, therefore, the data were considered estimated (J).

Total/Dissolved Comparison

For all samples, a comparison of the total and dissolved data demonstrated acceptable results for all analytes except those listed in the following table.

Sample	Analyte	Total Result	Dissolved Result	Qualifier
06-IX4-PSF-2	Ammonia	0.48 mg/L	0.98 mg/L	**J[1]**
06-PSF-2	Ammonia	1.1 mg/L	1.3 mg/L	**J[1]**
06-17-F	Ortho-Phosphate	0.22 mg/L	0.52 mg/L	**J[1]**
06-I-03	Ortho-Phosphate	0.21 mg/L	0.47 mg/L	**J[1]**
06-I-01	Ortho-Phosphate	0.24 mg/L	0.53 mg/L	**J[1]**
06-IX4-FF-1	Ammonia	0.58 mg/L	1.6 mg/L	**J[1]**
06-101-S	Aluminum	490 µg/L	550 µg/L	**J[2]**
	Ortho-Phosphate	0.18 mg/L	0.42 mg/L	**J[1]**
06-18-S	Kjeldahl Nitrogen	<0.10 mg/L	0.23 mg/L	**J[1]**
06-I-02	Ortho-Phosphate	0.26 mg/L	0.52 mg/L	**J[1]**
06-10-F	Ortho-Phosphate	0.31 mg/L	0.42 mg/L	**J[1]**
06-10-S	Ortho-Phosphate	0.19 mg/L	0.46 mg/L	**J[1]**
06-18-F	Kjeldahl Nitrogen	0.11 mg/L	0.25 mg/L	**J[1]**

Note:
1. The dissolved concentration exceeded the total concentration by more than the reporting limit or 10%. The data were estimated (J).
2. The dissolved concentration exceeded the acid soluble aluminum concentration by more than the reporting limit or 10%. The data were estimated (J).

Performance Evaluation Sample

Samples **06-20-F** and **06-20-S** were submitted to the laboratory as a double blind performance evaluation sample and an associated reference blank. The results for all certified analytes are summarized below.

Sample 06-20-F				
Analyte	**Certified Value**	**Laboratory Result**	**Acceptance Criteria**	**Pass/Fail**
Total Organic Carbon	15.0 mg/L	17 mg/L	12.9 – 17.1 mg/L	Pass
Dissolved Kjeldahl Nitrogen	0.250 mg/L	0.33 mg/L	0.190 – 0.312 mg/L	Fail
Total Kjeldahl Nitrogen	0.250 mg/L	0.34 mg/L	0.190 – 0.312 mg/L	Fail
Dissolved Phosphorous	0.250 mg/L	0.25 mg/L	0.0206 – 0.298 mg/L	Pass
Total Phosphorous	0.250 mg/L	0.23 mg/L	0.0206 – 0.298 mg/L	Pass
Dissolved Iron	0.0600 mg/L	0.044 mg/L	0.0523 – 0.0678 mg/L	Fail
Total Iron	0.0600 mg/L	0.065 mg/L	0.0523 – 0.0678 mg/L	Pass

Sample 06-20-S				
Analyte	**Certified Value**	**Laboratory Result**	**Acceptance Criteria**	**Pass/Fail**
Total Organic Carbon	--	1.1 mg/L	--	--
Dissolved Kjeldahl Nitrogen	--	0.010 mg/L	--	--
Total Kjeldahl Nitrogen	--	--	--	--
Dissolved Phosphorous	--	--	--	--
Total Phosphorous	--	--	--	--
Dissolved Iron	--	--	--	--
Total Iron	--	--	--	--

Acceptable results were obtained for four of the seven certified analytes. The results for dissolved and total Kjeldahl Nitrogen may be slightly high due to the background presence of this analyte in the bottles and/or laboratory. Based on the performance evaluation sample results, the data for dissolved and total Kjeldahl Nitrogen may be biased high and the data for dissolved iron may be biased low.

Analyte Quantification

The project-specific reporting limits were met for all analytes.

Table 1
Lake Tahoe Pilot Project Samples

Sample	SDG	Date Sampled
Project Samples		
06-I-01	20661	11/08/2002
06-I-02	20661	11/08/2002
06-I-03	20661	11/08/2002
06-04-F	20661	11/08/2002
06-10-S	20661	11/08/2002
06-10-F	20661	11/08/2002
06-11-S	20661	11/08/2002
06-11-F	20661	11/08/2002
06-A-1	20661	11/08/2002
06-A-2	20661	11/08/2002
06-PSF-2	20661	11/08/2002
06-FF-1	20661	11/08/2002
06-IX3-PSF-2	20661	11/08/2002
06-IX4-PSF-2	20661 211027 (Reanalysis)	11/08/2002
06-IX3-FF-1	20661	11/08/2002
06-IX4-FF-1	20661	11/08/2002
06-16-S (Field Duplicate of 06-IX4-PSF-2)	20661	11/08/2002
06-17-F (Field Duplicate of 06-I-03)	20661	11/08/2002
06-101-S	20661	11/08/2002
Field Blanks		
06-18-F	20661	11/08/2002
06-18-S	20661	11/08/2002
Equipment Blank		
06-19-S	20661	11/08/2002
Bottle Blanks		
06-16-F	20661	11/08/2002
PE Sample		
06-20-F	20661	11/08/2002
PE Sample Blank		
06-20-S	20661	11/08/2002

ATTACHMENT A
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by the URS Data Review Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
NJ The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

DATA QUALIFIER REASON CODE DEFINITIONS

a Analytical sequence deficiency or omission.
b Gross compound breakdown (4,4'-DDT/Endrin).
c Calibration failure; poor or unstable response.
d Laboratory duplicate imprecision.
e Laboratory duplicate control sample imprecision.
f Field duplicate imprecision.
g Poor chromatography.
h Holding time violation.
i Internal standard failure.
j Poor mass spectrographic performance.
k Serial dilution imprecision.
l Laboratory control sample recovery failure.
m Matrix spike/matrix spike duplicate recovery failure.
n Interference check sample recovery failure.
o Calibration blank contamination (metals/inorganics only).
p Preparation blank contamination (metals/inorganics only).
q Quantitation outside of linear range.
r Linearity failure in initial calibration.
s Surrogate spike recovery failure (GC organics and GC/MS organics only).
t Instrument tuning failure.
u No confirmation column present (GC Organics only).
v Value is estimated below the MDA (Rads only).
w Retention time (RT) outside of RT window.
x Field or equipment blank contamination.
y Trip blank contamination.
z Method blank contamination.
D Value exceeds quantitation limit.
Q Dissolved concentration significantly exceeded the total concentration.

Appendix D

Chemicals Used - Data Sheets

EAGLEBROOK®

Your Single Source™

Responsible Care®
Member – American Chemistry Council (ACC)

MSDS
(Material Safety Data Sheet)

PASS® C

EMERGENCY NUMBERS

IN CASE OF EMERGENCIES SUCH AS PRODUCT SPILLS, CALL:

CHEMTREC (800) 424-9300 USA (TOLL FREE)
CANUTEC (613) 996-6666 CANADA (CALL COLLECT)

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

	USA	CANADA
Supplier:	Eaglebrook, Inc. 4801 Southwick Dr. Suite 200 Matteson, IL 60443	Eaglebrook, Inc. of Canada / L'Environment Eaglebrook Québec 3405 Blvd. Marie Victorin Varennes, Québec J3X 1T6
Telephone:	(708) 747-5038 (800) 428-3311	(450) 652-0665 (800) 465-6171

Product Name:	Aluminum Hydroxide Chloride Solution
Synonym:	Aluminum Hydroxide Chloride Solution; Polyaluminum Chloride
Product Use:	Drinking Water Treatment

2. HAZARDOUS MATERIAL

Ingestion at high concentration causes serious problems to digestive system. If a spill occurs, there is a surface water contamination hazard.

