Chino Basin
Recycled Water Groundwater Recharge Program

Annual Report
2005

Prepared by:

Inland Empire Utilities Agency

and

Wildermuth Environmental Inc.

May 1, 2006

6075 Kimball Avenue • Chino • CA • 91710 • Tel: 909.993.1600 • Fax: 909.357.3870

Richard Atwater
CEO and General Manager

Kenneth Manning
CEO

May 1, 2006

Regional Water Quality Control Board, Santa Ana Region
Attention: Mr. Gerard Thibeault
3737 Main Street, Suite 500
Riverside, California 92501-3348

Subject: Chino Basin Recycled Water Recharge Program
Transmittal of the Annual Report for 2005

Dear Mr. Thibeault,

The Inland Empire Utilities Agency (IEUA) and the Chino Basin Watermaster (Watermaster) hereby submit the *Annual Report for 2005* regarding the *Recycled Water Groundwater Recharge Program* being implemented by IEUA and Watermaster. This document is submitted pursuant to requirements in Order No. R8-2005-0033 and Monitoring and Reporting Program No. R8-2005-0033:

- California Regional Water Quality Control Board, Santa Ana Region. Order No. R8-2005-0033. Water Recycling Requirements for Inland Empire Utilities Agency and Chino Basin Watermaster. Phase 1 Chino Basin Recycled Water Groundwater Recharge Project, San Bernardino County. Draft Order: April 2005.
- California Regional Water Quality Control Board, Santa Ana Region. Monitoring and Reporting Program No. R8-2005-0033 for Inland Empire Utilities Agency and Chino Basin Watermaster. Phase 1 Chino Basin Recycled Water Groundwater Recharge Project, San Bernardino County.

ACTIVITIES, FINDINGS, AND CONCLUSIONS

The following bullets summarize the principal activities, findings, and conclusions of the *Recycled Water Groundwater Recharge Program* for 2005:

- There are 21 recharge basins described in the OBMP Recharge Master Plan, Phase II Report. Three of the eight Phase I Basins had work associated with the Recycled Water Groundwater Recharge Program conducted during the 2005 calendar year. Lysimeters and monitoring wells were installed at Banana, Hickory, and Turner Basins. Of the permitted Phase I recharge basins, only Banana Basin and Hickory Basin were used for the recharge of recycled water in 2005. No recycled water was recharged in the remaining Phase I basins (RP3, Declez, and Turner Basins).
- The infiltration rate of both Banana and Hickory Basins was estimated to range between 0.6 and 0.9 feet per day.

Inland Empire Utilities Agency
P.O. Box 9020
Chino Hills, CA 91709
909.993.1740

Chino Basin Watermaster
9641 San Bernardino Road
Rancho Cucamonga, CA 91730
909.484.3888

- Electrical conductivity (EC) was used as a tracer or indicator of the source of water, since there are consistent and substantial difference in EC values for recycled water, State Water Project (SWP) water and stormwater/local runoff.
- All lysimeters in the basins are representative of recharged water (i.e., there appears to be no geologic features that would cause anomalous results: preferential pathways or lenses of fine grained materials). The 25-foot below ground surface (bgs) lysimeter was chosen as the compliance point lysimeter for Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell.
- Recycled water reached the 25 foot bgs lysimeter in Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell, 18, 11, and 25 days, respectively, after recycled water was introduced into the basins.
- During the 2005 recharge operations, the average percent reduction in TOC for Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell was 69, 64, and 75 percent, respectively.
- The soil aquifer treatment is quite effective and there appears to be additional reduction of TOC with increasing depth.
- During the 2005 recharge operations, the average percent reduction in TN for Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell was 51, 49, and 32 percent, respectively.
- Although not explicitly called for in its permit, IEUA will include in each Annual Report a Recycled Water Management Plan for each recharge site. The Recycled Water Management Plan is a necessary tool to demonstrate how IEUA will meet a recharge site's RWC following a site's startup period. Small excursions above the initial RWC of 20 percent are occasionally required during the start-up period based on diluent water availability for basins with little historical diluent recharge. The Recycled Water Management Plan will be updated regularly and presented annually to reflect current conditions. The Recycled Water Management Plan for Banana and Hickory Basins shows temporary excursions above the current RWC limit of 20 percent and that by 60 months of operations, the RWC limit is met.
- In light of the generally encouraging trends seen in the lysimeter data, IEUA recommends a reduced first year lysimeter monitoring plan. Furthermore, sampling would only be conducted when recycled water is shown to be in the basin or in the lysimeters, based on basin operations and EC. Compliance sampling for total nitrogen would be conducted on the treatment plant effluent.
- All monitoring wells with the exception BH/1/2 continue to show background EC. Based on estimated travel times in the Title 22 Engineering Report, the travel time to BH-1/2 is approximately six months. IEUA began recharging recycled water in Banana Basin in July 2005 and preliminary EC results suggest that this well are currently affected by recycled water recharge.
- The results of the Turner Tracer study, using a recharge event with SWP water are inconclusive. The downgradient monitoring wells show slight historical fluctuations, but do not show a definite mixing line between native groundwater chemistry and SWP water chemistry. Possible explanations include:
    - not enough SWP water was introduced in late 2004;
    - the production well screens are long and screened deeper than the water table; and
    - these wells are at a distance that would require a travel time of at least 12 to 24 months.
- The water chemistry of a sampled collected from the program monitoring well that was installed at Turner Basin (T-2/2), appears to be a mixture of SWP and native groundwater.

- Watermaster monitors all well drilling activities within 500 feet of the recharge basins and issues quarterly certification letters to the RWQCB of all well drilling activities. The last such letter is dated February 16, 2006. No potable supply wells exist within the 500 foot buffer zone. IEUA is working closely with the County of San Bernardino's Department of Environmental Health Services (DEHS) in its well permitting activities. IEUA has provided DEHS maps that show – to the Township/Range/Quarter Section level – which quarter sections are located within the 500-foot buffer zone. DEHS is utilizing these maps to screen well permits.
- There are currently insufficient data to establish that blending is occurring in the aquifer. Changes in groundwater elevation and groundwater chemistry have not been observed within the closest downgradient monitoring well (BH-1). As such, a comparison of observed data with the flow and transport model's flow paths cannot be made. Enough data should be compiled by the next annual report to perform this analysis.

DECLARATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments thereto; and that, based on my inquiry of the individuals immediately responsible for obtaining the information, I believe that the information is true accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Executed on the 1st day of May 2006 at IEUA's office in Chino, California

for Richard Atwater
Chief Executive Officer and General Manager

Kenneth Manning
Chief Executive Officer

Chino Basin

Recycled Water Groundwater Recharge Program

Annual Report 2005

Reviewed and Approved by:

Mark J. Wildermuth, P.E.
President/Principal Engineer

Prepared by:

Inland Empire Utilities Agency

and

WILDERMUTH ENVIRONMENTAL INC.

May 1, 2006

6075 Kimball Avenue • Chino • CA • 91710 • Tel: 909.993.1600 • Fax: 909.357.3870

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1. INTRODUCTION

The Inland Empire Utilities Agency (IEUA), Chino Basin Watermaster (Watermaster), Chino Basin Water Conservation District, and San Bernardino County Flood Control District jointly sponsor the Chino Basin Recycled Water Groundwater Recharge Program. This is a comprehensive water supply program to enhance water supply reliability and improve groundwater quality in local drinking water wells throughout the Chino Groundwater Basin by increasing the recharge of stormwater, imported water, and recycled water. This program is an integral part of Watermaster's Optimum Basin Management Plan (OBMP).

There are 21 recharge basins described in the *OBMP Recharge Master Plan, Phase II Report* (B&V and WEI, 2001). Three of the eight Phase I Basins (DDB and WEI, 2006) had work associated with the Recycled Water Groundwater Recharge Program conducted during the 2005 calendar year. Lysimeters and monitoring wells were installed at Banana, Hickory, and Turner Basins. Of the permitted Phase I recharge basins, only Banana Basin and Hickory Basin were used for the recharge of recycled water in 2005. No recycled water was recharged in the remaining Phase I basins (RP3, Declez, and Turner Basins).

This document is the Annual Report for recycled water recharge operations in the Chino Groundwater Basin for the 2005 calendar year. This report documents the work associated with the Recycled Water Groundwater Recharge Program at Hickory and Banana Basins. Although no recharge of recycled water occurred at the Turner Basins, this report does include a description of site work conducted in 2005 in preparation of recharge of recycled water. Soil aquifer treatment (SAT)—the reduction in concentration of total organic carbon (TOC) and total nitrogen (TN)—in the Banana and Hickory Basins was demonstrated by monitoring the compliance point lysimeters.

1.1 Requirements of Order No. R8-2005-0033

This Recycled Water Groundwater Recharge Program, which is being implemented by IEUA and Watermaster, is subject to the following requirements:

- California Regional Water Quality Control Board, Santa Ana Region. Order No. R8-2005-0033. Water Recycling Requirements for Inland Empire Utilities Agency and Chino Basin Watermaster. Phase 1 Chino Basin Recycled Water Groundwater Recharge Project, San Bernardino County. April 15, 2005.
- California Regional Water Quality Control Board, Santa Ana Region. Monitoring and Reporting Program (M&RP) No. R8-2005-0033 for Inland Empire Utilities Agency and Chino Basin Watermaster. Phase 1 Chino Basin Recycled Water Groundwater Recharge Project, San Bernardino County. April 15, 2005.

The M&RP (RWQCB, 2005b) describes the requirements for the Annual reports. This document is the 2005 Annual Report. The following is an excerpt from Section VI of the M&RP:

> VI. Reporting Requirements
>
> B. Annual Monitoring Reports
>
> 1. By May 1 of each year, the users shall submit an annual report to the Board. The report shall contain both tabular and graphical summaries of the monitoring data obtained during the previous calendar year. The users shall discuss the compliance record and a summary of corrective actions taken as a result of violations, suspensions of recharge, detections of monitored constituents and any observed trends, information on the travel of the recycled water, description of any changes in operation of any unit processes or facilities, and description of any anticipated changes, including any impacts on other unit processes.

2. The annual report shall be prepared by a qualified engineer registered in California and experienced in the field of water reclamation for groundwater recharge regarding the operation of the Phase I Recharge Project and the results of the monitoring and investigations of the impacts of recycled water recharge at the Phase I recharge basins.

3. The annual report shall include the following:

   a. A list of the analytical methods employed for each test and associated laboratory quality assurance/quality control procedures. The report shall restate, for the record, the laboratories used by the users to monitor compliance with this Order and their status of certification. Upon request by Regional Board staff, the users shall also provide a summary of performance.

   b. A mass balance to ensure that blending is occurring in the aquifer at each recharge basin. Recharge water groundwater flow paths shall be determined annually from groundwater elevation contours and compared to the flow and transport model's flow paths, travel of recharge waters, including leading edge of the recharged water plume, any anticipated changes. The flow and transport model shall be updated to match as closely as possible the actual flow patterns observed within the aquifer if the flow paths have significantly changed.

   c. A summary of corrective actions taken as a result of violations, suspensions of recharge, detections of monitored constituents and any observed trends, information on the travel of the recycled water (estimated location of the leading edge), description of any changes in operation of any unit processes or facilities, and description of any anticipated changes, including any impacts on other unit processes.

   d. A summary of calibration records for equipments, such as pH meters, flow meters, turbidity meters, and lysimeters.

   e. All downgradient public drinking water systems. A summary discussion on whether domestic drinking water wells extracted water within the buffer zone defined by the area less than 500 feet and 6 months underground travel time from the recharge basins, including the actions/measures that were undertaken to prevent reoccurrence. If there were none, a statement to that effect shall be written.

   f. Prior to start-up of the IEUA Phase I Recharge Project, tracers will need to be identified

4. At least one year after the blended recharged water has reached at least one groundwater monitoring well, the users shall submit a report to the CDHS and Regional Board evaluating the compliance with the minimum underground retention time, distance to the nearest point of extraction, blending, and the maximum RWC requirements. The annual report shall include water quality data on turbidity, coliform, total nitrogen, dissolved oxygen, regulated contaminants, TOC, and non-regulated contaminants compliance.

1.2 Organization of the Annual Report

Section 2 of this report describes the installation of lysimeters at the Banana, Hickory, and Turner Basins. Section 3 summarizes the recharge operations. Sections 4 and 5 discuss lysimeter sampling and monitoring results as well as soil aquifer treatment efficiency in terms of TOC and TN removal. Section 6 details the determination of the Start-Up Period and the compliance point lysimeter. Sections 7 and 8 describe the Recycled Water Contribution (RWC) determination and the Recycled Water Management Plan for the Banana and Hickory Basins. Section 9 reports the groundwater monitoring results and travel time estimates. Section 10 of this report discusses aquifer blending and flow and transport modeling. Section 11 provides the compliance record and corrective actions. Section 12 discusses the analytical methodology and Section 13 provides the references.

2. BOREHOLE DRILLING AND LYSIMETER INSTALLATION

In 2005, boreholes and lysimeters at the Hickory, Banana, and Turner Basins were drilled and constructed on May 4 through 6 (Hickory), June 7 (Banana), October 5 (Turner 1), and November 22 (Turner 4). The locations of the basins are shown in Figures 2-1 and 2-2 and the locations of the lysimeters at the Banana and Hickory Basins are shown in Figures 2-3 and 2-4, respectively. The locations of the Turner Basin lysimeters are shown in the as-built drawings included in Appendix A. Lysimeter construction occurred in general accordance with the *Project Plans for the Construction of the Hickory and Banana Basins Lysimeter Installation* (January 23, 2005), *Turner Basin as-builts* (included in Appendix A), the *Banana Basin Start-Up Protocol* and *Hickory Basin Start-Up Protocol* (June 2005), and the draft *Turner Basin Start-Up Protocol* (October 2005).

2.1 Assembly and Pre-Testing

All lysimeter units were assembled and pre-tested prior to field mobilization to ensure that each unit functioned properly. Each unit was assembled, tested for pressure leaks, and cleaned in accordance with manufacturer recommendations. Each lysimeter consisted of a 2-inch OD dual-chamber stainless steel body equipped with two 1/4 inch OD stainless steel nipples and a stainless steel porous "cup." A 1/4 inch OD x 0.170-inch ID polyethylene tube is attached to the vacuum/pressure nipple and a 1/4 inch OD x 1/8 inch Teflon™ tube is attached to the sampling nipple with stainless steel unions.

The lysimeter valve, tubing unions, and welded joints were tested for leaks by applying approximately 0.5 bars of pressure on the lysimeter while submerged in distilled water. While under pressure, the lysimeter was observed for bubbles emanating from any portion of it. If no bubbles were observed, the lysimeter assembly was considered pressure-tight and was then cleaned.

Each assembly was cleaned by flushing internally with 70% isopropyl alcohol and rinsing with distilled water. Initially, a minimum vacuum of 0.5 bars was applied to the vacuum/pressure tube while clamping the sampling tube shut and submerging the porous cup within the alcohol. The alcohol was then evacuated from the lysimeter body by applying a minimum pressure of 0.5 bars to the vacuum/pressure tube and opening the sampling tube until the lysimeter body was emptied. The lysimeter body was then rinsed internally four times with distilled water (a total of approximately 1 gallon) following the same procedure described above. After performing a final exterior rinse with distilled water, each lysimeter assembly (lysimeter body, tubes, and unions) was inserted intact within a new plastic 55-gallon plastic bag and sealed pending installation in the field.

2.2 Borehole Drilling and Soil Sample Collection

A CME-75 all-terrain hollow-stem auger drill rig was used to drill the boreholes. The lysimeter clusters consist of five individual lysimeter assemblies installed in separate boreholes in the bottom of the basin: three at depths of 5, 10, and 15 feet below ground surface (bgs), and two at 25 feet bgs. At each of the Turner Basin lysimeter clusters, an additional lysimeter was installed to a depth of 35 feet bgs. All drilling was observed by a California Professional Geologist. The boreholes were drilled with 8 inch nominal OD continuous flight augers.

At the Hickory and Banana Basin lysimeter clusters, relatively undisturbed soil samples were collected from one 25-foot boring at approximately 5, 10, 15, 20, and 25 feet bgs. At Turner Basins 1 and 4, relatively undisturbed soil samples were collected from each of the 35-foot borings at approximately 5, 10, 15, 20, 25, 30, and 35 feet bgs. Each soil sample was collected with a 3 inch diameter split-spoon sampler equipped with three (3) 6-inch long brass sample sleeves. The sampler was driven approximately 18 inches below borehole depth using a rig-mounted pneumatic hammer.

After driving the sampler, the split-spoon was retrieved to the ground surface, opened, and the sample sleeves were removed. The ends of sleeve of the retrieved samples were lined with Teflon™ sheeting, sealed with tight-fitting plastic end caps, labeled, and stored in an ice-cooled chest pending chemical analysis. One sample from each depth material was sent to the analytical laboratory for a leaching test (e.g., TCLP or WET). These samples were analyzed for TOC, nitrate, nitrite, total Kjeldahl nitrogen, TDS, and trace metals (Table 2-1).

Borehole geologic logs were prepared based on cuttings and soil samples collected from the 25 foot boreholes at Banana and Hickory Basins and from the 35 foot boreholes at Turner Basins 1 and 4. Soil sample characteristics are described using the Unified Soil Classification System (USCS). Borehole logs were prepared by a California Professional Geologist and are included in Appendix A.

Based on the borehole geologic logs included in appendix A, the soil types observed below Banana Basin consisted of very fine to fine sand from 0 to 5 feet bgs and fine to coarse sand with gravel from 5 to 25 feet bgs. The sediments observed below Hickory Basin consisted of fine to coarse grain sand with gravel and gravelly sand from 0 to 5 feet bgs and gravelly sand from 5 to 25 feet bgs. The soil types logged below Turner Basin 1 and 4 consisted of silty sand from 0 to 30 feet bgs and fine to very coarse sand at 35 feet bgs.

2.3 Lysimeter Installation

Lysimeter construction proceeded upon reaching total borehole depth. Each lysimeter was installed within the continuous auger string as a precautionary measure against borehole collapse. Upon reaching total borehole depth, the string was raised approximately one foot from the bottom of the borehole prior to installation of any materials to prevent the lysimeter assembly from becoming wedged within the auger. The lysimeter assembly was then removed from its plastic bag and a 1.9 inch OD Schedule 40 polyvinyl chloride (PVC) flush-threaded extension casing was threaded onto the top of the lysimeter body. The extension casing of each lysimeter extended approximately 2 feet above the surrounding grade. Approximately 22 pounds (10 kilograms) of the native soil slurry was installed within the bottom portion of the borehole to create an approximate 1.5 to 2 foot thick layer at the bottom of the borehole. After letting the slurry settle via dewatering, the lysimeter assembly was lowered into the borehole via the PVC extension casing and gently pressed into the top of the slurry.

A minimum 1 foot layer of No. 60 granular sand and then a minimum 2-foot layer of 3/8-inch bentonite pellets were successively installed on top of the native soil slurry prior to placement of the neat cement seal (note: the 5 foot depth lysimeter was sealed to ground surface with bentonite pellets). The pellets were hydrated in accordance with manufacturer recommendations to allow them to expand and create a tight seal. The neat cement grout was prepared in accordance with ASTM C150 “Standard Specifications for Portland Cement” Type II. The grout was mixed in a 55 gallon barrel at a ratio of 7 gallons of fresh water to each 94 pound bag of dry cement; up to 3% by weight of bentonite powder was added and vigorously stirred in with a motor-driven paddle to reduce shrinkage during grout curing. The grout seal was then placed from the top of the bentonite pellet seal to approximately 2 feet bgs.

2.4 Trenching and Head Assembly

Following the installation of the lysimeter assemblies, the lysimeter tubes were extended toward the lysimeter head assembly locations along the northern basin berm. A trench was dug adjacent to each lysimeter to allow the placement of the lysimeter conduit (1.9-inch diameter PVC), which carries the lysimeter tubing to the lysimeter head assembly along the basin berm.

Each trench was excavated to approximately 2.5 feet bgs with a four-wheel drive backhoe to facilitate the burial of the conduits protecting the paired tubes. After trenching was completed, the lysimeter extension

casings were cut off approximately 2 feet bgs and fitted with curved 90 degree 1.9 inch OD Schedule 40 PVC elbow connectors. The paired lysimeter tubes were then threaded through 1.9 inch OD Schedule 40 PVC conduit extending from the elbow to the lysimeter head assemblies via the trench. An electric heater box was used to bend the conduit to fit the geometry within the trenches prior to threading the paired tubes through to the surface. After the conduits were labeled with the appropriate lysimeter information and secured at the lysimeter head assembly locations, an approximate 4 inch layer of imported sand/gravel was installed within the trench and the conduits were gently lifted on top of this layer prior to installing another 4-inch layer on top of them for protection and identification during potential future excavation.

The trenches were backfilled to grade with the native soils that had been excavated. The backfill located adjacent to the lysimeters within the basin and the lysimeter head assemblies was compacted with a gasoline-powered manually-operated soil compactor to prevent accidental damage. All extra soils generated during borehole drilling and trenching that were not used to backfill trenches were spread over the bottom surface of the basin such that no hummocks (i.e. vehicular, slip, trip, and/or fall hazards) were produced.

The lysimeter head assemblies were secured in place within a single concrete pad aligned parallel with the edge of the berm with approximately 4 inches protruding above the surrounding grade. A structural concrete was mixed onsite with an electric concrete mixer and poured into the form. The locking metal well protectors were set on approximately 2 foot centers and extend approximately 2 feet above grade.

A Monoflex lysimeter head assembly was installed within each locking steel well protector. Each head assembly consists of a vacuum pressure gauge, two ball valves, and two termination ports for the vacuum/pressure and sampling tubes leading to the corresponding lysimeter assembly. After installation of the head assemblies, each lysimeter was pressure tested by applying both a vacuum and pressure to the system, closing the ball valves, and observing the pressure gauge for leaks.

2.5 Crash Post Installation

The lysimeters and lysimeter head assemblies are protected against damage from vehicles and heavy equipment by concrete-filled crash posts. Each lysimeter cluster is encircled by several crash posts installed in a box-like array, with sufficient spacing to reduce hindrance with field activities, yet close enough (approximate 5-foot intervals) to prevent entry of vehicles. The lysimeter head assemblies are encircled by a U-shaped array of crash posts with the open end aligned up slope.

Each crash post consists of an approximate 6 foot length of 4 inch diameter galvanized steel pipe set into concrete such that it extends approximately 4 feet above grade. Each crash post is filled with concrete and painted bright yellow to increase its visibility and further reduce accidental vehicular or heavy equipment impacts.

2.6 Drilling and Installation of Groundwater Monitoring Wells

Monitoring well construction began in May 2005 at well BH-1 and finished in September 2005 at T-2. The well screens were set to capture the water table and the deeper portion of the aquifer. The wells and casings are identified in Table 22.

All boreholes were drilled to final diameter in one pass without the use of pilot boreholes. Lithologic and well completion logs were prepared for each location and are presented in Appendix A.

The wells were constructed in compliance with the latest edition or supplement of *State of California Water Well Standards, Bulletin No. 74-81* dated December 1981 and *Bulletin No. 74-90* dated June 1991, local modifications to these Standards, and Sections 13800 through 13806 of the *California Water Code*.

2.6.1 Mobilization, Demobilization, and Site Clean-Up

Mobilization included the acquisition of all well permits, discharge permits, encroachment permits, and the right of entry agreements required to perform the work at each well site. Prior to performing work, the drilling locations were marked in white paint and Underground Service Alert (USA) was notified to clear the locations for underground utilities. Mobilization also included the transportation of personnel, equipment, and operating supplies to and from the site; the establishment of portable sanitary facilities, drinking water, drilling water, a field office, and other necessary facilities at the site; and other preparatory work at the site, including all work at the site necessary to conduct drilling, construction, and development operations. Other preparatory work included earthworks and noise control. The entire area was used for material storage and drilling operations, including areas occupied by the field office, construction equipment, engines, motors, and dewatering equipment, and was enclosed by chain link fencing. Noise attenuation/suppression methods were implemented as necessary to minimize disturbance to persons living and/or working nearby and the general public.

The flooded reverse circulation drilling unit, an Ingersoll-Rand RO 300, was in good condition and had sufficient capacity to drill and construct the monitoring wells as specified. The drill pipe was in good condition and was connected by standard tool joints. The drill pipe was steam-cleaned prior to its arrival at the site. Environmentally safe pipe dope was used on the threads of the drill stem and tremie pipe as needed.

Portable mud tanks were utilized at each drill site. The tanks were periodically cleared of drill cuttings to ensure that the drilling fluid remained within specification prior to re-entry into the borehole. Watertight roll-off bins were provided for the temporary storage of drill cuttings. Baker tanks were onsite to contain excess fluids created during the drilling, construction, and development phases of the well.

Demobilization included the removal of all equipment, materials, and temporary facilities that were installed during the mobilization, well drilling, completion, and development phases of the work. Demobilization also included the restoration of the sites to their original condition.

2.6.2 Conductor Casing

At each well site, a 30-inch diameter borehole was drilled with a bucket auger to a depth of approximately 50 feet. A California Professional Geologist was onsite during the conductor casing installation.

All casing materials were new. The steel plate used in the fabrication of the conductor casing had a thickness of 3/8-inch and met the requirements of American Society for Testing and Materials (ASTM) A 53, Grade B or ASTM A 139, Grade B. The steel conductor casing used for each site had a diameter of 24 inches, was fabricated with a minimum 20 foot lengths, and the ends of each joint were machine-beveled. Centralizers were of the same chemical and physical properties as the conductor casing. Centralizers were placed at intervals of 20 feet with the first centralizer located five feet above the bottom of the conductor casing.

All field joints were properly butt-welded with two passes during welding to assure complete penetration and are watertight. Special care was exercised to insure that the casing was straight. Welders were certified in accordance with American Welding Society Section IX level AR-3 or equivalent for water well applications. The conductor casing was held in plumb position and landed on the bottom of the hole.

After the conductor casing was installed and aligned, the annular space between the conductor casing and the conductor casing borehole was filled with a sand-cement grout from the bottom of the boring to ground surface to form the external sanitary seal. The grout was pumped into the annular space through a tremie pipe. The bottom of the tremie pipe remained submerged in the grout throughout the grout placement. The grout was allowed to cure for 24 hours prior to subsequent site work.

The sand-cement grout used for the sanitary seal was a 10.5-sack cement grout. There was no more than two parts by weight of sand to one part by weight of cement. The water-cement ratio was 5 to 7 gallons per sack of cement (94 pounds). The cement used for the sanitary seal was a standard brand Portland cement conforming to ASTM C150, Type II or Type V. the water used for cement and grout mixtures was clean and of potable quality. The materials used as additives for Portland cement mixtures in the field met the requirements and latest revisions thereof; ASTM-C494, "Standard Specifications for Chemical Admixtures for Concrete."

2.6.3 Well Borehole Drilling and Sampling

The purpose of the well borehole was to determine the thickness and nature of all formations penetrated, the location of water bearing strata, and other hydrogeologic information. Each well borehole was drilled in one pass, to the diameters and depths indicated in Table 2-2. The onsite geologist determined the terminal depth of the borehole based on an evaluation of the soil cutting derived from the borehole.

Drill cuttings were collected at approximately 1 foot intervals from the drilling fluid return line. Cuttings were examined by a California Professional Geologist and described on a borehole log form. All lithologic descriptions are in accordance with the Unified Soil Classification System.

2.6.4 Drilling Fluid

As part of the quality assurance activities, a drilling fluids program that was designed by a qualified drilling fluid engineer was employed during the drilling activities. In addition, the daily construction reports contain a complete drilling fluids condition summary. These include, but are not limited to, mud weight, sand content, pH, viscosity, water loss in cubic centimeters, and variations in the addition and amount of approved products or water. The drilling rig was supplied at all times with standard American Petroleum Institute (API) drilling fluid measuring equipment to monitor the drilling fluid characteristics listed above.

2.6.5 Deviation Survey, Geophysical Logs, and Caliper Survey

After the completion of well borehole drilling at each location, a deviation survey, geophysical logs, and a caliper survey were performed. Before running the deviation survey, geophysical logs, and caliper survey, the driller ceased drilling and circulated fluid for a minimum of one hour. The deviation survey is used to determine if the borehole is straight and plumb. The deviation survey consisted of a Welenco Drift-Pac™ Deviation and Directional Interpretation Package. The geophysical logs consisted of a spontaneous potential, 16-inch normal, 64-inch normal, single point, and guard resistivity, natural gamma, and temperature. The horizontal scale for the plot of the spontaneous potential was 20 millivolts per inch. The horizontal scale for the plot of the 16-inch normal, 64-inch normal, single point, and guard resistivity was 20 ohm-meter per inch. The vertical scale for all logs was 20 feet per inch (*e.g.*, scale begins at 0 and continues in whole number increments of 1 foot per division). The vertical scale complied with API standards in both grid pattern and depth labeling.

A caliper survey was run and the borehole diameter was within the specified diameter. The caliper used to perform the survey had three arms and was capable of indicating a hole diameter up to 60 inches. The horizontal scale for the caliper plot was 4 inches diameter per inch. The vertical scale for all logs was 20 feet per inch (e.g. scale begins at 0 and continues in whole number increments of 1 foot per division).

2.6.6 Well Casing and Screen

The well casings used on this project were nominal 4-inch diameter, schedule 10, type 304 stainless steel. The well screens were nominal 4-inch diameter, type 304 stainless steel continuous wire-wrap with a 0.030 inch slot (30-slot). The screens have the same inner diameter and wall thickness as the blank casing.

The bottom of each well casing is fitted with an end cap. The end caps are of the same chemical and physical properties as the stainless steel blank casing. All casing materials were new.

Centralizers were installed approximately 5 feet below and 5 feet above each screen interval. Centralizers are also installed at 50 foot intervals from the top of the screen to the bottom of the conductor casing. The stainless steel centralizers were securely attached to the blank casing.

Following the completion of the geophysical logs, the geologist completed the final well design. The final well design specified where the casing and screen intervals, gravel intervals, seal intervals, and sanitary seals were placed in the borehole.

Prior to installing the casing strings, a tremie pipe was placed to the bottom of the borehole. Each casing string was placed in the borehole prior to the installation of any gravel envelopes or seals. The well casing strings were suspended in tension from the surface by means of a clamp and landing plate. The bottom of the deepest casing string was at a sufficient distance above the bottom of the hole to ensure that none of the casing was supported from the bottom of the hole.

Prior to installing annular materials, the driller sounded the bottom of the casing to verify its total depth.

2.6.7 Gravel Envelope

The gravel envelope consisted of well-rounded, graded, silica sand with a uniformity coefficient less than 2.5. All gravel was approved by the geologist based on sieve analyses verification of the grain size distribution (8 X 16 gradation). Prior to the placement of the gravel, the drilling fluid was adequately thinned with clean water. Each gravel envelope was pumped into the annulus of the well between annular seals through a construction tremie pipe. The gravel was not allowed to freefall more than 20 feet from the bottom of the tremie pipe to the top of the gravel or the seal interface established from the previous sounding. Gravel envelopes were installed from 1 foot below to 5 feet above each well screen interval. Prior to installing the annular seal, each gravel envelope was gently consolidated using of a tight-fitting surge block. Additional gravel envelope material was added as needed to the design depth. A 2 foot layer of No. 60 sand was installed on top of the consolidated gravel envelope to prevent the infiltration of annular seal materials.

2.6.8 Annular Seal

Seals composed of bentonite pellets and a sand/bentonite slurry (No. 3 silica sand and bentonite mixed 1:1) were installed in the annulus of each well to hydraulically separate the major aquifers that were penetrated. A 5 foot layer of bentonite pellets was placed on top of the No. 60 sand to create a seal between the casing and borehole wall. The sand/bentonite slurry was used for the annular seal above the bentonite pellet seal. The sand/bentonite slurry was thoroughly mixed prior to placement in the borehole.

The seal was installed by pumping the mixture via a construction tremie pipe to the intervals specified by the geologist. The sand/bentonite slurry was not allowed to freefall more than 20 feet from the bottom of the tremie pipe to the top of the seal interface, which was established from the previous sounding. The bottom of the construction tremie pipe was placed below the top of the rising grout column. Each seal was placed from the bottom of each interval to the top in a continuous operation. The uppermost annular seal was installed to 50 feet bgs.

The driller measured each seal to verify the location of the top of the seal after each load of seal mixture was placed. Upon completion of each annular seal, or portion thereof, no additional work was performed until the depth to the top of that seal was accurately determined by sounding. The driller calculated the amount of seal material necessary to backfill the specified interval. The driller recorded all calculations and volumes of seal mixture used and the soundings obtained after each seal placement and verified those calculations with the geologist.

2.6.9 Sanitary Seal

The cement used for the sanitary seal was a standard brand Portland cement conforming to ASTM C150, Type II. The grout used for the sanitary seal was a 10.5-sack sand-cement grout. There was not more than two parts by weight of sand to one part by weight of cement. The water-cement ratio was 7 gallons per sack of cement (94 pounds). After the placement of the casings, screens, gravel envelopes, and the final lift of the annular seal, the sanitary seal was installed 50 to 5 feet bgs. The annular space between the well casings and conductor casing were grouted using a tremie pipe from the top of the annular seal to 5 feet bgs. The tremie pipe extended from the ground surface to the bottom of the zone to be grouted. Grout was placed from bottom to top in a continuous operation. The tremie pipe was slowly raised as the grout was placed, but the discharge end of the tremie pipe remained submerged in the emplaced grout at all times until grouting was completed. The driller calculated the amount of grout necessary to complete the sanitary seal. The volume placed was not less than the calculated volume of the annular space between the borehole conductor casing and the well casings. The driller recorded all calculations and volumes used as well as the soundings obtained after each interval was pumped and verified those calculations with the geologist.

2.6.10 Well Development

Development commenced no sooner than 24 hours after completion of the sanitary seal. Development proceeded from shallowest to deepest casing for all steps. Each casing was bailed of sediment as required to clean the casing to the bottom of the silt trap. Each casing was then swabbed with a tight-fitting swab tool. Following swabbing and bailing, the driller measured and recorded the static piezometric level in the casing.

Each well was developed using a submersible pump. The length of time each well was pumped was dependent on the field conditions encountered and as approved by the geologist. After pumping of the well casings was complete, the driller sounded the bottom of the well casings. If sediment existed in the bottom of the well casing, the driller proceeded with bailing until the bottom of the casing was clear of sediment.

Table 2-1
Soil Sample Leaching Analytical Results

Sample No.	Total Organic Carbon	Nitrate + Nitrite		Total Kjeldahl Nitrogen	Total Dissolved Solids	Metals*
Banana Basin						
B-25A-5	1.2	0.046		0.3	26	ND
B-25A-10	1.6	0.034		0.3	56	ND
B-25A-15	1	0.091		0.3	56	ND
B-25A-20	1.2	0.05		0.3	45	ND
B-25A-25	1	0.054		0.3	66	ND
Turner Basin 1 and 4						
T1-35-5	1	0.123		0.44	NA	Boron: 0.15
T1-35-10	1	0.165		0.3	NA	Boron: 0.10
T1-35-15	1	0.079		0.46	NA	Boron: 0.10
T1-35-20	1	0.075		0.3	NA	Boron: 0.12
T1-35-25	1	0.114		0.3	NA	Boron: 0.15
T1-35-30	1.7	0.111		0.3	NA	Boron: 0.13
T1-35-35	1	0.074		0.3	NA	Boron: 0.10
T1-Backfill 1	2.2	0.25		0.46	NA	Boron: 0.23
T1-Backfill 2	1.3	0.221		0.37	NA	Boron: 0.18
T1-Backfill 3	1	0.182		0.47	NA	Boron: 0.16
T4-35-5	1	0.083		0.26	NA	ND
T4-35-10	1	0.078		0.24	NA	ND
T4-35-15	1.4	0.041		0.3	NA	ND
T4-35-20	2	0.113		0.95	NA	ND
T4-35-25	1.7	0.094		0.31	NA	ND
T4-35-30	1	0.033		0.3	NA	ND
T4-35-35	1.3	0.054		0.3	NA	ND
T4-Backfill 1	1.6	0.082		0.5	NA	TTHM: 0.13
T4-Backfill 2	1	0.034		0.3	NA	ND
T4-Backfill 3	1	0.039		0.3	NA	TTHM: 0.08
Hickory Basin						
HW-25A-5	2210	<1.0	0.017	0.35	6020	Cobalt: 0.01 Copper: 0.38 Zinc: 0.26
HW-25A-10	2120	<1.0	<0.015	0.49	5320	Cobalt: 0.01 Copper: 0.32 Zinc – 0.28
HW-25A-15	2110	<1.0	<0.015	0.36	5290	Cobalt: 0.02 Copper: 0.40 Zinc: 0.32
HW-25A-20	2090	<1.0	<0.015	0.3	5340	Copper – 0.02 Lead – 0.50 Zinc – 0.34

Table 2-1
Soil Sample Leaching Analytical Results

Sample No.	Total Organic Carbon	Nitrate + Nitrite		Total Kjeldahl Nitrogen	Total Dissolved Solids	Metals*
Hickory Basin Continued						
HW-25A-25	2110	<1.0	<0.015	0.3	5420	Chromium – 0.01 Cobalt – 0.02 Copper – 0.47 Zinc – 0.33
HE-25A-5	2070	<1.0	0.016	0.57	5300	Copper – 0.01 Zinc – 0.03
HE-25A-10	2070	<1.0	0.016	0.31	5300	Cobalt – 0.02 Copper – 0.43 Zinc – 0.31
HE-25A-15	2100	<1.0	<0.015	0.3	5280	Cobalt – 0.02 Copper – 0.44 Zinc – 0.27
HE-25A-20	2040	<1.0	0.016	0.32	5260	Cobalt – 0.02 Copper – 0.30 Zinc – 0.23
HE-25A-25	2090	<1.0	<0.015	0.3	5180	Cobalt – 0.01 Copper – 0.15 Zinc – 0.17

Note:

All units are in milligrams per liter (mg/L)

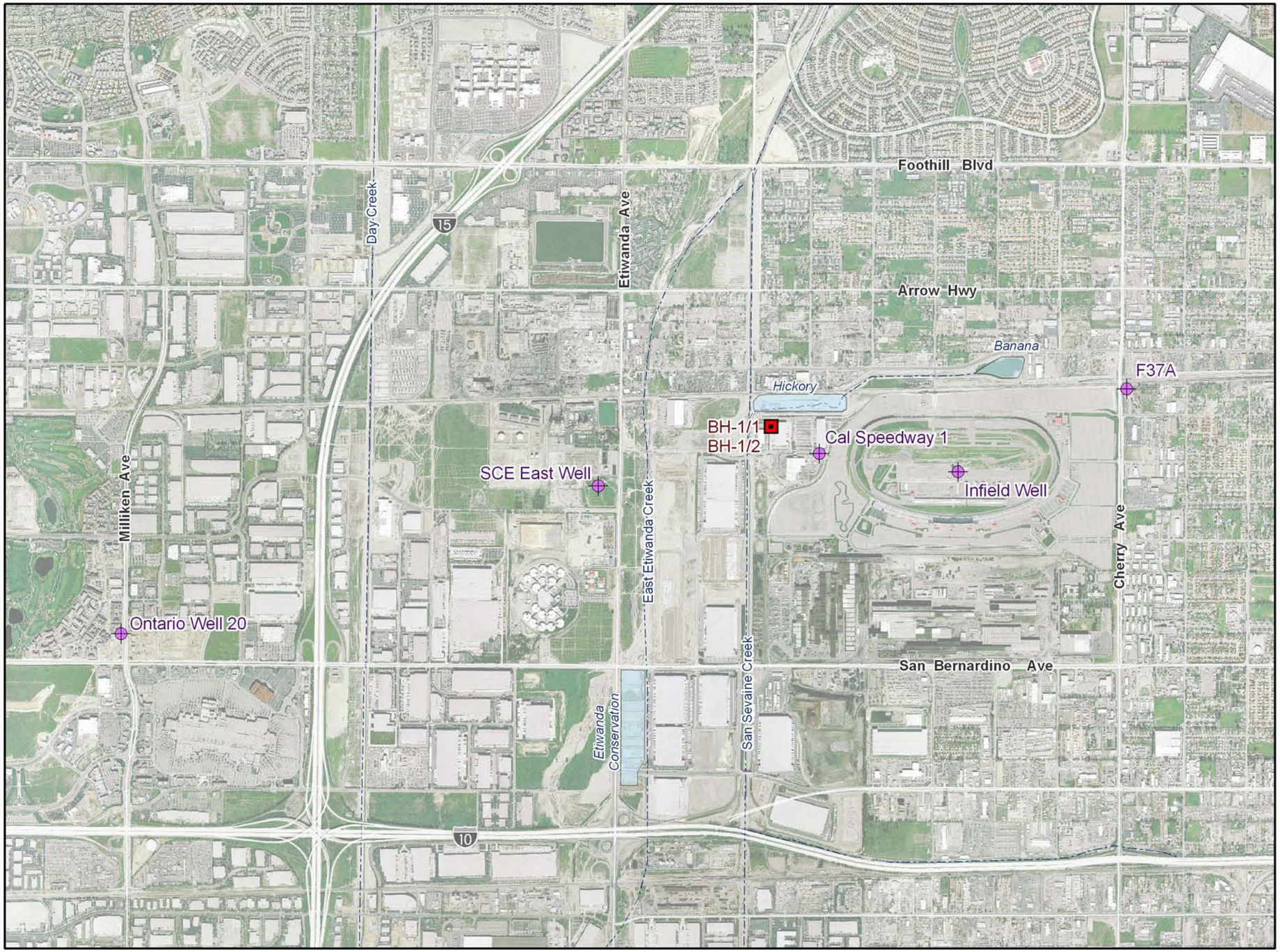
ND: indicates all metals were less than the method detection limit

TTHM: Total Thallium

*All metals not listed were less than the method detection limit

Table 2-2
Well Construction Information

Nested Well	Borehole Diameter	Bottom of Aquifer	Total Borehole Depth	Total Casing Depth	Screened Interval	Depth to Bedrock
	(inches)	(feet below ground surface)				
BH-1/1	17.5	1210	501	405	360-400	Not Encountered
BH-1/2				475	430-470	
T-1/1	17.5	1204	412	365	340-360	Not Encountered
T-1/2				405	380-400	
T-2/1	17.5	1182	420	375	350-370	Not Encountered
T-2/2				417	392-412	



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0 2,000 4,000 Feet
0 500 1,000 Meters

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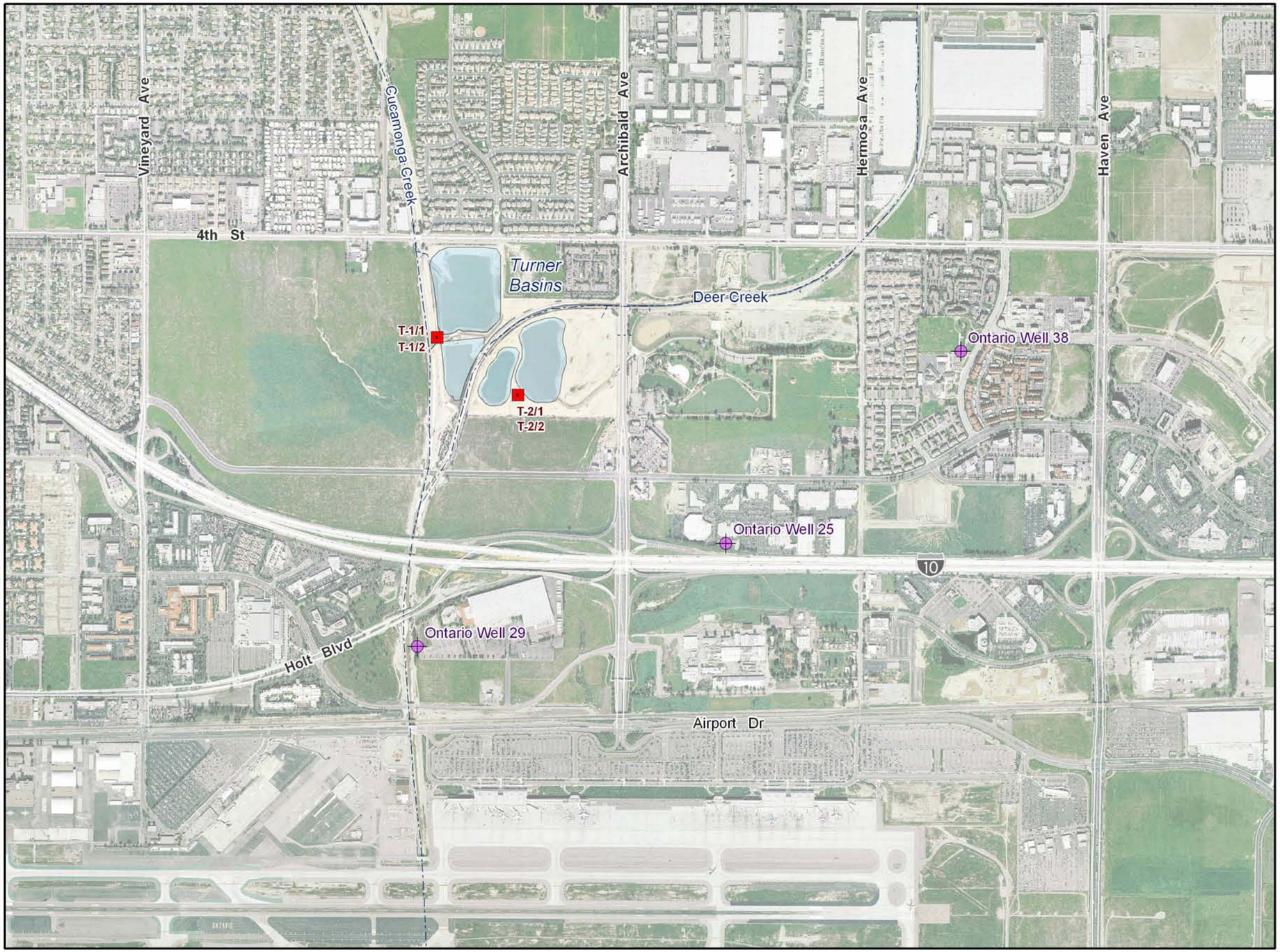
Recycled Water Recharge Program
Annual Report - 2005

Monitoring Well Network
Hickory and Banana Basins

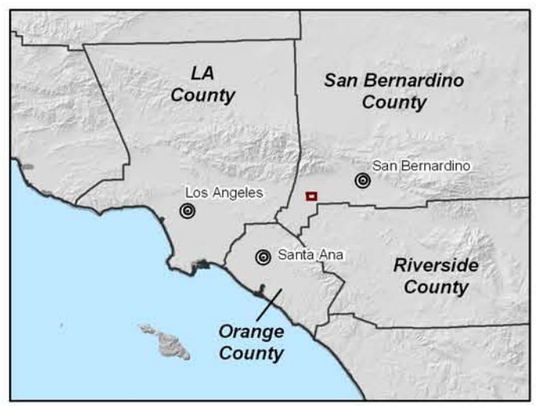
Figure 2-1



Monitoring Well

Existing Wells
Included in groundwater monitoring well network

Recharge Basins



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0 1,000 2,000 Feet
0 500 Meters

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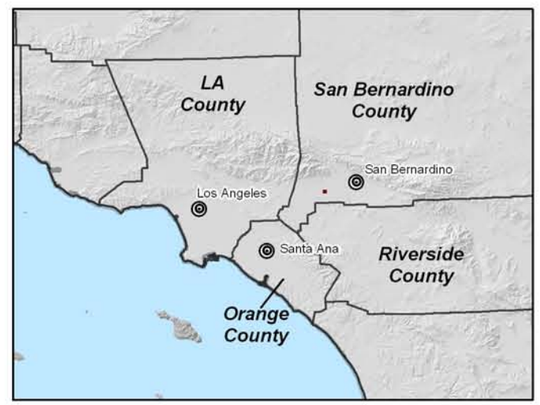
Chino Basin Watermaster

Recycled Water Recharge Program
Annual Report - 2005

Monitoring Well Network
Turner Basins

Figure 2-2



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0 100 200 Feet

0 50 Meters

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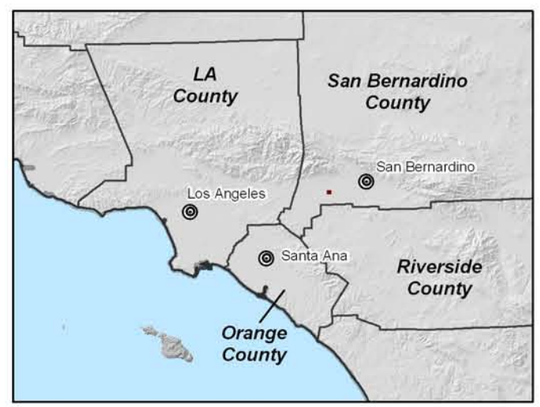
Location of Lysimeters
Banana Basin

Figure 2-3

Monitoring Well



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0 100 200 300 Feet
0 100 Meters

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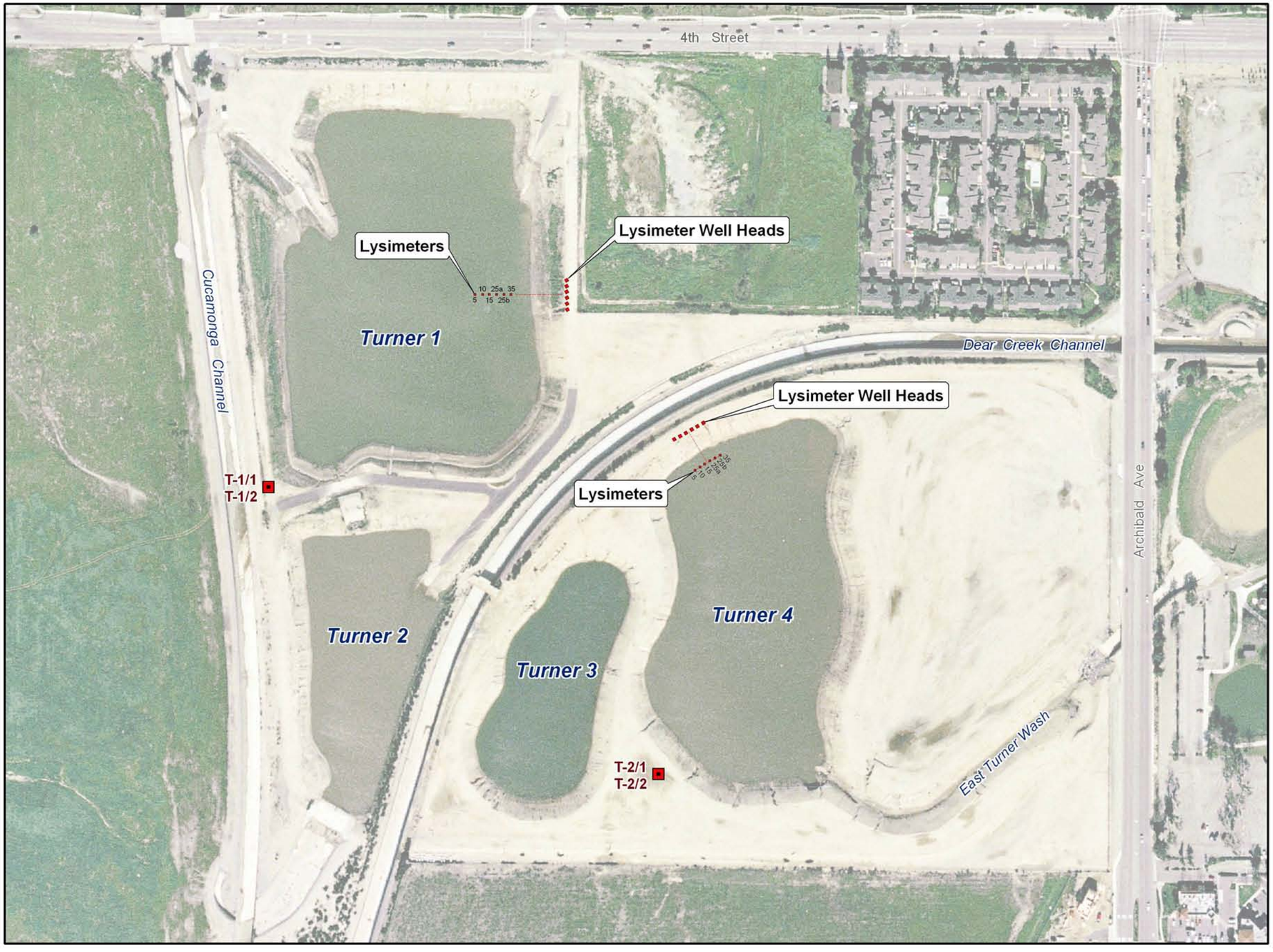
Annual Report - 2005

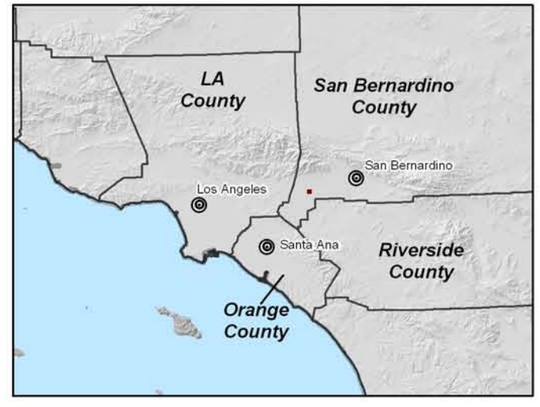
Location of Lysimeters

Hickory Basin

Figure 2-4



Monitoring Well



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0 100 200 Feet
0 50 Meters

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Location of Lysimeters
Turner Basins

Figure 2-5

3. RECHARGE OPERATIONS

3.1 Volume of Historical Diluent Water Recharged

WEI and IEUA have estimated the recharge in Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell over the previous 5 years (60 months). Note that these basins were historically operated solely as flood control basins and not as conservation basins; therefore, the historical averages are lower than can be expected in the future. Also note that there are no regular historical measurements of inflow, outflow, or water surface elevation that can be directly used to estimate recharge at Banana Basin. To estimate recharge, WEI used the Wasteload Allocation Model (WLAM). The WLAM generates runoff from historical daily rainfall data, routes the flow through the network of stream and recharge basins, and estimates the percolation at the bottom of recharge basins. The estimated recharge of stormwater from July 2000 to June 2005 is 1,496 acre feet (AF) for Banana Basin, 1,384 AF for Hickory Basin, and 1,064 AF for Turner Basin. These estimates are summarized in Table 3-1.

3.2 Recharge Operations

IEUA's Groundwater Recharge Coordinator recorded the volume of water delivered to Banana and Hickory Basin before and during the Start-Up Period. The delivered volumes included SWP water from MWD Turnout CB18 (pre-Start-Up Period diluent water), local runoff, stormwater, and recycled water from the Whittram force main. CB18 flows commingle with local runoff in San Sevaine Channel prior to diversion into Hickory Basin. Commingled imported water and local runoff water are delivered to Banana Basin by pumping from Hickory Basin. Recycled water is delivered to the Banana and Hickory Basins directly from the Whittram force main. Stormwater volumes are estimated from the change in storage in the basin based on positive changes in water elevation. The outflow of stormwater from the basins is not measured or estimated as these waters do not recharge. Table 3-2 lists the daily water deliveries to the basins. Turner Basin has not yet received any recycled water deliveries; therefore, this basin is not discussed in this section or included in Table 3-2.

3.3 Estimated Recharge Rate

The IEUA's Groundwater Recharge Coordinator has estimated the infiltration rate of both Banana and Hickory Basins to range between 0.6 and 0.9 feet per day (note that infiltration rates may vary with depth of water). Table 3-4 shows the infiltration test data for Banana Basin.

Table 3-1
Estimated Volume of Historical Diluent Water Recharged
(acre-feet)

Banana Basin

Year	July	August	September	October	November	December	January	February	March	April	May	June	Total	Average per Month
2000/01	0	0	0	28	13	0	87	122	79	61	0	0	390	32
2001/02	12	0	0	0	39	17	50	21	31	13	1	0	184	15
2002/03	0	0	0	0	39	59	0	81	39	87	62	0	366	31
2003/04	0	0	0	0	34	37	5	83	28	0	0	0	188	16
2004/05	0	0	0	63	17	25	94	111	25	19	15	0	368	31
Monthly Average	2	0	0	18	28	28	47	84	40	36	15	0		
												Total	**1496**	

Hickory Basin

Year	July	August	September	October	November	December	January	February	March	April	May	June	Total	Average per Month
2000/01	0	0	0	2	0	0	10	13	6	6	0	0	37	3
2001/02	1	0	0	0	61	2	35	0	4	1	0	0	105	9
2002/03	0	0	0	0	82	122	0	146	106	89	7	0	551	46
2003/04	0	0	0	0	5	35	1	129	55	0	0	0	224	19
2004/05	0	0	0	118	2	39	150	127	27	4	0	0	467	39
Monthly Average	0	0	0	24	30	40	39	83	39	20	1	0		
												Total	**1384**	

Turner Basin

Year	July	August	September	October	November	December	January	February	March	April	May	June	Total	Average per Month
2000/01	0	0	0	5	1	0	35	57	41	29	0	0	**167**	14
2001/02	0	0	0	0	20	19	20	24	13	3	2	0	**100**	8
2002/03	0	0	0	0	10	31	0	29	32	38	52	0	**192**	16
2003/04	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0
2004/05	0	0	0	48	79	49	102	113	81	66	67	0	**605**	50
Monthly Average	0	0	0	11	22	20	31	45	33	27	24	0		
												Total	**1064**	

Source: WEI (2005) Estimates for Chino Basin Watermaster and IEUA

Table 3-2
Volume of Diluent and Recycled Water Recharged

Date	Imported Water	MWD CB18 Water Routing		Local Runoff / Storm Flow		Recycled Water	
	MWD CB-18 (AF)	Hickory (AF)	Banana (AF)	Hickory (AF)	Banana (AF)	Hickory (AF)	Banana (AF)
07/01/05	7.3	0.0	7.3	4.0	0.0	0.0	0.0
07/02/05	12.7	2.7	10.0	4.0	0.0	0.0	0.0
07/03/05	12.9	2.9	10.0	4.0	0.0	0.0	0.0
07/04/05	12.9	2.9	10.0	4.0	0.0	0.0	0.0
07/05/05	15.5	5.5	10.0	4.0	0.0	0.0	0.0
07/06/05	20.0	10.0	10.0	4.0	0.0	0.0	0.0
07/07/05	15.1	5.1	10.0	4.0	0.0	0.0	0.0
07/08/05	11.9	1.9	10.0	4.0	0.0	0.0	0.0
07/09/05	12.3	2.3	10.0	4.0	0.0	0.0	0.0
07/10/05	12.1	2.1	10.0	4.0	0.0	0.0	0.0
07/11/05	17.7	7.7	10.0	4.0	0.0	0.0	0.0
07/12/05	16.3	6.3	10.0	4.0	0.0	0.0	0.0
07/13/05	14.5	4.5	10.0	4.0	0.0	0.0	0.0
07/14/05	14.3	4.3	10.0	4.0	0.0	0.0	0.0
07/15/05	14.3	4.3	10.0	4.0	0.0	0.0	0.0
07/16/05	14.3	4.3	10.0	4.0	0.0	0.0	0.0
07/17/05	14.3	4.3	10.0	4.0	0.0	0.0	0.0
07/18/05	14.3	4.3	10.0	4.0	0.0	0.0	0.0
07/19/05	14.3	4.3	10.0	4.0	0.0	0.0	0.0
07/20/05	5.0	0.0	5.0	4.0	0.0	0.0	0.0
07/21/05	0.0	0.0	0.0	4.0	0.0	0.0	0.0
07/22/05	0.0	0.0	0.0	4.0	0.0	0.0	0.0
07/23/05	0.0	0.0	0.0	4.0	0.0	0.0	0.0
07/24/05	0.0	0.0	0.0	4.0	0.0	0.0	0.0
07/25/05	0.0	0.0	0.0	4.0	0.0	0.0	0.0
07/26/05	0.0	0.0	0.0	4.0	0.0	0.0	0.0
07/27/05	4.4	4.4	0.0	4.0	0.0	0.0	2.0
07/28/05	10.9	10.9	0.0	4.0	0.0	0.0	4.0
07/29/05	13.9	13.9	0.0	4.0	0.0	0.0	6.0
07/30/05	17.1	17.1	0.0	4.0	0.0	0.0	4.0
07/31/05	16.7	16.7	0.0	4.0	0.0	0.0	4.0
08/01/05	20.0	20.0	0.0	4.0	0.0	0.0	4.0
08/02/05	26.2	26.2	0.0	4.0	0.0	0.0	6.0
08/03/05	29.4	29.4	0.0	4.0	0.0	0.0	6.0
08/04/05	32.3	32.3	0.0	4.0	0.0	0.0	9.9
08/05/05	32.3	32.3	0.0	4.0	0.0	0.0	9.9
08/06/05	32.9	32.9	0.0	4.0	0.0	0.0	9.9
08/07/05	29.0	29.0	0.0	4.0	0.0	0.0	7.9
08/08/05	26.2	26.2	0.0	4.0	0.0	0.0	9.9
08/09/05	18.4	18.4	0.0	4.0	0.0	0.0	9.9
08/10/05	15.3	15.3	0.0	4.0	0.0	0.0	9.9
08/11/05	12.1	12.1	0.0	4.0	0.0	0.0	7.9
08/12/05	12.7	12.7	0.0	4.0	0.0	0.0	7.9
08/13/05	12.5	12.5	0.0	4.0	0.0	0.0	7.9
08/14/05	12.7	12.7	0.0	4.0	0.0	0.0	6.0
08/15/05	12.7	12.7	0.0	4.0	0.0	0.0	7.9
08/16/05	6.9	6.9	0.0	4.0	0.0	0.0	7.9
08/17/05	0.0	0.0	0.0	0.0	0.0	0.0	7.9
08/18/05	5.8	5.8	0.0	2.0	0.0	0.0	9.9
08/19/05	12.3	12.3	0.0	2.0	0.0	0.0	9.9
08/20/05	12.5	12.5	0.0	2.0	0.0	0.0	7.9
08/21/05	12.5	12.5	0.0	2.0	0.0	0.0	7.9
08/22/05	4.2	4.2	0.0	2.0	0.0	0.0	7.9
08/23/05	8.3	8.3	0.0	2.0	0.0	0.0	9.9
08/24/05	13.9	13.9	0.0	2.0	0.0	0.0	6.0
08/25/05	6.7	6.7	0.0	2.0	0.0	0.0	7.9
08/26/05	0.0	0.0	0.0	0.0	0.0	0.0	6.0
08/27/05	0.0	0.0	0.0	0.0	0.0	0.0	7.9
08/28/05	0.0	0.0	0.0	0.0	0.0	0.0	7.9
08/29/05	0.0	0.0	0.0	0.0	0.0	0.0	9.9
08/30/05	0.0	0.0	0.0	0.0	0.0	0.0	9.9
08/31/05	0.0	0.0	0.0	0.0	0.0	0.0	7.9
09/01/05	4.8	4.8	0.0	2.0	0.0	0.0	4.0

Table 3-2
Volume of Diluent and Recycled Water Recharged

Date	Imported Water	MWD CB18 Water Routing		Local Runoff / Storm Flow		Recycled Water	
	MWD CB-18 (AF)	Hickory (AF)	Banana (AF)	Hickory (AF)	Banana (AF)	Hickory (AF)	Banana (AF)
09/02/05	10.5	10.5	0.0	2.0	0.0	0.0	2.0
09/03/05	10.5	10.5	0.0	2.0	0.0	0.0	4.0
09/04/05	10.5	10.5	0.0	2.0	0.0	0.0	4.0
09/05/05	10.5	10.5	0.0	2.0	0.0	0.0	4.0
09/06/05	10.5	10.5	0.0	2.0	0.0	0.0	3.0
09/07/05	10.5	10.5	0.0	2.0	0.0	0.0	3.8
09/08/05	2.8	2.8	0.0	2.0	0.0	0.0	3.8
09/09/05	0.0	0.0	0.0	1.0	0.0	3.6	9.9
09/10/05	0.0	0.0	0.0	2.0	0.0	6.5	8.9
09/11/05	0.0	0.0	0.0	2.0	0.0	6.1	8.7
09/12/05	0.0	0.0	0.0	2.0	0.0	5.0	5.0
09/13/05	0.0	0.0	0.0	2.0	0.0	4.4	11.9
09/14/05	0.0	0.0	0.0	2.0	0.0	6.1	8.9
09/15/05	0.0	0.0	0.0	2.0	0.0	5.0	7.7
09/16/05	0.0	0.0	0.0	2.0	0.0	5.4	6.3
09/17/05	0.0	0.0	0.0	2.0	0.0	6.1	8.7
09/18/05	0.0	0.0	0.0	2.0	0.0	5.9	9.3
09/19/05	0.0	0.0	0.0	2.0	0.0	5.9	6.9
09/20/05	0.0	0.0	0.0	23.1	0.0	9.9	0.0
09/21/05	0.0	0.0	0.0	0.0	0.0	10.7	0.0
09/22/05	0.0	0.0	0.0	0.0	0.0	11.1	0.0
09/23/05	0.0	0.0	0.0	0.0	0.0	10.3	0.0
09/24/05	0.0	0.0	0.0	0.0	0.0	11.1	0.0
09/25/05	0.0	0.0	0.0	0.0	0.0	11.1	0.0
09/26/05	0.0	0.0	0.0	0.0	0.0	11.1	0.0
09/27/05	0.0	0.0	0.0	0.0	0.0	10.5	0.0
09/28/05	0.0	0.0	0.0	0.0	0.0	0.2	0.0
09/29/05	0.0	0.0	0.0	0.0	0.0	0.4	0.0
09/30/05	0.0	0.0	0.0	0.0	0.0	0.2	0.0
10/01/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/02/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/03/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/04/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/05/05	0.0	0.0	0.0	0.0	0.0	6.9	0.0
10/06/05	0.0	0.0	0.0	0.0	0.0	10.1	0.0
10/07/05	0.0	0.0	0.0	0.0	0.0	10.1	0.0
10/08/05	0.0	0.0	0.0	0.0	0.0	6.9	0.0
10/09/05	0.0	0.0	0.0	0.0	0.0	6.9	0.0
10/10/05	0.0	0.0	0.0	0.0	0.0	6.4	4.0
10/11/05	0.0	0.0	0.0	0.0	0.0	7.4	4.0
10/12/05	0.0	0.0	0.0	0.0	0.0	7.4	4.0
10/13/05	0.0	0.0	0.0	0.0	0.0	7.9	4.0
10/14/05	0.0	0.0	0.0	0.0	0.0	7.7	4.0
10/15/05	0.0	0.0	0.0	0.0	0.0	6.9	4.0
10/16/05	0.0	0.0	0.0	0.0	0.0	4.5	1.5
10/17/05	0.0	0.0	0.0	10.9	10.9	0.0	0.0
10/18/05	0.0	0.0	0.0	10.9	17.9	0.0	0.0
10/19/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/20/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/21/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/22/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/23/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/24/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/25/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/26/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/27/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/28/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/29/05	0.0	0.0	0.0	0.0	0.0	1.0	0.0
10/30/05	0.0	0.0	0.0	0.0	0.0	1.3	0.0
10/31/05	0.0	0.0	0.0	0.0	0.0	1.0	0.0
11/01/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11/02/05	0.0	0.0	0.0	0.0	0.0	1.6	0.0

Table 3-2
Volume of Diluent and Recycled Water Recharged

Date	Imported Water	MWD CB18 Water Routing		Local Runoff / Storm Flow		Recycled Water	
	MWD CB-18 (AF)	Hickory (AF)	Banana (AF)	Hickory (AF)	Banana (AF)	Hickory (AF)	Banana (AF)
11/03/05	0.0	0.0	0.0	0.0	0.0	3.5	1.2
11/04/05	0.0	0.0	0.0	0.0	0.0	3.5	0.4
11/05/05	0.0	0.0	0.0	0.0	0.0	2.9	0.3
11/06/05	0.0	0.0	0.0	0.0	0.0	5.7	0.6
11/07/05	0.0	0.0	0.0	0.0	0.0	1.3	0.1
11/08/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11/09/05	0.0	0.0	0.0	0.0	0.0	4.2	0.5
11/10/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11/11/05	0.0	0.0	0.0	0.0	0.0	4.9	0.5
11/12/05	0.0	0.0	0.0	0.0	0.0	9.2	1.0
11/13/05	0.0	0.0	0.0	0.0	0.0	8.0	0.9
11/14/05	0.0	0.0	0.0	0.0	0.0	1.4	0.2
11/15/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11/16/05	0.0	0.0	0.0	0.0	0.0	2.9	0.3
11/17/05	0.0	0.0	0.0	0.0	0.0	4.2	0.5
11/18/05	0.0	0.0	0.0	0.0	0.0	7.1	0.8
11/19/05	0.0	0.0	0.0	0.0	0.0	2.9	0.3
11/20/05	0.0	0.0	0.0	0.0	0.0	2.6	0.3
11/21/05	0.0	0.0	0.0	0.0	0.0	0.9	0.1
11/22/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11/23/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11/24/05	0.0	0.0	0.0	0.0	0.0	5.0	0.0
11/25/05	0.0	0.0	0.0	0.0	0.0	5.3	0.0
11/26/05	0.0	0.0	0.0	0.0	0.0	5.3	0.0
11/27/05	0.0	0.0	0.0	0.0	0.0	5.6	0.0
11/28/05	0.0	0.0	0.0	0.0	0.0	4.5	0.0
11/29/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11/30/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/01/05	0.0	0.0	0.0	0.0	0.0	3.0	0.0
12/02/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/03/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/04/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/05/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/06/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/07/05	0.0	0.0	0.0	0.0	0.0	4.0	0.4
12/08/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/09/05	0.0	0.0	0.0	1.0	1.0	0.0	0.0
12/10/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/11/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/12/05	0.0	0.0	0.0	0.0	0.0	0.4	0.2
12/13/05	0.0	0.0	0.0	0.0	0.0	2.5	1.1
12/14/05	0.0	0.0	0.0	0.0	0.0	3.0	1.3
12/15/05	0.0	0.0	0.0	0.0	0.0	1.3	0.6
12/16/05	0.0	0.0	0.0	0.0	0.0	2.5	0.0
12/17/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/18/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/19/05	0.0	0.0	0.0	0.0	0.0	2.1	0.0
12/20/05	1.4	1.4	0.0	0.0	0.0	0.0	0.0
12/21/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/22/05	0.0	0.0	0.0	0.0	0.0	2.2	0.0
12/23/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/24/05	0.0	0.0	0.0	0.0	0.0	2.8	2.8
12/25/05	0.0	0.0	0.0	0.0	0.0	2.0	2.0
12/26/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/27/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/28/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/29/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/30/05	0.0	0.0	0.0	0.0	0.0	1.9	0.6
12/31/05	0.0	0.0	0.0	18.0	6.8	4.0	1.3
01/01/06	0.0	0.0	0.0	11.6	5.0	5.2	1.7
01/02/06	0.0	0.0	0.0	0.0	0.0	2.8	0.9
01/03/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01/04/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3-2
Volume of Diluent and Recycled Water Recharged

Date	Imported Water	MWD CB18 Water Routing		Local Runoff / Storm Flow		Recycled Water	
	MWD CB-18 (AF)	Hickory (AF)	Banana (AF)	Hickory (AF)	Banana (AF)	Hickory (AF)	Banana (AF)
01/05/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01/06/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01/07/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01/08/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01/09/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01/10/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01/11/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01/12/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01/13/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01/14/06	0.0	0.0	0.0	1.0	1.0	0.0	0.0
01/15/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01/16/06	0.0	0.0	0.0	0.0	0.0	0.0	0.6
01/17/06	0.0	0.0	0.0	0.0	0.0	0.0	5.6
01/18/06	0.0	0.0	0.0	0.0	0.0	10.3	0.0
01/19/06	0.0	0.0	0.0	0.0	0.0	9.1	0.8
01/20/06	0.0	0.0	0.0	0.0	0.0	8.9	1.2
01/21/06	0.0	0.0	0.0	0.0	0.0	6.0	6.0
01/22/06	0.0	0.0	0.0	0.0	0.0	10.9	0.0
01/23/06	0.0	0.0	0.0	0.0	0.0	10.9	0.0
01/24/06	0.0	0.0	0.0	0.0	0.0	7.9	2.6
01/25/06	0.0	0.0	0.0	0.0	0.0	0.0	9.9
01/26/06	0.0	0.0	0.0	0.0	0.0	3.8	5.6
01/27/06	0.0	0.0	0.0	0.0	0.0	0.0	5.6
01/28/06	0.0	0.0	0.0	0.0	0.0	2.5	2.0
01/29/06	0.0	0.0	0.0	0.0	0.0	1.2	3.5
01/30/06	0.0	0.0	0.0	0.0	0.0	0.0	1.8
01/31/06	0.0	0.0	0.0	0.0	0.0	3.3	2.6
02/01/06	0.0	0.0	0.0	0.0	0.0	3.9	2.8
02/02/06	0.0	0.0	0.0	0.0	0.0	0.0	6.9
02/03/06	0.0	0.0	0.0	0.0	0.0	6.8	0.0
02/04/06	0.0	0.0	0.0	0.0	0.0	6.8	0.0
02/05/06	0.0	0.0	0.0	0.0	0.0	6.1	0.7
02/06/06	0.0	0.0	0.0	0.0	0.0	0.0	6.4
02/07/06	0.0	0.0	0.0	0.0	0.0	1.4	2.7
02/08/06	0.0	0.0	0.0	0.0	0.0	4.5	0.0
02/09/06	0.0	0.0	0.0	0.0	0.0	2.7	0.0
02/10/06	0.0	0.0	0.0	0.0	0.0	5.2	2.6
02/11/06	0.0	0.0	0.0	0.0	0.0	0.0	9.0
02/12/06	0.0	0.0	0.0	0.0	0.0	4.5	4.0
02/13/06	0.0	0.0	0.0	0.0	0.0	4.9	2.9
02/14/06	0.0	0.0	0.0	0.0	0.0	0.0	7.4
02/15/06	0.0	0.0	0.0	0.0	0.0	7.5	0.0
02/16/06	0.0	0.0	0.0	0.0	0.0	3.9	1.2
02/17/06	0.0	0.0	0.0	0.0	0.0	0.0	6.3
02/18/06	0.0	0.0	0.0	0.0	0.0	3.6	2.3
02/19/06	0.0	0.0	0.0	0.0	0.0	4.0	0.0
02/20/06	0.0	0.0	0.0	0.0	0.0	6.9	0.0
02/21/06	0.0	0.0	0.0	0.0	0.0	5.4	0.0
02/22/06	0.0	0.0	0.0	0.0	0.0	1.1	0.0
02/23/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02/24/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02/25/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02/26/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02/27/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02/28/06	0.0	0.0	0.0	34.6	22.3	0.0	0.0
03/01/06	0.0	0.0	0.0	2.1	1.0	0.0	0.0
03/02/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/03/06	0.0	0.0	0.0	8.8.	7.9	0.0	0.0
03/04/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/05/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/06/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/07/06	0.0	0.0	0.0	0.0	2.9	0.0	0.0
03/08/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3-2
Volume of Diluent and Recycled Water Recharged

Date	Imported Water	MWD CB18 Water Routing		Local Runoff / Storm Flow		Recycled Water	
	MWD CB-18 (AF)	Hickory (AF)	Banana (AF)	Hickory (AF)	Banana (AF)	Hickory (AF)	Banana (AF)
03/09/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/10/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/11/06	0.0	0.0	0.0	0.0	11.8	0.0	0.0
03/12/06	0.0	0.0	0.0	4.0	0.0	0.0	0.0
03/13/06	0.0	0.0	0.0	1.0	0.0	0.0	0.0
03/14/06	0.0	0.0	0.0	1.0	0.0	0.0	0.0
03/15/06	0.0	0.0	0.0	1.0	0.0	0.0	0.0
03/16/06	0.0	0.0	0.0	1.0	0.0	0.0	0.0
03/17/06	0.0	0.0	0.0	1.3	4.8	0.0	0.0
03/18/06	0.0	0.0	0.0	1.3	0.6	0.0	0.0
03/19/06	0.0	0.0	0.0	1.8	3.6	0.0	0.0
03/20/06	0.0	0.0	0.0	1.8	0.0	0.0	0.0
03/21/06	0.0	0.0	0.0	1.8	7.6	0.0	0.0
03/22/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/23/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/24/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/25/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/26/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/27/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/28/06	0.0	0.0	0.0	8.6	13.3	0.0	0.0
03/29/06	0.0	0.0	0.0	0.0	1.6	0.0	0.0
03/30/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/31/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2005 Totals	**814.4**	**622.1**	**192.3**	**303.0**	**36.6**	**363.3**	**438.0**
Cumulative Totals	**814.4**	**622.1**	**192.3**	**376.9**	**120.0**	**525.4**	**543.5**

= Zeros added where null values were observed in data.

Table 3-3
Recycled Water Contribution

Source of Recharged Water	Units	Banana	Hickory	Turner
Historical Diluent - Previous 54 months	AF	1455	1384	1064
State Water Project Water: 2005	AF	192	622	NA
Local Runoff: 2005	AF	37	303	NA
Recycled Water: 2005	AF	438	363	0
Recycled Water Contribution		20.6%	13.6%	0.0%

AF - acre-feet

NA - not applicable

Table 3-4
Banana Basin Infiltration Tests

Parameter	Infiltration Test 1	Infiltration Test 2
Start Date/Time (T_1)	9/20/2005 21:00	9/21/2005 17:00
Start Water Depth (H_1) [feet]	7.32	6.62
End Date/Time (T_2)	9/21/2005 17:00	9/22/2005 11:00
End Water Depth (H_2) [feet]	6.62	6.12
Change in Water Depth: $dH = -(H_2 - H_1)$ [feet]	0.7	0.5
Change in Time: $dT = (T_2 - T_1)$ [days]	0.83	0.75
Infiltration Rate: dH/dT [feet/day]	0.84	0.67
Comment	6 hours after RW turned off	24 hours after RW turned off

4. LYSIMETER SAMPLING AND MONITORING RESULTS

The M&RP schedule (RWQCB, 2005b) for the Banana and Hickory Basins and the respective lysimeter sampling is as follows:

- EC: Grab, Twice per Week
- TOC: Grab, Weekly
- Nitrate-Nitrogen: Grab, Twice per Week
- Nitrite-Nitrogen: Grab, Twice per Week
- Ammonia: Grab, Twice per Week
- Total Kjeldahl Nitrogen (TKN): Twice per Week
- Total Nitrogen (TN) – by Addition: Grab, Twice per Week

Although the Turner Basin lysimeters were constructed in 2005, these basins have yet to receive recycled water. The Turner Basin lysimeters were not sampled until January 2006. Once the Turner Basin's Start-Up Period begins, it will be sampled according to the above schedule. The data for the Banana and Hickory Basins are summarized in Tables 4-1 through 4-12. Tables 4-1 through 4-3 detail the EC results for the surface water samples from Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell, and from each of the lysimeters. Tables 4-4 through 4-6 provide TOC results for the surface water samples from Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell and from each of the lysimeters. Tables 4-7 through 4-9 list the results for nitrogen species (ammonia, nitrite, nitrate, total Kjeldahl nitrogen [TKN], and total nitrogen [TN]) for the surface water samples from Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell and from each of the lysimeters. Tables 4-10 through 4-12 summarize the TN data; detailing TN by depth and percent reduction of TN for the surface water samples from Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell and from each of the lysimeters.

Tables 4-1 through 4-6 and 4-10 through 4-12 contain cells that are shaded, for both the surface water and lysimeter samples, to indicate that the recycled water component was greater than or equal to 75 percent when the samples were collected. The reported TOC concentration (11.7 mg/L) on December 23, 2005 for the 25 foot bgs lysimeter at Banana Basin is an outlier and may be a sampling or laboratory artifact. This value was not used in the graphs in Section 5 nor was it used in the computation of TOC reduction. There is a column in Tables 4-4 through 4-6 and 4-10 through 4-12 that provides the percentage of recycled water in the 25 foot bgs lysimeter. This analysis is based on a comparison of the EC values of diluent water and recycled water and is discussed further in Section 6.

Table 4-1
Basin and Lysimeter Monitoring Results for Banana Basin: Electrical Conductivity

Station ID	Units	Notes	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter
				5	10	15	25	
07/12/05	µmhos/cm	[1]	319	NS	NS	NS	1197	Residual Water
07/19/05	µmhos/cm	[1]	300	NS	NS	NS	569	Residual Water
07/26/05	µmhos/cm	[1]	NS-BD	NS	NS	NS	866	Residual Water
07/29/05	µmhos/cm	[1]	644	NS	NS	NS	866	Residual Water
08/02/05	µmhos/cm		730	470	490	460	700	Residual Water
08/09/05	µmhos/cm		750	710	695	685	725	Residual Water
08/16/05	µmhos/cm		715	755	730	750	755	100%
08/23/05	µmhos/cm		720	720	690	690	705	96%
08/24/05	µmhos/cm		776	NA	NA	NA	NA	IDC
08/26/05	µmhos/cm		740	760	740	700	730	100%
08/30/05	µmhos/cm		760	NA	NA	NA	795	100%
09/06/05	µmhos/cm		740	NA	NA	NA	NA	IDC
09/13/05	µmhos/cm		711	760	750	735	820	100%
09/20/05	µmhos/cm		735	770	770	760	790	100%
09/27/05	µmhos/cm		725	750	745	730	790	100%
10/04/05	µmhos/cm		680	NS	765	735	770	100%
10/13/05	µmhos/cm		780	755	790	805	770	100%
10/18/05	µmhos/cm		360	735	780	805	760	100%
10/25/05	µmhos/cm		305	715	760	825	755	100%
11/01/05	µmhos/cm		315	630	735	770	745	100%
11/08/05	µmhos/cm		550	490	670	650	700	95%
11/15/05	µmhos/cm		585	455	600	555	630	84%
11/22/05	µmhos/cm		620	515	595	520	580	75%
11/29/05	µmhos/cm		630	600	620	555	545	70%
12/06/05	µmhos/cm		640	650	645	610	530	67%
12/13/05	µmhos/cm		665	665	675	660	550	70%
12/20/05	µmhos/cm		695	670	700	685	590	77%
12/27/05	µmhos/cm		690	670	720	695	580	75%

[1]EC estimated from TDS value (see text)

ND: Not Detected

NS: Not Sampled

NS-BD: Not Sampled-Basin Dry

NT: Insufficient Sample for Analytical Test

IDC: Insufficient Data for Calculation

Indicates that the sampled water is >75 percent recycled water, based on:

SWP = 343 umhos/cm
RW = 727 umhos/cm
→ 75 percent recycled water would have an EC of 630 umhos/cm or greater.

SWP = 343 umhos/cm
Local Runoff = 130 umhos/cm
→ 75 percent recycled water would have an EC of 578 umhos/cm or greater.

Table 4-2
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell: Electrical Conductivity

Station ID	Units	Notes	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter
				5	10	15	25	
8/2/2005	µmhos/cm		330	360	NT	NT	350	Residual Water
8/9/2005	µmhos/cm		320	340	NT	NT	330	Residual Water
8/16/2005	µmhos/cm		345	345	NT	NT	335	Residual Water
8/23/2005	µmhos/cm		310	345	NT	NT	320	Residual Water
8/26/2005	µmhos/cm		340	400	NT	NT	355	Residual Water
8/30/2005	µmhos/cm		295	NT	NT	NT	350	Residual Water
9/6/2005	µmhos/cm		415	NT	NT	NT	375	Residual Water
9/13/2005	µmhos/cm		640	580	NT	NT	455	54%
9/20/2005	µmhos/cm		660	695	NT	NT	670	90%
9/27/2005	µmhos/cm		695	630	NT	NT	635	85%
10/4/2005	µmhos/cm		690	755	NT	NT	645	86%
10/13/2005	µmhos/cm		800	NT	NT	NT	760	100%
10/18/2005	µmhos/cm		505	1020	NT	NT	770	100%
10/25/2005	µmhos/cm		455	NT	NT	NT	940	100%
11/1/2005	µmhos/cm		NS-BD	NT	NT	NT	950	100%
11/8/2005	µmhos/cm		NS-BD	NT	NT	NT	930	100%
11/15/2005	µmhos/cm		735	880	775	NT	760	100%
11/22/2005	µmhos/cm		725	790	835	975	730	100%
11/29/2005	µmhos/cm		745	740	915	NT	710	97%
12/6/2005	µmhos/cm		745	750	880	885	730	100%
12/13/2005	µmhos/cm		745	755	855	850	735	100%
12/20/2005	µmhos/cm		735	750	845	845	750	100%
12/27/2005	µmhos/cm		745	745	820	820	730	100%

NS-BD: Not Sampled-Basin Dry

NT: Insufficient Sample for Analytical Test

IDC: Insufficient Data for Calculation

Indicates that the sampled water is >75 percent recycled water, based on:

SWP = 343 umhos/cm
RW = 727 umhos/cm
→ 75 percent recycled water would have an EC of 630 umhos/cm or greater.

SWP = 343 umhos/cm
Local Runoff = 130 umhos/cm
→ 75 percent recycled water would have an EC of 578 umhos/cm or greater.

Table 4-3
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Electrical Conductivity

Station ID	Units	Notes	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter
				5	10	15	25	
8/2/2005	µmhos/cm		330	355	510	620	480	Residual Water
8/9/2005	µmhos/cm		320	342.5	340	570	395	Residual Water
8/16/2005	µmhos/cm		345	292.5	320	370	360	Residual Water
8/23/2005	µmhos/cm		330	345	340	360	NT	Residual Water
8/26/2005	µmhos/cm		340	375	370	400	400	Residual Water
8/30/2005	µmhos/cm		385	NT	NT	NT	420	Residual Water
9/6/2005	µmhos/cm		NS-BD	NT	NT	NT	425	Residual Water
9/13/2005	µmhos/cm		640	555	400	410	440	52%
9/20/2005	µmhos/cm		665	645	415	640	445	53%
9/27/2005	µmhos/cm		780	750	695	650	485	59%
10/4/2005	µmhos/cm		700	735	725	750	755	100%
10/13/2005	µmhos/cm		775	815	760	715	735	100%
10/18/2005	µmhos/cm		440	765	765	750	760	100%
10/25/2005	µmhos/cm		470	470	735	780	770	100%
11/1/2005	µmhos/cm		765	530	735	775	790	100%
11/8/2005	µmhos/cm		700	770	645	710	775	100%
11/15/2005	µmhos/cm		760	775	590	680	NT	*96%*
11/22/2005	µmhos/cm		715	NT	560	635	NT	*96%*
11/29/2005	µmhos/cm		750	880	560	595	NT	*96%*
12/6/2005	µmhos/cm		790	820	645	590	685	93%
12/13/2005	µmhos/cm		750	810	650	590	NT	*96%*
12/20/2005	µmhos/cm		715	850	720	605	NT	*96%*
12/27/2005	µmhos/cm		790	810	735	635	NT	*96%*

NS-BD: Not Sampled-Basin Dry

NT: Insufficient Sample for Analytical Test

IDC: Insufficient Data for Calculation

Indicates that the sampled water is >75 percent recycled water, based on:

SWP = 343 umhos/cm
RW = 727 umhos/cm
→ 75 percent recycled water would have an EC of 630 umhos/cm or greater.

SWP = 343 umhos/cm
Local Runoff = 130 umhos/cm
→ 75 percent recycled water would have an EC of 578 umhos/cm or greater.

95% Denotes an interpolated value.

Table 4-4
Basin and Lysimeter Monitoring Results for Banana Basin: Total Organic Carbon (mg/L)

Date	Surface Water	Lysimeter Samples (ft bgs)					Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25	25 - Running Average		
07/06/05	5.1	4.0	5.2	6.7	2.4		Residual Water	53%
07/12/05	5.2	3.1	3.9	5.2	2.3		Residual Water	55%
07/19/05	5.0	3.0	2.8	3.3	2.5		Residual Water	50%
07/26/05	NS-BD	2.9	2.8	3.8	2.4		Residual Water	IDC
08/02/05	6.5	3.3	3.2	3.8	2.8		Residual Water	46%
08/09/05	6.7	3.3	3.1	3.3	2.2		Residual Water	60%
08/16/05	13.1	3.8	3.3	3.5	2.5	2.5	100%	56%
08/23/05	7.0	5.1	4.0	4.0	2.6	2.6	96%	60%
08/24/05	9.5	NA	NA	NA	NA		*98%*	IDC
08/30/05	9.0	4.9	3.7	4.0	2.0	2.4	100%	79%
09/06/05	11.4	4.4	3.7	3.3	2.2	2.3	*100%*	79%
09/13/05	8.8	4.8	3.3	3.0	2.1	2.3	100%	59%
09/20/05	9.7	4.4	3.2	2.9	2.3	2.3	100%	78%
09/27/05	9.1	4.0	3.0	2.6	2.0	2.2	100%	81%
10/04/05	10.6	4.0	3.0	2.8	2.0	2.2	100%	78%
10/13/05	9.3	3.9	2.7	2.6	2.0	2.2	100%	79%
10/18/05	2.1	4.2	2.7	2.3	1.8	2.2	100%	81%
10/25/05	8.3	4.2	2.7	2.4	1.8	2.1	100%	83%
11/01/05	8.6	3.8	2.9	2.7	2.0	2.1	100%	75%
11/08/05	8.2	3.5	2.6	2.2	2.4	2.1	95%	49%
11/15/05	9.1	3.5	2.3	2.1	1.8	2.1	84%	78%
11/22/05	7.4	2.8	1.9	1.5	2.3	2.1	75%	73%
11/25/05	7.5	2.9	2.2	1.6	1.5		*73%*	82%
11/29/05	7.5	2.8	2.1	1.6	1.6		70%	82%
12/02/05	7.2	2.7	1.7	1.5	1.2		*69%*	87%
12/06/05	7.2	2.7	1.7	1.4	1.0		67%	88%
12/09/05	8.7	2.6	1.6	1.4	1.0		*69%*	87%
12/13/05	9.8	3.0	1.9	1.6	1.2		70%	84%
12/16/05	8.9	2.6	1.6	1.3	1.2		*74%*	84%
12/20/05	8.4	2.7	1.6	1.4	1.1	2.1	77%	84%
12/23/05	8.6	2.7	1.7	1.4	11.7	2.3	*76%*	-63%
12/27/05	8.6	2.7	1.9	1.3	1.1	2.4	75%	88%
12/29/05	8.8	2.7	1.6	1.3	0.9	2.4	*77%*	90%
Average	**8.8**	**3.8**	**2.9**	**2.7**	**2.4**			**69%**

[1]Sample Number is the number of samples once the compliance point lysimeter is sampling primarily recharged recycled water.
ND: Not Detected
NS-BD: Not Sampled-Basin Dry
NT: Insufficient Sample for Analytical Test
IDC: Insufficient Data for Calculation
Indicates that the sampled water is >75 percent recycled water

95% Denotes an interpolated value.

Table 4-5
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell: Total Organic Carbon (mg/L)

Date	Surface Water	Lysimeter Samples (ft bgs)					Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25	25 - Running Average		
06/10/05	6.3	7.2	7.8	4.9	*3.0*		Residual Water	53%
06/15/05	13.4	6.4	NT	NT	2.8		Residual Water	79%
06/20/05	17.2	NT	NT	NT	2.8		Residual Water	84%
06/27/05	5.5	7.1	NT	NT	2.9		Residual Water	47%
07/05/05	6.3	4.9	NT	NT	2.9		Residual Water	54%
07/12/05	6.1	4.0	NT	NT	2.6		Residual Water	57%
07/19/05	5.1	3.8	NT	NT	2.6		Residual Water	49%
07/26/05	8.8	5.4	NT	NT	2.8		Residual Water	68%
08/02/05	5.1	4.4	NT	NT	2.9		Residual Water	43%
08/09/05	4.4	3.8	NT	NT	2.5		Residual Water	43%
08/16/05	20.0	3.5	NT	NT	2.5		Residual Water	88%
08/23/05	6.5	5.0	NT	NT	3.7		Residual Water	43%
08/30/05	6.9	4.9	NT	NT	2.7		Residual Water	61%
09/13/05	8.3	4.7	NT	NT	2.4		54%	71%
09/20/05	21.6	4.8	NT	NT	3.1	3.1	90%	61%
09/27/05	14.1	16.2	NT	NT	10.0	6.6	85%	37%
10/04/05	98.4	9.8	NT	NT	7.2	7.4	86%	56%
10/13/05	10.7	5.7	NT	NT	4.3	6.7	100%	96%
10/18/05	10.5	4.7	NT	NT	3.9	6.3	100%	93%
10/25/05	11.8	NT	NT	NT	2.8	5.7	100%	74%
11/15/05	7.9	6.1	7.1	NT	5.0	5.1	100%	49%
11/22/05	7.1	4.1	5.5	9.2	3.4	5.0	100%	60%
11/25/05	8.0	5.4	5.4	9.5	3.5	4.9	*98%*	56%
11/29/05	8.3	4.0	4.8	12.3	3.8	4.8	97%	50%
12/02/05	7.4	4.1	3.7	4.4	3.5	4.8	98%	51%
12/06/05	7.4	4.4	3.7	4.1	3.3	4.7	100%	59%
12/09/05	9.1	4.6	3.7	3.8	3.6	4.7	*100%*	57%
12/13/05	9.6	5.5	4.1	4.5	3.1	4.6	100%	58%
12/16/05	8.7	4.6	3.3	3.7	2.9	4.5	*100%*	60%
12/20/05	8.1	5.0	3.5	3.7	2.7	4.5	100%	71%
12/23/05	8.9	4.8	3.4	5.1	2.6	4.4	*100%*	73%
12/27/05	8.4	4.7	3.6	3.6	2.5	4.3	100%	71%
12/30/05	8.4	4.2	3.5	3.5	3.5	4.3	*100%*	56%
Average	**21.0**	**5.3**	**3.4**	**5.6**	**4.3**	**5.4**		**64%**

NS-BD: Not Sampled-Basin Dry
NT: Insufficient Sample for Analytical Test
IDC: Insufficient Data for Calculation
Indicates that the sampled water is >75 percent recycled water
64% Denotes an interpolated value.

Table 4-6
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Total Organic Carbon (mg/L)

Date	Surface Water	Lysimeter Samples (ft bgs)					Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25	25 - Running Average		
06/10/05	6.0	4.0	2.3	2.8	*1.9*		Residual Water	68%
06/15/05	NT	3.7	2.6	2.4	1.4		Residual Water	IDC
06/20/05	NT	NT	2.2	2.1	1.3		Residual Water	IDC
06/27/05	6.8	3.2	3.2	2.2	1.6		Residual Water	77%
07/05/05	6.6	3.2	2.4	2.2	1.5		Residual Water	77%
07/12/05	5.7	3.1	2.9	2.1	1.6		Residual Water	72%
07/19/05	5.2	2.7	2.7	1.9	1.2		Residual Water	78%
07/26/05	NT	3.0	2.6	1.8	1.2		Residual Water	IDC
08/02/05	6.2	3.3	2.8	2.1	1.2		Residual Water	81%
08/09/05	4.5	3.2	3.0	2.2	1.6		Residual Water	64%
08/16/05	20.1	2.9	3.0	2.7	1.8		Residual Water	91%
08/23/05	6.4	6.7	6.9	5.3	2.3		Residual Water	64%
08/30/05	14.4	4.0	4.3	3.7	2.6		Residual Water	82%
09/06/05	NS-BD	3.5	3.8	2.9	2.5		Residual Water	IDC
09/13/05	8.2	3.7	3.2	2.5	2.7		52%	68%
09/20/05	9.4	3.4	3.0	2.4	2.2		53%	77%
09/27/05	7.2	4.0	3.4	2.9	2.1		59%	70%
10/04/05	19.8	8.1	4.0	3.2	2.8	2.8	100%	71%
10/13/05	9.0	5.4	4.1	3.5	2.3	2.5	100%	75%
10/18/05	10.6	3.3	2.9	2.5	2.3	2.5	100%	73%
10/25/05	11.5	3.5	2.5	2.1	3.2	2.6	100%	74%
11/01/05	8.3	2.6	2.1	2.0	2.0	2.6	100%	88%
11/08/05	7.9	2.5	2.1	1.8	1.7	2.4	100%	82%
11/15/05	10.5	2.6	5.3	1.8	2.1	2.3	*96%*	81%
11/22/05	7.9	1.8	1.4	1.3	1.4	2.2	*96%*	86%
11/25/05	7.6	1.9	1.5	1.4	1.3	2.2	*96%*	85%
11/29/05	7.8	2.4	1.6	1.2	1.6	2.1	*96%*	81%
12/02/05	7.8	2.4	1.9	1.3	1.3	2.1	*96%*	83%
12/06/05	10.0	1.9	1.7	1.3	1.2	2.0	*96%*	85%
12/09/05	9.9	1.7	1.4	1.3	1.3	2.0	*96%*	85%
12/13/05	11.7	2.4	1.5	1.6	1.5	2.0	93%	84%
12/16/05	9.3	2.0	1.3	1.1	1.1	1.9	*96%*	87%
12/20/05	9.3	2.6	1.4	1.2	1.2	1.7	*96%*	84%
12/23/05	10.2	2.2	1.3	1.2	1.1	1.9	*96%*	82%
12/27/05	7.9	2.0	1.4	1.2	1.3	1.8	*96%*	84%
12/30/05	8.8	2.3	1.6	1.3	1.2	1.8	*96%*	85%
Average	**9.5**	**3.2**	**2.4**	**1.9**	**1.8**			**75%**

NS-BD: Not Sampled-Basin Dry

NT: Insufficient Sample for Analytical Test

IDC: Insufficient Data for Calculation

Indicates that the sampled water is >75 percent recycled water

64% Denotes an interpolated value.

3.0 Denotes an average of individual samples collected at lysimeters HW-25a and HW-25b

Table 4-7
Basin and Lysimeter Monitoring Results for Banana Basin:
Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
Banana Basin-SW	0 ft	07/06/05	0.1	0.03	0.10	0.52	0.65
Banana Basin-5	5 ft	07/06/05	0.1	0.05	0.54	0.32	0.91
Banana Basin-10	10 ft	07/06/05	0.1	0.32	0.32	0.43	1.07
Banana Basin-15	15 ft	07/06/05	0.1	0.08	<0.1	0.52	0.60
Banana Basin-25	25 ft	07/06/05	0.1	0.1	1.15	0.21	1.46
Banana Basin-SW	0 ft	07/12/05	0.1	0.09	0.20	0.76	1.05
Banana Basin-5	5 ft	07/12/05	0.07	0.01	0.20	0.22	0.43
Banana Basin-10	10 ft	07/12/05	0.1	0.21	2.20	0.38	2.79
Banana Basin-15	15 ft	07/12/05	0.1	0.08	0.08	0.36	0.52
Banana Basin-25	25 ft	07/12/05	0.1	0.03	0.50	0.21	0.74
Banana Basin-SW	0 ft	07/15/05	0.3	0.03	0.10	1.10	1.23
Banana Basin-5	5 ft	07/15/05	0.1	<0.01	0.27	0.26	0.53
Banana Basin-10	10 ft	07/15/05	0.09	0.05	0.60	0.35	1.00
Banana Basin-15	15 ft	07/15/05	0.1	0.06	0.19	0.36	0.61
Banana Basin-25	25 ft	07/15/05	0.1	0.03	0.28	0.22	0.53
Banana Basin-SW	0 ft	07/19/05	0.2	0.1	0.10	0.76	0.96
Banana Basin-5	5 ft	07/19/05	0.1	0.02	0.23	0.38	0.63
Banana Basin-10	10 ft	07/19/05	0.1	0.05	0.27	0.30	0.62
Banana Basin-15	15 ft	07/19/05	0.1	0.03	0.10	0.29	0.42
Banana Basin-25	25 ft	07/19/05	0.2	0.03	0.35	0.24	0.62
Banana Basin-SW	0 ft	07/22/05	0.2	0.05	<0.1	0.87	0.92
Banana Basin-5	5 ft	07/22/05	0.1	<0.1	0.18	0.21	0.39
Banana Basin-10	10 ft	07/22/05	0.1	0.04	0.20	0.28	0.52
Banana Basin-15	15 ft	07/22/05	0.1	0.03	0.08	0.26	0.37
Banana Basin-25	25 ft	07/22/05	0.1	0.04	0.24	0.21	0.49
Banana Basin-SW	0 ft	07/26/05	NS-BD	NS-BD	NS-BD	NS-BD	IDC
Banana Basin-5	5 ft	07/26/05	0.1	<0.01	0.17	0.25	0.42
Banana Basin-10	10 ft	07/26/05	0.1	<0.01	0.13	0.26	0.39
Banana Basin-15	15 ft	07/26/05	0.1	<0.01	0.03	0.32	0.35
Banana Basin-25	25 ft	07/26/05	0.1	<0.01	0.39	0.21	0.60
Banana Basin-SW	0 ft	07/29/05	0.1	0.03	3.00	1.8	4.83
Banana Basin-5	5 ft	07/29/05	0.1	<0.01	0.31	0.26	0.57
Banana Basin-10	10 ft	07/29/05	0.1	<0.01	0.16	0.25	0.41
Banana Basin-15	15 ft	07/29/05	0.1	<0.01	0.09	0.26	0.35
Banana Basin-25	25 ft	07/29/05	0.1	<0.01	0.33	0.25	0.58
Banana Basin-SW	0 ft	08/02/05	0.1	0.047	0.64	1.1	1.79
Banana Basin-5	5 ft	08/02/05	0.1	0.03	0.90	0.28	1.21
Banana Basin-10	10 ft	08/02/05	0.1	<0.01	0.61	0.27	0.88
Banana Basin-15	15 ft	08/02/05	0.1	0.069	0.53	0.28	0.88
Banana Basin-25	25 ft	08/02/05	0.1	<0.01	0.90	0.21	1.11
Banana Basin-SW	0 ft	08/05/05	0.1	<0.01	1.40	0.88	2.28
Banana Basin-5	5 ft	08/05/05	0.04	0.022	1.51	0.35	1.88
Banana Basin-10	10 ft	08/05/05	0.1	0.02	0.51	0.38	0.91
Banana Basin-15	15 ft	08/05/05	0.4	0.083	0.35	0.33	0.76
Banana Basin-25	25 ft	08/05/05	0.04	0.019	0.82	0.23	1.07

Table 4-7
Basin and Lysimeter Monitoring Results for Banana Basin:
Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
Banana Basin-SW	0 ft	08/09/05	0.1	<0.01	0.53	0.83	1.36
Banana Basin-5	5 ft	08/09/05	0.04	0.015	1.60	0.32	1.94
Banana Basin-10	10 ft	08/09/05	0.04	0.053	1.30	0.41	1.76
Banana Basin-15	15 ft	08/09/05	0.04	0.138	1.62	0.42	2.17
Banana Basin-25	25 ft	08/09/05	0.04	<0.01	1.30	0.31	1.61
Banana Basin-SW	0 ft	08/12/05	<0.1	<0.01	1.59	1.7	3.29
Banana Basin-5	5 ft	08/12/05	<0.1	0.022	1.25	0.54	1.81
Banana Basin-10	10 ft	08/12/05	<0.1	0.028	1.06	0.33	1.41
Banana Basin-15	15 ft	08/12/05	<0.1	0.055	0.69	0.52	1.27
Banana Basin-25	25 ft	08/12/05	<0.1	<0.01	1.28	0.25	1.53
Banana Basin-SW	0 ft	08/16/05	0.1	0.014	1.42	1.20	2.63
Banana Basin-5	5 ft	08/16/05	<0.1	0.013	0.59	0.35	0.96
Banana Basin-10	10 ft	08/16/05	<0.1	0.024	0.84	0.34	1.20
Banana Basin-15	15 ft	08/16/05	<0.1	0.032	0.86	0.31	1.20
Banana Basin-25	25 ft	08/16/05	<0.1	<0.01	0.91	0.24	1.15
Banana Basin-SW	0 ft	08/19/05	0.1	<0.01	0.28	0.93	1.21
Banana Basin-5	5 ft	08/19/05	0.1	<0.01	0.38	0.38	0.76
Banana Basin-10	10 ft	08/19/05	0.1	0.013	0.45	0.34	0.80
Banana Basin-15	15 ft	08/19/05	0.1	0.021	0.45	0.31	0.78
Banana Basin-25	25 ft	08/19/05	0.1	<0.01	0.66	0.48	1.14
Banana Basin-SW	0 ft	08/23/05	0.1	<0.01	1.47	1.20	2.67
Banana Basin-5	5 ft	08/23/05	<0.1	<0.01	0.05	0.45	0.50
Banana Basin-10	10 ft	08/23/05	<0.1	<0.01	0.18	0.46	0.64
Banana Basin-15	15 ft	08/23/05	<0.1	<0.01	0.13	0.32	0.45
Banana Basin-25	25 ft	08/23/05	0.1	<0.01	0.48	0.23	0.71
Banana Basin-SW	0 ft	08/24/05	0.054	<0.2	0.71	2.00	2.71
Banana Basin-SW	0 ft	08/26/05	0.1	<0.01	1.51	1.50	3.01
Banana Basin-5	5 ft	08/26/05	<0.1	<0.01	0.03	0.48	0.51
Banana Basin-10	10 ft	08/26/05	<0.1	<0.01	0.06	0.43	0.49
Banana Basin-15	15 ft	08/26/05	<0.1	<0.01	0.05	0.46	0.51
Banana Basin-25	25 ft	08/26/05	<0.1	<0.01	0.15	0.24	0.39
Banana Basin-SW	0 ft	08/30/05	<0.1	<0.01	0.46	1.00	1.46
Banana Basin-5	5 ft	08/30/05	<0.1	<0.01	0.12	0.51	0.63
Banana Basin-10	10 ft	08/30/05	0.1	<0.01	0.16	0.25	0.41
Banana Basin-15	15 ft	08/30/05	0.1	<0.01	0.18	<0.2	0.18
Banana Basin-25	25 ft	08/30/05	<0.1	<0.01	0.28	<0.2	0.28
Banana Basin-SW	0 ft	09/02/05	<0.1	<0.01	0.34	1.80	2.14
Banana Basin-5	5 ft	09/02/05	<0.1	<0.01	0.44	0.69	1.13
Banana Basin-10	10 ft	09/02/05	<0.1	<0.01	0.21	0.42	0.63
Banana Basin-15	15 ft	09/02/05	<0.1	<0.01	0.28	0.46	0.74
Banana Basin-25	25 ft	09/02/05	<0.1	<0.01	0.37	0.37	0.74
Banana Basin-SW	0 ft	09/06/05	0.04	0.01	2.00	1.70	3.71
Banana Basin-5	5 ft	09/06/05	<0.1	0.008	0.15	0.59	0.75
Banana Basin-10	10 ft	09/06/05	0.1	0.009	0.13	0.56	0.70
Banana Basin-15	15 ft	09/06/05	0.1	0.009	0.37	0.54	0.92
Banana Basin-25	25 ft	09/06/05	NA	NA	NA	0.35	IDC

Table 4-7
Basin and Lysimeter Monitoring Results for Banana Basin:
Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
Banana Basin-SW	0 ft	09/09/05	0.18	0.014	4.126	1.30	5.44
Banana Basin-5	5 ft	09/09/05	<0.1	<0.01	0.05	0.46	0.51
Banana Basin-10	10 ft	09/09/05	<0.1	<0.01	0.15	0.34	0.49
Banana Basin-15	15 ft	09/09/05	0.1	0.007	0.44	0.39	0.83
Banana Basin-25	25 ft	09/09/05	<0.1	<0.01	0.35	0.44	0.79
Banana Basin-SW	0 ft	09/13/05	<0.1	<0.500	2.50	1.90	4.40
Banana Basin-5	5 ft	09/13/05	<0.1	<0.01	<0.1	0.55	0.55
Banana Basin-10	10 ft	09/13/05	<0.1	<0.01	0.78	0.47	1.25
Banana Basin-15	15 ft	09/13/05	0.1	<0.01	1.4	0.4	1.80
Banana Basin-25	25 ft	09/13/05	0.04	<0.01	0.52	0.23	0.75
Banana Basin-SW	0 ft	09/16/05	0.1	<1.000	1	0.2	1.20
Banana Basin-5	5 ft	09/16/05	0.1	<0.500	<0.50	0.2	0.20
Banana Basin-10	10 ft	09/16/05	0.1	<0.500	0.5	0.2	0.70
Banana Basin-15	15 ft	09/16/05	0.1	<1.000	1	0.2	1.20
Banana Basin-25	25 ft	09/16/05	0.1	<1.000	<1.0	0.2	0.20
Banana Basin-SW	0 ft	09/20/05	0.36	0.019	1.60	2.00	3.62
Banana Basin-5	5 ft	09/20/05	0.1	0.005	0.11	0.49	0.60
Banana Basin-10	10 ft	09/20/05	0.1	0.012	0.99	0.36	1.37
Banana Basin-15	15 ft	09/20/05	0.1	0.011	1.52	0.52	2.05
Banana Basin-25	25 ft	09/20/05	0.1	0.006	0.66	0.24	0.91
Banana Basin-SW	0 ft	09/23/05	0.6	0.037	1.49	0.2	1.72
Banana Basin-5	5 ft	09/23/05	0.1	0.005	<0.1	0.2	0.21
Banana Basin-10	10 ft	09/23/05	0.1	0.013	0.73	0.2	0.95
Banana Basin-15	15 ft	09/23/05	0.1	0.01	1.67	0.2	1.88
Banana Basin-25	25 ft	09/23/05	0.1	0.006	0.62	0.2	0.83
Banana Basin-SW	0 ft	09/27/05	0.1	<0.01	0.39	2.5	2.89
Banana Basin-5	5 ft	09/27/05	0.1	0.006	0.12	0.62	0.75
Banana Basin-10	10 ft	09/27/05	0.1	0.009	0.28	0.37	0.66
Banana Basin-15	15 ft	09/27/05	0.1	0.009	1.15	0.57	1.73
Banana Basin-25	25 ft	09/27/05	<0.1	<0.01	0.69	0.53	1.22
Banana Basin-SW	0 ft	09/30/05	0.1	<0.01	<0.1	2.7	2.70
Banana Basin-5	5 ft	09/30/05	0.1	0.01	0.26	0.68	0.95
Banana Basin-10	10 ft	09/30/05	0.1	0.007	0.19	0.35	0.54
Banana Basin-15	15 ft	09/30/05	0.1	0.01	0.56	0.37	0.94
Banana Basin-25	25 ft	09/30/05	0.1	<0.01	0.53	0.26	0.79
Banana Basin-SW	0 ft	10/04/05	<0.1	<0.01	<0.1	1.4	1.40
Banana Basin-5	5 ft	10/04/05	0.1	<0.01	0.16	4.3	4.46
Banana Basin-10	10 ft	10/04/05	<0.1	<0.01	0.20	0.3	0.50
Banana Basin-15	15 ft	10/04/05	0.1	<0.01	0.36	0.34	0.70
Banana Basin-25	25 ft	10/04/05	<0.1	<0.01	0.59	0.26	0.85
Banana Basin-SW	0 ft	10/07/05	0.1	<0.01	<0.1	1.3	1.30
Banana Basin-5	5 ft	10/07/05	<0.1	<0.01	0.21	0.45	0.66
Banana Basin-10	10 ft	10/07/05	0.1	<0.01	0.28	0.41	0.69
Banana Basin-15	15 ft	10/07/05	0.1	<0.01	0.42	0.36	0.78
Banana Basin-25	25 ft	10/07/05	0.1	<0.01	0.58	0.29	0.87

Table 4-7
Basin and Lysimeter Monitoring Results for Banana Basin:
Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
Banana Basin-SW	0 ft	10/13/05	0.1	<0.01	0.66	1.3	1.96
Banana Basin-5	5 ft	10/13/05	0.1	<0.01	0.20	0.52	0.72
Banana Basin-10	10 ft	10/13/05	0.1	<0.01	0.51	0.33	0.84
Banana Basin-15	15 ft	10/13/05	0.1	<0.01	0.70	0.38	1.08
Banana Basin-25	25 ft	10/13/05	0.1	<0.01	0.62	0.32	0.94
Banana Basin-SW	0 ft	10/14/05	0.1	0.011	1.77	1.1	2.88
Banana Basin-5	5 ft	10/14/05	0.1	<0.01	<0.1	0.54	0.54
Banana Basin-10	10 ft	10/14/05	0.1	<0.01	0.67	0.57	1.24
Banana Basin-15	15 ft	10/14/05	0.1	<0.01	0.88	0.83	1.71
Banana Basin-25	25 ft	10/14/05	0.1	<0.01	0.70	<0.2	0.70
Banana Basin-SW	0 ft	10/18/05	0.2	0.047	0.91	2	2.95
Banana Basin-5	5 ft	10/18/05	0.1	<0.01	<0.1	0.47	0.47
Banana Basin-10	10 ft	10/18/05	0.1	0.01	0.48	0.28	0.77
Banana Basin-15	15 ft	10/18/05	0.1	0.011	0.92	0.23	1.17
Banana Basin-25	25 ft	10/18/05	0.1	<0.01	0.63	<0.2	0.63
Banana Basin-SW	0 ft	10/21/05	0.1	0.048	0.78	1.4	2.22
Banana Basin-5	5 ft	10/21/05	<0.1	<0.01	<0.1	0.52	0.52
Banana Basin-10	10 ft	10/21/05	<0.1	0.01	0.30	0.29	0.60
Banana Basin-15	15 ft	10/21/05	<0.1	0.012	0.95	0.26	1.23
Banana Basin-25	25 ft	10/21/05	<0.1	<0.01	0.68	0.46	1.14
Banana Basin-SW	0 ft	10/25/05	<0.1	0.039	0.31	1.3	1.65
Banana Basin-5	5 ft	10/25/05	1.2	0.01	0.37	0.46	0.84
Banana Basin-10	10 ft	10/25/05	0.2	<0.01	0.25	0.49	0.74
Banana Basin-15	15 ft	10/25/05	0.2	0.011	0.83	0.32	1.16
Banana Basin-25	25 ft	10/25/05	0.1	<0.01	0.56	0.3	0.86
Banana Basin-SW	0 ft	10/28/05	0.1	0.033	0.22	1.1	1.35
Banana Basin-5	5 ft	10/28/05	0.1	<0.01	<0.1	0.97	0.97
Banana Basin-10	10 ft	10/28/05	0.1	0.019	0.32	0.63	0.97
Banana Basin-15	15 ft	10/28/05	0.1	0.01	0.31	<0.2	0.32
Banana Basin-25	25 ft	10/28/05	0.1	<0.01	0.51	1.3	1.81
Banana Basin-SW	0 ft	11/01/05	0.2	0.02	0.10	1.3	1.42
Banana Basin-5	5 ft	11/01/05	0.1	<0.01	<0.1	0.65	0.65
Banana Basin-10	10 ft	11/01/05	0.1	<0.01	0.20	0.73	0.93
Banana Basin-15	15 ft	11/01/05	0.1	<0.01	0.40	0.33	0.73
Banana Basin-25	25 ft	11/01/05	0.1	<0.01	0.40	<0.2	0.40
Banana Basin-SW	0 ft	11/04/05	0.2	0.01	0.10	1.1	1.21
Banana Basin-5	5 ft	11/04/05	<0.1	<0.01	<0.1	<0.2	0.00
Banana Basin-10	10 ft	11/04/05	<0.1	<0.01	0.20	0.33	0.53
Banana Basin-15	15 ft	11/04/05	NT	NT	NT	0.35	IDC
Banana Basin-SW	0 ft	11/08/05	0.1	HM	0.42	1.2	IDC
Banana Basin-5	5 ft	11/08/05	0.1	<0.01	<0.1	<0.2	0.00
Banana Basin-10	10 ft	11/08/05	0.1	<0.01	<0.1	0.39	0.39
Banana Basin-15	15 ft	11/08/05	0.1	0.01	<0.1	0.55	0.56
Banana Basin-25	25 ft	11/08/05	0.1	0.03	<0.1	0.54	0.57

Table 4-7
Basin and Lysimeter Monitoring Results for Banana Basin:
Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
Banana Basin-SW	0 ft	11/11/05	0.1	<0.01	0.54	1.2	1.74
Banana Basin-5	5 ft	11/11/05	0.1	0.01	0.46	0.34	0.81
Banana Basin-10	10 ft	11/11/05	0.1	<0.01	<0.1	0.41	0.41
Banana Basin-15	15 ft	11/11/05	0.1	<0.01	0.43	0.42	0.85
Banana Basin-25	25 ft	11/11/05	0.1	<0.01	0.43	0.45	0.88
Banana Basin-SW	0 ft	11/15/05	<0.1	HM	HM	1.2	IDC
Banana Basin-5	5 ft	11/15/05	<0.1	HM	HM	<0.2	IDC
Banana Basin-10	10 ft	11/15/05	<0.1	HM	HM	0.40	IDC
Banana Basin-15	15 ft	11/15/05	<0.1	HM	HM	0.27	IDC
Banana Basin-25	25 ft	11/15/05	<0.1	HM	0.47	0.23	IDC
Banana Basin-SW	0 ft	11/18/05	0.1	<0.01	<0.1	2.3	2.30
Banana Basin-5	5 ft	11/18/05	0.1	<0.01	0.10	0.43	0.53
Banana Basin-10	10 ft	11/18/05	<0.1	<0.01	0.20	0.22	0.42
Banana Basin-15	15 ft	11/18/05	0.1	<0.01	0.60	0.35	0.95
Banana Basin-25	25 ft	11/18/05	<0.1	<0.01	0.50	1.7	2.20
Banana Basin-SW	0 ft	11/22/05	0.1	<0.01	<0.1	1.1	1.10
Banana Basin-5	5 ft	11/22/05	0.1	0.10	<0.1	0.35	0.45
Banana Basin-10	10 ft	11/22/05	0.1	<0.01	0.16	0.26	0.42
Banana Basin-15	15 ft	11/22/05	0.1	0.01	0.56	0.37	0.94
Banana Basin-25	25 ft	11/22/05	0.1	<0.01	0.52	0.22	0.74
Banana Basin-SW	0 ft	11/25/05	<0.1	<0.01	<0.1	1	1.00
Banana Basin-5	5 ft	11/25/05	<0.1	<0.01	<0.1	0.31	0.31
Banana Basin-10	10 ft	11/25/05	<0.1	<0.01	0.20	0.31	0.51
Banana Basin-15	15 ft	11/25/05	0.1	<0.01	0.52	0.25	0.77
Banana Basin-25	25 ft	11/25/05	<0.1	<0.01	0.57	0.25	0.82
Banana Basin-SW	0 ft	11/29/05	0.1	<0.01	<0.1	0.95	0.95
Banana Basin-5	5 ft	11/29/05	0.2	<0.01	0.10	0.26	0.36
Banana Basin-10	10 ft	11/29/05	0.1	0.02	0.40	<0.2	0.42
Banana Basin-15	15 ft	11/29/05	0.2	<0.01	0.50	<0.2	0.50
Banana Basin-25	25 ft	11/29/05	0.1	<0.01	<0.1	<0.2	0.00
Banana Basin-SW	0 ft	12/02/05	NA	0.001	0.003	1.2	1.20
Banana Basin-5	5 ft	12/02/05	<0.1	<0.01	0.08	0.45	0.53
Banana Basin-10	10 ft	12/02/05	<0.1	<0.01	0.31	0.31	0.62
Banana Basin-15	15 ft	12/02/05	<0.1	<0.01	0.45	0.3	0.75
Banana Basin-25	25 ft	12/02/05	<0.1	<0.01	0.48	0.43	0.91
Banana Basin-SW	0 ft	12/06/05	0.1	0.00	NA	1.3	IDC
Banana Basin-5	5 ft	12/06/05	0.1	<0.01	0.05	0.32	0.37
Banana Basin-10	10 ft	12/06/05	0.1	<0.01	0.35	<0.2	0.35
Banana Basin-15	15 ft	12/06/05	0.1	<0.01	0.50	0.21	0.71
Banana Basin-25	25 ft	12/06/05	0.1	<0.01	0.45	<0.2	0.45
Banana Basin-SW	0 ft	12/09/05	0.1	NA	0.13	1.4	IDC
Banana Basin-5	5 ft	12/09/05	0.1	0.08	0.11	0.88	1.07
Banana Basin-10	10 ft	12/09/05	0.04	0.01	0.45	0.22	0.68
Banana Basin-15	15 ft	12/09/05	0.1	<0.01	0.58	0.37	0.95
Banana Basin-25	25 ft	12/09/05	0.04	<0.01	0.45	0.38	0.83

Table 4-7
Basin and Lysimeter Monitoring Results for Banana Basin: Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
Banana Basin-SW	0 ft	12/13/05	0.2	NA	0.06	1.4	IDC
Banana Basin-5	5 ft	12/13/05	0.1	0.046	0.17	0.40	0.61
Banana Basin-10	10 ft	12/13/05	0.1	0.032	0.59	0.29	0.91
Banana Basin-15	15 ft	12/13/05	0.1	0.015	0.68	0.23	0.92
Banana Basin-25	25 ft	12/13/05	0.1	0.01	0.46	<0.2	0.47
Banana Basin-SW	0 ft	12/16/05	0.1	0.007	0.34	1.4	1.75
Banana Basin-5	5 ft	12/16/05	0.1	0.001	0.09	<0.2	0.09
Banana Basin-10	10 ft	12/16/05	0.1	0.007	0.69	0.51	1.21
Banana Basin-15	15 ft	12/16/05	0.1	0.004	0.81	0.44	1.25
Banana Basin-25	25 ft	12/16/05	0.1	0.00	0.50	0.25	0.75
Banana Basin-SW	0 ft	12/20/05	0.12	0.04	0.25	1.50	1.79
Banana Basin-5	5 ft	12/20/05	<0.1	<0.01	0.09	0.34	0.44
Banana Basin-10	10 ft	12/20/05	<0.1	0.013	0.82	0.36	1.19
Banana Basin-15	15 ft	12/20/05	<0.1	<0.01	0.92	0.31	1.23
Banana Basin-25	25 ft	12/20/05	<0.1	<0.01	0.57	<0.2	0.57
Banana Basin-SW	0 ft	12/23/05	0.2	0.001	0.067	1.90	1.97
Banana Basin-5	5 ft	12/23/05	0.1	<0.01	0.38	0.31	0.69
Banana Basin-10	10 ft	12/23/05	0.1	<0.01	0.94	0.49	1.43
Banana Basin-15	15 ft	12/23/05	0.1	<0.01	1.06	0.30	1.36
Banana Basin-25	25 ft	12/23/05	0.1	<0.01	0.43	0.42	0.85
Banana Basin-SW	0 ft	12/27/05	0.1	0.02	0.118	1.40	1.54
Banana Basin-5	5 ft	12/27/05	0.1	<0.01	0.27	0.60	0.87
Banana Basin-10	10 ft	12/27/05	0.1	0.019	0.90	0.23	1.15
Banana Basin-15	15 ft	12/27/05	0.1	<0.01	1.14	0.26	1.40
Banana Basin-25	25 ft	12/27/05	0.1	0.001	0.57	0.41	0.98
Banana Basin-SW	0 ft	12/29/05	0.1	0.002	0.02	1.20	1.22
Banana Basin-5	5 ft	12/29/05	0.1	<0.01	0.60	0.50	1.10
Banana Basin-10	10 ft	12/29/05	0.1	<0.01	0.94	0.49	1.43
Banana Basin-15	15 ft	12/29/05	0.1	<0.01	1.24	0.41	1.65
Banana Basin-25	25 ft	12/29/05	0.1	0.001	0.68	0.30	0.98

NA: Result not available from laboratory

HM: Hold-time missed due to laboratory QA/QC problems

ND: Not Detected

NS-BD: Not Sampled-Basin Dry

NT: Insufficient Sample for Analytical Test

IDC: Insufficient Data for Calculation

< : Result is below the laboratory detection limit; detection limit was not provided by the Lab

Table 4-8
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell:
Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
HW-SW	0 ft	06/10/05	NT	0.02	0.2	1.20	1.4
HW-5	5 ft	06/10/05	NT	0.05	0.5	0.49	1.0
HW-25B	25 ft	06/10/05	<0.1	0.04	1.0	0.33	1.4
HW-25A	25 ft	06/10/05	<0.1	0.02	1.5	0.33	1.9
HW-SW	0 ft	06/15/05	<0.1	0.04	<0.1	1.90	1.9
HW-5	5 ft	06/15/05	<0.1	0.01	<0.1	0.50	0.5
HW-25	25 ft	06/15/05	<0.1	0.02	0.3	0.32	0.6
HW-SW	0 ft	06/20/05	0.2	0.01	<0.1	2.10	2.1
HW-5	5 ft	06/20/05	NT	NT	NT	0.93	IDC
HW-25	25 ft	06/20/05	0.1	<0.01	0.3	0.46	0.8
HW-5	5 ft	06/23/05	NT	NT	NT	0.52	IDC
HW-25B	25 ft	06/23/05	0.1	<0.01	0.3	0.24	0.5
HW-SW	0 ft	06/27/05	0.1	0.02	0.4	0.81	1.2
HW-5	5 ft	06/27/05	0.1	0.06	5.3	1.00	6.3
HW-25	25 ft	06/27/05	0.1	0.01	0.7	0.42	1.1
HW-SW	0 ft	06/30/05	0.1	0.05	<0.1	0.74	0.8
HW-5	5 ft	06/30/05	0.1	0.01	0.6	0.31	0.9
HW-15	15 ft	06/30/05	0.1	0.02	1.3	NT	IDC
HW-25	25 ft	06/30/05	0.1	0.02	0.6	<0.2	0.6
HW-SW	0 ft	07/05/05	0.1	0.05	0.1	0.54	0.7
HW-5	5 ft	07/05/05	0.1	0.01	0.4	0.36	0.7
HW-25	25 ft	07/05/05	0.1	0.02	0.4	0.25	0.7
HW-SW	0 ft	07/07/05	0.1	0.01	0.1	0.50	0.6
HW-5	5 ft	07/07/05	0.1	<0.01	0.2	0.50	0.7
HW-25	25 ft	07/07/05	0.1	0.02	0.4	0.35	0.8
HW-SW	0 ft	07/12/05	0.2	0.10	0.2	1.40	1.7
HW-5	5 ft	07/12/05	0.1	<0.01	0.2	0.27	0.5
HW-25	25 ft	07/12/05	0.1	0.01	0.4	0.2	0.6
HW-SW	0 ft	07/15/05	0.1	0.02	0.2	0.73	1.0
HW-5	5 ft	07/15/05	0.1	0.03	0.1	0.31	0.4
HW-25	25 ft	07/15/05	0.1	0.01	0.5	0.21	0.7
HW-SW	0 ft	07/19/05	0.1	0.11	0.1	0.76	1.0
HW-5	5 ft	07/19/05	1.0	0.08	0.2	0.38	0.6
HW-25	25 ft	07/19/05	0.1	<0.01	0.5	0.27	0.8
HW-SW	0 ft	07/22/05	0.1	<0.01	<0.1	0.93	0.9
HW-5	5 ft	07/22/05	0.1	0.02	<0.1	0.46	0.5
HW-25	25 ft	07/22/05	0.1	<0.01	0.5	0.22	0.7
HW-SW	0 ft	07/26/05	0.2	<0.01	<0.1	1.4	1.4
HW-5	5 ft	07/26/05	0.1	<0.01	<0.1	0.51	0.5
HW-25	25 ft	07/26/05	0.1	<0.01	0.2	0.23	0.4
HW-SW	0 ft	07/29/05	0.1	0.02	<0.1	0.92	0.9
HW-5	5 ft	07/29/05	0.1	<0.01	<0.1	0.55	0.6
HW-25	25 ft	07/29/05	0.1	<0.01	0.1	0.36	0.5
HW-SW	0 ft	08/02/05	0.1	0.05	0.2	0.74	1.0
HW-5	5 ft	08/02/05	0.1	<0.01	<0.1	0.44	0.4
HW-25	25 ft	08/02/05	0.1	<0.01	0.4	0.28	0.7
HW-SW	0 ft	08/05/05	0.1	0.02	<0.1	1.1	1.1
HW-5	5 ft	08/05/05	0.1	<0.01	0.2	0.35	0.6
HW-25	25 ft	08/05/05	0.2	<0.01	0.4	0.31	0.7
HW-SW	0 ft	08/09/05	<0.1	0.01	<0.1	0.53	0.5
HW-5	5 ft	08/09/05	<0.1	0.02	0.1	0.31	0.4
HW-25	25 ft	08/09/05	<0.1	<0.01	0.4	0.22	0.6

Table 4-8
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell:
Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
HW-SW	0 ft	08/12/05	<0.1	0.01	<0.1	0.5	0.5
HW-5	5 ft	08/12/05	<0.1	<0.01	<0.1	0.28	0.3
HW-25	25 ft	08/12/05	<0.1	<0.01	0.3	0.22	0.6
HW-SW	0 ft	08/16/05	<0.1	0.17	0.8	1.40	2.4
HW-5	5 ft	08/16/05	<0.1	<0.01	0.1	0.29	0.4
HW-25	25 ft	08/16/05	<0.1	<0.01	0.3	0.18	0.5
HW-SW	0 ft	08/19/05	0.2	0.07	0.2	1.0	1.3
HW-5	5 ft	08/19/05	0.1	<0.01	<0.1	0.61	0.6
HW-25	25 ft	08/19/05	0.1	<0.01	0.1	0.38	0.4
HW-SW	0 ft	08/23/05	0.1	<0.01	<0.1	0.6	0.6
HW-5	5 ft	08/23/05	<0.1	<0.01	0.2	0.3	0.5
HW-25	25 ft	08/23/05	0.1	<0.01	0.5	0.22	0.7
HW-SW	0 ft	08/26/05	<0.1	0.02	<0.1	0.5	0.5
HW-5	5 ft	08/26/05	<0.1	<0.01	<0.1	0.84	0.8
HW-25	25 ft	08/26/05	<0.1	<0.01	0.3	0.2	0.5
HW-SW	0 ft	08/30/05	0.1	0.02	<0.1	0.76	0.8
HW-5	5 ft	08/30/05	<0.1	0.01	<0.1	0.38	0.4
HW-25	25 ft	08/30/05	<0.1	<0.01	0.4	0.24	0.7
HW-5	5 ft	09/02/05	<0.1	<0.01	1.6	0.36	2.0
HW-25	25 ft	09/02/05	<0.1	<0.01	0.6	0.92	1.5
HW-SW	0 ft	09/06/05	0.1	0.02	<0.1	1.7	1.7
HW-5	5 ft	09/06/05	NT	NT	NT	0.63	IDC
HW-25	25 ft	09/06/05	<0.1	<0.01	0.6	1.95	2.5
HW-SW	0 ft	09/09/05	<0.1	0.01	<0.1	0.77	0.8
HW-5	5 ft	09/09/05	<0.1	<0.01	0.1	0.44	0.5
HW-25	25 ft	09/09/05	<0.1	<0.01	0.8	<0.20	0.8
HW-SW	0 ft	09/13/05	0.1	<0.50	1.4	1.2	2.6
HW-5	5 ft	09/13/05	<0.1	<0.01	0.6	0.41	1.0
HW-25	25 ft	09/13/05	<0.1	<0.20	0.9	0.2	1.1
HW-SW	0 ft	09/16/05	0.1	<0.50	0.5	0.20	0.7
HW-5	5 ft	09/16/05	0.2	<1.00	<1.0	0.2	0.2
HW-25	25 ft	09/16/05	0.1	<0.50	0.5	0.2	0.7
HW-SW	0 ft	09/20/05	0.4	0.06	2.0	2.8	4.9
HW-5	5 ft	09/20/05	0.1	<0.01	0.1	0.48	0.6
HW-25	25 ft	09/20/05	0.1	<0.01	0.7	0.34	1.0
HW-SW	0 ft	09/23/05	0.5	0.37	0.4	0.2	0.9
HW-5	5 ft	09/23/05	0.1	0.01	<0.1	0.2	0.2
HW-25	25 ft	09/23/05	0.1	<0.01	0.6	0.2	0.8
HW-SW	0 ft	09/27/05	0.1	0.04	0.3	1.90	2.2
HW-5	5 ft	09/27/05	0.1	<0.01	<0.1	0.98	1.0
HW-25	25 ft	09/27/05	0.1	<0.01	0.1	0.8	0.9
HW-SW	0 ft	09/30/05	NT	NT	NT	1.7	IDC
HW-5	5 ft	09/30/05	0.1	0.01	0.1	0.96	1.1
HW-25	25 ft	09/30/05	0.1	<0.01	<0.1	0.49	0.5
HW-SW	0 ft	10/04/05	0.2	<0.01	<0.1	3.30	3.3
HW-5	5 ft	10/04/05	0.1	<0.01	0.3	0.59	0.9
HW-25	25 ft	10/04/05	<0.1	<0.01	<0.1	0.48	0.5
HW-SW	0 ft	10/07/05	0.5	0.06	0.3	2.4	2.8
HW-5	5 ft	10/07/05	0.1	<0.01	2.5	1.3	3.8
HW-25	25 ft	10/07/05	0.1	<0.01	0.2	0.4	0.6

Table 4-8
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell:
Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
HW-SW	0 ft	10/13/05	0.1	0.01	0.2	1.7	1.9
HW-5	5 ft	10/13/05	NT	NT	NT	0.74	IDC
HW-25	25 ft	10/13/05	0.1	<0.01	1.0	0.38	1.4
HW-SW	0 ft	10/14/05	0.1	<0.01	<0.1	1.7	1.7
HW-5	5 ft	10/14/05	0.1	<0.01	0.3	0.65	1.0
HW-25	25 ft	10/14/05	0.1	<0.01	0.8	0.32	1.1
HW-SW	0 ft	10/18/05	0.2	0.03	1.0	1.3	2.3
HW-5	5 ft	10/18/05	0.1	<0.01	0.8	0.43	1.3
HW-25	25 ft	10/18/05	0.1	<0.01	0.6	0.4	1.0
HW-SW	0 ft	10/21/05	0.8	0.01	<0.1	3.5	3.5
HW-5	5 ft	10/21/05	0.1	0.02	0.4	0.34	0.7
HW-25	25 ft	10/21/05	<0.1	<0.01	0.7	0.39	1.1
HW-SW	0 ft	10/25/05	0.2	0.02	3.3	1.7	5.0
HW-25	25 ft	10/25/05	0.2	0.01	1.2	0.37	1.6
HW-25	25 ft	11/01/05	0.1	0.01	1.5	0.48	2.0
HW-25	25 ft	11/08/05	0.1	HM	1.6	0.36	IDC
HW-SW	0 ft	11/11/05	0.2	0.02	0.3	1.6	1.9
HW-25	25 ft	11/11/05	0.1	<0.01	1.9	0.32	2.2
HW-SW	0 ft	11/15/05	0.1	HM	HM	0.98	IDC
HW-5	5 ft	11/15/05	0.1	HM	HM	0.75	IDC
HW-10	10 ft	11/15/05	<0.1	HM	HM	0.71	IDC
HW-25	25 ft	11/15/05	<0.1	HM	HM	0.68	IDC
HW-SW	0 ft	11/18/05	0.1	0.01	2.1	1.3	3.4
HW-5	5 ft	11/18/05	0.1	<0.01	0.2	0.7	0.9
HW-10	10 ft	11/18/05	<0.1	<0.01	0.6	0.60	1.2
HW-15	15 ft	11/18/05	NT	NT	NT	1.10	IDC
HW-25	25 ft	11/18/05	<0.1	<0.01	1.2	0.57	1.8
HW-SW	0 ft	11/22/05	0.1	<0.01	1.1	1.5	2.6
HW-5	5 ft	11/22/05	0.1	<0.01	0.2	0.6	0.9
HW-10	10 ft	11/22/05	0.2	<0.01	0.4	0.57	1.0
HW-15	15 ft	11/22/05	0.1	HM	HM	1.20	1.5
HW-25	25 ft	11/22/05	0.4	0.02	0.2	0.62	0.8
HW-SW	0 ft	11/25/05	0.1	<0.01	0.1	1.9	2.0
HW-5	5 ft	11/25/05	0.1	<0.01	0.3	0.7	1.0
HW-10	10 ft	11/25/05	0.1	<0.01	0.4	0.73	1.2
HW-15	15 ft	11/25/05	0.4	0.04	0.4	1.50	2.0
HW-25	25 ft	11/25/05	0.1	<0.01	0.9	0.60	1.5
HW-SW	0 ft	11/29/05	0.2	<0.01	0.1	1.3	1.4
HW-5	5 ft	11/29/05	0.2	<0.01	0.3	0.8	1.1
HW-10	10 ft	11/29/05	0.3	<0.01	0.3	0.98	1.3
HW-15	15 ft	11/29/05	NT	NT	NT	1.30	IDC
HW-25	25 ft	11/29/05	0.2	<0.01	0.3	0.49	0.8
HW-SW	0 ft	12/02/05	<0.1	<0.01	<0.1	1.9	1.9
HW-5	5 ft	12/02/05	0.3	<0.01	0.1	1.0	1.1
HW-10	10 ft	12/02/05	0.2	<0.01	0.3	0.75	1.0
HW-15	15 ft	12/02/05	0.3	0.11	0.3	1.00	1.4
HW-25	25 ft	12/02/05	<0.1	<0.01	0.2	0.92	1.2
HW-SW	0 ft	12/06/05	NT	<0.01	<0.1	1.2	1.2
HW-5	5 ft	12/06/05	0.6	<0.01	<0.1	1.0	1.0
HW-10	10 ft	12/06/05	0.2	<0.01	0.3	0.56	0.9
HW-15	15 ft	12/06/05	0.3	0.12	0.3	0.80	1.2
HW-25	25 ft	12/06/05	0.3	<0.01	0.3	0.40	0.7

Table 4-8
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell:
Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
HW-SW	0 ft	12/09/05	0.1	<0.01	0.1	2.2	2.3
HW-5	5 ft	12/09/05	0.2	0.01	0.1	0.9	1.0
HW-10	10 ft	12/09/05	0.3	0.01	0.3	0.60	0.9
HW-15	15 ft	12/09/05	0.1	0.11	0.3	0.87	1.3
HW-25	25 ft	12/09/05	0.1	0.01	0.2	0.60	0.8
HW-SW	0 ft	12/13/05	0.1	<0.01	<0.1	1.3	1.3
HW-5	5 ft	12/13/05	0.3	0.01	0.1	0.9	1.0
HW-10	10 ft	12/13/05	0.2	0.01	0.3	0.63	1.0
HW-15	15 ft	12/13/05	0.3	0.11	0.3	0.85	1.3
HW-25	25 ft	12/13/05	0.1	<0.01	0.3	0.51	0.8
HW-SW	0 ft	12/16/05	0.1	<0.01	<0.1	1.6	1.6
HW-5	5 ft	12/16/05	0.3	<0.01	0.2	1.0	1.1
HW-10	10 ft	12/16/05	0.2	0.01	0.3	0.68	1.0
HW-15	15 ft	12/16/05	0.4	0.09	0.3	0.67	1.1
HW-25	25 ft	12/16/05	0.1	<0.01	0.3	0.90	1.2
HW-SW	0 ft	12/20/05	<0.1	<0.01	<0.1	1.5	1.5
HW-5	5 ft	12/20/05	0.2	<0.01	0.2	1.0	1.1
HW-10	10 ft	12/20/05	0.1	<0.01	0.3	0.51	0.9
HW-15	15 ft	12/20/05	0.3	<0.01	0.3	0.85	1.3
HW-25	25 ft	12/20/05	<0.1	<0.01	0.4	0.59	1.0
HW-SW	0 ft	12/23/05	0.1	<0.01	0.2	1.7	1.9
HW-5	5 ft	12/23/05	0.2	<0.01	0.2	0.9	1.1
HW-10	10 ft	12/23/05	0.1	0.01	0.4	0.85	1.2
HW-15	15 ft	12/23/05	0.2	0.09	0.3	1.20	1.6
HW-25	25 ft	12/23/05	0.1	<0.01	0.4	0.49	0.9
HW-SW	0 ft	12/27/05	0.1	<0.01	<0.1	1.7	1.7
HW-5	5 ft	12/27/05	0.2	<0.01	<0.1	1.1	1.1
HW-10	10 ft	12/27/05	0.1	0.01	0.3	0.62	1.0
HW-15	15 ft	12/27/05	0.1	0.06	0.4	1.40	1.8
HW-25	25 ft	12/27/05	0.1	<0.01	0.4	0.47	0.9
HW-SW	0 ft	12/30/05	0.2	<0.01	0.2	1.7	1.7
HW-5	5 ft	12/30/05	0.2	<0.01	<0.1	0.75	0.8
HW-10	10 ft	12/30/05	0.2	<0.01	<0.1	0.43	0.4
HW-15	15 ft	12/30/05	0.3	<0.01	<0.1	0.66	0.7
HW-25	25 ft	12/30/05	0.2	<0.01	<0.1	0.44	0.4

HM: Hold-time missed due to laboratory QA/QC problems
NS-BD: Not Sampled-Basin Dry
NT: Insufficient Sample for Analytical Test
IDC: Insufficient Data for Calculation

Table 4-9
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
HE-SW	0 ft	06/10/05	NT	0.01	<0.1	0.73	0.7
HE-5	5 ft	06/10/05	<0.1	<0.01	0.4	0.44	0.8
HE-10	10 ft	06/10/05	NT	NT	NT	0.62	IDC
HE-15	15 ft	06/10/05	<0.1	0.01	3.1	0.44	3.6
HE-25B	25 ft	06/10/05	<0.1	0.02	1.8	0.38	2.2
HE-25A	25 ft	06/10/05	<0.1	0.01	1.9	0.33	2.2
HE-5	5 ft	06/15/05	NT	NT	NT	0.40	IDC
HE-10	10 ft	06/15/05	<0.1	0.05	0.8	0.27	1.1
HE-15	15 ft	06/15/05	<0.1	<0.01	3.5	0.40	3.9
HE-25	25 ft	06/15/05	<0.1	0.02	3.5	0.23	3.7
HE-5	5 ft	06/20/05	NT	NT	NT	0.36	IDC
HE-10	10 ft	06/20/05	<0.1	0.02	1.2	0.51	1.7
HE-15	15 ft	06/20/05	<0.1	0.01	2.2	0.61	2.8
HE-25	25 ft	06/20/05	<0.1	0.01	3.2	0.45	3.7
HE-SW	0 ft	06/23/05	0.3	<0.01	<0.1	2.50	2.5
HE-5	5 ft	06/23/05	NT	NT	NT	0.94	IDC
HE-10	10 ft	06/23/05	0.1	0.01	1.1	0.31	1.4
HE-15	15 ft	06/23/05	0.1	0.01	1.7	0.31	2.0
HE-25	25 ft	06/23/05	0.1	<0.01	3.5	0.24	3.7
HE-SW	0 ft	06/27/05	0.1	0.02	0.4	0.77	1.2
HE-5	5 ft	06/27/05	NT	NT	NT	0.38	IDC
HE-10	10 ft	06/27/05	0.1	0.05	0.9	0.29	1.3
HE-15	15 ft	06/27/05	0.1	0.02	1.4	<0.2	1.4
HE-25	25 ft	06/27/05	0.1	<0.01	3.4	<0.2	3.4
HE-SW	0 ft	06/30/05	0.1	<0.01	<0.1	0.57	0.6
HE-5	5 ft	06/30/05	0.1	0.01	4.5	0.49	5.0
HE-10	10 ft	06/30/05	0.1	0.03	0.8	<0.2	0.8
HE-15	15 ft	06/30/05	NT	NT	NT	<0.2	IDC
HE-25	25 ft	06/30/05	0.1	<0.01	3.2	<0.2	3.2
HE-SW	0 ft	07/05/05	0.2	<0.01	<0.1	1.10	1.1
HE-5	5 ft	07/05/05	0.1	0.02	0.6	0.35	0.9
HE-10	10 ft	07/05/05	0.1	<0.01	0.6	0.22	0.8
HE-15	15 ft	07/05/05	0.1	0.02	1.2	<0.2	1.2
HE-25	25 ft	07/05/05	0.1	0.02	2.2	0.22	2.4
HE-SW	0 ft	07/07/05	0.1	<0.01	0.1	0.50	0.6
HE-5	5 ft	07/07/05	NT	NT	NT	0.28	IDC
HE-10	10 ft	07/07/05	0.1	0.01	2.4	0.40	2.8
HE-15	15 ft	07/07/05	0.1	<0.01	1.5	0.27	1.8
HE-25	25 ft	07/07/05	0.1	0.01	3.6	0.21	3.8
HE-SW	0 ft	07/12/05	0.1	0.02	<0.1	0.86	0.9
HE-5	5 ft	07/12/05	NT	NT	NT	0.31	IDC
HE-10	10 ft	07/12/05	NT	NT	NT	0.43	IDC
HE-15	15 ft	07/12/05	0.1	0.02	1.5	0.28	1.8
HE-25	25 ft	07/12/05	0.1	0.02	3.5	0.21	3.7
HE-SW	0 ft	07/15/05	0.1	<0.01	0.1	0.69	0.8
HE-5	5 ft	07/15/05	0.1	0.03	0.5	0.29	0.8

Table 4-9
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
HE-10	10 ft	07/15/05	0.1	0.03	4.6	0.45	5.0
HE-15	15 ft	07/15/05	0.1	<0.01	1.5	0.27	1.8
HE-25	25 ft	07/15/05	<0.1	<0.01	4.4	<0.2	4.4
HE-SW	0 ft	07/19/05	0.1	0.01	<0.1	0.56	0.6
HE-5	5 ft	07/19/05	NT	NT	NT	0.31	IDC
HE-10	10 ft	07/19/05	0.1	0.07	5.1	0.41	5.5
HE-15	15 ft	07/19/05	0.1	0.07	1.4	<0.2	1.5
HE-25	25 ft	07/19/05	0.1	<0.1	3.7	<0.2	3.7
HE-SW	0 ft	07/22/05	0.1	<0.01	<0.1	0.98	1.0
HE-5	5 ft	07/22/05	0.1	0.02	<0.1	0.36	0.4
HE-10	10 ft	07/22/05	0.1	0.04	5.5	0.37	5.9
HE-15	15 ft	07/22/05	0.1	0.06	1.4	0.32	1.8
HE-25	25 ft	07/22/05	0.1	0.05	1.6	0.21	1.9
HE-5	5 ft	07/26/05	0.1	<0.01	<0.1	0.27	0.3
HE-10	10 ft	07/26/05	0.1	0.05	4.9	0.39	5.4
HE-15	15 ft	07/26/05	0.1	<0.01	1.4	0.24	1.6
HE-25	25 ft	07/26/05	0.1	<0.01	3.9	<0.20	3.9
HE-SW	0 ft	07/29/05	0.1	0.01	0.1	1.30	1.4
HE-5	5 ft	07/29/05	0.1	<0.01	<0.1	0.30	0.3
HE-10	10 ft	07/29/05	0.1	0.02	4.1	0.32	4.5
HE-15	15 ft	07/29/05	<0.1	<0.01	1.6	0.12	1.7
HE-25	25 ft	07/29/05	0.1	0.01	1.9	0.16	2.1
HE-SW	0 ft	08/02/05	0.2	0.03	<0.1	1.10	1.1
HE-5	5 ft	08/02/05	0.1	<0.01	0.4	0.45	0.9
HE-15	15 ft	08/02/05	0.1	<0.01	1.5	0.18	1.7
HE-25	25 ft	08/02/05	0.1	<0.01	3.6	0.42	4.0
HE-SW	0 ft	08/05/05	0.1	0.05	0.1	0.66	0.8
HE-5	5 ft	08/05/05	0.2	<0.01	0.2	0.38	0.6
HE-10	10 ft	08/05/05	0.1	<0.01	0.4	0.25	0.7
HE-15	15 ft	08/05/05	0.3	0.03	2.5	0.34	2.8
HE-25	25 ft	08/05/05	0.2	<0.01	1.2	0.16	1.4
HE-SW	0 ft	08/09/05	<0.1	0.01	<0.1	0.61	0.6
HE-5	5 ft	08/09/05	<0.1	<0.01	0.7	0.30	1.0
HE-10	10 ft	08/09/05	<0.1	<0.01	0.1	0.26	0.4
HE-15	15 ft	08/09/05	<0.1	<0.01	0.7	0.27	0.9
HE-25	25 ft	08/09/05	<0.1	<0.01	0.6	0.17	0.8
HE-SW	0 ft	08/12/05	<0.1	<0.01	<0.1	0.50	0.5
HE-5	5 ft	08/12/05	<0.1	<0.01	0.2	0.29	0.5
HE-10	10 ft	08/12/05	<0.1	<0.01	0.3	0.24	0.5
HE-15	15 ft	08/12/05	<0.1	<0.01	0.5	0.21	0.7
HE-25	25 ft	08/12/05	<0.1	<0.01	0.8	0.14	0.9
HE-SW	0 ft	08/16/05	0.1	0.13	1.0	1.80	3.0
HE-5	5 ft	08/16/05	<0.1	<0.01	0.2	0.31	0.5
HE-10	10 ft	08/16/05	<0.1	<0.01	0.2	0.31	0.5
HE-15	15 ft	08/16/05	<0.1	<0.01	0.2	0.31	0.5
HE-25	25 ft	08/16/05	<0.1	<0.01	0.6	0.14	0.8

Table 4-9
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell:
Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
HE-SW	0 ft	08/19/05	0.4	0.04	0.1	2.40	2.6
HE-5	5 ft	08/19/05	0.1	0.06	0.5	0.51	1.0
HE-10	10 ft	08/19/05	0.1	0.09	0.5	0.50	1.1
HE-15	15 ft	08/19/05	0.1	0.06	0.6	0.36	1.0
HE-25	25 ft	08/19/05	0.1	<0.01	0.3	0.15	0.5
HE-SW	0 ft	08/23/05	0.1	0.01	<0.1	0.63	0.6
HE-5	5 ft	08/23/05	<0.1	<0.01	0.2	0.39	0.6
HE-10	10 ft	08/23/05	<0.1	<0.01	0.7	0.29	1.0
HE-15	15 ft	08/23/05	<0.1	<0.01	0.5	0.35	0.8
HE-25	25 ft	08/23/05	0.1	<0.01	0.7	<0.2	0.7
HE-SW	0 ft	08/26/05	<0.1	<0.01	<0.1	0.78	0.8
HE-5	5 ft	08/26/05	<0.1	<0.01	0.4	0.36	0.7
HE-10	10 ft	08/26/05	<0.1	<0.01	0.6	0.36	0.9
HE-15	15 ft	08/26/05	<0.1	<0.01	0.6	0.30	0.9
HE-25	25 ft	08/26/05	<0.1	<0.01	0.7	0.24	0.9
HE-SW	0 ft	08/30/05	<0.1	<0.01	<0.1	2.10	2.1
HE-10	10 ft	08/30/05	<0.1	<0.01	1.0	0.25	1.2
HE-15	15 ft	08/30/05	<0.1	<0.01	1.2	0.68	1.9
HE-25	25 ft	08/30/05	<0.1	<0.01	1.6	<0.20	1.6
HE-SW	0 ft	09/02/05	<0.1	<0.01	<0.1	2.60	2.6
HE-5	5 ft	09/02/05	<0.1	<0.01	1.0	0.43	1.4
HE-10	10 ft	09/02/05	<0.1	<0.01	1.2	0.42	1.6
HE-15	15 ft	09/02/05	<0.1	<0.01	1.2	0.42	1.6
HE-25	25 ft	09/02/05	<0.1	<0.01	0.8	0.31	1.1
HE-10	10 ft	09/06/05	<0.1	<0.01	1.4	0.35	1.7
HE-15	15 ft	09/06/05	<0.1	<0.01	1.0	0.41	1.5
HE-25	25 ft	09/06/05	<0.1	<0.01	1.8	0.59	2.4
HE-SW	0 ft	09/09/05	<0.1	0.01	<0.1	1.10	1.1
HE-5	5 ft	09/09/05	<0.1	<0.01	2.1	0.73	2.8
HE-10	10 ft	09/09/05	<0.1	<0.01	1.4	0.41	1.8
HE-15	15 ft	09/09/05	<0.1	<0.01	1.0	0.59	1.6
HE-25	25 ft	09/09/05	<0.1	<0.01	1.2	0.33	1.5
HE-SW	0 ft	09/13/05	0.1	<0.20	0.7	1.30	2.0
HE-5	5 ft	09/13/05	<0.1	<0.01	2.5	0.48	3.0
HE-10	10 ft	09/13/05	<0.1	<0.01	<0.1	0.23	0.2
HE-15	15 ft	09/13/05	<0.1	<0.01	0.9	0.34	1.2
HE-25	25 ft	09/13/05	<0.1	<0.20	1.4	0.21	1.6
HE-SW	0 ft	09/16/05	0.1	<0.50	<0.5	0.82	0.8
HE-5	5 ft	09/16/05	0.1	<0.50	2.5	0.31	2.8
HE-10	10 ft	09/16/05	0.1	<0.50	1.2	0.32	1.5
HE-15	15 ft	09/16/05	0.1	<0.50	0.9	0.45	1.3
HE-25	25 ft	09/16/05	0.1	<0.50	1.3	0.20	1.5
HE-SW	0 ft	09/20/05	0.1	0.03	0.7	1.60	2.4
HE-5	5 ft	09/20/05	0.1	0.01	1.3	0.55	1.9
HE-10	10 ft	09/20/05	<0.1	<0.01	1.4	0.27	1.7
HE-15	15 ft	09/20/05	0.1	<0.01	1.1	0.21	1.3

Table 4-9
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
HE-25	25 ft	09/20/05	0.1	<0.01	1.2	<0.20	1.2
HE-SW	0 ft	09/23/05	0.1	0.01	0.8	1.10	1.9
HE-5	5 ft	09/23/05	0.1	0.01	1.1	0.45	1.6
HE-10	10 ft	09/23/05	0.1	<0.01	3.3	0.53	3.8
HE-15	15 ft	09/23/05	<0.1	<0.01	2.3	0.40	2.7
HE-25	25 ft	09/23/05	0.1	<0.01	1.6	0.31	1.9
HE-SW	0 ft	09/27/05	<0.1	<0.01	0.8	1.40	2.2
HE-5	5 ft	09/27/05	0.1	<0.01	0.8	0.46	1.2
HE-10	10 ft	09/27/05	0.1	<0.01	1.1	0.62	1.7
HE-15	15 ft	09/27/05	0.1	<0.01	1.3	0.38	1.7
HE-25	25 ft	09/27/05	0.1	<0.01	2.2	0.41	2.6
HE-SW	0 ft	09/30/05	0.1	<0.01	<0.1	2.0	2.0
HE-5	5 ft	09/30/05	0.1	0.01	0.5	0.47	0.9
HE-10	10 ft	09/30/05	0.1	0.01	0.6	0.40	1.0
HE-15	15 ft	09/30/05	0.1	<0.01	0.9	0.71	1.6
HE-25	25 ft	09/30/05	0.1	<0.01	0.9	0.56	1.4
HE-SW	0 ft	10/04/05	0.1	<0.01	<0.1	2.20	2.2
HE-5	5 ft	10/04/05	0.1	<0.01	<0.1	0.59	0.6
HE-10	10 ft	10/04/05	<0.1	<0.01	0.6	0.36	1.0
HE-15	15 ft	10/04/05	0.1	<0.01	0.8	0.33	1.1
HE-25	25 ft	10/04/05	<0.1	<0.01	0.5	0.64	1.2
HE-SW	0 ft	10/07/05	0.1	<0.01	0.7	1.30	2.0
HE-5	5 ft	10/07/05	0.1	<0.01	<0.1	0.55	0.6
HE-10	10 ft	10/07/05	0.1	<0.01	0.6	0.33	1.0
HE-15	15 ft	10/07/05	0.1	<0.01	0.7	0.29	1.0
HE-25	25 ft	10/07/05	0.1	<0.01	0.5	0.36	0.9
HE-SW	0 ft	10/13/05	0.1	0.01	1.0	1.30	2.3
HE-5	5 ft	10/13/05	0.1	<0.01	<0.1	0.63	0.6
HE-10	10 ft	10/13/05	0.1	<0.01	0.3	0.64	0.9
HE-15	15 ft	10/13/05	0.1	<0.01	0.5	0.36	0.8
HE-25	25 ft	10/13/05	0.1	<0.01	5.7	0.49	6.2
HE-SW	0 ft	10/14/05	0.1	<0.01	0.2	1.20	1.4
HE-5	5 ft	10/14/05	0.1	<0.01	0.2	0.81	1.1
HE-10	10 ft	10/14/05	0.1	<0.01	0.3	0.52	0.9
HE-15	15 ft	10/14/05	0.2	<0.01	0.1	0.40	0.5
HE-25	25 ft	10/14/05	0.1	<0.01	<0.1	0.45	0.5
HE-SW	0 ft	10/18/05	0.2	0.04	1.1	3.80	4.9
HE-5	5 ft	10/18/05	0.1	<0.01	0.2	0.35	0.6
HE-10	10 ft	10/18/05	0.1	<0.01	0.3	0.29	0.6
HE-15	15 ft	10/18/05	0.1	<0.01	0.5	0.34	0.8
HE-25	25 ft	10/18/05	0.1	<0.01	0.5	0.20	0.7
HE-SW	0 ft	10/21/05	0.1	0.05	0.8	1.70	2.5
HE-5	5 ft	10/21/05	<0.1	<0.01	0.2	0.77	1.0
HE-10	10 ft	10/21/05	<0.1	<0.01	1.2	0.59	1.8
HE-15	15 ft	10/21/05	<0.1	<0.01	0.7	0.30	1.0
HE-25	25 ft	10/21/05	<0.1	<0.01	0.3	0.30	0.6

Table 4-9
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
HE-SW	0 ft	10/25/05	0.7	0.03	0.2	1.80	2.0
HE-5	5 ft	10/25/05	0.2	<0.01	0.6	0.32	0.9
HE-10	10 ft	10/25/05	0.1	<0.01	0.6	0.38	0.9
HE-15	15 ft	10/25/05	0.2	<0.01	0.4	0.29	0.7
HE-25	25 ft	10/25/05	0.2	0.04	0.2	0.55	0.8
HE-5	5 ft	10/28/05	NT	NT	NT	0.31	IDC
HE-10	10 ft	10/28/05	0.1	<0.01	0.9	0.35	1.3
HE-15	15 ft	10/28/05	0.1	<0.01	0.8	<0.2	0.8
HE-25	25 ft	10/28/05	0.1	<0.01	0.4	<0.2	0.4
HE-SW	0 ft	11/01/05	0.1	0.01	0.5	1.80	2.3
HE-5	5 ft	11/01/05	0.1	<0.01	2.0	0.37	2.4
HE-10	10 ft	11/01/05	0.1	<0.01	1.1	0.35	1.5
HE-15	15 ft	11/01/05	0.1	<0.01	1.1	0.91	2.0
HE-25	25 ft	11/01/05	0.2	0.01	0.5	0.99	1.5
HE-SW	0 ft	11/04/05	0.1	<0.01	0.2	1.40	1.6
HE-5	5 ft	11/04/05	<0.1	0.01	5.2	0.55	5.8
HE-10	10 ft	11/04/05	<0.1	<0.01	1.2	0.35	1.6
HE-15	15 ft	11/04/05	<0.1	<0.01	1.3	0.29	1.6
HE-25	25 ft	11/04/05	NT	NT	NT	0.34	IDC
HE-SW	0 ft	11/08/05	0.1	HM	<0.1	1.10	IDC
HE-5	5 ft	11/08/05	0.1	HM	1.0	0.63	IDC
HE-10	10 ft	11/08/05	0.1	HM	1.3	<0.2	IDC
HE-15	15 ft	11/08/05	0.1	HM	1.4	0.31	IDC
HE-25	25 ft	11/08/05	0.1	HM	1.0	0.45	IDC
HE-SW	0 ft	11/11/05	0.1	<0.01	0.2	1.50	1.7
HE-5	5 ft	11/11/05	0.1	<0.01	1.1	0.31	1.4
HE-10	10 ft	11/11/05	0.1	<0.01	1.4	0.25	1.6
HE-15	15 ft	11/11/05	0.1	NT	NT	<0.2	IDC
HE-25	25 ft	11/11/05	NT	NT	NT	0.29	IDC
HE-SW	0 ft	11/15/05	<0.1	HM	HM	1.50	IDC
HE-5	5 ft	11/15/05	<0.1	HM	HM	0.34	IDC
HE-10	10 ft	11/15/05	<0.1	HM	HM	0.21	IDC
HE-15	15 ft	11/15/05	<0.1	HM	HM	0.39	IDC
HE-SW	0 ft	11/18/05	0.1	0.02	2.1	1.70	3.8
HE-5	5 ft	11/18/05	<0.1	0.02	2.5	0.54	3.1
HE-10	10 ft	11/18/05	<0.1	<0.01	1.0	0.26	1.3
HE-15	15 ft	11/18/05	<0.1	<0.01	1.4	0.36	1.8
HE-25	25 ft	11/18/05	0.1	0.02	1.8	0.49	2.3
HE-SW	0 ft	11/22/05	0.1	<0.01	1.2	1.70	2.9
HE-5	5 ft	11/22/05	NT	NT	NT	0.42	IDC
HE-10	10 ft	11/22/05	0.1	0.01	0.2	0.36	0.6
HE-15	15 ft	11/22/05	0.1	0.37	2.1	0.26	2.7
HE-25	25 ft	11/22/05	NT	NT	NT	0.25	IDC
HE-SW	0 ft	11/25/05	<0.1	<0.01	0.4	1.30	1.7
HE-5	5 ft	11/25/05	<0.1	0.01	2.9	0.47	3.4
HE-10	10 ft	11/25/05	<0.1	<0.01	0.9	0.39	1.3

Table 4-9
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell:
Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
HE-15	15 ft	11/25/05	<0.1	<0.01	1.1	0.27	1.4
HE-25	25 ft	11/25/05	NT	NT	NT	0.27	IDC
HE-SW	0 ft	11/29/05	0.3	<0.01	0.3	1.30	1.6
HE-5	5 ft	11/29/05	0.1	0.02	3.6	0.36	4.0
HE-10	10 ft	11/29/05	0.1	<0.01	1.0	<0.2	1.0
HE-15	15 ft	11/29/05	0.1	<0.01	1.1	<0.2	1.1
HE-25	25 ft	11/29/05	NT	NT	NT	0.28	IDC
HE-SW	0 ft	12/02/05	<0.1	<0.01	0.3	1.60	1.9
HE-5	5 ft	12/02/05	<0.1	<0.01	1.5	0.42	1.9
HE-10	10 ft	12/02/05	<0.1	<0.01	3.7	0.41	4.1
HE-15	15 ft	12/02/05	<0.1	<0.01	1.0	0.25	1.3
HE-25	25 ft	12/02/05	NT	NT	NT	0.33	IDC
HE-SW	0 ft	12/06/05	0.2	<0.01	<0.1	1.60	1.6
HE-5	5 ft	12/06/05	0.1	0.01	1.2	0.30	1.5
HE-10	10 ft	12/06/05	0.3	0.01	4.3	0.29	4.6
HE-15	15 ft	12/06/05	0.1	<0.01	1.3	0.29	1.6
HE-25	25 ft	12/06/05	0.1	<0.01	1.4	<0.2	1.4
HE-SW	0 ft	12/09/05	0.3	0.01	0.7	2.00	2.7
HE-5	5 ft	12/09/05	0.1	<0.01	1.3	0.24	1.5
HE-10	10 ft	12/09/05	0.1	<0.01	3.1	<0.2	3.1
HE-15	15 ft	12/09/05	0.1	<0.01	1.6	0.57	2.1
HE-25	25 ft	12/09/05	0.1	<0.01	1.2	0.69	1.9
HE-SW	0 ft	12/13/05	0.1	0.01	0.7	1.60	2.3
HE-5	5 ft	12/13/05	0.1	0.01	1.8	0.41	2.2
HE-10	10 ft	12/13/05	0.1	0.01	3.1	0.34	3.5
HE-15	15 ft	12/13/05	0.1	<0.01	1.9	0.36	2.3
HE-25	25 ft	12/13/05	NT	NT	NT	0.26	IDC
HE-SW	0 ft	12/16/05	0.1	0.01	0.9	1.80	2.7
HE-5	5 ft	12/16/05	2.1	0.02	2.2	0.52	2.7
HE-10	10 ft	12/16/05	0.2	<0.01	3.0	<0.2	3.0
HE-15	15 ft	12/16/05	1.4	<0.01	2.2	0.28	2.4
HE-25	25 ft	12/16/05	<0.1	<0.01	1.3	0.37	1.6
HE-SW	0 ft	12/20/05	<0.1	<0.01	<0.1	1.50	1.5
HE-5	5 ft	12/20/05	<0.1	<0.01	2.3	0.31	2.6
HE-10	10 ft	12/20/05	<0.1	<0.01	2.8	<0.2	2.8
HE-15	15 ft	12/20/05	<0.1	<0.01	2.6	0.29	2.9
HE-25	25 ft	12/20/05	NT	NT	NT	<0.2	IDC
HE-SW	0 ft	12/23/05	0.1	<0.01	<0.1	2.10	2.1
HE-5	5 ft	12/23/05	0.1	<0.01	1.6	0.77	2.4
HE-10	10 ft	12/23/05	0.1	<0.01	2.8	0.47	3.3
HE-15	15 ft	12/23/05	0.1	<0.01	3.0	0.77	3.8
HE-25	25 ft	12/23/05	NT	NT	NT	0.42	IDC
HE-SW	0 ft	12/27/05	0.1	<0.01	<0.1	1.20	1.2
HE-5	5 ft	12/27/05	0.1	<0.01	1.3	0.48	1.8
HE-10	10 ft	12/27/05	0.1	<0.01	3.0	0.30	3.3
HE-15	15 ft	12/27/05	0.1	<0.01	3.2	0.39	3.6

Table 4-9
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Ammonia, Nitrite, Nitrate, TKN, and TN (mg/L)

Station ID	Depth	Date	NH_3-N	NO_2-N	NO_3-N	TKN	TN
HE-25	25 ft	12/27/05	NT	NT	NT	0.29	IDC
HE-SW	0 ft	12/30/05	0.1	<0.01	<0.1	1.20	1.2
HE-5	5 ft	12/30/05	0.2	<0.01	<0.1	0.70	0.7
HE-10	10 ft	12/30/05	0.2	<0.01	<0.1	0.35	0.4
HE-15	15 ft	12/30/05	0.2	<0.01	<0.1	0.25	0.3
HE-25	25 ft	12/30/05	NT	NT	NT	0.27	IDC

HM: Hold-time missed due to laboratory QA/QC problems

NS-BD: Not Sampled-Basin Dry

NT: Insufficient Sample for Analytical Test

IDC: Insufficient Data for Calculation

Table 4-10
Basin and Lysimeter Monitoring Results for Banana Basin: Summary for Total Nitrogen (mg/L)

Station ID	Units	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
			5	10	15	25		
07/06/05	mg/L	0.7	0.9	1.1	0.6	1.4	Residual Water	-117%
07/12/05	mg/L	1.1	0.4	2.8	0.4	0.7	Residual Water	30%
07/15/05	mg/L	1.2	0.6	1.0	0.6	0.6	Residual Water	55%
07/19/05	mg/L	1.0	0.6	0.7	0.4	0.6	Residual Water	41%
07/22/05	mg/L	0.9	0.4	0.5	0.3	0.5	Residual Water	51%
07/26/05	mg/L	NS-BD	0.5	0.4	0.3	0.6	Residual Water	IDC
07/29/05	mg/L	4.8	0.6	0.5	0.3	0.6	Residual Water	44%
08/02/05	mg/L	1.8	1.2	0.9	0.9	1.1	Residual Water	10%
08/05/05	mg/L	2.3	1.9	0.9	0.7	1.1	Residual Water	-2%
08/09/05	mg/L	1.4	1.9	1.8	2.2	1.6	Residual Water	-75%
08/12/05	mg/L	3.3	1.9	1.5	1.3	1.6	Residual Water	-68%
08/16/05	mg/L	2.6	1.0	1.2	1.2	1.1	100%	76%
08/19/05	mg/L	1.2	0.8	0.8	0.7	1.2	*98%*	54%
08/23/05	mg/L	2.7	0.5	0.7	0.4	0.7	96%	68%
08/24/05	mg/L	2.7	IDC	IDC	IDC	IDC	*98%*	IDC
08/26/05	mg/L	3.0	0.5	0.4	0.5	0.4	100%	72%
08/30/05	mg/L	1.5	0.6	0.4	0.2	0.3	100%	92%
09/02/05	mg/L	2.1	1.1	0.6	0.7	0.7	*100%*	74%
09/06/05	mg/L	3.7	0.7	0.7	0.9	IDC	*100%*	IDC
09/09/05	mg/L	IDC	0.5	0.5	0.8	0.8	*100%*	66%
09/13/05	mg/L	4.4	0.6	1.3	1.8	0.8	100%	75%
09/16/05	mg/L	1.2	0.2	0.7	1.2	0.2	*100%*	89%
09/20/05	mg/L	3.6	0.6	1.4	2.1	0.9	100%	58%
09/23/05	mg/L	1.7	0.2	0.9	1.9	0.8	*100%*	75%
09/27/05	mg/L	2.9	0.7	0.7	1.7	1.2	100%	IDC
09/30/05	mg/L	2.7	1.0	0.5	0.9	0.8	*100%*	81%
10/04/05	mg/L	1.4	4.5	0.5	0.7	0.8	100%	30%
10/07/05	mg/L	1.3	0.7	0.7	0.8	0.9	*100%*	71%
10/13/05	mg/L	2.0	0.7	0.8	1.1	0.9	100%	59%
10/14/05	mg/L	2.9	0.5	1.2	1.7	0.7	*100%*	73%
10/18/05	mg/L	3.0	0.5	0.8	1.2	0.6	100%	77%
10/21/05	mg/L	2.2	0.5	0.6	1.2	1.1	*100%*	34%
10/25/05	mg/L	1.6	0.8	0.7	1.2	0.9	100%	34%
10/28/05	mg/L	1.4	1.0	1.0	0.3	1.8	*100%*	-112%
11/01/05	mg/L	1.4	0.7	0.9	0.7	0.4	100%	86%
11/04/05	mg/L	1.2	0.0	0.5	IDC	NT	*98%*	IDC
11/08/05	mg/L	IDC	0.0	0.4	0.6	0.6	95%	74%
11/11/05	mg/L	1.7	0.8	0.4	0.9	0.9	*90%*	51%
11/15/05	mg/L	IDC	IDC	IDC	IDC	IDC	84%	IDC
11/18/05	mg/L	2.3	0.5	0.4	1.0	2.2	*80%*	-57%
11/22/05	mg/L	1.1	0.5	0.4	0.9	0.7	75%	39%
11/25/05	mg/L	1.0	0.3	0.5	0.8	0.8	*73%*	49%
11/29/05	mg/L	1.0	0.4	0.4	0.5	0.0	70%	100%
12/02/05	mg/L	IDC	0.5	0.6	0.8	0.9	*69%*	58%
12/06/05	mg/L	IDC	0.4	0.4	0.7	0.5	67%	80%
12/09/05	mg/L	IDC	1.1	0.7	1.0	0.8	*69%*	41%
12/13/05	mg/L	IDC	0.6	0.9	0.9	0.5	70%	53%
12/16/05	mg/L	1.8	0.1	1.2	1.3	0.8	*74%*	22%
12/20/05	mg/L	1.8	0.4	1.2	1.2	0.6	77%	IDC
12/23/05	mg/L	2.0	0.7	1.4	1.4	0.9	*76%*	31%
12/27/05	mg/L	1.5	0.9	1.2	1.4	1.0	75%	IDC
12/29/05	mg/L	1.2	1.1	1.4	1.7	1.0	*77%*	35%
Average	**mg/L**	**2.1**	**0.8**	**0.8**	**1.1**	**0.9**		**51%**

ND: Not Detected
NS: Not Sampled
NS-BD: Not Sampled-Basin Dry
NT: Insufficient Sample for Analytical Test
IDC: Insufficient Data for Calculation
Indicates that the sampled water is >75 percent recycled water
64% Denotes an interpolated value.

