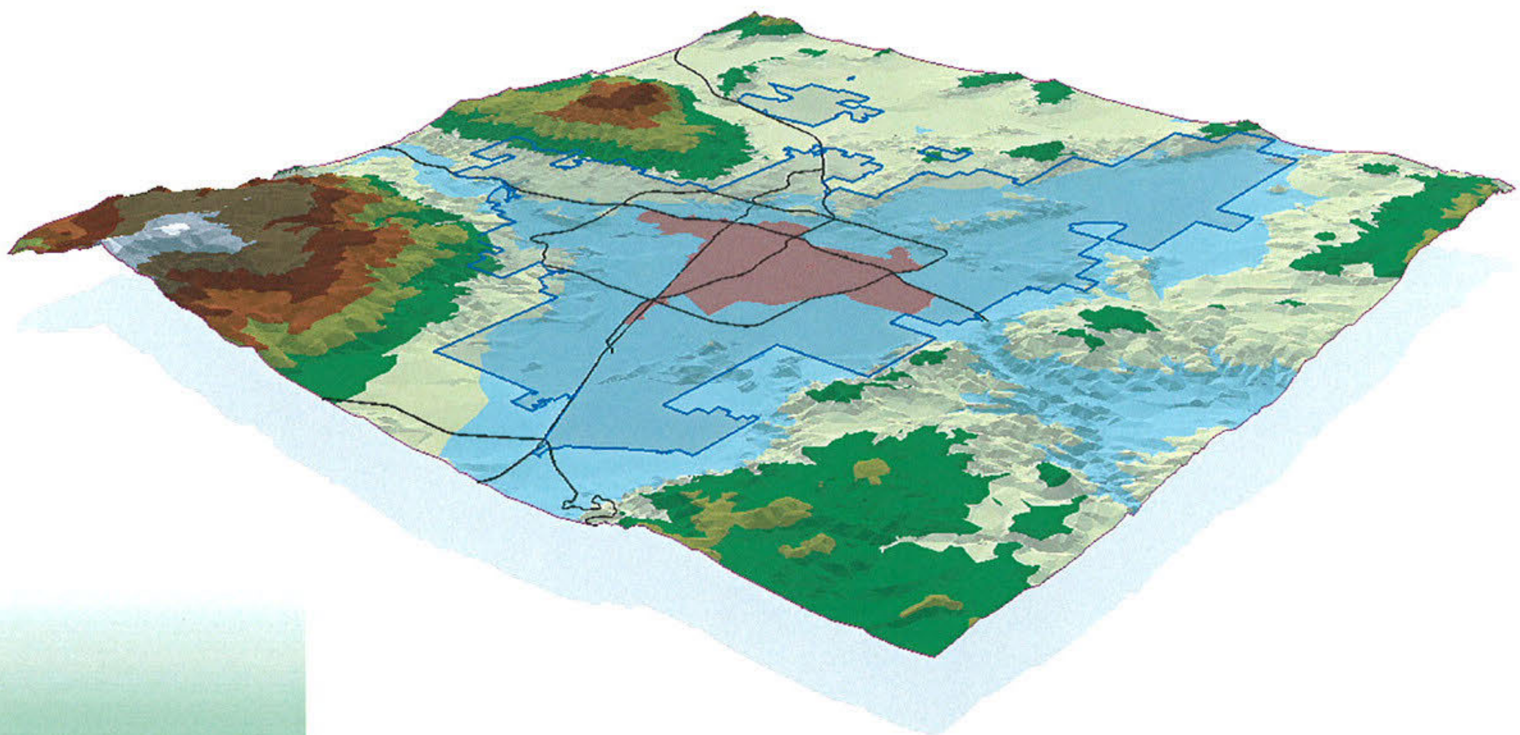
CENTRAL TRUCKEE MEADOWS REMEDIATION DISTRICT

Remediation Management Plan

Volume 1

October 28, 2002



Prepared for Washoe County Department of Water Resources
by CDM and Bouvette Consulting

CTM
REMEDIATION DISTRICT

October 28, 2002

Washoe County
Department of
Water Resources
4930 Energy Way
Reno, NV 89502-4106
Tel: (775) 954-4600
Fax: (775) 954-4610

Mr. Allen Biaggi, Administrator
Nevada Division of Environmental Protection
333 Nye Lane
Carson City, NV 89710

Subject: **Central Truckee Meadows Remediation District**
Remediation Management Plan

Dear Mr. Biaggi:

Enclosed for your review and approval is the final Central Truckee Meadows Remediation District, Remediation Management Plan (RMP) dated October 28, 2002. This RMP documents the activities performed to date in characterizing the nature and extent of tetrachloroethene (PCE) in groundwater beneath the central Truckee Meadows and in evaluating alternative approaches to remediate the condition. Moreover, this document describes the actions and processes that will be implemented as part of the overall District activities to mitigate effects of PCE in the groundwater underlying the Central Truckee Meadows.

On July 9, 2002 a draft RMP was distributed to stakeholders that have been involved during the process of planning and implementation of the Central Truckee Meadows Remediation District (CTMRD) program. Since this release, the CTMRD staff has held dozens of meetings with the Nevada Division of Environmental Protection, Washoe County District Health Department, Truckee Meadows Water Authority, Cities of Reno and Sparks, and various other stakeholders. This final RMP includes revisions that were the result of these meetings as well as written comments.

In accordance with Subsection 1 of Nevada Revised Statutes 540A.260 and NDEP acceptance of the workplan (L. Dodgion, 8/29/97), this RMP is submitted to the NDEP for approval. Washoe County truly appreciates NDEP's valuable commitment and contributions to the development of the RMP and the ongoing overall progress of the CTMRD. The Washoe County Board of County Commissioners will be considering approval of this RMP at their November 19, 2002 meeting. If you have any questions about the District, or the final RMP, please contact me at (775)954-4664 or via email at jruefer@mail.co.washoe.nv.us.

Sincerely,

Jeanne

Jeanne Ruefer
Manager, Water Resource Planning Division

Department of
Water Resources

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Acronyms

BCC	Board of County Commissioners
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylenes
CA	cooperative agreement
$CaCO_3$	calcium carbonate
CAHs	chlorinated aliphatic hydrocarbons
CDM	Camp Dresser & McKee Inc.
CERCLA	Comprehensive Environmental Resource Conservation and Liability Act
COPCs	chemicals of potential concern
County	Washoe County Department of Water Resources
CTM	Central Truckee Meadows
CTMRD	Central Truckee Meadows Remediation District
DCE	dichloroethene and dichloroethylene
DNAPL	dense non-aqueous phase liquids
DO	dissolved oxygen
DWR	Department of Water Resources
EPA	Environmental Protection Agency
ft	foot/feet
GIS	graphical information system
HGP	Helms Gravel Pit
HI	Hazard Index
IDW	investigation derived waste

µg/L	micrograms per liter
MCLs	maximum contaminant levels
MFR	mountain front recharge
MIP	membrane interface probe
mg/L	milligrams per liter
MMA	McDonald Morrissey Associates
MNA	monitored natural attenuation
NCP	National Contingency Plan
NDEP	Nevada Division of Environmental Protection
NPDES	National Pollution Discharge Elimination System
NRS	Nevada Regulatory Statute
O&M	operation and maintenance
PAG	Public Advisory Group
PCE	tetrachloroethene
PITT	partitioning interwell tracer test
POTW	Publicly owned treatment works
RDGs	Remediation District Goals
RDOs	Remediation District Objectives
RMP	Remediation Management Plan
SPPCo	Sierra Pacific Power Company
s.u.	scientific units
TCE	trichloroethene
TDS	total dissolved solids

TM	Technical Memorandum
TMWA	Truckee Meadows Water Authority
TWG	Technical Working Group
$\mu S/cm^2$	microsiemens per square centimeter
USTs	underground storage tanks
UV	ultraviolet
VOCs	volatile organic compounds
WCDHD	Washoe County District Health Department

Executive Summary

Background and Limited History

PCE

PCE, an organic solvent also known as perchloroethylene, tetrachloroethylene, and PERC, is used in a variety of commercial/industrial operations (e.g., commercial dry cleaning, paint manufacturing and distribution, and auto repair). PCE was initially found in groundwater within the limits of the city of Reno within the public water supply wells operated by Sierra Pacific Power Company (now the Truckee Meadows Water Authority (TMWA)) in 1987. Subsequent groundwater investigations have identified widespread occurrences of PCE and other volatile organic compounds (VOCs) in groundwater.

Legislative History

To address the presence of PCE in groundwater, which impacts both the drinking water supply and future construction projects that penetrate the water table, Senate Bill 489 (SB 489) was developed by a consortium of shared water and business interests and passed by the State Legislature in 1995. This bill required the Board of County Commissioners (BCC) to create a "Remediation District" upon the certification of a groundwater contamination problem by either the Nevada Division of Environmental Protection (NDEP) administrator or the district health officer or both. Washoe County Board of County Commissioners received certification letters from both NDEP and the Washoe County District Health Department (WCDHD) in August 1995.

Upon receiving the certification letters, Washoe County was responsible for preparing a plan for remediation (or Remediation Management Plan [RMP]) that must be approved by NDEP, which identifies remedial actions that are reasonable and economically feasible in response to the release or threat of release of any hazardous substance into the environment, which may affect the water quality of CTM. Based on the letters received by the County, the only hazardous substance that is covered by the actions of the CTMRD is PCE.

Unfortunately, SB 489 lacked language allowing for the funding of the environmental sampling needed to evaluate the condition of surface water, groundwater, soils, and soil gas prior to the development of the RMP. In addition, SB 489 lacked mechanisms to fund remedial action operation and maintenance expenses. Therefore, the sampling and the development of the RMP were put on hold until the legislation could be amended. NRS 540A was created and promulgated in 1997, allowing the County to begin funding of the CTMRD.

Initial Funding of the CTMRD and Performed Activities

The first funds for the CTMRD were obtained through the tax roll in 1998 based on the benefits received by the water users within Sierra Pacific Power Company's wholesale and retail service area (Figure ES-1). Note that Figure ES-1 delineates the boundary of the CTMRD. These funds were used for the design, construction, and operation of groundwater treatment facilities to treat groundwater produced by five water supply wells (Kietkze Lane, Mill Street, High Street, Morrill Avenue, and Corbett School).

The funding also allowed for the environmental sampling to be performed starting in 1998. Over the last 4 years, environmental sampling of specified surface water locations and groundwater wells, as well as development of a comprehensive listing and mapping of historic land use throughout the CTM, has been performed by the County. In addition, the County has undertaken selected sampling of area sanitary sewers.

In addition, the County retained CDM to:

- Characterize the nature and extent of the PCE contamination beneath CTM;
- Formalize and document the goals and objectives of the CTMRD;
- Develop and screen candidate remedial actions; and
- Select remedies and processes for implementation.

This work also included performing analyses to understand potential human health risks associated with the presence of PCE, simulating groundwater flow through the aquifer system beneath the CTM, and characterizing the contaminant transport mechanisms influencing the migration of PCE in the subsurface. These efforts are documented in a series of four project technical memoranda.

The initial three technical memoranda (TMs) characterize the physical, toxicological, and hydrogeochemical setting within the CTM as it relates to the distribution and nature of PCE, the contaminant of concern. The fourth TM provides documentation and analyses that will apply to the selection of remedial technologies and remedial actions for contaminant source areas of PCE. This TM would apply to those source areas for which no viable owner is identified to assume financial responsibility for planning and implementation of remedial actions independent of the CTMRD. These technical memoranda are referenced throughout the RMP.

Phases of the CTMRD

The CTMRD has been, and will continue to be, implemented over three distinct phases:

- **Phase 1** – Phase 1, or Work Plan Development and Implementation Phase, consisted of a range of activities designed to characterize the nature and extent of the PCE contamination and to determine an effective approach to address the condition. Additionally, Phase 1 included implementation of treatment for the removal of PCE at existing water supply wells. The Phase 1 activities are documented in this RMP.

- **Phase 2** – Phase 2 is the Source Identification and Remediation Phase of the CTMRD. The Source Identification and Remediation Phase will be based on the recommendations presented in this RMP.

- **Phase 3** – Phase 3 is the Closure Phase, during which time sites and sources, as well as the overall remediation program, will be completed. The Closure Phase of the CTMRD is not expected to occur for the overall remediation program until wellhead treatment of PCE is no longer needed at the public water supply wells, which is anticipated to be many decades from now. Closure of small source area remediation, planned and implemented in accordance with those guidelines set forth in this document, will likely occur independent of the Closure Phase of the CTMRD.

Purpose of the Remediation Management Plan

The goal of the RMP is to provide guidance and define remedial actions that are needed for implementation as part of the Remediation Phase of the CTMRD. The primary purposes of the RMP are as follows:

- Provide detailed background information.

- Provide a concise listing of recommended actions.

- Define the boundaries of the CTMRD.

- Identify the costs associated with implementation of the RMP and the continued funding of the CTMRD during Phases 2 and 3.

- Present discussions related to the equitable allocation of costs among those entities receiving benefit derived from implementation of the RMP.

- Identify key collaborative relationships among entities that need to be involved with the implementation of the RMP.

The RMP is considered to be a "living" document, in that the overall CTMRD program is expected to be further developed and refined based on lessons learned during program implementation and based on ongoing stakeholder and public comment. This RMP has incorporated input from various stakeholders based on review of the Draft Remediation Plan, dated July 9, 2002. Any major modifications to the RMP will require NDEP and BCC approval.

Work Plan Development and Implementation Phase Summary

Planning phase activities, which were initiated in 1996, consisted of multiple components including: (1) early field investigations and groundwater sampling, (2) design, construction, and operation of public water supply wellhead treatment on five TMWA wells (High St., Morrill Ave., Kietzke Lane, Mill St., and Corbett School), (3) planning, including preparation of the CTMRD Work Plans (1996 and 2001), (4) field investigation program, (5) numerical groundwater modeling and risk analysis, and (6) remedial technologies identification and screening. The Work Plan Development and Implementation Phase ends with the preparation and acceptance of the RMP.

Distribution of PCE

There are substantial data available to characterize the extent of PCE - data that are reliable, and accurate, and are representative of the state of the science that exists to delineate contaminant extent consistent with the key goals of the CTMRD; data that can be obtained reasonably and in an economically feasible manner. To this end, the data used to develop the distribution of PCE in CTM included:

- Historical land use;
- PCE studies and remedial actions on file with NDEP and WCDHD performed for private parties;
- Groundwater quality data collected by the County, TMWA, NDEP, WCDHD, and various private property owners;
- Sanitary sewer sampling results; and
- Knowledge of the direction of groundwater flow and the fate of PCE in the shallow and deep aquifer systems.

Figure ES-2 depicts the distribution of land use and business types that may have, or currently handle PCE. Based on the land use information, and those other data listed above, the potential distribution of PCE beneath CTM is presented in Figure ES-3.

Summary of Environmental Sampling and Related Activities

The various environmental sampling programs and qualitative and quantitative analyses presented and discussed in this section can be summarized as follows:

- PCE contamination in the groundwater beneath the CTM exists in a broad distribution. PCE exists to depths of 350 feet or greater beneath ground surface, over an area of as much as 16 square miles impacting perhaps as much as 200 billion gallons of water – water that is vital to the public drinking water supply in the metropolitan Reno area.

- PCE contamination of this breadth is the result of uncontrolled or accidental discharges from dozens to hundreds of sources and hot spots located throughout CTM. In the Downtown Reno area alone, past investigators identified over 300 potential sources based on historical land use. Given the prevalent direction of groundwater flow and areas of groundwater discharge, sources in the downtown Reno area could not contribute to contamination found along South Virginia Street, in Sparks, in the Corbett School and Mill Street wells, along Moana Lane, or north of I-80. Each of these areas where contamination has been found outside of Reno's downtown area are likely to represent unique sets of sources – unique sets of past and/or present uncontrolled or accidental discharges.

- Although much of the contamination is likely a result of past PCE disposal practices, it is possible that current PCE disposal practices may be contributing contamination to the groundwater flow system. In particular, sampling of the sanitary sewers in both Reno and Sparks at locations downstream of businesses that may handle PCE indicated that "slugs" of PCE were being conveyed unknowingly by the underground pipelines. The presence of PCE into the sanitary sewers, albeit illegal, may constitute an ongoing source of PCE to the shallow groundwater. Further evaluation of the sewers in connection to groundwater contamination is warranted.

- Field investigations and a review of NDEP and WCDHD project files have identified a dozen or more sources, or suspected sources of PCE within CTM. These sources, which include past and current dry cleaners, as well as other locations without specific businesses associated with them, will require additional characterization and evaluation to determine the need for and scope of remedial actions.

- Beyond contaminating the drinking water, the PCE beneath CTM may also impact construction of future projects (both from a human health concern and a construction dewatering points of view) that disturb the shallow groundwater and indoor air quality within any structure placed above the contaminated groundwater. An analysis was performed to determine if the current contaminant distribution creates unacceptable risk to humans under either of these two scenarios. Based on the analyses, there does not appear to be any current human exposure that poses an unacceptable risk. It is possible that future construction workers may be at risk to unacceptable contaminant concentrations of PCE if sources are found at levels of 770 microgram per liter or greater (using a straight line approximation of current risks presented in the body of the report).

Summary of Recommendations

Based on the results of the environmental sampling programs and qualitative and quantitative analyses, the following recommendations for remedial actions and related activities are carried into the Remediation Management Plan.

- Wellhead treatment at the five TMWA wells (Mill Street, High Street, Morrill Avenue, Corbett School, and Kietkze Lane) must continue to safeguard the drinking water for the citizens of CTM.

- Wellhead treatment should be added to any additional public water supply wells operated in the area of known or suspected PCE contamination, if PCE contaminant concentrations are found to exceed federal or local safe drinking water standards.

- Source remediation must occur to remove and/or control the effects of past and ongoing uncontrolled and accidental discharges on the groundwater beneath the CTM. Source remediation will need to be prioritized to allow for the appropriate and focused expenditure of CTMRD funds on reasonable and economically feasible actions. Source remediation will therefore consist of various phases of source characterization, remedial and benefit evaluations, and remedial action implementation.

- At least two potential source areas and one potential source type should be further investigated to forward remedial actions. These investigations will focus on determining what impacts a potential source area has on the drinking water supply and future construction activities; identifying potentially responsible parties – such that the source can be referred to NDEP if appropriate; and evaluating whether or not a remedial action will be reasonable and economically feasible. The two potential sources areas are Mill Street/Kietzke Lane and Fourth Street/Ralston. Selected areas of the Reno and Sparks sanitary sewer systems constitute the potential source type.

- Another key component of the overall remediation program is consistent and comprehensive groundwater monitoring. The objectives of groundwater monitoring are to track seasonal changes in groundwater elevation, to gather data to better define the nature and extent of the PCE plume, to track changes in PCE concentration, and to assess the influence of TMWA water supply well pumping on the PCE plume. In addition, groundwater monitoring will include components of sampling and analysis consistent with those defined by the U.S. Environmental Protection Agency to support monitored natural attenuation (MNA). MNA will be evaluated as a mechanism for reducing the toxicity, mobility, or volume of PCE within the aquifer system (natural attenuation in groundwater systems results from the integration of several subsurface attenuation mechanisms).

Remediation District Objectives and Goals

A presentation of the Remediation District Objectives (RDOs) and Remediation District Goals (RDGs) is relevant to framing the components of the RMP. The RDOs, which are based mainly on the requirements set forth in NRS 540A, are defined as:

- Protect the water quality within the CTM for municipal, industrial, or domestic uses.
- Protect from liability property owners that did not cause or contribute to subsurface PCE (and its degradation products) contamination that may impact drinking water within the CTM.

The RDGs, which translate the CTMRD objectives into more specific requirements for the selected remedial actions, have been defined as follows:

- Maintain the continued use of CTM groundwater for public water supply.
- Manage PCE in groundwater and/or surface water in such a manner as to protect property owners and potable water users in the CTM.
- Select remedial action(s) that are reasonable and economically feasible.
- Allocate equitably the costs associated with implementation of the RMP and its components.

Remediation Management Plan Components

The RMP is intended to identify a range of activities that will be used to control, manage and remediate the PCE contamination beneath the CTM in both the short-term and the long-term. Remediation of the contamination conditions consists of providing treatment for the public water supply wells, eliminating/remediating sources and contaminated groundwater (to the extent that such actions are reasonable and economically feasible), and monitoring the effects of these actions on the groundwater. Peripheral support activities are also included in the RMP, since administrative, public outreach, and educational tasks are vital to the success of the RMP implementation.

Therefore, the RMP components are differentiated into three categories, based on the nature of the remedial actions to be performed and the type of benefits that are provided by the actions.

- **Clean Drinking Water Activities** – focused on the removal of PCE from the public drinking water supply to the benefit of water users within the TMWA wholesale and retail service area.
- **Remedial Activities** – focused on the identification, characterization, evaluation and remediation of historic sources of PCE, and the related monitoring programs requisite to all remedial actions to the benefit of residential and commercial property owners located above the areas containing or suspected of containing PCE contamination.

- **Program Outreach, Education, and Administration Activities** – focused on the management of resources to optimize the remedial activities including outreach and educational tasks, and project administration and fund management to the benefit of water users and property owners.

Clean Drinking Water Activities

The goal of the clean drinking water activities described in this section is to remove PCE from the drinking water supplied by TMWA's groundwater production wells. These measures include wellhead treatment and pumping plan implementation.

Wellhead Treatment

The elements of the wellhead treatment component that the County will fund are as follows:

- Continue to pay the debt service for the bond used to finance wellhead treatment for the Kietzke, Corbett, Mill, High and Morrill Street wells.

- Continue to pay for operation and maintenance of wellhead treatment for these five wells.

- Create a fund that can be used: to finance future wellhead treatment design, construction, and, as appropriate, operations and maintenance for wells that do not currently have wellhead treatment but will require it sometime in the future; or finance other types of remedies deemed appropriate for protection and/or treatment of groundwater produced for potable water supply (or other municipal, industrial or domestic uses).

Pumping Plan Implementation

A pumping plan agreement was developed between Washoe County and TMWA (formerly Sierra Pacific Power Company) defining a minimum daily quantity of water that must be pumped from each of the five water supply wells with wellhead treatment. The objective of the pumping plan is to maintain a degree of hydraulic control on the deep aquifer zone impacted by PCE (i.e., to limit migration of the PCE plume downgradient of the five water supply wells). As more information is collected and a better understanding of the relationship between the groundwater contamination and water supply production is developed, the CTMRD will work with TMWA to re-evaluate and update the current Pumping Plan.

Remedial Activities

The three elements of Remedial Activities, which have been identified based on the data collected and discussions with NDEP and WCDHD, are groundwater monitoring, MNA, and source remediation. These activities appear, at this time, to be the only cleanup activities that are reasonable and economically feasible.

Groundwater Monitoring Program

Groundwater monitoring will continue to be performed as part of the overall CTMRD remediation program. The objective of the groundwater monitoring will be to track water quality conditions beneath the CTM, including the naturally occurring processes that contribute to the attenuation of shallow and deep groundwater contamination (i.e., MNA as described below). A description of the groundwater monitoring program including MNA components is provided in Appendix E.

Monitored Natural Attenuation (MNA)

Monitored Natural Attenuation (MNA) is an *in-situ* remediation technology that involves naturally occurring processes (e.g., biodegradation, dispersion, matrix diffusion, sorption, volatilization, and chemical degradation). These processes serve to reduce the concentration, and in some instances, mass of contaminants in groundwater and soils. MNA is recognized by the U.S. Environmental Protection Agency as a viable method of remediation that can be evaluated relative to contaminants, and the chemical, physical, and biological characteristics of the soil and groundwater to determine its effectiveness at a particular location. This method of remediation may be used as the sole remediation technology when it: (1) is combined with some degree of source control; (2) is shown to be fully protective of human health and the environment; and (3) meets remedial objectives within a reasonable time frame. Data generated as part of the groundwater monitoring program will be used to evaluate the effectiveness and applicability of MNA to the conditions within the CTM. MNA may also be used in combination with other process options as a concurrent technology, or in a phased manner following the completion of other technologies.

Source Area Remediation

Based on the nature of the PCE contamination, it is estimated that there may be dozens, if not hundreds, of currently unidentified sources, including both those of historic origin and current discharges. An important component of the overall remediation efforts will be to remediate these potential source areas that are not related to identifiable responsible parties (given that it will be the responsibility of NDEP to oversee remedial actions by identifiable responsible parties).

The process of conducting remedial actions on any particular source will involve gathering that data needed to select and design remedial measures, and implementing the selected remedy. Since the County does not have unlimited taxpayer revenues to implement remedial actions on sources, the PCE Source Management Process allows for ranking of potential PCE source areas based on various criteria established to estimate the potential for sources to impact public water supply and human health. This process, as illustrated in Figure ES-4, includes the following linked activities:

- **Prioritization of Potential Source Areas** - Based on available data from various entities develop a prioritized listing of sites and potential source areas for further action under this program. Further action may include source characterization efforts, referral to NDEP, source remedial evaluations, and/or source remedial actions.

- **Source Characterization** - Conduct source characterization activities on those potential source sites and areas that are determined by the Technical Working Group (TWG) members to be of the highest priority.

- **Responsible Party Evaluations and Source Referrals** - Review to determine whether or not adequate information has been collected to differentiate a potential source area from regional conditions, and identify a localized area or parcel as the location of the source. Upon consultation with NDEP, and once adequate data evidence has been collected in accordance with the available resources pursuant to NRS 540A.280, the CTMRD will refer "potential" source areas certain cases to NDEP for appropriate action. The Cooperative Agreement to be developed among Washoe County DWR, NDEP, and WCDHD will refine the source referral process.

- **Source Remedial Evaluations** - For those potential source sites and areas that are not referred to other entities or agencies, or have been returned from other entities or agencies to be included in the CTMRD, a focused feasibility study will be performed working with the TWG to evaluate and recommend selection of a remedial action for that source that is reasonable and economically feasible. The result of the focused feasibility study will be production of a Site Specific Remediation Plan that will be developed by the TWG collaborative process which includes the CTMRD, NDEP, and WCDHD.

- **Benefit Evaluations** - Evaluate and identify potential changes in water user and/or property owner benefits related to the proposed remedial action.

- **Source Remediation** – Implement a Site Specific Remediation Plan for those sources that have been selected, based on priority and available funding.

The implementation of the PCE Source Management Process will require a consistent commitment of resources and the collaboration of the TWG members since the activities to be performed by the CTMRD within any calendar year will be dependent on changing site conditions, data, and priorities. To coordinate the actions and sharing of information among these entities related to the management of sources, a Cooperative Agreement will need to be developed and executed. This agreement would define the nature of the relationship(s) and the standard processes that the entities will follow to implement the PCE Source Management Process.

Program Outreach, Education, and Administration Activities

Program outreach, education and administration include those activities related to the management of resources needed to implement the RMP components defined in this section.

Public Outreach and Education

The objective of this element is to perform activities related to:

- Provide members of the community with educational information regarding the CTMRD, the RMP components, the management and expenditures of tax dollars, and the status of the project activities using media and public information channels.
- Conduct occasional community workshops for promoting information exchanges and creating a forum for public feedback.
- Establish and maintain a CTMRD Public Advisory Group consisting of key project stakeholders and implementers (e.g., NDEP, WCDHD, TMWA, City of Reno, City of Sparks, area business interests, neighborhood advisory boards, citizen advisory boards, etc.) to:
    - Promote technology and information transfer;
    - Stimulate effective sharing of ideas;
    - Create means to evaluate and exchange viewpoints on public policy associated with the implementation of the CTMRD and related matters; and
    - Generally allow for a direct feedback mechanism from various project stakeholders and implementers to Washoe County and the Board of County Commissioners.

Project Administration Tasks

The objective of these activities is to manage the resources of the County (both human and financial) with respect to implementation of remedial and programmatic activities. Project administration tasks include, but are not limited to, management of County staff, database and information management, fund management, tax bill development and billing support, and facilitation of institutional and intergovernmental communications.

Implementation Review

Note that on an annual basis, the CTMRD program will be reviewed in terms of the appropriateness of activities and the funds spent and retained (e.g., trust funds) over the previous year. The objective of the review will be to identify:

- Available funding for source remediation.

- Available funding for design and construction of new treatment at public water supply well(s).
- Available funding for source prioritization, characterization, and remedial evaluations.
- Need for additional benefit areas within CTM related to specific source areas and groundwater plumes.

The review will result in the development of a group of resolutions and/or ordinances that will be brought to the BCC for consideration and action.

Remediation Management Program Implementation

The conditions of PCE contamination within the CTM – extensive area of impact; multiple sources; consistent, low level of contamination – require an innovative approach for management and remediation. The RMP defines a "first of its kind" remediation program for the CTMRD. Implementation of the program will require not only the cooperative efforts of the Technical Working Group members, but also the involvement and input from a broad range of project stakeholders. The full range of program activities that make up Phase 2 of the CTMRD (Source Identification and Remediation Phase) includes the primary remediation program components identified in Section 3 as well as a series of program initiation activities that are required for successful implementation of the overall program.

A number of program initiation, or set-up, activities have been identified, that need to be performed during the first months of the RMP implementation. The intent is to establish the roles and responsibilities of each of the key stakeholders (i.e., governmental entities, water purveyors), to assist the CTMRD in meeting its objectives and goals. The program initiation activities, which will be a District focus during the first year of RMP implementation, include development of cooperative agreement with NDEP and WCDHD. Each of these sets of activities is described below.

- **Cooperative Agreement**. A model Cooperative Agreement needs to be developed to allow the members of TWG to coordinate relevant operations and process activities, establish roles and responsibilities, define communication protocols, and commit appropriate resources to the RMP implementation. The Cooperative Agreement, which will be developed in accordance with NRS 227.080 (Interlocal Cooperation Act), will establish the relationships among the signatories and guide the TWG's involvement in the implementation of the remediation program of the CTMRD. The Cooperative Agreement will also be used to define the ground rules for refining program goals and operating procedures over time. Protocols to be addressed include:

- *Regular Periods of Program Evaluation*. This issue relates to how the processes that make-up any particular program component are to be evaluated for effectiveness, efficiency, and applicability on a regular basis, so that the remediation management program maintains its focus and applicability over the span of its use.

- *Data Management and Reporting Protocols.* This issue relates to how the various entities will standardize data collection activities and project reporting requirements, and share and manage data. Given the number of entities involved in the implementation of the program, mechanisms may need to be created to ensure that relevant data is provided to the CTMRD as public and private entities collect information.

Table ES-1 presents a listing of currently identified activities that need to be performed to initiate implementation of the Remediation Phase of the CTMRD and a summary of the key attributes that need to be developed for each activity.

Remediation Program Cost Components

The CTMRD remediation program components will be funded through the use of annual funding accounts. These funding accounts will be created as either annual allowance accounts or trust fund accounts, as described in more detail below.

It is important to note that the Remediation Program costs are capped at the total costs indicated by the sum of the annual allowances and the trust funds, or about $2,400,000. Although the use of these funds, and the allocation of the funds to each of the annual allowances or trust funds from year to year may vary, the amount received by the CTMRD though the County's tax bill will remain the same from year to year (established as a minimum level of funding). Only under special circumstances approved by the BCC will the amount of funding to CTMRD be altered.

Annual Allowance Accounts

Annual allowance accounts will be utilized to fund activities that will occur every year, based on the priorities of the CTMRD, the need for a specific activity, and the availability of funds. Specific cost allowance funds are highlighted below:

Current Wellhead Treatment Facilities and Pumping Plan Implementation. These expenditures would include debt service payment on bonds for construction of the existing water supply well treatment systems or operations and maintenance (O&M) costs associated with these systems, including replacement of treatment facilities. These costs would also include the continued implementation of the Pumping Plan agreed upon between the County and TMWA in 1998, which requires TMWA to pump the five wells with wellhead treatment year round to maintain hydraulic control of the deep aquifer system to a reasonable degree. It is anticipated that the Pumping Plan will be amended in the future so as to be consistent with CTMRD needs.

Table ES-1
Summary of Activities Required to Implement Source Identification and Remediation Phase of the CTMRD

Activity	***Key Stakeholder Organization with Washoe County Department of Water Resources***					***Summary of Activity Requirements***
	NDEP	***WCDHD***	***City of Reno***	***City of Sparks***	***TMWA***	
PROGRAM INITIATION ACTIVITIES						
Prepare and Execute Cooperative Agreement	✔	✔				• Engagement methods • Relationships, roles • Resources allocations • Communications protocols • Information sharing • Reassignment protocol (from NDEP back to CTMRD)
CLEAN DRINKING WATER ACTIVITIES						
Wellhead Treatment		✔			✔	• Continue debt service and O&M
Pumping Plan Review Procedures					✔	• Data sharing • Modeling • Contingency plan development
REMEDIAL ACTIVITIES						
Groundwater Monitoring Program/MNA	✔	✔			✔	• Develop Scope • Receive and Evaluate Bids • Perform Monitoring • Disseminate Results • Coordinate Data Collection and Management Policies
Develop Policies and Protocols for Implementing Source Prioritization, Source Characterization, Source Referrals, and Source Remediation	✔	✔				• Define Data Collection and Management Procedures • Define Review and Comment Protocols • Define Reporting Methodologies • Define Communication Protocols
Responsible Party Evaluation and Enforcement Actions by NDEP	✔					• Responsible Party corrective actions • Responsible Party cost recovery
OTHER ACTIVITIES						
Characterization of Sanitary Sewer Impacts on Shallow Groundwater	✔	✔	✔	✔		• Develop Scope • Receive and Evaluate Bids • Perform Monitoring • Disseminate Results • Coordinate Data Collection and Management Policies
Evaluation of PCE Ban Legislation	✔	✔	✔	✔	✔	• Conduct Evaluation of Other State Programs • Evaluate Legislative Requirements
Evaluation of PCE/Dry Cleaner Fund	✔	✔	✔	✔	✔	• Conduct Evaluation of Other State Programs • Evaluate Legislative Requirements

Source Management Elements include source prioritization, characterization, feasibility studies, and analysis of benefits.

Project Outreach, Education and Administration Costs include those costs that will be incurred by the County in the efforts to conduct and maintain public outreach and educational programs and for administration and management of the CTMRD. These funds will be used to support performing public outreach and educational programs including providing information repositories in public places, conducting public workshops, and implementing community outreach programs. These funds will also support employee salaries and expenses associated with database and information management, program communications within the CTMRD and with NDEP and WCDHD, budget and account management, billings, and associated contractor procurement.