Component	Concentration	CAS Number
Polyaluminum Chloride	25% – 40%	1327-41-9

3. HAZARDS IDENTIFICATION

Principal Risk:	WHMIS – Class E. Irritating to skin, eyes and mucous membranes.
Potential Effects on Health:	May cause an irritation.
Carcinogenicity:	Does not contain any carcinogens or potential carcinogens.

4. FIRST AID MEASURES

First Aid:	In every case of overexposure ask for medical attention. Move victim to fresh air.
Skin Contact:	Wash with soap and water. Remove any contaminated clothing and wash before reuse. If an irritation develops, get medical attention.
Eye Contact:	Flush eyes thoroughly with water for at least 15 minutes, taking care to keep the eyelids opened to be sure that the rinsing is complete. Get medical attention.
Inhalation:	Move to fresh air. Give artificial respiration if breathing has stopped. If breathing is difficult, give oxygen. Get medical attention.

Ingestion: Do not use mouth-to-mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one way valve, or other proper respiratory medical device. Get medical attention.

5. FIRE FIGHTING MEASURES

Flash Point:	N/A
Flammable Limits:	N/A
Autoignition:	N/A
Hazardous Combustion Product:	N/A
Fire Fighting Instructions:	N/A
Fire and Explosion Hazards:	Non combustible

6. PREVENTION MEASURES

Wear appropriate personal protective equipment. Contain and eliminate the release. Neutralize with lime, limestone, or soda ash. This will generate carbon dioxide, so additional ventilation may be necessary. Collect the residues for proper disposal. Notify the appropriate environmental authorities.

Spill, Leak, Accidental

Neutralize with an alkaline solution (lime-water, sodium carbonate, sodium bicarbonate or sodium hydroxide). Liquid remaining after neutralization may be flushed to a sanitary sewer, if authorised. Recycle if possible. WARNING: Spills make floors slippery. Will give a strong astringent taste to water supply. High concentration may increase lead content of water if lead supply pipes are used.

Handling and Storage

Handle in containers, piping and pumps made of stainless steel, fiberglass or plastic. Avoid prolonged or repeated skin contact.

Exposure Controls and Personal Protection

Ventilation:	There should be enough local ventilation to keep the TLV below the ACGIH limits.
Gloves:	Use neoprene or equivalent. Never use leather.
Eyes:	Wear chemical goggles or a face shield.
Respirator:	Use an approved dust and mist respirator with acid mist if necessary.
Clothing:	Protective clothing if necessary, should be neoprene or equivalent.

When cleaning, decontaminating or performing maintenance on tanks, containers, piping systems and accessories, and in any other situations where airborne contaminants and/or dust could be generated, use protective equipment to protect against ingestion or inhalation. HEPA or air supplied respirator, full Tyvek coveralls with head cover, gloves and boots or chemical suits, are suggested.

7. PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point:	Decomposes at 90° C
Specific Gravity:	1.20 – 1.26
Vapor Pressure (mm Hg):	N/A
Percent Volatile By Vol.:	N/A
Vapor Density (Air=1):	N/A
Form:	Clear Liquid
Appearance:	Colorless to faint yellow
Odor:	Odorless
Solubility (water):	Hydrolyses

pH Solution:	2.2 – 2.8
Flash Point:	N/A
Flammability:	N/A
Freezing Point:	<0° C

8. STABILITY AND REACTIVITY

Stability:	Stable
Hazardous Polymerization:	Does not occur.
Hazardous Decomposition:	May liberate sulphur oxides and aluminum oxides when boiled to dryness or heated above 200° C. May liberate chlorine.
Conditions to Avoid:	Contact with strong mineral acids, excessive heat, bases or alkalies, and hydro-reactive materials (i.e. Oleum).
Incompatible Materials:	Moderately acidic and slowly corrodes steel. Do not store in containers made of aluminum, magnesium, zinc, or copper alloys.

9. TOXICOLOGICAL INFORMATION

*No data available.

10. ECOLOGICAL INFORMATION

*No data available.

14. OTHER INFORMATION

NFPA RATING

Health:	1
Flammability:	0
Reactivity:	1
Special Hazards:	CORROSIVE

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15. ABBREVIATIONS

ACGIH:	American Conference of Government Industrial Hygienists
AWWA:	American Water Works Association
CAS:	Chemical Abstracts Service
CIRC:	Cancer International Research Center
DOT:	Department of Transport
FRP:	Fiberglass Reinforced Plastic
HEPA:	High Efficiency Particulate Arresting
LEL:	Lower Explosive Limit
LD_{50}:	Lethal Dose
N/A:	Not Applicable
NFPA:	National Fire Protection Agency
NIOSH:	National Institute for Occupational Safety and Health
NSF:	National Sanitation Foundation
RCRA:	Resource Conservation and Recovery Act
RTECS:	Registry of Toxic Effects of Substances
TDG:	Transport of Dangerous Goods
TLV:	Threshold Limit Value
TWA:	Time Weight Average
UEL:	Upper Explosive Limit
WHMIS:	Workplace Hazardous Material Information System

MSDS Prepared on April 6, 2001 by:

Jason Evans
Eaglebrook, Inc.
4801 Southwick Drive
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Matteson, IL 60443
(800) 428-3311 telephone
jevans@eaglebrk.com

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CYTEC

MATERIAL SAFETY DATA

MSDS No: 08764
Date: 04/07/2000
Supersedes: 07/01/1997

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: **SUPERFLOC® A-836 Flocculant**

SYNONYMS: None

CHEMICAL FAMILY: Anionic polyacrylamide

MOLECULAR FORMULA: Polymer

MOLECULAR WGT: Polymer

CYTEC INDUSTRIES INC., FIVE GARRET MOUNTAIN PLAZA, WEST PATERSON, NEW JERSEY 07424, USA
For Product Information call 1-800/652-6013. Outside the USA and Canada call 1-973/357-3193.
EMERGENCY PHONE: For emergency involving spill, leak, fire, exposure or accident call CHEMTREC: 1-800/424-9300. Outside the USA and Canada call 1-703/527-3887.

2. COMPOSITION/INFORMATION ON INGREDIENTS

OSHA REGULATED COMPONENTS

COMPONENT	CAS. NO.	%	TWA/CEILING	REFERENCE
No Permissible Exposure Limits (PEL/TLV) have been established by OSHA or ACGIH.				

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

APPEARANCE AND ODOR: Off-white granular solid, odorless

STATEMENTS OF HAZARD:
IMPORTANT! SPILLS OF THIS PRODUCT ARE VERY SLIPPERY WHEN WET

POTENTIAL HEALTH EFFECTS

EFFECTS OF OVEREXPOSURE:
The acute oral (rat) and dermal (rabbit) LD50 values for this product are >5.0 g/kg and > 10.0 g/kg, respectively. Inhalation of the vapors is not likely to cause adverse health effects. Direct contact with this material may cause minimal eye and skin irritation.

4. FIRST AID MEASURES

Material is not expected to be harmful by ingestion. No specific first aid measures are required.
In case of skin contact, wash affected areas of skin with soap and water.
In case of eye contact, immediately irrigate with plenty of water for 15 minutes.
Material is not expected to be harmful if inhaled. If inhaled, remove to fresh air.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT: Not applicable

FLAMMABLE LIMITS
(% BY VOL): Not applicable

AUTOIGNITION TEMP: Not available

DECOMPOSITION TEMP: Not available

EXTINGUISHING MEDIA AND FIRE FIGHTING INSTRUCTIONS

As with many solids, any dust that is generated may be explosive if mixed with air in critical proportions and in the presence of a source of ignition. Use water, carbon dioxide or dry chemical to extinguish fires. Wear self-contained, positive pressure breathing apparatus.

6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Spilled material becomes very slippery when wet. Sweep up spills and place in a waste disposal container. Flush the area thoroughly with water and scrub to remove residue. If slipperiness remains, apply more dry-sweeping compound. Do not flush large quantities of the material to sewer.