Table 4-11
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell: Summary for Total Nitrogen

Station ID	Units	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
			5	10	15	25		
06/10/05	mg/L	1.4	1.0	1.4	NT	1.9	Residual Water	-30%
06/15/05	mg/L	1.9	0.5	NT	NT	0.6	Residual Water	68%
06/20/05	mg/L	2.1	IDC	NT	NT	0.8	Residual Water	64%
06/23/05	mg/L	NT	IDC	NT	NT	0.5	Residual Water	IDC
06/27/05	mg/L	1.2	6.3	NT	NT	1.1	Residual Water	11%
06/30/05	mg/L	0.8	0.9	NT	IDC	0.6	Residual Water	27%
07/05/05	mg/L	0.7	0.7	NT	NT	0.7	Residual Water	-3%
07/07/05	mg/L	0.6	0.7	NT	NT	0.8	Residual Water	-26%
07/12/05	mg/L	1.7	0.5	NT	NT	0.6	Residual Water	66%
07/15/05	mg/L	1.0	0.4	NT	NT	0.7	Residual Water	24%
07/19/05	mg/L	1.0	0.6	NT	NT	0.8	Residual Water	22%
07/22/05	mg/L	0.9	0.5	NT	NT	0.7	Residual Water	25%
07/26/05	mg/L	1.4	0.5	NT	NT	0.4	Residual Water	69%
07/29/05	mg/L	0.9	0.6	NT	NT	0.5	Residual Water	47%
08/02/05	mg/L	1.0	0.4	NT	NT	0.7	Residual Water	29%
08/05/05	mg/L	1.1	0.6	NT	NT	0.7	Residual Water	37%
08/09/05	mg/L	0.5	0.4	NT	NT	0.6	Residual Water	-11%
08/12/05	mg/L	0.5	0.3	NT	NT	0.6	Residual Water	-12%
08/16/05	mg/L	2.4	0.4	NT	NT	0.5	Residual Water	78%
08/19/05	mg/L	1.3	0.6	NT	NT	0.4	Residual Water	66%
08/23/05	mg/L	0.6	0.5	NT	NT	0.7	Residual Water	-22%
08/26/05	mg/L	0.5	0.8	NT	NT	0.5	Residual Water	-4%
08/30/05	mg/L	0.8	0.4	NT	NT	0.7	Residual Water	13%
09/02/05	mg/L	NT	2.0	NT	NT	1.5	Residual Water	IDC
09/06/05	mg/L	1.7	IDC	NT	NT	2.5	Residual Water	-45%
09/09/05	mg/L	0.8	0.5	NT	NT	0.8	*27%*	3%
09/13/05	mg/L	2.6	1.0	NT	NT	1.1	54%	59%
09/16/05	mg/L	0.7	0.2	NT	NT	0.7	*72%*	0%
09/20/05	mg/L	4.9	0.6	NT	NT	1.0	90%	-33%
09/23/05	mg/L	0.9	0.2	NT	NT	0.8	*88%*	63%
09/27/05	mg/L	2.2	1.0	NT	NT	0.9	85%	-23%
09/30/05	mg/L	IDC	1.1	NT	NT	0.5	*85%*	87%
10/04/05	mg/L	3.3	0.9	NT	NT	0.5	86%	48%
10/07/05	mg/L	2.8	3.8	NT	NT	0.6	*93%*	68%
10/13/05	mg/L	1.9	IDC	NT	NT	1.4	100%	52%
10/14/05	mg/L	1.7	1.0	NT	NT	1.1	*100%*	64%
10/18/05	mg/L	2.3	1.3	NT	NT	1.0	100%	63%
10/25/05	mg/L	5.0	NT	NT	NT	1.6	100%	5%
11/01/05	mg/L	NT	NT	NT	NT	2.0	*100%*	36%
11/08/05	mg/L	NT	NT	NT	NT	IDC	*100%*	IDC
11/11/05	mg/L	1.9	NT	NT	NT	2.2	*100%*	46%
11/15/05	mg/L	IDC	IDC	IDC	IDC	IDC	100%	IDC
11/18/05	mg/L	3.4	0.9	1.2	IDC	1.8	*100%*	33%
11/22/05	mg/L	2.6	0.9	1.0	1.5	0.8	100%	57%
11/25/05	mg/L	2.0	1.0	1.2	2.0	1.5	*98%*	39%
11/29/05	mg/L	1.4	1.1	1.3	IDC	0.8	97%	77%
12/02/05	mg/L	1.9	1.1	1.0	1.4	1.2	98%	58%
12/06/05	mg/L	1.2	1.0	0.9	1.2	0.7	100%	65%
12/09/05	mg/L	2.3	1.0	0.9	1.3	0.8	*100%*	47%
12/13/05	mg/L	1.3	1.0	1.0	1.3	0.8	100%	59%
12/16/05	mg/L	1.6	1.1	1.0	1.1	1.2	*100%*	11%
12/20/05	mg/L	1.5	1.1	0.9	1.3	1.0	100%	58%
12/23/05	mg/L	1.9	1.1	1.2	1.6	0.9	*100%*	40%
12/27/05	mg/L	1.7	1.1	1.0	1.8	0.9	100%	43%
12/30/05	mg/L	1.7	0.8	0.4	0.7	0.4	*100%*	71%
Average	**mg/L**	**2.1**	**1.0**	**1.0**	**1.4**	**1.2**		**49%**

NS-BD: Not Sampled-Basin Dry
NT: Insufficient Sample for Analytical Test
IDC: Insufficient Data for Calculation
Indicates that the sampled water is >75 percent recycled water
64% Denotes an interpolated value.

Table 4-12
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Summary for Total Nitrogen

Station ID	Units	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
			5	10	15	25		
06/10/05	mg/L	0.7	0.8	IDC	3.6	2.2	Residual Water	-203%
06/15/05	mg/L	NT	IDC	1.1	3.9	3.7	Residual Water	IDC
06/20/05	mg/L	NT	IDC	1.7	2.8	3.7	Residual Water	IDC
06/23/05	mg/L	2.5	IDC	1.4	2.0	3.7	Residual Water	-48%
06/27/05	mg/L	1.2	IDC	1.3	1.4	3.4	Residual Water	-182%
06/30/05	mg/L	0.6	5.0	0.8	IDC	3.2	Residual Water	-456%
07/05/05	mg/L	1.1	0.9	0.8	1.2	2.4	Residual Water	-226%
07/07/05	mg/L	0.6	0.5	2.8	1.8	3.8	Residual Water	-278%
07/12/05	mg/L	0.9	0.5	IDC	1.8	3.7	Residual Water	-119%
07/15/05	mg/L	0.8	0.8	5.0	1.8	4.4	Residual Water	IDC
07/19/05	mg/L	0.6	0.6	5.5	1.5	3.7	Residual Water	-68%
07/22/05	mg/L	1.0	0.4	5.9	1.8	1.9	Residual Water	-60%
07/26/05	mg/L	NT	0.3	5.4	1.6	3.9	Residual Water	-477%
07/29/05	mg/L	1.4	0.3	4.5	1.7	2.1	Residual Water	-108%
08/02/05	mg/L	1.1	0.9	NT	1.7	4.0	Residual Water	-511%
08/05/05	mg/L	0.8	0.6	0.7	2.8	1.4	Residual Water	-65%
08/09/05	mg/L	0.6	1.0	0.4	0.9	0.8	Residual Water	-1%
08/12/05	mg/L	0.5	0.5	0.5	0.7	0.9	Residual Water	-50%
08/16/05	mg/L	3.0	0.5	0.5	0.5	0.8	Residual Water	23%
08/19/05	mg/L	2.6	1.0	1.1	1.0	0.5	Residual Water	61%
08/23/05	mg/L	0.6	0.6	1.0	0.8	0.7	Residual Water	52%
08/26/05	mg/L	0.8	0.7	0.9	0.9	0.9	Residual Water	23%
08/30/05	mg/L	2.1	NT	1.2	1.9	1.6	Residual Water	-96%
09/02/05	mg/L	2.6	1.4	1.6	1.6	1.1	Residual Water	-62%
09/06/05	mg/L	NS-BD	NT	1.7	1.5	2.4	Residual Water	-372%
09/09/05	mg/L	1.1	2.8	1.8	1.6	1.5	*26%*	36%
09/13/05	mg/L	2.0	3.0	0.2	1.2	1.6	52%	37%
09/16/05	mg/L	0.8	2.8	1.5	1.3	1.5	*53%*	-34%
09/20/05	mg/L	2.4	1.9	1.7	1.3	1.2	53%	-59%
09/23/05	mg/L	1.9	1.6	3.8	2.7	1.9	*56%*	-7%
09/27/05	mg/L	2.2	1.2	1.7	1.7	2.6	59%	0%
09/30/05	mg/L	2.0	0.9	1.0	1.6	1.4	*80%*	28%
10/04/05	mg/L	2.2	0.6	1.0	1.1	1.2	100%	-5%
10/07/05	mg/L	2.0	0.6	1.0	1.0	0.9	*100%*	49%
10/13/05	mg/L	2.3	0.6	0.9	0.8	6.2	100%	-291%
10/14/05	mg/L	1.4	1.1	0.9	0.5	0.5	*100%*	77%
10/18/05	mg/L	4.9	0.6	0.6	0.8	0.7	100%	62%
10/21/05	mg/L	2.5	1.0	1.8	1.0	0.6	*100%*	71%
10/25/05	mg/L	2.0	0.9	0.9	0.7	0.8	100%	60%
10/28/05	mg/L	NT	IDC	1.3	0.8	0.4	*100%*	81%
11/01/05	mg/L	2.3	2.4	1.5	2.0	1.5	100%	25%
11/04/05	mg/L	1.6	5.8	1.6	1.6	IDC	*100%*	IDC
11/08/05	mg/L	IDC	IDC	IDC	IDC	IDC	100%	IDC
11/11/05	mg/L	1.7	1.4	1.6	IDC	IDC	*100%*	IDC
11/15/05	mg/L	IDC	IDC	IDC	IDC	NS	100%	IDC
11/18/05	mg/L	3.8	3.1	1.3	1.8	2.3	*100%*	-8%
11/22/05	mg/L	2.9	IDC	0.6	2.7	IDC	100%	IDC
11/25/05	mg/L	1.7	3.4	1.3	1.4	IDC	*97%*	IDC
11/29/05	mg/L	1.6	4.0	1.0	1.1	IDC	*96%*	IDC
12/02/05	mg/L	1.9	1.9	4.1	1.3	IDC	*95%*	IDC
12/06/05	mg/L	1.6	1.5	4.6	1.6	1.4	93%	17%
12/09/05	mg/L	2.7	1.5	3.1	2.1	1.9	*96%*	26%
12/13/05	mg/L	2.3	2.2	3.5	2.3	IDC	*96%*	IDC
12/16/05	mg/L	2.7	2.7	3.0	2.4	1.6	*96%*	48%
12/20/05	mg/L	1.5	2.6	2.8	2.9	IDC	*96%*	IDC
12/23/05	mg/L	2.1	2.4	3.3	3.8	IDC	*96%*	IDC
12/27/05	mg/L	1.2	1.8	3.3	3.6	IDC	*96%*	IDC
12/30/05	mg/L	1.2	0.7	0.4	0.3	IDC	*96%*	IDC
Average	**mg/L**	**2.1**	**1.7**	**2.0**	**1.7**	**1.5**		**31.6%**

NS-BD: Not Sampled-Basin Dry
NT: Insufficient Sample for Analytical Test
IDC: Insufficient Data for Calculation
Indicates that the sampled water is >75 percent recycled water
64% Denotes an interpolated value.

5. SOIL AQUIFER TREATMENT EFFICIENCY: TOC AND TN REMOVAL

Figures 5-1 through 5-3 depict TOC as a function of increasing depth. The "0 feet bgs" sample represents a surface water grab sample while the other depths correspond to the lysimeter sample depths. The values plotted are an average of all results from July 6, 2005 to December 6, 2005 for Banana Basin and July 6, 2005 to December 6, 2005 for Hickory Basin West Cell and Hickory Basin East Cell. Note that SAT—reduction in TOC concentration—appears to continue to at least 25 feet bgs and may continue at greater depths. Figures 5-4 through 5-6 show the time histories of TOC values for the basins and lysimeters. In the upper part of the graph, the period when various sources of water were diverted into Banana Basin or Hickory Basin West Cell and Hickory Basin East Cell are recorded as bars across given periods. Note that the reduction of TOC with depth is consistent with time. Also depicted in Figures 5-4 through 5-6 is the 20 sample running average for TOC; beginning on August 16, 2005 for Banana Basin, September 20, 2005 for Hickory Basin West Cell, and October 4, 2005 for Hickory Basin East Cell, which are the first dates that the 25 foot bgs lysimeters had recycled water components that were greater than or equal to 75 percent. The Recycled Water Quality Specification A.10 (Regional Board, 2005a) states, "At each recharge basin, the monthly average TOC concentration of the recycled water prior to reaching the regional groundwater table, shall not exceed the average TOC value calculated from the following formula:"

$$TOC_{average} = \frac{0.5 mg/L}{RWC_{average}}$$

Using this formula, the dashed line on Figures 5-4 through 5-6 at TOC = 2.5 mg/L represents a TOC limit with a RWC of 20 percent.

Figures 5-7 through 5-12 are similar graphs, but for TN. There appears to be more variability in the TN results, which may reflect very low TN concentrations in the recycled water—the fraction that is recharged may be more recalcitrant. Note that the TN in all lysimeters is typically less than 2 mg/L and that the compliance metric is 10 mg/L.

Soil aquifer treatment—TOC and TN reduction—was estimated using the following algorithm:

1. The travel time of recharged water was estimated using EC as a natural tracer. As discussed further in Section 6, recycled water reached the 25 foot bgs lysimeter on August 16, 2005; 18 days after recycled water was introduced into Banana Basin on July 29, 2005. Recognizing that travel time can vary over time, 18 days was used as the offset throughout the Start-Up Period.
2. Grab samples of surface water from Banana Basin and lysimeter samples were collected on a frequency of weekly or twice-weekly; hence, there are rarely pairs of samples collected from the surface water on a given day and the lysimeter 18 days later. Therefore, linear interpolation was used to estimate TOC values in both the surface water and in the 25 foot bgs lysimeter for each day of the Start-Up Period (Tables 5-1 through 5-3).
3. TOC reduction was calculated by the following formula:

$$\%TOC\_reduction = \frac{TOC_{SW} - TOC_{lys-offset}}{TOC_{SW}}$$

   where the $TOC_{lys\text{-}offset}$ is the value 18 days after the surface water sample was collected. A similar calculation was performed for TN reduction (Tables 5-4 through 5-6). Similar offsets were applied in the TOC reduction estimation for the Hickory Basin West Cell and Hickory Basin East Cell.

Figures 5-13 through 5-15 are time histories of TOC reduction, local runoff, and storm flow. Note that local runoff and storm flow events are based on onsite field observations and recorded rainfall events. In

the periods following the introduction of diluent water, there was a decrease in TOC reduction; presumably due to the recalcitrant nature of TOC in stormwater and local runoff. Figures 5-16 through 5-18 are time histories of TN reduction, local runoff, and storm flow.

During the 2005 recharge operations, the average percent reduction in TOC at the Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell were 69, 64, and 75 percent, respectively, while the percentage of recycled water in the compliance lysimeter was greater than or equal to 75 percent, based on EC values. The average percent reductions in TN at Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell were 51, 49, and 32 percent (Tables 4-10 through 4-12), respectively, while the percentage of recycled water in the compliance lysimeter was greater than or equal to 75 percent. A TN concentration of 6.2 mg/L was reported for the compliance lysimeter at Hickory Basin East Cell on October 13, 2006. This may be a sampling or laboratory artifact, and contributed to the low percent TN reduction in this cell. Nonetheless, average TN concentrations in each of the basins and cells were well below the permit requirements: 0.9, 1.2, and 1.7 mg/L for Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell, respectively.

Table 5-1
Basin and Lysimeter Monitoring Results for Banana Basin: Total Organic Carbon (mg/L) Interpolated

Date	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
07/06/05	5.1	4.0	5.2	6.7	2.4	Residual Water	53%
07/07/05	5.1	3.8	5.0	6.4	2.4	Residual Water	53%
07/08/05	5.1	3.7	4.8	6.2	2.4	Residual Water	54%
07/09/05	5.2	3.6	4.5	5.9	2.4	Residual Water	54%
07/10/05	5.2	3.4	4.3	5.7	2.3	Residual Water	55%
07/11/05	5.2	3.3	4.1	5.4	2.3	Residual Water	55%
07/12/05	5.2	3.1	3.9	5.2	2.3	Residual Water	55%
07/13/05	5.2	3.1	3.8	4.9	2.3	Residual Water	55%
07/14/05	5.1	3.1	3.6	4.6	2.4	Residual Water	54%
07/15/05	5.1	3.1	3.4	4.3	2.4	Residual Water	53%
07/16/05	5.1	3.1	3.3	4.1	2.4	Residual Water	52%
07/17/05	5.0	3.0	3.1	3.8	2.4	Residual Water	52%
07/18/05	5.0	3.0	2.9	3.5	2.5	Residual Water	51%
07/19/05	5.0	3.0	2.8	3.3	2.5	Residual Water	50%
07/20/05	5.1	3.0	2.8	3.3	2.5	Residual Water	51%
07/21/05	5.2	3.0	2.8	3.3	2.5	Residual Water	52%
07/22/05	5.3	3.0	2.8	3.4	2.5	Residual Water	53%
07/23/05	5.4	3.0	2.8	3.4	2.5	Residual Water	54%
07/24/05	5.5	3.0	2.8	3.5	2.5	Residual Water	55%
07/25/05	5.6	3.0	2.8	3.5	2.4	Residual Water	56%
07/26/05	NS-BD	2.9	2.8	3.8	2.4	Residual Water	IDC
07/27/05	5.8	3.1	3.0	3.8	2.6	Residual Water	49%
07/28/05	5.9	3.1	3.0	3.8	2.6	Residual Water	49%
07/29/05	6.1	3.2	3.1	3.8	2.7	Residual Water	49%
07/30/05	6.2	3.2	3.1	3.8	2.7	Residual Water	48%
07/31/05	6.3	3.2	3.1	3.8	2.7	Residual Water	47%
08/01/05	6.4	3.2	3.1	3.8	2.8	Residual Water	46%
08/02/05	6.5	3.3	3.2	3.8	2.8	Residual Water	46%
08/03/05	6.5	3.3	3.2	3.7	2.7	Residual Water	47%
08/04/05	6.5	3.3	3.1	3.7	2.6	Residual Water	48%
08/05/05	6.6	3.3	3.1	3.6	2.5	Residual Water	49%
08/06/05	6.6	3.3	3.1	3.5	2.5	Residual Water	50%
08/07/05	6.6	3.3	3.1	3.4	2.4	Residual Water	53%
08/08/05	6.6	3.3	3.1	3.4	2.3	Residual Water	55%
08/09/05	6.7	3.3	3.1	3.3	2.2	Residual Water	58%
08/10/05	7.6	3.3	3.1	3.3	2.3	Residual Water	58%
08/11/05	8.5	3.4	3.1	3.3	2.3	Residual Water	58%
08/12/05	9.4	3.5	3.2	3.4	2.4	Residual Water	58%
08/13/05	10.3	3.5	3.2	3.4	2.4	Residual Water	IDC
08/14/05	11.3	3.6	3.3	3.4	2.4	Residual Water	58%
08/15/05	12.2	3.7	3.3	3.5	2.5	Residual Water	59%
08/16/05	13.1	3.8	3.3	3.5	2.5	100%	59%
08/17/05	12.2	3.9	3.4	3.6	2.5	99%	59%

Table 5-1
Basin and Lysimeter Monitoring Results for Banana Basin: Total Organic Carbon (mg/L) Interpolated

Date	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
08/18/05	11.4	4.1	3.5	3.6	2.5	99%	60%
08/19/05	10.5	4.3	3.6	3.7	2.5	98%	60%
08/20/05	9.6	4.5	3.7	3.8	2.6	98%	61%
08/21/05	8.7	4.7	3.8	3.9	2.6	97%	60%
08/22/05	7.9	4.9	3.9	3.9	2.6	97%	60%
08/23/05	7.0	5.1	4.0	4.0	2.6	96%	60%
08/24/05	9.5	NA	NA	NA	NA	98%	IDC
08/25/05	9.4	5.0	3.9	4.0	2.5	98%	62%
08/26/05	9.3	5.0	3.9	4.0	2.4	99%	64%
08/27/05	9.3	5.0	3.8	4.0	2.3	99%	65%
08/28/05	9.2	4.9	3.8	4.0	2.2	99%	71%
08/29/05	9.1	4.9	3.7	4.0	2.1	100%	75%
08/30/05	9.0	4.9	3.7	4.0	2.0	100%	79%
08/31/05	9.3	4.8	3.7	3.9	2.0	100%	80%
09/01/05	9.7	4.7	3.7	3.8	2.1	100%	82%
09/02/05	10.0	4.7	3.7	3.7	2.1	100%	83%
09/03/05	10.4	4.6	3.7	3.6	2.1	100%	84%
09/04/05	10.7	4.6	3.7	3.5	2.1	100%	82%
09/05/05	11.1	4.5	3.7	3.4	2.2	100%	81%
09/06/05	11.4	4.4	3.7	3.3	2.2	100%	79%
09/07/05	11.0	4.5	3.7	3.2	2.2	100%	77%
09/08/05	10.7	4.6	3.6	3.2	2.2	100%	75%
09/09/05	10.3	4.6	3.6	3.2	2.2	100%	72%
09/10/05	9.9	4.7	3.5	3.1	2.2	100%	69%
09/11/05	9.6	4.7	3.4	3.1	2.1	100%	77%
09/12/05	9.2	4.8	3.4	3.1	2.1	100%	77%
09/13/05	8.8	4.8	3.3	3.0	2.1	100%	77%
09/14/05	9.0	4.8	3.3	3.0	2.1	100%	77%
09/15/05	9.1	4.7	3.3	3.0	2.2	100%	76%
09/16/05	9.2	4.6	3.3	3.0	2.2	100%	76%
09/17/05	9.3	4.6	3.3	3.0	2.2	100%	76%
09/18/05	9.4	4.5	3.2	2.9	2.2	100%	76%
09/19/05	9.6	4.4	3.2	2.9	2.2	100%	77%
09/20/05	9.7	4.4	3.2	2.9	2.3	100%	78%
09/21/05	9.6	4.3	3.2	2.9	2.2	100%	79%
09/22/05	9.5	4.3	3.2	2.8	2.2	100%	80%
09/23/05	9.5	4.2	3.1	2.8	2.1	100%	81%
09/24/05	9.4	4.2	3.1	2.8	2.1	100%	82%
09/25/05	9.3	4.1	3.1	2.7	2.1	100%	81%
09/26/05	9.2	4.1	3.1	2.7	2.0	100%	81%
09/27/05	9.1	4.0	3.0	2.6	2.0	100%	81%
09/28/05	9.4	4.0	3.0	2.7	2.0	100%	80%
09/29/05	9.6	4.0	3.0	2.7	2.0	100%	79%
09/30/05	9.8	4.0	3.0	2.7	2.0	100%	78%

Table 5-1
Basin and Lysimeter Monitoring Results for Banana Basin: Total Organic Carbon (mg/L) Interpolated

Date	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
10/01/05	10.0	4.0	3.0	2.7	2.0	100%	77%
10/02/05	10.2	4.0	3.0	2.8	2.0	100%	77%
10/03/05	10.4	4.0	3.0	2.8	2.0	100%	78%
10/04/05	10.6	4.0	3.0	2.8	2.0	100%	78%
10/05/05	10.5	4.0	3.0	2.8	2.0	100%	78%
10/06/05	10.3	4.0	2.9	2.8	2.0	100%	79%
10/07/05	10.2	4.0	2.9	2.7	2.0	100%	79%
10/08/05	10.0	4.0	2.8	2.7	2.0	100%	79%
10/09/05	9.9	4.0	2.8	2.7	2.0	100%	79%
10/10/05	9.7	4.0	2.8	2.7	2.0	100%	79%
10/11/05	9.6	3.9	2.7	2.7	2.0	100%	79%
10/12/05	9.4	3.9	2.7	2.6	2.0	100%	79%
10/13/05	9.3	3.9	2.7	2.6	2.0	100%	79%
10/14/05	7.8	4.0	2.7	2.6	2.0	100%	79%
10/15/05	6.4	4.0	2.7	2.5	1.9	100%	79%
10/16/05	4.9	4.1	2.7	2.4	1.9	100%	80%
10/17/05	3.5	4.2	2.7	2.4	1.9	100%	81%
10/18/05	2.1	4.2	2.7	2.3	1.8	100%	81%
10/19/05	3.0	4.2	2.7	2.3	1.8	100%	82%
10/20/05	3.9	4.2	2.7	2.3	1.8	100%	82%
10/21/05	4.7	4.2	2.7	2.3	1.8	100%	83%
10/22/05	5.6	4.2	2.7	2.4	1.8	100%	83%
10/23/05	6.5	4.2	2.7	2.4	1.8	100%	83%
10/24/05	7.4	4.2	2.7	2.4	1.8	100%	83%
10/25/05	8.3	4.2	2.7	2.4	1.8	100%	83%
10/26/05	8.3	4.1	2.8	2.4	1.8	100%	82%
10/27/05	8.4	4.1	2.8	2.5	1.8	100%	82%
10/28/05	8.4	4.0	2.8	2.5	1.9	100%	81%
10/29/05	8.4	4.0	2.8	2.6	1.9	100%	80%
10/30/05	8.5	3.9	2.9	2.6	1.9	100%	80%
10/31/05	8.5	3.8	2.9	2.6	1.9	100%	79%
11/01/05	8.6	3.8	2.9	2.7	2.0	100%	75%
11/02/05	8.5	3.7	2.9	2.6	2.0	99%	68%
11/03/05	8.4	3.7	2.9	2.6	2.1	99%	57%
11/04/05	8.4	3.7	2.8	2.5	2.2	98%	38%
11/05/05	8.3	3.6	2.8	2.4	2.2	97%	-8%
11/06/05	8.3	3.6	2.7	2.4	2.3	96%	22%
11/07/05	8.2	3.5	2.7	2.3	2.4	96%	38%
11/08/05	8.2	3.5	2.6	2.2	2.4	95%	49%
11/09/05	8.3	3.5	2.6	2.2	2.4	93%	58%
11/10/05	8.5	3.5	2.6	2.2	2.3	92%	65%
11/11/05	8.6	3.5	2.5	2.2	2.2	90%	71%
11/12/05	8.7	3.5	2.5	2.2	2.1	89%	75%
11/13/05	8.9	3.5	2.4	2.1	2.0	87%	76%

Table 5-1
Basin and Lysimeter Monitoring Results for Banana Basin: Total Organic Carbon (mg/L) Interpolated

Date	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
11/14/05	9.0	3.5	2.4	2.1	1.9	86%	77%
11/15/05	9.1	3.5	2.3	2.1	1.8	84%	78%
11/16/05	8.9	3.4	2.3	2.0	1.9	83%	78%
11/17/05	8.7	3.3	2.2	1.9	2.0	81%	77%
11/18/05	8.4	3.2	2.2	1.9	2.0	80%	76%
11/19/05	8.2	3.1	2.1	1.8	2.1	79%	76%
11/20/05	7.9	3.0	2.0	1.7	2.1	78%	75%
11/21/05	7.7	2.9	2.0	1.6	2.2	76%	74%
11/22/05	7.4	2.8	1.9	1.5	2.3	75%	73%
11/23/05	7.4	2.9	2.0	1.6	2.0	74%	76%
11/24/05	7.5	2.9	2.1	1.6	1.7	73%	79%
11/25/05	7.5	2.9	2.2	1.6	1.5	73%	82%
11/26/05	7.5	2.9	2.1	1.6	1.5	72%	82%
11/27/05	7.5	2.9	2.1	1.6	1.5	71%	82%
11/28/05	7.5	2.9	2.1	1.6	1.6	71%	82%
11/29/05	7.5	2.8	2.1	1.6	1.6	70%	82%
11/30/05	7.4	2.8	2.0	1.6	1.5	70%	83%
12/01/05	7.3	2.7	1.9	1.5	1.3	69%	85%
12/02/05	7.2	2.7	1.7	1.5	1.2	69%	87%
12/03/05	7.2	2.7	1.7	1.5	1.2	68%	87%
12/04/05	7.2	2.7	1.7	1.4	1.1	68%	87%
12/05/05	7.2	2.7	1.7	1.4	1.1	67%	87%
12/06/05	7.2	2.7	1.7	1.4	1.0	67%	88%
12/07/05	7.7	2.6	1.7	1.4	1.0	68%	87%
12/08/05	8.2	2.6	1.6	1.4	1.0	68%	87%
12/09/05	8.7	2.6	1.6	1.4	1.0	69%	87%
12/10/05	8.9	2.7	1.7	1.4	1.1	69%	86%
12/11/05	9.2	2.8	1.7	1.5	1.1	69%	85%
12/12/05	9.5	2.9	1.8	1.6	1.2	70%	84%
12/13/05	9.8	3.0	1.9	1.6	1.2	70%	84%
12/14/05	9.5	2.9	1.8	1.5	1.2	71%	84%
12/15/05	9.2	2.7	1.7	1.4	1.2	72%	84%
12/16/05	8.9	2.6	1.6	1.3	1.2	74%	84%
12/17/05	8.8	2.6	1.6	1.3	1.2	74%	85%
12/18/05	8.7	2.6	1.6	1.3	1.1	75%	85%
12/19/05	8.5	2.6	1.6	1.4	1.1	76%	85%
12/20/05	8.4	2.7	1.6	1.4	1.1	77%	84%
12/21/05	8.5	2.7	1.7	1.4	4.6	77%	35%
12/22/05	8.5	2.7	1.7	1.4	8.2	76%	-14%
12/23/05	8.6	2.7	1.7	1.4	11.7	76%	-63%
12/24/05	8.6	2.7	1.8	1.4	9.1	76%	-26%
12/25/05	8.6	2.7	1.8	1.4	6.4	76%	17%
12/26/05	8.6	2.7	1.9	1.4	3.7	75%	54%
12/27/05	8.6	2.7	1.9	1.3	1.1	75%	88%

Table 5-1
Basin and Lysimeter Monitoring Results for Banana Basin: Total Organic Carbon (mg/L) Interpolated

Date	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
12/28/05	8.7	2.7	1.7	1.3	1.0	76%	89%
12/29/05	8.8	2.7	1.6	1.3	0.9	77%	90%
12/30/05	8.7	2.8	1.7	1.3	1.0	77%	90%
12/31/05	8.6	2.8	1.7	1.3	1.0	77%	89%
Average	**9.0**	**3.8**	**2.7**	**2.6**	**2.3**		**70%**

[1]Sample Number is the number of samples once the compliance point lysimeter is sampling primarily recharged recycled water.
ND: Not Detected
NS-BD: Not Sampled-Basin Dry
NT: Insufficient Sample for Analytical Test
IDC: Insufficient Data for Calculation
Indicates that the sampled water is >75 percent recycled water
2.6 Denotes an interpolated value.

Table 5-2
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell: Total Organic Carbon (mg/L)

Date	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
06/10/05	6.3	7.2	7.8	4.9	3.0	Residual Water	53%
06/11/05	7.4	0.9			2.9	Residual Water	60%
06/12/05	9.2	6.9			2.9	Residual Water	69%
06/13/05	10.6	6.7			2.8	Residual Water	73%
06/14/05	12.0	6.6			2.8	Residual Water	77%
06/15/05	13.4	6.4	NT	NT	2.8	Residual Water	79%
06/16/05	13.9	6.5			2.8	Residual Water	80%
06/17/05	14.9	6.5			2.8	Residual Water	81%
06/18/05	15.7	6.6			2.8	Residual Water	82%
06/19/05	16.4	6.6			2.8	Residual Water	83%
06/20/05	17.2	NT	NT	NT	2.8	Residual Water	56%
06/21/05	15.5	6.7			2.8	Residual Water	62%
06/22/05	13.9	6.8			2.8	Residual Water	69%
06/23/05	12.2	6.9			2.9	Residual Water	73%
06/24/05	10.5	6.9			2.9	Residual Water	76%
06/25/05	8.9	7.0			2.9	Residual Water	78%
06/26/05	7.2	7.0			2.9	Residual Water	79%
06/27/05	5.5	7.1	NT	NT	2.9	Residual Water	80%
06/28/05	5.6	6.8			2.9	Residual Water	81%
06/29/05	5.7	6.5			2.9	Residual Water	82%
06/30/05	5.8	6.2			2.9	Residual Water	83%
07/01/05	5.9	6.0			2.9	Residual Water	81%
07/02/05	6.0	5.7			2.9	Residual Water	79%
07/03/05	6.1	5.4			2.9	Residual Water	76%
07/04/05	6.2	5.1			2.9	Residual Water	73%
07/05/05	6.3	4.9	NT	NT	2.9	Residual Water	68%
07/06/05	6.2	4.7			2.8	Residual Water	61%
07/07/05	6.2	4.6			2.8	Residual Water	50%
07/08/05	6.2	4.5			2.7	Residual Water	51%
07/09/05	6.1	4.3			2.7	Residual Water	52%
07/10/05	6.1	4.2			2.7	Residual Water	54%
07/11/05	6.1	4.1			2.6	Residual Water	55%
07/12/05	6.1	4.0	NT	NT	2.6	Residual Water	56%
07/13/05	5.9	3.9			2.6	Residual Water	57%
07/14/05	5.8	3.9			2.6	Residual Water	58%
07/15/05	5.6	3.9			2.6	Residual Water	59%
07/16/05	5.5	3.8			2.6	Residual Water	58%
07/17/05	5.4	3.8			2.6	Residual Water	58%
07/18/05	5.2	3.8			2.6	Residual Water	58%
07/19/05	5.1	3.8	NT	NT	2.6	Residual Water	58%
07/20/05	5.6	4.0			2.6	Residual Water	57%
07/21/05	6.1	4.2			2.6	Residual Water	56%
07/22/05	6.7	4.5			2.7	Residual Water	56%
07/23/05	7.2	4.7			2.7	Residual Water	54%
07/24/05	7.7	4.9			2.8	Residual Water	52%
07/25/05	8.2	5.2			2.8	Residual Water	50%
07/26/05	8.8	5.4	NT	NT	2.8	Residual Water	49%
07/27/05	8.2	5.2			2.8	Residual Water	47%
07/28/05	7.7	5.1			2.8	Residual Water	46%
07/29/05	7.2	5.0			2.8	Residual Water	44%
07/30/05	6.7	4.8			2.9	Residual Water	49%
07/31/05	6.1	4.7			2.9	Residual Water	53%
08/01/05	5.6	4.5			2.9	Residual Water	57%
08/02/05	5.1	4.4	NT	NT	2.9	Residual Water	60%
08/03/05	5.0	4.3			2.8	Residual Water	63%
08/04/05	4.9	4.2			2.8	Residual Water	66%

Table 5-2
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell: Total Organic Carbon (mg/L)

Date	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
08/05/05	4.8	4.1			2.7	Residual Water	69%
08/06/05	4.7	4.0			2.7	Residual Water	68%
08/07/05	4.6	4.0			2.6	Residual Water	66%
08/08/05	4.5	3.9			2.6	Residual Water	64%
08/09/05	4.4	3.8	NT	NT	2.5	Residual Water	62%
08/10/05	6.7	3.7			2.5	Residual Water	59%
08/11/05	8.9	3.7			2.5	Residual Water	55%
08/12/05	11.1	3.6			2.5	Residual Water	51%
08/13/05	13.3	3.6			2.5	Residual Water	50%
08/14/05	15.6	3.5			2.5	Residual Water	49%
08/15/05	17.8	3.5			2.5	Residual Water	48%
08/16/05	20.0	3.5	NT	NT	2.5	Residual Water	47%
08/17/05	18.1	3.7			2.7	Residual Water	42%
08/18/05	16.1	3.9			2.8	Residual Water	37%
08/19/05	14.2	4.1			3.0	Residual Water	32%
08/20/05	12.3	4.4			3.2	Residual Water	52%
08/21/05	10.3	4.6			3.4	Residual Water	62%
08/22/05	8.4	4.8			3.5	Residual Water	68%
08/23/05	6.5	5.0	NT	NT	3.7	Residual Water	72%
08/24/05	6.5	5.0			3.6	Residual Water	77%
08/25/05	6.6	5.0			3.4	Residual Water	81%
08/26/05	6.7	5.0			3.3	Residual Water	84%
08/27/05	6.7	5.0			3.1	Residual Water	83%
08/28/05	6.8	4.9			3.0	Residual Water	81%
08/29/05	6.8	4.9			2.8	Residual Water	80%
08/30/05	6.9	4.9	NT	NT	2.7	Residual Water	78%
08/31/05	7.0	4.9			2.7	Residual Water	74%
09/01/05	7.1	4.9			2.7	Residual Water	68%
09/02/05	7.2	4.9			2.6	Residual Water	59%
09/03/05	7.3	4.8			2.6	Residual Water	60%
09/04/05	7.4	4.8			2.6	Residual Water	61%
09/05/05	7.5	4.8			2.6	Residual Water	61%
09/06/05	7.6	4.8			2.5	Residual Water	62%
09/07/05	7.7	4.8			2.5	Residual Water	63%
09/08/05	7.8	4.8			2.5	Residual Water	64%
09/09/05	7.9	4.8			2.5	27%	64%
09/10/05	8.0	4.7			2.4	41%	65%
09/11/05	8.1	4.7			2.4	48%	66%
09/13/05	8.3	4.7	NT	NT	2.4	54%	67%
09/14/05	10.2	4.7			2.5	60%	66%
09/15/05	12.1	4.7			2.6	65%	65%
09/16/05	14.0	4.7			2.7	70%	64%
09/17/05	15.9	4.8			2.8	75%	63%
09/18/05	17.8	4.8			2.9	80%	62%
09/19/05	19.7	4.8			3.0	85%	62%
09/20/05	21.6	4.8	NT	NT	3.1	90%	61%
09/21/05	20.5	6.4			4.1	90%	49%
09/22/05	19.5	8.1			5.1	89%	37%
09/23/05	18.4	9.7			6.1	88%	27%
09/24/05	17.3	11.3			7.0	87%	31%
09/25/05	16.2	12.9			8.0	86%	34%
09/26/05	15.2	14.6			9.0	85%	36%
09/27/05	14.1	16.2	NT	NT	10.0	85%	37%
09/28/05	26.1	15.3			9.6	85%	46%
09/29/05	38.2	14.4			9.2	85%	53%
09/30/05	50.2	13.5			8.8	85%	59%

Table 5-2
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell: Total Organic Carbon (mg/L)

Date	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
10/01/05	62.3	12.5			8.4	86%	59%
10/02/05	74.3	11.6			8.0	86%	59%
10/03/05	86.4	10.7			7.6	86%	59%
10/04/05	98.4	9.8			7.2	86%	58%
10/04/05	98.4	9.8	NT	NT	7.2	86%	56%
10/05/05	88.7	9.3			6.9	88%	55%
10/06/05	78.9	8.9			6.5	89%	54%
10/07/05	69.2	8.4			6.2	91%	76%
10/08/05	59.4	8.0			5.9	92%	85%
10/09/05	49.7	7.5			5.6	94%	89%
10/10/05	39.9	7.0			5.2	95%	92%
10/11/05	30.2	6.6			4.9	97%	93%
10/12/05	20.4	6.1			4.6	98%	95%
10/13/05	10.7	5.7	NT	NT	4.3	100%	96%
10/14/05	10.7	5.5			4.2	100%	96%
10/15/05	10.6	5.3			4.1	100%	95%
10/16/05	10.6	5.1			4.1	100%	95%
10/17/05	10.5	4.9			4.0	100%	94%
10/18/05	10.5	4.7	NT	NT	3.9	100%	93%
10/19/05	10.7	4.8			3.7	100%	92%
10/20/05	10.9	4.8			3.6	100%	91%
10/21/05	11.1	4.9			3.4	100%	89%
10/22/05	11.2	4.9			3.2	100%	84%
10/23/05	11.4	5.0			3.1	100%	71%
10/24/05	11.6	5.0			2.9	100%	73%
10/25/05	11.8	NT	NT	NT	2.8	100%	74%
10/26/05	11.6	5.1			2.9	100%	73%
10/27/05	11.4	5.2			3.0	100%	72%
10/28/05	11.3	5.2			3.1	100%	71%
10/29/05	11.1	5.3			3.2	100%	70%
10/30/05	10.9	5.3			3.3	100%	70%
10/31/05	10.7	5.4			3.4	100%	69%
11/01/05	10.5	5.4			3.5	100%	69%
11/02/05	10.3	5.5			3.6	100%	68%
11/03/05	10.2	5.5			3.7	100%	68%
11/04/05	10.0	5.6			3.8	100%	68%
11/05/05	9.8	5.6			3.9	100%	66%
11/06/05	9.6	5.7			4.0	100%	65%
11/07/05	9.4	5.7			4.2	100%	63%
11/08/05	9.2	5.8			4.3	100%	61%
11/09/05	9.0	5.8			4.4	100%	60%
11/10/05	8.9	5.9			4.5	100%	58%
11/11/05	8.7	5.9			4.6	100%	56%
11/12/05	8.5	6.0			4.7	100%	55%
11/13/05	8.3	6.0			4.8	100%	53%
11/14/05	8.1	6.1			4.9	100%	51%
11/15/05	7.9	6.1	7.1	NT	5.0	100%	49%
11/16/05	7.8	5.8	6.9		4.8	100%	50%
11/17/05	7.7	5.6	6.6		4.5	100%	52%
11/18/05	7.6	5.3	6.4		4.3	100%	53%
11/19/05	7.5	5.0	6.2		4.1	100%	55%
11/20/05	7.3	4.7	6.0		3.8	100%	57%
11/21/05	7.2	4.4	5.7		3.6	100%	59%
11/22/05	7.1	4.1	5.5	9.2	3.4	100%	60%
11/23/05	7.4	4.6	5.5	9.3	3.4	100%	59%

Table 5-2
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell: Total Organic Carbon (mg/L)

Date	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
11/24/05	7.7	5.0	5.4	9.4	3.4	99%	58%
11/25/05	8.0	5.4	5.4	9.5	3.5	99%	56%
11/26/05	8.1	5.1	5.2	10.2	3.5	98%	55%
11/27/05	8.2	4.7	5.1	10.9	3.6	98%	53%
11/28/05	8.2	4.3	4.9	11.6	3.7	98%	51%
11/29/05	8.3	4.0	4.8	12.3	3.8	97%	50%
11/30/05	8.0	4.0	4.4	9.7	3.7	98%	50%
12/01/05	7.7	4.0	4.0	7.1	3.6	98%	51%
12/02/05	7.4	4.1	3.7	4.4	3.5	98%	51%
12/03/05	7.4	4.2	3.7	4.3	3.4	99%	54%
12/04/05	7.4	4.2	3.7	4.3	3.4	99%	56%
12/05/05	7.4	4.3	3.7	4.2	3.3	100%	58%
12/06/05	7.4	4.4	3.7	4.1	3.3	100%	59%
12/07/05	8.0	4.5	3.7	4.0	3.4	100%	59%
12/08/05	8.5	4.6	3.7	3.9	3.5	100%	58%
12/09/05	9.1	4.6	3.7	3.8	3.6	100%	57%
12/10/05	9.2	4.9	3.8	4.0	3.4	100%	57%
12/11/05	9.4	5.1	3.9	4.2	3.3	100%	57%
12/12/05	9.5	5.3	4.0	4.3	3.2	100%	56%
12/13/05	9.6	5.5	4.1	4.5	3.1	100%	58%
12/14/05	9.3	5.2	3.8	4.3	3.0	100%	59%
12/15/05	9.0	4.9	3.5	4.0	3.0	100%	60%
12/16/05	8.7	4.6	3.3	3.7	2.9	100%	60%
12/17/05	8.5	4.7	3.3	3.7	2.9	100%	64%
12/18/05	8.4	4.8	3.4	3.7	2.8	100%	67%
12/19/05	8.2	4.9	3.5	3.7	2.8	100%	70%
12/20/05	8.1	5.0	3.5	3.7	2.7	100%	71%
12/21/05	8.4	4.9	3.5	4.2	2.7	100%	72%
12/22/05	8.6	4.9	3.4	4.6	2.6	100%	73%
12/23/05	8.9	4.8	3.4	5.1	2.6	100%	73%
12/24/05	8.8	4.8	3.4	4.7	2.5	100%	73%
12/25/05	8.6	4.7	3.5	4.3	2.5	100%	72%
12/26/05	8.5	4.7	3.5	4.0	2.5	100%	71%
12/27/05	8.4	4.7	3.6	3.6	2.5	100%	71%
12/28/05	8.4	4.5	3.5	3.5	2.9	100%	66%
12/29/05	8.4	4.4	3.5	3.5	3.2	100%	61%
12/30/05	8.4	4.2	3.5	3.5	3.5	100%	56%
Average	**20.5**	**6.4**	**3.4**	**5.6**	**4.3**		**64%**

NS-BD: Not Sampled-Basin Dry
NT: Insufficient Sample for Analytical Test
IDC: Insufficient Data for Calculation
Indicates that the sampled water is >75 percent recycled water
64% Denotes an interpolated value.

Table 5-3
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Total Organic Carbon (mg/L)

Date	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
06/10/05	6.0	4.0	2.3	2.8	*1.9*	Residual Water	68%
06/11/05	6.0	4.0	2.3	2.8	1.8	Residual Water	70%
06/12/05	6.1	3.9	2.4	2.7	1.7	Residual Water	72%
06/13/05	6.1	3.8	2.5	2.6	1.6	Residual Water	74%
06/14/05	6.2	3.8	2.5	2.5	1.5	Residual Water	76%
06/15/05	NT	3.7	2.6	2.4	1.4	Residual Water	IDC
06/16/05	6.3	3.7	2.5	2.4	1.4	Residual Water	78%
06/17/05	6.3	3.6	2.4	2.3	1.3	Residual Water	79%
06/18/05	6.4	3.6	2.4	2.2	1.3	Residual Water	79%
06/19/05	6.4	3.5	2.3	2.2	1.3	Residual Water	79%
06/20/05	NT	NT	2.2	2.1	1.3	Residual Water	IDC
06/21/05	6.5	3.4	2.4	2.1	1.4	Residual Water	79%
06/22/05	6.6	3.4	2.5	2.1	1.4	Residual Water	79%
06/23/05	6.6	3.3	2.6	2.2	1.4	Residual Water	78%
06/24/05	6.7	3.3	2.8	2.2	1.5	Residual Water	78%
06/25/05	6.7	3.2	2.9	2.2	1.5	Residual Water	77%
06/26/05	6.8	3.2	3.0	2.2	1.6	Residual Water	77%
06/27/05	6.8	3.2	3.2	2.2	1.6	Residual Water	77%
06/28/05	6.8	3.2	3.1	2.2	1.6	Residual Water	77%
06/29/05	6.8	3.2	3.0	2.2	1.6	Residual Water	77%
06/30/05	6.8	3.2	2.9	2.2	1.6	Residual Water	77%
07/01/05	6.7	3.2	2.8	2.2	1.6	Residual Water	77%
07/02/05	6.7	3.2	2.7	2.2	1.5	Residual Water	77%
07/03/05	6.7	3.2	2.6	2.2	1.5	Residual Water	77%
07/04/05	6.6	3.2	2.5	2.2	1.5	Residual Water	77%
07/05/05	6.6	3.2	2.4	2.2	1.5	Residual Water	75%
07/06/05	6.5	3.2	2.5	2.2	1.5	Residual Water	75%
07/07/05	6.3	3.2	2.6	2.2	1.5	Residual Water	75%
07/08/05	6.2	3.1	2.6	2.2	1.5	Residual Water	75%
07/09/05	6.1	3.1	2.7	2.2	1.5	Residual Water	75%
07/10/05	5.9	3.1	2.8	2.2	1.5	Residual Water	IDC
07/11/05	5.8	3.1	2.8	2.1	1.6	Residual Water	75%
07/12/05	5.7	3.1	2.9	2.1	1.6	Residual Water	75%
07/13/05	5.6	3.0	2.9	2.1	1.5	Residual Water	76%
07/14/05	5.5	3.0	2.9	2.1	1.4	Residual Water	77%
07/15/05	5.5	2.9	2.8	2.0	1.4	Residual Water	IDC
07/16/05	5.4	2.9	2.8	2.0	1.3	Residual Water	80%
07/17/05	5.4	2.8	2.8	2.0	1.3	Residual Water	81%
07/18/05	5.3	2.8	2.8	1.9	1.2	Residual Water	82%
07/19/05	5.2	2.7	2.7	1.9	1.2	Residual Water	83%
07/20/05	5.3	2.7	2.7	1.9	1.2	Residual Water	83%
07/21/05	5.4	2.8	2.7	1.9	1.2	Residual Water	83%
07/22/05	5.4	2.8	2.7	1.9	1.2	Residual Water	83%
07/23/05	5.5	2.9	2.7	1.9	1.2	Residual Water	83%
07/24/05	5.6	2.9	2.7	1.9	1.2	Residual Water	82%
07/25/05	5.6	2.9	2.6	1.8	1.2	Residual Water	82%
07/26/05	NT	3.0	2.6	1.8	1.2	Residual Water	82%
07/27/05	5.8	3.0	2.6	1.9	1.2	Residual Water	82%
07/28/05	5.9	3.1	2.7	1.9	1.2	Residual Water	82%
07/29/05	5.9	3.1	2.7	1.9	1.2	Residual Water	82%
07/30/05	6.0	3.2	2.7	2.0	1.2	Residual Water	82%
07/31/05	6.1	3.2	2.7	2.0	1.2	Residual Water	82%
08/01/05	6.1	3.3	2.8	2.1	1.2	Residual Water	81%
08/02/05	6.2	3.3	2.8	2.1	1.2	Residual Water	81%
08/03/05	5.9	3.3	2.8	2.1	1.3	Residual Water	79%
08/04/05	5.7	3.3	2.9	2.1	1.3	Residual Water	78%

Table 5-3
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Total Organic Carbon (mg/L)

Date	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
08/05/05	5.5	3.3	2.9	2.1	1.4	Residual Water	76%
08/06/05	5.2	3.2	2.9	2.1	1.4	Residual Water	74%
08/07/05	5.0	3.2	3.0	2.2	1.5	Residual Water	73%
08/08/05	4.7	3.2	3.0	2.2	1.6	Residual Water	72%
08/09/05	4.5	3.2	3.0	2.2	1.6	Residual Water	70%
08/10/05	6.7	3.1	3.0	2.3	1.6	Residual Water	70%
08/11/05	9.0	3.1	3.0	2.3	1.7	Residual Water	69%
08/12/05	11.2	3.0	3.0	2.4	1.7	Residual Water	68%
08/13/05	13.4	3.0	3.0	2.5	1.7	Residual Water	67%
08/14/05	15.6	3.0	3.0	2.6	1.7	Residual Water	67%
08/15/05	17.9	2.9	3.0	2.7	1.7	Residual Water	67%
08/16/05	20.1	2.9	3.0	2.7	1.8	Residual Water	67%
08/17/05	18.1	3.4	3.5	3.1	1.8	Residual Water	67%
08/18/05	16.2	4.0	4.1	3.5	1.9	Residual Water	66%
08/19/05	14.2	4.5	4.7	3.8	2.0	Residual Water	65%
08/20/05	12.3	5.1	5.2	4.2	2.1	Residual Water	IDC
08/21/05	10.3	5.6	5.8	4.6	2.1	Residual Water	63%
08/22/05	8.3	6.1	6.4	5.0	2.2	Residual Water	62%
08/23/05	6.4	6.7	6.9	5.3	2.3	Residual Water	61%
08/24/05	7.5	6.3	6.6	5.1	2.3	Residual Water	61%
08/25/05	8.7	5.9	6.2	4.9	2.4	Residual Water	61%
08/26/05	9.8	5.5	5.8	4.6	2.4	Residual Water	61%
08/27/05	11.0	5.1	5.5	4.4	2.5	Residual Water	60%
08/28/05	12.1	4.8	5.1	4.2	2.5	Residual Water	58%
08/29/05	13.3	4.4	4.7	3.9	2.6	Residual Water	55%
08/30/05	14.4	4.0	4.3	3.7	2.6	Residual Water	52%
08/31/05	13.96	3.9	4.3	3.6	2.6	Residual Water	51%
09/01/05	13.51	3.8	4.2	3.4	2.6	Residual Water	49%
09/02/05	13.07	3.8	4.1	3.3	2.5	Residual Water	46%
09/03/05	12.63	3.7	4.0	3.2	2.5	Residual Water	44%
09/04/05	12.18	3.6	3.9	3.1	2.5	Residual Water	63%
09/05/05	11.74	3.5	3.8	3.0	2.5	Residual Water	72%
09/06/05	NS-BD	3.5	3.8	2.9	2.5	Residual Water	78%
09/07/05	10.85	3.5	3.7	2.8	2.5	Residual Water	81%
09/08/05	10.41	3.5	3.6	2.8	2.5	Residual Water	84%
09/09/05	9.96	3.6	3.5	2.7	2.5	26%	86%
09/10/05	9.52	3.6	3.5	2.6	2.6	39%	87%
09/11/05	9.08	3.7	3.4	2.6	2.6	45%	86%
09/12/05	8.63	3.7	3.3	2.5	2.6	49%	84%
09/13/05	8.2	3.7	3.2	2.5	2.7	52%	81%
09/14/05	8.4	3.7	3.2	2.5	2.6	52%	79%
09/15/05	8.5	3.6	3.2	2.5	2.5	52%	75%
09/16/05	8.7	3.6	3.1	2.5	2.5	52%	70%
09/17/05	8.9	3.5	3.1	2.5	2.4	52%	62%
09/18/05	9.0	3.5	3.1	2.5	2.3	53%	69%
09/19/05	9.2	3.4	3.0	2.4	2.3	53%	74%
09/20/05	9.4	3.4	3.0	2.4	2.2	53%	78%
09/21/05	9.1	3.5	3.0	2.5	2.2	54%	80%
09/22/05	8.8	3.6	3.1	2.6	2.2	55%	82%
09/23/05	8.4	3.7	3.2	2.7	2.2	56%	84%
09/24/05	8.1	3.7	3.2	2.7	2.2	57%	85%
09/25/05	7.8	3.8	3.3	2.8	2.2	58%	85%
09/26/05	7.5	3.9	3.4	2.9	2.1	59%	84%
09/27/05	7.2	4.0	3.4	2.9	2.1	59%	84%
09/28/05	9.0	4.6	3.5	3.0	2.2	65%	82%
09/29/05	10.8	5.2	3.6	3.0	2.3	71%	81%
09/30/05	12.6	5.8	3.7	3.1	2.4	77%	79%

Table 5-3
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Total Organic Carbon (mg/L)

Date	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
10/01/05	14.4	6.3	3.8	3.1	2.5	83%	IDC
10/02/05	16.2	6.9	3.8	3.2	2.6	88%	76%
10/03/05	18.0	7.5	3.9	3.2	2.7	94%	74%
10/04/05	19.8	8.1	4.0	3.2	2.8	100%	71%
10/05/05	18.6	7.8	4.0	3.3	2.8	100%	71%
10/06/05	17.4	7.5	4.0	3.3	2.7	100%	70%
10/07/05	16.2	7.2	4.1	3.3	2.6	100%	69%
10/08/05	15.0	6.9	4.1	3.4	2.6	100%	68%
10/09/05	13.8	6.6	4.1	3.4	2.5	100%	70%
10/10/05	12.6	6.3	4.1	3.4	2.5	100%	71%
10/11/05	11.4	6.0	4.1	3.4	2.4	100%	73%
10/12/05	10.2	5.7	4.1	3.5	2.3	100%	74%
10/13/05	9.0	5.4	4.1	3.5	2.3	100%	75%
10/14/05	9.4	5.0	3.9	3.3	2.3	100%	75%
10/15/05	9.7	4.6	3.6	3.1	2.3	100%	76%
10/16/05	10.0	4.1	3.4	2.9	2.3	100%	75%
10/17/05	10.3	3.7	3.1	2.7	2.3	100%	74%
10/18/05	10.6	3.3	2.9	2.5	2.3	100%	73%
10/19/05	10.7	3.3	2.8	2.4	2.4	100%	70%
10/20/05	10.9	3.3	2.8	2.4	2.6	100%	67%
10/21/05	11.0	3.3	2.7	2.3	2.7	100%	64%
10/22/05	11.1	3.4	2.7	2.3	2.8	100%	61%
10/23/05	11.2	3.4	2.6	2.2	3.0	100%	67%
10/24/05	11.4	3.4	2.6	2.2	3.1	100%	71%
10/25/05	11.5	3.5	2.5	2.1	3.2	100%	74%
10/26/05	11.0	3.3	2.4	2.1	3.1	100%	79%
10/27/05	10.6	3.2	2.4	2.1	2.9	100%	82%
10/28/05	10.1	3.1	2.3	2.0	2.7	100%	85%
10/29/05	9.7	3.0	2.3	2.0	2.5	100%	87%
10/30/05	9.2	2.8	2.2	2.0	2.4	100%	87%
10/31/05	8.8	2.7	2.1	2.0	2.2	100%	87%
11/01/05	8.3	2.6	2.1	2.0	2.0	100%	88%
11/02/05	8.3	2.6	2.1	1.9	2.0	100%	87%
11/03/05	8.2	2.6	2.1	1.9	1.9	100%	86%
11/04/05	8.1	2.6	2.1	1.9	1.9	100%	85%
11/05/05	8.1	2.5	2.1	1.9	1.8	100%	84%
11/06/05	8.0	2.5	2.1	1.9	1.8	100%	83%
11/07/05	8.0	2.5	2.1	1.9	1.7	100%	81%
11/08/05	7.9	2.5	2.1	1.8	1.7	100%	82%
11/09/05	8.2	2.4	2.0	1.8	1.7	100%	82%
11/10/05	8.5	2.3	1.9	1.7	1.8	100%	82%
11/11/05	8.7	2.2	1.8	1.6	1.8	99%	82%
11/12/05	9.0	2.1	1.7	1.5	1.9	99%	82%
11/13/05	9.3	1.9	1.6	1.5	2.0	99%	82%
11/14/05	9.6	1.8	1.5	1.4	2.0	99%	81%
11/15/05	10.5	2.6	5.3	1.8	2.1	99%	81%
11/16/05	9.2	2.4	4.7	1.8	2.0	98%	82%
11/17/05	7.9	2.2	4.2	1.7	1.9	98%	83%
11/18/05	6.5	2.0	3.6	1.6	1.8	98%	84%
11/19/05	5.2	1.8	3.1	1.6	1.7	98%	85%
11/20/05	3.9	1.6	2.5	1.5	1.6	98%	86%
11/21/05	2.6	1.4	2.0	1.4	1.5	97%	86%
11/22/05	7.9	1.8	1.4	1.3	1.4	97%	86%
11/23/05	7.8	1.8	1.5	1.3	1.3	97%	86%
11/24/05	7.7	1.8	1.5	1.3	1.3	97%	86%
11/25/05	7.6	1.9	1.5	1.4	1.3	97%	85%

Table 5-3
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Total Organic Carbon (mg/L)

Date	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
11/26/05	3.1	1.6	1.4	1.3	1.4	96%	84%
11/27/05	4.6	1.9	1.4	1.3	1.4	96%	83%
11/28/05	6.2	2.2	1.5	1.3	1.5	96%	82%
11/29/05	7.8	2.4	1.6	1.2	1.6	96%	81%
11/30/05	7.8	2.4	1.7	1.3	1.5	96%	82%
12/01/05	7.8	2.4	1.8	1.3	1.4	95%	83%
12/02/05	7.8	2.4	1.9	1.3	1.3	95%	83%
12/03/05	8.3	2.2	1.8	1.3	1.3	95%	84%
12/04/05	8.9	2.1	1.8	1.3	1.3	95%	84%
12/05/05	9.4	2.0	1.8	1.3	1.3	95%	85%
12/06/05	10.0	1.9	1.7	1.3	1.2	94%	86%
12/07/05	10.0	1.8	1.6	1.3	1.3	94%	86%
12/08/05	9.9	1.8	1.5	1.3	1.3	94%	86%
12/09/05	9.9	1.7	1.4	1.3	1.3	94%	87%
12/10/05	10.3	1.9	1.4	1.4	1.3	94%	87%
12/11/05	10.8	2.0	1.5	1.4	1.4	93%	85%
12/12/05	11.2	2.2	1.5	1.5	1.4	93%	82%
12/13/05	11.7	2.4	1.5	1.6	1.5	93%	77%
12/14/05	10.9	2.2	1.4	1.4	1.4	96%	74%
12/15/05	10.1	2.1	1.4	1.3	1.2	96%	69%
12/16/05	9.3	2.0	1.3	1.1	1.1	96%	58%
12/17/05	9.3	2.1	1.3	1.2	1.1	96%	86%
12/18/05	9.3	2.3	1.3	1.2	1.2	96%	85%
12/19/05	9.3	2.4	1.4	1.2	1.2	96%	85%
12/20/05	9.3	2.6	1.4	1.2	1.2	96%	84%
12/21/05	9.6	2.4	1.4	1.2	1.2	96%	62%
12/22/05	9.9	2.3	1.3	1.2	1.1	96%	75%
12/23/05	10.2	2.2	1.3	1.2	1.1	96%	82%
12/24/05	9.6	2.2	1.3	1.2	1.1	96%	85%
12/25/05	9.0	2.1	1.3	1.2	1.2	96%	85%
12/26/05	8.5	2.1	1.3	1.2	1.2	96%	84%
12/27/05	7.9	2.0	1.4	1.2	1.3	96%	84%
12/28/05	8.2	2.1	1.4	1.2	1.2	96%	85%
12/29/05	8.5	2.2	1.5	1.2	1.2	96%	86%
12/30/05	8.8	2.3	1.6	1.3	1.2	96%	85%
Average	**9.4**	**3.2**	**2.4**	**2.0**	**2.5**		**75%**

NS-BD: Not Sampled-Basin Dry

NT: Insufficient Sample for Analytical Test

IDC: Insufficient Data for Calculation

Indicates that the sampled water is >75 percent recycled water

Table 5-4
Basin and Lysimeter Monitoring Results for Banana Basin: Summary for Total Nitrogen (mg/L) Interpolated

Station ID	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
07/06/05	0.7	0.9	1.1	0.6	1.4	Residual Water	-117%
07/07/05	0.7	0.8	1.3	0.6	1.3	Residual Water	-81%
07/08/05	0.8	0.7	1.6	0.5	1.2	Residual Water	-51%
07/09/05	0.9	0.7	1.9	0.5	1.1	Residual Water	-26%
07/10/05	0.9	0.6	2.2	0.5	1.0	Residual Water	-5%
07/11/05	1.0	0.5	2.5	0.5	0.9	Residual Water	13%
07/12/05	1.1	0.4	2.8	0.4	0.7	Residual Water	30%
07/13/05	1.1	0.5	2.2	0.5	0.7	Residual Water	39%
07/14/05	1.2	0.5	1.6	0.6	0.6	Residual Water	48%
07/15/05	1.2	0.6	1.0	0.6	0.6	Residual Water	55%
07/16/05	1.2	0.6	0.9	0.6	0.6	Residual Water	52%
07/17/05	1.1	0.6	0.8	0.5	0.6	Residual Water	49%
07/18/05	1.0	0.6	0.7	0.5	0.6	Residual Water	45%
07/19/05	1.0	0.6	0.7	0.4	0.6	Residual Water	41%
07/20/05	0.9	0.5	0.6	0.4	0.5	Residual Water	44%
07/21/05	0.9	0.5	0.6	0.3	0.5	Residual Water	48%
07/22/05	0.9	0.4	0.5	0.3	0.5	Residual Water	51%
07/23/05	0.9	0.4	0.5	0.3	0.5	Residual Water	47%
07/24/05	0.9	0.4	0.4	0.3	0.5	Residual Water	42%
07/25/05	0.9	0.4	0.4	0.3	0.6	Residual Water	38%
07/26/05	NS-BD	0.5	0.4	0.3	0.6	Residual Water	IDC
07/27/05	2.2	0.5	0.4	0.3	0.6	Residual Water	31%
07/28/05	3.0	0.5	0.4	0.3	0.6	Residual Water	38%
07/29/05	4.8	0.6	0.5	0.3	0.6	Residual Water	44%
07/30/05	4.1	0.7	0.6	0.4	0.7	Residual Water	34%
07/31/05	3.3	0.9	0.7	0.6	0.8	Residual Water	25%
08/01/05	2.5	1.0	0.8	0.7	1.0	Residual Water	17%
08/02/05	1.8	1.2	0.9	0.9	1.1	Residual Water	10%
08/03/05	1.9	1.4	0.9	0.8	1.1	Residual Water	6%
08/04/05	2.1	1.7	0.9	0.8	1.1	Residual Water	2%
08/05/05	2.3	1.9	0.9	0.7	1.1	Residual Water	-2%
08/06/05	2.0	1.9	1.1	1.1	1.2	Residual Water	-24%
08/07/05	1.8	1.9	1.3	1.4	1.3	Residual Water	-40%
08/08/05	1.6	1.9	1.5	1.8	1.5	Residual Water	-58%
08/09/05	1.4	1.9	1.8	2.2	1.6	Residual Water	-75%
08/10/05	2.0	1.9	1.7	1.9	1.6	Residual Water	-73%
08/11/05	2.6	1.9	1.6	1.6	1.6	Residual Water	-71%
08/12/05	3.3	1.9	1.5	1.3	1.6	Residual Water	-68%
08/13/05	3.1	1.6	1.4	1.3	1.4	Residual Water	IDC
08/14/05	3.0	1.4	1.3	1.3	1.3	Residual Water	40%
08/15/05	2.8	1.2	1.2	1.3	1.2	Residual Water	59%
08/16/05	2.6	1.0	1.2	1.2	1.1	100%	76%
08/17/05	2.2	0.9	1.0	1.1	1.2	99%	72%
08/18/05	1.7	0.8	0.9	0.9	1.2	99%	65%
08/19/05	1.2	0.8	0.8	0.7	1.2	98%	54%
08/20/05	1.6	0.7	0.7	0.7	1.1	98%	40%
08/21/05	1.9	0.6	0.7	0.6	1.0	97%	51%
08/22/05	2.3	0.5	0.7	0.5	0.8	97%	60%
08/23/05	2.7	0.5	0.7	0.4	0.7	96%	68%
08/24/05	2.7	IDC	IDC	IDC	IDC	98%	IDC
08/25/05	2.9	0.5	0.5	0.4	0.6	99%	68%
08/26/05	3.0	0.5	0.4	0.5	0.4	100%	72%
08/27/05	2.6	0.5	0.4	0.4	0.4	100%	71%
08/28/05	2.2	0.6	0.4	0.3	0.4	100%	82%
08/29/05	1.8	0.6	0.4	0.2	0.3	100%	88%
08/30/05	1.5	0.6	0.4	0.2	0.3	100%	92%
08/31/05	1.7	0.8	0.5	0.4	0.4	100%	86%

Table 5-4
Basin and Lysimeter Monitoring Results for Banana Basin: Summary for Total Nitrogen (mg/L) Interpolated

Station ID	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
09/01/05	1.9	1.0	0.6	0.5	0.6	100%	80%
09/02/05	2.1	1.1	0.6	0.7	0.7	100%	74%
09/03/05	2.5	1.0	0.6	0.8	0.7	100%	72%
09/04/05	2.9	0.9	0.7	0.8	0.8	100%	65%
09/05/05	3.3	0.8	0.7	0.9	0.8	100%	54%
09/06/05	3.7	0.7	0.7	0.9	IDC	100%	IDC
09/07/05	3.9	0.7	0.6	0.9	0.8	100%	52%
09/08/05	4.2	0.6	0.6	0.9	0.8	100%	60%
09/09/05	IDC	0.5	0.5	0.8	0.8	100%	66%
09/10/05	3.9	0.5	0.7	1.1	0.8	100%	71%
09/11/05	4.1	0.5	0.9	1.3	0.8	100%	72%
09/12/05	4.2	0.5	1.1	1.6	0.8	100%	73%
09/13/05	4.4	0.6	1.3	1.8	0.8	100%	75%
09/14/05	3.3	0.4	1.1	1.6	0.6	100%	78%
09/15/05	2.3	0.3	0.9	1.4	0.4	100%	83%
09/16/05	1.2	0.2	0.7	1.2	0.2	100%	89%
09/17/05	1.8	0.3	0.9	1.4	0.4	100%	74%
09/18/05	2.4	0.4	1.0	1.6	0.6	100%	67%
09/19/05	3.0	0.5	1.2	1.8	0.7	100%	62%
09/20/05	3.6	0.6	1.4	2.1	0.9	100%	58%
09/21/05	3.0	0.5	1.2	2.0	0.9	100%	65%
09/22/05	2.4	0.3	1.1	1.9	0.9	100%	71%
09/23/05	1.7	0.2	0.9	1.9	0.8	100%	75%
09/24/05	2.0	0.3	0.9	1.8	0.9	100%	75%
09/25/05	2.3	0.5	0.8	1.8	1.0	100%	74%
09/26/05	2.6	0.6	0.7	1.8	1.1	100%	73%
09/27/05	2.9	0.7	0.7	1.7	1.2	100%	IDC
09/28/05	2.8	0.8	0.6	1.5	1.1	100%	72%
09/29/05	2.8	0.9	0.6	1.2	0.9	100%	77%
09/30/05	2.7	1.0	0.5	0.9	0.8	100%	81%
10/01/05	2.4	1.8	0.5	0.9	0.8	100%	82%
10/02/05	2.1	2.7	0.5	0.8	0.8	100%	75%
10/03/05	1.7	3.6	0.5	0.8	0.8	100%	63%
10/04/05	1.4	4.5	0.5	0.7	0.8	100%	30%
10/05/05	1.4	3.2	0.6	0.7	0.9	100%	53%
10/06/05	1.3	1.9	0.6	0.8	0.9	100%	64%
10/07/05	1.3	0.7	0.7	0.8	0.9	100%	71%
10/08/05	0.7	0.8	1.3	0.6	1.3	100%	64%
10/09/05	0.8	0.7	1.6	0.5	1.2	100%	60%
10/10/05	0.9	0.7	1.9	0.5	1.1	100%	54%
10/11/05	0.9	0.6	2.2	0.5	1.0	100%	44%
10/12/05	1.0	0.5	2.5	0.5	0.9	100%	58%
10/13/05	2.0	0.7	0.8	1.1	0.9	100%	59%
10/14/05	2.9	0.5	1.2	1.7	0.7	100%	73%
10/15/05	2.9	0.5	1.1	1.6	0.7	100%	76%
10/16/05	2.9	0.5	1.0	1.4	0.7	100%	76%
10/17/05	2.9	0.5	0.9	1.3	0.6	100%	77%
10/18/05	3.0	0.5	0.8	1.2	0.6	100%	77%
10/19/05	2.7	0.5	0.7	1.2	0.8	100%	66%
10/20/05	2.5	0.5	0.7	1.2	1.0	100%	53%
10/21/05	2.2	0.5	0.6	1.2	1.1	100%	34%
10/22/05	2.1	0.6	0.6	1.2	1.1	100%	24%
10/23/05	1.9	0.7	0.7	1.2	1.0	100%	27%
10/24/05	1.8	0.8	0.7	1.2	0.9	100%	30%
10/25/05	1.6	0.8	0.7	1.2	0.9	100%	34%
10/26/05	1.5	0.9	0.8	0.9	1.2	100%	-64%
10/27/05	1.5	0.9	0.9	0.6	1.5	100%	-90%
10/28/05	1.4	1.0	1.0	0.3	1.8	100%	-112%
10/29/05	1.4	0.9	1.0	0.4	1.5	100%	-59%
10/30/05	1.4	0.8	0.9	0.5	1.1	100%	-12%
10/31/05	1.4	0.7	0.9	0.6	0.8	100%	62%

Table 5-4
Basin and Lysimeter Monitoring Results for Banana Basin: Summary for Total Nitrogen (mg/L) Interpolated

Station ID	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
11/01/05	1.4	0.7	0.9	0.7	0.4	100%	86%
11/02/05	1.4	0.4	0.8	0.7	0.4	98%	85%
11/03/05	1.3	0.2	0.7	0.7	0.4	96%	85%
11/04/05	1.2	0.0	0.5	IDC	NT	98%	IDC
11/05/05	1.3	0.0	0.5	0.6	0.5	97%	83%
11/06/05	1.4	0.0	0.5	0.6	0.5	95%	81%
11/07/05	1.4	0.0	0.4	0.6	0.5	92%	78%
11/08/05	IDC	0.0	0.4	0.6	0.6	95%	74%
11/09/05	1.6	0.3	0.4	0.7	0.7	93%	68%
11/10/05	1.7	0.5	0.4	0.8	0.8	91%	60%
11/11/05	1.7	0.8	0.4	0.9	0.9	90%	51%
11/12/05	1.8	0.8	0.4	0.9	1.1	87%	35%
11/13/05	1.9	0.7	0.4	0.9	1.3	85%	17%
11/14/05	1.8	0.6	0.4	0.9	1.4	82%	6%
11/15/05	IDC	IDC	IDC	IDC	IDC	84%	IDC
11/16/05	2.1	0.6	0.4	0.9	1.8	86%	-33%
11/17/05	2.2	0.6	0.4	0.9	2.0	83%	-45%
11/18/05	2.3	0.5	0.4	1.0	2.2	80%	-57%
11/19/05	2.0	0.5	0.4	0.9	1.8	78%	-29%
11/20/05	1.7	0.5	0.4	0.9	1.5	77%	-9%
11/21/05	1.4	0.5	0.4	0.9	1.1	76%	14%
11/22/05	1.1	0.5	0.4	0.9	0.7	75%	39%
11/23/05	1.1	0.4	0.5	0.9	0.8	74%	41%
11/24/05	1.0	0.4	0.5	0.8	0.8	73%	42%
11/25/05	1.0	0.3	0.5	0.8	0.8	73%	43%
11/26/05	1.0	0.3	0.5	0.7	0.6	72%	IDC
11/27/05	1.0	0.3	0.5	0.6	0.4	71%	74%
11/28/05	1.0	0.3	0.4	0.6	0.2	71%	88%
11/29/05	1.0	0.4	0.4	0.5	0.0	70%	100%
11/30/05	1.0	0.4	0.4	0.5	0.1	70%	97%
12/01/05	1.0	0.4	0.4	0.5	0.1	70%	94%
12/02/05	IDC	0.5	0.6	0.8	0.9	69%	49%
12/03/05	1.1	0.5	0.6	0.7	0.8	68%	
12/04/05	1.2	0.5	0.5	0.7	0.8	68%	64%
12/05/05	1.2	0.5	0.5	0.7	0.7	68%	66%
12/06/05	IDC	0.4	0.4	0.7	0.5	67%	80%
12/07/05	1.3	0.7	0.5	0.8	0.6	68%	69%
12/08/05	1.4	0.7	0.5	0.8	0.7	68%	62%
12/09/05	IDC	1.1	0.7	1.0	0.8	69%	41%
12/10/05	1.5	0.8	0.8	0.9	0.6	69%	46%
12/11/05	1.5	0.7	0.8	0.9	0.6	70%	46%
12/12/05	1.6	0.7	0.9	0.9	0.6	70%	46%
12/13/05	IDC	0.6	0.9	0.9	0.5	70%	53%
12/14/05	1.7	0.2	1.2	1.2	0.7	73%	27%
12/15/05	1.7	0.1	1.2	1.2	0.7	73%	25%
12/16/05	1.8	0.1	1.2	1.3	0.8	74%	22%
12/17/05	1.8	0.2	1.2	1.2	0.7	74%	26%
12/18/05	1.8	0.3	1.2	1.2	0.7	75%	34%
12/19/05	1.8	0.4	1.2	1.2	0.6	76%	41%
12/20/05	1.8	0.4	1.2	1.2	0.6	77%	IDC
12/21/05	1.9	0.5	1.3	1.3	0.7	77%	42%
12/22/05	1.9	0.6	1.4	1.3	0.8	76%	36%
12/23/05	2.0	0.7	1.4	1.4	0.9	76%	31%
12/24/05	1.9	0.7	1.4	1.4	0.9	76%	IDC
12/25/05	1.8	0.8	1.3	1.4	0.9	76%	31%
12/26/05	1.6	0.8	1.2	1.4	0.9	75%	31%
12/27/05	1.5	0.9	1.2	1.4	1.0	75%	IDC
12/28/05	1.4	1.0	1.3	1.5	1.0	76%	33%
12/29/05	1.2	1.1	1.4	1.7	1.0	77%	35%
12/30/05	1.5	0.9	1.3	1.6	0.9	77%	41%
12/31/05	1.8	0.8	1.2	1.5	0.9	77%	IDC

Table 5-4
Basin and Lysimeter Monitoring Results for Banana Basin: Summary for Total Nitrogen (mg/L) Interpolated

Station ID	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
Average	2.1	0.8	0.8	1.1	0.9		50%

ND: Not Detected
NS: Not Sampled
NS-BD: Not Sampled-Basin Dry
NT: Insufficient Sample for Analytical Test
IDC: Insufficient Data for Calculation

1.1

Table 5-5
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell: Summary for Total Nitrogen

Station ID	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
06/10/05	1.4	1.0	1.4	NT	1.9	Residual Water	-30%
06/11/05	1.5	0.9			1.6	Residual Water	-6%
06/12/05	1.6	0.8			1.4	Residual Water	16%
06/13/05	1.7	0.7			1.1	Residual Water	36%
06/14/05	1.8	0.6			0.9	Residual Water	53%
06/15/05	1.9	0.5	NT	NT	0.6	Residual Water	68%
06/16/05	1.9	1.0			0.6	Residual Water	67%
06/17/05	2.0	1.5			0.7	Residual Water	67%
06/18/05	2.0	2.0			0.7	Residual Water	66%
06/19/05	2.1	2.4			0.7	Residual Water	65%
06/20/05	2.1	IDC	NT	NT	0.8	Residual Water	64%
06/21/05	2.0	3.4			0.7	Residual Water	53%
06/22/05	1.9	3.9			0.6	Residual Water	61%
06/23/05	NT	IDC	NT	NT	0.5	Residual Water	69%
06/24/05	1.6	4.9			0.7	Residual Water	62%
06/25/05	1.5	5.3			0.8	Residual Water	56%
06/26/05	1.4	5.8			1.0	Residual Water	50%
06/27/05	1.2	6.3	NT	NT	1.1	Residual Water	43%
06/28/05	1.1	4.5			0.9	Residual Water	53%
06/29/05	0.9	2.7			0.8	Residual Water	63%
06/30/05	0.8	0.9	NT	IDC	0.6	Residual Water	72%
07/01/05	0.8	0.8			0.6	Residual Water	71%
07/02/05	0.8	0.8			0.6	Residual Water	68%
07/03/05	0.7	0.8			0.7	Residual Water	65%
07/04/05	0.7	0.8			0.7	Residual Water	IDC
07/05/05	0.7	0.7	NT	NT	0.7	Residual Water	56%
07/06/05	0.7	0.7			0.7	Residual Water	50%
07/07/05	0.6	0.7	NT	NT	0.8	Residual Water	43%
07/08/05	0.8	0.7			0.7	Residual Water	40%
07/09/05	1.0	0.6			0.7	Residual Water	36%
07/10/05	1.3	0.6			0.7	Residual Water	30%
07/11/05	1.5	0.6			0.6	Residual Water	22%
07/12/05	1.7	0.5	NT	NT	0.6	Residual Water	25%
07/13/05	1.5	0.5			0.6	Residual Water	16%
07/14/05	1.2	0.5			0.7	Residual Water	8%
07/15/05	1.0	0.4	NT	NT	0.7	Residual Water	-1%
07/16/05	1.0	0.5			0.7	Residual Water	-6%
07/17/05	1.0	0.5			0.7	Residual Water	-14%
07/18/05	1.0	0.6			0.8	Residual Water	-23%
07/19/05	1.0	0.6	NT	NT	0.8	Residual Water	8%
07/20/05	1.0	0.6			0.7	Residual Water	29%
07/21/05	0.9	0.5			0.7	Residual Water	43%
07/22/05	0.9	0.5	NT	NT	0.7	Residual Water	53%
07/23/05	1.0	0.5			0.6	Residual Water	63%
07/24/05	1.2	0.5			0.6	Residual Water	61%
07/25/05	1.3	0.5			0.5	Residual Water	58%
07/26/05	1.4	0.5	NT	NT	0.4	Residual Water	54%
07/27/05	1.2	0.5			0.5	Residual Water	52%
07/28/05	1.1	0.6			0.5	Residual Water	50%
07/29/05	0.9	0.6	NT	NT	0.5	Residual Water	48%
07/30/05	0.9	0.6			0.5	Residual Water	44%
07/31/05	0.9	0.5			0.6	Residual Water	39%

Table 5-5
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell: Summary for Total Nitrogen

Station ID	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
08/01/05	0.9	0.5			0.6	Residual Water	33%
08/02/05	1.0	0.4	NT	NT	0.7	Residual Water	28%
08/03/05	1.0	0.5			0.7	Residual Water	35%
08/04/05	1.1	0.5			0.7	Residual Water	40%
08/05/05	1.1	0.6	NT	NT	0.7	Residual Water	45%
08/06/05	1.0	0.5			0.7	Residual Water	51%
08/07/05	0.8	0.5			0.7	Residual Water	47%
08/08/05	0.7	0.5			0.6	Residual Water	43%
08/09/05	0.5	0.4	NT	NT	0.6	Residual Water	36%
08/10/05	0.5	0.4			0.6	Residual Water	37%
08/11/05	0.5	0.3			0.6	Residual Water	39%
08/12/05	0.5	0.3	NT	NT	0.6	Residual Water	40%
08/13/05	1.0	0.3			0.6	Residual Water	41%
08/14/05	1.5	0.4			0.5	Residual Water	46%
08/15/05	1.9	0.4			0.5	Residual Water	50%
08/16/05	2.4	0.4	NT	NT	0.5	Residual Water	54%
08/17/05	2.0	0.5			0.5	Residual Water	49%
08/18/05	1.7	0.6			0.5	Residual Water	44%
08/19/05	1.3	0.6	NT	NT	0.4	Residual Water	36%
08/20/05	1.1	0.6			0.5	Residual Water	5%
08/21/05	1.0	0.5			0.6	Residual Water	-10%
08/22/05	0.8	0.5			0.7	Residual Water	-26%
08/23/05	0.6	0.5	NT	NT	0.7	Residual Water	-43%
08/24/05	0.6	0.6			0.7	Residual Water	32%
08/25/05	0.5	0.7			0.6	Residual Water	59%
08/26/05	0.5	0.8	NT	NT	0.5	Residual Water	72%
08/27/05	0.6	0.7			0.6	Residual Water	76%
08/28/05	0.7	0.6			0.6	Residual Water	70%
08/29/05	0.7	0.5			0.6	Residual Water	61%
08/30/05	0.8	0.4	NT	NT	0.7	Residual Water	48%
08/31/05	0.9	0.9			0.9	Residual Water	16%
09/01/05	1.1	1.4			1.2	Residual Water	-28%
09/02/05	NT	2.0	NT	NT	1.5	Residual Water	-91%
09/03/05	1.5	1.8			1.7	Residual Water	-189%
09/04/05	1.7	1.6			2.0	Residual Water	-247%
09/05/05	1.9	1.4			2.2	Residual Water	-311%
09/06/05	1.7	IDC	NT	NT	2.5	Residual Water	-381%
09/07/05	1.4	0.9			1.9	Residual Water	-228%
09/08/05	1.1	0.7			1.3	Residual Water	-106%
09/09/05	0.8	0.5	NT	NT	0.8	27%	-6%
09/10/05	1.2	0.7			0.8	34%	-7%
09/11/05	1.7	0.8			0.9	41%	0%
09/12/05	2.1	0.9			1.0	48%	8%
09/13/05	2.6	1.0	NT	NT	1.1	54%	IDC
09/14/05	2.0	0.7			0.9	60%	35%
09/15/05	1.3	0.5			0.8	66%	50%
09/16/05	0.7	0.2	NT	NT	0.7	72%	63%
09/17/05	1.7	0.3			0.8	77%	55%
09/18/05	2.8	0.4			0.9	81%	38%
09/19/05	3.8	0.5			1.0	86%	13%
09/20/05	4.9	0.6	NT	NT	1.0	90%	-33%
09/21/05	3.6	0.5			1.0	89%	22%
09/22/05	2.2	0.3			0.9	88%	48%
09/23/05	0.9	0.2	NT	NT	0.8	88%	63%
09/24/05	1.3	0.4			0.8	87%	69%
09/25/05	1.6	0.6			0.8	86%	58%
09/26/05	1.9	0.8			0.8	85%	37%
09/27/05	2.2	1.0	NT	NT	0.9	85%	-23%
09/28/05	2.4	1.0			0.7	85%	58%
09/29/05	2.5	1.0			0.6	85%	78%
09/30/05	IDC	1.1	NT	NT	0.5	85%	87%

Table 5-5
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell: Summary for Total Nitrogen

Station ID	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
10/01/05	2.8	1.0			0.5	86%	90%
10/02/05	3.0	1.0			0.5	86%	86%
10/03/05	3.1	0.9			0.5	86%	79%
10/04/05	3.3	0.9	NT	NT	0.5	86%	48%
10/05/05	3.1	1.8			0.5	89%	58%
10/06/05	2.9	2.8			0.6	91%	64%
10/07/05	2.8	3.8	NT	NT	0.6	93%	68%
10/08/05	2.6	3.4			0.7	94%	66%
10/09/05	2.5	3.0			0.9	95%	63%
10/10/05	2.3	2.6			1.0	97%	60%
10/11/05	2.2	2.2			1.2	98%	IDC
10/12/05	2.1	1.8			1.3	99%	55%
10/13/05	1.9	IDC	NT	NT	1.4	100%	52%
10/14/05	1.7	1.0	NT	NT	1.1	100%	64%
10/15/05	1.9	1.1			1.1	100%	67%
10/16/05	2.0	1.1			1.1	100%	66%
10/17/05	2.2	1.2			1.0	100%	65%
10/18/05	2.3	1.3	NT	NT	1.0	100%	63%
10/19/05	2.7	1.1			1.0	100%	60%
10/20/05	3.1	0.9			1.1	100%	57%
10/21/05	3.5	0.7	NT	NT	1.1	100%	53%
10/22/05	3.9	0.7			1.2	100%	44%
10/23/05	4.3	0.7			1.4	100%	34%
10/24/05	4.6	0.8			1.5	100%	23%
10/25/05	5.0	NT	NT	NT	1.6	100%	5%
10/26/05	4.8	0.8			1.7	100%	10%
10/27/05	4.7	0.8			1.7	100%	14%
10/28/05	4.5	0.8			1.8	100%	18%
10/29/05	4.3	0.8			1.8	100%	21%
10/30/05	4.1	0.8			1.9	100%	30%
10/31/05	3.9	0.8			2.0	100%	37%
11/01/05	NT	NT	NT	NT	2.0	100%	36%
11/02/05	3.5	0.8			2.0	100%	43%
11/03/05	3.4	0.8			2.0	100%	48%
11/04/05	3.2	0.8			2.1	100%	52%
11/05/05	3.0	0.8			2.1	100%	55%
11/06/05	2.8	0.8			2.1	100%	58%
11/07/05	2.6	0.8			2.1	100%	56%
11/08/05	NT	NT	NT	NT	IDC	100%	IDC
11/09/05	2.3	0.8			2.2	100%	51%
11/10/05	2.1	0.8			2.2	100%	49%
11/11/05	1.9	NT	NT	NT	2.2	100%	46%
11/12/05	2.1	0.8			2.2	100%	IDC
11/13/05	2.3	0.8			2.1	100%	41%
11/14/05	2.5	0.9			2.0	100%	40%
11/15/05	IDC	IDC	IDC	IDC	IDC	100%	IDC
11/16/05	3.0	0.9			1.9	100%	37%
11/17/05	3.2	0.9			1.8	100%	35%
11/18/05	3.4	0.9	1.2	IDC	1.8	100%	33%
11/19/05	3.2	0.9	1.1		1.5	100%	IDC
11/20/05	3.0	0.9	1.1		1.3	100%	43%
11/21/05	2.8	0.9	1.0		1.1	100%	49%
11/22/05	2.6	0.9	1.0	1.5	0.8	100%	57%
11/23/05	2.4	0.9	1.0	1.7	1.1	99%	50%
11/24/05	2.2	1.0	1.1	1.8	1.3	99%	44%
11/25/05	2.0	1.0	1.2	2.0	1.5	98%	39%
11/26/05	1.9	1.0	1.2	1.9	1.4	98%	IDC
11/27/05	1.7	1.1	1.2	1.8	1.2	98%	61%
11/28/05	1.6	1.1	1.3	1.7	1.0	97%	69%
11/29/05	1.4	1.1	1.3	IDC	0.8	97%	77%
11/30/05	1.6	1.1	1.2	1.6	0.9	97%	71%

Table 5-5
Basin and Lysimeter Monitoring Results for Hickory Basin West Cell: Summary for Total Nitrogen

Station ID	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
12/01/05	1.7	1.1	1.1	1.5	1.0	98%	65%
12/02/05	1.9	1.1	1.0	1.4	1.2	*98%*	58%
12/03/05	1.7	1.1	1.0	1.4	1.1	99%	59%
12/04/05	1.6	1.1	1.0	1.3	0.9	99%	61%
12/05/05	1.4	1.0	0.9	1.3	0.8	100%	63%
12/06/05	1.2	1.0	0.9	1.2	0.7	100%	65%
12/07/05	1.6	1.0	0.9	1.3	0.8	100%	60%
12/08/05	1.9	1.0	0.9	1.3	0.8	100%	54%
12/09/05	2.3	1.0	0.9	1.3	0.8	100%	47%
12/10/05	2.1	1.0	0.9	1.3	0.8	100%	42%
12/11/05	1.8	1.0	1.0	1.3	0.8	100%	49%
12/12/05	1.6	1.0	1.0	1.3	0.8	100%	54%
12/13/05	1.3	1.0	1.0	1.3	0.8	100%	59%
12/14/05	1.4	1.0	1.0	1.2	0.9	100%	46%
12/15/05	1.5	1.1	1.0	1.2	1.1	100%	31%
12/16/05	1.6	1.1	1.0	1.1	1.2	100%	11%
12/17/05	1.6	1.1	1.0	1.2	1.2	100%	4%
12/18/05	1.6	1.1	1.0	1.2	1.1	100%	30%
12/19/05	1.5	1.1	0.9	1.2	1.0	100%	47%
12/20/05	1.5	1.1	0.9	1.3	1.0	100%	58%
12/21/05	1.6	1.1	1.0	1.4	1.0	100%	53%
12/22/05	1.8	1.1	1.1	1.5	0.9	100%	48%
12/23/05	1.9	1.1	1.2	1.6	0.9	100%	40%
12/24/05	1.8	1.1	1.2	1.7	0.9	100%	29%
12/25/05	1.8	1.1	1.1	1.7	0.9	100%	34%
12/26/05	1.7	1.1	1.0	1.8	0.9	100%	39%
12/27/05	1.7	1.1	1.0	1.8	0.9	100%	43%
12/28/05	1.7	1.0	0.8	1.4	0.8	100%	52%
12/29/05	1.7	0.9	0.6	1.1	0.6	100%	61%
12/30/05	1.7	0.8	0.4	0.7	0.4	100%	71%
Average	**2.1**	**1.1**	**1.0**	**1.4**	**1.2**		**48%**

NS-BD: Not Sampled-Basin Dry
NT: Insufficient Sample for Analytical Test
IDC: Insufficient Data for Calculation

1.7

Table 5-6
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Summary for Total Nitrogen

Station ID	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
06/10/05	0.7	0.8	IDC	3.6	2.2	Residual Water	-203%
06/11/05	0.9	1.0		3.6	2.5	Residual Water	-190%
06/12/05	1.0	1.3		3.7	2.8	Residual Water	-181%
06/13/05	1.1	1.5		3.8	3.1	Residual Water	-173%
06/14/05	1.3	1.7		3.8	3.4	Residual Water	-168%
06/15/05	NT	IDC	1.1	3.9	3.7	Residual Water	IDC
06/16/05	1.6	2.1	1.2	3.7	3.7	Residual Water	-139%
06/17/05	1.7	2.3	1.3	3.5	3.7	Residual Water	-119%
06/18/05	1.8	2.5	1.5	3.3	3.7	Residual Water	-102%
06/19/05	2.0	2.7	1.6	3.0	3.7	Residual Water	-88%
06/20/05	NT	IDC	1.7	2.8	3.7	Residual Water	IDC
06/21/05	2.2	3.1	1.6	2.5	3.7	Residual Water	-65%
06/22/05	2.4	3.3	1.5	2.3	3.7	Residual Water	-56%
06/23/05	2.5	IDC	1.4	2.0	3.7	Residual Water	-48%
06/24/05	2.2	3.7	1.4	1.8	3.6	Residual Water	-66%
06/25/05	1.8	3.9	1.3	1.7	3.5	Residual Water	-91%
06/26/05	1.5	4.1	1.3	1.6	3.4	Residual Water	-127%
06/27/05	1.2	IDC	1.3	1.4	3.4	Residual Water	-182%
06/28/05	1.0	4.5	1.1	1.4	3.3	Residual Water	-235%
06/29/05	0.8	4.8	1.0	1.4	3.2	Residual Water	-316%
06/30/05	0.6	5.0	0.8	IDC	3.2	Residual Water	-456%
07/01/05	0.7	4.2	0.8	1.3	3.0	Residual Water	-346%
07/02/05	0.8	3.4	0.8	1.3	2.9	Residual Water	-266%
07/03/05	0.9	2.5	0.8	1.2	2.7	Residual Water	-206%
07/04/05	1.0	1.7	0.8	1.2	2.6	Residual Water	-158%
07/05/05	1.1	0.9	0.8	1.2	2.4	Residual Water	-226%
07/06/05	0.9	0.7	1.8	1.5	3.1	Residual Water	-256%
07/07/05	0.6	0.5	2.8	1.8	3.8	Residual Water	-278%
07/08/05	0.7	0.5	3.1	1.8	3.8	Residual Water	-231%
07/09/05	0.7	0.5	3.4	1.8	3.8	Residual Water	-194%
07/10/05	0.8	0.5	3.6	1.8	3.7	Residual Water	IDC
07/11/05	0.8	0.5	3.9	1.8	3.7	Residual Water	-140%
07/12/05	0.9	0.5	IDC	1.8	3.7	Residual Water	-119%
07/13/05	0.9	0.6	4.5	1.8	3.9	Residual Water	-116%
07/14/05	0.8	0.7	4.8	1.8	4.2	Residual Water	-114%
07/15/05	0.8	0.8	5.0	1.8	4.4	Residual Water	IDC
07/16/05	0.7	0.8	5.2	1.7	4.2	Residual Water	-90%
07/17/05	0.7	0.7	5.3	1.6	4.1	Residual Water	-71%
07/18/05	0.6	0.6	5.4	1.6	3.9	Residual Water	-54%
07/19/05	0.6	0.6	5.5	1.5	3.7	Residual Water	-68%
07/20/05	0.7	0.5	5.7	1.6	3.1	Residual Water	-67%
07/21/05	0.8	0.5	5.8	1.7	2.5	Residual Water	-64%
07/22/05	1.0	0.4	5.9	1.8	1.9	Residual Water	-60%
07/23/05	1.0	0.4	5.8	1.7	2.4	Residual Water	-144%
07/24/05	1.1	0.3	5.7	1.7	2.9	Residual Water	-273%
07/25/05	1.2	0.3	5.5	1.6	3.4	Residual Water	-496%
07/26/05	NT	0.3	5.4	1.6	3.9	Residual Water	-477%
07/27/05	1.3	0.3	5.1	1.6	3.3	Residual Water	-321%
07/28/05	1.3	0.3	4.8	1.7	2.7	Residual Water	-202%
07/29/05	1.4	0.3	4.5	1.7	2.1	Residual Water	-108%
07/30/05	1.3	0.5	3.9	1.7	2.6	Residual Water	-132%
07/31/05	1.3	0.6	3.4	1.7	3.0	Residual Water	-258%

Table 5-6
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Summary for Total Nitrogen

Station ID	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
08/01/05	1.2	0.8	2.8	1.7	3.5	Residual Water	-488%
08/02/05	1.1	0.9	NT	1.7	4.0	Residual Water	-511%
08/03/05	1.0	0.8	1.7	2.1	3.1	Residual Water	-339%
08/04/05	0.9	0.7	1.2	2.5	2.2	Residual Water	-192%
08/05/05	0.8	0.6	0.7	2.8	1.4	Residual Water	-65%
08/06/05	0.8	0.7	0.6	2.4	1.2	Residual Water	-39%
08/07/05	0.7	0.8	0.5	1.9	1.1	Residual Water	-27%
08/08/05	0.7	0.9	0.5	1.4	0.9	Residual Water	-15%
08/09/05	0.6	1.0	0.4	0.9	0.8	Residual Water	-1%
08/10/05	0.6	0.8	0.4	0.9	0.8	Residual Water	-15%
08/11/05	0.5	0.7	0.5	0.8	0.9	Residual Water	-31%
08/12/05	0.5	0.5	0.5	0.7	0.9	Residual Water	-50%
08/13/05	1.1	0.5	0.5	0.7	0.9	Residual Water	-57%
08/14/05	1.7	0.5	0.5	0.6	0.8	Residual Water	-20%
08/15/05	2.4	0.5	0.5	0.6	0.8	Residual Water	5%
08/16/05	3.0	0.5	0.5	0.5	0.8	Residual Water	23%
08/17/05	2.8	0.7	0.7	0.7	0.7	Residual Water	38%
08/18/05	2.7	0.9	0.9	0.8	0.6	Residual Water	50%
08/19/05	2.6	1.0	1.1	1.0	0.5	Residual Water	61%
08/20/05	2.1	0.9	1.0	1.0	0.5	Residual Water	IDC
08/21/05	1.6	0.8	1.0	0.9	0.6	Residual Water	56%
08/22/05	1.1	0.7	1.0	0.9	0.6	Residual Water	54%
08/23/05	0.6	0.6	1.0	0.8	0.7	Residual Water	52%
08/24/05	0.7	0.6	1.0	0.9	0.8	Residual Water	43%
08/25/05	0.7	0.7	1.0	0.9	0.8	Residual Water	33%
08/26/05	0.8	0.7	0.9	0.9	0.9	Residual Water	23%
08/27/05	1.1	0.8	1.0	1.2	1.1	Residual Water	3%
08/28/05	1.4	0.9	1.1	1.4	1.3	Residual Water	-23%
08/29/05	1.8	1.0	1.1	1.6	1.4	Residual Water	-55%
08/30/05	2.1	NT	1.2	1.9	1.6	Residual Water	-96%
08/31/05	2.3	1.2	1.4	1.8	1.4	Residual Water	-86%
09/01/05	2.4	1.3	1.5	1.7	1.3	Residual Water	-75%
09/02/05	2.6	1.4	1.6	1.6	1.1	Residual Water	-62%
09/03/05	2.4	1.6	1.7	1.5	1.4	Residual Water	-126%
09/04/05	2.2	1.8	1.7	1.5	1.7	Residual Water	-197%
09/05/05	2.0	2.0	1.7	1.5	2.0	Residual Water	-278%
09/06/05	NS-BD	NT	1.7	1.5	2.4	Residual Water	-372%
09/07/05	1.5	2.4	1.8	1.5	2.1	Residual Water	-86%
09/08/05	1.3	2.6	1.8	1.6	1.8	Residual Water	-3%
09/09/05	1.1	2.8	1.8	1.6	1.5	27%	36%
09/10/05	1.3	2.8	1.4	1.5	1.5	34%	49%
09/11/05	1.6	2.9	1.0	1.4	1.6	41%	45%
09/12/05	1.8	2.9	0.6	1.3	1.6	48%	41%
09/13/05	2.0	3.0	0.2	1.2	1.6	54%	37%
09/14/05	1.6	2.9	0.7	1.2	1.6	54%	24%
09/15/05	1.2	2.9	1.1	1.3	1.5	54%	4%
09/16/05	0.8	2.8	1.5	1.3	1.5	54%	-34%
09/17/05	1.2	2.6	1.5	1.3	1.4	54%	-124%
09/18/05	1.6	2.3	1.6	1.3	1.4	53%	-100%
09/19/05	2.0	2.1	1.6	1.3	1.3	53%	-78%
09/20/05	2.4	1.9	1.7	1.3	1.2	53%	-59%
09/21/05	2.2	1.8	2.4	1.8	1.5	54%	-32%
09/22/05	2.1	1.7	3.1	2.2	1.7	55%	-17%
09/23/05	1.9	1.6	3.8	2.7	1.9	56%	-7%
09/24/05	2.0	1.5	3.3	2.5	2.1	57%	1%
09/25/05	2.1	1.4	2.8	2.2	2.3	58%	1%
09/26/05	2.1	1.3	2.3	2.0	2.4	58%	0%
09/27/05	2.2	1.2	1.7	1.7	2.6	59%	0%
09/28/05	2.2	1.1	1.5	1.7	2.2	64%	8%
09/29/05	2.1	1.0	1.3	1.7	1.8	68%	17%
09/30/05	2.0	0.9	1.0	1.6	1.4	73%	28%

Table 5-6
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Summary for Total Nitrogen

Station ID	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
10/01/05	2.1	0.8	1.0	1.5	1.3	76%	IDC
10/02/05	2.1	0.7	1.0	1.4	1.3	79%	17%
10/03/05	2.2	0.7	1.0	1.2	1.2	83%	8%
10/04/05	2.2	0.6	1.0	1.1	1.2	86%	-5%
10/05/05	2.1	0.6	1.0	1.0	1.1	89%	19%
10/06/05	2.1	0.6	1.0	1.0	1.0	91%	37%
10/07/05	2.0	0.6	1.0	1.0	0.9	93%	49%
10/08/05	2.1	0.6	1.0	0.9	1.8	94%	11%
10/09/05	2.1	0.6	0.9	0.9	2.7	95%	
10/10/05	2.2	0.6	0.9	0.9	3.5	97%	
10/11/05	2.2	0.6	0.9	0.9	4.4	98%	
10/12/05	2.3	0.6	0.9	0.9	5.3	99%	
10/13/05	2.3	0.6	0.9	0.8	6.2	100%	-291%
10/14/05	1.4	1.1	0.9	0.5	0.5	100%	77%
10/15/05	2.3	0.9	0.8	0.6	0.5	100%	78%
10/16/05	3.2	0.8	0.7	0.7	0.6	100%	73%
10/17/05	4.0	0.7	0.7	0.7	0.7	100%	68%
10/18/05	4.9	0.6	0.6	0.8	0.7	100%	62%
10/19/05	4.1	0.7	1.0	0.9	0.7	100%	65%
10/20/05	3.3	0.9	1.4	0.9	0.7	100%	68%
10/21/05	2.5	1.0	1.8	1.0	0.6	100%	71%
10/22/05	2.4	1.0	1.6	0.9	0.7	100%	70%
10/23/05	2.3	0.9	1.4	0.8	0.7	100%	67%
10/24/05	2.1	0.9	1.2	0.8	0.8	100%	63%
10/25/05	2.0	0.9	0.9	0.7	0.8	100%	60%
10/26/05	2.1	1.1	1.0	0.7	0.7	100%	67%
10/27/05	2.1	1.3	1.1	0.8	0.5	100%	74%
10/28/05	NT	IDC	1.3	0.8	0.4	100%	81%
10/29/05	2.2	1.7	1.3	1.1	0.7	100%	69%
10/30/05	2.2	1.9	1.4	1.4	1.0	100%	55%
10/31/05	2.3	2.2	1.4	1.7	1.2	100%	41%
11/01/05	2.3	2.4	1.5	2.0	1.5	100%	25%
11/02/05	2.1	3.5	1.5	1.9	1.5	100%	25%
11/03/05	1.8	4.6	1.5	1.7	1.6	100%	24%
11/04/05	1.6	5.8	1.6	1.6	IDC	100%	IDC
11/05/05	1.6	5.1	1.6	1.6	1.7	100%	23%
11/06/05	1.6	4.5	1.6	1.6	1.7	100%	23%
11/07/05	1.6	3.9	1.6	1.6	1.8	100%	22%
11/08/05	IDC	IDC	IDC	IDC	IDC	100%	IDC
11/09/05	1.6	2.6	1.6	1.7	1.9	100%	18%
11/10/05	1.7	2.0	1.6	1.7	1.9	100%	39%
11/11/05	1.7	1.4	1.6	IDC	IDC	100%	IDC
11/12/05	2.0	1.6	1.6	1.7	2.0	100%	59%
11/13/05	2.3	1.9	1.5	1.7	2.1	100%	49%
11/14/05	2.6	2.1	1.5	1.7	2.1	100%	36%
11/15/05	IDC	IDC	IDC	IDC	NS	100%	IDC
11/16/05	3.2	2.6	1.4	1.7	2.2	100%	7%
11/17/05	3.5	2.8	1.3	1.7	2.3	100%	0%
11/18/05	3.8	3.1	1.3	1.8	2.3	100%	-8%
11/19/05	3.6	3.1	1.1	2.0	2.3	100%	
11/20/05	3.4	3.2	0.9	2.2	2.2	100%	
11/21/05	3.1	3.2	0.7	2.5	2.2	100%	
11/22/05	2.9	IDC	0.6	2.7	IDC	100%	IDC
11/23/05	2.5	3.3	0.8	2.3	2.1	100%	6%
11/24/05	2.1	3.4	1.0	1.8	2.0	99%	10%
11/25/05	1.7	3.4	1.3	1.4	IDC	99%	IDC
11/26/05	1.7	3.6	1.2	1.3	1.9	98%	18%
11/27/05	1.7	3.7	1.1	1.3	1.8	98%	11%
11/28/05	1.6	3.8	1.1	1.2	1.8	98%	2%
11/29/05	1.6	4.0	1.0	1.1	IDC	97%	IDC
11/30/05	1.7	3.3	2.0	1.2	1.7	98%	

Table 5-6
Basin and Lysimeter Monitoring Results for Hickory Basin East Cell: Summary for Total Nitrogen

Station ID	Surface Water	Lysimeter Samples (ft bgs)				Percentage RW at 25 ft bgs Lysimeter	Percent Reduction
		5	10	15	25		
12/01/05	1.8	2.6	3.0	1.2	1.6	98%	
12/02/05	1.9	1.9	4.1	1.3	IDC	98%	IDC
12/03/05	1.8	1.8	4.2	1.3	1.5	99%	IDC
12/04/05	1.8	1.7	4.3	1.4	1.5	99%	10%
12/05/05	1.7	1.6	4.4	1.5	1.4	100%	13%
12/06/05	1.6	1.5	4.6	1.6	1.4	100%	17%
12/07/05	2.0	1.5	4.1	1.8	1.6	100%	21%
12/08/05	2.3	1.5	3.6	2.0	1.7	100%	24%
12/09/05	2.7	1.5	3.1	2.1	1.9	100%	26%
12/10/05	2.6	1.7	3.2	2.2	1.9	100%	IDC
12/11/05	2.5	1.8	3.3	2.2	1.8	100%	43%
12/12/05	2.4	2.0	3.4	2.2	1.8	100%	49%
12/13/05	2.3	2.2	3.5	2.3	IDC	100%	IDC
12/14/05	2.4	2.3	3.3	2.3	1.7	100%	52%
12/15/05	2.6	2.5	3.2	2.4	1.7	100%	50%
12/16/05	2.7	2.7	3.0	2.4	1.6	100%	48%
12/17/05	2.4	2.7	3.0	2.5	1.7	100%	41%
12/18/05	2.1	2.6	2.9	2.7	1.8	100%	28%
12/19/05	1.8	2.6	2.8	2.8	1.9	100%	11%
12/20/05	1.5	2.6	2.8	2.9	IDC	100%	IDC
12/21/05	1.7	2.5	2.9	3.2	2.0	100%	
12/22/05	1.9	2.4	3.1	3.5	2.1	100%	
12/23/05	2.1	2.4	3.3	3.8	IDC	100%	IDC
12/24/05	1.9	2.2	3.3	3.7	2.2	100%	
12/25/05	1.7	2.1	3.3	3.7	2.3	100%	
12/26/05	1.4	1.9	3.3	3.7	2.4	100%	
12/27/05	1.2	1.8	3.3	3.6	IDC	100%	IDC
12/28/05	1.2	1.4	2.3	2.5	2.5	100%	
12/29/05	1.2	1.1	1.3	1.4	2.6	100%	
12/30/05	1.2	0.7	0.4	0.3	IDC	100%	IDC
Average	**2.1**	**1.9**	**1.5**	**1.4**	**1.4**		**32%**

NS-BD: Not Sampled-Basin Dry
NT: Insufficient Sample for Analytical Test
IDC: Insufficient Data for Calculation
Indicates that the sampled water is >75 percent recycled water
1.2 Denotes an interpolated value

Figure 5-1
Banana Basin: Average Total Organic Carbon versus Depth
Values are Average of Samples Where Recycled Water was Greater than 75 Percent of Total

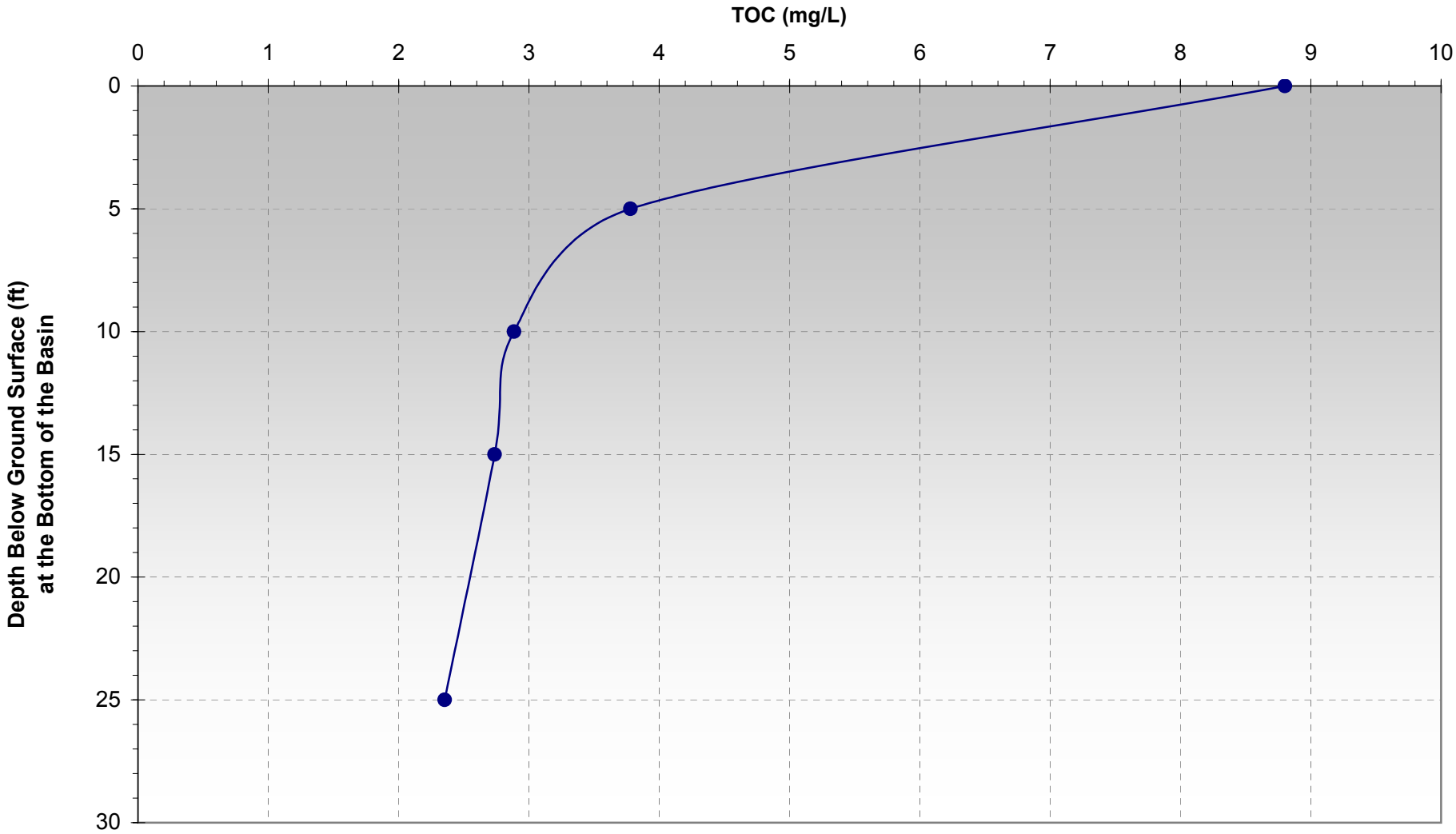


Figure 5-2
Hickory Basin West Cell: Average Total Organic Carbon versus Depth

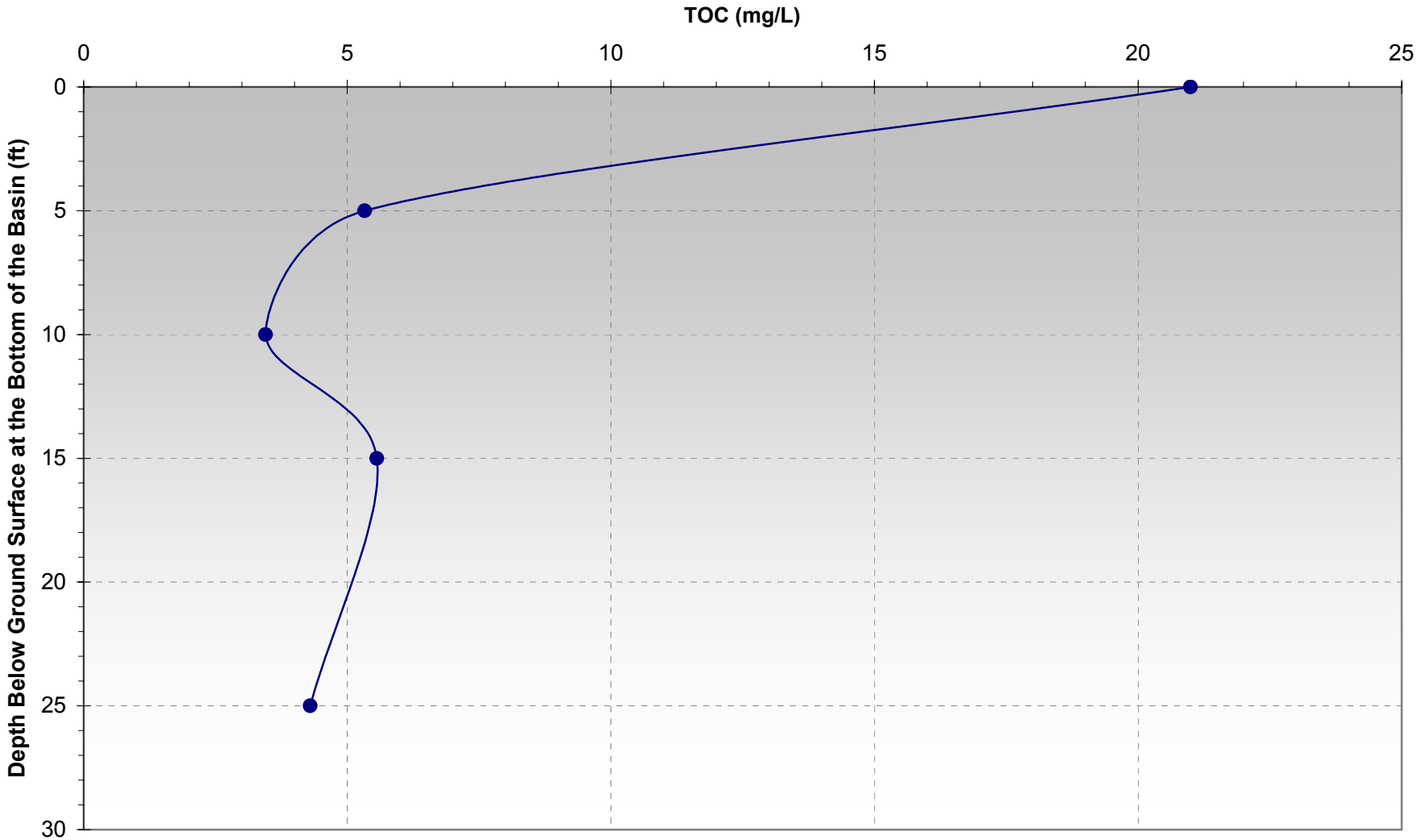


Figure 5-3
Hickory Basin East Cell: Average Total Organic Carbon versus Depth

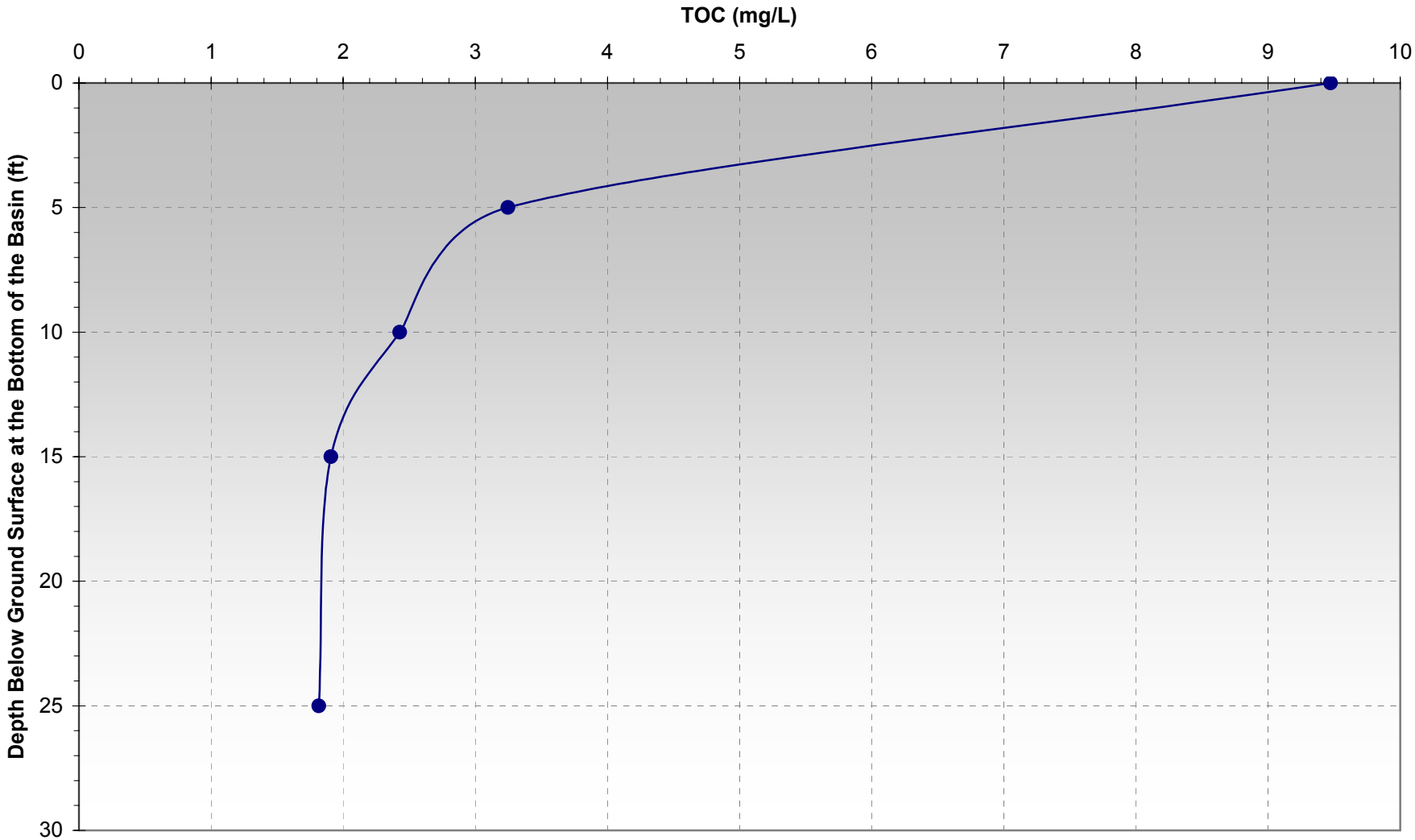


Figure 5-4
Banana Basin: Total Organic Carbon Time History

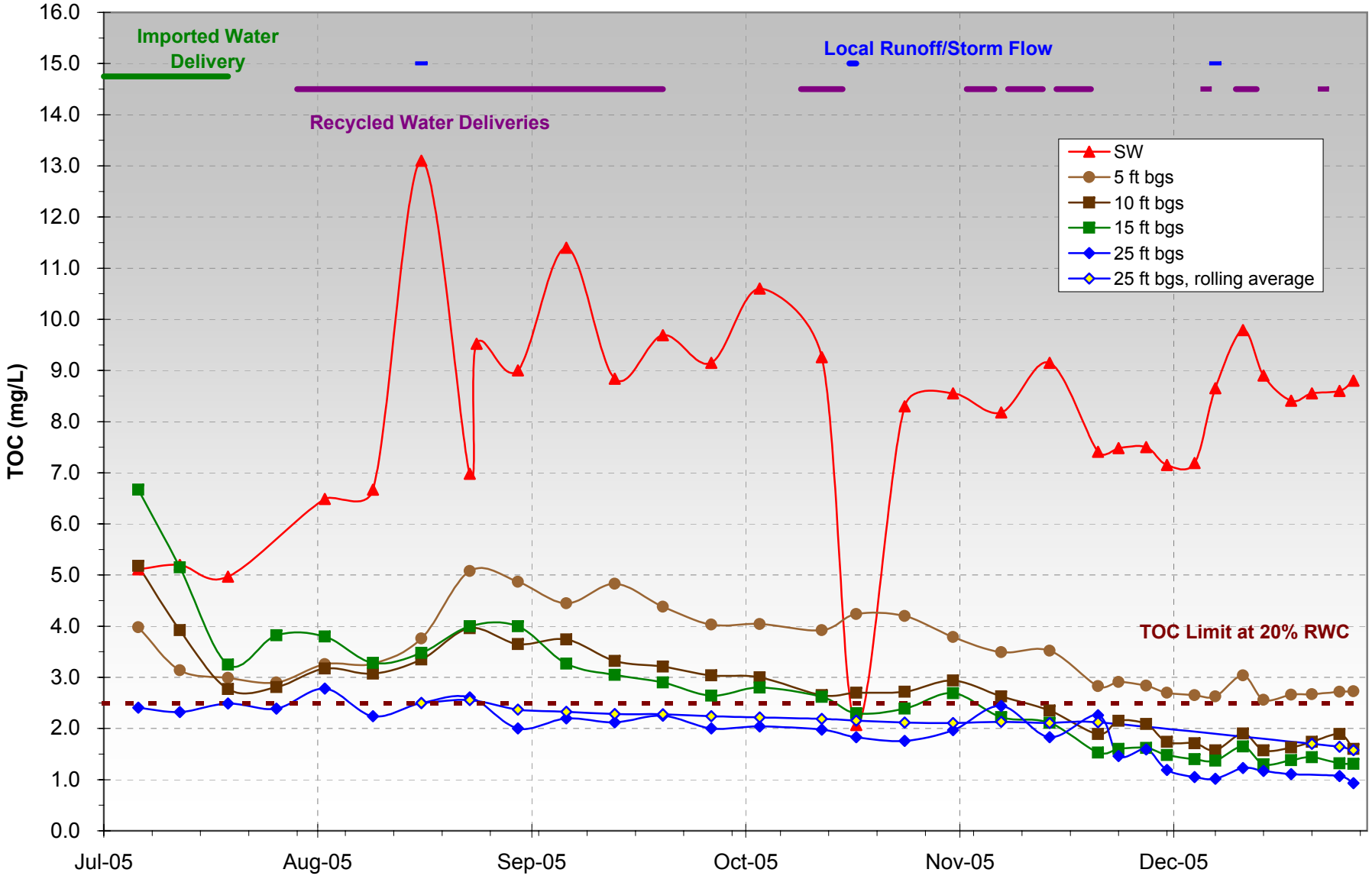


Figure 5-5
Hickory Basin West Cell: Total Organic Carbon Time History

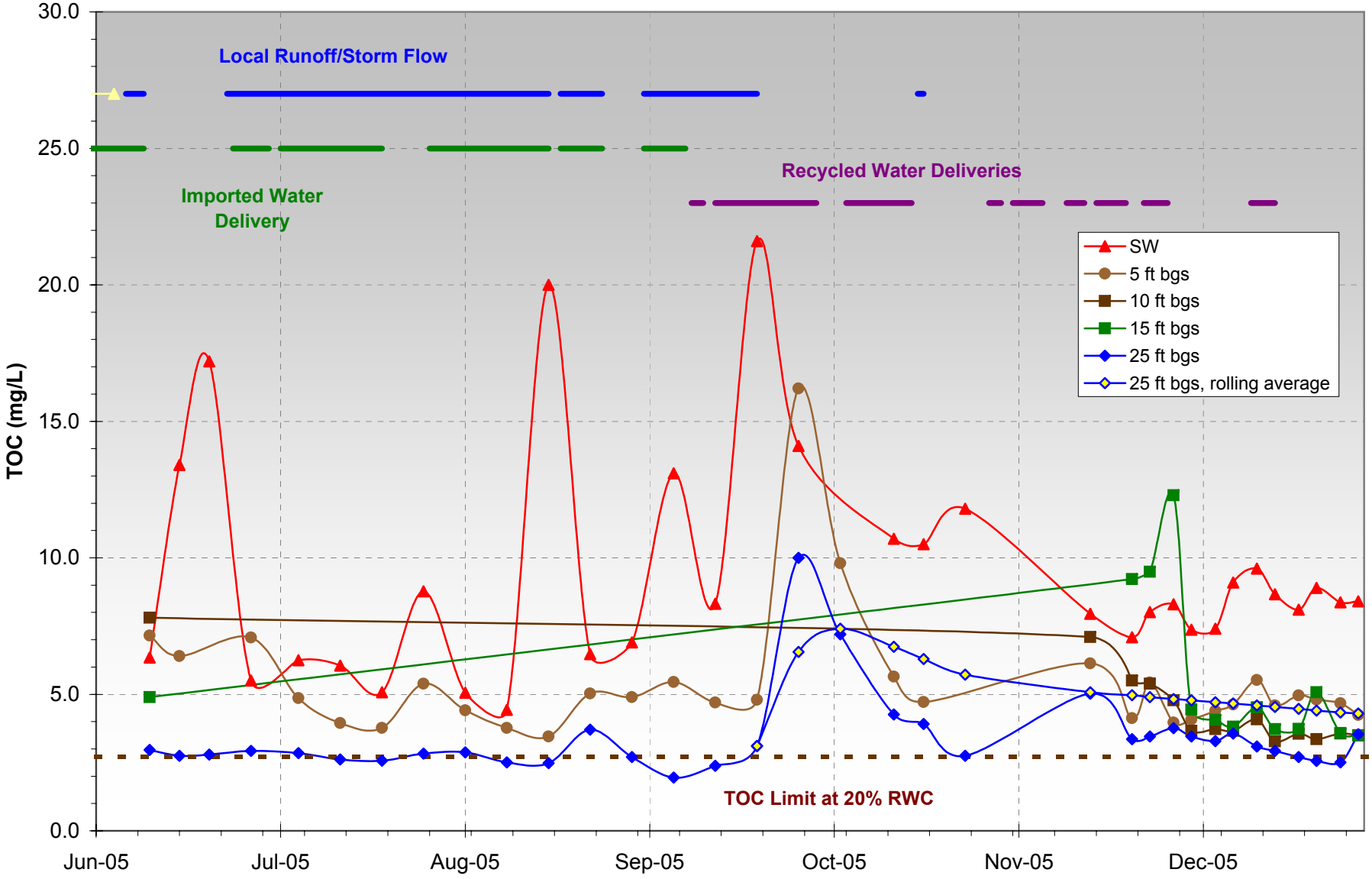


Figure 5-6
Hickory Basin East Cell: Total Organic Carbon Time History

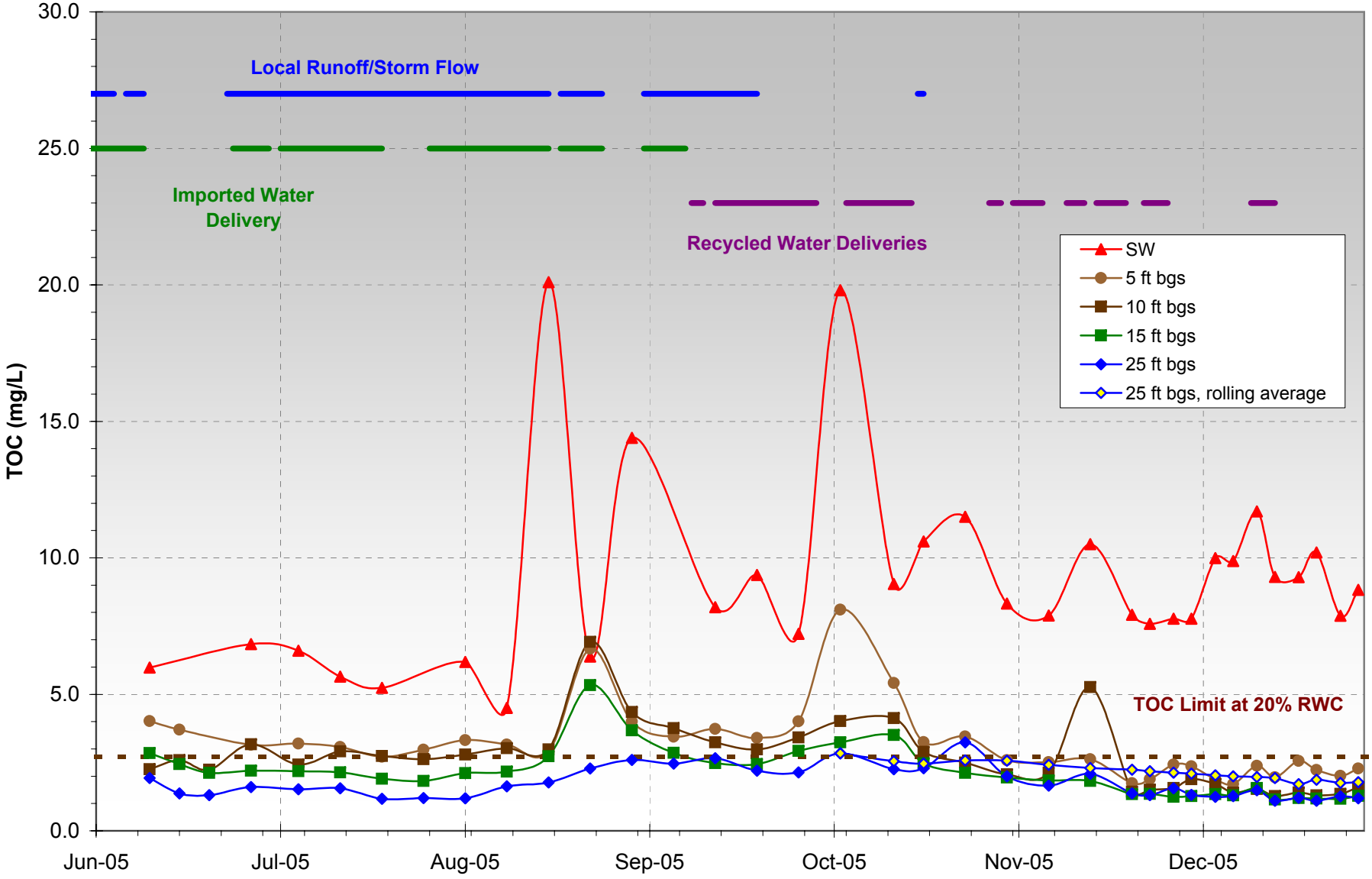


Figure 5-7
Banana Basin: Average Total Nitrogen versus Depth

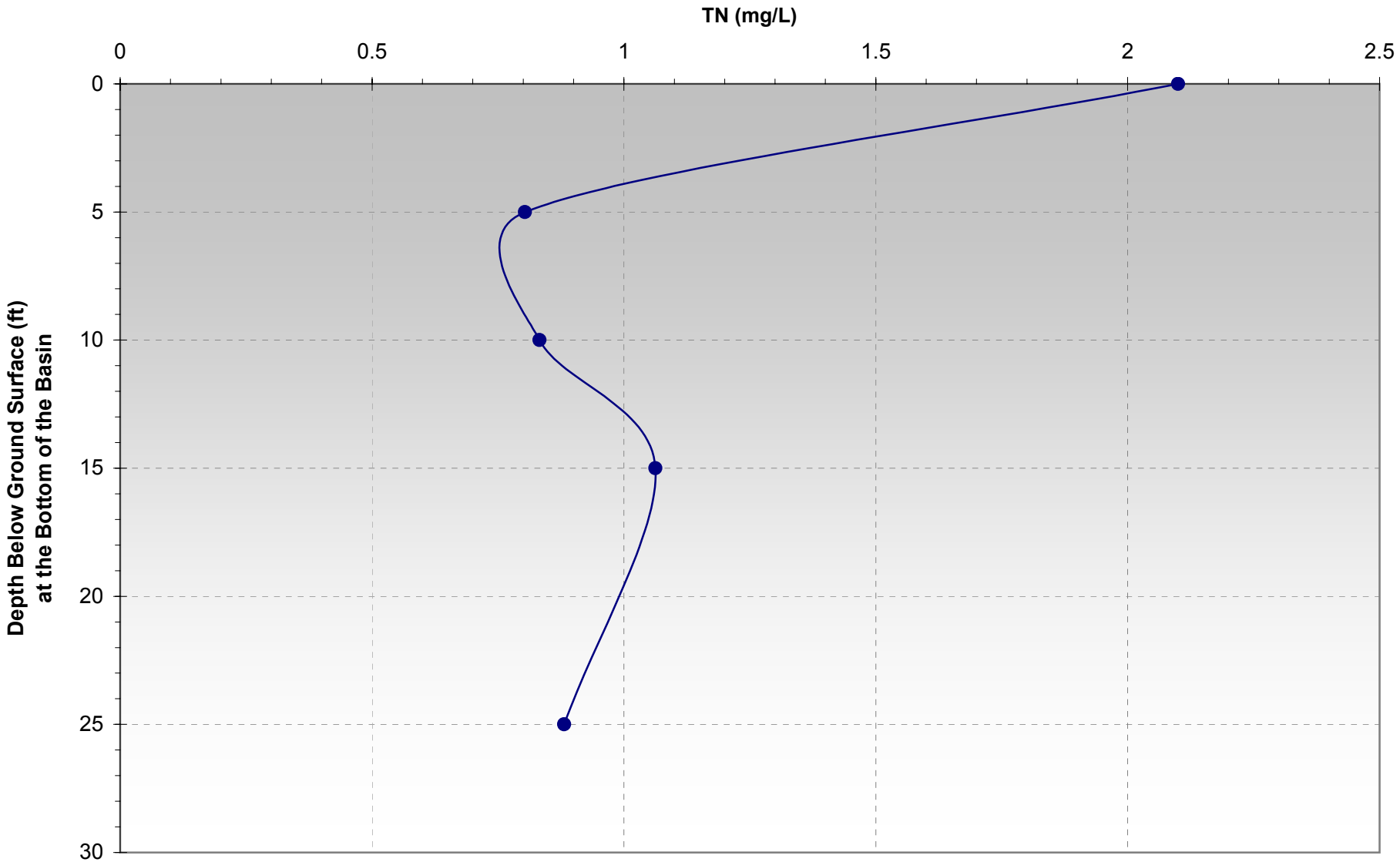


Figure 5-8
Hickory Basin West Cell: Average Total Nitrogen versus Depth

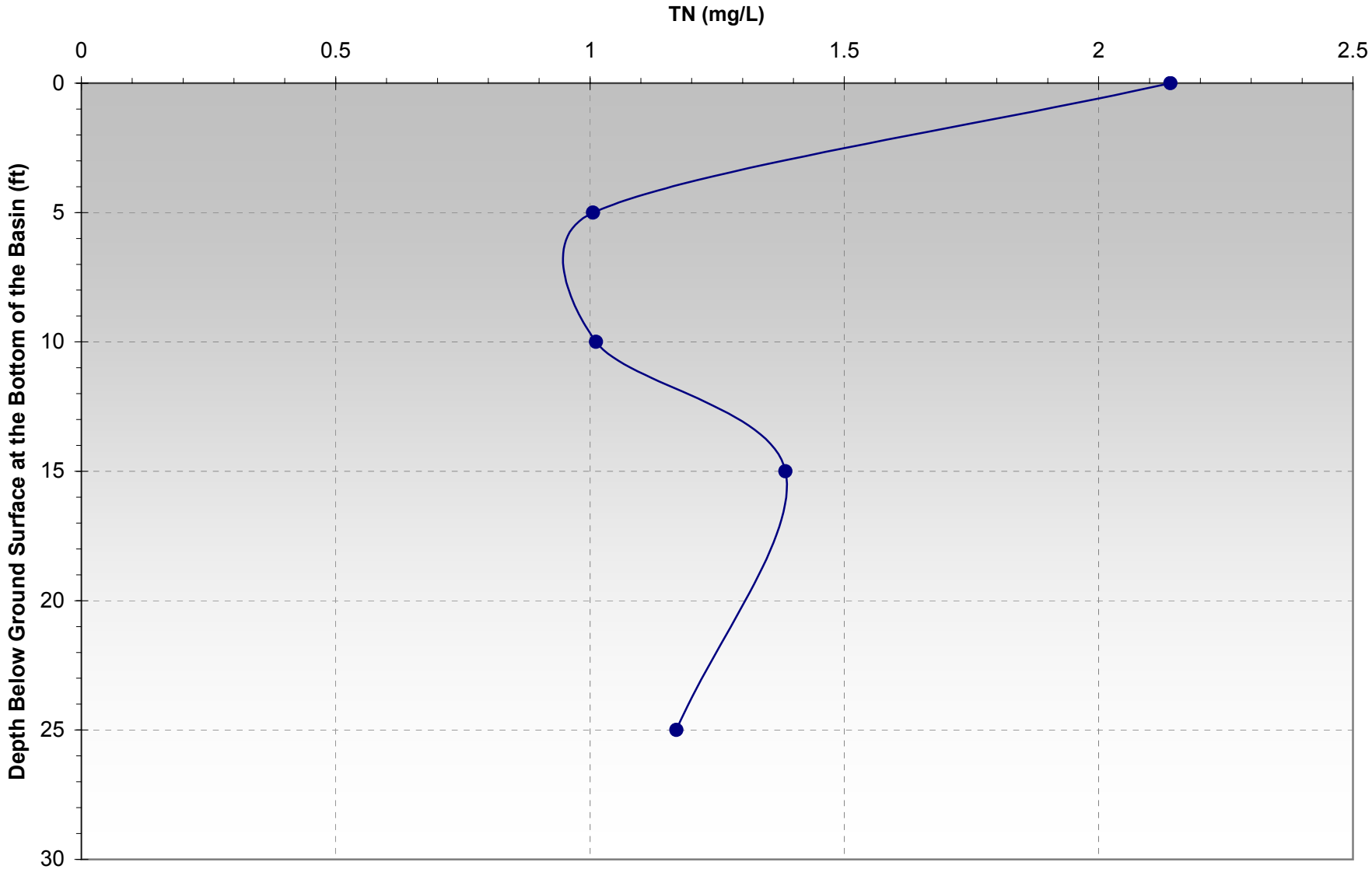


Figure 5-9
Hickory Basin East Cell: Average Total Nitrogen versus Depth

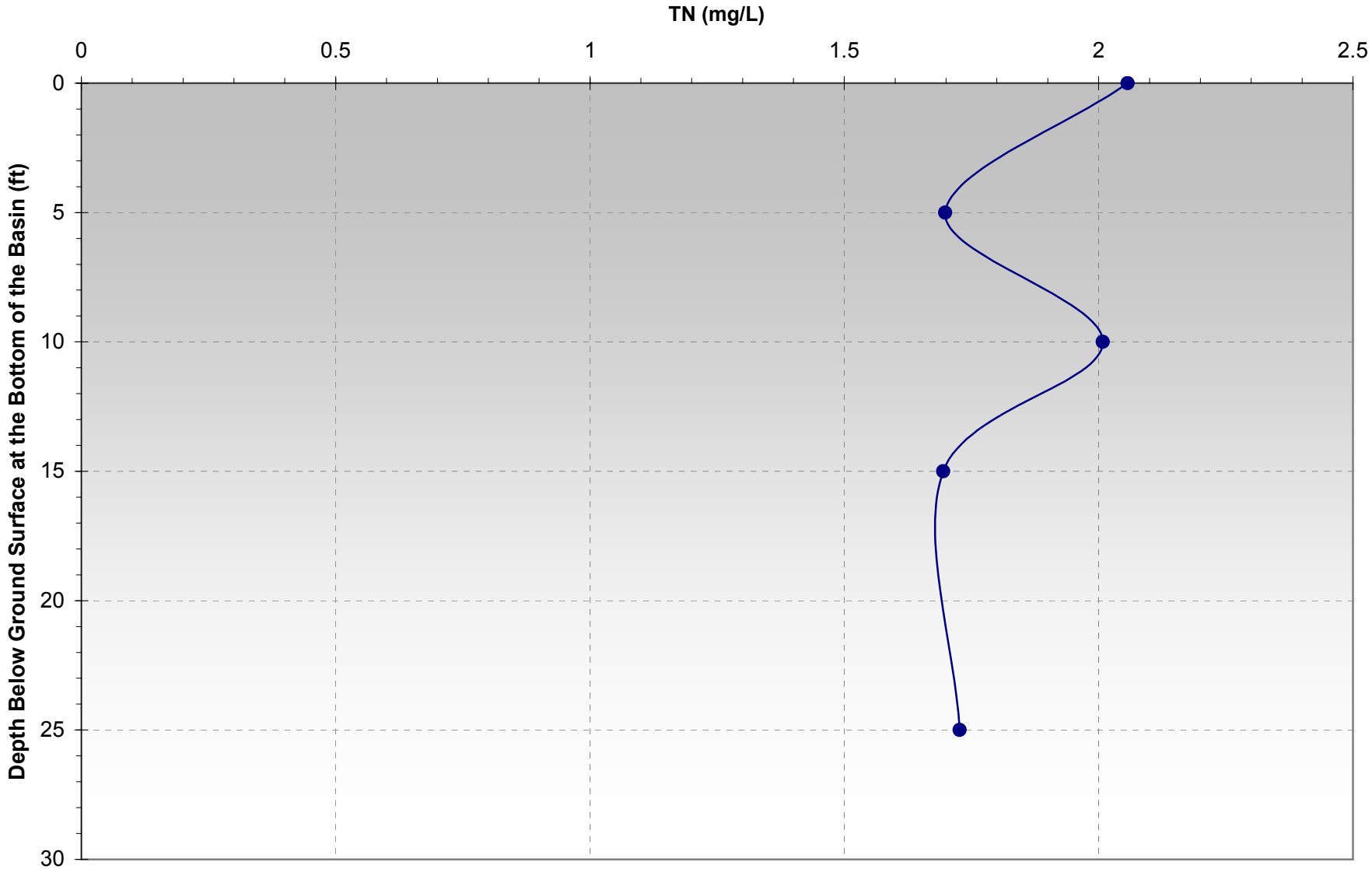


Figure 5-10
Banana Basin: Total Nitrogen Time History

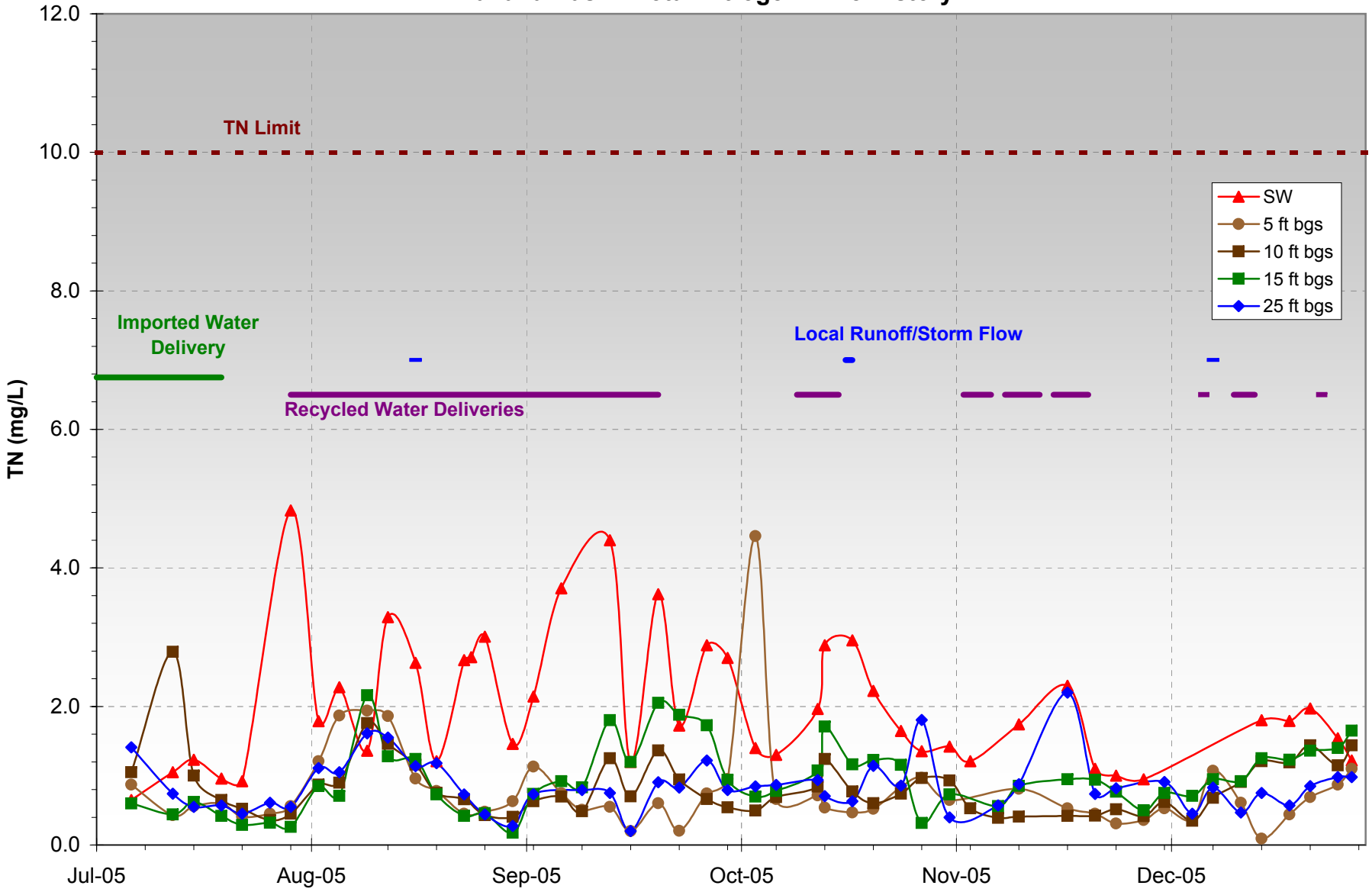


Figure 5-11
Hickory Basin West Cell: Total Nitrogen Time History

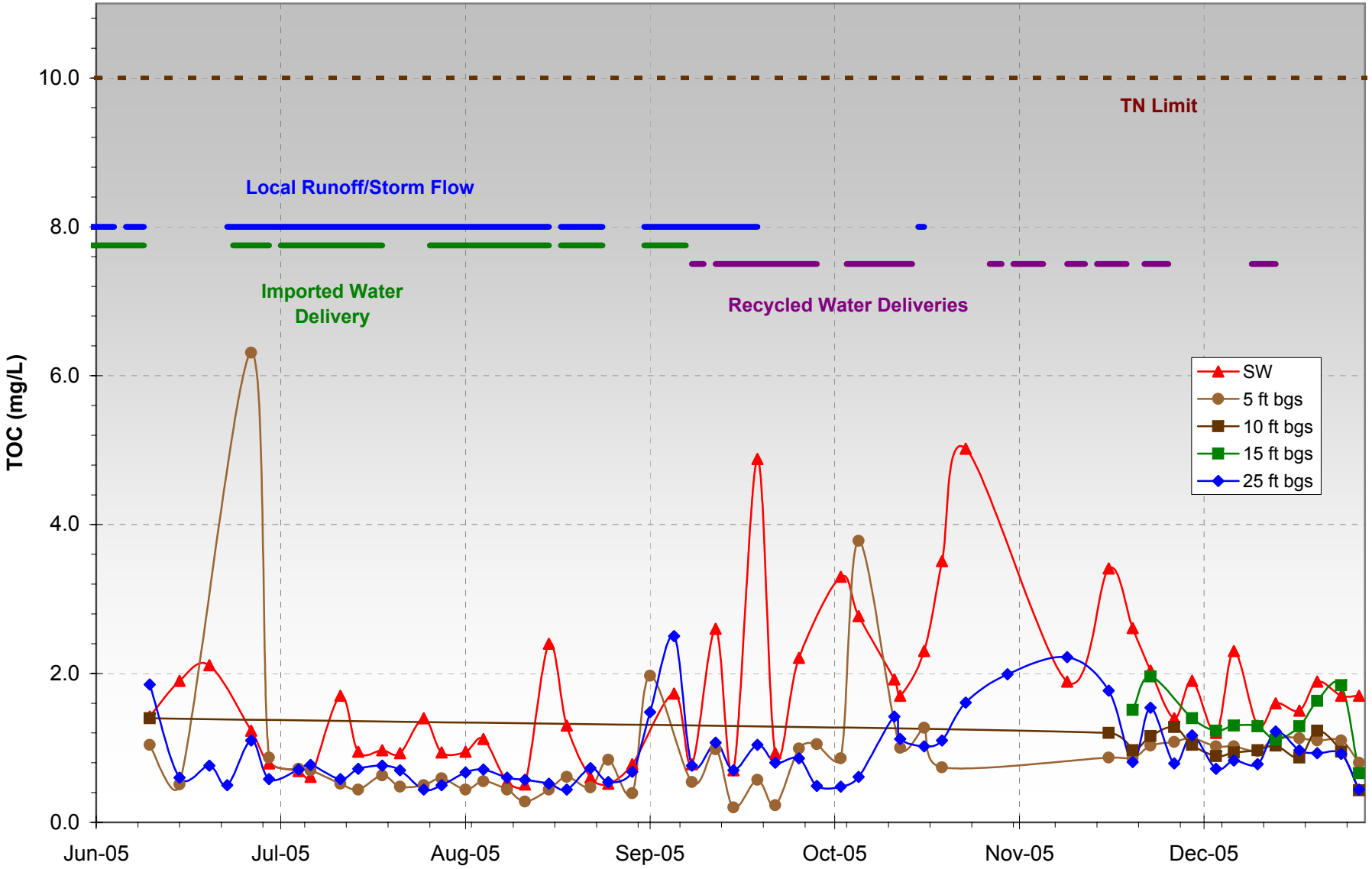


Figure 5-12
Hickory Basin East Cell: Total Nitrogen Time History

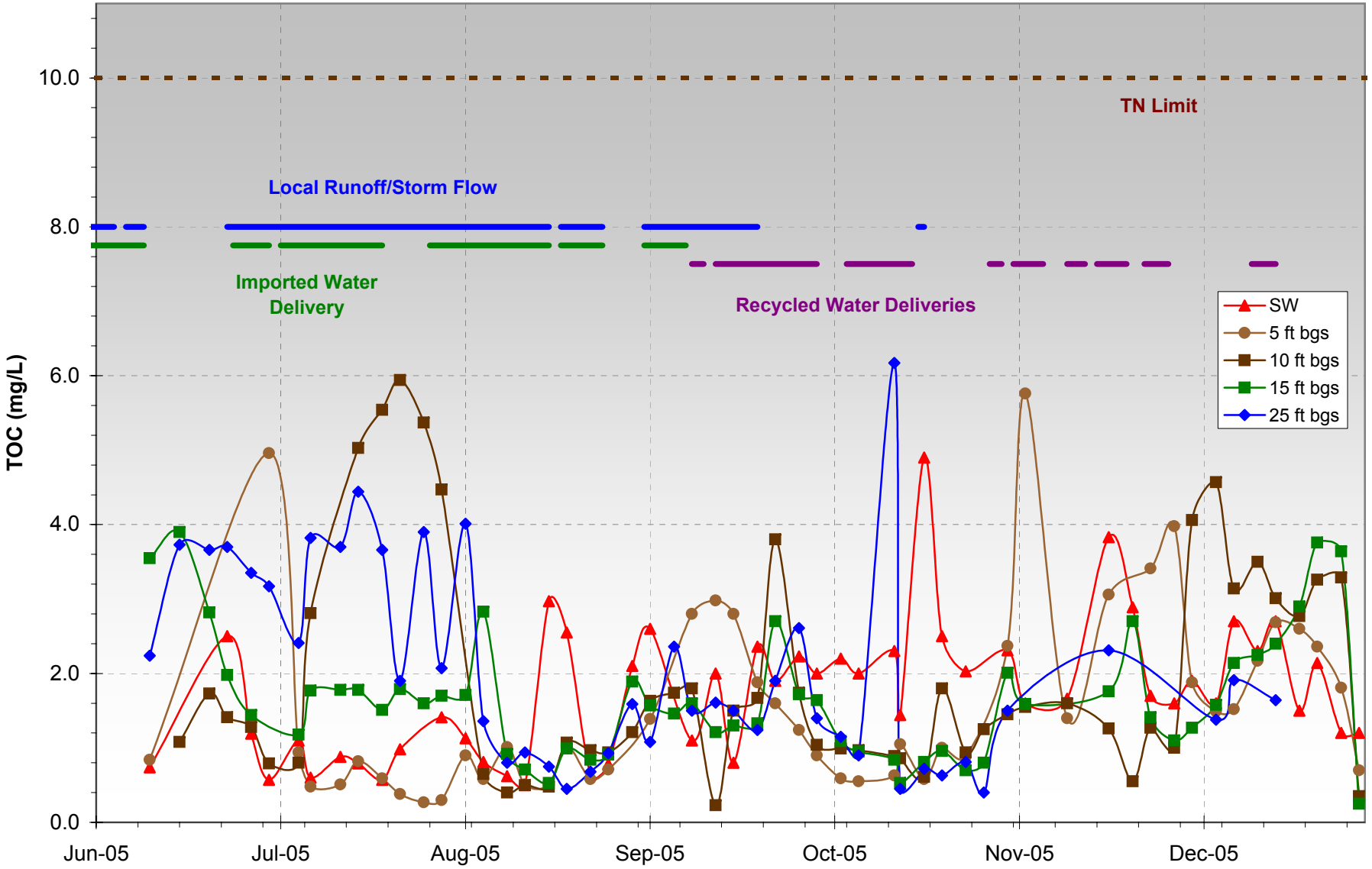


Figure 5-13
Banana Basin: Total Organic Carbon Reduction and Local Runoff/Storm Flow Time History