Trust Fund Accounts

Trust funds will be maintained in interest bearing accounts that will be used to support large capital expenses and operation and maintenance programs, as needed. In any one year, a trust fund account may or may not be used to support specific Remediation District activities.

Trust fund accounts continue to receive monies from annual Remediation District contributions and from interest received through the interest bearing accounts. These funds are then dispersed through large single capital cost draws, or for ongoing operations and maintenance. These trust funds may also be used to reimburse entities that are not responsible for the PCE contamination, but who have performed remedial actions consistent with the CTMRD program.

During the implementation of the remediation program, parties responsible for the investigation and cleanup of particular PCE sources may be identified. If funds used to cover the cost of remedial actions by the CTMRD can be recovered from these responsible parties, monies will be provided back to the CTMRD and placed into these trust funds.

Anticipated trust fund account expenditures are highlighted below:

- **Future Wellhead Treatment Facilities**. If PCE is detected in an existing water supply well without wellhead treatment, design and installation of a new groundwater treatment system may be required. The trust fund account would be the source of funds for this activity. The trust fund account would be the source of funds for this activity assuming one new well every three years requires wellhead treatment.

- **Remediation of PCE Sources**. If a PCE source is identified as part of the Source Management Activities and is not managed through NDEP, trust fund monies will be used to cover the cost of design and installation of remediation systems or operations and maintenance of new remediation systems once an evaluation of remedial options and benefits is performed.

Cost Summary

A breakdown of costs based on the Remediation Management Program components described above is presented in Table ES-2.

Table ES-2
Remediation Management Plan Budget
Central Truckee Meadows Remediation District

Remediation Management Plan Program Element	***Cost and Type of Fund***			
	Estimated Cost		***Annual Allowance Cost Categories***	***Trust Fund Categories***
CLEAN DRINKING WATER ACTIVITIES				
Pumping Plan Implementation [1]				
Annual Bond Payment	$400,000		✔	
Annual O&M Costs	$300,000		✔	
Replacement of existing facilities	$300,000		✔	
Wellhead Treatment Trust [2]	$430,000			✔
Total		$1,430,000		
REMEDIAL ACTIVITIES				
Groundwater Monitoring/ Monitored Natural Attenuation	$200,000		✔	
Source Area Remediation				
Source Prioritization	$30,000		✔	
Source Characterization	$170,000		✔	
Source Evaluations (mini-feasibility studies and benefit analyses)	$100,000		✔	
Source Remediation	$200,000			✔
Total		$700,000		
PROJECT OUTREACH, EDUCATION, AND ADMINISTRATION				
Public Outreach and Education	$150,000		✔	
Project Administration	$120,000		✔	
Total		$270,000		
TOTAL PROGRAM COST		**$2,400,000**		

Notes:
[1] *Pumping Plan Implementation* includes costs for current wellhead treatment of TMWA water supply wells.
[2] *Wellhead Treatment* applies to design and construction of treatment facilities for future contaminated production wells.

Summary of Benefits

An important element of the Work Plan Development and Implementation Phase was to define the allocation of costs for the Source Identification and Remediation Phase of the project. In accordance with the enabling legislation, NRS 540A, the BCC may recover the costs of developing and implementing the RMP by imposing an annual fee for properties within the CTMRD. This fee, which may be based on annualized water usage, is to be weighted and adjusted between parcels or properties within the CTMRD based on varying levels of contamination, impacts to property values resulting from the implementation of the RMP, or any other factors deemed appropriate and reasonable by the BCC. To date, the CTMRD has been funded through a fee based on water use for all entities within TMWA's wholesale and retail service area. The fee has been assessed as a line item on the annual tax bill.

Three distinct benefit groups that will exist once the Source Identification and Remediation Phase of the CTMRD begins have been identified as a result of the various environmental sampling and related analyses. Each of these groups receives a tangible benefit from the RMP components and activities. The three benefit groups that have been identified include:

- Water users within the TMWA wholesale and retail service area,
- Residential property owners within the "area of potential impact", and
- Non-residential property owners within the "area of potential impact".

A discussion of the location and benefit received for each of these entities is provided in the pages that follow. Figure ES-5 presents an overlay identifying the location of each of these two benefit groups.

Benefits to Water Users

Water users are those entities within TMWA's wholesale and retail service area, including the areas served by Sun Valley General Improvement District, Reno-Parr Water Company, Panther Valley Water Company, and the Washoe County Utilities Division. Within this boundary area, there are water use parcels (i.e., parcels of property which have access to and utilize water from a public water supply) and non-water use parcels. Currently, non-water use parcels located within the fee area have not been included in the fee structure. Changes to the existing legislation during the next legislative session (2004) are being considered as a way of including non-water use parcels into the fee structure.

Within this area, there are approximately 85,300 water users. The primary benefit for the water user group is access to a clean and sustainable water supply.

Benefits to Property Owners Within Area of Potential Impact

The property owner benefit group consists of the owners of those properties that overlie the area that has been identified as potentially impacted by detectable concentrations of PCE in groundwater. Figure ES-5 depicts the "area of potential PCE impact".

The existence of the CTMRD protects innocent property owners (i.e., property owners that did not cause or contribute. to the contamination condition) from liability for the costs associated with characterization and remediation of the contamination – but this benefit is more applicable to commercial properties than residential. Given the differences in residential and commercial property impacts associated with the presence of groundwater contamination within CTM, two distinct subgroups have been differentiated within the property owners benefit group - residential property owners and non-residential property owners – since the benefits derived from the existence of the CTMRD provides more benefit to commercial properties than residential properties

Residential Property Owners

This group consists of the owners of residential properties that overlie the area of potential impact. The primary benefits to individuals within this group are:

- Ongoing actions to eliminate or reduce PCE-contaminated soils and groundwater underlying their property, and
- Protection of property values by avoiding a CERCLA listing, which studies have shown may contribute to a decreased property value (up to approximately 20% decrease).

Non-residential Property Owners

This group consists of the owners of non-residential properties that overlie the area of potential impact. The primary benefits to individuals within this group are:

- Ongoing actions to eliminate or reduce PCE-contaminated soils and groundwater underlying their property,
- Protection of property values by avoiding a CERCLA listing, which studies have shown may contribute to a decreased property value (up to approximately 94% decrease), and
- Protection from individual liability for remediation of PCE-contaminated soils and groundwater underlying their property.

Table ES-3 provides a summary of the three benefit groups within the CTMRD boundary area and the general allocation of annual Remediation District costs to these groups.

Table ES-3
Benefit Group Summary
Central Truckee Meadows Remediation District

Remediation Plan Program Element	Benefit Group: All Water Users	Property Owners: Residential	Property Owners: Non-Residential
CLEAN DRINKING WATER ACTIVITIES			
Pumping Plan Implementation	✓		
Wellhead Treatment Trust	✓		
REMEDIAL ACTIVITIES			
Groundwater Monitoring/MNA		✓	✓
Source Area Remediation		✓	✓
PROJECT OUTREACH, EDUCATION, AND ADMINISTRATION			
Public Outreach and Education	✓	✓	✓
Project Administration	✓	✓	✓

The specific value of the benefit, as indicated by the cost allocated to each benefit group and parcel or property, is controlled by the language in NRS 540A. Based on NAC 540A.265, the BCC is required to base the CTMRD fee on "a percentage of the total amount billed in the preceding calendar year to each parcel or property within the district for water by the provider of retail water service to the parcel or property". In addition NAC 540A.265 stipulates that this fee may "be weighted and adjusted between parcels or properties within the district, if applicable, to reflect varying levels of effect of the contamination, varying levels of value resulting from remediation or other factors deemed relevant to the BCC".

Based on the discussions of benefit described in the above sections, the allocation of cost to those receiving benefit was as follows:

Table ES-4
Cost Allocation for Benefit Groups
Central Truckee Meadows Remediation District [1]

Remediation Program Components	Water Users	Property Owners [2]
Clean Drinking Water Activities	$ 1,430,000	$ 0
Remedial Activities	$ 0	$ 700,000
Project Outreach, Education and Administration	$ 135,000	$ 135,000
Total	**$ 1,565,000**	**$ 835,000**

[1] All costs are approximate - the basis of the costs listed in the table is provided in Section 5, *Remediation Management Program Cost Summary.*

[2] The allocation of costs between residential and commercial property owners will be based on the a fee that is weighted or adjusted, ranging from 2:1 to 4:1 of that fee associated with annualized water use.

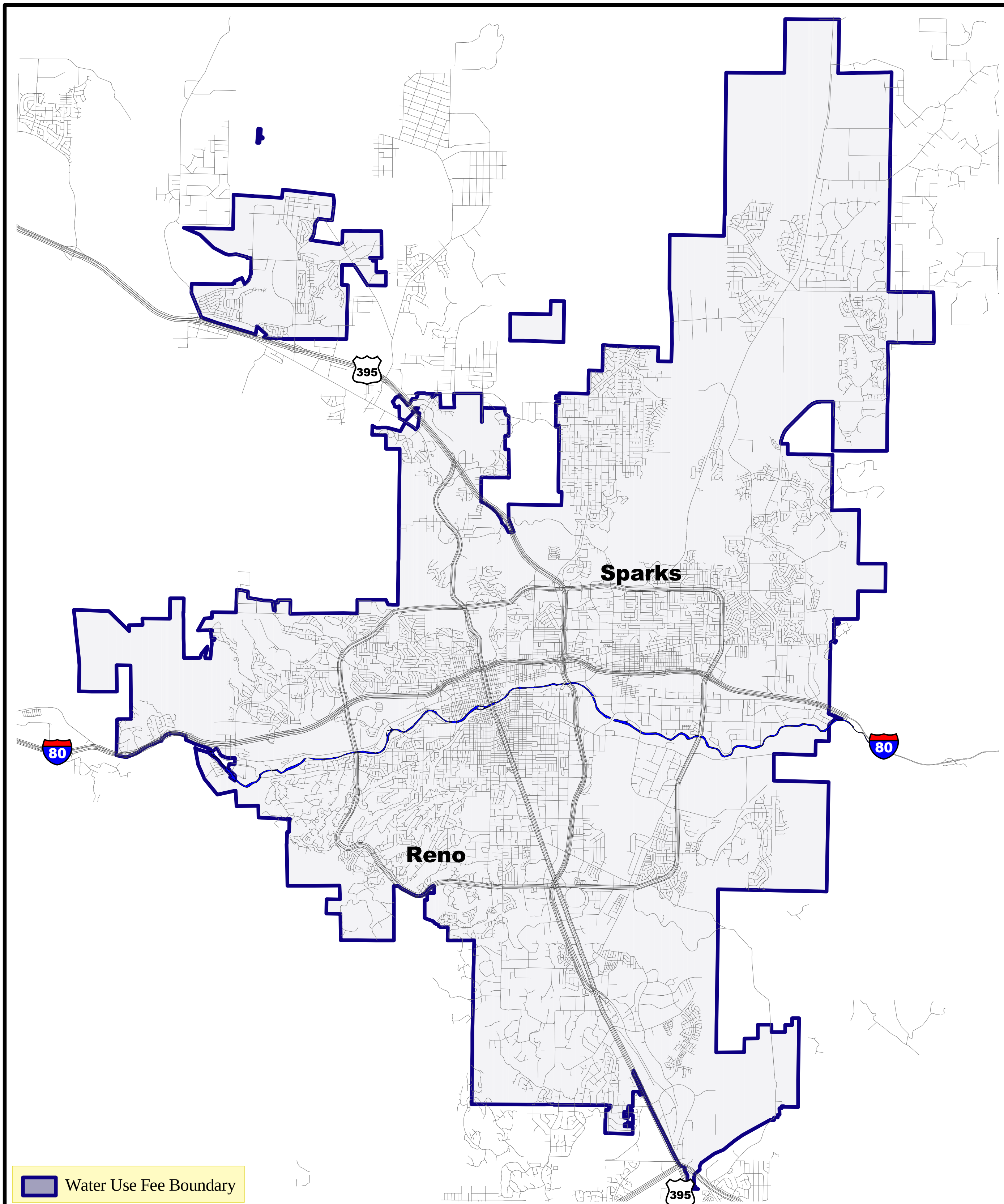


Figure ES-1 Wholesale / Retail Water Service Area

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

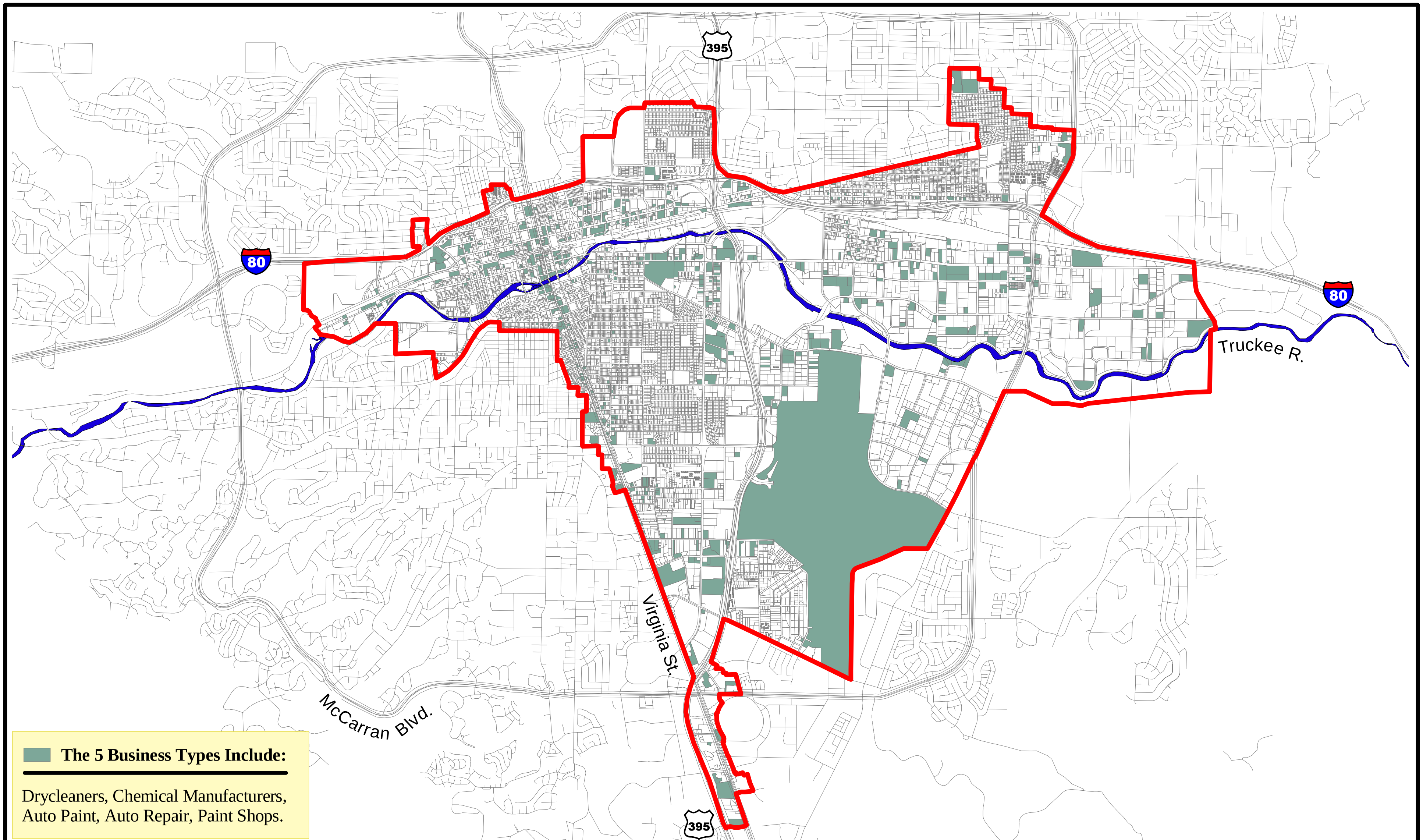


Figure ES-2 Parcels Containing 1 of the 5 Business Types

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

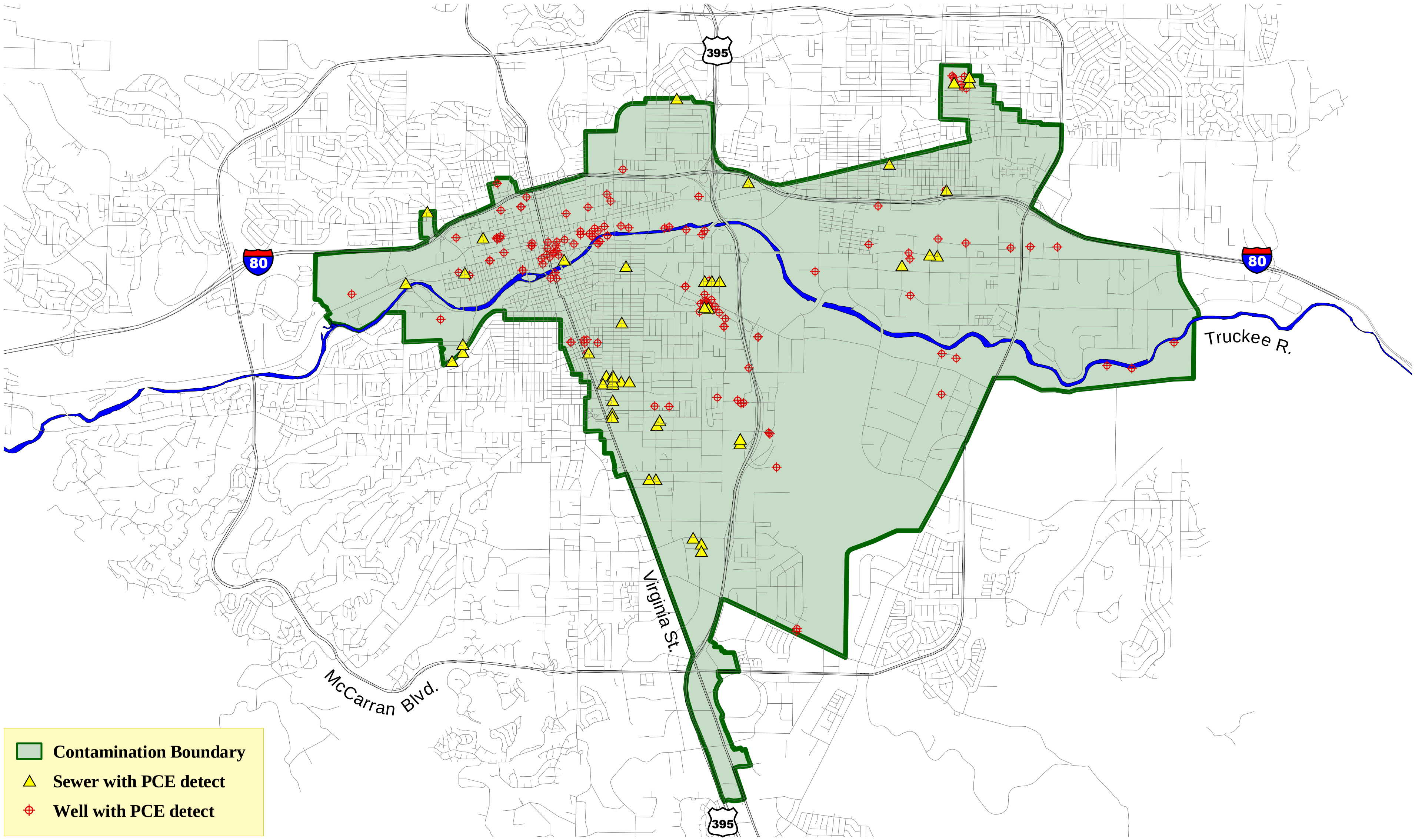


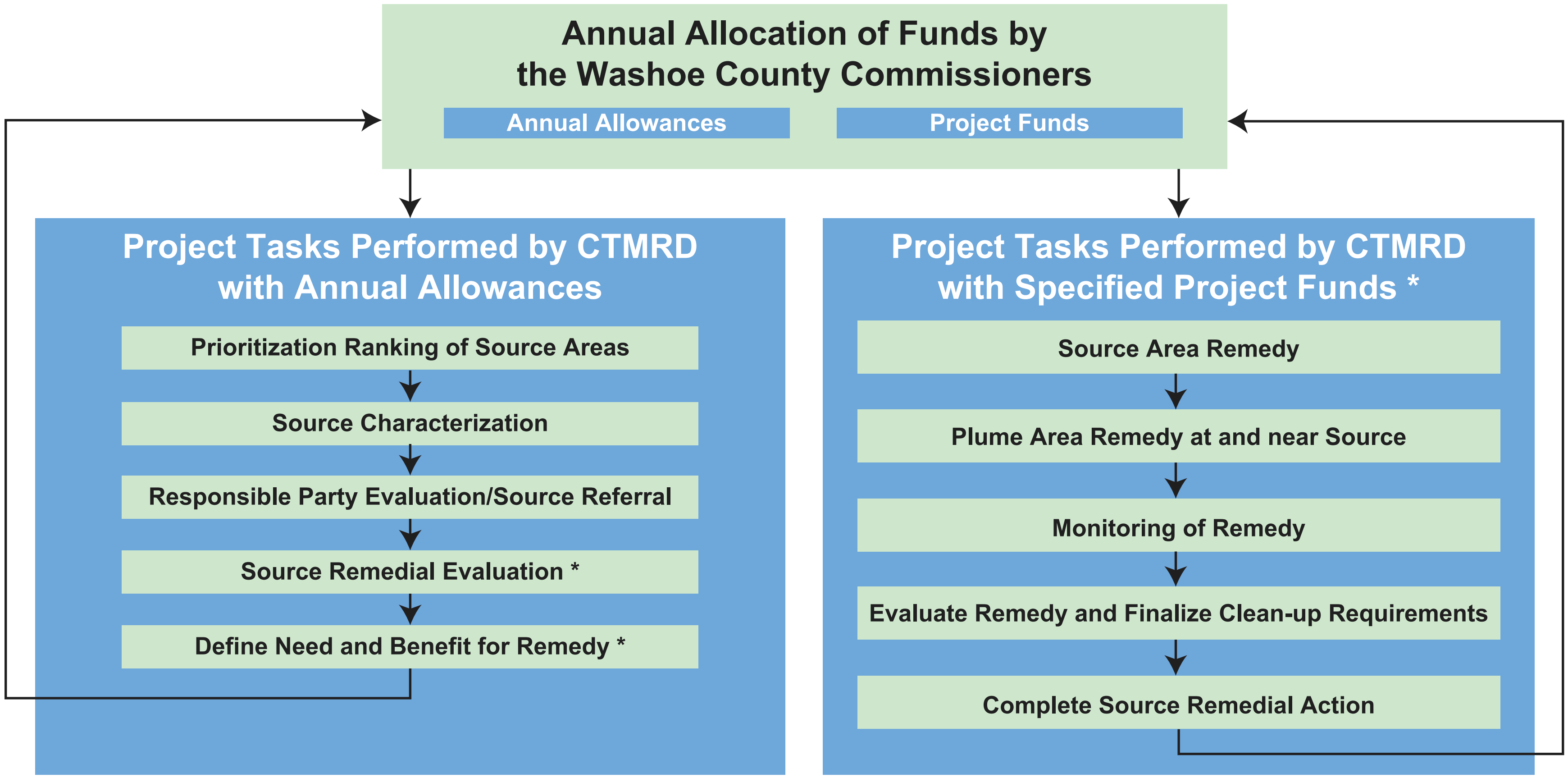
Figure ES-3 Summary of Sanitary Sewer PCE Detections Correlated to Groundwater Monitoring Well PCE Detections

0.5 0 0.5 Miles

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

S. Washoe County-
Sparks
Reno



These tasks are performed every year within a budget specified by the Board of County Commissioners, allocated based on benefit to property owners

* These tasks occur only for sources with non-viable responsible parties

These tasks are performed in accordance with a specified project budget, on an as needed basis. Funding must be approved by the Board of County Commissioners, allocated based on benefit to property owners (these funds may be allocated on a project basis rather than on an annual basis)

Figure ES-4 PCE Source Management Process

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

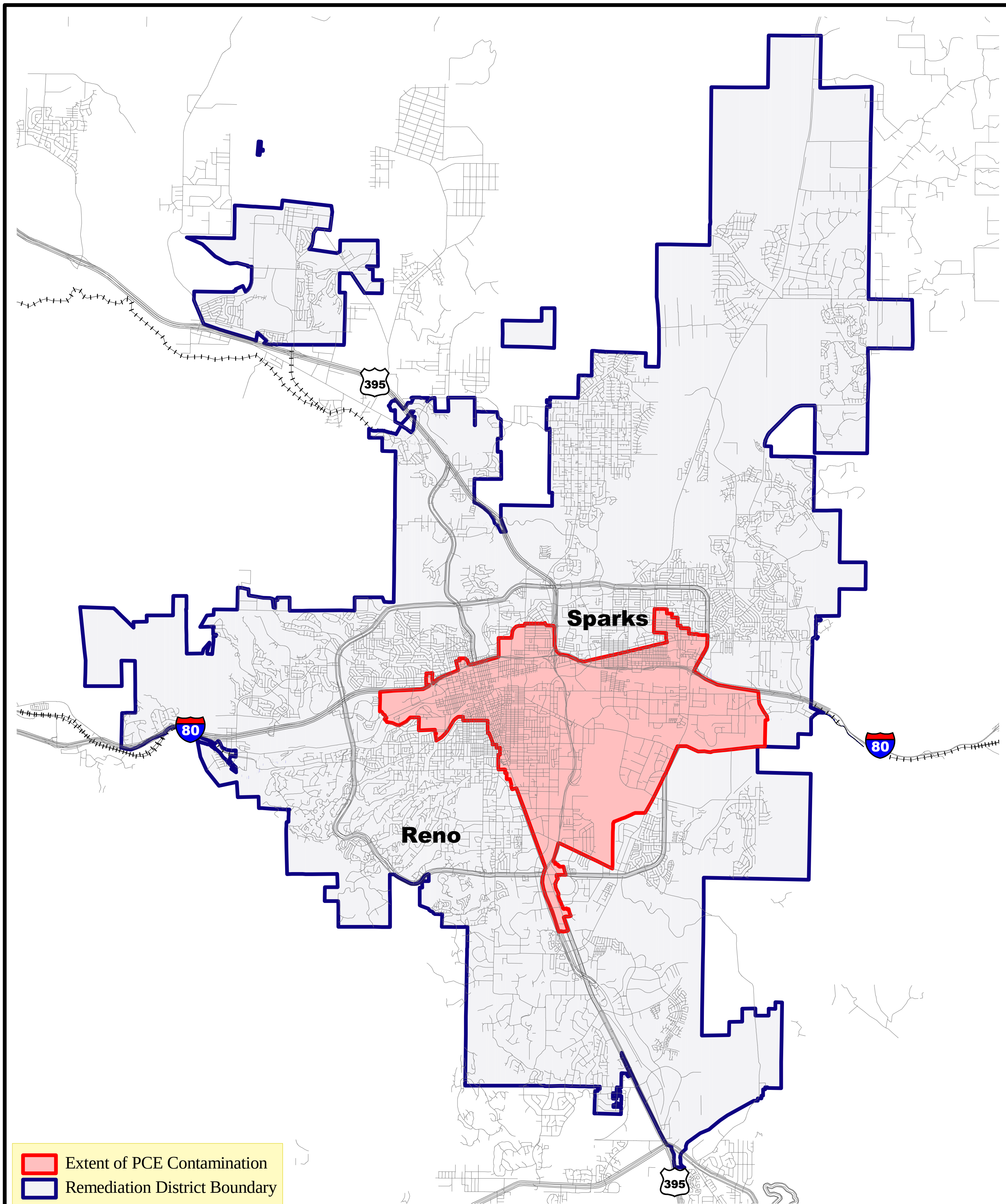


Figure ES-5 Known and Suspected PCE Distribution in CTM

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

Section 1
Introduction

The *Remediation Management Plan* (RMP) was prepared by Camp Dresser & McKee Inc. (CDM) and Bouvette Consulting on behalf of the Washoe County Department of Water Resources (County). The RMP documents activities performed to date to support the Central Truckee Meadows Remediation District (CTMRD or "Remediation District") and describes the actions and processes that will be implemented as part of the overall scope of Remediation District activities.

As will be described below, the CTMRD was created in response to the presence of tetrachloroethene (PCE) in groundwater beneath the Central Truckee Meadows (CTM). The CTMRD activities will be implemented in three distinct phases.

- **Phase 1** – Phase 1, or Work Plan Development and Implementation Phase, consisted of a range of activities designed to characterize the nature and extent of the PCE contamination and to determine an effective approach to address the condition. Additionally, Phase 1 included implementation of treatment for the removal of PCE at existing water supply wells. The Phase 1 activities are documented in this RMP. Completion of the Remediation Management Plan constitutes completion of Phase 1.

- **Phase 2** – Phase 2 is the Source Identification and Remediation Phase of the CTMRD. The Source Identification and Remediation Phase will be performed based on the recommendations presented in this RMP.

- **Phase 3** – Phase 3 is the Closure Phase, during which time sites and sources, as well as the overall remediation program, will be completed. The Closure Phase of the CTMRD will not occur for the overall remediation program until wellhead treatment of PCE is no longer needed at the public water supply wells, which is anticipated to be many decades from now. Closure of small source area remedial activities, planned and implemented in accordance with those guidelines set forth in this document, will likely occur independent of the Closure Phase of the CTMRD.

1.1 Background Information

PCE, an organic solvent also known as perchloroethylene, tetrachloroethylene, and PERC, is used in a variety of commercial/industrial operations (e.g., commercial dry cleaning, paint manufacturing and distribution, and auto repair). PCE was initially found in groundwater within the limits of the city of Reno. Subsequent groundwater investigations have identified widespread occurrences of PCE and other volatile organic compounds (VOCs) in groundwater.

To address the presence of PCE in groundwater, which affect both the drinking water supply and future construction projects that may penetrate the water table, Senate Bill 489 (SB 489) was developed by a consortium of shared water and business interests and passed by the State Legislature in 1995 (Appendix A). This bill required the Board of County Commissioners (BCC) to create a "Remediation District" upon the certification of a groundwater contamination problem by either the Nevada Division of Environmental Protection (NDEP) administrator or the district health officer or both. Washoe County BCC received certification letters from both NDEP and the Washoe County District Health Department (WCDHD) in August 1995. Appendix A provides copies of the letters received from NDEP and WCDHD. Upon receiving the certification letters, the Washoe County BCC was responsible for preparing a plan for remediation that must be approved by NDEP, which identifies remedial actions that are reasonable and economically feasible in response to the release or threat of release of any hazardous substance into the environment, which may affect the water quality of CTM. Based on the letters received by the County, the only hazardous substance that is covered by the actions of the CTMRD is PCE and its degradation products.

The current phase, or Work Plan Development and Implementation Phase, of the CTMRD was initiated in 1995, in response to the certifications received by the County. The earliest Phase 1 action involved the development of the *Central Truckee Meadows Remediation District Final Work Plan* (1996 Work Plan; CDM, 1996). The 1996 Work Plan, which was approved pursuant to NRS 540A.260 by NDEP in a letter dated August 1997 (presented in Appendix A), identified the need for environmental sampling to evaluate the condition of surface water, groundwater, soils, and soil gas prior to the development of the Remediation Management Plan.

Unfortunately, SB 489 lacked language allowing for the funding of the Work Plan activities, which were needed to develop the plan for remediation. In addition, SB 489 lacked mechanisms to fund remedial action operation and maintenance expenses. Therefore, the Work Plan and the development of the Remediation Management Plan were put on hold until the legislation could be amended. NRS 540A was created and promulgated in 1997, allowing the County to begin funding of the CTMRD. NRS 540A is attached in Appendix A.

The first monies for the CTMRD were obtained through the tax roll in 1998 based on the benefits received by the water users within the Sierra Pacific Power Company (SPPCo) wholesale and retail service area (Figure 1-1). These funds were used to reimburse SPPCo for the design, construction, and operations of groundwater treatment facilities to treat groundwater produced by five water supply wells (Kietkze, Mill, High, Morrill, and Corbett). The Truckee Meadows Water Authority (TMWA) has since taken over operations of the SPPCo water supply wells.

The funding also allowed for the Work Plan activities to be performed starting in 1998. Over the last 4 years, environmental sampling of specified surface water locations and groundwater wells, as well as development of a comprehensive listing and mapping of historic land use throughout the CTM, has been performed by the County. In addition, the County has undertaken selected sampling of area sanitary sewers (discussed in more detail in Section 2.3.1.10, and Washoe County, 2002).

In addition, the County retained CDM to update the 1996 Work Plan and to develop the RMP. The *Final Updated Work Plan* (Updated Work Plan; CDM, 2001) identified the following activities as critical to the development of the RMP:

- Characterize the nature and extent of the PCE contamination beneath CTM;
- Formalize and document the goals and objectives of the CTMRD;
- Develop and screen candidate remedial actions; and
- Select remedies and processes for implementation.

Discussions regarding site history; planning and development of the CTMRD program; and the site conceptual model for the CTM are compiled in the *Updated Work Plan* (CDM, 2001). To further characterize the nature and extent of PCE contamination and evaluate candidate remedial actions, analyses were performed to understand potential human health risks associated with the presence of PCE, simulate groundwater flow through the aquifer system beneath the CTM, and characterize the contaminant transport mechanisms influencing the migration of PCE in the subsurface. These efforts are documented in a series of four project technical memoranda. The technical memoranda, which were prepared to facilitate County, NDEP, and WCDHD review of elements in the ongoing development of the RMP, are highlighted below.

- *Technical Memorandum -- Field Investigation Program Data Summary*, dated July 9, 2002 (CDM, 2002a).
- *Technical Memorandum -- Human Health and Environmental Risk Analysis*, dated revised – July 9, 2002 (CDM, 2002b).
- *Technical Memorandum -- Groundwater Modeling*, dated July 9, 2002 (CDM, 2002c).
- *Technical Memorandum – Remedial Technologies Identification and Screening*, dated July 9, 2002 (CDM, 2002d).