7. HANDLING AND STORAGE

Spills should be scooped up or wiped up immediately, and the spill area flushed with water.

Maintain good housekeeping to control dust accumulations.

To avoid product degradation and equipment corrosion, do not use iron, copper or aluminum containers or equipment.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT (PPE)

Engineering controls are not usually necessary if good hygiene practices are followed. Before eating, drinking, or smoking, wash face and hands thoroughly with soap and water. Avoid unnecessary skin contact. Impervious gloves are recommended to prevent prolonged skin contact. For operations where eye or face contact can occur, eye protection is recommended.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR: Off-white granular solid, odorless

BOILING POINT: Not applicable

MELTING POINT: Not available

VAPOR PRESSURE: Not applicable

SPECIFIC GRAVITY: 0.75-0.95

VAPOR DENSITY: Not applicable

% VOLATILE (BY WT): 10-13; (water)

pH: 5-7; (aqueous solution)

SATURATION IN AIR (% BY VOL): Not available

EVAPORATION RATE: Not applicable

SOLUBILITY IN WATER: Limited by viscosity

VOLATILE ORGANIC CONTENT: Not available

10. STABILITY AND REACTIVITY

STABILITY: Stable

CONDITIONS TO AVOID: None known

POLYMERIZATION: Will Not Occur
CONDITIONS TO AVOID: None known

INCOMPATIBLE MATERIALS: Strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS: carbon dioxide; carbon monoxide; ammonia; oxides of nitrogen

11. TOXICOLOGICAL INFORMATION

Toxicological information for the product is found under Section 3. HAZARDS IDENTIFICATION. Toxicological information on the OSHA regulated components of this product is as follows:

This product contains no OSHA regulated (hazardous) components.

California Proposition 65 Warning (applicable in California only) - This product contains (a) chemical(s) known to the State of California to cause cancer.

12. ECOLOGICAL INFORMATION

Based on the results of a 5-Day Biodegradability assay, this product is not readily biodegradable (<10% after 28 days). Chemical Oxygen Demand (COD): ~0.29 mg O2/mg.

Marine Copepod (Acartia tonsa), 48 hr LC50: 342 mg/L; Marine Algae (Skeletonema costatum), 72 hr LC50: 2276 mg/L; Marine Amphipod (Corophium volutator); 10-day LC50: 1415 mg/L Seawater BOD 28: 1.7%

All ecological information provided was conducted with a structurally similar product.

LC50

BLUEGILL, 96 HOUR: 180 mg/L

TROUT 96 HOUR: 130 mg/L

FATHEAD MINNOW: 670 mg/L

DAPHNIA, 48 HOUR: > 1000 mg/L

WATER FLEA CERR: 24 mg/L

OCTANOL/H_2O PARTITION COEF.: Not available

13. DISPOSAL CONSIDERATIONS

The information on RCRA waste classification and disposal methodology provided below applies only to the Cytec product, as supplied. If the material has been altered or contaminated, or it has exceeded its recommended shelf life, the guidance may be inapplicable. Hazardous waste classification under federal regulations (40 CFR Part 261 et seq) is dependent upon whether a material is a RCRA "listed hazardous waste" or has any of the four RCRA "hazardous waste characteristics." Refer to 40 CFR Part 261.33 to determine if a given material to be disposed of is a RCRA "listed hazardous waste"; information contained in Section 15 of this MSDS is not intended to indicate if the product is a "listed hazardous waste." RCRA Hazardous Waste Characteristics: There are four characteristics defined in 40 CFR Section 261.21-61.24: Ignitability, Corrosivity, Reactivity, and Toxicity. To determine Ignitability, see Section 5 of this MSDS (flash point). For Corrosivity, see Sections 9 and 14 (pH and DOT corrosivity). For Reactivity, see Section 10 (incompatible materials). For Toxicity, see Section 2 (composition). Federal regulations are subject to change. State and local requirements, which may differ from or be more stringent than the federal regulations, may also apply to the classification of the material if it is to be disposed. Cytec encourages the recycle, recovery and reuse of materials, where permitted, as an alternate to disposal as a waste. Cytec recommends that organic materials classified as RCRA hazardous wastes be disposed of by thermal treatment or incineration at EPA approved facilities. Cytec has provided the foregoing for information only; the person generating the waste is responsible for determining the waste classification and disposal method.

14. TRANSPORT INFORMATION

This section provides basic shipping classification information. Refer to appropriate transportation regulations for specific requirements.

	D.O.T. SHIPPING INFORMATION	IMO SHIPPING INFORMATION
SHIPPING NAME:	NOT APPLICABLE/NOT REGULATED	NOT APPLICABLE/NOT REGULATED
HAZARD CLASS/ PACKING GROUP:	Not Applicable	Not Applicable
UN NUMBER:	Not Applicable	Not Applicable
IMDG PAGE:	Not Applicable	Not Applicable
D.O.T. HAZARDOUS SUBSTANCES:	(PRODUCT REPORTABLE QUANTITY) Not Applicable	Not Applicable
TRANSPORT LABEL REQUIRED:	None Required	None Required

	ICAO/IATA	TRANSPORT CANADA
SHIPPING NAME:	NOT APPLICABLE/NOT REGULATED	NOT APPLICABLE/NOT REGULATED
HAZARD CLASS:	Not Applicable	Not Applicable
SUBSIDIARY CLASS:	Not Applicable	Not Applicable
UN / ID NUMBER:	Not Applicable	Not Applicable
PACKING GROUP:	Not Applicable	Not Applicable
TRANSPORT LABEL REQUIRED:	None Required	None Required
PACKING INSTR:	PASSENGER Not Applicable CARGO Not Applicable	Not Applicable
MAX NET QTY:	PASSENGER Not Applicable CARGO Not Applicable	Not Applicable

ADDITIONAL TRANSPORT INFORMATION

TECHNICAL NAME (N.O.S.): Not Applicable

15. REGULATORY INFORMATION

INVENTORY INFORMATION

US TSCA:	This product is manufactured in compliance with all provisions of the Toxic Substances Control Act, 15 U.S.C. 2601 et. seq.
CANADA DSL:	Components of this product have been reported to Environment Canada in accordance with subsection 25 of the Canadian Environmental Protection Act and are included on the Domestic Substances List.

EEC EINECS: All components of this product are included in the European Inventory of Existing Chemical Substances (EINECS) in compliance with Council Directive 67/548/EEC and its amendments.

OTHER ENVIRONMENTAL INFORMATION

The following components of this product may be subject to reporting requirements pursuant to Section 313 of CERCLA (40 CFR 372), Section 12(b) of TSCA, or may be subject to release reporting requirements (40 CFR 307, 40 CFR 311, etc.) See Section 13 for information on waste classification and waste disposal of this product.

COMPONENT	CAS. NO.	%	TPQ(lbs)	RQ(lbs)	S313	TSCA 12B
This product does not contain any components regulated under these sections of the EPA						

PRODUCT CLASSIFICATION UNDER SECTION 311 OF SARA
Not Applicable under SARA TITLE III

16. OTHER INFORMATION

NFPA HAZARD RATING (National Fire Protection Association)

Fire 1
Health 0 0 Reactivity
—
Special

FIRE: Materials that must be preheated before ignition can occur.

HEALTH: Materials which on exposure under fire conditions would offer no hazard beyond that of ordinary combustible material.

REACTIVITY: Materials which in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water.

REASON FOR ISSUE:

Revised Section 12

Randy Deskin, Ph.D., DABT

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Ciba Specialty Chemicals Corporation
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Suffolk, VA 23434

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24-Hour Health/Environmental Emergency Phone: (800)873-1138

Ciba

Value beyond chemistry

Effective Date: 11/28/01 **Material Safety Data Sheet** MSDS No: 14866

SECTION 1. PRODUCT IDENTIFICATION

Trade Name: MAGNAFLOC LT25

Chemical Family: Copolymer of sodium acrylate and acrylamide.