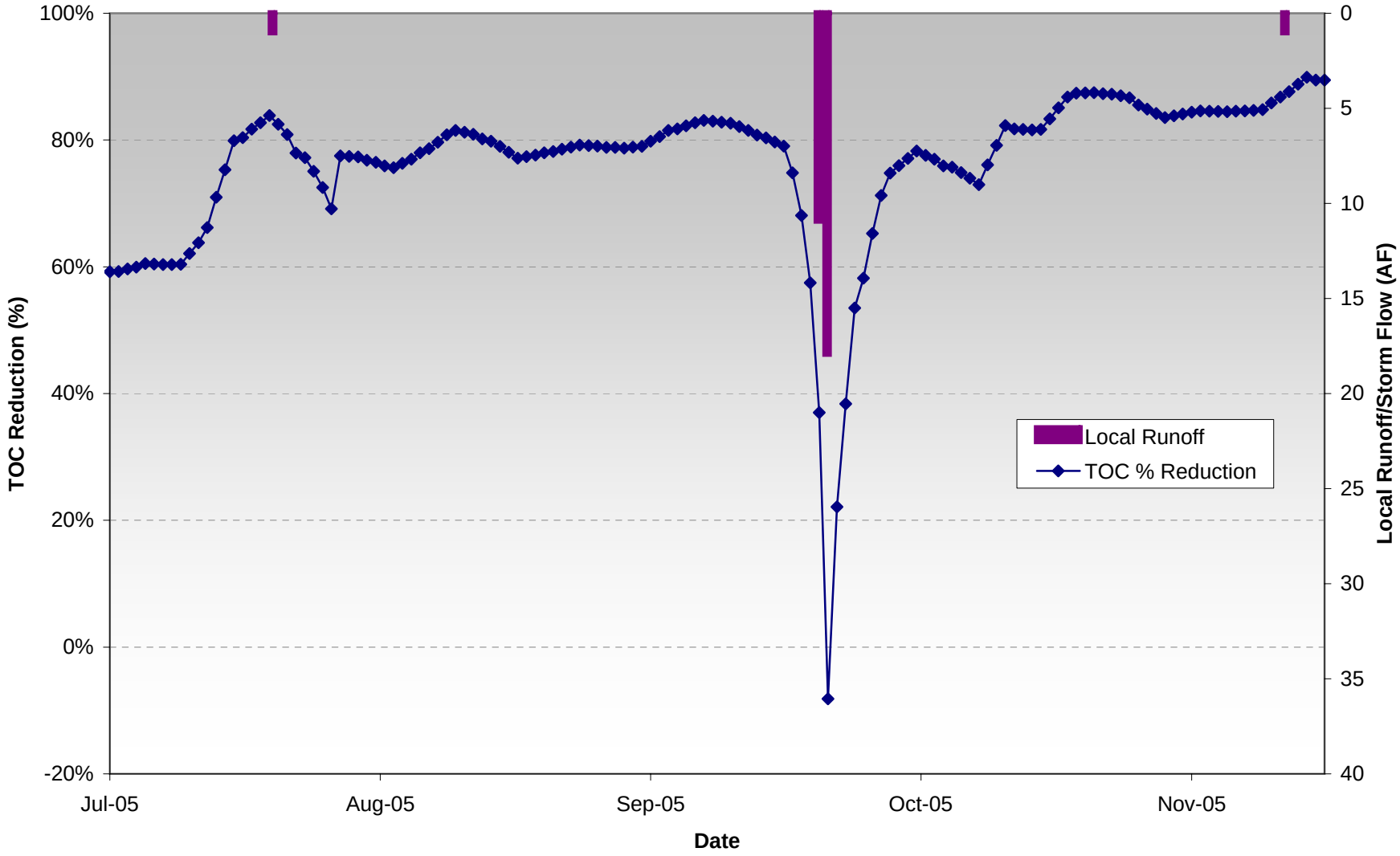


Figure 5-14
Hickory West Basin: Total Organic Carbon Reduction and Local Runoff/Storm Flow Time History

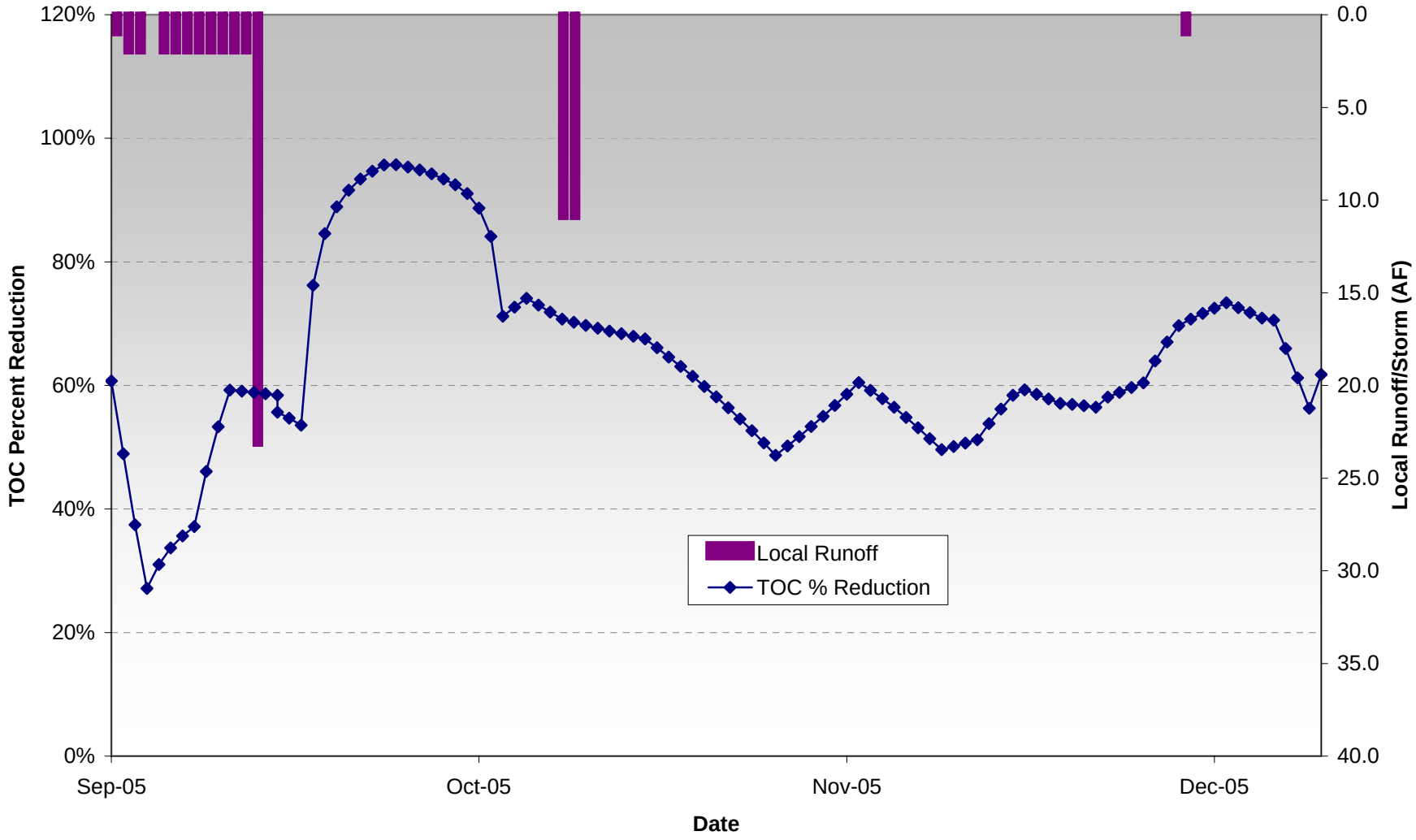


Figure 5-15
Hickory East Basin: Total Organic Carbon Reduction and Local Runoff/Storm Flow Time History

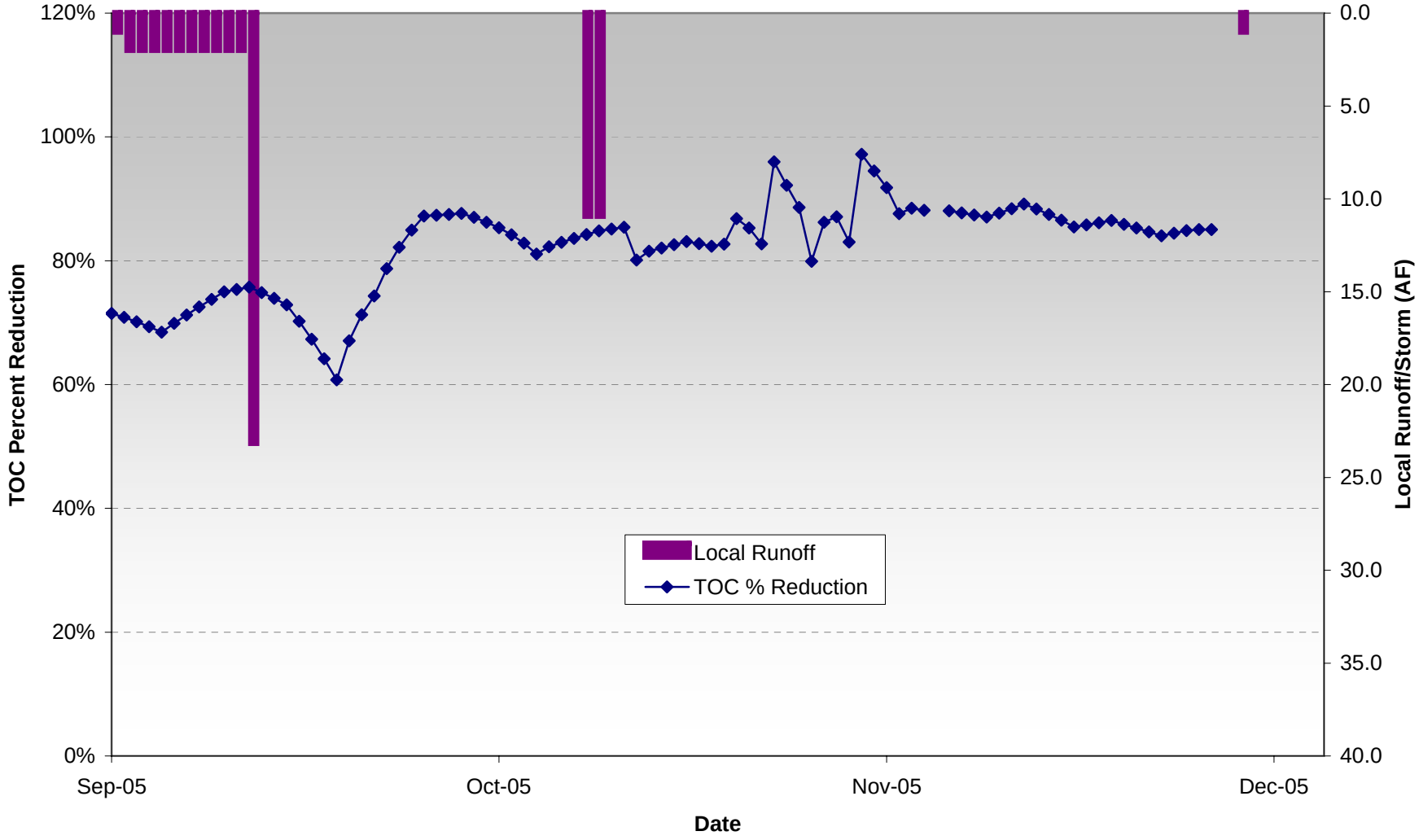


Figure 5-16
Banana Basin: Total Nitrogen Reduction and Local Runoff/Storm Flow Time History

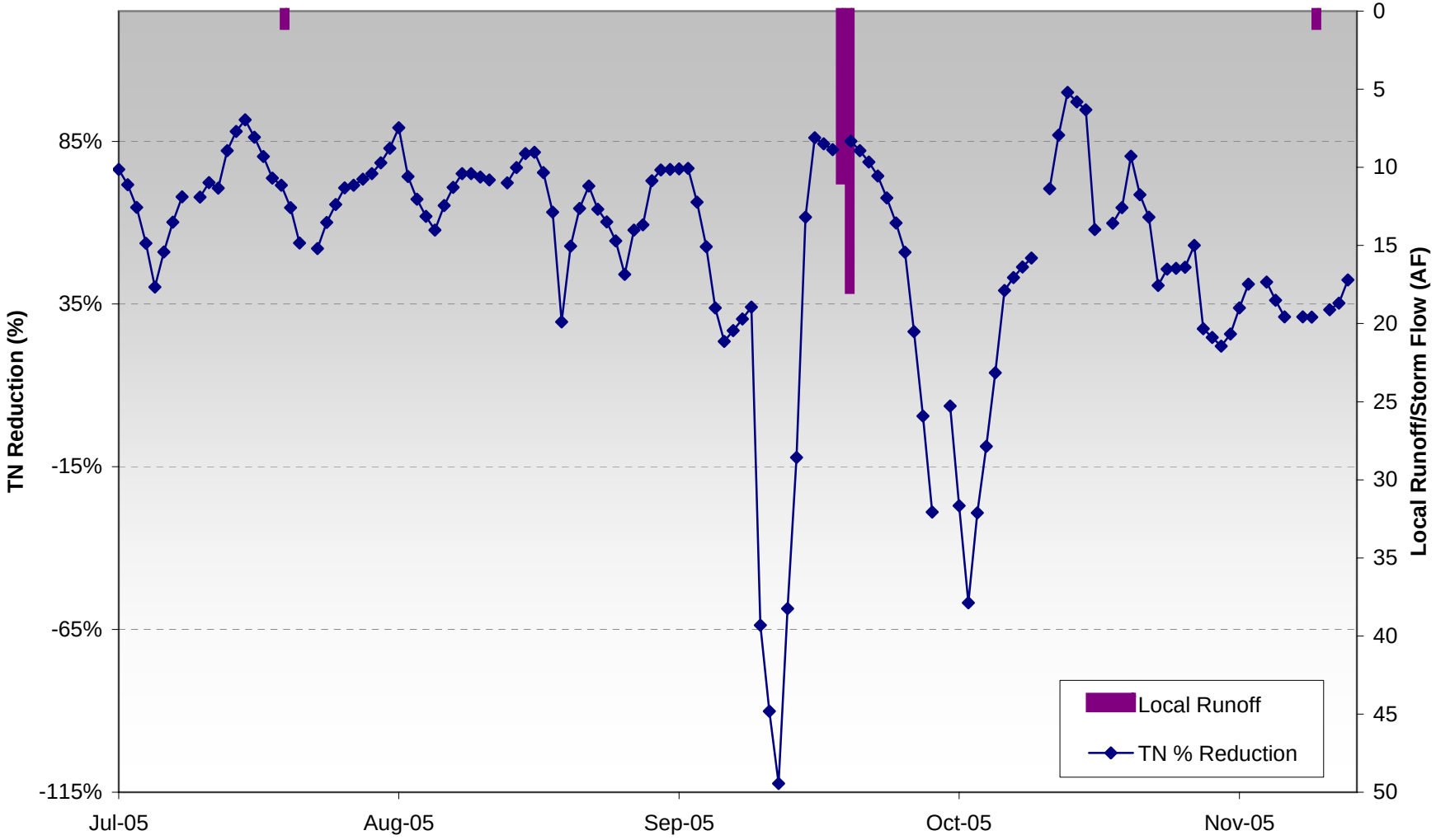


Figure 5-17
Hickory West Basin: Total Nitrogen Reduction and Local Runoff/Storm Flow Time History

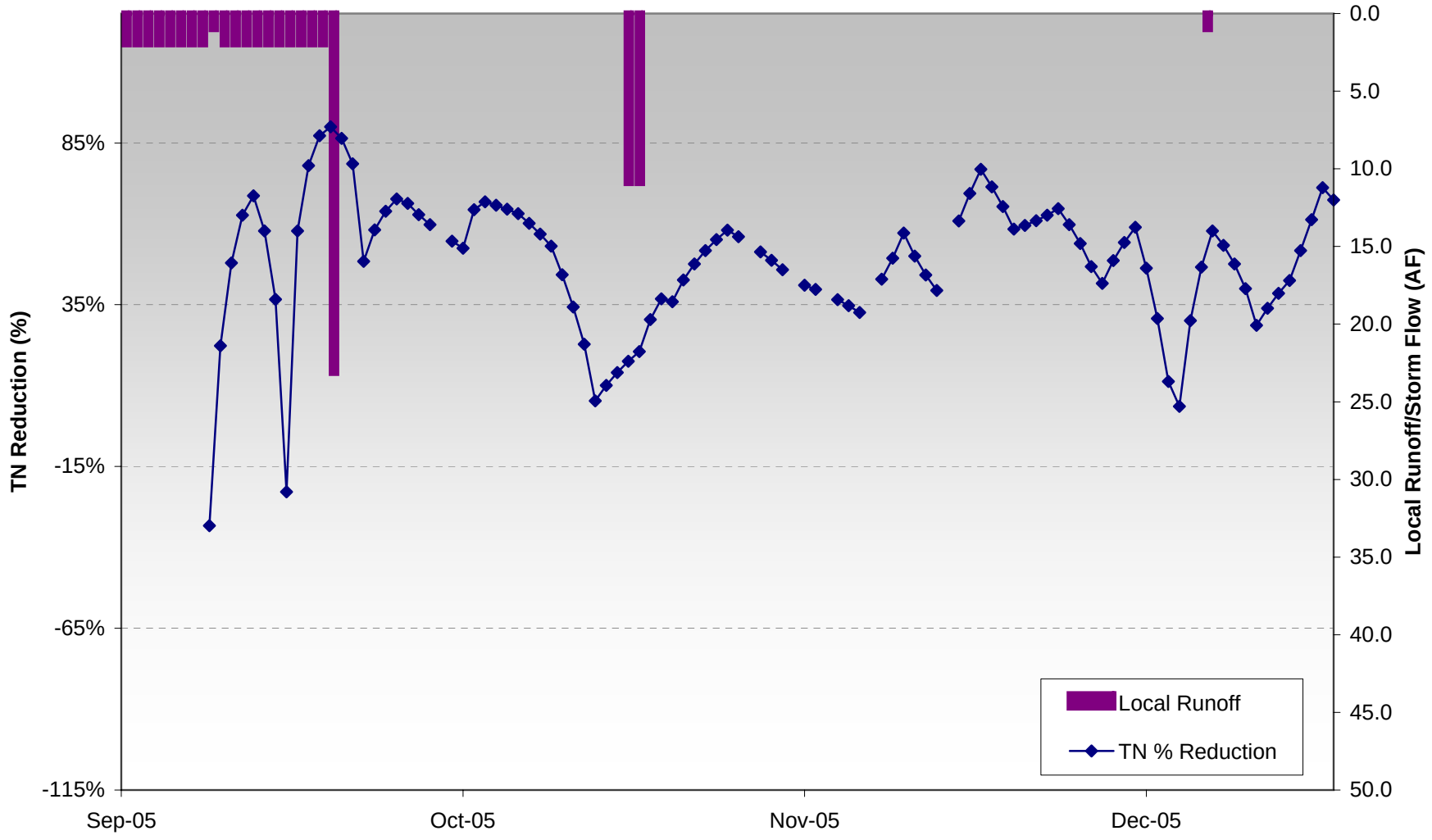
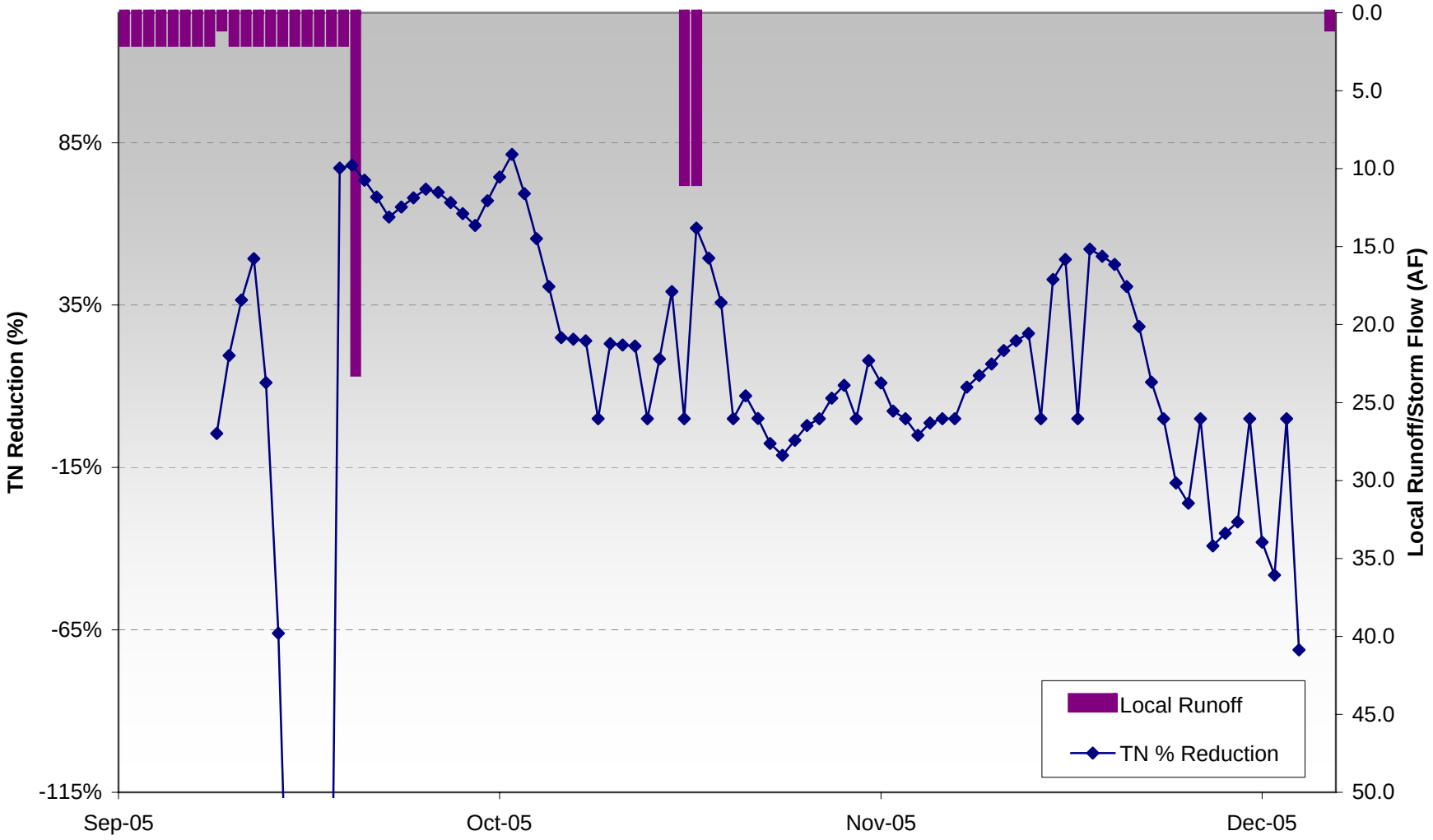


Figure 5-18
Hickory East Basin: Total Nitrogen Reduction and Local Runoff/Storm Flow Time History



6. START-UP PERIOD

6.1 Determination of the Start-Up Period

The Order (RWQCB, 2005a) establishes a Start-Up Period for each recharge basin in the Chino Basin Recycled Water Groundwater Recharge Program (Finding 9, page 3):

> At each recharge basin, a START-UP PERIOD not to exceed 180 days will be used at the outset of recycled water recharge operations. The purposes of each START-UP PERIOD are to establish site characteristics, including percolation rates, the physical characteristics of the vadose zone and soil aquifer treatment efficiency, and to establish a sampling regime, based on these characteristics, that is representative of recycled water following soil aquifer treatment. The length of the START-UP PERIOD at each basin will be contingent on site characteristics, including percolation rates and recycled water transit time in the subsurface. The Order requires IEUA to submit for CDHS and Regional Board approval a proposed START-UP PERIOD protocol at least two weeks prior to beginning each START-UP PERIOD. A START-UP PERIOD report will be prepared at the close of each START-UP PERIOD and will include recommendations for the optimum depths and locations for placement of lysimeters that will be used to measure compliance, and for a compliance-monitoring program. The report will also include recommendations for the maximum average RWC and Total Organic Carbon (TOC) limit for the initial year of recharge operations following the START-UP PERIOD. This Order requires that the average TOC limit during the START-UP PERIOD not exceed 0.5 mg/L divided by the maximum average RWC. As stated in Finding 8, above, the maximum average RWC is not to exceed 20 percent.

The Start-Up Period for each basin will be long enough to demonstrate effective TOC removal. As long as TOC concentrations continue to decline over time, the basin is still deemed to be in the Start-Up Period (up to 180 days).

Section H.8 of the Order mandates that lysimeters or an "alternative-monitoring plan" be used to demonstrate soil-aquifer treatment and compliance with the requirements of the Order. As discussed in Section 2, the Hickory and Banana Basin lysimeter clusters consist of five individual lysimeter assemblies installed in separate boreholes in the bottom of the basin: three at depths of 5, 10, and 15 feet below ground surface (bgs), and two at 25 feet bgs. At each of the Turner Basin lysimeter clusters, an additional lysimeter was installed to a depth of 35 feet bgs. EC was used as a tracer or indicator of the source of water. Table 6-1 provides information on EC for various water sources that may be recharged.

Tables 4-1 through 4-3 provide the results of EC measurements for surface water grab samples collected from the Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell, and samples collected from the lysimeters from July 2005 through January 2006. Figures 6-1 through 6-3 are time histories of EC values for the basins and the lysimeters. In the upper part of the graphs, the period when various sources of water were diverted into basins are represented as bars. EC in the basins and in the lysimeters increases after July 29, 2005 (Banana Basin) and after September 9, 2005 (Hickory Basin West Cell and Hickory Basin East Cell) when recycled water was first introduced into the basins. The high values in early July 2005 for the Banana Basin 25 foot lysimeter likely represent soil water, held by matric potential to soil particles, which has undergone some evaporative concentration. Recycled water reached all the lysimeters in Banana Basin by August 16, 2005, Hickory Basin West Cell by September 20, 2005, and Hickory Basin East Cell by October 4, 2005, and, thereafter, the EC values remained fairly stable. A significant storm event occurred on October 17 and 18, 2005 that resulted in about 28.8 AF of stormwater entering Banana Basin and 21.8 AF entering Hickory Basin. One sees an immediate EC concentration decrease in the basin with delayed responses in the lysimeters in order of greater depth.

Tables 4-1 through 4-3 contain cells that are shaded, for both the surface water and lysimeter samples, to indicate that the recycled water component was greater than or equal to 75 percent when the samples were collected. When the diluent water was primarily imported water, this was based on an average SWP EC of 343 µmhos/cm and an average recycled water EC of 727 µmhos/cm. A sample with a 75 percent or

greater recycled water component would have an EC of 630 µmhos/cm or greater. When the diluent water was primarily stormwater, this was based on an average stormwater EC of 130 µmhos/cm and an average recycled water EC of 727 µmhos/cm. A sample with a 75 percent or greater recycled component would have an EC of 578 µmhos/cm or greater.

Based on these results, recycled water reached the 25 foot bgs lysimeter in Banana Basin on August 16, 2005, 18 days after recycled water was introduced into Banana Basin on July 29, 2005, in Hickory Basin West Cell on September 20, 2005, and Hickory Basin East Cell on October 4, 2005, 11 and 25 days, respectively, after recycled water was introduced into the Hickory Basins on September 9, 2005. According to the Order, the Start-Up Period can be no longer than 180 days (Finding 9, page 3). The Start-Up Period continued for the full 180-days due to interruptions by storm flow and because of the concentrations of TOC in all the lysimeters continued to decrease during the Start-Up Period. The Start-Up Period was July 29, 2005 through January 25, 2006 for Banana Basin and September 9, 2005 through March 8, 2006 for Hickory Basin.

6.2 Compliance Point Lysimeter Selection

As demonstrated in Figures 6-1 through 6-3, all lysimeters in the basins are representative of recharged water (i.e. there appears to be no geologic features that would cause anomalous results: preferential pathways or lenses of fine grained materials). As discussed in Section 5, the SAT is quite effective and there appears to be additional reduction of TOC with increasing depth. Therefore, the 25-foot bgs lysimeter was selected to be the compliance point lysimeter.

Table 6-1
EC Concentrations for Various Sources of Recharge

Statistic	EC (µmhos/cm)			
	SWP[1]	RP-1[1]	RP-4[1]	Stormwater[2]
Minimum	319	700	735	
Maximum	375	710	750	
Mean	343	704	750	130
Standard Deviation	23	5	6	
Mean + 2*SD	297	694	730	
Mean + 2*SD	390	713	755	

[1]WEI and IEUA, 2005; WEI and IEUA, 2006; MWD 2005 and MWD 2006

[2]WEI, 2005a

Figure 6-1
Banana Basin: Electrical Conductivity Time History

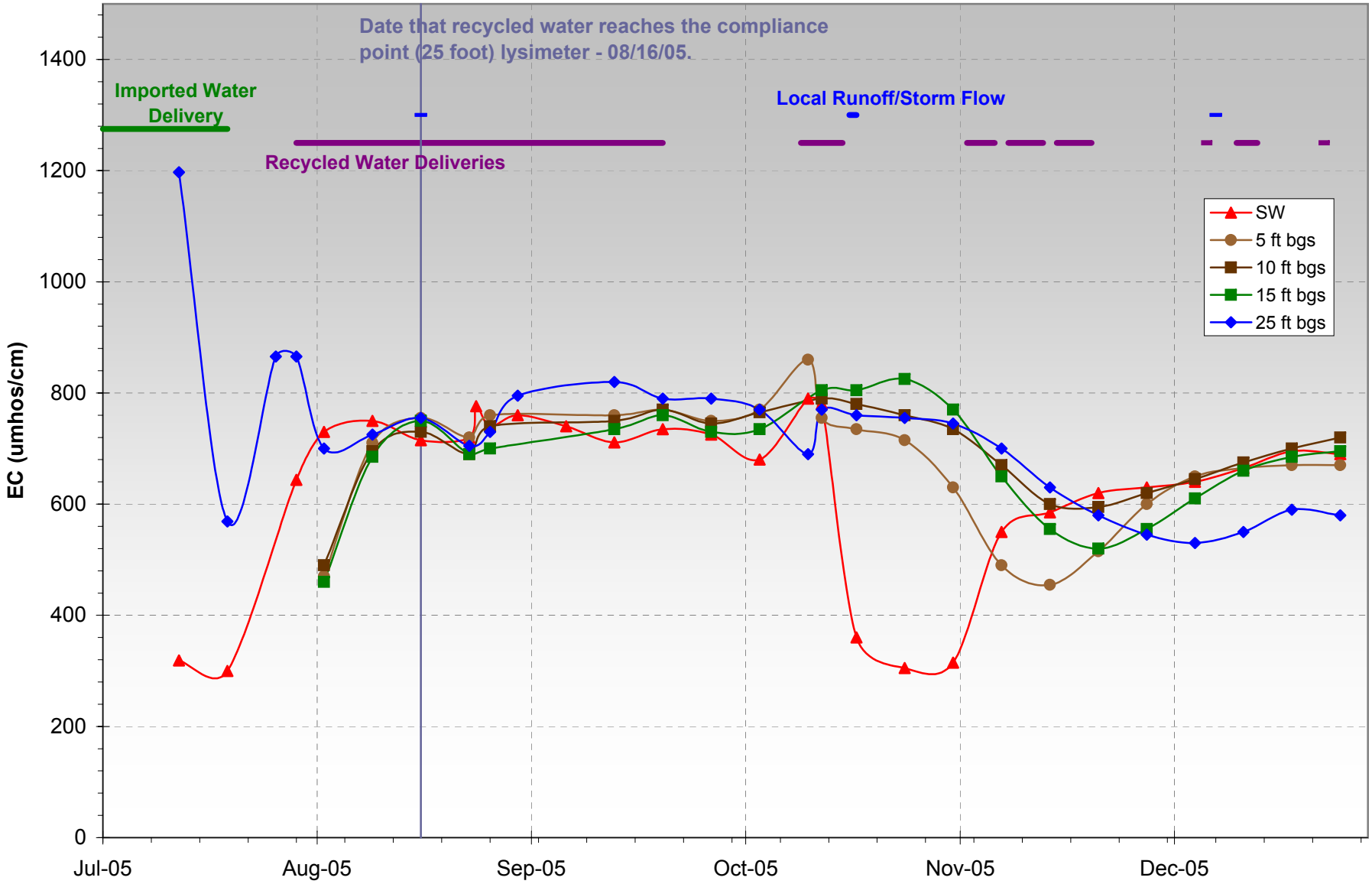


Figure 6-2
Hickory Basin West Cell: Electrical Conductivity Time History

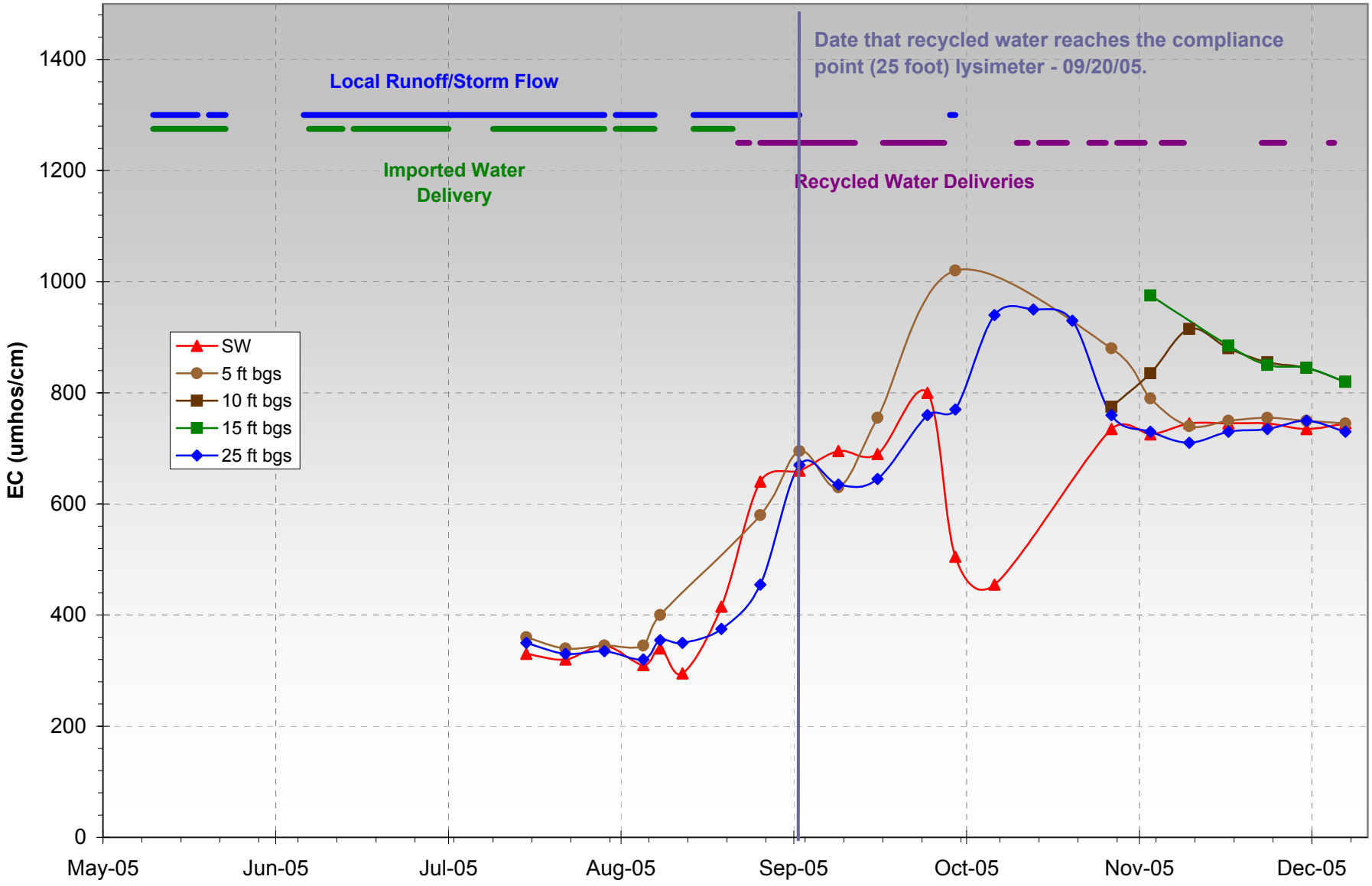
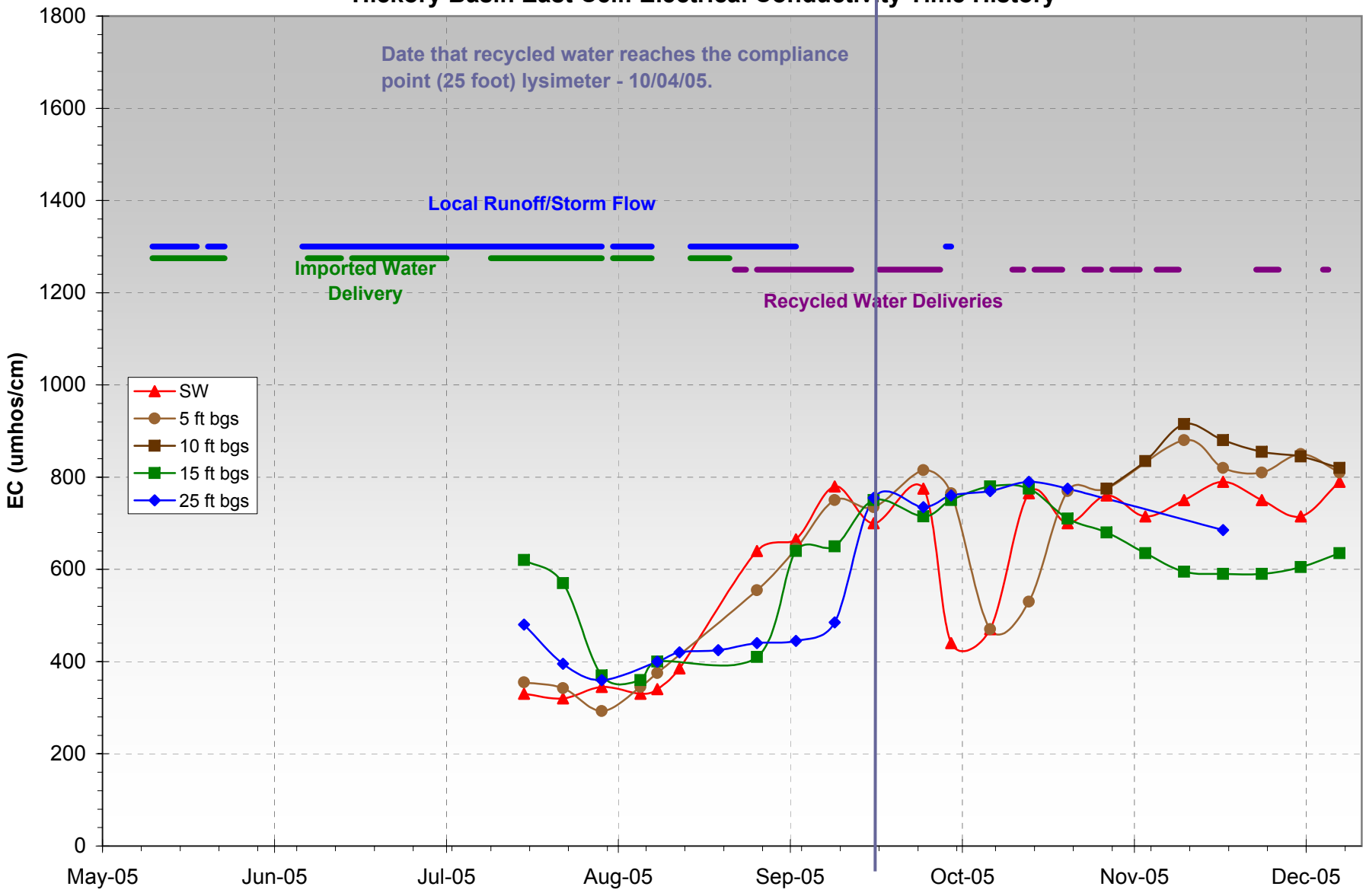


Figure 6-3
Hickory Basin East Cell: Electrical Conductivity Time History



7. RWC Determination and Recycled Water Management Plan

Finding 8 of the Order (RWQCB, 2005a) states:

> This Order limits the maximum average recycled water contribution (RWC) at each basin, based on a 60-month running average, to 20 percent, unless a higher percentage is approved in advance by CDHS and the Regional Board. Diluents will be stormwater and imported State Project Water from Northern California that is purchased from Metropolitan Water District of Southern California. Stormwater will be local captured runoff originating from the watersheds along the southern extent of the San Gabriel Mountains and from the developed and undeveloped areas below the mountains.

Table 7-1 shows the diluent water history prior to the Start-Up Period in Banana Basin and the volumes of diluent water and recycled water that were recharged during the Start-Up Period. The column with the heading "RWC" provides a calculation of the RWC based on a 60-month moving average. At the end of the 2005, the RWC at the Banana and Hickory Basins was 18.2 and 16.3 percent, respectively. Table 7-1 also shows a Recycled Water Management Plan that forecasts deliveries of recycled water and recharge of diluent water for the first 60 months of recycled water recharge. Although not explicitly called for in its permit, IEUA will include in each Annual Report a Recycled Water Management Plan for each recharge site. The Recycled Water Management Plan is a necessary tool to demonstrate how IEUA will meet a recharge site's RWC following a site's startup period. Small excursions above the initial RWC of 20 percent are occasionally required during the start-up period, based on diluent water availability for basins with little historical diluent recharge. The Recycled Water Management Plan will be updated regularly and presented annually to reflect current conditions. The Recycled Water Management Plan included in Table 7-1 and Figure 7-1 shows temporary excursions above the RWC current limit of 20 percent and that by 60 months of operations, the RWC limit is met.

As shown in Tables 4-4 through 4-6, the average percent reduction in TOC at the Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell were 69, 64, and 75 percent, respectively, while the percentage of recycled water in the compliance lysimeter was greater than or equal to 75 percent, based on EC values. Note that there is typically less SAT when the basin is recharging imported water or stormwater, which is confirmed in Figure 5-5. Figure 5-5 graphically displays a decrease in TOC percent reduction during measured local runoff and storm flow events. This is consistent with the TOC found in State Water Project water and stormwater is less biodegradable. The average percent reductions in TN at Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell were 51, 49, and 32 percent (Tables 4-10 through 4-12), respectively, while the percentage of recycled water in the compliance lysimeter was greater than or equal to 75 percent. A TN concentration of 6.2 mg/L was reported for the compliance lysimeter at Hickory Basin East Cell on October 13, 2006. This may be a sampling or laboratory artifact, and contributed to the low percent TN reduction in this cell. Nonetheless, average TN concentrations in each of the basins and cells were well below the permit requirements: 0.9, 1.2, and 1.7 mg/L for Banana Basin, Hickory Basin West Cell, and Hickory Basin East Cell, respectively.

The SAT treatment was highly effective at removing TOC and TN in the upper 25 feet of the unsaturated zone. One might expect further reduction in TOC and TN concentrations with depth. Based on the results presented in Tables 4-4 through 4-6 and Figures 5-4 through 5-6, the basins can achieve a running average TOC of 2 mg/L at 25 feet bgs. Based on the formula in the Order (RWQCB, 2005a):

$$TOC_{average} = \frac{0.5 mg/L}{RWC_{average}}$$

a TOC of 2 mg/L in the compliance point lysimeter would allow an RWC of 25 percent. The permitted maximum RWC for the basins is initially 20 percent.

Table 7-1
Recycled Water Management Plan:
Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Banana Basin										Hickory Basin								
Date		No. Mos. Since Initial RW Delivery	DW (AF)	DW 60-Month Total (AF)	RW (AF)	RW 60-Month Total (AF)	DW + RW 60-Month Total (AF)	RWC	Source	DATE		No. Mos. Since Initial RW Delivery	DW (AF)	DW 60-Month Total (AF)	RW (AF)	RW 60-Month Total (AF)	DW + RW 60-Month Total (AF)	RWC
2000/01	Jul-00	-60	0		0.				HISTORICAL DILUENT MODEL	2000/01	Jul-00	-62	0		0.			
	Aug-00	-59	0		0.						Aug-00	-61	0		0.			
	Sep-00	-58	0		0.						Sep-00	-60	0		0.			
	Oct-00	-57	28.3		0.						Oct-00	-59	2		0.			
	Nov-00	-56	12.7		0.						Nov-00	-58	0		0.			
	Dec-00	-55	0		0.						Dec-00	-57	0		0.			
	Jan-01	-54	86.9		0.						Jan-01	-56	10		0.			
	Feb-01	-53	122.2		0.						Feb-01	-55	13		0.			
	Mar-01	-52	78.5		0.						Mar-01	-54	6		0.			
	Apr-01	-51	61.1		0.						Apr-01	-53	6		0.			
	May-01	-50	0		0.						May-01	-52	0		0.			
	Jun-01	-49	0		0.						Jun-01	-51	0		0.			
2001/02	Jul-01	-48	12.2		0.					2001/02	Jul-01	-50	2		0.			
	Aug-01	-47	0		0.						Aug-01	-49	0		0.			
	Sep-01	-46	0		0.						Sep-01	-48	0		0.			
	Oct-01	-45	0		0.						Oct-01	-47	0		0.			
	Nov-01	-44	39.3		0.						Nov-01	-46	61		0.			
	Dec-01	-43	16.7		0.						Dec-01	-45	2		0.			
	Jan-02	-42	50.1		0.						Jan-02	-44	35		0.			
	Feb-02	-41	20.9		0.						Feb-02	-43	0		0.			
	Mar-02	-40	31		0.						Mar-02	-42	4		0.			
	Apr-02	-39	13.1		0.						Apr-02	-41	2		0.			
	May-02	-38	0.8		0.						May-02	-40	0		0.			
	Jun-02	-37	0		0.						Jun-02	-39	0		0.			
2002/03	Jul-02	-36	0		0.					2002/03	Jul-02	-38	0		0.			
	Aug-02	-35	0		0.						Aug-02	-37	0		0.			
	Sep-02	-34	0		0.						Sep-02	-36	0		0.			
	Oct-02	-33	0		0.						Oct-02	-35	0		0.			
	Nov-02	-32	38.9		0.						Nov-02	-34	82		0.			
	Dec-02	-31	59.3		0.						Dec-02	-33	122		0.			
	Jan-03	-30	0		0.						Jan-03	-32	0		0.			
	Feb-03	-29	80.5		0.						Feb-03	-31	146		0.			
	Mar-03	-28	38.9		0.						Mar-03	-30	106		0.			
	Apr-03	-27	86.9		0.						Apr-03	-29	89		0.			
	May-03	-26	61.7		0.						May-03	-28	7		0.			
	Jun-03	-25	0		0.						Jun-03	-27	0		0.			
2003/04	Jul-03	-24	0		0.					2003/04	Jul-03	-26	0		0.			
	Aug-03	-23	0		0.						Aug-03	-25	0		0.			
	Sep-03	-22	0		0.						Sep-03	-24	0		0.			
	Oct-03	-21	0		0.						Oct-03	-23	0		0.			
	Nov-03	-20	34.2		0.						Nov-03	-22	5		0.			
	Dec-03	-19	37.1		0.						Dec-03	-21	35		0.			
	Jan-04	-18	4.5		0.						Jan-04	-20	1		0.			
	Feb-04	-17	83.5		0.						Feb-04	-19	129		0.			
	Mar-04	-16	28.2		0.						Mar-04	-18	55		0.			
	Apr-04	-15	0.3		0.						Apr-04	-17	0		0.			
	May-04	-14	0		0.						May-04	-16	0		0.			
	Jun-04	-13	0		0.						Jun-04	-15	0		0.			
2004/05	Jul-04	-12	0		0.					2004/05	Jul-04	-14	0		0.			
	Aug-04	-11	0		0.						Aug-04	-13	0		0.			
	Sep-04	-10	0		0.						Sep-04	-12	0		0.			
	Oct-04	-9	62.8		0.						Oct-04	-11	118		0.			
	Nov-04	-8	17		0.						Nov-04	-10	2		0.			
	Dec-04	-7	25.3		0.						Dec-04	-9	39		0.			
	Jan-05	-6	93.6		0.						Jan-05	-8	150		0.			
	Feb-05	-5	110.8		0.						Feb-05	-7	128		0.			
	Mar-05	-4	24.9		0.						Mar-05	-6	27		0.			
	Apr-05	-3	19.3		0.						Apr-05	-5	4		0.			
	May-05	-2	14.6		0.						May-05	-4	0		0.			
	Jun-05	-1	0	1496	0.	0.	1496	0.0%			Jun-05	-3	0	1384	0.	0.	1384	0%
2005/06	Jul-05	1	192.3	1688	19.8	19.8	1708	1.2%	ACTUAL	2005/06	Jul-05	-2	204	1588	0.	0.	1588	0.0%
	Aug-05	2	0	1688	253.9	273.7	1962	14.0%			Aug-05	-1	448	2036	0.	0.	2036	0.0%
	Sep-05	3	0	1688	60.4	334.1	2023	16.5%			Sep-05	1	101	2137	207.2	207.2	2344	8.8%
	Oct-05	4	29	1689	25.3	359.4	2049	17.5%			Oct-05	2	22	2159	92.7	299.9	2459	12.2%
	Nov-05	5	0	1676	8.	367.4	2044	18.0%			Nov-05	3	0	2157	92.2	392.1	2549	15.4%
	Dec-05	6	19	1695	10.	377.4	2073	18.2%			Dec-05	4	20.4	2178	31.6	423.7	2601	16.3%
	Jan-06	7	6	1615	50.3	427.7	2042	20.9%			Jan-06	5	13	2192	82.9	506.6	2699	18.8%
	Feb-06	8	22.3	1515	55.2	482.9	1998	24.2%			Feb-06	6	35	2227	79.2	585.8	2812	20.8%
	Mar-06	9	55.1	1491	0.	482.9	1974	24.5%			Mar-06	7	27	2253	0.	585.8	2839	20.6%

Table 7-1
Recycled Water Management Plan:
Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Banana Basin										Hickory Basin								
Date		No. Mos. Since Initial RW Delivery	DW (AF)	DW 60-Month Total (AF)	RW (AF)	RW 60-Month Total (AF)	DW + RW 60-Month Total (AF)	RWC	Source	DATE		No. Mos. Since Initial RW Delivery	DW (AF)	DW 60-Month Total (AF)	RW (AF)	RW 60-Month Total (AF)	DW + RW 60-Month Total (AF)	RWC
	Apr-06	10	101	1531	10.	492.9	2024	24.4%	PROJECTED		Apr-06	8	86	2339	25.	610.8	2950	20.7%
	May-06	11	0	1531	0.	492.9	2024	24.4%			May-06	9	0	2339	50.	660.8	3000	22.0%
	Jun-06	12	0	1531	0.	492.9	2024	24.4%			Jun-06	10	0	2339	50.	710.8	3050	23.3%
2006/07	Jul-06	13	300	1819	0.	492.9	2312	21.3%		2006/07	Jul-06	11	175	2514	125.	835.8	3350	24.9%
	Aug-06	14	279	2098	0.	492.9	2591	19.0%			Aug-06	12	229	2743	50.	885.8	3629	24.4%
	Sep-06	15	258	2356	0.	492.9	2849	17.3%			Sep-06	13	258	3001	0.	885.8	3887	22.8%
	Oct-06	16	197	2553	40.	532.9	3086	17.3%			Oct-06	14	237	3238	0.	885.8	4124	21.5%
	Nov-06	17	181	2695	35.	567.9	3263	17.4%			Nov-06	15	216	3454	0.	885.8	4340	20.4%
	Dec-06	18	145	2823	50.	617.9	3441	18.0%			Dec-06	16	195	3649	0.	885.8	4535	19.5%
	Jan-07	19	124	2897	50.	667.9	3565	18.7%			Jan-07	17	174	3823	0.	885.8	4709	18.8%
	Feb-07	20	103	2979	50.	717.9	3697	19.4%			Feb-07	18	153	3976	0.	885.8	4862	18.2%
	Mar-07	21	32	2980	100.	817.9	3798	21.5%			Mar-07	19	132	4108	0.	885.8	4994	17.7%
	Apr-07	22	11	2978	100.	917.9	3896	23.6%			Apr-07	20	111	4219	0.	885.8	5105	17.4%
	May-07	23	0	2977	0.	917.9	3895	23.6%			May-07	21	0	4219	0.	885.8	5105	17.4%
	Jun-07	24	0	2977	0.	917.9	3895	23.6%			Jun-07	22	0	4219	0.	885.8	5105	17.4%
2007/08	Jul-07	25	300	3277	0.	917.9	4195	21.9%		2007/08	Jul-07	23	50	4269	250.	1135.8	5405	21.0%
	Aug-07	26	279	3556	0.	917.9	4474	20.5%			Aug-07	24	79	4348	200.	1335.8	5684	23.5%
	Sep-07	27	258	3814	0.	917.9	4732	19.4%			Sep-07	25	258	4606	0.	1335.8	5942	22.5%
	Oct-07	28	237	4051	0.	917.9	4969	18.5%			Oct-07	26	237	4843	0.	1335.8	6179	21.6%
	Nov-07	29	181	4193	35.	952.9	5146	18.5%			Nov-07	27	216	5059	0.	1335.8	6395	20.9%
	Dec-07	30	155	4289	40.	992.9	5282	18.8%			Dec-07	28	195	5254	0.	1335.8	6590	20.3%
	Jan-08	31	124	4413	50.	1042.9	5456	19.1%			Jan-08	29	174	5428	0.	1335.8	6764	19.7%
	Feb-08	32	103	4435	50.	1092.9	5528	19.8%			Feb-08	30	153	5581	0.	1335.8	6917	19.3%
	Mar-08	33	32	4428	100.	1192.9	5621	21.2%			Mar-08	31	132	5713	0.	1335.8	7049	18.9%
	Apr-08	34	11	4353	100.	1292.9	5645	22.9%			Apr-08	32	111	5824	0.	1335.8	7160	18.7%
	May-08	35	0	4291	0.	1292.9	5584	23.2%			May-08	33	0	5824	0.	1335.8	7160	18.7%
	Jun-08	36	0	4291	0.	1292.9	5584	23.2%			Jun-08	34	0	5824	0.	1335.8	7160	18.7%
2008/09	Jul-08	37	300	4591	0.	1292.9	5884	22.0%		2008/09	Jul-08	35	50	5874	250.	1585.8	7460	21.3%
	Aug-08	38	279	4870	0.	1292.9	6163	21.0%			Aug-08	36	79	5953	200.	1785.8	7739	23.1%
	Sep-08	39	258	5128	0.	1292.9	6421	20.1%			Sep-08	37	258	6211	0.	1785.8	7997	22.3%
	Oct-08	40	237	5365	0.	1292.9	6658	19.4%			Oct-08	38	237	6448	0.	1785.8	8234	21.7%
	Nov-08	41	216	5547	0.	1292.9	6840	18.9%			Nov-08	39	216	6664	0.	1785.8	8450	21.1%
	Dec-08	42	165	5675	30.	1322.9	6997	18.9%			Dec-08	40	195	6859	0.	1785.8	8645	20.7%
	Jan-09	43	134	5804	40.	1362.9	7167	19.0%			Jan-09	41	174	7033	0.	1785.8	8819	20.2%
	Feb-09	44	103	5824	50.	1412.9	7236	19.5%			Feb-09	42	153	7186	0.	1785.8	8972	19.9%
	Mar-09	45	32	5827	100.	1512.9	7340	20.6%			Mar-09	43	132	7318	0.	1785.8	9104	19.6%
	Apr-09	46	11	5838	100.	1612.9	7451	21.6%			Apr-09	44	111	7429	0.	1785.8	9215	19.4%
	May-09	47	0	5838	0.	1612.9	7451	21.6%			May-09	45	0	7429	0.	1785.8	9215	19.4%
	Jun-09	48	0	5838	0.	1612.9	7451	21.6%			Jun-09	46	0	7429	0.	1785.8	9215	19.4%
2009/10	Jul-09	49	300	6138	0.	1612.9	7751	20.8%		2009/10	Jul-09	47	50	7479	250.	2035.8	9515	21.4%
	Aug-09	50	279	6417	0.	1612.9	8030	20.1%			Aug-09	48	79	7558	200.	2235.8	9794	22.8%
	Sep-09	51	258	6675	0.	1612.9	8288	19.5%			Sep-09	49	258	7816	0.	2235.8	10052	22.2%
	Oct-09	52	237	6849	0.	1612.9	8462	19.1%			Oct-09	50	237	8053	0.	2235.8	10289	21.7%
	Nov-09	53	176	7008	40.	1652.9	8661	19.1%			Nov-09	51	216	8269	0.	2235.8	10505	21.3%
	Dec-09	54	155	7138	40.	1692.9	8831	19.2%			Dec-09	52	195	8464	0.	2235.8	10700	20.9%
	Jan-10	55	139	7183	35.	1727.9	8911	19.4%			Jan-10	53	174	8638	0.	2235.8	10874	20.6%
	Feb-10	56	113	7186	40.	1767.9	8953	19.7%			Feb-10	54	153	8791	0.	2235.8	11027	20.3%
	Mar-10	57	102	7263	30.	1797.9	9061	19.8%			Mar-10	55	132	8923	0.	2235.8	11159	20.0%
	Apr-10	58	81	7324	30.	1827.9	9152	20.0%			Apr-10	56	111	9034	0.	2235.8	11270	19.8%
	May-10	59	0	7310	0.	1827.9	9138	20.0%			May-10	57	0	9034	0.	2235.8	11270	19.8%
	Jun-10	60	0	7310	0.	1827.9	9138	20.0%			Jun-10	58	0	9034	0.	2235.8	11270	19.8%

RWC = 60-month running total of recycled water / 60-month running total of all recharged water.
All recharged water includes recycled water and diluent water (imported and storm water)
RWC Limit = 0.5 mg/L / the Running Average of Total Organic Carbon (TOC)

Figure 7-1
Recycled Water Management Plan
Banana Basin

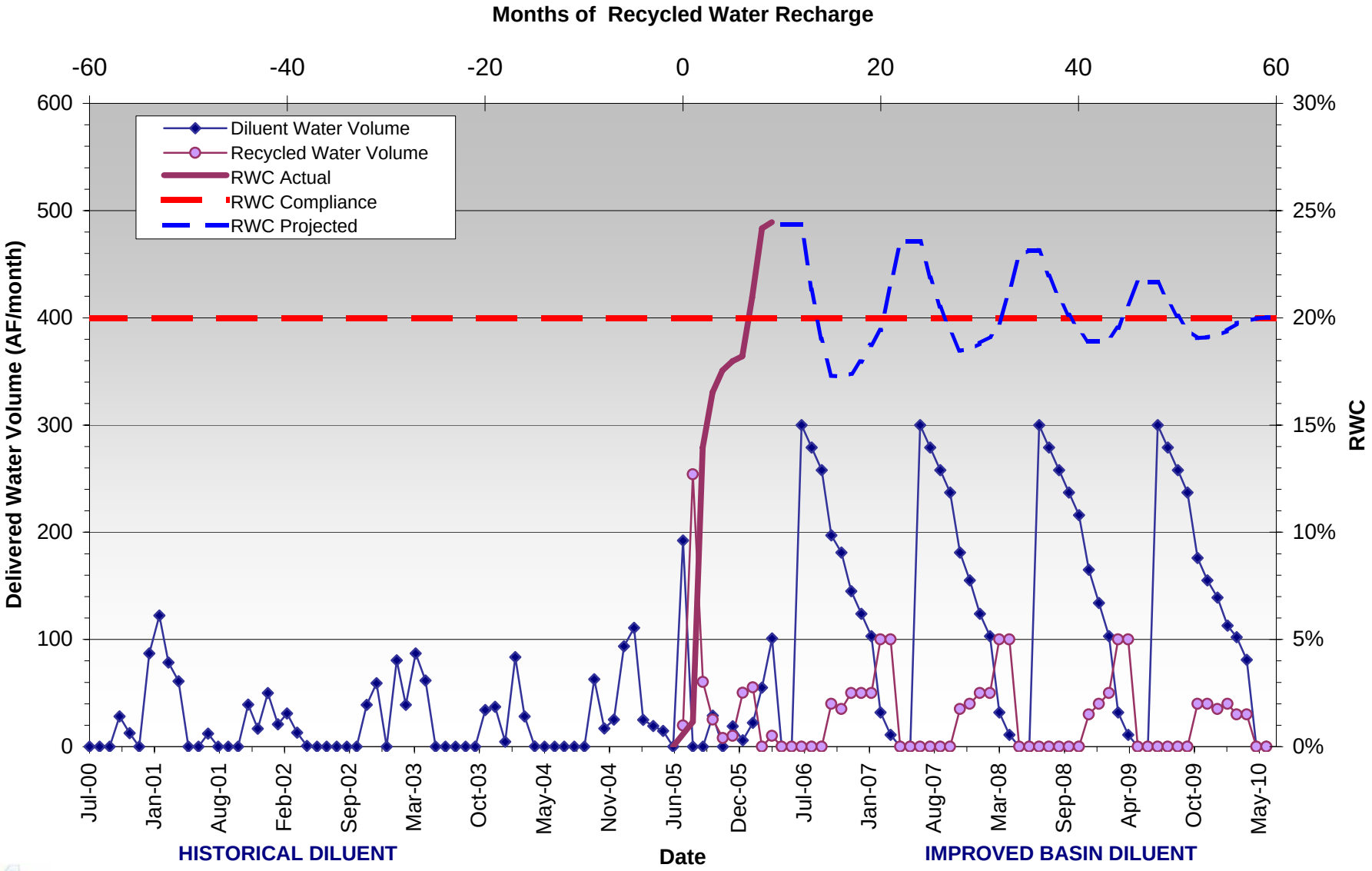
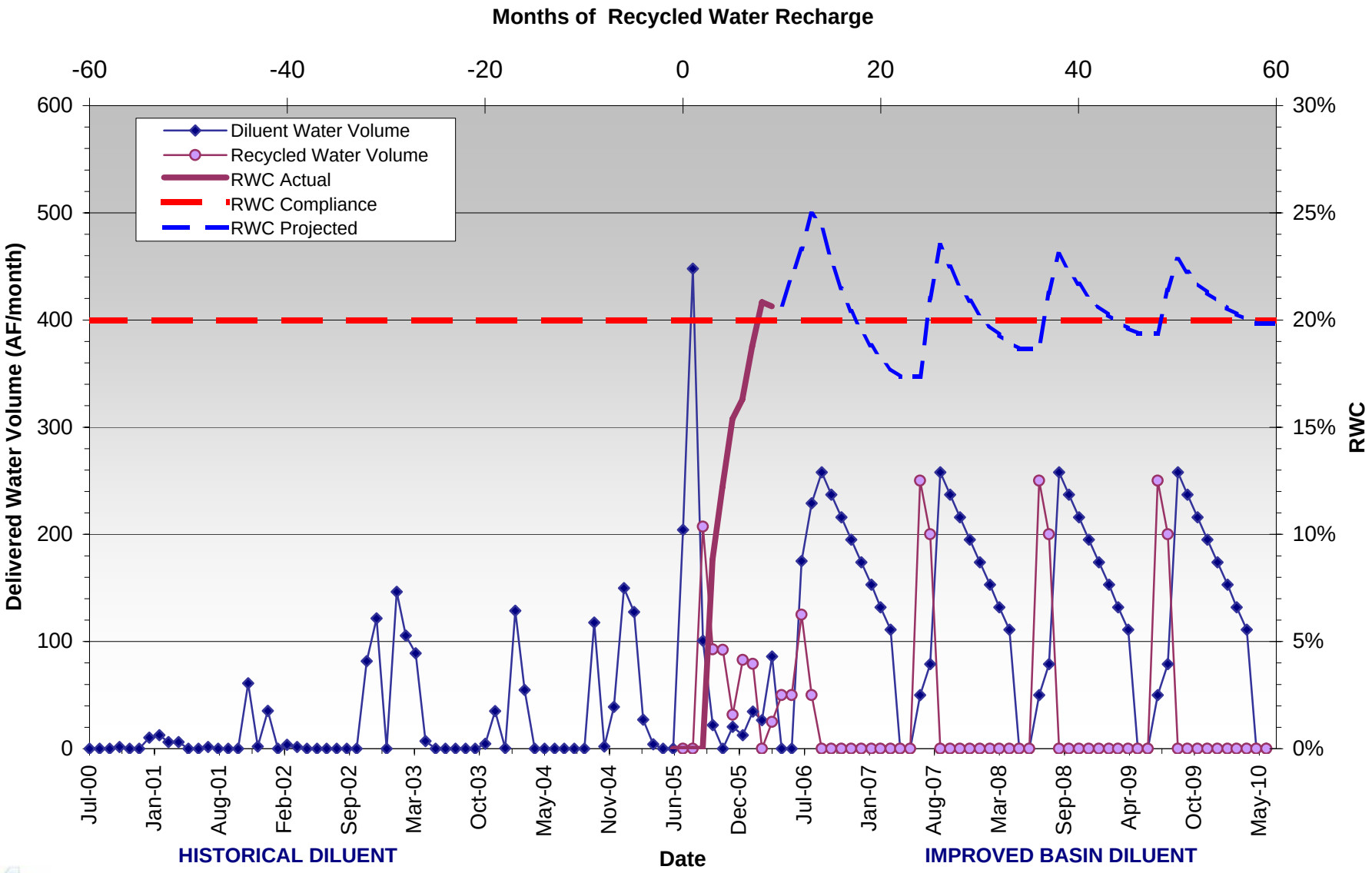


Figure 7-2
Recycled Water Management Plan
Hickory Basin



8. First Year Monitoring Plan

The Order (RWQCB, 2005a) Section G.4 allows for recommendations regarding the first year monitoring plan. As shown in the tables and graphs included in this report, lysimeter compliance criteria are consistently met at the 25 foot compliance lysimeter. The TOC trends are downward and the nitrogen species compliance criteria are met by RP-1 and RP-4 effluent. In light of the generally encouraging trends seen in the lysimeter data, we recommend a reduced first year lysimeter monitoring plan shown in Table 8-1.

Sampling would only be conducted when recycled water is shown to be in the basin or in the lysimeters, based on basin operations and EC. Compliance sampling for total nitrogen would be conducted on the treatment plant effluent.

Table 8-1
Initial Year Monitoring Plan

Analytes	Start-Up	Sampling Events per Week				
		Jan-Mar 2006 1st Qtr	Apr-Jun 2006 2nd Qtr	Jul-Aug 2006 3rd Qtr	Sep-Dec 2006 4th Qtr	Jan-Mar 2007 1st Qtr
Total Organic Carbon	1	1	1	every other	every other	every other
Total Nitrogen	2	1	1	every other	every other	every other
Total Inorganic Nitrogen	2	1	1	every other	every other	every other
Nitrate-Nitrogen	2	1	1	every other	every other	every other
Nitrite, ammonia, organic nitrogen	2	1	1	every other	every other	every other
Nitrite-Nitrogen	2	1	1	every other	every other	every other

9. GROUNDWATER MONITORING RESULTS AND TRAVEL TIME ESTIMATES

9.1 Groundwater Sampling and Monitoring Results

Groundwater quality within the vicinity of the Banana and Hickory Basins is monitored by sampling a network of six wells, including one nested monitoring well(BH-1) installed downgradient of Hickory Basin (Figure 2-1). BH-1 is screened in two zones: BH-1/1 is screened from 366-406 feet below the top of the casing and BH-1/2 is screened from 437 – 477 feet below the top of the casing. BH-1/1 is screened above the regional groundwater table and is not sampled at this time. Should the regional water table rise, sampling within BH-1/1 will begin. Groundwater monitoring results are presented in Table 7-1.

All monitoring wells with the exception BH/1/2 continue to show background EC. The MCL for one constituent was exceeded: aluminum in California Speedway 1, Ontario Well 20, and Fontana F-37A. Aluminum exceedances in groundwater samples are often artifacts of sampling (dissolution of fine particulates or colloidal material when the sample is acidified to preserve it). BH-1/2 had nitrate concentrations greater than the MCL. All waters recharged in the Chino Basin Recycled Water Groundwater Recharge Program (stormwater, SWP water, and recycled water) have very low concentrations of total nitrogen.

Groundwater quality within the vicinity of Turner Basin is monitored by a network of five wells (Figure 2-2). These wells were not sampled as part of the recycled water recharge program during 2005; however, these wells have been sampled as part of the tracer study at Turner Basin and are discussed further in Section 9.3.

9.2 Travel Time Estimates

Based on estimated travel times in the Title 22 Engineering Report (CH2M-Hill, 2003), the travel time to BH-1/2 is approximately six months. The IEUA began recharging recycled water in Banana Basin in July 2005 and preliminary EC results suggest that this well are currently affected by recycled water recharge. Hence, the groundwater quality results for 4Q05 at this well show a departure from background conditions.

9.3 Tracer Study at Turner Basin

The tracer study at Turner Basin consisted of recharging State Project Water in Turner Basin and monitoring surrounding wells for major anions and cations. The following volumes of water were recharged in late 2004: October: 16 AF, November: 75 AF, and December: 219 AF. Wells monitored for this study included Ontario Wells 7, 19, 25 and 29, and Turner Basin monitoring well T-2/2 (Figure 2-2). Native groundwater in the Chino Basin has a distinctive general water chemistry compared with State Water Project water, both of which are graphically displayed as a Piper diagram in Figure 9-1.

Based on the data collected, the results of the study are inconclusive. The downgradient monitoring wells show slight historical fluctuations, but do not show a definite mixing line between native groundwater chemistry and State Water Project water chemistry. Possible explanations for this in the existing production wells used in this tracer study are:

- not enough SWP water was introduced in late 2004;
- the production well screens are long and screened deeper than the water table; and
- these wells are at a distance that would require a travel time of at least 12 to 24 months.

The water chemistry of a sampled collected from the program monitoring well that was installed at Turner Basin (T-2/2), appears to be a mixture of SWP and native groundwater. Only one sample has been collected to date, and the well was installed 13 months after the SWP water was recharged in Turner Basin, so a travel time cannot be accurately estimated.

9.4 Downgradient Drinking Water Wells

Finding 16 of the Order (RWQCB, 2005a) states:

> Pathogenic microorganisms may be present in the recycled water, though this potential is highly unlikely provided that IEUA's treatment plants are operated properly. In order to assure that any such microorganisms that remain after treatment are effectively inactivated or removed in the subsurface, CDHS has determined that it is necessary to provide a retention time of at least 6 months for the recycled water in the groundwater basin before the water is extracted for drinking purposes and a minimum of 500 feet horizontal separation distance between all drinking water wells and recharge basins. CDHS found that the closest existing domestic supply wells downgradient from the Phase I recharge basins satisfy these minimum retention and horizontal distance separation requirements. Also, new drinking water wells must be constructed outside the areas required to achieve the minimum retention times and horizontal separation distance identified by CDHS. To implement the relevant CDHS Condition (Attachment A, Condition 17), this Order requires the users to implement measures to assure that the County of San Bernardino Department of Environmental Health Services, the lead permitting agency for construction of all public and private domestic supply wells in the project area, adopt ordinances restricting the drilling of wells within 500 feet of the recharge basins and where extracted water would not have at least 6 months underground residence time. Further, IEUA is required to use best efforts to closely monitor the well permitting activities of the County of San Bernardino Department of Environmental Health Services to assure that domestic supply wells are situated outside the soil aquifer treatment zone near the recharge basins.

In compliance with the above finding, Watermaster monitors all well drilling activities within 500 feet of the recharge basins and issues quarterly certification letters to the RWQCB of all well drilling activities. The last such letter is dated February 16, 2006. No potable supply wells exist within the limits established in finding 16 of the Order. IEUA is working closely with the County of San Bernardino's Department of Environmental Health Services (DEHS) in its well permitting activities. IEUA has provided DEHS maps that show – to the Township/Range/Quarter Section level – which quarter sections are located within the 500-foot buffer zone. DEHS is utilizing these maps to screen well permits.

Table 9-1
Groundwater Monitoring Results

CBWM ID	Local Name	Sample Date	Quarter	ALUMINUM(MG/L)	AMMONIA-NITROGEN(MG/L)	CHLORIDE(MG/L)	COLOR(UNITS)	COPPER(µg/L)	CORROSIVITY INDEX(MG/L)	DO(Field)(MG/L)	FOAMING AGENTS(MG/L)	IRON(MG/L)	MANGANESE(MG/L)	Methyl Tert-Butyl Ether (µg/L)	NITRATE-NITROGEN(MG/L)	NITRITE-NITROGEN(MG/L)	ODOR THRESHOLD @ 60 C(TON)	PH (Field)	SILVER(µg/L)	SODIUM(MG/L)	SPECIFIC CONDUCTANCE(MICROMHO)	SULFATE(MG/L)	THIOBENCARB(µg/L)	Kjeldahl Nitrogen, Total (mg/L)	TOTAL COLIFORM BACTERIA(MPN/100 ML)	TOTAL DISSOLVED SOLIDS(MG/L)	TOTAL HARDNESS (AS CACO3)(MG/L)	TOTAL ORGANIC CARBON(MG/L)	TOTAL NITROGEN (MG/L)	TURBIDITY(NTU)	ZINC(µg/L)
	Maximum Contaminant Level ►			0.2		250*	15*	1000	NC*	2**	0.5*	0.3*	0.05	5*	10	1	3*		0.1*		900*	250*	1*			500*				5*	5*
600660	INFIELD WELL	08-Aug-05	3Q2005	1.06	<0.1	10	<3	<1			<0.050	0.1	<0.002		5.5	<0.01	1	7.35	<2	19	428.5	13	<0.2	0.1		284.4	174	<0.3	5.60	0.14	<2
600660	INFIELD WELL	16-Dec-05	4Q2005	0.16	0.10	10		5	0.2			0.042	<0.002		6.2	<0.01		7.70	<2	17	395	15				262	169	0.15	6.20	0.3	<2
601002	BH-1/2	07-Jun-05	2Q2005	0.52	0.20	22	10	1.996	0.4		<0.050	0.652	0.040312		12.5	0.020	3	7.90	<2	21	430	15	<0.5	<0.1	<1.1	292	164	0.75	12.52	8.37	14
601002	BH-1/2	19-Jul-05	3Q2005		0.10					5.17					14.0	0.031								0.2					14.23		
601002	BH-1/2	03-Aug-05	3Q2005		0.10					5.15					14.0	<0.01								<0.1					14.00		
601002	BH-1/2	17-Aug-05	3Q2005		<0.1					5.00					14.1	<0.01								<0.1					14.10		
601002	BH-1/2	01-Sep-05	3Q2005		0.54					4.52					13.7	<0.01								<0.1					13.72		
601002	BH-1/2	15-Sep-05	3Q2005		<0.1					4.59					13.0	<0.2								0.1				0.53	13.10		
601002	BH-1/2	29-Sep-05	3Q2005		<0.1					4.31					13.2	<0.01					630			0.1				0.69	13.27		
601002	BH-1/2	12-Oct-05	4Q2005		0.10					5.89					13.8	<0.001					614			0.3				0.3	14.08		
601002	BH-1/2	27-Oct-05	4Q2005							5.62											600							<0.3	0.00		
601002	BH-1/2	08-Nov-05	4Q2005		0.10	61.9	<3			6.07	<0.05				13.3	<0.01	1	7.70		22	560	19	<0.2			450		<0.6	13.30	1.65	
601002	BH-1/2	23-Nov-05	4Q2005		0.10					5.61					13.4	<0.01					587			<0.2					13.43		
601002	BH-1/2	07-Dec-05	4Q2005							6.90					13.7	<0.01								<0.2					13.71		
601002	BH-1/2	27-Dec-05	4Q2005		0.10					6.43					12.7	<0.01		7.45			1170			0.28					12.97		
3600371	EAST WELL	05-Aug-05	3Q2005	1.03	0.10	13.3	<3	<1			<0.050	0.098	<0.002		6.4	<0.01	1	7.70	<2	19	368.4	15		0.2		241.3	150	<0.3	6.64	0.1	2
3600371	EAST WELL	09-Nov-05	4Q2005		0.10	5.08	<3	<1			<0.050				5.1	<0.01	1	7.55		17	335	15				232		<0.3	5.06	0.92	
3600371	EAST WELL	16-Dec-05	4Q2005																				<0.2						0.00		
3600573	F37A	05-Aug-05	3Q2005	1.10	0.20	13.6	<3	<1			<0.050	0.127	<0.002		8.8	<0.01	2	7.95	2	18	458.2	13	<0.2	0.2		298	197	<0.3	9.03	0.3	5
3600573	F37A	16-Dec-05	4Q2005	0.19	0.10	15	<3	9	0.5		<0.050	0.174	0.004		9.2	<0.01	2	7.85	2	17	430	13	<0.2	<0.2		292	188	0.13	9.20	0.5	5
3601364	1	08-Aug-05	3Q2005	1.11	<0.1	15.1	3	3			<0.050	0.334	0.005		8.0	<0.01	2	7.90	<2	19	453.1	17	<0.2	<0.2		274	177	<0.3	8.00	1.21	26
3602267	20	05-Aug-05	3Q2005	1.05	<0.1	6.4	<3	<1			<0.050	0.107	<0.002		1.8	<0.01	1	7.90	<2	13	300	6	<0.2	0.2		212	140	<0.3	1.96	0.3	<2
3602267	20	08-Nov-05	4Q2005				<3				<0.050						1						<0.2					<0.3			

NOTES:

[1] Sample Collected by the City of Ontario

* Secondary Maximum Contaminant Level

** Dissolved Oxygen May Not Fall Below 2 mg/L in Two Consecutive Samples

<0.01 Analyte Not Detected at or Above Indicated Detection Limit

Bold **Values in Bold Exceed Their Primary Maximum Contaminant Level**

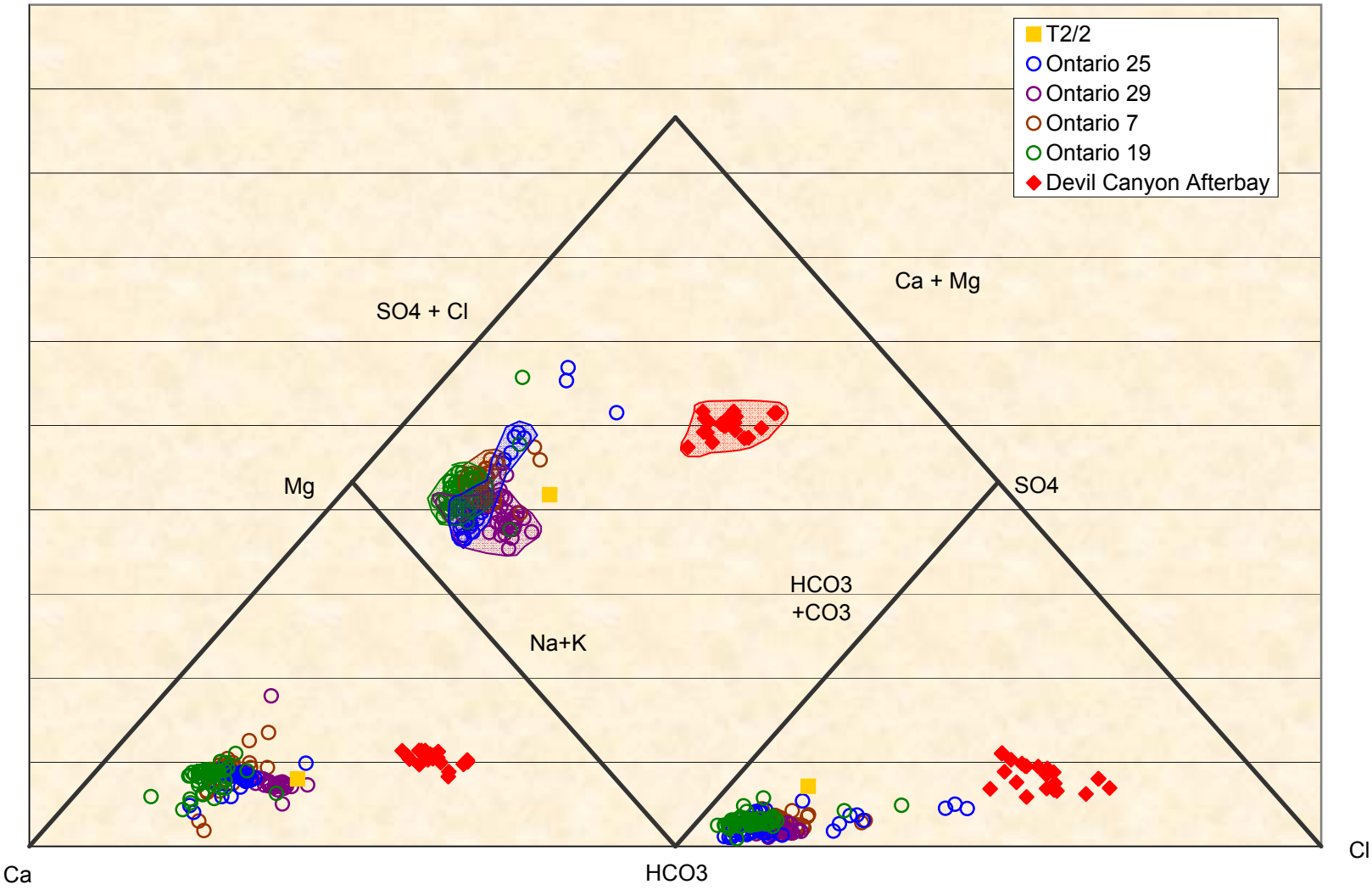
CBWM Chino Basin Watermaster

EF Lab had QC problems

NC Non-Corrosive

ND Not Detected

Figure 9-1
Turner Basin Cation/Anion Piper Diagram



10. AQUIFER BLENDING AND FLOW AND TRANSPORT MODELING

Section 4.B.3.b of the M&RP (RWQCB, 2005a) requires the inclusion of:

> A mass balance to ensure that blending is occurring in the aquifer at each recharge basin. Recharge water groundwater flow paths shall be determined annually from groundwater elevation contours and compared to the flow and transport model's flow paths, travel of recharge waters, including leading edge of the recharged water plume, any anticipated changes. The flow and transport model shall be updated to match as closely as possible the actual flow patterns observed within the aquifer if the flow paths have significantly changed.

There are currently insufficient data to establish that blending is occurring in the aquifer. Changes in groundwater elevation and groundwater chemistry have not been observed within the closest downgradient monitoring well (BH-1). As such, a comparison of observed data with the flow and transport model's flow paths cannot be made. Enough data should be compiled by the next annual report to perform this analysis.

11. Compliance Record and Corrective Actions

11.1 Regional Plants RP-1 and RP-4

No compliance issues or corrective actions occurred during 2005.

11.2 Recharge Operations

During October 2005, a combination of a storm event and less-than-expected demands from a recycled water customer caused water levels in Hickory Basin to rise. This coupled with Santa Ana winds led to erosion of the soil berm. The soil berm was repaired by adding additional soil and increasing the height 6 to 8-inches more than the original height. With the additional height, the berm will spill over its intended rip-rap point when storm waters increase the basin levels.

11.3 Lysimeter Sampling

After the first sampling event on June 10, 2005, the 10- and 15-foot lysimeters at Hickory Basin West Cell stopped functioning. These lysimeters were replaced in November 2005. With the exception of these lysimeters and their replacement, no operational problems were encountered this quarter.

Limited sample recovery occurred on occasion from recharge basin lysimeters. Water monitoring result tables indicate where an insufficient sample volume was present to conduct an analytical test with "IS." Samples analyzed on November 15, 2005 for Nitrite and Nitrate were affected by an equipment failure. These samples are noted in the tables with "EF." Total nitrogen values are based on concentrations of other nitrate ions. Where other nitrate ions were missing as a result of an insufficient sample volume, insufficient data for calculation was noted by "IDC" in the tables.

11.4 Monitoring Well Sampling

During the third quarter of 2005, Well BH-1/2 did not have the full suite of analysis run. This error was recognized and corrected during the fourth quarter of 2005.

During the fourth quarter of 2005, the California Speedway 1 Well (CBWM ID 3601364) was not sampled because it was not functioning properly.

12. Analytical Methodology

12.1 Laboratory Certification

The IEUA and MWH Laboratories were utilized for the analytical testing required during the recycled water recharge program. Both of the laboratories are California State certified environmental testing laboratories, pursuant to the California Environmental Laboratory Improvement Act. A copy of each laboratories' certification has been included in Appendix B.

12.2 Analytical Methodologies and QA/QC Procedures

To ensure the quality and reliability of test measurements and results, specific programs and procedures have been developed by both the IEUA and MWH Laboratories. Appendix C contains an electronic copy the QA/QC manual from each laboratory, including analytical methodologies.

12.3 Calibration of Field Instruments

The field instruments used during the recycled water field sampling include the following:

- Myron L Ultrameter II
- QED MP20 Multiparameter Meter with flow cell.

Field parameters were recorded during surface water sampling from recharge basins using the Myron L Ultrameter and monitored for temperature, pH, conductivity, and total dissolved solids. Parameters were collected from basin wells using a QED MP20 Multiparameter Meter. This instrument utilizes a flow-cell to allow purge water to flow through the meter chamber without exposure to the atmosphere. The QED meter monitors temperature, pH, conductivity, dissolved oxygen, and oxidation/reduction potential (ORP).

Field analytical instruments used throughout this project were maintained and calibrated each day of use. Calibration was conducted according to instructions provided by the instrument manufacturer. Meters were calibrated for instrument appropriate parameters including pH, dissolved oxygen, and conductivity. Calibration logs indicating the meter readings before and after calibration are stored in our field office for review and confirmation.

13. REFERENCES

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Metropolitan Water District of Southern California. 2005. Table D. Monthly Analyses of the District Water Supplies – September 2005.

Metropolitan Water District of Southern California. 2005. Table D. Monthly Analyses of the District Water Supplies – October 2005.

Metropolitan Water District of Southern California. 2005. Table D. Monthly Analyses of the District Water Supplies – November 2005.

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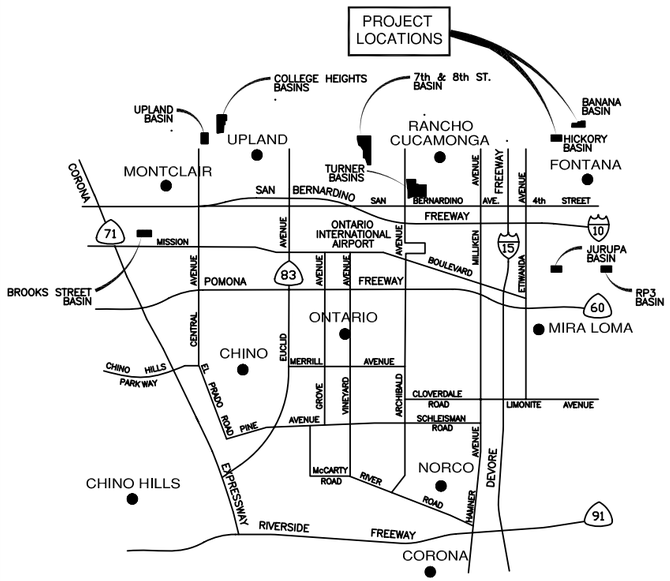
Appendix A.
Soil Boring Logs and
Lysimeter Construction As-Builts

AS-BUILTS OF THE

HICKORY AND BANANA BASIN LYSIMETER INSTALLATION

PROJECT NO.: 007-002-062

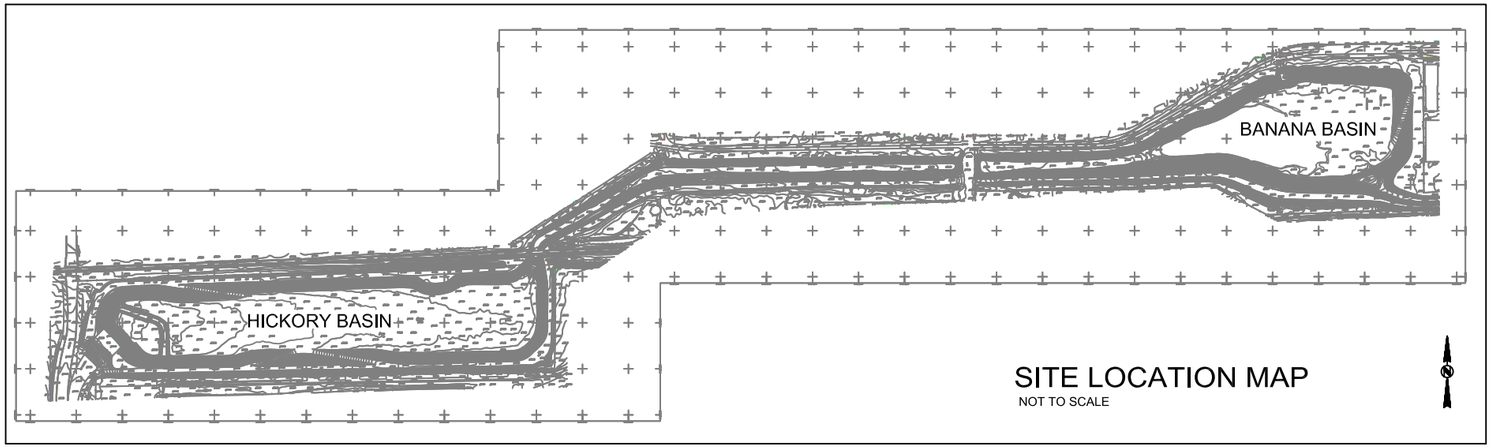
PREPARED FOR THE INLAND EMPIRE UTILITIES AGENCY
BY WILDERMUTH ENVIRONMENTAL, INC.



VICINITY MAP
NOT TO SCALE

LIST OF DRAWINGS		
DRAWING NO.	SHEET TITLE	SHEET NO.
	GENERAL	
A - 1	COVER SHEET	1 OF 5
A - 2	BANANA BASIN	2 OF 5
A - 3	HICKORY BASIN	3 OF 5
A - 4	AS-BUILT DETAILS 1 AND 2	4 OF 5
A - 5	AS-BUILT DETAILS 3 AND 4	5 OF 5

CONTACT PERSONNEL		
NAME	ADDRESS	PHONE NO.
ANDY CAMPBELL, PG, CHG	INLAND EMPIRE UTILITIES AGENCY 6075 KIMBALL AVENUE CHINO, CALIFORNIA 91710	(909) 993-1600
MARK WILDERMUTH, PE	WILDERMUTH ENVIRONMENTAL, INC. 23692 BIRTCHER DRIVE LAKE FOREST, CALIFORNIA 92630	(949) 420-3030
BILL LEEVER, PG, CHG	WILDERMUTH ENVIRONMENTAL, INC. 23692 BIRTCHER DRIVE LAKE FOREST, CALIFORNIA 92630	(949) 420-3030



SITE LOCATION MAP
NOT TO SCALE

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

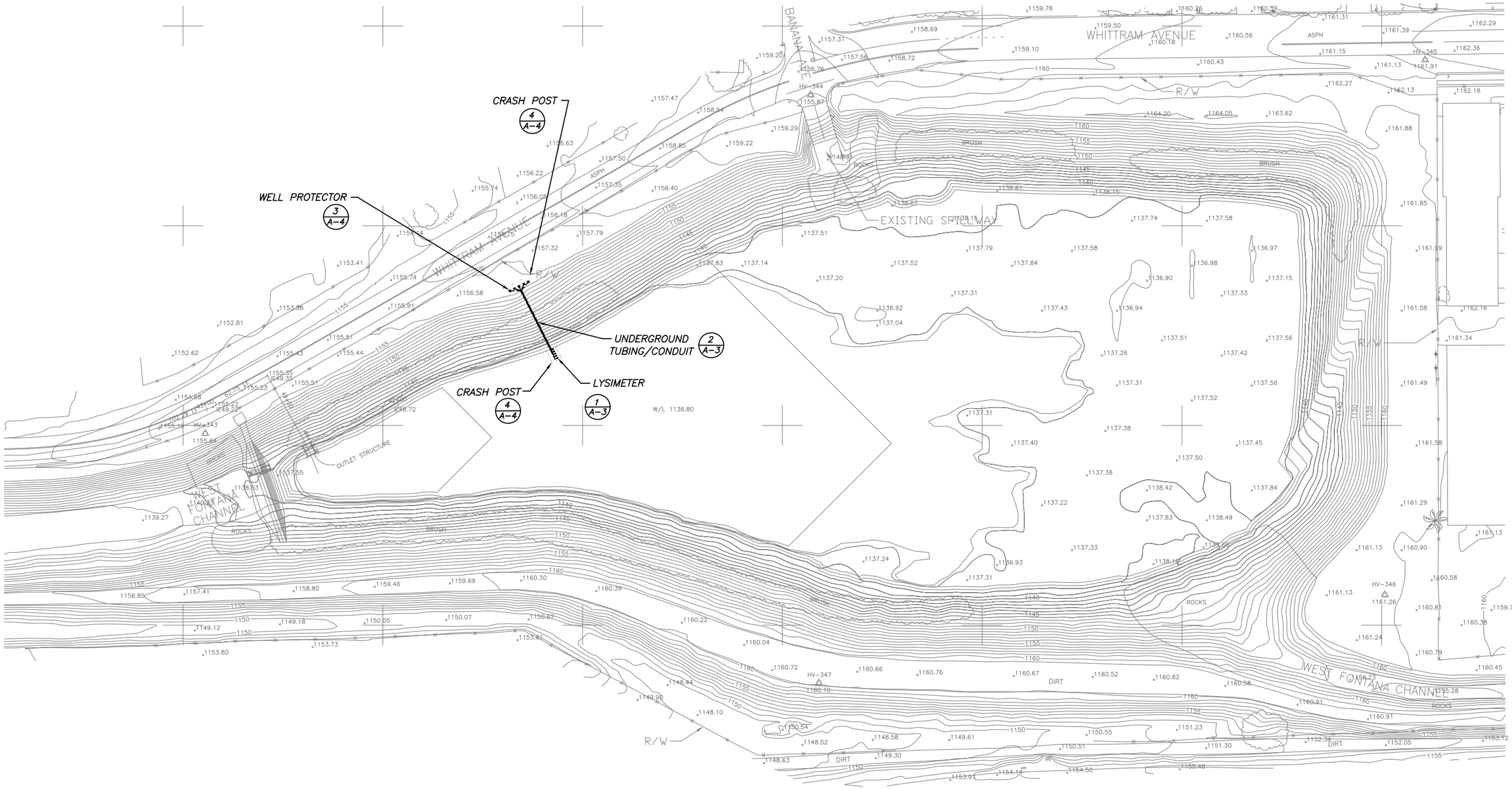
REVISIONS				
NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE
DESIGNED:		DRAWN:	CHECKED:	

WILDERMUTH ENVIRONMENTAL INC.
Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:	DRAWING NO.
AEM	WEL	03/28/06	A-1

COVER SHEET

SHEET NO. 1 OF 5



0 100' 200'

Scale: 1" = 100 FEET

North

Underground Service Alert

Call: TOLL FREE 1-800 227-2600

TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: DRAWN: CHECKED:

WILDERMUTH ENVIRONMENTAL INC.

Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	03/28/06

BANANA BASIN

DRAWING NO. A-2

SHEET NO. 2 OF 5

WEST CELL

EAST CELL

LYSIMETER 1 A-3

CRASH POST 4 A-4

UNDERGROUND TUBING/CONDUIT 2 A-3

WELL PROTECTOR 3 A-4

E 6,709,200 E 6,709,400 E 6,709,600 E 6,709,800 E 6,710,000 E 6,710,200 E 6,710,400 E 6,710,600

0 100' 200'

Scale: 1" = 100 FEET

North

Underground Service Alert

Call: TOLL FREE 1-800 227-2600

TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: DRAWN: CHECKED:

WILDERMUTH ENVIRONMENTAL INC.

Inland Empire UTILITIES AGENCY

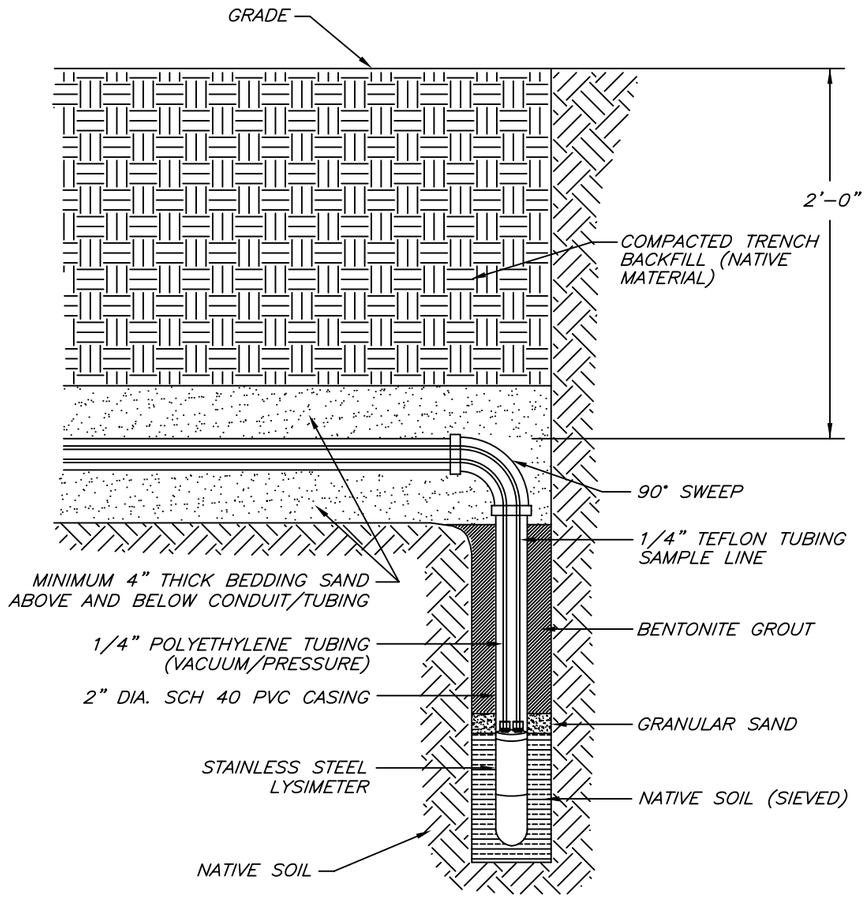
REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	03/28/06

HICKORY BASIN

DRAWING NO. A-3

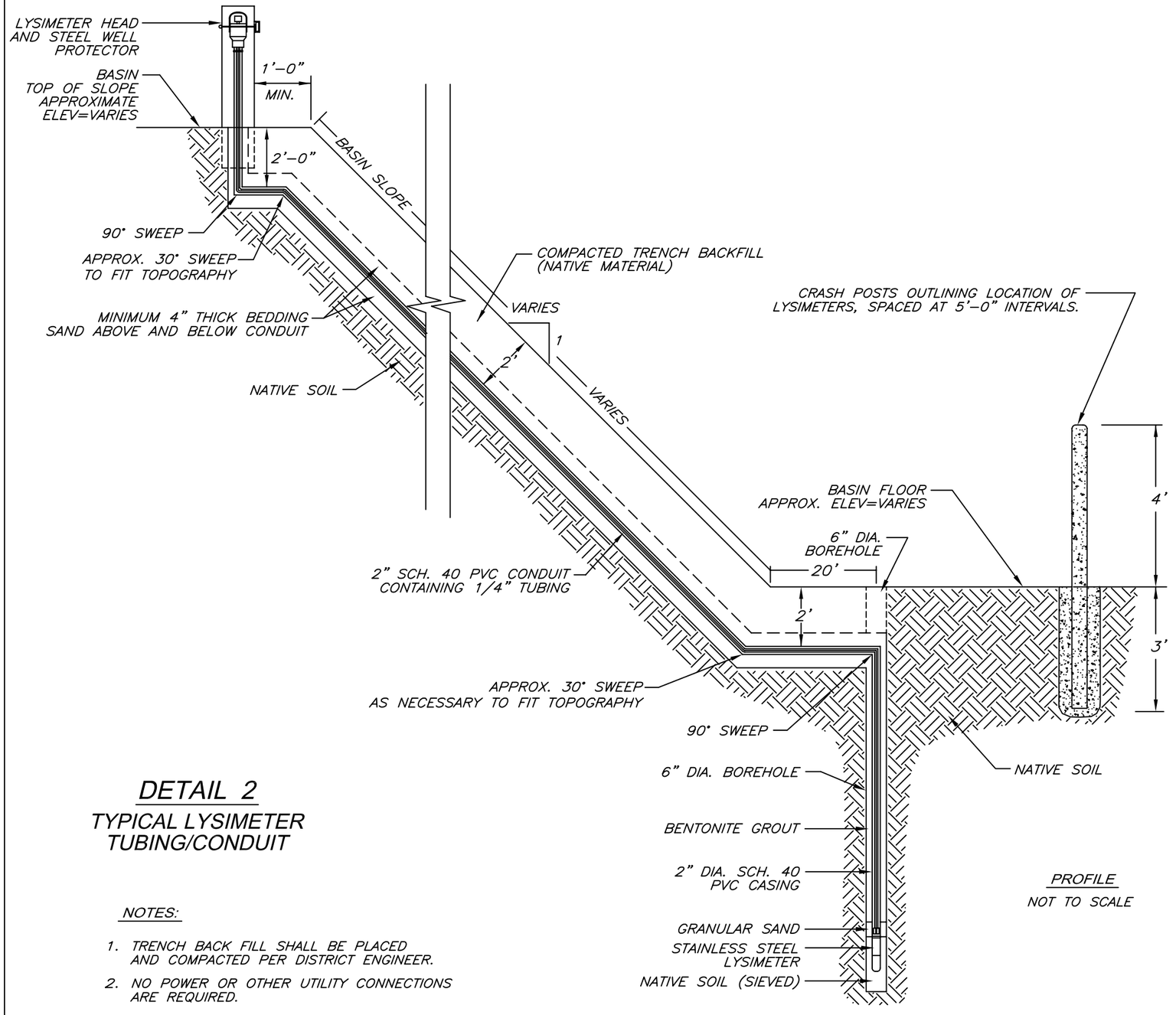
SHEET NO. 3 OF 5

A-3 HICKORY BASIN v02.dwg 5/5/2005 4:40 PM Bill Leever, Wildermuth Environmental, Inc.



DETAIL 1
TYPICAL LYSIMETER

PROFILE
NOT TO SCALE



DETAIL 2
TYPICAL LYSIMETER TUBING/CONDUIT

PROFILE
NOT TO SCALE

NOTES:

1. TRENCH BACK FILL SHALL BE PLACED AND COMPACTED PER DISTRICT ENGINEER.
2. NO POWER OR OTHER UTILITY CONNECTIONS ARE REQUIRED.

Underground Service Alert
Call: TOLL FREE 1–800 227–2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: | DRAWN: | CHECKED:

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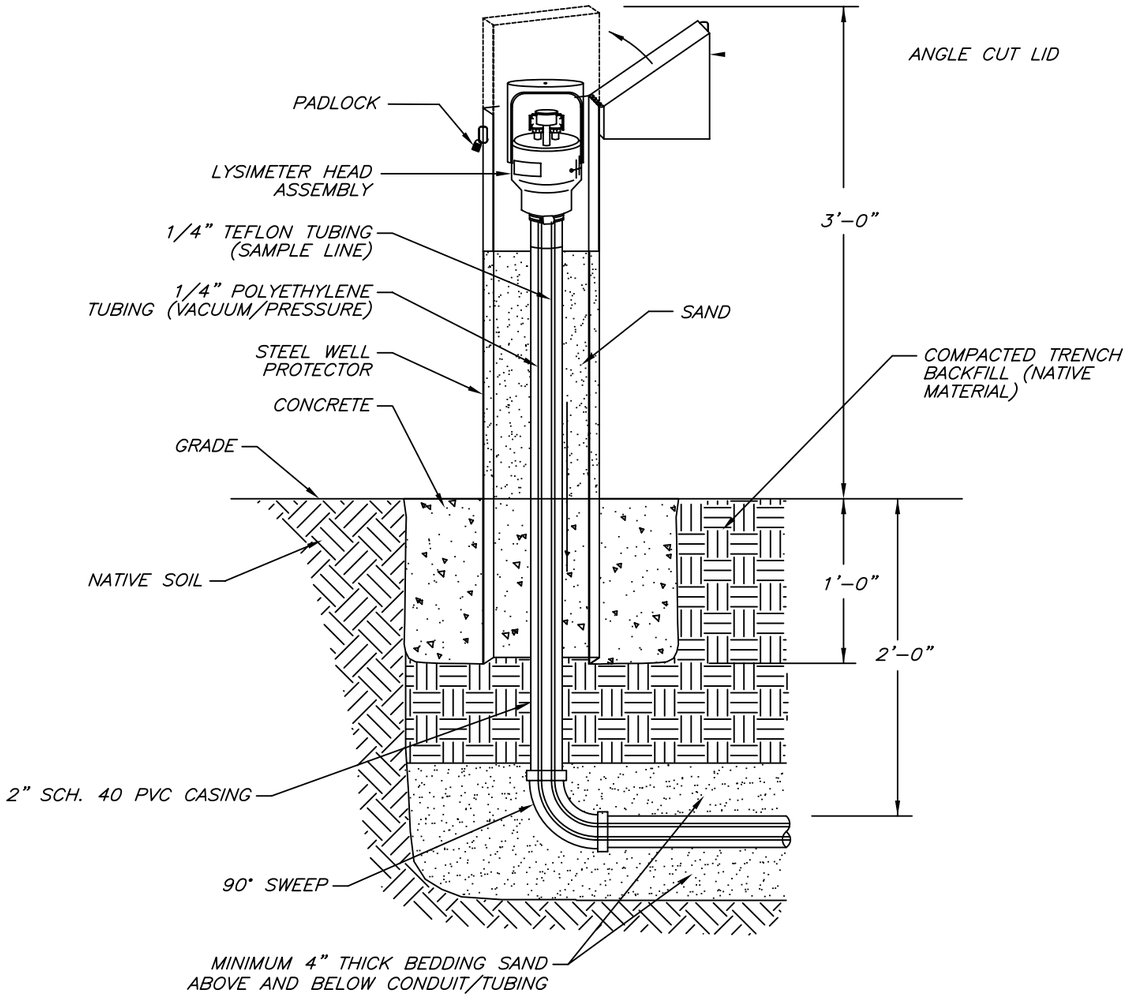
Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	03/28/06

AS-BUILT DETAILS 1 AND 2 BANANA AND HICKORY BASINS

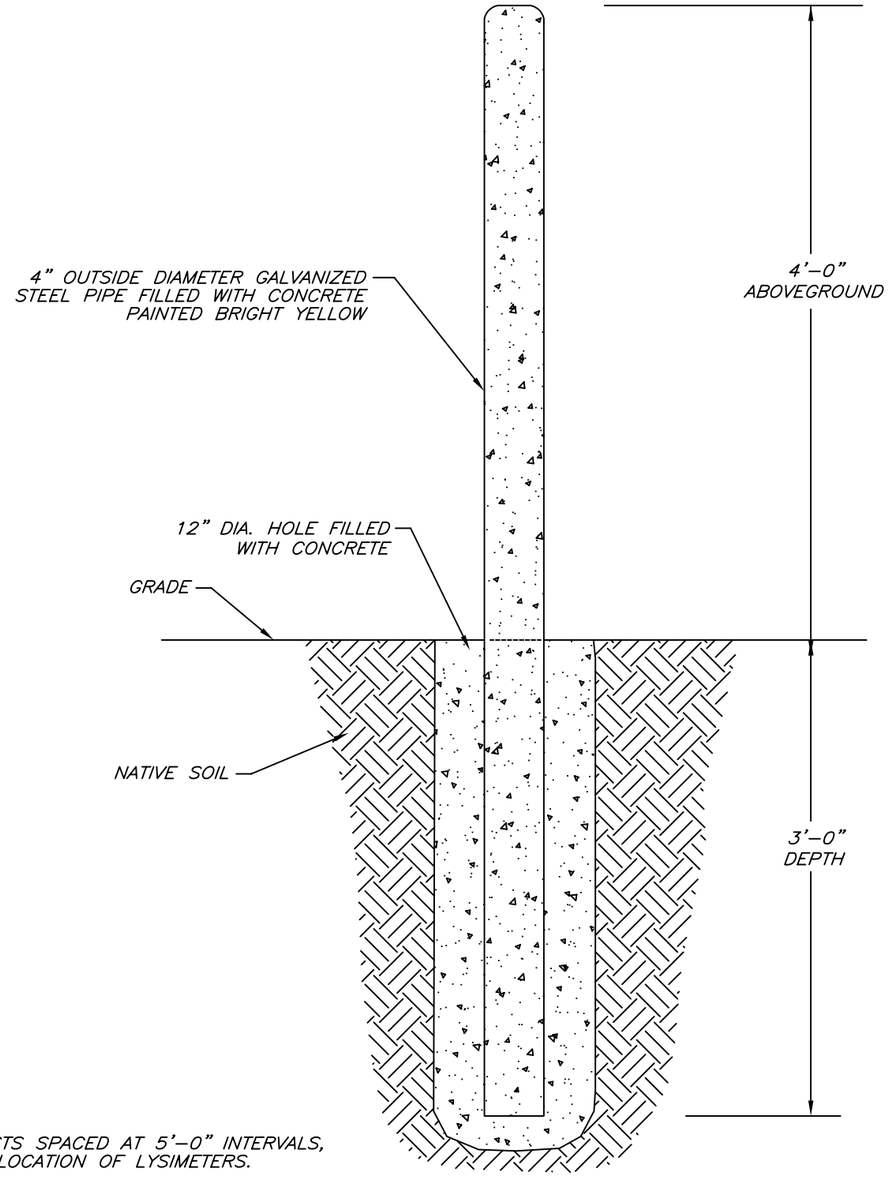
DRAWING NO. A–4

SHEET NO. 4 OF 5



PROFILE
NOT TO SCALE

DETAIL 3
TYPICAL STEEL WELL PROTECTOR AND LYSIMETER HEAD ASSEMBLY



NOTES:
CRASH POSTS SPACED AT 5'-0" INTERVALS, OUTLINING LOCATION OF LYSIMETERS.

PROFILE
NOT TO SCALE

DETAIL 4
TYPICAL CRASH POST

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: | DRAWN: | CHECKED:

WILDERMUTH ENVIRONMENTAL INC.
Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	03/28/06

AS-BUILT DETAILS 3 AND 4
BANANA AND HICKORY BASINS

DRAWING NO. A-5

SHEET NO. 5 OF 5

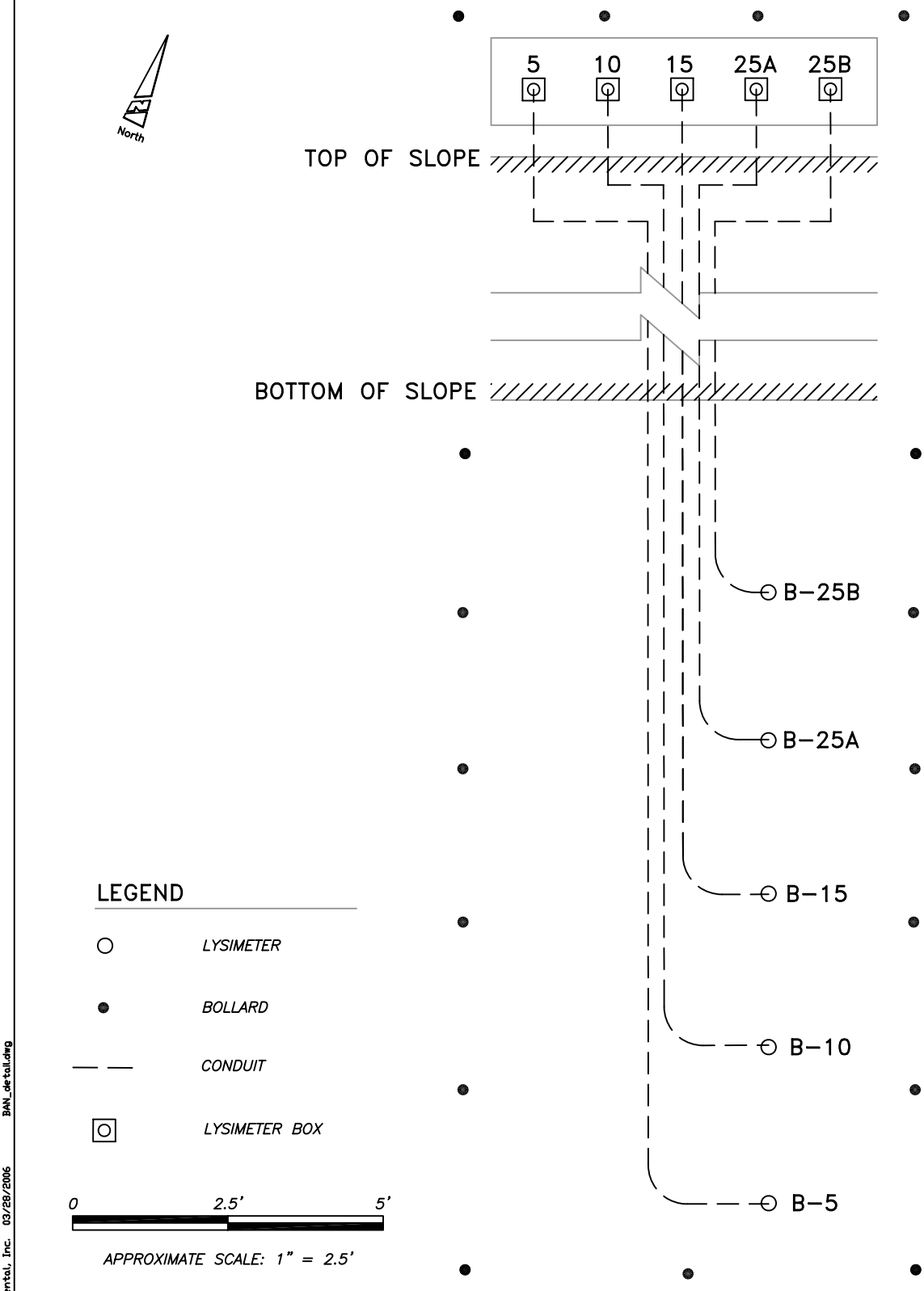


FIGURE A-6
BANANA BASIN LYSIMETER AS-BUILT

WILDERMUTH ENVIRONMENTAL INC.

Bill Leever, Wildermuth Environmental, Inc. 03/28/2006 BAN_detail.dwg

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

LYSIMETER: B-5

Date Started	6/7/05	Date Finished	6/7/05	Borehole Depth	5.5 feet	Drilling Contractor	Layne-Christensen Drilling
Lat.	34° 5' 42.23"	Long.	117° 29' 53.57"	Drill Bit Size/Type	8.25" Dia./Hollow Stem Bit	Driller	Armando Zimora
Ground Surface Elevation	1135.0 feet			Porous Interval	4.6-5 ft_bgs	Drill Rig Type	CME-75
Top of Casing Elevation	NA			Depth to Groundwater	Not Encountered	Drilling Method	Hollow Stem Auger
Logged By	B. Leever, PG, CHG			Reviewed By	A. Malone	Sampling Method	Split Spoon

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
1135	0			SAND (SP): brown, moist, very fine to fine sand with some silt	Sch. 40 PVC Conduit (1.9")	
					Bentonite Chips	
					No. 60 Transition Sand	
1130	5				Lysimeter Body (500 mL)	Sampled at 10:22 am. Blow Counts: 16/42/43
					10-mesh Native Sand	
				Bottom of boring at 5.5 feet below grade.	Lysimeter Porous Tip	
1125	10					
1120	15					
1115	20					
1110	25					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/28/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**	**LYSIMETER: B-10**	
Project Location:	**Chino Basin, California**		
Project Number:	**007-003**	Sheet 1 of 1	
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**		

Date Started	**6/7/05**	Date Finished	**6/7/05**	Borehole Depth	**10.5 feet**	Drilling Contractor	**Layne-Christensen Drilling**
Lat.	**34° 5' 42.23"**	Long.	**117° 29' 53.57"**	Drill Bit Size/Type	**8.25" Dia./Hollow Stem Bit**	Driller	**Armando Zimora**
Ground Surface Elevation	**1135.0 feet**			Porous Interval	**9.6-10 ft_bgs**	Drill Rig Type	**CME-75**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**B. Leever, PG, CHG**			Reviewed By	**A. Malone**	Sampling Method	**Split Spoon**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
1135	0			SAND (SP): brown, moist, very fine to fine sand with some silt		
					Bentonite Chips	
					Sch. 40 PVC Conduit (1.9")	Sampled at 10:22 am. Blow Counts: 16/42/43
1130	5			SAND and GRAVEL (SP-GW): brown, moist, fine to coarse sand with gravel to 3 inches diameter		
					No. 60 Transition Sand	
					Lysimeter Body (500 mL)	
					10-mesh Native Sand	Sampled at 10:33 am. Blow Counts: 19/47/50
1125	10				Lysimeter Porous Tip	
				Bottom of boring at 10.5 feet below grade.		
1120	15					
1115	20					
1110	25					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/28/2006

WILDERMUTH™
ENVIRONMENTAL INC.

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

LYSIMETER: B-15

Date Started	6/7/05	Date Finished	6/7/05	Borehole Depth	15.5 feet	Drilling Contractor	Layne-Christensen Drilling
Lat.	34° 5' 42.23"	Long.	117° 29' 53.57"	Drill Bit Size/Type	8.25" Dia./Hollow Stem Bit	Driller	Armando Zimora
Ground Surface Elevation	1135.0 feet			Porous Interval	14.6-15 ft_bgs	Drill Rig Type	CME-75
Top of Casing Elevation	NA			Depth to Groundwater	Not Encountered	Drilling Method	Hollow Stem Auger
Logged By	B. Leever, PG, CHG			Reviewed By	A. Malone	Sampling Method	Split Spoon

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
1135	0			SAND (SP): brown, moist, very fine to fine sand with some silt	Bentonite Chips; Sch. 40 PVC Conduit (1.9")	Sampled at 10:22 am. Blow Counts: 16/42/43
1130	5			SAND and GRAVEL (SP-GW): brown, moist, fine to coarse sand with gravel to 3 inches diameter		
1125	10			same as above with little gravel to 2 inches diameter	No. 60 Transition Sand; Lysimeter Body (500 mL); 10-mesh Native Sand; Lysimeter Porous Tip	Sampled at 10:33 am. Blow Counts: 19/47/50
1120	15			Bottom of boring at 15.5 feet below grade.		Sampled at 10:44 am. Blow Counts: 12/16/19
1115	20					
1110	25					

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**	**LYSIMETER: B-25A**
Project Location:	**Chino Basin, California**	
Project Number:	**007-003**	Sheet 1 of 1
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**	

Date Started	**6/7/05**	Date Finished	**6/7/05**	Borehole Depth	**25.5 feet**	Drilling Contractor	**Layne-Christensen Drilling**
Lat.	**34° 5' 42.23"**	Long.	**117° 29' 53.57"**	Drill Bit Size/Type	**8.25" Dia./Hollow Stem Bit**	Driller	**Armando Zimora**
Ground Surface Elevation	**1135.0 feet**			Porous Interval	**24.6-25 ft_bgs**	Drill Rig Type	**CME-75**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**B. Leever, PG, CHG**			Reviewed By	**A. Malone**	Sampling Method	**Split Spoon**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
1135	0			SAND (SP): brown, moist, very fine to fine sand with some silt		
					Bentonite Chips	
					Sch. 40 PVC Conduit (1.9")	Sampled at 10:22 am. Blow Counts: 16/42/43
1130	5			SAND and GRAVEL (SP-GW): brown, moist, fine to coarse sand with gravel to 3 inches diameter		
						Sampled at 10:33 am. Blow Counts: 19/47/50
1125	10			same as above with little gravel to 2 inches diameter		
						Sampled at 10:44 am. Blow Counts: 12/16/19
1120	15			same as above with little gravel to 2 inches diameter		
						Sampled at 10:53 am. Blow Counts: 30/43/43
1115	20			same as above with little gravel to 0.5 inches diameter		
					No. 60 Transition Sand	
					Lysimeter Body (1000 mL)	
					10-mesh Native Sand	Sampled at 11:08 am. Blow Counts: 21/27/33
1110	25				Lysimeter Porous Tip	
				Bottom of boring at 25.5 feet below grade.		

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/28/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**	**LYSIMETER: B-25B**	
Project Location:	**Chino Basin, California**		
Project Number:	**007-003**	Sheet 1 of 1	
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**		

Date Started	**6/7/05**	Date Finished	**6/7/05**	Borehole Depth	**25.5 feet**	Drilling Contractor	**Layne-Christensen Drilling**
Lat.	**34° 5' 42.23"**	Long.	**117° 29' 53.57"**	Drill Bit Size/Type	**8.25" Dia./Hollow Stem Bit**	Driller	**Armando Zimora**
Ground Surface Elevation	**1135.0 feet**			Porous Interval	**24.6-25 ft_bgs**	Drill Rig Type	**CME-75**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**B. Leever, PG, CHG**			Reviewed By	**A. Malone**	Sampling Method	**Split Spoon**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
1135	0			SAND (SP): brown, moist, very fine to fine sand with some silt	Bentonite Chips Sch. 40 PVC Conduit (1.9")	
1130	5			SAND and GRAVEL (SP-GW): brown, moist, fine to coarse sand with gravel to 3 inches diameter		Sampled at 10:22 am. Blow Counts: 16/42/43
1125	10			same as above with little gravel to 2 inches diameter		Sampled at 10:33 am. Blow Counts: 19/47/50
1120	15			same as above with little gravel to 2 inches diameter		Sampled at 10:44 am. Blow Counts: 12/16/19
1115	20			same as above with little gravel to 0.5 inches diameter	No. 60 Transition Sand Lysimeter Body (1000 mL) 10-mesh Native Sand Lysimeter Porous Tip	Sampled at 10:53 am. Blow Counts: 30/43/43
1110	25			Bottom of boring at 25.5 feet below grade.		Sampled at 11:08 am. Blow Counts: 21/27/33

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/28/2006

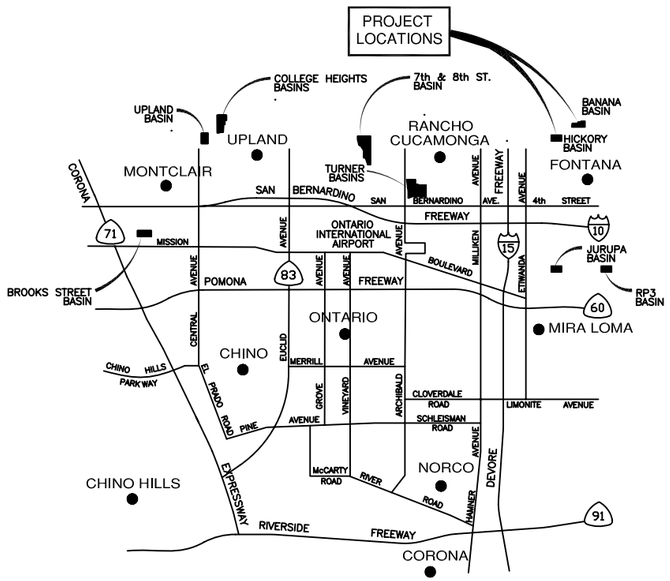
WILDERMUTH ENVIRONMENTAL INC.

AS-BUILTS OF THE

HICKORY AND BANANA BASIN LYSIMETER INSTALLATION

PROJECT NO.: 007-002-062

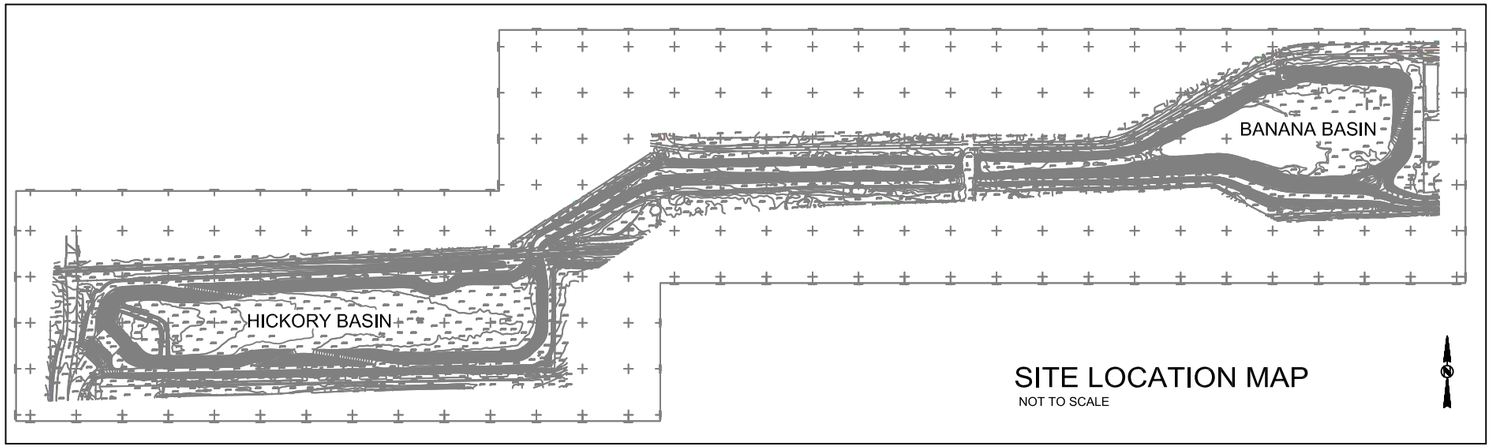
PREPARED FOR THE INLAND EMPIRE UTILITIES AGENCY
BY WILDERMUTH ENVIRONMENTAL, INC.



VICINITY MAP
NOT TO SCALE

LIST OF DRAWINGS		
DRAWING NO.	SHEET TITLE	SHEET NO.
	GENERAL	
A - 1	COVER SHEET	1 OF 5
A - 2	BANANA BASIN	2 OF 5
A - 3	HICKORY BASIN	3 OF 5
A - 4	AS-BUILT DETAILS 1 AND 2	4 OF 5
A - 5	AS-BUILT DETAILS 3 AND 4	5 OF 5

CONTACT PERSONNEL		
NAME	ADDRESS	PHONE NO.
ANDY CAMPBELL, PG, CHG	INLAND EMPIRE UTILITIES AGENCY 6075 KIMBALL AVENUE CHINO, CALIFORNIA 91710	(909) 993-1600
MARK WILDERMUTH, PE	WILDERMUTH ENVIRONMENTAL, INC. 23692 BIRTCHER DRIVE LAKE FOREST, CALIFORNIA 92630	(949) 420-3030
BILL LEEVER, PG, CHG	WILDERMUTH ENVIRONMENTAL, INC. 23692 BIRTCHER DRIVE LAKE FOREST, CALIFORNIA 92630	(949) 420-3030



SITE LOCATION MAP
NOT TO SCALE

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

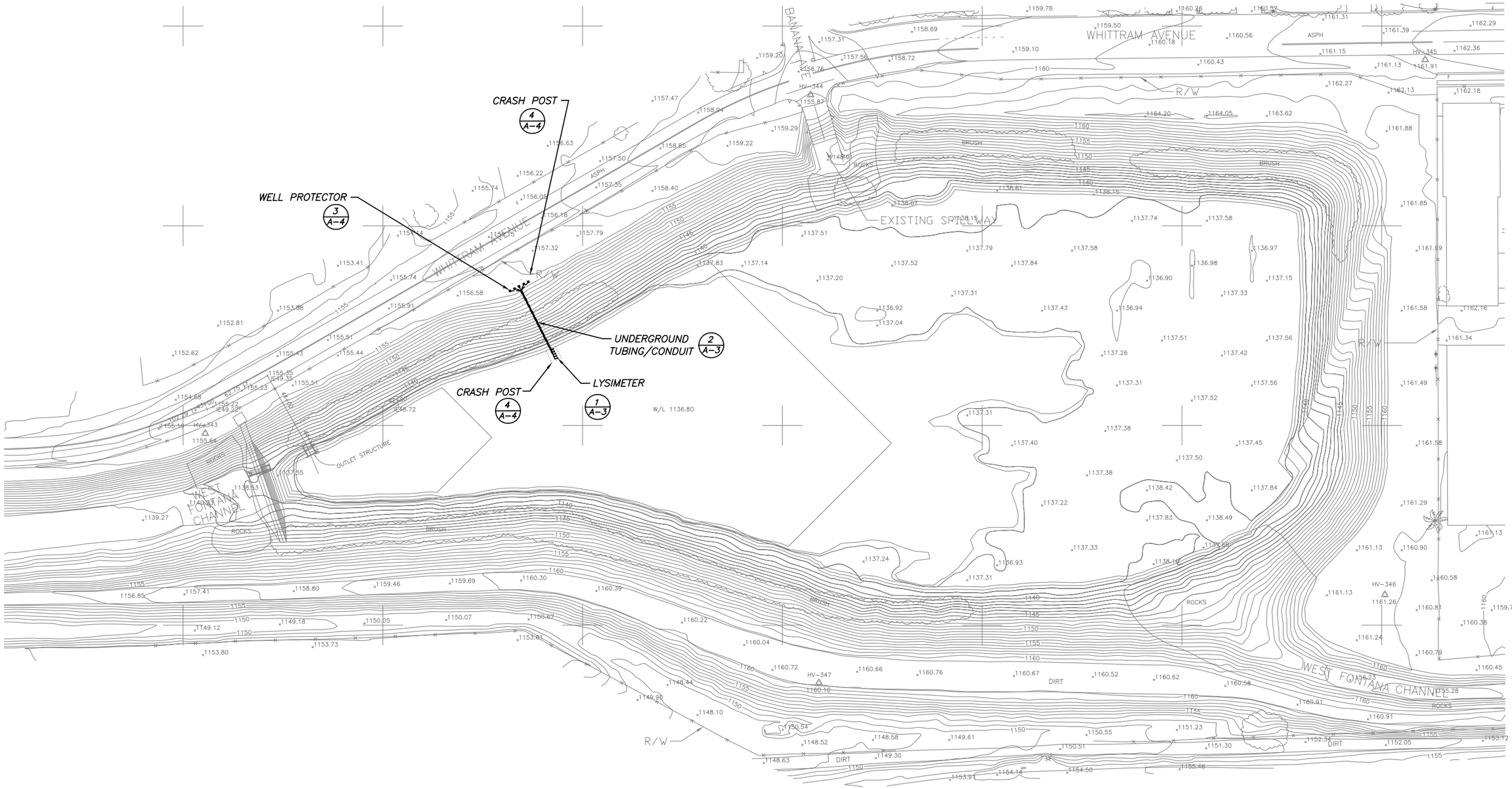
REVISIONS				
NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE
DESIGNED:		DRAWN:	CHECKED:	

WILDERMUTH ENVIRONMENTAL INC.
Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:	DRAWING NO.
AEM	WEL	03/28/06	A-1

COVER SHEET

SHEET NO. 1 OF 5



0 100' 200'

Scale: 1" = 100 FEET

North

Underground Service Alert

Call: TOLL FREE 1-800 227-2600

TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: DRAWN: CHECKED:

WILDERMUTH ENVIRONMENTAL INC.

Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	03/28/06

BANANA BASIN

DRAWING NO. A-2

SHEET NO. 2 OF 5

WEST CELL

EAST CELL

LYSIMETER 1 A-3

CRASH POST 4 A-4

UNDERGROUND TUBING/CONDUIT 2 A-3

WELL PROTECTOR 3 A-4

E 6,709,200 E 6,709,400 E 6,709,600 E 6,709,800 E 6,710,000 E 6,710,200 E 6,710,400 E 6,710,600

0 100' 200'

Scale: 1" = 100 FEET

North

Underground Service Alert

Call: TOLL FREE 1-800 227-2600

TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: DRAWN: CHECKED:

WILDERMUTH ENVIRONMENTAL INC.

Inland Empire UTILITIES AGENCY

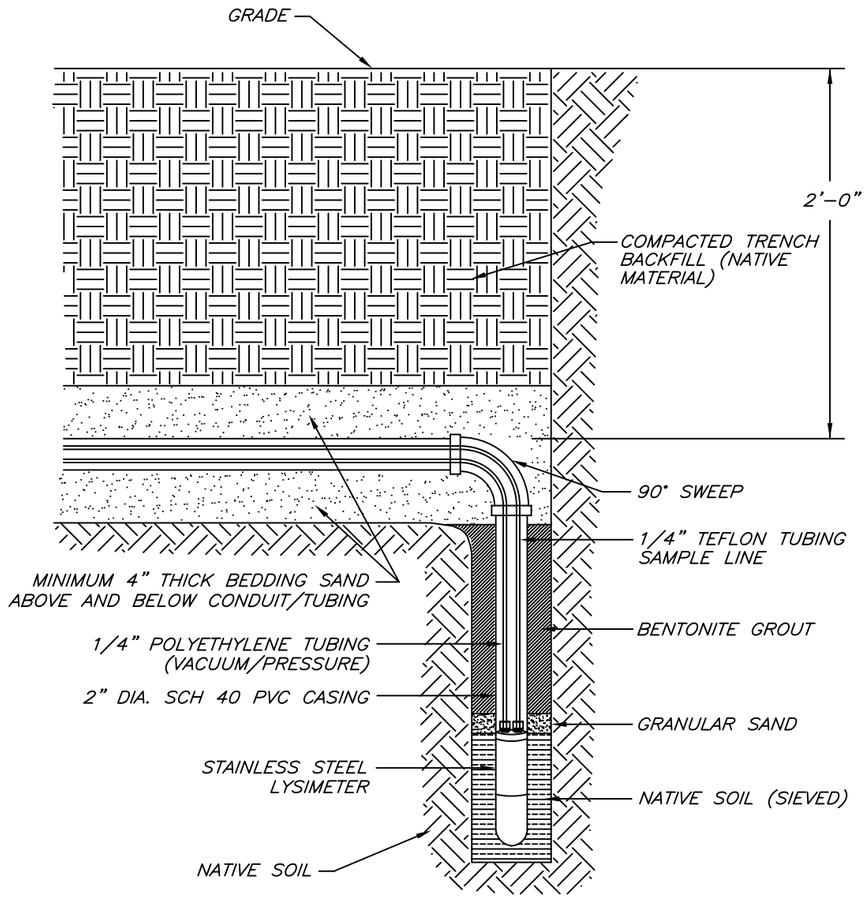
REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	03/28/06

HICKORY BASIN

DRAWING NO. A-3

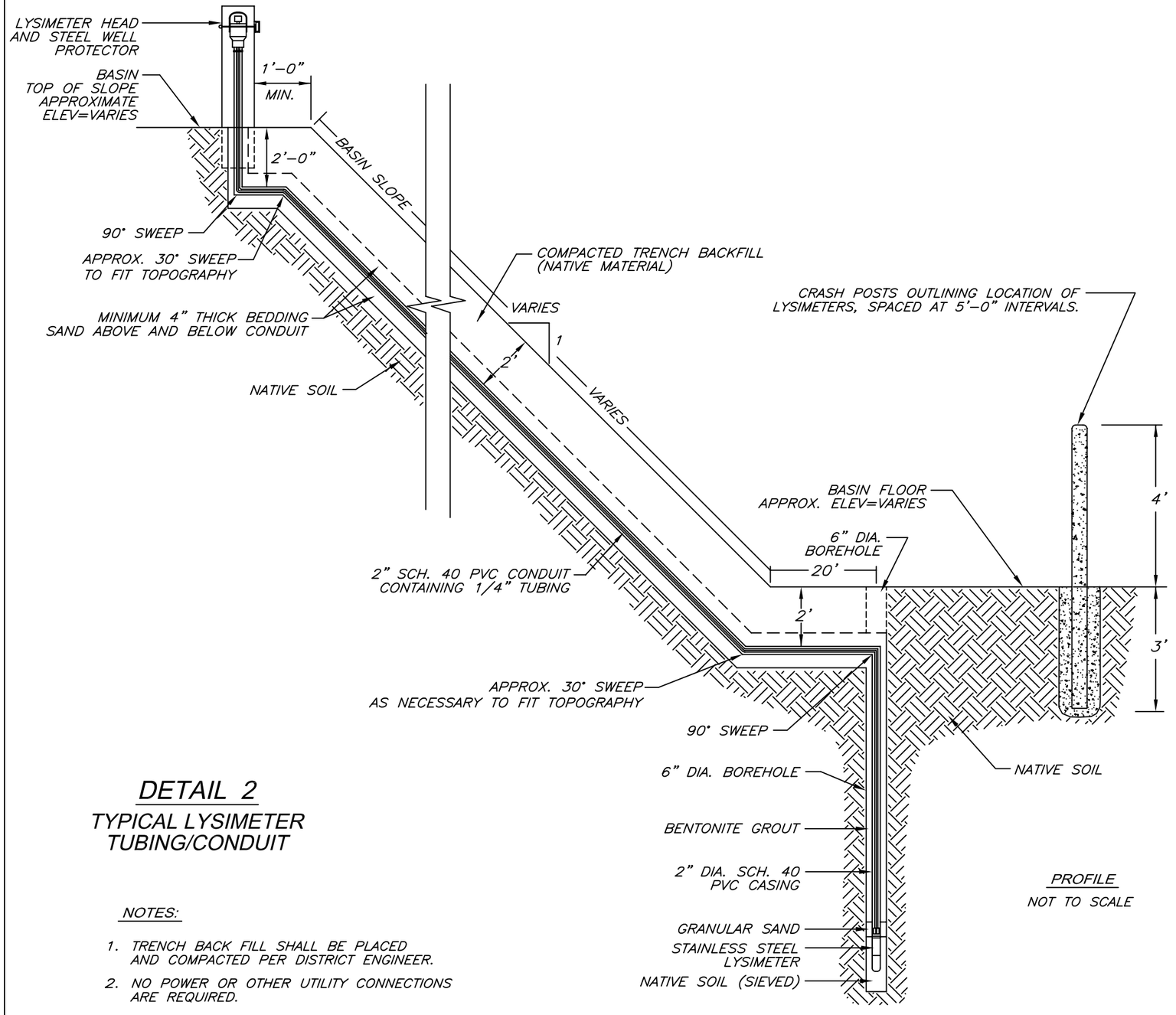
SHEET NO. 3 OF 5

A-3 HICKORY BASIN v02.dwg 5/5/2005 4:40 PM Bill Leever, Wildermuth Environmental, Inc.



DETAIL 1
TYPICAL LYSIMETER

PROFILE
NOT TO SCALE



DETAIL 2
TYPICAL LYSIMETER TUBING/CONDUIT

PROFILE
NOT TO SCALE

NOTES:

1. TRENCH BACK FILL SHALL BE PLACED AND COMPACTED PER DISTRICT ENGINEER.
2. NO POWER OR OTHER UTILITY CONNECTIONS ARE REQUIRED.

Underground Service Alert
Call: TOLL FREE 1–800 227–2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: | DRAWN: | CHECKED:

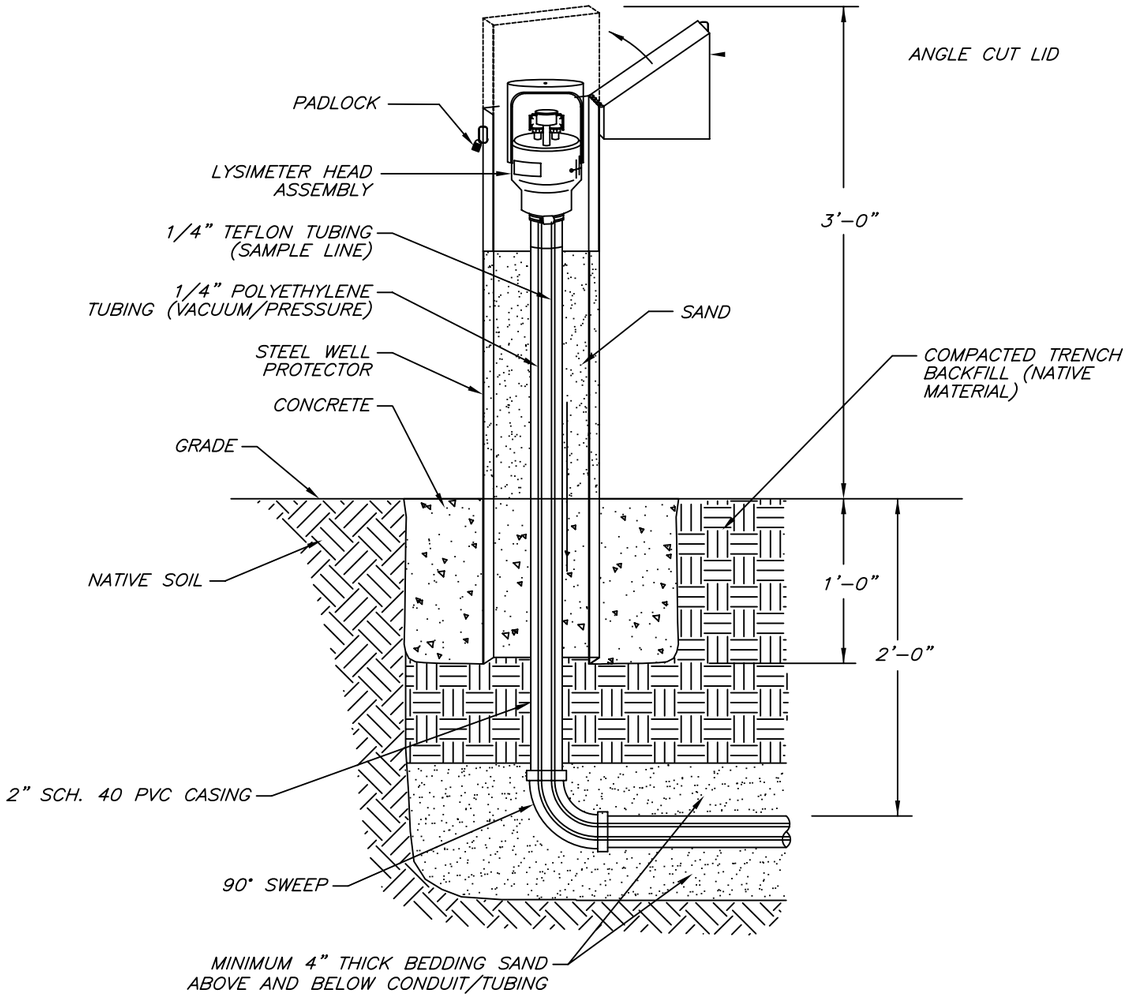
WILDERMUTH ENVIRONMENTAL INC.
Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	03/28/06

AS-BUILT DETAILS 1 AND 2 BANANA AND HICKORY BASINS

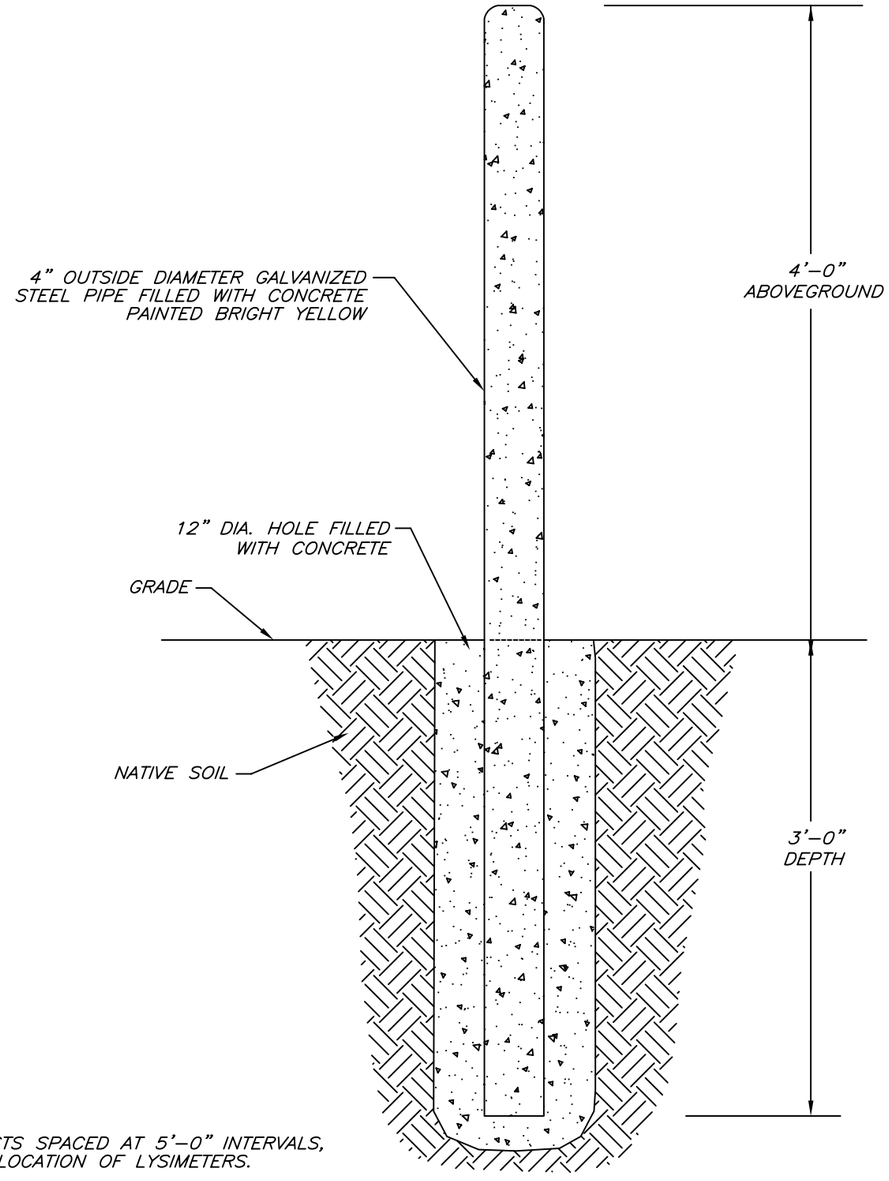
DRAWING NO. A–4

SHEET NO. 4 OF 5



PROFILE
NOT TO SCALE

DETAIL 3
TYPICAL STEEL WELL PROTECTOR AND LYSIMETER HEAD ASSEMBLY



NOTES:
CRASH POSTS SPACED AT 5'-0" INTERVALS, OUTLINING LOCATION OF LYSIMETERS.