The initial three technical memoranda (TMs) characterize the physical, toxicological, and hydrogeochemical setting within the CTM as it relates to the distribution and nature of PCE, the contaminant of concern. The fourth TM provides documentation and analyses that will apply to the selection of remedial technologies and remedial actions for contaminant source areas of PCE. This would apply to those source areas for which no viable owner is identified to assume financial responsibility for planning and implementation of remedial actions independent of the CTMRD. These technical memoranda are referenced throughout the RMP. They are attached as Appendices B, C, D and E, respectively.

1.2 Purpose of the Remediation Management Plan

The goal of the RMP is to provide guidance and define actions that are needed for implementation as part of Phase 2 of the CTMRD. The primary purposes of the RMP are as follows:

- Provide detailed background information. The recommendations presented herein constitute a range of actions based on investigations, evaluations, and analyses performed during the past three years, including the field investigations conducted in accordance with both the 1996 and 2001 Work Plans. Data generated during this period are provided in Appendix B.
- Provide a concise listing of recommended actions. The recommended actions include institutional processes that are a crucial component of the future Remediation Program.
- Define the boundaries of the CTMRD.
- Identify the costs associated with implementation of the RMP and the continued funding of the CTMRD during Phases 2 and 3.
- Present discussions related to the equitable allocation of costs among those entities receiving benefit derived from implementation of the RMP.
- Identify key collaborative relationships between entities that need to be involved with the implementation of the RMP.

The RMP is considered to be a “living”document, in that the overall CTMRD program is expected to be further developed and refined based on lessons learned during program implementation and based on ongoing stakeholder and public comment. This RMP has incorporated input from various stakeholders based on review of the Draft Remediation Plan, dated July 9, 2002. Any major modifications to the RMP will require NDEP and BCC approval.

1.3 Implementation of the Remediation Management Plan

The Washoe County BCC has decision-making authority relative to: development; implementation; and, when necessary, the revision of the RMP. The BCC is also responsible for funding for the various program elements defined in this RMP. The overall responsibility for implementation of the RMP rests with County DWR, in collaboration with NDEP, and WCDHD.

- **Washoe County Department of Water Resources**. The County DWR was delegated from the BCC the responsibility to develop and implement the Work Plan and the RMP. In this role, County DWR has assumed the responsibility for carrying out the Phase 1 activities, and for carrying out future Phase 2 and Phase 3 activities.

- **Nevada Division of Environmental Protection**. In accordance with NRS 540A, NDEP is a signatory of the certification acknowledging the existence of PCE groundwater impacts within the CTM and the need for the creation of the CTMRD. Under NRS 540A.260, NDEP is also responsible for approval of the RMP. NDEP also administers the state's environmental programs related to corrective actions and water pollution control.

- **Washoe County District Health Department**. In accordance with NRS 540A, WCDHD is also a signatory of the certification acknowledging the existence of PCE groundwater impacts. The WCDHD also co-administers the Safe Drinking Water Act program in concert with the Nevada State Health Division. The WCDHD is the primary regulating entity for the wellhead treatment of the TMWA wells.

These three entities have been involved in the development of the RMP through a series of Technical Working Group (TWG) meetings. Collaboration among these three entities during implementation of the remediation program components will help to ensure the protection of the drinking water supply within the CTM.

1.4 Remediation Management Plan Organization

This RMP consists of nine sections. Section 1, *Introduction*, provides background information, and defines the purpose of the RMP. Section 2, *Summary of Work Plan Implementation Phase Activities*, provides a detailed description of the physical, toxicological, and hydrogeochemical setting within the CTM, based in large part on the CTMRD program investigations and evaluations performed to date. Section 3, *Remediation Management Plan Components*, presents the objectives and goals of the CTMRD, and a detailed description of the recommended components of the RMP remediation program to mitigate the impacts of PCE found beneath CTM. Section 4, *Implementation Activities and Schedule*, presents a schedule for implementation of the RMP program elements. Program costs, and the equitable allocation of these costs, are critical issues associated with the implementation of the overall remediation program. Section 5, *Remediation Management Program Cost Summary*, discusses the costs of the individual components of the proposed remediation program. Section 6, *Benefit Analysis*, addresses the allocation of costs to water users and property owners within the boundaries of the Remediation District. Section 7, *Management of the Central Truckee Meadows Remediation District*, highlights the interactions among the various public entities as they relate to the ongoing operations/actions of the CTMRD. Section 8, *Nevada Revised Statute 459.500* Jurat, was prepared in accordance with State of Nevada requirements. This RMP concludes with Section 9, *References*.

Section 2
Summary of Work Plan Development and Implementation Phase Activities

2.1 Introduction

The objectives of this section are to provide a description of the range of activities that have been performed as part of Phase 1, Work Plan Development and Implementation Phase, of the CTMRD and to provide an overview of the results, conclusions, and recommendations for further remedial activities. Phase 1 activities, which were initiated in 1996, consisted of multiple components: (1) early field investigations and groundwater sampling, (2) design, construction, and operation of public water supply wellhead treatment, (3) planning, including preparation of the CTMRD Work Plans (1996 and 2001), (4) field investigation program, (5) numerical groundwater modeling and risk analysis, and (6) remedial technologies identification and screening. These efforts, which culminated in the development of this RMP, are highlighted on Figure 2-1.

Based on the body of work performed during the Work Plan Development and Implementation Phase of the CTMRD, a conceptual model of contamination was developed. This conceptual model, presented in Section 2.4, served as the basis for the development of the various components of the Source Identification and Remediation Phase of the CTMRD.

2.2 Background

This section provides background information related to the CTM, including physical setting, geology, hydrogeology, climate, and land-use.

2.2.1 Physical Setting

The Truckee Meadows refers to the topographic basin bounded by volcanic rock outcrops of the Virginia Range and Pah Rah mountains to the east, the Carson Range to the west, Steamboat Hills to the south, and the Peavine Mountain bedrock outcrops to the north. Figure 2-2 outlines the physical setting of the Truckee Meadows and identifies the CTMRD study area. The CTMRD study area is approximately defined by McCarran Boulevard on the west, south, and east, and Interstate Highway 80 (I-80) to the north. However, because the alluvial materials in the Reno area extend north of I-80 and east of McCarran, the study area and, especially, the groundwater model domain extend beyond these approximate boundaries as appropriate.

2.2.2 Geology/Hydrogeology

The geology of the area is conceptualized as bedrock basin composed of volcanic rocks of relatively low permeability and filled with a sequence of sedimentary deposits, which tend to decrease in permeability with depth below ground surface.

2.2.2.1 Geologic Description

Two major deposits form the geologic composition of the Truckee Meadows: volcanic rocks and unconsolidated, sedimentary deposits.

Volcanic Rocks

Volcanic rocks (also termed bedrock) comprise the mountains surrounding the Meadows and the low hills along the margins of the basin, and underlie the basin fill. In general, the volcanic rocks of the Truckee Meadows (also termed the "bedrock"), which are extrusive in nature, consist of lava flows, tuff, agglomerate, and tuff breccia of mostly andesitic composition, and exist at depth beneath the sedimentary deposits of the basin. Based on information presented by McDonald Morrissey Associates (MMA, 1993), depth to bedrock in the Central and South Truckee Meadows basins may be greater than 3,000 feet and 2,500 feet, respectively.

The hydraulic conductivity of the volcanic rocks of the mountains is believed to be low. Therefore, the amount of water transmitted by the volcanic rocks to the CTM basin is hypothesized to be relatively small.

Sedimentary Deposits

Cohen and Loeltz (1964) indicate that the unconsolidated deposits filling the CTM basin are comprised of the Truckee Formation and alluvium.

- <u>Truckee Formation</u>. The Truckee Formation is exposed in the northwest part of the study area where the Truckee River enters the basin. In areas where the formation is exposed, it is composed of massive to thinly bedded siltstone, silty sandstone, sandy conglomerate, diatomite, and diatomaceous silt- and sandstones. Drillers' logs have also characterized penetration of the Truckee Formation by abundant blue, green, and gray clay. The formation is considered less permeable than the alluvium, although quantification of hydraulic conductivity in this unit has been rare.

- <u>Alluvium</u>. The alluvium is the most permeable formation beneath the Truckee Meadows and is the primary unit through which water flows and contaminant transport occurs. The alluvium is composed of varying proportions of silt, sand, and gravel. Lenses of clay and clayey materials have also been observed, although to a lesser degree. The alluvium has been classified into two subdivisions termed the "younger" and "older" alluvium (Cohen, 1964).

The geophysical logging and short-term transient monitoring programs performed during the Work Plan Development and Implementation Phase of the CTMRD (Subsections 2.3.1.7 and 2.3.1.8, respectively) indicate a high degree of vertical resistance to flow in the alluvial deposits within the CTM basin. It is likely that this vertical anisotropy was caused by alternate high and low energy depositional environments. These environments could have led to alternate deposition of alluvial fans and lake and river deposits. These different types of units could have led to interbedded materials by depositing alternating units of coarse and fine grained alluvial materials. These alternating sequences would result in vertical anisotropy causing an overall resistance to vertical groundwater flow.

Faulted Zone

The surficial geologic mapping of the area indicates a faulted area in the vicinity of the High Street and Morrill Avenue wells. In addition to geologic mapping of this faulted area, evidence of fault(s) exist in water level measurements. Water level measurements indicate an abrupt water level change of 30-40 feet between sets of monitoring wells. This change is much greater than the 4-5 foot differences observed at other monitoring wells in the immediate vicinity with approximately the same horizontal spacing.

2.2.2.2 Hydrology

The CTM groundwater flow system is complex. Many different features act as stresses on the groundwater flow system. Table 2-1 presents the primary groundwater inflows and outflows in the CTM basin.

Table 2-1
Primary Groundwater Inflows and Outflows

Inflows	***Outflows***
Mountain Front Recharge	Pumping (Municipal, Industrial, Domestic, Remedial)
River, Stream, Ditch Leakage	Seepage to Rivers, Streams, Ditches
Agricultural Irrigation	Evapotranspiration
Lawn Watering	Subsurface Outflow
Municipal Water System Leakage	
Adjacent Valley Inflow	
Direct Infiltration from Precipitation	
Sewer/stormdrain leakage	

The following list briefly describes these primary inflow and outflows. A more complete description of these features along with estimated values are presented in Appendix C, *Groundwater Modeling TM*.

Inflows

- Mountain Front Recharge. Mountain front recharge (MFR) is a general term for the infiltration of surface runoff (derived primarily from precipitation and snow-melt) into the alluvium at the foot of mountain ranges where relatively impervious bedrock dips beneath much more pervious units of porous media. In addition, MFR can also occur from water infiltrating into bedrock fractures and entering the porous media flow system as subsurface flow.

- River, Stream, Ditch Leakage. Recharge to the groundwater system can also occur from naturally occurring leakage from surface water features such as rivers, streams, and ditches. Water in the surface water feature can seep through the stream bed and enter the groundwater system.

- Agricultural Irrigation. The portion of agricultural irrigation water that is not used by plants or evaporated back to the atmosphere can recharge the groundwater system.

- Lawn Watering. A portion of municipal water delivered is used outdoors for activities such as lawn watering. A portion of this water can infiltrated the ground and recharge the groundwater.

- Municipal Water System Leakage. Municipal water systems can also recharge the groundwater system through leakage of the piping system. These leaks are typical and can be a result of cracks in piping and leaks around pipe joints.

- Adjacent Valley Inflow. This inflow consists of groundwater that enters the CTM basin where basin joins adjacent basins. The locations of primary adjacent valley inflow are Chalk Bluff and Spanish Springs.

- Direct Infiltration of Precipitation. Most of the valley floor receives about 8 to 10 inches of precipitation per year. A groundwater recharge rate of 0.5 inches per year has been estimated by Cooley et. al. (1971) and Van Denburgh (1973).

- Sewer/Stormdrain Leakage. Leakage from municipal sewers or stormdrains has been shown to contribute to the recharge of the groundwater system. Consistent with leakage in municipal water systems, the leakage typically occurs as a result of cracks in piping and leaks around pipe joints.

Outflows

- Pumping. Groundwater pumping for domestic, municipal, and commercial/industrial purposes occurs in the Truckee Meadows. Within the CTM study area dewatering pumping (at Helms Gravel Pit [HGP]/Sparks Marina Park Lake [SMPL]) and remedial pumping (at the Sparks Solvent/Fuel Site) also occurs. The most significant amount of pumping within the basin occurs at the TMWA wells.

- Seepage to Rivers, Streams, Ditches. Portions of some of the surface water features (rivers, streams, ditches) can also act as groundwater discharge locations. In these features the groundwater levels are high enough to induce flow back into the surface water.

- Evapotranspiration. Evapotranspiration, which occurs mostly during the growing season between April and October, removes water from the groundwater system through evaporation from shallow groundwater and transpiration from plants.

- Subsurface Outflow. Subsurface outflow from the Truckee Meadows occurs through the alluvium underlying the Truckee River as it leaves the basin to the east through the Virginia Range.

2.2.3 Climate

Precipitation in the Truckee Meadows region ranges from 6 to 10 inches per year. In the higher elevations of the Carson Range, which bound the Truckee Meadows to the west, annual precipitation is on the order of 40 inches per year (H. Klieforth, Desert Research Institute, unpublished map, 1983). Precipitation that falls in the Carson Range and drains to the Truckee Meadows is a significant source of MFR.

2.2.4 Land-Use

The CTM study area includes the Reno/Sparks urban area and agriculturally developed land. The Reno/Sparks metropolitan area has the third greatest concentration of people in Nevada. Only Las Vegas and Henderson rank higher.

The central portion of the Reno/Sparks metropolitan business and industrial district exists in and along the northern overbank of the Truckee River. Downtown Reno is located both south and north of the Truckee River in the northwestern portion of the Truckee Meadows. Older commercial establishments, as well as the historic railroad switching yards and corridors, lie just east of downtown and west of Highway 395. East of Reno, in Sparks, north of the Truckee River, another older commercial and industrial area exists. This area includes the Sparks Tank Farm and railroad yard and numerous other industrial facilities whose operations date back to the 1960s and 1970s. Recent development of additional industrial land uses has expanded to the east of Reno-Tahoe International Airport and east of McCarran Boulevard in Sparks.

An understanding of land-use within the CTM is relevant to the work of the Remediation District because of the potential for PCE discharges to soil and groundwater from historic and existing businesses. Five categories of businesses have been identified as potential PCE sources by the Nevada Department of Environmental Protection (Westec/SRK, 1994):

- Paint Manufacturers/Wholesalers
- Dry Cleaners
- Chemical Manufacturers/Wholesalers
- Automobile Repair
- Automobile Painters/Body Repair

These business categories were considered as part of the evaluation of the nature and extent of PCE contamination within the CTM.

2.2.5 Investigative Work Prior to the Existence of the Remediation District

WESTEC/SRK

In March 1994, WESTEC and SRK produced a report for NDEP summarizing work performed to characterize the distribution of PCE in the downtown Reno area (WESTEC/SRK 1994). The work included a review of existing reports, installation of new monitoring wells, sampling 21 new and existing wells to characterize groundwater conditions and identify potential sources, groundwater modeling, risk assessment, and evaluations of various remedial alternatives.

Results of the 1994 fieldwork indicated that the alluvium is highly variable with little correlation between lithologic units. Groundwater appeared unconfined with no discrete aquifer zones present with depth. Twelve monitoring wells had no detectable PCE, 6 wells had PCE concentrations less than 10 micrograms per liter (µg/L), and 4 wells had PCE concentrations greater than 10 µg/L. The maximum detection of PCE was 410 µg/L. The study determined that PCE was not pervasive throughout the study area (i.e., downtown Reno) and was generally found in discrete locations, predominantly within the shallow aquifer zone (less than 50 feet below ground surface [bgs]).

WESTEC/SRK gathered information to evaluate potential historic sources using city directories from 1940 through 1991. Three hundred twenty potential sources were identified and included dry cleaners, automobile repair and paint shops, and gasoline service stations. Due to the large number of potential sources, correlating PCE in groundwater to a specific source was not possible.

Groundwater modeling was performed using the MODFLOW model and the MT3D solute transport model. Results showed that without remediation, PCE contaminated groundwater will continue to migrate in an eastward direction. Additionally, modeling indicated that the groundwater remediation effort would be only moderately successful without remediation of PCE source areas.

Sierra Pacific Power Company (SPPCo) Sampling

In 1987, the SPPCo identified the presence of PCE in samples collected from five public water supply wells as part of routine water sampling activities, which have continued on a monthly or quarterly schedule in all wells that are in production. Treatment systems, designed to remove PCE from the groundwater to meet the Federal drinking water standards for PCE, were constructed in 1995 (High Street and Morrill Avenue) and in 1999 (Corbett School, Mill Street, and Kietzke Lane). Operation of these systems is ongoing.

2.3 Summary of Work Plan Development and Implementation Phase Activities

This section provides an overview of investigations and analyses performed as part of the Work Plan Implementation Phase of the CTMRD, including field investigations (past investigations and the field investigation program performed during 2001), groundwater modeling, risk analyses, and the identification and screening of a range of remedial technologies.

2.3.1 Investigative Activities

Investigative activities that have been performed since the inception of the CTMRD, under the Work Plan Implementation Phase, have included implementation of various 1996 Work Plan activities such as surface water sampling, and locating and sampling existing monitoring wells. A review of CTM land use information was also performed as an extension of the SRK effort. Monitoring well installation and sampling, aquifer testing, geophysical logging, groundwater modeling, and risk analyses were performed in accordance with the 2001 Work Plan. Finally, the County undertook sampling of the area sanitary sewers with the objective of characterizing whether residual solids existed in sanitary sewer lines beneath CTM. These activities, with the exception of the sanitary sewer sampling and land use evaluations, are described in detail in the *Technical Memorandum - Field Investigation Program Data Summary*, a copy of which is included as Appendix B. The key results of all of the investigative activities, including the sanitary sewer sampling and the land use mappings, are presented in this section.

Soil, soil gas, and groundwater analytical data, and well construction data for the CTM wells (including some well construction data for other existing wells) is available in an environmental database that was developed during the Work Plan Implementation Phase. Washoe County DWR staff is currently managing the environmental database.

2.3.1.1 Surface Water Sampling

The County, in accordance with the 1996 Work Plan conducted a sampling program to characterize the nature and extent of PCE in the Truckee River and selected storm drains that discharge into the Truckee River in the Downtown Reno area. Grab samples of the surface water at each of six surface water and six outfall locations were collected in September and October 1999 and in April 2000. Surface water and outfall sampling locations are shown on Figure 2-3.

The results of the sampling indicated that no detectable concentrations of PCE are present in the Truckee River, even though evidence exists indicating that PCE is present in selected storm drain discharges to the Truckee River. The absence of PCE in the Truckee River water is expected based on the effects of volatilization and dilution of the PCE in outfall discharges. The analytical results of the surface water sampling effort are presented in Table 2-2.

Table 2-2
Surface Water Analysis

Field Sample #	Date Sampled (mo./day/yr.)	Temp. (°C)	pH (s.u.)	Conductivity (uS/cm^2)	Dissolved Oxygen (mg/L)	Hach Alkalinity (mg/L as CaCO3)	Alkalinity (mg/L as CaCO3)	Tetrachloroethylene (:g/L)	Trichloroethene (:g/L)	1,1,1-Trichloroethane (:g/L)	Xylenes (:g/L)	Choroform (:g/L)
SW-1	9/22/99	NA	8.33	75.4	9.75	45	46.2	ND	ND	ND	ND	ND
SW-2	9/22/99	NA	8.17	87.1	8.97	60	57.8	ND	ND	ND	ND	ND
SW-3	9/22/99	NA	8.69	63.5	9.94	50	41.3	ND	ND	ND	ND	ND
SW-4	9/22/99	NA	8.46	75.9	10.5	50	44.0	ND	ND	ND	ND	ND
SW-5	9/22/99	NA	8.51	78.6	9.10	50	41.8	ND	ND	ND	ND	ND
SW-6	9/22/99	NA	8.60	80.8	9.88	55	93.5	ND	ND	ND	ND	ND
OF-1	9/22/99	8.1	8.16	107.1	9.46	60	55.0	ND	ND	15.1	ND	2.3
	10/11/99	Outfall was dry										
	4/25/00	17.1	7.96	285.0	9.09	NA	NA	1.1	2.6	8.3	ND	3.3
Blind Field Dup	4/25/00							ND	ND	5.3	ND	ND
OF-2	9/22/99	6.6	7.66	268.0	8.72	150	145.8	12.8	ND	ND	ND	1.9
Blind Field Dup	9/22/99							13.4	ND	ND	ND	1.9
	10/11/99							13.2	ND	ND	ND	ND
Lab Dup	10/11/99							13.2	ND	ND	ND	ND
	4/25/00	17.5	7.56	392.0	11.3	NA	NA	10.6	ND	ND	ND	ND
OF-3	9/22/99	Outfall was not found										
OF-4	9/22/99	8.2	8.01	262.0	8.47	130	118.3	ND	ND		3.3	3.0
OF-5	9/22/99	6.1	8.68	64.8	10.01	50	44.0	ND	ND	ND	ND	ND
OF-6	9/22/99	6.9	8.12	173.5	9.32	105	93.5	ND	ND	ND	ND	ND

"ND" = non-detect

2.3.1.2 Sampling of Existing Groundwater Monitoring Wells

The 1996 Work Plan outlined an aggressive program of locating and sampling existing groundwater monitoring wells, and domestic and commercial water wells in CTM to complement the installation of new monitoring wells. The effort was deemed necessary given the areal and vertical extent of the aquifer system that required characterization.

The initial effort to locate the existing wells proved to be quite challenging. Records of well demolition, well replacement, and well owners have not been well maintained. Many wells believed to exist based on a review of NDEP and/or WCDHD records were not accessible to the County because of abandonment, owner changes, or other reasons. Nevertheless, approximately 160 wells were found and sampled by the County through the review of NDEP and/or WCDHD records, through interviews with local consultants, and through windshield surveys of the CTM.

Once located, the County conducted groundwater sampling efforts on a quarterly to annual basis, depending on accessibility constraints and analytical results. The County also surveyed the existing wells into a common datum, such that the wells could be located both horizontally and vertically within CTM. In addition to these monitoring wells, TMWA staff has collected groundwater samples from the 27 TMWA water supply wells. Approximately 1,200 groundwater samples have been collected and analyzed from the 178 groundwater monitoring and water supply wells.

A listing of all wells sampled as part of Phase I activities is provided in Appendix F. The well listing includes TMWA water supply wells, CTM wells (installed as part of the Phase 1 investigative program – described below), and other wells. Information provided in the table includes well designation, total depth, screened interval, and the number of samples collected as part of the Phase I activities. The location of the CTM wells is presented in Figure 2-4. The location of all of the wells sampled as part of the Phase I activities is presented in Figure 2-5. The analytical results of the sampling efforts are discussed in the *Field Investigation Program Data Summary* TM (Appendix B).

2.3.1.3 Well Installation

A total of 36 monitoring wells were drilled and installed, including 23 shallow wells and 13 deep wells. Monitoring well completion details are provided in Appendix B. The total depth of monitoring wells varied between 24.5 feet (CTM-20S) and 347 feet (CTM-10D and CTM-12D) bgs. Groundwater was encountered at depths between 17.5 feet (CTM-20S) and 124 feet (CTM-40S) bgs. Table 2-3 lists the shallow and deep monitoring wells and provides an overview of which wells were utilized for each of the field investigation activities. Figure 2-4 shows the locations of the 36 monitoring wells.

Table 2-3
Summary of Investigation Activities for Newly Installed Groundwater Monitoring Wells

Monitor Well ID	Total Depth (ft bgs)	Soil Gas Sampling Locations	Geophysical Logging Locations	Hydraulic Testing Locations	
				Slug Tests	Aquifer Test Observation Wells
Shallow Wells					
CTM-1S	51	✓		✓	
CTM-2S	50	✓(profile)		✓	
CTM-3S	51	✓		✓	
CTM-5S	60	✓		✓	
CTM-6S	43.5	✓		✓	
CTM-7S	41	✓		✓	✓
CTM-9S	60.5	✓(profile)		✓	
CTM-11S	45.5	✓		✓	
CTM-13S	56			✓	
CTM-14S	25	✓		✓	
CTM-15S	70.5			✓	
CTM-16S	40.5	✓(profile)		✓	
CTM-18S	35	✓		✓	
CTM-19S	31	✓		✓	
CTM-20S	24.5	✓		✓	
CTM-21S	36.5	✓		✓	
CTM-28S	44	✓		✓	
CTM-29S	35.5			✓	
CTM-31S	52			✓	
CTM-37S	46			✓	
CTM-39S	38.5				
CTM-40S	148.5				
CTM-41S	52.5				
Deep Wells					
CTM-4D	180		✓		
CTM-8D	261		✓		✓
CTM-10D	347		✓		
CTM-12D	347		✓		✓
CTM-17D	199.5		✓		✓
CTM-22D	252		✓		✓
CTM-23D	180.5		✓		✓
CTM-25D	177.5		✓		
CTM-27D	178.5		✓		
CTM-30D	152		✓		
CTM-33D	199		✓		
CTM-37D	85.5				
CTM-38D	95.5				

2.3.1.4 Soil Sampling

Soil samples were collected during borehole drilling. Three types of soil samples were collected: continuous core for lithologic logging, undisturbed soil samples for geotechnical analysis, and samples for environmental analysis. Borehole lithologic logs can be found in Appendix B, the *Field Investigation Program Data Summary TM*. Geotechnical analysis of undisturbed samples included grain size distribution, dry bulk density, surface area, specific gravity, and moisture content. Soil samples collected for environmental analyses were analyzed for volatile organic compounds by a certified laboratory. Geotechnical and laboratory results are in Appendix B.

2.3.1.5 Soil Gas Sampling

Soil gas samples were collected from 15 shallow monitoring well boreholes. Twelve of the samples locations had one soil gas sample collected. Three samples locations had a profile of three samples taken at increasing depths below ground surface. Boreholes sampled for soil gas and their associated sampling depths are listed in Table 2-3.

Samples were analyzed for volatile organic compounds by a certified laboratory. The sample results were used in the risk analysis to assess potential risk of indoor inhalation from migration of volatile organic vapors through the soil and cracks in building foundations to indoor air. Analytical results can be found in Appendix B.

2.3.1.6 Groundwater Sampling

Two types of groundwater samples were collected during the Work Plan Implementation Phase of Remediation District field program; discrete-depth groundwater samples and completed well groundwater samples.

Discrete-Depth Groundwater Sampling

Discrete-depth samples are formation groundwater samples collected during drilling operations and prior to installation of the monitoring wells. For shallow borings (i.e., less than 100 feet in depth), samples were collected from the first encountered groundwater. For boreholes greater than 100 feet in depth, discrete-depth groundwater samples were collected at 20-foot intervals in order to provide a vertical profile of dissolved VOCs in the aquifer.

Monitoring Well Groundwater Sampling

Two rounds of groundwater sampling were performed by Washoe County personnel following completion and development of the groundwater monitoring wells. The purpose of the initial samples was to obtain a baseline for water levels and water quality. Samples were delivered to a certified laboratory for analysis. The first round of groundwater samples was analyzed for a full suite of constituents, which included volatile organic compounds, semi-volatile organic compounds, and selected inorganic compounds. This provided a baseline analytical suite. The second round of samples was analyzed for volatile organic compounds only, which includes PCE, the principal contaminants of concern for the Remediation District. Over 100 samples have been collected from the 36 groundwater monitoring wells installed during the Phase 1 field program.

2.3.1.7 Geophysical Logging

Geophysical logging was performed on 11 of the 13 deep monitoring wells. The objective of the geophysical logging was to refine the understanding of lithology within the CTM and to contribute to the development of the groundwater flow model. The geophysical logging was performed after completion of the monitoring wells and run through the PVC casing. Table 2-3 lists the wells that were geophysically logged. The geophysical logging data reports are provided in Appendix B.

One of the objectives of the geophysical logging was to evaluate the existence of a clay layer thought to exist at a depth of about 100 feet bgs. The lithologic cores did not support the existence of a pervasive clay layer. The response of the gamma tool, the tool used to measure clay content in the formation, supported the field observations indicating that significant clay content does not exist at depth within the CTM study area.

Based on lithologic core and geological logging data, detailed cross sections were prepared and are included as part of Appendix B.

2.3.1.8 Hydraulic Testing

The two types of hydraulic testing were performed as part of the field investigation program – slug tests and aquifer pumping tests. The slug tests were somewhat useful for providing local hydraulic characterization data while the aquifer pumping tests provided hydraulic characterization data on a more regional scale.

Slug Test Data Summary
Slug tests were performed on 20 shallow wells. Slug test data were used to calculate a range of hydraulic conductivity (K) values. The results of the slug test analyses, including a graphical presentation of the data, are presented in Appendix B.

Aquifer Test Data Summary
In order to better understand the aquifer flow system in the Central Truckee Meadows, the aquifer testing program was conducted over a 3-week period, utilizing five TMWA water supply wells. Selected production wells were operating in accordance with a pumping program agreed upon between TMWA and Washoe County Department of Water Resources. Continuous data loggers were placed in monitoring wells in five locations near the TMWA wells. Hourly pumping data were obtained for the same period for the TMWA water supply wells.

Data logger results and well pumping data are presented in Appendix B. For all of the wells, with the exception of the Peckham water supply well, the water levels in the deep monitoring wells were directly impacted by the pumping rate in the adjacent TMWA well(s). The aquifer pumping test using the Peckham well did not yield any useful information because the well was turned off during the entire period of the data logger operation. The aquifer response in the deep wells was also noticeable during periods when the TMWA wells were shut down. Data logger information collected from the shallow aquifer observation wells did not indicate a response during periods of TMWA water supply well pumping. To analyze hydraulic properties near the TMWA pumping wells, the pumping time histories of the TMWA wells were input into the groundwater numerical model. Hydraulic properties (e.g., vertical and horizontal hydraulic conductivity) were adjusted so that simulated water levels reasonably replicated the observed data logger records in the observation wells (please see Figures 4-6 through 4-13 and Section 5.2, *Short-term Transient Calibration*, in the *Groundwater Modeling* TM – Appendix C).

2.3.1.9 Land Use Mapping

Historic PCE-users were identified for NDEP (1994) for the downtown Reno area including automotive paint shops, gasoline and fuel stations, laundries and dry cleaners, and paint shops. As previously indicated, WESTEC/SRK, for NDEP, identified 320 potential PCE sources base on this analysis of past land use. The County utilized this information and expanded the analyses to a coverage of the entire CTM. The effort lead to the refinement of the business types of concern to include:

- Dry cleaners and laundry facilities
- Chemical manufacturers and wholesalers
- Paint manufacturers and wholesalers
- Automobile painters and body repair shops
- Automobile repair shops

Two databases were used to develop the historical land use maps identifying the location of these types of businesses: maps published by Sanborn Insurance Company and business directories published by R. L. Polk and Company.

Sanborn Insurance Company produced and revised their maps of the Reno and Sparks over the period from 1904 to 1972. The maps, which were used to document the risk of fire to individual properties, identify the location of buildings, the owner's name, and/or a general business classification for each commercial structure. The maps from 1948 to 1955 were used for the purposes of the CTMRD mapping effort.

The Polk database contains directories of business types on an annual basis since 1920. The County inventoried businesses for the period 1935 to 1995 on five or six year increments. The 1999-2000 Nevada Bell Yellow Pages were used to supplement this database with more recent information.

The Polk database identified 855 potential PCE users including:

- 198 dry cleaners and laundry facilities
- 26 chemical manufacturers and wholesalers
- 70 paint manufacturers and wholesalers
- 131 automobile painters and body repair shops
- 430 automobile repair shops

Figure 2-6 depicts the distribution of business types that may have, or currently handle, PCE. Based on this figure, it can be seen that potential PCE users are scattered throughout CTM, with concentrations of businesses located:

- In the downtown Reno area between the Truckee River and I-80;
- In the Sparks commercial areas between the Truckee River and I-80; and
- Along Kietzke Lane and South Virginia Street in Reno.

The identification of the area that is potentially contaminated with PCE was based in part on the distribution of businesses represented by this figure.

2.3.1.10 Sewer Line Sampling

Between December 2000 and September 2001, the County collected samples from wastewater sewer lines throughout the CTM. The objective of the sewer sampling was to test for the presence of residual PCE. Residual PCE, if present, would represent potential source areas for current and future groundwater contamination.

Leaking sewer lines have long been recognized as a major pollution source in the U.S. As early as 1977, the EPA reported that exfiltration from sewer systems was known to be a serious problem from a groundwater contamination standpoint (EPA, 1977). They estimated that 5% of the 5 trillion gallons of municipal wastewater handled by sewer systems leaked into the ground.

PCE used to be discharged into the sanitary sewer systems of Sparks and Reno as a matter of course by businesses handling PCE prior to the development of the cities' industrial pretreatment programs initiated in the mid-1970s. Since that time, businesses have had limits related to the amount and concentrations of PCE that may be discharged into the sanitary sewers, however enforcement monitoring has not been well funded, such that businesses may have been able to discharge PCE – either as PCE or in a diluted form – into the cities' sanitary lines undetected.

PCE is a particularly problematic compound when discharged into the sewer. Because it is relatively insoluble and more dense than water, it will tend to seek and reside in low points along sewer lines, including cracks or crevasses. Based on EPA's findings, and the likelihood that PCE has been discharged into the sanitary lines at some time in the past, leakage from the sanitary sewers is a likely pathway for PCE to enter the shallow groundwater flow system.

The County's sewer sampling program was designed using the assumption that residual PCE within a sewer line would continuously "bleed off" into the wastewater stream such that wastewater sampling down gradient of a residual source would result in PCE detections. Sewer sampling locations were identified using the rationale that residual PCE is most likely to occur in sewer lines used by businesses that have historically used PCE in their operations. By focusing on a portion of these potential primary source business sites, it was believed that a small, cost effective sampling program could be completed that would help develop an understanding of the potential contribution to groundwater contamination of residual PCE in sewer lines.

As part of the sanitary sewer sampling program, the County collected and analyzed 367 wastewater samples from 182 manhole sites in the Truckee Meadows. These samples were collected in sewer lines adjacent to 128 areas where either dry cleaning facilities or chemical manufacturers/wholesalers had historically operated. The program was performed in three phases, defined by the following objectives:

- **Phase 1:** Identify sewer locations that contained detectable PCE or related VOCs.
- **Phase 2:** Track PCE contamination identified in Phase 1 to its residual source.
- **Phase 3:** Confirm and characterize PCE in contaminated waste streams identified during Phase 1 and 2.