Health	0
Flammability	1
Reactivity	0
Protective Equipment	X

HMIS RATING

Former Tradename:
PERCOL LT25

SECTION 2. COMPOSITION / INFORMATION ON INGREDIENTS

OSHA	CAS No.	CHEMICAL IDENTITY	EXPOSURE LIMITS					CARCINOGEN STATUS		
			ACGIH		OSHA		MFR.	IARC	NTP	OSHA
			TWA	STEL	PEL	STEL				
	25085-02-3	COPOLYMER OF ACRYLAMIDE:SODIUM ACRYLATE	NE	NE	NE	NE	NE	NR	NR	NR

NE = Not Established NR = Not Reviewed

SECTION 3. HAZARDS IDENTIFICATION

Emergency Overview:

Description: White, free flowing powder with little or no odor.

Statement of Hazards: NA (not a health hazard as defined by OSHA)

Precautionary Measures: Do not get in eyes, on skin, on clothing. Wash thoroughly after handling. Avoid prolonged or repeated inhalation of dust or skin contact. Slip hazard when wet.

Primary Route(s) of Entry: Inhalation.

Signs and Symptoms of Exposure: Eye contact may produce slight irritation and/or redness. Inhaled dust may cause some respiratory irritation.

Carcinogenicity: Not listed as a carcinogen by IARC, NTP, OSHA or ACGIH

Medical Conditions Aggravated by Exposure: Existing respiratory conditions.

Target Organ(s): NA

SECTION 4. FIRST AID MEASURES

Ingestion: Do not give an emetic unless directed by a physician. Never give anything by mouth to an unconscious person.

Skin: Remove contaminated clothing and launder before reuse. Wash effected area with soap and water.

Inhalation: Remove to fresh air.

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

SECTION 5. FIRE FIGHTING MEASURES

Flash Point:	Not Applicable
Autoignition:	Not Evaluated

Sensitivity to Mechanical Impact: None

Sensitivity to Static Discharge: Dust in sufficient concentration may result in an explosive mixture in air.

Fire Fighting Extinguishing Media: Carbon dioxide, dry chemical or foam.

Fire Fighting Equipment: No special procedures. However, wetted product presents a slip hazard. Pedestrian and vehicular traffic must proceed with caution where wet product may exist.

Fire and Explosion Hazards: Dust in sufficient concentration can result in an explosive mixture in air. Handle to minimize dusting, and eliminate open flame and other sources of ignition.

Extinguishing Media to Avoid: Water may create a slip hazard with product.

Hazardous Combustion Products: Oxides of carbon and nitrogen.

Dust Explosivity: Dust in suficient concentration may result in an explosive mixture in air.

Emergency Response Guidebook Information: No ERG # indicated. Handle as combustible material.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Accidental Release Measures: Product becomes slippery and difficult to handle when wet; spills are best handled while still dry. Sweep up and collect dry product. Absorb wet product with vermiculite or other inert material. Then water wash area to waste treatment to eliminate slip hazard.

SECTION 7. HANDLING AND STORAGE

Precautions: Good personal hygiene practices can reduce potential exposure. Wash with soap and water following any contact with this product, as well as before breaks and meals. Shower and change clothing at end of work shift. If clothing becomes contaminated, remove and launder or dry-clean before reuse.

Storage Information: Store in cool dry location.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Skin Protection: Not normally required.

Respiratory Protection: Use NIOSH approved dust respirator as required to control exposure. Follow ANSI Z88.2.

Eye Protection: Goggles (ANSI Z87.1 std; safety glasses alone do not protect from dust).

Engineering Controls: Provide mechanical ventilation to prevent dust concentrations, and to reduce potential exposure.

Additional Information: Provide eyewash station(s). Select additional protective equipment (eg apron, face shield, etc.), depending on conditions of use.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form:	Granular Powder
Color:	White
Odor:	Little or No
Odor Threshold:	Not applicable
Physical State:	Solid
Solubility in Water:	Soluble, solubility limited by viscosity
Vapor Pressure:	Not Applicable
Specific Gravity:	~0.75
Boiling Point:	Not Applicable
Melting Point:	Not Applicable
Freezing Point:	Not Applicable
Decomposition Temperature:	Not Evaluated
Evaporation Rate:	Not Applicable
Vapor Density:	Not Applicable
VOC:	Not Evaluated
pH:	~6 For 1 % solution.
Coefficient of water/oil:	Not Evaluated

Percent Volatile:
None expected above trace levels.

SECTION 10. STABILITY AND REACTIVITY

Conditions to Avoid: Avoid wet and humid conditions.

Stability: Stable.

Hazardous Polymerization: Will not occur..

Hazardous Decomposition Products: Thermal decomposition or combustion may produce oxides of carbon and nitrogen, various hydrocarbons, and/or ammonia which may be irritating or harmful.

Incompatibility: Strong oxidants such as liquid chlorine, enriched gaseous or liquid oxygen, and sodium or calcium hypochlorite.

SECTION 11. TOXICOLOGICAL INFORMATION

Acute Oral Toxicity:
Low oral toxicity. By analogy to similar materials, the acute LD50 (rat) is expected to be > 2000 mg/kg.

Carcinogenicity:
Not listed as a carcinogen by IARC, NTP, OSHA, or ACGIH.

Reproductive Toxicity:
No data for product. No effects anticipated.

Teratoginicity:
No data for product. No effects anticipated.

Mutagenicity:
No data for product. No effects anticipated.

Skin Irritation:
57-13-6 UREA
Mild irritant (human).

Intraveneous LD 50:
57-13-6 UREA
LD50(Rat): 5300 mg/kg.
LD50(Mice): 4600 mg/kg.
LD50(Rabbit): 4800 mg/kg.

Toxicologically Synergistic Products:
None known.

Additional Information:
57-13-6 UREA
LD50(Rat): 8200 mg/kg (Subcutaneous).
LD50(Mice): 8200 mg/kg (Subcutaneous).

SECTION 12. ECOLOGICAL INFORMATION

Ecological Information:
Product not considered toxic to aquatic organisms.

SECTION 13. DISPOSAL CONSIDERATIONS

RCRA Hazard Class: This product, when unadulterated, is not a RCRA regulated hazardous waste.

Waste Disposal Method: Disposal must be arranged in accordance with local, state and federal regulations. Care must be taken to prevent environmental contamination from the disposal of material, residues and containers.

SECTION 14. TRANSPORT INFORMATION

DOT:
Proper Shipping Name: NOT A DOT/IMO HAZARDOUS MATERIAL

SECTION 15. REGULATORY INFORMATION

US Federal Regulations:

Chemical Weapons Convention (CWC): This product does not contain any chemicals listed under the Chemical Weapons Convention Schedules of Chemicals.

Clean Air Act -Hazardous Air Pollutants (HAP): The following chemical(s) are listed as hazardous air pollutants (HAP) under the U.S. Clean Air Act Section 12 (40 CFR 61):

Chemical Name: ACRYLIC ACID (Impurity)
CASRN: 79-10-7
Percent in Composition: < 0.5 % by wt

Chemical Name: 2-Propenamide (Impurity)
Common Name: Acrylamide
CASRN: 79-06-1
Percent in Composition: < 0.025 % by wt

Clean Air Act - Ozone Depleting Substances (ODS): This product neither contains, nor was manufactured with, a Class I or Class II ozone depleting substance (ODS), as defined by the U.S. Clean Air Act Section 602 (40 CFR 82, Subpt. A, App. A+B).

Clean Water Act - Priority Pollutants (PP): This product does not contain any priority pollutants listed under the U.S. Clean Water Act Section 307 (2)(1) Priority Pollutant List (40 CFR 401.15).

Occupational Safety and Health Act (OSHA): This product is not considered to be a hazardous chemical under the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Resource Conservation and Recovery Act (RCRA): This product is not considered to be a P or U listed hazardous waste under RCRA (40 CFR 261).