PROFILE
NOT TO SCALE

DETAIL 4
TYPICAL CRASH POST

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: | DRAWN: | CHECKED:

WILDERMUTH ENVIRONMENTAL INC.
Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	03/28/06

AS-BUILT DETAILS 3 AND 4
BANANA AND HICKORY BASINS

DRAWING NO. A-5

SHEET NO. 5 OF 5

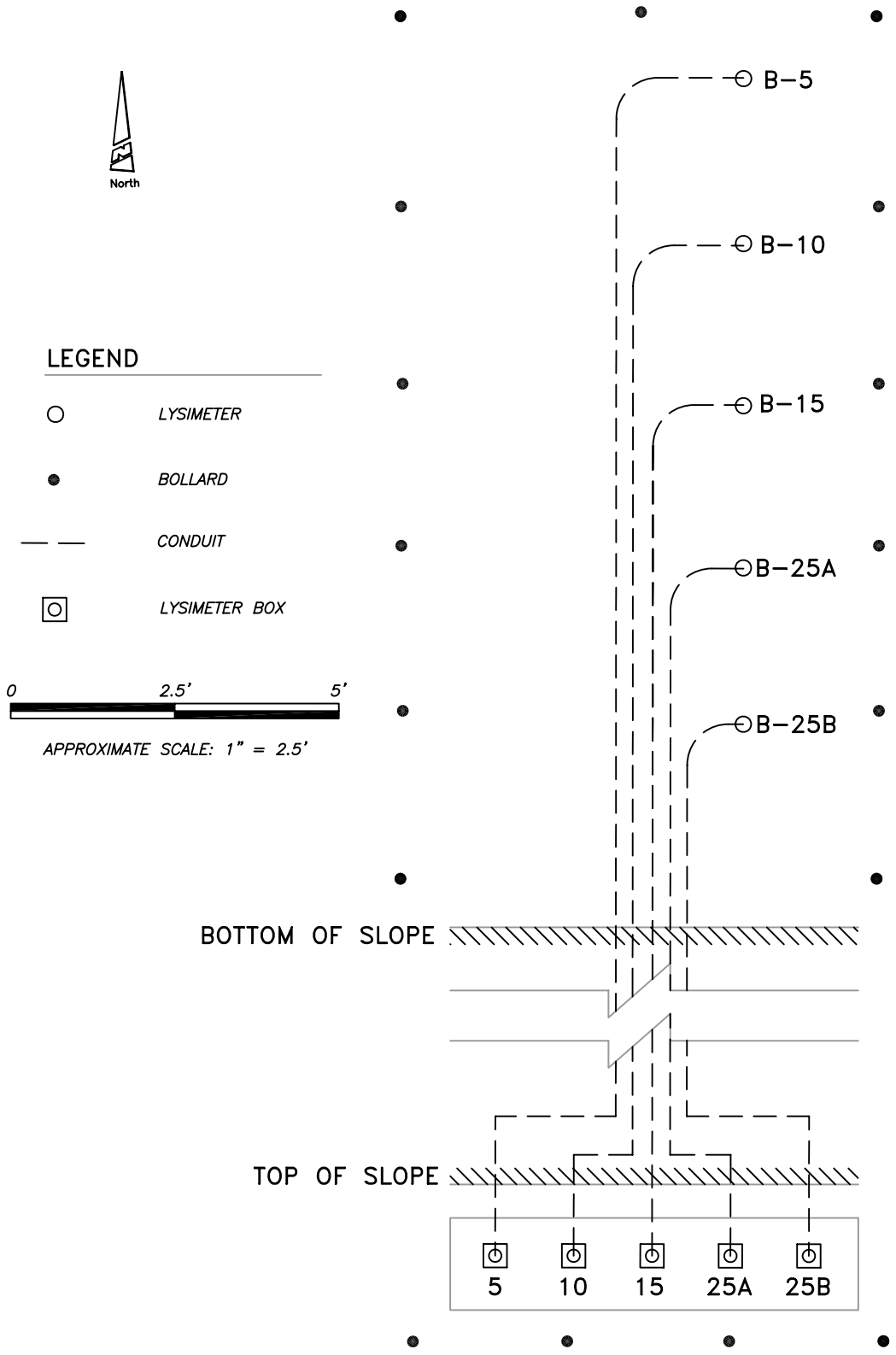


FIGURE A-6
HICKORY BASIN EAST LYSIMETER AS-BUILT

WILDERMUTH ENVIRONMENTAL INC.

Bill Leever, Wildermuth Environmental, Inc. 04/03/2006 he_detail.dwg

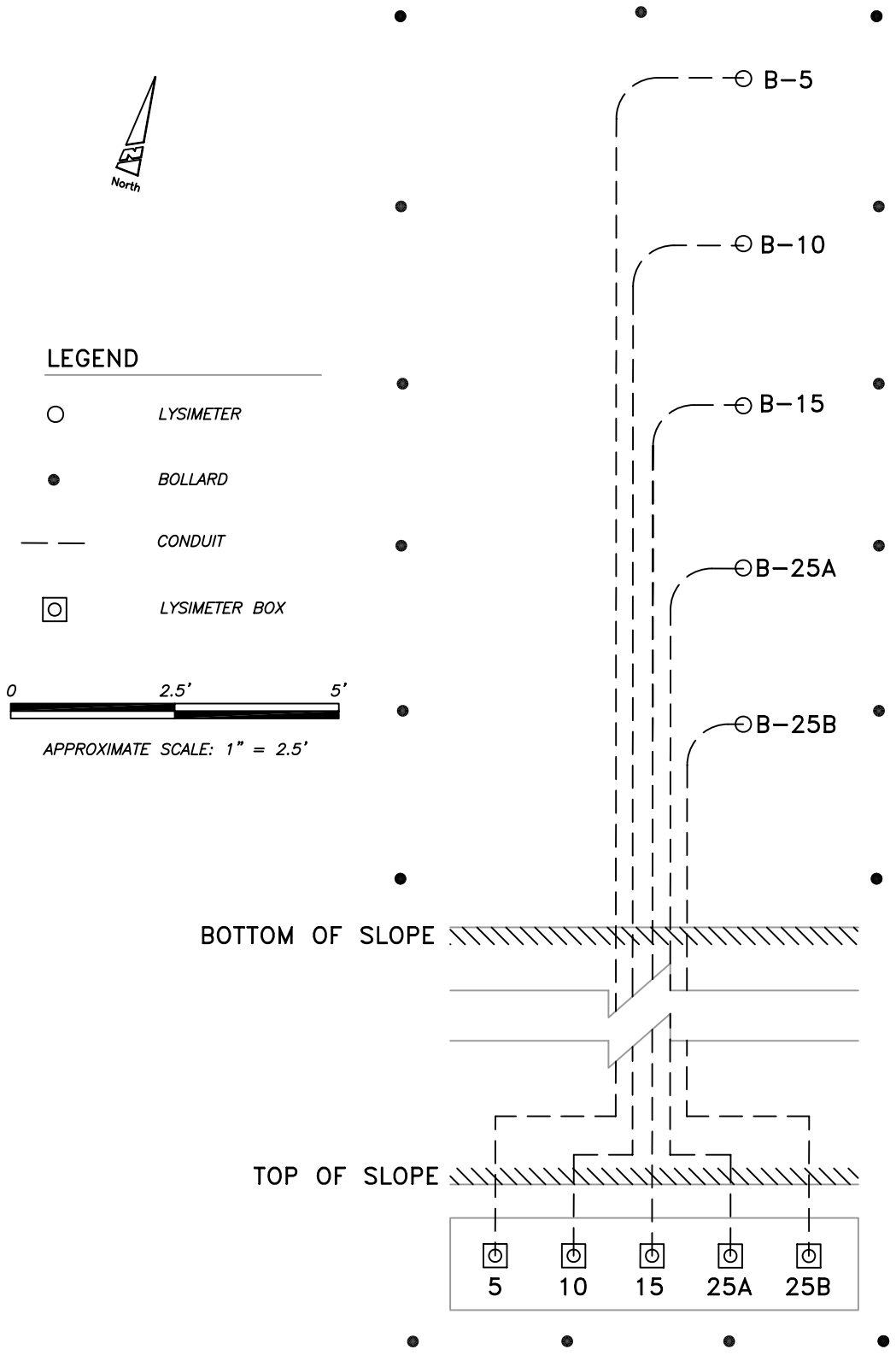


FIGURE A-7
HICKORY BASIN WEST LYSIMETER AS-BUILT

WILDERMUTH ENVIRONMENTAL INC.

Bill Leever, Wildermuth Environmental, Inc. 04/03/2006 hw_detail.dwg

Project Name:	**Recycled Water Groundwater Recharge Project**	**LYSIMETER: HE-05**
Project Location:	**Chino Basin, California**	
Project Number:	**007-003**	Sheet 1 of 1
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**	

Date Started	**5/5/05**	Date Finished	**5/5/05**	Borehole Depth	**5.5 feet**	Drilling Contractor	**Gregg Drilling**
Lat.	**34° 5' 31.2"**	Long.	**117° 30' 34.35"**	Drill Bit Size/Type	**6" Dia./Hollow Stem Bit**	Driller	**Greg**
Ground Surface Elevation	**1134.0 feet**			Porous Interval	**4.6-5 ft_bgs**	Drill Rig Type	**Marl 5T**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**F. LaValle**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Split Spoon**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			SAND (SW): dark brown, moist, fine to coarse sand with some fine gravel		
1130	5				Sch. 40 PVC (1.9") Bentonite Chips No. 60 Transition Sand Lysimeter Body (500 mL) 10-mesh Native Sand Lysimeter Porous Tip	
1125	10					
1120	15					
1115	20					
1110	25					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/30/2006

WILDERMUTH™ ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

LYSIMETER: HE-10

Sheet 1 of 1

Date Started	**5/5/05**	Date Finished	**5/5/05**	Borehole Depth	**10.5 feet**	Drilling Contractor	**Gregg Drilling**
Lat.	**34° 5' 31.2"**	Long.	**117° 30' 34.35"**	Drill Bit Size/Type	**6" Dia./Hollow Stem Bit**	Driller	**Greg**
Ground Surface Elevation	**1134.0 feet**			Porous Interval	**4.6-5 ft_bgs**	Drill Rig Type	**Marl 5T**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**F. LaValle**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Split Spoon**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			SAND (SW): dark brown, moist, fine to coarse sand with some fine gravel		
1130	5			Gravelly SAND (SW-GW): light grayish brown, moist, fine to coarse sand with gravel	Bentonite Chips Sch. 40 PVC Conduit (1.9") No. 60 Transition Sand Lysimeter Body (500 mL) 10-mesh Native Sand Lysimeter Porous Tip	
1125	10					
1120	15					
1115	20					
1110	25					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/30/2006

WILDERMUTH™ ENVIRONMENTAL INC.

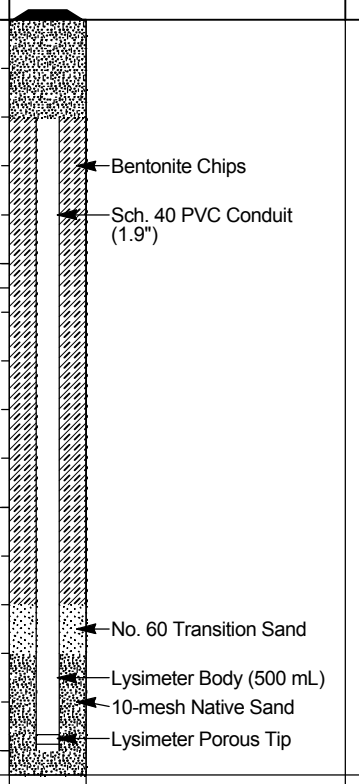
Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

LYSIMETER: HE-15

Sheet 1 of 1

Date Started	**5/5/05**	Date Finished	**5/5/05**	Borehole Depth	**15.5 feet**	Drilling Contractor	**Gregg Drilling**
Lat.	**34° 5' 31.2"**	Long.	**117° 30' 34.35"**	Drill Bit Size/Type	**6" Dia./Hollow Stem Bit**	Driller	**Greg**
Ground Surface Elevation	**1134.0 feet**			Porous Interval	**4.6-5 ft_bgs**	Drill Rig Type	**Marl 5T**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**F. LaValle**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Split Spoon**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			SAND (SW): dark brown, moist, fine to coarse sand with some fine gravel		
1130	5			Gravelly SAND (SW-GW): light grayish brown, moist, fine to coarse sand with gravel		
1125	10					
1120	15			same as above		
1115	20					
1110	25					



Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/30/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**	**LYSIMETER: HE-25A**	
Project Location:	**Chino Basin, California**		
Project Number:	**007-003**	Sheet 1 of 1	
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**		

Date Started	**5/4/05**	Date Finished	**5/4/05**	Borehole Depth	**25.5 feet**	Drilling Contractor	**Gregg Drilling**
Lat.	**34° 5' 31.2"**	Long.	**117° 30' 34.35"**	Drill Bit Size/Type	**6" Dia./Hollow Stem Bit**	Driller	**Greg**
Ground Surface Elevation	**1134.0 feet**			Porous Interval	**4.6-5 ft_bgs**	Drill Rig Type	**Marl 5T**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**F. LaValle**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Split Spoon**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			SAND (SW): dark brown, moist, fine to coarse sand with some fine gravel		
1130	5			Gravelly SAND (SW-GW): light grayish brown, moist, fine to coarse sand with gravel	Bentonite Chips Sch. 40 PVC Conduit (1.9")	
1125	10			same as above		
1120	15			same as above		
1115	20			same as above	No. 60 Transition Sand Lysimeter Body (1000 mL) 10-mesh Native Sand	
1110	25			same as above	Lysimeter Porous Tip	

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/30/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

LYSIMETER: HE-25B

Sheet 1 of 1

Date Started	5/4/05	Date Finished	5/4/05	Borehole Depth	25.5 feet	Drilling Contractor	Gregg Drilling
Lat.	34° 5' 31.2"	Long.	117° 30' 34.35"	Drill Bit Size/Type	6" Dia./Hollow Stem Bit	Driller	Greg
Ground Surface Elevation	1134.0 feet			Porous Interval	4.6-5 ft_bgs	Drill Rig Type	Marl 5T
Top of Casing Elevation	NA			Depth to Groundwater	Not Encountered	Drilling Method	Hollow Stem Auger
Logged By	F. LaValle			Reviewed By	B. Leever, PG, CHG	Sampling Method	Split Spoon

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			SAND (SW): dark brown, moist, fine to coarse sand with some fine gravel		
1130	5			Gravelly SAND (SW-GW): light grayish brown, moist, fine to coarse sand with gravel	Bentonite Chips; Sch. 40 PVC Conduit (1.9")	
1125	10			same as above		
1120	15			same as above		
1115	20			same as above	No. 60 Transition Sand; Lysimeter Body (1000 mL); 10-mesh Native Sand	
1110	25			same as above	Lysimeter Porous Tip	

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/30/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

LYSIMETER: HW-5

Sheet 1 of 1

Date Started	5/6/05	Date Finished	5/6/05	Borehole Depth	5.5 feet	Drilling Contractor	Gregg Drilling
Lat.	34° 5' 31.11"	Long.	117° 30' 44.63"	Drill Bit Size/Type	6" Dia./Hollow Stem Bit	Driller	Greg
Ground Surface Elevation	1134.0 feet			Porous Interval	4.6-5 ft_bgs	Drill Rig Type	Marl 5T
Top of Casing Elevation	NA			Depth to Groundwater	Not Encountered	Drilling Method	Hollow Stem Auger
Logged By	F. LaValle			Reviewed By	B. Leever, PG, CHG	Sampling Method	Split Spoon

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Gravelly SAND (SW): grayish brown, moist, fine to coarse sand with fine to coarse gravel		
1130	5				Sch. 40 PVC Conduit (1.9")	
					Bentonite Chips	
					No. 60 Transition Sand	
					Lysimeter Body (500 mL)	
					10-mesh Native Sand	
					Lysimeter Porous Tip	
1125	10					
1120	15					
1115	20					
1110	25					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/30/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

LYSIMETER: HW-10

Sheet 1 of 1

Date Started	5/6/05	Date Finished	5/6/05	Borehole Depth	10.5 feet	Drilling Contractor	Gregg Drilling
Lat.	34° 5' 31.11"	Long.	117° 30' 44.63"	Drill Bit Size/Type	6" Dia./Hollow Stem Bit	Driller	Greg
Ground Surface Elevation	1134.0 feet			Porous Interval	4.6-5 ft_bgs	Drill Rig Type	Marl 5T
Top of Casing Elevation	NA			Depth to Groundwater	Not Encountered	Drilling Method	Hollow Stem Auger
Logged By	F. LaValle			Reviewed By	B. Leever, PG, CHG	Sampling Method	Split Spoon

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Gravelly SAND (SW): grayish brown, moist, fine to coarse sand with fine to coarse gravel		
1130	5			same as above	Bentonite Chips; Sch. 40 PVC Conduit (1.9")	
1125	10			same as above	No. 60 Transition Sand; Lysimeter Body (500 mL); 10-mesh Native Sand; Lysimeter Porous Tip	
1120	15					
1115	20					
1110	25					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/30/2006

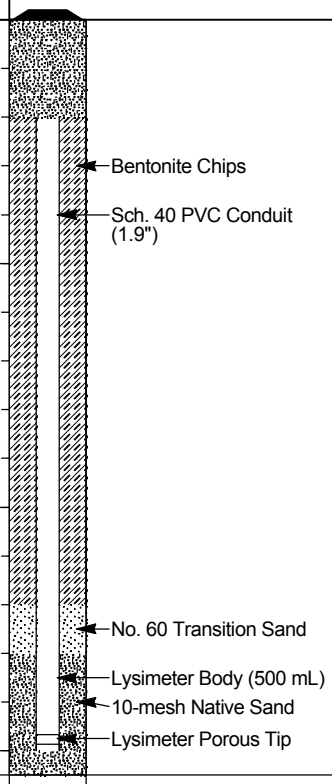
WILDERMUTH™ ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

LYSIMETER: HW-15

Date Started	**5/6/05**	Date Finished	**5/6/05**	Borehole Depth	**15.5 feet**	Drilling Contractor	**Gregg Drilling**
Lat.	**34° 5' 31.11"**	Long.	**117° 30' 44.63"**	Drill Bit Size/Type	**6" Dia./Hollow Stem Bit**	Driller	**Greg**
Ground Surface Elevation	**1134.0 feet**			Porous Interval	**4.6-5 ft_bgs**	Drill Rig Type	**Marl 5T**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**F. LaValle**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Split Spoon**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Gravelly SAND (SW): grayish brown, moist, fine to coarse sand with fine to coarse gravel		
1130	5			same as above		
1125	10			same as above		
1120	15			same as above		
1115	20					
1110	25					



Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/30/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

LYSIMETER: HW-25A

Sheet 1 of 1

Date Started	5/5/05	Date Finished	5/5/05	Borehole Depth	25.5 feet	Drilling Contractor	Gregg Drilling
Lat.	34° 5' 31.11"	Long.	117° 30' 44.63"	Drill Bit Size/Type	6" Dia./Hollow Stem Bit	Driller	Greg
Ground Surface Elevation	1134.0 feet			Porous Interval	4.6-5 ft_bgs	Drill Rig Type	Marl 5T
Top of Casing Elevation	NA			Depth to Groundwater	Not Encountered	Drilling Method	Hollow Stem Auger
Logged By	F. LaValle			Reviewed By	B. Leever, PG, CHG	Sampling Method	Split Spoon

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Gravelly SAND (SW): grayish brown, moist, fine to coarse sand with fine to coarse gravel		
1130	5			same as above	Bentonite Chips; Sch. 40 PVC Conduit (1.9")	
1125	10			same as above		
1120	15			same as above		
1115	20			same as above		
1110	25			same as above	No. 60 Transition Sand; Lysimeter Body (1000 mL); 10-mesh Native Sand; Lysimeter Porous Tip	

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/30/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**	**LYSIMETER: HW-25B**
Project Location:	**Chino Basin, California**	
Project Number:	**007-003**	Sheet 1 of 1
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**	

Date Started	**5/6/05**	Date Finished	**5/6/05**	Borehole Depth	**25.5 feet**	Drilling Contractor	**Gregg Drilling**
Lat.	**34° 5' 31.11"**	Long.	**117° 30' 44.63"**	Drill Bit Size/Type	**6" Dia./Hollow Stem Bit**	Driller	**Greg**
Ground Surface Elevation	**1134.0 feet**			Porous Interval	**4.6-5 ft_bgs**	Drill Rig Type	**Marl 5T**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**F. LaValle**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Split Spoon**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Gravelly SAND (SW): grayish brown, moist, fine to coarse sand with fine to coarse gravel		
1130	5			same as above	Bentonite Chips; Sch. 40 PVC Conduit (1.9")	
1125	10			same as above		
1120	15			same as above		
1115	20			same as above		
1110	25			same as above	No. 60 Transition Sand; Lysimeter Body (1000 mL); 10-mesh Native Sand; Lysimeter Porous Tip	

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 3/30/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**	**Monitoring Well: BH-1**	
Project Location:	**Chino Basin, California**		
Project Number:	**007-003**	Sheet 1 of 15	
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**		

Date Started	**5/5/05**	Date Finished	**5/17/05**	Borehole Depth	**501.0 feet**	Drilling Contractor	**Layne-Christensen Drilling**
Lat.	**34° 5' 27.92"**	Long.	**117° 30' 48.29"**	Drill Bit Size/Type	**17.5-inch Tri-cone**	Driller	**Victor Olveda**
Ground Surface Elevation	**1115.0 feet**			Screened Interval(s)	**360-400, 430-470**	Drill Rig Type	**Ingersoll-Rand RO 300 Mud**
Top of Casing Elevation	**1113.0 feet**			Depth to Groundwater	**421.8/10/11/2005**	Drilling Method	**Flooded Reverse Circulation**
Logged By	**D. Bramwell, PG, CEG**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Grab**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
1115	0			SAND (SP): brown, moist, fine to medium sand, some silt, small pebble to cobble		
				SAND (SP): dark yellowish, dry, fine to medium sand, trace silt		
1110	5				Cement inside conductor casing (4-50 ft-bgs)	
				SAND (SW): yellowish brown, dry, fine to coarse sand, clean to trace silt, trace pebble (sub-angular		
				SAND (SP): dark yellowish brown, moist, fine to medium sand, some silt, trace sub-angular pebble gravel		
1105	10			Silty SAND (SM): dark yellowish brown, moist, fine to medium sand, trace sub-angular pebble gravel	**BH1/2**: 4" dia. Sch 10 SS casing (with stainless steel screen from 360-400 ft-bgs)	
				SAND (SW): dark yellowish brown, dry, fine to coarse sand, trace to some silt, pebble to boulder sub-angular grains		
1100	15			SAND & GRAVEL (SW/GW): grayish brown, dry, fine to coarse sand, pebble to boulder gravel, clean to trace silt, sub-angular clasts are igneous and mafics	**BH2/2**: 4" dia. Sch 10 SS casing (with stainless steel screen from 430-470 ft-bgs)	
				SAND (SP): yellowish brown, dry, fine to medium sand, some sub-angular pebble to cobble, clean to trace silt		
				SAND (SW): yellowish brown, moist, fine to coarse sand, pebble to cobble gravel, clasts are igneous and mafics		
1095	20			SAND & GRAVEL (SW/GW): yellowish brown dry to moist, fine to coarse sand, pebble to cobble gravel, clasts are sub-angular to sub-rounded igneous and mafics	17.5" nominal dia. borehole (50-501 ft)	
				grades dry		
1090	25					
				Gravelly SAND (SP): brown, dry, fine to medium sand, pebble to cobble/boulder, some silt, clasts are sub-angular to sub-rounded igneous and mafics		
1085	30			SAND & GRAVEL (GW/SW): yellowish brown, dry to moist, fine to coarse		

Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 5/1/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: BH-1

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
1085	30			sand, pebble to cobble/boulder, clean to trace silt, clasts are sub-rounded igneous to mafic boulder clasts		
1080	35					
				SILT (ML): olive (5Y,4/4) dry, some very fine sand		
1075	40			Clayey SAND (SC): dark yellowish brown (10YR,4/6) fine sand, some pebble gravel	Cement inside conductor casing (4-50 ft-bgs)	
				CLAY (CL): dark yellowish brown (10YR,4/6) dry to moist, trace fine sand		
				SAND (SP): dark yellowish brown (10YR,4/4) fine to medium sand, some silt/clay		
				SAND (SW): dark yellowish brown, (10YR) dry, fine to coarse sand, trace silt, trace pebble gravel		
1070	45			Clayey SAND (SC): yellowish brown, moist, fine to medium sand, trace pebble gravel		
				SAND (SP): dark yellowish brown, moist, fine to medium sand, some silt/clay, trace pebble gravel		
				Clayey SAND (SC): yellowish brown, moist, fine to medium sand, some silt and clay		
				SAND (SP): dark yellowish brown (10YR,4/4) fine to medium sand		
1065	50			grades trace fine pebble gravel		
1060	55				50% Benseal/50% No. 3 Sand (50-348 ft. bgs)	
				SAND (SW): yellowish brown (10YR,5/4) fine to coarse sand, trace silt, trace fine pebble gravel		
1055	60			grades dark yellowish brown (10YR,4/4)		
				SAND (SP): dark yellowish brown (10YR,4/4) fine to coarse sand, trace silt		
1050	65					

WILDERMUTH ENVIRONMENTAL INC.

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

Monitoring Well: BH-1

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
1050	65			trace clay balls grades trace fine pebble gravel, clay balls graded out		
1045	70			SAND (SW): grayish brown (10YR,5/2) fine to coarse sand, clean to trace silt, trace pebble gravel		
1040	75			CLAY (CL): dark yellowish brown (10YR,4/6) moist		
				SAND (SP): yellowish brown (10YR,5/4) fine to medium sand, trace silt, trace fine pebble gravel		
1035	80			grades dark yellowish brown, (10YR,3/6) grades black heavy mafics, fine sand size	← 50% Benseal/50% No. 3 Sand (50-348 ft. bgs)	
1030	85					
				SAND (SW): yellowish brown (10YR,5/6) fine to coarse sand, trace silt, trace fine pebble gravel		
1025	90			CLAY (CL): dark yellowish brown (10YR,4/4) moist, trace sand		
				SAND & GRAVEL (SW/GP): yellowish brown (10YR,5/4) fine to coarse sand, gravel is fine pebble, clasts are igneous, mafics and quartzite		
1020	95			SAND (SW): yellowish brown (10YR,5/4) fine to coarse sand, trace silt, black minerals common		
1015	100			SAND (SW/SM): reddish brown (5YR,4/3) fine to coarse sand, some silt, trace reddish brown clay balls (clay interbeds with sand) trace pebble gravel		

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: BH-1

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
1015	100					
				SAND (SW): dark yellowish brown (10YR.4/4) fine to coarse sand, trace silt, trace fine pebble gravel, trace reddish brown clay balls		
1010	105			SAND (SP): dark yellowish brown (10YR,4/4) fine to medium sand, some silt, trace pebble gravel, trace reddish brown clay balls		
1005	110					
				SAND (SW): dark yellowish brown (10YR,4/4) fine to coarse sand, trace silt, trace fine pebble gravel		
				SAND (SP): dark yellowish brown (10YR,4/4) fine to medium sand, trace silt, trace fine pebble gravel		
1000	115					
				grades trace dark yellowish brown (10YR,3/4) clay balls	← 50% Benseal/50% No. 3 Sand (50-348 ft. bgs)	
				CLAY (CL): dark yellowish brown (10YR,3/6) moist, trace fine sand		
995	120					
				SAND (SW): dark yellowish brown, (10YR,3/4) fine to coarse sand, pebble gravel, trace silt, clasts are igneous, mafics and quartzite		
				SAND (SP): dark yellowish brown (10YR,4/4) fine to medium sand, trace silt, trace pebble gravel		
990	125					
				SAND (SW): dark yellowish brown (10YR,4/4) fine to coarse sand, trace silt, trace pebble gravel, clasts are igneous, mafics and quartzite		
985	130					
				CLAY (CL): dark reddish brown (5YR,3/4), moist		
				SAND (SP): reddish brown (5YR,4/4) fine to medium sand, some silt		
980	135					

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: BH-1

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
980	135			grades dark yellowish brown (10YR,4/4) some reddish brown clay balls (interbedded with poorly graded sand)		
				clay balls graded out		
				grades brown (10YR,4/3) trace silt, trace fine pebble gravel		
975	140			SAND (SP): brown (10YR,4/3) fine to medium sand, clean to trace silt, trace fine pebble gravels, sand size dark minerals common		
970	145			SAND (SW): brown (10YR,4/3) fine to coarse sand, clean to trace silt, trace fine pebble gravel, fine sand sized dark minerals		
965	150			grades yellowish brown (10YR,5/4) and some silt/clay	◄ 50% Benseal/50% No. 3 Sand (50-348 ft. bgs)	
960	155			SAND (SW): reddish brown (5YR,4/3) fine to coarse sand, trace to some pebble gravel,		
				CLAY (CL): dark yellowish brown (5YR,3/4) moist, trace sand, firm		
955	160			SAND (SW): dark yellowish brown (10YR,4/4) fine to coarse sand, pebble gravel, trace silt clay, clasts are sub-angular, igneous, mafic and quartz		
950	165			CLAY (CL): dark yellowish brown (10YR,4/4) moist, trace sand		
				SAND (SP): dark yellowish brown (10YR,4/4) fine to medium sand, trace silt, trace fine pebble gravel		
945	170					

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: BH-1

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
945	170					
				SAND (SW): dark yellowish brown (10YR,4/4) fine to coarse sand, trace silt, trace pebble gravel, trace clay balls clay balls grade out		
940	175			CLAY (CL): reddish brown (5YR,4/4) moist		
				SAND (SW): dark yellowish brown (10YR,4/4) fine to coarse sand, trace silt, trace fine pebble gravel		
935	180					
				SAND & GRAVEL (SW/GP): grayish brown (10YR,5/2) fine to coarse sand, very fine pebble to pebble gravel, clean to trace silt, clasts are sub-angular, igneous, mafic,quartz and volcanic		
930	185			SAND (SW): grayish brown (10YR,5/2) sand is fine to coarse, trace to some pebble gravel, trace silt	◄50% Benseal/50% No. 3 Sand (50-348 ft. bgs)	
				CLAY (CL): dark yellowish brown (10YR,4/6) moist, trace sand (interbeds with clay)		
925	190					
920	195			SAND (SW): yellowish red (5YR,4/6) fine to coarse sand, trace to some silt, some reddish brown (5YR,4/4) clay balls		
				SAND (SW): dark yellowish brown (10YR,4/4) fine to coarse sand, trace pebble gravel, clasts are sub-angular, igneous, mafics, trace silt		
915	200					
910	205					

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: BH-1

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
910	205					
				Sandy CLAY (SC): reddish brown (5YR,4/4) moist, fine sand		
905	210					
				SAND (SW): reddish brown (5YR,4/3) fine to coarse sand, trace to some silt/clay, trace pebble gravel		
900	215			CLAY (CL): reddish brown (5YR,4/4) moist, trace sand		
				SAND (SW): reddish brown (5YR,4/3) fine to coarse sand, trace to some silt/clay, trace pebble gravel, clasts are sub-angular to sub-rounded igneous, mafic and quartz		
				CLAY (CL): reddish brown (5YR,4/3) moist, trace to some sand		
895	220				50% Benseal/50% No. 3 Sand (50-348 ft. bgs)	
				SAND (SP): dark yellowish brown (10YR,4/4) fine to medium sand, trace silt, trace fine pebble gravel grades brown (5YR,4/40 moist, trace sand		
890	225			SILT (ML): reddish brown (5YR,4/4) moist, trace sand		
				CLAY (CL): reddish brown (5YR,4/4) moist, trace sand		
885	230					
880	235					
875	240					

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: BH-1

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
875	240					
				CLAY (CL): reddish brown (5YR,4/4) moist, trace sand		
				SAND (SW): dark yellowish brown (10YR,4/4) fine to coarse sand, some silt/clay, trace to some pebble gravel, clasts are sub-angular, igneous, mafic, quartz and metamorphic		
870	245					
865	250					
				CLAY (CL): dark yellowish brown (10YR,4/4) moist, trace sand		
				GRAVEL (GP): dark brown (10YR,3/3) very pebble to pebble gravel, trace to some sand, clasts are sub-angular, igneous, mafics and metamorphic		
860	255			CLAY (SC/CL): dark yellowish brown (10YR,3/4) moist, trace sand with interbeds of fine to coarse sand	◄50% Benseal/50% No. 3 Sand (50-348 ft. bgs)	
				grades dark yellowish brown (10YR,4/6)		
855	260			SAND (SW): dark yellowish brown (10YR,4/4) fine to coarse sand, some silt/clay, trace fine pebble gravel		
850	265			CLAY (CL): reddish brown (5YR,4/3) moist, trace sand		
845	270					
				SAND (SW): dark yellowish brown (10YR,4/4) fine to coarse sand, trace silt, trace to some fine pebble gravel		
840	275					

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: BH-1

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
840	275					
835	280					
830	285			CLAY (CL): olive brown (2.5YR,4/3) moist, trace sand		
				SAND & GRAVEL (SW/GP): dark yellowish brown (10YR,4/4) fine to coarse sand, very fine pebble to pebble gravel, trace silt, clasts are sub-angular, igneous, mafics and quartz		
825	290				50% Benseal/50% No. 3 Sand (50-348 ft. bgs)	
				SAND (SP): olive brown (2.5YR,4/3) fine to medium sand, some silt, trace fine pebble gravel		
820	295			SAND (SW): yellowish brown (10YR,5/4) fine to coarse sand, trace to some silt, trace fine pebble gravel		
				CLAY (CL): dark yellowish brown 910YR,4/6) moist, trace sand		
815	300			Gravelly SAND (SW): brown (10YR,4/3) fine to coarse sand, very fine pebble to pebble gravel, trace silt		
				CLAY (CL): dark yellowish brown (10YR,4/6) moist, trace sand, firm		
				grades trace sand (thin interbeds with clay)		
810	305			SAND (SW): dark yellowish brown (10YR,4/4) fine to coarse sand, some silt, trace fine pebble gravel		
				CLAY (CL): dark yellowish brown (10YR,3/4) dry, trace sand		
805	310					

Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 5/1/2006

WILDERMUTH ENVIRONMENTAL INC.

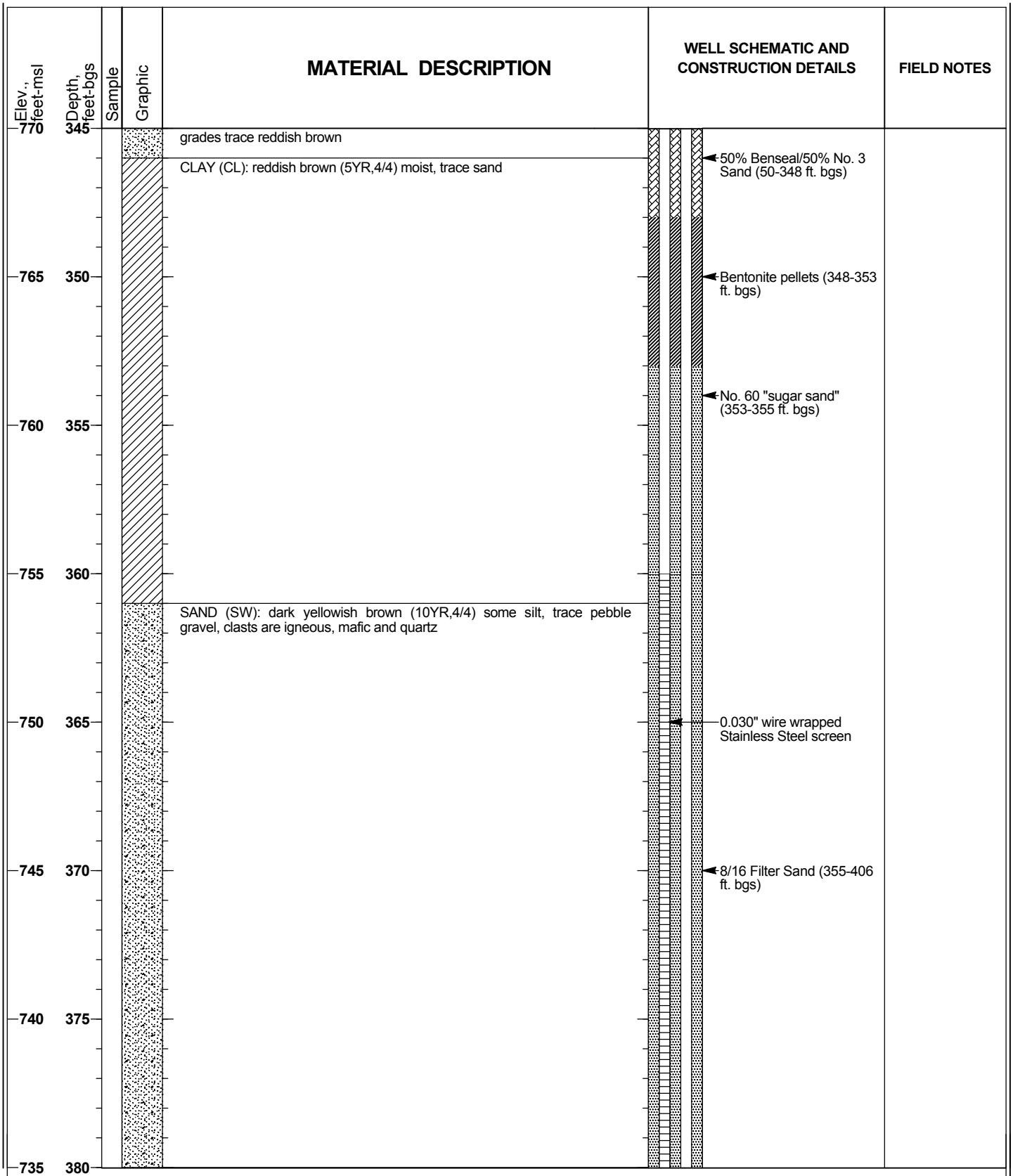
Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: BH-1

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
805	310			SAND (SP): dark yellowish brown (10YR,4/4) fine to coarse sand, some silt/clay		
				CLAY (CL): yellowish red (5YR,4/6) moist, trace sand, firm		
800	315			SAND (SW): yellowish brown (10YR,5/4) fine to coarse sand, some silt/clay, trace fine pebble gravel		
795	320					
790	325			grades trace dark yellowish brown (10YR,4/6) clay balls	50% Benseal/50% No. 3 Sand (50-348 ft. bgs)	
				clay balls grade out		
785	330			SAND & GRAVEL (SW/GW): dark yellowish brown (10YR,4/6) fine to coarse sand, very fine pebble to cobble gravel, clasts are sub-angular, igneous, mafics and quartz		
				SAND (SW): dark yellowish brown (10YR,4/4) fine to coarse sand, trace very fine pebble to pebble gravel, trace to some silt/clay		
780	335			SAND (SP): dark yellowish brown (10YR,4/4) fine to medium sand, trace to some silt/clay, trace pebble gravel		
775	340			SAND (SW): dark yellowish brown (10YR,4/4) fine to coarse sand, trace silt, trace to some fine pebble gravel, clasts are sub-angular, igneous, mafic and quartz		
770	345					

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

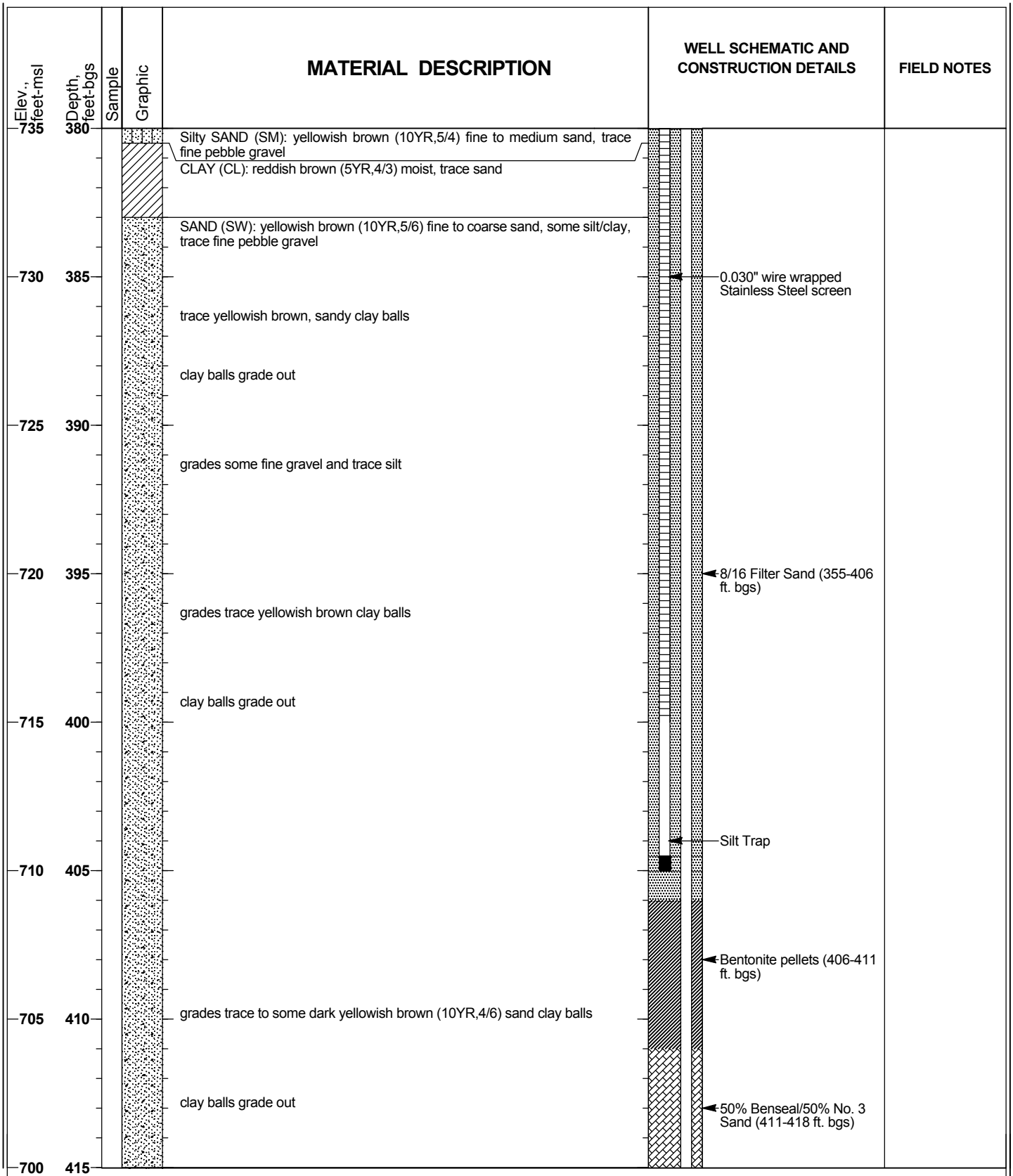
Monitoring Well: BH-1



WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: BH-1

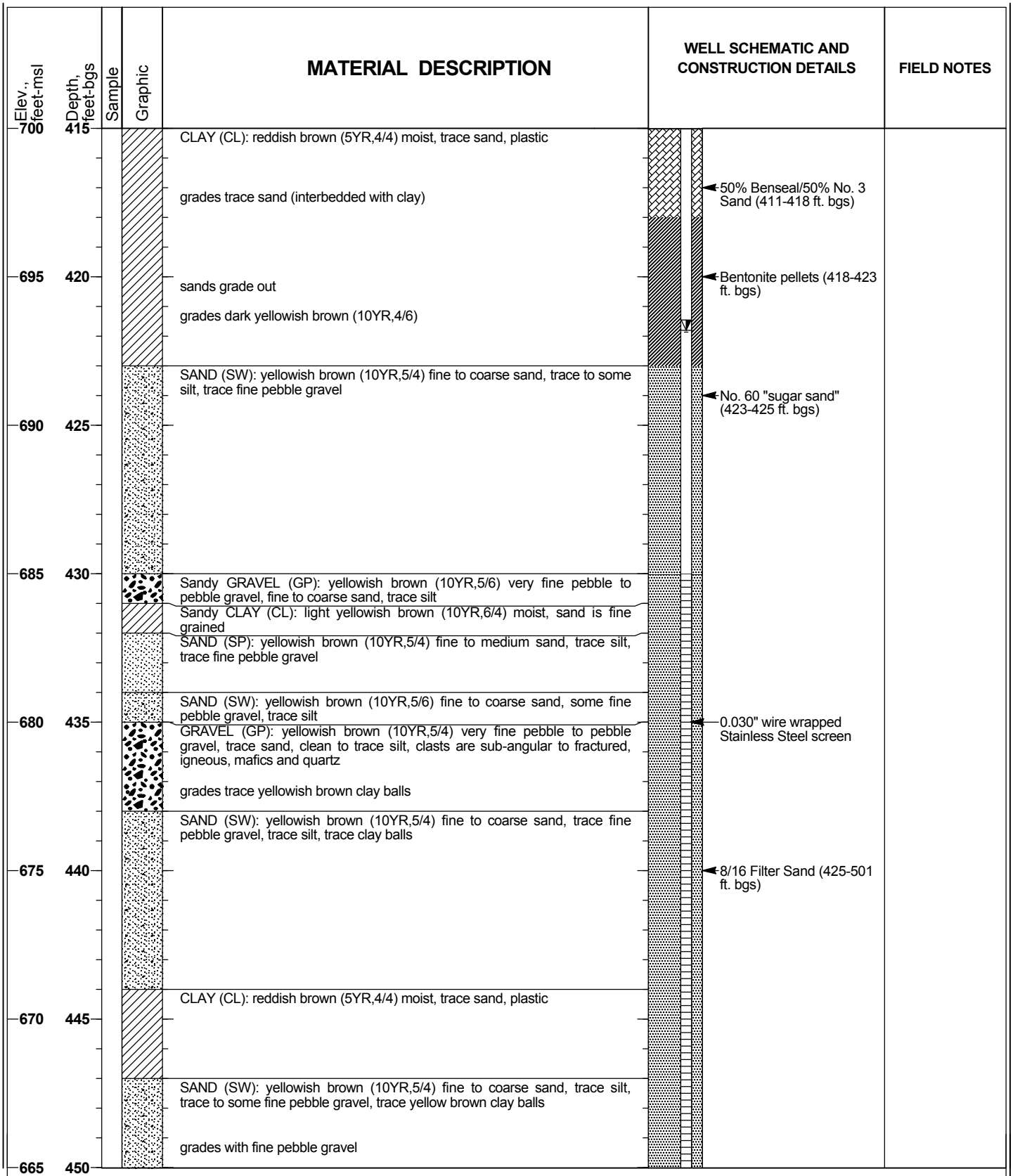


Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 5/1/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: BH-1

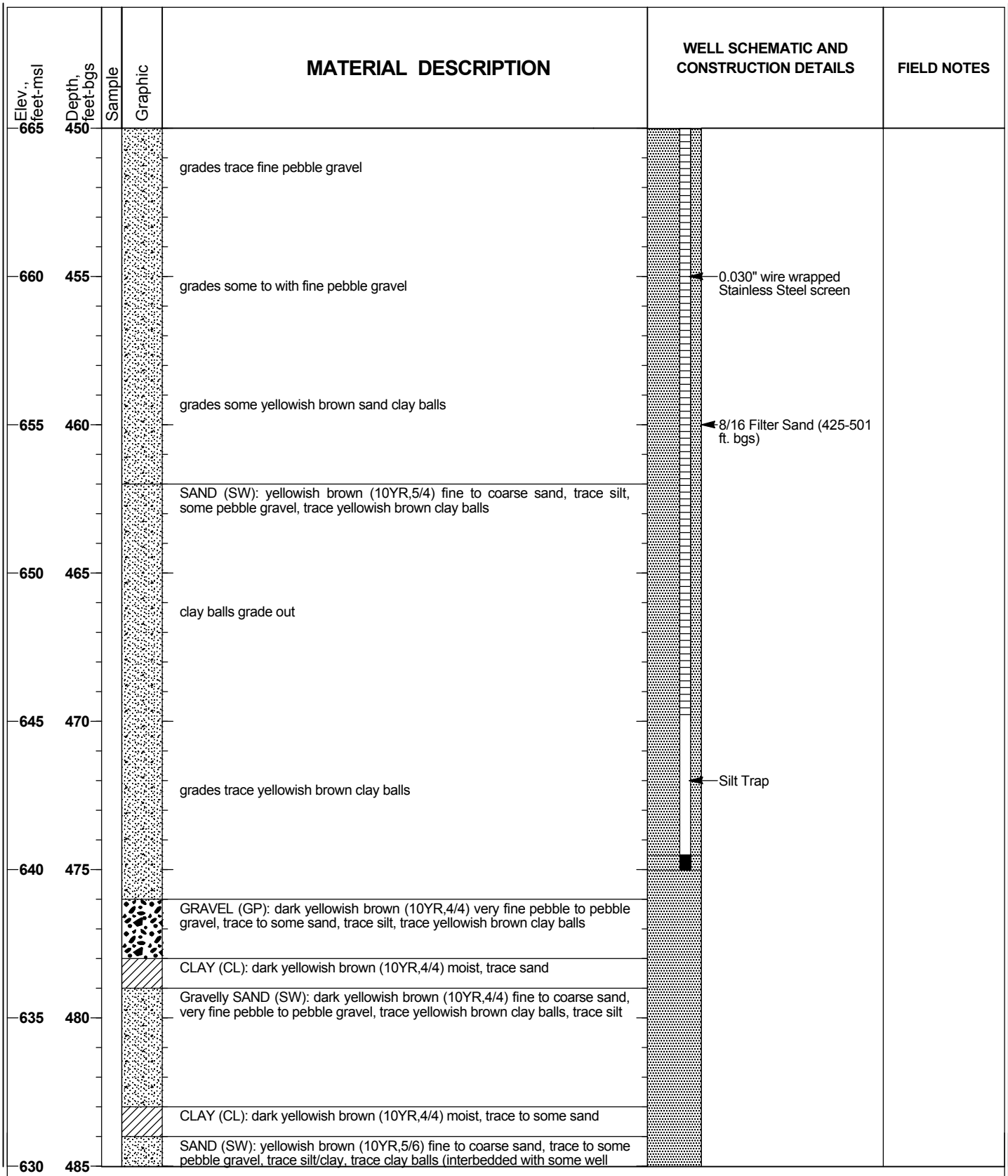


Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 5/1/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: BH-1



Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 5/1/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: BH-1

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
630	485			graded sand)		
625	490				8/16 Filter Sand (425-501 ft. bgs)	
620	495					
615	500					
610	505					
605	510					
600	515					
595	520					

Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 5/1/2006

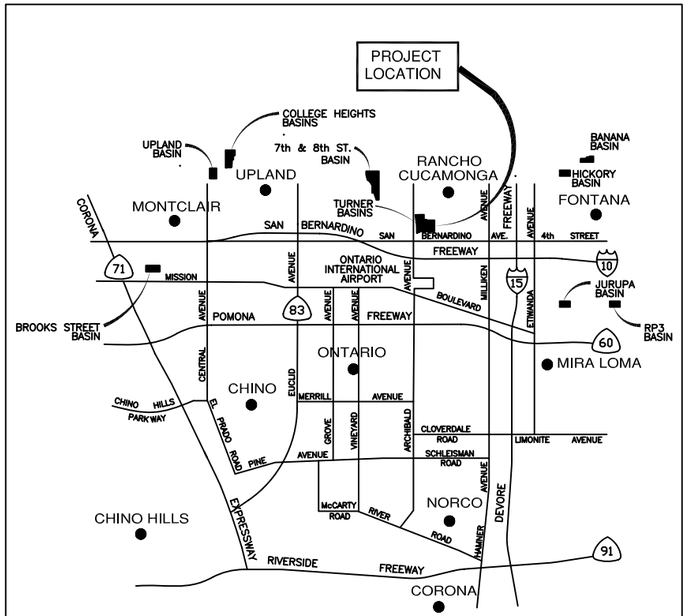
WILDERMUTH ENVIRONMENTAL INC.

AS-BUILTS FOR THE

TURNER BASIN
LYSIMETER AND WELL INSTALLATION

PROJECT NO.: 007-002-068

PREPARED FOR THE INLAND EMPIRE UTILITIES AGENCY
BY WILDERMUTH ENVIRONMENTAL, INC.



VICINITY MAP
NOT TO SCALE

SITE LOCATION MAP
NOT TO SCALE

LIST OF DRAWINGS

DRAWING NO.	SHEET TITLE	SHEET NO.
	GENERAL	
A - 1	COVER SHEET	1 OF 6
A - 2	TURNER BASINS	2 OF 6
A - 3	AS-BUILT DETAILS 1 AND 2	3 OF 6
A - 4	AS-BUILT DETAILS 3 AND 4	4 OF 6
A - 5	AS-BUILT DETAILS 5 AND 6	5 OF 6
A - 6	AS-BUILT DETAILS 7 AND 8	6 OF 6

CONTACT PERSONNEL

NAME	ADDRESS	PHONE NO.
ANDY CAMPBELL, PG, CHG	INLAND EMPIRE UTILITIES AGENCY 6075 KIMBALL AVENUE CHINO, CALIFORNIA 91710	(909) 993-1600
MARK WILDERMUTH, PE	WILDERMUTH ENVIRONMENTAL, INC. 23692 BIRTCHER DRIVE LAKE FOREST, CALIFORNIA 92630	(949) 420-3030
BILL LEEVER, PG, CHG	WILDERMUTH ENVIRONMENTAL, INC. 23692 BIRTCHER DRIVE LAKE FOREST, CALIFORNIA 92630	(949) 420-3030

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: | DRAWN: | CHECKED:

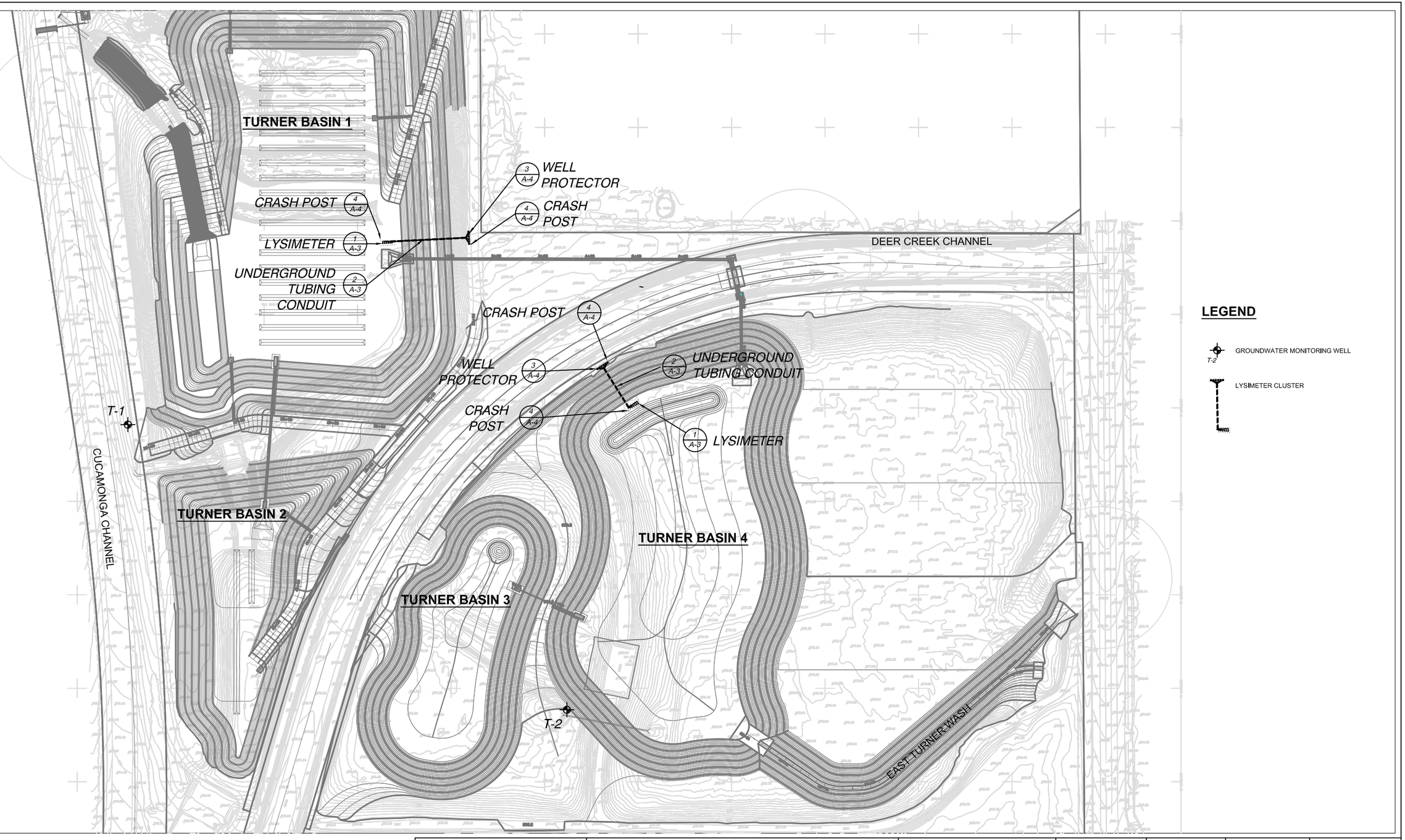
WILDERMUTH ENVIRONMENTAL INC.
Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	04/05/06

COVER SHEET

DRAWING NO. A–1

SHEET NO. 1 OF 6



LEGEND

- GROUNDWATER MONITORING WELL (T-2)
- LYSIMETER CLUSTER

Scale 1:2400

0 200' 400'

North

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: DRAWN: CHECKED:

WILDERMUTH ENVIRONMENTAL INC.

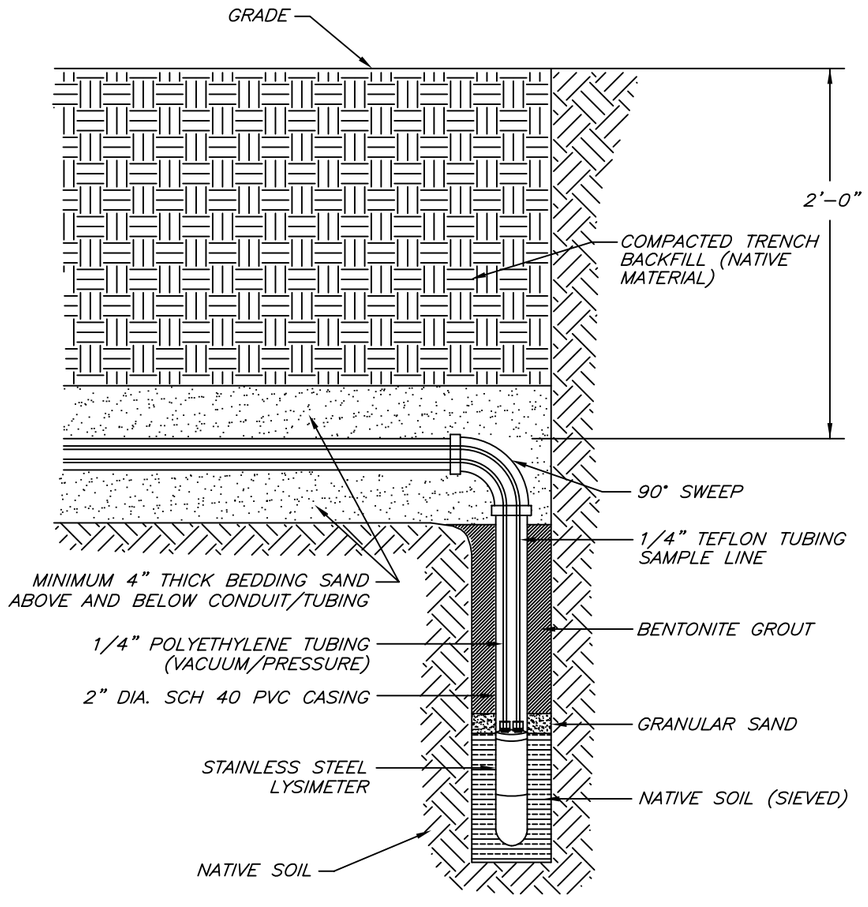
Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	04/05/06

TURNER BASIN

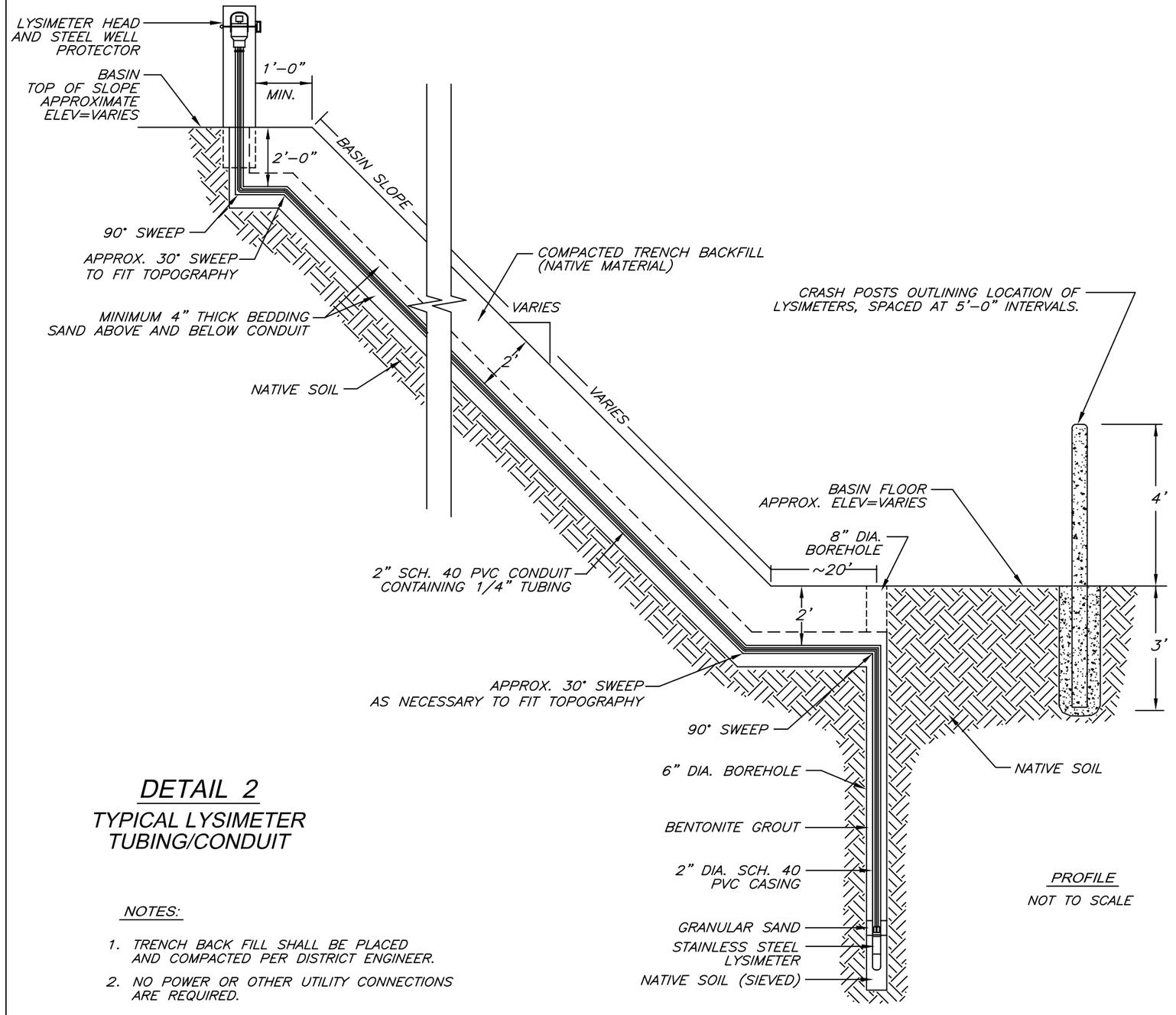
DRAWING NO. A-2

SHEET NO. 2 OF 6



DETAIL 1
TYPICAL LYSIMETER

PROFILE
NOT TO SCALE



DETAIL 2
TYPICAL LYSIMETER TUBING/CONDUIT

PROFILE
NOT TO SCALE

NOTES:

1. TRENCH BACK FILL SHALL BE PLACED AND COMPACTED PER DISTRICT ENGINEER.
2. NO POWER OR OTHER UTILITY CONNECTIONS ARE REQUIRED.

6 SEPARATE 8" DIA. BOREHOLES
5 FEET, 10 FEET, 15 FEET, 2–25 FEET AND 35 FEET DEEP

Underground Service Alert
Call: TOLL FREE 1–800 227–2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: | DRAWN: | CHECKED:

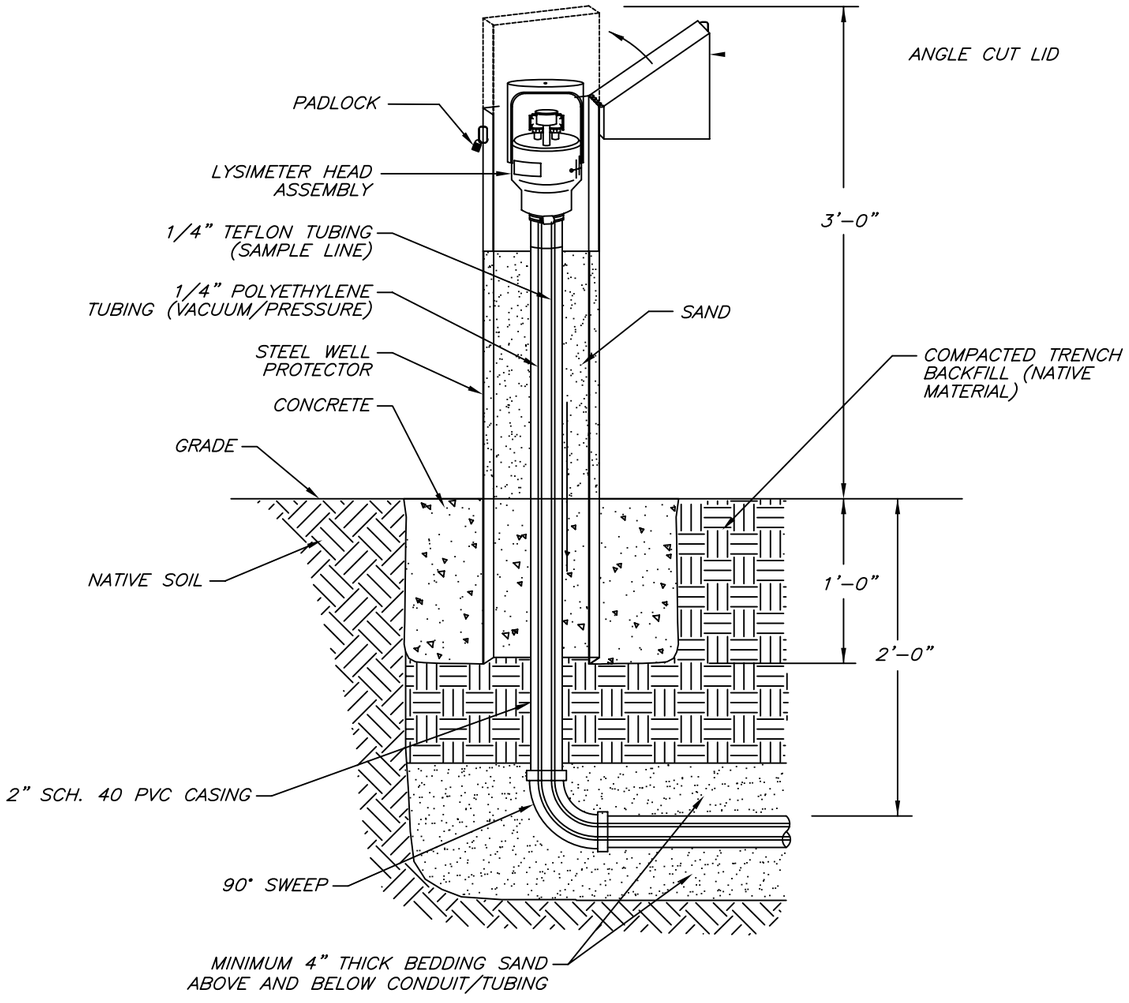
WILDERMUTH ENVIRONMENTAL INC.
Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	04/05/06

AS-BUILT DETAILS 1 AND 2 TURNER BASIN

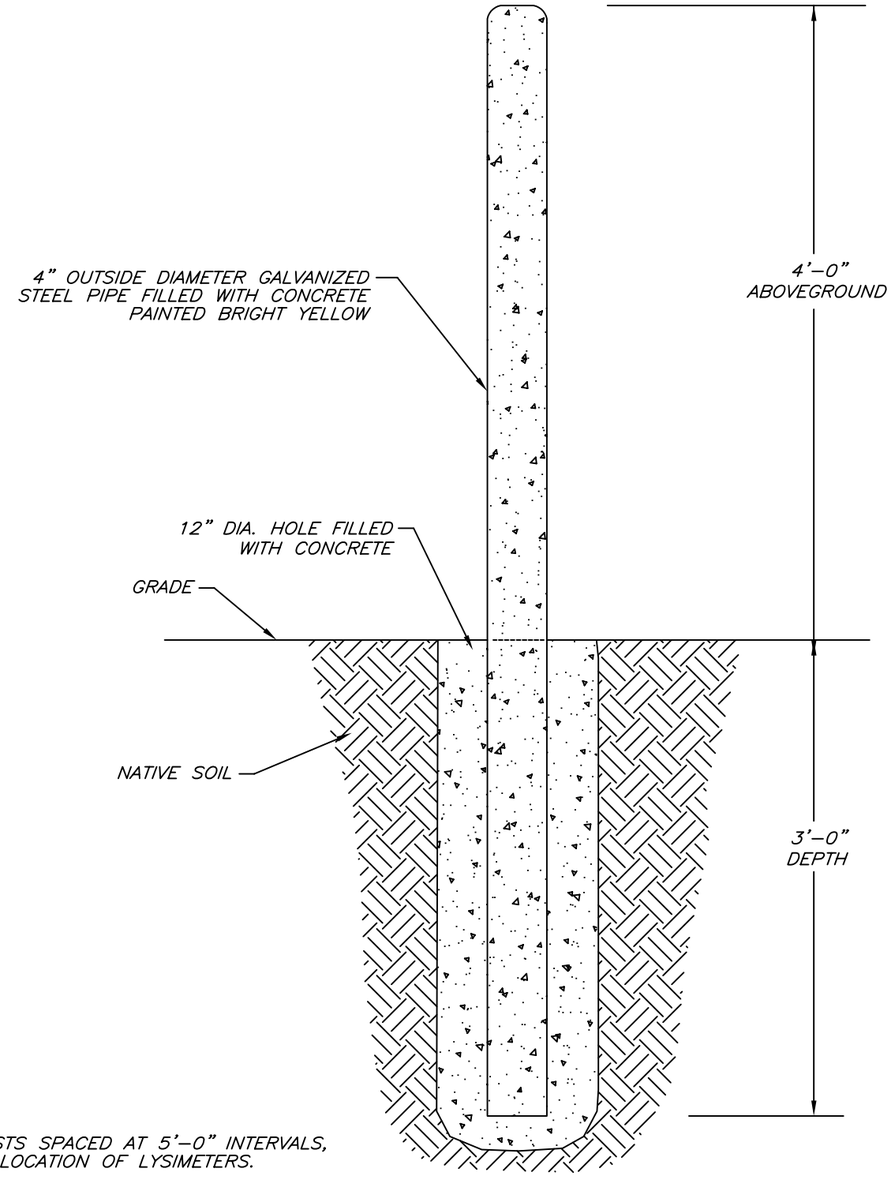
DRAWING NO. A–3

SHEET NO. 3 OF 6



PROFILE
NOT TO SCALE

DETAIL 3
TYPICAL STEEL WELL PROTECTOR AND LYSIMETER HEAD ASSEMBLY



NOTES:
CRASH POSTS SPACED AT 5'-0" INTERVALS, OUTLINING LOCATION OF LYSIMETERS.

PROFILE
NOT TO SCALE

DETAIL 4
TYPICAL CRASH POST

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: | DRAWN: | CHECKED:

WILDERMUTH ENVIRONMENTAL INC.
Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	04/05/06

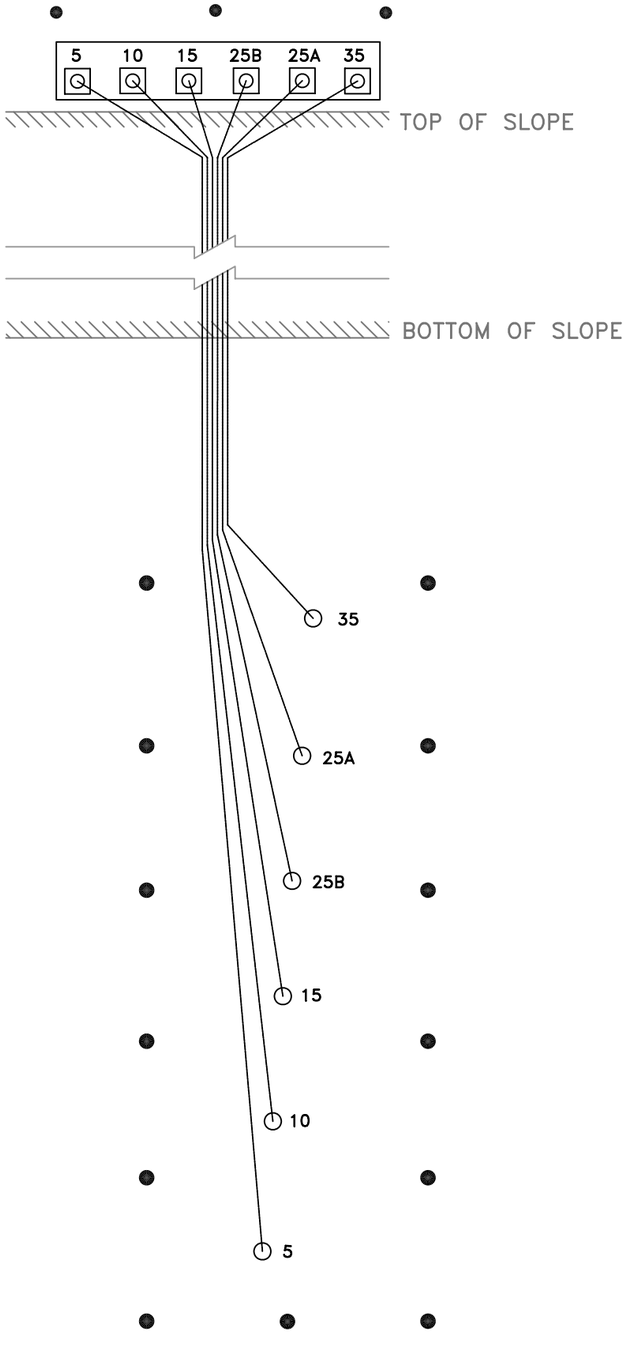
AS-BUILT DETAILS 3 AND 4
TURNER BASIN

DRAWING NO. A-4

SHEET NO. 4 OF 6

DETAIL 5

TURNER BASIN 1 LYSIMETER AS-BUILT



LEGEND

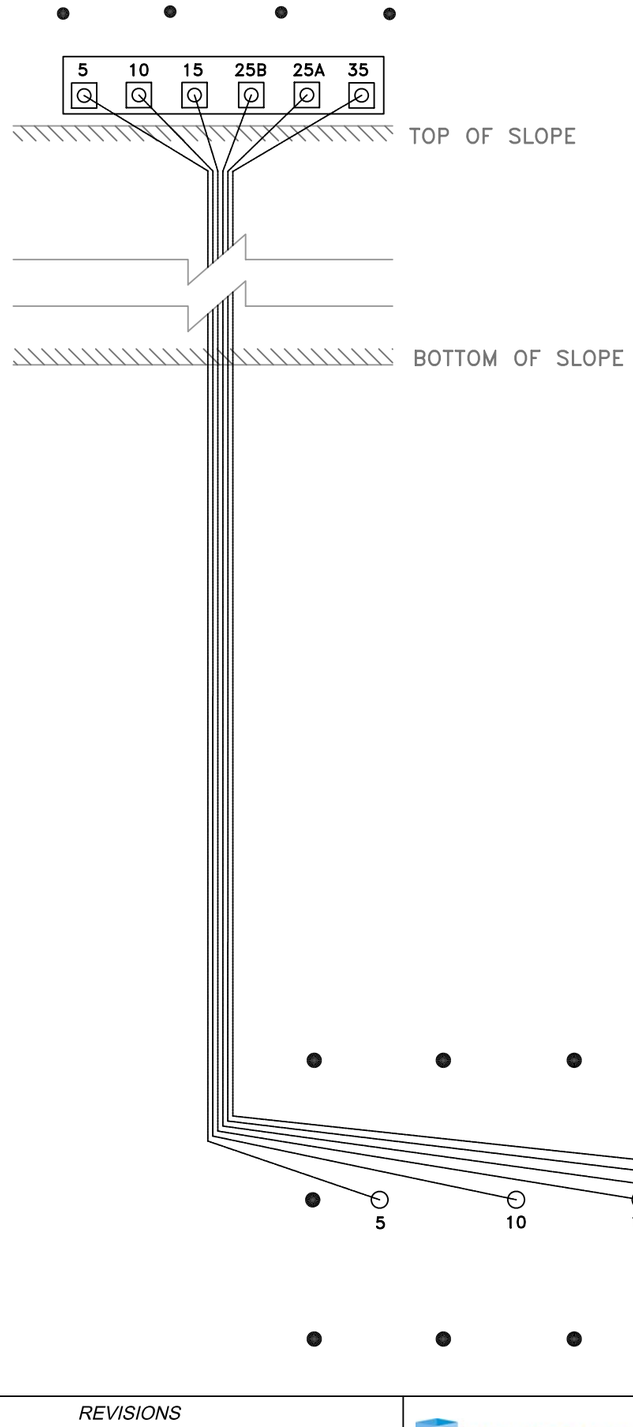
- LYSIMETER
- BOLLARD
- CONDUIT
- LYSIMETER BOX

0 5' 10'

APPROXIMATE SCALE: 1" = 5'

DETAIL 6

TURNER BASIN 4 LYSIMETER AS-BUILT



LEGEND

- LYSIMETER
- BOLLARD
- CONDUIT
- LYSIMETER BOX

0 5' 10'

APPROXIMATE SCALE: 1" = 5'

Underground Service Alert

Call: TOLL FREE 1-800 227-2600

TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: DRAWN: CHECKED:

WILDERMUTH ENVIRONMENTAL INC.

Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	04/05/06

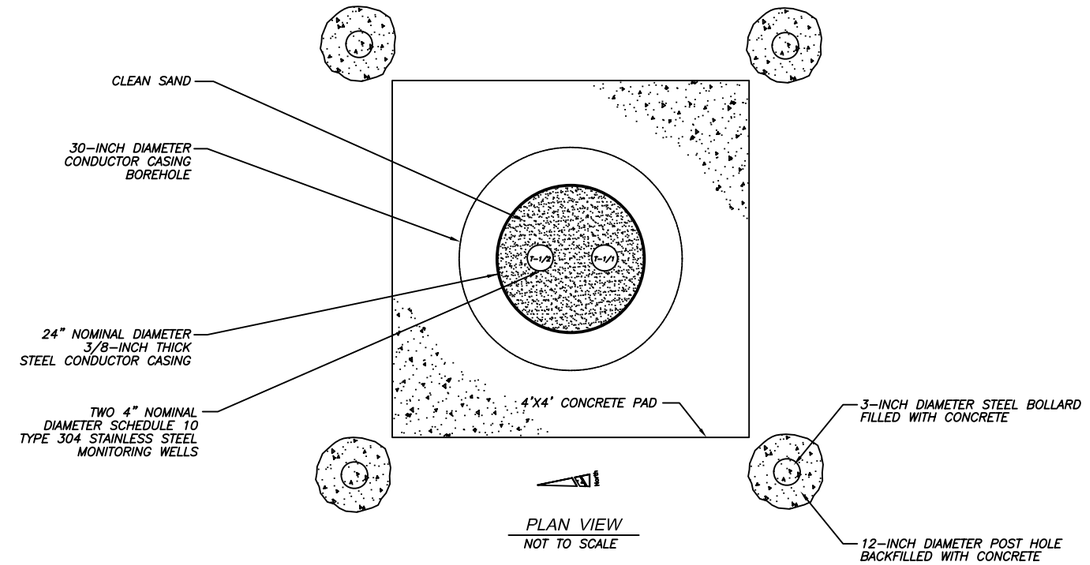
AS-BUILT DETAILS 5 AND 6
TURNER BASIN

DRAWING NO. A-5

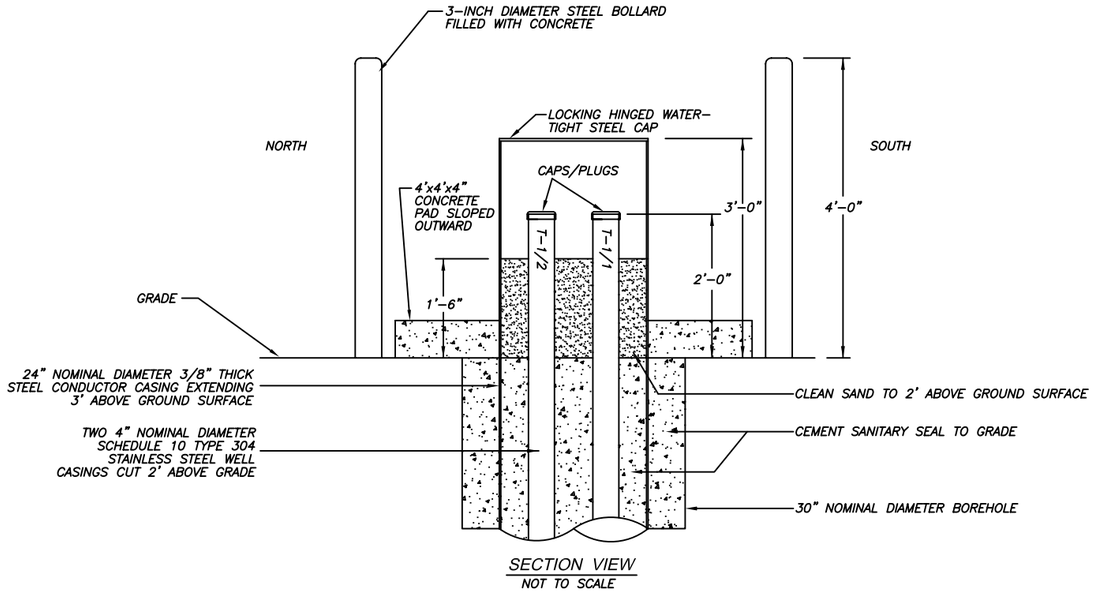
SHEET NO. 5 OF 6

DETAIL 7

TURNER BASIN WELL T-1 AS-BUILT



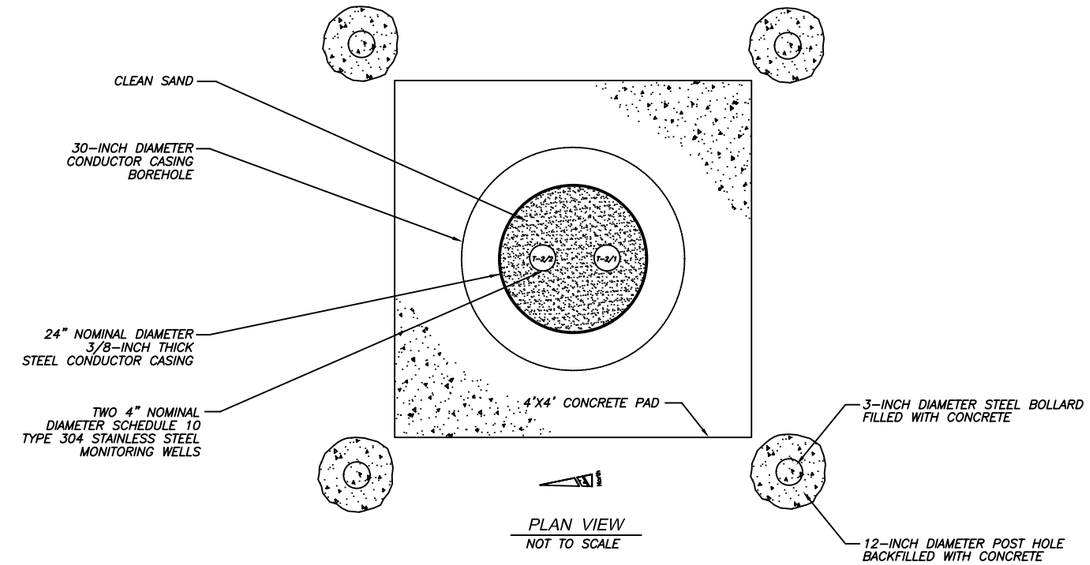
PLAN VIEW
NOT TO SCALE



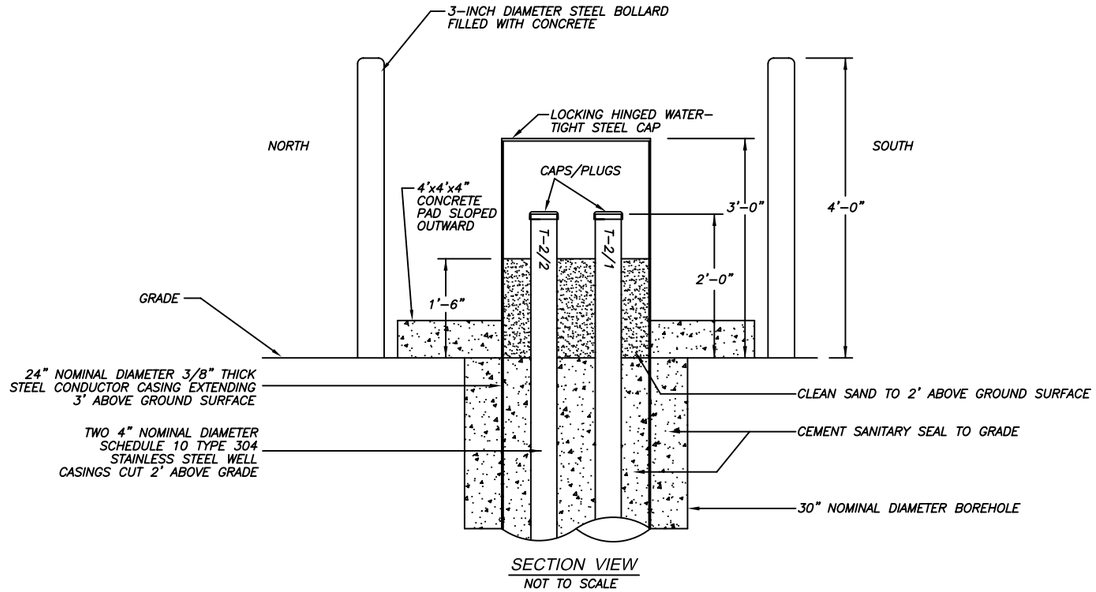
SECTION VIEW
NOT TO SCALE

DETAIL 8

TURNER BASIN WELL T-2 AS-BUILT



PLAN VIEW
NOT TO SCALE



SECTION VIEW
NOT TO SCALE

Underground Service Alert

Call: TOLL FREE 1–800 227–2600

TWO WORKING DAYS BEFORE YOU DIG

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION:	APPROVED/DATE

DESIGNED: | DRAWN: | CHECKED:

WILDERMUTH ENVIRONMENTAL INC.

Inland Empire UTILITIES AGENCY

REVIEWED BY:	DRAWN BY:	START DATE:
AEM	WEL	04/05/06

AS-BUILT DETAILS 7 AND 8
TURNER BASIN

DRAWING NO. A–6

SHEET NO. 6 OF 6

Project Name:	**Recycled Water Groundwater Recharge Project**	**LYSIMETER: T1-5**
Project Location:	**Chino Basin, California**	
Project Number:	**007-003**	Sheet 1 of 1
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**	

Date Started	**5/5/05**	Date Finished	**5/5/05**	Borehole Depth	**5.5 feet**	Drilling Contractor	**Layne-Christensen Drilling**
Lat.	**34° 4' 32.45"**	Long.	**117° 35' 52.45"**	Drill Bit Size/Type	**8.25" Dia./Hollow Stem Bit**	Driller	**Armando Zimora**
Ground Surface Elevation	**1012.0 feet**			Porous Interval	**4.6-5 ft_bgs**	Drill Rig Type	**CME-75**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**D. Gamon, PG**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Split Spoon**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Silty SAND (SM): brown, moist, fine to medium sand with some silt, dense		
1010	2				Sch. 40 PVC Conduit (1.9")	
	4				Bentonite Chips No. 60 Transition Sand Lysimeter Body (500 mL) 10-mesh Native Sand Lysimeter Porous Tip	
	6					
1005	8					
	10					
1000	12					
	14					
	16					
995	18					
	20					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

LYSIMETER: T1-10

Sheet 1 of 1

Date Started	10/5/05	Date Finished	10/5/05	Borehole Depth	10.5 feet	Drilling Contractor	Layne-Christensen Drilling
Lat.	34° 4' 32.45"	Long.	117° 35' 52.45"	Drill Bit Size/Type	8.25" Dia./Hollow Stem Bit	Driller	Armando Zimora
Ground Surface Elevation	1012.0 feet			Porous Interval	9.6-10 ft_bgs	Drill Rig Type	CME-75
Top of Casing Elevation	NA			Depth to Groundwater	Not Encountered	Drilling Method	Hollow Stem Auger
Logged By	D. Gamon, PG			Reviewed By	B. Leever, PG, CHG	Sampling Method	Split Spoon

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Silty SAND (SM): brown, moist, fine to medium sand with some silt, dense		
1010	2				Bentonite Chips	
	4				Sch. 40 PVC Conduit (1.9")	
	6					
1005						
	8				No. 60 Transition Sand	
					Lysimeter Body (1000 mL)	
					10-mesh Native Sand	
	10				Lysimeter Porous Tip	
1000	12					
	14					
	16					
995						
	18					
	20					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**	**LYSIMETER: T1-15**	
Project Location:	**Chino Basin, California**		
Project Number:	**007-003**	Sheet 1 of 1	
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**		

Date Started	**10/5/05**	Date Finished	**10/5/05**	Borehole Depth	**15.5 feet**	Drilling Contractor	**Layne-Christensen Drilling**
Lat.	**34° 4' 32.45"**	Long.	**117° 35' 52.45"**	Drill Bit Size/Type	**8.25" Dia./Hollow Stem Bit**	Driller	**Armando Zimora**
Ground Surface Elevation	**1012.0 feet**			Porous Interval	**14.6-15 ft_bgs**	Drill Rig Type	**CME-75**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**D. Gamon, PG**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Split Spoon**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Silty SAND (SM): brown, moist, fine to medium sand with some silt, dense		
1010	2				Bentonite Chips	
	4				Sch. 40 PVC Conduit (1.9")	
	6					
1005	8					
	10			becomes very dense		
1000	12				No. 60 Transition Sand	
					Lysimeter Body (1000 mL)	
	14			Gravelly SAND (SW): brown, moist, medium to coarse sand with fine gravel	10-mesh Native Sand	
				Silty SAND (SM): brown, moist, fine to medium sand with some silt, dense	Lysimeter Porous Tip	
	16					
995	18					
	20					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

LYSIMETER: T1-25A

Date Started	10/5/05	Date Finished	10/5/05	Borehole Depth	25.5 feet	Drilling Contractor	Layne-Christensen Drilling
Lat.	34° 4' 32.45"	Long.	117° 35' 52.45"	Drill Bit Size/Type	8.25" Dia./Hollow Stem Bit	Driller	Armando Zimora
Ground Surface Elevation	1012.0 feet			Porous Interval	24.6-25 ft_bgs	Drill Rig Type	CME-75
Top of Casing Elevation	NA			Depth to Groundwater	Not Encountered	Drilling Method	Hollow Stem Auger
Logged By	D. Gamon, PG			Reviewed By	B. Leever, PG, CHG	Sampling Method	Split Spoon

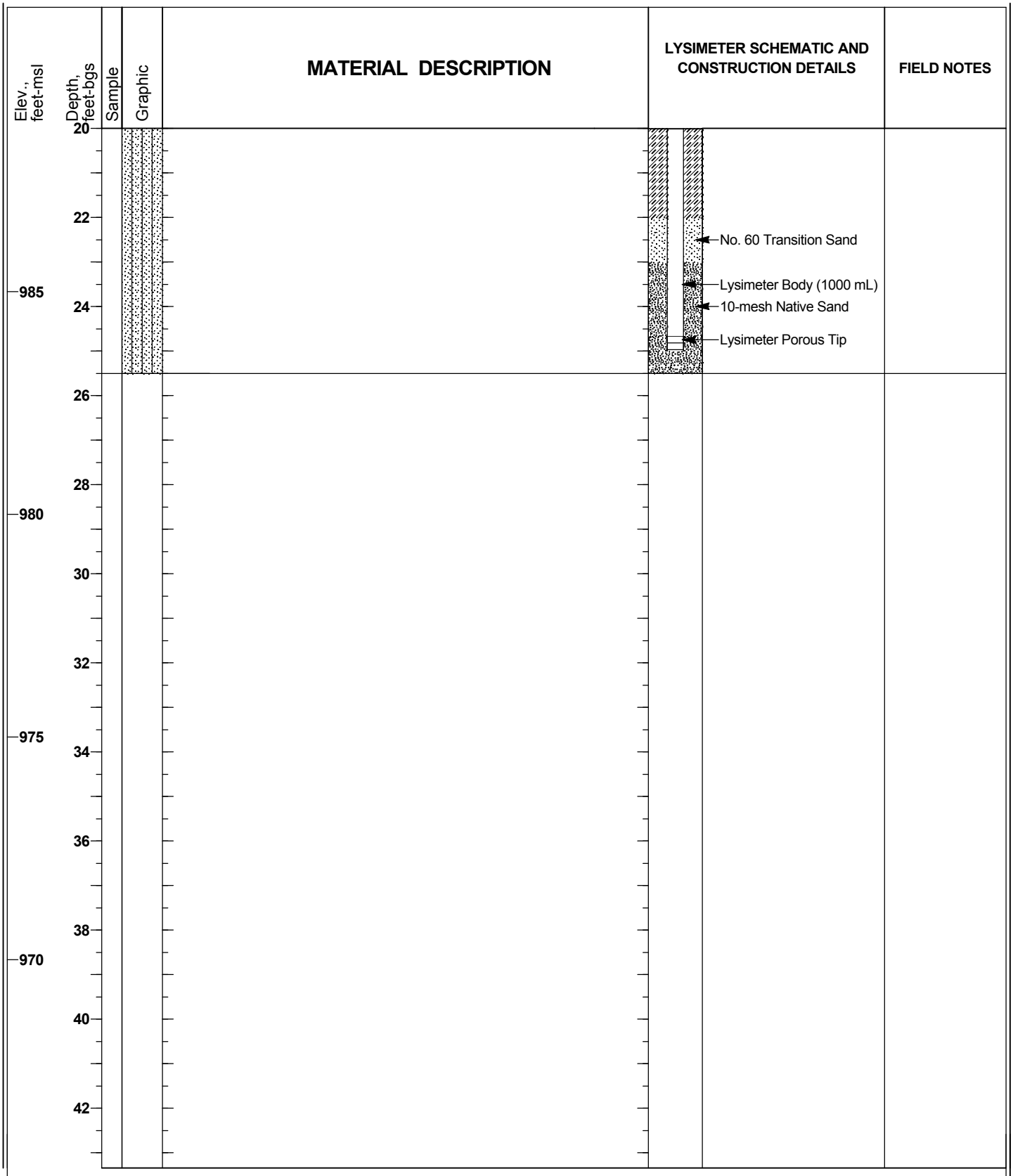
Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Silty SAND (SM): brown, moist, fine to medium sand with some silt, dense		
1010	2				Bentonite Chips	
	4				Sch. 40 PVC Conduit (1.9")	
	6					
1005	8					
	10			becomes very dense		
1000	12					
	14			Gravelly SAND (SW): brown, moist, medium to coarse sand with fine gravel		
				Silty SAND (SM): brown, moist, fine to medium sand with some silt, dense		
	16					
995	18					
	20					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

LYSIMETER: T1-25A



WILDERMUTH™ ENVIRONMENTAL INC.

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

LYSIMETER: T1-25B

Date Started	10/5/05	Date Finished	10/5/05	Borehole Depth	25.5 feet	Drilling Contractor	Layne-Christensen Drilling
Lat.	34° 4' 32.45"	Long.	117° 35' 52.45"	Drill Bit Size/Type	8.25" Dia./Hollow Stem Bit	Driller	Armando Zimora
Ground Surface Elevation	1012.0 feet			Porous Interval	24.6-25 ft_bgs	Drill Rig Type	CME-75
Top of Casing Elevation	NA			Depth to Groundwater	Not Encountered	Drilling Method	Hollow Stem Auger
Logged By	D. Gamon, PG			Reviewed By	B. Leever, PG, CHG	Sampling Method	Split Spoon

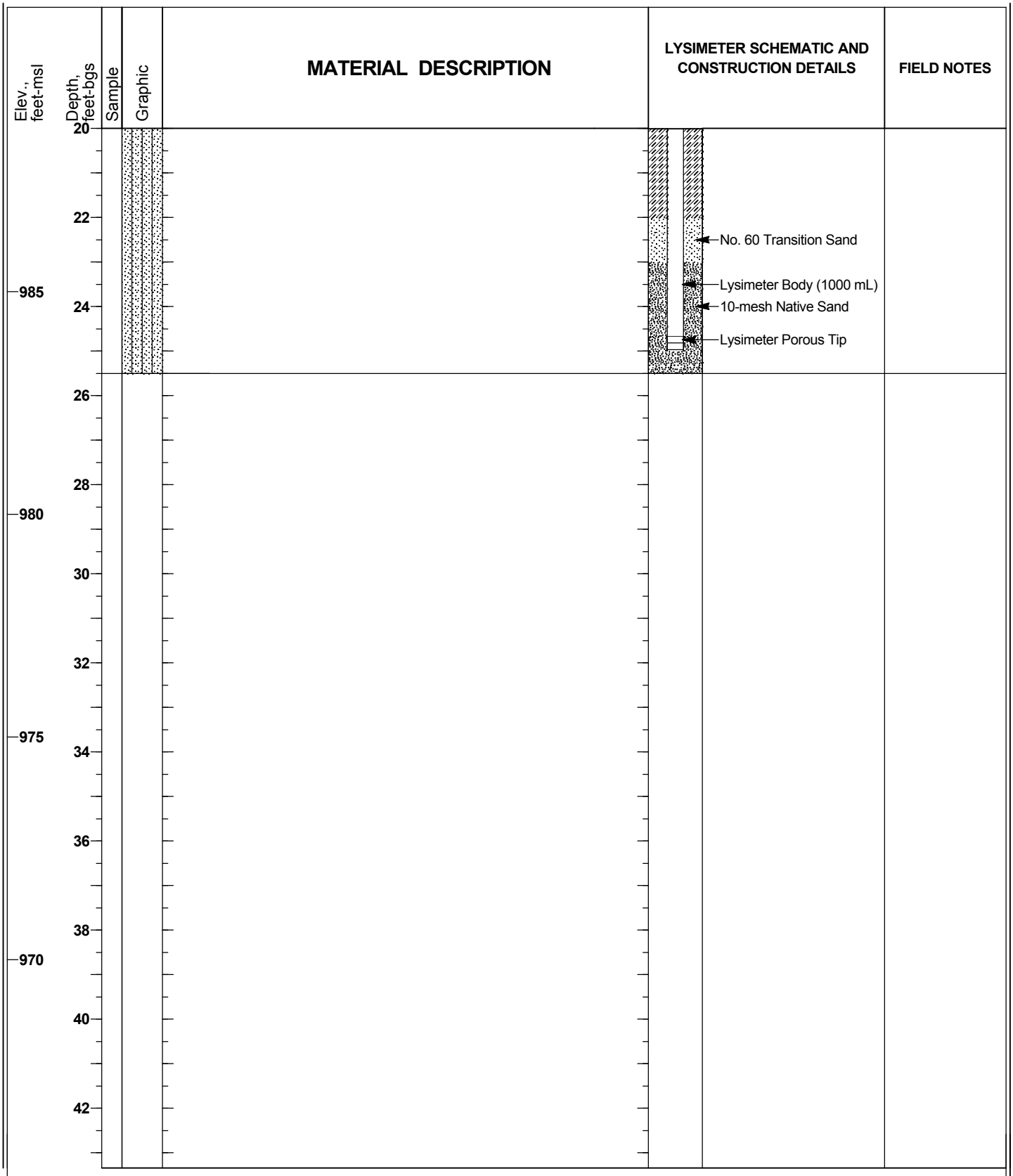
Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Silty SAND (SM): brown, moist, fine to medium sand with some silt, dense		
1010	2				Bentonite Chips	
	4				Sch. 40 PVC Conduit (1.9")	
	6					
1005	8					
	10			becomes very dense		
1000	12					
	14			Gravelly SAND (SW): brown, moist, medium to coarse sand with fine gravel		
				Silty SAND (SM): brown, moist, fine to medium sand with some silt, dense		
	16					
995	18					
	20					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

LYSIMETER: T1-25B



WILDERMUTH™ ENVIRONMENTAL INC.

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

LYSIMETER: T1-35

Date Started	10/5/05	Date Finished	10/5/05	Borehole Depth	35.5 feet	Drilling Contractor	Layne-Christensen Drilling
Lat.	34° 4' 32.45"	Long.	117° 35' 52.45"	Drill Bit Size/Type	8.25" Dia./Hollow Stem Bit	Driller	Armando Zimora
Ground Surface Elevation	1012.0 feet			Porous Interval	34.6-35 ft_bgs	Drill Rig Type	CME-75
Top of Casing Elevation	NA			Depth to Groundwater	Not Encountered	Drilling Method	Hollow Stem Auger
Logged By	D. Gamon, PG			Reviewed By	B. Leever, PG, CHG	Sampling Method	Split Spoon

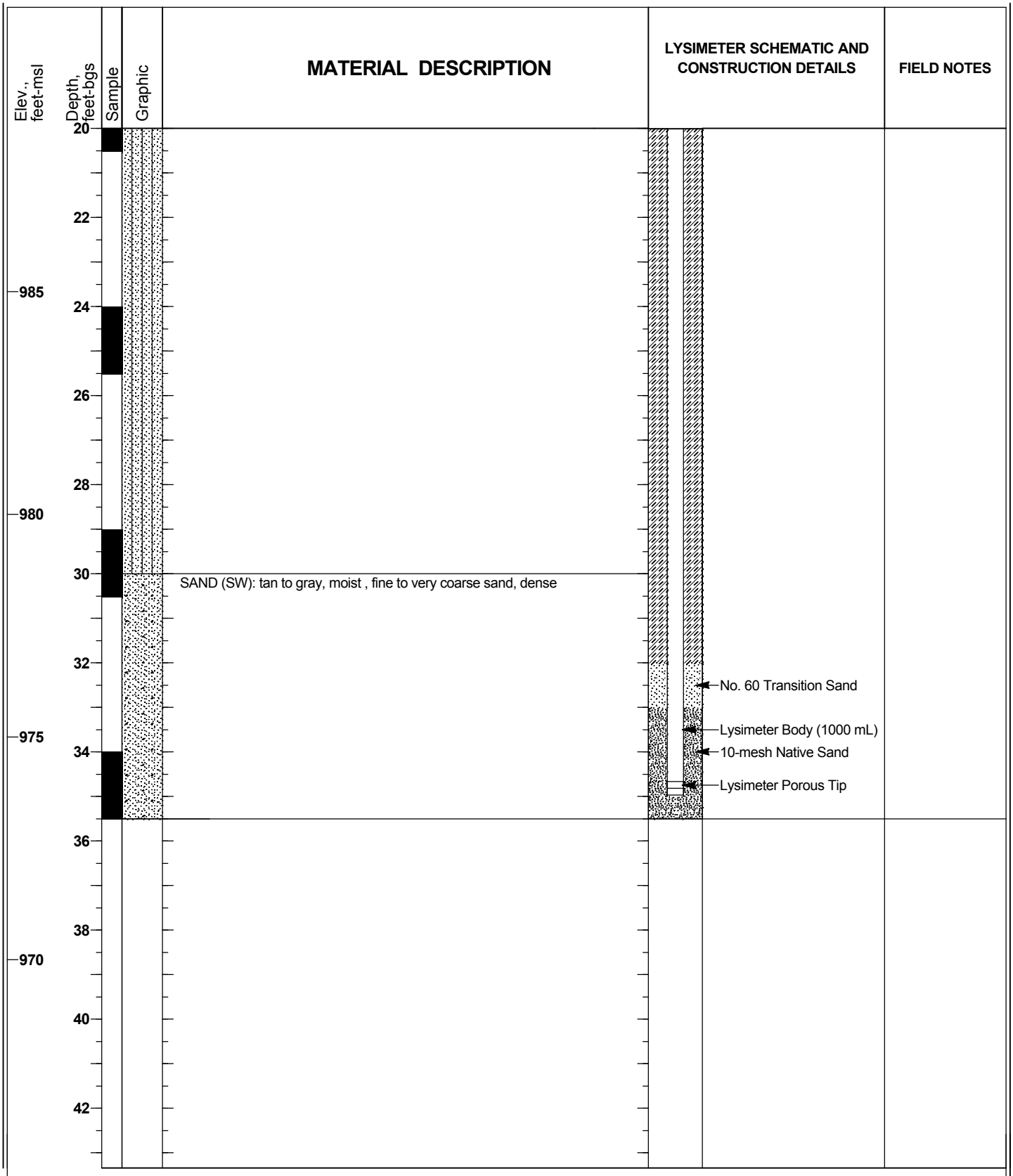
Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Silty SAND (SM): brown, moist, fine to medium sand with some silt, dense		
1010	2				Bentonite Chips	
	4				Sch. 40 PVC Conduit (1.9")	
	6					
1005	8					
	10					
				becomes very dense		
1000	12					
	14			Gravelly SAND (SW): brown, moist, medium to coarse sand with fine gravel		
				Silty SAND (SM): brown, moist, fine to medium sand with some silt, dense		
	16					
995	18					
	20					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

LYSIMETER: T1-35



Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

LYSIMETER: T4-5

Sheet 1 of 1

Date Started	**11/22/05**	Date Finished	**11/22/05**	Borehole Depth	**5.5 feet**	Drilling Contractor	**Layne-Christensen Drilling**
Lat.	**34° 4' 29.49"**	Long.	**117° 35' 49.37"**	Drill Bit Size/Type	**8.25" Dia./Hollow Stem Bit**	Driller	**Armando Zimora**
Ground Surface Elevation	**998.0 feet**			Porous Interval	**4.6-5 ft_bgs**	Drill Rig Type	**CME-75**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**D. Gamon, PG**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Split Spoon**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Gravelly SAND (SP): brown, wet, medium to coarse sand with fine gravel, very dense		
	2				Sch. 40 PVC Conduit (1.9")	
995					Bentonite Chips	
	4				No. 60 Transition Sand	
					Lysimeter Body (500 mL)	
					10-mesh Native Sand	
					Lysimeter Porous Tip	
	6					
990	8					
	10					
	12					
985						
	14					
	16					
980	18					
	20					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**	**LYSIMETER: T4-10**	
Project Location:	**Chino Basin, California**		
Project Number:	**007-003**	Sheet 1 of 1	
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**		

Date Started	**11/22/05**	Date Finished	**11/22/05**	Borehole Depth	**10.5 feet**	Drilling Contractor	**Layne-Christensen Drilling**
Lat.	**34° 4' 29.49"**	Long.	**117° 35' 49.37"**	Drill Bit Size/Type	**8.25" Dia./Hollow Stem Bit**	Driller	**Armando Zimora**
Ground Surface Elevation	**998.0 feet**			Porous Interval	**9.6-10 ft_bgs**	Drill Rig Type	**CME-75**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**D. Gamon, PG**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Split Spoon**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Gravelly SAND (SP): brown, wet, medium to coarse sand with fine gravel, very dense		
	2					
995					Bentonite Chips	
	4				Sch. 40 PVC Conduit (1.9")	
	6					
					No. 60 Transition Sand	
990	8				Lysimeter Body (1000 mL)	
					10-mesh Native Sand	
	10				Lysimeter Porous Tip	
	12					
985						
	14					
	16					
980	18					
	20					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

LYSIMETER: T4-15

Sheet 1 of 1

Date Started	11/22/05	Date Finished	11/22/05	Borehole Depth	15.5 feet	Drilling Contractor	Layne-Christensen Drilling
Lat.	34° 4' 29.49"	Long.	117° 35' 49.37"	Drill Bit Size/Type	8.25" Dia./Hollow Stem Bit	Driller	Armando Zimora
Ground Surface Elevation	998.0 feet			Porous Interval	14.6-15 ft_bgs	Drill Rig Type	CME-75
Top of Casing Elevation	NA			Depth to Groundwater	Not Encountered	Drilling Method	Hollow Stem Auger
Logged By	D. Gamon, PG			Reviewed By	B. Leever, PG, CHG	Sampling Method	Split Spoon

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Gravelly SAND (SP): brown, wet, medium to coarse sand with fine gravel, very dense		
	2					
995					Bentonite Chips	
	4				Sch. 40 PVC Conduit (1.9")	
	6					
990	8					
	10					
	12				No. 60 Transition Sand	
985					Lysimeter Body (1000 mL)	
	14				10-mesh Native Sand	
					Lysimeter Porous Tip	
	16					
980	18					
	20					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

LYSIMETER: T4-25A

Date Started	11/22/05	Date Finished	11/22/05	Borehole Depth	25.5 feet	Drilling Contractor	Layne-Christensen Drilling
Lat.	34° 4' 29.49"	Long.	117° 35' 49.37"	Drill Bit Size/Type	8.25" Dia./Hollow Stem Bit	Driller	Armando Zimora
Ground Surface Elevation	998.0 feet			Porous Interval	24.6-25 ft_bgs	Drill Rig Type	CME-75
Top of Casing Elevation	NA			Depth to Groundwater	Not Encountered	Drilling Method	Hollow Stem Auger
Logged By	D. Gamon, PG			Reviewed By	B. Leever, PG, CHG	Sampling Method	Split Spoon

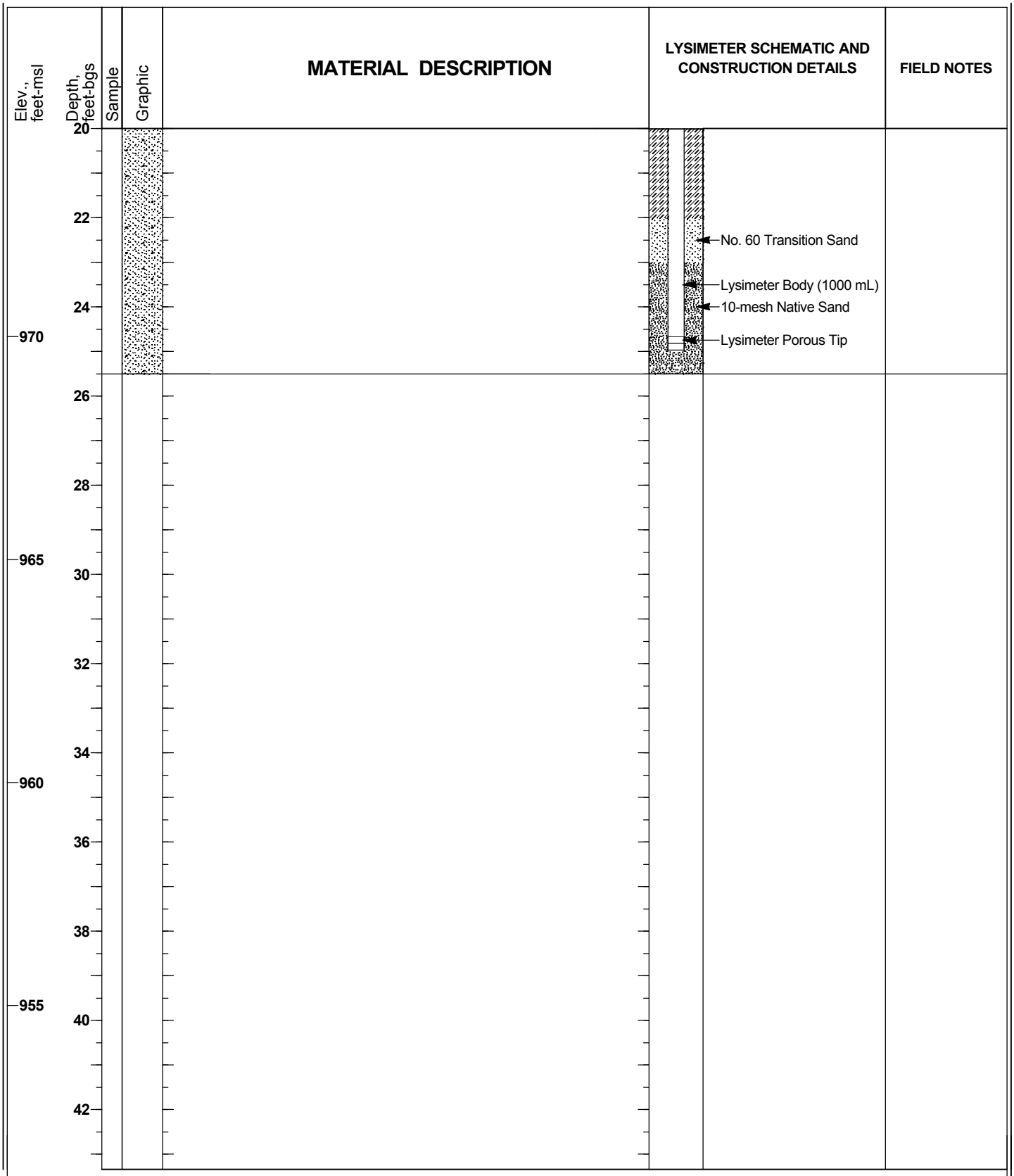
Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Gravelly SAND (SP): brown, wet, medium to coarse sand with fine gravel, very dense		
	2					
995					← Bentonite Chips	
	4				← Sch. 40 PVC Conduit (1.9")	
	6					
990	8					
	10					
	12					
985						
	14					
	16					
980	18					
	20			Gravelly SAND (SW): brown, moist, fine to coarse sand with fine gravel		

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

LYSIMETER: T4-25A



WILDERMUTH™ ENVIRONMENTAL INC.

Project Name: Recycled Water Groundwater Recharge Project
Project Location: Chino Basin, California
Project Number: 007-003
Client: Inland Empire Utilties Agency/Chino Basin Watermaster

LYSIMETER: T4-25B

Date Started	11/22/05	Date Finished	11/22/05	Borehole Depth	25.5 feet	Drilling Contractor	Layne-Christensen Drilling
Lat.	34° 4' 29.49"	Long.	117° 35' 49.37"	Drill Bit Size/Type	8.25" Dia./Hollow Stem Bit	Driller	Armando Zimora
Ground Surface Elevation	998.0 feet			Porous Interval	24.6-25 ft_bgs	Drill Rig Type	CME-75
Top of Casing Elevation	NA			Depth to Groundwater	Not Encountered	Drilling Method	Hollow Stem Auger
Logged By	D. Gamon, PG			Reviewed By	B. Leever, PG, CHG	Sampling Method	Split Spoon

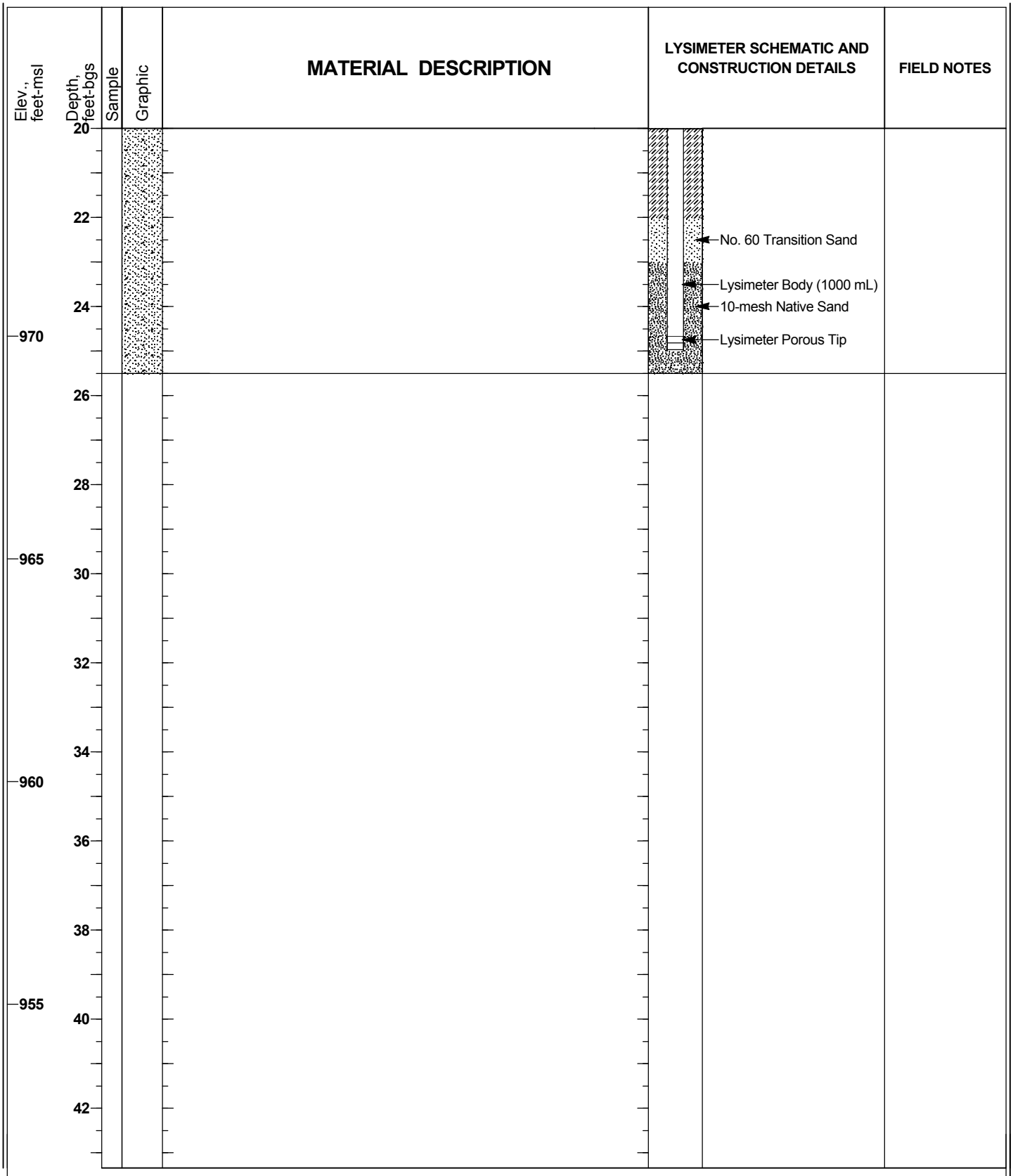
Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Gravelly SAND (SP): brown, wet, medium to coarse sand with fine gravel, very dense		
	2					
995					Bentonite Chips	
	4				Sch. 40 PVC Conduit (1.9")	
	6					
990	8					
	10					
	12					
985						
	14					
	16					
980	18					
				Gravelly SAND (SW): brown, moist, fine to coarse sand with fine gravel		
	20					

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

LYSIMETER: T4-25B



WILDERMUTH™ ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

LYSIMETER: T4-35

Date Started	**11/22/05**	Date Finished	**11/22/05**	Borehole Depth	**35.5 feet**	Drilling Contractor	**Layne-Christensen Drilling**
Lat.	**34° 4' 29.49"**	Long.	**117° 35' 49.37"**	Drill Bit Size/Type	**8.25" Dia./Hollow Stem Bit**	Driller	**Armando Zimora**
Ground Surface Elevation	**998.0 feet**			Porous Interval	**34.6-35 ft_bgs**	Drill Rig Type	**CME-75**
Top of Casing Elevation	**NA**			Depth to Groundwater	**Not Encountered**	Drilling Method	**Hollow Stem Auger**
Logged By	**D. Gamon, PG**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Split Spoon**

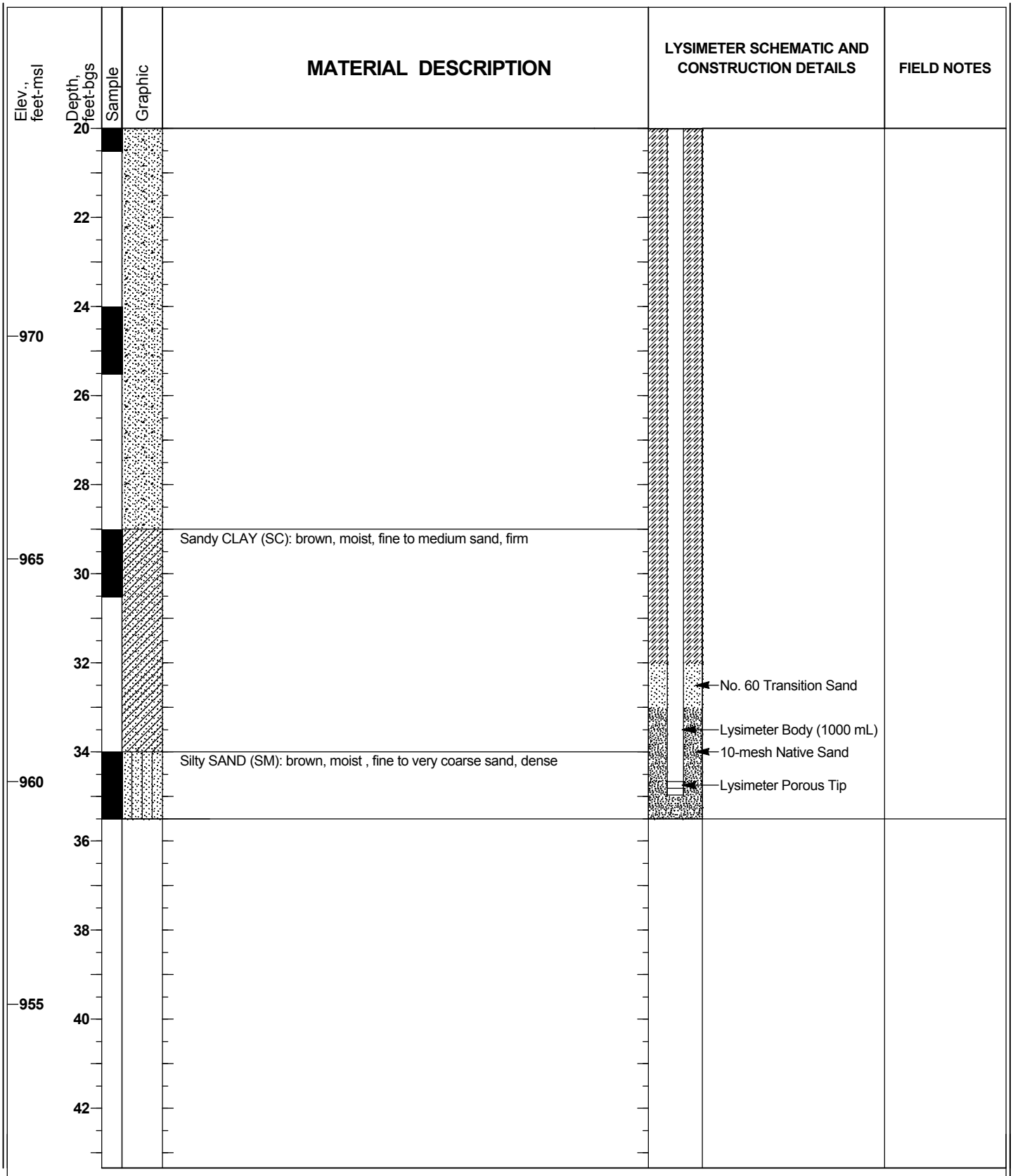
Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	LYSIMETER SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			Gravelly SAND (SP): brown, wet, medium to coarse sand with fine gravel, very dense		
	2					
995					Bentonite Chips	
	4				Sch. 40 PVC Conduit (1.9")	
	6					
990	8					
	10					
	12					
985						
	14					
	16					
980	18					
	20			Gravelly SAND (SW): brown, moist, fine to coarse sand with fine gravel		

Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

LYSIMETER: T4-35



Report: LYSIMETER LOG; File: IEUA_GRRP.GPJ; 4/5/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**	**Monitoring Well: T-1**	
Project Location:	**Chino Basin, California**		
Project Number:	**007-003**	Sheet 1 of 12	
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**		

Date Started	**8/4/05**	Date Finished	**8/17/05**	Borehole Depth	**412.0 feet**	Drilling Contractor	**Layne-Christensen Drilling**
Lat.	**34° 4' 28.09"**	Long.	**117° 36' 0.83"**	Drill Bit Size/Type	**17.5-inch Tri-cone**	Driller	**Victor Olveda**
Ground Surface Elevation	**1003.0 feet**			Screened Interval(s)	**340-360, 380-400**	Drill Rig Type	**Ingersoll-Rand RO 300 Mud**
Top of Casing Elevation	**1005.0 feet**			Depth to Groundwater	**356.9/03-30-2006**	Drilling Method	**Flooded Reverse Circulation**
Logged By	**D. Bramwell, PG, CEG**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Grab**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			SAND (SP): yellowish brown (10YR 5/6), dry, fine to medium sand with trace silt and trace gravel	24" diameter steel with water tight locking lid	
				SAND (SW): dark yellowish brown (10YR 4/6), dray, fine to coarse sand with trace silt and trace sub-rounded gravel		
1000						
	5				30" nominal dia. borehole with 24" diameter x 3/8" thick steel conductor casing and cement sanitary seal (0-50 feet-below ground surface)	
995				SAND (SP): dark yellowish brown (10YR 3/4), moist, fine sand with some silt and trace mica		
				Sandy CLAY (SC): dark yellowish brown (10YR 3/4), moist, fine sand		
	10			Clayey/Silty SAND (SC): dark yellowish brown (10YR 3/4), moist, fine sand	T-1/1: 4" dia. Sch 10 Type 304 casing (with stainless steel screen from 340-360 ft. bgs)	
990				SAND (SW): dark yellowish brown (10YR 3/4), dry to moist, fine to medium sand with trace fine gravel		
	15				T-1/2: 4" dia. Sch 10 Type 304 casing (with stainless steel screen from 380-400 ft. bgs)	
985				SAND (SP): dark yellowish brown (10YR 3/6), dry, fine to medium sand with trace to some silt and trace fine gravel		
	20					
980				Silty SAND (SM): dark yellowish brown (10YR 4/6), moist, very fine to fine sand		
				SAND (SP): dark yellowish brown (10YR 4/6), dry to moist, fine to medium sand with trace to some silt and fine gravel		
	25				Cement inside conductor casing (0-50 ft. bgs)	
975				Sandy CLAY (SC): dark yellowish brown (10YR 4/6), moist, fine to medium sand with trace fine gravel		
	30					

Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-1

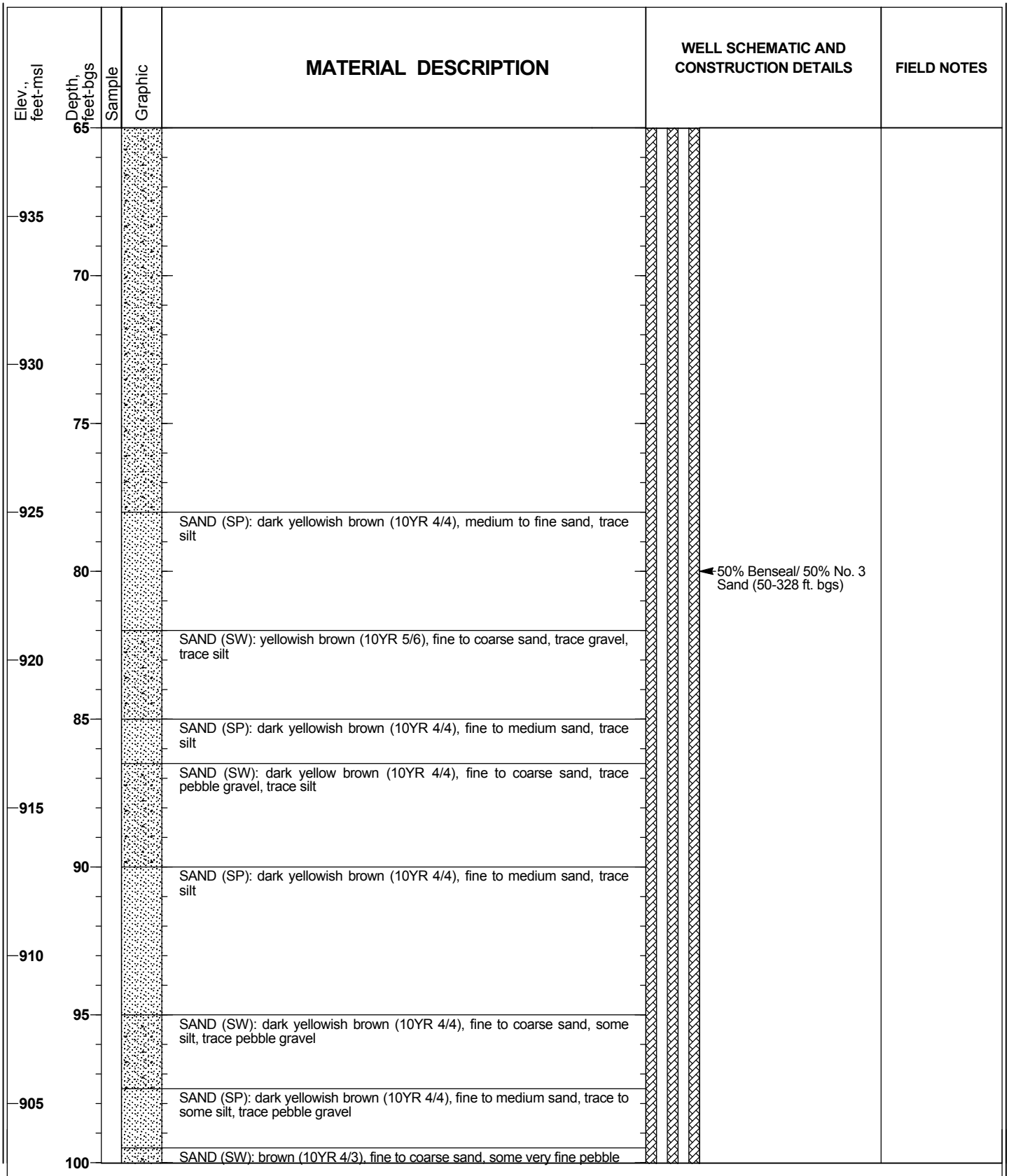
Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	30			SAND (SW): dark yellowish brown (10YR 4/6), dry, fine to coarse sand with some fine to coarse gravel, some pebble to cobble gravel, trace silt		
970						
				SILT (ML): dark yellowish brown (10YR 4/6), dry, trace fine sand and fine gravel		
	35			SAND (SP): strong brown (7.5YR 4/6), dry to moist, fine sand with some silt, clay and fine gravel		
965						
				CLAY (CL): reddish brown (5YR 4/3), dry, trace fine sand		
	40				Cement inside conductor casing (0-50 ft. bgs)	
				SAND (SP): dark yellowish brown (10YR 4/6), dry, fine to medium sand with trace silt and fine gravel		
960						
	45			Silty SAND (SM): dark yellowish brown (10YR 4/6), dry to moist, very fine sand		
				SAND (SW): dark yellowish brown (10YR 4/4), dry, fine to coarse sand with trace silt and fine gravel		
955						
	50					
950						
	55				50% Benseal/ 50% No. 3 Sand (50-328 ft. bgs)	
945				SAND (SP): yellowish brown (10YR 5/6), fine to medium sand with trace silt		
	60					
				SAND (SW): brown (10YR 4/3), fine to coarse sand, trace silt, trace gravel		
940						
	65					

Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-1



WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-1

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
900	100			gravel, sub-rounded to pebble size angular fragments from igneous clasts, trace silt		
				pebble size angular fragments grades out		
895	105					
	110			SAND (SP): yellowish brown (10YR 5/4) fine to medium sand, clean to trace silt		
890						
	115				50% Benseal/ 50% No. 3 Sand (50-328 ft. bgs)	
885				SAND (SW): yellowish brown (10YR 5/4) fine to coarse sand, trace silt, trace pebble gravel		
	120					
880						
				grades dark yellowish brown (10YR 4/4)		
	125			grades dark yellowish brown (10YR 3/6), some silt, trace reddish brown (5YR 4/4) clay balls grades dark yellowish brown (10YR 4/6), some silt/clay, clay balls grade out		
875						
	130					
				Sandy CLAY (SC): reddish brown (5YR 4/4), moist, fine sand		
870				SAND (SP): dark yellowish brown (10YR 4/6), fine to medium sand, some silt/clay		
	135			SAND & GRAVEL (SW/GP): dark yellowish brown, fine to coarse sand, gravel is sub-rounded & angular fragments, very fine pebble to pebble size		

Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH™ ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-1

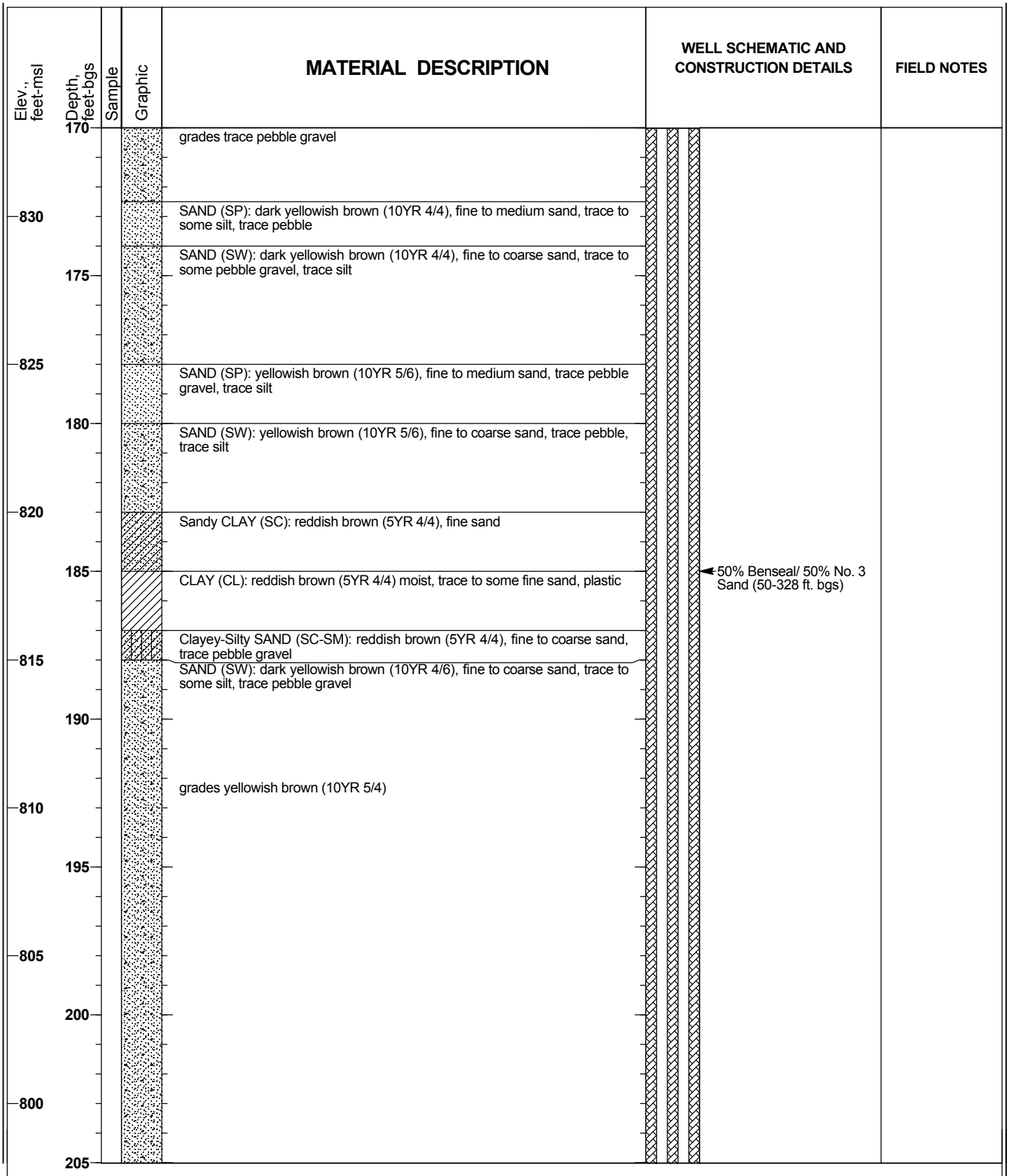
Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	135			fragments of igneous & mafic clasts, trace silt		
				SAND (SW): dark yellowish brown (10YR 4/4), fine to coarse sand, trace silt, trace pebble gravel		
				SAND (SP): yellowish brown (10YR 4/4), fine to medium sand, trace to some silt, trace very fine pebble gravel		
865				SAND (SW): dark yellowish brown (10YR 4/4), fine to coarse sand, trace fine gravel, trace to some silt		
	140					
				SAND & GRAVEL (SW/GP): dark yellowish brown (10YR 4/4), fine to coarse sand, gravel is pebble, trace silt		
860						
	145					
855				SAND (SW): dark yellowish brown (10YR 4/4), fine to coarse sand, trace pebble, trace silt		
	150				50% Benseal/ 50% No. 3 Sand (50-328 ft. bgs)	
				CLAY (CL): dark yellowish brown (10YR 3/6), moist, trace sand, plastic		
				SAND (SW): dark yellowish brown (10YR 4/4), fine to coarse sand, trace to some silt, trace pebble gravel		
850						
	155					
845						
	160					
840						
	165					
835						
				grades some pebble gravel		
	170					

Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-1



Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-1

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
795	205					
	210			grades some pebble to cobble gravel		
790				decrease of cobble gravel		
	215					
785				trace dark yellowish brown (10YR 4/6), sandy clay balls		
	220				50% Benseal/ 50% No. 3 Sand (50-328 ft. bgs)	
780						
	225					
				SAND (SP): yellowish brown (10YR 5/4), fine to medium sand, trace to some silt, trace pebble gravel		
775				SAND (SW): yellowish brown (10YR 5/4), fine to coarse sand, trace pebble gravel, trace silt		
	230			SAND (SP): dark yellowish brown (10YR 4/4), fine to medium sand, trace silt, trace to some pebble gravel		
770				SAND (SW): yellowish brown (10YR 5/4), fine to coarse sand, trace to some pebble gravel, trace silt		
	235					
765				SAND & GRAVEL (SW/GW): dark yellowish brown (10YR 4/4), fine to coarse sand, gravel is pebble to boulder(?) clean to trace silt		
	240					

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-1

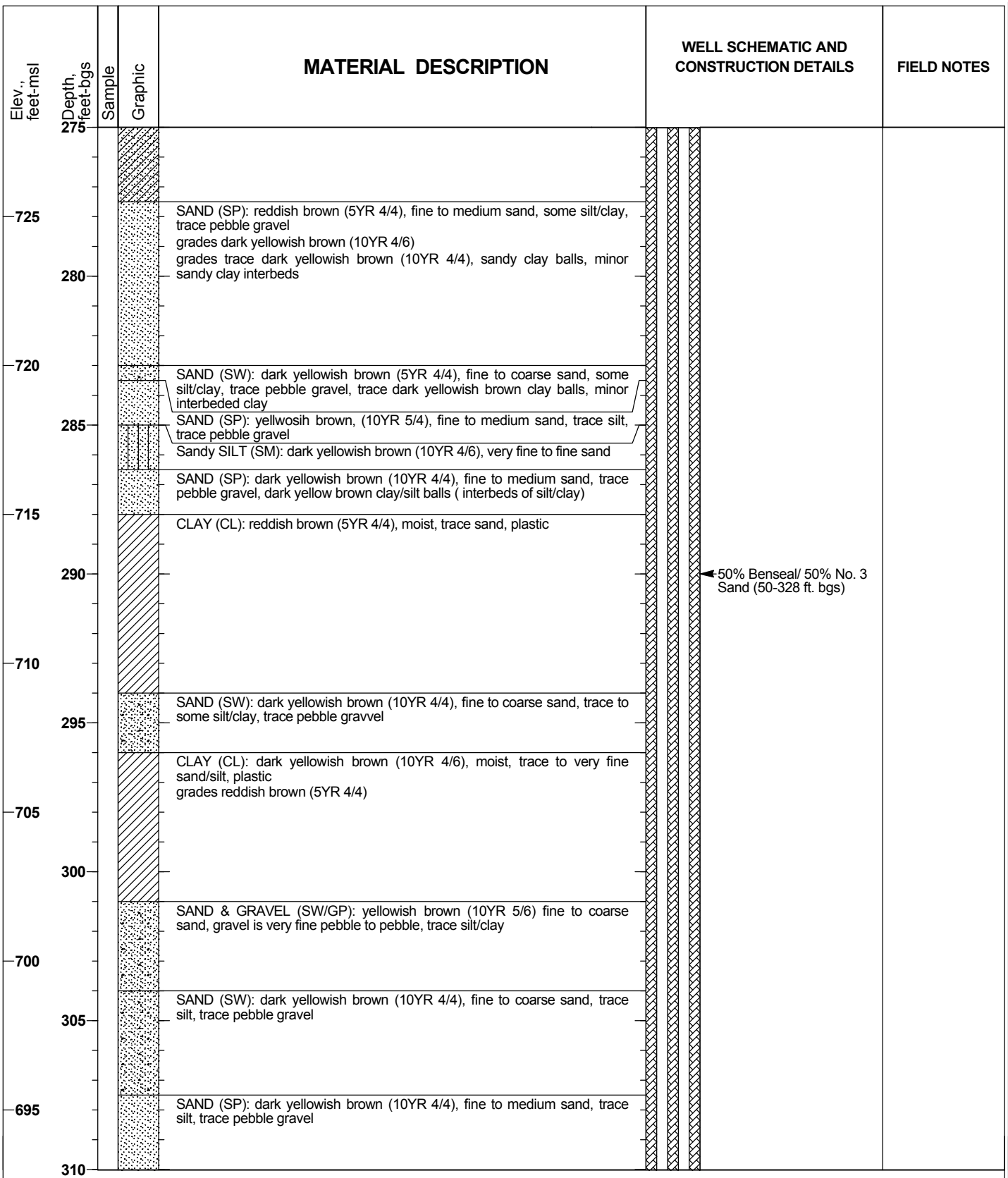
Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
760	240			SAND (SP): dark yellowish brown (10YR 4/4), fine to medium sand, trace silt, trace pebble gravel		
				SAND (SW): yellowish brown (10YR 5/6), fine to coarse sand, trace to some pebble gravel, clean to trace silt		
755	245					
750	250					
745	255				50% Benseal/ 50% No. 3 Sand (50-328 ft. bgs)	
740	260					
				SAND (SP): dark yellowish brown (10YR 4/4), fine to medium sand, trace silt, trace pebble gravel		
735	265			CLAY (CL): yellowish brown (10YR 5/6), moist, trace sand, plastic		
				SAND (SW): yellowish brown (10YR 5/6), fine to coarse sand, trace silt, trace pebbel gravel		
730	270					
	275			Sandy CLAY (SC): reddish brown (5YR 4/4), moist, fine sand		

Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH™ ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

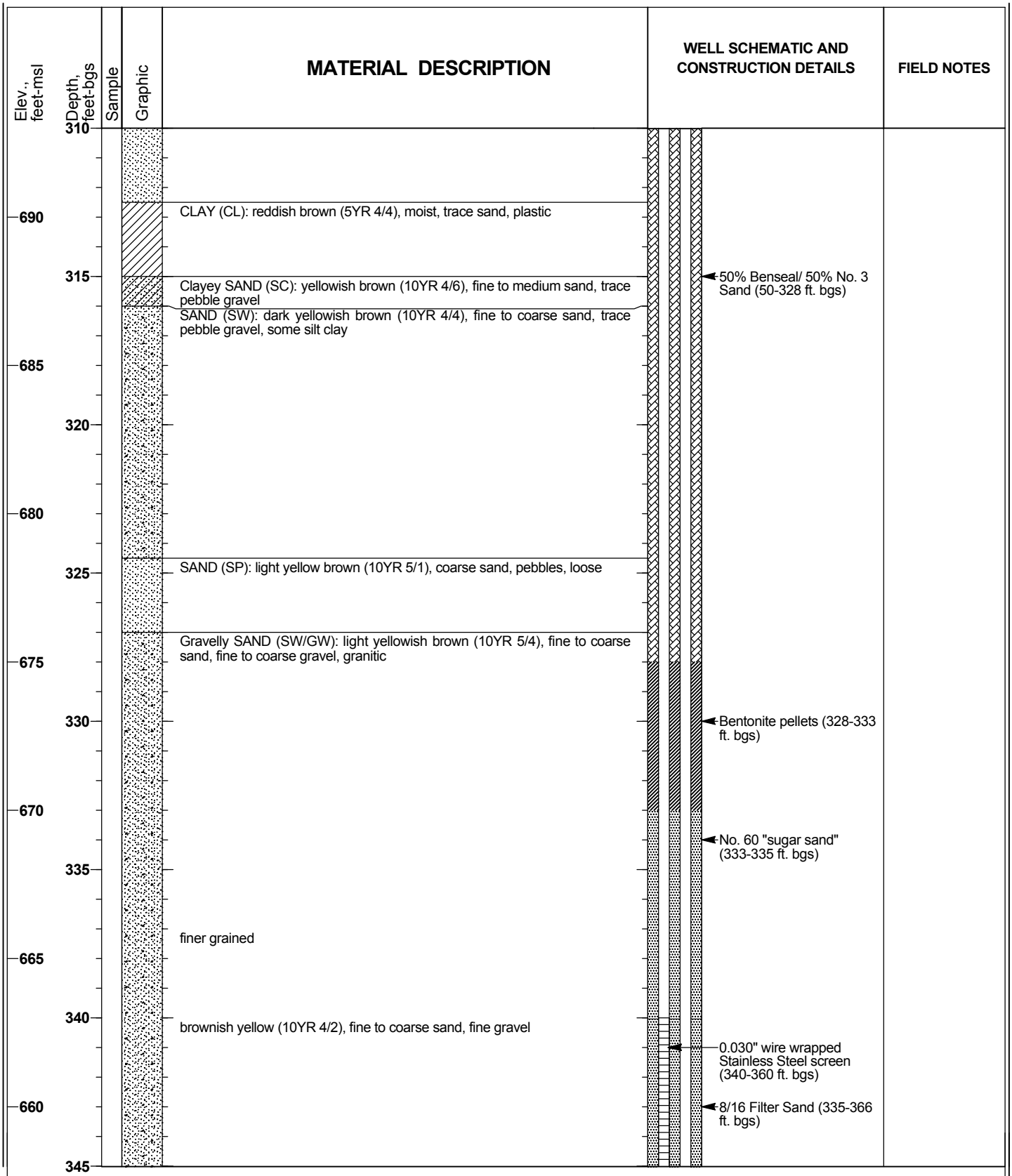
Monitoring Well: T-1



WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-1

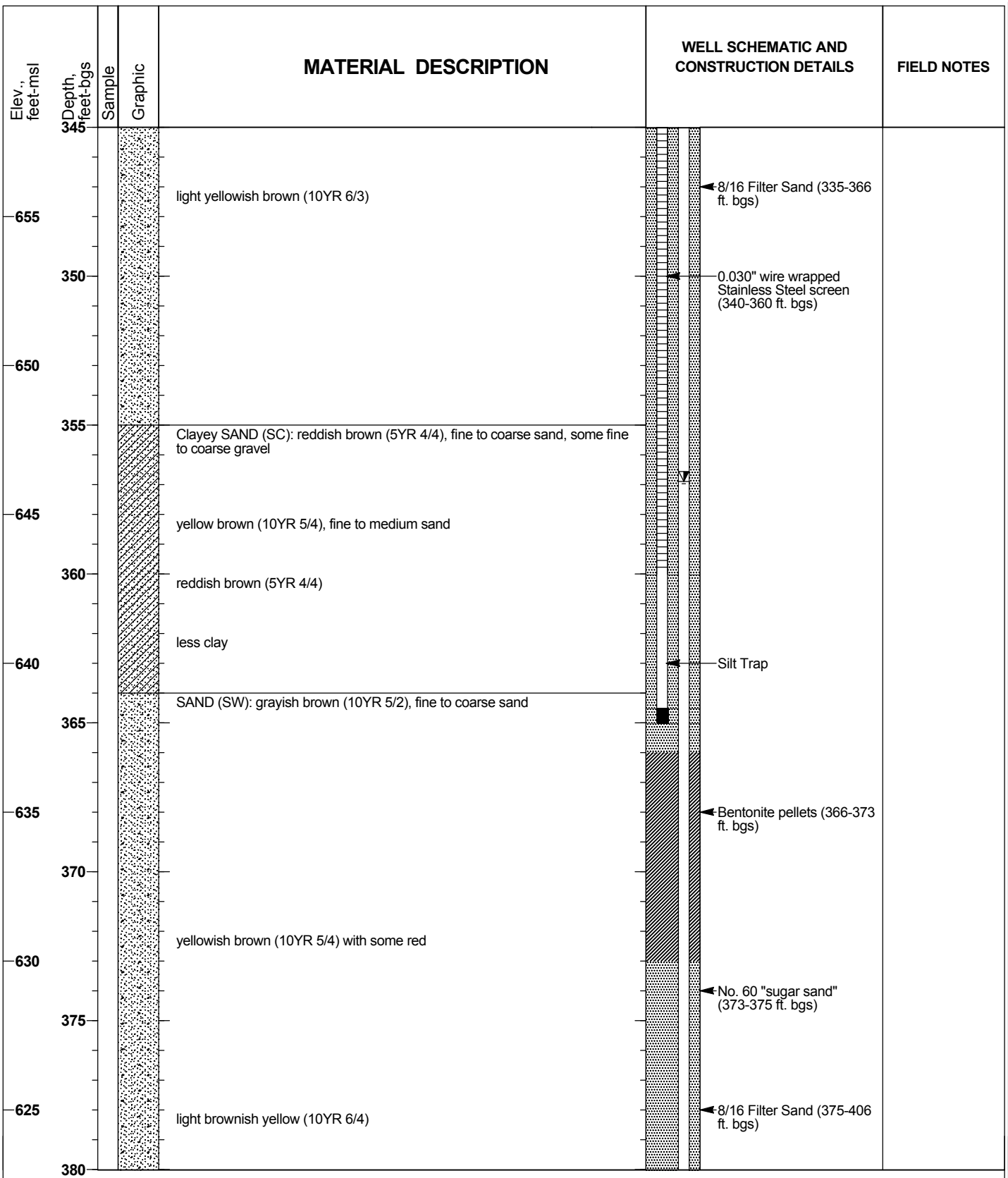


Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-1

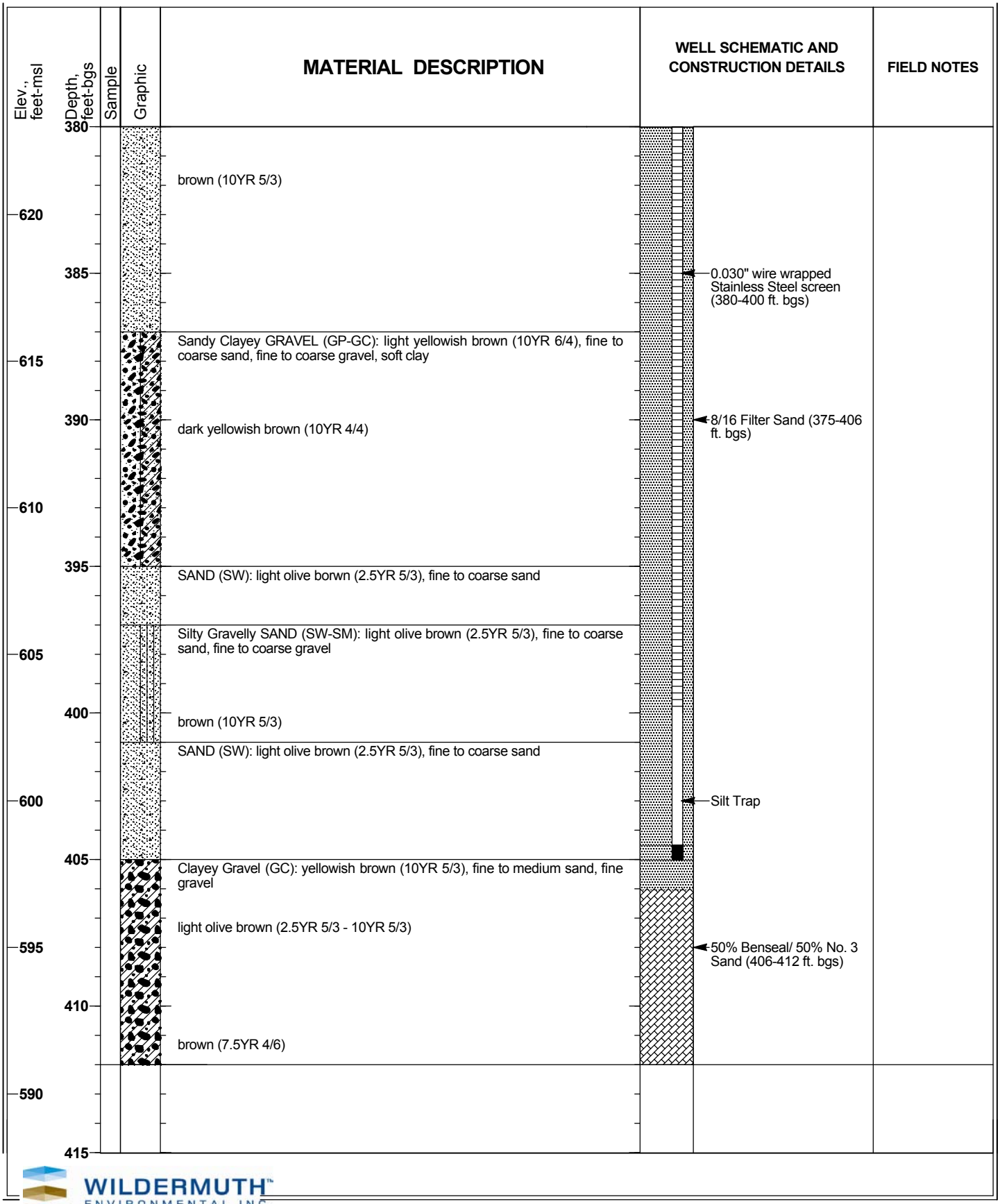


Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-1



Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**	**Monitoring Well: T-2**	
Project Location:	**Chino Basin, California**		
Project Number:	**007-003**	Sheet 1 of 13	
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**		

Date Started	**8/29/05**	Date Finished	**9/15/05**	Borehole Depth	**420.0 feet**	Drilling Contractor	**Layne-Christensen Drilling**
Lat.	**34° 4' 21.66"**	Long.	**117° 35' 49.96"**	Drill Bit Size/Type	**17.5-inch Tri-cone**	Driller	**Victor Olveda**
Ground Surface Elevation	**981.0 feet**			Screened Interval(s)	**350-370, 392-412**	Drill Rig Type	**Ingersoll-Rand RO 300 Mud**
Top of Casing Elevation	**983.0 feet**			Depth to Groundwater	**351.9, 10/5/2005**	Drilling Method	**Flooded Reverse Circulation**
Logged By	**D. Bramwell, PG, CEG**			Reviewed By	**B. Leever, PG, CHG**	Sampling Method	**Grab**

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
					24" diameter steel with water tight locking lid	
980	0			SAND (SP): yellowish brown (10YR 5/4), dry, fine to medium sand, trace silt		
	5				30" nominal dia. borehole with 24" diameter x 3/8" thick steel conductor casing and cement sanitary seal (0-50 ft. bgs)	
975				grades yellowish brown (10YR 5/6)		
				SAND (SW): dark yellowish brown (10YR 4/4), dry to moist, fine to coarse sand, trace silt, trace to some pebble to cobble, gravel		
	10				T-2/1: 4" dia. Sch 10 Type 304 casing (with stainless steel screen from 350-370 ft. bgs)	
970				grades moist		
	15				T-2/2: 4" dia. Sch 10 Type 304 casing (with stainles steel screen from 392-412 ft. bgs)	
965				trace black to very dark brown, silt balls,moist		
				grades moist to wet		
				grades moist		
	20				Cement inside conductor casing (0-50 ft. bgs)	
960				dark yellowish brown (10YR 4/4), grades clean		
				grades moist to wet		
	25					
955				SAND (SP): dark yellowish brown (10YR 4/6), dry to moist, fine to medium sand, trace silt, trace pebble to cobble		
				grades moist		
				SAND (SW): dark yellowish brown (10YR 4/6, moist, fine to coarse sand, clean to trace silt, some pebble to cobble gravel		
				Gravelly SAND (SW): dark yellowish brown, moist to wet, fine to coarse sand, gravel is pebble to boulder(?) trace silt		
	30					

Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-2

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
950	30			SAND (SP): dark yellowish brown (10YR 4/4), moist, fine to medium sand, trace silt, trace pebble to cobble		
				Silty SAND (SM): dark yellowish brown (10YR 4/6), moist, fine sand, trace mica, trace gravel		
				SAND (SW): dark yellowish brown (10YR 4/4), dry to moist, fine to coarse sand, trace silt, some pebble to cobble		
945	35			Silty SAND (SM): dark yellowish brown (10YR 3/6), moist, very fine to fine sand, trace mica		
				SAND (SW): dark yellowish brown (10YR 4/4), moist to dry, sand is fine to coarse, some silt, some pebble to cobble		
				grades moist to wet		
940	40				Cement inside conductor casing (0-50 ft. bgs)	
				Silty SAND (SM): reddish brown (5YR 4/3), moist to wet, very fine to fine sand, trace mice		
				SILT (ML): reddish brown (5YR 4/3), dry, trace to some fine sand, trace pebble gravel		
				SAND (SP): reddish brown (5YR 4/4) dry to moist, fine to very fine sand, trace to some silt, trace mica		
935	45			grades dark yellowish brown (10YR 4/6), fine to medium sand, trace silt		
930	50					
925	55			yellowish brown (10YR 5/4), fine to medium sand, trace silt, trace pebble gravel	50% Benseal/ 50% No. 3 Sand (50-338 ft. bgs)	
920	60			grades dark yellowish brown (10YR 3/6)		
	65			grades trace reddish brown (5YR 4/4), clay balls		

Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-2

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
915	65			SAND (SW): dark yellowish brown (10YR 3/6), fine to coarse sand, trace to some silt/clay, trace pebble gravel, trace dark yellowish brown sandy clay balls		
910	70					
	75			SAND (SP): yellowish brown (10YR 5/4) fine to medium sand, some silt		
905						
	80				50% Benseal/ 50% No. 3 Sand (50-338 ft. bgs)	
900						
	85					
895						
	90					
890						
	95			SAND (SW): dark yellowish brown (10YR 4/4), fine to coarse sand, trace silt, trace pebble gravel		
885						
	100					

Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-2

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
880	100					
875	105					
870	110					
865	115			SAND (SP): dark yellowish brown, (10YR 4/4), fine to medium sand, trace silt, trace pebble gravel	50% Benseal/ 50% No. 3 Sand (50-338 ft. bgs)	
860	120			SAND (SW): yellowish brown (10YR 5/6), fine to coarse sand, trace silt, trace pebble gravel		
855	125			Gravelly SAND (GW): dark yellowish brown (10YR 4/4), fine to coarse sand, pebble gravel, clean to trace silt		
850	130			SAND (SW): yellowish brown (10YR 5/6), fine to coarse sand, trace to some pebble gravel, clean to trace silt SAND (SP); yellowish brown (10YR 5/6),fine to medium sand, trace pebble gravel, clean to trace silt, trace dark yellowish brown, (10YR 3/6), clay balls		
	135			Sandy CLAY (SC): reddish brown (5YR 4/4), moist, fine sand SAND (SW): reddish brown (5YR 4/4), fine to coarse sand, some silt/clay		

Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-2

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
845	135			CLAY (CL): dark yellowish brown (10YR 4/60, moist, some fine sand		
	140					
840				SAND (SP): dark yellowish brown (10YR 4/4), fine to medium sand, trace to some silt/clay, trace pebble gravel		
	145			SAND (SW): yellowish brown (10YR 5/4), fine to coarse sand, trace pebble gravel, trace silt		
835				SAND (SP): yellowish brown (10YR 5/4), fine to medium sand, trace pebble gravel, trace silt		
	150				50% Benseal/ 50% No. 3 Sand (50-338 ft. bgs)	
830						
	155					
825				SAND (SW): yellowish brown (10YR 5/4), fine to coarse sand, trace silt, trace pebble gravel		
	160					
820						
	165					
815				Clayey SAND (SC): dark yellowish brown (10YR 4/6), fine sand fine to medium sand		
	170					

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-2

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
810	170					
				SAND & GRAVEL (SW/GP): dark yellowish brown (10YR 4/4), fine to coarse sand, clean to trace silt, pebble gravel		
805	175					
	180			Sandy CLAY (SC-CL): reddish brown (5YR 4/3), moist, fine sand		
800						
	185			Clayey Silty SAND (SC-SM): reddish brown (5YR 4/3), fine to coarse, trace pebble	◄50% Benseal/ 50% No. 3 Sand (50-338 ft. bgs)	
795						
	190			SAND (SW): yellowish brown (10YR 5/6), fine to coarse sand, some silt/clay, trace pebble gravel		
790						
785	195					
	200			SAND (SP): yellowish brown (10YR 5/4), fine to medium sand, trace silt, trace pebble gravel		
780						
	205			SAND (SW): yellowish brown (10YR 5/6), fine to coarse sand, clean to trace silt, trace pebble gravel		

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-2

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
775	205					
770	210					
765	215			CLAY (CL): reddish brown (5YR 4/4), moist		
				Clayey Silty SAND (SC-SM): reddish brown (5YR 4/4), fine to medium grained		
760	220			SAND (SW): yellowish brown (10YR 5/6), fine to coarse sand, trace silt, trace pebble gravel	50% Benseal/ 50% No. 3 Sand (50-338 ft. bgs)	
755	225					
750	230			SAND (SP): yellowish brown (10YR 5/6), fine to medium sand, trace silt, trace pebble gravel		
745	235			SAND (SW): yellowish brown (10YR 5/4), fine to coarse sand, clean to trace silt, trace pebble gravel		
	240					

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-2

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
740	240					
	245					
735						
	250			CLAY (CL): reddish brown (5YR 4/4), moist trace sand		
730				Clayey SAND (SC): reddish brown (5YR 4/4), fine to medium sand		
	255			SAND (SW): yellowish brown (10YR 5/6), fine to coarse sand, trace silt, trace pebble gravel	◄50% Benseal/ 50% No. 3 Sand (50-338 ft. bgs)	
725						
	260					
720				SAND & GRAVEL (SW-GP): yellowish brown (10YR 5/4), sand is fine to coarse, pebble gravel, trace silt		
	265			Clayey Silty SAND (SC-SM): dark yellowish brown (10YR 4/6), fine to coarse sand, trace pebble gravel		
715				CLAY (CL): reddish brown (5YR 4/4), moist trace to some sand, plastic		
	270					
710				Clayey Silty SAND (SC-SM): yellowish brown (10YR 5/6), fine to medium sand		
	275			grades reddish brown (5YR 4/4)		

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Project Name:	**Recycled Water Groundwater Recharge Project**
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Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-2

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
705	275			SAND (SW): dark yellowish brown (10YR 4/6), fine to coarse sand, some clay/silt, trace pebble gravel		
				trace dark yellowish brown, sandy silty balls		
700	280			Clayey SAND (SC): dark yellowish brown (10YR 4/6), fine to medium sand, trace pebble gravel		
695	285			SAND (SW): dark yellowish brown (10YR 4/6), fine to coarse sand, some to trace silt/clay, trace pebble gravel		
690	290			CLAY (CL): dark yellowish brown (10YR 4/6), moist, trace sand,	50% Benseal/ 50% No. 3 Sand (50-338 ft. bgs)	
685	295					
680	300					
675	305			Clayey SAND (SC): reddish brown (5YR 4/3), fine to coarse sand, trace pebble gravel		
				SAND (SW): dark yellowish brown, (10YR 4/4), fine to coarse sand, trace silt, trace pebble gravel		
	310					

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Monitoring Well: T-2

Elev., feet-msl	Depth, feet-bgs	Sample	Graphic	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
670	310			CLAY (CL): dark yellowish brown (10YR 4/6), moist trace sand		
665	315					
660	320			Clayey-Silty SAND (SC-SM): dark yellowish brown (10YR 4/6), fine to coarse sand, trace pebble gravel		
				graded reddish brown (5YR 4/3)		
655	325				50% Benseal/ 50% No. 3 Sand (50-338 ft. bgs)	
				SAND (SW): yellowish brown (10YR 5/6), fine to coarse sand, clean to trace silt, trace pebble gravel		
650	330					
645	335					
640	340				Bentonite pellets (338-343 ft. bgs)	
				trace yellowish brown clay balls	No. 60 "sugar sand" (343-345 ft. bgs)	
	345					

Project Name:	**Recycled Water Groundwater Recharge Project**
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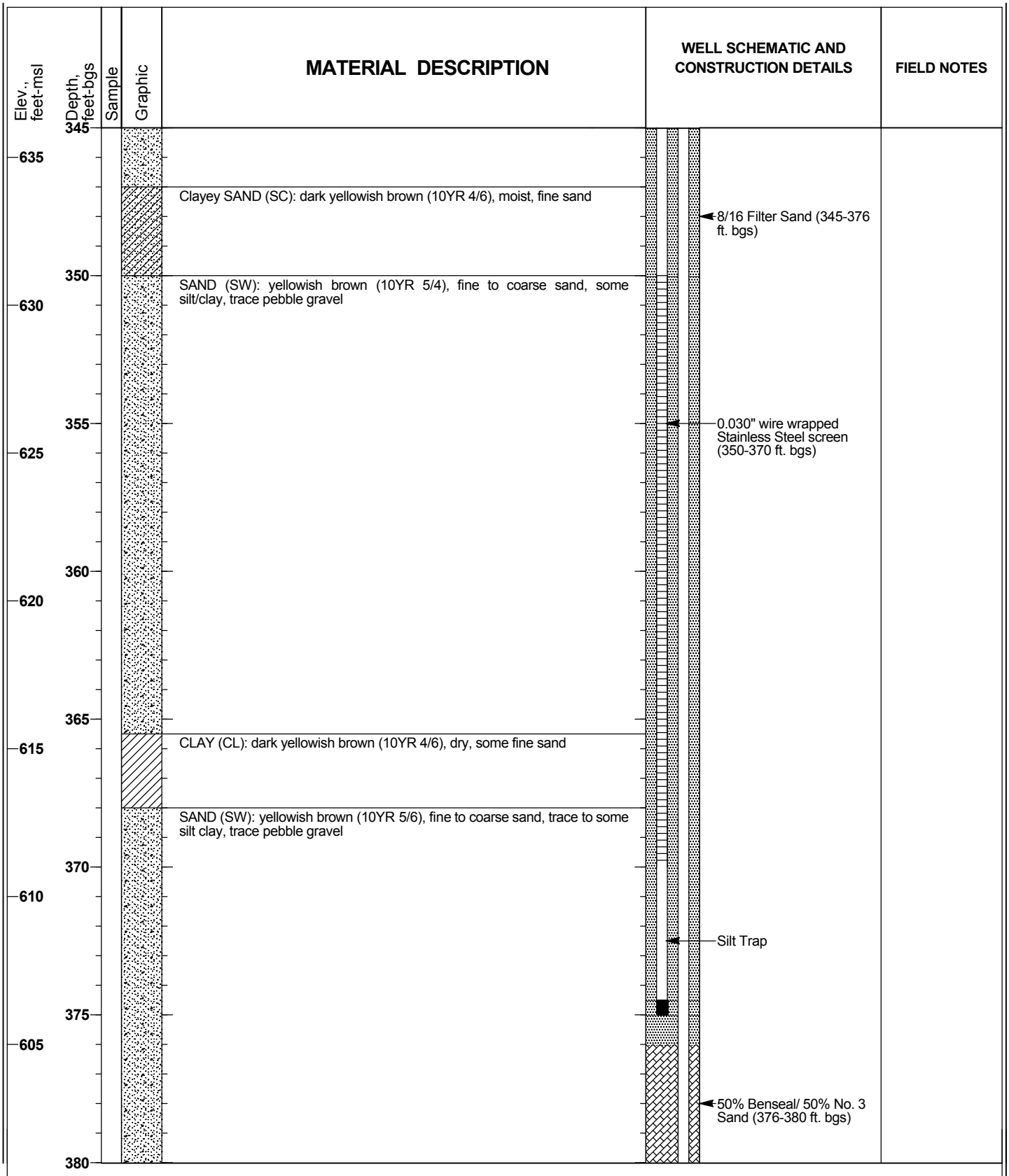
Monitoring Well: T-2

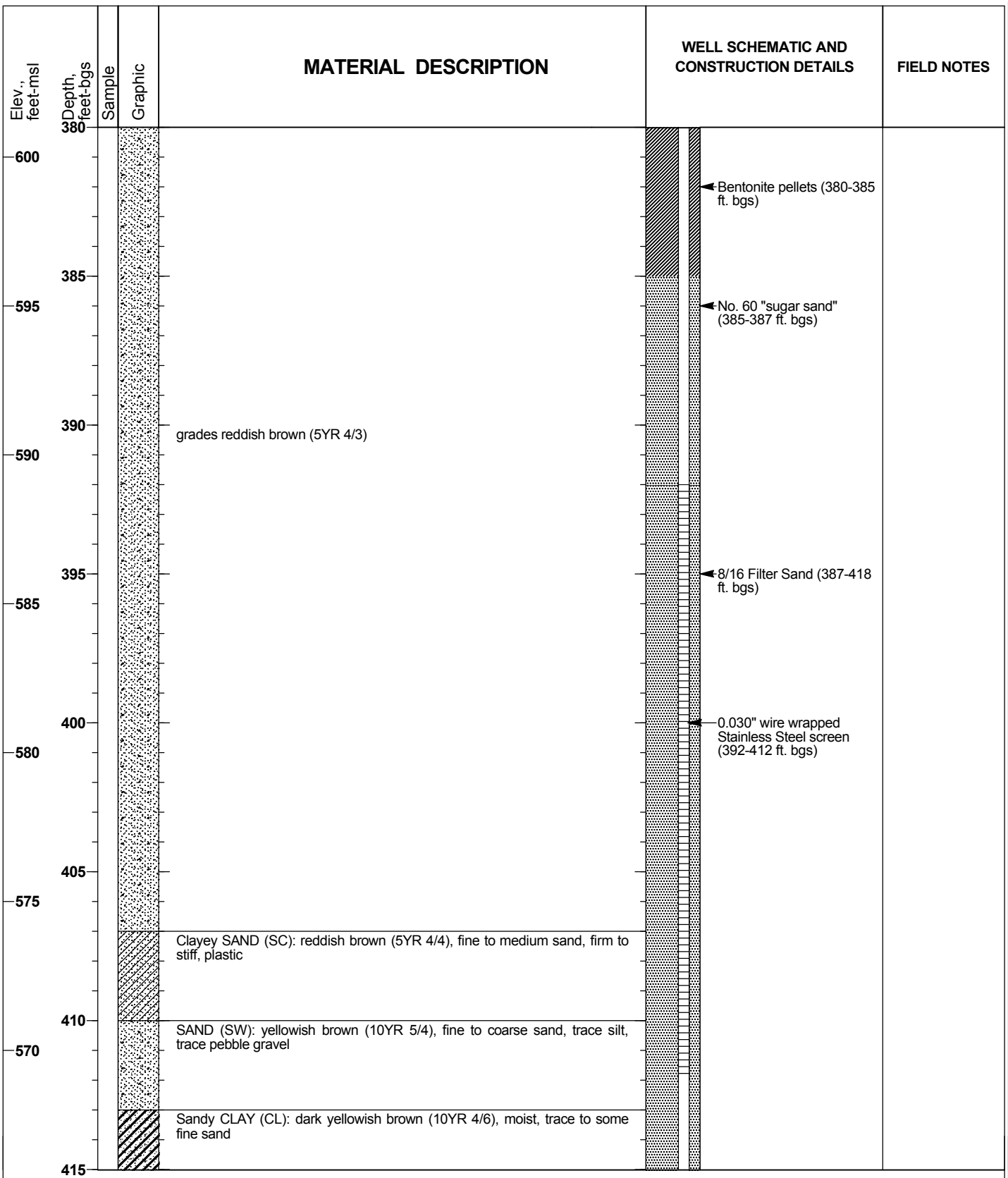


Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-2

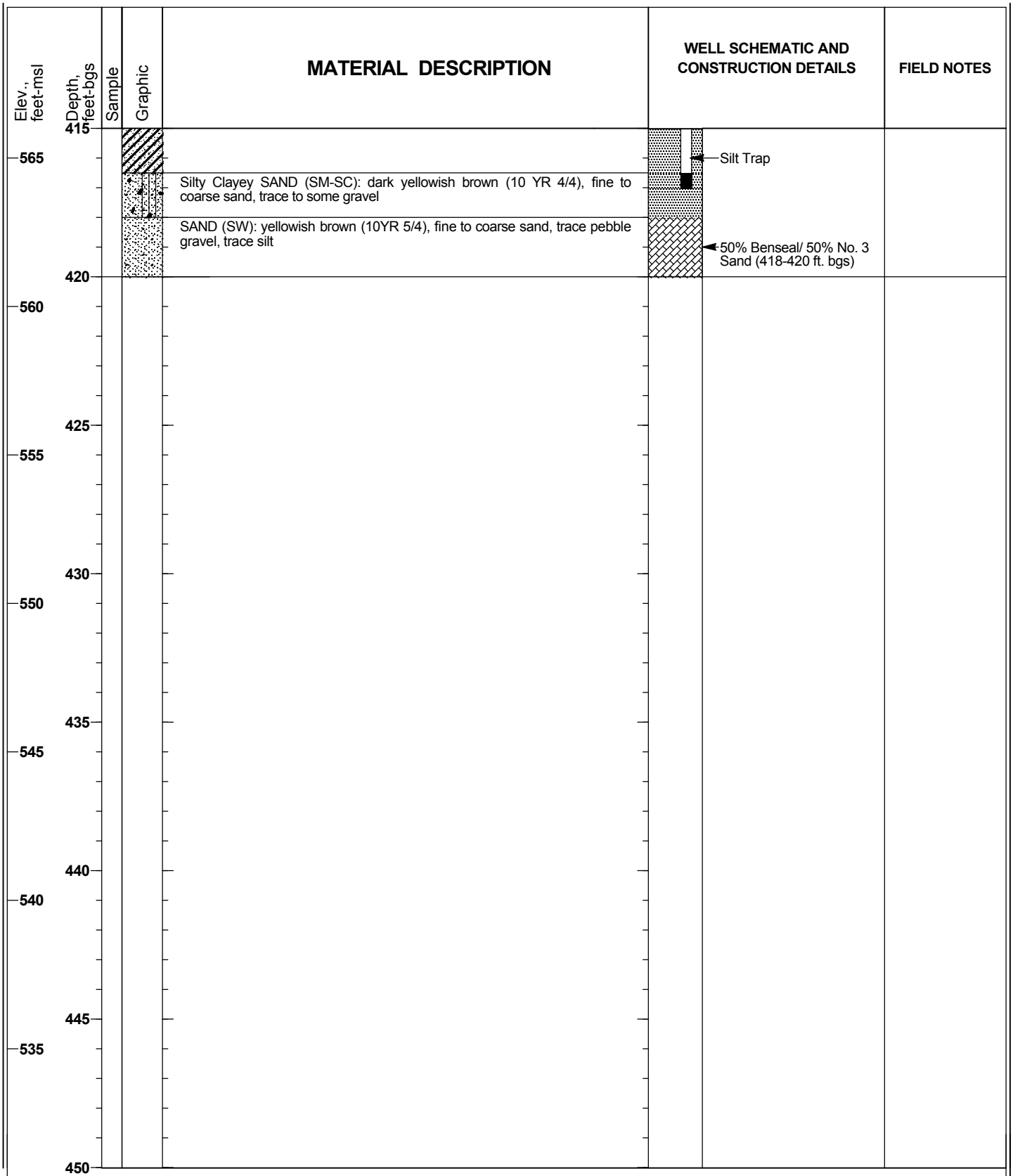


Report: WELL LOG V2; File: IEUA_GRRP.GPJ; 4/11/2006

WILDERMUTH ENVIRONMENTAL INC.