Analytical results from Phase 1 sampling identified 26 sewer lines with waste streams that contained detectable PCE. These "contaminated" waste streams were widely distributed throughout the study area.

Phase 2 sampling, designed to track PCE contamination identified by Phase 1 to its residual source, was complicated by: 1) temporal variations in PCE concentrations, 2) multiple potential PCE source areas, and 3) concerns about the possibility of active disposal of PCE wastes into the sewer. Sample tracking at 10 of the 26 contaminated sewer lines effectively isolated the source of PCE to discrete sections of the sewer line. Tracking at another four localities identified multiple source areas that may contribute PCE to the waste stream. The remaining 12 localities had non-definitive results due either to insufficient sampling or to unrepeatable analytical results (see Figure 2-7).

Phase 3 sampling, designed to confirm and characterize detected PCE in the waste streams of contaminated sewer lines, indicated that concentrations from samples collected at a single site could vary by several orders of magnitude over time. In general, the sample sites, as presented in Figure 2-6, that had the highest mean concentration of PCE also had the greatest degree of temporal variability. As an example, nine samples collected at one site had a mean value of 3,981 micrograms per liter (μg/L) PCE, with a range of 16 to 34,000 μg/L PCE. This sort of variability was not expected prior to the onset of the study. Although it was expected that PCE concentration would vary with the volume of flow through the sewer lines, no relationship between flow rates and PCE concentration was observed. In light of these findings, more quantitative fieldwork needs to be performed to assess the reasons for temporal variation in PCE concentrations, particularly at the most contaminated locations.

The consolidated results from all three phases of the sampling program revealed that of the 26 contaminated waste streams identified, 18 reaches of sewer line contained contamination (defined as wastewater whose maximum detected PCE concentration exceeds 5 μg/L). Of those 18, nine contained anomalous and significant contamination, defined as wastewater whose maximum detected PCE concentration exceeded 100 μg/L PCE. The nine sub-regions that encompass each of these nine contaminated sewer line reaches are described in detail in the County's Sanitary Sewer Sampling Report (Washoe County, 2002). The magnitude of PCE concentrations in wastewater within these nine reaches of sewer line was not expected and warrants additional investigation. Reviews of published documentation of sewer sampling suggest that wastewater with PCE concentrations of a similar magnitude is typical of actively discharging dry cleaning sites. Eight out of these nine sub-regions contain active dry cleaning facilities.

Figure 2-8 summarizes the results of the sanitary sewer sampling efforts by correlating the location of elevated detected PCE concentrations in the sanitary sewers with detected groundwater concentrations. Based on this mapping, it can be seen that there are locations where elevated concentrations of PCE in the sanitary lines coexist above areas with detectable levels of PCE concentrations in the groundwater. Although more information is needed to characterize the potential impact of the sanitary lines on the shallow groundwater quality, it is clear that PCE contained within the sanitary sewers may be a contributor to groundwater contamination beneath CTM.

The sewer sampling program showed that PCE occurs in sewer lines in the Truckee Meadows. Contaminant levels were consistent with concentration observed from actively discharging operations. If this contaminated wastewater is the result of residual PCE solvent or sludge residing in cracks and crevasses along the sewer line, then remedial tactics should be focused on those sections of sewer line identified as residual source areas. However, if the source of PCE is from actively discharging operations, then a more active enforcement program will need to be considered by the appropriate regulatory agencies. In either case, PCE contamination in sewer lines has probably been, and may continue to be, a potential source contributing to groundwater contamination in the Truckee Meadows. The fact that only 25% of the potential primary source business sites were examined in this sampling program makes it likely that there are more, as yet unidentified sections of sewer line that either contain residual PCE sources or host PCE contaminated discharge.

2.3.2 Groundwater Modeling

As part of the CTMRD project, a groundwater flow model was developed to evaluate groundwater and contaminant movement within the CTM basin. As stated in the Final Updated Work Plan (CDM, 2001), the objectives of the groundwater modeling task were:

- Develop the CTM water budget,
- Characterize the flow patterns in the shallow and deep aquifers and the interactions between these units,
- Estimate the capture zones of five water supply wells (High, Morrill, 4th Street, Mill, Kietzke, and Corbett) under current and future pumping conditions,
- Evaluate candidate remedial alternatives (with respect to effectiveness, protectiveness of human health and the environment, etc.), and
- Characterize the potential benefit to property owners resulting from any remedial action (including no remedial actions beyond institutional controls and monitoring).

Complete documentation of the groundwater flow model construction, calibration, and results are presented in Appendix C, *Groundwater Modeling TM*.

2.3.2.1 Model Construction

The groundwater model was constructed based on data acquired from the previous MMA/Guyton flow model (MMA, 1993; Guyton, 1997), Washoe County DWR, TMWA, data collected as part of this CTMRD project, and various other sources.

The conceptual model consisted of the basic information discussed in the previous sections. A more detailed description of the conceptual model can be found in Appendix C, the Groundwater Modeling TM. As mentioned previously, the geology of the area is conceptualized as bedrock basin composed of volcanic rocks of relatively low permeability and filled with a sequence of sedimentary deposits. The sedimentary deposits act as the primary transmitter of groundwater. Inflows to the groundwater flow system include mountain front recharge, infiltration from rivers, streams, and ditches, recharge from surface application of water, and direct recharge from precipitation. Outflows consist of groundwater pumping (municipal, industrial, commercial, domestic, and remedial), seepage to streams, and evapotranspiration. Groundwater also enters and exits the CTM basin through subsurface flow where the CTM basin joins adjacent valleys. Figure 2-9 shows the domain of the CTMRD groundwater model.

2.3.2.2 Model Calibration

The primary means of calibrating the groundwater flow model consisted of simulating three transient periods.

- Short-term Transient Calibration (August 2001): The configuration of CDM's field program did not allow traditional pumping tests to be performed. However, monitoring of water levels in response to the cyclic nature of TMWA pumping allowed for an analysis similar to a pumping test.

- Long-term Transient Calibration (1999-2001): A suitable steady-state flow condition does not appear to exist in the CTM basin. The 1999-2001 period was chosen for calibration because this period contains sufficient quantity of water level data (both temporally and spatially).

- Historical Transient Simulation (1961-2001): The historical transient simulation results were used to check the model against other, longer-term data. For example, the simulation results were compared to water levels at two USGS wells that had a long period of water level data records and to the dewatering pumping rates at Helms Gravel Pit/Sparks Marina Park Lake (HGP/SMPL).

2.3.2.3 Model Results

The modeling task resulted in some basic conclusions about the groundwater flow regime within the CTM basin.

- Anistropy. The modeling calibration process, along with data collected during the geophysical logging of the new CTM wells, indicated that a high degree of vertical anisotropy exists within the alluvial basin deposits. This anisotropy results in a resistance to vertical flow. This resistance can result in large vertical flow gradients. These high gradients are most prominent when the TMWA wells pump higher rates during the summer. This vertical resistance to flow does not appear to be the result of a continuous "aquitard" unit. Rather, the resistance seems to be distributed through the depth of the alluvial materials. This distributed resistance is probably the result of multiple smaller fine grained lenses appearing throughout the basin.

- Horizontal Flow Pattern. The general flow direction through the center of the CTM is from west to east. As an example, Figure 2-10 shows contours of the simulated water table elevation (shallow aquifer) at a 20 ft interval. This figure shows the simulated water table at the end of March and August 2001. Note that the flow directions in the shallow aquifer do not vary greatly between the two seasons. Figure 2-11 shows contours (20 ft interval) for the simulated heads in the deeper aquifer, approximately 150 ft below ground surface. This figure shows the simulated results for March and August 2001. Again, the predominant flow direction through the center of the basin is west to east. However, TMWA pumping exerts sufficient influence during the summer months to significantly alter the horizontal flow directions. The summer pumping regime also sets up higher horizontal gradients.

- Vertical Flow Pattern. Simulated model results can be viewed in cross-section. Figure 2-12 shows the simulated heads on an east-west cross section through the model. This figure, again, shows the simulated results for March and August 2001. This cross section passes through the 10 TMWA wells. The significant impacts of the TMWA wells can be seen during the summer pumping condition. The summer conditions sets up a condition allowing more downward flow than the winter conditions. Figure 2-13 shows the same information for north-south cross section. Both of these figures indicate that primary change in flow directions occurs in the center of the CTM near the main TMWA wells.

- Seasonal Impacts. TMWA pumping, which varies seasonally, is a major stress on groundwater levels in the CTM basin. Figure 2-14 shows simulated flow directions in the deeper aquifer during March 2001 and August 2001. The figure represents the simulated direction of groundwater flow during March and August 2001. This figure indicates that the direction of flow within the deeper aquifer can vary due to the influence of TMWA pumping. These results indicate that the area which contributes to one of the TMWA pumping wells may differ between the summer and winter months. Therefore, the area tributary to a TMWA well includes areas that are upgradient of the well in both the summer and winter months.

A more complete discussion of the flow patterns, both spatially and temporally, can be found in Appendix C.

2.3.2.4 TMWA Well Capture Zones

The impact of TMWA pumping on the overall (advective) groundwater flow directions and the capture zones for the TMWA wells are of particular interest within the CTM basin. Five TMWA wells are currently fitted with facilities to treat PCE contamination in the pumped water (i.e. wellhead treatment). These wells are: High St., Morrill Ave., Kietzke Lane, Mill St., and Corbett School. Pumping at these wells is maintained at prescribed rates based on a pumping plan set up by Sierra Pacific Power Company (now operated by TMWA) (SPPCo 2000).

To better understand the flow system and its relationship to TMWA pumping, capture zone simulations were made for the TMWA wells. Capture zones depict the areas that are tributary to a groundwater discharge point (e.g. a pumping well). Figures 2-15a and 2-15b shows the simulated water table capture zones for the TMWA wells. These capture zones were simulated to represent long-term flow paths (e.g. an “eventual” flow path). The simulated flow field from August 1999 to August 2001 was repeated through the length of the simulation. Therefore, the simulated flow field used in these simulations accounts for seasonal variations in TMWA pumping, but at 1999-2001 levels. The apparent separation between the pumping well and its corresponding capture zone is related to the vertical separation between the well screen and the capture zone location. The TMWA wells are primarily screened deep in the aquifer. The capture zones represent the area tributary to the wells from the water table. Appendix C further discusses the vertical extent of the capture zones.

These figures indicate that the majority of the downtown area west of I-395 and between the Truckee River and I-80 is tributary to the High Street, Morrill Avenue, and Kietzke Lane wells. Therefore, these wells would likely receive the majority of the contamination emanating from those known and unknown sources in these areas. The Mill Street and Corbett School wells appear to produce water that is tributary from the South Virginia Street area. It should be noted that the TMWA wells also draw water up from below the wells screens (i.e. not all the water pumped from the TMWA wells has passed downward to get to the well screen).

2.3.3 Risk Analyses

As part of the Work Plan Implementation Phase, human health and ecological risk analyses were performed to evaluate the risk associated with contaminants in shallow groundwater and in other media that may be impacted by contaminants in shallow groundwater (e.g., off-gas from shallow groundwater with migration into indoor air). The results of the risk analyses were used to determine the need for remediation of these media. Potential human health impacts associated with contaminants in deep groundwater were evaluated only qualitatively. The risk analyses for human exposure to shallow groundwater and deep groundwater and the environmental impacts to ecological receptors are summarized in the following sections. The *Human Health and Ecological Risk Assessment TM* is provided in Appendix D.

2.3.3.1 Shallow Groundwater

Shallow groundwater at the Site is not currently used for drinking water purposes and is not expected to be used for such purposes in the future. However, construction workers who excavate below the groundwater table could be exposed directly to contaminants in shallow groundwater. This possibility is evaluated in the risk analysis. Potential human health risk associated with contaminants in shallow groundwater and media that may be impacted by shallow groundwater (surface water, sediment, indoor air, and ambient air) were evaluated

Soil gas, surface water, and sediment exposure pathways were not considered complete and were not further evaluated in the human health risk analysis. The maximum detected concentrations for all chemicals in soil gas were below the screening criteria, so no chemicals were selected as chemicals of potential concern (COPCs) for soil gas. No volatile organic compounds (VOCs) were detected in the surface water samples from locations not directly associated with outfalls. Sediment data for the CTM are not available and the COPCs for shallow groundwater at the CTM do not tend to partition to sediment.

For the analysis, the CTM study areas A through H from the Final Updated Work Plan (CDM, 2001) were slightly revised to incorporate all of the groundwater sampling points. These areas were used to divide the data for calculation of exposure concentrations and calculation of the human health risks. The following bullets summarize the results of the risk analysis for exposure to shallow groundwater.

- Three COPCs – benzene, MTBE, and PCE – were selected as COPCs for shallow groundwater. Exposure to shallow groundwater was quantitatively evaluated for construction workers for the following pathways - incidental ingestion of shallow groundwater and dermal contact with shallow groundwater.

- Total incremental cancer risk estimates from exposure to groundwater by construction workers range from 5×10^{-9} at Area E to 4×10^{-6} at Area F (Figure 2-16). Total cancer risk estimates for all areas except Area F are equal to or less than 10^{-6}. As outlined in the National Contingency Plan (NCP), incremental cancer risks to an individual in the range of 10^{-6} to 10^{-4} are generally considered acceptable by USEPA (1990). The estimated cancer risk for Area F (4×10^{-6}) is at the bottom of the acceptable 10^{-6} to 10^{-4} risk range. Approximately 99% percent of the cancer risk estimate for Area F is from exposure to benzene and approximately 1% of the risk estimate is from PCE. These results suggest no unacceptable cancer risks from exposure to PCE for construction workers within the CTM. The cancer risk estimate for benzene is at the bottom of the acceptable risk range, suggesting no substantial risks from exposure to benzene in groundwater.

- Estimated hazard indices (HIs) are less than one for all exposure areas except Area F, which had an estimated HI of 2 (Figure 2-15). Approximately 90% of this HI estimate is from benzene and approximately 9% is from MTBE and the remaining 1% is from PCE. The estimated HI above one indicates some potential for adverse noncancer health effects from exposure to benzene for construction workers, who have relative intensive exposure to groundwater in Area F (e.g., ingest 5 ml of groundwater almost daily for an entire year).

2.3.3.2 Deep Groundwater

Deep groundwater within the CTM study area is an important part of the public drinking water supply. Because drinking water supplies must meet state and federal maximum contaminant level (MCLs), it is not necessary to conduct quantitative risk analyses and to determine site-specific remediation goals for the deep aquifer. However, chemicals that exceed MCLs need to be addressed in the remediation planning as part of the CTM Remediation District Project. The following bullets summarize the qualitative discussion in the risk analyses on the exposure to deep groundwater.

- According to field investigation data, benzene, MTBE, PCE, and trichloroethylene are present in the deep aquifer groundwater at concentrations that exceed MCLs, which indicates a potential for adverse health effects.

- Statutory requirements require wellhead treatment or control if concentrations of any contaminants exceed MCLs. Currently, five existing deep aquifer water supply wells deep aquifer are protected by wellhead treatment systems. Health impacts for people using water from the currently protected wells are not likely. However, if contaminants migrate to water supply wells, which are not protected by wellhead treatment systems, residents may be exposed to groundwater contaminants.

Note that risk analyses were not performed to characterize the impact of shallow groundwater transport into the deep aquifer, and ultimately the public water supply wells, because of the lack of information regarding the nature and location of source areas. Nonetheless, the identification of clean-up requirements for the shallow groundwater must account for impacts of specific source areas on the deeper groundwater and public water supply wells, in addition to the impacts on future construction workers.

2.3.3.4 Environmental Impacts Analysis

Contaminants in shallow groundwater could theoretically be discharged into surface water and sediment in the Truckee River where they may impact ecological receptors. Site-related contaminants were, however, not detected in surface water in the Truckee River and are, therefore, likely not present in sediment. Therefore, ecological impacts associated with groundwater discharges into the Truckee River are not considered to be of concern for the CTM.

2.3.4 Remedial Technologies Identification and Screening

This section presents an overview of *Remedial Technologies Identification and Screening TM*, which is included in this document as Appendix E. The specific objectives of this TM were to:

- Identify the general response actions that are applicable to source areas and their related plumes.

- Discuss the volume and extent of PCE contamination – both based on the available data and in terms of hypothetical source areas.

- Identify source area characterization methods that are potentially applicable for CTM.

- Identify and screen technologies and process options, and develop a list of remedial technologies and process options that may be used to remediate source areas or their related plumes.

It is the list of retained remedial technologies and process options that is used to focus and streamline future remedial action evaluations that will be performed during implementation of this Remediation Management Plan.

2.3.4.1 Points of Application

Based on data generated as part of the field investigation program, the risk analyses, and the groundwater modeling, three distinct "areas" or "zones" of contamination have been identified. These areas of contamination, which have been differentiated based in part on the point of application of a particular remedial action, are listed below:

- Source areas;
- Groundwater plume areas (both shallow and deep); and
- Wellheads used for potable water supply.

Remedial actions, as well as field characterization activities, will address source "management" as it relates to prioritizing, characterizing, evaluating and remediating sources and their related plumes, and shallow and deep groundwater contamination, where individual plumes have co-mingled. The presentation of remedial technologies and process options presented herein will address these three points of application within the CTMRD.

Figure 2-17 presents a cross-sectional view of the conceptual model of contamination within the CTMRD. In this figure, the source area, the plume area and the public water supply wellheads are all identified. The conceptual source area, as indicated on this figure, includes both contamination above the groundwater in vadose zone soils and within the saturated zone (as shown in bright red). The plume area includes both shallow groundwater and deep groundwater. For the purposes of screening potentially applicable remedial technologies, groundwater is considered to be shallow if it is less than 100 feet below ground surface. Deep groundwater is all groundwater below that depth. This depth was selected based in part on the distribution of PCE contamination, the lithology, and the practical aspects of implementing remedial actions at depths of greater than 100 feet, in that one set of alternative technologies that are applicable and cost effective above 100 feet, may not be cost effective below 100 feet. Public water supply wellheads are considered a critical point of application within the CTM because of the extensive use of groundwater as a water supply source.

Potentially applicable characterization and remedial technologies and methods have been evaluated for use in these three areas. Issues such as depth below ground surface, contaminant concentrations, or contaminant volumes or mobility will influence applicability of a given technology to source areas or shallow or deep groundwater plume areas. Therefore, recommendations for characterization and remediation methods have been segregated into lists for source areas, plume areas, and wellhead treatment, as appropriate. Note that in some cases the recommendations for plume area remediation may be differentiated into subcategories for shallow and deep groundwater, as the situation warrants.

2.3.4.2 Source Areas

Source characterization is an essential step before being able to select the most effective process options for source area remediation. The *Remedial Technologies Identification and Screening TM* provides guidance for identifying and evaluating characterization methods and remediation technologies for addressing PCE source areas. Data generated as part of the field investigation program indicated widespread distribution of PCE contamination at low concentrations in the shallow aquifer and portions of the deep aquifer (i.e., depths greater than 100 feet). These data coupled with PCE levels that have been consistently detected in public water supply wells (i.e., Mill, Kietzke, High, Morrill and Corbett) suggest that numerous, widely distributed sources are likely responsible for the observed contaminant distribution.

Although high, localized groundwater PCE concentrations have been identified, the data are not sufficient to adequately identify or characterize individual potential source areas for purposes of evaluating and selecting specific remedial actions or responses. Similarly, a sewer line sampling program implemented by the CTMRD identified several stretches of sewer line that contained PCE and related VOCs (see a summary of this sampling program in Section 2.3.1.10). Given that only a limited number of source areas have been suggested by the groundwater and sewer line data to date, and the likelihood that many more sources exist within the CTMRD, an important function of this Remediation Management Plan is to define processes that will be used to identify, characterize, and remediate source areas.

Table 2-4 contains a list of source area characterization methods that were identified in the TM as being potentially applicable at CTM. This table also presents the main advantages and disadvantages of each characterization method.

The results of the screening process for technologies and process options that apply to the contamination areas or points of application (performed as part of the Remedial Technologies TM) are presented in Tables 2-5 and 2-6 for groundwater and soils, respectively. The process options within each technology type receiving the highest performance ratings for the evaluation criteria were retained for possible incorporation into one or more remedial action alternatives. These retained process options are listed for each of the three areas of contamination in Table 2-6. Provided below are summary discussions of each contamination area and the retained process options.

Table 2-4
Summary of Source Area Characterization Methods that are Potentially Applicable to CTM

Source Area Characterization Method	Advantages	Disadvantages
Sampling Methods		
Active Soil Gas Survey	Cost effective and provides near-real time data.	Limited by the depth to which direct push can be used.
Passive Soil Gas Survey	Cost effective and does not require technical expertise to implement.	Does not provide near-real time data and requires two mobilizations.
Standard Monitoring Well Sampling	Widely accepted method that can provide samples from distinct intervals.	Higher cost of well installation and generation of investigation derived waste (IDW).
Direct Push Sampling	Low cost leads to ability to sample more locations. Low volume of IDW.	Limited depth of sampling in fine grained or gravelly soils.
Test Pits and Excavation	Provides accurate information about subsurface conditions.	Many health and safety issues may apply and slope stabilization methods may be required.
Membrane Interface Probe (MIP)	Can provide vertical profile of contamination in soils or groundwater.	Detection limits are typically in the tens of ppm. Limited to depth of direct push sampling.
Sonic Drilling	Generates continuous cores for subsurface characterization and no drilling fluids are needed.	Limited availability of equipment and expensive compared with other drilling methods.
Video Camera Survey	Provides detailed information about the condition of sewer lines.	May be expensive.
Geophysical Characterization		
Ground Penetrating Radar	Can be used to locate USTs, utility lines, buried drums or septic tanks.	Generally limited to depths of less than 30 feet. Signal is attenuated by some clays and high TDS water.
Soil Conductivity	Can be used in conjunction with direct push sampling for verification of results.	Equipment and trained personnel may not be widely available.
Metals Detectors	Inexpensive and can be used to detect USTs, pipelines, utility lines, buried drums etc.	Limited to locating metallic objects.
Electrical Resistivity Survey	Can be used to investigate large areas for buried objects, stratigraphy and groundwater contamination.	Interpretation of results is often subjective and utilities may interfere with survey methods.
Borehole Geophysical Logs	Can be used to determine lithology, porosity, well casing depths and delineate stratigraphy.	Typically more expensive than other methods and often requires an open borehole.
Analytical Techniques		
Mobile Laboratory	Provides near-real time results that allow for scope modifications in the field.	May be more expensive than off site lab, depending on the number of samples analyzed.
Immunoassay Kits and Colimetric Tubes	Easy to use and cost effective screening tool.	Typically have high detection limits and are compound specific.
DNAPL Detection		
Hydrophobic Dye (Sudan IV)	Easy to use and cost effective screening tool.	Results may not be definitive and the dye used is toxic.
Partitioning Interwell Tracer Test (PITT)	Uses tracers with different partitioning coefficients to determine DNAPL presence.	Expensive for use on small source areas and requires technical expertise.

General Response Actions	Remedial Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Comments and Areas Where Potentially Applicable
No Further Action	None	Not Applicable	Action is limited to groundwater monitoring only.	Low	High	Low	May be applicable for limited portions of plume areas or small source areas with limited access.
Natural Attenuation	Monitoring	Monitored Natural Attenuation	Structured monitoring program designed to verify contaminant attenuation through naturally occurring processes is protective of human health and the environment.	Low	High	Moderate	Potentially applicable for plume and source areas, especially when combined with active source reduction measures.
Institutional Controls	Use Restrictions	Use Restrictions	Limit exposure through placement of access or deed restrictions on properties within potentially impacted areas.	Low	Moderate	Moderate	Potentially applicable for plume and source areas. Although such measures do not directly address contaminant mass, they limit the potential for unacceptable human exposure to contaminants.
		Public Education	Increase public awareness through public hearings and media.	Low	High	Low	Potentially applicable. Although such measures do not directly address contaminant mass, they limit the potential for unacceptable human exposure to contaminants.
Hydraulic Containment	Vertical Barriers	Slurry Wall	Trench around contaminated areas and backfill excavation with a soil-bentonite or cement-bentonite mix	Moderate	Moderate	High	Potentially applicable. Potential for lateral and vertical migration of VOCs at inaccessible source areas.
		Grout Curtain	Pressure injection of grout along contamination boundaries in regular overlapping pattern of drilled holes	Moderate	Moderate	High	Not applicable. Continuity of curtain is difficult to achieve and potential for lateral and vertical migration of VOCs from source areas is likely.
		Sheet Piling	Lengths of steel sheets are connected and driven into the ground along contamination boundaries	Moderate	Moderate	High	Not applicable. Potential for lateral and vertical migration of VOCs from source areas. Also, not cost effective in most applications.
	Surface Water Infiltration Reduction	Source Area Capping	Clay, asphalt, concrete, or building structures placed over areas of high surface water infiltration to limit local groundwater recharge	Low	High	Low	Potentially applicable to reduce influx of contaminants into groundwater and limit contaminant mobility at some source areas. Effectiveness, however, is low/moderate due to limited recharge that currently occurs at the CTMRD.
		Storm Water Diversion/Control	Structures designed to prevent runon into infiltration areas and manage accumulation and discharges of precipitation	Low	High	Low	Potentially applicable to reduce influx of contaminants into groundwater and limit contaminant mobility at some source areas. Effectiveness, however, is low/moderate due to limited recharge that currently exists at the CTMRD.

Process Option Eliminated from Further Consideration

Table 2-5
Screening of Groundwater Remediation Technologies and Process Options

General Response Actions	Remedial Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Comments and Areas Where Potentially Applicable
Groundwater Collection/Extraction	Extraction	Groundwater Extraction Wells	Installation of a series of wells to extract contaminated groundwater	Moderate/High	High	Moderate	Potentially applicable for containment and/or mass removal from plume and source areas. Extraction would be most effective in more permeable water-bearing units, or if necessary, in conjuction with interceptor drains. Extraction in low permeable zones would be limited by small hydraulic capture zones.
		Dual Phase Extraction	Applying a high vacuum to a well located within the contaminated zone and screened across the water table, thereby inducing two phase flow: soil vapor and groundwater.	Moderate	High	Moderate	Potentially applicable at source areas with lower permeability soils. Simultaneously removes contaminants from vadose zone and groundwater.
		Interceptor Drains / Infiltration Galleries	Perforated pipe in trenches backfilled with porous media to collect contaminated water, or distribute amendments through piping network.	Moderate	Moderate	Moderate	Potentially applicable but limited to source areas with low permeability soils that preclude effective extraction by wells. More cost-effective when implemented in conjunction with concurrent soils excavation activities.
Treatment	*In Situ* Treatment	Enhanced Bioremediation	Enhance existing microbial conditions by injecting electron donating/accepting compounds, nutrients, and/or microorganisms into the subsurface	Low to High	Moderate	Moderate	Potentially applicable at source areas and small plume areas when used in conjunction with infiltration galleries, or applied to more permeable water-bearing units. Requires pilot testing to determine if proper conditions can be established.
		Chemical Oxidation	Inject chemical oxidizing agents to destroy contaminants in place	Low to Moderate	Moderate	Moderate	Potentially applicable to saturated soils at source areas applied to more permeable water-bearing units. Contaminated media need to be well-defined and the oxidant demand of aquifer materials needs to be determined in a lab.
		Air Sparging	System of wells to inject air into groundwater to remove volatiles by air stripping	Low to Moderate	Moderate	Moderate	Potentially applicable to saturated soils at source areas, however, use is limited to high permeability soils with limited heterogeneities. VOC-laden vapors must be collected via SVE for above ground treatment.
		Reactive Gate	Slurry wall that channels groundwater into a permeable cell ("gate") containing iron, or other medium, that reacts with or traps contaminants	Low to Moderate	Low to Moderate	High	Not applicable due to lack of competent bedrock to key gate into at reasonable depth.
		Phytoremediation	Use of specific plant types to enhance degradation of contaminants in groundwater	Low	High	Low	Not applicable. Root system of plants not likely to extend fully through the contaminated zone; groundwater uptake rates not sufficient to provide effective treatment.
	Ex Situ Treatment	Air Stripping	Air forced through liquid in a packed column or by diffused aeration to promote transfer of volatile contaminants into vapor	High	Moderate	Moderate	Applicable for plume and source areas and wellhead treatment. Treatment system "off-gas" would likely require treatment. Pretreatment for removal of total suspended solids and reduced metals may be required.
		Membrane Technologies	Use of high pressure to force water through a membrane leaving contaminants behind	Low	Low to Moderate	High	Not applicable. Not as reliable or cost effective as other technologies for VOC removal from groundwater; Reject stream requires disposal.
		UV-Enhanced Chemical Oxidation	Combination of ultraviolet light (UV) and strong oxidant to oxidize organics	High	Low to Moderate	High	Not applicable. Not as reliable or cost effective as other technologies for VOC removal from groundwater;
		Biological Treatment	Use of microorganisms to oxidize or reduce VOCs	Moderate	Moderate	High	Not applicable. Not as reliable, and characterized by high operation and maintenance relative to other process options.

Process Option Eliminated from Further Consideration

Table 2-5 (cont.)
Screening of Groundwater Remediation Technologies and Process Options

General Response Actions	Remedial Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Comments and Areas Where Potentially Applicable
	Ex Situ Treatment (Continued)	Activated Carbon Adsorption	Adsorption of organic contaminants onto activated carbon by passing contaminated media through reactive carbon columns.	Moderate to High	High	Moderate	Potentially applicable for vapor and liquid phase VOCs at plume and source areas and for wellhead treatment. Compare cost effectiveness to air stripping.
		Synthetic Resin Adsorption Units	Selective adsorption of organic contaminants onto synthetic resins	Moderate	Moderate	Moderate	Not applicable. This technology has greater tolerance for high moisture content vapor streams as compared to activated carbon. However, the Implementability is considered moderate due to emerging status of process option and PCE is effectively removed by carbon.
		Thermal Oxidation	Thermal destruction of VOC vapors through combustion processes	Low to Moderate	Moderate	High	Not applicable. Off-gas not antipicated to have combustable VOCs in range to make this alternative cost-competitive with other process options.
		Catalytic Oxidation	Thermal destruction of VOC vapors through combustion processes coupled with catalytic oxidizers	Low to Moderate	Moderate	Moderate to High	Potentially applicable, but only at source areas with very high contaninant concentrations in off gas. Treated vapors would likely require scrubbing processes to remove hydrogen chloride. Furthermore, off-gas not antipicated to have combustable VOCs in range to make this alternative cost-competitive with other process options.
		Vapor Condensation Units	Condensation of VOC vapors through the use of a heat exchanger	Low	Moderate	Moderate	Not applicable. Most applicable to high contaminant concentrations (over the long-term) and low waste stream flow rates. Under these conditions, this option is not cost effective compared to other process options.
		Oxidant Impregnated Materials	Oxidation of VOCs using high surface area materials such as alumina or zeolite coated with permanganate	Moderate to High	High	Moderate	Not applicable for vapor phase VOCs. This option is only applicable as a polishing treatment for low hydrophobicity compounds (e.g., VC) in effluent of vapor phase activated carbon units.
Disposal	Onsite Disposal	Injection Wells	Injection wells inject extracted and treated water into aquifer	Low	Low	High	Not applicable. Potential exists for impacting production wells and difficulty in obtaining reinjection permits.
		Surface Discharge	Extracted and treated water discharged on the surface (e.g., wetlands)	High	Low	Moderate	Potentially applicable, but appropriate disposal locations are limited and costs are highly variable depending on the treatment required for discharge.
		Exfiltration Beds	Extracted and treated water discharged through perforated pipe in trenches backfilled with porous media	Low	Low	Moderate	Not applicable. Potential exists for impacting production wells and difficulty in obtaining reinjection permits.
		Atmospheric Emission	Discharge of vapor treatment "off-gas" to the atmosphere. Such off-gas may originate from various treatment options discussed above.	High	Moderate	Low	Applicable for vapor streams treated for VOCs. Implementation of this technology is moderate as regulatory permits would be required.
	Offsite Disposal	Storm Sewer Discharge	Extracted and treated water discharged to storm sewer	High	Moderate	Moderate	Potentially applicable, but would require National Pollutant Discharge Elimination Sytsem Permit (NPDES) permitting and monitoring.
		POTW	Extracted and treated water discharged to local POTW for treatment	High	Moderate	Moderate to High	Potentially applicable, but would require permits and monitoring for connection to POTW.

Process Option Eliminated from Further Consideration

Table 2-5 (cont.)
Screening of Groundwater Remediation Technologies and Process Options

General Response Actions	Remedial Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Comments and Areas Where Potentially Applicable
No Further Action	None	Not Applicable	Action is limited to groundwater and soil monitoring only.	Low	High	Low	May be applicable for small source areas with limited access.
Removal	Excavation	Surgical Excavation	Limited excavation of contaminated soils at or above the water table generally using backhoes or trackhoes.	Moderate to High	Moderate	Moderate	Applicable at source areas with limited vadose zone contamination that is well defined and accessible. Groundwater contaminants can also be removed if excavation extends below water table and excavtion is dewatered, however, groundwater treatment and disposal is then required.
Treatment	*In Situ* Treatment	Enhanced Bioremediation	Enhance existing microbial conditions by injecting electron donating/accepting compounds, nutrients, and/or microorganisms into the subsurface	Low to High	Moderate	Moderate	Potentially applicable for saturated soils at source areas when used in conjunction with infiltration galleries, or applied to more permeable water-bearing units. Requires pilot testing to determine if proper conditions can be established.
		Chemical Oxidation	Inject chemical oxidizing agents to destroy contaminants in place	Low to High	Moderate	Moderate	Not applicable to unsaturated soils at source areas, but may be applied to more permeable water-bearing units. Contaminated media need to be well-defined and the oxidant demand of aquifer materials needs to be determined in a lab.
		Soil Vapor Extraction	Extract soil vapors from a vertical well screened within the contaminated vadose zone. Treat the extracted vapors at the surface.	Moderate to High	Moderate	Moderate	Potentially applicable to unsaturated soils at source areas, particularly when soils are inaccessible or excavation is costly.
		Phytoremediation	Use of specific plant types to enhance degradation of contaminants in groundwater	Low	High	Low	Not applicable. Root system of plants not likely to extend fully through the contaminated zone; land uses around most source areas likely preclude planting of vegetation required.
	Ex Situ Treatment	Ex Situ Soil Vapor Extraction	Excavated soils are stockpiled in covered piles with perforated piping inserted throughout. Vapors are extracted from the piping and treated.	Moderate to High	Moderate to Low	Moderate	Potentiall applicable for source areas with large tracks of vacant land where soil piles could be established and operated. Treatment system "off-gas" would likely require treatment.
		Low Temperature Thermal Desorption	Soils are heated to 200 to 600 degrees F to volatize water and organic contaminants. A carrier gas or vacuum system transports vapors to treatment system.	Moderate to High	Low to Moderate	High	Not applicable. Not as reliable or cost effective as other technologies for VOC removal from soils.
		Incineration	High temperatures - 1,600 to 2,200 degree F are used to volatiles and combust contaminants.	High	Low	High	Not applicable. Not as reliable or cost effective as off site disposal as hazardous waste.
		Biological Treatment	Use of microorganisms to oxidize or reduce VOCs	Moderate	Low	Moderate	Not applicable. Not as reliable, and characterized by high operation and maintenance relative to other process options.
Disposal	Offsite Disposal	Non-Hazardous Waste Landfill	Excavated soils are transported to an off site landfill permitted for non-hazardous waste.	High	Moderate	Moderate	Potentially applicable for clean soils excavated at source areas, but would require sampling of soils to demonstrate soils are non-hazardous.
		Hazardous Waste Landfill	Excavated soils are transported to an off site landfill permitted for hazardous waste disposal.	High	Low	High	Potentially applicable for hazardous soils excavated at source areas, but transportaion distance may be long and costs high.