SARA Title III: Section 302 - Extremely Hazardous Substances (EHS): This product contains the following chemicals regulated under Section 302 (40 CFR 355) as extremely hazardous substances:

Chemical Name: ACRYLAMIDE
CASRN: 79-06-1
Percent in Composition: < 0.025 % by wt

SARA Title III: Section 304 - CERCLA: This product contains the following chemicals regulated under Section 304 (40 CFR 302) as hazardous substance(s) for emergency release notification ("CERCLA" List):

Chemical Name: ACRYLIC ACID (Impurity)
CASRN: 79-10-7
Percent in Composition: < 0.5 % by wt

Component RQ: 5000

Chemical Name: 2-Propenamide (Impurity)
Common Name: Acrylamide
CASRN: 79-06-1
Percent in Composition: < 0.025 % by wt
Component RQ: 5000

SARA Title III: Section 311/312 - Hazard Communication Standard (HCS): This product is not regulated under Section 311-312 (40 CFR 370).

SARA Title III: Section 313 Toxic Chemical List (TCL): This product does not contain any chemicals for routine annual toxic chemical release reporting under Section 313 (40 CFR 372).

TSCA Section 5(e) - Consent Order / SNUR: This product is not subject to a Section 5(e) Consent Order or Significant New Use Rule (SNUR).

TSCA Section 8(b) - Inventory Status: All chemical(s) comprising this product are either exempt or listed on the TSCA inventory.

TSCA Section 12(b) - Export Notification: This product contains the following chemical(s) that are subject to a Section 12(b) export notification:

Chemical Name: ACRYLIC ACID (Impurity)
CASRN: 79-10-7

State Regulations:

California Proposition 65: The following is required composition information. This product contains the following chemical(s) which are currently listed on the California list of Known Carcinogens and Reproductive Toxins:

Chemical Name: ACRYLAMIDE
CASRN: 79-06-1
Percent in Composition: < 0.025 % by wt

Massachusetts Right-to-Know: The following is required composition information:

Chemical Name: 2-Propenamide (Impurity)
Common Name: Acrylamide
CASRN: 79-06-1
Percent in Composition: < 0.025 % by wt

Chemical Name: ACRYLIC ACID (Impurity)
CASRN: 79-10-7
Percent in Composition: < 0.5 % by wt

New Jersey Right-to-Know: The following is required composition information:

Chemical Name: COPOLYMER OF ACRYLAMIDE:SODIUM ACRYLATE
CASRN: 25085-02-3

Chemical Name: WATER
CASRN: 7732-18-5

Chemical Name: UREA
CASRN: 57-13-6

Pennsylvania Right-to-Know: The following is required composition information:

Chemical Name: COPOLYMER OF ACRYLAMIDE:SODIUM ACRYLATE
CASRN: 25085-02-3
Comment: Not on Pennsylvania Hazardous Substance List

Chemical Name: WATER
CASRN: 7732-18-5
Comment: Not on Pennsylvania Hazardous Substance List

SECTION 16. OTHER INFORMATION

MSDS No:	14866
Reason Issued:	New format
Prepared By:	Leon Knight
Approved By:	
Supersedes Date:	10/11/00

Sections Modified: Section 15.

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NSF Status Maximum use level for potable water: 1 mg/L.

Appendix E

Modified Sampling Procedures

The modified “clean” sampling procedure is as follows:

1. Pre-printed labels were placed on certified pre-cleaned sample containers provided by the projects contract laboratory (ESS brand certified bottles, Environmental Sampling Supply, Oakland, CA). Pre-printed chain-of-custody forms (date and time left blank) with an attached carbon page for making a copy were placed with each bottle set. Sample bottle labels contained the following information: project name, sample location/treatment system (sample ID number), date and time, sample type (grab or composite), bottle__ of__ (for multi-bottle samples), sampler initials, preservatives (if any), and required analyses. The chain-of- custody form duplicated the same information.
2. The sample processing area was readied by placement of a clean laboratory bench absorbent pad under labeled sample containers with the corresponding chain-of-custody form. The date and time of sampling was recorded on the sample container at the time of processing.
3. A 5-gallon sample container was placed on a magnetic stir plate and a clean stir bar was placed into the sample container. The sample container was mixed throughout the remainder of the sample processing activities.
4. Tubing used to filter samples was cut to length and bagged using “clean” techniques prior to the run. At the time of filtering, the tubing was removed from the bulk storage tub, and using a “clean hands” approach, the tubing was removed from the baggie (leaving bags covering both ends of the tubing) and the tubing was inserted into the quick-release peristaltic pump drive.
5. After removing the baggie from one end of the tubing, a pre-conditioned 0.45 µm disposable capsule filter was placed on the now exposed end. The capsule filter end of the tubing assembly was then placed into the mixed 5-gallon container while being careful that the capsule filter was not submerged.
6. After removing the baggie from the other end of the tubing, the sample was filtered directly into a clean oversized sample container. If it was believed that filtration might require more than 30 minutes, the technician left the sample to filter into a pre-cleaned oversized container on its own while collecting other samples that did not require filtration while the oversized container was being filled. Samples that did not require filtration were collected by dipping a clean plastic beaker into the 5-gallon sample bucket (on the mixer) and then transferring to individual sample containers.
7. The peristaltic pump used for filtering was turned off once the container was filled. Bottles were then opened and filled from the oversized container while wearing clean nitrile gloves and without touching the inside of the bottle, bottle cap, or tubing end.
8. Filtered samples were placed into a larger plastic bag and remained separate from unfiltered samples.

9. The samples were inventoried and the chain-of-custody forms were completed for each treatment unit.

Samples were then placed into iced and labeled coolers. Once the cooler was filled (two sample sets per cooler), the chain-of-custody forms were placed into a plastic bag inside of the cooler until signed at relinquishment.

Appendix F

Staff Summary

Appendix F Staff Summary

This Executive Summary presents a brief synopsis of the first year treatment processes evaluated, the project objectives and preliminary findings of the Lake Tahoe Small-Scale Storm Water Treatment Pilot Project completed by the State of California Department of Transportation.

1.1 Introduction

Storm water discharge regulations adopted by the United States Environmental Protection Agency (USEPA) establish storm water permit requirements under the National Pollution Discharge Elimination System (NPDES) Program. In July 1999, the State Water Resources Control Board (SWRCB) issued a system-wide NPDES permit (No. CAS000003, Order No. 99-06-DWQ), which included requirements to both research and implement best management practices (BMPs) and comply with the basin plans of the various regional water quality control boards. The Basin Plan of the Lahontan Regional Water Quality Control Board (LRWQCB) includes separate numeric effluent limits for surface discharges and runoff discharged to infiltration systems, as presented in Table 1-1 (LRWQCB, 1994). These values comprise the benchmark for treatment methodologies.

Table 1-1. Numeric Storm Water Discharge Limits

Constituent	Units	Maximum Effluent Concentration	
		Runoff Discharged to Infiltration Systems	Surface Discharges
Total Nitrogen as N	mg/L	5	0.5
Total Phosphate[(a)] as P	mg/L	1	0.1
Total Iron (Fe)	mg/L	4	0.5
Turbidity	NTU	200	20
Oil and Grease	mg/L	40	2.0

(a) Basin plan specifies that total phosphate is measured as "total phosphorus" (LRWQCB, 1994). Project measurements include both total and dissolved phosphorus (as mg-P/L) and total and dissolved orthophosphate (as mg-P/L).

Caltrans has constructed an applied studies facility at the existing Caltrans South Lake Tahoe Maintenance Station and implemented a small-scale storm water treatment pilot project. This project is the first step in field-testing various filter medias and chemical treatment applications having the potential to improve storm water runoff quality from Caltrans properties within the Lake Tahoe Basin.

1.2 Objectives

The overall objective of the small-scale storm water treatment pilot project report was to:

Evaluate the effectiveness of various storm water treatment methods for producing an effluent that complies with the numeric discharge limitations (summarized in Table 1-1).