Project Name:	**Recycled Water Groundwater Recharge Project**
Project Location:	**Chino Basin, California**
Project Number:	**007-003**
Client:	**Inland Empire Utilties Agency/Chino Basin Watermaster**

Monitoring Well: T-2



WILDERMUTH ENVIRONMENTAL INC.

Appendix B.
Laboratory Certifications

Appendix C.
Analytical Methodologies and QA/QC Procedures

State of California—Health and Human Services Agency
Department of Health Services

SANDRA SHEWRY
Director

ARNOLD SCHWARZENEGGER
Governor

March 17, 2006

Certificate No.: 1808

NELLETJE GROENVELD
INLAND EMPIRE UTILITIES AGENCY LABORATORY
P.O. BOX 9020
CHINO HILLS, CA 91709

Dear NELLETJE GROENVELD:

This is to advise you that the laboratory named above has been certified as an environmental testing laboratory pursuant to the provisions of the California Environmental Laboratory Improvement Act (Health and Safety Code (HSC), Division 101, Part 1, Chapter 4, Section 100825, et seq.).

The Fields of Testing for which this laboratory has been certified under this Act are indicated on the enclosed "Accredited Fields of Testing." Certification shall remain in effect until **October 31, 2006** unless revoked. This certificate is subject to an annual fee as prescribed by Section 100860(a), HSC, due on October 31, 2005.

Your application for renewal must be received 90 days before the expiration of your certificate to remain in force according to the California Code of Regulations, Title 22, Division 4, Chapter 19, Section 64801 through 64827.

Any changes in laboratory location or structural alterations, which may affect adversely the quality of analysis in the fields of testing for which the laboratory has been granted certification, require prior notification. Notification is also required for changes in ownership or laboratory director within 30 days after the change (HSC, Section 100845(b) and (d)).

Your continued cooperation is essential to maintain high quality of the data produced by environmental laboratories certified by the State of California.

If you have any questions, please contact Bill Walker at (213) 580-5731.

Sincerely,

George C. Kulasingam

George C. Kulasingam, Ph.D.
Program Chief
Environmental Laboratory Accreditation Program

Enclosure

CALIFORNIA DEPARTMENT OF HEALTH SERVICES
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM
Accredited Fields of Testing

INLAND EMPIRE UTILITIES AGENCY LABORATORY **Lab Phone** (909) 993-1600
LABORATORY
2450 E. PHILADELPHIA STREET
ONTARIO, CA 91761

Certificate No: 1808 **Renew Date: 10/31/2006**

Field of Testing: 101 - Microbiology of Drinking Water

101.010	001	Heterotrophic Bacteria	SM9215B
101.020	001	Total Coliform	SM9221A,B
101.021	001	Fecal Coliform	SM9221E (MTF/EC)
101.120	001	Total Coliform (Enumeration)	SM9221A,B,C
101.130	001	Fecal Coliform (Enumeration)	SM9221E (MTF/EC)
101.160	001	Total Coliform (Enumeration)	SM9223

Field of Testing: 102 - Inorganic Chemistry of Drinking Water

102.030	001	Bromide	EPA 300.0
102.030	003	Chloride	EPA 300.0
102.030	005	Fluoride	EPA 300.0
102.030	006	Nitrate	EPA 300.0
102.030	007	Nitrite	EPA 300.0
102.030	008	Phosphate, Ortho	EPA 300.0
102.030	010	Sulfate	EPA 300.0
102.045	001	Perchlorate	EPA 314.0
102.100	001	Alkalinity	SM2320B
102.120	001	Hardness	SM2340B
102.121	001	Hardness	SM2340C
102.130	001	Conductivity	SM2510B
102.145	001	Total Dissolved Solids	EPA 160.1
102.190	001	Cyanide, Total	SM4500-CN E
102.200	001	Fluoride	SM4500-F C
102.220	001	Nitrite	SM4500-NO2 B
102.240	001	Phosphate, Ortho	SM4500-P E
102.260	001	Total Organic Carbon	SM5310B
102.261	001	DOC	SM5310B
102.262	001	Total Organic Carbon	SM5310C
102.520	001	Calcium	EPA 200.7
102.520	002	Magnesium	EPA 200.7
102.520	003	Potassium	EPA 200.7
102.520	004	Silica	EPA 200.7
102.520	005	Sodium	EPA 200.7
102.520	006	Hardness (calc.)	EPA 200.7
102.533	001	Silica	SM4500-Si D

Field of Testing: 103 - Toxic Chemical Elements of Drinking Water

103.130	001	Aluminum	EPA 200.7
103.130	003	Barium	EPA 200.7
103.130	004	Beryllium	EPA 200.7
103.130	005	Cadmium	EPA 200.7
103.130	007	Chromium	EPA 200.7
103.130	008	Copper	EPA 200.7
103.130	009	Iron	EPA 200.7
103.130	011	Manganese	EPA 200.7
103.130	012	Nickel	EPA 200.7
103.130	015	Silver	EPA 200.7

103.130	017	Zinc	EPA 200.7
103.130	018	Boron	EPA 200.7
103.140	001	Aluminum	EPA 200.8
103.140	002	Antimony	EPA 200.8
103.140	003	Arsenic	EPA 200.8
103.140	004	Barium	EPA 200.8
103.140	005	Beryllium	EPA 200.8
103.140	006	Cadmium	EPA 200.8
103.140	007	Chromium	EPA 200.8
103.140	008	Copper	EPA 200.8
103.140	009	Lead	EPA 200.8
103.140	010	Manganese	EPA 200.8
103.140	012	Nickel	EPA 200.8
103.140	013	Selenium	EPA 200.8
103.140	014	Silver	EPA 200.8
103.140	015	Thallium	EPA 200.8
103.140	016	Zinc	EPA 200.8
103.140	017	Boron	EPA 200.8
103.140	018	Vanadium	EPA 200.8
103.161	001	Mercury	EPA 245.2
Field of Testing:		104 - Volatile Organic Chemistry of Drinking Water	
104.040	000	Volatile Organic Compounds	EPA 524.2
Field of Testing:		107 - Microbiology of Wastewater	
107.010	001	Heterotrophic Bacteria	SM9215B
107.020	001	Total Coliform	SM9221B
107.040	001	Fecal Coliform	SM9221C,E (MTF/EC)
107.245	001	E. coli	SM9223
Field of Testing:		108 - Inorganic Chemistry of Wastewater	
108.050	001	pH	EPA 150.1
108.060	001	Residue, Filterable	EPA 160.1
108.070	001	Residue, Non-filterable	EPA 160.2
108.080	001	Residue, Total	EPA 160.3
108.090	001	Residue, Volatile	EPA 160.4
108.100	001	Residue, Settleable	EPA 160.5
108.110	001	Turbidity	EPA 180.1
108.112	001	Boron	EPA 200.7
108.112	002	Calcium	EPA 200.7
108.112	003	Hardness (calc.)	EPA 200.7
108.112	004	Magnesium	EPA 200.7
108.112	005	Potassium	EPA 200.7
108.112	006	Silica	EPA 200.7
108.112	007	Sodium	EPA 200.7
108.120	002	Chloride	EPA 300.0
108.120	004	Nitrate	EPA 300.0
108.120	005	Nitrite	EPA 300.0
108.120	006	Nitrate-nitrite, Total	EPA 300.0
108.120	007	Phosphate, Ortho	EPA 300.0
108.120	008	Sulfate	EPA 300.0
108.200	001	Ammonia	EPA 350.1
108.201	001	Ammonia	EPA 350.2
108.202	001	Ammonia	EPA 350.3
108.211	001	Kjeldahl Nitrogen	EPA 351.2
108.212	001	Kjeldahl Nitrogen	EPA 351.3
108.250	001	Dissolved Oxygen	EPA 360.1

108.266	001	Phosphorus, Total	EPA 365.4
108.320	001	Chemical Oxygen Demand	EPA 410.1
108.321	001	Chemical Oxygen Demand	EPA 410.2
108.322	001	Chemical Oxygen Demand	EPA 410.3
108.340	001	Total Organic Carbon	EPA 415.1
108.380	001	Oil and Grease	EPA 1664
108.410	001	Alkalinity	SM2320B
108.420	001	Hardness (calc.)	SM2340B
108.421	001	Hardness	SM2340C
108.430	001	Conductivity	SM2510B
108.464	001	Chlorine	SM4500-Cl F
108.465	001	Chlorine	SM4500-Cl G
108.470	001	Cyanide, Manual Distillation	SM4500-CN C
108.472	001	Cyanide, Total	SM4500-CN E
108.510	001	Nitrite	SM4500-NO2 B
108.540	001	Phosphate, Ortho	SM4500-P E
108.541	001	Phosphorus, Total	SM4500-P E
108.580	001	Sulfide	SM4500-S= D
108.590	001	Biochemical Oxygen Demand	SM5210B
108.602	001	Chemical Oxygen Demand	SM5220D
108.611	001	Total Organic Carbon	SM5310C

Field of Testing: 109 - Toxic Chemical Elements of Wastewater

109.010	001	Aluminum	EPA 200.7
109.010	002	Antimony	EPA 200.7
109.010	003	Arsenic	EPA 200.7
109.010	004	Barium	EPA 200.7
109.010	005	Beryllium	EPA 200.7
109.010	007	Cadmium	EPA 200.7
109.010	009	Chromium	EPA 200.7
109.010	010	Cobalt	EPA 200.7
109.010	011	Copper	EPA 200.7
109.010	012	Iron	EPA 200.7
109.010	013	Lead	EPA 200.7
109.010	015	Manganese	EPA 200.7
109.010	016	Molybdenum	EPA 200.7
109.010	017	Nickel	EPA 200.7
109.010	019	Selenium	EPA 200.7
109.010	021	Silver	EPA 200.7
109.010	023	Thallium	EPA 200.7
109.010	026	Vanadium	EPA 200.7
109.010	027	Zinc	EPA 200.7
109.020	001	Aluminum	EPA 200.8
109.020	002	Antimony	EPA 200.8
109.020	003	Arsenic	EPA 200.8
109.020	004	Barium	EPA 200.8
109.020	005	Beryllium	EPA 200.8
109.020	006	Cadmium	EPA 200.8
109.020	007	Chromium	EPA 200.8
109.020	008	Cobalt	EPA 200.8
109.020	009	Copper	EPA 200.8
109.020	010	Lead	EPA 200.8
109.020	011	Manganese	EPA 200.8
109.020	012	Molybdenum	EPA 200.8
109.020	013	Nickel	EPA 200.8
109.020	014	Selenium	EPA 200.8

109.020	015	Silver	EPA 200.8
109.020	016	Thallium	EPA 200.8
109.020	017	Vanadium	EPA 200.8
109.020	018	Zinc	EPA 200.8
109.191	001	Mercury	EPA 245.2
Field of Testing:		110 - Volatile Organic Chemistry of Wastewater	
110.040	040	Halogenated Hydrocarbons	EPA 624
110.040	041	Aromatic Compounds	EPA 624
110.040	043	Other Volatile Organics	EPA 624
Field of Testing:		111 - Semi-volatile Organic Chemistry of Wastewater	
111.101	032	Polynuclear Aromatic Hydrocarbons	EPA 625
111.101	034	Phthalates	EPA 625
111.101	036	Other Extractables	EPA 625
111.170	030	Organochlorine Pesticides	EPA 608
111.170	031	PCBs	EPA 608
Field of Testing:		113 - Whole Effluent Toxicity of Wastewater	
113.023	005B	Daphnid (C. dubia)	EPA 2002 (EPA-821-R-02-012), Static
113.051	005	Daphnid (C. dubia)	EPA 1002 (EPA-821-R-02-013)

State of California—Health and Human Services Agency
Department of Health Services

SANDRA SHEWRY
Director

ARNOLD SCHWARZENEGGER
Governor

February 2, 2006

Certificate No.: 01114CA

ANDREW D. EATON, Ph.D.
MWH LABORATORIES, a division of MWH Americas, Inc.
750 ROYAL OAKS DRIVE, SUITE 100
MONROVIA, CA 91016-3629

Dear ANDREW D. EATON, Ph.D.:

Enclosed is a corrected copy of your accreditation papers. We apologize for any inconvenience this may have caused you.

If you have any questions, please contact our office at (510) 620-3155.

Sincerely,

George C. Kulasingam, Ph.D.
Program Chief
Environmental Laboratory Accreditation Program

Enclosure

CALIFORNIA DEPARTMENT OF HEALTH SERVICES

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM - NELAP RECOGNIZED

Fields of Accreditation

MWH LABORATORIES, a division of MWH Americas, Inc. **Lab Phone** (626) 386-1100

750 ROYAL OAKS DRIVE, SUITE 100
MONROVIA, CA 91016-3629

Certificate No: 01114CA Renew Date: 1/31/2007

101 - Microbiology of Drinking Water			
101.010	001	SM9215B	Heterotrophic Bacteria
101.020	001	SM9221A,B	Total Coliform
101.021	001	SM9221E (MTF/EC)	Fecal Coliform
101.060	002	SM9223	Total Coliform
101.060	003	SM9223	E. coli
101.120	001	SM9221A,B,C	Total Coliform (Enumeration)
101.130	001	SM9221E (MTF/EC)	Fecal Coliform (Enumeration)
101.160	001	SM9223	Total Coliform (Enumeration)
102 - Inorganic Chemistry of Drinking Water			
102.020	001	EPA 180.1	Turbidity
102.030	001	EPA 300.0	Bromide
102.030	002	EPA 300.0	Chlorate
102.030	003	EPA 300.0	Chloride
102.030	004	EPA 300.0	Chlorite
102.030	006	EPA 300.0	Nitrate
102.030	007	EPA 300.0	Nitrite
102.030	010	EPA 300.0	Sulfate
102.040	001	EPA 300.1	Bromide
102.040	002	EPA 300.1	Chlorite
102.040	003	EPA 300.1	Chlorate
102.040	004	EPA 300.1	Bromate
102.045	001	EPA 314.0	Perchlorate
102.050	001	EPA 335.4	Cyanide
102.060	001	EPA 353.2	Nitrate calc.
102.061	001	EPA 353.2	Nitrite
102.070	001	EPA 365.1	Phosphate, Ortho
102.100	001	SM2320B	Alkalinity
102.110	001	SM2330B	Corrosivity (Langlier Index)
102.120	001	SM2340B	Hardness
102.130	001	SM2510B	Conductivity
102.140	001	SM2540C	Total Dissolved Solids
102.145	001	EPA 160.1	Total Dissolved Solids
102.163	001	SM4500-Cl G	Free & Total Chlorine
102.180	001	SM4500-ClO2 D	Chlorine Dioxide
102.191	001	SM4500-CN F	Cyanide, Total
102.192	001	SM4500-CN G	Cyanide, amenable
102.200	001	SM4500-F C	Fluoride
102.210	001	SM4500-H+ B	pH
102.212	001	EPA 150.1	pH

As of 2/2/2006 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

102.240	001	SM4500-P E	Phosphate, Ortho
102.262	001	SM5310C	Total Organic Carbon
102.263	001	SM5310C	DOC
102.270	001	SM5540C	Surfactants
102.280	001	SM5910B	UV254
102.520	001	EPA 200.7	Calcium
102.520	002	EPA 200.7	Magnesium
102.520	003	EPA 200.7	Potassium
102.520	004	EPA 200.7	Silica
102.520	005	EPA 200.7	Sodium
102.520	006	EPA 200.7	Hardness (calc.)
102.533	001	SM4500-Si D	Silica
103 - Toxic Chemical Elements of Drinking Water			
103.130	001	EPA 200.7	Aluminum
103.130	003	EPA 200.7	Barium
103.130	004	EPA 200.7	Beryllium
103.130	005	EPA 200.7	Cadmium
103.130	007	EPA 200.7	Chromium
103.130	008	EPA 200.7	Copper
103.130	009	EPA 200.7	Iron
103.130	011	EPA 200.7	Manganese
103.130	012	EPA 200.7	Nickel
103.130	015	EPA 200.7	Silver
103.130	017	EPA 200.7	Zinc
103.140	001	EPA 200.8	Aluminum
103.140	002	EPA 200.8	Antimony
103.140	003	EPA 200.8	Arsenic
103.140	004	EPA 200.8	Barium
103.140	005	EPA 200.8	Beryllium
103.140	006	EPA 200.8	Cadmium
103.140	007	EPA 200.8	Chromium
103.140	008	EPA 200.8	Copper
103.140	009	EPA 200.8	Lead
103.140	010	EPA 200.8	Manganese
103.140	012	EPA 200.8	Nickel
103.140	013	EPA 200.8	Selenium
103.140	014	EPA 200.8	Silver
103.140	015	EPA 200.8	Thallium
103.140	016	EPA 200.8	Zinc
103.150	003	EPA 200.9	Arsenic
103.150	012	EPA 200.9	Selenium
103.160	001	EPA 245.1	Mercury
103.300	001	EPA 100.1	Asbestos
103.301	001	EPA 100.2	Asbestos
104 - Volatile Organic Chemistry of Drinking Water			
104.030	001	EPA 504.1	1,2-Dibromoethane
104.030	002	EPA 504.1	1,2-Dibromo-3-chloropropane
104.030	003	EPA 504.1	1,2,3-Trichloropropane

104.040	001	EPA 524.2	Benzene
104.040	002	EPA 524.2	Bromobenzene
104.040	003	EPA 524.2	Bromochloromethane
104.040	006	EPA 524.2	Bromomethane
104.040	007	EPA 524.2	n-Butylbenzene
104.040	008	EPA 524.2	sec-Butylbenzene
104.040	009	EPA 524.2	tert-Butylbenzene
104.040	010	EPA 524.2	Carbon Tetrachloride
104.040	011	EPA 524.2	Chlorobenzene
104.040	012	EPA 524.2	Chloroethane
104.040	014	EPA 524.2	Chloromethane
104.040	015	EPA 524.2	2-Chlorotoluene
104.040	016	EPA 524.2	4-Chlorotoluene
104.040	018	EPA 524.2	Dibromomethane
104.040	019	EPA 524.2	1,3-Dichlorobenzene
104.040	020	EPA 524.2	1,2-Dichlorobenzene
104.040	021	EPA 524.2	1,4-Dichlorobenzene
104.040	022	EPA 524.2	Dichlorodifluoromethane
104.040	023	EPA 524.2	1,1-Dichloroethane
104.040	024	EPA 524.2	1,2-Dichloroethane
104.040	025	EPA 524.2	1,1-Dichloroethene
104.040	026	EPA 524.2	cis-1,2-Dichloroethene
104.040	027	EPA 524.2	trans-1,2-Dichloroethene
104.040	028	EPA 524.2	Dichloromethane
104.040	029	EPA 524.2	1,2-Dichloropropane
104.040	030	EPA 524.2	1,3-Dichloropropane
104.040	031	EPA 524.2	2,2-Dichloropropane
104.040	032	EPA 524.2	1,1-Dichloropropene
104.040	033	EPA 524.2	cis-1,3-Dichloropropene
104.040	034	EPA 524.2	trans-1,3-Dichloropropene
104.040	035	EPA 524.2	Ethylbenzene
104.040	036	EPA 524.2	Hexachlorobutadiene
104.040	037	EPA 524.2	Isopropylbenzene
104.040	038	EPA 524.2	4-Isopropyltoluene
104.040	039	EPA 524.2	Naphthalene
104.040	040	EPA 524.2	Nitrobenzene
104.040	041	EPA 524.2	N-propylbenzene
104.040	042	EPA 524.2	Styrene
104.040	043	EPA 524.2	1,1,1,2-Tetrachloroethane
104.040	044	EPA 524.2	1,1,2,2-Tetrachloroethane
104.040	045	EPA 524.2	Tetrachloroethene
104.040	046	EPA 524.2	Toluene
104.040	047	EPA 524.2	1,2,3-Trichlorobenzene
104.040	048	EPA 524.2	1,2,4-Trichlorobenzene
104.040	049	EPA 524.2	1,1,1-Trichloroethane
104.040	050	EPA 524.2	1,1,2-Trichloroethane
104.040	051	EPA 524.2	Trichloroethene
104.040	052	EPA 524.2	Trichlorofluoromethane

104.040	053	EPA 524.2	1,2,3-Trichloropropane
104.040	054	EPA 524.2	1,2,4-Trimethylbenzene
104.040	055	EPA 524.2	1,3,5-Trimethylbenzene
104.040	056	EPA 524.2	Vinyl Chloride
104.040	057	EPA 524.2	Xylenes, Total
104.040	058	EPA 524.2	Hexachloroethane
104.045	001	EPA 524.2	Bromodichloromethane
104.045	002	EPA 524.2	Bromoform
104.045	003	EPA 524.2	Chloroform
104.045	004	EPA 524.2	Dibromochloromethane
104.045	005	EPA 524.2	Trihalomethanes
104.050	002	EPA 524.2	Methyl tert-butyl Ether (MTBE)
104.050	004	EPA 524.2	tert-Amyl Methyl Ether (TAME)
104.050	005	EPA 524.2	Ethyl tert-butyl Ether (ETBE)
104.050	006	EPA 524.2	Trichlorotrifluoroethane
104.050	011	EPA 524.2	Oxygenates

105 - Semi-volatile Organic Chemistry of Drinking Water

105.010	001	EPA 505	Aldrin
105.010	002	EPA 505	Alachlor
105.010	004	EPA 505	Chlordane
105.010	005	EPA 505	Dieldrin
105.010	006	EPA 505	Endrin
105.010	007	EPA 505	Heptachlor
105.010	008	EPA 505	Heptachlor Epoxide
105.010	009	EPA 505	Hexachlorobenzene
105.010	011	EPA 505	Lindane
105.010	012	EPA 505	Methoxychlor
105.010	014	EPA 505	Toxaphene
105.010	015	EPA 505	PCBs as Aroclors (screen)
105.010	016	EPA 505	PCB-1016
105.010	017	EPA 505	PCB-1221
105.010	018	EPA 505	PCB-1232
105.010	019	EPA 505	PCB-1242
105.010	020	EPA 505	PCB-1248
105.010	021	EPA 505	PCB-1254
105.010	022	EPA 505	PCB-1260
105.082	001	EPA 515.3	2,4-D
105.082	002	EPA 515.3	Dinoseb
105.082	003	EPA 515.3	Pentachlorophenol
105.082	004	EPA 515.3	Picloram
105.082	005	EPA 515.3	2,4,5-TP
105.082	006	EPA 515.3	Bentazon
105.082	007	EPA 515.3	Dalapon
105.082	008	EPA 515.3	Dicamba
105.083	001	EPA 515.4	2,4-D
105.083	002	EPA 515.4	Dinoseb
105.083	003	EPA 515.4	Pentachlorophenol
105.083	004	EPA 515.4	Picloram

105.083	005	EPA 515.4	2,4,5-TP
105.083	006	EPA 515.4	Dalapon
105.083	007	EPA 515.4	Bentazon
105.083	008	EPA 515.4	Dicamba
105.090	001	EPA 525.2	Alachlor
105.090	002	EPA 525.2	Aldrin
105.090	003	EPA 525.2	Atrazine
105.090	004	EPA 525.2	Benzo(a)pyrene
105.090	005	EPA 525.2	Butachlor
105.090	006	EPA 525.2	Chlordane
105.090	007	EPA 525.2	Dieldrin
105.090	008	EPA 525.2	Di(2-ethylhexyl) Adipate
105.090	009	EPA 525.2	Di(2-ethylhexyl) Phthalate
105.090	010	EPA 525.2	4,4'-DDD
105.090	011	EPA 525.2	4,4'-DDE
105.090	012	EPA 525.2	4,4'-DDT
105.090	013	EPA 525.2	Endrin
105.090	014	EPA 525.2	Heptachlor
105.090	015	EPA 525.2	Heptachlor Epoxide
105.090	016	EPA 525.2	Hexachlorobenzene
105.090	017	EPA 525.2	Hexachlorocyclopentadiene
105.090	018	EPA 525.2	Lindane
105.090	019	EPA 525.2	Methoxychlor
105.090	020	EPA 525.2	Metolachlor
105.090	021	EPA 525.2	Metribuzin
105.090	022	EPA 525.2	Molinate
105.090	023	EPA 525.2	Pentachlorophenol
105.090	024	EPA 525.2	Propachlor
105.090	025	EPA 525.2	Simazine
105.100	001	EPA 531.1	Aldicarb
105.100	002	EPA 531.1	Aldicarb Sulfone
105.100	003	EPA 531.1	Aldicarb Sulfoxide
105.100	004	EPA 531.1	Carbaryl
105.100	005	EPA 531.1	Carbofuran
105.100	006	EPA 531.1	3-Hydroxycarbofuran
105.100	007	EPA 531.1	Methomyl
105.100	008	EPA 531.1	Oxamyl
105.101	001	EPA 531.2	Carbofuran
105.101	002	EPA 531.2	Oxamyl
105.101	003	EPA 531.2	Aldicarb
105.101	004	EPA 531.2	Aldicarb Sulfone
105.101	005	EPA 531.2	Aldicarb Sulfoxide
105.101	006	EPA 531.2	Carbaryl
105.101	007	EPA 531.2	3-Hydroxycarbofuran
105.101	008	EPA 531.2	Methomyl
105.120	001	EPA 547	Glyphosate
105.140	001	EPA 548.1	Endothall
105.150	001	EPA 549.2	Diquat

105.170	001	EPA 551.1	Bromochloroacetonitrile
105.170	005	EPA 551.1	Chloral Hydrate
105.170	007	EPA 551.1	Chloropicrin
105.170	008	EPA 551.1	Dibromoacetonitrile
105.170	010	EPA 551.1	1,2-Dibromo-3-chloropropane
105.170	011	EPA 551.1	1,2-Dibromoethane
105.170	012	EPA 551.1	Dichloroacetonitrile
105.170	013	EPA 551.1	1,1-Dichloro-2-propanone
105.170	015	EPA 551.1	Trichloroacetonitrile
105.170	018	EPA 551.1	1,1,1-Trichloro-2-propanone
105.175	001	EPA 551.1	Bromodichloromethane
105.175	002	EPA 551.1	Bromoform
105.175	003	EPA 551.1	Chloroform
105.175	004	EPA 551.1	Dibromochloromethane
105.175	005	EPA 551.1	Trihalomethanes
105.190	001	SM6251B	Bromoacetic Acid
105.190	002	SM6251B	Bromochloroacetic Acid
105.190	003	SM6251B	Chloroacetic Acid
105.190	005	SM6251B	Dibromoacetic Acid
105.190	006	SM6251B	Dichloroacetic Acid
105.190	007	SM6251B	Trichloroacetic Acid
105.190	008	SM6251B	Haloacetic Acids (HAA5)

106 - Radiochemistry of Drinking Water

106.010	001	EPA 900.0	Gross Alpha
106.010	002	EPA 900.0	Gross Beta
106.060	001	EPA 904.0	Radium-228
106.092	001	EPA 200.8	Uranium
106.270	001	SM7110C	Gross Alpha
106.610	001	SM7500-Rn	Radon-222

107 - Microbiology of Wastewater

107.010	001	SM9215B	Heterotrophic Bacteria
107.020	001	SM9221B	Total Coliform
107.030	001	SM9221B	Total Coliform with Chlorine Present
107.040	001	SM9221C,E (MTF/EC)	Fecal Coliform
107.050	001	SM9221E	Fecal Coliform with Chlorine Present
107.100	001	SM9230B	Fecal Streptococci
107.100	002	SM9230B	Enterococci

108 - Inorganic Chemistry of Wastewater

108.020	001	EPA 120.1	Conductivity
108.050	001	EPA 150.1	pH
108.060	001	EPA 160.1	Residue, Filterable
108.070	001	EPA 160.2	Residue, Non-filterable
108.080	001	EPA 160.3	Residue, Total
108.090	001	EPA 160.4	Residue, Volatile
108.100	001	EPA 160.5	Residue, Settleable
108.110	001	EPA 180.1	Turbidity
108.112	001	EPA 200.7	Boron

108.112	002	EPA 200.7	Calcium
108.112	003	EPA 200.7	Hardness (calc.)
108.112	004	EPA 200.7	Magnesium
108.112	005	EPA 200.7	Potassium
108.112	006	EPA 200.7	Silica
108.112	007	EPA 200.7	Sodium
108.120	002	EPA 300.0	Chloride
108.120	004	EPA 300.0	Nitrate
108.120	005	EPA 300.0	Nitrite
108.120	006	EPA 300.0	Nitrate-nitrite, Total
108.120	008	EPA 300.0	Sulfate
108.140	001	EPA 310.1	Alkalinity
108.180	001	EPA 335.1	Cyanide, amenable
108.181	001	EPA 335.2	Cyanide, Total
108.182	001	EPA 335.3	Cyanide, Total
108.191	001	EPA 340.2	Fluoride
108.200	001	EPA 350.1	Ammonia
108.211	001	EPA 351.2	Kjeldahl Nitrogen
108.231	001	EPA 353.2	Nitrate calc.
108.232	001	EPA 353.2	Nitrate-nitrite, Total
108.240	001	EPA 354.1	Nitrite
108.260	001	EPA 365.1	Phosphate, Ortho
108.261	001	EPA 365.1	Phosphorus, Total
108.262	001	EPA 365.2	Phosphate, Ortho
108.263	001	EPA 365.2	Phosphorus, Total
108.270	001	EPA 370.1	Dissolved Silica
108.291	001	EPA 376.2	Sulfide
108.310	001	EPA 405.1	Biochemical Oxygen Demand
108.323	001	EPA 410.4	Chemical Oxygen Demand
108.360	001	EPA 420.1	Phenols, Total
108.361	001	EPA 420.2	Phenols, Total
108.370	001	EPA 425.1	Surfactants
108.385	001	SM2120B	Color
108.390	001	SM2130B	Turbidity
108.410	001	SM2320B	Alkalinity
108.420	001	SM2340B	Hardness (calc.)
108.430	001	SM2510B	Conductivity
108.440	001	SM2540B	Residue, Total
108.441	001	SM2540C	Residue, Filterable
108.442	001	SM2540D	Residue, Non-filterable
108.443	001	SM2540F	Residue, Settleable
108.465	001	SM4500-Cl G	Chlorine
108.473	001	SM4500-CN G	Cyanide, amenable
108.480	001	SM4500-F C	Fluoride
108.490	001	SM4500-H+ B	pH
108.508	001	SM4500-NH3 H	Ammonia
108.531	001	SM4500-O G	Dissolved Oxygen
108.540	001	SM4500-P E	Phosphate, Ortho

108.541	001	SM4500-P E	Phosphorus, Total
108.550	001	SM4500-Si D	Dissolved Silica
108.590	001	SM5210B	Biochemical Oxygen Demand
108.591	001	SM5210B	Carbonaceous BOD
108.602	001	SM5220D	Chemical Oxygen Demand
108.611	001	SM5310C	Total Organic Carbon
108.620	001	SM5320B	Total Organic Halides
108.640	001	SM5540C	Surfactants
109 - Toxic Chemical Elements of Wastewater			
109.002	001	EPA 100.2	Asbestos
109.010	001	EPA 200.7	Aluminum
109.010	002	EPA 200.7	Antimony
109.010	004	EPA 200.7	Barium
109.010	005	EPA 200.7	Beryllium
109.010	007	EPA 200.7	Cadmium
109.010	009	EPA 200.7	Chromium
109.010	010	EPA 200.7	Cobalt
109.010	011	EPA 200.7	Copper
109.010	012	EPA 200.7	Iron
109.010	015	EPA 200.7	Manganese
109.010	016	EPA 200.7	Molybdenum
109.010	017	EPA 200.7	Nickel
109.010	021	EPA 200.7	Silver
109.010	024	EPA 200.7	Tin
109.010	025	EPA 200.7	Titanium
109.010	026	EPA 200.7	Vanadium
109.010	027	EPA 200.7	Zinc
109.020	001	EPA 200.8	Aluminum
109.020	002	EPA 200.8	Antimony
109.020	003	EPA 200.8	Arsenic
109.020	004	EPA 200.8	Barium
109.020	005	EPA 200.8	Beryllium
109.020	006	EPA 200.8	Cadmium
109.020	007	EPA 200.8	Chromium
109.020	008	EPA 200.8	Cobalt
109.020	009	EPA 200.8	Copper
109.020	010	EPA 200.8	Lead
109.020	011	EPA 200.8	Manganese
109.020	012	EPA 200.8	Molybdenum
109.020	013	EPA 200.8	Nickel
109.020	014	EPA 200.8	Selenium
109.020	015	EPA 200.8	Silver
109.020	016	EPA 200.8	Thallium
109.020	017	EPA 200.8	Vanadium
109.020	018	EPA 200.8	Zinc
109.190	001	EPA 245.1	Mercury
109.410	003	SM3113B	Arsenic
109.410	015	SM3113B	Selenium

109.811	001	SM3500-Cr D	Chromium (VI)
110 - Volatile Organic Chemistry of Wastewater			
110.040	001	EPA 624	Benzene
110.040	002	EPA 624	Bromodichloromethane
110.040	003	EPA 624	Bromoform
110.040	004	EPA 624	Bromomethane
110.040	005	EPA 624	Carbon Tetrachloride
110.040	006	EPA 624	Chlorobenzene
110.040	007	EPA 624	Chloroethane
110.040	008	EPA 624	2-Chloroethyl Vinyl Ether
110.040	009	EPA 624	Chloroform
110.040	010	EPA 624	Chloromethane
110.040	011	EPA 624	Dibromochloromethane
110.040	012	EPA 624	1,2-Dichlorobenzene
110.040	013	EPA 624	1,3-Dichlorobenzene
110.040	014	EPA 624	1,4-Dichlorobenzene
110.040	015	EPA 624	1,1-Dichloroethane
110.040	016	EPA 624	1,2-Dichloroethane
110.040	017	EPA 624	1,1-Dichloroethene
110.040	018	EPA 624	trans-1,2-Dichloroethene
110.040	019	EPA 624	1,2-Dichloropropane
110.040	020	EPA 624	cis-1,3-Dichloropropene
110.040	021	EPA 624	trans-1,3-Dichloropropene
110.040	022	EPA 624	Ethylbenzene
110.040	023	EPA 624	Methylene Chloride
110.040	024	EPA 624	1,1,2,2-Tetrachloroethane
110.040	025	EPA 624	Tetrachloroethene
110.040	026	EPA 624	Toluene
110.040	027	EPA 624	1,1,1-Trichloroethane
110.040	028	EPA 624	1,1,2-Trichloroethane
110.040	029	EPA 624	Trichloroethene
110.040	030	EPA 624	Trichlorofluoromethane
110.040	031	EPA 624	Vinyl Chloride
111 - Semi-volatile Organic Chemistry of Wastewater			
111.100	001	EPA 625	Acenaphthene
111.100	002	EPA 625	Acenaphthylene
111.100	003	EPA 625	Anthracene
111.100	004	EPA 625	Benzidine
111.100	005	EPA 625	Benz(a)anthracene
111.100	006	EPA 625	Benzo(b)fluoranthene
111.100	007	EPA 625	Benzo(k)fluoranthene
111.100	008	EPA 625	Benzo(g,h,i)perylene
111.100	009	EPA 625	Benzo(a)pyrene
111.100	010	EPA 625	Benzyl Butyl Phthalate
111.100	011	EPA 625	Bis(2-chloroethoxy)methane
111.100	012	EPA 625	Bis(2-chloroethyl) Ether
111.100	013	EPA 625	Bis(2-chloroisopropyl) Ether
111.100	014	EPA 625	Di(2-ethylhexyl) Phthalate

111.100	015	EPA 625	4-Bromophenyl Phenyl Ether
111.100	016	EPA 625	4-Chloro-3-methylphenol
111.100	017	EPA 625	2-Chloronaphthalene
111.100	018	EPA 625	2-Chlorophenol
111.100	019	EPA 625	4-Chlorophenyl Phenyl Ether
111.100	020	EPA 625	Chrysene
111.100	021	EPA 625	Dibenz(a,h)anthracene
111.100	022	EPA 625	1,2-Dichlorobenzene
111.100	023	EPA 625	1,3-Dichlorobenzene
111.100	024	EPA 625	1,4-Dichlorobenzene
111.100	025	EPA 625	3,3'-Dichlorobenzidine
111.100	026	EPA 625	2,4-Dichlorophenol
111.100	027	EPA 625	Diethyl Phthalate
111.100	028	EPA 625	2,4-Dimethylphenol
111.100	029	EPA 625	Dimethyl Phthalate
111.100	030	EPA 625	Di-n-butyl phthalate
111.100	031	EPA 625	Di-n-octyl phthalate
111.100	032	EPA 625	2,4-Dinitrophenol
111.100	033	EPA 625	2,4-Dinitrotoluene
111.100	034	EPA 625	2,6-Dinitrotoluene
111.100	035	EPA 625	Fluoranthene
111.100	036	EPA 625	Fluorene
111.100	037	EPA 625	Hexachlorobenzene
111.100	038	EPA 625	Hexachlorobutadiene
111.100	039	EPA 625	Hexachlorocyclopentadiene
111.100	040	EPA 625	Hexachloroethane
111.100	041	EPA 625	Indeno(1,2,3-c,d)pyrene
111.100	042	EPA 625	Isophorone
111.100	043	EPA 625	2-Methyl-4,6-dinitrophenol
111.100	044	EPA 625	Naphthalene
111.100	045	EPA 625	Nitrobenzene
111.100	046	EPA 625	2-Nitrophenol
111.100	047	EPA 625	4-Nitrophenol
111.100	048	EPA 625	N-nitrosodimethylamine
111.100	049	EPA 625	N-nitrosodi-n-propylamine
111.100	050	EPA 625	N-nitrosodiphenylamine
111.100	051	EPA 625	Pentachlorophenol
111.100	052	EPA 625	Phenanthrene
111.100	053	EPA 625	Phenol
111.100	054	EPA 625	Pyrene
111.100	055	EPA 625	1,2,4-Trichlorobenzene
111.100	056	EPA 625	2,4,6-Trichlorophenol
111.120	048	EPA 1625	N-nitrosodimethylamine

112 - Radiochemistry of Wastewater

112.010	001	EPA 900.0	Gross Alpha
112.010	002	EPA 900.0	Gross Beta

STATE OF CALIFORNIA
DEPARTMENT OF HEALTH SERVICES
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

NELAP - RECOGNIZED

ACCREDITATION

Is hereby granted to

MWH LABORATORIES, a division of MWH Americas, Inc.

750 ROYAL OAKS DRIVE, SUITE 100

MONROVIA, CA 91016-3629

Scope of accreditation is limited to the
"NELAP Fields of Accreditation"
which accompanies this Certificate.

Continued accredited status depends on successful
ongoing participation in the program.

This Certificate is granted in accordance with provisions of
Section 100825, et seq. of the Health and Safety Code.

Certificate No.: **01114CA**

Expiration Date: **01/31/2007**

Effective Date: **01/31/2006**

Richmond, California
subject to forfeiture or revocation

George C. Kulasingam, Ph.D.
Program Chief
Environmental Laboratory Accreditation Program

State of California—Health and Human Services Agency
Department of Health Services

California
Department of
Health Services

SANDRA SHEWRY
Director

ARNOLD SCHWARZENEGGER
Governor

January 1, 2005

Certificate No.: **1422**

ANDREW EATON, Ph.D.
MWH LABORATORIES
750 ROYAL OAKS DRIVE, SUITE 100
MONROVIA, CA 91016-3629

Dear ANDREW EATON, Ph.D.:

This is to advise you that the laboratory named above continues to be certified as an environmental testing laboratory pursuant to the provisions of the California Environmental Laboratory Improvement Act (Health and Safety Code (HSC), Division 101, Part 1, Chapter 4, Section 100825, et seq.). Certification for all currently certified Fields of Testing that the laboratory has applied for renewal shall remain in effect until **01/31/2007** unless revoked.

Please note that the renewal application for certification is subject to an on-site visit, and continued use of the certificate is contingent upon:

* **successful completion of the site visit;**
* **acceptable performance in the required performance evaluation (PE) studies;**
* **timely payment of all fees, including an annual fee due before January 31, 2006;**
* **compliance with Environmental Laboratory Accreditation Program (ELAP) statutes (HSC, Section 100825, et seq.) and Regulations (California Code of Regulations (CCR),Title 22, Division 4, Chapter 19).**

An updated "Approved Fields of Testing" will be issued to the laboratory upon completion of the renewal process. The application for the next renewal must be received 90 days before the expiration of this certificate to remain in force according to the CCR, Section 64801 through 64827.

Please note that the laboratory is required to notify ELAP of any major changes in the laboratory such as the transfer of ownership, change of laboratory director, change in location, or structural alterations which may affect adversely the quality of analyses (HSC, Section 100845(b)(d)). Please include the above certificate number in all your correspondence to ELAP.

If you have any questions, please contact ELAP at (510) 540-2800.

Sincerely,

George C. Kulasingam, Ph.D.
Program Chief
Environmental Laboratory Accreditation Program

STATE OF CALIFORNIA
DEPARTMENT OF HEALTH SERVICES
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

ENVIRONMENTAL LABORATORY CERTIFICATION

Is hereby granted to

MWH LABORATORIES

a Division of MWH AMERICAS, Inc.

750 ROYAL OAKS DRIVE, SUITE 100

MONROVIA, CA 91016-3629

Scope of certification is limited to the
"Accredited Fields of Testing"
which accompanies this Certificate.

Continued certification status depends on successful completion of site visit, proficiency testing studies, and payment of applicable fees.

This Certificate is granted in accordance with provisions of Section 100825, et seq. of the Health and Safety Code.

Certificate No: **1422**
Expiration Date: **01/31/2007**
Effective Date: **01/01/2005**

Berkeley, California
subject to forfeiture or revocation.

George C. Kulasingam, Ph.D.
Program Chief
Environmental Laboratory Accreditation Program

State of California—Health and Human Services Agency
Department of Health Services

California Department of Health Services

SANDRA SHEWRY
Director

ARNOLD SCHWARZENEGGER
Governor

January 1, 2005

Certificate No.: **1422**

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MWH LABORATORIES
750 ROYAL OAKS DRIVE, SUITE 100
MONROVIA, CA 91016-3629

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Sincerely,

George C. Kulasingam, Ph.D.
Program Chief
Environmental Laboratory Accreditation Program

QUALITY ASSURANCE MANUAL

INLAND EMPIRE UTILITIES AGENCY

LABORATORY

2450 Philadelphia Ave.
Ontario, California 91761

Reviewed By _____
Nelletje Groenveld
Laboratory Manager

12th Edition
November 2005

SECTION 2

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SECTION 3.

ORGANIZATION AND RESPONSIBILITIES

The Manager of Laboratories provides direction and administrative support for Inland Empires Quality Assurance program. The Manager is ultimately responsible for all results produced within the laboratory and all final reports must be reviewed and signed by either the Manager or QC Officer prior to them being released. Additionally, the Manager is also responsible for providing an environment in which quality work can be produced.

The QC Officer is responsible for the conduct of the QA program and for taking or recommending corrective actions as is necessary. The QC Officer develops and oversees the various components of the program, monitors all activities and determines conformance with policy and procedures, conducts system audits, evaluates new ideas, advises management in review of technology, methods, equipment and facilities with respect to QA aspects. He/she coordinates internal audit schedules, evaluates data quality and maintains all program specific records. He/she advises and trains staff in QA aspects.

The Metal, General Chemistry, Organic and Biological Sections of the Laboratory each have their own supervisor who is responsible for the specific analytical operations within their section. These include proper sample handling, chain of custody, data review, staff training, timely completion of high quality results and sample disposal. Chemists, biologists, laboratory technicians and laboratory assistants perform the analyses according to the established methods and quality control requirements in effect at the time.

SECTION 4.

QA OBJECTIVES FOR MEASUREMENT DATA

The objective of the measurement program of the Inland Empire Utilities Agency Laboratory is to provide high quality measurement data, which are accurate, reliable and adequate for their intended purpose. To this end, the management is dedicated to the encouragement of excellence in measurement and to provide an environment conducive to its achievement. Since quantitative measurements are only estimates of the value of the measurement and are obtained with some level of uncertainty, they must be made so the limits of uncertainty can be assigned within a stated probability. To achieve this, measurements must be made in such a way to provide statistical predictability. When they are, then the measurement process is said to be in "statistical control" and the data produced become believable. To accomplish this, techniques are employed that evaluate the accuracy and precision of the analytical result.

Accuracy objectives are evaluated by calculating the percent of a laboratory standard recovered (LS) in either pure water or sample and precision by determining the relative percent difference (RPD) between duplicate samples or duplicate spikes. Unless historical control limits have been determined, the quality objectives established for the analyses in the laboratory are as follows:

Precision (RPD):	15% for aqueous samples; 30% for nonaqueous samples when the concentration is greater than 10 times the method detection limit.
Accuracy (LS):	90-110% for effluent samples 80-120% for industrial wastes and influents

Control of results is maintained by following standard operating procedures and observing sample custody and handling requirements.

SECTION 5.

SAMPLING PROCEDURES

Since all data resulting from a given sample must be evaluated on the conditions surrounding the actual sampling event, the main objective in the collection of any sample is to obtain a representative portion of the whole. Though often receiving minimal priority in actual training, the collection of a sample is probably one of the most critical stages in the process that culminates with a data report. The manner in which a particular sample is collected will influence, to some degree, each of the remaining steps leading to this report. To insure that the data generated from a sample are of the highest quality and validity, a thorough program in proper sample collection, handling and transport is necessary.

There are two basic types of samples that one can collect:

1. Grab Sample — The entire sample is collected at one particular moment in time. This is the preferred type for measurement of parameters that change over time and have no approved preservation method.

2. Composite Sample — Portions of the total sample are collected over a defined time period.

   They can be collected either automatically or manually. There are 6 different methods that one can use to collect a composite sample.

   A. Constant sample pumping rate.

   B. Sample pump rates proportional to flow.

   C. Constant volume taken at a constant time interval.

   D. Constant volume and time interval between samples proportional to flow.

   E. Constant time interval between samples and volumes proportional to total flow since last sample.

   F. Constant time interval between samples and volumes proportional to the flow rate at the moment of sampling.

Automatic samplers provide accurate unattended sampling and offer flexibility in composite methods. Since no one sampler can provide all the various sampling possibilities, the desired configuration can be purchased once the sampling program has been defined.

During and after collection, if prompt analysis is not possible, the sample must be preserved to maintain its integrity. To insure valid data from samples that must be held, container type, preservation and holding time requirements for the analysis desired must be followed in accordance to the EPA guidelines published in the Federal Register, 40 CFR Part 136.3, July 1, 1995. Staff follows these guidelines to assure correct handling of samples.

When an analysis requires the use of an outside laboratory, their containers are used and procedures followed.

SECTION 6.

SAMPLE CUSTODY

The measurement result requires a documented, traceable link between the measurement, the sample, and the physical condition that the sample represents. A system employing proper chain-of-custody procedures provides this link.

Chain-of-custody is a legally acceptable written record that includes all areas of the sample history, from beginning to end. It should indicate "who did what and when" until final disposition of the sample.

Since the majority of the samples analyzed by this lab are collected by non-laboratory personnel, the chain-of-custody forms (Attachment A, B & C) are initiated in the field and remains with the sample throughout its handling. Upon delivery to the laboratory, the sample is checked and verified that:

1. It is clearly marked and dated;

2. It was collected in a proper container;

3. It is properly preserved;

4. There is sufficient volume to perform all requested analyses;

5. It is received in good condition;

6. Chain-of-custody forms match the sample's description.

If these conditions are met, then a discrete laboratory log number is assigned and the form signed to confirm lab acceptance of the sample. The sample is then logged into the Laboratory Information Management System (LIMS). Any aliquots of the original sample are given unique IDs by the addition of a letter following the original sample number. The sample and any aliquots are then distributed to the appropriate sections of the lab or placed in designated storage areas. Anytime a sample is split into aliquots; care is taken to insure that they are representative. Well-mixing, blending or grinding may be required depending on the sample. A copy of the chain-of-custody document is provided to the individual relinquishing custody of the sample to the lab.

The majority of samples are stored at $4^{\circ}C$ in refrigerators that are located in a secured area. The storage temperature of each refrigerator is checked each day and recorded. The pH of any preserved samples or aliquots is documented in LIMS. Chain-of-custody forms and temperature records are filed for future reference.

SECTION 7.

CALIBRATION PROCEDURES AND FREQUENCY

Reagent chemicals used by Inland Empire are of ACS reagent grade or better, purchased from reputable laboratory supply companies. Standards are either prepared in house using high-purity starting materials or purchased as certified standard concentrates. Lot numbers of purchased reagents are entered in a supplies database, and Lot numbers are recorded in Reagent preparation logbooks, (an example of a Reagent log: Attachment D). Calibration procedures differ by analytical method and are summarized in Table 7 A.

Stock standard solutions are used before their individual expiration date. Intermediate and working calibration standard solutions are used within a specific time period after preparation. To ensure consistency, the newly prepared solutions are compared with a certified standard and must be within 10 percent before used. Summaries of QC procedures are as follows, the more detailed procedures can be found in the individual analyses Standard Operating Procedures (SOPs).

A. Metals by ICP, ICP/MS

Each day, prior to analysis, a calibration curve within the linear range is generated. The calibration curve must have a correlation coefficient of 0.995 or greater. A certified calibration check standard is analyzed once per shift. The apparent concentration of this standard must lie within 10 percent of the true concentration. Standards are prepared by diluting mixed-element concentrates, which have been prepared from either commercially available solutions or laboratory reagents. Comparability studies are conducted on all freshly prepared standards to validate their concentration. For ICP/MS, the instrument is tuned and mass calibrated. All samples are quantified using external calibration using internal standards.

B. Colorimetric Analyses

Cyanide, MBAS, nitrite, nitrate, phosphate and molybdate reactive silica fall into this category. Spectrophotometers are calibrated using three to six standards in the linear range with every batch of new reagents. Fresh standards are prepared from stock concentrates daily. The correlation coefficient of the curve must be 0.995 or greater. A certified calibration check standard is analyzed once each shift. The apparent concentration of this standard must lie within 10 percent of the true concentration.

C. Titrimetric Analyses

Chemical Oxygen Demand, total hardness, alkalinity, Kjeldahl nitrogen, ammonia and chlorine residuals are in this category. The titrants are standardized against a primary standard prior to use. A certified check standard is analyzed once each shift. The apparent concentration of this standard must lie within 10 percent of the true concentration.

D. Gravimetric Analyses

Total dissolved solids, Total solids, suspended solids and Oil & Grease are in this category. Since the laboratory depends heavily on the accuracy of the balance, all are checked daily with class S-1 weights. The recorded weight must agree within 0.05 percent of the expected weight. Where appropriate, a check standard is analyzed once each shift. The apparent concentration of this standard must lie within 10 percent of the true concentration. Balances are serviced and verified annually by a certified technician.

E. Ion Chromatography Analyses

Instruments are calibrated using three to five standards in the linear range with each batch of new eluent. The correlation coefficient of the curve must be 0.995 or greater. The calibration standards are prepared by dilution from stock concentrates. A certified calibration check standard is analyzed once every shift. The apparent concentration of this standard must lie within 10 percent of the true concentration.

F. Specific Ion Analyses

Ammonia and fluoride are determined with these instruments by known addition methods. A certified check standard is analyzed once every shift. The apparent concentration of standards must lie within 10 percent of the true concentration. Calibration standards are prepared by dilution from stock concentrates.

G. pH

The pH meter is calibrated with two buffers daily. Due to the wide pH ranges of samples analyzed by this laboratory, 4 and 7 or 7 and 10 buffers are used. A certified buffer is read each time a new buffer is prepared. A 6.86 buffer is read each day. The reading must be within 0.1 unit of the true value.

H. Biochemical Oxygen Demand (BOD)

The dissolved oxygen (D.O.) meter is calibrated according to the manufacture's directions. For all analyses, the minimum D.O. depletion must be 2 mg/l and there must be at least 1 mg/l residual left after 5 days. A check standard is analyzed once every batch. The apparent concentration must lie within the required range as listed in the literature.

I. Total Organic Carbon (TOC)

The TOC instrument is calibrated according to the manufacture's directions using a series of 5 standards each for total carbon and inorganic carbon. A certified check standard is analyzed once every shift. The apparent concentration of this standard must lie within 10 percent of the true concentration.

J. Available Cyanide by Flow Injection, Ligand Exchange and Amperometry

The flow Injection Analysis (FIA) system is calibrated according to the manufactures directions using a series of 6 standards. A Laboratory Control Standard prepared from

Mercury (II) Cyanide is analyzed once per shift to insure effectiveness of the Ligands. The apparent concentration of this standard must lie within established control limits.

K. Organochlorine Pesticides by Gas Chromatography

Initial Calibration is performed with a minimum of three and a maximum of five concentrations. The calibration curve for each compound must have a correlation factor of 0.995 or greater. Each run, a confirming calibration standard is run prior to the running of actual samples. If the standard concentration varies more than 15%, the instrument is recalibrated. All samples are quantitated by external standardization using a linear calibration curve.

L. Volatile Organics by GC/MS

Instrument sensitivity is checked with BFB (Bromofluorobenzene) every 12 hours of operation and confirmation of all key m/z criteria is achieved. If not, the mass spectrometer is re-tuned until all criteria are met. The initial calibration of the GS/MS is conducted using three to five concentrations. The calibration curve or response factor is verified every working day using a QC check standard. The internal standard calibration method is used to quantitative samples.

M. Base/Neutral and Acid Extractable Organics by GC/MS

The GC/MS system is checked at the beginning of each working day to see if ion abundance criteria are met for DFTPP and tailing criteria are met for benzidine and pentachlorophenol. Initial calibration of the GC/MS is conducted using three to five concentrations. The working calibration curve or response factor is verified on each working day using a mid level calibration standard. The response factor of each parameter should not vary more than 20% of the average response factor of the calibration curve. If so, a new calibration curve must be prepared for that compound prior to analysis. The internal standard calibration method is used to quantitative samples.

TABLE 7A

Calibration Procedures for Analytical Methods

Analysis	Calibration Methods	Frequency	Acceptance Criteria
ICP Metals			
Ag, Al, As B, Ba, Be, Ca, Cd, Co, Cr Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Si, Tl, V, Zn	Calibration Blank	Every 10 samples	Within 3 S.D. of the mean
	Calibration Curve	Daily	0.995 correlation
	Standardize	Every 10 samples	Within 5% of value
ICP/MS Metals			
Ag, Al, As B, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Tl, V, Zn	Calibration Blank	Every 10 samples	Within 3 S.D. of the mean
	Calibration Curve	Daily	0.995 correlation
	Calibration Check Standards	Every 10 samples	Within 10% of value
Anions by IC			
Chloride Fluoride Nitrite Nitrate Sulfate Bromide Orthophosphate	Blank	Every 10 samples	Within 3 S.D. of the mean
	Calibration Curve	Each batch of eluent	0.995 correlation
	Calibration check std.	Every 10 samples	Within 5% of value
Gravimetric			
O&G, TDS, TS, VS, TSS, VSS	Balance Check	Daily	Within 0.05% of value
	Balance Service	Annually	

Analysis	Calibration Methods	Frequency	Acceptance Criteria
PH	Two Buffers	Daily	Within 0.1 unit
Colori-Metric			
Nitrite	Calibration Blank	Every 10 samples	Within 3 S.D. of the mean
Nitrate	Calibration Curve	Each batch of new reagents	0.995 correlation
Phosphate			
MBAS			Within 5% of value
Cyanide	Calibration check standard	Every 10 samples	
Silica			
Specific Ion			
Ammonia	Blank	Every 10 samples	Within 3 S.D. of the mean
Fluoride	Serial Calibration	Each shift	Acceptable Slope
Coliform	Completed Test	Every 10 + samples	No growth
MPN	Media check	Every batch	
	Media response	Each Lot	Correct growth

TABLE 7A (con't)

Calibration Procedures for Analytical Methods

Analysis	Calibration Methods	Frequency	Acceptance Criteria
TOC	Calibration Curve	Each time combustion tube replaced, or each time Persulfate reagent is made	
	Blank	Daily	<MDL
	Calib. check Standard	Once per shift	Within 10% of Value
Organochlorine Pesticides	Confirming calibration standard	Daily	+/- 15%
Volatile Organics by GC/MS	Sensitivity check with BFB	Every 12 hr. of operation	m/z criteria
	Initial Calibration	Prior to analysis and when QC check standard fails	% RSD of RF <25%
	QC check sample	Daily	Must meet acceptance criteria of method
Base/Neutral Acid Extract by GC/MS	Sensitivity check with DFTPP	Daily	Ion abundance criteria
	Initial calibration	Prior to analysis and when QC check standard fails	% RSD of RF <25%
	QC check sample	Daily	Must meet acceptance criteria of method

SECTION 8.

ANALYTICAL PROCEDURES

The majority of the laboratory standard operating procedures (SOP) used in obtaining results come from one of two sources. These sources are:

1. Methods and Guidance for Analysis of Water, EPA-821-C-99-004, Revised June 1999.

2. Standard Methods for the Examination of Water and Wastewater, 18th Edition, APHA-AWWA-WPCF, 1992.

The following tables provide a complete reference for the methods employed.

TABLE 8 A. METHODS FOR WASTEWATER ANALYSIS

PHYSICAL PROPERTIES METHODS

Parameter	Method #	Ref.	Description
Turbidity	180.1	1	Nephelometric
T. Alkalinity	2320B	2	Titration to a set pH
Hardness	2340BC	2	EDTA Titration
Conductivity	2510B	2	Resistance ratio
Total Solids	160.3	1	Dried at 103-105°C
Total Dissolved Solids	160.1	1	Dried at 180°C
Total Suspended Solids	160.2	1	Dried at 103-105°C
Volatile Solids	160.4	1	Ignited at 550°C
Settable Solids	160.5	1	Volumetric

INORGANIC NONMETALLIC METHODS

Anions	300.0	1	Ion Chromatography
Boron	200.7	1	ICP
Cyanide	4500-E CN	2	Total after Distill
Cl Residual	4500-Cl F,G	2	DPD Ferrous Titrate
Chloride	300.0	1	Ion Chromatography
Cyanide, Available	OIA-1677	1	Ligand Exchange, Amperometry

Parameter	Method #	Ref.	Description
Fluoride	4500-F C	2	After Distillation
pH Value	150.1	1	Electrometric
Ammonia	350.2	1	Titrimetric
Ammonia	350.3	1	Electrode
Nitrite	4500-NO_2B	2	Colorimetric
Nitrite	300.0	1	Ion Chromatography
Nitrate	300.0	1	Ion Chromatography
Organic Nitrogen	351.3	1	Macro Kjeldahl
Ortho Phosphate	300.0	1	Ion Chromotagraphy
Ortho Phosphate	4500-P E	2	Colorimetric
Dissolved Oxygen	360.1	1	Electrode
Sulfide	4500-S-D	2	Methylene Blue
Sulfate	300.0	1	Ion Chromatography
Total Phosphate	4500-P E	2	Colorimetric
	ORGANIC METHODS		
Biochemical Oxygen Demand (BOD)	5210	2	5 day incubation
Chemical Oxygen Demand	410.123.	1	Open reflux
Oil & Grease	1664	1	Partition-Gravimetric
MBAS	5540 C	2	Colorimetric
Pesticides/PCBs	608	1	GC electron capture
Volatile Organics	624, 524	1	Capillary GC/MS
Base/Neutral Extract-able Organics	625	1	Capillary GC/MS
TOC	415.1	1	Combustion
TOC	5310C	2	Persulfate-Ultraviolet
	MICROBIOLOGICAL METHODS		
Heterotrophic Plate Count	9215 B	2	Pour Plate
Coliform Bacteria	9221ABE	2	Multiple Tube Fermentation
Coliform Bacteria	9223	2	Colilert

METAL METHODS

Plasma Emission	200.7		Inductively Coupled Plasma

INDIVIDUAL METHODS

Aluminum	200.7	1	ICP
Antimony	200.7	1	ICP
Arsenic	200.7	1	ICP
Barium	200.7	1	ICP
Beryllium	200.7	1	ICP
Cadmium	200.7	1	ICP
Calcium	200.7	1	ICP
Chromium	200.7	1	ICP
Cobalt	200.7	1	ICP
Copper	200.7	1	ICP
Iron	200.7	1	ICP
Lead	200.7	1	ICP
Magnesium	200.7	1	ICP
Manganese	200.7	1	ICP
Mercury	245.2	1	ICP
Molybdenum	200.7	1	ICP
Nickel	200.7	1	ICP
Potassium	200.7	1	ICP
Selenium	200.7	1	ICP
Silver	200.7	1	ICP
Sodium	200.7	1	ICP
Thallium	200.7	1	ICP
Vanadium	200.7	1	ICP
Zinc	200.7	1	ICP

Plasma Emission	200.8	1	Inductively Coupled Plasma Mass Spectrometry

INDIVIDUAL METHODS

Aluminum	200.8	1	ICP/MS
Antimony	200.8	1	ICP/MS
Arsenic	200.8	1	ICP/MS
Barium	200.8	1	ICP/MS
Beryllium	200.8	1	ICP/MS
Cadmium	200.8	1	ICP/MS
Chromium	200.8	1	ICP/MS

Cobalt	200.8	1	ICP/MS
Copper	200.8	1	ICP/MS
Lead	200.8	1	ICP/MS
Manganese	200.8	1	ICP/MS
Molybdenum	200.8	1	ICP/MS
Nickel	200.8	1	ICP/MS
Selenium	200.8	1	ICP/MS
Silver	200.8	1	ICP/MS
Thallium	200.8	1	ICP/MS
Vanadium	200.8	1	ICP/MS
Zinc	200.8	1	ICP/MS

SECTION 9.

DATA REDUCTION, VALIDATION AND REPORTING

Samples are collected and sent to an analytical laboratory in order to obtain the value of different constituents. In the process of providing this service, various amounts of data is collected. Before a result of an analysis can be reported back to the requestor, the data usually needs to be further reduced. The step prior to its release is to determine the acceptability of the result by the process of validation. The steps necessary to get the laboratory information to this stage follow:

A. Data Reduction

The data produced in this laboratory are generated by several different means. Some come from dedicated instruments with microcomputer interfaces. These systems usually receive an original signal from the instrument that is analyzing the sample and then transforms this raw information into a quantitative value. The analyst reviews the provided result either on a screen or printout, verifies the sample identification, checks quantitative formulas and arrives at a final numerical value. The analyst writes this result on a daily bench sheet or prints out a computer-generated spreadsheet listing all samples for a given analytical run.

Some instruments operate without a computer interface. Output from these are recorded on either a strip chart, printer strip, or directly to an analog or digital dial. This data usually needs additional reduction to obtain a reportable result. Any calculations, blank corrections or standard curves generated to obtain the final result are recorded and submitted with the daily worksheets.

Some lab analyses such as titration's or sensory evaluation do not use instruments. For these, the analyst records the quantitative result or observation on a bench sheet. Any additional reduction steps that might be necessary, as described above, are recorded with the data.

For all methods of data reduction, the analyst records the final results into the LIMS. Daily bench sheets are turned in for additional review and storage.

B. Data Validation

Data validation in this laboratory begins at the bench where the analyses are performed and continues through the reporting process. Depending on the circumstance, it may consist of one or more components of what the EPA has defined in Quality Assurance handbook for Air Pollution Measurement Systems for the process. "Data validation consists of data editing, screening, checking, auditing, verification, certification and review."

The majority of data that would otherwise be unacceptable if it continued through the process, can be discovered at the bench level of review. When an analysis is completed and the necessary data reduction and documentation performed, each analyst reviews their work a second time before entering results into the Laboratory Information Management System (LIMS). During this review, data is checked for consistency and compliance with the established QC criteria. Once satisfied that the data is valid, bench sheets are initialed by the analyst and result entry occurs. Once completed, the original bench sheet is turned in for Section Supervisor's review. If this second review process discovers any non-compliance of the QC criteria, data is withheld. After review of the problem, the supervisor will determine if the data is suspect and a corrective action report needs to be initiated. If not, then result reporting proceeds. Any corrective action reports are reviewed by the QC Officer and put on file.

At this stage, results needed for process control purposes are released to operations personnel. This is with the understanding that until final validation is completed, the result is still subject to change or rejection.

The LIMS also has a entry, validation and approval process. The technician enters the data, and then the lab section supervisor will validate and approve the data. Any changes made to the data in LIMS are documented by an audit trail.

C. Reporting

Once determined valid, the results are available for final reporting. Since this laboratory only provides data to meet District needs, there is only the need for a few formalized reports. The main one is the monthly plant reports to the Regional Board and EPA. Presently, to produce these reports, after the data is entered into the LIMS, it is transferred to a spreadsheet program to make required calculations. When finished, a draft report is printed and reviewed by all concerned personnel. Once all necessary corrections have been made, the final report is printed. This report receives a final review and signatures by the responsible parties before mailing. The LIMS also has standardized reports for individual samples which the Laboratory Manager or Supervising Chemist signs.

SECTION 10.

INTERNAL QUALITY CONTROL CHECKS

A. Preparation Blanks

Preparation blanks consist of organic-free or deionized water carried through the analytical method like a sample. They serve to measure contamination associated with reagents, preparation or instrumentation. One preparation blank is analyzed in every analytical batch of 10 or less samples.

B. Sample Blanks

Sample blanks are used when certain characteristics such as color or turbidity interfere with the determination. In a spectrophotometric analysis, for example, the natural absorbency of the sample is measured and subtracted from the absorbency of the treated sample. Sample blanks are analyzed only as necessary.

C. Calibration Blanks

Calibration blanks are prepared with standards to create a calibration curve. They differ from other standards only by the absence of an analyte and provide the "zero point" for the curve.

D. Internal Standards

Internal standards are measured amounts of certain compounds added after sample preparation. They are used in an internal standard calibration method to correct sample results suffering from physical effects. This is a method sometimes used for ICP analysis.

E. Spikes

Spikes are samples to which a known amount of an analyte has been added. Stock solutions used for spiking are purchased or prepared independently of calibration standards. Prepared and analyzed in each batch of 10 or less samples, spikes are treated the same way as samples. Spike recovery measures the effects of interference in the sample matrix and reflects the accuracy of the analysis.

F. Duplicates and Duplicate Spikes

Duplicates are additional aliquots of a sample that are treated the same throughout the analytical method. When the analyte concentration is consistently below the detection limit, duplicate spikes are substituted for duplicates. Duplicates and duplicate spikes are prepared and analyzed in every batch of 10 or less samples.

G. Laboratory Control Standards

Laboratory control standards or blank spikes are ultra-pure (nanopure) water to which known amounts of an analyte have been added. They are treated to the same preparation procedure and analysis as samples. Stock solutions used for these standards are purchased or prepared independently of calibration standards. Recovery of these standards tests the functioning of analytical methods and equipment. They are analyzed in every batch of 10 or less samples.

H. Calibration Check Standards

Calibration check standards are nanopure water to which known amounts of an analyte at mid-range of the calibration curve have been added. They are used to verify the accuracy of the calibration and instrument performance. Certified stock solutions are used to prepare these check standards and are purchased independently of calibration stock solutions. They are analyzed once in a work shift.

SECTION 11.

PREVENTATIVE MAINTENANCE

Preventative maintenance is a key element in an analytical laboratory's quality assurance program. In this laboratory, analysts and support personnel perform routine preventative maintenance tasks. These tasks might include the replacement of minor parts, cleaning exterior components and providing the instruments a climate-controlled environment.

For each instrument, the manufacture's specified preventative maintenance recommendations and frequency are followed. The majority of these instruments (e.g., atomic absorption spectrophotometers, analytical balance, ICP, ion chromatograph, uv/vis spectrophotometer, GC/MS, ICP/MS) are repaired and maintained under commercial service contracts. All record of service and repair is filed for future reference.

Instruments are constantly monitored by the use of daily calibrations, sensitivity and response checks. These indicate when a nonscheduled maintenance service is required. If an instrument does fail, the services of an independent laboratory are available and every effort is made to prevent any data loss.

Laboratory support systems (e.g., deionized water supplies, refrigerator and oven temperatures) are monitored daily. The improper functioning of any of these is enough to invalidate data. Since these are controllable devices, our quality assurance program is designed to prevent data loss by these systems.

SECTION 12.

ASSESSMENT OF PRECISION AND ACCURACY

Analytical data is of no value until we know how precise and accurate the data subsets are. We follow specific procedures to assess each dimension of the data we produce.

A. Precision

Precision analysis demonstrates how well the laboratory can replicate its work. Precision is usually discussed in terms of standard deviation (SD) or relative percent difference (RPD). It is estimated by analyzing replicates of the same sample or a number of duplicate pairs. The latter analysis is generally preferred for estimating the standard deviation of an analytical method because of sample availability and the precision of an analysis is based on sample type rather than one particular sample. This provides us with a more correct view of the overall analysis. We use the following calculation to estimate the standard deviation:

$$SD = \sqrt{\frac{n\sum X^2 - (\sum X)^2}{n(n-1)}}$$

Where: n = number of duplicate sets measured
X = absolute difference of the data pairs
s = standard deviation

Relative Percent Difference (RPD) between sample duplicates is determined by the following calculation:

$$RPD = \frac{Duplicate1 - Duplicate2}{Mean} \; x\,100$$

Where: Mean = Average of the duplicate pair

Once the RPD has been determined from a set of data determined to be "in control", a grand average and standard deviation is calculated. Control limits are then established for a method. As the EPA suggests, we set Warning Limits at two standard deviations and Control Limits at three standard deviations above the mean.

B. Accuracy

Accuracy analysis demonstrates how close a result is to the true or expected result. It

is somewhat more difficult to assess due to factors external to the laboratory, such as sampling and handling conditions. Assessment of accuracy is demonstrated by spike recovery determinations, standard analysis and the use of external check samples.

Statistical treatment of the data provides an objective measure of accuracy. The following calculation is used to determine the percent spike recovery:

$$P = 100\ X\ \frac{A - B}{T}$$

Where: P = percent spike recovery
A = concentration of spiked sample
B = concentration of original sample
T = true value of spike added

Using accumulated spike data for a method, control limits can be established by calculating the average recovery and the standard deviation of the recovery. Warning and Control limits are set as above for precision except that they are determined both above and below the mean recovery.

SECTION 13.

CORRECTIVE ACTION

Quality control failures logically fall into two categories: single QC outliers and systematic failure. When one of these occur, no data for that batch of analysis is reportable until the cause of the failure is determined and corrected or it can be demonstrated that the cause was random and no longer affects data.

The results from analyzing laboratory standards, lab control standards, preparation blanks, spike recoveries and duplicates determine when a quality control failure occurs. Additionally, many methods have QC criteria for calibrations, sensitivity checks and other method specific quality checks that are performed routinely.

When one of the above checks fails to meet acceptance limits, the analyst at the bench, and sometimes the section supervisor, initiates a corrective action. The action can take several forms and some can be accomplished with little interruption in analysis. For example, re-calibration might resolve a failure to meet calibration criteria; or replacement of the membrane on an ammonia probe results in a correct slope check. Table 13 A lists possible corrective action steps to take in response to QC failures.

When the analyst or section supervisor cannot resolve a failure, the laboratory QC officer is notified. Once the failure is resolved, a formal report and any facts of any arbitrarily reported data is prepared and submitted to the laboratory director. Regardless of the failure, corrective action always includes documenting both the failure and the action taken. Attachment E is used for documenting the event. Once completed and review by the QC officer, they are filed for future reference.

TABLE 13 A

Summary of Corrective Action

Control Item	Acceptance Criteria	Corrective Action
Calibration Blank	Within 3 SD of mean	Rerun calibration blank
Calibration Curve	0.995 correlation	Rerun/remake calibration standards
Reslope or standardization	Within 5% of value	Recalibrate; rerun last 10 samples
Preparation Blank	Less than 5 times the detection limit	Correct problem; re-prep batch
Calibration Check Standard	Within 10 % of value Above 10 times the MDL, RSD within current control limits	Examine calibration standards and instrument; re-prep standards and recalibrate
Duplicate or Duplicate Spike	Within current control limits	Examine instrument, prep procedures, reagents and equipment
Spiked Sample	Within 10% of value	Make serial dilution, use known addition method or re-spike another sample to confirm matrix effect
Lab Control Standard	Within 0.05% of value	Examine calibration standards and instrument; re-prep standards and recalibrate
Balance Check		Recalibrate balance; call

SECTION 14.

BIOASSAYS

Presently, the laboratory is only prepared to run acute and chronic bioassays using *Ceriodaphnia dubia*. Therefore, the Quality Assurance practices described will refer to the use of this organism and their practices only.

The methods employed for the acute and chronic biossays are found in the following sources:

1. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, 4th Edition, EPA 600/4-90-027F, 5th Edition, EPA 821-R-02-012.

2. Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, 3rd Edition, EPA 600/4-91-002, 4th Edition, EPA 821-R-02-013.

3. Taxonomy of *Ceriodaphnia* (Crustacea: Cladocera) in U.S. Environmental Protection Agency Cultures, EPA 600/4-86-032.

In order to obtain results of high quality for toxicity tests, the Quality Assurance practices must cover all aspects of the process from start to finish. These aspects consist of (1) sampling and handling; (2) the source and condition of the test organism; (3) condition of the equipment and instruments; (4) analytical methods used; (5) instrument calibration; (6) replication; (7) use of reference toxicants; (8) record keeping; and (9) data evaluation.

1. Sampling and Handling

Sampling procedures are described in Section 5 of this document. Chino Basin's NPDES permit requires the effluent toxicity tests be performed on 24 hour composite samples. Sample temperature is maintained at 4°C during collection and kept there until the start of the test. Samples are collected either in new "milk" jugs or cubitainers which are rinsed first with sample prior to being filled. Containers are never reused. On site tests are initiated within 24 hours of collection. Proper sample custody procedures are followed which are described in Section 6 of this document.

2. Test Organisms

The cladoceran, *Ceriodaphnia dubia*, is the organism used by this laboratory. Two separate cultures are maintained and they were obtained from the USEPA and Aqua Science Laboratory, Davis, CA. Identification of this organism is verified according to procedures found in reference 3 above.

3. Equipment

Separate Revco environmental chambers are used for the rearing of stock cultures and testing. Temperatures are checked and recorded twice daily to determine that they are operating within limits. Both are equipped with "cool-white" fluorescent lighting and have the ability to set photo-period length.

4. Analytical Methods

The analytical methods for conducting the bioassays follow established EPA procedures and are found in the above references. All routine chemical and physical analyses performed during the tests such as pH, DO, temperature, conductivity, alkalinity and hardness follow established quality assurance practices as described in this document. The methods used are found in Section 8.

5. Instrument Calibration

Calibration procedures for the routine chemical procedures are discussed in Section 7. All data are recorded on daily laboratory benchsheets. Results are transferred to bioassay spreadsheets and are included with the final report.

6. Replication

A minimum of 10 replicates at each dilution are used. When comparing 100% effluent against a control, 30 replicates at each dilution are used. Generally, the sensitivity of the test increases as the number of replications increases.

7. Reference Toxicants

To determine satisfactory laboratory performance and proper sensitivity of the organism, reference toxicants are used under the same conditions as the bioassays being performed. Control charts are constructed for each reference-toxicant-organism combination. Successive toxicity values are plotted and examined to determine if the results are within established limits. Limits for NOEC-LOEC calculations are set at one dilution above and below average NOEC's. Limits for IC_{25} calculations are set at 2 standard deviations above and below the mean IC_{25}'s. At least monthly, a bioassay is conducted using a reference toxicant. These are performed at the same time as a regular bioassay. Should the result from a given reference toxicant fall outside the established range, the entire test system becomes suspect and any data collected during the event is considered not reportable. When this occurs, the procedure is examined and repeated with a different batch of organisms.

8. Record Keeping

Proper record keeping is required. All data are recorded on a real time basis to prevent the loss of information. Records are kept on the test organisms, calibration of equipment and instruments, test conditions and results. It is the District's policy that all records are kept for a 10 year period before destruction.

9. Data Evaluation

In order for the test to be considered acceptable, several conditions must be met. For chronic tests, the control survival must be at least 90% within 96 hours and at least 80% by the end of the test. The number of offspring per surviving adult must be 15 or greater, and at least 60% must have had three broods. For acute tests, control survival must meet or exceed 90%. If a reference toxicant was run concurrently, it must fall within established limits.

If temperature, DO or other specified conditions fall outside specification, the test may still be conditionally acceptable. This would depend on the degree of departure and the judgement of the bioanalyst and regulatory authority. If determined to be reportable, the deviation from specifications would be noted with the data from the test.

Statistical analysis of the data from bioassay tests is calculated using the ToxCalc program purchased from Tidepool Scientific Software. Both hypothesis testing (NOEC, LOEC) and point estimates (EC, IC, LC) are provided. Results are first calculated at the 95% confidence level. If toxicity is detected at this level, the data are recalculated at the 99% confidence level to determine if toxicity is still detected. If no toxicity is detected, both results are reported to the regulatory agency.

This District has routinely split chronic *Ceriodaphnia* bioassays to different certified labs to determine if variability exists in the procedure. To date, 42 split samples have been tested and approximately 60% of the time when one lab reported toxicity, the other lab reported none. Because of these results, when samples are split and the results come back as toxic from one lab and non-toxic from another, the regulatory authorities have agreed to count the non-toxic result towards the District's compliance.

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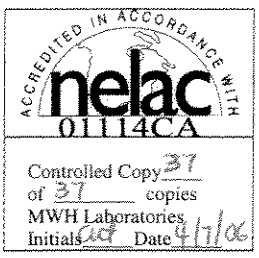
COMPREHENSIVE QUALITY ASSURANCE PLAN

Version 29

for

MWH LABORATORIES,
A DIVISION OF MWH AMERICAS, INC.
750 Royal Oaks Drive
Suite 100
Monrovia, CA 91016
(626) 386-1100



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COMPREHENSIVE QUALITY ASSURANCE PLAN

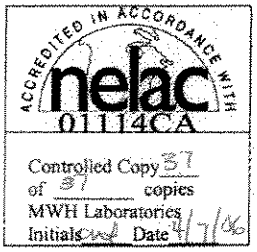
Prepared by and for
MWH LABORATORIES,
A DIVISION OF MWH AMERICAS, INC.
750 Royal Oaks Drive
Suite 100
Monrovia, CA 91016
(626) 386-1100

Prepared by: Nilda B. Cox **Date** 10/11/05
Nilda B. Cox
Quality Assurance Officer

Approved by: Carol J. Belt **Date** 10-12-05
Carol J. Belt
Asbestos Technical Director

Approved by: Andrew Eaton **Date** 10-12-05
Dr. Andrew Eaton
Technical Director/ Laboratory Director

Revised October, 2005



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3.0 STATEMENT OF POLICY

3.1. INTRODUCTION

MWH Laboratories, a Division of MWH Americas, Inc. is a premier, full-service water, wastewater and drinking water laboratory serving both US based and clients located outside the USA. MWH Laboratories provides organic, inorganic, microbial, and radiochemical analyses in support of the Clean Water Act (CWA), Safe Drinking Water Act (SDWA), National Pollutant Discharge Elimination Systems (NPDES), Resource Conservation and Recovery Act (RCRA), and the EPA Information Collection Rule (ICR- 1997-1999) as well as EPA Unregulated Contaminant Monitoring Regulation (UCMR) Program. The Quality Assurance Project Plan (QAPP) for UCMR is discussed in a separate document as addendum to the laboratory's comprehensive QA Plan. The essential elements of the Quality Assurance Program of MWH Laboratories and the quality control procedures utilized by the laboratory to ensure compliance to the UCMR requirements are discussed in the UCMR QAPP.

MWH Laboratories takes an active role in supporting the promulgation of improved methodologies and the practice of differentiating laboratories based on quality of data. MWH Laboratories participates in the methods development and validation of Standard Methods.

3.2. QUALITY ASSURANCE POLICY

MWH Laboratories is committed to the production of quality analytical data. The methods by which this is ensured are; 1) meeting or exceeding method performance criteria, 2) providing deliverables to our clients in a timely manner and 3) fostering a spirit of continuous improvement in all areas of operations.

MWH Laboratories provides the clients with data of known and documented quality with which to demonstrate regulatory compliance and for other decision-making purposes.(NELAC 5.0)

This Quality Assurance Manual defines the performance criteria and support procedures by which quality analytical data are generated. Supplementing this Quality Assurance Manual are Standard Operating Procedures (SOPs) for individual analytical methodologies. Together these provide the documentation framework for ensuring the generation of uniform, comparable and quality data over time.

The foundation of the quality policy lies in the involvement and continuous improvement activities of all personnel at MWH Laboratories. The spirit of innovation is encouraged and viewed as paramount to the continued success of the laboratory in serving its clients. A system of monitoring, auditing, and reviewing processes is used to bring to light the opportunities for improvement.

In the determination of all QA policies, we recognize our clients to be our contractors, the regulatory community and the general public. Our day to day operations will be defined with consideration to the goals and health of all our clients. Protection of clients' confidential information and proprietary rights will be considered. Where data are provided for external audits and for other similar reasons, client's name and identity will be concealed to protect client's confidential information. In the event that the laboratory transfers ownership or goes out of business, the laboratory will notify all our clients to ensure that records are maintained or transferred according to the clients instructions. [NELAC 5.4.12.2.4.f and 4.1.8e)]

3.3. MISSION STATEMENT

MWH Laboratories will provide outstanding client service and high quality analytical data to all clients at all times.

3.4. CODE OF ETHICS AND POLICY/DATA INTEGRITY PROCEDURES/ REVIEW OF REQUESTS AND CONTRACTS/CONTRACT AMENDMENT

MWH Laboratories was a founding member (1989) of actLABS, the California Association of Testing Laboratories. ACTLabs subsequently became part of ACIL (Americal Council of Independent Labs). Beginning in 1997 our increased geographic client base required us to give up our actLABS membership.

As a former actLAB member, the laboratory is committed to ensuring the integrity of our data, meeting the quality needs of clients and setting high quality and ethical standards in the environmental industry. MWH Laboratories, as a former actLABS member, is committed to managing our businesses by agreeing to:

- Produce results that are accurate and include QA/QC information which meets client predefined Data Quality Objectives.
- Present services in a confidential, honest, and forthright manner.
- Provide employees with guidelines and an understanding of the ethical and quality standards of our industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Operate the laboratory to ensure its personnel are free from any commercial, financial and other undue pressure that might adversely affect the quality of the work.
- Obey all pertinent federal, state, and local laws and regulations, and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate preparation has been made. Before commencing new work, the laboratory reviews all new work to ensure that it has the appropriate facilities and resources.

- Requests, tenders and contracts received by the laboratory are reviewed to ensure that the laboratory has the necessary personnel, information resources, facilities, equipment, PT, MDLs, QC and current applicable Accreditation Status. (NELAC 5.4.4).
- Contract may be any written or oral agreement to provide client with environmental testing. The laboratory informs client results of review if there are any potential conflicts, deficiency, lack of accreditations or inability to complete clients work.
- For any contract amendment for NELAC compliance, the laboratory repeats the review process. Also as per NELAC 5.4.4.5, if the laboratory's accreditation is suspended, revoked, or voluntarily withdrawn, the laboratory reports to clients any applicable changes of its accreditation status.

Records of reviews, including any significant changes, shall be maintained. Records shall also be maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract.

For repetitive routine tasks, the review need be made only at the initial enquiry stage or on granting of the contract for on-going routine work performed under a general agreement with the client, provided that the client's requirements remain unchanged.

For routine, simple tasks and repetitive routine tasks, the designated Project Manager (PM) reviews client samples received by the laboratory and logged in the LIMS system. Review of logged tests and methods are documented in the Sample Acknowledgement Report by affixing PM's signature/or initials and date of review. The Sample Acknowledgement Report is sent to the client to document approval of LOGGED samples and methods of analysis.

For new clients and comprehensive testing, contracts are generated, and appropriate lab personnel, such as the Lab Director, reviews the Contracts to assure that the lab is capable to provide testing prior to start of work. (NELAC 5.4.4.2).

In addition, any employee of MWH Laboratories identified as not conforming to the code of ethics of the laboratory, committing fraud, improper data manipulation, data falsification, deviating from the contractual requirements, or any supervisor or employee putting any undue pressure to another co worker which might adversely affect the quality of the work will be subject to disciplinary procedures, including suspension and up to termination of employment. [NELAC 5.4.1.5 b)].

In order to meet the requirements of NELAC data integrity program [NELAC 5.1.7 & 5.5.2.7]), the laboratory implements a proactive program for prevention and detection of improper, unethical or illegal action. This program includes training courses on the laboratory's Laboratory Ethics and Data Integrity Procedures, and educating all personnel on questionable practices. Details of the Laboratory Ethics and Data Integrity Procedures are found in the laboratory SOP.
The laboratory SOP includes the implementation of Data Integrity Procedures outlined in NELAC 5.1.7 including:

1. Management Responsibilities (NELAC 5.4.2.6, 5.4.2.6.1 AND 5.4.2.6.2) on Data Integrity Procedures/Signed Contract/Ethics Agreement for all laboratory personnel.
2. Control and documentation (NELAC 5.4.15) – Internal Audit/Periodic Monitoring of Data Integrity/Evidence of Vulnerabilities.
3. Data Integrity Training (NELAC 5.5.2.7) and documentation of Examples of Improper Practices in the Laboratory Ethics SOP.

3.5. CAPABILITIES

Analytical capabilities include water, wastewater, and drinking water, for clients in the private and public sector where work is dictated by the regulatory requirements for the Safe Drinking Water Act (SDWA), Resource Conservation and Recovery Act (RCRA), National Pollutant Discharge Elimination Systems (NPDES), Clean Water Act (CWA) and the Superfund Amendments and Reauthorization Act (SARA) and the EPA UCMR Program. In addition, our specialized laboratory services include;

- analysis and identification of inorganic & organic disinfection by-products
- taste and odor compounds in drinking water
- identification and quantitation of coliforms and aeromonas in drinking water and wastewater
- comparability of alternate test procedures for drinking water and wastewater analysis

3.6. CERTIFICATIONS

MWH Laboratories is currently certified in 46 states or territories to perform various analyses for regulated parameters. Please refer to Table 3-1 for the list of the states, laboratory identification number, and the certification type. An updated list is available in the QA office.

Table 3-1 - State Certification

Item #	State	Lab ID	Drinking Water	Waste water	Hazardous Waste
1.	Air Force		X		
2.	Alabama	41060	X		
3.	Alaska	CA-06-03	X		
4.	Arizona	AZ0455	X	X	
5.	Arkansas				
6.	California - NELAP	01114CA	X	X	X
7.	California - ELAP	1422	X	X	X
8.	Colorado		X		
9.	Commonwealth of Mariana Island	0007; 0008	X		
10.	Connecticut	PH-0107	X	X	X

Table 3-1 - State Certification (con't)

Item #	State	Lab ID	Drinking Water	Waste water	Hazardous Waste
11.	Delaware	CA 006	X		
12.	District of Columbia				
13.	Florida	E87748	X		
14.	Georgia	947	X		
15.	Guam		X		
16.	Hawaii		X		
17.	Idaho		X		
18.	Illinois	1004	X		
19.	Indiana	C-CA-01	X		
20.	Kansas	E-10268	X		
21.	Kentucky	90107	X		
22.	Louisiana	LA 030009	X		
23.	Maine		X		
24.	Maryland	224	X		
25.	Massachusetts	M-CA006	X		
26.	Michigan	9906	X		
27.	Mississippi		X		
28.	Montana (Chemistry)	Cert. 0035	X		
29.	Nebraska		X		
30.	Nevada (all)	CA-00006-2003-29	X	X	
31.	New Hampshire	295902	X		
32.	New Jersey	CA 008	X		
33.	New York	11320	X		
34.	North Carolina	06701	X		
35.	North Dakota	R-009	X		
36.	Ohio				
37.	Oklahoma				
38.	Oregon	ORELAP-CA 200003	X		
39.	Pennsylvania	68-565	X		
40.	Rhode Island	265	X		
41.	South Carolina	87016001	X		

Table 3-1 - State Certification (con't)

Item #	State	Lab ID	Drinking Water	Waste water	Hazardous Waste
42.	South Dakota		X		
43.	Tennessee	TN02839	X		
44.	Texas	TX243- 2003A	X		
45.	Utah	MONT-1	X		
46.	Vermont		X		
47.	Virginia	00210	X		
48.	West Virginia	9943C	X		
49.	Washington	C324	X		
50.	Wisconsin	998316660	X		
51.	Wyoming		X		
52.	CA Rad Chem	3069-19	X		
53.	Soil Permit	S-35334		X	X
54.	ATP Approval				

MWH Laboratories may accept, analyze, and report results for samples from non- certified states where the samples are intended for non-regulatory monitoring.

3.7. FACILITIES –ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

MWH Laboratories is located at 750 Royal Oaks Drive, Suite 100, Monrovia, California, and has more than 20,000 square feet of analytical laboratory workspace with a staff of 116. Laboratories include:

Asbestos
GC extractables/ volatiles
GC/MS extractables/ volatiles
Ion Chromatography
Metals/ Metals extraction
Organic extractions
Radioactivity
TOC/ TOX
General physical
Microbiology
Wet chemistry
Sample receipt
Sample storage
Shipping - sample bottles preparation

Sample disposal

See Table 3-2 for the list of the major analytical equipment used during sample preparation and analyses. For microbiology, pressure cookers are not used for sterilization of growth media (NELAC D.3.8.b.2.1).

When there is a change in lab location, and ownership, the laboratory will report in writing to their accrediting authorities within 30 calendar days of the change [NELAC std 4.1.8 a)].

See Figure 3-1 for the Floor Plan of the 1st Floor and Figure 3-2 (page 12) for the Floor Plan of the 2nd Floor.

The laboratory ensures that the laboratory environment conditions do not invalidate the results or adversely affect the required quality of any measurement.

The laboratory monitors, controls and records environmental conditions as required by the relevant specifications, methods and procedures, or where they influence the quality of the results. Biological sterility and dust are monitored in microbiology to ensure that environmental conditions do not jeopardize the results of the environmental tests and/or calibrations. (NELAC 5.5.3). The laboratory micro walls, floors, work surfaces are non absorbent and easy to clean and disinfect (NELAC D.3.8.a)

Incompatible areas such as Volatiles, Sample Extraction, Microbiology, culture handling or incubation areas are separated to prevent cross-contamination (NELAC 5.5.3.3).

Table 3.2
MWH Laboratories Inorganic and Microbiology Major Lab Equipment
April, 2005

	Vendor	Model	Year Acquired	Detector	Tests	serial #
Metals	Perkin-Elmer	ELAN 6000	1999	ICPMS	Low Level Metals	3929707
	Perkin-Elmer	FIMS400	2000	Cold Vapor	Mercury by 1631	4605
	Perkin-Elmer	9000DRC	2003	ICPMS	Low Level Metals	Q1280212
	Perkin-Elmer	Z5100	1998	Graphite Furnace/Flame	Low Level Metals, Cations	145325
	Dionex	DX500	1998	UV/VIS-AD20 (2 UV VIS	Low Level Cr-VI, Low Bromate	93090167
	Perkin-Elmer	Optima 4300DV	2003	ICP	Low Level Metals	077N 2121801
	Perkin-Elmer	5100	1999	PMT	Metals – GF	145375
Rad	Protean 8 channel	MPC9604	1998	Proportional Counter	Gross Alpha/Beta,	83023
	Beckman	6000	1993	Liquid Scintillation System	Radon, Tritium	7067177
	Protean	9025	1996	Automated Proportional Counter	Gross Alpha/Beta, Radium	712049
TOC-TOX-SUVA	COSA	10 Sigma	1997	Coulometric	TOX	78R10847
	COSA	10 Sigma	1996	Coulometric	TOX	75R10116
	Milton Roy	601	1994	UV/VIS	Anions, Nutrients, SUVA	0626774 A
	Dohrmann	DC-80	1993	UV-persulfate infrared	TOC, DOC	N3K22428 T

Table 3.2 (Con't)
MWH Laboratories Inorganic and Microbiology Major Lab Equipment
April, 2005

General Minerals - Nutrients	Dionex	DX120	1997	Conductivity	Anions	970750115
	FISHER	925	1996	Ion Analyzer	Anion, pH	A029165
	Mitsubishi	GT-06	1994	Automatic Titration	Alkalinity	73 M - 21053
	Dionex -Dual Channel (2)	DX500	1993, 1999	Conductivity	Anions, DBPs, Perchlorate	93100009, 98070159
	Lachat	Quickchem 8000	1992, 1999	Colorimetric	Nutrients	2000-0636
	Sequoia-Turner	Model 390	1992	VIS	Anions, Nutrients	001583 TN
	ManTech	PC-Titrate	2002	Titrimetric, Colorimetric	EC, pH, Alk, F, Turbidity	MS-QC2-596 MS-OJ1-519 MS-OL0-476 MS-002-525
	Fisher	825 MP	1987	Ion Analyzer	Anions, pH	2180
Miscellaneous	Reliance Glass	Midi Still	1998	Distillation	Cyanide/Phenol/ Ammonia	NA
	YSI	Model 59	1994	DO Probe	BOD, DO	92H042256
	Olympus	BH-2	1992	Fluorescence Microscope	Protozoan	T2-105170
	Orion	101	1990	Conductivity	Conductance	127
	Hitachi-TEM	600AB	2001	X-ray	Asbestos	542-50-00

Table 3.2 (Con't)
MWH Laboratories Organic and Microbiology Major Lab Equipment
April, 2005

	Type	Model	Year Acquired	Detectors	Tests	ID	Serial #
GC Systems	Varian	3400	1998	Dual ECDs	Herbicides – 515.4	19	3400-23378
	Varian	3500	1998	Dual ECDs	EDB – 504.1	20	3500-6346
	HP	5890	1996	PID/ELCD	Volatiles - 524.2	17	3336A57972
	Varian	3400	1995	Dual ECDs	Pesticides - 608	16	3400-20620
	Varian	3400	1996	Dual ECDs	551.1	18	3400-13835
	HP	5890	1993	Dual PID/ ELCDs	Volatiles 524.2/ 601/602	15	3223A42730
	Varian	3400	1991	Dual ECDs	Not in Use	12	3400-13647
	Varian	3500	1991	Dual ECDs	Pesticides - 508	14	3500-13787
	Varian	3500	1990	Dual ECDs	Aldehydes SM6252B	10	3400-10256
	Varian	3500	1988	Dual TSDs	N/P Pesticides 507/614/8141	7	3500-4813
	HP	5890	1988	Dual ECDs	HAA- 6251B	8	2750A19022
	HP	5890	1988	Dual ECDs	Not in Use	9	2750A19303
	HP	5890	1987	Dual ECDs	Not in Use	6	2750A14788
	Varian	3500	1986	Dual ECDs	DBPs -551.1	5	3500-2314
	Varian	3400	1986	Dual ECDs	Not in Use	11	3400-3512
	Varian	3800	2001	Dual ECDs	515.3	21	3800-100193
	Varian	3400	1985	Dual ECD	551.1	13	3400-1853
	Varian	3800	2001	Dual ECDs	505/ 504.1(low-level TCP)	22	3800-08107
	Varian	3800	2002	Dual ECDs	515.3/505	23	3800-08827
	Agilent	3800	2003	Dual ECDs	HAA – 6251B	24	US10306042
	Agilent	3800	2003	Dual ECDs	HAA – 6251B	25	US10315084
	Agilent	3800	2003	Dual ECDs	515.3/515.4	26	US10315085

Table 3.2 (con't)
MWH Laboratories Organics Lab Equipment, April, 2005

	Type	Model	Year Acquired	Detectors	Tests	ID	Serial #
GCMS SYSTEM	HP	5890/5972	1997	VOA - MS	524.2, 624, 8260	J	3118A02321
	HP	5890/5972	1995	VOA - MS	524.2, 624, 8260	H	3501A02407
	HP	5890/5972	1995	Semivoa - MS	625, 525.2, 8270	F	3524A02890
	Varian Ion Trap	Saturn III	1994	Semivoa - MS	Endothall -548.1	ST	737/17818
	Finnigan	Trace	1999	VOA - MS	524.2, 624, 8260	T2	16422/991569
	Finnigan	Trace	1999	Semivoa - MS	525.2	T1	16210/991700
	Finnigan Ion Trap	Polaris Q	2000	Semivoa - MS	NDMA	ITQ1	S/N 110003
	Varian Ion Trap w CI/MS	Saturn	2000	Semivoa - MS	SPME	ITS2	S/N MS 110125
	Finnigan Ion Trap	Polaris Q	2001	VOA - MS	524.2 (with tba @ 2 ppb)	ITQ2	S/N 13593
	Varian Ion Trap	Saturn 2000	2001	Semivoa - MS	548.1, 528	ITS3	S/N 13 MR01
	Finnigan	Trace	2002	Semivoa - MS	525.2	T3	16425 20004158
	Agilent	6890/5973	2003	MSD	525	K	US30945838
	Agilent	6890/5973	2003	MSD	524/624/8260	L	US33246003
HPLC	Dionex	HPLC	2002	Fluorescence	531.1	3	1530109 1630102
	Waters	2690/2487	1998	UV Detector	Diquat – 549.2, Diuron – 532	2	N96SM4168R
	Waters	LC Module1	1992	Fluorescence Detector	Glyphosate, Carbamates – 547, 531.1	2	1000205
	HP	1090	1987	UV Detector	Diquat -549.2, Diuron - 532	1	2750A01783

Figure 3.1 Floor Plan – First Floor

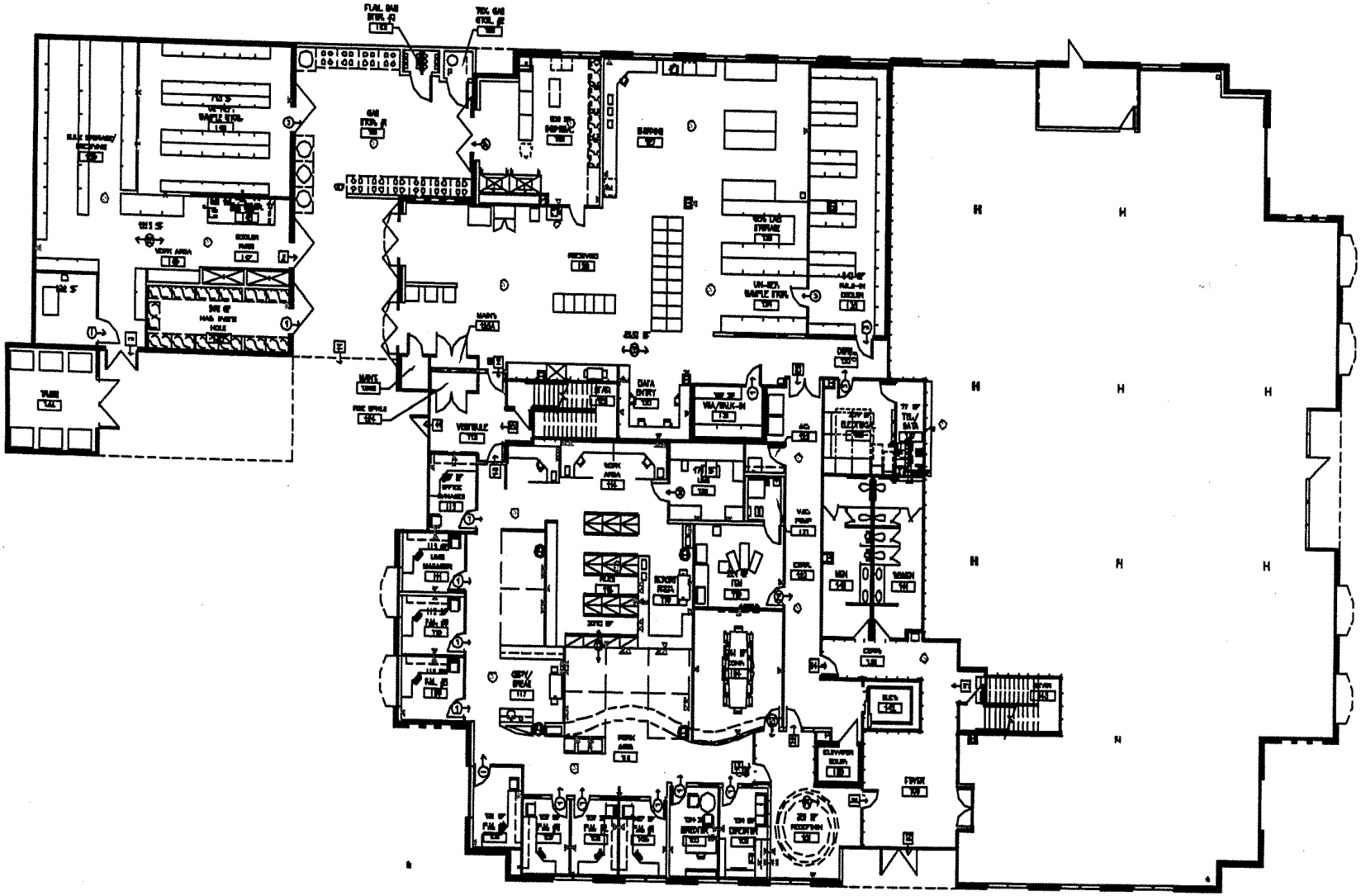
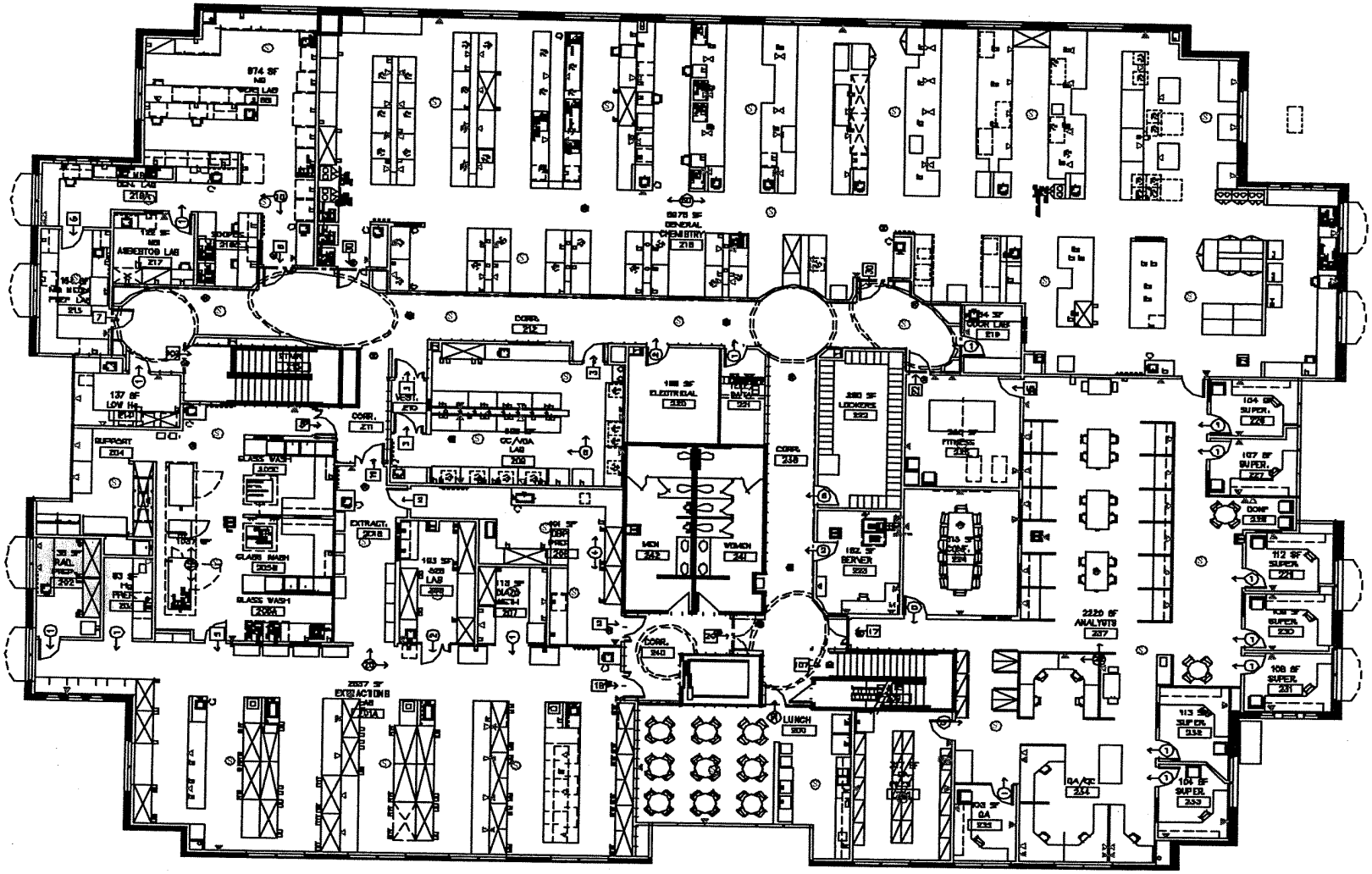


Figure 3.2 Floor Plan – Second Floor



4.0. PROGRAM ORGANIZATION AND RESPONSIBILITY

4.1. MWH LABORATORIES ORGANIZATION

MWH Laboratories provides a wide range of both organic and inorganic chemical analyses, as well as a wide spectrum of microbiological analyses. All MWH analysts and technicians analyzing drinking water samples meet the minimum qualifications specified in the Manual for the Certification of Laboratories Analyzing Drinking Water, Criteria and Procedures, Quality Assurance, 5th Edition. The organization and chain of command for the laboratory is shown in Figure 4-1. Details of assigned positions, responsibilities and qualifications are summarized below. The laboratory is organized in such a way that confidence in its independence of judgment and integrity is maintained at all times and has managerial staff with the authority and resources needed to discharge their duties. The QA Officer reports directly to the MWH Lab. Director and has the authority to make independent technical judgment not influenced by production, marketing and financing issues [NELAC 5.4.1]. Qualified supervisors are certified as to their educational and technical background and experience, to ensure that supervision is provided by persons familiar with the calibration or test methods and procedures, the objective of the calibration or test and the assessment of the results.

General Manager Director/Financial Officer: Ms. Mona Altieri

Ms. Altieri has over 20 years of experience in the business world. She is trained in accounting and is a Certified Public Accountant in California and Ohio. She began working with the MWH Accounting and Finance Group in 1994 and transferred to the laboratory in May of 2004. Her responsibilities include cost analysis, overhead control and operational efficiency, as well as setting revenue and profit goals that will provide steady and controlled growth for the laboratory over the next five years. Her prior experience as Controller for several companies, including MWH, and also as a Sole Practitioner running her own tax practice for six years prior to joining MWH, are proving invaluable as she is finding new ways of streamlining costs and improving the efficiency of the laboratory.

Laboratory Director/ Technical Director: Dr. Andrew Eaton

Dr. Eaton has over 30 years of analytical experience including over 20 years of managerial experience. As Laboratory Director/ Technical Director, Dr. Andrew Eaton sets laboratory policy and is responsible for overall laboratory performance, technical operation and direction [NELAC 5.4.1.5h)]. In his capacity as Technical Director, Dr. Eaton certifies that personnel with appropriate educational and/or technical background perform all tests for which the laboratory is accredited. Such certification for each personnel is documented in the analyst demonstration of capability (DOC) certification statement [NELAC 5.C.2)]. The DOC certification statement was modified to include the certification for the analyst for having the appropriate educational and/or technical background. A copy of the certification statement is retained in the training files of each affected employee [NELAC 5.4.1.5h)].
In his role as Lab Director/Technical Director, he has ultimate responsibility for ensuring the efficiency and accuracy of laboratory procedures, project management, and marketing. Prior to his current assignment, Dr. Eaton served as Technical and Marketing Director of

the laboratory. As Technical Director, Dr. Eaton is responsible for Project Management on large projects with significant technical issues, serves as a technical advisor to the laboratory staff and clients, worked on special assignments such as productivity assessments and financial analyses, as well as marketing activities with clients whose projects are highly technical in nature. Dr. Eaton also serves as a member of the Joint Editorial Board for Standard Methods for the Examination of Water and Wastewater (SM). In this capacity, he is responsible for recommending new methods for inclusion in SM and ensuring that all proposed methods include appropriate levels of QC and validation. Formerly on the Board of Association of California Testing Labs (actLABS), Dr. Eaton also served on the Board of Directors as a member of Methods and Data Comparability Board, which reports to the National Water Quality Monitoring Council. He is a member of the INELA program policy and structure committee.

Asbestos Technical Director: Carol J. Belt

Ms. Belt has over 20 years of environmental laboratory experience in MWH Laboratories conducting microbiology and asbestos analyses. Her expertise includes analysis of drinking water and wastewater samples for microbiological testing and asbestos analysis. She is responsible for training analysts in various microbiological procedures and in the analytical method for the determination of asbestos fibers in water. As the Technical Director for Asbestos analysis, Ms. Belt has the overall responsibility for the technical operation of the asbestos testing in the laboratory and currently oversees all aspects of the asbestos testing She is responsible for monitoring the performance of the entire procedure and accurate reporting of all samples received for asbestos analysis. She is also responsible to train other technicians on this methodology and is responsible to certify trained analysts as to their educational and technical background and demonstration of capability.

Client Services Manager: Mr. James Hein

As Client Services Manager, Mr. Hein is responsible for overseeing the client services group, including project management; bottle prep, sample control, tracking regulations, and special project requirements. Mr. Hein has over 16 years of environmental laboratory experience. His experience has encompassed analytical methods development for soils, sediments and water, the development of data assessment procedures for validation of analytical data, and the implementation of numerous bench scale treatment studies for the removal of various environmental pollutants. He has managed projects requiring coordination of schedule, personnel, budget and compliance to technical specifications for local, state and federal agencies as well as private sector companies.

In the absence of the Technical Director or QA Officer, Mr. Hein is designated as the Deputy Technical Director/ QA Officer. In the absence of the Technical Director/QA Officer and Mr. Hein, any of the Department Supervisors is assigned to be the Lab Deputy Technical Director/ QA Officer.

Quality Assurance Officer/Health & Safety/Hazardous Waste Coordinator: Ms. Nilda B. Cox

As Quality Assurance Officer, Ms. Cox is responsible for the Laboratory Quality System and its implementation. Ms Cox is also responsible for insuring that routine laboratory quality control procedures are being performed and properly documented. Ms. Cox is responsible for performing routine audits of laboratory data and procedures, implementing a program of blind performance evaluation samples, reviewing control charts, maintaining state certifications and suggesting modifications to the Quality Assurance (QA) program at MWH which could improve our efficiency and quality. She is also the Health and Safety Coordinator for the laboratory, working with all laboratory personnel and the MWH Corporate Health and Safety Manager. Ms. Cox has over 14 years of environmental experience in Quality Assurance, including hazardous waste management and safety compliance in the laboratory. Her experience also includes 8 years as senior chemist and supervisor of QA/QC Methods Development Group, Chemistry Department and in-charge of the Industrial Hygiene Monitoring Program for a medical device company. Additional experience includes 6 years in Research and Development in the field of agriculture.

General Chemistry Manager: Mr. Ali Haghani

As MWH Laboratories' General Chemistry Manager, Mr. Haghani is responsible for managing the Extractions, GC, GCMS/HPLC, and Inorganics Departments (Metals, Wet Chem, IC, and Radiochem). He is responsible for overseeing six supervisors and a staff of over 50 analysts performing sample preparation and analysis of environmental samples for organics and a wide range of inorganic parameters. He is also responsible for day-to-day scheduling of analysts workloads, providing guidance and technical expertise to the analyst, and checking the validity of their work. He ensures that holding times are not exceeded and all QA guidelines are met. Mr. Haghani has over 10 years of experience in the environmental measurement business. Mr. Haghani has technical expertise in inorganic and organic analytical chemistry.

Extraction Supervisor: Mr. David Tripp

Mr. Tripp has over nineteen years experience in the field of analytical chemistry for the environmental laboratory. He has experience in both organic and inorganic analyses using EPA methods on a variety of analytical instruments. His experience includes installation, operation, maintenance and trouble-shooting of instruments, sample preparation, training analysts, validating data, and laboratory design and relocation.

Mr. Tripp manages the Extraction Lab for MWH. His responsibilities include supervising seven chemists, meeting quality control and method requirements, scheduling work, recruiting and training staff, and managing the group budget. He works closely with Client Services, the Lab Directors and department managers to schedule incoming work and to meet QC requirements and specific client needs.

GC Supervisor: Mr. Martin McNally

As MWH Laboratories' GC supervisor, Mr. McNally is responsible for day to day supervision of a staff of 8 analysts performing organics analyses by gas chromatography. Mr. McNally schedules analysts' workloads to ensure that holding times are not exceeded, approves final data, and insures that all QA guidelines are met. Mr. McNally has over 9 years experience performing organic analyses.

Microbiology Supervisor: Mr. Johnny Fukuoka

Mr. Fukuoka obtained his BA, Bacteriology Degree at the University of California, Los Angeles in 1972 and Post Baccalaureate studies in Microbiology at the California State University in 1977. He was a Microbiology Manager from 1977-1995 in an environmental laboratory supervising all testing performed in the Microbiology Department. He has been a microbiologist/technical advisor since 1995 concerning all technical issues in the department. In this capacity, he also oversees the Microbiology customer service. Mr. Fukuoka has over 20 years of experience in the field of microbiology.
As Microbiology Supervisor, Mr. Fukuoka is responsible for the supervision of a staff of 5 analysts performing various microbiological tests. Mr. Fukuoka schedules analysts' workloads to ensure that holding times are not exceeded and that all QA guidelines are met.

4.2. QUALITY ASSURANCE PROGRAM MANAGEMENT

The Quality Assurance Officer is responsible for ensuring the quality of work generated by the laboratory staff through the implementation of a continually updated quality assurance program that all members of the laboratory staff must adhere. The Quality Assurance Officer is responsible to be knowledgeable in the NELAC Quality Systems Current Standard and its implementation. [NELAC 5.4.1.5.i, 5.4.2.5].
Attendance in the NELAC Interim and annual Conference are documented in the QA Officer's Training Files. The Quality Assurance Officer has direct access to the highest level of management, which is the Technical/Laboratory Director, at which decisions are made on laboratory policy or resources [NELAC 5.4.1.5.i].

Specific areas of responsibility include:

- Providing guidelines for QA orientation program to newly hired personnel and ensuring that they are familiar with the quality assurance program operating within the laboratory.

- Overseeing and maintaining the training program files for each analyst at MWH Laboratories.

- Interacting with auditors and certification authorities in conjunction with lab certification for both in state and out-of-state programs.

- Maintaining copies of procedural write-ups and ensuring that all personnel working in the laboratory follow established standard operational procedures. Due to the size of MWH

Laboratories, this objective is carried out with the aid of the various supervisors of the analytical groups.

- Submitting and evaluating blind performance samples and reviewing the results with the analytical staff. Any apparent problems are fully investigated and appropriate modifications are implemented. The results of the performance samples as well as a written summary of problems and appropriate corrective action are documented and reviewed with the group leaders and analytical staff at group meetings.

- Coordinating analysis of Performance Evaluation (PE)/Proficiency Testing (PT) (i.e. water supply study-WS, water pollution study-WP) samples; reviewing results with the analytical staff at group meetings; and providing timely response to certification authorities with respect to any identified problem areas.

- Ensuring that analysts are monitoring long-term quality control trends with quality control charts and insuring that corrective action is initiated whenever an out of control event occurs.

- Maintaining QA documentation files.

- Ensuring that sample log-in and traceability are done correctly and that the chain of custody forms and other relevant documentation are properly maintained by periodic spot checks of the records.

- Ensuring that all laboratory procedures currently in use are acceptable and will not compromise quality.

- Serving as the focal point for QA/QC and is responsible for the oversight and/or review of quality control data. The QA Officer and her designee perform periodic audits of laboratory data or procedures to insure that QA objectives are being met. Where QA oversight is provided, the QA Officer and her designee function independently from the laboratory operations. The QA Officer and her designee evaluate data objectively and perform assessments without managerial influence.

- Providing the staff with quality assurance information and updates.

- Writing or reviewing project specific QA plans.

- Preparing annual reports to management on QA related activities in the laboratory. Through the annual report, the QA Officer notifies the laboratory management of deficiencies in the Quality System and monitors corrective actions. See sec 15.1.

- Implementing procedures that allow for adequate documentation and control of specific documents. These procedures use a unique identification system that allows for tracking, training documentation, traceability of official copies and the time period the procedure or document was in force. To ensure that QA Manual and SOPs remained controlled

documents, the master SOPs and QA Manual (original official version of the SOP and QA Manual) and copies of the SOP and QA Manual will be identified. The cover page of each copy will contain a unique identification indicating that the document is controlled copy ___ of ____ copies, initialed and dated by the QA Officer in red ink. This ensures that the analyst is currently using the right update or version.

A SOP/ QA Manual Distribution Form will be prepared for each SOP/ QAM that will include the SOP/QAM ID, control number, individual receiving the SOP/QA Manual, date of issue and the date of completion of the analyst SOP/QAM training documentation.

- Implementing the record management system for control of laboratory notebooks; instrument logbook; standard logbook; and records for data reduction validation storage and reporting. Laboratory archival system are also implemented to laboratory books and logbooks.

- Implementing an archival system for managing and removal of all outdated documentation. Records that are archived are; Training Records for personnel no longer with the laboratory; Outdated QA Manual/SOPs; only current versions of the QA Manual/SOPs are retained in the laboratory areas. All outdated versions of the QA Manual/SOPs are returned to the QA Officer for archiving. In addition, all outdated logbooks/workbooks, including maintenance books, are turned in to the QA Officer for archiving. Archived information is stored in-house for 2 years and is then transferred off-site, for storage for another 3 years.

4.3. STAFF RESPONSIBILITIES

A comprehensive Quality Assurance Program requires the involvement of all laboratory personnel. The level of involvement for each analyst is dependent upon his or her assignment within the laboratory. Laboratory analysts are responsible for quality control parameters that are done at the time of analysis. Laboratory management is responsible for monitoring and evaluating the results of the quality control procedures performed by the analysts.

4.4. TRAINING

The objective for data generated by MWH Laboratories is that the quality and consistency of the data produced be independent of the analyst performing the analysis. This can only occur when all analyses are performed using SOPs, and the analyst performing the procedure has been properly trained and has demonstrated proficiency with the analysis. This is accomplished at MWH Laboratories by having a training checklist for each group or set of analyses within a group. This checklist is followed for each trainee analyst by the group supervisor with the help of an assigned analyst mentor. The trainee is issued a set of training materials (i.e. safety information, SOP, Ethics SOP, method reference etc.) and is given hands-on training under the direct supervision of the mentor analyst or supervisor. Progress is monitored closely for the first six months by using frequent performance reviews, quality control check samples, performance audits and bench sheet reviews. A training file for each analyst and method is kept in the QA department along with a training history form filled out

at the inception of the present training program or at the time of employment. Each analyst's training file includes; a resume indicating the analyst's qualifications, experience, transcript of records, job description, and an initial demonstration of capability (IDC) and continuing demonstration of proficiency for each analyst. Up-to-date technical staff training records of training course in ethical and legal responsibilities, including potential punishments and penalties for violations, are kept in the QA department. IDC is performed for each analyst and instrument. The IDC for each analyst includes a demonstration of the ability to achieve a low background, the precision and accuracy required by the method, the method detection limit (MDL) in accordance with procedure in 40 CFR 136, Appendix B and satisfactory performance on an unknown sample as on going proficiency test results are also filed. The IDC is repeated when there is a change in analyst, test method and instrument. A log of names, initials and signatures for all individuals responsible for signing or initialing any laboratory records is maintained by the QA group. IDC Certification serves as a record of Authorization and Competence [NELAC 5.5.2.6]. All Analysts, including contracted personnel when hired, are required to undergo the same training (IDC, MDL Studies, ability to achieve a low background, the precision and accuracy required by the method and satisfactory performance on a PT sample), and IDC Certificate of Competence [NELAC 5.5.2]. A copy is filed in the analyst training record. Demonstration of Capability will also be done for analysts working as a unit (work cells). Examples of work cells are extraction analysts preparing the IDC and MDL samples and the prepared sample analyzed by the appropriate GC, GCMS, or HPLC analysts. IDC certification is completed for the work cells as a group.

If spikes are not applicable, like for example TSS, QC samples are used for IDC. Spikes are also not available for Microbiology test methods thus, the laboratory uses PE samples obtained from NIST approved PT providers to certify analyst conducting Microbiological testing. The laboratory retains all associated supporting data necessary to reproduce analytical results summarized in the IDC certification statement. The QC sample used for the IDC analysis is obtained from an outside source. If an external vendor is not available, the laboratory prepares the QC sample independent of the instrument calibration standard. The QC sample concentration prepared for the IDC is approximately 10x the method or lab MDL. 4 aliquots of the sample are analyzed concurrently or over a period of days. Average recovery and standard deviation for each parameter of interest are calculated in the units used for reporting to clients. The resulting average recovery and standard deviation must meet the acceptance criteria for the method. When it is not possible to determine mean and standard deviations, such as for presence/absence and logarithmic values, the laboratory assess performance against established and documented criteria. If there is no mandatory criteria in the method, either reference or laboratory generated limits are used. Analysis of actual samples is not done until all parameters of interest meet acceptance criteria. If one or more of the test parameters do not meet the acceptance criteria, the problem is corrected, followed by repeated analysis of the four aliquots for those that failed to meet criteria. If the repeat analyses failed acceptance criteria the laboratory investigates, corrects the problem and repeats the test for all parameters.

4.4.1. Annual Competency Check

The laboratory performs an annual competency check for each analyst to ensure that each technical employee demonstrates an initial and ongoing proficiency for the tests performed by the technical employee.

Ongoing proficiency checks are done by ensuring that the training of personnel is kept up-to-date by the following:

1. Evidence on file that demonstrates that each employee has read, understood, and is using the latest version of the laboratory's in-house SOP documentation and all other documentation, which relates to his/her job responsibilities.

2. Training courses or workshops on specific equipment, analytical techniques or laboratory procedures shall all be documented.

3. A certification that the technical personnel have read, understood and agreed to perform the most recent version of the test method (the approved method or standard operating procedure) and documentation of continued proficiency by at least one of the following once per year:

   i. Acceptable performance of a blind sample (single blind to the analyst).

   ii. Another initial demonstration of method performance;

   iii. Successful analysis of a blind performance sample on a similar test method using the same technology (e.g., GC/MS Volatiles by purge and trap for 524.2, 624 or 5030B/8260) would only require documentation for one of the test methods. The laboratory must determine the acceptable limits of the blind performance sample prior to analysis (NELAC 5.5.2.6.c.3.i.)

   iv. At least four consecutive laboratory control samples with acceptable levels of precision and accuracy. The laboratory uses the Provider acceptable NELAC limits of any blind PT sample that is used to document the annual proficiency documentation for each analyst (NELAC 5.5.2.6.c.3.iii.)

   v. If item # iv cannot be performed, because spiking is not an option or QC samples not available, analysis of authentic samples that have been analyzed by another trained analyst with statistically identical results or analysis of Proficiency test samples obtained from NIST approved providers can de done.

   vi. For specialized work cells where extraction analysts have to do the sample preparation for LCS and MDL samples and the analyses of the prepared samples are done by the analysts belonging to another group, such as GC or GCMS areas, the group as a unit completes a Demonstration of Capability.

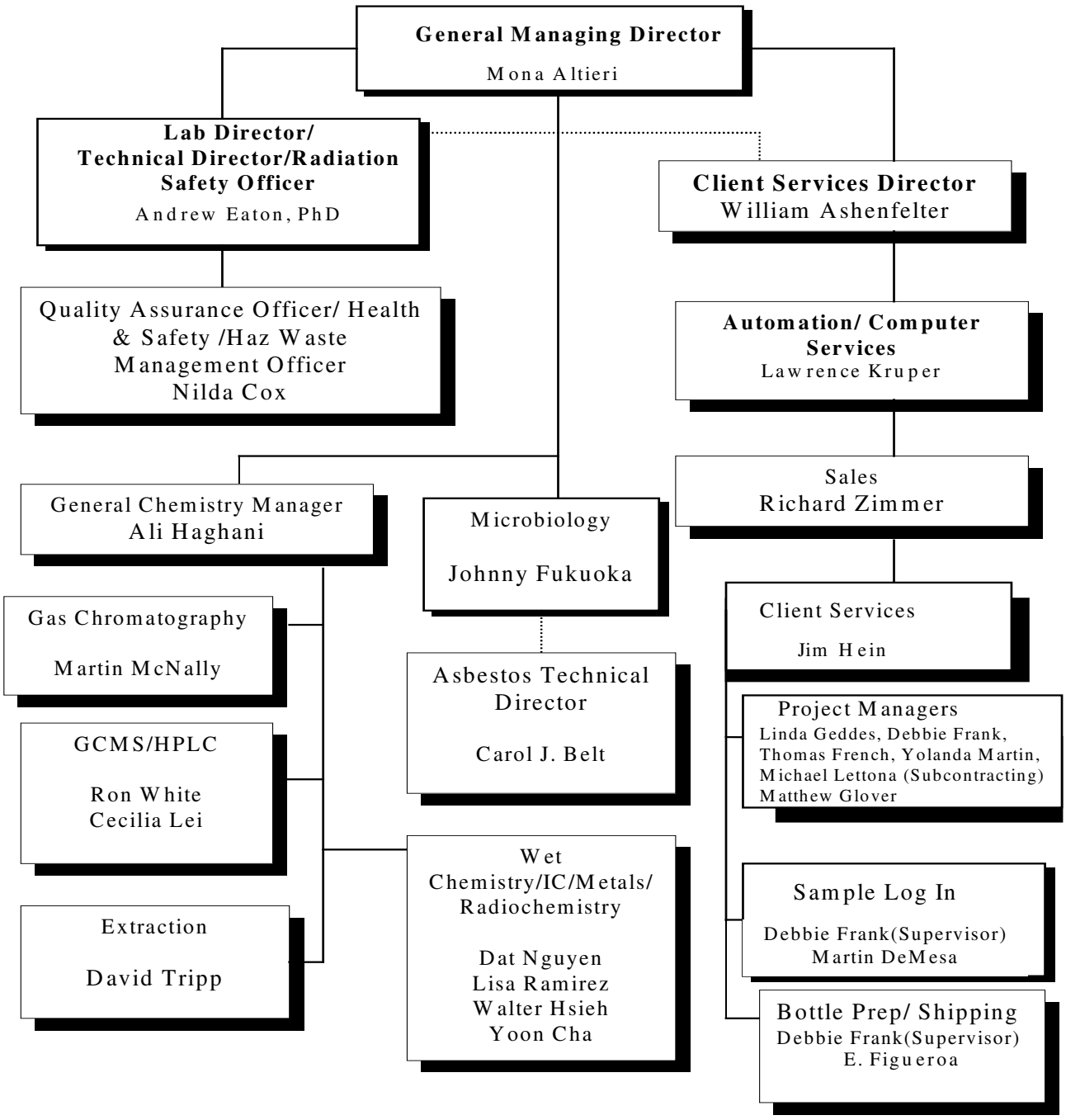
4. Continuing demonstration of method performance (such as laboratory control and matrix spike samples) is monitored by use of control charts.

5. Initial demonstration of method performance is completed each time there is a significant change in instrument type, personnel, or test method.

6. All initial demonstrations of capability and method certification shall be documented through the use of certification statement found in Appendix C of NELAC Quality Systems Standards. A copy of the certification should be retained in the personnel records of each affected employee. (NELAC C.2)

Figure 4.1

MWH Laboratories Organizational Chart



5.0 QUALITY ASSURANCE OBJECTIVES

The quality of data produced by MWH Laboratories may be measured by the following characteristics: precision, accuracy, completeness, representatives, comparability, timeliness, and documentation. MWH Laboratories has set specific objectives for each of these characteristics as a means of meeting the data quality objectives of the client. A definition of each of the characteristics follows, along with the specific objectives for each of the characteristics.

Table 5-1 lists specific limit objectives for precision and accuracy for drinking water analyses.

Table 5-2 lists specific limit objectives for precision and accuracy for wastewater analyses.

Table 5-3 lists specific limit objectives for precision and accuracy for hazardous waste analyses.

Criteria for precision and accuracy included are only for representative reference methods. Criteria for the other methods can be found in relevant SOPs.

5.1. PRECISION

Analytical precision is an important component of overall data quality since it is a measure of how far an individual determination may be from the mean of replicate measurements. If the precision of an analysis is poor, there is a good probability that the reported result will differ substantially from the true value even if there are no systematic errors leading to bias in the result. Precision is often directly related to concentration. For equations relevant to the determination of precision, please see section 11.1.10.

5.2. ACCURACY

Accuracy is the agreement between an experimentally determined value and the accepted reference value. Analytical accuracy is a measure of analytical bias due to systematic errors. A measure of this bias along with a measure of the precision will provide the overall accuracy of the results. For equations relevant to the determination of accuracy, please see section 11.

5.3. REPRESENTATIVENESS/SAMPLING OF SUB-ALIQUOT

All sample aliquots, which are analyzed, must be representative of the bulk sample from which they are taken (NELAC 5.5.7). Representativeness is easily achieved for aqueous samples free of suspended material. Obtaining a representative sample is a more difficult task for soils and sludge.
Unless a sample is known to be non-randomly heterogeneous in its composition, the most appropriate manner of obtaining a representative aliquot for analysis is by simple random sampling after the material has been mixed as thoroughly as possible. Thorough mixing is acceptable for inorganic analyses, but any samples requiring volatile or semi-volatile organic

analyses must be handled in a manner, which minimizes loss of these volatile compounds from the sample.

When analyzing a soil sample for volatile organic constituents, the aliquot for organic analysis must be withdrawn first unless a separate container for organic analysis was collected at the site. Special procedures involving collection in methanol may be appropriate for soil volatiles. Soil samples requiring analysis for inorganic constituents must be thoroughly mixed prior to random selection of sample for analysis.

The laboratory documents the sampling techniques of aliquots from a submitted sample in the method SOPs to ensure that representative of sample are obtained. (NELAC 5.5.7.1).

5.4. COMPARABILITY

The characteristic of comparability determines whether analytical conditions are uniform for each analytical run to insure that all of the reported data will be consistent. This requires temporal stability of analytical conditions within the laboratory.

To insure temporal stability, uniform analytical and quality control protocols will be closely adhered to for each analytical run. In addition, traceable standards are used as part of every analytical run. Every analyst is required to demonstrate his precision and accuracy for a particular analysis by analyzing four replicate matrix spiked samples. All newly trained or backup analysts must demonstrate comparable precision and accuracy.

5.5. COMPLETENESS

The characteristic of completeness is a measure of the percentage of specified data, which are valid. Valid data are obtained when samples are analyzed in accordance with the quality control procedures outlined in this manual and none of the quality control criteria is exceeded. Any sample data, which do not meet the specified quality control criteria, will automatically be reanalyzed if sufficient quantity of sample is available and analytical holding times have not been exceeded. The laboratory strives for a completeness percentage of 100%.

5.6. TIMELINESS

EPA guidelines require that samples be analyzed for constituents within specified holding times. These holding times represent a compromise between allowance of a realistic time to perform the analysis and minimization of elapsed time to insure sample integrity.

MWH Laboratories has adopted a computerized sample tracking system and supervisory review process to insure that samples are scheduled for extraction and analysis within the EPA holding times. In the unforeseen circumstance of instrument maintenance problems, MWH Laboratories will do everything possible to meet EPA holding times without compromising the quality of the reported data. The client is notified if a holding time may be exceeded.

5.7. DOCUMENTATION

Proper documentation is a vital component in supporting the integrity of analytical results. All of the proceeding quality control components will not support reported data unless they have been fully documented for subsequent review. MWH Laboratories maintains documentation of sample handling, chain of custody (if applicable), analytical procedures, raw and calculated data, supporting chromatograms, quality control data, and final reports. Please see section 12 for data reduction, validation, and reporting procedures.

Table 5-1 Precision and Accuracy for Drinking Water
(A) Inorganics - Wet Chemistry

Parameter Method Name	Method Number	Parameters/ Analytes	LCS/LFB	MS/LFM	Precision RPD Maximum
			% Rec.	% Rec.	
Alkalinity	SM2320B	Bicarbonate	90 - 110	80 - 120	10
		Carbonate	90 - 110	80 - 120	10
		Hydroxide	90 - 110	80 - 120	10
Bromate, BrO3	EPA 317	Bromate	85 - 115	75 - 125	20
Bromate, BrO_3	EPA 300.1	Bromate	85 - 115	75 - 125	20
Bromide, Br	EPA 300.0	Bromide	90 - 110	90 - 110	20
Bromide, Br	EPA 300.1	Bromide	85 - 115	75 - 125	20
Chloride	EPA300.0	Chloride	90 - 110	90 - 110	20
Chlorine Dioxide	SM 4500-ClO2 D	Chlorine Dioxide	85 - 115	85 - 115	15
Chlorite, CLO_2	EPA 300.0	Chlorite	90 - 110	90 - 110	20
Chlorite, CLO_2	EPA 300.1	Chlorite	85 - 115	75 - 125	20
Chlorate, CLO_3	EPA 300.0	Chlorate	90 - 110	90 - 110	20
Chlorate, CLO_3	EPA 300.1	Chlorate	85 - 115	75 - 125	20
Color	SM 2120B	Color	-	-	+1 color unit (0-10)
					+5 units (10-110)
					+10 units (>110)
Conductivity	SM2510B	Conductivity	-	-	20
Corrosivity (Langlier Index)	SM 2330B	Corrosivity	85 - 115	85 - 115	15
Cyanide	SM4500CN-F, G	Cyanide	80 - 120	80 - 120	20
	EPA335.4	Cyanide	90 - 110	90 - 110	20
Fluoride	SM4500 F-C	Fluoride	90 - 110	80 - 120	20
Foaming Agents/ Surfactant	ESM5540C	Surfactant (MBAS)	90 - 110	80 - 120	20
Free & Total Chlorine	SM 4500 Cl G	Free & Total Chlorine	85 - 115	85 - 115	15
Hardness	EPA 200.7	CA Hardness	-	-	-
Nitrate (chlorinated/non-chlorinated)	EPA300.0/353.2	Nitrate	90 - 110	90 - 110	20

Table 5-1 Precision and Accuracy for Drinking Water
(A). Inorganics - Wet Chemistry (con't)

Parameter Method Name	Method Number	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB	MS/LFM	
			% Rec.	% Rec.	
Nitrate & Nitrite (non-chlorinated)	EPA 353.2	Nitrate & Nitrite	90 - 110	90 - 110	20
Nitrite	EPA300.0	Nitrite	90 - 110	90 - 110	20
	EPA353.2	Nitrite	90 - 110	90 - 110	20
Odor	SM 2150B	Odor	-	-	20
o-Phosphate	365.1	o-Phosphate	90 - 110	80 - 120	20
	SM4500 P-E	o-Phosphate	90 - 110	80 - 120	20
Perchlorate	EPA314.0	Perchlorate	85 - 115	80 - 120	20
pH	EPA150.1/ SM4500-HB	pH	-	-	+ 0.1 pH unit
Phenols	EPA 420.1/420.2	Phenols	90 - 110	80 - 120	10
Residual Disinfectant (Total/ Free Residual Chlorine)	SM4500 Cl-G	Residual Disinfectant	-	-	-
Silica	EPA200.7	Silica	85 - 115	70 - 130	-
	SM 4500 Si D	Dissolved /Reactive Silica	90 - 110	80 - 120	20
Total Dissolved Solids (TDS)	SM2540C /EPA 160.1	Total Dissolved Solids (TDS)	85 - 115	-	10
Total Suspended Solids (TSS)	SM2540D/EPA 160.2	Total Suspended Solids (TSS)	80 - 120	-	10
Sulfate	EPA300.0	Sulfate	90 - 110	90 - 110	20
Total Organic Carbon / Dissolved Organic Carbon (DOC)	SM 5310C	TOC/DOC	90 - 110	90 - 110	20
Turbidity	EPA180.1	Turbidity	N / A	N / A	20
UV 254	SM 5910 B	UV	85 - 115	N / A	10 (6.0 mg/LDOC)

(B) Inorganics - Metals

Parameter Method Name	EPA Method Number	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB	MS/LFM	
			% Rec	% Rec	
Metals	EPA200.7	Aluminum, Al	85 - 115	70 - 130	20
		Barium, Ba	85 - 115	70 - 130	20
		Beryllium, Be	85 - 115	70 - 130	20
		Boron, B	85 - 115	70 - 130	20
		Calcium, Ca	85 - 115	70 - 130	20

- LCS/LFB, MS/LFM, % RPD – See sections 11.1.11.1,11.1.11.2 and 11.1.10 for definitions of LCS/LFB, MS/LFM And % RPD, respectively.