(Shaded box) Process Option Eliminated from Further Consideration

Table 2-6
Screening of Soil Remediation Technologies and Process Options

2.3.4.3 Plume Area

Given the process options identified in Table 2-7, the remedial alternatives potentially applicable to addressing contamination within the Plume Area include:

- No Action
- Monitored Natural Attenuation
- Institutional Controls (including Use Restrictions and Public Education)
- Groundwater Pump and Treat (includes groundwater extraction and optional treatment and disposal methods)

The following discussion addresses the application of groundwater pump and treat as a remedial alternative to address plume area contamination under the conditions existing within the CTM. The available groundwater data have been evaluated to estimate the volume of the contaminated water within the aquifer beneath the CTM. Contaminated groundwater is assumed to be any groundwater that contains detectable amounts of PCE. The estimated areal extent of contamination is approximately 16 square miles (see Section 2.4.4). The thickness of the zone of contaminated groundwater is more difficult to estimate given the large areal extent and the variability in the depth of PCE contamination. The thickness of the zone of contaminated groundwater varies from several feet near source areas to more than 350 feet in localized areas near production wells. For the purposes of this estimate, it is assumed that the average thickness of contaminated groundwater is 250 feet and the average porosity of the aquifer is 0.3. The resulting volume of contaminated groundwater is approximately 625,000 acre-feet or about 200 billion gallons.

Groundwater pump and treat can be implemented with the objective of contaminant mass removal or hydraulic containment, both of which can be implemented on a small-scale or on a large-scale

- ***Small-Scale Remediation.*** Small-scale operations practically apply to remediation of source areas (higher concentration conditions within a fairly limited areal extent).
- ***Large-Scale Remediation.*** Effective large-scale contaminant mass removal or hydraulic containment within the plume area would necessitate the installation of numerous groundwater extraction wells and would require extraction and treatment of significant volumes of groundwater. Such an operation would be cost prohibitive both in terms of initial capital costs (groundwater extraction well installation and treatment facility construction) and costs associated with ongoing operations and maintenance, including the cost of disposal of treated water.

Table 2-7
Retained Process Options for Plume and Source Areas and Wellhead Treatment

Area	General Response Action	Process Option	Media Addressed
Source Areas	No Action	No Further Action	None
	Monitoring	MNA	Groundwater
	Institutional Controls	Use Restrictions	Groundwater
		Public Education	Groundwater
	Containment	Slurry Wall	Groundwater
		Capping	Groundwater
		Stormwater Diversion/Control	Groundwater
	Groundwater Collection/Extraction	Groundwater Extraction Wells	Groundwater
		Dual Phase Extraction	Groundwater and vadose soils
		Infiltration Galleries	Groundwater
	Groundwater Treatment	Enhanced Biodegradation	Groundwater
		Chemical Oxidation	Groundwater
		Air Sparging	Groundwater
		Air Stripping	Extracted Groundwater
		Activated Carbon	Extracted Groundwater and Vapors
		Catalytic Oxidation	Vapors
	Treated Water Disposal	Surface Discharge	Treated Groundwater
		Atmospheric Discharge	Treated Vapors
		Storm Sewer Discharge	Treated Groundwater
		Discharge to POTW	Treated Groundwater
		Soil Vapor Extraction	Vadose Zone Soils
		Excavation	Vadose Zone Soils
		Off Site Disposal	Excavated Soils
Plume Areas	No Action	No Further Action	None
	Monitoring	MNA	Groundwater
	Institutional Controls	Use Restrictions	Groundwater
		Public Education	All
	Groundwater Collection/Extraction	Groundwater Extraction Wells	Groundwater
	Treatment	Enhanced Biodegradation	Groundwater
		Air Stripping	Extracted Groundwater
		Activated Carbon	Extracted Groundwater
	Treated Water Disposal	Surface Discharge	Treated Groundwater
		Atmospheric Discharge	Treated Vapors
		Storm Sewer Discharge	Treated Groundwater
		Discharge to POTW	Treated Groundwater
Wellhead Treatment	No Action	No Further Action	None
	Institutional Controls	Use Restrictions	Groundwater
		Public Education	All
	Treatment	Air Stripping	Extracted Groundwater
		Activated Carbon	Extracted Groundwater

Because of the limited effectiveness of groundwater pump and treat relative to mass removal or hydraulic containment over such a large areal extent and the associated high costs, this technology is not considered practical on a large scale. However, groundwater pump and treat, particularly when focused on remediation of source areas (higher concentration conditions within a fairly limited areal extent), is considered feasible and potentially effective.

2.3.4.4 Public Water Supply Wellhead

The process options retained for public water supply wellheads are:

- No Action
- Institutional Controls (including Use Restrictions and Public Education)
- Wellhead Treatment (via air stripping or activated carbon)

Five existing public water supply wells currently have operating wellhead treatment facilities that use air stripping. Operations at these wells have demonstrated this process option to be an effective method for treating groundwater to established safe drinking water standards. Wellhead treatment of groundwater from public water supply wells will continue to be utilized as an element in the overall CTMRD remediation program.

2.4 Conceptual Model of Contamination Beneath CTMRD

Based on the body of work performed as part of the Work Plan Implementation Phase of the CTMRD, a conceptual model of contamination was developed. A description of the conceptual model of contamination is provided below.

2.4.1 Contamination Flow and Transport

The first indications that PCE contamination existed in the CTM alluvium occurred in 1987 during the sampling of the local public water supply wells operated by Sierra Pacific Power Company (SPPCO) (which are now operated by TMWA). PCE concentrations have been monitored nearly continuously on a monthly basis by SPPCO and TMWA since 1987. PCE has been detected regularly in the TMWA wells at concentrations greater than 5 μg/L. Time history plots of PCE in the five TMWA wells are provided in Figures 2-18 and 2-19.

These data indicate that for many of the public water supply wells, PCE concentrations have been increasing since 1987 at various rates – ranging from the steady increases at Mill Street and Kietzke Lane wells (approximately 1 μg/L PCE concentration increase per year since the late 1980's), to the limited changes that have occurred at the High and Morrill Street wells – 15 and 20 μg/L, respectively (concentrations have remained at fairly consistent over the last 15 years). In order to protect the public from PCE concentrations above drinking water standards, air strippers were installed on the five water supply wells.

Highlighted below are the most striking observations about these data and the impacts of PCE on the public water supply.

- All the wells, except 21st Street, that have concentrations of PCE above 5 μg/L are currently equipped with wellhead treatment in the form of air stripping to remove the PCE from the water before it is transmitted into the public drinking water supply.
- Wellhead treatment was operational at High and Morrill Street wells in June 1996, and at the Kietzke, Corbet and Mill wells in September 1998.
- After wellhead treatment was installed on these wells and the wells began pumping, concentrations were observed to decrease over time for as many as 3 years.
- After the initial decrease, which was expected given the typical impacts of dilution on production wells contaminated by limited groundwater borne contaminants, all these five wells continue to demonstrate concentrations of PCE between about 9 and 20 μg/L, even with the dilution.
- Given that the five TMWA wells with wellhead treatment produce on average about 1.3 billion gallons of water a year (since the summer of 1998), about 20 gallons of PCE are removed from the aquifer by the production wells each year. This is the equivalent of about 4 drums of pure PCE per decade.

2.4.2 PCE Sources and Source Areas

Given that the observed concentrations of PCE in the shallow groundwater are relatively low and wide spread, and that the PCE contamination penetrates the groundwater to depths of 350 feet or more, it appears that a large quantity of the groundwater tributary to the public water supply wells contains detectable levels of PCE. In fact, the average PCE concentration in the shallow aquifer is about 20 μg/L and the average PCE concentration in groundwater produced by the impacted TMWA wells is about 15 μg/L. Therefore, it would appear that the majority of the produced groundwater originates from the zone 350 feet and above, with only limited dilution occurring.

For the PCE to occur in such a large area, both horizontally and vertically, it is likely that the PCE emanates from many widely distributed sources – sources that may include both small scale sources and the sanitary sewers that carry wastewater from all points in the CTM to the regional wastewater treatment plant. Each of these potential source types is described below.

2.4.2.1 Potential Small-Scale Sources

Numerous small-scale sources that may be impacting shallow groundwater contamination likely exist throughout CTM. Historical land use along the chief thoroughfares such as Kietzke Lane, South Virginia Street, 4th Street, Keystone Avenue, etc. includes a myriad of light industrial uses such as dry cleaners, metal painting shops, printers, automobile and body repair shops, and chemical and paint manufacturers. Property ownership over the past 50 to 70 years have changed hands, such that some of the past potential contributors may long since be gone as evidenced by the land use analyses performed by the County and discussed in Section 2.3.1.9. Still other contributors may still exist today, as evidenced by the sanitary sewer sampling results presented in Section 2.3.1.10.

Releases from these types of light industrial operations could occur in a number of ways.

- Poor housekeeping could contribute occasional spills and accidental releases to the ground's surface, eventually leading to the development of soil and groundwater contamination.
- Leaking underground facilities (e.g., tanks, wet wells, dry wells, sewer line connections) could contribute contaminant mass to the soil and groundwater on a daily or weekly basis.
- Poor operational practices could lead to the habitual dumping of solvents into leaking sewers, wells, or unlined pits, which could lead to significant soil and groundwater contamination.

Any and all of these types of release could have occurred, and may continue to be occurring within the CTM. It is estimated that 75% of all active dry cleaners probably have some level of solvent contamination (Schmidt, et.al., 1999). Current regulations are more stringent than past regulations regarding the storage, handling, and disposal of solvents, however, small quantities of controlled material, which can cause significant environmental damage, are difficult to track and regulate.

As previously indicated, only three suspected source areas have been identified through the field activities conducted to date. Given the likelihood that other source areas exist within CTM, a deliberate, focused effort will be planned and implemented to install additional groundwater monitoring wells near locations with past land uses that may be consistent with the use of solvents, for these type of sources are probably the most significant contributors to the PCE contamination in CTM.

2.4.2.2 Sanitary Sewers

Localized hotspots do not appear to be the sole cause of the PCE contamination within CTM given the widespread, low level contaminant concentrations observed in the alluvial aquifer system. Therefore, a more wide spread "source type" may be a significant contributor to the PCE contaminant distribution observed in the aquifer system. Leaking sanitary or storm sewers used to carrying process water discharged either legally or illegally from light industrial operations may be the culprit.

Past business practices for some light industrial operations including the "dumping" of process wastewater, either in batch or continuously, into the sanitary sewer system. Although this practice was allowed through a portion of the 1970's, it is no longer allowed today. The Cities' and County's stormwater NPDES permit controls dry weather discharges of process water into storm sewers, whereas discharges to the sanitary sewers are controlled by the Cities of Reno and Sparks industrial pre-treatment program, which began in 1977.

Unfortunately storm and sanitary sewers leak. Leaks occur around joints, in locations where the pipe may have broken or corroded, and during the construction of new lines and connections. Given that storm and sanitary sewers are designed to be placed on course grained bedding material that is typically of a higher permeability than the surrounding natural formation, the storm and sanitary lines can also become conduits for contaminant migration, both because of the potential for leaking materials to migrate into and along the bedding material and because these pipes regularly carry water. Therefore, PCE that enters into a storm or sanitary sewer could potentially leak out into the pipe's bedding material and be flushed from the bedding material each time water leaks out of the pipe and contacts the contaminant mass.

The likelihood that PCE contamination existing within the sanitary sewers beneath the streets of Reno and Sparks is considerable considering that past and perhaps current (albeit illegal) practices for PCE disposal involves discharging of high concentrations of PCE into the sanitary sewers. For example, recent sampling of the sanitary lines found concentrations of PCE above 5 μg/L in numerous locations throughout CTM (see Figure 2-7). This figure illustrates that PCE at detectable concentrations were found recently in 26 separate locations across CTM. Follow-up sampling further characterized the PCE in the sanitary sewers, with the following results:

- Of the 26 locations, additional sampling isolated the source of the PCE to individual sewer reaches (i.e., a location between two manholes) at 15 sites. Sampling at the other sites produced either ambiguous information or did not verify previous sampling results.

- In nine separate locations (Figure 2-7), PCE concentrations above 100 μg/L were detected and in at least one location (Sub region 1) a PCE concentration was detected at 34,000 μg/L. (The solubility of PCE is about 150,000 μg/L).

The presence of PCE in the sanitary lines may be indicative of a long-standing, albeit illegal, business practice within the Reno metropolitan area. Given leakage of the sanitary sewers, long-term discharge of small volumes of PCE in the sewers could have contributed to the current distribution of PCE in the alluvial aquifer, especially in the nine subregions. Further, if PCE exists in high enough concentrations when discharged, which can be roughly defined as in the 1,000 μg/L range, PCE remaining within the soils or bedding material around the sanitary sewer could contribute PCE to the public water supply wells for decades to centuries.

Unfortunately the impact of PCE discharges into the City's sanitary sewers is not easily characterized given the temporal variability and spatial extent of the lines. Additional data collection to evaluate the nature of the impact of PCE discharges into the sanitary sewers within the nine sub regions identified in the Sewer Line Wastewater Report is warranted.

2.4.3 PCE Transport Mechanisms

Advection, caused by the flow of groundwater from high piezometric head to low piezometric head, appears to dominate the migration patterns of the PCE in CTM. Generally, groundwater flows from west to east, along with the historical flow paths, however, the influence of groundwater supply pumping has become increasingly important to the fate of PCE within the CTM aquifer system.

To begin with, the sources of PCE are all shallow by nature, impacting the water table at the groundwater – vadose zone interface. The presence of PCE to depths of 350 feet is indicative of the impact of groundwater production on the vertical migration of the contaminant. For example, the nearly "steady state" nature of the PCE contaminant concentrations in the three TMWA wells – High, Morrill, and Kietzke – appears to indicate that production pumping from these wells is continuing to draw substantial quantities of groundwater from the contaminated zone of groundwater beneath Downtown Reno.

It is uncertain whether or not these three TMWA production wells are pumping at high enough rates to capture all of the shallow groundwater flowing beneath the downtown Reno area since the production pumping fluctuates seasonally and limited water level data exists east of Wells Avenue and west of Galletti and 21st Street wells. However, it is clear that a substantial quantity of PCE contamination migrating from west to east beneath the downtown Reno area is being captured by the three TMWA wells given that:

- Most of the groundwater flowing through CTM discharges into TMWA production wells (see Figures 2-14a and 2-14b); and

- The only wells that capture groundwater originating in the Downtown Reno area are the High, Morrill and Kietzke wells, as well as the 4th Street well (which does not require wellhead treatment) (see Figure 2-14a).

Similarly, the Mill and Corbet wells capture significant amounts of groundwater from the water table located beneath the commercial properties lining South Virginia Street (from Mill to Moana), Plumb and Moana. As indicated during the sanitary sewer sampling effort (see Figure 2-7), PCE was detected above 100 μg/L in numerous locations along these major commercial thoroughfares. It is likely, therefore, that sources of PCE contamination located south of Mill Street along or near these major streets have, and continue to, contribute PCE to the Mill and Corbet wells.

Based on advection alone (as indicated by the capture zone maps presented in Section 2.3.2.4), the suspected source area at the intersection of Mill Street and Kietzke would not impact any of the five TMWA wells currently operating with air stripping facilities. Based on the piezometric surfaces presented in Section 6.2, this possible source area appears to contribute PCE to groundwater that migrates east and northeast toward Reno Hilton Lake, Truckee River, and the Galletti and 21st Street wells.

2.4.3.1 Density Impacts

Note that impacts of density, caused by elevated concentrations of PCE in the saturated zone, may influence the localized migration of PCE contamination downward into the alluvium. This type of density gradient, related to the presence of dense non-aqueous phase liquids (DNAPL), may occur in areas immediately adjacent to locations where PCE had been dumped onto or leaked into the ground. Aqueous phase concentrations above 1 percent of effective solubility (which is about 1,500 μg/L depending on the presence of other contaminants in the groundwater) can be correlated to the presence of DNAPL in or adjacent to the saturated zone.

Note that in only one sample (at well 133j), was the PCE above 1,000 μg/L, and the concentration in that well has since dropped to below 500 μg/L. Although DNAPL may exist with the CTMRD, the data collected thus far do not indicate the presence of DNAPLs at this time.

2.4.3.2 Dispersion

Advection alone does not dictate the areal and vertical extent of the PCE in the alluvial aquifer. Dispersion, caused by the heterogeneity of the porous media through which the groundwater flows, also may cause PCE to spread horizontally and vertically through the water column. Dispersion along with advection may be especially important to the vertical migration of PCE in the alluvial sediments, given that dispersion by itself may not cause significant vertical migration of groundwater contaminants into the water column. Dispersion through the sediments such as those found in CTM may cause the contamination to migrate dozens of feet downward into the saturated sediments in addition to the vertical migration caused solely by advection and downward vertical gradients. Dispersion may also be increased in situations where the groundwater flow alternates direction under the influence of seasonal pumping.

2.4.3.3 Retardation

Retardation is used as a characteristic parameter to represent the two associated processes of contaminant adsorption on to and desorption from the soil in the saturated zone. Retardation is used to adjust the groundwater velocity, creating an apparent groundwater velocity that takes into account to process of mass being removed from (through sorption) and added to (through desorption) migrating groundwater. Although the adsorption and desorption processes are not linear by nature, nor are they reversible and congruent, we have assumed that they are for this project.

Incorporating retardation into the simulations and analyses presented herein does not remove mass from the water column, it only acts to reduce the apparent velocity of the migrating PCE contamination. Retardation has been correlated to the fraction of organic material within the soil matrix and the grain size distribution. Given that the aquifer system within CTM is nearly devoid of naturally occurring organic material (i.e., it is less than 0.01 percent), retardation was assumed to not influence the rate of contaminant migration.

2.4.3.4 Degradation and Natural Attenuation

Natural attenuation in groundwater systems results from the integration of several subsurface attenuation mechanisms that may effectively reduce the contaminant toxicity, mobility, or volume. Natural attenuation mechanisms are classified as either nondestructive or destructive. Nondestructive mechanisms are processes that result in reduction of contaminant concentration without destruction of contaminant mass. These mechanisms include dispersion, dilution, sorption, and volatilization. Destructive mechanisms include intrinsic biodegradation and abiotic (chemical) degradation.

For chlorinated aliphatic hydrocarbons (CAHs) such as PCE, reductive dechlorination is the most effective biodegradation process in terms of mass reduction. Reductive dechlorination is the process by which anaerobic microbes (dehalogenators, halorespirers) substitute a hydrogen atom for a chlorine atom on the CAH molecule. Through this process, the more chlorinated CAHs can be dechlorinated to form less chlorinated compounds (e.g., PCE to TCE to cis-1,2-DCE to vinyl chloride and finally to ethene). In order to complete the reductive dechlorination reaction, an oxidation reaction is needed. Microbes will use natural organic matter and other carbon sources like BTEX as carbon and energy sources. These microbes will metabolize the carbon sources and as a by-product produce hydrogen. The presence of cis-1,2-DCE and vinyl chloride (biodegradation products of PCE and TCE) is an indication of the occurrence of reductive dechlorination.

Only five of the wells sampled as part of the field investigations (less than 1%) have had detections of cis-1,2-DCE and no wells have had detections of vinyl chloride. The lack of cis-1,2-DCE and vinyl chloride production within the groundwater at CTM is an indication that conditions are not favorable for reductive dechlorination.

The high levels of DO and sulfate measured in most of the groundwater wells are the likely cause for the non-favorable conditions. Anaerobic conditions prevail at DO concentrations less than approximately 0.5 mg/L. At DO concentrations above 0.5 mg/L, aerobic biodegradation of the carbon source (toluene) prevails. Aerobic biodegradation of toluene consists of aerobic microbes using oxygen to oxide toluene and produce carbon dioxide. PCE and TCE do not typically biodegrade aerobically. Even in wells with low DO, sulfate levels are typically above 50 mg/L. In field situations, it is often observed that dechlorination of cis-1,2-DCE and vinyl chloride does not occur in the presence of levels of sulfate in excess of 50 mg/L.

It is nonetheless important to note that the dechlorination of PCE may be occurring at numerous locations within CTM given the widespread distribution of PCE and gasoline service stations. Literally dozens to hundreds of past gasoline service stations have leaked fuel into the shallow groundwater, causing the local groundwater to become anaerobic, which is conducive to the dechlorination of PCE. Fuel constituents mixed with solvents such as PCE have been found to promote dechlorination reactions at the Sparks Solvent Fuel Site in Sparks and the Stead Solvent Site in Stead.

2.4.4 Distribution of PCE

The distribution of PCE has been developed for a number of reasons. First, the benefit afforded commercial, and to a lesser extent, residential property owners relates to whether or not a parcel overlies PCE contamination. Second, remedial actions, and the design and evaluation of remedial actions, will need to be focused on those areas where PCE is either known to exist or is suspected to exist.

Of course, the development of a map of PCE extent is limited by the data available to create the map. Since the CTM is such a large land area, it is unreasonable to expect that a groundwater quality data point can be obtained to represent each parcel. In fact, the vast majority of parcels that are included in the area of known or suspected PCE contamination do not have wells or sampling points associated with them.

However, there are substantial data available to characterize the extent of PCE - data that are reliable, and accurate, and are representative of the state of the science that exists to delineate contaminant extent. To this end, the data used to develop the distribution of PCE in CTM included:

- Historical land use;
- PCE studies and remedial actions on file with NDEP and WCDHD performed for private parties;
- Groundwater quality data collected by the County, TMWA, NDEP, WCDHD, and various private property owners;
- Sanitary sewer sampling results; and
- Knowledge of the direction of groundwater flow and the fate of PCE in the shallow and deep aquifer systems.

Figure 2-20 depicts the known and suspected distribution of PCE beneath CTM given the interpretation of these available data.

The following points are highlighted as partial justification of the contaminant distribution:

- The downtown Reno area, extending west to Keystone Avenue is clearly contaminated with PCE, as are areas south along South Virginia Street to at least Moana Lane, based on observed groundwater concentrations in the shallow and deep groundwater and historical land use data.

- Contamination found near Mill Street and Kietzke Lane influence groundwater quality from that location east to at least the Truckee River and likely beyond to TMWA's water supply wells at Galletti and 21st.

- Contamination along South Virginia, which may exist as far south as Nell Road based on historical land use and sites on file with NDEP and WCDHD, has migrated eastward, along the predominant direction of groundwater flow to locations such as Corbett School, Mill Street, and probably Peckham Lane.

- PCE contamination has been found west of Downtown near California and Booth, near Keystone and Seventh, and near Fourth Street and Summit Ridge based on NDEP and WCDHD files.

- PCE contamination has been found north of I-80 in the vicinity of the County Buildings on Ninth and Wells, based on groundwater monitoring data, and along Prater Way in Sparks, based on groundwater monitoring and land use data. PCE has also been found at Pyramid Way and Greenbrae according to NDEP and WCDHD files.

- PCE contamination has been found east of I-395 and south of the Truckee River at locations along Mill Street, within the Airport and National Guard facilities, and east of the airport in the commercial areas, based on groundwater monitoring data. These areas also have numerous business entities that may have handled PCE in the past.

- PCE has been found at numerous locations throughout the Sparks commercial and warehouse district between I-80 and the Truckee River, based on groundwater monitoring data, historical land use data, and the NDEP and WCDHD files. Potential source areas may exist from as far west as Kietkze Lane to as far east as Kleppe Lane based on sanitary sewer data and NDEP files.

Overall, the known and suspected distribution of PCE beneath CTM as depicted represents the aggregation of the relevant data available at this time. It is possible, and even likely, that the understanding of the distribution of PCE contamination will be refined in the future as more data are collected and made available. To this end, the Remediation Management Plan must be flexible enough to allow for amendment and revision, as needed to support revisions to County ordinances and the identification of benefits for property owners.

2.5 Summary and Recommendations

The various environmental sampling programs and qualitative and quantitative analyses presented and discussed in this section can be summarized as follows:

- PCE contamination in the groundwater beneath the CTM exists in a broad distribution. PCE exists to depths of 350 feet or greater beneath ground surface, over an area of as much as 16 square miles impacting perhaps as much as 200 billion gallons of water – water that is vital to the public drinking water supply in the metropolitan Reno area.

- PCE contamination of this breadth is the result of uncontrolled or accidental discharges from dozens to hundreds of sources and hot spots located throughout CTM. In the Downtown Reno area alone, past investigators identified over 300 potential sources based on historical land use. Given the prevalent direction of groundwater flow and areas of groundwater discharge, sources in the downtown Reno area could not contribute to contamination found along South Virginia Street, in Sparks, in the Corbett School and Mill Street wells, along Moana Lane, or north of I-80. Each of these areas where contamination has been found outside of Reno's downtown area are likely to represent unique sets of sources – unique sets of past and/or present uncontrolled or accidental discharges.

- Although much of the contamination is likely a result of past PCE disposal practices, it is also possible that current PCE disposal practices may be contributing contamination to the groundwater flow system. In particular, sampling of the sanitary sewers in both Reno and Sparks at locations downstream of businesses that may handle PCE indicated that "slugs" of PCE were being conveyed unknowingly by the underground pipelines. The presence of PCE into the sanitary sewers, albeit illegal, may constitute an ongoing source of PCE to the shallow groundwater. Further evaluation of the sewers in connection to groundwater contamination is warranted.

- Field investigations and a review of NDEP and WCDHD project files have identified a dozen or more sources, or suspected sources of PCE within CTM. These sources, which include past and current dry cleaners, as well as other locations without specific businesses associated with them, will require additional characterization and evaluation to determine the need for and scope of remedial actions.

- Beyond contaminating the drinking water, the PCE beneath CTM may also impact construction of future projects (both from a human health concern and a construction dewatering point of view) that disturb the shallow groundwater and indoor air quality within any structure placed above the contaminated groundwater. An analysis was performed to determine if the current contaminant distribution creates unacceptable risk to humans under either of these two scenarios. Based on the analyses, there does not appear to be any current human exposure that poses an unacceptable risk. It is possible that future construction workers may be at risk to unacceptable contaminant concentrations of PCE if sources are found at levels of 770 microgram per liter or greater (using a straight line approximation of current risks presented in Section 2.3.3.1).

Based on the results of the environmental sampling programs and qualitative and quantitative analyses, the following recommendations for remedial actions and related activities are carried into the Remediation Management Plan.

- Wellhead treatment at the five TMWA wells (Mill Street, High Street, Morrill Avenue, Corbett School, and Kietkze Lane) must continue to safeguard the drinking water for the citizens of CTM.

- Wellhead treatment should be added to any additional public water supply wells operated in the area of known or suspected PCE contamination, if PCE contaminant concentrations are found to exceed federal or state safe drinking water standards.

- Source remediation must occur to remove and/or control the effects of past and ongoing uncontrolled and accidental discharges on the groundwater beneath the CTM. Source remediation will need to be prioritized to allow for the appropriate and focused expenditure of CTMRD funds on reasonable and economically feasible actions. Source remediation will therefore consist of various phases of source characterization, remedial and benefit evaluations, and remedial action implementation.

- At least two potential source areas and one potential source type should be further investigated to forward remedial actions. These investigations will focus on determining what impacts a potential source area has on the drinking water supply and future construction activities; identifying potentially responsible parties – such that the source can be referred to NDEP if appropriate; and evaluating whether or not a remedial action will be reasonable and economically feasible. The two potential sources areas are Mill Street/Kietzke Lane and Fourth Street/Ralston. Selected areas of the Reno and Sparks sanitary sewer systems constitute the potential source type.

- Another key component of the overall remediation program is consistent and comprehensive groundwater monitoring. The objectives of groundwater monitoring are to track seasonal changes in groundwater elevation, to gather data to better define the nature and extent of the PCE plume, to track changes in PCE concentration, and to assess the influence of TMWA water supply well pumping on the PCE plume. In addition, groundwater monitoring will include components of sampling and analysis consistent with those defined by EPA to support monitored natural attenuation (MNA) evaluations. Consistent with direction provided by NDEP, MNA will be evaluated as a mechanism for reducing the toxicity, mobility, or volume of PCE within the aquifer system (natural attenuation in groundwater systems results from the integration of several subsurface attenuation mechanisms).