1.3 Approach

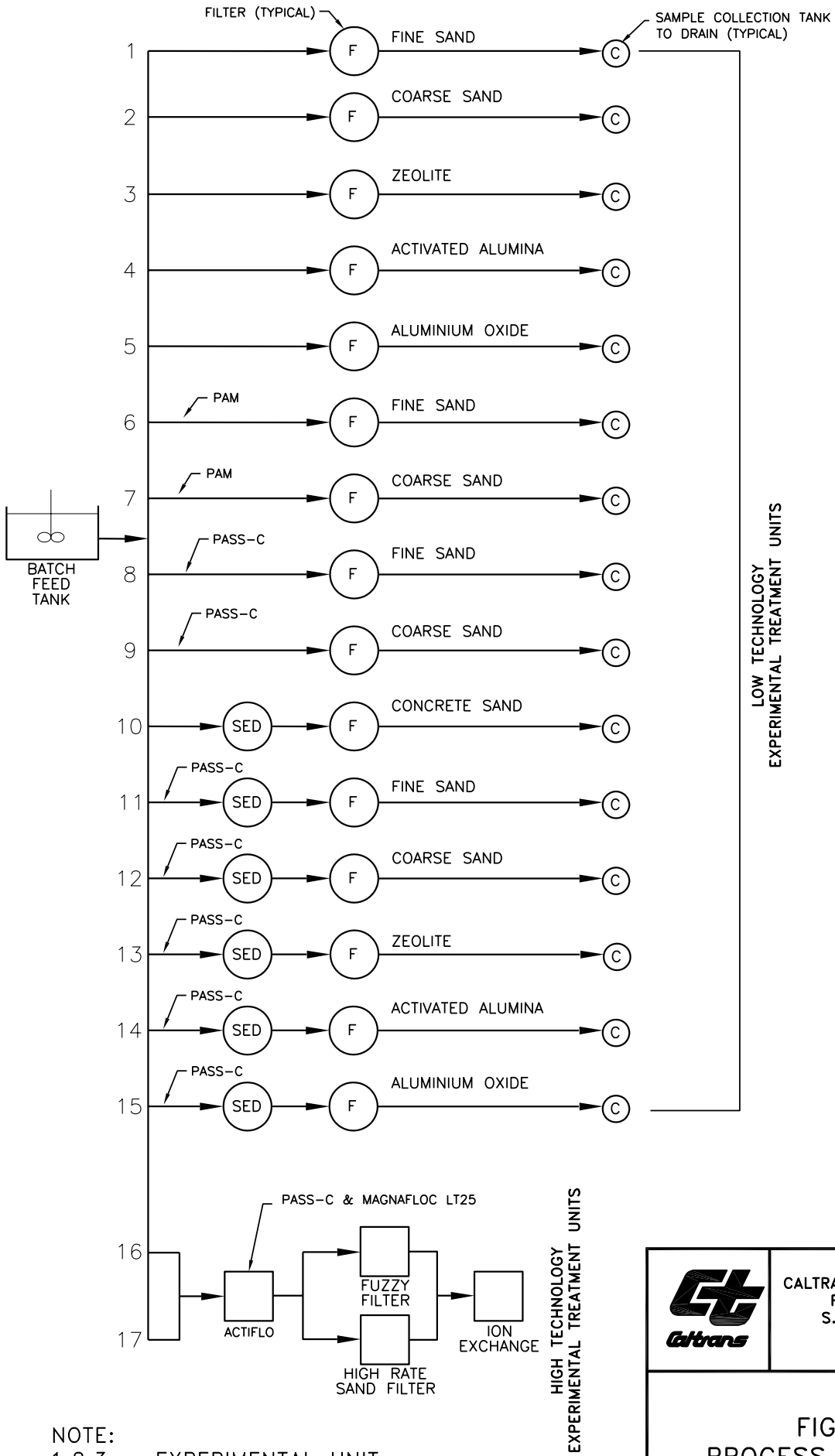
The first year of the Small-Scale Pilot Project was accomplished in two parts. Part A consisted of a laboratory-scale jar testing program for the selection of a chemical coagulant and dose for use in the pilot scale treatment facility. Part B consisted of construction and operation of a small-scale treatment facility to test the efficacy of various treatment technologies. Both low technology and high technology processes were investigated in Part B of the project. The treatment processes selected for inclusion were those considered to be most feasible for implementation and/or most likely to remove the contaminants from storm water, as identified in Table 1-1.

Storm water treatment technologies investigated in Part B included sedimentation (with and without chemical addition) and filtration (with and without prior sedimentation, and filter units with and without direct chemical addition). Altogether, 15 filter or filter/sedimentation combinations were evaluated (hereinafter referred to as the “low technology” systems). These systems utilized six filter media types and two different chemicals. Components and configuration of the fifteen low technology treatment systems are presented graphically in Figure 1-1. A second type of storm water treatment technology investigated in Part B included a high-rate mechanized system involving coagulation, flocculation, sedimentation, pressure filtration, and ion exchange (hereinafter referred to as the “high technology” system, see Figure 1-1).

The overall pilot set-up was designed to allow for a comparative evaluation of coagulation, enhanced sedimentation, and granular media filtration for the removal of nitrogen, phosphorus, and other contaminants from Caltrans discharged storm water runoff.

1.3.1 Low-Technology Systems

The fifteen low technology systems were designed to test the effectiveness of sedimentation and filtration (using six filter medias), alone and combined, both with and without chemical coagulation/flocculation. Investigated storm water treatment systems that were considered low technology included: sedimentation, chemical-assisted sedimentation, filtration, filtration with direct chemical addition, sedimentation coupled with filtration, and chemical-assisted sedimentation coupled with filtration. Filter media used in the low-technology systems were selected after a review of the literature and included fine sand, coarse sand, concrete sand, activated alumina, aluminum oxide, and zeolite (clinoptilolite). Altogether, 15 low technology systems were evaluated, based on various combinations of sedimentation, filtration, chemical use, and filter media.



NOTE:
1,2,3 = EXPERIMENTAL UNIT
(REFERENCE **TABLE 3-1**)

CALTRANS SMALL-SCALE STORMWATER
PILOT TREATMENT FACILITY
S.L.T. MAINTENANCE STATION
SOUTH LAKE TAHOE, CA

FIGURE 1-1
PROCESS FLOW DIAGRAM

discontinued. PAM was dosed directly preceding media filtration with passive "tea bag" system. Lack of dose control lead to premature filter failure.

Filter media used in the low-technology systems were selected after a review of the literature and included fine sand, coarse sand, concrete sand, activated alumina, aluminum oxide, and zeolite (clinoptilolite). Altogether, 15 low technology systems were evaluated, based on various combinations of sedimentation, filtration, chemical use, and filter media.

The coagulant PASS-C® (Eaglebrook Chemical) was selected as a direct result of Part A of this study. The jar test results showed that using storm water collected within the Tahoe Basin, a dose of 100 mg/L (neat) had greatest potential to remove phosphorus and improve overall storm water quality (while not requiring alkalinity addition). It is likely that several other coagulants would perform similarly, and the selection of PASS-C® does not constitute endorsement. The inclusion of PAM was based in-part on research in the storm water field for its ability to lower turbidity and TSS. The ability to passively dose a product is attractive to Caltrans since the operational demands during use are theoretically low.

1.3.2 High-Technology Systems

High-technology treatment systems consisted of a simulation of the Actiflo® high rate sedimentation process followed by effluent polishing using either Fuzzy Filter® (FF) filtration or a high rate pressure sand filtration (PSF). Effluent from either of the two polishing filters then went through both anion and cation exchange resin cartridges. The Actiflo® process a registered trademark of KRÜGER, inc., a division of US Filter. The Fuzzy Filter® is a registered trademark of Schreiber® Wastewater Treatment Technologies. The pressure sand filter and ion exchange units are not proprietary processes.