Table 5-1 Precision and Accuracy for Drinking Water – (B) Inorganics Metals (con't)

Parameter Method Name	EPA Method Number	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB	MS/LFM	
			% Recovery	% Recovery	
Metals	EPA200.7 (con't)	Cadmium, Cd	85 - 115	70 - 130	20
		Chromium, Cr	85 - 115	70 - 130	20
		Copper, Cu	85 - 115	70 - 130	20
		Iron, Fe	85 - 115	70 - 130	20
		Magnesium, Mg	85 - 115	70 - 130	20
		Manganese, Mn	85 - 115	70 - 130	20
		Nickel, Ni	85 - 115	70 - 130	20
		Potassium, K	85 - 115	70 - 130	20
		Silica	85 - 115	70 - 130	20
		Silver, Ag	85 - 115	70 - 130	20
		Sodium, Na	85 - 115	70 - 130	20
		Zinc, Zn	85 - 115	70 - 130	20
Metals	EPA200.8	Aluminum, Al	85 - 115	70 - 130	20
		Antimony, Sb	85 - 115	70 - 130	20
		Arsenic, As	85 - 115	70 - 130	20
		Barium, Ba	85 - 115	70 - 130	20
		Beryllium, Be	85 - 115	70 - 130	20
		Cadmium, Cd	85 - 115	70 - 130	20
		Chromium, Cr	85 - 115	70 - 130	20
		Copper, Cu	85 - 115	70 - 130	20
		Lead, Pb	85 - 115	70 - 130	20
		Manganese, Mn	85 - 115	70 - 130	20
		Nickel, Ni	85 - 115	70 - 130	20
		Selenium, Se	85 - 115	70 - 130	20
		Silver, Ag	85 - 115	70 - 130	20
		Thallium, Tl	85 - 115	70 - 130	20
		Vanadium, V	85 - 115	70 - 130	20
		Zinc, Zn	85 - 115	70 - 130	20
Metals	EPA200.9	Arsenic, As	85 - 115	70 - 130	20
		Selenium, Se	85 - 115	70 - 130	20
Metals	EPA 218.6	Chromium VI (Dissolved)	90 - 110	90 - 110	10
Metals	EPA 245.1	Mercury, Hg	85 - 115	70 - 130	20
Asbestos	EPA100.1/100.2	Asbestos	-	-	15

Table 5-1 Precision and Accuracy for Drinking Water (con't)

(C) Microbiology/Microscopy Tests

Parameter Method Name	Method Number	Analyte Parameter	Accuracy		Precision RPD Maximum
			LCS/LFB	MS/LFM	
			% Rec.	% Rec.	
Fecal Coliforms--EC Medium, MTF	SM9221E	Fecal Coliforms EC Medium (Enumeration)	-	-	-
Heterotrophic Plate Count (Standard Plate Count)	SM9215B	Heterotrophic Plate Count	-	-	10
Total Coliform by Multiple Tube Fermentation (MF)	SM9221B	Total Coliform/Enumeration	-	-	-
Total Coliform/ E-Coli (Colilert)	SM 9223B	Total Coliforms (Present or Absent)	-	-	-
Total Coliform/Colilert (Enumeration)	SM 9223B	Total Coliform (Enumeration)	-	-	-
Total Coliform (MF)	SM9222A, B, C	Total Coliform	-	-	-
Total Coliforms (MTF) Enumeration	SM9221A, B	Total Coliforms	-	-	-
Total Coliform and E-Coli	Colisure	Total Coliform and E-Coli	-	-	-

(D) Organics

Parameter Method Name	EPA Method Number	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB	MS/LFM	
			% Rec.	% Rec.	
Chlorinated Acids	EPA 515.3	2,4,5-TP (Silvex)	70 - 130	70 - 130	-
		2,4,5-T	70 - 130	70 - 130	-
		2,4-D	70 - 130	70 - 130	-
		2,4-DB	70 - 130	70 - 130	-
		Acifluorfen	70 - 130	70 - 130	-
		DCPA	70 - 130	70 - 130	-
		Dichloroprop	70 - 130	70 - 130	-
		3,5-Dichlorobenzoic Acid	70 - 130	70 - 130	-
		Bentazon	70 - 130	70 - 130	-
		Dalapon	70 - 130	70 - 130	-
		Dicamba	70 - 130	70 - 130	-
		Dinoseb	70 - 130	70 - 130	-
		4-Nitrophenol	70 - 130	70 - 130	-
		Pentachlorophenol	70 - 130	70 - 130	-
		Picloram	70 - 130	70 - 130	-
		2,4-Dichlorophenylacetic Acid (surr)	70 - 130	70 - 130	-

Table 5-1 Precision and Accuracy for Drinking Water (con't)
(D) Organics (con't)

Parameter Method Name	EPA Method Number	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Chlorinated Acids	EPA 515.4	2,4,5-TP (Silvex)	70 - 130	70 - 130	-
		2,4,5-T	70 - 130	70 - 130	-
		2,4-D	70 - 130	70 - 130	-
		2,4-DB	70 - 130	70 - 130	-
		Acifluorfen	70 - 130	70 - 130	-
		DCPA	70 - 130	70 - 130	-
		Dichloroprop	70 - 130	70 - 130	-
		Dinoseb	70 - 130	70 - 130	-
		4-Nitrophenol	-	-	-
		Pentachlorophenol	70 - 130	70 - 130	-
		Picloram	70 - 130	70 - 130	-
		2,4-Dichlorophenylacetic Acid (surr)	70 - 130	70 - 130	-
		3,5-Dichlorobenzoic Acid	70 - 130	70 - 130	-
		Bentazon	70 - 130	70 - 130	-
		Dalapon	70 - 130	70 - 130	-
		Dicamba	70 - 130	70 - 130	-
Organohalide Pesticides and Commercial Polychlorinated Biphenyl (PCB)	EPA 505	Alachlor	70 - 130	65 - 135	20
		Aldrin	70 - 130	65 - 135	20
		Atrazine	70 - 130	65 - 135	20
		Chlordane	70 - 130	65 - 135	20
		Alpha-Chlordane	70 - 130	65 - 135	20
		Gamma-Chlordane	70 - 130	65 - 135	20
		Dieldrin	70 - 130	65 - 135	20
		Endrin	70 - 130	65 - 135	20
		Heptachlor	70 - 130	65 - 135	20
		Heptachlor Epoxide	70 - 130	65 - 135	20
		Hexachlorobenzene	70 - 130	65 - 135	20
		Lindane	70 - 130	65 - 135	20
		Methoxychlor	70 - 130	65 - 135	20
		Cis-Nonachlor	70 - 130	65 - 135	20
		Trans-Nonachlor	70 - 130	65 - 135	20
		Simazine	70 - 130	65 - 135	20
		Toxaphene	70 - 130	65 - 135	20

Table 5-1 Precision and Accuracy for Drinking Water (con't)
(D) Organics (con't)

Parameter Method Name	EPAMethod Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Organohalide Pesticides and Commercial Polychlorinated Biphenyl (PCB)	EPA 505 (con't)	Aroclor 1016	70 - 130	65 - 135	20
		Aroclor 1221	70 - 130	65 - 135	20
		Aroclor 1232	70 - 130	65 - 135	20
		Aroclor 1242	70 - 130	65 - 135	20
		Aroclor 1248	70 - 130	65 - 135	20
		Aroclor 1254	70 - 130	65 - 135	20
		Aroclor 1260	70 - 130	65 - 135	20
DBCP/EDB	EPA504.1	1,2-Dibromo-3-chloropropane (DBCP)	70 - 130	65 - 135	20
		1,2-Dibromoethane (EDB)	70 - 130	65 - 135	20
		1,2,3-Trichloropropane (1,2,3-TCP)	70 - 130	65 - 135	20
		1,2-Dibromopropane (surr)	60 - 140	60 - 140	-
Diquat & Paraquat	EPA549.2	Diquat	70 - 130	70 - 130	-
		Paraquat	70 - 130	70 - 130	-
Endothall	EPA548.1	Endothall	66 - 120	66 - 120	-
Glyphosate	EPA547	Glyphosate	70 - 130	70 - 130	-
Haloacetic Acids *	SM6251B	Bromochloroacetic Acid	85 - 115	78 - 117	20
		Chlorodibromoacetic Acid	85 - 115	70 - 130	-
		Dibromoacetic Acid	85 - 115	79 - 119	20
		Dichloroacetic Acid	85 - 115	78 - 117	20
		Monobromoacetic Acid	85 - 115	79 - 117	23
		Monochloroacetic Acid	85 - 115	70 - 130	20
		Tribromoacetic Acid	85 - 115	70 - 130	
		Trichloroacetic Acid	85 - 115	77 - 121	20
		3,5-Dichlorobenzoic Acid	70 - 130	70 - 130	-
Nitrogen- and Phosphorus- Containing Pesticides	EPA507 (method limits)	Alachlor (Alanex)	65 - 125	60 - 130	-
		Atrazine	62 - 122	57 - 127	-
		Simazine	70 - 130	65 - 135	-
		Dimethoate	62 - 122	57 - 127	-
		Molinate	62 - 122	57 - 127	-
		Diazinon	62 - 122	57 - 127	-
		Prometryn (Caparol)	62 - 122	57 - 127	-
		Thiobencarb	62 - 122	57 - 127	-
		1,3-Dimethyl-2-nitrobenzene (surr)	70 - 130	70 - 130	-

Table 5-1 Precision and Accuracy for Drinking Water (con't)
(D) Organics (con't)

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
N-ethylcarbomoyloximes and N-Methylcarbamates	EPA531.1	3-Hydroxycarbofuran	80 - 120	65 - 135	-
		Aldicarb (Temik)	80 - 120	65 - 135	-
		Aldicarb Sulfone	80 - 120	65 - 135	-
		Aldicarb Sulfoxide	80 - 120	65 - 135	-
		Baygon	80 - 120	65 - 135	-
		Carbaryl	80 - 120	65 - 135	-
		Carbofuran (Furadan)	80 - 120	65 - 135	-
		Methiocarb	80 - 120	65 - 135	-
		Methomyl	80 - 120	65 - 135	-
		Oxamyl (Vydate)	80 - 120	65 - 135	-
		4-Bromo-3,5-Dimethylphenyl-N-Methylcarbamate (BDMC)	70 - 130	70 - 130	-
N-ethylcarbamoyloximes and N-Methylcarbamates	EPA531.2	3-Hydroxycarbofuran	70 - 130	70 - 130	-
		Aldicarb (Temik)	70 - 130	70 - 130	-
		Aldicarb Sulfone	70 - 130	70 - 130	-
		Aldicarb Sulfoxide	70 - 130	70 - 130	-
		Baygon	70 - 130	70 - 130	-
		Carbaryl	70 - 130	70 - 130	-
		Carbofuran (Furadan)	70 - 130	70 - 130	-
		Methiocarb	70 - 130	70 - 130	-
		Methomyl	70 - 130	70 - 130	-
		Oxamyl (Vydate)	70 - 130	70 - 130	-
		4-Bromo-3,5-Dimethylphenyl-N-Methylcarbamate (BDMC)	70 - 130	70 - 130	-
Purgeable Organic Compounds/ Halogenated & Aromatic Volatiles/ Trihalomethanes, Di-Isopropyl Ether (DIPE), Tertiary Amyl methyl Ether (TAME) Tert-Butyl ethyl ether (ETBE)	EPA524.2	1,1,1-Trichloroethane	70 - 130	70 - 130	20
		1,1,2,2-Tetrachloroethane	70 - 130	70 - 130	20
		1,1,1,2-Tetrachloroethane	70 - 130	70 - 130	20
		1,1,2-Trichloroethane	70 - 130	70 - 130	20
		1,1-Dichloroethane	70 - 130	70 - 130	20
		1,1-Dichloroethylene	70 - 130	70 - 130	20
		1,2,3-Trichlorobenzene	70 - 130	70 - 130	20

Table 5-1 Precision and Accuracy for Drinking Water (con't)
(D) Organics (con't)

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision
			LCS/LFB	MS/LFM	RPD
			% Rec.	% Rec.	Maximum
Purgeable Organic Compounds/ Halogenated & Aromatic Volatiles/ Trihalomethanes, Di-Isopropyl Ether (DIPE), Tertiary Amyl methyl Ether (TAME) Tert-Butyl ethyl ether (ETBE)	EPA524.2 (con't)	1,2,4 Trichlorobenzene	70 - 130	70 - 130	20
		1,2,3- Trichloropropane	70 - 130	70 - 130	20
		1,2,4- Trimethylbenzene	70 - 130	70 - 130	20
		1,3,5 Trimethyl benzene	70 - 130	70 - 130	20
		1,1-Dichloropropene	70 - 130	70 - 130	20
		1,2-Dichloropropane	70 - 130	70 - 130	20
		1,3-Dichloropropane	70 - 130	70 - 130	20
		2,2-Dichloropropane	70 - 130	70 - 130	20
		Benzene	70 - 130	70 - 130	20
		Bromobenzene	70 - 130	70 - 130	20
		Bromochloromethane	70 - 130	70 - 130	20
		Bromodichloromethane	70 - 130	70 - 130	20
		Bromoform	70 - 130	70 - 130	20
		Bromomethane	70 - 130	70 - 130	20
		Carbon Tetrachloride	70 - 130	70 - 130	20
		Chlorobenzene	70 - 130	70 - 130	20
		Chlorodibromomethane	70 - 130	70 - 130	20
		Chloroform (Trichloromethane)	70 - 130	70 - 130	20
		Chloroethane	70 - 130	70 - 130	20
		Chloromethane (Methyl Chloride)	70 - 130	70 - 130	20
		Dichloromethane	70 - 130	70 - 130	20
		Dibromomethane	70 - 130	70 - 130	20
		Dichlorodifluoromethane	70 - 130	70 - 130	20
		Ethylbenzene	70 - 130	70 - 130	20
		Fluorotrichloromethane (Freon 11)	70 - 130	70 - 130	20
		Hexachlorobutadiene	70 - 130	70 - 130	20
		Isopropylbenzene	70 - 130	70 - 130	20
		Methyl Tert-Butyl Ether (MTBE)	70 - 130	70 - 130	20
		m-Dichlorobenzene (1,3-DCB)	70 - 130	70 - 130	20
		Naphthalene	70 - 130	70 - 130	20
		n-Butylbenzene	70 - 130	70 - 130	20
		n-Propylbenzene	70 - 130	70 - 130	20
		Styrene	70 - 130	70 - 130	20
		Tetrachloroethylene (PCE)	70 - 130	70 - 130	20
		Tert-Butyl Alcohol (TBA)	70 - 130	70 - 130	20
		Carbon Disulfide	70 - 130	70 - 130	20
		Methyl Isobutyl Ketone (MIBK)	70 - 130	70 - 130	20

Table 5-1 Precision and Accuracy for Drinking Water (con't)
(D) Organics (con't)

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Purgeable Organic Compounds/ Halogenated & Aromatic Volatiles/ Trihalomethanes, Di-Isopropyl Ether (DIPE), Tertiary Amyl methyl Ether (TAME) Tert-Butyl ethyl ether (ETBE)	EPA524.2 (con't)	Toluene	70 - 130	70 - 130	20
		Trichloroethylene	70 - 130	70 - 130	20
		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	70 - 130	70 - 130	20
		Vinyl Chloride	70 - 130	67 - 152	20
		cis-1,2-Dichloroethylene	70 - 130	86 - 129	20
		cis-1,3-Dichloropropene	70 - 130	85 - 120	20
		sec-Butylbenzene	70 - 130	70 - 130	20
		m,p-Xylenes	70 - 130	70 - 130	20
		1,2-Dichlorobenzene	70 - 130	70 - 130	20
		o-Chlorotoluene	70 - 130	70 - 130	20
		o-Xylene	70 - 130	70 - 130	20
		p-Chlorotoluene	70 - 130	70 130	20
		p-Isopropyltoluene	70 - 130	70 - 130	20
		1,4-Dichlorobenzene	70 - 130	70 - 130	20
		2-Butanone (MEK)	70 - 130	56 - 85	20
		4-Methyl-2-Pentanone	70 - 130	70 - 130	20
		trans-1,2-Dichloroethylene	70 - 130	85 - 129	20
		trans-1,3-Dichloropropene	70 - 130	80 - 131	20
		tert-Butylbenzene	70 - 130	70 - 130	20
		Di-Isopropyl Ether (DIPE)	70 - 130	70 - 130	20
		Tertiary Amyl methyl ether (TAME)	70 - 130	70 130	20
		Tertiarry Butyl ethyl Ether (ETBE)	70 - 130	70 130	20
		Nitrobenzene	80 - 120	70 - 130	20
		Hexachloroethane	80 - 120	70 - 130	20
		1,2-dichlorobenzene	80 - 120	70 - 130	20
		1,2-Dichloroethane	80 - 120	70 - 130	20
		1,2-Dichloroethane-d4 (surr)	70 - 130	70 - 130	-
		4-Bromofluorobenzene (surr)	70 - 130	70 - 130	-
		Toluene-d8 (surr)	70 - 130	70 - 130	-
TCP-Low	CA DHS SRLPT/ GCMS	1,2,3-Trichloropropane	80 - 120	70 - 130	20

Table 5-1 Precision and Accuracy for Drinking Water (con't)
(D) Organics (con't)

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Semi-Volatile Organics Acid/Base Neutrals	EPA 525.2	Acenaphthylene	70 - 130	80 - 131	-
		Alachlor	70 - 130	70 - 130	-
		Aldrin	70 - 130	70 - 130	-
		Anthracene	70 - 130	70 130	-
		Atrazine	70 - 130	70 130	-
		Benzo(a)anthracene	70 - 130	80 - 131	-
		Benzo(a)pyrene	70 - 130	70 - 130	-
		Benzo(b)fluoranthene	70 - 130	70 - 130	-
		Benzo(g,h,i)perylene	70 - 130	70 130	-
		Benzo(k)fluoranthene	70 - 130	70 130	-
		Butylbenzylphthalate	70 - 130	80 - 131	-
		Caffeine	70 - 130	70 - 130	-
		a-Chlordane	70 - 130	70 - 130	-
		g-Chlordane	70 - 130	70 130	-
		Chrysene	70 - 130	70 130	-
		Di-(2-Ethylhexyl)phthalate	70 - 130	70 - 130	-
		Di-(2-Ethylhexyl)adipate	70 - 130	70 - 130	-
		Di-n-Butylphthalate	70 - 130	70 - 130	-
		Dibenzo(a,h)anthracene	70 - 130	70 - 130	-
		Diethylphthalate	70 - 130	70 - 130	-
		Dimethylphthalate	70 - 130	70 - 130	-
		Endrin	70 - 130	70 - 130	-
		Fluorene	70 - 130	70 - 130	-
		Butachlor	70 - 130	70 - 130	-
		4,4-DDD	70 - 130	70 - 130	-
		4,4-DDE	70 - 130	70 - 130	-
		4,4-DDT	70 - 130	70 - 130	-
		Metolachlor	70 - 130	70 - 130	-
		Metribuzin	70 - 130	70 - 130	-
		Propachlor	70 - 130	70 - 130	-
		Heptachlor	70 - 130	70 - 130	-
		Heptachlor Expoxide	70 - 130	70 - 130	-

Table 5-1 Precision and Accuracy for Drinking Water (con't)
(D) Organics (con't)

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Semi-Volatile Organics Acid/Base Neutrals	EPA 525.2	Hexachlorobenzene	70 - 130	70 - 130	-
		Hexachlorocyclopentadiene	70 - 130	70 - 130	-
		Indeno(1,2,3,c,d)pyrene	70 - 130	70 - 130	-
		Lindane	70 - 130	70 - 130	-
		Methoxychlor	70 - 130	70 - 130	-
		Molinate	70 - 130	70 - 130	-
		Pentachlorophenol	70 - 130	70 - 130	-
		Phenanthrene	70 - 130	70 - 130	-
		Pyrene	70 - 130	70 - 130	-
		Simazine	70 - 130	70 - 130	-
		Thiobencarb	70 - 130	70 - 130	-
		trans-Nonachlor	70 - 130	70 - 130	-
		Perylene-d12 (surr)	70 - 130	70 - 130	-
Trihalomethanes, Chloral Hydrate, and Haloacetonitrile	551.1	Bromodichloromethane	80 - 120	80 - 120	20
		Bromoform	80 - 120	80 - 120	20
		Chloral Hydrate	80 - 120	80 - 120	20
		Chloroform	80 - 120	80 - 120	20
		Dibromochloromethane	80 - 120	80 - 120	20
		Dibromoacetonitrile	80 - 120	80 - 120	20
		Dichloroacetonitrile	80 - 120	80 - 120	20
		1,1-Dichloro-2-propanone	80 - 120	80 - 120	20
		Trichloroacetonitrile	80 - 120	80 - 120	20
		1,1-Trichloro-2-propanone	80 - 120	80 - 120	20
		1,2-Dibromopropane (surr)	80 - 120	80 - 120	-

* Low Level LFB/LCS 50-150 % Recovery

(E) Radiochemistry

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Gross Alpha	EPA 900.0/ SM 7110C	Gross Alpha	80 - 120	80 - 120	-
Gross Beta	EPA 900.0	Gross Beta	80 - 120	80 - 120	-
Radon 222, Liquid Scintillation	SM7500-Rn	Radon 222	80 - 120	-	-
Radium 228	EPA 904	Radium 228	80 - 120	-	-
Gross Alpha	SM 7110C	Gross Alpha	80 - 120	-	-
Uranium	EPA 200.8 (Screen)	Uranium	80 - 120	80 - 120	-

Table 5-2 Precision and Accuracy for Wastewater
(A) Inorganics - Wet Chemistry

Parameter Method Name	Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Alkalinity	SM2320B/EPA 310.1	Bicarbonate	90 - 110	80 - 120	10
		Carbonate	90 - 110	80 - 120	10
		Hydroxide	90 - 110	80 - 120	10
Ammonia	EPA350.1 / SM4500NH3 –H	Ammonia	90 - 110	90 - 110	20
Biochemical Oxygen Demand (BOD)	EPA 405.1 / SM5210B	Biochemical Oxygen Demand	85 - 115	-	-
Boron	EPA200.7	Boron	85 - 115	70 - 130	-
Carbon Biochemical Oxygen Demand (cBOD)	SM5210B	Carbon Biochemical Oxygen Demand	85 - 115	-	-
Chemical Oxygen Demand (COD)	EPA410.4 / 5220 D	Chemical Oxygen Demand (COD)	90 - 110	90 - 110	20
Chloride	EPA300.0	Chloride	90 - 110	90 - 110	20
Chlorine, Total Residual	SM4500 Cl G	Chlorine, Total Residual	85 - 115	-	-
Chromium VI	SM3500 Cr-D, Colorimetric	Chromium VI	85 - 115	70 - 130	20
Cyanide, Total	EPA335.2/ EPA335.3	Cyanide, Total	90 - 110	90 - 110	20
Cyanide, Amenable to Chlorination	EPA 335.1/SM 4500CN-G	Cyanide, Amenable to Chlorination	80 - 120	80 - 120	20
Fluoride	EPA340.2/ SM4500 F-C	Fluoride	90 - 110	80 - 120	20
Hardness	SM2340B	Hardness	90 - 110	80 - 120	20
Total Kjeldahl Nitrogen	EPA351.2	Kjeldahl Nitrogen	90 - 110	90 - 110	20
Nitrate	EPA353.2	Nitrate + Nitrite	90 - 110	90 - 110	20
	EPA300.0	Nitrate	90 - 110	90 - 110	20
Nitrite	EPA300.0	Nitrite	90 - 110	90 - 110	20
	EPA 354.1/353.2	Nitrite	90 - 110	90 - 110	20
Phenols	EPA 420.1 / 420.2	Phenols	74 - 116	74 - 116	20
pH	EPA 150.1/ SM4500-HB	pH	-	-	+ 0.1 pH unit
Orthophosphate	EPA365.1/ SM4500 P-E	Orthophosphate	90 - 110	80 - 120	20
Perchlorate	EPA 314	Perchlorate	85 - 115	80 - 120	20

Table 5-2 Precision and Accuracy for Wastewater
(A) Inorganics - Wet Chemistry (con't)

Parameter Method Name	Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Phosphorus, Total	EPA365.1/ SM4500 P-E	Phosphorus, Total	90 - 110	90 - 110	10
Residue, Filterable (Total Dissolved Solids--TDS)	SM2540C / EPA 160.1	TDS	85 - 115	-	10
Residue, Non-filterable (Total Suspended Solids--TSS)	SM2540D / EPA 160.2	TSS	80 - 120	-	10
Residue, Settleable (Settleable Solids)	SM2540F / EPA160.5	Residue, Settleable (Settleable Solids)	-	-	-
Specific Conductance	SM2510B / EPA 120.1	Specific Conductance	95 - 105	-	5
Sulfate	EPA300.0	Sulfate	90 - 110	90 - 110	20
Sulfide (Total & Soluble)	EPA376.2	Sulfide	90 - 110	80 - 120	20
Total Residue	EPA 160.3 / SM 2540 B	Total Solids	80 - 120	-	10
Total Organic Carbon (TOC)	SM5310C	Total Organic Carbon (TOC)	90 - 110	90 - 110	20
Total Organic Halide (TOX)	SM 5320B	Total Organic Halide (TOX)	85 - 115	90 - 110	-
Dissolved Silica	SM 4500 Si D	Dissolved Silica	85 - 115	70 - 130	-
Dissolved Oxygen	SM 4500-O G	Dissolved Oxygen	85 - 115	70 - 130	-
Color	SM 2120B	Color	-	-	-
Surfactants	EPA 425.1	Surfactants	90 - 110	80 - 120	20
Turbidity	SM 2130B	Turbidity	90 - 110	-	-

(B) Inorganics - Metals

Parameter Method Name	Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Metals	EPA200.7	Aluminum, Al	85 - 115	70 - 130	20
		Antimony	85 115	70 130	20
		Barium, Ba	85 - 115	70 - 130	20
		Beryllium, Be	85 - 115	70 - 130	20
		Boron, B	85 - 115	70 - 130	20
		Cadmium, Cd	85 - 115	70 - 130	20
		Calcium, Ca	85 - 115	70 - 130	20
		Chromium, Cr	85 - 115	70 - 130	20
		Cobalt, Co	85 - 115	70 - 130	20

Table 5-2 Precision and Accuracy for Wastewater
(B) Inorganics – Metals (con't)

Parameter Method Name	Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB	MS/LFM	
			% Rec.	% Rec.	
Metals	EPA200.7 (con't)	Copper, Cu	85 - 115	70 - 130	20
		Iron, Fe	85 - 115	70 - 130	20
		Magnesium, Mg	85 - 115	70 - 130	20
		Manganese, Mn	85 - 115	70 - 130	20
		Molybdenum	85 115	70 130	20
		Nickel, Ni	85 - 115	70 - 130	20
		Potassium, K	85 - 115	70 - 130	20
		Silica	85 - 115	70 - 130	20
		Silver, Ag	85 - 115	70 - 130	20
		Sodium, Na	85 - 115	70 - 130	20
		Tin, Sn	85 - 115	70 - 130	20
		Vanadium	85 - 115	70 - 130	20
		Zinc, Zn	85 - 115	70 - 130	20
Metals	EPA 200.8	Aluminum, Al	85 - 115	70 - 130	20
		Antimony, Sb	85 - 115	70 - 130	20
		Arsenic, As	85 - 115	70 - 130	20
		Barium, Ba	85 - 115	70 - 130	20
		Beryllium, Be	85 - 115	70 - 130	20
		Cadmium, Cd	85 - 115	70 - 130	20
		Chromium, Cr	85 - 115	70 - 130	20
		Cobalt, Co	85 - 115	70 - 130	20
		Copper, Cu	85 - 115	70 - 130	20
		Lead, Pb	85 - 115	70 - 130	20
		Manganese, Mn	85 - 115	70 - 130	20
		Molybdenum, Mo	85 - 115	70 - 130	20
		Nickel, Ni	85 - 115	70 - 130	20
		Selenium, Se	85 - 115	70 - 130	20

Table 5-2 Precision and Accuracy for Wastewater
(B) Inorganics – Metals (con't)

Parameter Method Name	Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Metals	EPA200.8 (con't)	Silver, Ag	85 - 115	70 - 130	20
		Thallium, Tl	85 - 115	70 - 130	20
		Vanadium, V	85 - 115	70 - 130	20
		Zinc, Zn	85 - 115	70 - 130	20
Metals	SM 3113B/EPA200.9	Arsenic, As	85 - 115	70 - 130	20
		Selenium, Se	85 - 115	70 - 130	20
Mercury	EPA 245.1/7470A	Mercury,Hg	85 - 115	70 - 130	20
Chromium VI	SM 3500Cr D	Chromium VI	85 - 115	70 - 130	20
Silica, Dissolved	SM 4500Si D	Silica, Dissolved	85 - 115	70 - 130	20
Asbestos	EPA100.1/100.2	Asbestos	-	-	15

(C) Microbiology/Microscopy Tests

Parameter Method Name	Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Fecal Coliforms By Multiple Tube Fermentation /EC Medium	SM9221C, E (MTF/EC)	Fecal Coliforms	-	-	-
Fecal Streptococci/ Enterococci by MTF	SM9230B	Fecal Streptococci/ E-Coli by MTF	-	-	-
Heterotrophic Plate Count	SM9215B	Heterotrophic Plate Count	-	-	-
Total Coliforms Multiple Tube Fermentation (MTF)	SM9221B	Total Coliforms	-	-	-

Table 5-2 Precision and Accuracy for Wastewater (con't)
(D) Organics

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Halogenated Volatiles	EPA 601	1,1-Dichloroethene	28 - 167	28 - 167	20
		Chlorobenzene	38 - 150	38 - 150	20
		Trichloroethene	35 - 146	35 - 146	20
		Bromochloromethane (surr)	53 - 156	53 - 156	-
		p-Chlorotoluene (ELCD) (surr)	51 - 165	51 - 165	-
		p-Chlorotoluene (PID) (surr)	58 - 130	58 - 130	-
Aromatic Volatiles	EPA602	Benzene	39 - 150	39 - 150	20
		Toluene	46 - 148	46 - 148	20
		Bromochloromethane (surr)	53 - 156	53 - 156	-
		p-Chlorotoluene (ELCD) (surr)	51 - 165	51 - 165	-
		p-Chlorotoluene (PID) (surr)	58 - 130	58 - 130	-
Organochlorine Pesticides/PCB	EPA608	Aldrin	42 - 122	42 - 122	20
		Dieldrin	36 - 146	36 - 146	20
		Endrin	30 - 147	30 - 147	20
		g-BHC	32 - 127	32 - 127	20
		Heptachlor	34 - 111	34 - 111	20
		p,p' DDT	25 - 160	25 - 160	20
		PCB 1242 Aroclor	39 - 150	39 - 150	20
		Dibutyl Chlorendate (surr)	15 - 133	15 - 133	-
Halogenated Volatiles/ Aromatic Volatiles	EPA624	1,1-Dichloroethylene	0.5 - 234	0.5 - 234	20
		Benzene	35 - 151	35 - 151	20
		Chlorobenzene	37 - 160	37 - 160	20
		Toluene	47 - 150	47 - 150	20
		Trichloroethylene	71 - 157	71 - 157	20
		1,2-Dichloroethane-d4 (surr)	77 - 121	77 - 121	-
		Toluene-d8 (surr)	91 - 107	91 - 107	-
		4-Bromofluorobenzene (surr)	82 - 117	82 - 117	-
Semi-Volatiles Acid	EPA625	Phenol	5 - 112	5 - 112	42

Table 5-2Precision and Accuracy for Wastewater (con't)
(D) Organics (con't)

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Semi-Volatiles Acid and Base/ Neutral Compounds	EPA625 **Acid:**	2-Chlorophenol	23 - 134	23 - 134	40
		4-Chloro-3-cresol	22 - 147	22 - 147	42
		2-Nitrophenol	29 - 182	29 - 182	50
		Pentachlorophenol	14 - 176	14 - 176	50
		Di-N-Butylphthalate	1 - 118	1 - 118	40
		2-Fluorophenol (surr)	32 - 131	32 - 131	-
		2,4,6-Tribromophenol (surr)	36 - 141	36 - 141	-
		phenol-d6 (surr)	50 - 114	50 - 114	-
	Base/ Neutral:	Acenaphthene	47 - 145	47 - 145	31
		N-Nitroso-di-N-Propylamine	5 - 230	5 - 230	38
		1,4-Dichlorobenzene	20 - 124	20 - 124	28
		1,2,4-Trichlorobenzene	44 - 142	44 - 142	28
		2,4-Dinitrotoluene	39 - 139	39 - 139	38
		Pyrene	52 - 115	52 - 115	31
		Nitrobenzene-d5 (surr)	45 - 113	45 - 113	-
		2-Fluorobiphenyl (surr)	40 - 109	40 - 109	-
		p-Terphenyl-d14 (surr)	23 - 117	23 - 117	-

(D) Radiochemistry

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Gross Alpha/Proportional Counting	EPA900.0	Gross Alpha	80 - 120	80 - 120	20
Gross Beta	EPA900.0	Gross Beta	80 - 120	80 - 120	20

Table 5-3 Precision and Accuracy for Hazardous Waste

(A) Inorganics - Wet Chemistry

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB	MS/LFM	
			% Rec.	% Rec.	
Conductivity	EPA 9050	Conductivity	-	-	20
Nitrate	EPA 9056	Nitrate	90 - 110	80 - 120	20
pH	EPA 9040B	pH	-	-	+ 0.1 pH unit
Phenolics	EPA 9066	Phenols	90 - 110	90 - 110	20
Total Organic Halogen	EPA 9020B	Total Organic Halogen	85 - 115	70 - 130	20

(B) Inorganics – Metals

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB	MS/LFM	
			% Rec.	% Rec.	
Metals, Total	EPA6010B	Aluminum, Al	85 - 115	70 - 130	20
		Antimony, Sb	85 - 115	70 - 130	20
		Barium, Ba	85 - 115	70 - 130	20
		Beryllium, Be	85 - 115	70 - 130	20
		Cadmium, Cd	85 - 115	70 - 130	20
		Chromium, Cr	85 - 115	70 - 130	20
		Cobalt, Co	85 - 115	70 - 130	20
		Copper, Cu	85 - 115	70 - 130	20
		Manganese, Mn	85 - 115	70 - 130	20
		Molybdenum, Mo	85 - 115	70 - 130	20
		Nickel, Ni	85 - 115	70 - 130	20
		Silver, Ag	85 - 115	70 - 130	20
		Strontium, Sr	70 - 130	70 - 130	20
		Tin	85 - 115	70 - 130	20
		Titanium	70 - 130	70 - 130	20
		Vanadium, V	85 - 115	70 - 130	20
		Zinc, Zn	85 - 115	70 - 130	20

Table 5-3 Precision and Accuracy for Hazardous Waste
(B) Inorganics – Metals (con't)

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB	MS/LFM	
			% Rec.	% Rec.	
Metals , Total (con't)	EPA6020	Antimony, Sb	85 - 115	70 - 130	20
		Arsenic, As	85 - 115	70 - 130	20
		Barium, Ba	85 - 115	70 - 130	20
		Beryllium, Be	85 - 115	70 - 130	20
		Cadmium, Cd	85 - 115	70 - 130	20
		Chromium, Cr	85 - 115	70 - 130	20
		Cobalt, Co	85 - 115	70 - 130	20
		Copper, Cu	85 - 115	70 - 130	20
		Lead, Pb	85 - 115	70 - 130	20
		Molybdenum, Mo	85 - 115	70 - 130	20
		Nickel, Ni	85 - 115	70 - 130	20
		Selenium, Se	85 - 115	70 - 130	20
		Silver, Ag	85 - 115	70 - 130	20
		Thallium, Tl	85 - 115	70 - 130	20
		Vanadium, V	85 - 115	70 - 130	20
		Zinc, Zn	85 - 115	70 - 130	20
Chromium VI	EPA 7196A	Chromium VI	85 - 115	70 - 130	20
Mercury	EPA7470A	Mercury, Hg	85 - 115	70 - 130	20

(C) Organics

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB	MS/LFM	
			% Rec.	% Rec.	
Halogenated/ Aromatic Volatiles	EPA8260B	Acetone	70 - 130	70 - 130	30
		Acrolein (Propenal)	70 - 130	70 - 130	30
		Acrylonitrile	70 - 130	70 - 130	30
		Benzene	70 - 130	70 - 130	30
		Bromodichloromethane	70 - 130	70 - 130	30
		Bromoform	70 - 130	70 - 130	30
		Bromomethane	70 - 130	70 - 130	30

Table 5-3 Precision and Accuracy for Hazardous Waste (C) Organics (con't)

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Halogenated/ Aromatic Volatiles (con't)	EPA8260B (con't)	2-Butanone (MEK)	70 - 130	70 - 130	30
		Carbon disulfide	70 - 130	70 - 130	30
		Carbon tetrachloride	70 - 130	70 - 130	30
		Chlorobenzene	70 - 130	70 - 130	30
		Chlorodibromomethane	70 - 130	70 - 130	30
		Chloroethane	70 - 130	70 - 130	30
		2-Chloroethyl vinyl ether	70 - 130	70 - 130	30
		Chloroform	70 - 130	70 - 130	30
		Chloromethane	70 - 130	70 - 130	30
		Acetone	70 - 130	70 - 130	30
		Dibromomethane	70 - 130	70 - 130	30
		1,2-Dichlorobenzene	70 - 130	70 - 130	30
		1,3-Dichlorobenzene	70 - 130	70 - 130	30
		1,4-Dichlorobenzene	70 - 130	70 - 130	30
		Dichlorodifluoromethane	70 - 130	70 - 130	30
		1,1-Dichloroethane	70 - 130	70 - 130	30
		1,2-Dichloroethane	70 - 130	70 - 130	30
		1,1-Dichloroethylene	70 - 130	70 - 130	30
		cis-1,2-Dichloroethene	70 - 130	70 - 130	30
		trans-1,2-Dichloroethene	70 - 130	70 - 130	30
		1,2-Dichloropropane	70 - 130	70 - 130	30
		cis-1,3-Dichloropropene	70 - 130	70 - 130	30
		trans-1,3-Dichloropropene	70 - 130	70 - 130	30
		Ethylbenzene	70 - 130	70 - 130	30
		2-Hexanone	70 - 130	70 - 130	30
		Methylene chloride	70 - 130	70 - 130	30
		4-Methyl-2-pentanone (MIBK)	70 - 130	70 - 130	30
		Naphthalene	70 - 130	70 - 130	30
		2-Pentanone	70 - 130	70 - 130	30
		Styrene	70 - 130	70 - 130	30
		1,1,2,2-Tetrachloroethane	70 - 130	70 - 130	30
		Tetrachloroethene	70 - 130	70 - 130	30
		Toluene	70 - 130	70 - 130	30
		1,2,4-Trichlorobenzene	70 - 130	70 - 130	30
		1,1,1-Trichloroethane	70 - 130	70 - 130	30
		1,1,2-Trichloroethane	70 - 130	70 - 130	30

Table 5-3 Precision and Accuracy for Hazardous Waste (C) Organics (con't)

Parameter Method Name	EPA Method Name	Parameters/ Analytes	Accuracy		Precision RPD Maximum
			LCS/LFB % Rec.	MS/LFM % Rec.	
Halogenated/ Aromatic Volatiles (con't)	EPA8260B (con't)	Trichloroethene	70 - 130	70 - 130	30
		Trichlorofluoromethane	70 - 130	70 - 130	30
		Vinyl acetate	70 - 130	70 - 130	30
		Vinyl chloride	70 - 130	70 - 130	30
		o-Xylene	70 - 130	70 - 130	30
		m-Xylene	70 - 130	70 - 130	30
		p-Xylene	70 - 130	70 - 130	30
		1,2-Dichloroethane-d4 (surr)	80 - 120	80 - 120	-
		Toluene-d8 (surr)	88 - 110	88 - 110	-
		4-Bromofluorobenzene (surr)	86 - 115	86 - 115	-
Semi-Volatile Organic Compounds	EPA8270C	Phenol	5 - 112	5 - 112	42
		2-Chlorophenol	23 - 134	23 - 134	40
		4-Chloro-3-cresol	22 - 147	22 - 147	42
		2-Nitrophenol	29 - 182	29 - 182	50
		Pentachlorophenol	14 - 176	14 - 176	50
		Acenaphthene	47 - 145	47 - 145	31
		Di-n-Butylphthalate	1 - 118	1 - 118	40
		N-nitroso-di-n-propylamine	5 - 230	5 - 230	38
		1,4-Dichlorobenzene	20 - 124	20 - 124	28
		1,2,4-Trichlorobenzene	44 - 142	44 - 142	28
		2,4-Dinitrotoluene	39 - 139	39 - 139	38
		Pyrene	52 - 115	52 115	31
		Nitrobenzene-d5 (surr)	45 - 113	45 - 113	-
		2-Fluorobiphenyl (surr)	40 - 109	43 - 109	-
		p-Terphenyl-d14 (surr)	23 - 117	23 - 117	-
		2-Fluorophenol (surr)	32 - 131	32 - 131	-
		2,4,6-Tribromophenol (surr)	36 - 141	36 - 141	-
		Phenol-d6 (surr)	50 - 114	50 - 114	-

6.0 SAMPLE COLLECTION, PRESERVATION, IDENTIFICATION, HANDLING, & STORAGE

Sample collection and sample handling techniques are important aspects of the overall sample analysis process and have a major impact on the validity of the results. Specific containers and preservatives are used to ensure that the analytes originally present in the sample are not lost through degradation or do not become more concentrated. In addition, contaminants that would interfere with the analysis or give erroneously high results must be mitigated. Sampling services are not normally available from the laboratory, but detailed written procedures to ensure sampling consistency and compliance with method requirements are available to our clients.

6.1. SAMPLE COLLECTION AND BOTTLE PREPARATION

Production of quality analytical data requires that the collected sample is representative of the sampled area. Sampling procedures should adhere to the guidelines established by EPA and other regulatory agencies and be appropriate for the sample matrix and types of analytical parameters to be determined. If a client chooses to collect their own samples, experienced lab staff can brief clients by telephone on the proper methods of sample collection. The laboratory provides sampling instructions to clients to guide clients on the appropriate sample collection procedures.

Sample bottles for all analyses except bacteriological are purchased precleaned according to EPA Protocol specifications from various vendors. Certification statements for each lot of bottles are kept on file in the shipping department and each bottle is marked with its lot number. Each new lot of bottles used for volatiles analyses are checked for volatiles and trace metals contamination. All files regarding Bottle Testing are kept in the QA Files. Bottles are wrapped in bubble bags to prevent breakage and shipped to the sampling site in coolers. A copy of the original bottle work order is included with each shipment and should be returned with properly cooled samples to the laboratory. The work order specifies the numbers of bottles sent for each analysis and is used during the log in procedure in the laboratory.

6.2. CONTAINERS, PRESERVATIVES, HOLDING TIMES & SAMPLE KITS

MWH Laboratories supplies the appropriate sample containers, preservatives, chain-of-custody forms, coolers, and packing materials to a client upon request. The container types, bottle sizes, preservatives, container closures, and holding times are shown in Table 6-1, pages 4-8, for Drinking Water, Table 6-2, pages 9-13, for Wastewater, and Table 6-3, pages 14-15, for Hazardous Waste. These specifications follow CFR 136-149, Required Containers, Preservation Technique and Holding times July 1, 2003 edition and updates. Also followed is the Manual for the Certification of Laboratories Analyzing Drinking Water, Fifth Edition, Table IV-6, page IV-23. Arrangements for sample kits may be made through the client services department. Preservatives are shipped to clients only in the specified container (see above); bulk preservatives are not normally shipped. Reagent grade (or better) preservatives are used only. The chemicals used as preservatives are as follows:

Hydrochloric acid	ammonium chloride	Ethylene Diamine
Sodium hydroxide	nitric acid	Ascorbic Acid
Sodium thiosulfate	zinc acetate	Potassium Citrate
Sulfuric acid	sodium sulfite	

Containers are delivered to the client by the following methods; (1) client comes to laboratory to take delivery, (2) containers are sent to client by courier, (3) containers are shipped (via UPS/FedEx/DHL) in coolers. To ensure that samples meet the temperature requirements, the laboratory checks the sample temperature upon receipt. The temperature check documents that the samples are kept cold during transport (NELAC 5.5.8).

6.3. SAMPLE STORAGE

All samples are retained for 30 days after the data are reported except for most microbiological samples and/or short holding time tests that are held until holding time has expired. A different storage period can be arranged at the request of the client. All samples are kept in the proper storage environment for one month from receipt and then stored in the waste storage area until disposal. Under normal circumstances storage is maintained in a refrigerator kept at 4 ± 2 ^{o}C for one month from receipt (NELAC 5.5.8). Temperature in the storage areas are monitored twice a day to ensure all samples meet storage temperature requirements. Storage temperatures are recorded in appropriate logbooks (NELAC 5.5.8)

6.4. SAMPLE DISPOSAL

All samples that are considered to be potentially hazardous based upon analytical results or matrix, will be disposed of through a hazardous waste disposal company or a client may request that the samples be returned to them for disposal. All disposal arrangements should be made with a project manager. All samples are retained for 3-months and are disposed of in accordance to RCRA and county regulations (NELAC 5.5.8).

6.5. SUBCONTRACTED LABORATORY WORK

On occasion laboratory work may be subcontracted to certified laboratories approved by MWH Laboratories. The subcontractor laboratory will be approved only if the laboratory meets all the necessary certification requirements required by the state where the samples are collected. For example, samples collected from Alaskan Public Water supplies for compliance monitoring must be analyzed by a laboratory certified by the State of Alaska or the USEPA (18 AAC 80.255). For any part of testing covered under NELAP, the laboratory sends the work with a subcontractor accredited under NELAP or with a laboratory that meets applicable satisfactory and regulatory requirements for performing the test and submitting the results of the tests performed [NELAC 5.4.5.1]. Under no circumstances will work be subcontracted without client approval. The laboratory advises the client in writing of its intention to sub-contract any portion of the testing to another laboratory during the project bid proposal or purchase order procurement [NELAC 5.4.5]. Test results provided by the subcontractor are identified by the subcontractor name or applicable accreditation

number. The subcontractor shall report the results in writing or electronically. (NELAC 5.5.10.5). The laboratory shall make a copy of the subcontractor's report available to the client when requested by the client. Subcontracted work is documented in the chain of custody (COC). The COC and other appropriate records are included with the final data package as part of the final deliverables. To comply with California ELAP regulations (Title 22, Division 4, Chapter 19, Article 10, Section 64819), MWH reports must include the original copies of reports prepared by the subcontracted laboratories. See section 12.5 for all the information required in the final test report.

To help ensure all subcontractors meet MWH Data Quality Objectives and produce documented data of known and consistently high quality, the following documentation should be requested from the vendor and reviewed by MWH Laboratories:

1) Laboratory QA Manual
2) Proficiency Evaluation (PE)/ Proficiency Testing (PT) Data and corrective action report for unacceptable reported results
3) Certifications and NELAP Accreditation
4) Laboratory state Non-NELAP onsite audit/ NELAP assessment results and response to the audit's/ assessment's findings

At a minimum, the lab's accreditation status should be verified.

Data deliverables should meet MWH project needs and requirements. MWH is responsible to the Client for subcontractors except in the case where the client or a regulatory agency specifies which subcontractor is to be used(NELAC 5.4.5.3). At a minimum, laboratory deliverables submitted to MWH should include final report, QC results and acceptable limits. Level 4 data deliverables may be requested by MWH Laboratories for review as needed. Onsite audit of subcontract laboratory may also be conducted by MWH Laboratories as needed.

Project managers and designated subcontracting administrator should ensure all documents to evaluate subcontractor's qualifications are submitted to MWH Laboratories for review by QA department and/or subcontracting administrator. Before subcontracting samples, the designated subcontracting administrator shall review certifications to ensure that the laboratory's subcontractor's certification/ accreditation is current. If certification is not current, the subcontracting administrator shall contact the vendor for a current copy of the vendor's certification before shipping samples.

A register of all subcontractors and a record of evidence (such as NELAP accreditation or appropriate compliance to applicable regulatory requirements) are kept by the designated subcontracting administrator [NELAC 5.4.5.4].

Table 6-1 Preservation and Holding Times for Drinking Water
(A) Inorganics - Wet Chemistry

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample Size	Type of Container
Alkalinity	SM2320B	Cool, 4°C	14 days	NA	100 mL	Plastic
Bromate	EPA 300.0/ EPA 300.1/ EPA 317.0	5mg Ethylene Diamine/ 125 mL	28 days	NA	125 mL	Plastic
Bromide	EPA 300.0 / EPA 300.1	None	28 days	NA	125 mL	Plastic
Chloride	EPA300.0	none	28 days	NA	125 mL	Plastic
Chlorate	EPA 300.0 / EPA 300.1	5 mg Ethylene Diamine/125 mL	28 days	NA	125 mL	Plastic
Chlorite	EPA 300.0 / EPA 300.1	5 mg Ethylene Diamine/ 125 mL Cool, 4°C	14 days	NA	125mL	Plastic
Color	SM2120B	Cool, 4°C	48 hours	NA	500 mL	Glass
Conductivity	SM2510B	Cool, 4°C	28 days	NA	125 mL	Plastic
Cyanide	SM4500CN-F/ EPA335.4	Cool, 4°C, 1 mL Ascorbic acid. (if chlorinated), 1 mL NaOH, pH>12	14 days	NA	125 mL	Plastic
Fluoride	SM4500 F-C	none	28 days	NA	125 mL	Plastic
Foaming Agents Surfactant (MBAS)	SM5540C	Cool, 4°C	48 hours	NA	500 mL	Plastic
Haloacetic Acids	SM 6251 B	65 mg NH4Cl/40ml Cool, 4°C	14 days	7 days	2x40 ml	Amber Glass Vial with Teflon lined cap
Nitrate (chlorinated)	EPA300.0/ EPA 353.2	Cool, 4°C	28 days	NA	125 mL	Plastic
Nitrate (non-chlorinated)	EPA300.0/ EPA 353.2	Cool, 4°C	48-hrs	NA	125 mL	Plastic
Nitrate & Nitrite (non-chlorinated)	EPA300.0/ EPA 353.2	Cool, 4°C, 0.5 mL H_2SO_4, pH<2	28 days	NA	125 mL	Plastic
Nitrite	EPA300.0	Cool, 4°C	48 hours	NA	125 mL	Plastic
Odor	SM2150B	Cool, 4°C	24 hours	NA	500 mL	Glass
Perchlorate	EPA 300.0/ EPA 314	Cool, 4°C	28 days	NA	125 mL	Plastic
pH	EPA150.1/ SM4500-HB	Cool, 4°C	*7 days	NA	125 mL	Plastic
o-Phosphate	EPA300.0/ SM4500 P-E	Filter immediately, Cool, 4°C	48 hours	NA	125 mL	Polyglass Glass

Table 6-1 Preservation and Holding Times for Drinking Water (con't)
(A) Inorganics – Wet Chemistry (con't)

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample Size	Type of Container
Residual Disinfectant (Total/Free Residual Chlorine)	SM 4500 Cl-G	Cool, 4°C (Analyzed on the day of collection)	Immediately	NA	125 mL	Amber Glass Bottle
Silica Dissolved/Reactive Silica	EPA200.7 SM 4500Si-D	Cool, 4°C	28 days	NA	125 mL	Plastic
Solids (TDS)	SM2540C	Cool, 4°C	7 days	NA	125 mL	Plastic
Sulfate	EPA300.0	Cool, 4°C	28 days	NA	125 mL	Plastic
Turbidity	EPA180.1	Cool, 4°C	48 hours	NA	125 mL	Plastic
Total Organic Carbon/ Dissolved Organic Carbon (DOC)	SM 5310 C	0.5 ml H2SO4 to pH<2 Cool, 4°C	28 days	NA	125 mL	Amber Glass Bottle Teflon lined cap
UV 254	SM 5910 B	Cool, 4°C	48 hours	NA	125 mL	Amber Glass Bottle Teflon lined cap

*** pH must be analyzed immediately on-site**

(B) Inorganics – Metals

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample Size	Type of Container
Metals (except Hg)	EPA200.7/ EPA200.8/ EPA200.9	0.5 mL HNO_3, pH<2	6 months	NA	500 mL	Plastic
Metals (Ca, Mg, K, Na)	EPA200.7	0.5 mL HNO_3, pH<2	6 months	NA	500 mL	Plastic
Mercury	EPA245.1	2 mL HNO_3, pH<2	28 days	NA	500 mL	Plastic
Chromium VI (Dissolved)	EPA218.6	Ammonium Sulfate/Ammonium Hydroxide Buffer 4 ^{0}C, pH 9-9.5	24 hrs	NA	125 mL	Plastic
Asbestos	EPA100.1/100.2	Cool, 4°C	48 hours	NA	800 mL	1 L Plastic Bottle
Hardness	EPA200.7	Hardness	28 days	NA	500 mL	Plastic

Table 6-1 Preservation and Holding Times for Drinking Water (con't)
(C) Microbiology/Microscopy Tests

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample Size	Type of Container
Drinking Water Source Enumeration	SM9223 (Colilert) SM9221BE (MTF)	Cool, 4°C, 0.2 mL of 3% $Na_2S_2O_3$	8 hours	NA	100 mL	Sterile Plastic Bottle
Fecal Coliforms--EC Medium	SM9221E1 (MTF)	Cool, 4°C, 0.2 mL 3% $Na_2S_2O_3$	30 hours	NA	100 mL	Sterile Plastic Bottle
Heterotrophic Plate Count (Standard Plate Count)	SM9215B	Cool, 4°C, 0.2 mL 3% $Na_2S_2O_3$	30 hours	NA	100 mL	Sterile Plastic Bottle
Total Coliforms;By Multiple Tube Fermentation (MTF)	SM9221B	Cool, 4°C, 0.2 mL 3% $Na_2S_2O_3$	30 hours	NA	100 mL	Sterile Plastic Bottle
Total Coliforms--E. Coli	SM9223B	Cool, 4°C,	30 hours	NA	100 mL	Sterile Plastic Bottle
Total Coliforms (P/A & Enumeration	SM9222A, B, C	Cool, 4°C,	30 hours	NA	100 mL	Sterile Plastic Bottle
Total Coliforms--E. Coli	Colisure	Cool, 4°C,	30 hours	NA	100 mL	Sterile Plastic Bottle

(D) Organics

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample Size	Type of Container
Chlorinated Herbicides (GC with Electron Capture	EPA515.4	10 °C (first 48 hours, ≤ 6 °C after 48 hours	14 days	4°C, dark 28 days	1 L	Amber Glass with Teflon lined
Purgeable Organic Compounds/ Halogenated Aromatics, THMs, Di-Isopropyl Ether (DIPE), Tertiary Amyl methyl ether (TAME), Tert Butyl ethyl ether (ETBE)	EPA 524.2 EPA 524.2/ CA DHS	25 mg Ascorbic Acid, HCl pH < 2; Cool, 4°C Cool, 4°C	14 days	NA	2x40 ml	Teflon Lined Septum
Determination of Chlorinated Acids in Drinking Water by Liquid – Liquid Extraction	EPA515.3	Thiosulfate; Cool, ≤ 10°C for the first 48 hours; ≤ 6°C after Dark	14 days/48 hours	4°C, dark 14 days	125 ml	Amber Glass with Teflon lined Cap
THMs	EPA 551.1	10-50 mg NH_4Cl/40 ml + 400-mg phosphate buffer/ 40 ml 400 mg phosphate	14 days	-	3x40 ml	Clean glass vial
DBCP/EDB	EPA504.1	3 mg Sodium Thiosulfate Cool, 4°C	14 days	4°C, 24 hours	40 mL	Glass with Teflon Lined Septum
Organohalide Pesticides and PCB	EPA 505	3 mg Sodium Thiosulfate Cool, 4°C	14 days 7 days for heptachlor	4°C, 24 hours	40 mL	Vial with PTFE-lined Screw caps

Table 6-1 Preservation and Holding Times for Drinking Water (con't)
(D) Organics (con't)

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample	Type of Container
Nitrogen- and Phosphorus-Containing Pesticides, including thiobencarb (GC with Nitrogen- Phosphorus Detector)	EPA507	80mg Sodium Thiosulfate Cool, 4°C, Dark	14 days	4°C, dark 14 days	1 L	Amber Glass with teflon lined Cap
Carbamates	EPA 531.2	0.38 g/40-mL vial Potassium dihydrogen citrate If residual chlorine is present, 6-mg of sodium thiosulfate/40-mL vial	Cool, <10°C first 48 hrs; <6°C thereafter; dark; 28-days; pH - 3.8	≤ 6°C; 28-days	40 mL	Vial with PTFE-lined Screw caps
Diquat & Paraquat (HPLC with Photoiode, Array Detector)	EPA549.2	100 mg Sodium Thiosulfate (H_2SO_4, pH<2 if bio active) Cool,4°C, Dark	7 days	21 days	1 L	Amber Plastic
Endothall (GC/MS)	EPA548.1	Sodium Thiosulfate (HCl, pH 1.5-2 if high bio activity) Cool, 4°C, Dark	7 days	14 days < or = 4°C	250 mL	Amber Glass with teflon lined septum
Glyphosate (HPLC with Fluorescence Detector)	EPA547	6 mg Sodium Thiosulfate	14 days (18 mo. If frozen)	NA	60 mL	Amber Glass with teflon lined septum
Haloacetic Acids	SM6251B	65 mg NH4Cl / 40 ml Cool, 4°C,	14 days	7 days	2 x 40 mL	Amber Glass with teflon lined Cap
N-Methylcarbamoyloximes and N-Methylcarbamates (HPLC with Fluorescence Detector)	EPA531.1	Sodium Thiosulfate Monochloroacetic acid, pH<3, Cool, 4°C	Cool, 4°C 28 days	NA	40 mL	Amber Glass with teflon lined Cap
Purgeable Organic Compounds/Halogenated & Aromatic Volatiles/ Trihalomethanes/ Di-Isopropyl Ether (DIPE), Tertiary Amyl Methyl Ether (TAME), Tertiary Butyl Ethyl ether (ETBE) (GC/MS)	EPA524.2	25 mg Ascorbic Acid[a] pH<2, Cool, 4°C Note: [a]add HCl after dechlorination.	14 days	NA	2 x 40 mL	Amber Glass with teflon lined Cap
Low level TCP (GC/MS)	EPA524.2 /CA DHS	Cool, 4°C				
Semi-Volatile Organics Acid/Base Neutrals, including thiobencarb (GC/MS)	EPA525.2	40-50 mg Sodium Sulfite, Dark, Cool, 4°C, HCl, pH<2	14 days	30 days from collection	1 L	Amber Glass with teflon lined Cap

- HCl must be added after sample dechlorination.

Table 6-1 Preservation and Holding Times for Drinking Water (con't)
(E) Radiochemistry

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample Size	Type of Container
Gross Alpha	EPA900.0	2.0 mL HNO_3 to pH<2	6 months	NA	1 L	Plastic
Gross Beta	EPA900.0	2.0 mL HNO_3 to pH<2	6 months	NA	1 L	Plastic
Radon 222	SM 7500 Rn-B/ SM 7110/EPA 904.0	None	4days	NA	250 ml	glass
Radium 228	EPA 904	2-mL HNO_3 per liter; pH <2	6-months, if unpreserved, after 5-days, preserved and held in the orginal container for minimum of 16-hrs.before analysis	NA	1 L	Plastic
Uranium	EPA 200.8	0.5 mL HNO_3 to pH<2	6 months	NA	125 mL	Plastic

Table 6-2 Preservation and Holding Times for Wastewater
(A) Inorganics - Wet Chemistry

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample Size	Type of Container
Alkalinity, (Bicarbonate, Carbonate, & Total	SM2320B	Cool, 4°C	14 days	NA	125 mL	Plastic
Ammonia	EPA350.1 SM4500F-C	Cool, 4°C, 0.5 mL of H_2SO_4 to pH < 2	28 days	NA	125 mL	Plastic
Biochemical Oxygen Demand (BOD)	SM5210B	Cool, 4°C	48 hours	NA	500 mL	Plastic
Boron	EPA200.7	0.5 mL HNO_3 to pH< 2	6 months	NA	120 mL	Plastic
Bromide	EPA300.0	None	28 days	NA	125 mL	Plastic
Carbon Biochemical Oxygen Demand (cBOD)	SM5210B	Cool, 4°C	48 hours	NA	500 mL	Plastic
Chemical Oxygen Demand (COD)	EPA410.4	Cool, 4°C, 0.5 mL of H_2SO_4 to pH < 2	28 days	NA	125 mL	Plastic
Chloride	EPA300.0	None	28 days	NA	125 mL	Plastic
Chlorine, Total Residual	SM4500 Cl G	Cool, 4°C	24 hours (immediately)	NA	250 mL	Amber Glass
Chromium VI	SM3500Cr-D	Cool, 4°C	24 hours	NA	125 mL	Plastic
Cyanide, Total	EPA335.2 EPA335.3	Cool, 4°C, 4 mL NAOH to pH>12, 0.6 g Ascorbic Acid (if chlorinated)	14 days	NA	1 L	Plastic
Cyanide, Amenable to Chlorination	EPA 335.1	Cool, 4°C, 4 mL of NAOH to pH>12, 0.6 g Ascorbic Acid (if chlorinated)	14 days	NA	1 L	Plastic
Fluoride	EPA340.2 SM4500 F-C	None	28 days	NA	125 mL	Plastic
Hardness	SM2340B	1.0 mL HNO_3 to pH< 2	6 months	NA	250 mL	Plastic
Kjeldahl Nitrogen	EPA351.2	Cool, 4°C, 0.5 mL of H_2SO_4 to pH < 2	28 days	NA	125 mL	Plastic
Nitrate	EPA353.2/ EPA300.0	Cool, 4°C	48 hours	NA	125 mL	Plastic
Nitrite	EPA300.0/ EPA 354.1/353.2	Cool, 4°C	48 hours	NA	125 mL	Plastic
Orthophosphate	EPA365.2/ SM4500 P-E/ EPA300.0	Filter Immediately, Cool, 4°C	48 hours	NA	125 mL	Plastic
Perchlorate	EPA314.0	None	28 days	NA	125 mL	Plastic

Table 6-2 Preservation and Holding Times for Wastewater (con't)
A. Inorganics - Wet Chemistry (con't)

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample Size	Type of Container
pH	EPA 150.1/ SM4500-HB	None	7 days	NA	125 mL	Plastic
Phenols	EPA420.2/ EPA400.1	Cool, 4°C, 2.0 mL H_2SO_4 to pH < 2	24 hours	NA	500 mL	Amber Glass
Phosphorus, Total	EPA365.2/ SM4500 P-E	Cool, 4°C,0.5 mL H_2SO_4 to pH < 2	28 days	NA	125 mL	Plastic
Residue, Filterable (Total Dissolved Solids--TDS)	SM2540C	Cool, 4°C	7 days	NA	500 mL	Plastic
Residue, Non-filterable (Total Suspended Solids,TSS)	SM2540D	Cool, 4°C	7 days	NA	500 mL	Plastic
Residue, Settleable (Settleable Solids)	EPA160.5	Cool, 4°C	48 hours	NA	500 mL	Plastic
Specific Conductance	SM2510B	Cool, 4°C	28 days	NA	125 mL	Plastic
Sulfate	EPA300.0	Cool, 4°C	28 days	NA	125 mL	Plastic
Sulfide (Total & Soluble)	EPA376.2	Cool, 4°C Zinc Acetate, plus NaOH to pH > 9	7 days	NA	125 mL	Plastic
Total Organic Carbon (TOC)	SM5310C	Cool, 4°C,0.5 mL H_2SO_4 to pH < 2	28 days	NA	125 mL	Amber Glass
Total Organic Halide (TOX)	SM 5320B	Sulfite & H_2SO_4	14 days	NA	250mL	Amber Glass
Turbidity	EPA180.1	Cool, 4°C	48 hours	NA	125 mL	Plastic

B. Inorganics – Metals

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample Size	Type of Container
Aluminum, Al	EPA200.7 EPA200.8	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Antimony, Sb	EPA200.7 EPA200.8	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Arsenic, As	EPA200.8 EPA200.9 SM 3113B	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic

Table 6-2 Preservation and Holding Times for Wastewater (con't)
(B) Inorganics - Metals (con't)

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample Size	Type of Container
Barium, Ba	EPA200.7 EPA200.8	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Beryllium, Be	EPA200.7 EPA200.8	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Cadmium, Cd	EPA200.7 EPA200.8	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Calcium, Ca	EPA200.7	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Chromium, Total, Cr	EPA200.7 EPA200.8	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Cobalt, Co	EPA200.7 EPA200.8	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Copper, Cu	EPA200.7 EPA200.8	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Iron, Fe	EPA200.7	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Lead, Pb	EPA200.8	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Magnesium, Mg	EPA200.7	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Manganese, Mn	EPA200.7 EPA200.8	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Mercury, Hg	EPA245.1	2.0 mL HNO_3 to pH< 2	28 days	NA	500 mL	Plastic
Molybdenum, Mo	EPA200.7 EPA200.8	0.5 mL HNO_3 to pH< 2	6 months	NA	125 mL	Plastic
Nickel, Ni	EPA200.7 EPA200.8	0.5 mL HNO3 to pH< 2	6 months	NA	125 mL	Plastic
Potassium, K	EPA200.7	0.5 mL HNO3 to pH< 2	6 months	NA	125 mL	Plastic
Selenium, Se	EPA200.8 EPA200.9	0.5 mL HNO3 to pH< 2	6 months	NA	125 mL	Plastic
Silver, Ag	EPA200.7 EPA200.8	0.5 mL HNO3 to pH< 2	6 months	NA	125 mL	Plastic
Sodium, Na	EPA200.7	0.5 mL HNO3 to pH< 2	6 months	NA	125 mL	Plastic
Thallium, Tl	EPA200.8	0.5 mL HNO3 to pH< 2	6 months	NA	125 mL	Plastic
Tin, Sn	EPA200.7	0.5 mL HNO3 to pH< 2	6 months	NA	125 mL	Plastic
Vanadium, V	EPA200.7 EPA200.8	0.5 mL HNO3 to pH< 2	6 months	NA	125 mL	Plastic
Zinc, Zn	EPA200.7 EPA200.8	0.5 mL HNO3 to pH< 2	6 months	NA	125 mL	Plastic
Asbestos	EPA100.1/ EPA 100.2	Cool, 4°C	48 hours	NA	800mL	Plastic (1 L)

Table 6-2 Preservation and Holding Times for Wastewater (con't)
(C) Microbiology/Microscopy Tests

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample Size	Type of Container
Fecal Coliforms By Multiple Tube	SM9221E	Cool, 4°C; 0.2 mL 3% $Na_2S_2O_3$ (if chlorinated)	6 hours	NA	100 mL	Sterile Plastic
Fecal Streptococci/ Enterococci by MTF	SM9230B	Cool, 4°C; 0.2 mL 3% $Na_2S_2O_3$ (if chlorinated)	6 hours	NA	100 mL	Sterile Plastic
Heterotrophic Plate Count	SM9215B	Cool, 4°C; 0.2 mL 3% $Na_2S_2O_3$ (if chlorinated)	6 hours	NA	100 mL	Sterile Plastic
Total Coliforms By Multiple Tube Fermentation (MTF)	SM9221B	Cool, 4°C; 0.2 mL 3% $Na_2S_2O_3$ (if chlorinated)	6 hours	NA	100 mL	Sterile Plastic

(D) Organics

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample Size	Type of Container
Halogenated Volatiles	EPA601	Cool, 4°C, 10 mg $Na_2S_2O_3$ for residual Cl_2, HCl** pH < 2	14 days	NA	40 mL	Amber Glass/Teflon lined Septum
Halogenated Volatiles/ Aromatic Volatiles	EPA624	Cool, 4°C, 10 mg $Na_2S_2O_3$ for residual Cl_2,HCl** pH < 2	14 days	NA	40 mL	Amber Glass/Teflon lined Septum
Aromatic Volatiles	EPA602	Cool, 4°C, 10 mg $Na_2S_2O_3$ for residual Cl_2, HCl** pH < 2	14 days	NA	40 mL	Amber Glass/Teflon lined Septum
Organochlorine Pesticides	EPA608	Cool, 4°C,10-mg $Na_2S_2O_3$ for residual Cl_2, pH 5 - 9 (if not extracted in 72 hours)	7 days	40 days	1 L	Amber Glass/Teflon lined Cap
Polychlorinated Biphenyl s (PCBs)	EPA608	Cool, 4°C, $Na_2S_2O_3$ for residual Cl_2, pH 5 - 9 (if not extracted in 72 hours)	7 days	40 days	1 L	Amber Glass/Teflon lined Cap
Total Petroleum Hydrocarbons (TPH)	EPA418.1	Cool, 4°C, 2.0 mL HCl	28 days	NA	1 L	Glass
Semi-Volatiles, Acid and Base/ Neutral Compounds	EPA625	Cool, 4°C, 80 mg $Na_2S_2O_3$ for residual Cl_2	7 days	40 days	1 L	Amber Glass/Teflon lined Cap

**HCl must be added after sample dechlorination

Table 6-2 Preservation and Holding Times for Wastewater (con't)

(E) Radiochemistry

Parameter/ Method Name	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Minimum Sample Size	Type of Container
Gross Alpha	EPA900.0	4.0 mL HNO_3 (18%) to pH<2	6 months	NA	1 L	Plastic
Gross Beta	EPA900.0	4.0 mL HNO_3 (18%) to pH<2	6 months	NA	1 L	Plastic
Radon 222	SM 7500 Rn-B	NONE	4 days	NA	250 ml	glass

Table 6-3 Preservation and Holding Times for Hazardous Waste
(A) Inorganics - Wet Chemistry

Parameter/ Method Name	Matrix	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Sample Size	Type of Container
Chromium VI	Aqueous	EPA7196A	Cool, 4°C	24 hours	NA	125 mL	Plastic
Conductivity	Aqueous	EPA 9050	Cool, 4°C	28 days	NA	125 mL	Plastic
Cyanide, Total	Aqueous	EPA9012	4 mL NaOH to pH > 12, Cool, 4°C	14 days	NA	1 L	Plastic
Fluoride	Aqueous	EPA340.2	Cool, 4°C	28 days	NA	125 mL	Plastic
Nitrate as N	Aqueous	EPA 9056	Cool, 4°C	48 hours	NA	125 mL	Plastic
Perchlorate	Aqueous	EPA314	Cool, 4°C	28 days	NA	125 mL	Plastic
pH	Aqueous	EPA 9040B	None	7 days	NA	125 mL	Plastic
Phenol	Aqueous	EPA 9066	Cool, 4°C, 2.0 mL H_2SO_4 to pH < 2	24 hours	NA	500 mL	Amber Glass
Sulfide, Total	Aqueous	EPA9030A	Zinc Acetate, NaOH pH > 9, Cool, 4°C	7 days	NA	125 mL	Plastic
Total Organic Halides (TOX)	Aqueous	EPA 9020B	Sulfite & H_2SO_4	14 days	NA	250mL	Amber Glass

(B) Inorganics – Metals

Parameter/ Method Name	Matrix	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Sample Size	Type of Container
Arsenic, As, Dissolved	Aqueous	EPA 6020	0.5 mL HNO_3 to pH < 2, Cool, 4°C	6 months	NA	125 mL	Plastic
Arsenic, As, Total							
Mercury, Total	Aqueous	EPA7470A	2.0 mL HNO_3 to pH < 2, Cool, 4°C	28 days	NA	500 mL	Plastic
Mercury, Dissolved			Filtered on site, 2.0 mL HNO_3 to pH < 2, Cool, 4°C				
Metals, Total *	Aqueous	EPA6010B EPA6020	0.5 mL HNO_3 to pH < 2, Cool,4°C	6 months	NA	125 mL	Plastic
Metals, Dissolved *	Aqueous	EPA6010B EPA6020	Filtered on site, HNO_3 to pH < 2, Cool, 4°C	6 months	NA	125 mL	Plastic

***** Aluminum, Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, strontium, thallium, tin, titanium, vanadium and zinc.

Table 6-3 Preservation and Holding Times for Hazardous Waste (con't)
(C) Organics

Parameter/ Method Name	Matrix	EPA/SM Method Number	Preservative	Sample Holding Time	Extract Holding Time	Sampl e Size	Type of Container
Halogenated Volatiles	Aqueous	EPA8021B	10 mg $Na_2S_2O_3$ for residual chlorine, HCl pH < 2, Cool, 4°C	14 days	NA	40 mL	Amber Glass/Teflon lined Septum
		EPA8260B	10 mg $Na_2S_2O_3$ for residual chlorine, HCl pH < 2, Cool, 4°C	14 days	NA	40 mL	Amber Glass/Teflon lined Septum
Aromatic Volatiles	Aqueous	EPA8021B	10 mg $Na_2S_2O_3$ for residual chlorine, HCl pH < 2, Cool, 4°C	14 days	NA	40 mL	Amber Glass/Teflon lined Septum
		EPA8260B	10 mg $Na_2S_2O_3$ for residual chlorine, HCl pH < 2, Cool, 4°C	14 days	NA	40 mL	Amber Glass/Teflon lined Septum
Semi-Volatile Organic Compounds	Aqueous	EPA8270C	80 mg $Na_2S_2O_3$, Cool, 4°C	7 days	40 days	1 L	Amber Glass/Teflon lined Cap

7.0 SAMPLE CUSTODY

7.1 SAMPLE RECEIPT AND LOG-IN/SAMPLE RECEIPT PROTOCOL

MWH Laboratories receives all samples through its sample control group. Upon receipt of samples, the sample control group inspects each sample for breakage or leakage, inverted septa, inappropriate caps or bottles, air bubbles in volatile organics samples, incomplete sample labels, incomplete paperwork, or discrepancies between the sample labels and the paperwork. The sample custodian (SC) checks the sample temperature to ensure that the required temperature is maintained during transport. EPA requires that sample temperature of 4 $\pm$ 2 $^{\circ}$C shall be maintained during transport. The sample custodian records the sample temperature on the Chain of Custody. If the reading is above 6 $^{\circ}$C, the PM is notified who calls the client regarding his sample condition. For samples that arrive at the laboratory > 6 $^{\circ}$C, the client will be notified that the effected samples are unacceptable for regulatory compliance purposes, and analysis is at the discretion of the client.

The sample custodian also screens all hazardous waste and wastewater samples with the Geiger Counter meter for presence of radiation levels above background. For additional details refer to Sample Receiving and Log-In SOP. Any sample receipt problems are recorded either on the Chain of Custody (COC) Form (Figure 7-6) for Level I or on COC and Sample Cooler Receipt Form (Figure 7-1) for Level II samples. The Client Services Manager or designated Project Manager is notified about the problems. The client is informed of these problems, the appropriate course of action is determined and a decision is made immediately whether re-sampling is required.

Sample control employees are designated to receive all shipments and deliveries to the laboratory. The procedure for receiving samples is detailed in the Sample Receipt SOP kept on file in the log-in area and central QA files. A MWH Laboratories Work Request Form (WR) is filled out for each client's samples. An example of the WR is shown in Figure 7-2. A computer assigned laboratory number is placed on each sample bottle and the bottles are stored in refrigerators segregated by analysis type.

Sample Labeling System

Sample bottles must be clearly labeled so that the laboratory tracking system can function optimally. All sample bottles are shipped with labels containing the particular parameters to be tested from each bottle as well as any preservative information. The client must fill in the sampling date and sample site, and the client name/identification, on the label. The sample control group insures that all returned samples contain sample site identifications.

After log-in, the sample control group attaches a label with the laboratory sample tracking number to each sample bottle. All sample bottles collected for a particular sample site normally receive the same laboratory sample tracking number and a stamped label with this number is attached to each bottle. When analysts run a sample work schedule for their particular analysis, they receive a computer printout listing the

laboratory sample numbers requiring that analysis. The analyst must then find the samples with these assigned numbers in their appropriate containers in refrigerated storage. The work schedule printout also gives the name of the client and sample ID that is always compared with the information printed on the sample label to insure a proper identification.

The assigned laboratory numbers utilized for sample tracking are always a ten-digit number. The first six digits represent the year, month and day the sample was logged in. The remaining four digits are utilized to give each sample a unique identification number and these numbers are assigned consecutively from 1 to 9999 by the computer when the samples are logged in. These last four digits are reset back to one (1) at the beginning of each day. The laboratory also assigns a unique laboratory identification number to each sample and subsample container, and attaches a durable label to each sample container. The assignment of unique laboratory ID is done for each subsample except for samples that have short holding times. All laboratory ID code assigned to each sample is documented in each appropriate logbooks/workbooks for related laboratory activities such as sample preparation calibration and analysis.

Sample Receipt Acceptance Criteria:

The laboratory establishes and implements sample acceptance/rejection policy per NELAC -5.5.8.3.2. The laboratory accepts a sample when the following criteria are met:

a) Proper, full, and complete documentation, which shall include sample identification, the location, date and time of collection, collector's name, preservation type, sample type and any special remarks concerning the sample;

b) Proper sample labeling to include unique identification and a labeling system for the samples with requirements concerning the durability of the labels (water resistant) and the use of indelible ink;

c) Use of appropriate sample containers;

d) Adherence to specified holding times;

e) Adequate sample volume. Sufficient sample volume must be available to perform the necessary tests.

f) Procedures to be used when sample shows signs of damage or contamination.

g) All samples, which require thermal preservation, shall be considered acceptable if the arrival temperature is either within +/- 2°C of the required temperature or the method specified range. For samples with a specified temperature of 4°C, samples with a temperature ranging from just above the freezing temperature of water to 6° C shall be acceptable. Samples that are hand delivered to the laboratory immediately after collection may not meet these criteria. In these cases, the

samples shall be considered acceptable if there is evidence that the chilling process has begun such as arrival on ice.

h) The laboratory implements procedures for checking chemical preservation using readily available techniques, such as pH or free chlorine, prior to or during sample preparation or analysis [NELAC 5.5.8.3.1a) 2)]. Residual Free Chlorine and pH testing are done for Volatile samples by 524.2. Also samples for semivolatiles by 525.2 analysis and THMs by 551.1 are verified for proper preservation by checking the pH of the sample at the sample preparation area.

Results of all checks are recorded in the appropriate logbooks. If the sample does not meet the laboratory sample receipt acceptance criteria, the laboratory either:

1) Retain correspondence and/or records of conversations concerning the final disposition of rejected samples; or

2) Fully document any decision to proceed with the analysis of samples not meeting acceptance criteria.

2.1. The condition of these samples shall, at a minimum, be noted on the chain of custody or transmittal form and laboratory receipt documents.

2.2. The analysis data shall be appropriately "qualified" on the final report.

After LIMS entries have been completed for a group, a sample acknowledgment is printed out (see figure 7-9). The original acknowledgment is sent to the client, typically by the end of the following business day, and reviewed by the client's project manager. The sample acknowledgment report allows the clients to confirm if methods and tests assigned to the samples are correct.

7.2. CHAIN OF CUSTODY

Chain of custody procedures provides legal evidence that tampering with a sample has not occurred. This is achieved by documenting an accurate written record tracing possession of the sample from collection through its final analysis and disposal. The laboratory maintains two levels of custody.

7.2.1. Level I

This process relies on the fact that the laboratory is a secure building. The laboratory either has custody of the sample, or not. Evidence of laboratory custody is shown through the signatures on the chain of custody form. Documentation is available in the laboratory for the tracking and disposition of a sample, however this information is not intended to withstand rigorous legal scrutiny. Level I chain of custody is consistent with EPA's definition of custody. Documentation associated with this level of custody includes;

- a copy of the Chain of Custody is kept in the project file.
- run logs indicating when samples were handled/analyzed

7.2.2. Level II

Also known as Legal Chain of Custody, this process requires that the disposition of each sample be defined in terms of time and possession for the life span of the sample; from sample bottle preparation to the disposal or complete depletion of the sample during analysis.

- requirements for Level I followed
- chain of custody signed by sample control personnel upon receipt of sample(s)
- airbills and/or courier receipts filed in the project file by sample control
- internal custody logbook and key to secured storage refrigerators maintained by sample control personnel; all sample/extract/digestate transfers, including those to secured storage, recorded herein
- internal custody logbook entries include client, client sample ID, date sampled, analyses, laboratory ID, internal dates and times transferred, initials (all samples are returned at the end of each shift) see Figure 7-4.
- upon disposal the technician will complete the custody notebook (all client identifying label(s) on the container defaced or removed)
- all errors deleted by drawing a single line through the item, dating and initialing and reasons clearly indicated
- disposal of samples occur only with the concurrence of the affected legal authority, sample data user and/or submitter of the sample
- conditions of disposal and all correspondence between all parties concerning final disposition of the physical sample recorded and retained by the laboratory
- Level II chain of custody sample disposal logbook indicate the date of disposal, nature of disposal (such as sample depleted, sample disposed in hazardous waste facility or sample returned to client, and the name of the individual who performed the task

As a standard protocol, the laboratory utilizes Level I chain of custody. Level II chain of custody is available upon request at an additional charge.

The QA officer or the project manager periodically inspects the chain of custody logbook to verify that analysts are signing samples back into custody the same day they are removed.

When samples are sent to a sub-contract laboratory, a chain of custody is initiated by sample control. The original chain of custody is filed in the project file with a reference to the second chain of custody. This sample is tracked internally and is identified as a subbed-out sample from an entry made into LIMs by sample control. All information from the original chain of custody is transferred to the second chain of custody in addition our internal Laboratory IDs are referenced. If samples were extracted at MWH

Laboratories and the extracts sent out, then the QC set for that extraction batch is sent out to the sub-contract laboratory also.

The MWH Laboratories chain of custody form provided with sample bottle shipment is presented in Figure 7-6.

7.3. SAMPLE STORAGE

Samples are kept in refrigerators or if storage at ambient temperature is permitted, on shelving in the designated area. Samples in the designated areas are available for the analyst to take as necessary. Documentation that these samples have been taken is available in the run log along with other pertinent information as shown in figure 7-7. Samples and extracts share the same refrigerators, however samples designated for volatile analysis are not kept in the same refrigerators as sample designated for non-volatile analysis. Samples, which follow the Level II custody requirements, are stored in a separate area monitored by sample control personnel. This storage area is locked and entry is permitted only upon signing for the custody of the sample(s)/extract(s) or digestates(s).

Standards are stored in designated refrigerators or freezers. Samples/extracts/digestates are not stored in these refrigerators due to the potential for cross-contamination.

Refrigerator temperatures are monitored and recorded twice daily at least 4 hours apart.

Sample disposal procedures are available in the disposal area and describe the requirements for the safe and effective disposal of all sample, extract and digestate waste contained in the laboratory. Means of disposal include dispensing into manifested 55 gallon drums and pH balance, dilution and flushing.

7.4. SAMPLE TRACKING

When samples pass initial inspection, they are logged into the computer running Multi-LIMS. This system tracks samples from the time they arrive in the laboratory until final data are transmitted to the client. Multiple queries can be made of the database, and new routines can be written for retrieving certain information in a specified format. The following are example queries made of Multi-LIMS, printouts of these queries are available for personnel, on demand;

a) Sample Disposition

Shows which analyses have been performed on a given sample, which results have been validated by the manager/supervisor, and the results.

b) Due Date/Hold time Date

Allows analysts to schedule tests by accessing sample information according to priority date (hold time/turnaround time); query can be made per test, per group, per client, or per prompted date.

c) QC Data

Accessibility to QC information which can be tabulated and used to derive acceptability ranges, trend analyses, control charts etc.

d) Formats

Data available to clients in various hard-copy layouts and or electronic data format.

Multi-LIMS is a Laboratory Information Management System (LIMS) software package developed by Nuovotech, Inc., located in Baton Rouge, LA, specifically for the needs of an environmental analytical laboratory. The UNIX based system consists of programs written in 4GL and C to access the SQL standard database.

The system provides functions to access client accounts, tests/analyses, sample tracking, test backlog generation, data entry/verification, data validation, client data in a variety of formats, monthly financial and statistical reports, and archival storage of data.

The security of the information contained in the LIMS is kept through the restricted use of the database. A password is assigned to all personnel who use the LIMS system. The type of information entered, or queried is dependent on the level of access associated with the password.

Three levels of access are defined in LIMS:

a) analyst/reviewer

Original data is entered by an analyst. Once entered the person who entered it may not change this data. A review, or secondary check, is performed by a supervisor or peer. Data may be changed by the supervisor or peer.

b) manager/validation

After the secondary check the group manager validates the data. Upon validation the data is available to the client.

c) user

Personnel who only query the database, rather than enter data, are assigned this third level of access.

Aside from sample queries, the only forms that are routinely printed out from LIMS are the final report and the corresponding invoice. Copies of these are kept, while the originals are sent to the client. If electronic deliverables are provided, hardcopy reports are still sent.

d) Hardcopy Storage

Hardcopy is stored by client and then by work order number. This allows for timely access to a file for any given client. Working files are kept for two years. All previous files are boxed and stored at an off site facility.

e) Electronic Data Deliverables

Electronic data or magnetic medium data are delivered to the client upon request. This data is formatted by prompting LIMS to download the required data into a temporary file. This file is copied onto disk or sent via electronic mail to the client destination. The working file is not maintained. It is, rather, erased, or written over. The original information will be available in LIMS.

f) LIMS Maintenance

LIMS maintenance is performed by Hewlett Packard and as a supplement, our manager of computer services. MWH Laboratories has not purchased the source code for the LIMS system and hence does very limited programming on the system. Instead, software "packs" are purchased from the vendor which add to the abilities of the system. Software validation is performed by the vendor prior to the sale of the "pack" to commercial laboratories. Hardware is installed maintained and guaranteed by Hewlett Packard. Our service contract with Hewlett Packard allows for the expedient attention to hardware breakdowns or servicing.

A hardware/software maintenance logbook is kept with the manager of computer services. In addition to this record, all servicing performed by Hewlett Packard or outside vendors is documented by their staff and available for our use.

7.4.1. Sample Status

Samples are logged into the system upon receipt in the laboratory. A laboratory number is assigned to each sample by the computer and the required tests are scheduled. Each sample then appears on the work schedule for the appropriate department. Turnaround time is automatically assigned to each sample test based on the sampling date and time and EPA holding times.

The work schedule is the primary means of checking the backlog for the analyst. The analyst can schedule the samples according to priority date, which is calculated according to the laboratory turnaround time and priority. An example of a computer generated work schedule is shown in figure 7-8.

Operations meetings are held weekly to discuss the status of data. An Operations Report (figure 7-10) is used by the supervisors and Project Managers during operations meetings. The Operations Report includes the group No., Client ID, Total number of Tests, Tests ready to be validated and, incomplete tests by department. The Operations Reports allow the supervisor and the project manager to monitor sample status. Also during the Operations meeting, Project managers are informed of any issues that may have arisen so that they can proactively contact the client. A list of samples with short turnaround time, 72 hours or less, is kept at sample control. Sample control contacts the analyst when short holding time samples arrive. Bottle orders are completed when clients request containers and supplies. This allows sample control to monitor the amount of samples due to arrive in the near future.

7.4.2. Data Entry and Report Generation

Data entry is accomplished through a variety of interactive sub-systems. Some situations require the entry of raw data and the system performs calculations, and reports final results and detection limits. In other cases, final data is entered. When the final scheduled test result goes into the system, the Group Supervisor passes on the reports to the validation section within the system for approval. In all cases, client reports are generated and printed automatically after the verification and approval by the supervisor of each analytical group.

Results are stored on-line for approximately six months after which they are transferred to magnetic tape. During the six month storage time immediate access is available to these reports. A list of all reports completed, indexed by client number, is maintained on the system. A few keystrokes can recall every report produced for a given client. Additionally, the system provides constant information on laboratory performance. This includes turnaround times reports for every analysis done by the laboratory, and productivity reports grouped into cost isolation accounts. A weekly laboratory Turnaround time report, generated by the Lab Director, allows the tracking of turnaround time per department to ensure that the laboratory continuously improves its turnaround time and meet client needs. See example of weekly Lab Turnaround Time Report on (figure 7-11). Quarterly Productively Workload Reports are generated by test and matrices that allow the laboratory to manage any changes in the volume and type of work undertaken. See example of workload report on (figure 7-12).

The system provides several levels of security. The first level is the entry of a password to initially log on to the computer, and then the person must be designated as a qualified user of Multi-LIMS. Additionally, the department to which a person is assigned governs/accesses the various functions of the system. The system also provides for read-only access to results to further protect the data from unauthorized modification or deletion.

Figure 7-1. Cooler Receipt Form.

MWH LABORATORIES COOLER RECEIPT FORM

PROJECT: _____ DATE RECEIVED: _____

Use back of form to note check-in problems and describe action(s) regarding the resolution(s) of problems.

A. PRELIMINARY EXAMINATION
Date Cooler opened: _____
By (print) _____ (sign)_____

1. Did cooler come with shipping slip (air bill, etc.)? Yes No
   If yes, attach and enter carrier and air bill number here: _____

2. Were custody seals on outside of cooler? Yes No
   If yes, how many and where: _____
   If yes, enter the following: seal date: _____ seal name: _____

3. Were custody seals unbroken and intact at delivery? Yes No

4. Were custody papers sealed in bag and taped to lid? Yes No

5. Were custody papers filled out properly (ink, etc.)? Yes No

6. Did you sign custody papers in appropriate place? Yes No

7. Was project identifiable from custody papers? Yes No

8. Have designated person(s) initial and acknowledge receipt: _____ date: _____

B. LOGIN PHASE
Date samples were logged in: _____
By (print) _____(sign)_____

9. Describe packing: _____

10. If required, was enough ice used? Yes No

11. Were all bottles sealed in separate plastic bags? Yes No

12. Did all bottles arrive unbroken and in good condition? Yes No

13. Were all bottle labels complete (ID, date, sign, preservative)?

14. Did all bottle labels agree with custody papers? If no, list on back. Yes No

15. Were correct containers used for the analytes? Yes No

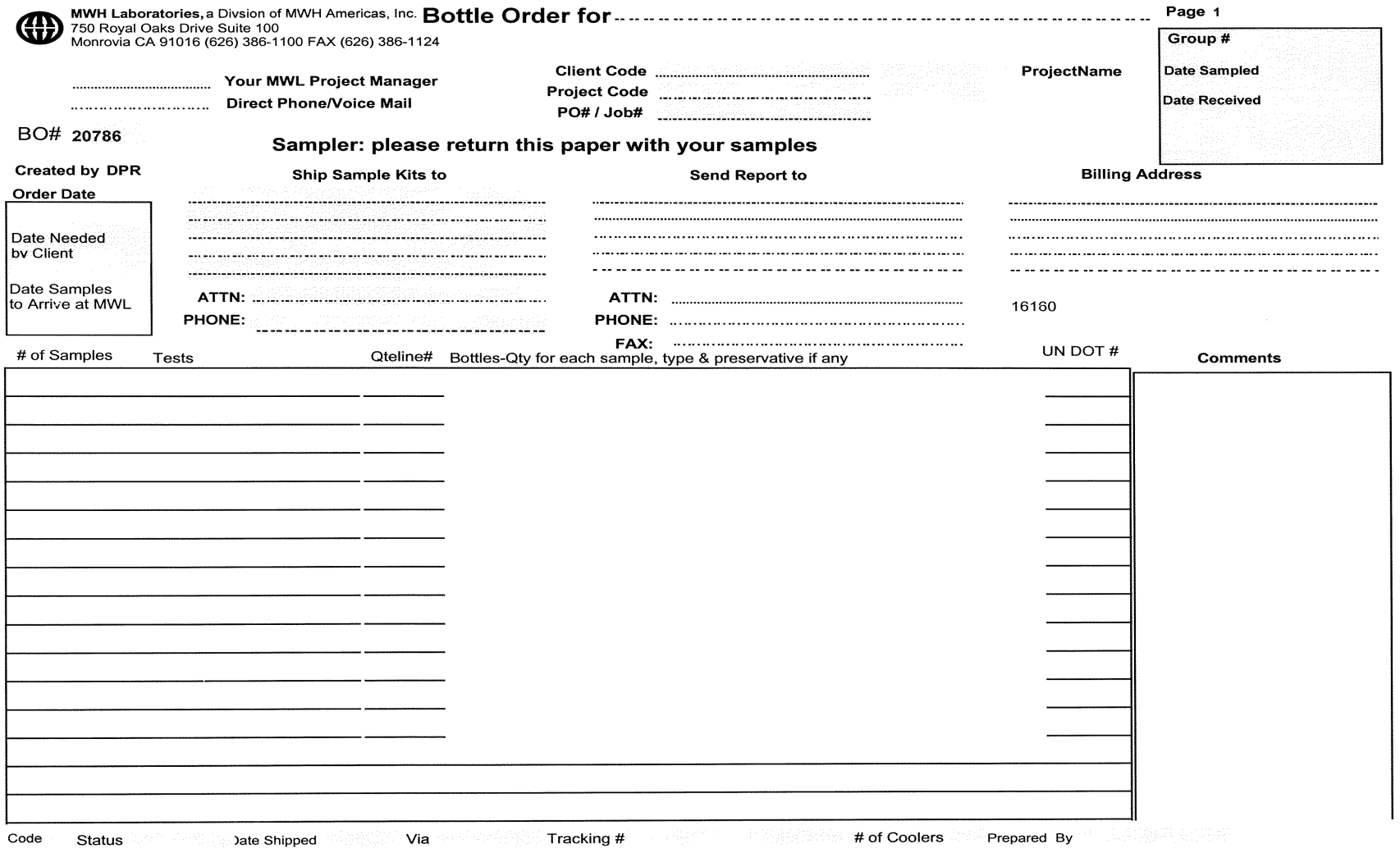
16. Were correct preservatives used when required? Yes No

17. Was sufficient amount of sample sent for tests? Yes No

18. Bubbles absent in VOA vials? If no, list by sample ID on back. Yes No

19. Was Client Services informed of problems? Yes No

Figure 7-2. Price Quotation/Work Order form



MWH Laboratories, a Divsion of MWH Americas, Inc.
750 Royal Oaks Drive Suite 100
Monrovia CA 91016 (626) 386-1100 FAX (626) 386-1124

Bottle Order for ..... Page 1

..... Your MWL Project Manager
..... Direct Phone/Voice Mail

Client Code .....
Project Code .....
PO# / Job# .....

ProjectName

Group #
Date Sampled
Date Received

BO# 20786

Sampler: please return this paper with your samples

Created by DPR
Order Date

Date Needed by Client
Date Samples to Arrive at MWL

Ship Sample Kits to	Send Report to	Billing Address
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
ATTN:	ATTN:	16160
PHONE:	PHONE:	
	FAX:	

# of Samples	Tests	Qteline#	Bottles-Qty for each sample, type & preservative if any	UN DOT #	Comments

Code Status Date Shipped Via Tracking # # of Coolers Prepared By

Figure 7-3. Example sample labels.

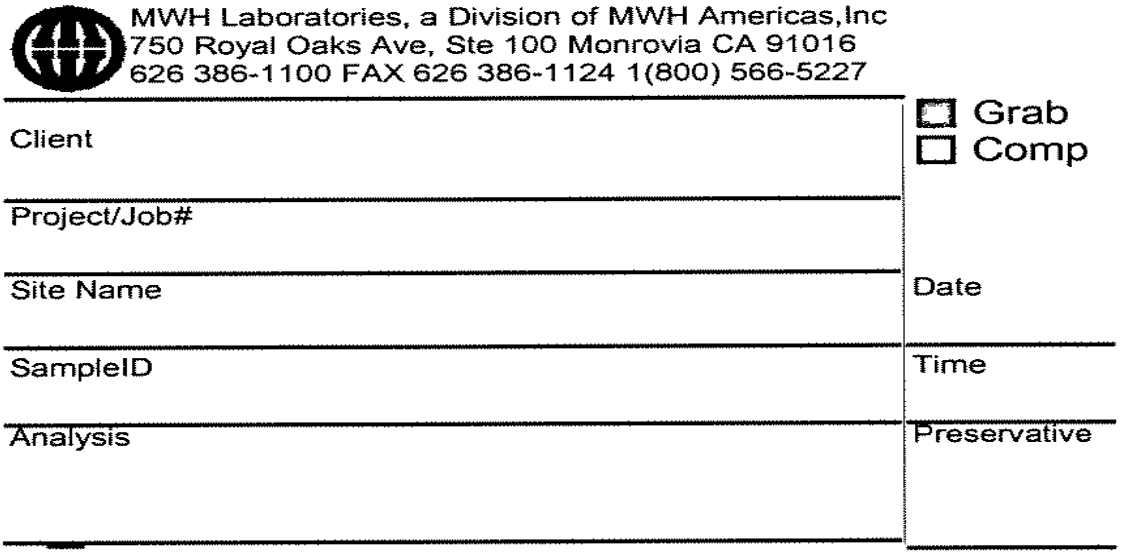


Figure 7-4. Internal Custody Logbook

Internal C.O.C

Log In Revd Date	Client	Client Sample ID	Sampling Date	Analysis (Tag #)	Laboratory Sample ID	Removal Code	Received			Returned		
							By	Date	Time	By	Date	Time

MWH Laboratories

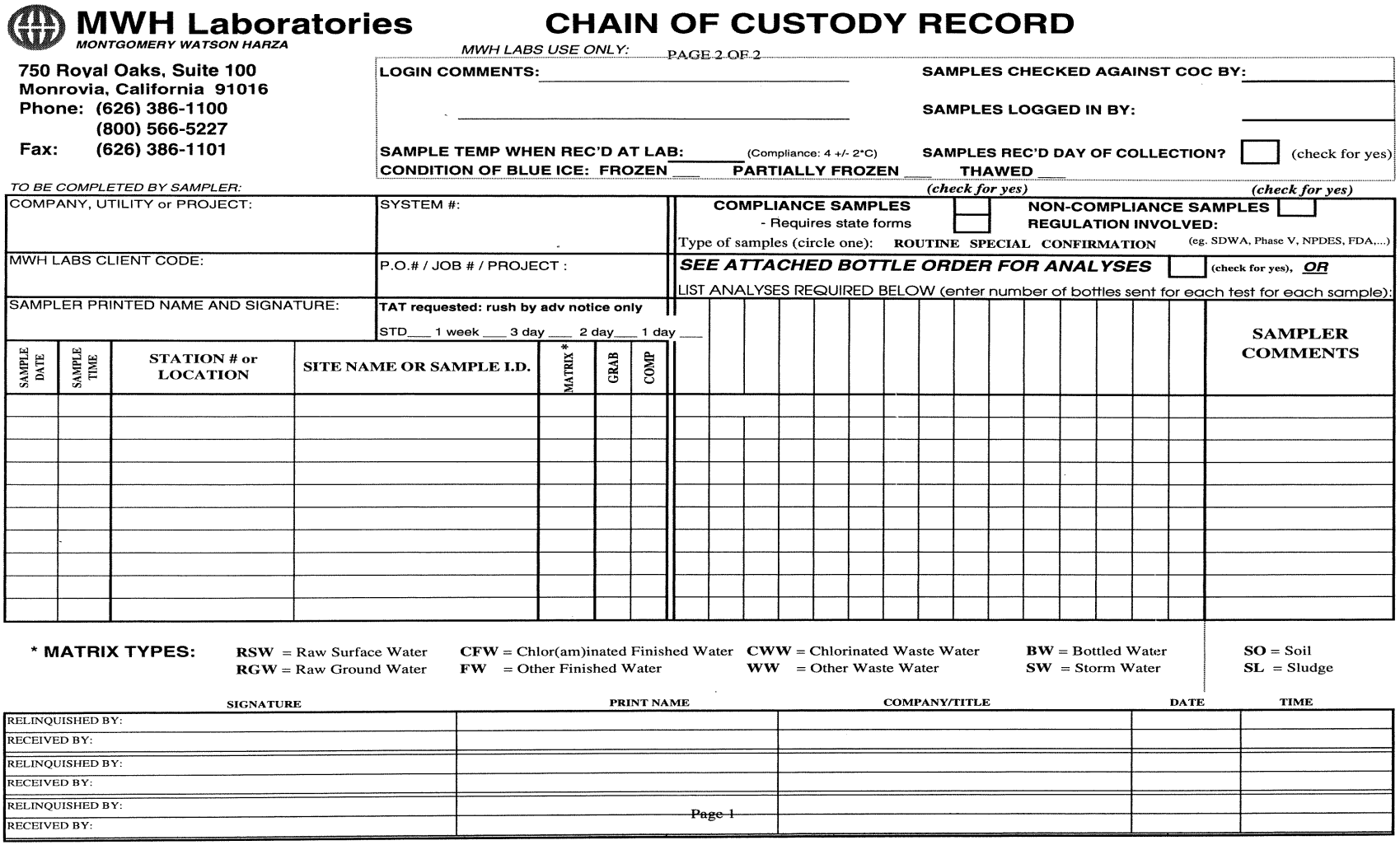
Footnote: **P Preparation; Extraction, Digestion, Incubation**
A Analyze
D Disposal
R Relocate (state new location)

Figure 7-5. Internal Sample Disposal (Level II)

Level II Chain of Custody Sample Disposal Logbook

Log in Rec'd Date	Client	Lab Sample ID	Authorized to Dispose By:	Tag Label		Date of Disposal	Nature of Disposal				Initials	Signature
				Yes	No		Sample Depleted	Hazwaste Drum	Sewer	Returned to Client		

Figure 7-6. Chain-of-Custody form



MWH Laboratories
MONTGOMERY WATSON HARZA

750 Royal Oaks, Suite 100
Monrovia, California 91016
Phone: (626) 386-1100
(800) 566-5227
Fax: (626) 386-1101

CHAIN OF CUSTODY RECORD

MWH LABS USE ONLY: PAGE 2 OF 2

LOGIN COMMENTS: _____

SAMPLES CHECKED AGAINST COC BY: _____

SAMPLES LOGGED IN BY: _____

SAMPLE TEMP WHEN REC'D AT LAB: _____ (Compliance: 4 +/- 2°C)

SAMPLES REC'D DAY OF COLLECTION? ☐ (check for yes)

CONDITION OF BLUE ICE: FROZEN ___ PARTIALLY FROZEN ___ THAWED ___

TO BE COMPLETED BY SAMPLER:

COMPANY, UTILITY or PROJECT:	SYSTEM #:	COMPLIANCE SAMPLES (check for yes) ☐ - Requires state forms ☐ NON-COMPLIANCE SAMPLES (check for yes) ☐ REGULATION INVOLVED: (eg. SDWA, Phase V, NPDES, FDA,...)
MWH LABS CLIENT CODE:	P.O.# / JOB # / PROJECT :	Type of samples (circle one): ROUTINE SPECIAL CONFIRMATION — SEE ATTACHED BOTTLE ORDER FOR ANALYSES ☐ (check for yes), OR
SAMPLER PRINTED NAME AND SIGNATURE:	TAT requested: rush by adv notice only STD___ 1 week ___ 3 day ___ 2 day___ 1 day ___	LIST ANALYSES REQUIRED BELOW (enter number of bottles sent for each test for each sample):

SAMPLE DATE	SAMPLE TIME	STATION # or LOCATION	SITE NAME OR SAMPLE I.D.	MATRIX *	GRAB	COMP												SAMPLER COMMENTS

*** MATRIX TYPES:**

RSW = Raw Surface Water
RGW = Raw Ground Water
CFW = Chlor(am)inated Finished Water
FW = Other Finished Water
CWW = Chlorinated Waste Water
WW = Other Waste Water
BW = Bottled Water
SW = Storm Water
SO = Soil
SL = Sludge

	SIGNATURE	PRINT NAME	COMPANY/TITLE	DATE	TIME
RELINQUISHED BY:					
RECEIVED BY:					
RELINQUISHED BY:					
RECEIVED BY:					
RELINQUISHED BY:					
RECEIVED BY:					

Page 1

Figure 7-7. Run Logbook

File ID: 090902an SO4

Sample ID	Date	Time	Dil	Raw	Rept.	Limit	Comment
autocal1	08/28/02	12:04	1	0	ND		
autocal2	08/28/02	12:14	1	1.4378	1.4		
autocal3	08/28/02	12:25	1	2.3498	2.3		
autocal4	08/28/02	12:35	1	4.1549	4.2		
autocal5	08/28/02	12:46	1	9.6369	9.6		
autocal6	08/28/02	12:57	1	19.066	19		
autocal7	08/28/02	13:07	1	48.880	49		
autocal8	08/28/02	13:18	1	101.08	100		
autocal9	08/28/02	13:29	1	199.82	200		
MCV	09/09/02	15:12	1	38.980	39	90-110	97.4%
HCV	09/09/02	15:23	1	155.65	156	90-110	97.2%
MRL	09/09/02	15:33	1	2.0927	2.09	50-150	104%
MBLANK	09/09/02	15:44	1	0	ND		
LCS	09/09/02	15:55	1	50.071	50.1	90-110	100%
LCSD	09/09/02	16:05	1	50.256	50.3	90-110	100%
2209050186_1/10	09/09/02	16:16	10	75.929	76		
2209060020_1/10	09/09/02	16:27	10	140.38	140		
2209060023_1/20	09/09/02	16:37	10	108.48	110		
2209090029	09/09/02	16:48	2	134.74	130		
2209090029MS	09/09/02	16:59	2	235.77	236	[101.032]	101%
2209090029MSD	09/09/02	17:09	2	234.68	235	[99.941]	99.9%
2209090029T	09/09/02	17:09	2		100.00	80 - 120	
2209090049_1/10	09/09/02	17:20	10	790.31	790		
2209090050_1/10	09/09/02	17:30	10	1505.8	1500		
2209090051_1/10	09/09/02	17:41	10	1218.1	1200		
MCV	09/09/02	17:52	1	39.511	39.5	90-110	98.7%
CCB	09/09/02	18:02	1	0	ND		
2209090052_1/10	09/09/02	18:13	10	0	ND		
2209090053_1/10	09/09/02	18:24	10	210.09	210		
2209090054	09/09/02	18:34	10	206.05	210		
2209090054MS	09/09/02	18:45	10	706.73	707	[500.688]	100%
2209090054MSD	09/09/02	18:56	10	706.22	706	[500.176]	100%
2209090054T	09/09/02	18:56	10		500.00	80 - 120	
2209090055_1/10	09/09/02	19:06	10	124.43	120		
2209090056	09/09/02	19:17	10	1054.3	1100		
2209090057	09/09/02	19:27	10	279.55	280		
2209090062	09/09/02	19:38	10	32.315	32		
2209090063	09/09/02	19:49	10	1284.7	1300		
MBLANK	09/09/02	19:59	10	0	ND		
LCS	09/09/02	20:10	1	50.356	50.4	90-110	100%
LCSD	09/09/02	20:21	1	50.300	50.3	90-110	100%
HCV	09/09/02	20:31	1	158.08	158	90-110	98.8%

Figure 7-8. Example Work Schedule Printout

DEPARTMENT : Wet Chemistry (CHMWET)
WORKSTATION: Manual Distillation for RFA (EXRFA)

MWH Laboratories
WorkSchedule
06-sep-2002 03:02:42

TEST CODE: CN 1 Cyanide by manual distillation UNITS: mg/l SIGNIFICANT DIGITS: 3
METHOD : E335.4 PREP REQUIRED: Y DETECTION LIMIT: 0.0050

Group#	Sample#	R#	Company Name	Code	Result	LastResult	Project	Sample Source	Priority	Sample	PrepDate	DueDate	Locator	Upper Warning	Spike	Resp Code
100178	2209040042	0	City of Flagstaff Ri	FLAGSTAFF-RW			RECLAIMED	FINAL EFFLUENT 090302	14-sep-2002	03-sep-2002		14-sep-2002		0.0000		

SAMPLE: CLHS,PB-HS DUE 9-11-02.

TEST CODE: PHENOL 1 Phenolic Compounds UNITS: mg/l SIGNIFICANT DIGITS: 3
METHOD : 420.1, 420.2 PREP REQUIRED: Y DETECTION LIMIT: 0.0100

Group#	Sample#	R#	Company Name	Code	Result	LastResult	Project	Sample Source	Priority	Sample	PrepDate	DueDate	Locator	Upper Warning	Spike	Resp Code
100072	2208290373	0	Water Replenishment	WRD-RGWRP			WRD RGWRP	5910100	08-sep-2002	29-aug-2002		08-sep-2002		0.0000		
100175	2209040024	0	CDM Engineers and Co.	CDM/GLENDALE			DRINKING	6197043-TW58	14-sep-2002	04-sep-2002		14-sep-2002		0.0000		

TEST CODE: WCN 1 Weak Acid Dissociable Cyanide UNITS: mg/l SIGNIFICANT DIGITS: 3
METHOD : EPA/SM 4500 PREP REQUIRED: Y DETECTION LIMIT: 0.0050

Group#	Sample#	R#	Company Name	Code	Result	LastResult	Project	Sample Source	Priority	Sample	PrepDate	DueDate	Locator	Upper Warning	Spike	Resp Code
100243	2209050048	0	Kerr McGee Chemical	KERRMCGEE-MP			CLO4	STABILIZED WATER	15-sep-2002	04-sep-2002		15-sep-2002		0.0000		

Figure 7-9 Sample Acknowledgement

MWH Laboratories
750 Royal Oaks Drive, Monrovia, CA 91016
PHONE: 626-386-1100/FAX: 626-386-1101

ACKNOWLEDGMENT OF SAMPLES RECEIVED

Customer Code:
Group#:
Project#: DRINKING
Proj Mgr: Tom French
Phone: (480) 778-1558

The following samples were received from you on **10/28/04**. They have been scheduled for the tests listed beside each sample. If this information is incorrect, please contact your service representative. Thank you for using MWH Laboratories.

Sample#	Sample Id	Matrix	Sample Date
	Tests Scheduled		
2410280140	COMP2 POE 011,017	Water	27-oct-2004 08:30:00
	@525AZ @DIQUAT @ML515.4 @ML531 D1613EDD ENDOTHAL GLYPHOS		
2410280145	COMP2 POE 002,004	Water	27-oct-2004 10:20:00
	GLYPHOS		
2410280146	COMP4 POE 002,004,031,032	Water	27-oct-2004 10:20:00
	D1613EDD		
2410280149	POE 011 COUNTRY CLUB 2 WELL	Water	27-oct-2004 08:00:00
	@EDB-DBC @ML505 @VOASDWA		
2410280152	POE 017 RANDOM WELL	Water	27-oct-2004 08:30:00
	@EDB-DBC @ML505 @VOASDWA		
2410280157	POE 002 HEMLOCK CIRCLE WELL	Water	27-oct-2004 10:20:00
	@VOASDWA		
2410280158	POE 004 PAYSON RANCHOS WELL	Water	27-oct-2004 09:30:00
	@VOASDWA		
2410280159	POE 031 GOAT CAMP 1 WELL	Water	27-oct-2004 09:45:00
	@VOASDWA		
2410280160	POE 032 SKY PARK WELL	Water	27-oct-2004 09:00:00
	@VOASDWA		
2410280161	TRAV BLANK-ANALYZE	Water	27-oct-2004 00:00:00
	@VOASDWA		

Test Acronym Description

Test Acronym	Description
@525AZ	525 Semivolatiles by GC/MS
@DIQUAT	Diquat and Paraquat
@EDB-DBC	EDB and DBCP by GC-ECD
@ML505	Pesticides by EPA 505
@ML515.4	Herbicides by 515.4
@ML531	Aldicarbs
@VOASDWA	Regulated VOCs plus Lists 1&3
D1613EDD	2,3,7,8-Tcdd 1613 Drinking Wtr

- 1 -

Figure 7-10 Operations Report

Backlog of Incomplete Groups for ADE
As of 23 October, 2004
Page 1

Due	Group #	Client	CJL	CBG	COL	DIL	MER	DEB	WIM	WAM	CSD
-161	126818	MWH EDC	4		4						
-161	126828	MWH EDC	4		4						
-160	126869	MWH EDC	3		3						
-132	128403	WW RIX	13		13						
-56	132040	MDL_IDOC	5		RDY						
-14	135778	MP CLO4	6							RDY	4
-14	135779	MP CLO4	12						RDY	RDY	6
-14	135793	BW	5			RDY	1				1
-14	136257	MP CLO4	1							RDY	
-13	135926	BW	5			RDY	1				1
-13	135927	BW	5			RDY	1				1
-13	135929	BW	5			RDY	1				1
-11	136153	MP CLO4	1							RDY	
-11	136159	PILO	12			3			RDY	3	3
-9	136644	MP CLO4	1							RDY	
-8	136214	BW	5			RDY	1		RDY		1
-7	136255	MP CLO4	7						RDY	RDY	4
-7	136278	-MP CLO4	10							RDY	
-7	136279	DRINKING	2							2	
-4	136516	MP CLO4	31							11	
-4	136518	MP CLO4	8						6	2	
-3	136685	MP CLO4	2							2	
-2	137033	MP CLO4	1							RDY	
-1	136589	BW	8			4	2		RDY		1
-1	136613	CLO4	2							2	
0	136625	CLO4	20						3	11	4
0	136627	CLO4	37						15	12	6
0	136628	CLO4	24		3	3	3		RDY	6	6

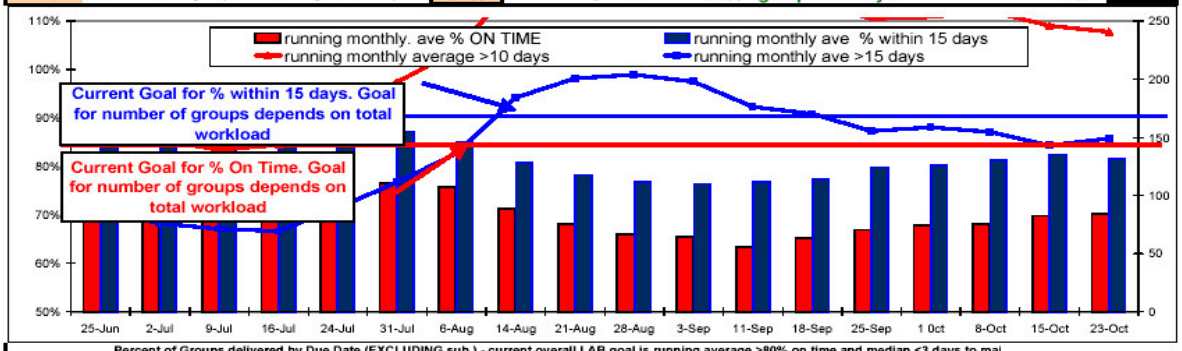
Figure 7-11 Weekly Lab Turnaround Time

Weekly Lab Turnaround Time Statistics for week ending 10/23/2004

minor improvement in number of late groups at 10 days, but slipped a bit for 15 days, mainly due to IC problems. GCMS still behind on MDLs, but otherwise looking very good; GC good improvement overall, wet chem and metals rad looking okay, and Micro continues to do fine! need to clean up old stuff and get ICs functional again

Green - doing great, white-marginal, red- way behind

212	actual >10 day groups(not including subs)	73%	Goal =	80%	groups <10 days	157
146	actual >15 days (not including sub work)	81%	Goal =	90%	groups <15 days	78



Percent of Groups delivered by Due Date (EXCLUDING sub) - current overall LAB goal is running average >80% on time and median <3 days to mai

as of	Total groups	Total LATE groups	running monthly average >10 days	running monthly. ave % ON TIME	% On TIME (80%)	Micro (90%)	VOA BNA NDMA (85%)	525 UCMR HPLC (80%)	GC (85%)	TOX TOC Wet (90%)	Met/ Rad (80%)	IC/RFA (90%)	Subbed work (60%)	median for days from print to mail (1)	reports mailed
25-Jun	710	110	160	78%	85%	100%	79%	80%	94%	93%	75%	85%	47%	1	367
2-Jul	731	192	147	80%	74%	100%	73%	66%	73%	66%	68%	77%	57%	1	448
9-Jul	713	116	140	81%	84%	85%	76%	74%	85%	85%	77%	87%	51%	0	208
16-Jul	854	155	143	81%	82%	94%	78%	72%	71%	93%	87%	89%	56%	1	356
24-Jul	959	256	166	79%	73%	94%	80%	64%	64%	90%	69%	81%	40%	1	394
31-Jul	893	268	197	77%	70%	91%	81%	69%	68%	80%	59%	80%	50%	1	572
6-Aug	898	326	224	76%	70%	91%	81%	69%	68%	80%	59%	80%	50%	1	342
14-Aug	1052	409	283	71%	61%	93%	74%	65%	66%	78%	50%	61%	61%	2	380
21-Aug	835	284	309	68%	66%	100%	71%	69%	66%	90%	56%	73%	61%	1	416
28-Aug	731	272	312	66%	63%	95%	80%	78%	56%	86%	48%	75%	48%	2	353
3-Sep	724	238	306	65%	67%	88%	69%	79%	62%	89%	53%	89%	49%	1	478
11-Sep	747	301	301	63%	60%	86%	70%	77%	43%	85%	57%	82%	47%	2	269
18-Sep	818	237	266	65%	71%	86%	79%	78%	69%	92%	70%	82%	56%	2	446
25-Sep	813	212	252	67%	74%	97%	77%	95%	83%	95%	77%	77%	64%	1	392
1 Oct	848	280	254	68%	67%	84%	73%	75%	73%	91%	71%	71%	53%	1	485
8-Oct	839	262	258	68%	69%	98%	75%	83%	76%	87%	65%	66%	54%	1	310
15-Oct	751	238	246	70%	68%	90%	72%	93%	66%	87%	64%	66%	58%	1	383
23-Oct	783	212	241	70%	73%	95%	71%	89%	80%	86%	77%	66%	59%		

Percent of Groups <5 days overdue (EXCLUDING sub) - LAB Goal is running average 90+% by -5 days and 75% mailed in 3 day

as of	Total groups	Total groups > 15 days	running monthly ave >15 days	running monthly ave % within 15 days	% within 15 days (90%)	Micro (95%)	VOA BNA NDMA (95%)	525 UCMR HPLC (85%)	GC (90%)	TOX TOC Wet (95%)	Met/ Rad (90%)	IC/RFA (95%)	Subbed work (75%)	75 % for days from print to mail(2)	reports mailed
25-Jun	710	47	86	88%	93%	100%	94%	89%	98%	99%	87%	98%	58%	1	367
2-Jul	732	82	76	89%	89%	100%	85%	82%	86%	87%	86%	93%	74%	2	448
9-Jul	713	75	72	90%	89%	99%	86%	89%	94%	89%	85%	91%	60%	1	208
16-Jul	854	73	69	91%	91%	97%	89%	79%	89%	96%	93%	97%	62%	3	356
24-Jul	959	128	90	89%	87%	98%	91%	74%	76%	98%	88%	95%	50%	4	394
31-Jul	893	169	111	87%	81%	97%	82%	84%	81%	95%	76%	94%	62%	4	572
6-Aug	898	175	136	85%	81%	93%	89%	75%	76%	92%	73%	93%	61%	3	342
14-Aug	1052	265	184	81%	75%	95%	84%	79%	76%	88%	66%	80%	73%	4	380
21-Aug	835	194	201	78%	77%	100%	79%	81%	78%	95%	67%	85%	69%	3	416
28-Aug	731	181	204	77%	75%	100%	85%	93%	69%	95%	68%	89%	67%	4	353
3-Sep	724	152	198	76%	79%	97%	89%	88%	75%	93%	62%	97%	64%	3	478
11-Sep	747	178	176	77%	76%	91%	75%	91%	69%	93%	69%	98%	56%	4	269
18-Sep	818	170	170	77%	79%	98%	82%	85%	74%	97%	75%	93%	60%	3	446
25-Sep	812	122	156	80%	85%	100%	82%	100%	91%	99%	83%	93%	71%	3	392
1-Oct	848	165	159	80%	81%	98%	77%	86%	88%	99%	85%	85%	70%	3	485
8-Oct	839	162	155	81%	81%	100%	79%	99%	82%	98%	77%	82%	66%	2	310
15-Oct	751	123	143	82%	84%	100%	77%	100%	83%	99%	83%	89%	71%	4	382
23-Oct	783	146	149	82%	81%	98%	76%	92%	87%	91%	84%	80%	66%		

Green - doing great, white-marginal(<5% off goal), red- way behind (>5% off goal)

Figure 7-12 Work Load Report by Test and Matrix

Confidential MWH Labs Workload by Test and Matrix for December 2002

Matrix	Test Code	12/02	Method Reference
Water	1623SUB	17	EPA 1623
Water	2CEVE5	20	ML/EPA 524.2
Water	@502MOD	38	ML/EPA 502.2
Water	@504-LOW	26	ML/EPA 504.1
Water	@504MOD	5	ML/EPA 504.1
Water	@525PLUS	295	ML/EPA 525.2
Water	@551-ICR	6	ML/EPA 551.1
Water	@ACIDS	21	ML 625/8270
Water	@ACIDS	21	ML/SW 8270
Water	@ACOPEDD	4	ML/EPA 900.0
Water	@ALDEHYD	29	ML/SM 6252
Water	@ALPHEDD	22	ML/EPA 900.0
Water	@BDOC	6	ML/SM 9217 mod
Water	@BTEX-WW	8	ML/EPA 624
Water	@CLDEMAN	1	ML/SM2350
Water	@COLI-PA	203	SM9223
Water	@COLI10	172	ML/SM9223
Water	@DIAZEDD	43	EPA 625 MOD
Water	@DIAZSUB	93	EPA 625 MOD
Water	@DIOXANE	4	SM/SW 8270
Water	@DIQUAT	64	ML/EPA 549.2
Water	@EDB-DBC	99	ML/EPA 504.1
Water	@EDB-WRD	6	ML/EPA 504.1
Water	@H3EDD	16	EPA 906.0
Water	@HALOAC	418	ML/SM 6251B
Water	@INHIBRE	1	ML/SM9020
Water	@ML505+	2	ML/EPA 505
Water	@ML515.3	159	ML/EPA 515.3
Water	@ML525	410	ML/EPA 525.2
Water	@ML531	113	ML/EPA 531.1
Water	@ML532	22	EPA 532
Water	@ML551.1	287	EPA 551.1
Water	@ML601	2	ML/EPA 601
Water	@ML601	2	ML601/SW 8010
Water	@ML601LF	4	ML/EPA 601
Water	@ML602LF	4	ML/EPA 602
Water	@MOD8011	99	ML/EPA 8011
Water	@MPA	3	E 910/9-92-029
Water	@MPN10	3	ML/SM 9221B

8.0. ANALYTICAL PROCEDURES

8.1 SOURCES FOR METHODS

The analytical methods performed by MWH Laboratories are based primarily on methods specified by various federal, state, and local regulations. If more stringent standards or requirements are included in the mandated test method or by regulation, the laboratory ensures that all personnel SOPs meet such requirements even if the requirement is more stringent than the corresponding NELAC standard. If it is unclear which requirements are more stringent, the laboratory follows the standard from the method or regulation. All analysts must follow all the Quality Control protocols and all essential QC measures specified by the laboratory's method manual (SOPs). The majority of methods come from the U.S. Environmental Protection Agency. Other methods are from Standard Methods for the Examination of Water and Wastewater, 18th, 19th, 20th and online Editions. Additional methods may be used when appropriate.

Methods from the EPA are listed on section 8.12, the footnote section.

Laboratory developed methods may be used when the client does not specify the method to be used or where methods are employed that are not required, as in the Performance Based Measurement System Approach, the methods shall be fully documented and validated (NELAC 5.5.4.2.2, 5.5.4.5 and Appendix C), and be available to the Client and other recipients of the relevant reports. The laboratory shall select appropriate methods that have been published either in international, regional or national standards, or by reputable technical organizations, or in relevant scientific texts or journals, or as specified by the manufacturer of the equipment. Laboratory-developed methods or methods adopted by the laboratory are used only if appropriate to the intended use and are validated. The laboratory informs the Client as to the method chosen. [NELAC 5.5.4.2.1c)]

The laboratory informs the Client when the method proposed by the Client is considered to be inappropriate or out of date. (NELAC 5.5.4.2.1).

The introduction of environmental test and calibration methods developed for the laboratory for its own use shall be a planned activity and shall be assigned to qualified personnel equipped with adequate resources.

The laboratory shall evaluate selectivity by following the checks established within the method, which may include mass spectral tuning, second column confirmation, ICP inter-element interference checks, chromatography retention time windows, sample blanks, spectrochemical absorption or fluorescence profiles, co-precipitation evaluations, and electrode response factors. (NELAC Appendix C.3.4)

8.1.1. Initial Test Method Evaluation Procedures

For all test methods other than microbiology the following LOD and LOQ requirements apply.

Limit of Detection (LOD)

1. The laboratory shall determine the LOD by performing the MDL studies determination to conform to CFR136 for the method for each target analyte of concern in the quality system matrices. All sample-processing steps of the analytical method shall be included in the determination of the LOD.
2. The validity of the LOD shall be confirmed by quantitative identification of the analyte(s) in a QC sample in each quality system matrix containing the analyte at no more than 2-3X the LOD for single analyte tests and 1-4X the LOD for multiple analyte tests. This verification must be performed on every instrument that is to be used for analysis of sample and reporting data.
3. An LOD study is not required for any component for which spiking solutions or quality control samples are not available such as temperature, or, when test results are not to be reported to the LOD (versus the method reporting limit or working range of instrument calibration). Where an LOD study is not performed, the laboratory may not report a value below the Limit of Quantitation. Since EPA Manual for Drinking Water 5th Edition requires MDL studies, the laboratory conducts LOD determination for all drinking water methods.

Limit of Quantitation (LOQ):

1. The laboratory shall determine the LOQ for each analyte of concern according to a defined, documented procedure. LOQ/MRL is 2-3x LOD/MDL. At a minimum, MRL=MDL.
2. The LOQ study is not required for any component or property for which spiking solutions of quality control samples are not commercially available or otherwise inappropriate (e.g., pH).
3. The validity of the LOQ shall be confirmed by successful analysis of a QC sample containing the analytes of concern in each quality system matrix 1-2 times the claimed LOQ. A successful analysis is one where the recovery of each analyte is within the established test method acceptance criteria or client data quality objectives for accuracy. This single analysis is not required if the bias and precision of the measurement system is evaluated at the LOQ.

Standard Methods

The laboratory shall evaluate the Precision and Bias of a Standard Method for each analyte of concern for each quality system matrix according to the single-concentration four-replicate recovery study procedures in NELAC Appendix C.1 (or alternate procedure documented in the quality manual when the analyte cannot be spiked into the sample matrix and QC samples are not commercially available). (NELAC Appendix C.3.3.a)

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Non Standard Methods

Methods not covered by Standard Methods are properly validated before use. Non-Standard Methods when used by the laboratory are subjected to agreement with the Client incorporating the Client's specification requirements, including the purpose of the environmental test. The method is validated appropriately before use. [NELAC 5.5.4.4].
For laboratory-developed test methods or non-standard test methods as defined in NELAC 5.5.4.3 and 5.5.4.4 that were not in use by the laboratory before July 2003, the laboratory must have a documented procedure to evaluate precision and bias. The laboratory must also compare results of the precision and bias measurements with criteria established by the client, by criteria given in the reference method or criteria established by the laboratory.

Precision and bias measurements must evaluate the method across the analytical calibration range of the method. The laboratory must also evaluate precision and bias in the relevant quality system matrices and must process the samples through the entire measurement system for each analyte of interest. (NELAC Appendix C .3.3.b)

Examples of a systematic approach to evaluate precision and bias could be the following:

1. Analyze QC samples in triplicate containing the analytes of concern at or near the limit of quantitation, at the upper-range of the calibration (upper 20%) and at a mid-range concentration. Process these samples on different days as three sets of samples through the entire measurement system for each analyte of interest. Each day one QC sample at each concentration is analyzed. A separate method blank shall be subjected to the analytical method along with the QC samples on each of the three days. (Note that the three samples of the MRL concentration can demonstrate sensitivity as well). For each analyte, calculate the mean recovery for each day, for each level over days, and for all nine samples. Calculate the relative standard deviation for each of the separate means obtained. Compare the standard deviations for the different days and the standard deviations for the different concentrations. If the different standard deviations are all statistically insignificant (e.g., F-test), then compare the overall mean and standard deviation with the established criteria from above.
2. A validation protocol such as the Tier I, Tier II, and Tier III requirements in US EPA Office of Water's Alternate Test Procedure (ATP) approval process.

8.1.2 Validation of Methods [NELAC 5.5.4.5]

The laboratory shall validate non-standard methods, laboratory-designed/developed methods, standard methods used outside their published scope, and amplifications and modifications of standard methods to confirm that the methods are fit for the intended use. The validation shall be as extensive as is necessary to meet the needs of the given application or field of application. The initial test method evaluation requirements given in Appendix C.3 of NELAC Standard 2003 discussed in Section 4.4, MDL and IDC requirements for new analysts are done in validating new

methods and non-standard methods (NELAC 5.5.4.5.2). This is also applicable when an analyte not currently found on the laboratory's list of accredited analytes is added to an existing accredited test method. Initial evaluation must be performed for that analyte. (NELAC C.1) The laboratory records the results obtained for the IDC, MDL, LOD and LOQ studies. The method is fit for the intended use when the results meet all the MDL and IDC criteria for the method.

The range and accuracy of the values obtainable from validated methods (e.g. the uncertainty of the results, detection limit, selectivity of the method, linearity, limit of repeatability and/or reproducibility, robustness against external influences and/or cross-sensitivity against interference from the matrix of the sample/test object), are assessed for the intended use, and relevant to the Client's needs [NELAC 5.5.4.5.3].

8.2 METHODS USED

The analytical methods used by MWH Laboratories can be grouped into three major categories: drinking water methods, wastewater methods, and methods for hazardous wastes and solid samples. The following tables provide method descriptions and method numbers for the methods used in these three major groups:

Table 8-1 Method Description for Drinking Water

Table 8-2 Method Description for Wastewater

Table 8-3 Method Description for Hazardous Waste

8.3 DETECTION LIMITS

The method used in the quantitation of detection limits is as described in 40 CFR 136 Appendix B, which in summary is the analysis of at least seven replicates from which a statistically derived Method Detection Limit (MDL) is calculated. The replicates are determined over at least a 3 day period. This statistically derived limit is based on 3.143 times the standard deviation of 7 low concentration replicates (3-5 times the calculated detection limit). It is the laboratory's policy to be conservative when reporting a method detection limit on a non-detected sample.

Consequently, the laboratory has implemented the concept of minimum reporting levels (MRLs). The limit used on a laboratory report must be at or above the lowest standard associated with that analytical run. This ensures that all data reported as "detected" will have some degree of analytical precision associated with it. Data reported below these levels must be appropriately qualified. Copies of current MRLs for the laboratory are available upon request.

8.4 METHOD MODIFICATIONS

All method modifications are documented fully in individual SOPs. Methods are modified if and only if the original method goals for precision and accuracy have been met or better. Modifications are usually implemented due to available resources, or to expedite the process without sacrificing quality. Methods are validated prior to analyzing client samples. Validation is based on the method as described in the internal SOP. The validation includes an MDL study, an analyst precision and accuracy study, and subsequent review by the Group Manager, Lab Director and Quality Assurance Officer.

8.5 REAGENT STORAGE AND DISPOSAL

All reagents, solvents and reactive chemicals are stored in their original containers in appropriate cabinets or storage closets specifically designed for this use. See Table 8-4, for storage instruction. Date received and date opened must be recorded on each reagent container.

8.6 DISPOSAL

All laboratory wastes including excess samples, excess calibration standards, any excess test items, digestates, leachates, extracts or other sample preparation products are identified by their composition. Six waste streams are identified in the laboratory; extraction solvent, Methylene chloride wastewater, chloroform, Freon, rapid flow analyzer, corrosive acids and bases, HPLC, and flammable. Each type of waste is placed into a separate, clearly identified steel drum located in a secure area outside the laboratory. Each drum also has a characterization sheet (manifest) attached. This sheet is completed everytime a waste is introduced into the drum. Drums are taken for disposal/recycling once the drum is 75 % full or every three months from the start date of accumulation.

A large majority of samples received by MWH Laboratories are raw or finished waters. These sample remains, if not extracted, are disposed of by neutralizing with sodium hydroxide (NaOH) or sulfuric acid (H_2SO_4) and flushing down the sink while running cold water. The type and amount of waste is recorded in a logbook.

A continuous strip chart recorder is attached to the effluent outfall into the city sewer to record pH of all outgoing fluids from the laboratory.

Soils are disposed of in 55 gallon drums. Characterization sheet is attached to drum.

8.7 GLASSWARE CLEANING

Table 8-5, contains the SOP for glassware cleaning. All class volumetric glassware is dried at room temperature rather than oven baked.

TABLE 8-1 Method Description for Drinking Water
(A) Inorganics – Wet Chemistry

Parameter/Method Name	EPA Method Number	Method Description	Reference
Alkalinity	SM2320B	Titrimetric	4
Ammonia	EPA350.1	Colorimetric	1
Bromate	EPA 300.0 / 300.1	Ion Chromatography	6/18
Bromide	EPA300.0/300.1	Ion Chromatography	6/18
Chloride	EPA300.0	Ion Chromatography	6
Chlorate	EPA 300.0/300.1	Ion Chromatography	6/18
Chlorite	EPA300.0/300.1	Ion Chromatography	6/18
Color	SM2120B	Visual	4
Conductivity	SM2510B	Wheatstone Bridge	4
Cyanide	SM4500CN-F	Selective Electrode Method	4
Cyanide	EPA335.4	Manual Distillation, Spectrophotometric	6
Fluoride	SM4500 F-C	Potentiometric - Ion Selection Electrode	4
Foaming Agents/Surfactant (MBAS)	SM5540C	Colorimetric	4
Nitrate (chlorinated)	EPA300.0/353.2	Ion Chromatography	6
Nitrate (non-chlorinated)	EPA300.0/353.2	Ion Chromatography	6
Nitrate & Nitrite (non-chlorinated)	EPA300.0/353.2	Automated Cadmium Reduction, RFA	6
Nitrite	EPA300.0 EPA353.2	Ion Chromatography Automated Cadmium Reduction	6 6
Odor	SM2150B	Odor	4
Perchlorate	EPA 314.0	Ion Chromatography	6
pH	EPA150.1/ SM4500-HB	Electrometric	1
o-Phosphate	EPA300.0	Ion Chromatography	6
o-Phosphate	SM4500 P-E	Color, Ascorbic Acid	4
Residual Chlorine (Total/Free Chlorine)	SM4500 Cl-G	DPD Colorimetric/HaCH	4
Silica	EPA200.7	ICP	2
Dissolved Silica/Reactive Silica	SM 4500 Si D	Molybdosilicate	4
Solids (TDS)	SM2540C	Gravimetric	4
Sulfate	EPA300.0	Ion Chromatography	6
Temperature	SM2550B	Thermometric	4
Total Organic Carbon(TOC)/ Dissolved Organic Carbon (DOC)	SM5310C	UV Persulfate	4
Turbidity	EPA180.1	Nephelometric	6
UV 254	SM5910B	Determination of UV absorbing organic . constituents by UV absorption method at 254	4a
TOX (Total Organic Halogen or) Dissolved Organic Halogen (DOX	SM 5320B	Adsorption-Pyrolysis-Titrimetric Method	4

TABLE 8-1 Method Description for Drinking Water (con't)
(B) Inorganics – Metals

Parameter/Method Name	EPA Method Number	Method Description	Reference
Chromium VI (Dissolved)	EPA 218.6	Ion Chromatography	2
Metals (except Hg)	EPA200.7	ICP (Inductively Coupled Plasma)	2
Metals (except Hg)	EPA200.8	ICPMS (Inductively Coupled Plasma Mass Spectra)	2
Metals (Arsenic & Selenium only)	EPA200.9	AA (Atomic Absorption) - Platform	2
Mercury	EPA245.1	Manual Cold Vapor	2
Asbestos	EPA 100.2	TEM (Transmission Electron Microscopy)	9

(C) Microbiology/Microscopy Tests

Parameter/Method Name	EPA Method Number	Method Description	Reference
Drinking Water Source Enumeration (MTF)	SM9221B	Multiple Tube Fermentation (MTF)	4
Drinking Water Source Enumeration/Colilert	SM9223	MMO-MUG Test/Colilert	4
Fecal Coliforms/EC Medium	SM9221E1	Multiple Tube fermentation (MTF) / EC Medium	4
Heterotrophic Plate Count	SM9215B	Pour Plate Count	4
Total Coliform & E. Coli	Colisure	Colisure	4
Total Coliform (MF)Asbestos	SM 9222A, B, CEPA100.1/100.2	Membrane FiltrationTEM (Transmission Electron Microscopy)	49
Total Coliform (MF) Enumeration	SM 9222A, B, C	Membrane Filtration	4
Total Coliforms	SM9221B	Multiple Tube Fermentation (MTF)	4
Total Coliforms + --E. Coli / Present or Absent	SM9223B	MMO-MUG Test/Colilert	4

TABLE 8-1 Method Description for Drinking Water (con't)

(D) Organics

Parameter/Method Name	EPA Method Number	Method Description	Reference
DBCP/EDB	EPA504.1	Microextraction, GC/ECD	3d
Organohalide Pesticides and Commercial Polychlorinated Biphenyl (PCB) Products in water by Microextraction and Gas Chromatography	EPA505	Microextraction, GC/ECD	3d
Nitrogen- and Phosphorus- Containing Pesticides including ThioBencarb	EPA507	GC, Nitrogen Phosphorus Detector, liquid liquid extraction	3d
Chlorinated Herbicides	EPA515.4	GC, Electron Capture Detector (ECD)	21
Chlorinated Herbicides	EPA 515.3	GC, Electron Capture Detector (ECD)	20
Purgeable Organic Compounds/ Halogenated & Aromatic Volatiles/Trihalomethanes/Di-isopropyl Ether(DIPE),Tertiary Amyl Methyl Ether (TAME), Tert-Butyl ethyl ether (ETBE), TBA, CS2, MIBK 1,2,3-Trichloropropane (TCP)	EPA524.2 CA DHS 524.2	Purge and Trap capillary Column, GCMS	3d
Semi-Volatile Organics -- Acide/Base Neutrals including ThioBencarb	EPA525.2	Liquid Solid Extraction (LSE), capillary column, GCMS	3d
N-Methylcarbamoyloximes and N-Methylcarbamates	EPA531.1 EPA531.2	HPLC with Fluorescence Detector HPLC with Fluorescence Detector	3d 22
Glyphosate	EPA547	HPLC/Post Column Reactor - Fluorescence Detector	3a
Endothall	EPA548.1	GCMS, Liquid Solid Extraction (LSE)	3b
Diquat & Paraquat	EPA549.2	HPLC, Liquid Solid Extraction (LSE) UV Detector	19
Trihalomethanes	EPA 551.1	GC, Electron Capture Detector (ECD), liquid liquid extraction	3d
Haloacetic Acids	SM6251B	GC, Electron Capture Detector (ECD)	4a

(E) Radiochemistry

Parameter/Method Name	EPA Method Number	Method Description	Reference
Gross Alpha	EPA900.0	Proportional Counting	13
Gross Beta	EPA900.0	Proportional Counting	13
Radon 222	SM 7500 Rn-B	Liquid Scintillation	4
Radium 228	EPA 904.0	Radiochemical	13
Gross Alpha	SM 7110C	Co-Precipitation	4
Uranium	EPA 200.8	ICP MS	2

TABLE 8-2 Method Description for Wastewater
(A) Inorganics – Wet Chemistry

Parameter/ Method Name	EPA Method Number	Method Description	Reference
Alkalinity, Total (Bicarbonate, Carbonate, & Hydroxide)	SM2320B/EPA 310.1	Titrimetric, Potentiometric	4
Ammonia	EPA350.1	Colorimetric	1
Biochemical Oxygen Demand (BOD)	SM5210B	BOD/Probe	4
Boron	EPA200.7	ICP	2
Bromide	EPA300.0	Ion Chromatography	6
Carbonaceous Biochemical Oxygen Demand (cBOD)	SM5210B	BOD/Probe with Nitrification Inhibitor	4
Chemical Oxygen Demand (COD)	EPA410.4	Colorimetric	1
Chloride	EPA300.0	Ion Chromatography	6
Chlorine, Total Residual	SM4500 Cl G	Spectrophotometric, DPD, HACH	4
Chromium VI	SM3500D Cr-D	0.45 micron Filtration Followed by Colorimetric	4
Cyanide, Total	EPA335.2/EPA335.3	Manual Distillation followed by Auto Spectrophotometric	1
Cyanide, Amenable to Chlorination	EPA 335.1/SM 4500CN G	Automated Colorimetric after treatment	1
Fluoride	EPA340.2/SM4500 F-C	Ion Selective Electrode	1/4
Hardness	SM2340B	Calculation Ca plus Mg as CO_3^-	4
Kjeldahl Nitrogen	EPA351.2	Colorimetric, Semi-auto block digester	1
Nitrate	EPA353.2 EPA300.0	Cadmium Reduction Ion Chromatography	1 6
Nitrite	EPA300.0 EPA 353.2 EPA 354.1	Ion Chromatography Cadmium Reduction Colorimetric	6 1 1
Total Residue	SM 2540B EPA 160.3	Gravimetric Gravimetric	4 1
Orthophosphate	EPA365.2/SM4500 P-E EPA300.0	Manual Single Reagent Ion Chromatography	1/4 6
Perchlorate	EPA 300.0 Mod	Ion Chromatography	6
Phenols	EPA420.2	Manual Distillation Followed by Colorimetric	1
pH	EPA 150.1/SM4500-HB	Electrometric	1/4
Phosphorus, Total	EPA365.2/SM4500 P-E	Persulfate Digestion followed by Manual Colorimetric	1/4
Residue, Filterable (Total Dissolved Solids--TDS)	SM2540C/EPA 160.1	Gravimetric	4/1
Residue, Non-filterable (Total Suspended Solids--TSS)	SM2540D/EPA 160.2	Gravimetric	4/1
Residue, Settleable (Settleable Solids)	SM 2540F/ EPA160.5	ImHoff Cone	4/1
Specific Conductance	EPA120.1/SM2510B	Wheatstone Bridge	1/4
Sulfate	EPA300.0	Ion Chromatography	6
Sulfide (Total & Soluble)	EPA376.2	Colorimetric	1
Total Organic Carbon (TOC)	SM5310C	UV Persulfate	4

TABLE 8-2 Method Description for Wastewater (con't)
(B) Inorganics – Metals

Parameter/Method Name	EPA Method Number	Method Description	Reference
Aluminum, Al	EPA200.7 EPA200.8	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2 2
Antimony, Sb	EPA200.7 EPA200.8	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2 2
Arsenic, As	EPA200.8 EPA200.9 SM 3113B	Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS) Digestion, Graphite Furnace, Atomic Absorption Platform	2 2
Barium, Ba	EPA200.7 EPA200.8	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2 2
Beryllium, Be	EPA200.7 EPA200.8	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2 2
Cadmium, Cd	EPA200.7 EPA200.8	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2 2
Calcium, Ca	EPA200.7	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP)	2
Chromium, Cr	EPA200.7 EPA200.8	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2 2
Cobalt, Co	EPA200.7 EPA200.8	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2 2
Copper, Cu	EPA200.7 EPA200.8	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2 2
Iron, Fe	EPA200.7	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP)	2
Lead, Pb	EPA200.8	Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2
Magnesium, Mg	EPA200.7	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP)	2
Manganese, Mn	EPA200.7 EPA200.8	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2 2
Mercury, Hg	EPA245.1	Digestion, Cold Vapor Manual	1
Molybdenum, Mo	EPA200.7 EPA200.8	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2 2
Nickel, Ni	EPA200.7 EPA200.8	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2 2
Potassium, K	EPA200.7	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP)	2
Selenium, Se	EPA200.8 EPA200.9	Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS) Digestion, Graphite Furnace, Atomic Absorption Platform	2 2

TABLE 8-2 Method Description for Wastewater (con't)
(B) Inorganics – Metals

Parameter/Method Name	EPA Method Number	Method Description	Reference
Selenium, Se	EPA 200.8	Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2
	EPA 200.9	Digestion, Graphite Furnace, Atomic Absorption Platform	2
	SM3113B	Digestion, Graphite Furnace, Atomic Absorption Platform	4
Silver, Ag	EPA200.7	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP)	2
	EPA200.8	Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2
Sodium, Na	EPA200.7	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP)	2
Tin, Sn	EPA200.7	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP)	2
Thallium, Tl	EPA200.8	Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2
Vanadium, V	EPA200.7	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP)	2
	EPA200.8	Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2
Zinc, Zn	EPA200.7	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP)	2
	EPA200.8	Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	2
Silica	EPA200.7	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP)	2
Silica Dissolved	SM4500Si D	Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP)	4
Asbestos	EPA 100.2	Transmission Electron Microscopy	9

(C) Microbiology/Microscopy Tests

Parameter/Method Name	EPA Method Number	Method Description	Reference
Total Coliforms By Multiple Tube Fermentation (MTF)	SM9221B	Multiple Tube Fermentation (MTF)	4
Fecal Coliforms By Multiple Tube/EC	SM9221E	MTF (EC Medium)	4
Fecal Streptococci and Enterococci by MTF	SM9230B	Multiple Tube Fermentation (MTF)	4
Heterotrophic Plate Count	SM9215B	Pour Plate Count	4

TABLE 8-2 Method Description for Wastewater (con't)
(D) Organics

Parameter/Method Name	EPA Method Number	Method Description	Reference
Halogenated Volatiles	EPA601	GC/Hall Purge and Trap	12
Halogenated/Aromatic Volatiles	EPA624	GC/MS	12
Aromatic Volatiles	EPA602	GC/PID, Purge and Trap	12
Organochlorine Pesticides	EPA608	GC/ECD	12
Polychlorinated Biphenyl (PCB)	EPA608	GC/ECD	12
Total Petroleum Hydrocarbons (TPH)	EPA418.1	IR	1
Semi-Volatiles Acid and Base/ Neutral Compounds	EPA625	GC/MS	12

(E) Radiochemistry

Parameter/Method Name	EPA Method Number	Method Description	Reference
Gross Alpha	EPA900.0	Proportional Counting	13
Gross Beta	EPA900.0	Proportional Counting	13

TABLE 8-3 Method Description for Hazardous Waste
(A) Inorganics – Wet Chemistry

Parameter/Method Name	EPA Method Number	Method Description	Reference
Chromium VI	EPA7196A	Colorimetric	15
Conductivity	EPA 9050	Conductivity	16
Nitrate	EPA 9056	Nitrate	16
pH	EPA 9040B	pH	16
Phenolics	EPA 9066	Phenols	16
Total Organic Halides	EPA 9020 B	Absorption - Pyrolysis - Titrimetric Method	16

(B) Inorganics – Metals

Parameter/ Method Name	EPA Method Number	Method Description	Reference
Antimony, Sb	EPA6010B EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	15 15/16
Barium, Ba	EPA6010B EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	15 15/16
Berrylium, Be	EPA6010B EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	15 15/16
Cadmium, Cd	EPA6010B EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	15 15/16
Chromium, Cr	EPA6010B EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	15 15/16
Cobalt, Co	EPA6010B EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	15 15/16
Copper, Cu	EPA6010B EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	15 15/16
Lead, Pb	EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	15/16
Mercury, Hg	EPA7471A	Manual Cold Vapor/Solid or Semi Solid (CV)	16
Molybdenum, Mo	EPA6010B EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	15 15/16
Nickel, Ni	EPA6010B EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	15 15/16
Selenium, Se	EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	15/16
Silver, Ag	EPA6010B EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP) EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	15 15/16
Thallium, Tl	EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP)	15/16

(B) Inorganics – Metals (con't)

Parameter/ Method Name	EPA Method Number	Method Description	Reference
Vanadium, V	EPA6010B EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS) EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma Emission Spectroscopy (ICP)	15 15/16
Zinc, Zn	EPA6010B EPA6020	EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS) EPA3005A/3010A Acid Digestion, Inductively Coupled Plasma/Mass Spectrometry (ICPMS)	15 16

TABLE 8-3 Method Description for Hazardous Waste
(C) Organics

Parameter/Method Name	EPA Method Number	Method Description	Reference
Halogenated Volatiles	EPA8260B	Purge & Trap, GC/MS	16
Aromatic Volatiles	EPA8260B	Purge & Trap, GC/MS	16
Organochlorine Pesticides	EPA8081A	EPA3550A Extraction, GC	16
PCBs (Aroclors)	EPA 8082	EPA 3550A Extraction,GC	16
Semi-Volatile Organic Compounds (BNAs)	EPA8270C	EPA3550A Extraction, GC/MS	16
Organophosphorus Pesticides	EPA8141A	EPA3550A Extraction, GC	16
EDB/DBCP	EPA 8011	Microextraction, GC/ECD	16

8.8 FOOTNOTES

1 Method 150.1, 150.2, and 245.2 are available from USEPA, EMSL, Cincinnati, OH 45268. The identical methods were formerly in "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1983.

2 "Methods for the Determination of Metals in Environmental Samples - Supplement I," EPA-600/R-94-111, May 1994. Available at NTIS, PB 94-184942.

3 USEPA "Methods for the Determination of Organic Compounds in Drinking Water," 12/88. Revised 7/91 (502.2, 515.1, 504, 507, 508, 531.1) EPA 600/4-88-039.

3a USEPA "Methods for the Determination of Organic Compounds in Drinking Water - Supplement I". EPA-600/4-90-020, July 1990. (547, 551)

3b USEPA "Methods for the Determination of Organic Compounds in Drinking Water - Supplement II." EPA-600/R-92-129, August 1992. (524.2, 548.1, 549.1)

3c USEPA "Methods for the Determination of Organic Compounds in Drinking Water, Method 525.2, 504.1, and 508.1"

3d USEPA "Methods for the Determination of Organic Compounds in Drinking Water, Supplement III (502.2, 504.1, 505, 507, 508, 524.2, 525.2, 531.1, 551.1), EPA/600/R-95/131, 08/95. For 1,2,3-TCP low level, CA DHS "Determination for 1,2,3-Trichloropropane in Drinking Water by Purge and Trap Gas Chromatography/ Mass Spectroscopy," (524.2), 02/02.

4 Standard Methods for the Examination of Water and Wastewater, 18th Edition, 1992, American Public Health Association, 1015 Fifteenth Street NW, Washington, D.C. 20005.

4a Standard Methods for the Examination of Water and Wastewater, 19th Edition, 1995, American Public Health Association, 1015 Fifteenth Street NW, Washington, D.C. 20005.

8.8 FOOTNOTES (Con't)

5 Available from Books and Open-File Reports Section, U.S. Geological Survey, Federal Center, Box 25425, Denver, CO 80225-0425.

6 "Methods for the Determination of Inorganic Substances in Environmental Samples," EPA-600/R-93-100, August 1993. Available at NTIS, PB94-121811.

7 Technical Bulletin 601 "Standard Method of Test for Nitrate in Drinking Water," July 1994, PN 221890-001, ATI Orion, 529 Main Street, Boston, MA 02129. This method is identical to Orion WeWWG/5880, which is approved for nitrate analysis. ATI Orion republished the method in 1994, and renumbered it as 601, because the 1985 manual "Orion Guide to Water and Wastewater Analysis," which contained WeWWG/5880, is no longer available.

8 Method B-1011, "Waters Test Method for Determination of Nitrite/Nitrate in Water Using Single Column Ion Chromatography," Millipore Corporations, Waters Chromatography Division, 34 Maple Street, Milford, MA 01757.

9 Method 100.1, "Analytical Method for Determination of Asbestos Fibers in Water," EPA-600/4/83-043, EPA, September 1983. Available at NTIS, PB 83-260471.

10 Method 100.2, "Determination of Asbestos Structure Over 10-mm In Length in Drinking Water," EPA-600/R-94-134, June 1994. Available at NTIS, PB 94-201902.

11 Industrial Method No. 129-71W, "Fluoride in Water and Wastewater," December 1972, and Method No. 380-75WE, "Fluoride in Water and Wastewater," February 1976, Technician Industrial Systems, Tarrytown, NY 10591.

12 40 CFR Parts 100, 136 to 141. July 1, 1995

13 "Prescribed Procedures for Measurement of Radioactivity in Drinking Water", EPA-600/4-80-032 (1980), US EPA, August 1980.

14 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846, 2nd edition, revised April 1985 and 3rd edition, September 1986.

15 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846, Update I.

16 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846, Update II.

17 Methods for the Determination of Nonconventional Pesticides in Municipal and Industrial Wastewater – Volume 1 – EPA 821/R-93-010A. August 1993. Revision 1. Method 614. The Determination of Organophosphorus Pesticides in Municipal and Industrial Wastewater.

18 Method 300.1 Determination of Inorganic Anions in Drinking Water by Ion Chromatography, Revision 1.0 1997 (Stand Alone Method)

19 Federal Register, 12/1/99, USEPA 40 CFR Parts 141 & 143 National Primary & Secondary Drinking Water Regulations: Analytical Methods for Chemical & Microbiological Contaminants & Revisions to Laboratory Certification Requirements; Final Rule

20 Method 515.3 Determination of Chlorinated Acids in Drinking Water by Liquid – Liquid Extraction, Derivatization and Gas Chromatography with electron capture detection. Revision 1.0, 07/96 (Stand Alone Method)

21 Method 515.4 Determination of Chlorinated Acids in Drinking Water by Liquid-liquid Microextraction, Derivatization, And Fast Gas Chromatography with Electron Capture Detection, Revision 1.0, April, 2000, EPA 815-R-00-014

22 Method 531.2 Measurement of n-Methyl Carbamoyloximes and n-Methylcarbamates in Water by Direct Aqueous Injection – HPLC with Postcolumn Derivitization, Revision 1.0, September, 2001, EPA 815-B-01-002

TABLE 8-4 Reagent and Standard Storage

Chemical	Method of Storage
Nitric Acid	Stored in original containers in cabinet designed for acid storage.
Hydrochloric Acid	See Above
Sulfuric Acid	See Above
Flammable Solvents	Stored in original containers in flammable storage cabinets.
Oxidizers	Stored separately from flammable in cabinet designed for oxidizers.
Ethyl Ether.	Stored in original containers in flammable storage cabinets. New lots are tested for peroxides. Each bottle is tested before and after peroxide removal with an activated
Stock Standard Solutions.	Stored in freezer at $0^{o}C$ in unbroken ampules
Working Standard Solutions	Stored in refrigerator at $4^{o}C$ labeled with prep information and expiration date.
Reagent Chemicals	Stored in cabinets in air conditioned laboratory areas
.Hazardous Chemicals	Any chemical which is a health toxin and a known carcinogen, is stored in a secured area with restricted access

TABLE 8-5 Glassware Washing Procedures

Cleaning Procedures:

A. Miscellaneous glassware:

1. Wash all glassware with hot tap water and a brush using Extran detergent. Any glassware that can be placed in the automatic dishwasher safely will be washed in the dishwasher using approximately 10 milliliters of Extran detergent per load.
2. Rinse thoroughly with hot tap water.
3. Rinse thoroughly with deionized water.
4. Wrap glassware with foil coverings.
5. Invert and air dry in contaminant free environment.

B. Extractable Organics:

1. Step 1,2 and 3 above under miscellaneous.
2. Cover all openings with double layers of foil wrapped tightly.
3. Bake at 800°F for one hour.Remove from oven when completely cool and distribute to laboratories maintaining the foil coverings.

C. Herbicides Extractable Organics:

1. Step 1,2, and 3 above under miscellaneous.
2. Dip glassware in dilute solution of HCl .
3. Remove from acid and rinse thoroughly with deionized water.
4. Invert and air dry in contaminant free environment.
5. Bake at 800°F for one hour.
6. Remove from oven when completely cool and distribute to laboratories maintaining the foil coverings.

D. Metals Glassware:

1. Step 1,2, and 3 above under miscellaneous.
2. Place glassware in a dilute solution of HNO_3 and soak overnight.
3. Remove from acid and rinse thoroughly with deionized water.
4. Invert and air dry in contaminant free environment.

E. Bacteriological Glassware:

1. Step 1,2, and 3 above under miscellaneous.
2. Cover all openings with double layers of foil wrapped tightly.
3. Place sterility indicator tape on each piece of glassware or autoclavable plasticware.
4. Place into the autoclave and sterilize at 121°C for 15 minutes.
5. Remove from autoclave when cool and place in laboratory without disturbing the foil covering.

F. Asbestos Glassware:

1. Immerse all glasswares in deionized water until all glasswares are fully covered in the sonicator.
2. Put approximately 30 grams of alconox in the water
3. Turn on sonicator for 10 minutes.
4. After sonication, rinse three times with deionized water.
5. Place glasswares in clean tub and cover with foil.

9.0 CALIBRATION PROCEDURES AND FREQUENCY

The production of analytical data of known, defensible and documented quality, requires adherence to standardized procedures, which cover all aspects of laboratory operation. The following sections provide details of the standardized procedures relating to instrumentation calibration.

9.1 INSTRUMENT CALIBRATION

Prior to use, every instrument must be calibrated according to a specified procedure found in the method-specific SOP. Table 3-2 of Section 3.0 lists all major laboratory equipment. Table 9-1, lists the minimum calibration frequency of use and the acceptance criteria for the various calibration techniques, on a method by method basis. Table 9-2, also summarizes the calibration procedures that are used on an instrument basis. Table 9-5, lists the ion abundance criteria, which must be met during calibration, for mass spectroscopy methods. Calibration frequency and criteria included in the tables are only for representative reference methods. Calibration procedures for other methods can be found in relevant SOPs.

Each instrument, and support equipment including reference standards of measurements such as Class S weights or equivalent weights, and traceable thermometers are marked and identified to indicate its calibration status such as “Calibration not needed”, “Calibrate before use”, “Calibration due date”.

9.2 REAGENTS AND CALIBRATION STANDARDS

Purchasing Services, Supplies and Standard Measurement of Traceability (NELAC 5.4.6).

Documentation procedures for the purchase, receipt and storage of reagents and standards used for the technical operations of the laboratory must be followed by all personnel. All chemicals used by MWH Laboratories are ACS Reagent Grade, or better. Wherever possible, standards are from sources that are traceable to the National Institute for Standards and Technology. The laboratory ensures the use of reagents of same or better purity than that specified in the method. Thus, the analyst checks the label of the container to verify that the purity of the reagents meets the requirements of the particular method. A logbook is maintained for all standards. Each log contains the date of fresh stock preparation, the manufacturers lot number and supplier, the preparer's initials, the weight of material and the final volume used to prepare the stock.

Documented procedures shall exist for the purchase, reception and storage of consumable materials used for the technical operations of the laboratory as per NELAC 5.5.6.4:

a) The laboratory shall retain records for all standards, reagents, reference materials and media including the manufacturer/vendor, the manufacturer’s Certificate of Analysis or purity (if supplied), the date of receipt, recommended storage

conditions, and an expiration date after which the material shall not be used unless it is verified by the laboratory. [NELAC 5.5.6.4a)]

b) Original containers (such as provided by the manufacturer or vendor) shall be verified and labeled with an expiration date. [NELAC 5.5.6.4b)]

c) Records shall be maintained on standard and reference material preparation. These records shall indicate traceability to purchased stocks or neat compounds, reference to the method of preparation, date of preparation, expiration date and preparer's initials.

d) Where traceability to National Standards is not applicable, the laboratory shall provide satisfactory evidence of correlation of results, example participation in proficiency testing or independent analysis. [NELAC 5.5.6.2.2]

e) All containers of prepared standards and reference materials must bear a unique identifier and expiration date, and be linked to documentation requirements in 9.2.c above. (NELAC 5.5.6.4.d)

f) Procedures shall be in place to ensure prepared reagents meet the requirements of the test method. If the method does not specify, at a minimum, the laboratory uses analytical "Reagent Grade" or better quality for all reagents [NELAC 5.5.6.4.e)]

g) All containers of prepared reagents must bear a preparation date. An expiration date shall be defined on the container or documented elsewhere as indicated in the laboratory's quality manual or SOP. [NELAC 5.5.6.4.f), 5.5.9.2 a) 6) and D.1.4 b)]

Table 9-3, lists the length of time that stock solutions, working standards, and calibration standards may be used. Table 9-4, lists the sources of standard materials used by MWH Laboratories.