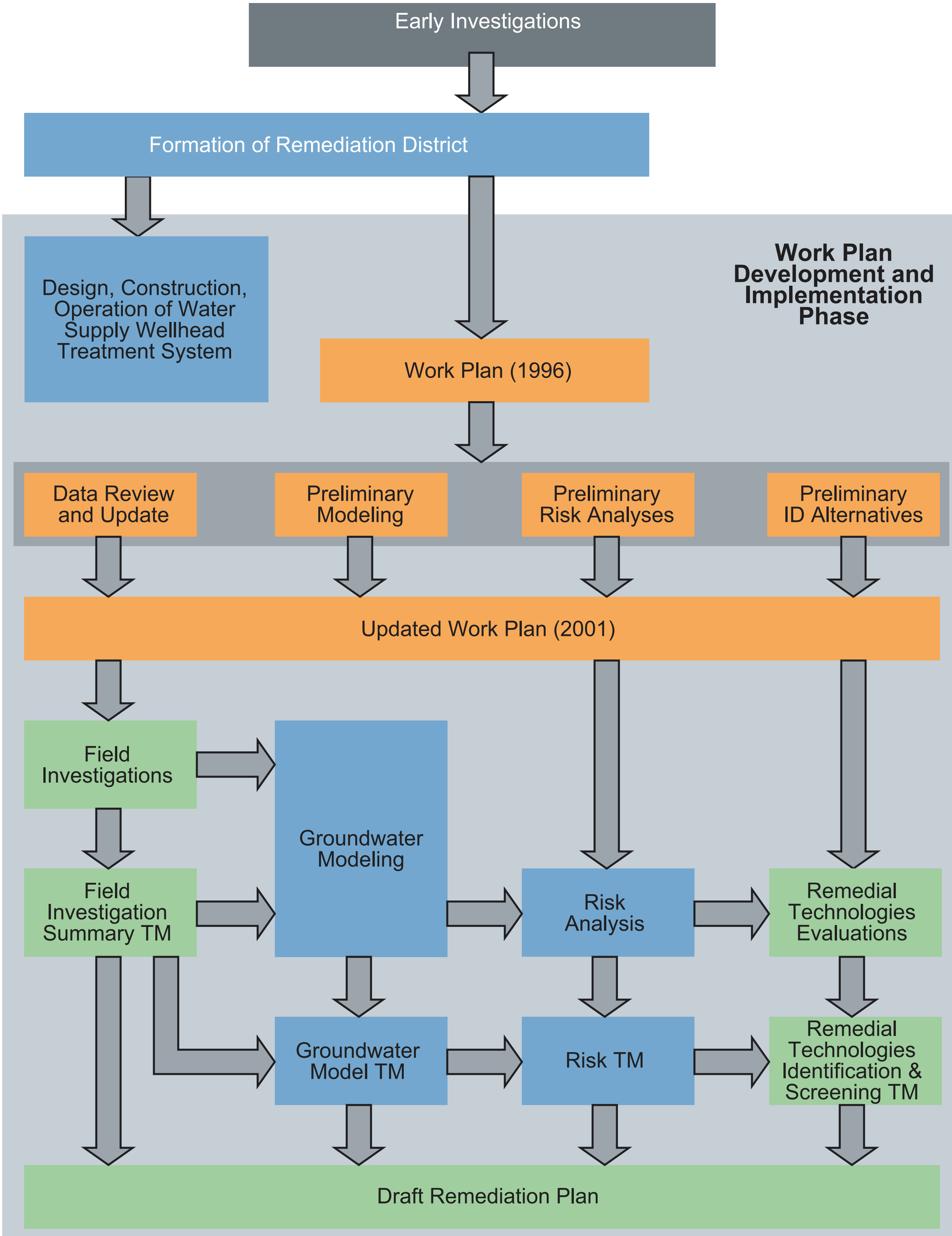


Figure 2-1 Work Plan Development and Implementation Phase Project Flow Chart

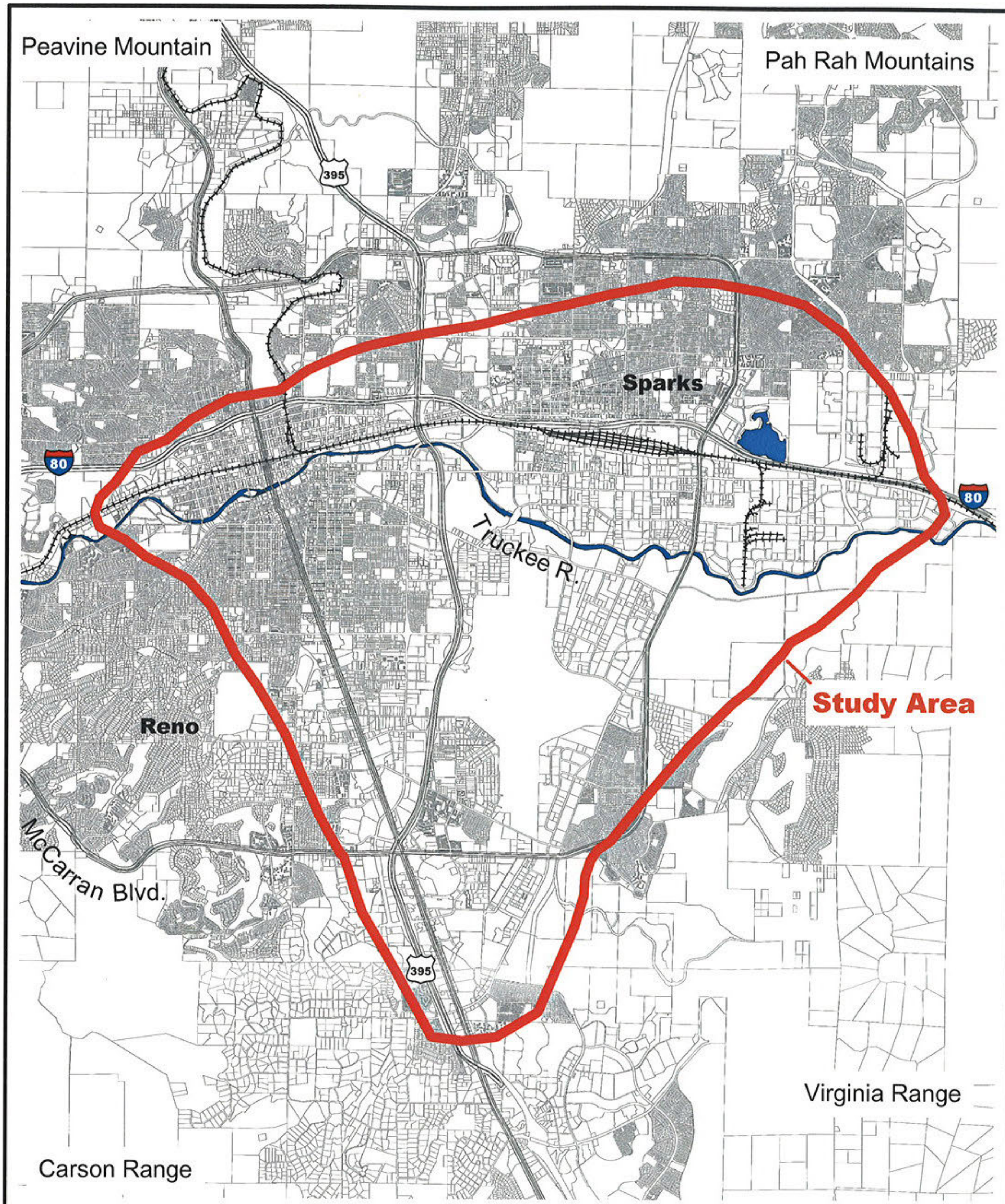


Figure 2-2 Physical Setting

CTM
REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

S. Washoe County
Sparks
Reno

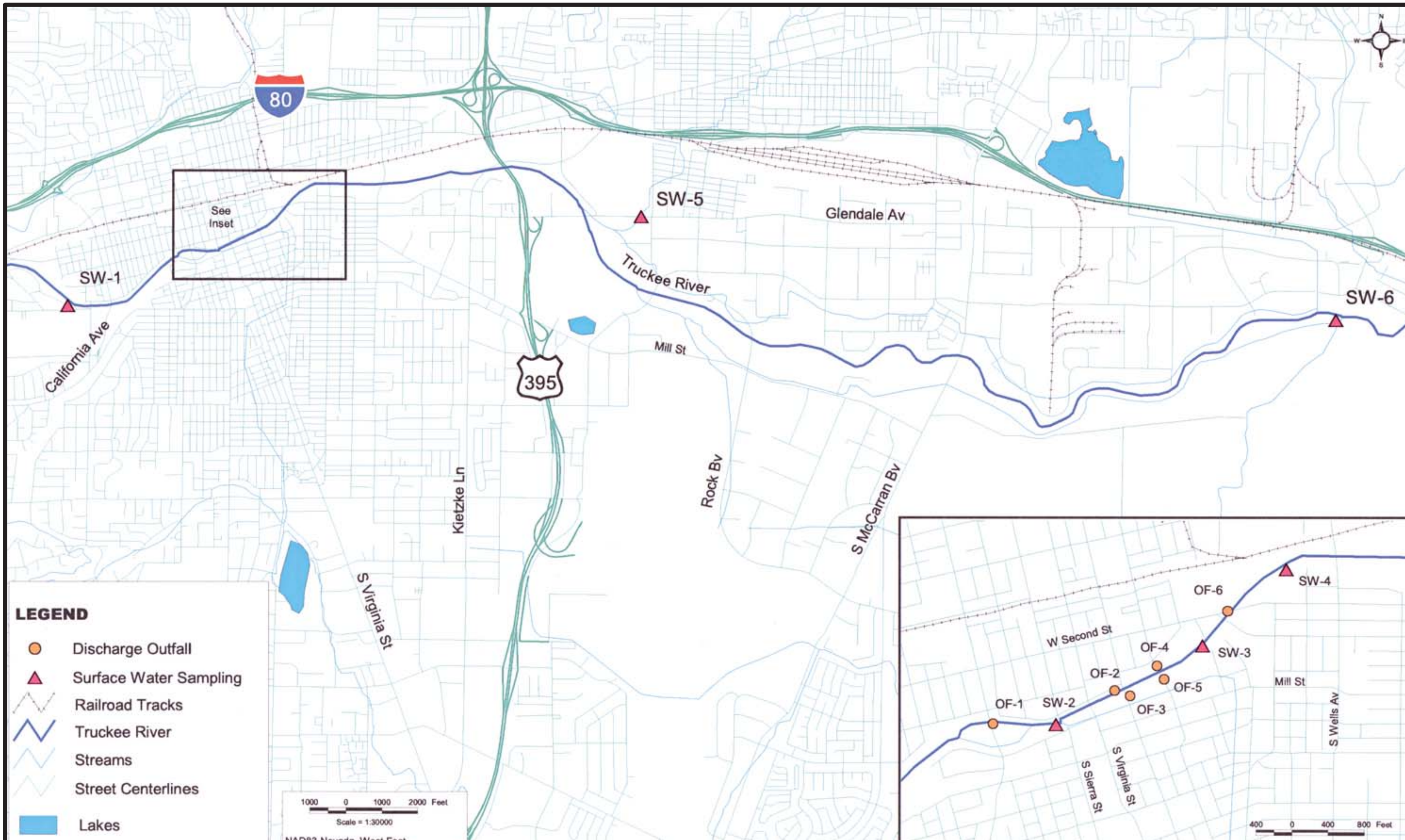


Figure 2-3 Surface Water Sampling Locations

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

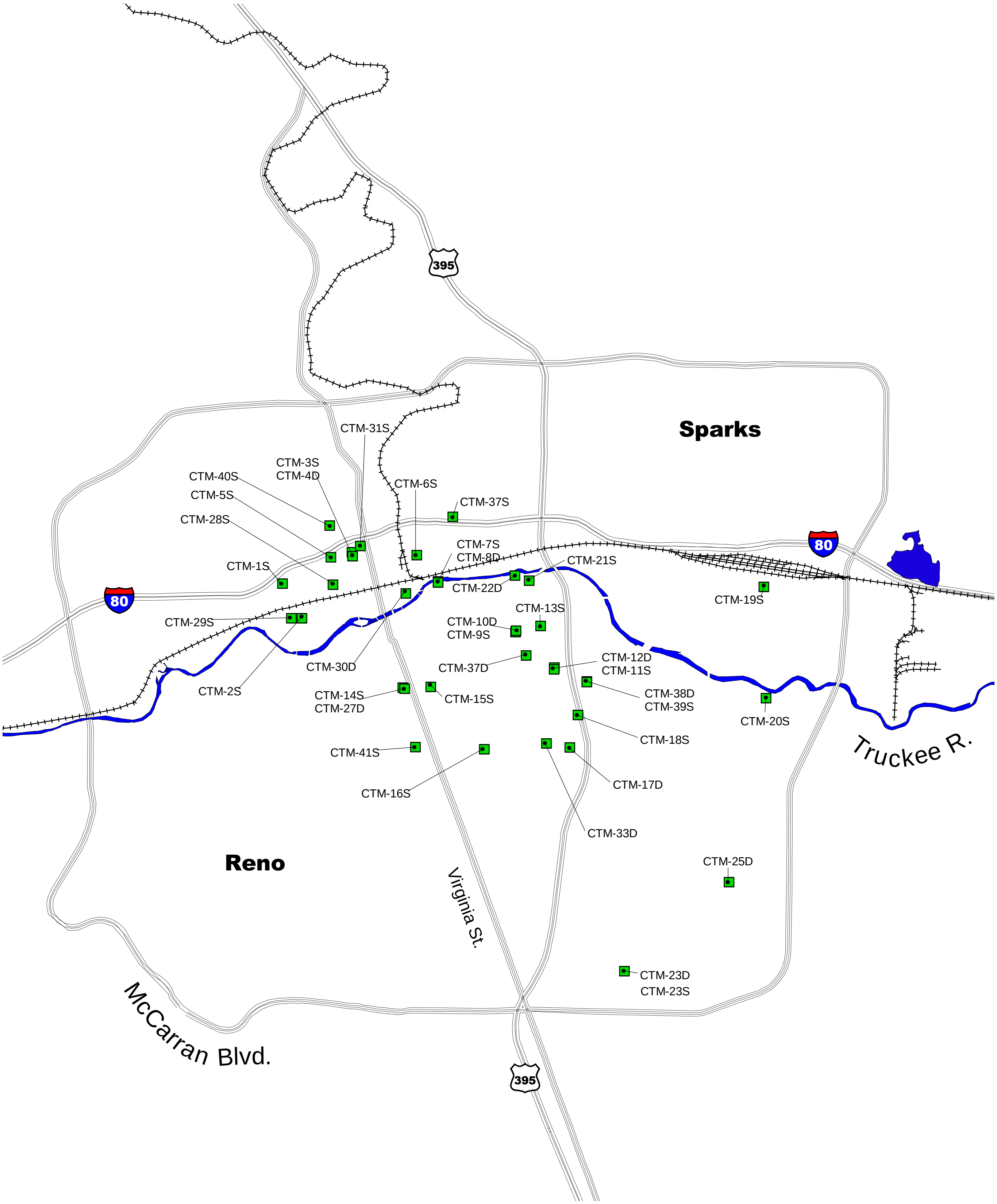


Figure 2-4 Location of Newly Installed CTM Monitoring Wells

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

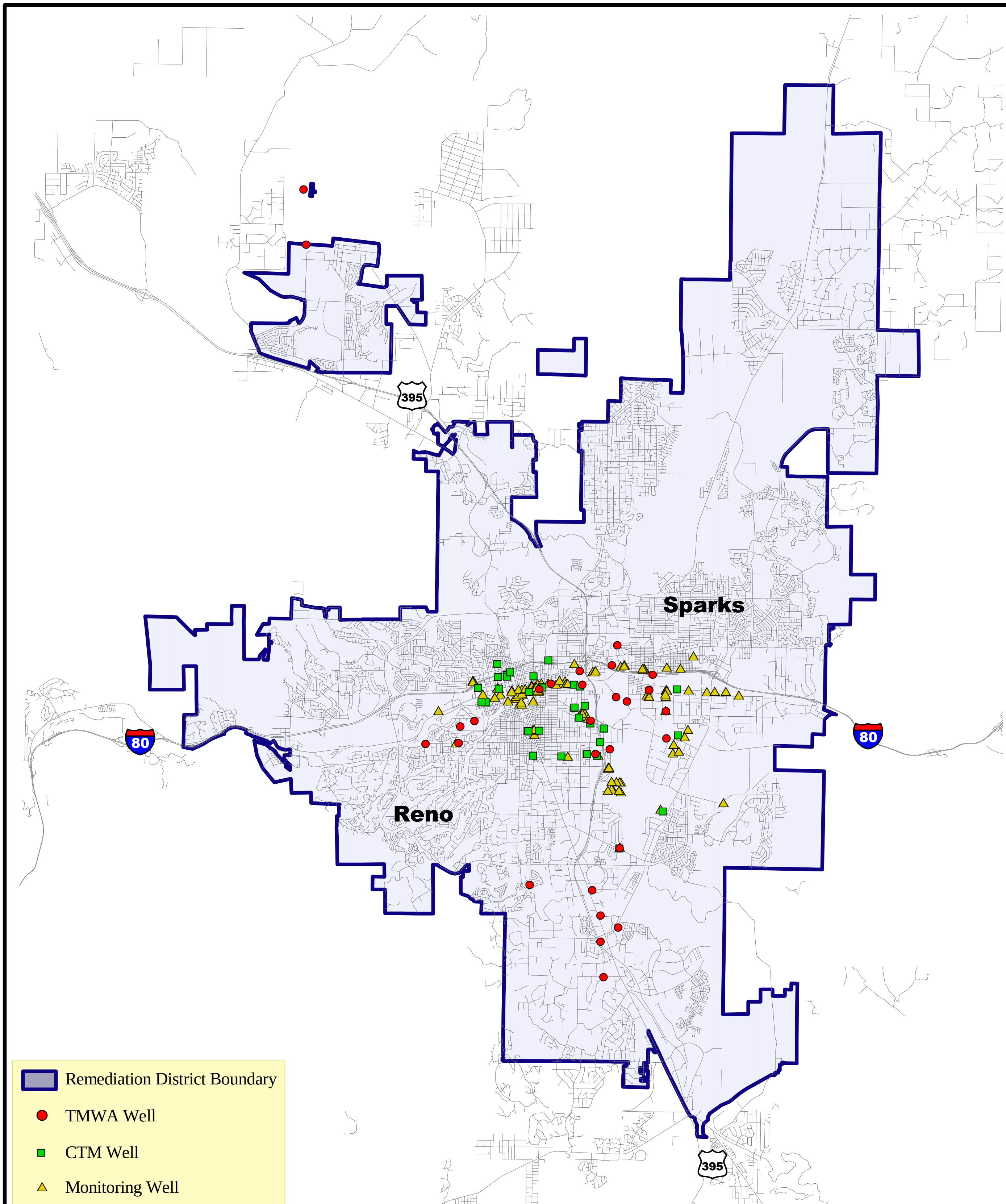


Figure 2-5 Wells Within CTM Remediation District

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

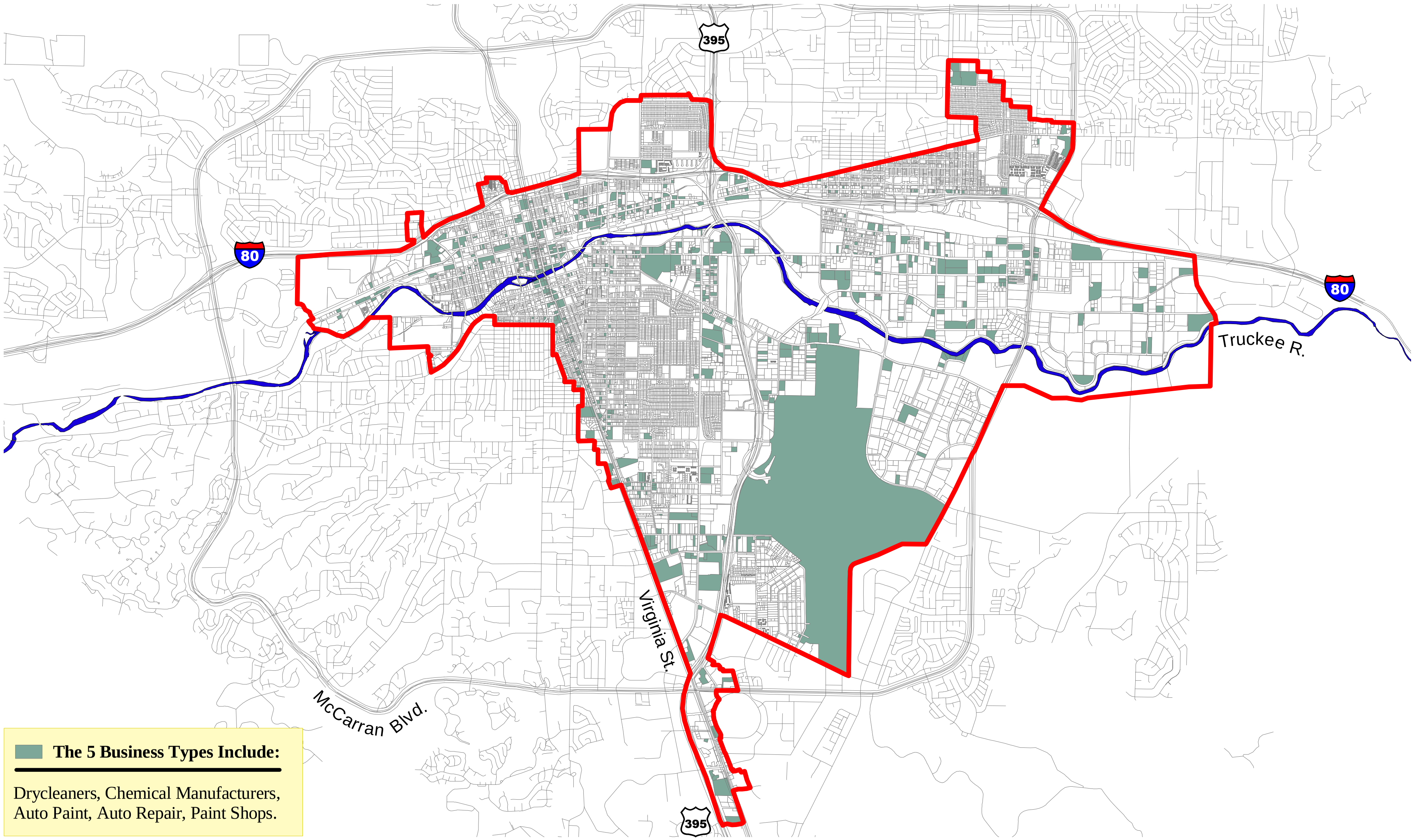
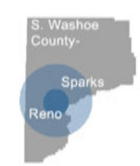


Figure 2-6 Parcels Containing 1 of the 5 Business Types

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District



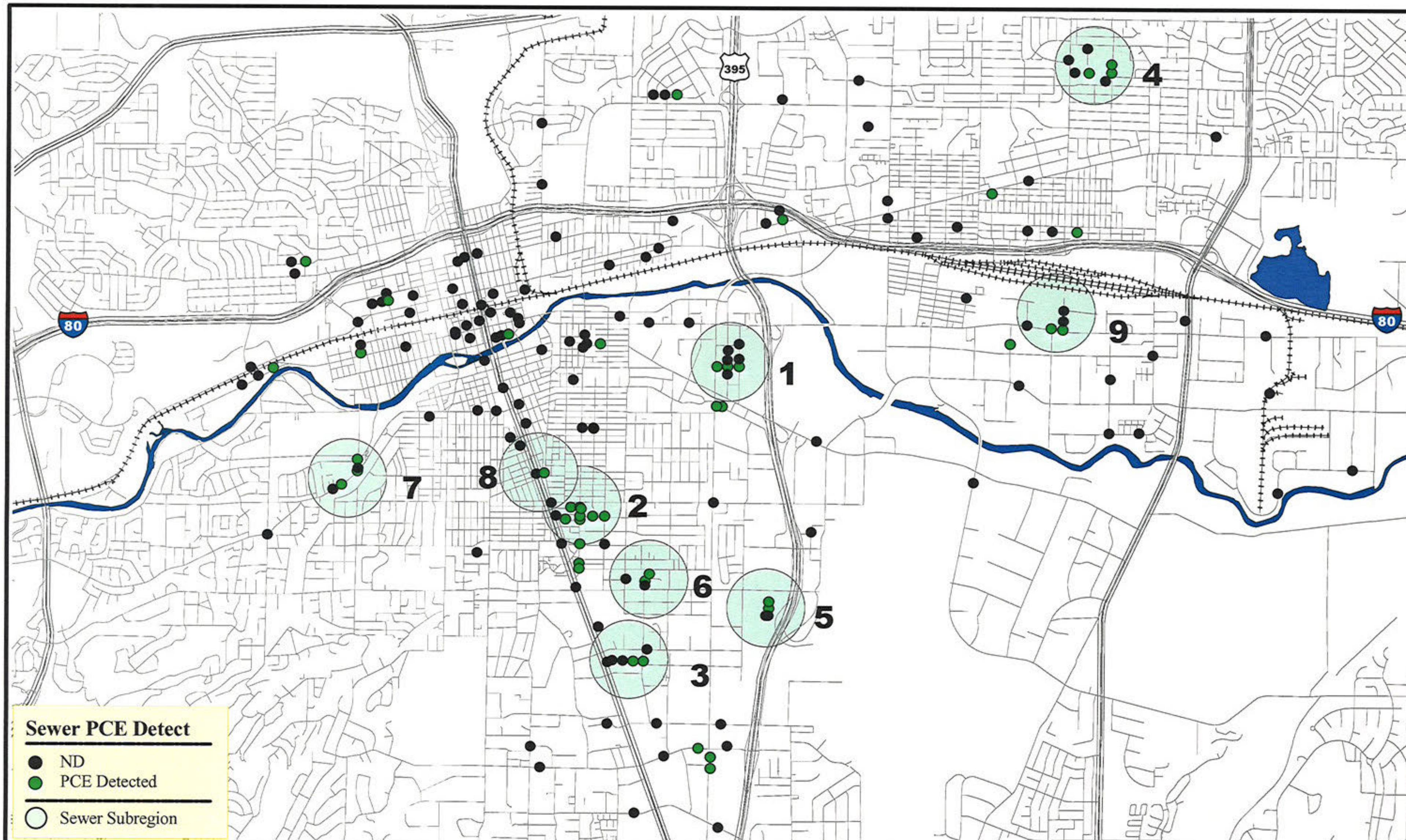


Figure 2-7 Sanitary Sewer Sampling Program Subregions

CTM
REMEDIATION
DISTRICT

Central Truckee Meadows Remediation District

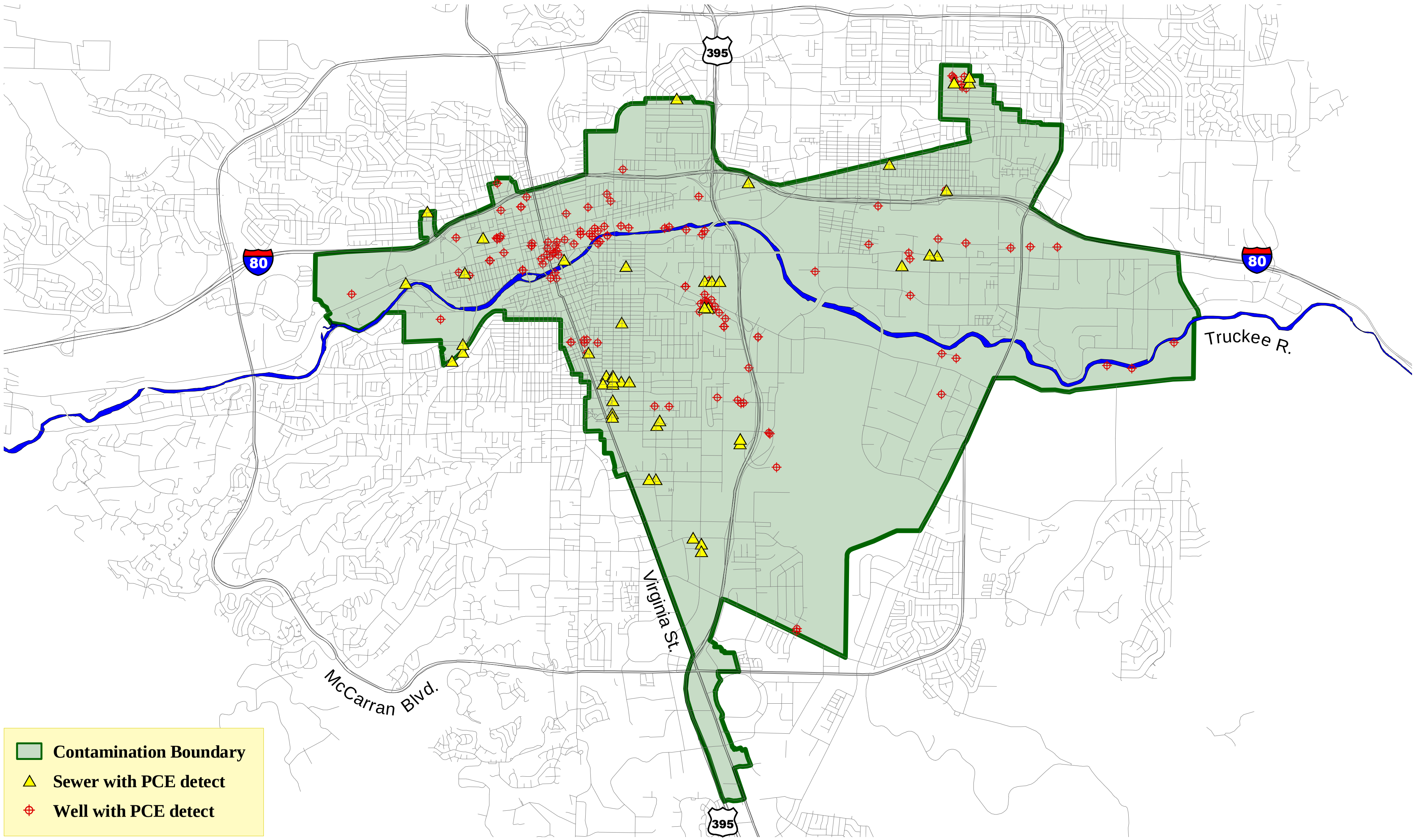


Figure 2-8 Summary of Sanitary Sewer PCE Detections Correlated to Groundwater Monitoring Well PCE Detections

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

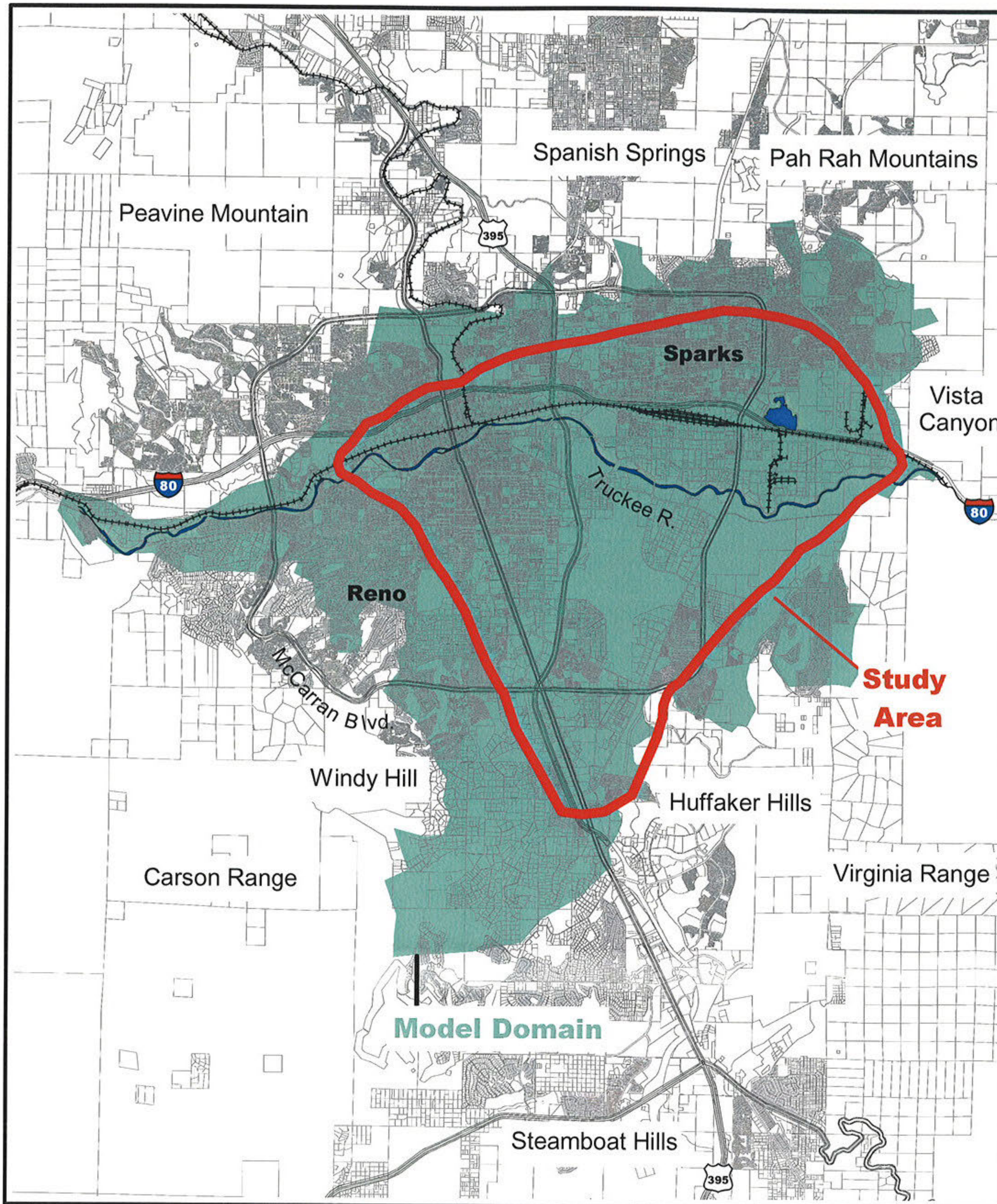
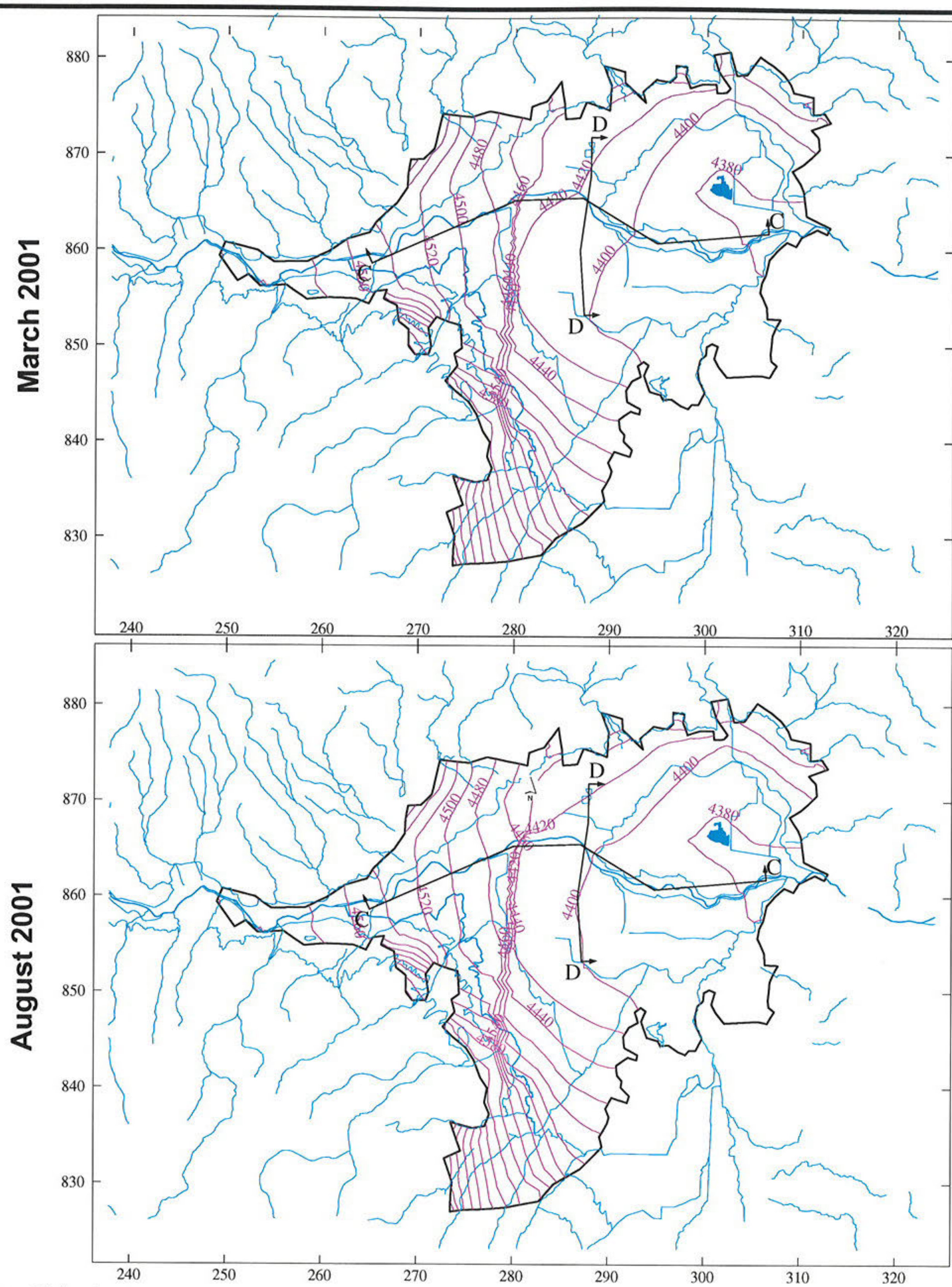


Figure 2-9 Groundwater Model Domain

CTM
REMEDIATION DISTRICT

Central Truckee Meadows Remediation District



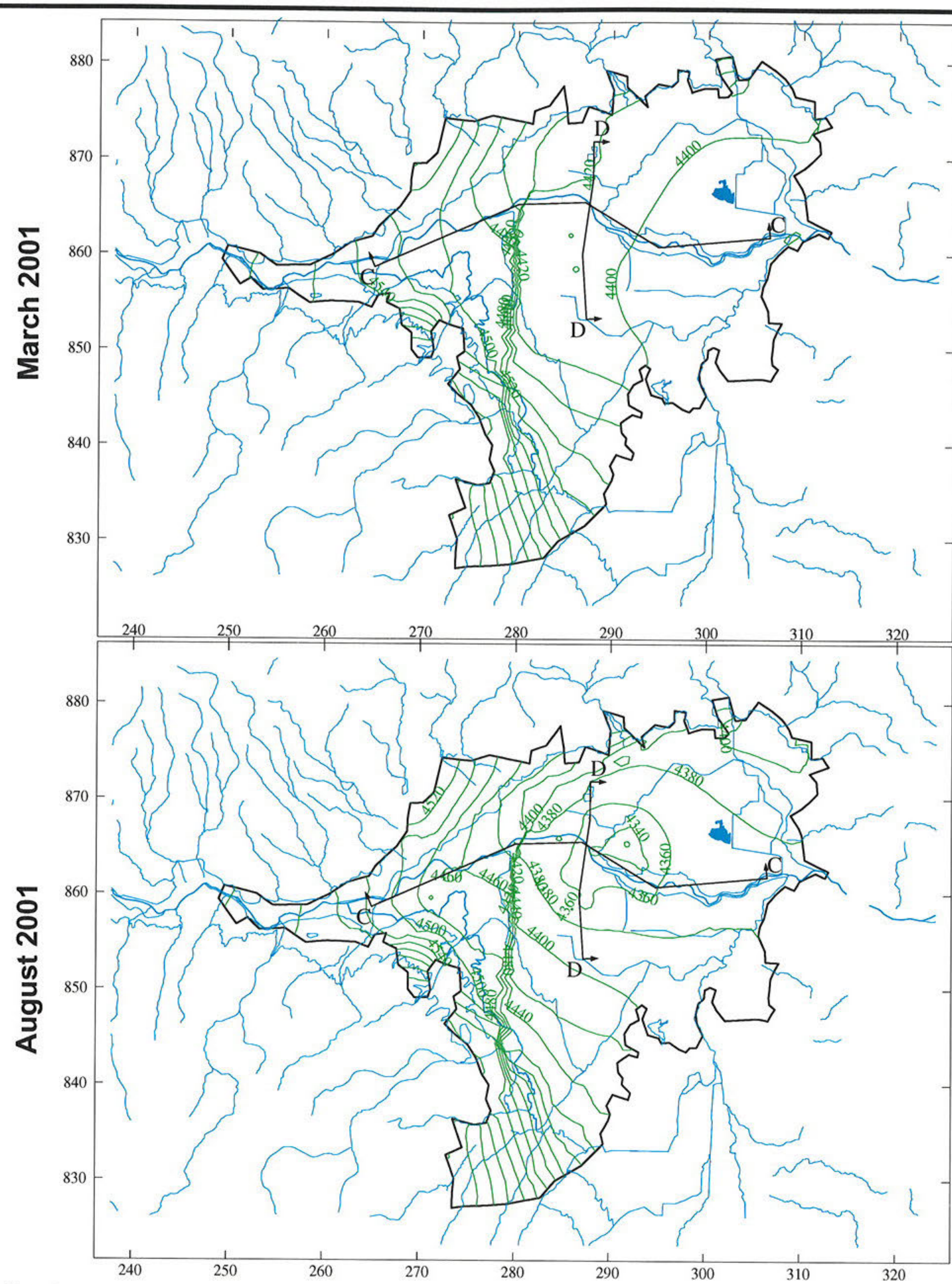
Note: Shallow heads are defined as level 7 in the model (simulated water table).