For each Experimental Run, two high technology treatment trains were investigated. One train consisted of an Actiflo® sedimentation process, followed by a Fuzzy Filter® filtration process, followed by ion exchange. The other train made use of a high rate sand filter in lieu of the Fuzzy Filter®, with all other process components being the same. The Actiflo® sedimentation process makes use of a ballast sand and chemicals to enhance sedimentation, thus decreasing area needs. The ballast sand serves two functions: 1) it provides nucleation sites for flocculation, facilitated with the use of PASS-C® (coagulant) and Magnafloc® LT25 (polymer), and 2) it increases floc particle density to increase the rate of sedimentation. The Fuzzy Filter® is a high flow rate filtration system that makes use of a synthetic fiber sphere medium in lieu of sand. The unique feature of the synthetic medium is its compressibility, allowing for modification of filter performance by compressing or decompressing the medium within the vessel. The ion exchange units were the same units used in each of the two trains. Components of the high technology treatment systems are also presented schematically in Figure 1-1.

1.3.3 Influent Storm Water Used

Separate from this study, the storm water runoff water quality in the Tahoe Basin has been monitored and characterized as part of the Tahoe Highway Runoff Characterization and Sand Trap Effectiveness Study (CSTW-RT-02-044). The storm water collected and treated as part

of this study was compared to the water quality characteristics observed in the Highway Runoff Characterization Study to determine the applicability of treatment results. Influent concentrations of selected contaminants treated over the six experimental runs are presented in Table 1-2 along with the reported concentrations of “typical” Lake Tahoe Basin storm water from the other study. The water treated as part of this project was observed to be similar in contaminant composition to that observed in the Lake Tahoe Basin and, therefore, any findings are considered applicable throughout the Basin. Caution should be used, however in comparing simple mean values to event mean concentrations (EMC) listed in the table.

1.4 Summary of Findings

Based on an examination of the pilot test results, preliminary evaluations of the various treatment systems were performed. Project results with respect to meeting the applicable discharge limits are summarized in Table 1-3. In viewing Table 1-3, the reader should be mindful that these evaluations involve a degree of judgment (especially the "Y+", "M", and "?" designations), and that they are based on six data points or less.

Low Technology Treatment Systems. Generally speaking, chemical coagulation/sedimentation was a key element in whether or not a system met any of the performance standards in this study. The non-chemical systems provided insufficient treatment to meet the effluent standards. Adding chemical coagulation allowed at least some systems to meet some standards, particularly turbidity standards. As can be seen in Table 1-3, the following points can be made:

- Sedimentation only, filtration only, and sedimentation coupled with filtration through concrete sand did <u>not</u> produce effluents that met the surface water discharge standards for any of the regulated constituents (the situation with respect to less stringent infiltration standards is mixed).
- Influent storm water runoff used for study had concentrations of phosphorus, nitrogen, and oil and grease were lower than the water quality standards for infiltration. Consequently, almost all of the systems met these standards. Some degree of treatment was observed in most of the systems receiving chemical addition (PASS-C® or PAM), though whether or not this degree of treatment is sufficient to meet the standard starting with a “dirtier” influent cannot be ascertained from the data available.
- Activated alumina removed phosphorus and iron better than the other media. It was particularly effective at removing the dissolved fractions of these constituents. Although activated alumina removed some total aluminum, the media leached substantial amounts of dissolved aluminum (0.2 – 1.1 mg/L) into the effluent. The same can be said for the aluminum oxide medium.

Table 1-2. Storm Water Runoff Quality for the Tahoe Basin and the Six Experimental Runs

Parameter	Units of Measure	Typical Lake Tahoe Basin Storm Water Quality[a] (EMC)			Pilot Project Influent Quality[b] Run Average						
		Min.	Max	Mean	Mean	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
pH	pH units	5.9	9.6	7.3	7.2	7.5[c]	7.5	7.3	7.4	7.0	6.6
EC	µmhos/cm	25	21,000	2,735	971	2,357[c]	192	480	2,302	364	129
TSS	mg/L	36	2,500	761	239	372	46	260	430	153	173
TOC	mg/L	2.6	180	27	42	7.6	10	6.9	6.3	40	183
Turbidity	NTU	25	1,500	531	539	904[c]	66	1,038	864	178	184
Oil and Grease	mg/L	6	45	22	4[d]	7	<2	<2	9	<5	6
Nitrate - Nitrogen	mg-N/L	0.1	2	0.4	0.3[d]	<0.1	0.7	<0.1	<0.1	0.2	0.6
Nitrite – Nitrogen	mg-N/L	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
TKN – T	mg-N/L	0.6	14	2.4	2.3	4.1	0.8	1.1	1.0	2.1	4.4
Total Nitrogen	mg-N/L	0.7	16	2.8	2.6	4.1	1.5	1.1	1.0	2.3	5.0
Phosphorus – T	mg-P/L	0.09	1.5	0.40	0.80	1.03	0.20	1.12	0.93	0.47	1.10
Aluminum - T	mg-P/L	<0.03	1.1	0.11	0.20[d]	0.20	<0.03	0.11	0.09	0.09	0.68
Aluminum - D	mg-P/L	0.03	0.6	0.08	0.21[d]	0.17	0.08	<0.03	0.61	0.15	0.24
Aluminum (Acid Sol)[e]	µg/L	*NR*	*NR*	*NR*	8,889	12,000	2,967	32,000	3,533	1,533	1,300
Iron - T	µg/L	*NR*	*NR*	*NR*	38[d]	<25	<25	<25	<25	50	128
Iron - D	µg/L	*NR*	*NR*	*NR*	1,255	3,200	327	2,800	627	337	237

(a) Data from Caltrans Tahoe Highway Runoff Characterization and Sand Trap Effectiveness Studies, 2001-02 Monitoring Season,CSTW-RT-02-044
(b) Average of the pilot project storm water influent samples (see I-Avg, Table 5.1 for samples included in this average)
(c) Field measurements for pH, EC and Turbidity
(d) Averages calculated using ½ of reporting limit value for concentrations below reporting limit
(e) Acid soluble aluminum by EPA method 440/5-86-008 (unfiltered sample collected in the field, acidified and filtered in the laboratory)
NR = Not Run, T = Total, D = Dissolved

Table 1-3. Summary of Pilot Treatment Process Performance With Respect to Meeting the Tahoe Basin Discharge Regulations

	Meets INFILTRATION standard for:					Meets SURFACE WATER standard for:				
	Turb	P	N	O&G	Fe	Turb	P	N	O&G	Fe
Processes WITHOUT Chemical Coagulation										
Sedimentation (only)	N	Y-	Y-	Y-	N	N	N	N	N	N
Fine Sand filter (only)	N	Y+	Y+	Y+	N	N	N	N	?	N
Coarse sand filter (only)	N	Y+	Y+	Y-	N	N	N	N	N	N
Zeolite filter (only)	N	Y+	Y+	Y+	N	N	N	N	?	N
Activated alumina filter (only)	M	Y	Y+	Y+	M	M	M	M	M	N
Aluminum oxide (filter only)	N	Y	Y+	Y+	N	N	N	N	?	N
Concrete sand filter and settling	M	Y+	Y+	Y+	M	N	N	N	M	N
Processes WITH Chemical Coagulation										
Sedimentation + PASS-C®	Y	Y+	Y-	Y+	Y	M	M	N	M	N
Fine sand filter + PAM	Y	?	?	?	?	M	?	?	?	?
Coarse sand filter + PAM	Y	Y	Y+	?	M	N	N	N	?	N
Fine sand filter + PASS-C®	Y	Y+	Y-	Y+	Y	M	M	N	M	M
Coarse sand filter + PASS-C®	M	Y+	Y-	Y+	M	N	N	N	?	N
Fine sand filter + PASS-C® and settling	Y	Y+	Y-	Y+	Y	Y	M	N	M	M
Coarse sand filter + PASS-C® and settling	Y	Y+	Y+	Y+	Y	Y	M	M	M	N
Zeolite filter + PASS-C and settling	Y	Y+	Y+	Y+	Y	Y	M	M	M	M
Activated alumina filter + PASS-C® and settling	Y	Y+	Y+	Y+	Y	Y	Y	M	M	Y
Aluminum oxide filter + PASS-C® and settling	Y	Y+	Y-	Y+	Y	Y	Y	N	M	Y
"High Tech" Systems										
Actiflo® (PASS-C®+ LT25)	Y	Y+	Y-	Y+	Y	Y	M	N	M	Y
Actiflo® (PASS-C®+ LT25) and pressure sand filter	Y	Y+	Y+	Y+	Y	Y	Y	M	M	Y
Actiflo® (PASS-C®+ LT25) and Fuzzy filter	Y	Y+	Y+	Y+	Y	Y	M	M	M	Y
Actiflo® (PASS-C®+ LT25) with filtration and ion exchange	Y	Y	Y+	Y+	Y	Y	M	M	M	Y