See also sec 11.1.6 for details on calibration standard.

9.3 CALIBRATION POLICY

9.3.1. Applicability

The creation of this or any other policy is designed to be a guideline to ensure that all data are treated alike, and thus ensuring that data generated on any particular day of analysis are representative of the norm. The policies are not intended to be absolute criteria for the acceptance or rejection of any analytical data.

There is no substitute for the inherent familiarity that each analyst has with his or her specific analysis, and consequently their assessment of the data must be considered in cases where the acceptance criteria outlined in policy or SOPs cannot be achieved. Data generated in situations where one or more of the requirements outlined in this or any

other policy can not be met will be reviewed on a case-by-case basis by QA staff and the appropriate supervisor for acceptance provided that a detailed Quality Investigation Report (QIR) has been completed and included in the data package to justify any deviation from policy or SOP protocols. Example of a QIR is shown in Figure 11-1 page 35 of section 11.

9.3.2 Linearity

All calibrations should be linear unless otherwise defined in the specific SOP. Linearity here is defined as a calibration curve that meets the back-calculation criteria presented below, unless the SOP contains different criteria. Specific protocols outlined in a given SOP will always take precedence over generic policies outlined in this QA Manual.

If the method does not specify the acceptance criteria for the linear curve, the laboratory will establish a policy for acceptance criteria of 0.995. The calibration curve is verified using any one of the following:

a) An initial calibration verification standard (ICV's) is immediately run after the curve. The standard is preferably obtained from a 2nd source or different lot if lot can be demonstrated from the manufacturer as prepared independently from other lots [NELAC 5.5.5.2.2.1d)]. Concentration that lie in the middle of the curve should have an acceptable recovery of ± 10% of the true value.

b) The linear curve will be acceptable if the curve meets the back-calculation criteria, i.e. back calculating the initial calibration standards against the developed model, with an acceptance criteria of ± 10 % recovery of the true value.

9.3.3 Selection of Quantitation Technique (Organics)

For organic analysis, a decision must be made during the validation process (and detailed in the SOP) as to whether an internal or external quantitation technique will be routinely employed.

The internal standard method of quantitation **cannot** be employed unless all of the following conditions are met:

a) The internal standard must be added post-extraction. For NDMA and Method 525.2, it is added pre-extraction.

b) The internal standard must be added quantitatively.

c) Any analyte that is a target analyte using the method of interest may not be selected for use as the internal standard.

d) The concentration of the internal standard(s) must not exceed the calibration range of the method target analytes. In cases where the target analytes are associated with

more than one calibration range (i.e. analytes "1-4" are calibrated from 1 to 10 µg/L, while analyte "5" is calibrated from 10 to 100 µg/L, and analytes "6-10" are calibrated from 2.5 to 25 µg/L), the concentration of the internal standard should be prepared at a level between the highest calibration standard of the highest and lowest absolute calibration range. (e.g. approximately 50 µg/L in the example given).

The use of internal standard quantitation is of greatest benefit in those methods subject to a great deal of injection variability, and thus a great deal of variability in the absolute mass injected onto the column(s) employed. The drawback to this technique for GC methods is that any compound that exhibits a similar retention time as the compound used for the internal standard will be identified as the internal standard, leading to erroneous quantitation. For this reason, the internal standard technique is most useful for GC/MS where deuterated analytes not naturally occurring can be detected and quantified.

9.3.4 Selection of Calibration Method

During the method validation process, a least square regression is initially tried as a calibration method. The responses from each of the calibration standards must then be input into the linear regression equation to determine whether or not the corresponding concentrations meet the acceptance criteria outlined below. If the acceptance criteria cannot be met using a linear regression, then a second order polynomial fit can be used to fit the data, with the same acceptance criteria being applied. In the event that neither a simple linear regression nor a second order polynomial fit result in an equation which meets the calibration acceptance criteria, then the calibration range must be broken down into two or more smaller ranges. Each of the subsequent ranges must individually meet all of the requirements for a single calibration range. If a linear regression works, a single response factor may be used if the calibration is linear through the origin and it is consistent with the referenced method.

As part of the validation process, the specific calibration range and calibration algorithm must be determined and documented in the SOP. Once determined in this manner, the same protocols must be followed each time the method is employed. This will ensure that data reduction is not performed differently on separate data sets or by different analysts.

9.3.5 Minimum Number of Calibration Levels

The calibration must include a minimum of three initial calibration standards plus a blank unless specified otherwise in the SOP. Polynomial fits must include at least 5 standards. Minimum requirement for NELAP Lab as per NELAC Standard 5.5.5.2.2.1i) is: a minimum of two (2) standards (one of which is lowest quantitation limits, not including a blank or zero standard), if the reference method does not specify the minimum number of initial calibration standards

9.3.6 Selection of Calibration Levels

To avoid weighting a calibration curve to create a better fit than is warranted, three standards must be included per order of magnitude of concentration of the calibration curve. For example 0.1, 0.5, 1.0, 5.0, 10.0 has 3 standards per order of magnitude (0.1, 0.5 and 1.0, and 1.0, 5.0 and 10.0).

The lowest calibration standard shall be the lowest concentration for which quantitative data are to be reported (see NELAC Appendix C). Any data reported below the lower limit of quantitation is considered to have an increased quantitative uncertainty and is reported using either "J" flags or explained in the case narrative [NELAC 5.5.5.2.2.1.f)].

The highest calibration standard shall be the highest concentration for which quantitative data are to be reported (see NELAC Appendix C). Any data reported above the highest standard is considered to have an increased quantitative uncertainty and is reported using "E" flags or explained in the case narrative [NELAC 5.5.5.2.2.1.g)].

Measured concentrations outside the working range are reported as having less certainty and are reported using "E" flags or explained in the case narrative. The lowest calibration standard must be above the limit of detection, usually at MRL level except for ICP that allows zero point and single point calibration. [NELAC 5.5.5.2.2.1.h)].

A good approach to select calibration levels when the calibration range is expected to span at least one order of magnitude is to set the levels at 1MRL, 5MRL, and 10 MRL for a simple 3 point calibration. If more points are desired, then they would follow the same scheme, i.e. 50 MRL, 100 MRL.

9.3.7 Calibration Analytical Sequence

The calibration must progress from the analysis of the lowest to highest standard unless the instrumentation does not permit it. A blank must be analyzed after the highest calibration standard.

If the analysis requires an initial high standard to set the gain a blank must be run before starting with the low calibration standard unless the instrumentation does not permit it.

9.3.8 Calibration Acceptance Criteria

For linear curves, in general, the calculated value for standards (using the calibration curve or response factor) must be within 10% of the nominal value for mid-level standards. However, the value determined by the calibration curve for the lowest standard (conc. is at the MRL) must be within $\pm$50% of the true value or $\pm$ 25% of the true value if the lowest standard is >5X & <10X MRL. Mid level standards (conc. > 10X MRL) should be within $\pm$10% of the true value. Relevant SOPs should be reviewed for the method and laboratory calibration verification specific criteria.

9.3.9 Continuing Calibration

Continuing calibration (CC) is run as required by the method. Refer to specific SOPs to determine the frequency of continuing calibration verifications.

The continuing calibration standard must be near the mid-point of the calibration curve.

The calculated value for the continuing calibration standard must be within control limits stated in the specific SOP.

Calibration shall be verified for each batch for each compound, element, or other discrete chemical species, except for multi-component analytes such as Aroclors, Chlordane, or Toxaphene where a representative chemical related substance or mixture can be used.

Instrument calibration verification must be performed:

a. at the beginning and end of each analytical batch (except, if an internal standard is used, only one verification needs to be performed at the beginning of the analytical batch).
b. Whenever it is expected that the analytical system may be out of calibration or might not meet the verification acceptance criteria.
c. If the time period for calibration or the most previous calibration has expired: or
d. For analytical systems that contain a calibration verification requirement.

If the method does not specify, criteria for the acceptance of a continuing instrument calibration verification must be established, e.g., relative percent difference. If the continuing instrument calibration verification results obtained are outside established acceptance criteria, corrective actions must be performed. If routine corrective action procedures fail to produce a second consecutive (immediate) calibration verification within acceptance criteria, then either the laboratory has to demonstrate acceptable performance after corrective action with two consecutive calibration verifications, or a new initial instrument calibration must be performed. If the laboratory has not verified calibration, sample analyses may not occur until the analytical system is calibrated or calibration verified. If samples are analyzed using a system on which the calibration has not yet been verified the results shall be flagged. If these criteria are not met, a second continuing calibration standard must be run (either freshly prepared or a second injection, as appropriate). No individual analyte can fail the CC criteria two consecutive times. If the criteria are still not met, a new initial calibration must be run and the new calibration curve verified. The laboratory qualifies the data with “V” flag if the sample data is associated with failed calibration verification.

As per NELAC 5.5.5.10.e, data associated with an unacceptable calibration verification may be fully useable under the following special conditions:

a. If there was a high bias and there is a failed continuing calibration verification, the lab reports only data associated with samples that are non-detects.

b. If there was a low bias and there is a failed continuing calibration verification, the lab reports only data associated with samples that have a result greater than the maximum regulatory limit/decision level.

9.3.10 Confirmation

Confirmation is performed to verify the compound identification when positive results are detected on a sample from a location that has not been previously tested by the laboratory. Confirmations are performed on organic tests such as pesticides, herbicides, or acid extractable. GC confirmation is done following method requirements or recommendations. See method SOPs for detailed discussion of the confirmation methods. Confirmation is not required when sample is analyzed by mass spectrometer methods. All confirmation is documented in appropriate log books/work books.

9.3.11 Retention Time Windows

Absolute retention time and relative retention time aid in the identification of components in chromatographic analyses and to evaluate the effectiveness of a column to separate constituents. The laboratory ensures that it meets the method acceptance criteria for retention time windows. If the method does not specify acceptance criteria for retention time windows, the laboratory gathers a minimum of 30 data points and calculates the acceptance criteria range using 3 times the standard deviation of the average ($\bar{x} \pm 3sd$).

TABLE 9-1 Minimum Calibration Frequency and Acceptance Criteria

Analysis	Method	Calibration Technique	Acceptance Frequency	Criteria
Organohalide Pesticides and PCB products	505	Endrin Breakdown Initial Calibration Cal Verification Std	Daily beginning and end of analysis beginning and end of analysis	< 20% degradation % RSD < 20 80 – 120 %
		LRB	before start of analysis; each time set of samples extracted or reagents changed	< RL
		LFB	Every 20 samples (all samples extracted within a 24-hr period) points	%R = 70 – 130% Require control charts after 30 data
		LFM LFM Duplicate IDC, 7 LFBs QCS	Every 10 samples Every 20 samples Initial set up Quarterly	%R = 65-135 % 20 % RPD RSD ≤ 20 % %R= 70 – 130 %
Volatile Organics Including DIPE, TAME, ETBE Low level 1,2,3-TCP	524.2	BFB Sensitivity	Every 12 hours of operation	Ion abundance criteria (Table 9-5, section 9.0)
		Initial Calibration (7-pt)	Prior to analysis, or when CC fails	<20 % RSD /r>/=0.99
		Continuing Calibration	Every 12 hours of operation and at the end of analytical batch (highly recommended by Method)	RF within 30% of the initial calibration
		Surrogate	added to CCV, every sample & all initial calibration stds.	70-130 % Rec
		MS/MSD	Every 20 samples	upon client request 70-130 % Rec. %R = 65-135% (TCP)
		LCS/LFB	Every 20 samples Every 12 hrs or every 10 samples (TCP)	70-130 % Rec. low %R=60-140%(TCP) high %R=70-130%(TCP)
		LFB Dup (TCP: can be used in place of Lab Duplicate)	Quarterly	RPD </=20%
		Blank	Every 20 samples	<MRL
		QCS (TCP)	1 per set of samples; once a week (TCP)	% RSD < 20 (TCP) %R = 60-140% (TCP)
		Lab Duplicate (TCP)	1 per 20 samples (TCP)	% RPD < 20% (TCP)
Semi- Volatiles Organics	525.2	DFTPP Sensitivity	Every 12 hours of operation	Endrin Breakdown <20% must meet EPA specific criteria for method
		Initial Calibration	Prior to analysis, when CC fails	% RSD< 30

TABLE 9-1 Minimum Calibration Frequency and Acceptance Criteria (con't)

Analysis	Method	Calibration Technique	Acceptance Frequency	Criteria
Semi- Volatiles Organics	525.2 (con't)	Continuing Calibration	Every 12 hours of operation and at the end of analytical batch (highly recommended by Method)	%D ± 30 of true value
		MS	5 % or 1 per sample set Extracted whichever is more frequent	70-130 % Rec
		LCS/ LFB	5 % or 1 per sample set Extracted whichever is more frequent	70-130 % Rec
		Method Blank	1 per sample extraction set	< RL
		Surrogates	added to each sample before extraction	% R =70-130%
		IS	added to each sample before extraction	area count must not decrease by >50 % for continuing calibration
Trihalomethane/ Chloral Hydrate/ Haloacetonitrile	551.1	Initial calibration (Extracted)	Beginning of analysis	≤ 10 % RSD
		Lab Performance Check	Beginning of analysis	Table 7 of the method
		Endrin Breakdown	Beginning of analysis	< 20 %
		Calibration verification (CCV=LFB)	every 10 samples	% R = 80-120 % -90 % analytes & 75-125 % for all analytes
		LRB (Lab Reagent Blank)	1 per extraction Batch	< MRL
		LFB (Lab Fortified Blank)	every10 samples	% R = 80-120 % -90 % analytes & 75-125 % for all analytes
		LFM	every10 samples	80-120 %
		LFM/Duplicate	see sample duplicate	RPD < 20 for 90 % of analytes, RPD < 25 % for all analytes
		Sample Duplicate	10 %	
		Surrogate	All samples	80-120 %
		QCS	Quarterly	same as CCV
		IDC, 7 LFBs	Initial set up new analyst	R = 80-120 %, < 15 % RSD
		Stock solutions Verification; Outside Source.	every new lot	< 20% RPD

TABLE 9-1 Minimum Calibration Frequency and Acceptance Criteria (con't)

Analysis	Method	Calibration Technique	Acceptance Frequency	Criteria
Volatile Organics	624	BFB Sensitivity	Every 12 hours of operation	Ion abundance criteria (Table 9-5, section 9.0)
		Initial Calibration	Prior to analysis, or when CC fails	RF <35 % RSD
		Continuing Calibration (QC Check Std)	Every 12 hours of operation	All analytes' %R must meet % R as specified in Table 5 of Method 624 (See SOP)
		Surrogate	added to CCV, every sample & all initial calibration stds.	70-130 % Rec 80-120 % Rec
		MS/MSD	Every 20 samples	All analytes' %R must meet % R as specified in Table 5 of Method 624
		LCS/LFB	Every 20 samples	All analytes' %R must meet % R as specified in Table 5 of Method 624
Base Neutrals	625	DFTPP Sensitivity	Every 12 hours of operation	Ion abundance criteria (Table 9-5, section 9.0 Page 14)
		Initial Calibration	Prior to analysis, when CC fails	All analytes RF>35% RSD
		Continuing Calibration	Every 12 hours of operation	All analytes w/in $\pm$20% Of the predicted response
		MS/LFM	Every 20 samples	All analytes' %R must meet % R as specified in Table 6 of the method
		LCS/LFB	Every 20 samples	All analytes' %R must meet % R as specified in Table 6 of the method
HAA	6251B	Calibration curve (3-pt)	each batch	r > 0.995
		Method Blank	1 per 20 samples	< ½ MRL
		LCS/ LFB	5 % or 1 per sample set extracted or 20 samples w/in 24-hrs whichever is greater	85-115 % R (high level) 50-150% R (low level)
		MS/LFM	1 per sample set extracted or 20 samples	80-120 % R (high level)
O-Cl Pesticides Herbicides	608/8081A	Continuing Calibration	Every 10 samples	85-115 % of expected (600 series)
		Calibration blank	Every 20 samples	< MRL
		MS/MSD	Every 20 samples	Historical control limits or default to LCS Limits
		LCS/LFB	Every 20 samples	Historical control limits or default to method specifics

TABLE 9-1 Minimum Calibration Frequency and Acceptance Criteria (con't)

Analysis	Method	Calibration Technique	Acceptance Frequency	Criteria
ICP Metals	6010/200.7	Calibration curve (2-pt)	Each batch	
		Calibration blank	Every 10 samples	< MRL
		MS/MSD	Every 20 samples	70-130%
		LCS/LFB	Every 20 samples	85-115%
ICPMS Metals	200.8	Tuning Solution	At the start of QC program or after major maintenance or every 2 weeks	Good Performance: 0.75 amu peak width at 5% peak height Mass calibration: <0.1 amu from unit Mass Instrument stability: 5x run; <5% RSD
		Quality Control Sample(QCS)	Immediately after calibration, also 1 with every set of spls.	90 –100%
		Initial Calibration Verification	Every batch analyzed daily	90–110% Rec
		Calibration blank	Each batch	< MRL
		Linearity Check 5x CCV/upper limit of Calibration Range	Prior to sample sequence	90-110% Rec
		Replicate Integration	3 replicates	=/<20% RSD
		Continuing Calibration Verification (CCV)	Every 10 samples	90-110 % Rec
		Method Report Limit (MRL), Check/CRDL	Beginning of analysis and end of the sample run	50-150% or 75-125 % (see sec. 9.3.8)
		Laboratory Fortified Matrix (LFM)	Every 10 samples	70-130% Rec
		Laboratory Fortified Matrix (LFM Duplicate	Every 20 samples	20% RPD
		LCS/LFB	Immediately after calibration, one per batch of 20	85-115% Rec
		Internal Standards(IS)	Spike each sample, standard and blank	60-125% of the response in the calibration blank
		Method Blank	1- per batch of 20-samples	<1/2 MRL or <1/2 CRDL
		Instrument Blank	Prior to Calibration	<MRL
		MCL Check	One per batch	70-130% Rec

TABLE 9-1 Minimum Calibration Frequency and Acceptance Criteria (con't)

Analysis	Method	Calibration Technique	Acceptance Frequency	Criteria
Cr VI (Dissolved)	218.6	Initial Calibration	Daily	$r^2 > 0.999$
		IPC(CCV)	1-per 10 samples	95-105 % Rec
		LRB (Lab Reagent Blank)	1-per 10 samples	< RL
		LFB/QCS	1-per 10 samples	90-110% Rec (external source)
		LFM	1-per 10 samples	90-110% Rec
		LFMD	1-per 20 samples	90-110% Rec (RPD <10%)
		QCS	Quarterly (see LFB)	90-110%
		LDR	Start of program	minimum 7 stds
GFAA, (As, Se)	200.9	Initial Calibration	Each Batch	$r^2 > 0.995$
		Instrument Stability	Run 5X after warm up & before calibration	% RSD < 5%
		Calibration blank	Run immediately following each batch	< MRL
		Initial Calibration Verification(ICV/IPC)	Run immediately following calibration	95-105 % Rec
		Continuing Calibration Verification (IPC)	One every 10 samples and At the end of the sample run	90-110 % Rec
		Method Report Limit (MRL) Check	beginning of the run	50-150% Rec.
		LCS/ LFB	1-per 20 samples extracted or 20 samples w/in	85-115%R(Digested)
		MS/LFM	1-per 10 samples	80-120% Rec
		MSD/LFMD	1-per 20 samples	80-120% Rec
		Duplicate	Each sample	< 20 % RSD
		Continuing Calibration blank	1-per 10 samples and at the end of the run	< MRL
		Analytical Spike (SA, Analyte addition	Run when MS/MSD or LFM/LFMD failed 80-120%	85-115% Rec.
		Method of Standard Addition, 3-point curve	Run MSA when SA failed the 85-115% Recovery	$r \geq 0.995$

TABLE 9-1 Minimum Calibration Frequency and Acceptance Criteria (con't)

Automated Wet Chemistry:

Analysis	Method	Calibration Technique	Acceptance Frequency	Criteria
Cyanide Fluoride Nitrate Nitrite Phenolics	335.4,335.2/9010 340.2,SM4500F C 353.2,300.0 353.2,300.0 420.1/420.2	Calibration curve (7-11 pt)	Each batch	r > 0.995 (correlation coefficient)
		Calibration blank	1-per 10 samples	< MRL
		MS/MSD	Every 20 samples	Method Limits: Fl, Phenol; 80-120% Cn, NO_3; 90-110%
		LCS/LFB	Every 20 samples	Method Limits: Fl, Phenol; 90-110% Cn, NO_3; 90-110%
Residual Chlorine	SM 4500 Cl-G	LCS/LFB	Every 20 samples	85-115%Rec
		MS/LFM	Not Required	20 % RPD
		Duplicate	Every 20 samples	20 % RPD
Anions by IC	300.0/300.1	Calibration curve (7-11-pt)	Each batch	r > 0.995 correlation
		Calibration blank	1-per 10 samples	< MRL
		Method Blank	1- per batch of 20-samples	<MRL
		MS/MSD	Every 20 samples	80-120 %
		LCS/LFB	Every 20 samples	90-110 %
Tot. Dis.solved Solid	160.1/SM2540C	Method Blanlk	Each time used	<MRL
Tot. Suspended Solids	160.2/SM2540D	Method Blanlk	Every 10 samples	<MRL
Total Solids	160.3	Method Blanlk	Every 10 samples	<MRL
Tot Volatile Solids	160.4	LCS	Every 10-samples	+ 15 % of the expected value
Settleable Solids	160.5	LCS	Every 10-samples	+ 15 % of the expected value
pH	150.1/SM4500H^+B	3 buffers	Each time used	+0.1 pH unit of true value
Conductivity	120.1/SM 2510B	1 check solution	Each time used	+1 % of true value

TABLE 9-1 Minimum Calibration Frequency and Acceptance Criteria (con't)

Analysis	Method	Calibration Technique	Acceptance Frequency	Criteria
TOC	SM 5310C	Calibration curve (6-pt)	Each batch	r > 0.995 correlation
		Blanks	Each batch	< MRL
		MS/MSD	Every 20 samples/batch	90-110%
		LCS/LFB/CCV	Every 10 samples	90-110 %
		LCS1/MRL Check	Every batch	50-150%
		Lab Duplicate	All samples	<10 % RPD (TOC > 2.0 mg/L) <20 % RPD (TOC < 2.0 mg/L)
UV 254	SM 5910B	Calibration curve (4-pt) Verification	Prior to analysis of samples	90-110 %
		Blank/UV absorbance @ 254 nm	One per analysis/ batch	< ½ MRL
		LCS/LFB UV absorbance @ 254	Every 10 samples	85-115 %
		MS/LFM	Not Required	
		Lab Duplicate	All samples analyzed in duplicate	≤20 % RPD (UV 254 < 0.045 cm –1) ≤10 % RPD (UV 254 > 0.045 cm –1)

NOTE: 1) Any deviations from the listed methods are specified in the SOP.
2) Concentrations for all continuing calibrations are in the middle of the linear range.
3) For all other methods not listed in the QA Manual, see calibration frequency and acceptacne criteria at individual SOPs.

TABLE 9-2 Calibration Procedures

Instruments	Minimum # of Calibration Standards	Calibration Method
TOX	3 points standard (for precision only)	Titration
Anions, Nutrients (Ion Chromatography)		
Nitrate, NO_3 Nitrite, NO_2 Chloride, Cl_2 Sulfate, SO_4	11-points 11-points 7 - points 10-points	Quadratic Quadratic Quadratic Quadratic
Phenol, Cyanide	5 point	Linear Regression
Fluoride	3 point minimum	Linear Regression (log)
pH	3 point, 2 point	Slope
Radiation	Single point	Efficiency Curve
Microbiology	2 point	Positive/Negative Controls
Residual Chlorine (DPD Colorimetric)	Single Point	85-115 % of True Value
TOC (TOC Analyzer)	6 Point	Linear Regression
UV 254 (Spectronic 601) Spectrophotometer	3 Point	Efficiency Curve
524.2 (GCMS)	5-6 Points	Linear Regression
HAA (GC)	3 Point	Linear Regression

TABLE 9-3 Standard Storage and Holding Periods for Stock and Working Standard Solutions

Analyte	Stock Standard	Source Storage	Working Standard	Storage	Calibration Standard
Flame Metals	Expiration date	RT	6 months	RT	1-month
Furnace Metals	Expiration date	RT	6 months	RT	Daily
ICAP Metals	Expiration date	RT	6 months	RT	1-month
Volatile Gases	Expiration date	FZ	Weekly	FZ	Weekly
Volatile 524.2	Expiration date	FZ	Monthly	FZ	Monthly Weekly (gases)
BNA Compounds	3 months if opened,	FZ	Monthly if opened,	FZ	3 months
	Expiration date If sealed	FZ	6 months If sealed	FZ	
Pesticides/PCBs					
505	Expiration date	FZ	2 months	RF	2 months
608	Expiration date	FZ	6 months	RF	6 months
525.2	Expiration date	FZ	6 months	RF	
Anions					
300.0/300.1	6 Months	RF	Daily	RT	Daily
Nutrients	Semi-annually	RT	Monthly	RT	Daily
Phenol, Cyanide	Semi-annually	RT	Monthly	RT	Weekly
TOX	Yearly	RT	Monthly	RT	Daily
TOC	Yearly	RF	6 Months	RF	Daily
NO_2/Nitrate	1 Month	RF	Daily	RT	Daily
Chlorine	Yearly	RF	Daily	RT	Daily
UV 254	Yearly	RF	Monthly	RF	Daily
HAA's	2 months	FZ	2-Months	FZ	Daily

* Bimonthly - every two months
* Biweekly - every two weeks

RT - Room Temperature
RF - Refrigerated at 4°C
FZ - Frozen at 0°C

TABLE 9-4 Sources of Standard Materials

Analysis	Vendor Source
Flame Metals	EM Science & CPI & JT-Baker
Furnace Metals	Environmental Express
ICAP Metals	JT-Baker
Volatile Gases	Ultra Scientific, EM Science Ampules
Volatiles	Ultra Scientific, EM Science Ampules
BNA Compounds	Ultra Scientific, Accu Standard, Absolute Standard
Pesticides/PCBs	Accu-Standards
Anions	EM Science/Baker, Fisher
Nutrients	EM Science/Baker
Phenol, Cyanide	EM Science/Baker
TOX,TOC	CPI

TABLE 9-5 Ion Abundance Criteria

BROMOFLUOROBENZENE (BFB)

Mass	Ion Abundance Criteria
50	15 - 40% of mass 95
75	30 - 60% of mass 95 (624) ; 30-80 % mass 95 (524.2)
95	Base peak, 100% relative abundance
96	5 - 9% of mass 95
173	Less than 2% of mass 174
174	Greater than 50% of mass 95
175	5 - 9 % of mass 174
176	Greater than 95%, and less than 101% of mass 174
177	5 - 9% of mass 176

DECAFLUOROTRIPHOSPHINE (DFTPP)

Mass	Ion Abundance Criteria
51	30-60% of mass 198
68	Less than 2% of mass 69
70	Less than 2% of mass 69
127	40 - 60% of mass 198
197	Less than 1% of mass 198
198	Base Peak, 100% relative abundance
199	5 - 9% of mass 198
275	10 - 30% of mass 198
365	Greater than 1% of mass 198
441	Present, but less than mass 443
442	Greater than 40% of mass 198
443	17 - 23% of mass 442

10.0 PREVENTATIVE MAINTENANCE

10.1 ROUTINE MAINTENANCE ACTIVITIES

MWH Laboratories carries maintenance contracts on all major laboratory equipment, under which much of the preventative maintenance is performed. Routine servicing, such as cleaning of rods, source, or detectors, is performed on a regular basis by the analyst. This type of service is performed according to the procedures and at the frequency specified by the manufacturer. Routine maintenance is done when instrument performance starts to degrade as demonstrated by a failure to meet one or more QC criteria, decreased ion sensitivity, degrading peak resolution, lowered response factors, or shifts in calibration curves. Activities that are performed on a routine basis can be found in Table 10.1.

10.2 DOCUMENTATION

Instrument maintenance logbooks are maintained for most major instruments. All repairs and any routine or non-routine maintenance activities are recorded in the logbooks. The date of the activity, the person performing it, and the nature of the activity are recorded. Expendable items for all major instruments are kept on hand to minimize downtime.

The following are documented in the instrument logbooks:

1. name of the item of the equipment
2. manufacturer's name, type identification and serial number or other unique identification
3. date received and date placed in service
4. current location, where appropriate
5. condition when received (e.g. new, used, reconditioned)
6. copy of manufacturer's instructions where available
7. dates and results of calibrations and/or verifications and date of the next calibration and/or verification
8. details of maintenance plan carried out to date and planned for the future
9. history of any damage, malfunction, modification or repair
10. records of service calls
11. Calibration status for instrument that are calibrated outside the direct control of the laboratory are checked before use (after instrument is returned from outside repair) [NELAC 5.5.5.9]

10.3 CONTINGENCY PLANS

An effort is made to have a functionally equivalent backup instrument available in case of a catastrophic instrument failure. Maintenance contracts are carried on the major instruments and provide for 24-48 hour response for repairs. If necessary, MWH Laboratories has a list of qualified laboratories to subcontract work to, upon client approval.

In the event a holding time expires while the sample is in the custody of MWH Laboratories, a project manager will call the client to inform them of this situation Based

on subsequent arrangements made between the lab and the client, fees for re-sampling and subsequent analysis may be incurred by the lab.

TABLE 10.1

PREVENTATIVE MAINTENANCE REQUIREMENTS

Instrument	Items Checked or Serviced	Frequency
Analytical Balance	Verify accuracy,	Before each use
	Clean pans, compartment	After each use
	Electronics, gear trains,	Annual Service,
	Internal weights	Annual Calibration
Atomic Absorption Spectrophotometers, Flame, FLAA	Lamp alignment	Before each use
	Burner head alignment	Daily
	Check gases	Daily
	Check aspiration tubing	Daily
	Drain reservoir	As needed
	Clean optics	Every 6 months
	Clean nebulizer	As needed
Atomic Absorption Spectrophotometers, Furnace, GFAA	Lamp alignment	Before each use
	Clean furnace windows	Daily
	Check gases	Daily
	Check plumbing connections	Daily
	Clean optics	Every 6 months
	Change graphite tube	As needed
Autoclave	Pressure check	Annually
	Temperature device calibration	Annually
Chemistry Analyzers Titrators (automated) (RFA)	Change pump tubes	Every 1-5 runs
	Clean system with Chemwash	Every 1-5 runs
	Clean optic filters	Each time used
	Change dialyzer membranes	Each time used
	Replace poly transmission tubing	4-6 months
Autosamplers, GC & GC/MS	Clean/replace syringe	Weekly, or as needed
Conductivity Probe	Clean probe w/dil. acid	As needed -as indicated
	Keep probe in water	by change in cell constant
Dessicators	Replace dessicant	As indicated by Color change
Dissolved Oxygen Meter	Change probe filling solution and membrane	Quarterly or as needed
Gas Chromatographs (6251B-HAA)	Change septum	As needed
	Check carrier gases	As needed
	Replenish Hall Detector solvents	As needed
	Clean photo-ionization detector	As needed
	Change carrier gas	As needed (P<400psi)
	Remove first foot of capillary column	As needed

TABLE 10.1 (con't)
PREVENTATIVE MAINTENANCE REQUIREMENTS

Instrument	Items Checked or Serviced	Frequency
Gas Chromatographs (con't) (6251B-HAA)	Backup data disks	As needed
	Change in-line filters	As needed
	Replace packed columns	As needed
	Clean ECD	As needed
	Clean N-P detector	As needed
Gas Chromatography/Mass Spectrometers	Change septum	As needed
	Check carrier gases	Daily
	Change carrier gas	As needed (P<50psi)
	Remove first foot of capillary column	As needed
	Change in-line filters Change first 1/4 inch of column	6 months
	Packing and glass wool	Quarterly/as needed
Glass microliter syringes	Certificate of Analysis or accuracy Demonstrated	Initially (prior to use) of each batch
INCOS 50s	Filter (fan), Mechanical oil, Turbo oil	6 months
	Source and analyzer	As needed
Mechanical Volumetric Dispensing devices (i.e. Burettes) Model 4000s	Verify accuracy	Quarterly
	QEM filter, 2010 Interface box	6 months
	Vacuum chaff filter	6 months
	Clean source	Quarterly, As needed
	Clean rods	Quarterly, As needed
	DP oil	6 months
	Mechanical oil	6 months
High Pressure Liquid Chromatograph, HPLC	Filter and degas solvent	Prior to use
	Check DAD	Prior to use
	Filter samples	Prior to use
	Check autoinject and post	Prior to use
	Column purge gases	Daily each use
	Backup data disks	As needed
Incubators (Microbiology)	Check temperature	Start and End of cycle. Twice daily, at least 4 hours apart, on each day of use
Inductively Coupled Plasma Spectrophotometer	Clean nebulizer	Daily
	Replace peristaltic pump tubes	Monthly
	Empty rinse waste container	As needed
	Remove, clean torch assembly	Monthly
Ion Chromatograph (300.0/300.1)	Check plumbing	Daily
	Change guard column	bi-Monthly
	Clean conductivity cell w/dil. HCl	semi-annually

TABLE 10.1 (con't)
PREVENTATIVE MAINTENANCE REQUIREMENTS

Instrument	Items Checked or Serviced	Frequency
Ovens	Check temperature	Daily
Ovens for Sterilization	Check sterilization effectiveness	Monthly
pH Meters	Check pH probe response with 3 buffers	Daily/Each use
Refrigerators	Check temperature	Daily
Spectrophotometer	Clean cells	Daily
Spectronic 601(UV 254)	change Lamp	As needed
TOC Analyzer	Add potassium phthalate to reactor, cell and reservoir	Daily
	Check O_2 pressure	Daily
	Add new tin to tin trap	As needed (~monthly)
	Change O_2 tank	As needed (~2-months)
	Change pump tubing, Drain waste	As needed
	Replace filters	As needed (~monthly)
	Clean detection cell	As needed
	Add printer paper, Replace printer markers	As needed (~ 3 months)
	Check the tin and copper granules in the	3 months, replace as
	chloride trap for discoloration or clumping	needed
	Check for back pressure problem, Water level in the u-tube, Check Chloride scrubber for clumping Check permeation dryer tube	3 months
	Check for low pressure, water level in the u-tube. If water level is higher than the mark, check for displaced septa in reaction vessel and the u-tube.	monthly
	Check for Voltage on the rechargeable batteries.	Annually, replace if it doesn't meet specification.
TOX Analyzer	Change acetic acid in cell	Before and after each run
	Clean inlet tube	Weekly, or as needed
	Clean outlet tube	Weekly, or as needed
	Electronics check	Bi-monthly
DPD Colorimeter (Residual Chlorine)	Clean test tubes	Before every analysis
	Wipe color disc to be free of residue	Before every analysis
Laboratory ware	Presence of residue	Annual and each time lot of detergents or washing procedures change
Washed laboratory ware	Check at least one piece of labware possible acid or alkaline residue	at least once daily, each day of use

11.0 QUALITY CONTROL CHECKS and ROUTINES TO ASSESS PRECISION, ACCURACY AND METHOD DETECTION LIMITS

11.1 LABORATORY QUALITY CONTROL PARAMETERS

The laboratory has established a quality control program that is designed to provide two different types of information about a particular analysis. The ability to confidently evaluate laboratory performance in terms of analytical bias and precision is accomplished through the use of both laboratory control samples (LCS), in the absence of sample matrix effects, and the traditional approach of using matrix spikes and duplicate (MS/MSD) analyses.

The quality control program implemented at MWH Laboratories recognizes the problems associated with the use of matrix spikes and duplicates, and thus decisions regarding method data quality, when matrix effects are present, are made using data obtained from all control samples. The types and frequencies of control samples used at MWH Laboratories are summarized below. Control limits are calculated from historical data, whenever possible, for each method and matrix. Limits are updated at least once a year and the limits listed in this manual may not reflect what is actually in use at the time of sampling.

11.1.1 Method blanks

A method blank consists of laboratory pure water containing all of the reagents utilized in the analytical procedure. The method blank is prepared in the same manner as a sample and is processed through all of the analytical steps. All reagents are dated upon receipt in the laboratory and each new lot of reagents is checked by performance of method blanks.

Method blanks are performed to determine whether there is reagent contamination or instrument contamination due to sample carryover. The method blanks must remain below the MRL for each analyte of interest. Some analyses have a more stringent requirement (e.g. < ½ MRL). If samples require a preparatory procedure such as a digestion or extraction prior to analysis, a method blank must be carried through the entire process and analyzed in addition to the instrumental calibration blanks.

When a blank is determined to be contaminated, the cause must be investigated and measures taken to minimize or eliminate the problem. Samples associated with a contaminated blank shall be evaluated as to the best corrective action for the samples (e.g. reprocessing or data qualifying codes). In all cases the corrective action must be documented. (NELAC D.1.1.1.d.3.)

Method blanks are analyzed as part of the initial or daily calibration process (calibration blanks) and after every 20 samples for each matrix type to monitor the overall procedural blank as well as the purity of the reagents. If analyte in method blanks is >MRL and is >1/10 of amount measured in sample and if blank

contamination affects samples or individual data, quality, objectives, the problem is eliminated and reprocessed or affected samples appropriately qualified.

11.1.2 Travel blanks

Both methods 504.1 and 524.2 for volatiles determination require a trip blank with each set of samples. The trip blank is required to be analyzed in the event of any detects in the associated field samples

When running method 525.2 for phthalates determination for compliance monitoring purposes, the laboratory runs a trip blank if any of the samples are found positive for phthalates. This is necessary to show that samples were not contaminated from bottle caps, the HCl used for preservation or the latex gloves worn during sampling. If the samples show the presence of phthalates and there was no trip blank with the set of samples then subsequent resamples from the site must be accompanied by a trip blank. If the samples are not to be analyzed for phthalates, the laboratory does not need to run a trip blank.

If a client has submitted a trip blank and wishes it to be analyzed automatically, the sample is logged in with the appropriate tests and with the log-in ID "Trip Blank - Analyze" so that analysts will know to analyze and report them.

If a trip blank is submitted and is only to be analyzed in the event of hits, the sample is logged in with an ID of "Trip Blank-Hold."

For the analysis of ethylene dibromide and dibromochloropropane by Method 504.1 and phthalates by method 525.2, the analyst and supervisor ensure that if hits are detected in the associated samples, the trip blank is analyzed and reported within holding times.

Because of the relatively short holding times for VOAs by Method 524.2, the trip blanks are always analyzed whether or not there are hits in the associated sample. In this way, Trip Blanks are always analyzed within holding times.

If there is adequate holding time remaining the analyst may elect to not analyze the trip blank. However in this case, the data should be reduced immediately and if there are hits, the sample should be analyzed on the next run, still within holding time.

In the event that no hits are present in the associated client samples the analyst and supervisor enter NA for the trip blank and preferably place a comment on the sample "not analyzed, no hits in field samples".

In the event that an analyte is detected in the trip blank, the analyst gets the associated stationary blank from shipping and run that immediately to confirm that the hits are not due to lab contamination when the blank was prepared. The information to

associate the proper trip blank to the sample(s) is be found on the sample bottle label, through the LIMS numbering system, and/or on the COC.

11.1.3 Field blanks

Field blanks are used to identify contamination that may have occurred during the sample collection process. Empty containers are sent to the field and filled with analyte-free water at the sampling location at the time of sampling.

11.1.4 Sample blanks

Sample blanks are used with spectrophotometric methods where sample characteristics such as color may give erroneous results. The absorbance of a sample is measured before and after the color development process. The absorbance before is subtracted from the absorbance after to give the true absorbance. Sample blanks are analyzed on an as-needed basis.

11.1.5 Calibration blanks

For non-chromatographic analysis, calibration blanks are prepared along with the calibration standards and differ from the standards only in that the calibration blank does not contain any of the analyte(s) of interest. The calibration blank, by definition, provides the "zero point" in the calibration curve.

11.1.6 Calibration standards

Stock standards are obtained from the EPA Repository, or suppliers traceable to NIST, for the organic compounds. The metal stock solutions are obtained from NIST traceable sources. Initial calibration verification standards are obtained from a second “Manufacturer or lot” if lot can be demonstrated from the manufacturer as prepared independently from other lots [NELAC 5.5.5.2.2.1d)]. Stock solutions for surrogate parameters and other inorganic compounds are made up by the analysts from the appropriate reagent grade chemical specified in the procedure.

Stock standards are utilized to make working standards of lower concentration, which are then used to make calibration standards for the analytical run. The holding periods of stock standards, working standards, and calibration standards for the different analyses are provided in Table 9-3, of section 9.0.

Stock standards, working standards, and calibration standards are all prepared in accordance with the method procedure. A logbook is maintained for standards preparation providing the initials of the analyst preparing the standard, the date of preparation, the concentration made up, and the lot numbers and suppliers. Since only one set of working standards is prepared at a time, the date of an analytical run can be keyed to the date of the working standards preparation to provide traceability to the particular lots of reagents from which the calibration standards were derived. The policy for evaluation of stock standards is found in Section 9.

Calibration standards are run at the beginning of each day's analysis and a single standard is run at intervals throughout the analysis and at the end of the run to check for instrument drift. This "check" standard can also be used as an additional measure of analytical precision in addition to the LCS. As per NELAC 5.5.5.10.b) beginning and ending check standard must be at varying concentration within the established calibration range. If an internal standard is used, one CCV check must be analyzed per batch.

At the beginning of each day of analysis, all instruments must be calibrated. The calibration standards used must encompass a range of low, mid and high level concentrations to determine the calibration curve. The low level standard must be within the MRL value, the high level standard must be at the high end of the linear range and the mid level standard must be approximately midway between the low and high concentrations. Calibration procedures vary for the different instrumental methods and are summarized on Table 9-1, of section 9.0. Section 9.3 summarizes the lab policy for calibration.

11.1.7 Policy on Verification of Standards

All information relating to standards preparation and verification must be documented in the Standards Preparation notebook for that analysis. All documentation required must be examined by the analyst and signed off by the section supervisor. All documentation for each group must be stored in a central location (i.e. the standards preparation room). For microbiology, performance checks including the organisms used, their culture collection reference, date of issue of specification, or statements assuring that the relevant batch meets the product specifications is verified [NELAC 5.Appendix D.3.6 b)].

11.1.7.1 Mixtures

New standard mix preparations must be compared to the previous mix. The concentrations calculated for the new standard should be within 10% of the "true" value (or as per the specific SOP). If the new standard does not agree within 10%, a third standard must be prepared by a different analyst and compared to the previous two. The third standard should agree with either the "old" standard or the "new" standard. If the third standard agrees with the "old" standard the third standard is used as the "new" standard. If the third standard agrees with the "new" standard the "old" standard is discarded and both the "new" and third standards can be used. In both cases the "new" standard must be verified by comparing to a "known" reference standard before discarding the old standard. Note that for some methods it may not be possible for the new standard to agree within 10% (see the specific SOP).

A table must be prepared in the Standards Notebook for each standard prepared comparing the cumulative percent difference for each compound in that standard. The cumulative percent difference must not exceed 10%. If it does, a new standard must be

prepared. For example, if the difference between the first and second standards was -8% and the difference between the second and third standards was +3%, the cumulative percent difference would be -5%.

A new calibration curve must be prepared analyzing both the new standard and a known reference sample. The calculated value must fall within the acceptance limits for the reference sample.

11.1.7.2 Neat Compounds

The identity and purity of any new bottle of neat material must be verified either by the method it will be used to monitor or, preferably, by a different method.

For Organics, a solution of the new neat material must be compared to the old standard as a check on identity and purity. Acceptance criteria are detailed in the previous Mixtures section. For inorganics the new stock standard must be compared to the old stock standard as a check on concentration.

11.1.8 Internal and Surrogate Standards

Internal standards are run with GC/MS analyses to monitor the efficiency of the analytical procedure for each sample matrix encountered. They are useful in GC analyses to monitor retention time shifts and the efficiency of the auto-sampler injection. Surrogate standards are run with GC/MS and GC analyses to monitor the efficiency of the extraction for each sample matrix encountered. When there are no established criteria for surrogates from the method, the lab determines internal limits through control charts.

Control limits are re-established annually for surrogates based on historical laboratory data from environmental sample matrices. Internal and surrogate standards are added to each sample analyzed by EPA Methods as recommended and run in accordance with the method procedures. For references to specific compounds used for internal and surrogate standards please reference the SOP.

11.1.9 Spikes – Recoveries, RPDs

Spiked sample analyses (MS/MSD) are performed to evaluate the effect of the sample matrix on the analytical methodology. A known amount of the analyte(s) of interest is added to an aliquot of sample, which is then analyzed along with the unspiked sample. Spiked samples are prepared and subjected to the same process as the original sample. Spike recoveries are calculated, and used to determine whether the sample matrix interferes with the method.

Spike recoveries are calculated as follows:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

Where;

%R	=	percent spike recovery
SSR	=	spiked sample result
SR	=	sample result
SA	=	spike amount added.

The Laboratory documents the percent (%) recoveries, RPD for MS/MSD samples [NELAC 5.Appendix D.1.1.3.1d)].

11.1.10 Duplicates, Duplicate Spikes

Duplicate analysis of a sample has traditionally been used to obtain a measure of analytical precision in the form of a relative percent difference (RPD) calculation between the two values. MWH Laboratories routinely will analyze duplicate spiked control samples, MS/MSD to meet specific client's QC requirements such as Arizona.

Since no precision information is obtained when either or both of the duplicates have analyte concentrations below the method detection limit, duplicate analysis of the spiked samples makes the most sense. While still subject to interference problems the advantage of duplicate matrix spikes is clearly the ability to obtain calculated RPD values specific for a particular sample matrix. Clients are encouraged to submit sufficient sample for the analysis of MS/MSD samples by specific request when a RPD value for their particular matrix is desirable.

Ongoing analytical precision is evaluated by tracking the difference between the MS/MSD (or LCS pairs) analyzed with each batch of 20 samples. These differences are compared to control limits established for each analysis from historical monitoring. In the event that the method does not specify the criteria, control charts are reviewed to set laboratory internal/default QC criteria [NELAC 5.Appendix D.1.1.3.1d)].

For those analyses for which MS/MSD or LCS samples are not prepared, sample duplicates are analyzed to monitor performance.

The relative percent difference between duplicates or duplicate spikes is calculated as follows:

$$RPD = \frac{(S-D)}{(S+D)/2} \times 100$$

where;

RPD = Relative Percent Difference
S = First Sample Value (original)
D = Second Sample Value (duplicate)

11.1.11 Laboratory Control Standards

11.1.11.1 Laboratory Control Samples (LCS) (also known as LFBs)

The LCS is used to evaluate the performance of the total analytical system, including all preparation and analysis steps. (NELAC Appendix D.1.1.2.1)

Laboratory control samples (LCSs) are defined as an interference free matrix spiked with a particular set of method-specific target compounds at a level 5-10 times above the method reporting limit. LCS samples are prepared for two general types of matrices, aqueous matrices and non-aqueous matrices. The matrix used to prepare aqueous LCS samples is laboratory reagent water, while standard sand, approved by ASTM for its homogeneity, is used as a matrix for non-aqueous LCS samples.

The purpose of the LCS matrix is not to duplicate the sample matrix, but more importantly to provide a consistent matrix with which baseline performance data for an analysis can be generated. This feature of the LCS provides one of the most significant advantages over the use of matrix spikes and spike duplicates. The variable matrix interferences inherent to matrix spikes and spike duplicates are manifested in the extremely wide control limits presented in the methods. This variability results in a large relative standard deviation in the data used to calculate the control limits which forces the control limits to become wider. The control of this variability significantly reduces the relative standard deviation of the data and results in control limits that are representative of laboratory precision alone.

Laboratory control samples are analyzed throughout a run at a frequency of 5-10% for environmental samples of a similar matrix. Bias information is provided based on recovery data for the LCS and precision information is available by comparing LCS sample results using a RPD calculation. The frequencies are consistent with the requirements of most methods referenced in SW-846, Standard Methods, The EPA Manual for Chemical Analysis of Water and Waste, and the 40 CFR 136 for the wastewater methods.. Additional measures of precision and bias are obtained from other control samples, as specified in the SOP's.

In order to ensure that some measure of analytical control is provided with each batch of samples going through a pre-analysis preparation step, a LCS sample is prepared with each set of 20 samples extracted or digested for these analyses. In each case, a LCS sample will be associated with each set of samples prepared, to allow documentation of control of the analytical procedures.

11.1.11.2 Matrix Spike and Matrix Spike Duplicate Samples (MS/MSD)

MS/MSD samples are defined as a sample matrix spiked with a particular set of method-specific target compounds at a level 5-10 times above the method reporting limit. Samples are generally divided into two types of matrices, aqueous and non-aqueous.

MS/MSD samples are run at a frequency of one pair for every sample batch of 20 or less of a similar matrix. In cases where there is insufficient sample to run a MS/MSD as well as the original, a pair of LCS samples may be substituted to fulfill this requirement. There is often insufficient sample for aqueous samples to have a MS/MSD set up due to the large volumes of sample required for analysis. MWH Laboratories encourages clients who require precision and accuracy information based on a particular matrix to make arrangements to submit adequate sample volumes for this purpose. By supplying these samples, the client is able to obtain not only specific information regarding laboratory performance (from LCS sample data), but also a measure of the applicability of the sample matrix to the analytical method used (from the matrix spike and duplicate data). If the matrix spike is used in place of the LCS, the acceptance criteria must be as stringent as the LCS (NELAC D.1.1.2.1.c.).

11.1.12 Control Sample Protocols

11.1.12.1 LCS and MS/MSD Concentration Levels

The following criteria (in order of descending preference) are to be applied when determining the appropriate concentration of any particular analyte in the designated control sample:

1. If no MCL exists, or the MCL represents an impractical level relative to MDL or calibration range, the selected level should be set at the corresponding level used in the EPA's reference methods.

2. The level selected should be equal to any existing federal maximum contaminant level (MCL). This may not always be practical (as in the case of thallium [Tl]) when the MCL is too close to our actual MRL to yield consistent accuracy and precision.

3. If there is no EPA protocol for a particular method, or this level is inappropriate for the method, then the selected level should be near the midpoint of the calibration range. Optimally, this would be equivalent to the MCL, unless the calibration range spans more than 2 orders of magnitude.

4. If the calibration range spans 2 or more orders of magnitude, the selected level should be set at approximately 10 times the MRL for each analyte.

5. In the case of non-aqueous samples (i.e. those that are liquids that are not organic in nature, and are mono-phasic in composition), if the standard Ottawa sand is found to contain measurable background levels of any target analyte(s), then the selected concentration should be at a concentration no less than 25% higher than that of the background concentration. This criterion is the same as that in the CLP program.

In some cases multiple levels (MRL, midpoint, high) are used to monitor control throughout the calibration range.

11.1.12.2 Selection of Spike Analytes

Any analyte reported must be included in the LCS and MS spiked sample.

The selection of specific analytes to be spiked should be based on the following scheme:

1. If there are regulatory or method specific monitoring requirements for any of the target compounds, these compounds should be included.

2. If there are no regulatory or method specific monitoring requirements or additional analytes required to meet the absolute number to be included in the subset, follow NELAC 5.Appendix D.1.1.2c) requirements for LCS spiking composition and NELAC 5.Appendix D.1.1.3.1c) for MS spiking composition.

   For those test methods that have extremely long lists of analytes, a representative number may be chosen. The analytes selected should be representaive of all analytes reported.The following criteria shall be used for determining the minimum number of analytes to be spiked for LCS and MS.. However, the laboratory shall ensure that all targeted components are included in the spike mixture over a 2-year period.

   (a) For methods that include 1-10 targets, spike all components;
   (b) For methods that include 11-20 targets, spike at least 10 or 80%, whichever is greater;
   (c) For methods with more than 20 targets, spike at least 16 components.

3. If neither of the above criteria apply, then the analytes should be selected for the subset so that all the different classes of compounds in the list of target compounds for the method are represented.

4. Any unique, method-specific problem analyte or element (such as potential loss of a particular analyte during extraction, digestion, or cleanup step or an element subject to severe inter-element interference on the ICP) should be represented in the subset.

5. In the absence of specified spiking components, for those components that interfere with an accurate assessment such as spiking simultaneously with technical chlordane, toxaphene and PCBs, the spike chosen represents the chemistries and elution patterns of the components to be reported.

11.1.12.3 Control Sample Preparation

The intent of this program is to set our control sample analytes and concentration levels such that a single concentrated stock mix is (1) independently prepared (preferably from different neat materials) from calibration stock solutions, and (2) can be used to prepare LCS samples as well as MS/MSD samples for both aqueous and non-aqueous environmental samples.

The ratio of spiked concentrate to sample aliquot used to prepare MS/MSD samples must be 1 to 10%, depending on the method specifications. In the case of matrix spikes, this practice ensures that we are not diluting the environmental sample to such an extent that we are diluting out any matrix interferences. The purpose of the matrix spike is to provide information regarding the ability to recover an analyte from a particular matrix.

11.1.12.4 Control Sample Stock Source

In order to serve its purpose as an external verification (reference) of the calibration, it is essential that the stock solutions used to prepare LCS and matrix spike samples be prepared independently of calibration stocks. In the organics area, there is a lack of independent sources from which reference materials are obtained but the stock solutions should be prepared independently although they may share a common source.

The source of control sample reference materials should be selected in the following order of preference:

1. The neat compound must be prepared from completely independent sources. For example, a 1000-mg/L stock As solution obtained from Fisher is used to prepare As calibration standards, while a 1000 mg/L stock As solution obtained from Spex is used to prepare the control sample concentrate.
2. If it is impossible to obtain the reference material from two independent sources, then the material from a single source can be used provided that a different analyst than the one who prepared the calibration stock is responsible for preparing the control sample solution.

11.1.12.5 Control Sample Frequency

1. Analyses with a preliminary treatment step (i.e. extraction or digestion)

   LCS frequency is one for every 10 to 20 samples (see individual method SOPs) or at least one for every preparation batch.

MS/MSD or LCS pair (in cases where there is insufficient sample volume for a MS/MSD) is prepared for every sample batch of 20 samples or as per method specifications.

MS is analyzed at 10% frequency for drinking water samples as required by the Manual for the Certification of Laboratories Analyzing Drinking Water, 5th version.

2. Analyses not requiring pretreatment

A LCS must be run with each analytical run at a frequency of no less than one for every 10 or 20 samples (see individual method SOPs).

A MS/MSD or LCS pair must be run for every batch of 20 samples as defined in method specifications or NELAC standards.

Any exceptions to this frequency on a given run must be documented on a corrective action form.

11.1.12.6 Control Sample

For aqueous samples the LCS is prepared using deionized water (carbon-filtered for organic analyses).

Matrix spikes and spike duplicates are prepared using a sample matrix that is representative of the sample type being analyzed for a particular method, either aqueous or non-aqueous.

11.1.12.7 Control Sample Acceptance Criteria

MS acceptance criteria are compared to the acceptance criteria as published in the mandated test method. Advisory limits for each method are established initially based on method validation data. Initial control limits are defined as the mean recovery (accuracy) $\pm$ 3 times the standard deviation obtained from the analysis of 4 (or more) replicates spiked at approximately 10x MRL during the method validation process. Warning limits are set as the mean recovery (accuracy) ±2 times the standard deviation.

Firm acceptance criteria, based upon actual laboratory data, is established once a minimum of 20 data points has been generated. These historical control limits are compared to any method specified or recommended limits to assess their feasibility. Control limits are re-calculated at least yearly to verify that there has been no significant change in performance.

Precision is determined as the relative percent difference (RPD) between LCS pairs or MS/MSD samples. By linking a LCS or MS/MSD pair to each batch of 20 environmental samples, it is possible to link a measure of analytical precision (and two measures of analytical accuracy) to each environmental sample analyzed.

Precision control limits for some analytes have been adopted from the EPA CLP program where they exist, otherwise, control limits are set after the analysis of 20 MS/MSD or LCS pairs of samples (40 control samples). Control limits are set as the mean $\pm$ 3 standard deviations of the RPD from the 20-30 "pairs", with warning limits set at the mean $\pm$ 2 standard deviations. Until such time as 20-30 data points have been accumulated, interim acceptance criteria should be set as 3 times the standard deviations of the RPD obtained during the method validation process.

Whenever MS/MSD or LCS pairs do not meet these limits, an analysis may have a potential problem. Samples with failing LCS shall be reprocessed and reanalyzed or data reported with data qualifying codes. The source of any problems must be investigated and documented by preparing a corrective action or procedural variance report.

If the spike level is less than 25% of the ambient level in a sample, no data are qualified based on the spike recovery.

If a large number of analytes are in the LCS, it becomes statistically likely that a few will be outside control limits. This may not indicate that the system is out of control, therefore corrective action may not be necessary. Upper and lower marginal exceedance (ME) limits can be established to determine when corrective action is necessary. A ME is defined as being beyond the LCS control limits (3 standard deviations), but within the ME limits. ME limits are between 3 and 4 standard deviations around the mean. (NELAC Appendix D.1.1.2.1.e)

The number of allowable marginal exceedance is based on the number of analytes in the LCS. If more analytes exceed the LCS control limits than is allowed, or if any one analyte exceeds the ME limits, the LCS fails and corrective action is necessary. This marginal exceedance approach is relevant for methods with long lists of analytes. It will not apply to target analyte lists with fewer than 11 analytes.

The number of allowable marginal exceedances is as follows:

1. >90 analytes in LCS, 5 analytes allowed in ME of the LCS control limit;
2. 71-90 analytes in LCS, 4 analytes allowed in ME of the LCS control limit;
3. 51-70 analytes in LCS, 3 analytes allowed in ME of the LCS control limit;
4. 31-50 analytes in LCS, 2 analytes allowed in ME of the LCS control limit;
5. 11-30 analytes in LCS, 1 analyte allowed in ME of the LCS control limit.

11.1.12.8 External Reference Samples

Reference samples such as those available from NIST and EPA are analyzed to verify the accuracy of calibration standards. Reference standards with matrices comparable to the samples being analyzed are also included in the run whenever available.

External reference samples are analyzed immediately following the calibration standards for all inorganic and surrogate organic analyses. Appropriate reference samples for organics analyses by GC and GC/MS are less readily available and are only run when a new stock standard is prepared to verify its accuracy.

11.2 ANALYTICAL DOCUMENTATION

A critical dimension of any quality assurance program is the ability to document what is occurring in the laboratory. Accordingly, MWH Laboratories uses a number of forms to document various aspects of laboratory procedures. A discussion of these forms follows.

11.2.1 Analytical Data and Quality Control Forms

Printed forms are used by analysts to standardize the format of routine analyses. For analyses where forms are not available, the analyst records all required information in a notebook. The forms are designed to minimize calculation errors and provide a summary of all quality control data generated for the run.

Analysts are responsible for maintaining these forms. The QA group spot checks these forms periodically. These forms are actively maintained for a minimum period of 2 years, then sent to a storage facility.

11.2.1.1 Chromatograms and Data Processing

Hardcopy outputs of chromatograms and data processing are filed with the analytical data forms. The only exception to this occurs for GC/MS analyses. Chromatograms and library searches are stored on magnetic tape and the information is retrievable upon client request.

11.2.1.2 Inventory Control Logs

Records are maintained on the purchase of laboratory supplies detailing the vendor, purchase order number, date of order, and date of receipt. Bottles of reagents are dated upon received so that the shelf life can be monitored.

11.2.1.3 Stock Standard Logs

A logbook is maintained for preparation of analytical stock standards for each group. Each log contains the date of fresh stock preparation, the lot number and supplier, the preparer's initials, and the weights used to prepare the stock.

11.2.1.4 Bacteriological Growth Media Log

Upon receipt of new microbiological media, the date received is noted upon the container. Media supplies are dated not only upon receipt but also when initially opened. A written record of quality control on media, materials, and equipment is logged into the Micro QC book. The record includes the results of the check, the initials of the individual performing the check, and the date. Media prepared in the lab is logged into the Prepared Media Log by the analyst. These records include media lot number, date of preparation, manufacturer and lot number, type and amount of media prepared, sterilization time and temperature, final pH, the analyst's initials, and expiration date.

11.2.1.5 Instrument Monitoring and Maintenance Logs

When in use, the operating temperatures of incubators, water baths, hot air ovens, and refrigerators are checked daily and recorded. Adjustments or service calls are made when required. Autoclave sterility checks, using ampules of bacterial spores, are made at least quarterly, or whenever a problem is suspected but all items are autoclaved with sterility indicator tape. Records of the maintenance are maintained in equipment logs.

Analysts are responsible for daily calibration checks of the analytical balances in the laboratory with Class S weights and daily calibration checks of the drying ovens with an NIST traceable thermometer. Documentation of the balance and oven checks is maintained in the appropriate logbook. A yearly thermometer calibration check is done and all thermometers are labeled showing any necessary correction to achieve true readings. Balances are calibrated annually and Class S-weights are calibrated every 5 years by an outside vendor. Copies of these balance and thermometer records are filed with the QA records for the laboratory. All Class S weights and traceable thermometer standards are used for calibration only and for no other purpose to ensure that the performance as reference standards are always valid.

Balance calibration is verified on the day of use prior to weighing samples, standards or reagents. If balance does not meet the acceptable criteria of $\pm$ 0.1 %, the analyst reports to QA that balance needs service. The instrument is labeled “out of service” until repaired. The Analyst records the problem and identifies corrective action, date of service, and if corrective action resolved the problem.

Refrigerators, incubators, temperature are monitored 2 times daily at least 4 hrs interval. If temperature measured is not meeting the acceptance criteria of $4\pm 2^{\circ}$C, analyst reports to QA department. QA monitors the temperature after 2 hrs and more often if needed. If non-compliance is still observed, QA calls for service. The instrument is labeled “out of

service" until repaired. QA records the problem identified, corrective action, date of service if called and if corrective action resolved the problem.

Eppendorf pipette function verification is done on the day the standards are prepared for pipets used for the preparation of both the primary and secondary standards. Monthly frequency is done for pipets used either for the preparation of either the primary or secondary standards and Class A pipets used for the prep of the other set of stds. When used over a range of settings, the pipet is calibrated at the highest and lowest settings. If not meeting the acceptable range of $\pm$ 2 % of the set value, the analyst investigates and identifies the problem. The pipet is cleaned if needed and inspected for signs of wear or damages or for residual liquids that may have been sucked in the pipet. After the appropriate Corrective Action, the pipet is again calibrated. Corrective Action taken and problem identified is recorded. If corrective action did not resolve the problem, the analyst documents in the logbook that the pipet is off-line. The pipet is also labeled "out of service" until repaired.

All other major instruments if off line will be labeled "out of service" until repair.

For Microbiology Volumetric Equipment [NELAC 5.Appendix D.3.8b)3)]

Volumetric Equipment shall be calibrated as follows:

1. Equipment with movable parts such as automatic dispensers, dispensers/diluters, and mechanical hand pipettes shall be verified for accuracy quarterly.

2. Equipment such as filter funnels, bottles, non-class A glassware and other marked containers shall be calibrated once per lot prior to its use.

3. The volume of the disposable volumetric equipment such as sample bottles, disposable pipettes, and micropipette tips shall be checked once per lot.

A separate maintenance logbook is maintained for each analytical instrument. These logs contain a record of routine maintenance as well as any repair work required during instrument set-up.

11.2.1.6 Corrective Action Logs

The form, presented in Figure 11-1, requires documentation on the determination of the out-of-control event or variance, the diagnostics performed to bring the event back under control, and the manner in which re-establishment of control was demonstrated. A flow chart of QIR process can be found on Figure 11-2. The analyst and their supervisor sign the form and submit it to the appropriate Project Manager so that the client may be contacted if necessary, and the QA Officer, who signs the form after review. The analysts keep copies of completed forms in a notebook in their work area or file them with the appropriate raw data package. Additional copies are filed with the Project Manager. The QA Officer retains the original.

11.2.1.7 Laboratory Water Quality File

Pure water system for MWH Laboratories was assembled by US Filter in January 2003. It consists of reverse osmosis, mixed bed deionizers, ultraviolet disinfection, filtration, and an organic scavenger side stream return loop. The system is connected to a conductivity meter which signals when the mixed bed resin demineralizers need to be changed.

There are also indicator lights at a number of the taps throughout the laboratory which indicate the quality of the water by utilizing a red light/green light system. Ongoing water quality is monitored at the organic and inorganic taps by analyzing monthly samples for plate count, TOC, conductivity, NH_3, and residual chlorine when maintenance is performed on the water treatment system, or at startup after a period of disuse longer than one month. Annually, trace metals, inhibitory residue, and suitability ratios are monitored. These reports are sent to the QA Department for filing and are maintained for ten years.

11.2.1.8 Client Data Reports

Copies of all client reports are filed centrally by client name and maintained for a minimum of 2 years in an active file, then sent to an off-site storage facility for an additional 8 years.

11.2.2 Standard Operating Procedures

Laboratories shall maintain SOPs that accurately reflect all phases of current laboratory activities such as assessing data integrity, corrective actions, handling customer complaints, and all test methods.

The following format must be used for all final SOPs. Draft SOPs may or may not be written in this format. This is not of great concern since it is only essential that the critical information presented below be included in some manner.

1. Cover Page

   The SOP cover page consists of a summary of the most recent revision information and for signature and the date for the Analyst, Group Supervisor, QA Officer, and Technical Director/ Lab Director for approval. Effective date is included in the cover page.

2. . Header

   A header must be included in the upper right corner of each page of the SOP. The header must include the SOP reference name or number, the revision number, the revision date, page number and total number of pages.

I. Title

II. Scope/Application

A brief description of the types of matrices the method is applicable to as well as the regulatory programs may be supported by the use of the method.

This section is also used to indicate any special training or level of ability required to perform the method.

III. Method Summary

A brief description of the method, simple statement of analytical technique and any pre-treatment steps.

IV. Interferences

This section should include any known interferences, as well as potential interferences, particularly for GC/conventional detector methods. It should also include any interferences that may be present as a result of improper sampling procedures, equipment cleaning or analytical technique must be listed here.

V. Safety Considerations

Specify any known or suspected carcinogens, mutagens, or teratogens among the standards or reagents used. Indicate that the MSDS (material safety data sheets) are available and where they are located. Each analyst is required to familiarize him/herself with his or her contents before performing the analysis.

Each SOP includes reference to the Laboratory Chemical Hygiene Plan as per OSHA Standard 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories-Final Rule.

VI. Instrumentation/Apparatus

The instrumentation used, including specific columns employed for GC, LC, or GC/MS and whether or not there is a primary and confirmatory column is described under this heading.

VII. Reagents & Standards

The sources of all standards and reagents are listed.

VIII. Sample Collection, Handling and Preservation

Indicate bottle type, preservative and volume necessary for analysis. Include holding times for standards.

IX. Calibration Procedure

Detailed preparation instructions for each calibration, LCS or MS/MSD standard should be included. A table should be present to show how daily calibration and control standard solutions are prepared from working stock standards. Calibration frequency should be specified. Expiration information should be included for each type of standard prepared.

X. Analytical Procedure

Since the purpose of a SOP is to provide clear instruction to avoid loss of key information from one analyst to another, it is critical that this section be detailed enough that any analyst can anticipate and take appropriate corrective action in the event that a problem should arise.

XI. Quality Control Requirements

This section should describe the components, concentrations, frequency, and acceptance criteria for the LCS or MS/MSD samples, as well as any other method specific QC requirements, such as tuning, blanks, or calibration requirements.

XII. Calculations

All relevant calculations should be included, such as how instrument response relates to concentration, the calculation of response factors, etc.

XIII. Method Performance

The results of the initial method validation process should be included. The following information should be present:

a) Statistically calculated MDLs (40 CFR Part 136 Appendix B),

b) MDL spike levels, MWH Laboratories' MRLs, Accuracy for each compound (mean recovery of each compound determined from analysis of a minimum of 4 replicates spiked at 10 x MRL), precision data (RSD of the 4 replicates spiked at 10 x MRL).

This data will be used to set interim LCS and MS/MSD control limits (3 sigma) until sufficient data is accumulated to calculate limits based on actual laboratory historical data.

XIV. References

A list of method references, such as the relevant 500 or 600 series method, the SW-846 methods (including revision number and date), or publication should be provided.

XV. Deviations from Referenced Methodology

A review of the referenced method is carefully made and MWH Laboratories will specify any areas in which our method does not conform to referenced method requirements. If any such deviations are noted, an explanation as to what alternative was used and why is described. There are two basic types of method modifications: (1) those that are hardware related and (2) those that are policy or procedural modifications.

XVI. A copy of the bench sheet used for the analysis and where applicable, a chromatogram of the standards will be attached.

XVII. Method Detection Limit

Laboratory procedures of conducting MDL studies and a copy of the initial MDL study will be included.

XVIII. Definitions

Definitions will be referred to the QA Manual since the QA Manual includes a glossary section that defines all the terms used by the laboratory..

XIX. Pollution prevention

Potential threat of the standards and reagents to the environment is addressed in theSOP.

XX. Waste management

In addition to the hazardous waste protocol discussed in the SOP, the followingreferences where the information can be find are also included:

1. The Lab Hazwaste Management Plan
2. The federal hazardous waste management regulations –Resources Conservation and Recovery Act (RCRA)-Title 40 of the Code of Federal Regulations, Parts 260 through 270 (40 CFR 260-270)
3. CA Hazardous Waste Control Law (HWCL)-CCR Title 22 where 40 CFR was duplicated into CCR Title 22

XXI. Revisions

Revisions are discussed including the dates when revisions are made and the appropriate section numbers where the revisions could be found.

11.3 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND DETECTION LIMITS

Before analytical data can be used, it is necessary to determine the suitability of the data for a given purpose. The characteristics used to determine data suitability are precision, accuracy, and completeness. MWH Laboratories determines these characteristics by using specific procedures, which are detailed, in the following sections.

11.3.1 Precision

Precision is the measure of how well replicate analyses agree. MWH Laboratories uses Relative Percent Difference (RPD) to measure agreement between duplicate analyses. RPD is calculated as follows:

$$\mathbf{RPD} = \frac{(S-D)}{(S+D)/2} \times 100$$

where;

RPD = Relative Percent Difference
S = First Sample Value (original)
D = Second Sample Value (duplicate)

The precision of a method is expressed as the Relative Standard Deviation (RSD) of the percent recoveries. Percent RSD (%RSD) is calculated as follows:

$$\mathbf{\%RSD} = \frac{S}{X_{ave}} \times 100$$

where:

$X_{avg.}$ = the arithmetic mean of the recovery values, and

$$S = \sqrt{\Sigma \frac{(X_i-X)^2}{n-1}}$$

where:

S = Standard Deviation

X_i = the individual recovery values

X = the arithmetic mean of the recovery values

N = the number of determinations

To assess precision, MWH Laboratories uses the following:

- o Duplicate samples
- o Duplicate Matrix Spikes
- o Duplicate Laboratory Control Samples
- o Control Charts.

11.3.2 Accuracy – LCS % Recovery, MS– % Recovery, Setting Up Internal Limits

Accuracy measures the deviation of the analytical value from the "true" or known value. The true value for field samples are never known, so accuracy measurements are made on the analysis of QC samples analyzed with field samples. The primary QC tools for assessing accuracy are control standards (LCSs), matrix spikes and spike duplicates (MS/MSD) and surrogate spikes

Spike recoveries are calculated as follows:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

Where; %R = percent spike recovery
SSR = spiked sample result
SR = sample result
SA = spike amount added

For Laboratory Control Samples, percent recovery (%R) is calculated as follows:

$$\%R = \frac{\text{found concentration}}{\text{true concentration}} \times 100$$

Accuracy is monitored for nearly all methods by percent recoveries of the LCSs and plotted on control charts. The mean recovery +/- 2 standard deviations are the warning limits, and the mean recovery +/- 3 standard deviations are the control limits. In the event that the method has no acceptance criteria, control charts are reviewed and evaluated to establish internal limits or guidelines [NELAC 5.Appendix D.1.1.2.1d)]

To assess accuracy, MWH Laboratories uses the following:

- o Laboratory Control Samples
- o Matrix Spikes
- o Certified Reference Materials
- o Blind Audit Samples
- o Control Charts

11.3.3 Method Detection Limits (MDL) / Limit of Detection (LOD)

The laboratory shall utilize MDL determination by CFR 136 as one option to provide LOD for each analyte that is appropriate and relevant for the intended use of the data. An LOD is not required for a test method when test results are not reported outside the calibration range. LOD shall be determined by the protocol in the mandated test method or applicable regulation. If the protocol for determining LOD is not specified, the selection of the procedure must reflect instrument limitations and the intended application of the test method. (NELAC Appendix D.1.2.1)

The MDL shall be initially determined for the compounds of interest in each test method in a quality system matrix in which there are not target analytes nor interferences at a concentration that would impact the results of the MDL must be determined in the quality system matrix of interest. (NELAC Appendix D.1.2.1.a.)

Method Detection Limits (MDLs) will be determined as per 40CFR, part 136, Appendix B. Essentially, this requires that an estimate of the detection limit be determined for each target analyte based on analytical experience or published references. Seven replicates of DI water must then be spiked at this estimated MDL for each method analyte carried through the entire procedure over a minimum of 3 separate analysis/extraction days. The MDL is then calculated as the standard deviation of the 7 replicates multiplied by the statistical "t-value" associated with the actual number of replicates analyzed assuming N-1 degrees of freedom **(for exactly 7 replicates, the t-value is 3.143**; 40 CFR, Part 136).

LOD/MDL must be verified annually as per EPA Manual at a minimum (or more frequently if stated in the Method such as EPA 300.0 and 353.2 where the MDL study has to be repeated every 6 months). A copy of all associated data must be submitted to the QA group for filing.

An MDL study must be repeated for each new analyst trained in a particular method, or if there is a change in the instrumentation or the test method that is used for the analysis in question. This is a necessary requirement to ensure that each new analyst has received sufficient training such that the data generated will be comparable to that of former analysts. It is necessary to repeat the MDL process with a change in instrumentation to ensure that the new instrumentation is capable of achieving equivalent sensitivity. An MDL study must also be repeated when there is any significant change in background or instrument response.

A minimum of a three-point calibration will be performed prior to the MDL study. One of the points must be at the MDL spike level. The calibration must meet all criteria outlined in the Calibration Policy.

The spiked level must be within 10 times the calculated MDL or the process must be repeated at a lower spike concentration. The spike level should be greater than the calculated level.

Perform an MRL check and the acceptance criteria for recovery of spiked analyte at MRL is 50-150 % or ± 3 standard deviations, whichever is greater.

If there is a significant blank level, the spike level for the MDL determination must be at least three times greater than the blank concentration.

11.3.4 Minimum Reporting Limits (MRL) / Limits of Quantification (LOQ)

The Minimum Reporting Limit (MRL) is the lowest concentration normally reported to the client. It represents the detection value linked to a specific analyte for aqueous matrix in the LIMS system. The MRL represents a conservative, nominal reporting limit designed to be representative of the minimum quantifiable concentration level for a particular analyte in a real environmental matrix as opposed to the statistically derived MDL calculation.

The MRL will generally be established by multiplying the statistically derived MDL by a factor of 2 or 3. The rationale for this approach is that the resultant value becomes approximately 10 times the standard deviation obtained during the MDL study; the EPA frequently refers to this concentration as the "Limit of Quantification (LOQ)", and defines it as the level above which accurate quantitation can be achieved. This level is also more similar to the SW-846 and SDWA concept of "Practical Quantitation Limits" (PQL). At a minimum, the MRL needs to be greater than MDL. The MRL must be verified annually for each quality system matrix, method and analyte according to the procedure specified in NELAC C.3. Alternatively, the annual MRL verification is not required if the MDL is reevaluated or verified. (NELAC D.1.2.2.a and D.1.2.2.b).

Final MRLs should only be established after receiving input from the Group Supervisor, Client Services Manager, Lab Director and QA Officer. This ensures that all relevant issues regarding the selection of MRLs have been considered. These issues include specific minimum reporting limits required by a particular state or regulatory body, contractually required reporting limits for a specific client, the need to provide consistent reporting limits for our clients that have historically submitted samples associated with long-term monitoring efforts, as well as to remain competitive in the market. Thus a specific client may require that we use an MDL on our reports rather than an MRL. This deviation must be documented on client reports.

11.4 METHOD SPECIFIC QUALITY CONTROL

11.4.1 Gravimetry

All laboratory analytical balances and ovens are calibrated weekly with Class S weights and a certified thermometer. Records of this balance calibration are maintained by the balances and periodically turned in to the QA Officer for filing as records are completed.

A sufficient number of dessicators are maintained to insure that samples are not crowded to the point where they cannot cool to room temperature at the end of the specified drying period. Desiccant replacement is based on color changes.

LCS samples are analyzed at a frequency of 5 or 10% and is specified in each method SOP. At least one LCS is analyzed for each analytical run.

MS/MSD samples (or LCS pairs) are analyzed at the rate of once every batch of 20 samples of a similar matrix, or at other frequency, depending on the method requirements.

11.4.2 Titration

Use of an automated titrator set to proper delivery speed insures that every sample is titrated to the same endpoint. For manual titration, selection of the proper endpoint is achieved by comparing the color of the sample currently being titrated with the color of the previously titrated sample. The analyst must be particularly careful when performing a titration with a fading endpoint. In such instances, it is important to complete the titration as rapidly as possible.

An external reference sample is analyzed with each new set of standards or titrant to verify the accuracy of the titrant standardization and the endpoint determination. In addition, the endpoint pH is checked for each sample.
LCS samples are analyzed at a frequency of 5 or 10% and is specified in each method SOP. At least one LCS is analyzed for each analytical run.

MS/MSD samples (or LCS pairs) are analyzed at the rate of once every batch of 20 samples of a similar matrix, or at other frequency, depending on the method requirements.

11.4.3 Colorimetric Spectrophotometry

The alignment of the cell holder and light source is checked when absorbency indicates a problem.

A minimum of three standards plus a blank, equally spaced over the concentration range, are used to calibrate the spectrophotometer in the absorbance mode, except where methods specify the use of one standard only.

The analyst records the absorbance reading for the top standard and notes on the form if a gradual increase or decrease in the absorbance of this standard is occurring. A gradual decrease in absorbance values from week to week is usually indicative of a deteriorating standard or the initial stage of lamp failure.

The rate of color development and color stability of spectrophotometric procedures varies considerably. The allowable time interval for reading the absorbance of the sample is specified in the method and must be rigidly adhered to in order to obtain accurate results.

Measuring a blank and a calibration standard after every twenty samples checks the stability of the spectrophotometer. If the baseline absorbance or the standard absorbance value has changed by more than 0.005 absorbance units or 10% from the initial calibration standard, whichever is greater, the instrument must be recalibrated and all samples analyzed since the last acceptable calibration check must be reanalyzed.

Some water samples have a natural color or turbidity which absorbs appreciably at the wavelength used in the analysis. If the sensitivity of a procedure is sufficiently high, it is usually possible to minimize this interference by diluting the sample. If the sensitivity is not adequate to permit sample dilution, the turbidity or color interference is corrected for, by reading the absorbance of the sample carried through the procedure without addition of the indicator reagent when instrumentation permits it. This absorbance reading is then subtracted as a blank from the absorbance reading of the sample.

LCS samples are analyzed at a frequency of 5 or 10% and is specified in each method SOP. At least one LCS is analyzed for each analytical run.

MS/MSD samples (or LCS pairs) are analyzed at the rate of once every batch of 20 samples of a similar matrix, or at other frequency, depending on the method requirements.

11.4.4 Atomic Absorption & ICP Emission Spectroscopy & ICPMS

The sensitivity of each element is recorded in order to detect deficiencies in the instrument or operating conditions.

Each time the instrument is calibrated, the absorbance or emission reading of the top standard is recorded on the raw data form. If the cumulative difference of subsequent standard readings differs by more than 10% from the previous readings, as discussed in Section 8.3, a problem exists either with the operational settings, the performance of the instrument, or the accuracy of the standard solution. Corrective action must be taken before analyzing any samples. A gradual change in the standard readings from day to day is usually indicative of an instrument maintenance problem such as a dirty nebulizer system, a clogged burner, the initial stage of lamp failure or an instrument part malfunction.

Reagent blanks followed by a calibration check standard are run for each metal determined with a frequency of 10%. If there is a difference of >10% from the initial standard reading, the instrument must be recalibrated and all samples that were analyzed after the last acceptable calibration check must be reanalyzed.

For ICP analysis using the simultaneous system, inter-element correction factors must be available for each wavelength used. Background correction must be used for each element.

LCS samples are analyzed at a frequency of 5 or 10% as specified in each method SOP. At least one LCS is analyzed for each analytical run.

MS/MSD samples (or LCS pairs) are analyzed at the rate of once every batch of 20 samples of a similar matrix, or at other frequency, depending on the method requirements.

11.4.5 Radiochemistry

The laboratory participates in the biannual and alternate monthly EPA-administered performance studies for gross alpha and beta and radium. Results must be within the control limits established by EPA for each analysis.

The laboratory monitors monthly radiation measurement of laboratory instrumentation for radioactive contamination. The procedure is discussed in the CHP Manual including criteria and corrective action procedure. [NELAC Appendix D.4.4.d)]

Efficiency curves are run at least annually and the data recorded in the radiation notebook.

A background is run (monthly for gamma and alpha spectroscopy, weekly for gas proportional counter, and each day of use for scintillation counter) and a known reference sample is run with each batch of radiation samples analyzed. Background check measurements shall be performed each day of use for gamma and alpha spectroscopy and gas proportional counter [NELAC 5.Appendix D 4.8b)].Method blank shall be performed at a frequency of at least one per preparation batch. If the acceptance criteria specified in the SOP are not met, the specified corrective action and contingencies shall be followed and the result reported with appropriate data qualifying codes [NELAC 5.Appendix D 4.1 a)].

LCS samples are analyzed at a frequency of 5 or 10% and is specified in each method SOP. At least one LCS is analyzed for each analytical run. The activity of LCS shall be 2 – 10 times the detection limit or at a level comparable to that of the routine samples if the sample activities are expected to exceed 10 times the detection limit [NELAC 5.Appendix D 4.1 b) 3)].

Gross alpha and gross beta require MS for aqueous samples. When there is not sufficient sample aliquot size to perform a matrix spike, it shall be noted on the lab report [NELAC D 4.1 b).2]. MS activity shall be greater than 10 times the detection limit [NELAC 5.Appendix D 4.1 b) 4)].

The laboratory standards used to prepare LCS and MS shall be from a source independent of the laboratory standards used for instrument calibration [NELAC 5.Appendix D.4.1 b) 5)]. The MS shall be prepared by adding a known activity of target analyte.

Replicate shall be performed at a frequency of one per preparation batch where there is sufficient sample to do so. The replicate result shall be assessed against the specific acceptance criteria specified in the laboratory SOP. For low level samples (less than approximately three times the detection limit) the laboratory may analyze duplicate laboratory control samples or a replicate matrix spike (matrix spike and a matrix spike duplicate) to determine reproducibility within a preparation batch [NELAC 5.Appendix D 4.2].

Consistent test conditions for RAD testing is maintained through a radiological control program that addresses analytical radiological control. The program shall address the procedures for segregating samples with potentially widely varying levels of radioactivity. The radiological control program shall explicitly define how low level and high level samples will be identified, segregated and processed in order to prevent sample cross-contamination. The radiological control program shall include the measures taken to monitor and evaluate background activity or contamination on an ongoing basis (NELAC D.4.8).

11.4.6 Gas Chromatography

A laboratory water blank is analyzed for all analyses to check for artifacts from the GC system and for the presence of impurities in the water blank making it unsuitable for LCS preparation.

A field or travel blank should be analyzed for each set of field samples taken. With each set of travel blanks sent out, a stationary travel blank is kept in the laboratory for analysis to demonstrate that the water sent out was free of contamination.

A series of continuing calibration standards are run with the analysis each day for all GC analyses. The acceptance criteria for the initial 5 point curve and the calibration standards is given in Table 9-1 of section 9 page 7-13.

LCS and/or MS/MSD samples for assessing precision and accuracy are determined by carrying the control samples or spike and spike duplicates through the extraction procedure as well as the instrumental analysis.

LCS samples are analyzed at a frequency of 5 or 10% and is specified in each method SOP. At least one LCS is analyzed for each analytical run.

MS/MSD samples (or LCS pairs) are analyzed at the rate of once every batch of 20 samples of a similar matrix.

11.4.7 Gas Chromatography/Mass Spectrometry

11.4.7.1 GC/MS Tuning Specifications

The mass spectrometer must be shown to be properly tuned during each daily 12 hour shift. This insures that the masses and abundance's, which the data system determines, are accurate. The EPA has suggested criteria for tuning the GC/MS with two standard compounds, decafluorotriphenylphosphine (DFTPP) and 1-bromo-4-fluorobenzene (BFB). Tuning criteria are shown in Table 9-5 of section 9.0.

The following settings are maintained:

- Emission Current: 0.5 ma
- Electron Energy: 70 ev
- Electron Multiplier: 1000-2000 volts as required for sensitivity
- Dynodes: 3000 V

The GC/MS is calibrated when needed with FC43 gas to obtain a millimass defect of less than or equal to 20 millimass units. The calibration is verified with the FIT program to an RMS error of less than 10 percent.

The instrument zero is checked using the zero control and adjusting as necessary to provide a minimum background electrical noise.

11.4.7.2 Quantitation of Identified Compounds/Quantitation from Initial Instrument Calibration

The calibration procedure for GCMS is based on EPA Methods 524.2, 525.2, 624, 8260, 625, and 8270. A five point standard curve is run for all analytes. For each calibration compounds, a response factor (R_f) is calculated at each of the five standard deviation (% RSD) is calculated.

The procedure to be employed for evaluation of the acceptability of the initial calibration curve is summarized in section 11.4.7.3 for BNA and section 11.4.7.4 for VOA.

All quantitation are done from initial instrument calibration and not from continuing calibration unless required by the method, regulation or program [NELAC 5.5.5.2.2.1c)].

11.4.7.3 BNA:

The % RSD must be <30% for all calibration compounds for calibration to proceed. This protocol has been established to meet both CLP and the requirements of method 8270, which requires only that the %RSD for Calibration Check Compounds [CCC] (acenaphthene, 4-dichlorobenzene, hexachlorobutadiene, N-nitroso-di-n-phenylamine, di-n-octylphthalate, fluoranthene, benzo (a) pyrene, 4-chloro-3-methylphenol, 2,4-dichlorophenol, 4-nitrophenol, phenol, pentachlorophenol, and 2,4,6-trichlorophenol) be less than 30%.

In addition, the mean response factor for System Performance Check Compounds [SPCC] (N-nitroso-di-n-propylamine, hexachlorocyclopentadiene, 2,4-dinitrophenol, and 4-nitrophenol) must be greater than or equal to 0.050. The response of these compounds is significantly reduced as columns or standards deteriorate, and thus they serve as excellent indicators of analytical performance.

On subsequent days of analysis, a 40 µg/mL BNA standard containing all of the compounds is analyzed. The acceptability of this continuing calibration is evaluated as follows:

1) As with the initial calibration, the response factors (R_f) for each of the SPCC compounds must be verified to be at least 0.050. If this criterion is not met, corrective action must be taken and the standard re-analyzed. If the corrective action does not result in acceptable R_f's, then a new initial calibration must be performed.

2) The relative percent difference (RPD), calculated as:

$$RPD = \frac{(\text{Mean Rf} - \text{Daily Rf})}{\text{Mean Rf}} \times 100$$

The calculated RPD of the initial calibration points must not exceed 30% for more than 15% of the calibration compounds. More specifically, however, the RPD cannot exceed 30% for any of the CCCs defined above, or a new initial calibration curve must be generated. It should be noted that the 30% RPD criteria represents an absolute limit; RPD values greater than 20% should be considered a warning limit.

11.4.7.4 VOA:

The %RSD must be less than 30% for all calibration compounds for calibration to proceed. This protocol has been established to meet the requirements of method 8260, which require only that the %RSD for CCCs (1,1-dichloroethene, chloroform, 1,2-dichloropropane, toluene, ethylbenzene, and vinyl chloride) be less than 30%.

In addition, the mean response factor for SPCCs (chloromethane, 1,1-dichloroethane, bromoform, 1,1,2,2-tetrachloroethane, and chlorobenzene) must be greater than or equal to 0.300 (> 0.250 for bromoform). The response of these compounds is significantly reduced as a result of changes in purge flow, contamination in transfer lines, presence of active sites on the trap material, (or a diminished tune ratio of m/z 174/176 in the case of bromoform) and thus they serve as excellent indicators of analytical performance.

On subsequent days of analysis, a 2 µg/L VOA standard containing all of the compounds is analyzed. The acceptability of this continuing calibration is evaluated as follows:

1) As with the initial calibration, the response factors (R_f) for each of the SPCC compounds must be verified to be at least 0.300 (>0.250 for Bromoform). If this criterion is not met, corrective action must be taken and the standard re-analyzed. If the corrective action does not result in acceptable R_f's, then a new initial calibration must be performed.

2) RPD is calculated as:

$$RPD = \frac{(\text{Mean Rf - Daily Rf})}{\text{Mean Rf}} \text{ X } 100$$

The calculated RPD of the initial calibration points must not exceed 25% for more than 15% of the calibration compounds. More specifically, however, the RPD cannot exceed 20% for any of the CCC compounds defined above, or a new initial calibration curve must be generated.

It should be noted that the 20% RPD criteria represent an absolute limit; RPD values greater than 15% (or average $\pm$ 2sd) should be considered warning limits.

For both VOA and BNA analyses, quantitation on each day of analysis is performed using an internal standard calibration technique. If the daily standard meets the acceptance criteria defined above, the initial calibration is deemed valid, and thus is used for Quantitation.

11.4.7.5 Internal and Surrogate Standards (IS and SS)

The internal standard area counts are recorded for all volatile and semi-volatile samples.

If any sample is found to have an IS beyond +/-50% of the IS counts for the daily continuing calibration standard, the sample is re- analyzed unless an obvious matrix problem can be documented.

Surrogate standards are utilized in both the volatile and semi-volatile analysis.

The surrogate recoveries are recorded for all samples. The lab has established control limits for each surrogate compound for both analyses.

Any volatile sample surrogate recovery that falls outside of the lab limits is immediately re-analyzed. If surrogate recoveries are still outside of the limits, a QIR is written and the report is annotated. If the second result is within the control limits, this result is reported.

For semi-volatile samples with unacceptable surrogate recoveries, the extraction run logs are examined for matrix related or other documented problems. In addition, the LCS recoveries are reviewed for the sample extraction set. If none of these indicate a matrix problem, the sample is re-extracted. If the analysis of the re-extract shows unacceptable surrogate recoveries, a QIR form is generated, then the sample report is annotated and the data reported.

11.4.7.6 Criteria for Tentatively Identified Compounds (TIC's)

A primary advantage of GC/MS is the ability to identify compounds for which the retention time and mass spectra are not well known to the operator. This is accomplished by performing a library search using the EPA/NIST library of mass spectra and comparing unknown to the these spectra. The library search program gives five or ten of the "best fits". The best fits are determined by comparing the top eight mass fragments in the unknown to the spectra in the library. The program matches the mass numbers and the abundances at each mass number to those in the library. The program lists the possible identifications along with the numbers, which can be used by the MS operator to determine the quality of the identification. The fit is the degree to which the peaks and intensities in the unknown match those of a particular compound in the library. A perfect match would be 1000 or 1.000, depending on the software. MWH Labs utilizes CLP criteria for determining identification of unknowns. This includes the presence of all major ions greater than 10% relative intensity, agreement of +/-20% for major ions in the sample and reference spectra, and the review of all ions present in the sample spectrum for possible background contamination or interference.

In general a computer fit of 850 or 0.850 should be the minimum used for identification. It should be noted that even with computer library searches, there is no substitute for the judgment of a trained analyst.

11.4.7.7 Control Samples

LCS samples are analyzed at a frequency of 5%. At least one LCS is analyzed for each analytical run.

MS/MSD samples (or Duplicate) are analyzed at the rate of once every batch of 20 samples of a similar matrix, as required by NELAC. Duplicates are usable only when target analytes are positives [NELAC 5.Appendix D.1.1.3.2a)].

11.4.7.8 Blanks

Laboratory reagent water blank is normally the first sample analyzed at the beginning of each working day to demonstrate that the system is free from contamination. If the blank result indicates contamination, the system is cleaned by running additional water blanks or if necessary, finding an alternate source of contaminant free water.

11.4.8 Total Organic Carbon (TOC)

Prior to analysis of samples, a four point standard curve is run in duplicate by spiking reagent water with four different concentrations of potassium hydrogen phthalate. This curve is submitted with the raw data and quality control forms.

All samples are analyzed in duplicate. If the net values of the duplicates are not within acceptance criteria, a third replicate is analyzed and the two values meeting acceptance criteria are used. If all 3 values fail to meet, the sample is diluted and the procedure repeated.

Samples are diluted to fall within the linear range of the standards.

Every tenth sample is an LCS and %recoveries must fall within acceptable control limits. MS/MSD samples (or LCS pairs) are analyzed at the rate of once every batch of 20 samples of a similar matrix as per method requirements,.

11.4.9 Total Organic Halogen (TOX)

Three carbon blanks (carbon packed adsorption columns washed with nitrate-wash solution only) are analyzed at the beginning of each workday. All values must be within 20% of the average blank value obtained before standards can be run.

Each day, a set of three calibration standards is analyzed prior to analysis of samples. Calculated values for the standards must fall within 5% of the nominal value except for the 1.0 standard, which is allowed a 10% range.

Every eighth sample is, alternately, a continuing calibration standard or a carbon blank.

All samples are analyzed in duplicate. If the net values of the duplicates are not within acceptance criteria of 20%, a third and possibly a fourth replicate is analyzed. Results are compared to the first and second replicate and the average of the two closest samples is reported.

The titration cell is revitalized by rinsing with fresh cell solution after every twenty analyses or sooner if necessary.

Samples are diluted to fall within the linear range of the standards.

Two or three serial adsorption columns from each sample adsorption are analyzed separately to determine if any organic halogen breakthrough is occurring. In the event of breakthrough, an additional diluted sample is analyzed. Every tenth sample is an LCS and %recoveries must fall within acceptable control limits.

MS/MSD samples (or LCS pairs) are analyzed at the rate of once every batch of 20 samples of a similar matrix.

The purity and adsorption capacity of each new batch of carbon purchased is assessed by duplicate analysis of an adsorption efficiency standard. This adsorption efficiency standard (standards injected into reagent water then filtered) must be within 5% of the standard value. In addition, duplicate carbon blank results must be less than 1 µg Cl-.

11.4.10 General Microbiology- Use of Commercial Dehydrated Powder Testing for Free Chlorine

The individual collecting samples should be aware of the sampling precautions outlined in Standard Methods.

Specific sampling instructions are available from the MWH Laboratories Microbiology Department. They list required precautions to follow to maintain the integrity of the samples and prevent contamination.

The maximum holding time for microbiological samples is 30 hours for drinking water and 6 hours for water/wastewater.

The bottles should be shipped sealed in strong plastic zip lock or bubble bags. This keeps the melting ice from contaminating the samples. Ice cubes or their equivalent must be placed around the samples but care must be taken that the samples do not freeze.

Sterility check on sample containers shall be performed on at least one container for each lot of purchased pre-sterilized sample containers. For containers prepared and sterilized in the lab, a sterility check shall be performed on one container per sterilized batch with non-selective growth media [NELAC 5.Appendix D 3.1a)4)]. Microbiology sample containers are disposable high clarity polystyrene vessels with sodium thiosulfate sufficient to neutralize 10-90 mg/L of chlorine(IDEXY Cat No. WS216PS). Containers from each lot of "*ready to use*" are tested to ensure efficacy of $Na_2S_2O_3$ to 5 mg/L Cl_2 and 15 mg/L Cl_2. Thus, samples received in the lab are not tested for additional residual Cl_2 testing [NELAC-5.5.8.3.1a)3)].

A sterilization indicator is used during each autoclave cycle. If problems exist as indicated by a failure of the sterilization indicator, none of the items from that autoclave load is used and the group leader is notified. Demonstration of effective sterilization is provided by the use of biological indicators at least once per month of use [NELAC 5.Appendix D.3.8.b)2).ii)].

Culture media are prepared from commercial dehydrated powders or ready to use media such as colilert medium. The laboratory does not prepare media or its culture media from basic ingredients. [NELAC 5.Appendix D.3.6. and D.3.6a)]

Only nanopure water is used for the preparation of media. Once opened, the powdered media is tightly recapped to prevent hydration.

Prepared liquid medium is stored in the dark at refrigeration of 4°C and used within 3 months. The media is labeled with the type of medium, date prepared and the initials of the analyst who weighed out the dehydrated powder.

Prepared agar plates are stored in plastic bags, agar up, in the refrigerator. The bag is labeled to identify the type of medium, date prepared and the initials of the analyst who prepared it.

When bacteriological samples are incubated in a water bath or incubator, the temperature is recorded each morning and afternoon on the appropriate temperature sheet.

A thermometer calibrated at 44.5˚C is used for the water bath when fecal coliforms are incubated.

A positive control culture obtained from the American Type Culture Collection is inoculated for each batch of media including chromofluorogenic medium, incubated and read to indicate the acceptability of a media to a particular bacteria type. A negative control consisting of an inoculation of sterile phosphate buffer or an un-inoculated portion of media is also incubated to demonstrate the absence of contamination prior to first use of the medium. For filtration technique with each batch of samples, at least one beginning and ending control shall be prepared, with additional controls inserted after every 10 samples when the same equipment set is used to prepare multiple samples [NELAC 5.Appendix D 3.1 a) 2)]. When an interruption of more than 30 minutes occurs, the filtration funnels shall be resterilized.

When membrane filtration methods are used to analyze samples, a control blank of sterile dilution water is analyzed at the beginning of each set of samples. For membrane filter or plate media, duplicate counts shall be performed monthly on one positive sample for each month that the test is performed. If more than one analyst, each analyst shall count typical colonies on the same plate and count must be within 10%. If only one analyst, sample plate shall be counted twice by the analyst, with <5% difference between counts.

The laboratory analyzes a bacteriological proficiency test sample from ERA Provider, either annually or bi-annually for NELAP accreditation. A coliform test, through the confirmation step and standard plate count, is conducted on this reference sample.

The quality of laboratory pure water is analyzed monthly for conductivity, pH, chlorine residual, TOC, and standard plate count and annually for water suitability ratio, inhibitory residue (as needed), and trace metals (Pb, Cd, Cr, Cu, Ni, and Zn). The following criteria must be met. This data is recorded and submitted to the QA department.

Parameter	**Acceptance Criteria**
Ammonia	< 0.1 mg/L (monthly check)
Residual Chlorine	< 0.10 mg/L
TOC	< 1 mg/L
pH	5.5 - 7.5
EC	<2 µmhos/cm @ 25°C
	<2 µS (µsiemens/cm)
Trace Metals (Cd, Cr, Cu, Ni, Pb, Zn)	<0.05mg/L each collectively <0.1 mg/L
Bacteriological (HPC) Colony forming	<500 cfu (NELAC < 10000 cfu/ml)
Bacteriological Quality of Reagent Water (Suitability Ratio or Ratio of Growth Rate)	0.8: 3.0
Student's t	< 2.78 for annual use test

The washing and sterilization procedures for laboratory glassware are tested annually by testing glassware for inhibitory residues as shown in Standard Methods.

A completed test is conducted on 10% of all positive coliform samples. If no positives are found, at least one positive source water or control sample is completed quarterly.

Environmental monitoring is conducted weekly using PCA plates to measure background contamination occurring from bacteria, yeast and mold carried in the air. The number of colonies on the air density plate should not exceed 15 colonies/plate/15 minutes of exposure.

Method Evaluation

To demonstrate the suitability of a test method for its intended purpose, the laboratory ensures to meet the acceptance criteria by the EPA or State program requirements. Also, the laboratory must meet the following criteria per NELAC 5.Appendix D.3.3:

1) Accepted (official) test methods or commercialized test kits for official methods from recognized national or international standards organizations do not require a specific validation. However to demonstrate proficiency with the test method prior to first use, the laboratory performs comparison to a method already

approved for use in the laboratory, or by analyzing a minimum of ten spiked samples whose matrix is representative of those normally submitted to the laboratory, or by analyzing and passing one proficiency test series provided by an approved proficiency sample provider. The laboratory shall maintain this documentation as long as the method is in use and for at least 5 years past the date of last use [NELAC 5.Appendix D.3.3 a)], or 10-years to meet Hawaii requirements.

2) The laboratory participates in the proficiency test programs identified by NELAP [NELAC 5.4.1.5k)] or [NELAC 5.5.9.1b)]. The results of these analyses are used to evaluate the ability of the laboratory to produce acceptable data.

11.4.11 Asbestos

The sampling technique follows the methods outlined by EPA in Method 100.1- Analytical Method for Determining Asbestos Fibers in Water EPA-600/4-88-043, September 1983 and in Method 100.2. All samples are to be stored at 4 ^{0}C until filtration and completion of analysis.

Specific sampling instructions are available from the Microbiology Department. They list precautions to follow in order to maintain the integrity of the samples and prevent contamination.

The procedure is outlined in the Method 100.1/100.2. All modifications of procedures including reasons for modifications are recorded in the SOP.

All counts for calculations and report generation are entered into the H-P computer to eliminate inconsistency in the final report.

The manufacturers' manuals for proper operation of all equipment used in asbestos analyses are properly filed and accessible. Records of periodic inspection, calibration and service of equipment is maintained in appropriate logbooks. Phone numbers for instrument service are posted by each instrument.

A Blank using fiber-free water is processed each day that samples are filtered as stated in Method 100.1/100.2. The criterion for acceptability of bottle and process blanks is $\leq$ 0.01 MFL > 10 microns in length. If this limit is exceeded, the samples filtered on the same day as the blank must be re-filtered.

The lab participates in PT studies conducted twice a year.

All samples are filtered within 48 hours of sample collection. Samples received past 48 hours of collection are treated with O_3 –UV.

The absolute (HEPA) filtration system is monitored daily and filters are changed when needed.

Asbestos glassware is prepared using sonication as stated in the method.

When several grids of the same sample are counted, the deviation should not exceed ±15% as stated in the method.

The chi-square test is used to determine whether the fibers are randomly sized and uniformly distributed as stated in Method 100.1/100.2

Figure 11-1 Sample Quality Investigation Report (QIR)

Received by Supervisor on 10-jan-2003 08:17:22
QIR initiated by: nbc

QUALITY INVESTIGATION REPORT **QIR No.** GCVO0110815jdc070402jdc070402S6515GC18
Analysis date: 12/16/02 Analysis: @ML515.3
Analyst: rok Analytical instrument: GC23
Extraction Date: 12/08/02 Prepared By: rok

Group	Sample#	Sample ID	Customer	QC Ref	Test	PM
103444	2211270027	00896:RW35:QUILL PLA		189002	@ML515.3	LXG
103444	2211270027	00896:RW35:QUILL PLA		189002	@ML515.3	LXG

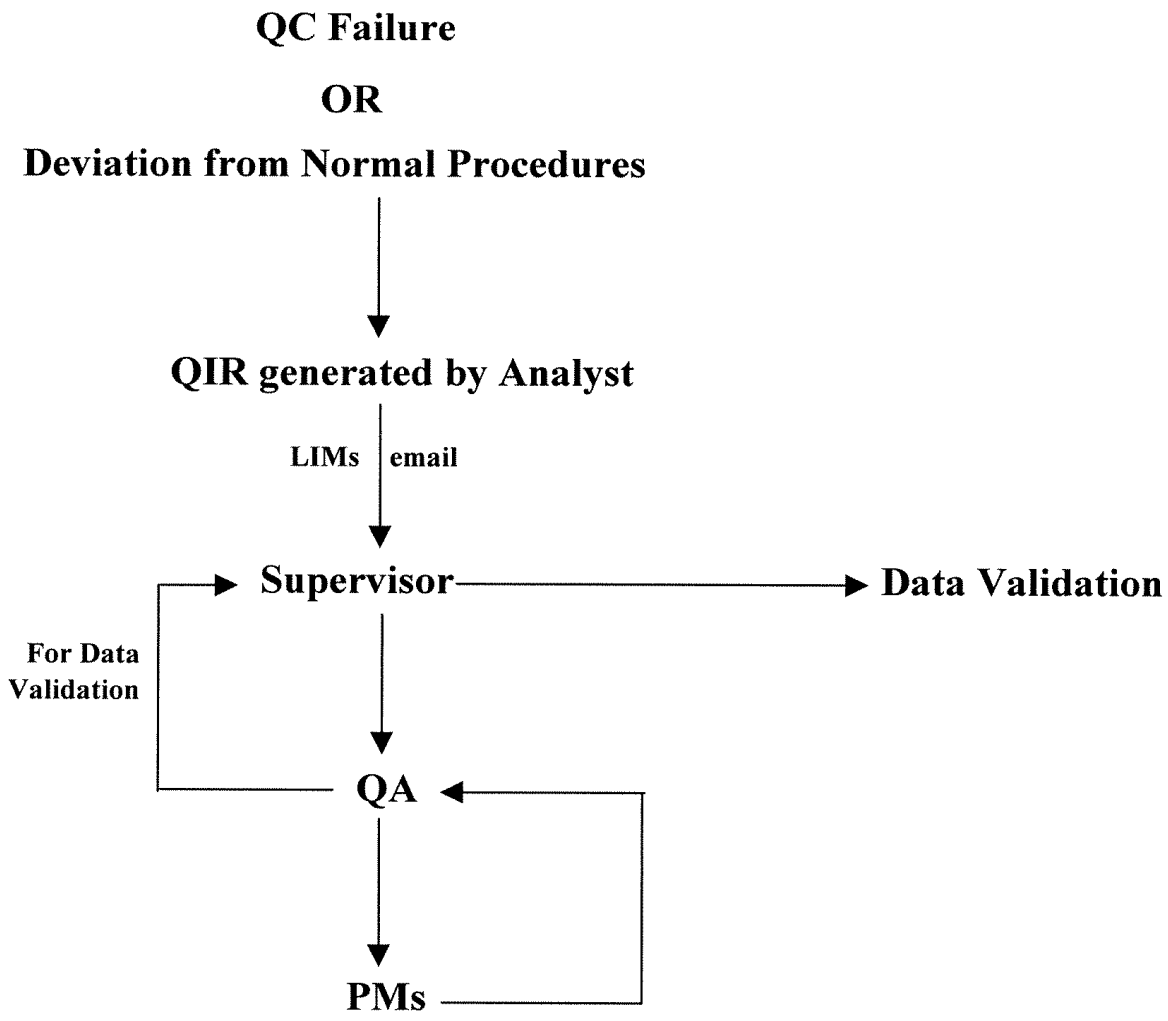
Brief Description: (include reason for non-compliance)
S6- Surrogate recovery was below laboratory and method
Test

Corrective Action Taken/Prevention:
Test

Impact on Data Quality:
Test

.
Data Disposition/Acceptable/Method/Regulations:
.
.
Annotation:
.
.
Client Contact:
.
.
Electronic Signatures:

Figure 11-2 Quality Investigation Report (QIR) Flow Chart



12.0 DATA REDUCTION, VALIDATION, AND REPORTING

The process of transforming raw analytical data into a finished report involves steps which are generally grouped into the categories of data reduction, data validation, and reporting. It involves mathematical modeling of the standard calibration curves, statistical analysis of the acquired data, calculations to account for preparation steps and dilution, verification of adherence to quality assurance procedures, and the generation of hardcopy output.

12.1. DATA REDUCTION

At MWH Laboratories the analyst performing an analysis has the primary responsibility for reducing raw data. This process consists of converting raw data values into final, reportable values by comparing individual sample results to those obtained for calibration purposes and then accounting for any dilution or concentration procedures.

The extent to which raw data from the instrument needs to be mathematically processed varies depending on the analysis. For the following methods finished data is directly read from the instrument; pH, conductivity, spectrophotometric/colorimetric measurements (i.e.: Chemical Oxygen Demand (COD), Chromium VI, phenols, phosphorus, Methylene Blue Activated Substances (MBAS, or commonly known as surfactant), odor and presence/absence bacteriological tests. Other methods require mathematical manipulation and in some cases, such as for pesticides by GC, qualitative assessment of actual presence.

Below is an outline of the data reduction techniques used.

12.1.1 GC

A data reduction software system is used to calculate target compound concentrations. These concentrations are calculated by multiplying the average response factor for the compound by the area count as determined by the instrument. Average response factors are determined through linear regression during initial calibration, and may only be used if the correlation criteria has been met. This assumes linearity of the calibration curve through the origin. If linearity is not established then a second order fit (logarithmic regression) may be used to determine response factors. Another alternative is to use single point calibration, which matches the area counts from a single calibration point to the area counts of the sample, upon which a sample concentration is determined. Single point calibration is rarely used. When method allows second order fits and single point calibrations are used as a temporary calibration; action is immediately taken to re-establish a linear calibration.

In all cases data is reduced by the data reduction software. Programs for linear, logarithmic and single point calibrations are available on command. Sample

dilution factors are entered into the data reduction software prior to analysis and calculated into the final result.

12.1.2 GC/MS

Reportable results are provided by the data reduction software for GC/MS analyses except for diluted samples For diluted samples the result from the system is multiplied by the dilution factor. Reporting limits are adjusted manually as well.

All regressions and calibration calculations are performed by the system software.

12.1.3 METALS

ICP & ICPMS results are processed and transferred directly into the LIMS system. Dilution and calibration information is entered and processed by the ICP software prior to data transfer.

System generated results GFAA are multiplied by 100 to compensate for the soil/solvent extraction ratio if samples are extracted.

All other results are reportable directly off the system.

12.1.4 HPLC / IC / SPECTROPHOTOMETRIC / POTENTIOMETRIC

All results are reportable directly off the system software or directly read off instrument. The cell constant for conductivity meter is 1. All samples and standards are allowed to come to room temperature prior to analysis. Temperature correction is not needed.

12.1.5 MICROBIOLOGY

The ability of an individual analyst to count colonies accurately shall be verified at least once per month, by having two or more analysts count colonies from the same plate on one positive sample. Counts must be within 10% difference to be acceptable [NELAC D 3.2].

12.2. RECORDS / CONTROL OF RECORDS

Figure 12.1 to 12.2 are example of worksheets and notebooks used in data reduction

Chromatograms and strip chart recordings are assigned unique alpha-numeric codes and backed-up on tape. Information contained within the code includes; test, date and numerical sequence.

Computer records are stored by internal sample ID and test and therefore can be queried on this information.

- Control of Records [NELAC 5.4.12]

1. The laboratory's document control procedures includes identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. Quality records include reports from internal audits and management reviews as well as records of corrective and preventive actions. Records are in the form of hard copy or electronic media.
2. All records are required to be legible and are stored and retained in such a way that they are readily retrievable in facilities that provide a suitable environment to prevent damage or deterioration and to prevent loss. Records are retained for 5 years held secure and in confidence [NELAC 5.4.12.1.3].
3. The laboratory has implemented procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records by setting up level of security and/or designating appropriate personnel responsible for the security of the records.
4. The following informations are documented as per NELAC 5.4.12.1.5.
   a) The records include the identity of personnel involved in sampling, sample receipt, preparation, calibration or testing.
   b) All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.
   c) The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes by setting format for naming electronic files.
   d) All changes to records are signed or initialed by responsible staff. The reason for the signature or initials are clearly indicated in the records such as "sampled by", "prepared by", or "reviewed by".
   e) All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent ink. (NELAC 5.4.12.15.e).
   f) Entries in records are not obliterated by methods such as erasures, overwritten files or markings. All corrections to record keeping errors are made by one line marked through the error. The individual making the correction signs (or initials) and date the correction. These criteria also apply to electronically maintained records [NELAC 5.4.12.1.5.f]. The laboratory keeps correspondence relating to lab activities for specific project. Documentation includes email correspondence between Project Manager and client.

- Technical Records [NELAC 5.4.12.2]

1. The laboratory retains technical records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each test report issued, for a defined period. The record for each environmental test or calibration contains sufficient information to facilitate and to enable the environmental test to be repeated under conditions as close as possible to the original. The records include the identity of personnel responsible for the performance of each environmental test and checking of results.
2. Observations, data and calculations are recorded at the time they are made and are identifiable to the specific task.

3. When mistakes occur in records, each mistake is crossed out, not erased, made illegible or deleted, and the correct value entered alongside. All such alterations to records are signed and initialed by the person making the correction. In the case of records stored electronically, equivalent measures are taken to avoid loss or change of original data. When corrections are due to reasons other than transcription errors, the reason for the correction shall be documented (NELAC 5.4.12.2.3).
4. Each report or documents issued shall include the name(s), function(s) and signature(s) or equivalent electronic identification of person(s) authorizing the report or documents, and date of issue. Use of computer password unique to each analyst and level of security prevents loss of original data and change of data.

12.3. DATA VALIDATION

Upon completion of each analytical run, the analyst fills out analytical raw data and QC summary sheets. Depending on the test, data entry is made into the LIMS. Entries are then reviewed by the analytical Supervisor or a backup peer analyst. They verify that all quality control parameters (including all those specified for each method in Section 11) fall within acceptance limits and also review the analytical data for calculation errors and inconsistencies. The raw data review includes all documentation associated with the samples, including chromatograms, instrument run logs, digestion logs, and other instrument printouts. Upon approval, the analyst enters the data into the computer. When all analytical results for a sample have been entered, a report is generated on the computer for screen validation by the Supervisor. Approved reports are batch printed each day. The Supervisor reviews and validates all of the reports in a report group. Validated reports are batch printed and reviewed by the Project manager.

All logbooks such as sample preparation, instrument maintenance, calibration, internal custody, and disposal are reviewed by the supervisor or manager of that group. Initials and date of review will be written on the final page reviewed. The review will focus on completeness, accuracy, trends and opportunities for improvement and compliance.

12.4. DATA REVIEW POLICY / CORRELATION OF RESULTS

All analytical data must be reviewed by a peer analyst qualified in that analysis or the group supervisor. Supervisors are ultimately responsible for the quality of reported results. Data review includes the following:

- Checking all QC data against the QC criteria.
- All the sample calculations must be checked. Samples, which are spot checked, must be marked by the reviewing analyst.
- The analytical run sheet must be signed by the primary analyst and the reviewing peer analyst. Changes to records must be signed and initialed by responsible staff [NELAC 5.4.12.1.5. d)].
- All Supervisors must spot check at least 5% of the data sheets. For inorganics and metals they must verify data entry for those samples by checking the database.

The Supervisor must initial each run sheet they review. For organics, the Supervisor must cross check at least one report per day for transcription error from bench sheets.

- All Supervisors must validate the data reported into the computer system. The Operations Manager then reviews and validates the final reports electronically. The reports are then printed and reviewed by the Project Manager.

- As part of the periodic system audits, the Quality Assurance Manager or QA staff must spot check data sheets to insure that the peer reviews are being performed and that review process is traceable to the peer review.

- Correlation of results for different characteristics of a sample (example Total Phosphate $\geq$ to Orthophosphate [NELAC 5.5.9.1e)]

12.5. DATA REPORTING

To meet the NELAC report requirement, the laboratory provides the following information in the final test report:

1. A Title
2. Name/address of laboratory
3. Phone number and name of contact person
4. Unique identification of the certificate or report and unique identification of each page, and the total number of pages
5. Name and address of client, where appropriate and project name if applicable
6. Description and unambiguous identification of the tested sample including the client identification code
7. Identification of results derived from samples that did not meet NELAC acceptance requirements such as improper container, holding time, or temperature. [NELAC 5.5.10.3.1 b)]
8. Date of receipt of sample, date and time of sample collection, date(s) of performance test, and time of sample preparation and/or analysis if the required holding time for either activity is less than or equal to 72 hours [NELAC 5.5.10.2g)]
9. Identification of the test method used, or unambiguous description of any non-standard method used.
10. Qualification of numerical results with “E1-E7” flags for values outside the working range. [NELAC 5.5.10.3.1 f)]
11. Any deviations from, additions to or exclusions from the test method, and any other information relevant to a specific test, such as environmental conditions including the use of relevant data qualifiers and their meaning
12. Measurement, examinations and derived results and identification of any failures (such as failed quality control). Radiochemistry results shall be reported with associated measurement uncertainty [NELAC D.4.6]
13. Identification whether the data are calculated on dry weight or wet weight, reporting units and when required a statement of the estimated uncertainty of the test result
14. Signature and title of the person(s) accepting responsibility for the content of the report and date of issue

15. Clear identification of all data provided by outside sources (subcontracted laboratories, clients, Non-NELAP accredited work, etc.)
16. Clear indication of numerical results with values outside of quantitation limits. Test results provided by subcontracted laboratories are identified by subcontractor name or applicable accreditation number.

When the validation steps are completed, and the managers and supervisors have keyed in their initials in the appropriate LIMS field to reflect this, the report number is automatically transferred to an electronic listing in LIMS. Reports on this list are printed out daily. The reports are reviewed for correctness against the data in LIMS and signed off by the project manager prior to being copied for the files and delivery to the client. An example of an analysis report form is shown in Figure 12.3, page 11. On page 17-18 is a sample QC Report in Figure 12.4. After the report is issued to the client, the laboratory reports remain unchanged. The report shall not be reproduced except in full, without the written approval of the laboratory. (NELAC 5.5.10.2.L). After issue of report, material amendments to the test report is done in the form of further document or data transfer including the statement "Supplement to test report, group number _____". For MWH revised report, cover page – report # xxxxxx'r'. Comment, report # xxxxxx'r' replaces the original test report. Also, amendments to the formal report must meet all the NELAC reporting requirements. The laboratory notifies clients in writing of any event such as the identification of defective measurement or test equipment that casts doubt on the validity of results given in any test report or amendment to a report [NELAC 5.13.13.2]. The laboratory also ensures that the NELAC reporting requirements are met for test results transmitted by telephone, telex, facsimile or other electronic or electromagnetic means and that all reasonable steps taken to preserve client confidentiality. Final laboratory report includes a statement in the cover page "Laboratory certifies that the test results meet all NELAC requirements unless noted in the comments section or the Case Narrative".

If Client requires monthly reports of data that does not include all items listed in 12.5, the laboratory is still required to provide all information in standard NELAC report format required by the Client for use in preparing such regulatory reports [NELAC 5.5.10.1 and NELAC 5.5.10.9 – Amendments to Test Reports and Calibration Certificates].

Electronic Transmission of Results:

In the case of transmission of environmental test results by telephone, telex, facsimile or other electronic means, the laboratory ensures preservation of Client confidentiality by attaching a cover page that includes to following statement: "This transmission and/or attachments contain information which are confidential and/or privileged. The information is intended for the addressee only. If you are not the intended recipient, any dissemination, distribution or copying of this communication is prohibited. If you have received this communication in error, please notify and return the original communication to the sender"[NELAC 5.5.10.7].

12.6. DATA STORAGE

MWH Laboratories maintains hardcopy report files and the supporting raw data for 3 years, electronic files onsite for 10 years, hard copies offsite for 3 years, after 3 years discard hardcopy and keep the electronic files for a total of 10 years. Arizona and Wisconsin want the original hard copy (not e-file). The report files are organized alphabetically by client and contain a copy of the report sent to the client, custody information and scheduling information. These files are centrally located and a custodian is assigned to maintain, retrieve, and copy files as needed. Reports and raw data are maintained for a total of ten years in a secured data storage facility. All data stored include subcontractor report.

Instrument raw data is stored on magnetic medium. Data is backed-up weekly onto tape and stored in the specific laboratory. If instruments are direct read and transcribed into notebooks, then the notebooks are stored in the lab until they are filed. At this point they are kept by the group manager and may be archived to the storage facility after 2 years.

All raw data is organized by instrument or test, then chronologically. Logbooks such as sample custody or balance calibration are organized chronologically.

Electronic data from LIMS is stored on tape reels.

12.7. DOCUMENT CONTROL

Document Control procedures are implemented that allow for adequate documentation and control of specific documents. These procedures use a unique identification system that allows for tracking, training documentation, traceability of official copies and the time period the procedure or document was in force. Documents issued to all personnel in the laboratory as part of the QS shall be reviewed and approved for use to authorized personnel prior to use. The list will identify the current revision status to ensure that invalid or obsolete documents are not used. The document control procedures includes that the authorized editions of documents are accessible by the analysts and invalid or obsolete documents are promptly removed from use. All QS documents such as SOP, QAM, logbooks are uniquely identified including the following;

1. Date of issue and/or revision ID
2. Page numbering
3. Total number of pages or markings to signify end of documents.
4. Issuing authorities [NELAC 5.4.3.2]

To ensure that QA Manual and SOPs remained controlled documents, the master SOPs and QA Manual (original official version of the SOP and QA Manual) and copies of the SOP and QA Manual will be identified. The cover page of each copy will contain a unique identification indicating that the document is controlled copy ___ of ____ copies, initialed and dated by the QA Officer in red ink. This ensures that the analyst is currently using the right update or version.

A SOP/ QA Manual Distribution Form will be prepared for each SOP/ QAM that will include the SOP/QAM ID, control number, individual receiving the SOP/QA Manual, date of issue and the date of completion of the analyst SOP/QAM training documentation.

Record management system is also implemented for control of laboratory notebooks; instrument logbook; standard logbook; and records for data reduction validation storage and reporting. Laboratory archival system will also be implemented to laboratory books and logbooks.

Notebooks and Logbooks are assigned unique ID number for control of laboratory records. Upon completion of the book, the analyst returns the book to QA. A new number is assigned to the newly issued notebook. See Table 12-1, page 9 for the laboratory document control system for notebooks and logbooks.

Changes to documents shall be reviewed and approved by the same function that performed the original review unless specifically designated otherwise. The designated personnel shall have access to pertinent background information upon which to base their review and approval.

12.8. ARCHIVAL SYSTEM

An archival system is implemented for managing and removal of all outdated documentation. Records that are archived are; Training Records for personnel no longer with the laboratory; Outdated QA Manual/SOPs, only current versions of the QA Manual/SOPs are retained in the laboratory areas. All outdated versions of the QA Manual/SOPs are returned to the QA Officer for archiving. In addition all outdated logbooks/workbooks including maintenance books are turned in to the QA Officer for archiving. Archived information is stored in-house for 2 years and is transferred off-site, for storage after 2 years. Archived information is documented in an access logbook kept by the QA Officer identifying the type of record archived and the date the record is archived and stored for 10 years.

12.9. GOOD AUTOMATED LABORATORY PRACTICES (GALP)

The laboratory assures that all requirements of the NELAC standard are complied with where computers or automated equipment are used for the capture, processing, manipulation, recording, reporting, storage or retrieval of test data.

Section 8.1 through 8.11 of the EPA document 2185 – GALP is adopted by the laboratory for its computer use even though GALP is not part of NELAC standard requirements. The laboratory ensures that the computer software is adequate for use and documented. To protect the integrity of data entry or capture, data storage, data transmission and data processing, the laboratory establishes and implements procedures in compliance to good automated laboratory practices. In addition, appropriate procedures are established for computer and automated equipment to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of calibration and test data. Also the laboratory establishes and implements appropriate

procedures for the maintenance of security of data including the prevention of unauthorized access to and the unauthorized amendment of computer records. The laboratory LIMS system provides several levels of security. The first level is the entry of a password to initially log on to the computer, then the person must be designated as a qualified user of multi-LIMS. Additionally, the department to which a person is assigned governs accesses to the various functions of the system. The system also provides for read – only access to results to further protect the data from unauthorized modification or deletion. See laboratory GALP SOP for the Implementation of Good Automated Laboratory Practices. Implementation of the GALP includes data point comparison and manual calculations to test LIMS accuracy to be done during the data package review by the Quality Assurance Unit (QAU) (QAM section 14.2.1). LIMS Audit Report form will be completed to document results of the LIMS audit. The laboratory QA group will ensure that all corrective actions are done when deficiencies are observed.

Figure 12.1 Sample Worksheet

PHENOL - LF

PHENOL/EPA METHOD 420.1

7-9-04

ANALYST:

Date of Analysis: 7.7.04

Date of Digestion: 7.6.04

For all reported samples:
Are all Instrument Performance Check Samples (IPC) within 80-120%: (Y) N
Are all Calibration Blanks (CB) less than MRL 0.01 ppm: (Y) N
Is the MRL standard recovery within 50-150%: (Y) N
Is the Correlation Coefficient of the Standard Curve >= 0.995: (Y) N

Sample I.D.	Dilution Factor	Final conc. (mg/L)	Percent Recovery (%)	Acceptance Limit	Comment
Initial Calibration Verification (ICV)	1	0.200	100%	90-110% Rec (0.18-0.22)	True Value 0.2 ppm (mg/L)
Initial Calibration Blank (ICB)	1	ND	NA	< 0.01ppm	
MRL	1	0.009	90.0%	50%-150% Rec (0.005 - 0.015)	True value - 0.01 ppm (mg/L)
LFB	1	0.0501	100%	80-120% Rec (0.04 - 0.06)	True value - 0.05 ppm (mg/L)
Method Blank	1	ND	NA	< 0.01ppm	
LCS - 1		0.0424	84.8%	80-120% Rec (0.04 - 0.06)	True value - 0.05 ppm (mg/L)
LCS - 2 (duplicate)		0.0436	87%	80-120% Rec (0.04 - 0.06)	True value - 0.05 ppm (mg/L)
Spiked Sample 1. 240702 0001		ND			
Laboratory Fortified Matrix (LFM/MS)		0.043	86%	80-120% Rec (0.04 - 0.06)	True value - 0.05 ppm (mg/L)
Laboratory Fortified Matrix DUP (LFMD/MSD)		0.044	88%	80-120% Rec (0.04 - 0.06)	True value - 0.05 ppm (mg/L)
2. 240702 0012		ND			
3. 0014		ND			
4. 0016		ND			
5. 0037		0.014			
6. 240619 0113		0.197			
7. " 0114		0.113			
8. 240701 0145		0.095			
9.		~~NA~~			
10.					
Continuing Calibration Blank (CCB)	1	ND	NA	< 0.01ppm	
LFB	1	0.05	100%	80-120% Rec (0.04 - 0.06)	True value - 0.05 ppm (mg/L)
Continuing Calibration Verification (CCV)	1	0.099	99%	90%-110% (0.09 - 0.11)	True value - 0.1 ppm (mg/L)
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
Continuing Calibration Blank (CCB)	1		NA	< 0.01ppm	
LFB	1			80-120% Rec (0.04 - 0.06)	True value - 0.05 ppm (mg/L)
Continuing Calibration Verification (CCV)	1			90%-110% (0.09 - 0.11)	True value - 0.1 ppm (mg/L)

Figure 12.2 Example Notebook

Referenced Methods: *EPA 525.2*				Batch #:					
Start Date:		Init:		Matrix: *water*					
Comp Date:		Init:		Reagent H2O: *Ultrapure* mfg/lot					
QC'd:		Init:		Solvent: MeOH *EM* mfg/lot					
Solutions: *50% HCl*	Prep Date:			EtAc *EM* mfg/lot					
	Prep Date:			MeCl2 *EM* mfg/lot					
	Prep Date:			Salt: Na2SO4 *EM* mfg/lot					
	Prep Date:			Na2SO3 *JTBaker* mfg/lot					
Room temp:	Chiller Temp:			Disk/Cartridge: C18HC *JTBaker* mfg/lot					
Bath temp:	Heater Temp:			Vacuum (in Hg):					
Surr/IS Spk Soln#:		Exp:		Volume:		Syringe Lot #:			
LFB/LFM Spk Soln#:		Exp:		Volume:		Syringe Lot #:			
LFB/LFM Spk Soln#:		Exp:		Volume:		Syringe Lot #:			
UCMR Spk Soln#:		Exp:		Volume:		Syringe Lot #:			
MDL Spk Soln#:		Exp:		Volume:		Syringe Lot #:			
Terphenyl-d14 Spk Soln#:		Exp:		Volume:		Syringe Lot #:			

Group	Sample #	Client Code	Sample Source	Test Code	Vi (mL)	Vf (mL)	pH	Cl- ppm	Ext#
Click here and insert left of this line – delete before move									
LRB									
LFB1									
LFB2									
LFB3									
LFM									
LFMD									
DUP									
LFM2									

Batch Comments:

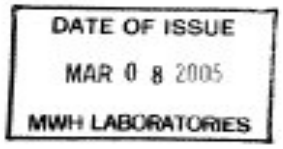
Figure 12.3 Example Analysis Report Form

Laboratory Report

for

MWH LABS

Attention: NILDA COX



NBC Nilda Cox
Project Manager

Report#: 141133

L ratory certifies that the test results meet all **NELAC** requirements unless noted in the Comments section or the Case Narrative. Following the cover page are Comments,QC Report,QC Summary,Data Report,Hits Report, totaling 86 page[s].

Figure 12.3 Example Analysis Report Form (con't)

FOR OFFICE USE ONLY

GROUP 141133
Date 03/07/05
Your Purchase order no. ERA WP120 PT JAN 05

Remit to:
MWH Laboratories
750 Royal Oaks Drive
Suite 100
Monrovia, CA 91016
PHONE:626-386-1100
FAX:626-386-1101

Ship To
MWH LABS

Attn: NILDA COX
PHONE:
FAX:

Sold To
MWH LABS

Rep To: NILDA COX
PHONE:
FAX:

QUANTITY	DESCRIPTION SAMPLE DATE	UNIT PRICE	TOTAL AMOUNT
1	2-Chloroethylvinylether**	0.00	0.00
	ID:ERA 16 WP120 VOLATIL/#2501130034		
2	BNA Extractable**	0.00	0.00
	ID:ERA 22 WP120 BASE NE/#2501130040		
	ID:ERA 24 WP120 ACIDS/#2501130042		
1	Purgeable Halocarbons**	0.00	0.00
	ID:ERA 16 WP120 VOLATIL/#2501130034		
1	Purgeable Aromatics**	0.00	0.00
	ID:ERA 16 WP120 VOLATIL/#2501130034		
1	N-Nitroso dimethylamine (NDMA)**	0.00	0.00
	ID:ERA 23 WP120 NDMA/#2501130041		
2	Polychlorinated Biphenyls(PCB)**	0.00	0.00
	ID:ERA 17 WP120 PCB1/#2501130035		
	ID:ERA 18 WP120 PCB2/#2501130036		
3	Pesticides/PCBs**	0.00	0.00
	ID:ERA 19 WP120 PESTICI/#2501130037		
	ID:ERA 20 WP120 CHLORDA/#2501130038		
	ID:ERA 21 WP120 TOXAPHE/#2501130039		
1	Volatile Organics HSL**	0.00	0.00
	ID:ERA 16 WP120 VOLATIL/#2501130034		
1	Silver, Total, ICAP**	0.00	0.00
	ID:ERA 9 WP120 TRACE ME/#2501130027		
1	Silver, Total, ICAP/MS**	0.00	0.00
	ID:ERA 9 WP120 TRACE ME/#2501130027		
1	Aluminum, Total, ICAP**	0.00	0.00
	ID:ERA 9 WP120 TRACE ME/#2501130027		
1	Aluminum, Total, ICAP/MS**	0.00	0.00
	ID:ERA 9 WP120 TRACE ME/#2501130027		
1	Alkalinity in CaCO3 units**	0.00	0.00
	ID:ERA 11 WP120 MINERAL/#2501130029		
1	Arsenic, Total, GF**	0.00	0.00
	ID:ERA 9 WP120 TRACE ME/#2501130027		

** - No Charge x 0.00

TERMS - PAY UPON RECEIPT - 18% Charge per year on past due accounts.

1 of 5

Figure 12.3 Example Analysis Report Form (con't)

MWH Laboratories
A Division of MWH Americas, Inc.
750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Hits Report #141133

MWH LABS
NILDA COX

Samples Received
13-jan-2005 11:08:49

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2501130040	ERA 22 WP120 BASE NEUTRAL				
02/14/05	4-Bromophenylphenylether		163		ug/l	20
02/14/05	4-Chlorophenylphenylether		92.6		ug/l	5.0
02/14/05	Acenaphthylene		18.4		ug/l	5.0
02/14/05	Anthracene		60.8		ug/l	5.0
02/14/05	Benzo(a)anthracene		35.6		ug/l	5.0
02/14/05	Benzo(a)pyrene		19.4		ug/l	5.0
02/14/05	Benzo(b)fluoranthene		28.7		ug/l	5.0
02/14/05	Benzo(g,h,i)perylene		25.0		ug/l	10
02/14/05	Butylbenzylphthalate		181		ug/l	20
02/14/05	Chrysene		41.2		ug/l	5.0
02/14/05	Di(2-Ethylhexyl)phthalate		79.2		ug/l	4.0
02/14/05	Di-n-butylphthalate		153		ug/l	40
02/14/05	Di-n-octylphthalate		27.2		ug/l	10
02/14/05	Diethylphthalate		26.3		ug/l	5.0
02/14/05	Dimethylphthalate		94.6		ug/l	5.0
02/14/05	Fluoranthene		27.4		ug/l	5.0
02/14/05	Fluorene		15.7		ug/l	5.0
02/14/05	Hexachlorocyclopentadiene		47.6		ug/l	10
02/14/05	Hexachloroethane		57.9		ug/l	5.0
02/14/05	Indeno(1,2,3-c,d)pyrene		28.6		ug/l	10
02/14/05	Isophorone		155		ug/l	20
02/14/05	N-Nitrosodi-N-propylamine		49.5		ug/l	5.0
02/14/05	N-Nitrosodimethylamine		67.5		ug/l	5.0
02/14/05	Naphthalene		79.2		ug/l	5.0
02/14/05	Phenanthrene		48.1		ug/l	5.0
02/14/05	Pyrene		39.0		ug/l	5.0
02/14/05	bis(2-Chloroethoxy)methane		42.6		ug/l	10
02/14/05	bis(2-Chloroethyl)ether		93.0		ug/l	10
02/14/05	bis(2-Chloroisopropyl)ether		74.3		ug/l	10
02/14/05	m-Dichlorobenzene (1,3-DCB)		79.0		ug/l	5.0

SUMMARY OF POSITIVE DATA ONLY.

Figure 12.3 Example Analysis Report Form (con't)

MWH Laboratories

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Hits Report #141133

MWH LABS
NILDA COX

Samples Received
13-jan-2005 11:08:49

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2501130040	ERA 22 WP120 BASE NEUTRAL				
	2501130041	ERA 23 WP120 NDMA				
01/26/05	N-Nitroso dimethylamine (NDMA)		75000		ng/l	2000
	2501130042	ERA 24 WP120 ACIDS				
02/14/05	2,4,5-Trichlorophenol		69.7		ug/l	5.0
02/14/05	2,4,6-Trichlorophenol		37.9		ug/l	5.0
02/14/05	2,4-Dichlorophenol		34.7		ug/l	5.0
02/14/05	2,4-Dimethylphenol		36.4		ug/l	5.0
02/14/05	2,4-Dinitrophenol		113		ug/l	50
02/14/05	2-Chlorophenol		77.4		ug/l	5.0
02/14/05	2-Methylphenol		84.3		ug/l	5.0
02/14/05	2-Nitrophenol		35.0		ug/l	5.0
02/14/05	4,6-Dinitro-o-cresol		121J		ug/l	200
02/14/05	4-Methylphenol		78.7		ug/l	5.0
02/14/05	4-Nitrophenol		55.5		ug/l	10
02/14/05	Pentachlorophenol		121		ug/l	80
02/14/05	Phenol		104		ug/l	5.0
02/14/05	p-Chloro-m-cresol		82.9		ug/l	5.0
	2501130043	ERA 25 WP120 BORON				
01/25/05	Boron, Total, ICAP		7.30		mg/l	0.25
	2501130044	ERA 26 WP120 MBAS				
01/18/05	Surfactants		0.415	0.5	mg/l	0.050

SUMMARY OF POSITIVE DATA ONLY.

Figure 12.3 Example Analysis Report Form (con't)

MWH Laboratories

350 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory Hits Report #141133

MWH LABS
NILDA COX

Samples Received
13-jan-2005 11:08:49

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2501130037	**ERA 19 WP120 PESTICIDES**				
02/04/05	Alpha-BHC		4.50		ug/l	1.0
02/04/05	Beta-BHC		4.27		ug/l	1.0
02/04/05	Delta-BHC		23.7		ug/l	4.0
02/04/05	Dieldrin		1.10		ug/l	0.20
02/04/05	Endosulfan I (alpha)		22.3		ug/l	4.0
02/04/05	Endosulfan II (beta)		28.7		ug/l	4.0
02/04/05	Endosulfan sulfate		24.6		ug/l	4.0
02/04/05	Endrin		7.52		ug/l	0.50
02/04/05	Endrin Aldehyde		5.47		ug/l	1.0
02/04/05	Endrin Ketone		7.94		ug/l	1.0
02/04/05	Gamma-BHC		15.9		ug/l	2.0
02/04/05	Heptachlor		0.722		ug/l	0.050
02/04/05	Heptachlor Epoxide		0.858		ug/l	0.050
02/04/05	Methoxychlor		7.08		ug/l	2.0
02/04/05	p,p' DDD		5.92		ug/l	1.0
02/04/05	p,p' DDE		4.22		ug/l	1.0
02/04/05	p,p' DDT		3.97		ug/l	0.40
	2501130038	**ERA 20 WP120 CHLORDANE**				
02/04/05	Chlordane		9.19		ug/l	1.0
	2501130039	**ERA 21 WP120 TOXAPHENE**				
02/05/05	Toxaphene		2.05		ug/l	0.50
	2501130040	**ERA 22 WP120 BASE NEUTRAL**				
02/14/05	2,4-Dinitrotoluene		22.6		ug/l	5.0
02/14/05	2-Chloronaphthalene		43.5		ug/l	5.0

SUMMARY OF POSITIVE DATA ONLY.

Figure 12.3 Example Analysis Report Form (con't)

MWH Laboratories
A Division of MWH Americas, Inc.
750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
Hits Report
#141133

MWH LABS
NILDA COX

Samples Received
13-jan-2005 11:08:49

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2501130040	ERA 22 WP120 BASE NEUTRAL				
	2501130041	ERA 23 WP120 NDMA				
01/26/05	N-Nitroso dimethylamine (NDMA)		75000		ng/l	2000
	2501130042	ERA 24 WP120 ACIDS				
02/14/05	2,4,5-Trichlorophenol		69.7		ug/l	5.0
02/14/05	2,4,6-Trichlorophenol		37.9		ug/l	5.0
02/14/05	2,4-Dichlorophenol		34.7		ug/l	5.0
02/14/05	2,4-Dimethylphenol		36.4		ug/l	5.0
02/14/05	2,4-Dinitrophenol		113		ug/l	50
02/14/05	2-Chlorophenol		77.4		ug/l	5.0
02/14/05	2-Methylphenol		84.3		ug/l	5.0
02/14/05	2-Nitrophenol		35.0		ug/l	5.0
02/14/05	4,6-Dinitro-o-cresol		121J		ug/l	200
02/14/05	4-Methylphenol		78.7		ug/l	5.0
02/14/05	4-Nitrophenol		55.5		ug/l	10
02/14/05	Pentachlorophenol		121		ug/l	80
02/14/05	Phenol		104		ug/l	5.0
02/14/05	p-Chloro-m-cresol		82.9		ug/l	5.0
	2501130043	ERA 25 WP120 BORON				
01/25/05	Boron, Total, ICAP		7.30		mg/l	0.25
	2501130044	ERA 26 WP120 MBAS				
01/18/05	Surfactants		0.415	0.5	mg/l	0.050

SUMMARY OF POSITIVE DATA ONLY.

Hits Report - Page 9 of 11

Figure 12.4 Example QC Report Form

MWH Laboratories
A Division of MWH Americas, Inc.

753 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: 626 386 1100
Fax: 626 386 1101
1 800 566 LABS (1 800 566 5227)

Laboratory
QC Report
#141133

MWH LABS
(continued)

MED	Ammonia Nitrogen	1.00	0.946	MGL	94.5	(90-110)	0.00

QC Ref #258971 Hexavalent chromium (Cr VI)

QC	Analyte	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPD (%)
LCS1	Hexavalent chromium (Cr VI)	0.050	0.0494	MGL	98.8	(85-115)	
LCS2	Hexavalent chromium (Cr VI)	0.050	0.0486	MGL	97.6	(85-115)	1.2
MBLK	Hexavalent chromium (Cr VI)	ND	<0.005	MGL			

QC Ref #258980 Total Organic Halogen

QC	Analyte	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPD (%)
MS	Spiked sample	Lab # 26	01180021	UGL		(0-0)	
LCS1	Total Organic Halogen	10	11.8	UGL	118.0	(85-115)	
LCS2	Total Organic Halogen	200	200	UGL	100.0	(85-115)	
MBLK	Total Organic Halogen	ND	<10	UGL			

QC Ref #259000 Purgeable Halocarbons

QC	Analyte	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPD (%)
LCS1	1,1,1-Trichloroethane	5.0	4.58	UGL	103.7	(61-136)	
LCS2	1,1,1-Trichloroethane	4.5	4.56	UGL	101.8	(61-136)	8.5
MBLK	1,1,1-Trichloroethane	ND	<0.50	UGL			
LCS1	1,1,2-Trichloroethane (1,1,2-T	4.0	4.36	UGL	108.5	(39-136)	
LCS2	1,1,2-Trichloroethane (1,1,2-T	4.0	3.63	UGL	85.8	(39-136)	12
MBLK	1,1,2-Trichloroethane (1,1,2-T	ND	<0.50	UGL			
LCS1	1,1-Dichloroethane	4.0	4.35	UGL	107.2	(28-167)	
LCS2	1,1-Dichloroethane	4.0	3.85	UGL	97.2	(28-167)	9.8
MBLK	1,1-Dichloroethane	ND	<0.50	UGL			
LCS1	1,1-Dichloroethene	4.0	4.31	UGL	107.7	(47-132)	
LCS2	1,1-Dichloroethene	4.0	4.01	UGL	100.2	(47-132)	7.2
MBLK	1,1-Dichloroethene	ND	<0.50	UGL			
LCS1	o-Dichlorobenzene (1,2-DCB)	4.0	5.36	UGL	134.0	(0-208)	

Spikes which exceed limits and Method Blanks with positive results are highlighted by Underlining. Criteria for MS and DUP are advisory only. Batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.

Figure 12.4 Example QC Report Form (con't)

MWH Laboratories
A Division of MWH Americas, Inc.

700 Royal Oaks Drive, Suite 100
Monrovia, California 91016-6520
Tel: 626 386 1100
Fax: 626 386 1101
1 (800) 566 LABS (1 800 566 5227)

Laboratory
QC Report
#141133

MWH LABS
(continued)

QC Ref #260616 Chloride

QC	Analyte	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPD (%)
LCS1	Chloride	25	24.6	MGL	98.4	(90-110)	
LCS2	Chloride	25	24.6	MGL	98.4	(90-110)	0.00
MBLK	Chloride	ND	<1.0	MGL			
MS	Chloride	25	26.9	MGL	107.6	(80-120)	
MSD	Chloride	25	27	MGL	108.0	(80-120)	0.37

QC Ref #260649 Nitrate + Nitrite as N by RFA

QC	Analyte	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPD (%)
MS	Spiked sample	Lab # 25	01280005	MGL		(0-0)	
LCS1	Nitrate + Nitrite as N by RFA	1.0	1.00	MGL	100.0	(90-110)	
LCS2	Nitrate + Nitrite as N by RFA	1.0	1.00	MGL	100.0	(90-110)	0.00
MBLK	Nitrate + Nitrite as N by RFA	ND	<0.50	MGL			
MS	Nitrate + Nitrite as N by RFA	1.0	1.03	MGL	103.0	(90-110)	
MSD	Nitrate + Nitrite as N by RFA	1.0	1.03	MGL	103.0	(90-110)	0.00

QC Ref #260656 Total Chlorine Residual

QC	Analyte	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPD (%)
LCS1	Total Chlorine Residual	1.0	0.96	MGL	96.0	(85-115)	

QC Ref #260717 Polychlorinated Biphenyls(PCB)

QC	Analyte	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPD (%)
LCS1	PCB 1016 Aroclor	2.0	1.98	UGL	98.8	(50-114)	
LCS2	PCB 1016 Aroclor	2.0	1.98	UGL	99.8	(50-114)	1.0
MBLK	PCB 1016 Aroclor	ND	<0.50	UGL			
MS	PCB 1016 Aroclor	2.0	2.08	UGL	104.0	(50-114)	

Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and DUP are advisory only. batch control is based on LCS. Criteria for duplicates
are advisory only. unless otherwise specified in the method.

Figure 12.5 Example Analysis Report (Report Comment)

MWH Laboratories
A Division of MWH Americas, Inc.

750 Royal Oaks Drive
Suite 100
Monrovia, California 91016-3629
Tel: 626 568 6400
Fax: 626 568 6324
1 800 566 LABS (1 800 566 5227)

Report Comments #103868

Group Comments

Analytical results for TBTSUB are submitted by East Bay Municipal Utilities District, Oakland,CA. CA ELAP #1060.

(QC Ref#: 2212110016)
Test: Subcontracted Analyses ( )
Metals SB,AS,BE,CD,CR,CU,PB,HG,NI,SE,AG,TL,ZN; 524.2, Mercury by 1631.

(QC Ref#: 2212110018)
Test: Subcontracted Analyses ( )
Metals SB,AS,BE,CD,CR,CU,PB,HG,NI,SE,AG,TL,ZN; 524.2, Mercury by 1631.

(QC Ref#: 2212110019)
Test: Subcontracted Analyses ( )
524.2

(QC Ref#: 2212110020)
Test: Subcontracted Analyses ( )
524.2

(QC Ref#: 2212110023)
Test: Subcontracted Analyses ( )
Results for Sulfite by EPA 300.0 are submitted by Sierra Environmental Monitoring, Reno, NV.

(QC Ref#: 2212110024)
QC Type: Y
CUSTSUB FOR SULFITE
Test: Subcontracted Analyses ( )
Results for Sulfite by EPA 300.0 are submitted by Sierra Environmental Monitoring, Reno, NV.

Figure 12.6 Example QC Report (QC Summary)

MWH Laboratories

Laboratory
QC Summary
#141133

MWH LABS
(continued)

QC Ref #259377 - Total Organic Carbon **Analysis Date: 01/24/2005**

2501130021 ERA 3 WP120 DEMAND

QC Ref #259406 - Strontium, ICAP **Analysis Date: 01/27/2005**

2501130027 ERA 9 WP120 TRACE METALS

QC Ref #259649 - Arsenic, Total, ICAP/MS **Analysis Date: 01/28/2005**

2501130027 ERA 9 WP120 TRACE METALS

QC Ref #259666 - Selenium, Total, GF **Analysis Date: 01/28/2005**

2501130027 ERA 9 WP120 TRACE METALS

QC Ref #259695 - Kjeldahl Nitrogen **Analysis Date: 01/28/2005**

2501130023 ERA 5 WP120 NUTRIENTS-COMPLEX

QC Ref #259732 - Pesticides/PCBs **Analysis Date: 02/04/2005**

2501130037 ERA 19 WP120 PESTICIDES
2501130038 ERA 20 WP120 CHLORDANE
2501130039 ERA 21 WP120 TOXAPHENE

QC Ref #259810 - Carbonaceous BOD **Analysis Date: 01/26/2005**

2501130033 ERA 15 WP120 DEMAND

Figure 12.6 Example QC Report (QC Summary) (con't)

MWH Laboratories
A Division of MWH Americas, Inc.

Laboratory
QC Summary
#141133

MWH LABS
(continued)

QC Ref #259817 - Biochemical Oxygen Demand,TotlAnalysis Date: 01/26/2005
2501130033 ERA 15 WP120 DEMAND

QC Ref #259833 - Chemical Oxygen Demand (COD) Analysis Date: 01/31/2005
2501130021 ERA 3 WP120 DEMAND

QC Ref #259882 - Beryllium, Total, ICAP/MS Analysis Date: 01/27/2005
2501130027 ERA 9 WP120 TRACE METALS

Ref #259883 - Vanadium, Total, ICAP/MS Analysis Date: 01/27/2005
2501130027 ERA 9 WP120 TRACE METALS

QC Ref #259887 - Manganese, Total, ICAP/MS Analysis Date: 01/27/2005
2501130027 ERA 9 WP120 TRACE METALS

QC Ref #259888 - Nickel, Total, ICAP/MS Analysis Date: 01/27/2005
2501130027 ERA 9 WP120 TRACE METALS

QC Ref #259889 - Copper, Total, ICAP/MS Analysis Date: 01/27/2005
2501130027 ERA 9 WP120 TRACE METALS

QC Ref #259891 - Zinc, Total, ICAP/MS Analysis Date: 01/27/2005
2501130027 ERA 9 WP120 TRACE METALS

QC Summary - Page 8 of 12

Table 12-1 Laboratory Document Control

Instrument Sequence Log Books and Instrument Run Logs	**Control No.** 1-200
Maintenance Log Books	201-400
QC Log Books (pH, Micro air monitoring, travel blank, etc.)	401-600
Reagent Prep Books	601-800
Sample Prep/Extraction Books	801-1000
Sample Data Records	1001-1200
Standard Log Books	1201-1400
SOP Books	1401-1600
Support Equipments Log Books (Balance, Pipette, Refrigerator, Incubator, Thermometer, etc)	1601-1800
MSC.	1801-2000
Certification Books	2001-2200
Forms Template	2201-2400

13.0 CORRECTIVE ACTION

`

Corrective actions may be required when there is a failure to meet quality control acceptance criteria, or when internal or external audit samples are not acceptable. Quality control measures for which control limits are established and maintained include: LCS, duplicates, method blanks, surrogate recoveries, MS/MSD, calibrations, continuing calibrations and sensitivity checks.

13.1 ESTABLISHING WARNING/ACTION LIMITS

The incorporation of quality control samples and reference materials into the laboratory quality control program is of little use in maintaining overall analytical quality control unless the laboratory has established acceptance criteria for these samples. Quality control samples falling outside of these criteria serve as flags to signal the production of unacceptable data which must be rerun or reported as suspect data if re-running is not an option due to expired holding times or lack of sample volume.

13.1.1 Approach to Setting Limits

The established acceptance limits for LCS samples for all analyses performed in MWH Laboratories are available on request. They are updated at least once per year. These limits are based upon historical recoveries of LCS samples associated with specific matrices (or where LCS samples are not utilized, they are based on spike recoveries or duplicate limits for matrix specific samples).

For those cases where insufficient historical information exists to set statistically meaningful LCS or matrix specific limits, MWH Labs has set limits based on the expected performance of the analysis until historical limits can be calculated. These limits are then associated with specific control requirements to determine out of control events.

13.1.2 Documentation of Limits

- Reagent Blanks

  Reagent blank values must remain lower than the reported MRL for each analytical procedure. If an analyst notices an increase in the reagent blank which is beginning to approach this limit, the source of contamination must be investigated before further analyses are performed.

- External Reference Samples

  Recoveries on external reference samples must fall within the acceptance limits provided with the true values.

- Internal and Surrogate Standards

As specified by the methods, internal standards are run with each of the calibration standards and the area counts are recorded on the same form as the response factors. Any standard that has an internal standard area count beyond ±50% of the average internal standard area count for all standards must be rerun to meet these criteria. Any sample with an internal standard count beyond ±50% (or as stated in the particular SOP) of the average internal standard counts for the standards must be rerun. Surrogate standards must meet the recovery limits specified in the analytical method or established historical limits, which are updated periodically. Current surrogate acceptance limits may be found in Table 13-1 of Section 13 and Table 5-1, 5-2, 5-3 of section 5.0.

- Blind Check Samples

  The results of blind check sample analyses must fall within the acceptance criteria provided with the samples. In addition, scoring on blind check samples is based on holding times and turnaround time.

13.1.3 LCS Control Limits

MWH Laboratories uses acceptance limits for LCS limits in water matrix to assess analytical control. All analysts have received a copy of these acceptance limits and must insure that their LCS sample results fall within the stated acceptable ranges. If specific control limits have not been provided for matrix spikes or duplicates, LCS criteria are used until sufficient data is generated to calculate historical limits for the MS/MSD samples for a particular matrix. Any samples associated with unacceptable LCS samples must be re-run unless other criteria are available to allow acceptance of the data without qualification. If a sample cannot be rerun due to exceeded holding times or lack of sufficient sample volume or weight, then the data must be qualified as estimated when reported to the client.

13.2 CONTROL CHARTS

MWH Laboratories collects LCS and MS/MSD data in the LIMS computer system for generation of control chart data and limits. Data can be downloaded and plotted on charts to determine trends, which may indicate problems with the analysis, or out of control events.

MWH Laboratories utilizes a Shewhart mean chart modified to percent recovery to monitor laboratory control sample bias. This procedure is referenced in the EPA Handbook for Analytical Quality Control in Water and Wastewater Laboratories (EPA-600/4-79-019), March 1979, on pages 6-2 to 6-6. Precision is monitored with control charts, but is compared to absolute limits established by the lab based on method specified limits.

Control charts for LCS and MS data are generated with the LIMS software periodically based on a maximum or 30 data point. The control chart limits are re-calculated at least annually. If analysis parameters are changed significantly or

method modifications are performed, control chart limits may be re-calculated more frequently. Both the analyst and the QA review the limits and charts to determine whether any of the data is out-of-control. If the control charts indicate an out-of-control event, appropriate corrective action is immediately taken to bring the analysis back into control. An example of the Shewhart percentage recovery control chart is presented in Figure 13-1 page 13-15.

13.3 PROCEDURES FOR DETERMINING AND REPORTING OUT-OF-CONTROL ANALYSES

13.3.1 Defining an Out-of-Control Analysis

An analysis is out-of-control whenever a quality control sample or parameter falls outside of acceptance limits. Quality control parameters are evaluated for their acceptability on a daily basis according to established acceptance limits and are also monitored with control charts to detect trends in variability, which are indicative of a shift in the methodology due to analytical error.

13.3.1.1 Criteria Used

- Daily Quality Controls

The quality control parameters utilized by MWH Laboratories were detailed in Section 11.1. All of these controls are evaluated on a daily basis and must pass the criteria detailed in this section. Each analyst is familiar with the criteria for his/her analyses and is responsible for insuring that all quality control parameters on the analytical run are acceptable. An analyst cannot enter his/her data into the laboratory computer until the data is reviewed and approved by an appropriately trained peer or supervisor. In addition, LCS and MS/MSD data are also entered into the computer and linked to specific batches.

LCS and MS/MSD results must fall within given acceptance limits. These limits are provided for water matrix. Reagent blanks must remain below the MRL established for each parameter. External reference samples must fall within the acceptance criteria provided with the true values. Internal and surrogate standards must meet the recoveries specified in the analytical procedure, if historical control chart based information is not available. A new working standard must be checked against the old reference standard to verify its accuracy and must fall within 10% of its true value. If this agreement is not met, a referee standard must be run. All standards must be traceable to primary standards.

Instrument calibrations must fall within acceptance criteria in order for runs to proceed. Table 13-2 on page 16 of Section 13.0 summarizes the instrument's initial calibration acceptance criteria for each analysis.

In addition to monitoring daily QC parameters for acceptability, control charts are utilized and interpreted as described in Section 13.3.1.2.

13.3.1.2 Approaches to Control Chart Interpretation

The control charts generated by the LIMS System flags the analyst that there is a potential problem whenever seven or more consecutive points fall above or below the mean.

If the above situation is observed, the cause of the shift in mean or increased variability must be investigated, corrected, and documented prior to analyzing any more samples.

13.3.2 Responding to an Out-of-Control Event

It is important to have an operational system within MWH Laboratories for recognizing out-of-control events as soon as they occur so the appropriate action can be taken to bring the analysis back into control. This will insure that no data gets reported from a period when the analysis was out-of-control.

13.3.2.1 Roles and Responsibilities

The analyst has primary responsibility for verifying that all daily QC parameters fall within the acceptance limits before submitting the data for review. Review at the analyst level enables most errors to be caught immediately and prevents reporting delays. Following the analyst's verification, the data is reviewed by an appropriately trained peer analyst or supervisor. All of the quality control parameters are reviewed for compliance with the acceptance criteria and the calculations on the raw data forms are checked for errors in data manipulation. If the reviewer notices a problem, the analyst is notified immediately and corrective action is taken. All samples associated with unacceptable quality control samples are rerun unless there is insufficient sample, in which case the client is notified by the Client Services group [NELAC 5.4.9]. Every out of control event must be documented by filing a Quality Investigation Report (QIR). See Figure 11-1 and Figure 11-2 of section 11.0.

The check of daily QC parameters indicates immediate problems with the data, but trends are only evident on the control charts. Both the analyst and the Group Supervisor are responsible for reviewing the control charts to see if any of the out-of-control events summarized in Section 13.3.1.2 have occurred. If so, the analyst must initiate corrective action before continuing with the analysis.

13.3.2.2 Defining Suspect Samples

Sample data is considered suspect if associated with unacceptable MS/MSD and LCS samples or part of an analytical run that had an unacceptable calibration or an external reference sample was out of an expected range. GC/MS data is considered suspect if the internal or surrogate standards were not recovered within the acceptable range. Sample data is also considered suspect if the reagent blank has substantially increased beyond normal range and exceeds any of the compound MRL's.

13.3.2.3 Ensuring that Suspect Data Are Not Reported

It is the ultimate responsibility of the Group Leader to ensure that suspect data are not reported. The laboratory procedures currently require that analysts may not enter their final data into the computer until their analytical data form and accompanying QC parameters have been reviewed and approved by an appropriately trained peer or supervisor. The QA Group performs periodic system audits to ensure that this procedure is working properly and prepares reports to lab management based on these audits.