Figure 2-10 Simulated Water Levels in Shallow Aquifer

THOUSANDS OF FEET

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District



Note: Deep heads are defined as level 4 in the model (approx. 200-250 ft bgs).

Figure 2-11 Simulated Water Level in Deep Aquifer

THOUSANDS OF FEET

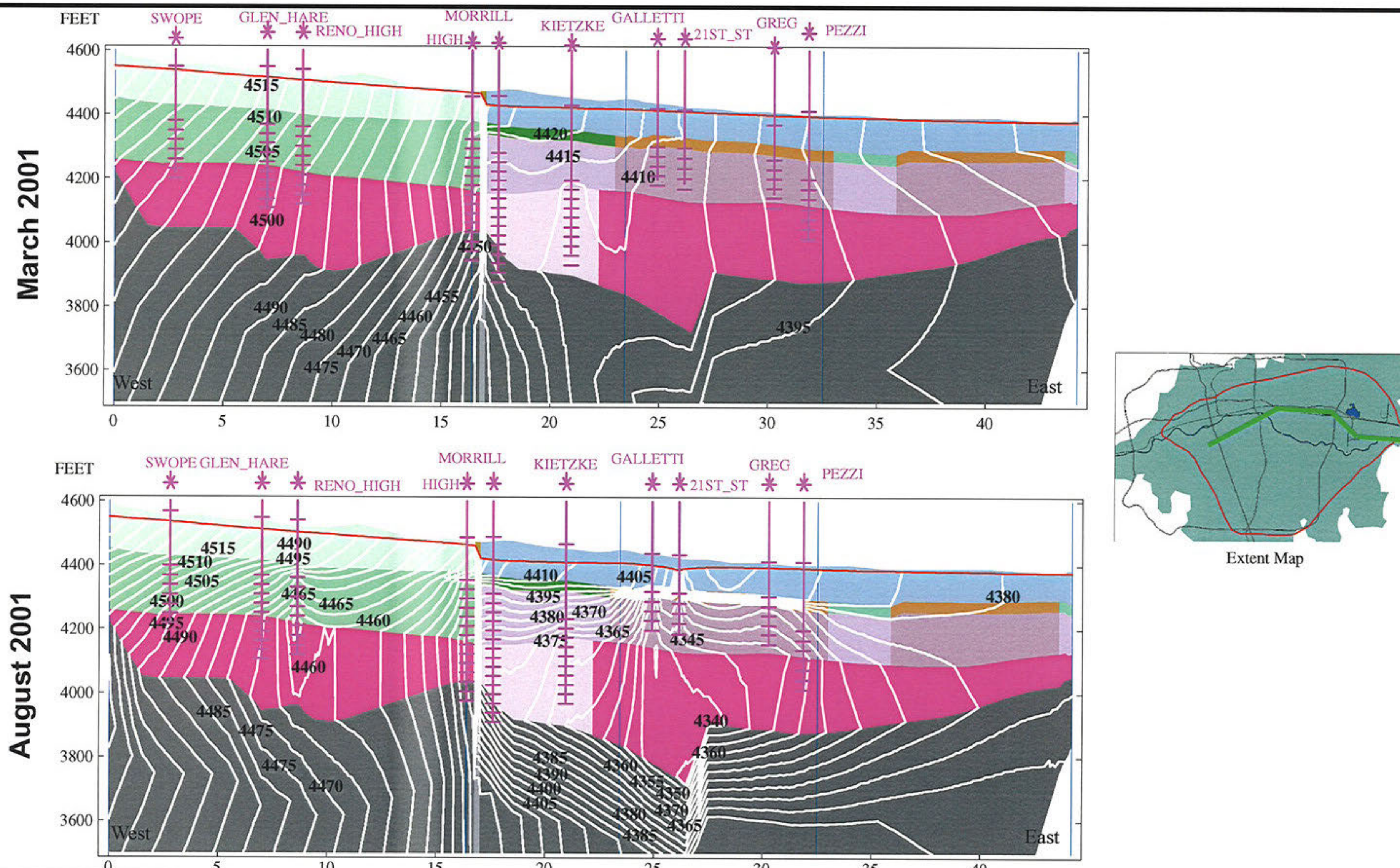


Figure 2-12 Simulated Water Level in East-West Cross Section

THOUSANDS OF FEET

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

S. Washoe County-
Sparks
Reno

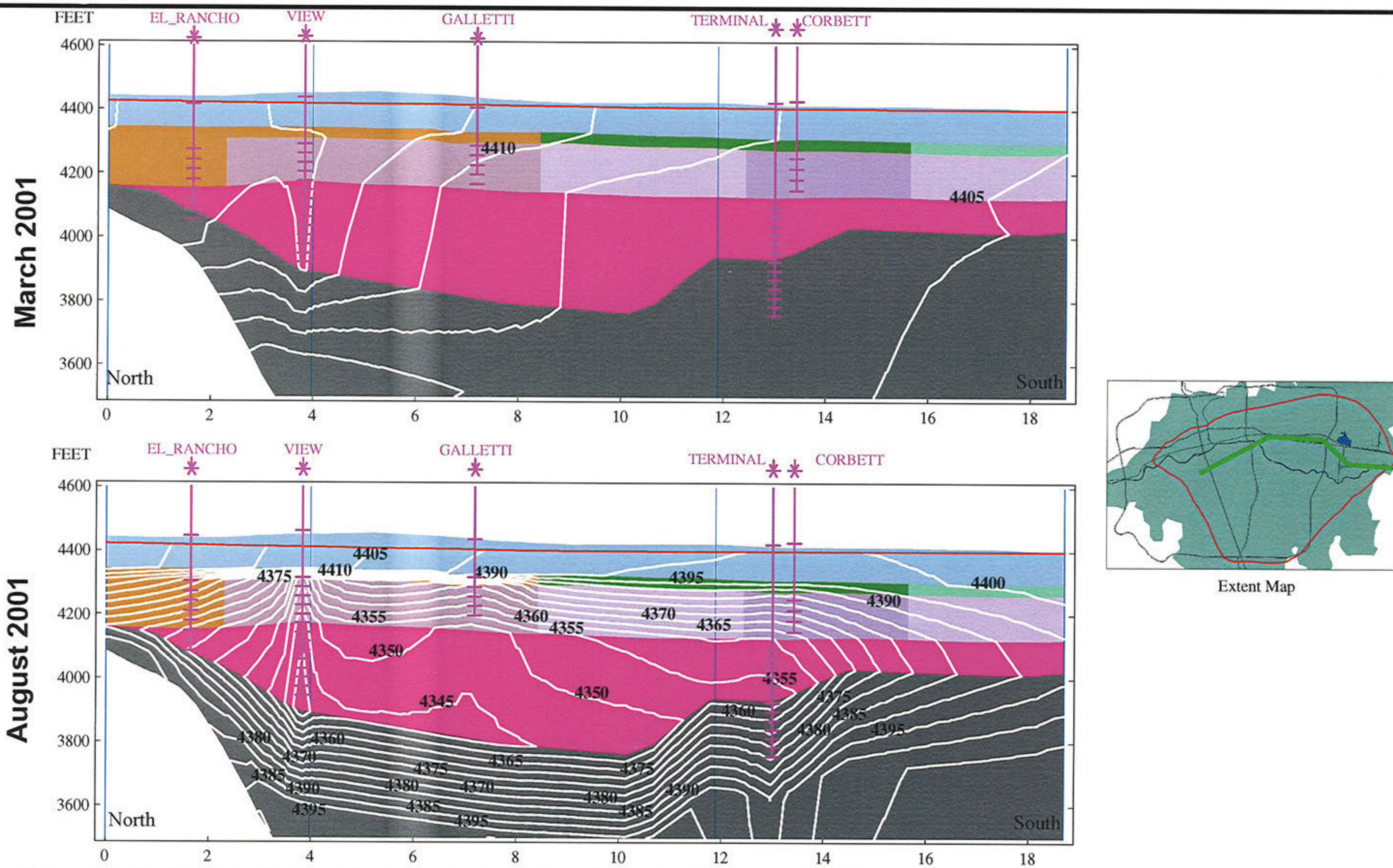


Figure 2-13 Simulated Water Level in North-South Cross Section

THOUSANDS OF FEET

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

S. Washoe County-
Sparks
Reno

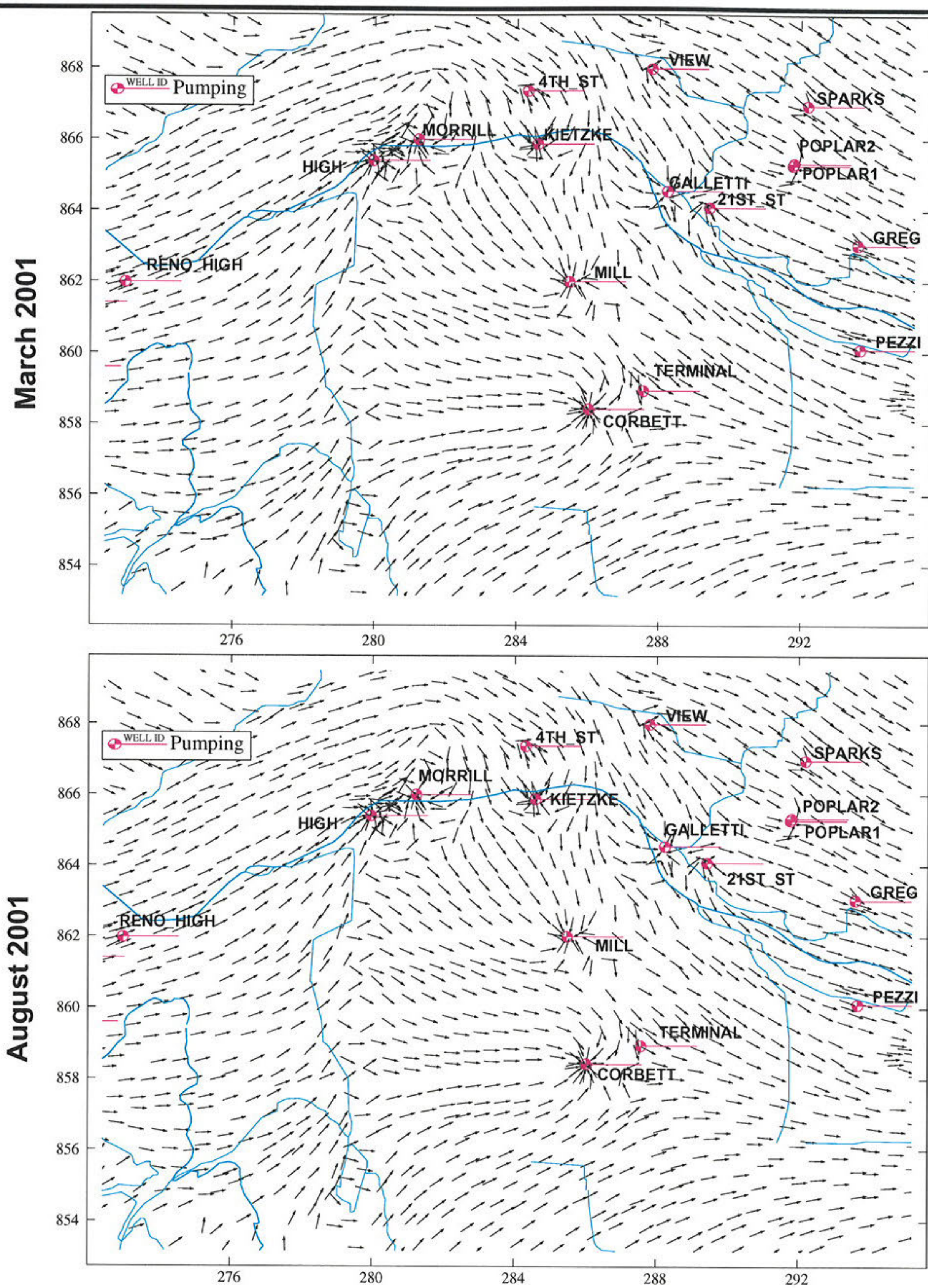
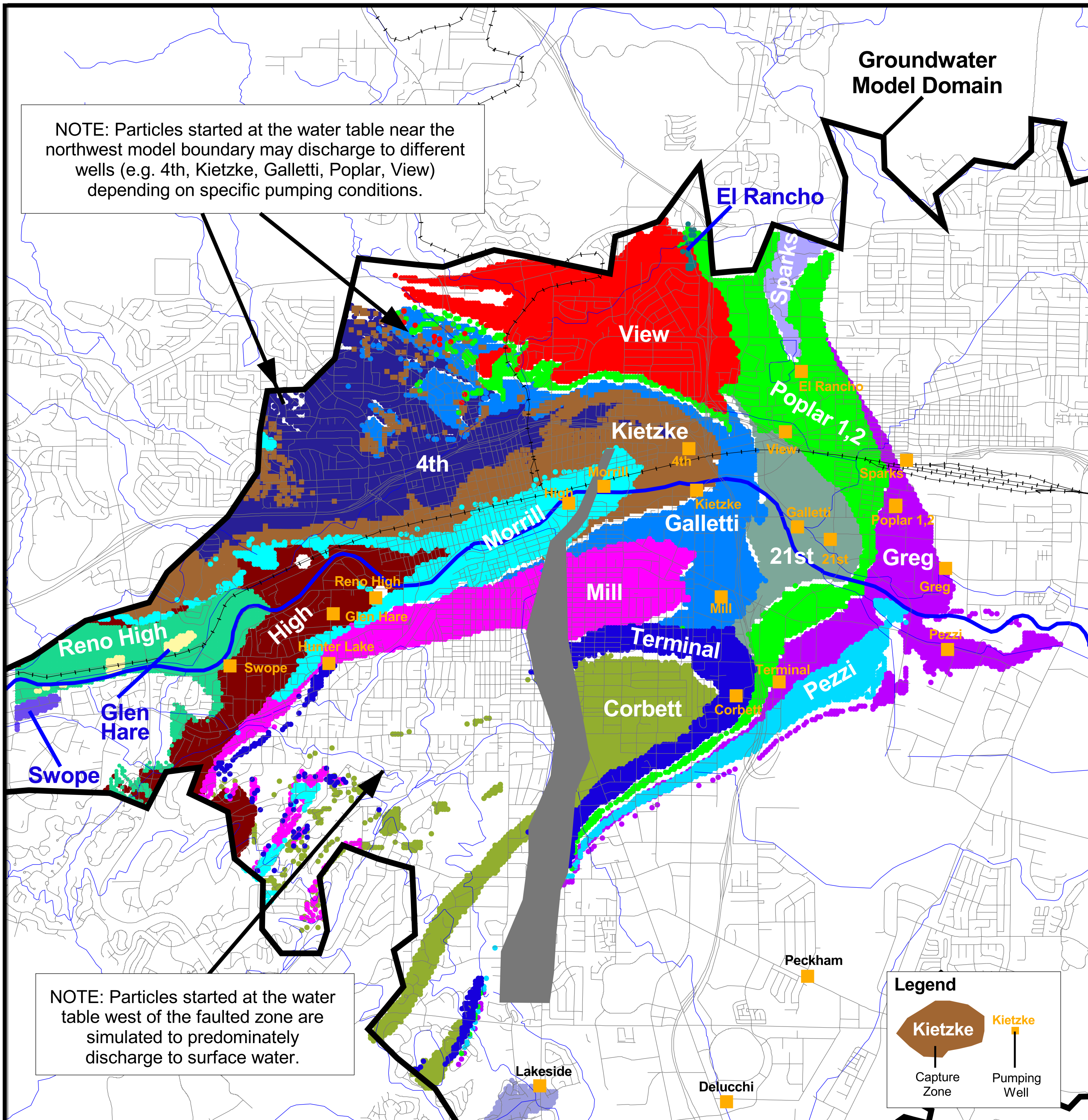


Figure 2-14 Simulated Velocity Vectors in Deeper Aquifer THOUSANDS OF FEET

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

Notes: Vectors are shown for Layer 4 - Vectors are not scaled.



Note: These capture zones were simulated using the transient August 1999 to August 2000 groundwater flow conditions. Simulations repeated this seasonal flow period to represent "long-term" or "eventual" patterns by reusing the seasonal flow pattern until the end of the simulation.

1 0 1 2 Miles

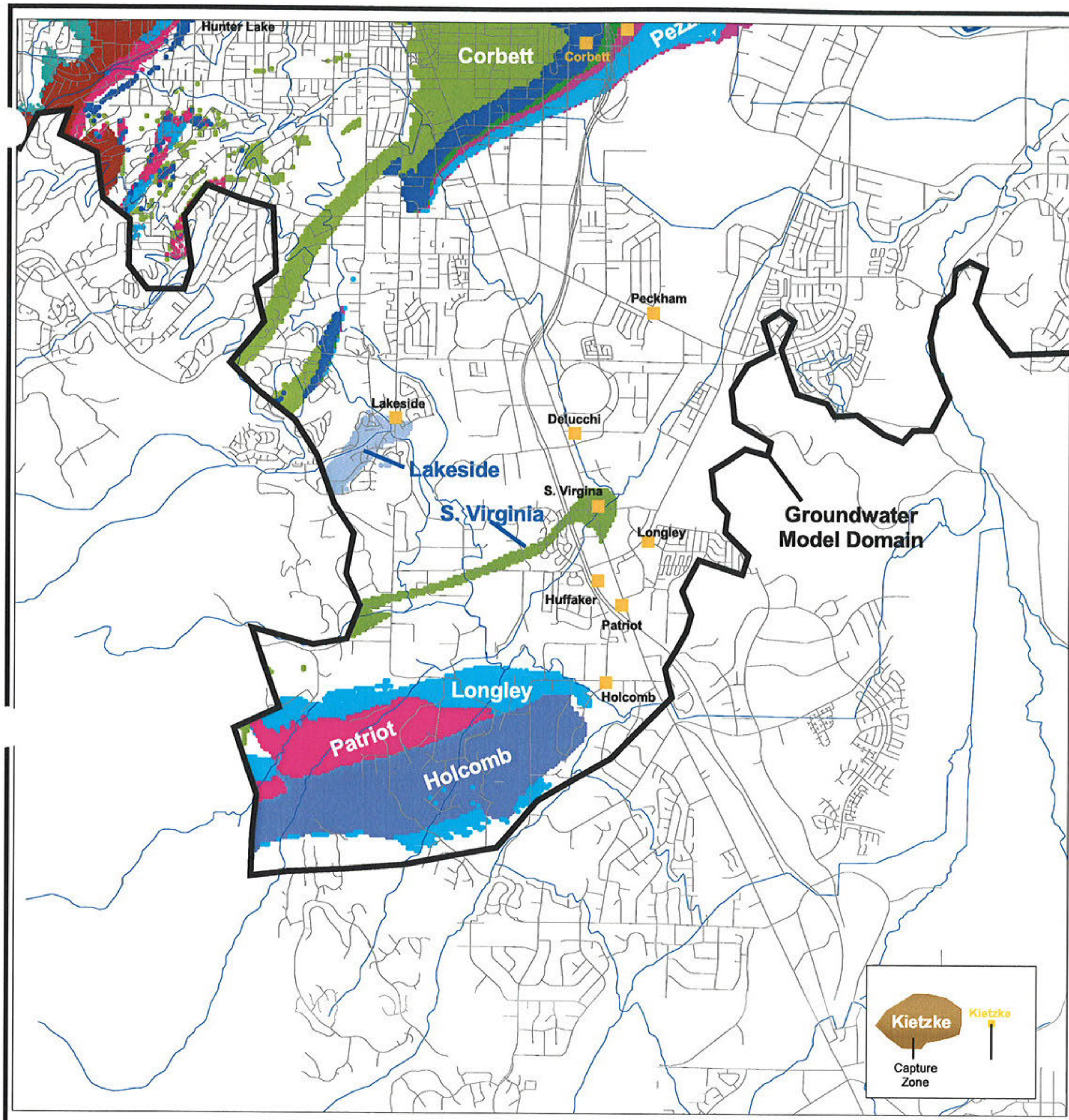
Figure 2-15a Simulated Water Table Capture Zones for TMWA Wells

THOUSANDS OF FEET

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

S. Washoe County- Sparks Reno



Note: These capture zones were simulated using the transient August 1999 to August 2000 groundwater flow conditions. Simulations were run to represent "long-term" or "eventual" patters by reusing the seasonal flow pattern until the end of the simulation

1 0 1 2 Miles

Figure 2-15b Simulated Water Table Capture Zones for TMWA Wells

THOUSANDS OF FEET

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

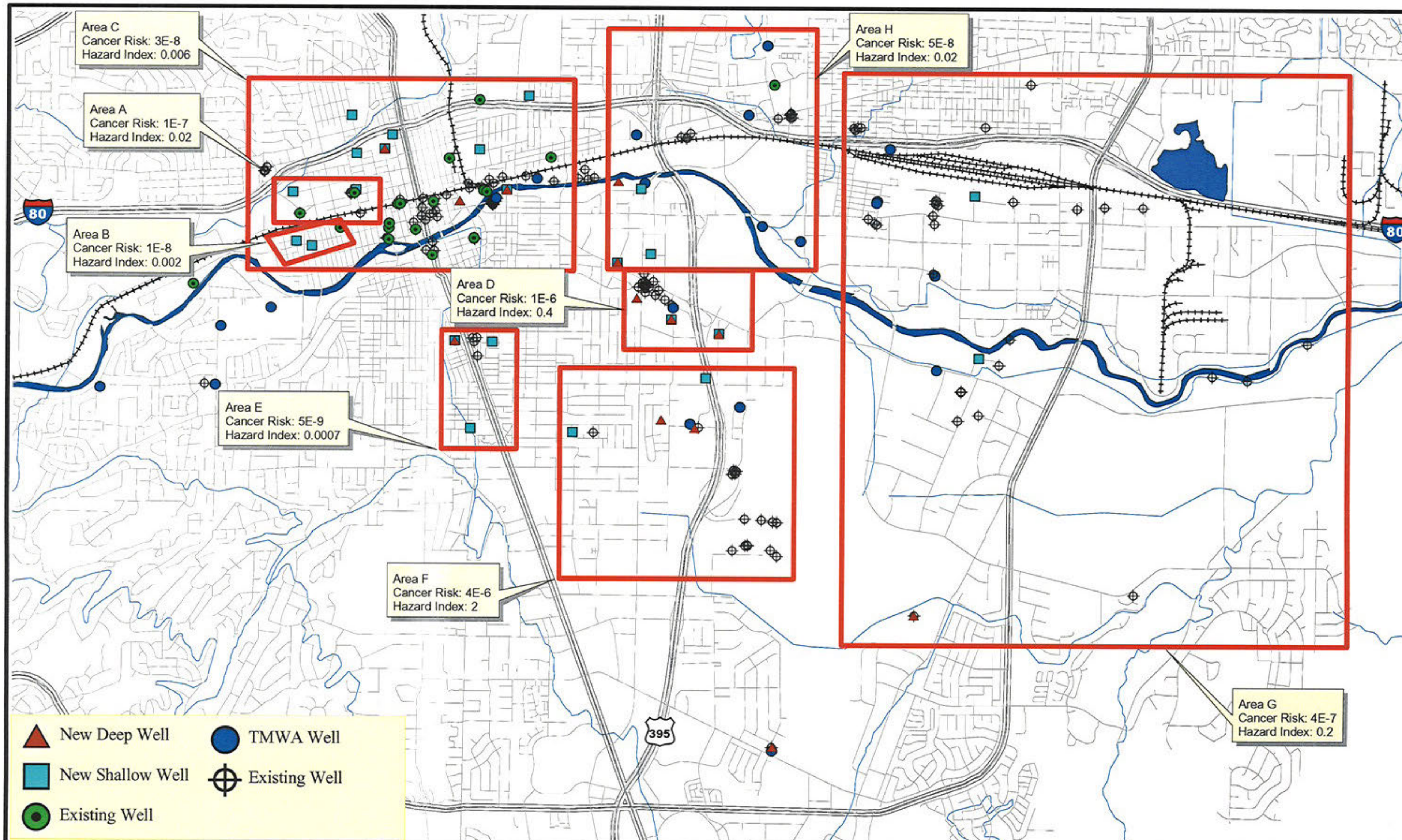


Figure 2-16 Cancer Risk and Hazard Index Values

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

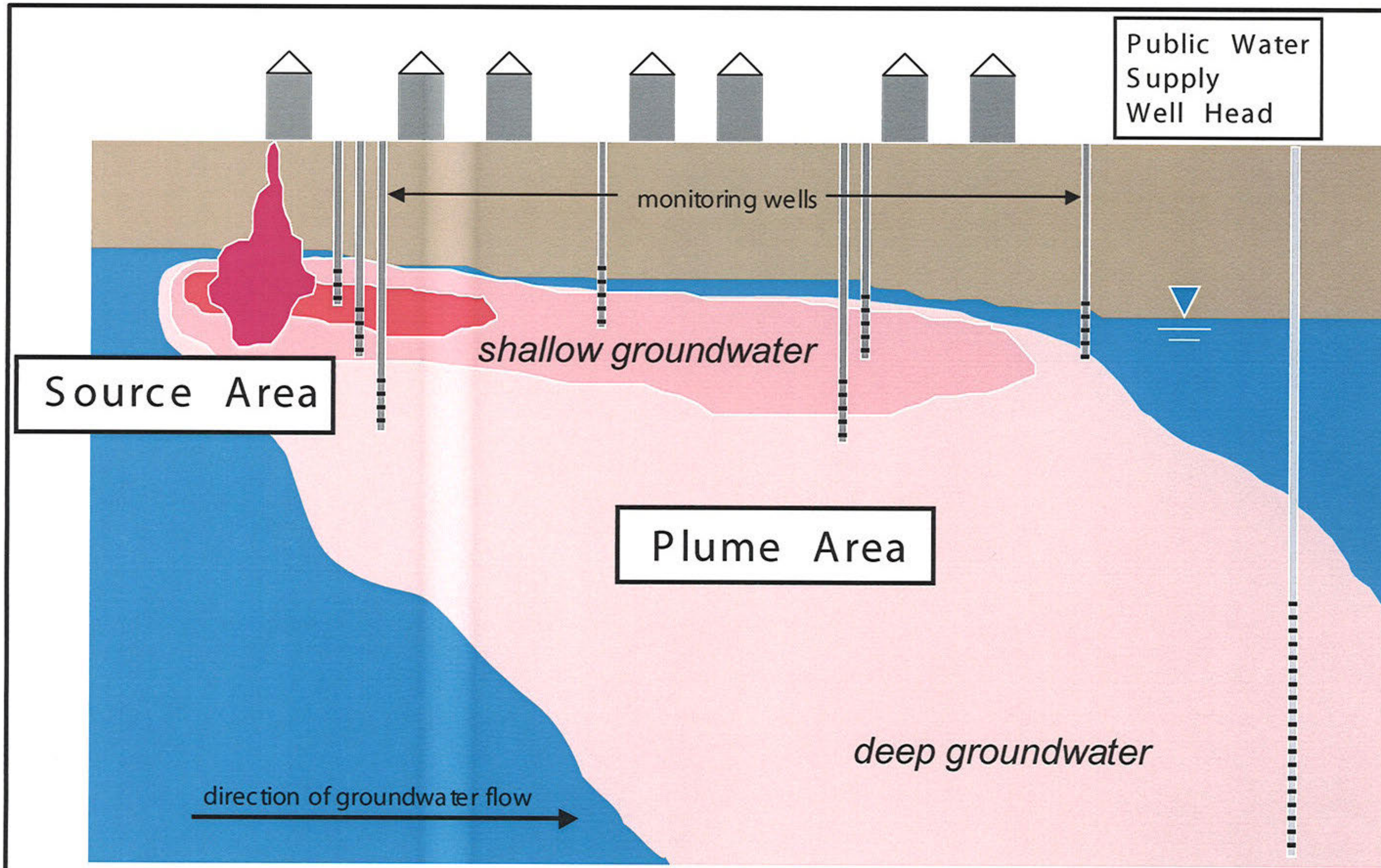


Figure 2-17 Conceptual Model of Contamination within the District

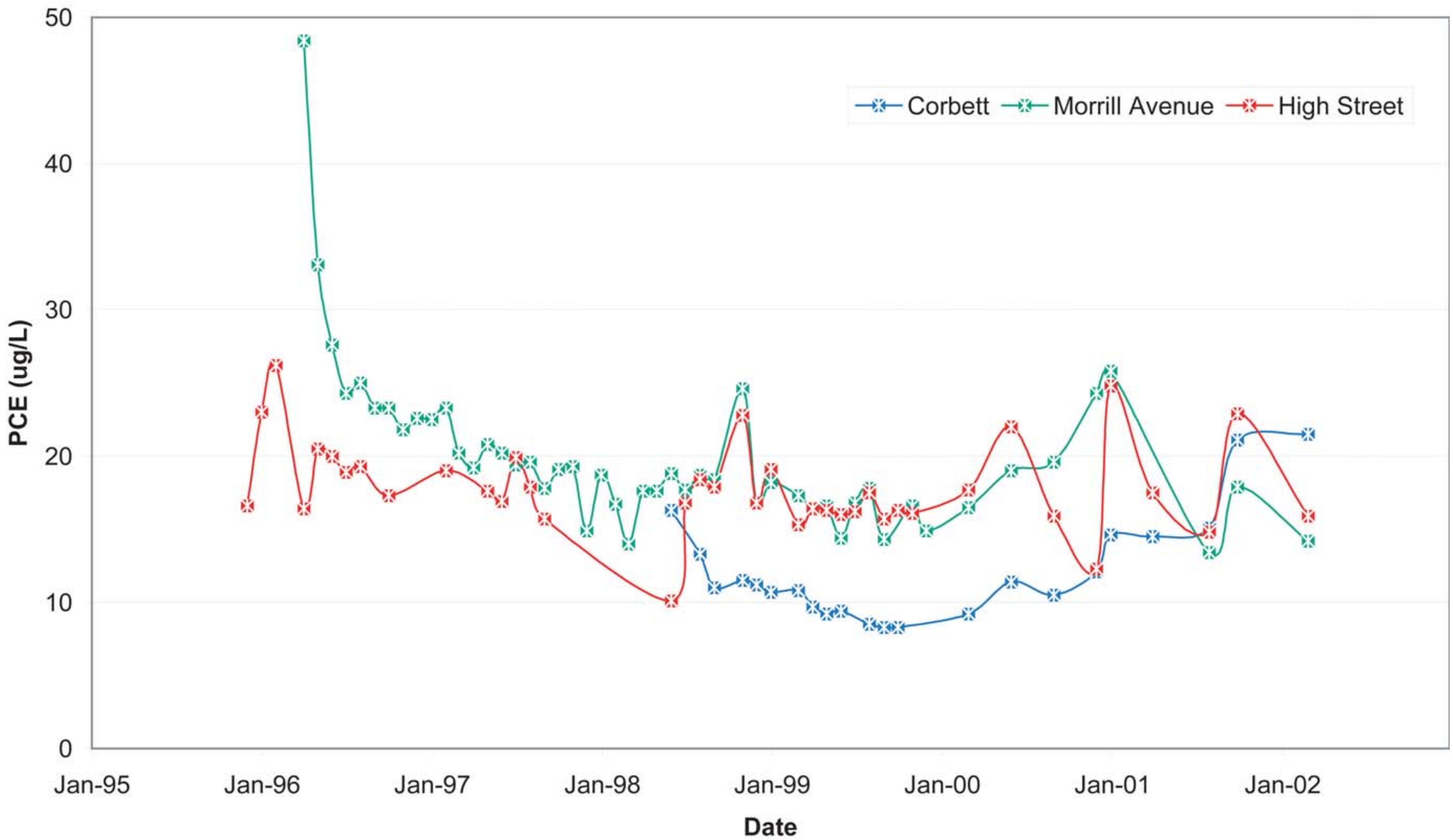


Figure 2-18 Time-Concentration Plots for PCE in TMWA Wells Corbett, Morrill Avenue, and High Street