Turb = turbidity, P = total phosphorus, N = total nitrogen, Fe = total iron, O&G = oil and grease
Y (yes) = Effluent usually met the standard (1 noncompliant result allowed).
Y+ (yes, but) = Effluent usually met the standard but the influent did also. Treatment was observed.
Y- (yes, but) = Effluent usually met the standard but the influent did also. Little or no treatment was observed.
M (maybe) = Treatment was observed but the effluent didn't consistently meet the standard. Refinement of the process may allow compliance.
N (no) = Effluent rarely or never met the standard.
? (unknown) = Data are insufficient in number or quality to make a judgment.

- Zeolite (clinoptilolite) was chosen as a filter media for its ability to capture ammonia, which was thought to constitute a significant fraction of the storm water's dissolved nitrogen. However, the influent storm water used contained very little ammonia. In the six storms studied, the largest component of the total nitrogen was usually organic-N and a significant fraction of this was dissolved. Therefore, results relating to ammonia removal by zeolite filtration are inconclusive.
- The low technology units that used a chemical coagulant were able to meet the turbidity and iron standards for surface water discharge in almost every case. The exceptions were the coarse sand filters. Whether using PAM or PASS-C®, the effluents of coarse sand filters were not quite clean enough to meet the standard consistently.
- Because of blinding problems, the fine sand filter with PAM was operated successfully for only a couple of runs, which did not generate enough information to make an evaluation. The performance of these systems with respect to the surface water standards might best be characterized as uncertain. These systems provided treatment, but the strict surface water discharge standards for phosphorus, nitrogen, oil and grease, and iron were not met consistently.
- Systems with PASS-C® enhanced sedimentation (2 hour settling time) coupled with filtration were successful at meeting the turbidity standards for surface water discharge in every case.
- As a practical matter, direct chemical addition without settling was operationally troublesome, at least at the chemical doses used in this study. Filters which received coagulants directly exhibited severe blinding problems. Adding a sedimentation step between the coagulant addition and the filter removed enough of the flocs that filter blinding was not a problem. In fact, coagulation and sedimentation alone was sufficient to meet the infiltration water quality standards.
- For PASS-C®, the dose used for enhanced sedimentation (100 mg/L neat) was chosen on the basis of jar testing and not varied throughout the study regardless of influent characteristics. Thus, coagulant optimization was not attempted and the potential to reduce chemical usage and/or increase coagulation performance is unknown.
- Although somewhat promising treatment results were obtained using granular PAM (e.g., Superfloc® A-836) as a filter aid, the “tea bag” dosing system tested in this study did not provide adequate control of chemical dose rates. As a consequence, subsequent filter blinding was a severe problem.
- The relatively poor performance of the filter units (not preceded by chemically enhanced sedimentation) in this study was unexpected. Previous Caltrans studies in the Retrofit Pilot Program in Southern California consistently produced effluents with relatively low TSS values (<20 mg/L) using sedimentation and filtration (>200 mg/L typical here). There are several factors that make direct comparisons difficult, however filter loading rate and particle size distribution are the leading explanations.

High-Technology Treatment Systems. Of all the systems studied, the "high tech" option exhibited the highest potential to meet all of the surface water discharge standards. The Actiflo® process was very effective, but also equipment-intensive and chemical-intensive, using both a coagulant (PASS-C®) and polymer (LT25), as well as ballast sand (“micro-

sand”). Many of the "high tech" treatment modules (pressure sand filtration, Fuzzy Filter® filtration and ion exchange) should be thought of as successive additions to the initial Actiflo® coagulation and settling unit. As can be seen in Table 1-3, the following points can be made:

- Actiflo® process (using PASS-C® and LT25 polymer) was by itself able to produce effluents that met the infiltration standard for all the regulated constituents. However, the storm water itself often had concentrations below these levels.
- Effluent from the Actiflo® process alone met the surface discharge standards for turbidity and iron and was close to meeting the phosphorus and oil and grease standards as well.
- When pressure sand filtration was added to the system, the effluent met the phosphorus standard and was closer to meeting the nitrogen standard ("M" designation) for surface water discharge. The Fuzzy Filter® exhibited approximately the same degree of nitrogen removal but did not remove phosphorus quite as well as the pressure sand filter.
- Little difference in performance was observed between the pressure sand filter and the Fuzzy Filter® used as polishing units following Actiflo® treatment. The filters did not significantly enhance turbidity removal, though they did reduce phosphorus and nitrogen concentrations somewhat.
- Adding ion exchange behind either of the filters improved phosphorus, nitrogen, and oil and grease treatment, but not to the level of consistently meeting the standard ("M" designation) for surface water discharge. Operational problems in this study such as plugging of resin pre-filters and polymer carry-over from upstream units probably masked the full treatment potential of this process.

1.5 Recommendations for Further Small-Scale Pilot Testing

In this study, the only systems tested that came close to meeting the water quality standards were those which included chemical coagulation. In the field, however, the installation and operation of chemical feed systems would be a significant challenge for Caltrans maintenance staff. Before concluding that chemical addition is necessary to meet the standards, it would be prudent to investigate a wider variety of chemical-free systems. In addition, efforts to optimize some of the systems tested in this study would be warranted. The following is a list of potential pilot testing activities that would support these goals:

1. Sedimentation times might be increased in the low technology systems to maximize performance. The Austin-style sand filters tested in Southern California used a 24-hour detention time as opposed to the 2-hour times used here.
2. Hydraulic loading rates on the filters can be reduced. The loading rates in Austin-style sand filters are significantly lower than those used in this study. In the Austin filters the flow is regulated by an orifice between the upstream sedimentation chamber and the filter bed. Alternative arrangements, such as downstream flow control to assure even distribution of the flow over the whole media bed, might also be investigated.

3. Additional low technology filter media, particularly those with adsorptive capabilities, might be tested. The concentrations of the dissolved fractions of several regulated constituents are nearly high enough to exceed the water quality standards.

4. Passive chemical dosing systems such as that used to deliver PAM in this study might be investigated further. Both alternative delivery mechanisms and alternative chemicals (i.e., those which dissolve less easily) can be considered. If coagulants are necessary in field-scale installations, a passive dosing system would be easier than an active one for Caltrans personnel to maintain.

5. The PASS-C® dose can be optimized. Both lower fixed dosing and variable dosing based on storm water quality can be considered.

6. The effects of different coagulant and polymer doses in the Actiflo® system on the downstream ion exchange columns can be investigated. There is some evidence in this study that polymer carry-over from upstream units may have reduced the effectiveness of the ion exchange units.

7. An alternative, nonproprietary "high tech" system can be configured and tested. Such a system would include chemical dosing, filtration and ion exchange, but use conventional, nonproprietary processes such as sedimentation without ballast sand in place of the Actiflo® unit, and pressure sand filtration in place of the Fuzzy Filter®.