13.3.2.4 Corrective Actions

If the calibration fails, the analyst must determine whether the problem lies with the standard, the reagents, or an instrument malfunction. This is usually determined by reviewing all of the calibration QC parameters and determining which specific parameters do not meet the criteria. For example: 1) the regression statistics and recalculated standards look fine, 2) there was little drift during the run, 3) the peaks appear satisfactory, 4) the reagent blank is low, but 5) the external reference sample was out of range, it is likely that the problem lies with the integrity of the standard used to make up the working standards and a new stock standard should be prepared.

If calibration appears acceptable but some of the duplicate and spiked samples are unacceptable, the analyst must determine whether there is a matrix problem interfering with the analysis or the preparatory digestion. If all of the unacceptable duplicates and spikes occur on a specific type of matrix, this is good evidence that there is a matrix interference problem. When a preparatory digestion is part of the procedure, the problem can be isolated to the digestion or the instrumental analysis by comparing the LCS, which was carried through the digestion to a LCS sample analyzed without digestion. If a matrix problem is indicated, the analyst must determine the most appropriate procedure for alleviating the interference such as diluting the sample, using standard additions, performing the analysis at a different wavelength, using a different GC column, or modifying the digestion procedure.

If an unacceptable result is obtained on a blind check sample, the problem must be isolated. To maintain the blind nature of the samples, the run containing the blind check sample is reviewed by the QA Group to determine if any of the quality control parameters were unacceptable or if the sample was run outside the optimum range of the calibration. If no apparent cause of error is found, a second check sample is submitted to determine whether the error occurred during preparation of the blind check sample.
If an out-of-control event is indicated by a shift or trend on a control chart, the following diagnostic strategy will be applied:

(1) A shift in the mean of the percentage recovery chart could be caused by incorrect preparation of a standard or a reagent, contamination of the sample, incorrect instrument calibration, instrument component deterioration such as lamp failure with AAS, or analyst error, dirty pipettes preventing proper drainage, or other preparatory steps.

(2) A trend of the mean upward could be caused by deterioration of the standard or the reagents or a change in the extraction efficiency

(3) A trend of the mean downward could be caused by concentration of the standard due to evaporation, deterioration of reagents, and a change in the extraction efficiency or instrument component failure

(4) Increased variability could be caused by switching to a different analyst, deviation from the procedure, variable extraction efficiencies

(5) A shift in the mean or increased variability can sometimes be caused by a sample load of an unusual matrix. If this is determined to be the cause of the problem, the analysis will not be considered out-of-control but the situation will be documented.

13.4 CORRECTIVE ACTION PROCEDURES, BY METHOD

Specific corrective actions on a method-by-method basis can be found in Table 13-3 of Section 13.0. Corrective action will be initiated as a result of findings from internal or external audits, not acceptable results from performance samples, large variation from split samples and inadequate quality as determined by data validation review.
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13.5 CORRECTIVE ACTION PROCEDURES, ROOT CAUSES, PREVENTIVE MEASURES, DATA FLAGS, QUALIFIERS, AND REPORT COMMENTS

Corrective action taken for all QC failures is documented by generating Quality Investigation Reports (QIRs). See Figure 11-1 of section 11.0. Failure to meet criteria of the LCS, surrogates spikes, internal standards, continuing calibration standards, holding time exceedance, improperly preserved samples, method blank contamination are QC failures that trigger the generation of QIR to identify the root cause of the problem. QIRs are also generated when the Matrix Spikes fail to meet acceptance criteria. For instance, when a matrix spike failure occurs during trace metals analysis, the analyst first checks the %RSD

for the multiple burns to see if the %RSD is less than 20%. Then the calibration verification will be checked along the calibration blank, preparation blank and the second source LCS standard recovery. The standards and reagents preparation and expiration dates are reviewed. Spiking solutions are verified to ensure that there are no errors made in calculations and in spiking. If the MS/MSD recoveries are outside the internal QC limits and all the associated QCs for the batch are acceptable; the RPD for MS/MSD recoveries should be checked. If the RPD is found to be within the 20% criteria, the unacceptable recoveries are annotated in the report as suspect due to matrix effect. If the concentration of the background is much higher than the spiking amount the report will be annotated also. If the RPD is outside the limits, the sample that was spiked is checked visually to see if the sample is homogenous, if the sample is homogenous the batch will be reanalyzed.

Additional information is documented about the QC failures in the bench by the analyst.

All corrective actions taken are documented in the QIRs (Quality Investigation Report). Root causes of the problems are documented in the QIR. Corrective actions implemented are monitored if corrective actions are effective to remove problem. (NELAC 5.4.10.4). QIRs also requires the analyst to document preventive measures to ensure that the problems will not re-occur (NELAC 5.4.11). Results are flagged not only for quality control failures where QIRs have been generated but also for all other QC failures that have impact on the data quality of the result. All results are flagged if data is suspect or QC were not acceptable. Comments on the results are provided to the clients on the final report for QC nonconformance. In addition, any QC data exceeding QC acceptance criteria are underlined to flag the user about the QC failure and its impact to the data quality of the associated samples in the batch.

Data qualifiers are used by the laboratory in reporting analytical results to flag the user about the data. Some of the qualifiers below were requested by a specific client as required in the Project's Quality Assurance Plan to ensure that the Data Quality Objectives of the Project are met.

Depending on the significance of nonconformance, the Client is notified by the Project Manager and work recalled, if necessary. The Client is notified immediately for possible re-sampling [NELAC 5.4.9.1d)].

Where the identification of nonconformance or departure casts doubts on the laboratory's compliance with its own policies and procedures, or on its compliance with this Standard, the laboratory shall ensure that the appropriate areas of activity are audited (NELAC 5.4.10.5)

Data Qualifiers
Revised on 05/02/05, Based on AZ Data Flag 5/13/02 Rev. 1.0

Underlined flags are for AZ drinking water samples only.

MWH List

Microbiology:

A1 = Too numerous to count.
A2 = Sample incubation period exceeded method requirement.
A3 = Sample incubation period was shorter than method requirement.
A4 = Target organism detected in associated method blank.
A5 = Incubator/water bath temperature was outside method requirements.
A6 = Target organism not detected in associated positive control.
A7 = Micro sample received without adequate headspace.

Method blank:

B1 = Target analyte detected in method blank at or above the method reporting limit.
B2 = Non-target analyte detected in method blank and sample, producing interference.
B3 = Target analyte detected in calibration blank at or above the method reporting limit.
B4 = Target analyte detected in blank at/above method acceptance criteria.
B5 = Target analyte detected in method blank at or above the method reporting limit, but below trigger level or MCL.
B6 = Target analyte detected in calibration blank at or above the method reporting limit, but below trigger level or MCL.
B7 = Target analyte detected in method blank at or above method reporting limit. Concentration found in the sample was 10 times above the concentration found in the method blank.

BA = Target analyte detected in method blank at or above the laboratory minimum reporting limit (MRL), but analyte not present in the sample.
BB = Target analyte detected in method blank at or above the laboratory minimum reporting limit (MRL). No major impact on the reported result since the target analyte is > 10 X the concentration level.
BC = NDMA detected in Method Blank is above CA DHS recommended value of 0.5 ppt, but within the internal lab limit of 1/3 MRL

Confirmation:

C1 = Confirmatory analysis not performed as required by the method.
C2 = Confirmatory analysis not performed. Confirmation of analyte presence established by site historical data.
C3 = Qualitative confirmation performed.
C4 = Confirmatory analysis was past holding time.
C5 = Confirmatory analysis was past holding time. Original result not confirmed.

Dilution:

D1 = Sample required dilution due to matrix interference.
D2 = Sample required dilution due to high concentration of target analyte.

D3 = Sample dilution required due to insufficient sample.
D4 = Minimum reporting level (MRL) adjusted to reflect sample amount received and analyzed.

Estimated concentration:

E1 = Concentration estimated. Analyte exceeded calibration range. Reanalysis not possible due to insufficient sample.
E2 = Concentration estimated. Analyte exceeded calibration range. Reanalysis not performed due to sample matrix.
E3 = Concentration estimated. Analyte exceeded calibration range. Reanalysis not performed due to holding time requirements.
E4 = Concentration estimated. Analyte was detected below laboratory minimum reporting level (MRL).
E5 = Concentration estimated. Analyte was detected below laboratory minimum reporting level (MRL), but not confirmed by alternate analysis.
E6 = Concentration estimated. Internal standard recoveries did not meet method acceptance criteria.
E7 = Concentration estimated. Internal standard recoveries did not meet laboratory acceptance criteria.

EA = Concentration estimated. Analyte was detected below laboratory minimum reporting limit but above laboratory method detection limit.

Hold time:

H1 = Sample analysis performed past holding time. Data not acceptable for regulatory compliance
H2 = Initial analysis within holding time. Reanalysis for the required dilution was past holding time.
H3 = Sample was received and analyzed past holding time.
H4 = Sample was extracted past required extraction holding time, but analyzed within analysis holding time.

BOD:

K1 = The sample dilutions set-up for the BOD analysis did not meet the oxygen depletion criteria of at least 2 mg/L. Any reported result is an estimated value.
K2 = The sample dilutions set up for the BOD analysis did not meet the criteria of a residual dissolved oxygen of at least 1 mg/L. Any reported result is an estimated value.
K3 = The seed depletion was outside the method acceptance limits.
K4 = The seed depletion was outside the method and laboratory acceptance limits. The reported result is an estimated value.
K5 = The dilution water D.O. depletion was > 0.2 mg/L.
K6 = Glucose/glutamic acid BOD was below method acceptance criteria.
K7 = A discrepancy between the BOD and COD results has been verified by reanalysis of the sample for COD.
K8= Glucose/glutamic acid BOD was above method acceptance levels.

Laboratory fortified blank/blank spike:

L1 = The associated blank spike recovery was above laboratory acceptance limits.
L2 = The associated blank spike recovery was below laboratory acceptance limits.
L3 = The associated blank spike recovery was above method acceptance limits. case
L4 = The associated blank spike recovery was below method acceptance limits.

Note: The L1, L2, L3 & L4 footnotes need to be added to all corresponding analytes for a sample.

LA = The associated blank spike recovery was below laboratory acceptance limits. Analyte is only qualitatively identified per method.
LB = The associated blank spike recovery was above laboratory acceptance limits. Analyte is only qualitatively identified per method.
LC = The blank spike recovery of Dinoseb is above method limits of 0 – 85% but within laboratory limits. Lab limits reflect better precision and accuracy than the method.

Matrix spike:

M1 = Matrix spike recovery was high, the method control sample recovery was acceptable.
M2 = Matrix spike recovery was low, the method control sample recovery was acceptable.
M3 = The accuracy of the spike recovery value is reduced since the analyte concentration in the sample is disproportionate to spike level. The method control sample recovery was acceptable.
M4 = The analysis of the spiked sample required a dilution such that the spike concentration was diluted below the reporting limit. The method control sample recovery was acceptable.
M5 = Analyte concentration was determined by the method of standard addition (MSA).
M6 = Matrix spike recovery was high. Data reported per ADEQ policy 0154.000.
M7 = Matrix spike recovery was low. Data reported per ADEQ policy 0154.000.

MA = Matrix spike recovery was above laboratory acceptance limits. Not method requirement but NELAC requirement. Laboratory fortified blank recovery was acceptable.
MB = Matrix spike recovery was below laboratory acceptance limits. Not method requirement but NELAC requirement. Laboratory fortified blank recovery was acceptable.
MC = Matrix spike recovery was above laboratory acceptance limits but within method limits. Laboratory fortified blank recovery was acceptable.
MD = Matrix spike recovery was below laboratory acceptance limits but within method limits. Laboratory fortified blank recovery was acceptable.
ME = Matrix spike recovery was above laboratory limits. Method does not have acceptance limits. Laboratory fortified blank recovery was acceptable.
MF = Matrix spike recovery was below laboratory limits. Method does not have acceptance limits. Laboratory fortified blank recovery was acceptable.
MG = Matrix spike recovery of Dinoseb is above method limits of 0 – 85 % but within laboratory limits. Lab limits reflect better precision and accuracy than the method.
MH = The MS/MSD recoveries were below the QC limits and the RPD was within control limit. Matrix effect for the spiked sample is suspected.

General:

N1 = See case narrative.
N2 = See corrective action report.

Sample Quality:

Q1 = Sample integrity was not maintained.
Q2 = Sample received with head space.
Q3 = Sample received with improper chemical preservation.
Q4 = Sample received and analyzed without chemical preservation.
Q5 = Sample received with inadequate chemical preservation, but preserved by the laboratory.
Q6 = Sample was received above recommended temperature.

Q7 = Sample inadequately dechlorinated.
Q8 = Insufficient sample received to meet method QC requirements. QC requirements satisfy ADEQ policies 0154 and 0155.
Q9 = Insufficient sample received to meet method QC requirements.
QP = AZ Q10-Sample received in an inappropriate sample container .
QQ = AZ Q11-Sample is heterogeneous. Sample homogeneity could not be readily achieved using routine laboratory practices.

QA = Sample received with incomplete documentation (ID).
QB = Sample received with improper sample label (ISL).
QC = Sample received with signs of damage or contamination (SDC).
QD = Same day sample receipt / sampling time but sample was received with no signs of chilling (c). (SRNC)

RPD Duplicates:

R1 = RPD exceeded the method control limit.
R2 = RPD exceeded the laboratory control limit.
R3 = Sample RPD between the primary and confirmatory analysis exceeded 40%. Per EPA Method 8000B, the higher value was reported.
R4 = MS/MSD RPD exceeded the method control limit. Recovery met acceptance criteria.
R5 = MS/MSD RPD exceeded the laboratory control limit. Recovery met acceptance criteria.
R6 = LFB/LFBD RPD exceeded the method control limit. Recovery met acceptance criteria.
R7 = LFB/LFBD RPD exceeded the laboratory control limit. Recovery met acceptance criteria.
R8 = Sample RPD exceeded the method control limit.
R9 = Sample RPD exceeded the laboratory control limit.

RA = MS/MSD RPD exceeded the method control limits of 48% RPD. Associated field sample results are reportable for UCMR compliance and EPA considers results valid since all other quality controls were acceptable.

Surrogate:

S1 = Surrogate recovery was above laboratory acceptance limits, but within method acceptance limits.
S2 = Surrogate recovery was above laboratory and method acceptance limits.
S3 = Surrogate recovery was above laboratory acceptance limits, but within method acceptance limits. No target analytes were detected in the sample.
S4 = Surrogate recovery was above laboratory and method acceptance limits. No target analytes were detected in the sample.
S5 = Surrogate recovery w as below laboratory acceptance limits, but within method acceptance limits.
S6 = Surrogate recovery was below laboratory and method acceptance limits. Re-extraction and/or reanalysis confirms low recovery caused by matrix effect.
S7 = Surrogate recovery was below laboratory and method acceptance limits. Unable to confirm matrix effect.
S8 = The analysis of the sample required a dilution such that the surrogate concentration was diluted below the method acceptance criteria. The method control sample recovery was acceptable.
S9 = The analysis of the sample required a dilution such that the surrogate concentration was diluted below the laboratory acceptance criteria. The method control sample recovery was acceptable.
SP = AZS10- Surrogate recovery was above laboratory and method acceptance limits.

SA = Sample Surrogate recovery was above laboratory and method acceptance limits. Re-extraction and or re-analysis confirms high recovery caused by matrix effect.

Method/analyte discrepancies:

T1 = Method promulgated by EPA, but not by ADHS at this time.
T2 = Cited ADHS licensed method does not contain this analyte as part of method compound list.
T3 = Method not promulgated either by EPA or ADHS.
T4 = Tentatively identified compound. Concentration is estimated and based on the closest internal standard.

Calibration Verification:

V1 = CCV recovery was above method acceptance limits. This target analyte was not detected in the sample.
V2 = CCV recovery was above method acceptance limits. This target analyte was detected in the sample. The sample could not be reanalyzed due to insufficient sample.
V3 = CCV recovery was above method acceptance limits. This target analyte was detected in the sample, but the sample was not reanalyzed.
V4 = CCV recovery was below method acceptance limits. The sample could not be reanalyzed due to insufficient sample.
V5 = CCV recovery after a group of samples was above acceptance limits. This target analyte was not detected in the sample. Acceptable per EPA Method 8000B.
V6 = Data reported from one-point calibration criteria per ADEQ policy 0155.000.
V7= Calibration verification recovery was above the method control limit for this analyte, however the average % difference or % drift for all the analytes met method criteria.
V8= Calibration verification recovery was below the method control limit for this analyte, however the average % difference or % drift for all the analytes met method criteria.

VA = Closing standard recovery was above laboratory limits. Closing standard not required by method.
VB = Closing standard recovery was below laboratory limits. Closing standard not required by method.

Calibration:

W1= The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8000B.

Resampling:

X = Laboratory recommends resampling.

Internal Standards

IC = CCV Internal Standard recovery was above laboratory and method limits.
ID = CCV Internal Standard recovery was below laboratory and method limits.
IE = Trip Blank Internal Standard recovery was above laboratory and method limits.
IF = Trip Blank Internal Standard recovery was below laboratory and method limits.

Field / trip blank

FA = Target analyte detected in trip blank above the laboratory minimum reporting limit (MRL)

Laboratory Performance Check

PA = PGF was below supplement III method limits (0.90 – 1.1) but met previous method limits (0.80 – 1.20). Per method and EPA e-mail recommendation, lab is re-evaluating system. Data are acceptable based on all other QC meeting method acceptance limits.

MWH General

NA = The sample was not analyzed
NR = The sample was analyzed but the results not reported due to failure of QC to meet method acceptance limits.

J = Analyte is positively identified, but tentatively quantified. The reported value is an estimate concentration of the analyte in the sample. The analyte was either detected between MDL and MRL or did not meet any one of the required QC criteria .(MA -CLO4 requirements)

Figure 13-1 Sample Control Chart

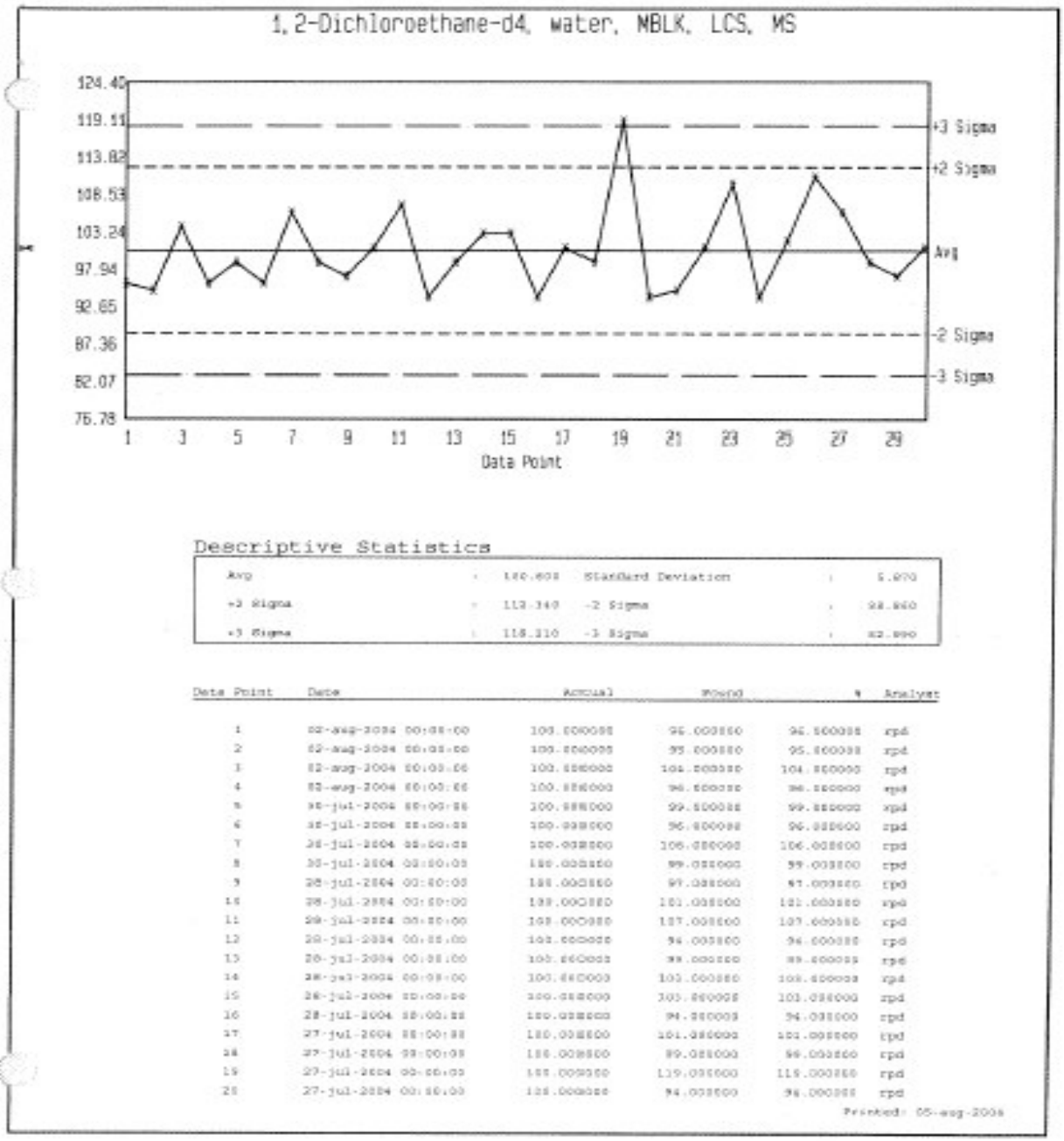
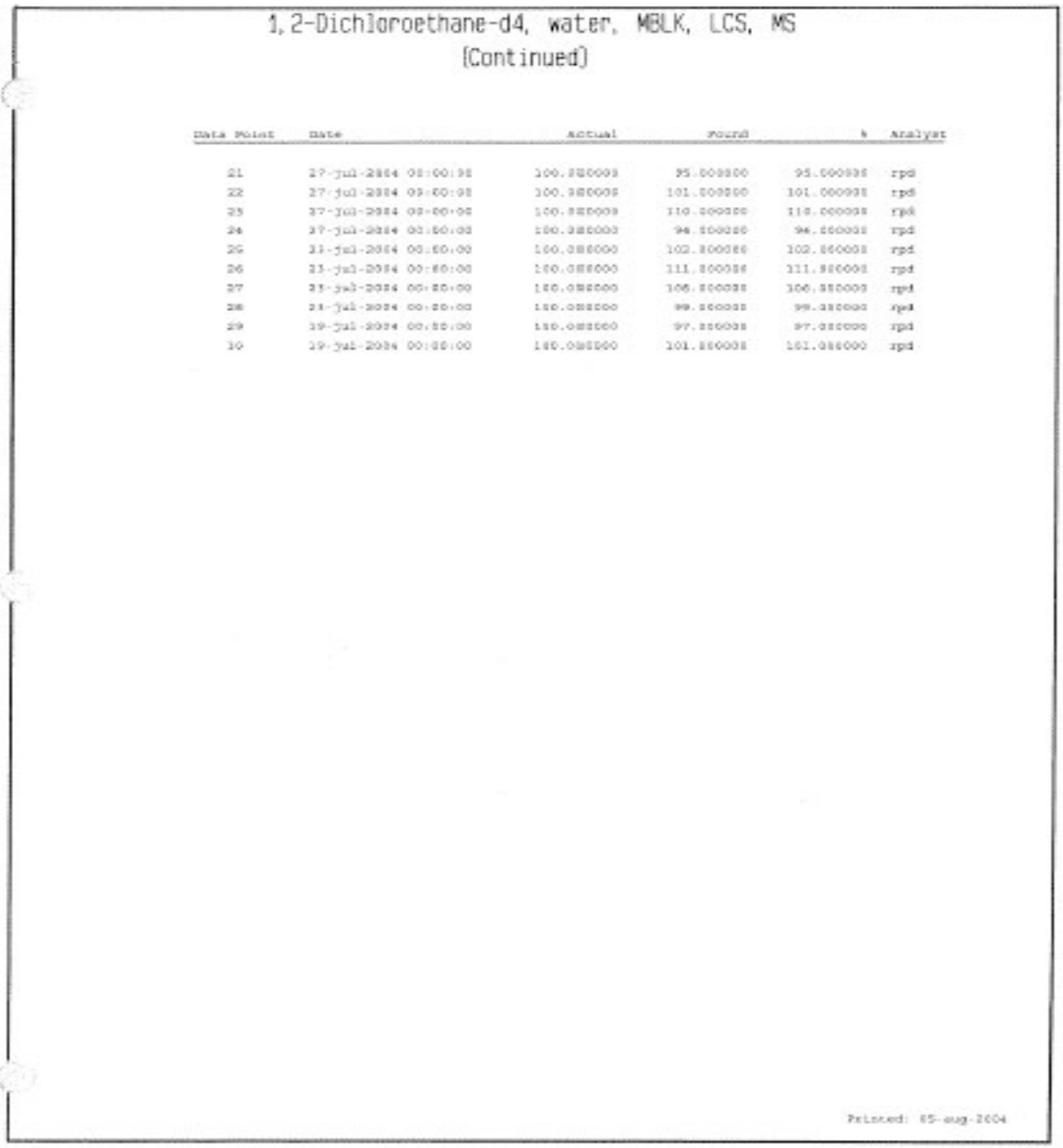


Figure 13-1 Sample Control Chart (Con't)



1,2-Dichloroethane-d4, water, MBLK, LCS, MS
(Continued)

Data Point	Date	Actual	Found	%	Analyst
21	27-jul-2004 08:00:00	100.000000	95.000000	95.000000	rpd
22	27-jul-2004 09:00:00	100.000000	101.000000	101.000000	rpd
23	27-jul-2004 03:00:00	100.000000	110.000000	110.000000	rpd
24	27-jul-2004 00:00:00	100.000000	94.000000	94.000000	rpd
25	31-jul-2004 00:00:00	100.000000	102.000000	102.000000	rpd
26	31-jul-2004 00:00:00	100.000000	111.000000	111.000000	rpd
27	31-jul-2004 00:00:00	100.000000	106.000000	106.000000	rpd
28	31-jul-2004 00:00:00	100.000000	99.000000	99.000000	rpd
29	19-jul-2004 00:00:00	100.000000	97.000000	97.000000	rpd
30	19-jul-2004 00:00:00	100.000000	101.000000	101.000000	rpd

Printed: 05-aug-2004

TABLE 13-1 Example of Surrogate Acceptance Limits

Method	Compound	Acceptance Limits, %
524.2	4-Bromofluorobenzene	70-130
	1,2-Dichloroethane-d4	70-130
	Toluene-d8	70-130
624	4-Bromofluorobenzene	82-117
	1,2-Dichloroethane-d4	77-121
	Toluene-d8	91-107
531.1	BDMC	70-130
602	Bromochloromethane	53-156
	p-Chlorotoluene (ELCD)	51-165
	p-Chlorotoluene (PID)	58-130
608	Dibutyl Chlorendate	24-150
625/8270	Nitrobenzene-d5	52-108
	2-Fluorobiphenyl	44-110
	Terphenyl-d14	24-143
	2-Fluorophenyl	21-100
	Phenol-d6	19-109
	2,4,6-Tribromophenol	43-117
6251 B	3,5-Dichlorobenzoic Acid	70-130
8260B	4-Bromofluorobenzene	74-121
	1,2-Dichloroethane-d4	70-121
	Toluene-d8	81-117
551.1	1,2-Dibromopropane	80-120
504.1/8011	1,2-Dibromopropane	60-140
525.2	perylene-d12	70-130
	1,3-dimethyl-2-nitrobenzene	70-130
	triphenylphosphate	70-130

TABLE 13-2 Example of Initial Calibration Acceptance Criteria

GCMS, EPA 524.2	Initial Calibration < 20 % RSD, r $\geq$ 0.995
GC	Initial Calibration RF <20% RSD or second order fit, continuing calibration. RF $\leq$ 20% Difference. Must meet specific method calibration criteria.
HPLC	Correlation coefficient must be >0.995 or 20% RSD
Metals	Initial calibration value for standards must be within 10% of the nominal value.
TOC	Initial calibration value for standards must be within 20% of the nominal value. r > 0.995
TOX	Initial calibration value for standards must be within 20% of the nominal value. r > 0.995
Anions/Nutrients EPA 300.0/300.1	Initial calibration value for standards must be within 10% of the nominal value. r > 0.995
pH	Values for 4, 7, 10 buffers must be +/- 0.1 pH unit of the nominal value
Radiation	Known reference must be within acceptance limits
UV 254	Initial Calibration value for the standards must be within 10 % of the normal value.
HAAs	Initial Calibration correlation coefficient r $\geq$ 0.995, $\leq$ 20 % RSD

NOTE: Refer to specific SOPs for all other methods initial calibration acceptance criteria.

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TABLE 13-3 Example of Summary of Corrective Action Procedures

Analysis Method	Item	Control Limits	Acceptance Criteria	Corrective Action
Volatile Organics	624	Sensitivity check Ion abundance with BFB	Tune instrument, criteria, see Table 9-5, Section 9.0,	repeat
		Initial calibration	All analytes RF< 35% RSD	Re-calibrate instrument
		Continuing calibration (QC Check Standard)	All analytes must meet % R as specified in Table 5 of Method 624	Rerun continuing calibration
		Method blank	<MRL	Determine cause of blank problem, reprep set if necessary
		Spiked samples (MS/MSD)	All analytes must meet % R as specified in Table 5 of Method 624	Qualify LCS results, Reprep set if necessary
		Duplicates (Dup)	RPD < than control limits	Re-prep and reanalyze
		Laboratory control samples (LCS)	All analytes must meet % R as specified in Table 5 of Method 624	Re-analyze batch
		Surrogate recovery	% R as specified in Table 5 of Method 624	Re-prep and reanalyze
Base/Neutral/Acid Extractable Organics	625 with DFTPP	Sensitivity check Ion abundance with BFB	Tune instrument, criteria, see Table 9-5, Section 9.0,	repeat
		Initial calibration	RF<35% RSD	Re-calibrate
		Continuing calibration	RF +/- 20%	Rerun continuing calibration, is still out, re-calibrate instrument
		Method blank	<MRL	Investigate problem, reprep set if necessary
		Spiked samples/LFM	All analytes must meet % R as specified in Table 6 of the method	If LCS in control, qualify LFM data, Reprep set if necessary.
		Laboratory control samples (LFB)	All analytes must meet % R as specified in Table 6 of the method	Re-analyze batch
		Surrogate recovery	% R as specified in Table 6 of the method	Re-prep and reanalyze
Purge Halocarbon	601	Initial Calibration Curve	RSD< 35% r $\geq$ 0.995	Repeat ICAL
Purge Aromatics	602	Initial Calibration Curve	RSD< 35% r $\geq$ 0.995	Repeat ICAL
Pest/PCBs	608/ 8081A/ 8082	Initial Calibration Curve	RSD$\leq$10% to use the average cal. factor; if RSD$\geq$10%, second order fit is used	Repeat ICAL and re-run samples from last continuing calibration check
		Method blank	<MRL	Investigate problem, re-extract set if necessary
		Laboratory control samples (LFB)	% R of all analytes within control limits of the method	Re-extract and re-analyze batch

TABLE 13-3 Example of Summary of Corrective Action Procedures (con't)

Analysis Method	Item	Control Limits	Acceptance Criteria	Corrective Action
Pest/PCBs, (con't)	608/ 8081A/8082	Surrogate recovery	% R as specified in Table 6 of the method	Re-prep and reanalyze; re-extract if necessary
Cyanide	335.3	Initial calibration	r >0.995	Repeat ICAL
Phenolics	420.2	Calibration blank	<MRL	Investigate problem, re-digest set if necessary
		Continuing calibration	$\pm$10% of the expected value	Rerun continuing calibration, is still out, re-calibrate instrument and rerun samples from last CCV.
		Method blank	<MRL	Investigate problem, re-digest set if necessary
		Laboratory control samples (LFB)	% R of all analytes within control limits of the method	Re-digest and re-analyze batch
		Spiked samples/LFM	All analytes must meet % R as specified in Table 6 of the method	If LCS in control, qualify LFM data, Reprep set of samples if necessary.
		Duplicates (Dup)	RPD < than control limits	Re-prep and reanalyze
Total Dissolved Solids, TDS	160.1/SM2540C	Balance check	expected value within 0.01% of balance	Re-calibrate
Total Suspended Solids, TSS	160.2/M2540D			
Total Solids, TS	160.3			
Total Volatile Residue, TV	160.4	Method blank	<MRL	Investigate root cause of blank problem. Reprep set if necessary.
Total Settleable Solids, TSS	160.5			
pH	150.1/ SM 4500 H^+B	3 buffers	within 0.1 pH unit of true value	Re-calibrate instrument
		Duplicates	RPD < than control limits	Re-prep duplicates and reanalyze
		Laboratory control samples (LFB)	% R within control limits of the method	Re-analyze batch
Anions - Perchlorate, BrO_3, ClO_2, ClO_3, Cl, NO_3, NO_2, PO_4,SO4	300.0/300.1	Calibration curve	r $\geq$ 0.995	Rerun calibration

TABLE 13-3 Example of Summary of Corrective Action Procedures (con't)

Analysis Method	Item	Control Limits	Acceptance Criteria	Corrective Action
Anions - Perchlorate, BrO_3, ClO_2, ClO_3, Cl, NO_3, NO_2, PO_4,SO4	300.0/300.1 (con't)	Continuing calibration Verification, /LCS/LFB	90-110 % Rec	Recalibrate, rerun last
		Spiked samples/LFM	Must meet 80-120 % R	If LFB in control, no action taken
		Method Blank	< MRL	Identify and eliminate source of problem. Do not do further sample analysis until contamination problem is resolved.
				Repeat sample prep using another source of reagent if contamination is found to be due to the Reagents used.
TOC	SM 5310 C	Calibration curve	$r \geq 0.995$	Rerun calibration
		Continuing calibration Verification, /LCS/LFB	90-110 % Rec	Recalibrate, rerun last 10 samples between the failing standard and the last standard meeting the acceptance
		MS/LFM	80-120 %	If LFB in control, no action taken
		Method Blank	< MRL	Identify and eliminate source of problem. Do not do further sample analysis until contamination problem is resolved. Repeat sample prep using another source of reagent if contamination is found to be due to the Reagents used.
		Lab Duplicate	$\leq$ 10 % (TOC $\geq$ 2.0 mg/L)	Reanalyze sample, if cannot be reanalyzed, flag sample not meeting QC criteria.
			$\leq$ 20 % (TOC $\leq$ 2.0 mg/L)	
TOX	SM5320	Initial calibration Curve	r >0.995	Repeat ICAL
		Continuing calibration	$\pm$10% of the expected value	Rerun continuing calibration, is still out, re-calibrate instrument and rerun last 10 samples.
		Method blank	< 5 x MRL	Investigate problem, re-analyze set of samples if necessary

TABLE 13-3 Example of Summary of Corrective Action Procedures (con't)

Analysis Method	Item	Control Limits	Acceptance Criteria	Corrective Action
TOX	SM5320 (con't)	Duplicates, (all samples)	if above 5X MRL RPD must be < control limits	Re-analyze to determine if matrix problem
		Spiked samples/LFM	% R within the control limits	If LCS in control, qualify LFM data, Reprep set of samples if necessary.
		Laboratory control samples (LFB)	% R within control limits of the method	Re-analyze batch
Metals by Graphite Furnace, As & Se	200.9	Initial calibration Curve	r >0.995	Rerun calibration standards
		Calibration blank	<MRL	Investigate problem, re-digest set if necessary
Mercury by Cold Vapor AAS	245.1/7470A/ 7471A	Initial calibration verification/IPC	+/- 5% of the expected value	Re-calibrate
		Continuing calibration	±10% of the expected value	Rerun continuing calibration, is still out, re-calibrate instrument and rerun last samples.from last Calibration Check
Mercury by Cold Vapor AAS	245.1/7470A/ 7471A (con't)	Method Blank	< MDL	Investigate problem, re-digest set of samples if necessary
		Duplicates	RPD < than control limits	Re-prep duplicates and re-analyze
		Spiked samples/LFM	% R within the control limits	If LCS in control qualify LFM data, Reprep set of samples if necessary.
		Laboratory control samples (LFB)	% R within control limits of the method	Re-prep and re-analyze batch
ICP Metals; Al, Ag, Ba, Be, Ca, Cd, Cr, Co, Cu, Fe, K,Mg, Mn,	200.7/6010	Standard validation	+/- 5% of the expected value	Purchase new concentrates
		Initial calibration verification/IPC		Rerun calibration standards
ICPMS Metals	200.8	Calibration blank	<MDL	Investigate problem, re-run blank
		Continuing calibration	±10% of the expected value	Rerun standards, is still out, re-calibrate instrument and rerun samples from last CCV.
		Method blank	<MDL	Investigate problem, re-digest set if necessary
		Spiked samples/LCS	% R within the control limits	If LCS in control qualify LCS data, Reprep set of samples if necessary.
		Laboratory control samples (LCS)	% R within control limits of the method	Re-prep and re-analyze batch

13-3 Example of Summary of Corrective Action Procedures (con't)

Analysis Method	Item	Control Limits	Acceptance Criteria	Corrective Action
Cr VI (Dissolved)	218.6	Initial Calibration	r≥ 0.999 or greater	Identify problem and rerun ICAL
		IPC (CCV)	95-105%	Perform another LPC. If failed again, Recalibrate and reanalyze previous 10 samples
		LRB	<RL	Correct source of contamination and Reanalyze sample.
		LFB/QCS (external source)	90-110 %	Procedure is out Of control, identify source of problem and resolve before continuing analysis
		LFM	90-110%	If failed but LFB passed, problem is matrix related Flag unspiked sample as "suspect matrix"
		LFMD	90-110%/10% RPD	If failed but LFB passed, Problem is matrix related Flag unspiked sample
		QCS LDR	90-110% minimum 7stds	See LFB Start of Program
HAAs	6251 B	Initial Calibration Curve	RSD< 20% r ≥ 0.995	If r < 0.995, use second order fit as calibration curve. Check for error if % RSD exceeds 30 %.
		Method blank	< ½ MRL	Identify and eliminate source of problem. Do not do further sample analysis until contamination problem is resolved. Repeat sample prep using another source of reagent if contamination is found to be due to the Reagents used.
		Laboratory control samples LCS/LFB/CCV)	Low ± 50% High ± 15%	If primary column results fail, use results fromsecondary. If both fail,re-analyze. If repeat fails, re-extract.
		LFM/LCS	Same as LCS/LFB	If LFB is in control, no action taken
		Surrogate recovery	70-130 % Rec	Re-analyze the samples
UV 254	SM 5910 B	Calibration curve	90-110 % Rec.	Rerun Calibration
		Method blank	< ½ MRL	Identify and eliminate source of problem. Do not do further sample analysis until contamination problem is resolved. Repeat sample prep using another source of reagent if contamination is found to be due to the Reagents used.
		CCV		Rerun continuing calibration, is still out, re-calibrate instrument and rerun last 10 samples between the failing standard and the last standard meeting the acceptance criteria.
		Mid/High Verification	85-115 %	
		LCS/LFB Low	75-125 %	
		Lab Duplicate	< 20 % (UV254 ≤ 0.045 cm^{-1}) < 10 % (UV254 > 0.045 cm^{-1})	Reanalyze sample. If cannot be reanalyzed, flag not meeting QC criteria.

TABLE 13-3 Example of Summary of Corrective Action Procedures (con't)

Analysis Method	Item	Control Limits	Acceptance Criteria	Corrective Action
Residual Chlorine	SM 4500 Cl-G	LCS/LFB	85-115 %	Rerun standard. Prepare new standard, if needed.
		Duplicate	≤20 % RPD	Reanalyze sample.
Organohalide Pesticides and PCB	505	Instrument Performance		Determine the cause and eliminate the problem; if necessary, generate a new curve or set of cal factors to verify the decreased response before searching for problem source.
		Endrin breakdown	< 20 % degradation	Perform routine maintenance.Consistent breakdown suggests breakdown occurrence in instrument system; methodology is in control.correct for potential background concentration.
		IDC	%R = 70-130% RSD ≤ 20 %	Source of problem identified and resolved before continuing analysis.
		LFB	%R = 70-130% (need control charts after 30 data points per lab performance)	Source of problem identified and resolved before continuing analysis.
		Initial Calibration Curve	% RSD < 20	Repeat test using a fresh cal std. If results still not agree, generate a new calibration curve.
		Continuing Calibration verification Standard	80-120 %	Reanalyze sample extracts for the suspected field sample analytes after acceptable cal is restored.
		LRB	< MRL	Determine source of contamination and eliminate interference before processing sample.
		LFM	% R = 65-135%	If lab performance is shown to be in control, problem is matrix-related, not system-related. Label result suspect/matrix to inform data user the results are suspect du to matrix effects
		LFMD	not required 20 % RPD (initial guidance)	
		QCS	70 – 130 %	Done quarterly. Source of problem identified and resolved.

TABLE 13-3 Example of Summary of Corrective Action Procedures (con't)

Analysis Method	Item	Control Limits	Acceptance Criteria	Corrective Action
Volatiles, DIPE TAME, ETBE	524.2	Sensitivity check Ion abundance with BFB	Tune instrument, criteria, see Table 9-5, Section 9.0 by GCMS	Retune Instrument. Ionizer may need to be cleaned before criteria can be met.
		Initial calibration	< 20% RSD, r ≥ 0.995	Re-calibrate instrument. Prepare new standard and analyze.
		Continuing calibration (QC Check Standard)	RF <30% RSD	Rerun continuing calibration. prepare new CCV std and re-analyze.
			RF <20% RSD (TCP)	
		Lab blank	< ½ MRL	Reanalyze. If blank cannot be reanalyzed, flag associated data when samples have hits > MRL.
			< MRL (TCP)	(TCP: source of contamination investigated and measures taken to correct, minimize, or eliminate problem)
		Lab Duplicates (Dup)	< 20 % RPD	Re-prep and reanalyze
		Laboratory control samples (LCS/LFB)	70-130%	Re-analyze batch
			80-120% (TCP)	Problem resolved before additional samples may be reliably analyzed
		Surrogate recovery	80-120 % (initial demonstration of capability , IDOC) 70-130 % (CCV, samples)	Re-prep and reanalyze
Trihalomethanes/ Chloral Hydrate/ Haloacetonitrile	551.1	Initial calibration curve (5 standards, one std. at MDL conc.) (Extracted)	≤ 10 % RSD	recalibrate if fails criteria
		Lab Performance Check	Table 7 of the method	Failed LPC, reevaluate the instrument system, if performance Criteria not met, install new column, correct column flows
		Endrin Breakdown	< 20 %	Perform routine maintenance In the injection port, replace injection port sleeve & all Associated seals & septa.
		Calibration Verification (CCV=LFB) (2 different conc. levels) (MLFB & HLFB)	% R = 80-120 % 90 % analytes & 75-125 % for all analytes	Reanalyze CCV. If failed again recalibrate & the previous samples reanalyzed or analytes out of acceptable range should be reported suspect to the data user.

TABLE 13-3 Example of Summary of Corrective Action Procedures (con't)

Analysis Method	Item	Control Limits	Acceptance Criteria	Corrective Action
Trihalomethanes/ Chloral Hydrate/ Haloacetonitrile	551.1 (con't)	LRB	< MRL	Determine source of contamination & eliminate the interference before processing samples
		LFB/CCV	% R = 80-120 % -90 % analytes &	Reanalyze CCV. If failed again recalibrate & the previous samples reanalyzed or analytes out of acceptable range should be reported suspect to the data user.
			75-125 % -for all analytes	
		LFM	80-120 %	When analyte recovery fails LFM criteria, a bias is concluded & analyte for that matrix is reported to the data user as suspect.
		LFM/Duplicate	see sample duplicate	
		Sample Duplicate	RPD < 20 for 90 % of analytes, RPD < 25 % or all analytes	If failing, repeat analyses. Upon repeated failure, sampling must be repeated or analyte out of control must be reported as suspect to the data user.
		Surrogate	80-120 % Rec.	Deviations in surrogate recovery may indicate an problem: Reanalyze extract if extraction upon reanalysis, recovery is failing extract fresh sample. If not, data for all analytes from the sample should be reported as suspect.
		CCV Surrogate	80-120 % Rec	Recalibrate if fails criteria
		Sample Peak	Within the linear range of calibration curve	Dilute final extract & reanalyze

14.0 PERFORMANCE AND SYSTEM AUDITS

The Quality Assurance Officer at MWH Laboratories is not directly involved in the production of analytical data. The QA department is responsible for an ongoing program of internal system audits and performance evaluation samples, and for coordinating all external audits and PE samples. In addition, the QA department is responsible for maintaining state and agency certifications.

14.1 PERFORMANCE EVALUATION/PROFICIENCY TESTING SAMPLES

Performance evaluation (PE) or Proficiency Testing (PT) samples are used to provide a direct evaluation of the ability of the analytical systems to generate data that is consistent with the laboratories' stated objectives for accuracy and precision. MWH Laboratories analyzes internal PE/PT samples as part of the ongoing QA program, while external PE /PT samples are analyzed as part of the certification and approval process for various state and federal agencies, as well as for other organizations.

14.1.1. Internal Performance Evaluation Samples / Internal Check Sample Program / Internal Proficiency Testing Program

Internal Performance Testing (PT) Program is done as part of the corrective action process for any PT reported as unacceptable and evaluated by the PT provider as “check for error” or did not pass the PT provider’s warning limits. Internal QC samples are also provided as needed as part of the analyst’s initial demonstration of capability. The QA group maintains a logbook of all blind PE samples for traceability of the true and reported values. A LIMS report is generated for each QC sample logged in the LIMS system. Problem areas are reviewed as soon as they surface; the probable cause is determined as expeditiously as possible and corrective action implemented. If a severe problem with the analysis is evident, the analysis is halted until the cause is found and corrected.

14.1.2. External Proficiency Testing (PT) Samples

External Proficiency Testing samples are analyzed twice a year as part of the NELAP certification and approval process for various state and federal agencies
Blind PE/PT samples are procured from NIST/NELAC Approved PE/PT Providers to include the following samples:

- Semi-annual Drinking Water PT Samples (WS series) Organic and Inorganic Samples
- WS Radiochemistry Gross Alpha, Beta , Radium 228 and Uranium PT samples
- WS Microbiology PT for Coliforms and HPC
- Semi-annual Waste Water PT Samples (WP series)/NPDES Organic and Inorganic PE/PT samples
- Annual NPDES/DMR PE/PT sample as required by EPA.

In addition the laboratory also participates in Client/State sponsored PE/PT programs.

Corrective Action Reports are generated when non-acceptable results are reported. Data reported by the laboratory not within the warning limits and flagged as "check for error" are also investigated to determine the root cause of the problems. Internal PE samples are provided to the analyst to determine if corrective action implemented was effective to resolve the problem. Acceptable results of the internal PE samples help the analyst to determine if the analysis is in control after the implementation of the corrective action.

Make-up PT or supplemental PT samples are also analyzed when the laboratory fails to maintain a record of passing two out of the most recent three PT studies and wishes to re-establish its history of successful performance. Analysis dates of make up PT studies must be at least 15 calendar days from the closing date of one study to the shipment date of another study. [NELAC 2.7.3]. Since some states, such as Massachusetts requires at least 30-days apart, thus the Lab adopts the "30-days apart" requirement for Make-up samples.

14.1.3. Proficiency Testing Protocol-Frequency, Laboratory Handling and Reporting

a. The laboratory enrolls and participates in a proficiency-testing program (PT) for each analyte or interdependent analyte group using all routine drinking water methods. When new analytes are added to the certification, 2 successful PT studies must be performed at least "15 or 30 (for Ma.)" calendar days apart from closing date of one study to the shipment of another study for the same field of proficiency testing and will be completed within 18 months from the date the additional groups are added on the Laboratory Application. [NELAC STD 2.7.2].

b. The laboratory participates in the PT program of a NIST approved PT provider/s twice in each calendar year.

c. The laboratory notifies the approving states such as WI of the authorized proficiency testing program or programs in which it has enrolled for each analyte or interdependent analyte group.

d. The laboratory follows the proficiency testing provider's instructions for preparing the proficiency-testing sample and analyzes the proficiency-testing sample as if it were a client sample.

e. The laboratory directs the proficiency-testing provider to send, either in hard copy or electronically, a copy of each evaluation of the laboratory's proficiency testing audit results to the state requiring the PT results. The laboratory allows the proficiency-testing provider to release all information necessary for the state to assess the laboratory's compliance to PT requirements.

f. The laboratory complies with the following prohibitions:

1. Performing multiple analyses (replicates, duplicates) which are not normally performed in the course of analysis of routine samples;
2. Averaging the results of multiple analyses for reporting when not specifically required by the method; or
3. Permitting anyone other than bona fide laboratory employees who perform the analyses on a day-to-day basis for the certified laboratory to participate in the generation of data or reporting of results.

g. The laboratory does not:

1. discuss the results of a proficiency testing audit with any other laboratory until after the deadline for receipt of results by the proficiency testing provider;
2. send proficiency testing samples or portions of samples to another laboratory to be tested; or
3. Knowingly receive a proficiency-testing sample from another laboratory for analysis and fail to notify the department of the receipt of the other laboratory's sample within five business days of discovery.

h. The laboratory maintains a copy of all proficiency testing records, including analytical worksheets. The proficiency testing records include a copy of the authorized proficiency testing provider report forms used by the laboratory to record proficiency testing results,

i. The director of the laboratory or representatives of the laboratory provides, if needed an attestation statement stating that the laboratory followed the proficiency testing provider's instructions for preparing the proficiency testing sample and analyzed the proficiency testing sample as if it were a client sample.

j. The laboratory analyzes and reports the results of the proficiency-testing test by the deadline set by the proficiency-testing provider.

k. If the laboratory fails a PT sample, a correction factor plan is submitted to CA NELAP and other states requiring corrective action, such as Nevada, Maine and Massachusetts, within 30-days after receipt of PT report.

l. The certified laboratory participates in only one remedial proficiency-testing audit for an analyte or independent analyte group in any 12-month period to obtain or upgrade approval under this section, as per Massachusetts's PE requirements.

m. The laboratory directs the proficiency-testing provider to send, either in hard copy or electronically, a copy of each evaluation of the certified laboratory's remedial proficiency testing results to California, and all other NELAP and other non-NELAP states. The laboratory allows the proficiency-testing provider to release all

information necessary for the state to assess the certified laboratory's compliance with this rule.

n. As per NELAC standard 2.5, PT samples are managed, analyzed and reported in the same manner as real routine samples.

14.2 SYSTEM AUDITS

System audits are performed both by external agencies, and by the laboratory Quality Assurance Group. The focus of these audits is the overall analytical "system", from login to delivery of the finished reports. The purpose of the audits is to document compliance with specified methodology contained in our SOPs.

All audit and review findings and any corrective actions that arise from them shall be documented. The laboratory shall ensure that these actions are discharged within the agreed time frame.

14.2.1 Data Package Review

Data package review is conducted annually by the Lab QA Manager or designee. At the start of the audit program, PE sample data package analyzed by using the drinking water, wastewater, hazardous waste methods are evaluated to have an objective assessment on the quality of the data generated by the lab. Annually several analytical methods i.e. at least one representative technology method from Wet Chem, Metals, Rad, GC, HPLC, GCMS, Asbestos and Microbiology are selected either from PE or client data reports for data package reviews. The laboratory ensures that at the end of the year, a representative method from NELAC list of technology for drinking water, wastewater, and hazardous waste analysis have been reviewed. Compliance with all the required QC is evaluated A data package review checklist is used to serve as guidelines during the data package review. A report on the results of the data package review is submitted to the supervisors and the Lab Director after the data package review for corrective actions.

In addition, a response to the findings and appropriate corrective action is implemented by the supervisors to ensure continuous compliance to all method requirements. Also, to develop a proactive program for the detection of improper, unethical or illegal actions, the QA Manager or designee during the data package review includes the detection of any potential improper, unethical or illegal action by any of the lab personnel. The data integrity checklist from Arizona is used as guideline.

14.2.2 External System Audits

External System audits are performed by outside agencies such as the California Department of Health Services (at least every 2 years for NELAC accreditation) and by other state agencies where MWH Laboratories is certified.

External audits are also conducted by the State of Arizona every year, and Wisconsin every three (3) years. All other NELAC states recognize DHS CA on-site assessment in accordance to NELAC secondary accreditation program. All corrective action reports audit findings and audit responses are retained by the laboratory for a minimum of 5 years (NELAC) and 10-years (Hawaii).

14.2.3 Internal Audits

The laboratory Quality Assurance Group conducts an annual lab internal audit to verify that its operations continue to comply with the requirements of the laboratory's quality system. [NELAC 5.4.13.1]

14.2.3.1 The laboratory periodically, in accordance with a predetermined schedule and procedure, conduct internal audits, at least annually, of the activities to verify that the operations continue to comply with the requirements of the quality systems of NELAC standards. The internal audit program addresses all elements of the quality system, including the environmental testing and/or calibration activities. The QA Officer plans and organizes audits as required by the schedule and requested by the management. Such audits are carried out by trained and qualified personnel who are independent of the activity to be audited. Personnel are trained not to audit their own activities except when it can be demonstrated that an effective audit will be carried out [NELAC 5.4.13.1].

14.2.3.2 When audit findings cast doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's environmental test or calibration results, the laboratory takes timely corrective action, and notifies the clients in writing when the investigations show that the laboratory results are affected. The laboratory notifies the client promptly, in writing of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of the results given in any test report or test certificate or amendment to a report or certificate. [NELAC 5.4.13.2].

14.2.3.3. The area of activity audited, the audit findings, and corrective actions that arise from them are recorded. The laboratory management ensures that these actions are discharge within the agreed time frame as indicated in the audit finding documentation. Typically, corrective action are required within 30-days after findings been published [NELAC 5.4.13.3].

14.2.3.4 Follow up audit activities of the laboratory are conducted to verify and record the implementation and effectiveness of the corrective action taken [NELAC 5.4.13.4].

The audits are carried out by the quality assurance Manager or designee(s) who will be independent of the activity to be audited. Also, to develop a proactive program for the detection of improper, unethical or illegal actions, the QA Manager or designee during the internal audit procedure includes the auditing of any improper, unethical or illegal action committed by the analyst or supervisor.

14.3 CERTIFICATIONS, ACCREDITATIONS AND AGENCY APPROVALS

MWH Laboratories participates in laboratory certification programs with California, and other 46 states and teritories.

MWH Laboratories is accredited in (01114 CA) CA Department of Health and Services NELAP and ELAP (Non NELAP) Program (Certificate No. 1422).

A copy of the Labs MWH NELAP Accreditation plus NELAP fields of accreditation (Fig. 14-1, Table 14-1) and a copy of the CA ELAP (Environmental Laboratory Accreditation Program) plus Fields of Testing are attached (Fig. 14-2, Table 14-2).

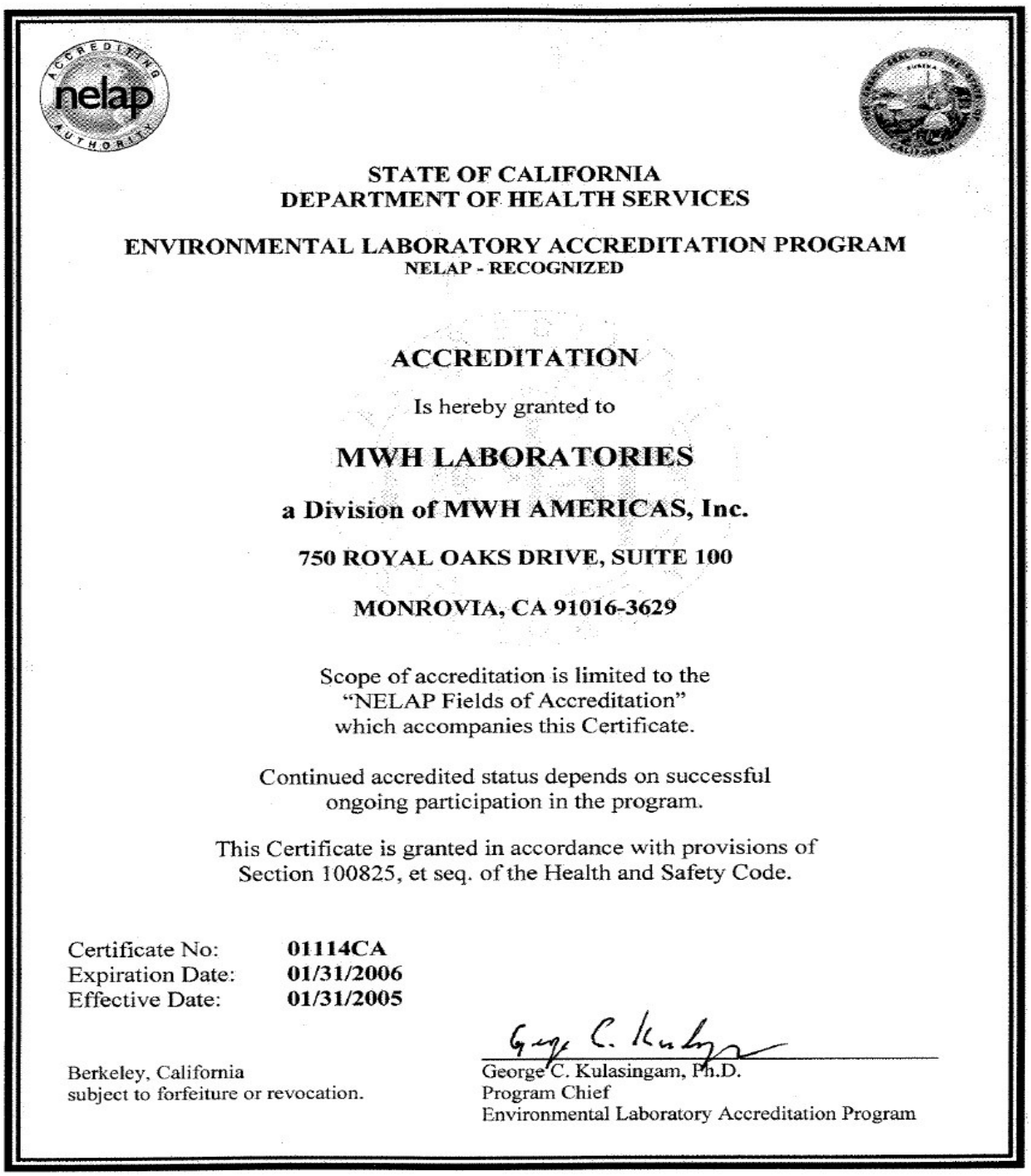
MWH Laboratories is currently certified in other 46 states under the NELAP Secondary Accreditation Program and other non-NELAP states Certification Program. See list of states that MWH Labs is certified for in Table 3-1 of Section 3.0.

Arizona Dept of Health Services requires that of copy of MWH Labs AZ certification and License (A20455) be attached in the Lab QAM. See enclosed AZ License and list of license parameters in Figure 14-3, Table 14-3.

Other Lab Approvals and License Include:

#	AGENCY	LAB ID	EXPIRATION DATE
1	LACSD	10249	-------
2	Radioactive Material License	3069-19	March 15, 2009
3	Soil Permit	S-65114	March 31, 2009
4	Consolidate Permit/License to Operate	AR0036980	On the process for Renewal

Figure 14-1 Laboratory Certificate – State of California



STATE OF CALIFORNIA
DEPARTMENT OF HEALTH SERVICES

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM
NELAP - RECOGNIZED

ACCREDITATION

Is hereby granted to

MWH LABORATORIES

a Division of MWH AMERICAS, Inc.

750 ROYAL OAKS DRIVE, SUITE 100

MONROVIA, CA 91016-3629

Scope of accreditation is limited to the
"NELAP Fields of Accreditation"
which accompanies this Certificate.

Continued accredited status depends on successful
ongoing participation in the program.

This Certificate is granted in accordance with provisions of
Section 100825, et seq. of the Health and Safety Code.

Certificate No: 01114CA
Expiration Date: 01/31/2006
Effective Date: 01/31/2005

Berkeley, California
subject to forfeiture or revocation.

George C. Kulasingam, Ph.D.
Program Chief
Environmental Laboratory Accreditation Program

Table 14-1 California Certified Analytes

State of California—Health and Human Services Agency
Department of Health Services

SANDRA SHEWRY
Director

ARNOLD SCHWARZENEGGI
Governor

February 8, 2005

Certificate No 01114CA

ANDREW EATON, Ph.D.
MWH LABORATORIES
750 ROYAL OAKS DRIVE, SUITE 100
MONROVIA, CA 91016-3629

Dear ANDREW EATON, Ph.D.:

Enclosed is an updated copy of your accreditation papers.

If you have any questions, please contact our office at (510) 540-2800.

Sincerely,

George C. Kulasingam, Ph.D.
Program Chief
Environmental Laboratory Accreditation Program

Enclosure

Environmental Laboratory Accreditation Program
1625 Shattuck Avenue, Room 101, Berkeley, CA 94709-1611
Phone (510) 540-2800, Fax (510) 849-5106

Table 14-1 (con't)

CALIFORNIA DEPARTMENT OF HEALTH SERVICES
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM - NELAP RECOGNIZED
Fields of Accreditation

MWH LABORATORIES
a Division of MWH AMERICAS, Inc.
750 ROYAL OAKS DRIVE, SUITE 100
MONROVIA, CA 91016-3629

Lab Phone (626) 386-1100

Certificate No: 01114CA **Renew Date: 01/31/2006** **INTERIM**

101 - Microbiology of Drinking Water			
101.010	001	SM9215B	Heterotrophic Bacteria
101.020	001	SM9221A,B	Total Coliform
101.021	001	SM9221E (MTF/EC)	Fecal Coliform
101.060	002	SM9223	Total Coliform
101.060	003	SM9223	E. coli
101.120	001	SM9221A,B,C	Total Coliform (Enumeration)
101.130	001	SM9221E (MTF/EC)	Fecal Coliform (Enumeration)
101.160	001	SM9223	Total Coliform (Enumeration)
102 - Inorganic Chemistry of Drinking Water			
102.020	001	EPA 180.1	Turbidity
102.030	001	EPA 300.0	Bromide
102.030	002	EPA 300.0	Chlorate
102.030	003	EPA 300.0	Chloride
102.030	004	EPA 300.0	Chlorite
102.030	006	EPA 300.0	Nitrate
102.030	007	EPA 300.0	Nitrite
102.030	010	EPA 300.0	Sulfate
102.040	001	EPA 300.1	Bromide
102.040	002	EPA 300.1	Chlorite
102.040	003	EPA 300.1	Chlorate
102.040	004	EPA 300.1	Bromate
102.045	001	EPA 314.0	Perchlorate
102.050	001	EPA 335.4	Cyanide
102.060	001	EPA 353.2	Nitrate calc.
102.061	001	EPA 353.2	Nitrite
102.070	001	EPA 365.1	Phosphate, Ortho
102.100	001	SM2320B	Alkalinity
102.110	001	SM2330B	Corrosivity (Langlier Index)
102.120	001	SM2340B	Hardness
102.130	001	SM2510B	Conductivity
102.140	001	SM2540C	Total Dissolved Solids
102.145	001	EPA 160.1	Total Dissolved Solids
102.163	001	SM4500-Cl G	Free & Total Chlorine
102.180	001	SM4500-ClO2 D	Chlorine Dioxide
102.191	001	SM4500-CN F	Cyanide, Total
102.192	001	SM4500-CN G	Cyanide, amenable
102.200	001	SM4500-F C	Fluoride
102.210	001	SM4500-H+ B	pH
102.212	001	EPA 150.1	pH

As of 02/08/2005, this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

Page 1 of 11

Table 14-1 (con't)

MWH LABORATORIES

Certificate No: 01114CA
Renew Date: 01/31/2006

102.240	001	SM4500-P E	Phosphate, Ortho
102.260	001	SM5310B	Total Organic Carbon
102.261	001	SM5310B	DOC
102.270	001	SM5540C	Surfactants
102.280	001	SM5910B	UV254
102.520	001	EPA 200.7	Calcium
102.520	002	EPA 200.7	Magnesium
102.520	003	EPA 200.7	Potassium
102.520	004	EPA 200.7	Silica
102.520	005	EPA 200.7	Sodium
102.520	006	EPA 200.7	Hardness (calc.)
102.533	001	SM4500-Si D	Silica
103 - Toxic Chemical Elements of Drinking Water			
103.130	001	EPA 200.7	Aluminum
103.130	003	EPA 200.7	Barium
103.130	004	EPA 200.7	Beryllium
103.130	005	EPA 200.7	Cadmium
103.130	007	EPA 200.7	Chromium
103.130	008	EPA 200.7	Copper
103.130	009	EPA 200.7	Iron
103.130	011	EPA 200.7	Manganese
103.130	012	EPA 200.7	Nickel
103.130	015	EPA 200.7	Silver
103.130	017	EPA 200.7	Zinc
103.140	001	EPA 200.8	Aluminum
103.140	002	EPA 200.8	Antimony
103.140	003	EPA 200.8	Arsenic
103.140	004	EPA 200.8	Barium
103.140	005	EPA 200.8	Beryllium
103.140	006	EPA 200.8	Cadmium
103.140	007	EPA 200.8	Chromium
103.140	008	EPA 200.8	Copper
103.140	009	EPA 200.8	Lead
103.140	010	EPA 200.8	Manganese
103.140	012	EPA 200.8	Nickel
103.140	013	EPA 200.8	Selenium
103.140	014	EPA 200.8	Silver
103.140	015	EPA 200.8	Thallium
103.140	016	EPA 200.8	Zinc
103.150	003	EPA 200.9	Arsenic
103.150	012	EPA 200.9	Selenium
103.160	001	EPA 245.1	Mercury
103.300	001	EPA 100.1	Asbestos
103.301	001	EPA 100.2	Asbestos
104 - Volatile Organic Chemistry of Drinking Water			
104.030	001	EPA 504.1	1,2-Dibromoethane
104.030	002	EPA 504.1	1,2-Dibromo-3-chloropropane
104.030	003	EPA 504.1	1,2,3-Trichloropropane

As of 02/08/2005, this list supersedes all previous lists for this certificate number.
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104.040	001	EPA 524.2	Benzene
104.040	002	EPA 524.2	Bromobenzene
104.040	003	EPA 524.2	Bromochloromethane
104.040	006	EPA 524.2	Bromomethane
104.040	007	EPA 524.2	n-Butylbenzene
104.040	008	EPA 524.2	sec-Butylbenzene
104.040	009	EPA 524.2	tert-Butylbenzene
104.040	010	EPA 524.2	Carbon Tetrachloride
104.040	011	EPA 524.2	Chlorobenzene
104.040	012	EPA 524.2	Chloroethane
104.040	014	EPA 524.2	Chloromethane
104.040	015	EPA 524.2	2-Chlorotoluene
104.040	016	EPA 524.2	4-Chlorotoluene
104.040	018	EPA 524.2	Dibromomethane
104.040	019	EPA 524.2	1,3-Dichlorobenzene
104.040	020	EPA 524.2	1,2-Dichlorobenzene
104.040	021	EPA 524.2	1,4-Dichlorobenzene
104.040	022	EPA 524.2	Dichlorodifluoromethane
104.040	023	EPA 524.2	1,1-Dichloroethane
104.040	024	EPA 524.2	1,2-Dichloroethane
104.040	025	EPA 524.2	1,1-Dichloroethene
104.040	026	EPA 524.2	cis-1,2-Dichloroethene
104.040	027	EPA 524.2	trans-1,2-Dichloroethene
104.040	028	EPA 524.2	Dichloromethane
104.040	029	EPA 524.2	1,2-Dichloropropane
104.040	030	EPA 524.2	1,3-Dichloropropane
104.040	031	EPA 524.2	2,2-Dichloropropane
104.040	032	EPA 524.2	1,1-Dichloropropene
104.040	033	EPA 524.2	cis-1,3-Dichloropropene
104.040	034	EPA 524.2	trans-1,3-Dichloropropene
104.040	035	EPA 524.2	Ethylbenzene
104.040	036	EPA 524.2	Hexachlorobutadiene
104.040	037	EPA 524.2	Isopropylbenzene
104.040	038	EPA 524.2	4-Isopropyltoluene
104.040	039	EPA 524.2	Naphthalene
104.040	040	EPA 524.2	Nitrobenzene
104.040	041	EPA 524.2	N-propylbenzene
104.040	042	EPA 524.2	Styrene
104.040	043	EPA 524.2	1,1,1,2-Tetrachloroethane
104.040	044	EPA 524.2	1,1,2,2-Tetrachloroethane
104.040	045	EPA 524.2	Tetrachloroethene
104.040	046	EPA 524.2	Toluene
104.040	047	EPA 524.2	1,2,3-Trichlorobenzene
104.040	048	EPA 524.2	1,2,4-Trichlorobenzene
104.040	049	EPA 524.2	1,1,1-Trichloroethane
104.040	050	EPA 524.2	1,1,2-Trichloroethane
104.040	051	EPA 524.2	Trichloroethene
104.040	052	EPA 524.2	Trichlorofluoromethane

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104.040	053	EPA 524.2	1,2,3-Trichloropropane
104.040	054	EPA 524.2	1,2,4-Trimethylbenzene
104.040	055	EPA 524.2	1,3,5-Trimethylbenzene
104.040	056	EPA 524.2	Vinyl Chloride
104.040	057	EPA 524.2	Xylenes, Total
104.040	058	EPA 524.2	Hexachloroethane
104.045	001	EPA 524.2	Bromodichloromethane
104.045	002	EPA 524.2	Bromoform
104.045	003	EPA 524.2	Chloroform
104.045	004	EPA 524.2	Dibromochloromethane
104.045	005	EPA 524.2	Trihalomethanes
104.050	002	EPA 524.2	Methyl tert-butyl Ether (MTBE)
104.050	004	EPA 524.2	tert-Amyl Methyl Ether (TAME)
104.050	005	EPA 524.2	Ethyl tert-butyl Ether (ETBE)
104.050	006	EPA 524.2	Trichlorotrifluoroethane
105 - Semi-volatile Organic Chemistry of Drinking Water			
105.010	001	EPA 505	Aldrin
105.010	002	EPA 505	Alachlor
105.010	004	EPA 505	Chlordane
105.010	005	EPA 505	Dieldrin
105.010	006	EPA 505	Endrin
105.010	007	EPA 505	Heptachlor
105.010	008	EPA 505	Heptachlor Epoxide
105.010	009	EPA 505	Hexachlorobenzene
105.010	011	EPA 505	Lindane
105.010	012	EPA 505	Methoxychlor
105.010	014	EPA 505	Toxaphene
105.010	015	EPA 505	PCBs as Aroclors (screen)
105.010	016	EPA 505	PCB-1016
105.010	017	EPA 505	PCB-1221
105.010	018	EPA 505	PCB-1232
105.010	019	EPA 505	PCB-1242
105.010	020	EPA 505	PCB-1248
105.010	021	EPA 505	PCB-1254
105.010	022	EPA 505	PCB-1260
105.082	001	EPA 515.3	2,4-D
105.082	002	EPA 515.3	Dinoseb
105.082	003	EPA 515.3	Pentachlorophenol
105.082	004	EPA 515.3	Picloram
105.082	005	EPA 515.3	2,4,5-TP
105.082	006	EPA 515.3	Bentazon
105.082	007	EPA 515.3	Dalapon
105.082	008	EPA 515.3	Dicamba
105.083	001	EPA 515.4	2,4-D
105.083	002	EPA 515.4	Dinoseb
105.083	003	EPA 515.4	Pentachlorophenol
105.083	004	EPA 515.4	Picloram
105.083	005	EPA 515.4	2,4,5-TP

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105.083	006	EPA 515.4	Dalapon
105.083	007	EPA 515.4	Bentazon
105.083	008	EPA 515.4	Dicamba
105.090	001	EPA 525.2	Alachlor
105.090	002	EPA 525.2	Aldrin
105.090	003	EPA 525.2	Atrazine
105.090	004	EPA 525.2	Benzo(a)pyrene
105.090	005	EPA 525.2	Butachlor
105.090	006	EPA 525.2	Chlordane
105.090	007	EPA 525.2	Dieldrin
105.090	008	EPA 525.2	Di(2-ethylhexyl) Adipate
105.090	009	EPA 525.2	Di(2-ethylhexyl) Phthalate
105.090	010	EPA 525.2	4,4'-DDD
105.090	011	EPA 525.2	4,4'-DDE
105.090	012	EPA 525.2	4,4'-DDT
105.090	013	EPA 525.2	Endrin
105.090	014	EPA 525.2	Heptachlor
105.090	015	EPA 525.2	Heptachlor Epoxide
105.090	016	EPA 525.2	Hexachlorobenzene
105.090	017	EPA 525.2	Hexachlorocyclopentadiene
105.090	018	EPA 525.2	Lindane
105.090	019	EPA 525.2	Methoxychlor
105.090	020	EPA 525.2	Metolachlor
105.090	021	EPA 525.2	Metribuzin
105.090	022	EPA 525.2	Molinate
105.090	023	EPA 525.2	Pentachlorophenol
105.090	024	EPA 525.2	Propachlor
105.090	025	EPA 525.2	Simazine
105.100	001	EPA 531.1	Aldicarb
105.100	002	EPA 531.1	Aldicarb Sulfone
105.100	003	EPA 531.1	Aldicarb Sulfoxide
105.100	004	EPA 531.1	Carbaryl
105.100	005	EPA 531.1	Carbofuran
105.100	006	EPA 531.1	3-Hydroxycarbofuran
105.100	007	EPA 531.1	Methomyl
105.100	008	EPA 531.1	Oxamyl
105.101	001	EPA 531.2	Carbofuran
105.101	002	EPA 531.2	Oxamyl
105.101	003	EPA 531.2	Aldicarb
105.101	004	EPA 531.2	Aldicarb Sulfone
105.101	005	EPA 531.2	Aldicarb Sulfoxide
105.101	006	EPA 531.2	Carbaryl
105.101	007	EPA 531.2	3-Hydroxycarbofuran
105.101	008	EPA 531.2	Methomyl
105.120	001	EPA 547	Glyphosate
105.140	001	EPA 548.1	Endothall
105.150	001	EPA 549.2	Diquat
105.170	001	EPA 551.1	Bromochloroacetonitrile

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105.170	007	EPA 551.1	Chloropicrin
105.170	008	EPA 551.1	Dibromoacetonitrile
105.170	012	EPA 551.1	Dichloroacetonitrile
105.170	013	EPA 551.1	1,1-Dichloro-2-propanone
105.170	015	EPA 551.1	Trichloroacetonitrile
105.170	018	EPA 551.1	1,1,1-Trichloro-2-propanone
105.175	001	EPA 551.1	Bromodichloromethane
105.175	002	EPA 551.1	Bromoform
105.175	003	EPA 551.1	Chloroform
105.175	004	EPA 551.1	Dibromochloromethane
105.175	005	EPA 551.1	Trihalomethanes
105.190	001	SM6251B	Bromoacetic Acid
105.190	002	SM6251B	Bromochloroacetic Acid
105.190	003	SM6251B	Chloroacetic Acid
105.190	005	SM6251B	Dibromoacetic Acid
105.190	006	SM6251B	Dichloroacetic Acid
105.190	007	SM6251B	Trichloroacetic Acid
105.190	008	SM6251B	Haloacetic Acids (HAA5)
106 - Radiochemistry of Drinking Water			
106.010	001	EPA 900.0	Gross Alpha
106.010	002	EPA 900.0	Gross Beta
106.060	001	EPA 904.0	Radium-228
106.092	001	EPA 200.8 (Screen)	Uranium
106.270	001	SM7110C	Gross Alpha
106.610	001	SM7500-Rn	Radon-222
107 - Microbiology of Wastewater			
107.010	001	SM9215B	Heterotrophic Bacteria
107.020	001	SM9221B	Total Coliform
107.030	001	SM9221B	Total Coliform with Chlorine Present
107.040	001	SM9221C,E (MTF/EC)	Fecal Coliform
107.050	001	SM9221E	Fecal Coliform with Chlorine Present
107.100	001	SM9230B	Fecal Streptococci
107.100	002	SM9230B	Enterococci
108 - Inorganic Chemistry of Wastewater			
108.020	001	EPA 120.1	Conductivity
108.050	001	EPA 150.1	pH
108.060	001	EPA 160.1	Residue, Filterable
108.070	001	EPA 160.2	Residue, Non-filterable
108.080	001	EPA 160.3	Residue, Total
108.090	001	EPA 160.4	Residue, Volatile
108.100	001	EPA 160.5	Residue, Settleable
108.110	001	EPA 180.1	Turbidity
108.112	001	EPA 200.7	Boron
108.112	002	EPA 200.7	Calcium
108.112	003	EPA 200.7	Hardness (calc.)
108.112	004	EPA 200.7	Magnesium
108.112	005	EPA 200.7	Potassium

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108.112	006	EPA 200.7	Silica
108.112	007	EPA 200.7	Sodium
108.120	002	EPA 300.0	Chloride
108.120	004	EPA 300.0	Nitrate
108.120	005	EPA 300.0	Nitrite
108.120	006	EPA 300.0	Nitrate-nitrite, Total
108.120	008	EPA 300.0	Sulfate
108.140	001	EPA 310.1	Alkalinity
108.180	001	EPA 335.1	Cyanide, amenable
108.181	001	EPA 335.2	Cyanide, Total
108.182	001	EPA 335.3	Cyanide, Total
108.191	001	EPA 340.2	Fluoride
108.200	001	EPA 350.1	Ammonia
108.211	001	EPA 351.2	Kjeldahl Nitrogen
108.231	001	EPA 353.2	Nitrate calc.
108.232	001	EPA 353.2	Nitrate-nitrite, Total
108.240	001	EPA 354.1	Nitrite
108.260	001	EPA 365.1	Phosphate, Ortho
108.261	001	EPA 365.1	Phosphorus, Total
108.262	001	EPA 365.2	Phosphate, Ortho
108.263	001	EPA 365.2	Phosphorus, Total
108.270	001	EPA 370.1	Dissolved Silica
108.291	001	EPA 376.2	Sulfide
108.310	001	EPA 405.1	Biochemical Oxygen Demand
108.323	001	EPA 410.4	Chemical Oxygen Demand
108.360	001	EPA 420.1	Phenols, Total
108.361	001	EPA 420.2	Phenols, Total
108.370	001	EPA 425.1	Surfactants
108.385	001	SM2120B	Color
108.390	001	SM2130B	Turbidity
108.410	001	SM2320B	Alkalinity
108.420	001	SM2340B	Hardness (calc.)
108.430	001	SM2510B	Conductivity
108.440	001	SM2540B	Residue, Total
108.441	001	SM2540C	Residue, Filterable
108.442	001	SM2540D	Residue, Non-filterable
108.443	001	SM2540F	Residue, Settleable
108.465	001	SM4500-Cl G	Chlorine
108.473	001	SM4500-CN G	Cyanide, amenable
108.480	001	SM4500-F C	Fluoride
108.490	001	SM4500-H+ B	pH
108.508	001	SM4500-NH3 H	Ammonia
108.531	001	SM4500-O G	Dissolved Oxygen
108.540	001	SM4500-P E	Phosphate, Ortho
108.541	001	SM4500-P E	Phosphorus, Total
108.550	001	SM4500-Si D	Dissolved Silica
108.590	001	SM5210B	Biochemical Oxygen Demand
108.591	001	SM5210B	Carbonaceous BOD

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108.602	001	SM5220D	Chemical Oxygen Demand
108.611	001	SM5310C	Total Organic Carbon
108.640	001	SM5540C	Surfactants
109 - Toxic Chemical Elements of Wastewater			
109.002	001	EPA 100.2	Asbestos
109.010	001	EPA 200.7	Aluminum
109.010	002	EPA 200.7	Antimony
109.010	004	EPA 200.7	Barium
109.010	005	EPA 200.7	Beryllium
109.010	007	EPA 200.7	Cadmium
109.010	009	EPA 200.7	Chromium
109.010	010	EPA 200.7	Cobalt
109.010	011	EPA 200.7	Copper
109.010	012	EPA 200.7	Iron
109.010	015	EPA 200.7	Manganese
109.010	016	EPA 200.7	Molybdenum
109.010	017	EPA 200.7	Nickel
109.010	021	EPA 200.7	Silver
109.010	024	EPA 200.7	Tin
109.010	026	EPA 200.7	Vanadium
109.010	027	EPA 200.7	Zinc
109.020	001	EPA 200.8	Aluminum
109.020	002	EPA 200.8	Antimony
109.020	003	EPA 200.8	Arsenic
109.020	004	EPA 200.8	Barium
109.020	005	EPA 200.8	Beryllium
109.020	006	EPA 200.8	Cadmium
109.020	007	EPA 200.8	Chromium
109.020	008	EPA 200.8	Cobalt
109.020	009	EPA 200.8	Copper
109.020	010	EPA 200.8	Lead
109.020	011	EPA 200.8	Manganese
109.020	012	EPA 200.8	Molybdenum
109.020	013	EPA 200.8	Nickel
109.020	014	EPA 200.8	Selenium
109.020	015	EPA 200.8	Silver
109.020	016	EPA 200.8	Thallium
109.020	017	EPA 200.8	Vanadium
109.020	018	EPA 200.8	Zinc
109.190	001	EPA 245.1	Mercury
109.410	003	SM3113B	Arsenic
109.410	015	SM3113B	Selenium
109.811	001	SM3500-Cr D	Chromium (VI)
110 - Volatile Organic Chemistry of Wastewater			
110.040	001	EPA 624	Benzene
110.040	002	EPA 624	Bromodichloromethane
110.040	003	EPA 624	Bromoform
110.040	004	EPA 624	Bromomethane

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110.040	005	EPA 624	Carbon Tetrachloride
110.040	006	EPA 624	Chlorobenzene
110.040	007	EPA 624	Chloroethane
110.040	008	EPA 624	2-Chloroethyl Vinyl Ether
110.040	009	EPA 624	Chloroform
110.040	010	EPA 624	Chloromethane
110.040	011	EPA 624	Dibromochloromethane
110.040	012	EPA 624	1,2-Dichlorobenzene
110.040	013	EPA 624	1,3-Dichlorobenzene
110.040	014	EPA 624	1,4-Dichlorobenzene
110.040	015	EPA 624	1,1-Dichloroethane
110.040	016	EPA 624	1,2-Dichloroethane
110.040	017	EPA 624	1,1-Dichloroethene
110.040	018	EPA 624	trans-1,2-Dichloroethene
110.040	019	EPA 624	1,2-Dichloropropane
110.040	020	EPA 624	cis-1,3-Dichloropropene
110.040	021	EPA 624	trans-1,3-Dichloropropene
110.040	022	EPA 624	Ethylbenzene
110.040	023	EPA 624	Methylene Chloride
110.040	024	EPA 624	1,1,2,2-Tetrachloroethane
110.040	025	EPA 624	Tetrachloroethene
110.040	026	EPA 624	Toluene
110.040	027	EPA 624	1,1,1-Trichloroethane
110.040	028	EPA 624	1,1,2-Trichloroethane
110.040	029	EPA 624	Trichloroethene
110.040	030	EPA 624	Trichlorofluoromethane
110.040	031	EPA 624	Vinyl Chloride
111 - Semi-volatile Organic Chemistry of Wastewater			
111.100	001	EPA 625	Acenaphthene
111.100	002	EPA 625	Acenaphthylene
111.100	003	EPA 625	Anthracene
111.100	004	EPA 625	Benzidine
111.100	005	EPA 625	Benz(a)anthracene
111.100	006	EPA 625	Benzo(b)fluoranthene
111.100	007	EPA 625	Benzo(k)fluoranthene
111.100	008	EPA 625	Benzo(g,h,i)perylene
111.100	009	EPA 625	Benzo(a)pyrene
111.100	010	EPA 625	Benzyl Butyl Phthalate
111.100	011	EPA 625	Bis(2-chloroethoxy)methane
111.100	012	EPA 625	Bis(2-chloroethyl) Ether
111.100	013	EPA 625	Bis(2-chloroisopropyl) Ether
111.100	014	EPA 625	Di(2-ethylhexyl) Phthalate
111.100	015	EPA 625	4-Bromophenyl Phenyl Ether
111.100	016	EPA 625	4-Chloro-3-methylphenol
111.100	017	EPA 625	2-Chloronaphthalene
111.100	018	EPA 625	2-Chlorophenol
111.100	019	EPA 625	4-Chlorophenyl Phenyl Ether
111.100	020	EPA 625	Chrysene

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111.100	021	EPA 625	Dibenz(a,h)anthracene
111.100	022	EPA 625	1,2-Dichlorobenzene
111.100	023	EPA 625	1,3-Dichlorobenzene
111.100	024	EPA 625	1,4-Dichlorobenzene
111.100	025	EPA 625	3,3'-Dichlorobenzidine
111.100	026	EPA 625	2,4-Dichlorophenol
111.100	027	EPA 625	Diethyl Phthalate
111.100	028	EPA 625	2,4-Dimethylphenol
111.100	029	EPA 625	Dimethyl Phthalate
111.100	030	EPA 625	Di-n-butyl phthalate
111.100	031	EPA 625	Di-n-octyl phthalate
111.100	032	EPA 625	2,4-Dinitrophenol
111.100	033	EPA 625	2,4-Dinitrotoluene
111.100	034	EPA 625	2,6-Dinitrotoluene
111.100	035	EPA 625	Fluoranthene
111.100	036	EPA 625	Fluorene
111.100	037	EPA 625	Hexachlorobenzene
111.100	038	EPA 625	Hexachlorobutadiene
111.100	039	EPA 625	Hexachlorocyclopentadiene
111.100	040	EPA 625	Hexachloroethane
111.100	041	EPA 625	Indeno(1,2,3-c,d)pyrene
111.100	042	EPA 625	Isophorone
111.100	043	EPA 625	2-Methyl-4,6-dinitrophenol
111.100	044	EPA 625	Naphthalene
111.100	045	EPA 625	Nitrobenzene
111.100	046	EPA 625	2-Nitrophenol
111.100	047	EPA 625	4-Nitrophenol
111.100	048	EPA 625	N-nitrosodimethylamine
111.100	049	EPA 625	N-nitrosodi-n-propylamine
111.100	050	EPA 625	N-nitrosodiphenylamine
111.100	051	EPA 625	Pentachlorophenol
111.100	052	EPA 625	Phenanthrene
111.100	053	EPA 625	Phenol
111.100	054	EPA 625	Pyrene
111.100	055	EPA 625	1,2,4-Trichlorobenzene
111.100	056	EPA 625	2,4,6-Trichlorophenol
111.120	048	EPA 1625	N-nitrosodimethylamine
111.170	001	EPA 608	Aldrin
111.170	002	EPA 608	a-BHC
111.170	003	EPA 608	b-BHC
111.170	004	EPA 608	d-BHC
111.170	005	EPA 608	g-BHC (Lindane)
111.170	006	EPA 608	Chlordane
111.170	007	EPA 608	4,4'-DDD
111.170	008	EPA 608	4,4'-DDE
111.170	009	EPA 608	4,4'-DDT
111.170	010	EPA 608	Dieldrin
111.170	011	EPA 608	Endosulfan I

As of 02/08/2005, this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

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Table 14-1 (con't)

MWH LABORATORIES

Certificate No: 01114CA
Renew Date: 01/31/2006

111.170	012	EPA 608	Endosulfan II
111.170	013	EPA 608	Endosulfan Sulfate
111.170	014	EPA 608	Endrin
111.170	015	EPA 608	Endrin Aldehyde
111.170	016	EPA 608	Heptachlor
111.170	017	EPA 608	Heptachlor Epoxide
111.170	018	EPA 608	Toxaphene
111.170	019	EPA 608	PCB-1016
111.170	020	EPA 608	PCB-1221
111.170	021	EPA 608	PCB-1232
111.170	022	EPA 608	PCB-1242
111.170	023	EPA 608	PCB-1248
111.170	024	EPA 608	PCB-1254
111.170	025	EPA 608	PCB-1260
112 - Radiochemistry of Wastewater			
112.010	001	EPA 900.0	Gross Alpha
112.010	002	EPA 900.0	Gross Beta

As of 02/08/2005, this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

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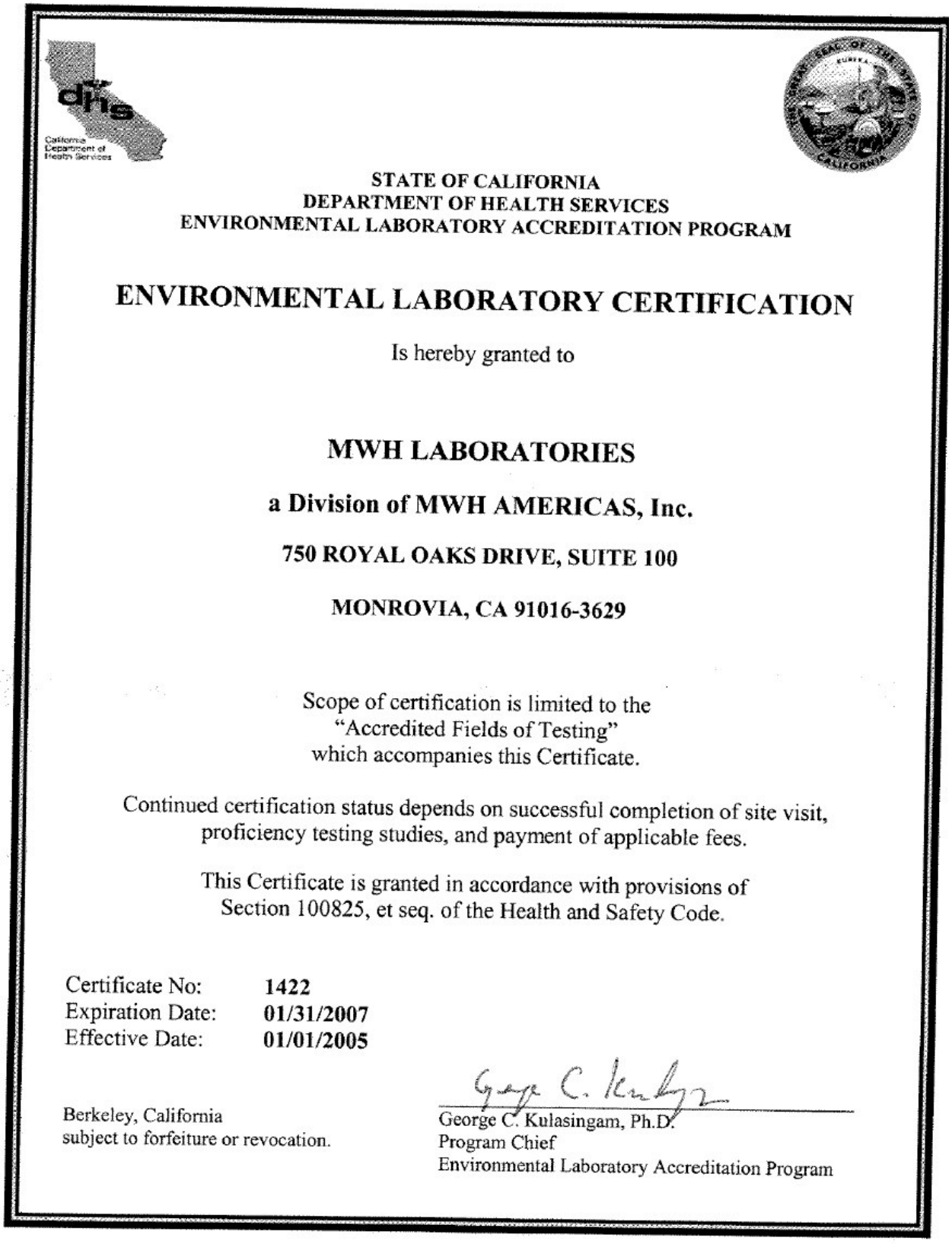
Figure 14-2 Laboratory Certificate – State of California (ELAP)



STATE OF CALIFORNIA
DEPARTMENT OF HEALTH SERVICES
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

ENVIRONMENTAL LABORATORY CERTIFICATION

Is hereby granted to

MWH LABORATORIES

a Division of MWH AMERICAS, Inc.

750 ROYAL OAKS DRIVE, SUITE 100

MONROVIA, CA 91016-3629

Scope of certification is limited to the
"Accredited Fields of Testing"
which accompanies this Certificate.

Continued certification status depends on successful completion of site visit, proficiency testing studies, and payment of applicable fees.

This Certificate is granted in accordance with provisions of Section 100825, et seq. of the Health and Safety Code.

Certificate No: **1422**
Expiration Date: **01/31/2007**
Effective Date: **01/01/2005**

Berkeley, California
subject to forfeiture or revocation.

George C. Kulasingam, Ph.D.
Program Chief
Environmental Laboratory Accreditation Program

Table 14-2 California Certified Analytes (ELAP)

State of California—Health and Human Services Agency
Department of Health Services

SANDRA SHEWRY
Director

ARNOLD SCHWARZENEGGER
Governor

January 1, 2005

Certificate No.: **1422**

ANDREW EATON, Ph.D.
MWH LABORATORIES
750 ROYAL OAKS DRIVE, SUITE 100
MONROVIA, CA 91016-3629

Dear ANDREW EATON, Ph.D.:

This is to advise you that the laboratory named above continues to be certified as an environmental testing laboratory pursuant to the provisions of the California Environmental Laboratory Improvement Act (Health and Safety Code (HSC), Division 101, Part 1, Chapter 4, Section 100825, et seq.). Certification for all currently certified Fields of Testing that the laboratory has applied for renewal shall remain in effect until **01/31/2007** unless revoked.

Please note that the renewal application for certification is subject to an on-site visit, and continued use of the certificate is contingent upon:

- **successful completion of the site visit;**
- **acceptable performance in the required performance evaluation (PE) studies;**
- **timely payment of all fees, including an annual fee due before January 31, 2006;**
- **compliance with Environmental Laboratory Accreditation Program (ELAP) statutes (HSC, Section 100825, et seq.) and Regulations (California Code of Regulations (CCR),Title 22, Division 4, Chapter 19).**

An updated "Approved Fields of Testing" will be issued to the laboratory upon completion of the renewal process. The application for the next renewal must be received 90 days before the expiration of this certificate to remain in force according to the CCR, Section 64801 through 64827.

Please note that the laboratory is required to notify ELAP of any major changes in the laboratory such as the transfer of ownership, change of laboratory director, change in location, or structural alterations which may affect adversely the quality of analyses (HSC, Section 100845(b)(d)). Please include the above certificate number in all your correspondence to ELAP.

If you have any questions, please contact ELAP at (510) 540-2800.

Sincerely,

George C. Kulasingam, Ph.D.
Program Chief
Environmental Laboratory Accreditation Program

Environmental Laboratory Accreditation Program
1625 Shattuck Ave # 101, Berkeley, CA 94709-1611
Phone 510-540-2800 Fax 510-849-5106 http://www.dhs.ca.gov/elap

15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

In order to insure that the Quality Assurance program at the laboratory maintains a high profile, there are several mechanisms in place, which insure that QA information is routinely conveyed to laboratory management. This includes a periodic QA report, reports on internal and external PE samples, and verbal transmittal of QA information to the Laboratory Director and group supervisors during a semiweekly staff meeting.

15.1 QA ANNUAL REPORT/ MANAGEMENT REVIEW

The Quality Assurance Manager prepares semi-annual QA/QC report to the Laboratory/Technical Director. This report details all the quality assurance activities conducted during the last 6-months, including performance evaluation sample results (both internal and external), holding time exceedances, de-briefing from external and internal systems audits, and a summary of all out of control events that required corrective action/preventive measures and the effectiveness of the initiated corrective action. Whenever any such quality assurance information impacts a specific analytical project, the events are immediately related to the Client Services Group, who is responsible for informing the client.

The QA Manager also submits the annual QC report to the Laboratory/Technical Director regarding QA/QC issues. The annual QC report includes the outcome of recent internal audits, assessments by external bodies, the results of inter-laboratory comparisons of proficiency tests and corrective actions. The annual QC report also include a discussion of the lab certifications, the laboratory SOPs generated for the year including SOP updates, control charts, acceptance limits updates, QA Manual updates and data review results.

The Laboratory/Technical Director performs an annual managerial review of the laboratory quality system and its testing and calibration activities to ensure its continuing suitability and effectiveness. Any necessary changes or improvements in the quality system and laboratory operations are introduced during the annual managerial review. Thus, the Laboratory/Technical Director reviews the annual QC report, provides an overall assessment of all the QC activities stated in the annual QC report and introduces any necessary changes or improvements in the quality system and laboratory operations. The annual managerial review also takes into account changes in the volume and type of work undertaken for the previous year and feedback from clients, complaints and other relevant factors, such as resources and staff training [NELAC 5.4.14].

15.2 PE SAMPLE EVALUATION REPORTS

The Quality Assurance Group conducts periodic system and performance audits of the laboratory and also maintains a program of blind performance evaluation samples. Results of these blind performance samples are scored according to the methods criteria.

In addition a debriefing to group leaders and the Laboratory Director is prepared by the QA group following each set of PE samples.

In addition, evaluations of any failures on external PE samples are prepared by Group Supervisors and summarized by the Quality Assurance Group for the certifying agencies, with copies conveyed to the Laboratory Director.

15.3 QUALITY ASSURANCE MANUAL / STANDARD OPERATING PROCEDURES REVIEW AND UPDATE

The Quality Assurance Manual and Standard Operating Procedures (SOP) of MWH Laboratories are reviewed and updated at least once a year. The laboratory's document control system allows for the amendment of documents by hand, pending the reissue of the documents. The changes are clearly marked, initialed and dated by the personnel that performed the original review. The revised document formerly reissued as soon as practicable (NELAC 5.4.3.3.3 & 5.4.3.3.1). All appropriate laboratory personnel signs the QA Plan Signature Page / SOP Training Documentation Form after the annual review of the QA Plan / SOPs. See Figure 15-1 for a copy of the QA Plan Signature Page. See Figure 15-2 for a copy of the SOP Training Documentation Form. See Table 15-1 for list of SOPs and their approval dates.

Figure 15-1 QA Plan Signature Page

This is to certify that I have read and understood MWH Laboratories' Quality Assurance Plan / UCMR.

I further certify that I will comply with the laboratory procedures and practices described in the manual for the generation of high quality data.

If you know any deviations in the laboratory practices, please notify your supervisor or QA Manager to evaluate if the said deviation adheres to good laboratory practices and affects data quality.

If you find errors in any section applicable to you, please notify your supervisor or QA Manager to correct them appropriately. The Quality Assurance Manual will be revised annually to reflect current laboratory practices.

Signature: _____ Date: _____

Name (print): _____ Date: _____

QAM - Rev. #: 29 Date: _____

Figure 15-2 SOP Training Documentation Form

SOP/METHOD TRAINING DOCUMENTATION

I certify that I have read, understood and agreed to perform the techniques and procedures includign the equipments stated in the most recent version of the approved test method and the laboratory standard operating procedure.

SOP Title _____

SOP Revision No.: _____

Date Revised: _____

Date Approved: _____

EPA/SM Method No.:_____

Revision No.: _____

Date Revised: _____

Analyst(s) /Supervisor	Print:	Signature:
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____

Training Dates :Start _____ Complete: _____

Duration:_____

Trainer Signature: _____Date: _____

Title (MWH Labs) _____

Supervisor Signature:_____Date: _____

Title (MWH Labs) _____

Table 15-1 List of SOPs and Approval Dates

SOP No.	Analytes	Method	Approval Date
Micro 1	Determination of asbestos fibers in water	EPA 100.1/100.2	6/14/04
Micro 2	Assimilable Organic Carbon Biossay	SM 9217 B 19th ed.	7/29/04
Micro 3	Ascaris Ova		1/22/1999
Micro 4	Clostridium perfringens analysis	ICR manual 08/95	4/28/1995
Micro 5	Determination of Coliform in drinking water by the ONPG-MUG Method (Colilert)	SM 19th ed. Sec 9223 B	10/12/04
Micro 6	Determination of Coliform in water, wastewater and soil by Multiple Tube Fermentation Technique	SM 18th ed. Sec. 9221	9/12/2002
Micro 7	Coliphage Assay of water samples		4/28/1995
Micro 8	Total Culturable Virus Analysis	ICR-08/95 Draft version	9/28/1998
Micro 9	Determination of Fecal Streptococci and enterococci in water, wastewater and soil	SM 18th ed Sec. 9230	3/8/2002
Micro 10	Detection of Giardia Cysts and Cryptosporidium ocysts in water by Fluorescent Antibody Technique	ICR Microbial Laboratory Manual EPA 600/R 95/ 178 April 96 Final version	4/20/2000
Micro 10	Microbiology / Giardia & Sampling Crypto		5/4/2001
Micro 11	Heterotrophic plate count	SM 19 th ed. 9215 A, B	3/8/2002
Micro 12	Total Culturable Virus	EPA ICR Microbial Laboratory Manual April 96	8/30/2000
Micro 13	Microscopic Particulate Analysis	EPA 910/9-92-029	7/20/2003
Micro 14	Determination of Salmonella in water and wastewater	SM9260B/D, 19th ed.	6/10/1996
Micro 15	Analysis of Enteric Virus in Wastewater & Sludge	SM9510G, 19th ed.	3/13/1998
Micro 16	Determination of Coliforms in Water by the CPRG-MUG Method / Colisure	SM 20th ed. Sec. 9223	11/22/2000
Micro 17	Determination of Escherichia Coli in water and waste water by Multiple Tube Fermentation Technique	SM 18th ed. Sec. 9221 F	11/16/04
Micro 18	Environmental Monitoring for Microbiological Contaminants		6/14/2000
Micro 19	Water Suitability Test	SM 19th ed Sec. 9020B	9/13/2002
Micro 20	Inhibitory Residues	SM 19th ed Sec. 9020B	11/16/04
Micro 21	Microbiology Demonstration of Capability		5/13/2002
Micro 22	Demonstration of Coliforms in Water by Membrane Filtration	SM 18th ed Sec. 9222B	4/5/2002
Micro 23	Male-specific (F+) and somatic coliphage in water by single agar layer (SAL) Procedure	EPA 1602 April 2000 Draft	7/20/2003
Micro 24	pH Check of Clean Glassware Using Bromthymol Blue	SM9020B	9/13/2002
Micro 25	Aeromonas n Finished Water by Membrane Filtration	EPA 1605	8/29/03
Micro 26	Determination of Coliforms in Drinking Water by the 18-hr on PG-MUG Method	SM9223B	06/25/04
Rad 1	Co-Precipitation method for Gross Alpha Radioactivity in Drinking Water	SM 7110 C	9/11/2002
Rad 2	Radon by Liquid Scintillation Counter	SM 7500-Rn	6/28/2002
Rad 3	Uranium by Radiochemical Method	EPA 908.0	10/10/2000
Rad 4	Alpha emitting Radium Isotopes	EPA 903.0	10/12/2000

Table 15-1 List of SOPs and Approval Dates (con't)

SOP No.	Analytes	Method	Approval Date
Rad 5	Liquid Scintillation Method for Tritrium	EPA 906	10/10/2000
Rad 6	Gross alpha and beta Radioactivity	EPA 900.0	2/13/04
Rad 7	Gross alpha and beta Radioactivity	EPA 900.0 / 9310	5/12/2000
Rad 8	Radium 228	EPA 904	08/5/03
Met 1	Analysis of Trace Elements by ICP Emission Spectroscopy	ICP, EPA 200.7	11/16/04
Met 2	Trace Metals by ICP/MS	ICP/MS, EPA 200.8	07/26/04
Met 3	Graphite Furnace Analysis of Trace Metals	GFAA EPA 200.9	11/08/04
Met 4 a Met 4 b	Mercury by Cold Vapor Atomic Absorption	SW846 Method 7470A, EPA 245.1	11/16/04
Met 16	Analysis of Trace Elements by ICP Emission Spectroscopy	EPA 6010B	6/12/2000
Met 19	Hexavalent Chromium, Colorimetric Method	EPA 7196 A / SM 3500 CR-D	5/17/2001
Met 21	Cations by Flame Atomic Absorption	SM 3111B	11/22/2000
Met 22	FLAA/Lithium	3111B	10/7/1998
Met 23	Formation of Trihalomethanes and other disinfection by products THMFP	SM 5710 B	4/3/1998
Met 24	Acid Digestion of Sediments, Sludge, and Soils	3050 B	1/26/1999
Met 25	Trace Metals by ICP/MS	EPA 6020	4/10/2000
Met 26	Silica by the Molybdosilicate Method	SM 4500-Si-D, EPA 370.1	11/7/2002
Met 27	Hardness by Calculation	SM 2340B	10/18/02
Met 28	pH / Turbidity Check for Metals	-	10/27/2000
Met 29	Determination of Dissolved Hexavalent Chromium by Ion Chromatography	EPA 218.6	2/6/2001
HPLC 1	Carbamates Analysis in Drinking Water	531.1	11/16/04
HPLC 2	Glyphosate Analysis in Drinking Water by High Performance Liquid Chromatography	547	02/13/04
HPLC 3	Diquat /Paraquat Analysis in Drinking Water by HPLC	549.2	02/16/04
HPLC 4	Solid Phase Extraction of Diuron in Potable Water and Analysis by High Performance Liquid Chromatography	632 (Analytical) 553 (Extraction)	6/12/2000
HPLC 5	Carbamates Analysis in Drinking Water by HPLC with post column derivatization	531.2	01/28/05
HPLC 6	Solid Phase Extraction of Diuron in Potable Water and Analysis by High Performance Liquid Chromatography	632	06/09/00
GC 2	Purgeable Halocarbons and Purgeable Aromatic Compounds	502.2	9/13/2002
GC 3	EDB, DBCP and 1,2,3-TCP	504.1	02/13/04
GC 4	Nitrogen- and Phosphorus-containing Pesticides	507	02/13/04
GC 5	Chlorinated Pesticides	508	10/14/2002
GC 6	Chlorinated Acids	515.1	9/12/2002
GC 7	Trihalomethanes and Chlorinated Organic Solvents	551	10/18/2000
GC 8	Chlorination Disinfection Byproducts and Chlorinated Organic Solvents	551.1	09/22/03
GC 9	Haloacetic Acids	SM6251 B	02/16/04
GC 10	Purgeable Halocarbons	601	02/16/04

Table 15-1 List of SOPs and Approval Dates (con't)

SOP No.	Analytes	Method	Approval Date
GC 11	Purgeable Aromatics	602	4/10/2000
GC 12	Oganochlorine Pesticides and PCBs	608	9/12/2002
GC 13	Ethion	614	3/13/1998
GC 16	1,2,-Dibromoethane & 1,2-Dibromo-3-Chloropropane by Microextraction & Gas Chromatography	8011	02/16/04
GC 18	Aromatic & Halogenated Volatiles by Gas Chromatography	8021 B	04/10/00
GC 20	Organochlorine Pesticides by Gas Chromatography	8081 A	4/12/2002
GC 21	Polychlorinated Biphenyls by Gas Chromatography	8082	7/28/2000
GC 22	THMFP (Trihalomethane Formation Potential)	SM5710B	4/3/1998
GC 23	Aldehydes	6252 A	8/4/1998
GC 24	Organophosphorus Compounds by Gas Chromatography	8141 A	8/3/2000
GC 25	Chlorinated Herbicides by GC using Methylation	8151 A	4/10/2000
GC 26	High Total Chlorine	4500-Cl-B	4/9/2000
GC 27	Free and Total Chlorine Analysis	4500-Cl-G	08/29/03
GC 28	Aromatic and Halogenated Volatiles by Gas Chromotography	8021B	4/10/2000
GC 29	Formation of Trihalomethanes and other disinfection by-products. Modified Standard Method 5710 B	SM 5710 B	4/3/1998
GC 30	Aldehydes	SM 6252	8/4/1998
GC 31	Determination of Organophosphorus Pesticides in Municipal & Industrial WW (EPA method)	614	6/14/2001
GC 32	Chlorinated Acids in Drinking Water	515.3	6/25/2002
GC 33	Chlorine Dioxide Analysis	SM 4500-CLO2-D	1/18/2002
GC 34	Chlorinated Pesticides and PCBs	EPA 505	11/17/04
Extract 1	Extraction 508 Pesticides	508	07/08/03
Extract 2	Extraction of Chlorinated Herbicides by Liquid/Liquid Extraction	MOD 515.1	9/11/2002
Extract 3	Liquid - Solid Extraction	EPA 525.2	11/17/04
Extract 4	Liquid-Solid Extraction Method for Endothall Analysis	548.1	11/17/04
Extract 5	Liquid-Solid Extraction of Diquat and Paraquat	549.2	07/08/03
Extract 6	Liquid-Liquid Extraction	507	06/20/03
Extract 7	Extraction of Chlorinated Herbicides	615/8151 A	8/3/2000
Extract 8	Extraction OP/Triazine Pesticides Liquid-Liquid Extraction	614/ 8141A/ 3510B	6/14/2001
Extract 9	Extraction of Organochlorine Pesticides & PCBS	608	4/9/2000
Extract 10	NDMA Continuous Liquid - Liquid Extraction	Modified 625/ 1625, 3520/ 8270 C	03/01/04
Extract 11	Extraction BNA Continuous Liquid-Liquid Extraction	8270 C	6/20/2003
Extract 12	Ultrasonic Extraction of Organochlorine Pesticides	8081 A	4/11/2000
Extract 13	Extraction OP/Triazine Pesticides Soxhlet Extraction	8141A, 3540 C	4/11/2000
Extract 14	Ultrasonic Extraction of Chlorinated Herbicides	8151 A	4/11/2000
Extract 15	Ultrasonic Extraction of Base, Neutral, Acid compounds	8270 C	6/12/2000

Table 15-1 List of SOPs and Approval Dates (con't)

SOP No.	Analytes	Method	Approval Date
GCMS 1	Volatile Organic Compounds in Drinking Water by GC/MS	524.2 (Modified)	3/24/2003
GCMS 2	Determination of Semivolatile Organic Compounds in Drinking Water by Gas Chromatography/Mass Spectrometry	525.2	3/17/2003
GCMS 3	Endothall Analysis by Liquid-Solid Extraction and GCMS	548.1	10/15/2002
GCMS 4	Volatile Organic Compounds in Aqueous Matrix by GC/MS	624 (Modified)	6/12/2000
GCMS 5	Analysis of Semivolatile Organic Compounds by GCMS	625	3/12/2004
GCMS 6	Volatiles Organics	8240	4/28/1995
GCMS 7	Volatile Organic Compounds in Water by GC/MS	8260 B	11/27/2000
GCMS 8	Analysis of Semivolatile Organic Compounds by GCMS	8270 C	6/11/2003
GCMS 9	Closed Loop Stripping	SM 6040	4/22/2002
GCMS 10	CLP Level IV Deliverables		11/3/1994
GCMS 11	THMFP-Trihalomethane Formation Potential	SM 5710B	4/3/1998
GCMS 12	Volatile Organic Compounds in Drinking Water for Kennedy-Jenks Pilot Study	524.2	10/1/1998
GCMS 13	Taste and Odor by Solid Phase Micro Extraction MIB - Geosmin		5/27/1999
GCMS 14	NDMA by GCMS	625/1625	7/31/2002
GCMS 15	Determination of Selected Semivolatile Organic Compounds in Drinking Water by Solid Phase Extractions and Capillary Column GCMS	526	12/10/2001
GCMS 16	Determination of Phenols in Drinking Water by Solid Phase Extraction and Capillary Column GCMS	528	12/10/2001
Wet Chem 1	Cyanide Analysis by Ion Selective Electrode (ISE)	SM4500-CN F	10/14/2002
Wet Chem 2	Fluoride by Ion Selective Electrode	SM4500-F C	03/01/04
Wet Chem 3	Alkalinity	EPA 310.1/ SM 2320B	02/13/04
Wet Chem 4	Total Dissolved Solids (TDS) in water	2540 C	10/15/02
Wet Chem 5	Total Suspended Solids (TSS) in water	SM2540D/ 160.2	9/6/2000
Wet Chem 6	Turbidity - Nephelometric	EPA 180.1	9/11/2002
Wet Chem 7	Total Solids (TS) in Aqueous Sample	SM2540B/ 160.3	4/10/2000
Wet Chem 9	Settleable Solids	EPA 160.5/SM2540 F	08/12003
Wet Chem 10	Residual Chlorine	SM4500CL G	6/22/1998
Wet Chem 11	Color	EPA 2120 B	10/14/2002
Wet Chem 12	Conductivity (EC)	SM2510B/ EPA 120.1	3/16/04
Wet Chem 13	Cyanide (Reflux-Distillation) Midi Distillation	EPA335.4	7/29/2000
Wet Chem 14	Orthophosphate, Total, Suspended and Dissolved	EPA 365.2/SM4500-P E	3/8/2002
Wet Chem 15	Odor	SM2150	04/26/04
Wet Chem 16	Determination of Perchlorate in Drinking water using Ion Chromatography	EPA 314.0/ CADHS 300.0 Modified	10/14/2002
Wet Chem 17	Biochemical Oxygen Demand	SM5210B / EPA 405.1	9/12/2002
Wet Chem 18	Oil & Grease	EPA413.1	6/12/2000
Wet Chem 19	Phenolics	EPA420.1 / 420.2	7/23/2003

Table 15-1 List of SOPs and Approval Dates (con't)

SOP No.	Analytes	Method	Approval Date
Wet Chem 21	Determination of Nitrate / Nitrite by Flow Injection Analysis	EPA 353.2	7/23/2003
Wet Chem 22	Nitrogen, Kjeldahl, Total (Colorimetric, Semi-Automated Digester)	EPA 351.2	9/11/2002
Wet Chem 23	Nitrite - Nitrogen - LACHAT Quick Chem	EPA 353.2 Lachat	10/8/1997
Wet Chem 24	Ignitability	EPA 1010	-
Wet Chem 25	Determination of Anions by Ion Chromatography	EPA 300.0 A, B 300.1 B	02/13/04
Wet Chem 26	Total Volatile Solids/Volatile Suspended Solids in Liquid	SM2540E / 160.4	08/12/03
Wet Chem 27	Ammonia as Nitrogen by Rapid Flow Analyzer (RFA)	EPA 350.1/ SM 4500-NH3,D,H	7/23/2003
Wet Chem 28	pH Value	EPA 150.1/ SM 4500-H/ 9040	10/14/2002
Wet Chem 30	Glassware - BTB-pH Check	SM 18th Ed.	1/12/1999
Wet Chem 31	Surfactants, Anionic (MBAS)	SM 5540 C/ EPA 425.1	10/14/2002
Wet Chem 32	Total Organic Carbon by UV/ Persulfate Oxidation	SM 5310 C	9/11/2002
Wet Chem 33	Dissolved Organic Carbon by UV/ Persulfate Oxidation	SM5310C	02/13/04
Wet Chem 34	Analytical method for Ultraviolet Absorption of Organic constituents at 254 nm	SM5910B	4/10/2000
Wet Chem 35	Sulfide Determination (Methylene Blue)	EPA 376.2 , SM 4500-S^{2-}	3/8/2002
Wet Chem 36	Chemical Oxygen Demand (COD)	EPA 410.4 SM 5220 D	03/01/04
Wet Chem 37	Determination of Total Cyanide by Semi-Automated Colorimetry	EPA 335.2/335.3 335.4/335.1	3/8/2002
Wet Chem 38	Determination of Total Phosphate by Flow Injection Analysis Colorimetry	EPA 365.1	7/23/2003
Wet Chem 39	Langelier Index by Calculation	SM 2330 B	4/10/2000
Wet Chem 40	Hardness by Calculation	SM 2340 B	4/10/2000
Wet Chem 40	Determination of Inorganic Oxyhalide Disinfection By-Products in drinking water using Ion Chromatography with the addition of a post column reagent for Trace Bromate Analysis.	EPA 300.0B/300.1B/Draft EPA 317.1 PCR	1/30/2002
Wet Chem 41	Acidity	EPA 310.1, SM 2310 B	4/10/2000
Wet Chem 42	Dissolved Organic Halogen: Adsorption-Pyrolysis-Titrimetric Method	SM 5320 B	02/16/04
Wet Chem 43	Dissolved Oxygen, Membrane Electrode	SM 4500-O-G	6/12/2000
Wet Chem 45	Oil & Grease IR/TPH IR Method	EPA 413.2 / 418.1	6/12/2000
Wet Chem 46	Determination of Perchlorate in Soil Matrix by IC using Ion Pac AS-16	EPA 314 (Modified)	11/28/2001
Wet Chem 47	Determination of Nitrate/Nitritee by Flow Injection analysis	EPA 354.1	08/05/03
Wet Chem 48	Determination of Low Level Perchlorate in Drinking Water using Ion Chromatography	EPA 314.0	03/17/04
NonMethod 1	Sample Receiving and Log In	N/A	07/02/03
NonMethod 2	Chain of Custody	N/A	05/08/02

Table 15-1 List of SOPs and Approval Dates. (con't)

SOP No.	Analytes	Method	Approval Date
NonMethod 3	Preparation and Shipment of Sample Kits	N/A	06/12/00
NonMethod 4	Hazardous Waste Management and Sample Disposal Procedures	N/A	05/29/00
NonMethod 5	Code of Ethics and Quality	N/A	07/30/02
NonMethod 6	Environmental Monitoring for Microbiological	N/A	04/28/00
NonMethod 7	Standards and Reagent Preparation, Documentation, and Labeling	N/A	11/22/00
NonMethod 8	Compositing and Subsampling in the Laboratory	N/A	04/28/00
NonMethod 9	Free Chlorine Test for 502.2, 524.2 and THM by Aquaquant 1.4434 Chlorine	N/A	05/01/00
NonMethod 10	Implementation of Good Automated Laboratory Practices (GALP)	N/A	10/27/00
NonMethod 11	Balance Maintenance	N/A	10/27/00
NonMethod 12	Manual Integration	N/A	10/27/00
NonMethod 13	Retention of Significant figures	N/A	10/27/00
NonMethod 14	Instrument Maintenance	N/A	10/16/02
NonMethod 15	Use of Class A glassware	N/A	10/16/02
NonMethod 16	Glassware Cleaning	N/A	10/27/00
NonMethod 17	Preparing glassware soaking acid solution	N/A	10/27/00
NonMethod 18	Data Entry & Data Transfer	N/A	10/27/00
NonMethod 19	Temperature Monitoring and Thermometer Calibration	N/A	01/16/01
NonMethod 20	Handling and Disposal of Foreign Soil Samples	N/A	04/22/03
UCMR 1	Determination of Perchlorate in Drinking Water Using Ion Chromatography	EPA 314.0	09/22/03
UCMR 2	Chlorinated Acids in Drinking Water	EPA 515.4	7/2/2003
UCMR 3	Volatiles in Drinking Water by GC/MS	EPA 524.2	3/17/2003
UCMR 4	Determination of Semivolatile Organic Compounds in Drinking Water by Gas Chromatography/Mass Spectrometry	EPA 525.2 (Analytical) / EPA 525.2 (Extraction)	3/17/2003 / 2/25/03
UCMR 5	Determination of Semivolatile Organic Compunds in drinking wate by solid phase extraction and capillary column GC/MS	EPA 526	12/10/01
UCMR 6	Determination of Phenols in Drinking water by solid phase extraction and capillary column GC/MS	EPA 528	12/10/01
UCMR 7	Determination of phenylurea compounds in drinking water by solid phase extraction and high performance liquid chromatography with UV detection	EPA 532	8/15/2001

16.0 MWH Labs Standard Policy on Resolution of Complaints

MWH Labs will, if it is feasible and within holding times, arrange for repeat of all analyses that do not meet regulatory requirements. We hold ourselves responsible for reporting or re-reporting all results in a format that complies with regulatory requirements, and will make every attempt to correct and when feasible will repeat work at no additional charge for all analyses compromised due to laboratory error in shipping, sample preparation, or analysis. In the event of a sample loss within the required sample collection window, we will discuss with clients the merits of available options versus re-sampling for either the individual parameter or the entire suite of samples. In all circumstances, MWH Labs will keep clients completely informed and aware of potential or actual problems as they arise, using e-mail or telephone (NELAC 5.4.8).

Where a complaint, or any other circumstance raises doubt concerning compliance with the laboratory's policies, with the requirement of the NELAC Standard or otherwise concerning the quality of the laboratory's data, the MWH Quality Assurance Department will immediately conduct an audit of the affected areas of activity (NELAC 5.4.10.5).

Documentation of the complaints or initiating event, internal audit findings and resulting corrective action will be maintained by the MWH Quality Assurance Department (NELAC 5.4.10.3).

APPENDIX I

Arizona Certification and Approval

Arizona Department of Health Services

Division of Public Health Services
Office of the Assistant Director
Public Health Preparedness Services

250 N. 17th Avenue
Phoenix, Arizona 85007
(602) 364-0720
(602) 364-0759 FAX

JANET NAPOLITANO, GOVERNOR
CATHERINE R. EDEN, DIRECTOR

December 29, 2004

Andrew Eaton, Ph.D.
MWH Laboratories
750 Royal Oaks Drive, Suite 100
Monrovia, CA 91016

Dear Dr. Eaton:

This is to confirm that your laboratory has fulfilled all requirements for Arizona Environmental Laboratory Licensure under the Arizona Revised Statute §§ 36.495 et.sec. and rules.

Your Arizona Environmental Laboratory License number is AZ0455, which is the number you will need to use when reporting compliance results to ADEQ or the USEPA.

If there are any questions, please do not hesitate to call me at the letterhead telephone number.

Sincerely,

Barbara A Escobar

Barbara A. Escobar
Program Manager
Office of Laboratory Licensure,
Certification & Training
Bureau of State Laboratory Services

BAE:cf

Arizona Department of Health Services
Office of L oratory Licensure, Certification & Train
250 North 17th Avenue, Phoenix, AZ 85007
Tuesday, November 30 2004

Page: 1

AZ License: AZ0455
Lab Director: Dr. Andrew Eaton

Lab Name: MWH Laboratories
Phone: (626) 386-1100
Fax: (626) 386-1101

Program HW

Parameter	EPA Method	Billing Code	Cert Date
1,2-Dibromoethane & 1,2-Dibromo-3-Chloropropane	EPA 8011	SOC5	06/29/99
Purge And Trap	EPA 5030B	*	11/30/04
Total Organic Halides	EPA 9020B	MISC2	04/26/99
Volatile Organics	EPA 8260B	VOC8	10/18/99

Total Licensed Parameters in this Program: 4

Program SDW

Parameter	EPA Method	Billing Code	Cert Date
1,2-Dibromoethane & 1,2-Dibromo-3-Chloropropane	EPA 504.1	SOC5	11/12/96
Acid And Base/Neutral Compounds	EPA 525.2	SOC16	11/17/95
Alkalinity	SM 2320B	NIA1	07/15/96
Aluminum	EPA 200.7	MTL3	09/30/96
Aluminum	EPA 200.8	MTL7	11/17/95
Antimony	EPA 200.8	MTL7	12/19/94
Arsenic	EPA 200.8	MTL7	12/19/94
Arsenic	EPA 200.9	MTL2	12/19/94
Asbestos	EPA 100.1	MISC27	05/25/94
Asbestos	EPA 100.2	MISC27	06/03/03
Barium	EPA 200.7	MTL3	11/24/93
Barium	EPA 200.8	MTL7	12/21/94
Beryllium	EPA 200.7	MTL3	01/10/94
Beryllium	EPA 200.8	MTL7	11/17/95
Bromate	EPA 300.0	NIIIA1	10/27/03
Bromate	EPA 300.1	NIIIA1	06/05/01
Bromide	EPA 300.0	NIIIA1	09/02/03
Bromide	EPA 300.1	NIIIA1	11/16/01
Cadmium	EPA 200.7	MTL3	11/24/93
Cadmium	EPA 200.8	MTL7	12/21/94
Calcium	EPA 200.7	MTL3	09/26/94
Carbamates	EPA 531.1	SOC2	11/24/93
Carbamates	EPA 531.2	SOC2	08/14/03
Chloramine	SM 4500 CL-G	MISC24	09/22/03
Chloride	EPA 300.0	NIIIA1	11/24/93
Chlorinated Acids	EPA 515.3	SOC3	07/05/01
Chlorinated Acids	EPA 515.4	SOC3	08/14/03
Chlorinated Pesticides	EPA 505	SOC9	04/03/03
Chlorinated Pesticides	EPA 525.2	SOC16	10/28/97
Chlorine Dioxide	SM 4500CL02 D	NIA10	11/16/01
Chlorine Residual Total	SM 4500-CL G	NIA3	07/15/96

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Office of Laboratory Licensure, Certification & Train
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AZ License: AZ0455 **Lab Name: MWH Laboratories**

Program SDW

Parameter	EPA Method	Billing Code	Cert Date
Chlorite	EPA 300.0	NIIIA1	03/24/99
Chlorite	EPA 300.1	NIIIA1	03/05/01
Chromium Total	EPA 200.7	MTL3	11/24/93
Chromium Total	EPA 200.8	MTL7	11/17/95
Color	SM 2120B	NIA4	10/28/97
Copper	EPA 200.7	MTL3	11/24/93
Copper	EPA 200.8	MTL7	12/19/94
Corrosivity	SM 2330B	NIA5	11/24/93
Cyanide	EPA 335.4	MISC7	07/15/96
Cyanide	SM 4500 CN F	MISC7	07/15/96
Cyanide Amenable	SM 4500 CN G	MISC7	12/11/02
Dbps And Chlorinated Solvents	EPA 551.1	VOC9	10/25/04
Diquat And Paraquat	EPA 549.2	SOC22	02/20/01
Endothall	EPA 548.1	SOC23	12/21/94
Fecal Coliform	SM 9221E	MIC5	12/11/02
Fluoride	SM 4500-F C	NIB3	07/15/96
Glyphosate	EPA 547	SOC24	11/24/93
Gross Alpha	EPA 900	RADIO	01/10/94
Gross Alpha	SM 7110C	RADIO	10/18/00
Gross Beta	EPA 900	RADIO	10/27/03
Haloacetic Acids	SM 6251B	SOC25	03/24/99
Hardness	EPA 200.7 CA&MG	MTL3	10/25/04
Hardness	SM 2340B	NIA5	11/24/93
Heterotrophic Plate Count	SM 9215B	MIC9	09/02/03
Hydrogen Ion (Ph)	EPA 150.1	NIA6	11/24/93
Hydrogen Ion (Ph)	SM 4500H B	NIA6	11/12/96
Iron	EPA 200.7	MTL3	11/24/93
Lead	EPA 200.8	MTL7	12/19/94
Magnesium	EPA 200.7	MTL3	09/26/94
Manganese	EPA 200.7	MTL3	11/24/93
Manganese	EPA 200.8	MTL7	12/19/94
Mercury	EPA 245.1	MTL5	11/24/93
Nickel	EPA 200.7	MTL3	01/10/94
Nickel	EPA 200.8	MTL7	12/19/94
Nitrate	EPA 300.0	NIIIA1	11/24/93
Nitrate	EPA 353.2	NIB1	04/02/98
Nitrite	EPA 300.0	NIIIA1	01/10/94
Nitrite	EPA 353.2	NIIB4	12/11/02
Nitrogen & Phosphorus Pesticides	EPA 525.2	SOC16	10/28/97
Odor	SM 2150B	NIA5	10/29/03
Ortho-Phosphate	EPA 365.1	NIIB5	11/17/95

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AZ License: AZ0455 **Lab Name: MWH Laboratories**

Program SDW

Parameter	EPA Method	Billing Code	Cert Date
Ortho-Phosphate	SM 4500-P E	NIIB5	07/15/96
Perchlorate	EPA 314.0	MISC24	03/30/01
Phthalate Esters And Adipates	EPA 525.2	SOC16	10/28/97
Polychlorinated Biphenyls	EPA 505	SOC9	04/03/03
Polycyclic Aromatic Hydrocarbons	EPA 525.2	SOC12	10/28/97
Radium 228	EPA 904	RADIO	01/06/04
Residue Filterable	SM 2540C	NIA8	07/15/96
Selenium	EPA 200.8	MTL7	12/19/94
Selenium	EPA 200.9	MTL2	12/19/94
Silica	EPA 200.7	MTL3	11/17/95
Silica	SM 4500-SI D	MTL4	11/08/02
Silver	EPA 200.7	MTL3	11/24/93
Silver	EPA 200.8	MTL7	11/17/95
Sodium	EPA 200.7	MTL3	09/26/94
Specific Conductance	SM 2510B	NIA7	07/15/96
Strontium	EPA 200.7	MTL3	11/24/93
Sulfate	EPA 300.0	NIIIA1	11/24/93
Surfactant (Mbas)	SM 5540C	NIA4	07/15/96
Thallium	EPA 200.8	MTL7	12/19/94
Total Coliforms And E. Coli By Colilert	SM 9223B	MIC3	04/02/98
Total Coliforms By Mtf	SM 9221B & C	MIC1	04/02/98
Total Organic Carbon	SM 5310C	MISC1	03/24/99
Total Trihalomethanes	EPA 524.2	VOC9	11/12/96
Total Trihalomethanes	EPA 551.1	VOC9	03/24/99
Turbidity, Ntu: Nephelometric	EPA 180.1	NIA9	05/21/98
Uranium	EPA 200.8	MTL7	09/08/04
Uv Absorbing Organic Constituents	SM 5910B	NIIB2	10/18/99
Volatile Organics	EPA 524.2	VOC1	01/15/03
Zinc	EPA 200.7	MTL3	11/24/93
Zinc	EPA 200.8	MTL7	12/19/94

Total Licensed Parameters in this Program: 102

Program WW

Parameter	EPA Method	Billing Code	Cert Date
Acid And Base/Neutral Compounds	EPA 1625	SOC16	11/16/01
Alkalinity, Total	EPA 310.1	NIA1	04/30/99
Alkalinity, Total	SM 2320B	NIA1	04/02/98
Aluminum	EPA 200.7	MTL3	04/02/98
Aluminum	EPA 200.8	MTL7	04/02/98
Ammonia	EPA 350.1	NIIB1	04/02/98
Antimony	EPA 200.7	MTL3	04/02/98

Arizona Department of Health Services
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AZ License: AZ0455 **Lab Name: MWH Laboratories**

Program WW

Parameter	EPA Method	Billing Code	Cert Date
Antimony	EPA 200.8	MTL7	04/02/98
Arsenic	EPA 200.8	MTL7	04/02/98
Arsenic	EPA 200.9	MTL2	04/02/98
Arsenic	SM 3113B	MTL2	09/02/03
Barium	EPA 200.7	MTL3	04/02/98
Barium	EPA 200.8	MTL7	04/02/98
Base/Neutrals And Acids	EPA 625	SOC16	05/09/94
Beryllium	EPA 200.7	MTL3	04/02/98
Beryllium	EPA 200.8	MTL7	04/02/98
Biochemical Oxygen Demand	EPA 405.1	DEM1	04/26/99
Biochemical Oxygen Demand	SM 5210B	DEM1	03/10/98
Boron	EPA 200.7	MTL3	04/02/98
Bromide	EPA 300.0	NIIIA1	04/02/98
Cadmium	EPA 200.7	MTL3	04/02/98
Cadmium	EPA 200.8	MTL7	04/02/98
Calcium	EPA 200.7	MTL3	04/02/98
Chemical Oxygen Demand	EPA 410.4	DEM2	04/02/98
Chemical Oxygen Demand	SM5220D	DEM2	10/27/03
Chloride	EPA 300.0	NIIIA1	04/02/98
Chlorine Residual Total	SM 4500-CL G	NIA3	04/02/98
Chromium Total	EPA 200.7	MTL3	04/02/98
Chromium Total	EPA 200.8	MTL7	04/02/98
Chromium, Hexavalent	SM 3500-CR D	MTL4	05/18/98
Cobalt	EPA 200.7	MTL3	04/02/98
Cobalt	EPA 200.8	MTL7	04/02/98
Color	SM 2120B	NIA4	09/02/03
Copper	EPA 200.7	MTL3	04/02/98
Copper	EPA 200.8	MTL7	04/02/98
Cyanide Amenable To Chlorination	EPA 335.1	MISC7	04/02/98
Cyanide Amenable To Chlorination	SM 4500-CN G	MISC7	10/27/03
Cyanide, Total	EPA 335.2	MISC7	04/02/98
Cyanide, Total	EPA 335.3	MISC7	04/02/98
Fluoride	EPA 340.2	NIB3	04/02/98
Fluoride	SM 4500-F C	NIB3	04/02/98
Gross Alpha	EPA 900	RADIO	10/18/99
Gross Beta	EPA 900.0	RADIO	10/18/99
Hardness	EPA 200.7	MTL3	12/11/02
Hardness	SM 2340B	NIA5	04/02/98
Hydrogen Ion (Ph)	EPA 150.1	NIA6	03/10/98
Hydrogen Ion (Ph)	SM 4500-H B	NIA6	03/10/98
Iron	EPA 200.7	MTL3	04/02/98

Ari ona Department of Health Services
Office of L oratory Licensure, Certification & Train.
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AZ License: AZ0455 **Lab Name: MWH Laboratories**

Program WW

Parameter	EPA Method	Billing Code	Cert Date
Kjeldahl Nitrogen	EPA 351.2	NIIB3	03/10/98
Lead	EPA 200.8	MTL7	04/02/98
Magnesium	EPA 200.7	MTL3	04/02/98
Manganese	EPA 200.7	MTL3	04/02/98
Manganese	EPA 200.8	MTL7	04/02/98
Mercury	EPA 245.1	MTL5	04/02/98
Molybdenum	EPA 200.7	MTL3	04/02/98
Molybdenum	EPA 200.8	MTL7	04/02/98
Nickel	EPA 200.7	MTL3	04/02/98
Nickel	EPA 200.8	MTL7	04/02/98
Nitrate	EPA 300.0	NIIIA1	04/02/98
Nitrate	EPA 353.2	NIB1	04/02/98
Nitrite	EPA 300.0	NIIIA1	04/02/98
Nitrite	EPA 354.1	NIIB4	09/02/03
Organochlorine Pesticides And Polychlorinated Biphenyls	EPA 608	SOC9	03/12/98
Ortho-Phosphate	EPA 365.2	NIIB5	04/02/98
Ortho-Phosphate	SM 4500-P E	NIIB5	04/02/98
Oxygen Dissolved	SM 4500-O G	*	10/25/04
Phenols	EPA 420.1	MISC8	12/11/02
Phenols	EPA 420.2	MISC8	06/03/98
Phosphorus Total	EPA 365.1	NIIB6	04/26/99
Phosphorus Total	EPA 365.2	NIIB6	04/02/98
Phosphorus Total	SM 4500-P E	NIIB6	10/25/04
Phosphorus Total	SM 4500-P F	NIIB6	04/26/99
Potassium	EPA 200.7	MTL3	04/02/98
Residue Filterable	EPA 160.1	NIA8	04/26/99
Residue Filterable	SM 2540C	NIA8	04/02/98
Residue Nonfilterable	EPA 160.2	NIIA5	10/27/03
Residue Nonfilterable	SM 2540D	NIIA5	03/10/98
Residue Total	EPA 160.3	NIIA4	10/18/99
Residue Total	SM 2540B	NIIA4	10/18/99
Residue Volatile	EPA 160.4	NIIA7	10/27/03
Residue, Settleable Solids	EPA 160.5	NIIA6	05/18/98
Residue, Settleable Solids	SM 2540F	NIIA6	12/11/02
Selenium	EPA 200.8	MTL7	04/02/98
Selenium	EPA 200.9	MTL2	04/02/98
Selenium	SM 3113B	MTL2	09/02/03
Silica, Dissolved	EPA 200.7	MTL3	09/02/03
Silica, Dissolved	EPA 370.1	MISC13	12/11/02
Silica, Dissolved	SM 4500-SI D	MISC13	11/08/02

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AZ License: AZ0455 **Lab Name: MWH Laboratories**

Program WW

Parameter	EPA Method	Billing Code	Cert Date
Silver	EPA 200.7	MTL3	04/02/98
Silver	EPA 200.8	MTL7	04/02/98
Sodium	EPA 200.7	MTL3	04/02/98
Specific Conductance	EPA 120.1	NIA7	12/11/02
Specific Conductance	SM 2510B	NIA7	04/02/98
Strontium	EPA 200.7	MTL3	11/17/95
Sulfate	EPA 300.0	NIIIA1	04/02/98
Sulfide	EPA 376.2	MISC11	04/02/98
Surfactants (Mbas)	EPA 425.1	NIIA3	12/11/02
Surfactants (Mbas)	SM 5540C	NIIA3	10/18/99
Thallium	EPA 200.7	MTL3	04/02/98
Thallium	EPA 200.8	MTL7	04/02/98
Tin	EPA 200.7	MTL3	10/18/99
Total Coliforms By Mtf	SM 9221B	MIC1	04/02/98
Total Organic Carbon	SM 5310C	MISC1	04/02/98
Turbidity	EPA 180.1	NIA9	05/19/98
Turbidity	SM 2130B	NIA9	05/19/98
Vanadium	EPA 200.7	MTL3	04/02/98
Vanadium	EPA 200.8	MTL7	04/02/98
Volatile Organics	EPA 601	VOC2	09/25/96
Volatile Organics	EPA 602	VOC3	09/25/96
Volatile Organics	EPA 624	VOC8	05/09/94
Zinc	EPA 200.7	MTL3	04/02/98
Zinc	EPA 200.8	MTL7	04/02/98

Total Licensed Parameters in this Program: 112

Instruments	Quantity	Date
GAS CHROMATOGRAPH	15	11/16/01
GAS CHROMATOGRAPH/MASS SPECTROMETER	8	11/16/01
ION CHROMATOGRAPH	7	11/16/01
HIGH PERFORMANCE LIQUID CHROMATOGRAPH	3	11/16/01
INDUCTIVELY COUPLED PLASMA/MASS SPECTROMETER	2	10/18/99
TOTAL ORGANIC HALIDE	2	11/25/02
RADIATION COUNTING INSTRUMENT	2	11/25/02
INDUCTIVELY COUPLED PLASMA SPECTROMETER	1	11/25/02
TRANSMISSION ELECTRON MICROSCOPE	1	10/16/02
ATOMIC ABSORPTION SPECTROPHOTOMETER	1	10/25/04
MERCURY ANALYZER	1	10/18/99

Softwares

Arizona Department of Health Services
Office of Laboratory Licensure, Certification & Training
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AZ License: AZ0455 **Lab Name: MWH Laboratories**

ENVIROQUANT - GCMS
MILLENNIUM CHROMATOGRAPHY MANAGER - HPLC
TURBOCHROM - GC
PEAKNET VERSION 6.0 - IC
PERKIN ELMER ELAN VERSION 2.4 - ICP/MS
PERKIN ELMER WINLAB 32 VERSION 2.7 - ICP
PERKIN ELMER - AA

Arizona Department of Health Services

ENVIRONMENTAL LABORATORY LICENSE

Issued to:

Laboratory Director: Andrew Eaton, Ph.D.
Owner/Representative: Mona Altieri

MWH Laboratories
AZ0455

is in compliance with Environmental Laboratory's applicable standards for the State of Arizona and maintains on file a List of Parameters for which the laboratory is certified to perform analysis.

PERIOD OF LICENSURE FROM: 12/15/2004 TO: 12/14/2005

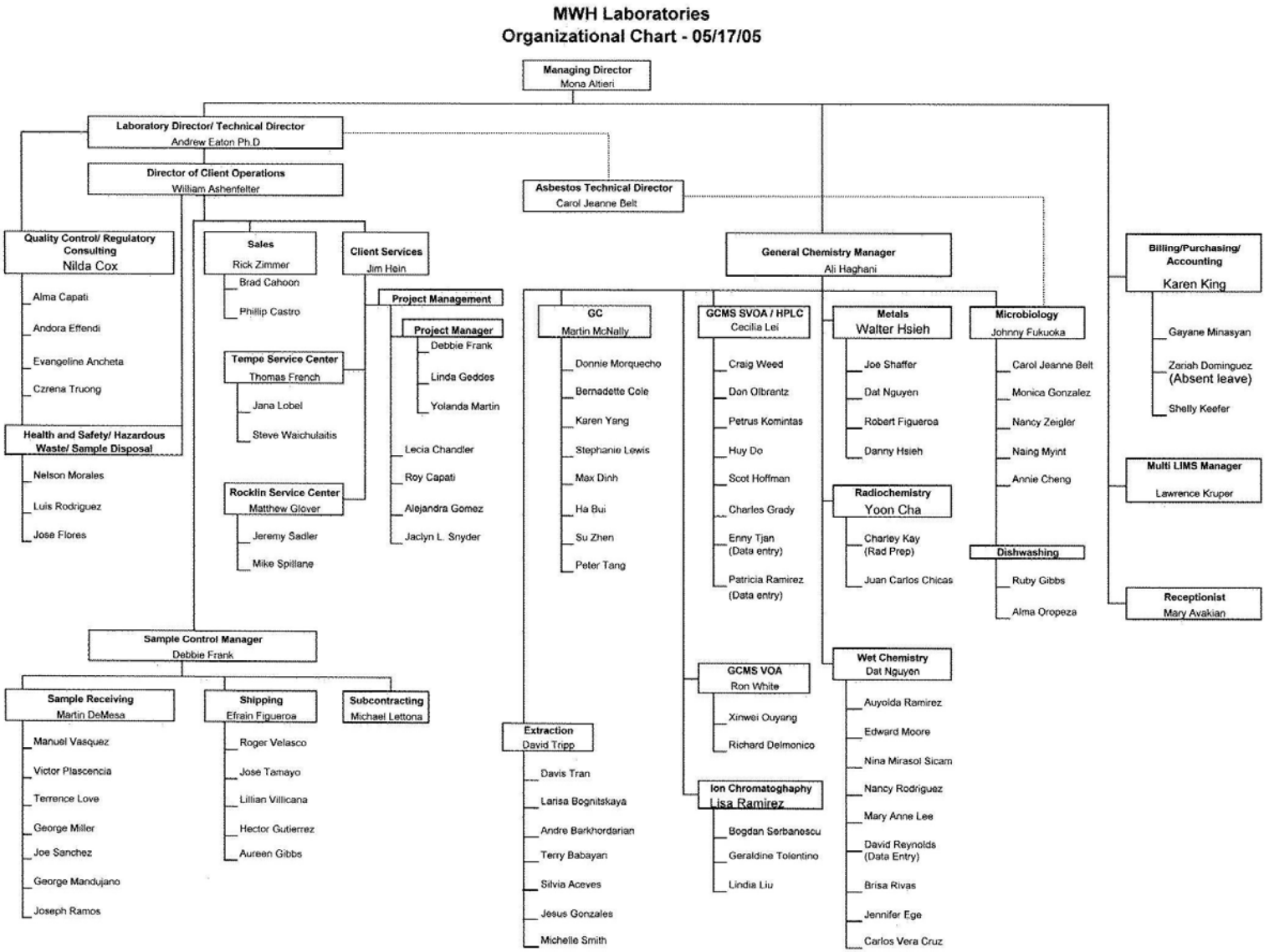
Steven D. Baker, Chief
Office of Laboratory Licensure,
Certification & Training
Bureau of State Laboratory Services

APPENDIX II

Staff Qualifications

Laboratory Organizational Chart

Organizational Chart



MWH Laboratories

APPENDIX III

Glossary
MWH Vendor List

Glossary

Calibration Blank (CB) –
A volume of reagent water fortified with the same matrix as the calibration standards, but without the analytes, internal standards, or surrogates analytes.

Calibration Standard (CAL) –
A solution prepared from the primary dilution standard solution and stock standard solutions of the internal standards and surrogate analytes. The CAL solutions are used to calibrate the instrument response with respect to analyte concentration.

Dissolved Analyte –
The concentration of analyte in an aqueous sample that will pass through a 0.45 µm membrane filter assembly prior to sample acidification (Section 11.1).

Dissolved Phosphorus (P-D) –
All of the phosphorus present in the filtrate of a sample filtered through a phosphorus-free filter of 0.45 micron pore size and measured by the persulfate digestion procedure.

Dissolved Orthophosphate (P-D ortho) –
As measured by he direct colorimetric analysis procedure.

Dissolved Hydrolyzable Phosphorus (P-D, hydro) –
As measured by the sulfuric acid hydrolysis procedure and minus predetermined dissolved orthophosphates.

Dissolved Organic Phosphorus (P-D, org) –
As measured by the persulfate digestion procedure, and minus dissolved hydrolyzable phosphorus and orthophosphate

Estimated Detection Limit (EDL) –
Defined as either the MDL or a level of compound in a sample yielding a peak in the final extract with a signal to noise (S/N) ratio of approximately five, whichever is greater.

External Standard (ES) –
A pure analyte(s) that is measured in an experiment separate from the experiment used to measure the analyte(s) in the sample. The signal observed for a known quantity of the pure external standard(s) is used to calibrate the instrument response for the corresponding analyte(s). The instrument response is used to calculate the concentrations of the analyte(s) in the sample.

Field Duplicates (FD1 and FD2) –
Two separate samples collected at the same time and place under identical circumstances and treated exactly the same throughout field and laboratory

procedures. Analyses of FD1 and FD2 give a measure of the precision associated with sample collection, preservation and storage, as well as with laboratory procedures. Since laboratory duplicates cannot be analyzed, the collection and analysis of field duplicates for this method is critical.

Field Reagent Blank (FRB) –
An aliquot of reagent water or other blank matrix that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the FRB is to determine if method analytes or other interferences are present in the field environment.

Instrument Performance Check Solution (IPC) –
A solution of one or more method analytes surrogates, internal standards, or other test substances used to evaluate the performance of the instrument system with respect to a defined set of criteria.

Instrument Detection Limit (IDL) –
The concentration equivalent to the analyte signal which is equal to three times the standard deviation of a series of 10 replicate measurements of the calibration blank signal at the same wavelength (Table 1.)

Internal Standard –
Pure analyte(s) added to a sample, extract, or standard solution in known amount(s) and used to measure the relative responses of other method analytes that are components of the same sample or solution. The internal standard must be an analyte that is not a sample component

Laboratory Reagent Blank (LRB) –
An aliquot of reagent water or other blank matrices that are treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, internal standards, and surrogates that are used with other samples. The LRB is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus.

Linear Calibration Range (LCR) –
The concentration range over which the instrument response is linear.

Laboratory Duplicates (LD1 and LD2) –
Two aliquots of the same sample taken in the laboratory and analyzed separately with identical procedures. Analyses of LD1 and LD2 indicates precision associated with laboratory procedures, but not with sample collection, preservation, or storage procedures.

Laboratory Fortified Blank (LFB) –

An aliquot of LRB to which known quantities of the method analytes are added in the laboratory. The LFB is analyzed exactly like a sample, and its purpose is to determine whether the methodology is in control and whether the laboratory is capable of making
accurate and precise measurements.

Laboratory Fortified Sample Matrix (LFM) –
An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations.

Linear Dynamic Range (LDR) –
The concentration range over which the instrument response to an analyte is linear.

Laboratory Performance Check Solution (LPC) –
A solution of selected method analytes, surrogate(s), internal standard(s), or other test substances used to evaluate the performance of the instrument system with respect to a defined set of method criteria.

Linear Calibration Range (LCR) –
The concentration range over which the instrument response is linear.

Material Safety Data Sheet (MSDS) –
Written information provided by vendors concerning a chemical's toxicity, health hazards, physical properties, fire, and reactivity data including storage, spill, and handling precautions.

Method Detection Limit (MDL) –
The minimum concentration of an analyte that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero (Section 9.2.4 and Table 4.). Procedural Standard Calibration -- A calibration method where aqueous calibration standards are prepared and processed (e.g., purged, extracted, and/or derivatized) in exactly the same manner as a sample. All steps in the process from addition of sampling preservatives through instrumental analyses are included in the calibration. Using procedural standard calibration compensates
for any inefficiencies in the processing procedure.

Plasma Solution –
A solution that is used to determine the optimum height above the work coil for viewing the plasma (Sections 7.15 and 10.2.3).

Primary Calibration Standard (PCAL) –
A suspension prepared from the primary dilution stock standard suspension. The PCAL suspensions are used to calibrate the instrument response with respect to analyte concentration.

Primary Dilution Standard Solution (PDS) –
A solution of several analytes prepared in the laboratory from stock standard solutions and diluted as needed to prepare calibration solutions and other needed analyte solutions. The following forms, when sufficient amounts of phosphorus are present in the sample to warrant such consideration, may be calculated:

Insoluble Phosphorus (P-I) = (P) - (P-D).

Insoluble Orthophosphate (P-I, ortho) = (P, ortho) - (P-D, ortho).

Insoluble Hydrolyzable Phosphorus (P-I, hydro) = (P, hydro) - (P-D, hydro).

Insoluble Organic Phosphorus (P-I, org) = (P, org) - (P-D, org).
All phosphorus forms shall be reported as P, mg/L, to the third place.

Procedural Standard Calibration –
A calibration method where aqueous calibration standards are prepared and processed (e.g., purged, extracted, and/or derivatized) in exactly the same manner as a sample. All steps in the process from addition of sampling preservatives through instrumental analyses are included in the calibration. Using procedural standard calibration compensates for any inefficiencies in the processing procedure.

Quality Control Sample (QCS) –
A solution of method analytes of known concentrations which is used to fortify an aliquot of LRB or sample matrix. The QCS is obtained from a source external to the laboratory and different from the source of calibration standards. It is used to check either laboratory or instrument performance.

Secondary Calibration Standards (SCAL) –
Commercially prepared, stabilized sealed liquid or gel turbidity standards calibrated against properly prepared and diluted formazin or styrene divinylbenzene polymers.

Stock Standard Suspension (SSS) –
A concentrated suspension containing the analyte prepared in the laboratory using assayed reference materials or purchased from a reputable commercial source. Stock standard suspension is used to prepare calibration suspensions and other needed suspensions.

Solid Sample –
For the purpose of this method, a sample taken from material classified as either soil, sediment or sludge.

Spectral Interference Check (SIC) Solution –

A solution of selected method analytes of higher concentrations, which is used to evaluate the procedural routine for correcting known interelement spectral interferences with respect to a defined set of method criteria.

Standard Addition –
The addition of a known amount of analyte to the sample in order to determine the relative response of the detector to an analyte within the sample matrix. The relative response is then used to assess either an operative matrix effect or the sample analyte concentration.

Stock Standard Solution (SSS) –
A concentrated solution containing one or more method analytes prepared in the laboratory using assayed reference materials or purchased from a reputable commercial source

Surrogate Analyte (SA) –
A pure analyte(s), which is extremely unlikely to be found in any sample, and which is added to a sample aliquot in known amount(s) before extraction or other processing and is measured with the same procedures used to measure other sample components. The purpose of the SA is to monitor method performance with each sample.

Total Recoverable Analyte –
The concentration of analyte determined either by "direct analysis" of an unfiltered acid preserved drinking water sample with turbidity of <1 NTU , or by analysis of the solution extract of a solid sample or an unfiltered aqueous sample following digestion by refluxing with hot dilute mineral acid(s) as specified in the method.

Total Phosphorus (P) –
All of the phosphorus present in the sample regardless of forms, as measured by the persulfate digestion procedure.

Total Orthophosphate (P-ortho) –
Inorganic phosphorus [(PO)] in the 4 -3 sample as measured by the direct colorimetric analysis procedure.

Total Hydrolyzable Phosphorus (P-hydro) –
Phosphorus in the sample as measured by the sulfuric acid hydrolysis procedure and minus predetermined orthophosphates. This hydrolyzable phosphorus includes polyphosphates [(P O) , (P O) , etc.] plus some organic 2 7 3 10-4 –5 phosphorus.

Total Organic Phosphorus (P-org) –
Phosphorus (inorganic plus oxidizable organic) in the sample as measured by the persulfate digestion procedure, and minus hydrolyzable phosphorus and orthophosphate.

Tuning Solution –

A solution which is used to determine acceptable instrument performance prior to calibration and sample analyses.

Water Sample –
For the purpose of this method, a sample taken from one of the following sources: drinking, surface, ground, storm runoff, industrial or domestic wastewater.

MWH Vendor List

Supplier	Address	Used by	Intended Use
Absolute Standards, Inc.	P. O. Box 5585 Hamden, Ct. 06518-0585	GCMS Lab	Standards
AccuStandard	125 Market Street New Haven, Ct. 06513	GCMS Lab	Standards
Agilent Technologies	Chemical Analysis Group 2850 Centerville Rd. Wilmington, De. 19808	GCMS Lab, GC Lab	Supplies, instrument maintenance, repair, technical support
American Type Culture Collection	12301 Parklawn Lane Rockville, Me. 20852	Microbiology Lab	Bacterial Controls
Beckman Instruments, Inc.	2500 Harbor Blvd., E-20-D Fullerton, Ca. 92634	Inorganic Lab	Instrument maintenance, repair, technical support
Chem Service, Inc.	660 Tower Lane P. O. Box 310 West Chester, Pa. 19380	GC Lab	Reagents, supplies
CPI International	P. O. Box 1290 Suisun City, Ca. 94585-1290	Inorganic Lab	Standards, Reagents
Crescent Chemical Co., Inc.	1324 Motor Parkway Hauppauge, NY 11788	Inorganic Lab	Reagents
Dionex Corporation	1228 Titan Way Sunnyvale, Ca. 94088-3603	Inorganic Lab	Instrument maintenance, repair, technical support
Environmental Express LTD	490 Wando Park Blvd. P. O. Box 669 Mt. Pleasant, SC. 29464	Inorganic Lab	Standards, reagents, supplies
Full Spectrum Analytics, Inc.	5635 West Las Positas Blvd. #403 Pleasanton, Ca. 94588	GCMS Lab, GC Lab	Instrument maintenance, repair, technical support
Hach Company	P. O. Box 389 Denver, Co. 80539	GC Lab	Reagents, supplies
IDEXX Distribution Corporation	6100 E. Shellby Dr. Memphis, Tn. 38141-7602	Microbiology Lab	Microbiological media
Isotope Products Laboratories	1800 North Keystone Street Burbank, Ca. 91504	Inorganic Lab	Standards
Los Gatos Circuits, Inc.	2030 Fortune Dr. Suite A San Jose, Ca. 95131	GCMS Lab, GC Lab	Instrument maintenance, repair, technical support
McBain Instruments	9601 Variel Ave. Chatsworth, Ca. 91311-4914	Microbiology Lab	Instrument maintenance, repair
OI Analytical	P. O. Box 9010 151 Graham Road College Station, Tx. 77842-0440	GC Lab	Instrument maintenance, repair, technical support, supplies, chemicals
Oxygen Service Company	1011 West Collin Ave. Orange, Ca. 92867	GC Lab	Reagents, supplies

MWH Vendor List

Supplier	Address	Used by	Intended Use
Perkin Elmer	761 Main Ave. Norwalk, Ct. 06859-0001	Inorganic Lab	Instrument maintenance, repair, technical support
Protean Instrument Corporation	P. O. Box 1008 260 Grand Street Lenoir City, Tn. 37771-1008	Inorganic Lab	Instrument maintenance, repair, technical support
Protocol Analytical Supplies, Inc.	472 Lincoln Blvd. Middlesex, NJ 08846	GCMS Lab	Standards
Restek Corporation	Penn Eagle Industrial Park 110 Benner Circle Bellefonte, Pa. 16823-8812	GC Lab	Reagents, supplies
Scientific Instrument	1027 Old York Road Ringoes, NJ 08551-1039	GCMS Lab	Supplies
Sigma_Aldrich, Inc.	P. O. Box 952968 St. Louis, Mo. 63195-2968	Inorganic Lab	Reagents
Supelco	Supelco Park Bellefonte, Pa. 16823-0048	GCMS Lab, GC Lab	Standards, reagents, supplies
Tekmar Company	7143 East Kemper Road Cincinnnati, Oh. 45249	GC Lab	Instrument maintenance, repair, technical support, supplies, chemicals
Temperature Standard Laboratory, Inc.	138 West Romona Ave. Monrovia, Ca. 91016	Quality Assurance Department	Calibration of reference thermometers
Thermo Optek Corporation	Service Operations Drawer CS 100623 Atlanta, Ga. 30384-0623	Inorganic Lab	Instrument maintenance, repair, technical support
Ultra Scientific	250 Smith Street North Kingstown, RI 02852-7723	Inorganic Lab, GCMS Lab, GC Lab, QA Department	Standards, supplies, reagents
Varian	Chromatography Systems 2700 Mitchell Drive Walnut Creek, Ca. 94598	GC Lab	Instrument maintenance, repair, technical support, supplies, chemicals
VWR Scientific Products Corporation*	P. O. Box 640169 Pittsburgh, Pa. 15264-0169	Inorganic Lab, GCMS Lab, GC Lab, QA Department	Standards, reagents, supplies, standard thermometers
Watson Brothers, Inc.	1235 South Victory Blvd. Burbank, Ca. 91502	Quality Assurance Department	Maintenance and calibration of the laboratory's balances and S class weights

*VWR supplies MWH Laboratories with reagents, standards and supplies from many companies, including but not limited to the following:

JT Baker, Mallinckrodt, Difco, Becton Dickinson, Ricca, Gelman, J & W Scientific, Ultra Scientific, EM Science

MWH Vendor List

Supplier	Address	Used by	Intended Use
Post Security		Facilities Management	Fire alarm panel maintenance
Iron Mountain	P.O. Box 65017 Charlotte, NC 28265-0017	All Departments	Archiving and off-site data storage
MOE Plumbing		Facilities Management	Building maintenance
Post Alarm		Facilities Management	Building security, escorts
Viking Refrigeration	1770 East Cypress Covina, CA 91724	Facilities Management	Refrigerator maintenance
DuraCold	1551 S. Primrose Lane Monrovia, CA 91016	Facilities Management, Sample Control Department	Walk-in coolers, storage refrigerator maintenance
Westeway Electrical Systems		Facilities Management	Building maintenance