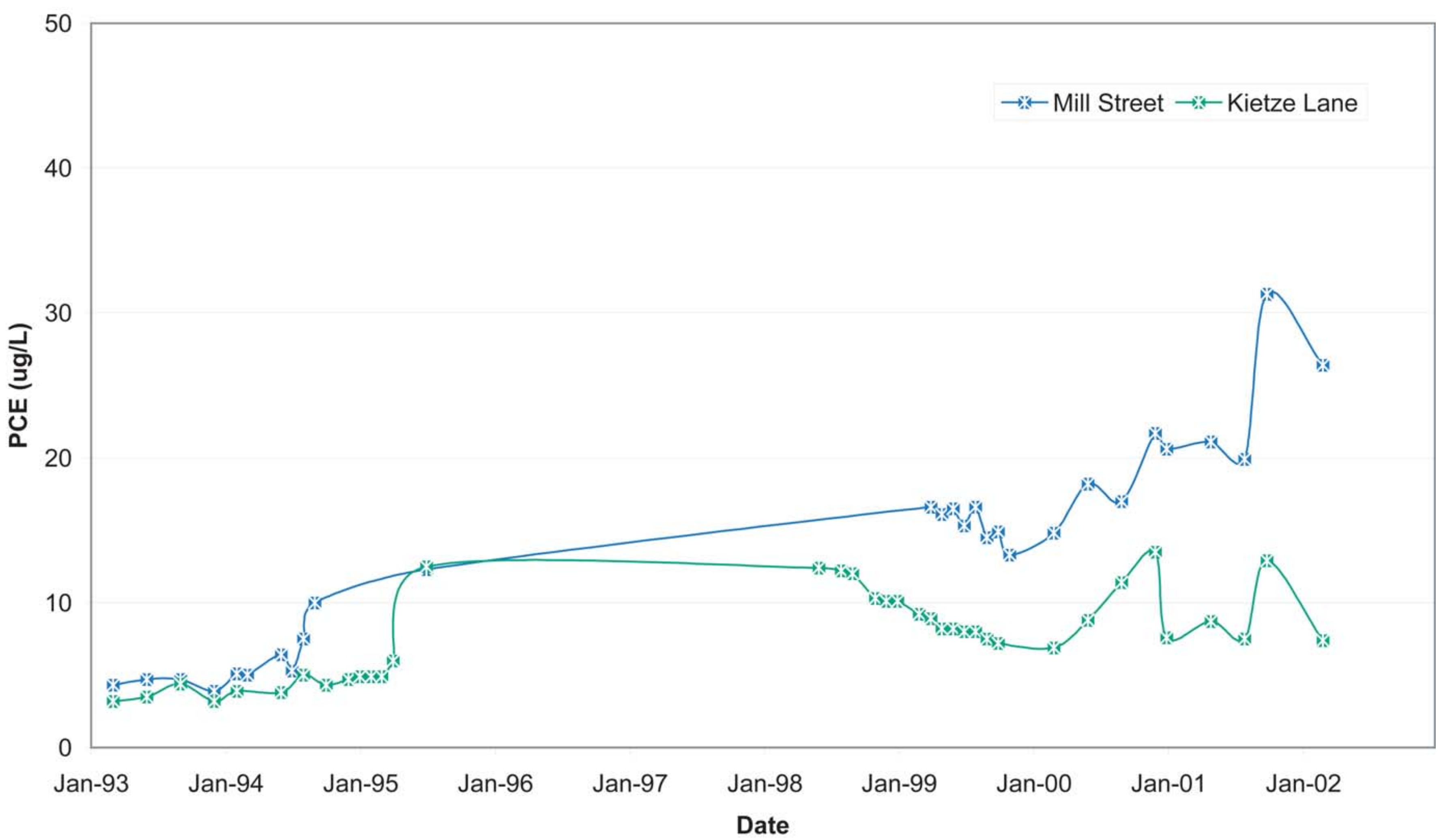


Figure 2-19 Time-Concentration Plots for PCE in TMWA Wells, Mill Street and Kietze Lane

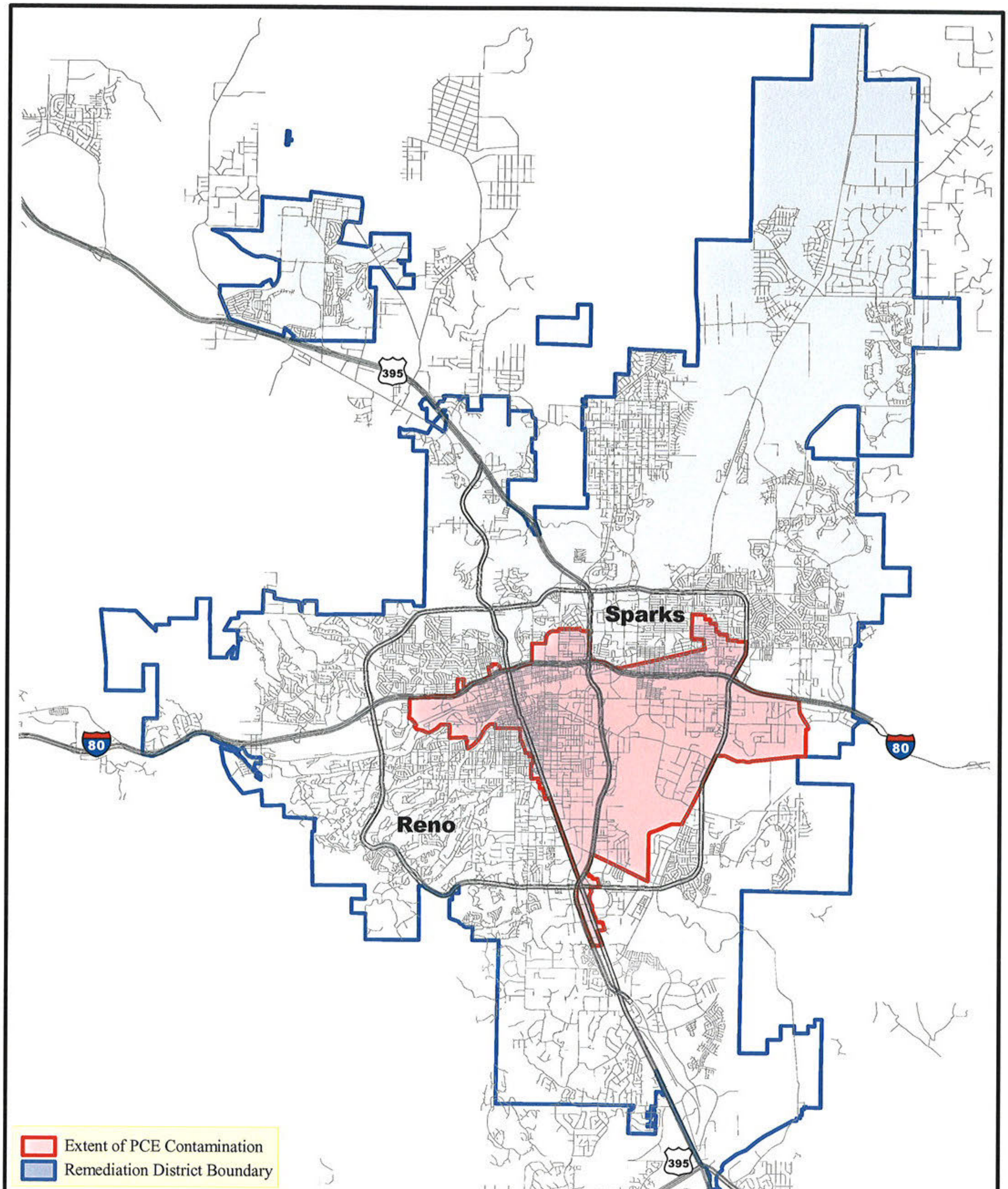


Figure 2-20 Known and Suspected PCE Distribution in CTM

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

Section 3
Remediation Management Plan Components

3.1 Introduction

This section of the RMP describes the various components of the Source Identification and Remediation Phase of the CTMRD and the purpose of each component. The components are intended to support remediation and long-term management of the PCE contamination found beneath the CTM. The key characteristics of the program are:

- **Applicability**. The program has been designed based specifically on the conditions within the CTM.

- **Simplicity**. The program has been designed to be as simple as possible, recognizing the complexity of the CTM hydrogeology and physical setting – one that is large (approximately 16 square miles) and deep (extending to over 350 feet below ground surface).

- **Flexibility**. It is anticipated that, over time, refinements and improvements to components of the remediation program may occur as a result of a shift in priorities based on new data or input from stakeholders. The remediation management program will have to be flexible enough to accommodate these changes and still be effective in meeting the overall Remediation District objectives and goals.

A listing of key activities that must be performed to implement the RMP components described in this section and an implementation schedule for performing the components and the key activities are presented in Section 4.

3.2 Remediation District Objectives and Goals

A presentation of the Remediation District Objectives (RDOs) and Remediation District Goals (RDGs) is relevant to framing the components of the RMP. The RDOs, which are based mainly on the requirements set forth in NRS 540A, are defined as:

- Protect the water quality within the CTM for municipal, industrial, or domestic uses.

- Protect from liability property owners that did not cause or contribute to subsurface PCE (and its degradation products) contamination that may impact drinking water within the CTM.

The RDGs, which translate the CTMRD objectives into more specific requirements for the selected remedial actions, have been defined as follows:

- Maintain the continued use of CTM groundwater for public water supply.
- Manage PCE in groundwater and/or surface water in such a manner as to protect property owners and potable water users in the CTM.
- Select remedial action(s) that are reasonable and economically feasible.
- Allocate equitably the costs associated with implementation of the RMP and its components.

3.3 Federal Procedures and Guidelines

The principal federal program available to address remediation of a contamination problem of the magnitude, complexity and extent of that found in the CTM is the Comprehensive Environmental Resource Conservation and Liability Act (CERCLA). Experiences with CERCLA suggest that it can lead to some undesirable affects including devaluation of properties, slow and costly cleanups and potential liability for all property owners within the boundaries of a designated CERCLA site. In part, the CTMRD was created as a surrogate for CERCLA but provided additional benefits to the community that are not available under CERCLA. In addition, federal guidelines for CERCLA sites stress the priority of performing "removal actions" to protect human health in situations where eminent health risks are known to exist. To this end, wellhead treatment of public water supply produced from wells with concentrations of PCE above regulated concentrations has been made a priority remedial action of the CTMRD.

3.4 Nevada State Statutes

3.4.1 NRS 540A

NRS chapter 540A, which was enacted in 1995, is the state statute that authorized the creation of the CTMRD and directs its activities. The principal purpose of the enabling legislation was to provide a mechanism to develop and implement remediation activities sufficient to assure the quality of water for municipal, industrial or domestic use within the region. Additionally, the statute provides protections to property owners who did not cause or contribute to the conditions for which the CTMRD was created.

The statute establishes the criteria by which remedial activities will be evaluated and what actions can be included in the plan for remediation. These elements are set forth in 540A.260(2) as follows:

> "2. The plan for remediation may include any action *which is reasonable and economically feasible* in the event of the release or threat of release of any hazardous substance into the environment which may affect the water quality in this state. Such action may include:

(a) Monitoring, assessing and evaluating the water which may be affected by the substance;

(b) Removing or disposing of the substance or remedying the condition of the water in any other manner; and

(c) *Taking such actions as are necessary to prevent, minimize or mitigate damage to the affected water.* [Italics supplied for emphasis.]"

In adopting what is now NRS 540A.250 to 540A.285 the Nevada Legislature provided direction to remediation districts to determine what remediation actions are appropriate to "prevent, minimize or mitigate" damage to groundwater of the district and which are "reasonable and economically feasible" to accomplish the proposed remedial activity. Remediation standards established under NRS540A are consistent with the standards established in other state and federal laws, which address environmental contamination. What NRS 540A offers that these other laws do not provide for is a mechanism for a community wide solution to a community wide problem.

NRS 540A gives the BCC the authority to seek funding and implement those remediation actions that are determined to be reasonable and economically feasible. The BCC does not have the discretion, however, to withhold funding from remedial actions that are deemed to be reasonable and economically feasible.

3.4.2 Other Nevada State Statutes

State statutes, which include the Nevada Water Pollution Control Law (NRS445A) and the Nevada Waste Management Law (NRS459), also provide some mechanisms to address contamination situations like those found in the CTM. These statutes, however, are structured to address an individual owner or responsible party and would be difficult to apply across an area as large as the CTMRD with many individual owners and responsible parties. Nonetheless, these statutes provide guidance to the CTMRD during planning and implementation of remediation activities.

3.5 Areas of Application for Remediation Management Plan Components

As discussed in Section 2 of this document and in the *Remedial Technologies Identification and Screening TM*, remedial actions have been designed to address the "points of application" beneath the CTM – source areas, groundwater plume areas (shallow and deep), and potable water supply wellheads. For the purposes of development of remedial actions, two areas of application have been defined: (1) *Source Areas and Shallow Groundwater Plumes* and (2) *Deep Groundwater and Wellhead Treatment*. Each of the areas of application is described below:

Source Areas and Shallow Groundwater Plumes. Source areas are considered to be directly linked to shallow groundwater plume areas. Deep groundwater plumes, however, were excluded from the "source area" remedial actions because of three issues:

- First, once contamination from a single source area migrates downward, it is likely to "co-mingle" with other contaminants that originated as shallow groundwater plumes that have also migrated into the deeper portion of the aquifer. Therefore, deep groundwater plumes in the CTM are generally not considered to be linked to any one source area, but rather a group of source areas.

- Second, the costs of performing characterization and remediation on shallow groundwater plumes are significantly less than performing the same activities on deep groundwater plumes. As an example, there are greater costs associated with investigating deep aquifer conditions and greater cost per unit of PCE mass removal due to the generally lower PCE concentrations in the deep aquifer.

- Third, removal of PCE from deep groundwater is currently ongoing in the form of wellhead treatment on five existing public water supply wells when that water is removed for beneficial uses.

Application of the RMP to source areas and groundwater contaminated with PCE will be the focus of much of the cooperative activities among members of the TWG. As will be discussed in more detail within this section and in Section 7, the CTMRD, with concurrence and, at time, formal support from the TWG, will make recommendations to the BCC regarding the expenditure of CTMRD funds for source area prioritization; characterization; and evaluation, selection, and implementation of remedial actions, as appropriate. In addition, the TWG will aide in the identification of source areas and related shallow groundwater plumes that may be candidates for enforcement actions by NDEP.

Deep Groundwater Plumes and Wellhead Treatment. Deep groundwater PCE plumes have been shown to be tributary to several TMWA water supply wells. Wellhead treatment is currently used to remove PCE from water pumped from five TMWA water supply wells (Kietkze, Mill, High, Morrill, and Corbett). Wellhead treatment for these wells was implemented rather than replacing the wells. Application of this wellhead treatment technology will continue for any additional wells where PCE concentrations exceed safe drinking water standards, for the following reasons:

- The alluvial aquifer system from which Reno and Sparks draw groundwater is limited in aerial extent, bounded on all sides by mountains and bedrock outcrops. Therefore, there are no "untapped" aquifer systems that are available for new water supply production.

- The quality of the groundwater contained within the CTM basin is impacted by naturally occurring arsenic and geothermal activity, limiting the location of viable well sites for potable water supply.

- Adjacent valleys (e.g., Lemmon Valley and Spanish Springs) are closed basins, where current groundwater pumpage exceeds (or is equal to) the basin yield. Therefore, additional groundwater production from these valleys is restricted by the State Engineers Office, and is not allowed.

- Local infrastructure that allows produced groundwater to maintain system pressure for fire fighting and public water supply in metro area structures is linked to those wells that currently have wellhead treatment. Relocation of these wells would require a significant investment in construction of infrastructure improvements to replace existing water distribution system piping and pumps.

- Finally, wells with existing wellhead treatment exert some degree of plume control within the deep aquifer. Relocating these wells to other locations within CTM would allow PCE contamination in the deep aquifer to migrate unchecked and uncontrolled toward "clean" water supply wells located in other areas within the deep aquifer (e.g., TMWA wells in the eastern portion of the CTM).

3.6 Remediation Management Plan Components

The RMP is intended to identify a range of activities that will be used to control, manage and remediate the PCE contamination beneath the CTM in both the short-term and the long-term. Remediation of the contamination conditions consists of providing treatment for the public water supply wells, eliminating/remediating sources and contaminated groundwater (to the extent that such actions are reasonable and economically feasible), and monitoring the effects of these actions on the groundwater. Peripheral support activities are also included in the RMP, since administrative, public outreach, and educational tasks are vital to the success of the RMP implementation.

Therefore, the RMP components are differentiated into three categories, based on the nature of the remedial actions to be performed and the type of benefits that are provided by the actions.

- <u>Clean Drinking Water Activities</u> – focused on the removal of PCE from the public drinking water supply to the benefit of water users within the TMWA wholesale and retail service area.

- <u>Remedial Activities</u> – focused on the identification, characterization, evaluation, and remediation of historic sources of PCE, and the related monitoring programs requisite to all remedial actions to the benefit of residential and commercial property owners located above the areas containing or suspected of containing PCE contamination.

- Program Outreach, Education, and Administration Activities – focused on the management of resources to optimize the remedial activities including outreach and educational tasks, and project administration and fund management to the benefit of water users and property owners.

Note that the management activities critical to the implementation of the RMP exist within each of these categories of RMP components. As discussed in detail in Section 7, management of the implementation of the RMP will be conducted chiefly by Washoe County DWR, in collaboration with NDEP and WCDHD. These three entities working in a cooperative partnership will provide direct input and guidance to the BCC regarding all technical aspects of the RMP implementation that support the wise expenditure of CTMRD funds to perform the clean drinking water activities; the remedial activities; and the program outreach, education and administration activities.

Each of the RMP components is described in detail below.

3.6.1 Clean Drinking Water Activities

The goal of the clean drinking water activities described in this section is to remove PCE from the drinking water supplied by TMWA's groundwater production wells. These measures include wellhead treatment and pumping plan implementation.

3.6.1.1 Wellhead Treatment

Wellhead treatment of groundwater produced for public water supply is a vital component of the RMP. In fact, if funding becomes limited for any reason during the implementation of the remediation program, wellhead treatment will most likely take priority over any other remedial activity.

PCE in the deep groundwater has been characterized as being widespread and dilute (average concentration of 15 to 20 micrograms per liter (μg/L) over the entire CTM). Further, remediation of deep groundwater is generally limited to different types of "pump and treat" technologies. Small scale or localized pumping of groundwater from the deep aquifer is considered neither reasonable (because only a limited amount of PCE within deep aquifer would be removed) nor cost effective (because deep extraction wells are expensive to construct and operate, and it is expensive to dispose of treated groundwater under the State's UIC or NPDES programs). For these reasons, remediation of the deep groundwater is considered to be reasonable and cost effective only on a large scale by wellhead treatment at existing water supply wells.

Large-scale contaminant mass removal through groundwater treatment has been ongoing since 1996. The key characteristics of wellhead treatment at the TMWA water supply wells include:

- Public water supply pumping removes large volumes of deep groundwater for treatment.

- Public water supply pumping helps to control migration of the PCE plume to water supply wells that are not currently above the MCL for PCE.

- Treatment of groundwater from the five TMWA wells removes an estimated 20 gallons of "pure" PCE each year.

- Wellhead treatment performs perhaps the most important single action associated with the existence of the CTMRD – protection of the citizens of CTM from direct exposure to PCE in their drinking water.

- Wellhead treatment at the public water supply wells eliminates the need for developing and implementing costly treated water discharge permitting programs through either the state's UIC or NPDES programs.

- Wellhead treatment allows for the beneficial use of the treated water without substantial infrastructure costs that would be associated with new production and distribution facilities that would be required for distributing potable water produced by non-drinking water supply wells.

Wellhead treatment at public water supply wells does not include any specific investigation or monitoring activities to be performed by the CTMRD because the owners of all public water supply wells are required to perform routine monitoring for water quality, including testing for PCE. Further, no decision-making activities need to be developed to control the distribution of groundwater that exceeds safe drinking water standards for if the PCE concentrations in groundwater from an untreated water supply well exceed acceptable concentrations, then the owner is required to cease use of the well for public water supply until such time that appropriate treatment can be installed and operated. Under these circumstances, the owner of the well will be given the option to contact the CTMRD to determine if wellhead treatment is appropriate for their facility.

The need for wellhead treatment will be identified through data collection and other activities that well owners, rather than the CTMRD, conduct. CTMRD resources will be committed to work with water purveyors to identify methods other than wellhead treatment to protect the public drinking water supply (e.g., placement of new wells, and development and implementation of a pumping plan) realizing that the effectiveness of other methods may be limited, as discussed earlier.

The elements of the wellhead treatment component that the CTMRD will fund are as follows:

- Continue to pay the debt service for the bond used to finance wellhead treatment for the Kietzke, Corbett, Mill, High and Morrill Street wells.

- Continue to pay for operation and maintenance of wellhead treatment for these five wells.

- Continue to update and evaluate the Pumping Plan that was developed for purposes of defining minimum daily groundwater production rates from wells with wellhead treatment.

- Create an account that can be used: to finance future wellhead treatment design, construction, and, as appropriate, operations and maintenance for wells that do not currently have wellhead treatment but will require it sometime in the future; or finance other types of remedies deemed appropriate for protection and/or treatment of groundwater produced for potable water supply (or other municipal, industrial or domestic uses).

3.6.1.2 Pumping Plan Implementation

A Pumping Plan agreement was developed between the CTMRD and TMWA (formerly Sierra Pacific Power Company) defining a minimum daily quantity of water that must be pumped from each of the five water supply wells with wellhead treatment. The objective of the Pumping Plan is to maintain a degree of hydraulic control on the deep aquifer zone impacted by PCE, thereby limiting migration of the PCE plume downgradient of the five water supply wells. As described in Section 2, Figures 2-14a and 2-14b, the average capture zones of the five TMWA wells do capture a significant portion of the PCE contamination migrating from beneath downtown Reno and from South Virginia Street. However, other sources of PCE are expected to exist in other areas not contained by these wells. Therefore, sampling of water supply wells downgradient of the five existing treated wells will continue to be performed to assess the need for groundwater treatment systems on additional water supply wells.

As more information is collected and a better understanding of the relationship between the groundwater contamination and water supply production is developed, the CTMRD will work with TMWA to re-evaluate and update the current Pumping Plan. The effort of re-evaluating and updating the Pumping Plan will include database management, groundwater modeling, and alternative evaluations conducted through a cooperative partnership between CTMRD and TMWA.

3.6.2 Remedial Activities

The three elements of Remedial Activities, which have been identified based on the data collected and discussions with NDEP and WCDHD, are groundwater monitoring, MNA, and source remediation. These activities appear, at this time, to be the only cleanup activities that are reasonable and economically feasible.

3.6.1 Groundwater Monitoring Program

Groundwater monitoring will continue to be performed as part of the overall CTMRD remediation program. The objective of the groundwater monitoring will be to track water quality conditions beneath the CTM, including the naturally occurring processes that contribute to the attenuation of shallow and deep groundwater contamination (i.e., MNA as described below). A description of the groundwater monitoring program including MNA components is provided in Appendix E.

3.6.2 Monitored Natural Attenuation (MNA)

Monitored Natural Attenuation (MNA) is an *in-situ* remediation technology that involves naturally occurring processes (e.g., biodegradation, dispersion, matrix diffusion, sorption, volatilization, and chemical degradation). These processes serve to reduce the concentration, and in some instances, mass of contaminants in groundwater and soils. MNA is recognized by the U.S. Environmental Protection Agency as a viable method of remediation that can be evaluated relative to contaminants, and the chemical, physical, and biological characteristics of the soil and groundwater to determine its effectiveness at a particular location (EPA, 1999). This method of remediation may be used as the sole remediation technology when it: (1) is combined with some degree of source control; (2) is shown to be fully protective of human health and the environment; and (3) meets remedial objectives within a reasonable time frame. Data generated as part of the groundwater monitoring program will be used to evaluate the effectiveness and applicability of MNA to the conditions within the CTM. MNA may also be used in combination with other process options as a concurrent technology, or in a phased manner following the completion of other technologies.

For the CTMRD, a demonstration of the effectiveness of MNA is limited by the current lack of knowledge regarding the nature and location of existing source areas – either historic or ongoing. Therefore, as information is gathered to locate and characterize source areas, and as remedial actions are developed and implemented – either by CTMRD or by responsible parties with NDEP oversight – MNA should become increasingly viable and important in the control, management, and remediation of PCE within CTM. In this light, MNA is considered to be part of the long-term strategy for remediation of the PCE in CTM, but not necessarily the short-term. Nonetheless, CTMRD resources will be committed to performing MNA-type analyses and evaluations in a fashion consistent with federal guidelines in conjunction with its groundwater monitoring efforts to allow for the establishment of historical PCE concentration trend information critical to observing the impacts of MNA over a long period of time.

3.6.3 Source Area Remediation

Source area remediation is considered to be both a short-term and long-term solution to the PCE contamination within CTM since a key component of the overall remediation program is to eliminate as many sources of PCE that may be contributing to the PCE groundwater contamination found beneath the CTM as is reasonable and economically feasible. Based on the nature of the PCE contamination, it is estimated that there may be dozens, if not hundreds, of currently unidentified sources, including both those of historic origin and current discharges. Presented in this section is a process by which PCE sources or source areas and their related shallow groundwater plumes, once they are identified, will be addressed. The process of controlling, managing, and remediating source areas (i.e., the PCE Source Management Process) involves source characterization; responsible party identification; evaluation of remedial actions; and, if appropriate, implementation of remedial actions.

Since the CTMRD does not have unlimited taxpayer revenues to implement remedial actions on sources, the PCE Source Management Process allows for ranking of potential PCE source areas based on various criteria established to estimate the potential for sources to impact public water supply and human health. As will be discussed below, this ranking, or prioritization effort will be utilized to aide in the process of allocating CTMRD resources.

The PCE Source Management Process, as illustrated in Figure 3-1, includes a number of linked activities. These linked activities, performed as a collaborative effort among the Technical Working Group members, are highlighted below.

- **Prioritization Ranking of Potential Source Areas** – Based on available data from various entities develop a prioritized listing of sites and potential source areas for further action under this program. Further action may include source characterization efforts, referral to NDEP, source remedial evaluations, and/or source remedial actions.

- **Source Characterization** - Conduct source characterization activities on those potential source sites and areas that are determined by the TWG members to be of the highest priority.

- **Responsible Party Evaluations and Source Referrals** - Review to determine whether or not adequate information has been collected to differentiate a potential source area from regional conditions, and identify a localized area or parcel as the location of the source. Upon consultation with NDEP, and once adequate evidence has been collected pursuant to NRS 540A.280, the CTMRD will refer certain cases to NDEP for appropriate action. The Cooperative Agreement to be developed among Washoe County DWR, NDEP, and WCDHD will refine the source referral process.

- **Source Remedial Evaluations** - For those potential source sites and areas that are not referred to other entities or agencies, or have been returned from other entities or agencies to be included in the CTMRD, a focused feasibility study will be performed working with the TWG to evaluate and recommend selection of a remedial action for that source that is reasonable and economically feasible. The result of the focused feasibility study will be production of a Site Specific Remediation Plan that will be developed by the TWG collaborative process which includes the CTMRD, NDEP, and WCDHD.

- **Benefit Evaluations** - Evaluate and identify potential changes in water user and/or property owner benefits related to the proposed remedial action.

- **Source Remediation** – Implement a Site Specific Remediation Plan for those sources that have been selected, based on priority and available funding.

The implementation of the PCE Source Management Process will require a consistent commitment of resources and the collaboration of the TWG members since the activities to be performed by the CTMRD within any calendar year will be dependent on changing site conditions, data, and priorities. The TWG will work together to provide guidance and direction to the BCC regarding, but not necessarily limited to the following:

- Ranking of sites for purposes of allocating CTMRD funds
- Developing scopes of work for source characterization activities
- Determining when adequate evidence has been collected to document that a person has caused or contributed to the condition requiring remediation; the evidence will then be provided to NDEP for appropriate action.
- Evaluating and selecting appropriate remedial actions for source areas and their related shallow groundwater plumes that do not have viable responsible parties.
- Developing source closure criteria for sources where CTMRD resources are used to implement remedial activities.

To coordinate the actions and sharing of information among these entities related to the management of sources, an agreement (e.g., cooperative agreement (CA)) will need to be developed and executed. This agreement would define the nature of the relationship(s) and the standard processes that the entities will follow to implement appropriate management of sources and/or potential source areas. A more detailed description of the CA is provided in Section 4 *Implementation Activities and Schedule*.

As previously indicated, Figure 3-1 presents the overall process that will be followed to remediate source areas - prioritize, characterize, identify responsible parties, and as appropriate, evaluate and implement remedial activities. Each of these process elements or activities and the interrelationship among the various activities are discussed below.

Prioritization Ranking of Potential Source Areas

The prioritization of potential source areas is an activity that will occur on an annual basis (or more often if conditions warrant). The goals will be to identify all those locations from which PCE contamination may emanate and to rank these locations into a prioritized listing. Note that the site prioritization step will be applied throughout the entire process of addressing potential source areas. The CTMRD, working with NDEP, and WCDHD, will allocate funds for source characterization, source remedial evaluations, and if appropriate, remedial actions. Remedial actions will be implemented at listed sites in order of highest priority.

The ranking of source areas will first involve collecting existing information from all sources of data that may be used to characterize potential source areas. For example, NDEP and WCDHD maintain project files for past and ongoing remediation projects. In addition, TMWA may have water level and water quality data from various monitoring points that date back into the 1970s. Although much of these data are likely already within the CTMRD database, a comprehensive effort will be conducted to collect and organize data that may not currently reside in the database.

Once appropriate data have been collected, an inventory of sites which have utilized PCE on site or sites which have been identified as having PCE contamination will be developed. The CTMRD will use a broad range of data sources to create this inventory, including the following:

- Past or active chemical manufacturers, dry cleaners, paint shops, and other businesses that may have handled PCE;
- Past or active site remedial activities overseen by NDEP or WCDHD at any facilities or businesses that may have handled PCE;
- Locations where sanitary sewer sampling indicates that past or current discharging of PCE has occurred or is occurring; and
- Locations where groundwater quality sampling indicates that PCE concentrations are significantly greater than the regional PCE concentration.

Once the inventory of potential source areas has been developed, an analysis of these data will be performed, utilizing GIS-type mapping software and other methods, to screen and rank all potential source areas based on the prioritization criteria and process presented in Figure 3-2.

Using the prioritization ranking criteria contained in Figure 3-2, the TWG will develop a ranking of all potential source areas identified by the existing data. Once sufficient evidence has been gathered pursuant to NRS 540A.280, sites identified as Priority 1 sites will be referred to NDEP for appropriate actions since these sites are by definition characterized by a known ongoing discharge. Identification of Priority 1 sites will therefore require the TWG to establish some knowledge or information on source location and current business type, nature and ownership.

All other potential source areas will be assigned a priority of 2, 3 or 4 depending on the outcome of the prioritization analyses. The ranking of the potential source areas will be based on those screening criteria presented in Figure 3-2. These screening criteria include:

- Type of current and/or past land use/business type
- Relative PCE concentration measured in groundwater adjacent to the source

- Potential for source to impact water supply wells
- Potential for source to impact current or future construction or structural dewatering operations

It is important to note that assignment of a prioritization ranking to a potential source area may be influenced by data, professional judgment and/or issues beyond those screening criteria presented in Figure 3-2. As long as the members of the TWG agree to the assignments, and the justification for the assignments, other criteria may be used to set priorities in addition to those presented in the figure. Given the flexibility of the screening process, it is possible that source areas that have been closed by NDEP and/or WCDHD in the past may be re-opened based on the outcome of the prioritization ranking efforts.

All potential source areas contained in the site inventory will be assigned a priority of 2, 3, or 4 at this stage of the project, even if they are qualified as needing additional site characterization. Of course the ranking of sources can, and will, change from year to year, or even month to month, as new information becomes available. To this end, the TWG has complete discretion to revise the priority of any potential source area as additional data are collected, and new information becomes available.

Once the potential source areas have been ranked, and an agreement on further actions has been reached by the members of the TWG, the CTMRD will issue a letter to both WCDHD and NDEP indicating the results of the ranking effort, and recording the list of agreed upon actions to be performed by each member of the team.

The interactions among NDEP, WCDHD and the CTMRD during the development of the prioritization rankings for each potential source area are captured in Figure 3-3. As indicated in this figure, the TWG reviews data to develop the ranking. Next, Priority 1 sites are referred to NDEP. All other potential source area sites are carried into the source characterization activities performed by CTMRD, in collaboration with NDEP and WCDHD. Source characterization activities are described below.

Source Characterization

Based on the results of the prioritization of potential sources areas, the CTMRD will proceed with an appropriate amount of field investigation activities to characterize high priority "sites" not referred to the NDEP. The level of effort will depend on the availability of funds, site accessibility, and various other issues (e.g., weather conditions). Field investigation activities may include, but not be limited to, those field activities discussed and presented in the Remedial Technologies *Identification and Screening*. Table 2-6 summarizes the likely field investigation methods for soils and groundwater in and adjacent to a suspected source areas.

Once appropriate actions have been agreed upon by the TWG, including a revised ranking of source areas, based on the source characterization activities, a listing will be made of source areas that should be referred to NDEP for enforcement actions.

Again, the CTMRD will issue a letter to NDEP and WCDHD recording the agreements reached including the results of the source characterization efforts, and the recommendations for further actions by each member of the team.

This task will benefit greatly from the regular and deliberate sharing of data between NDEP, WCDHD, the Cities and the CTMRD, including those situations where independent data collection activities are funded as a result of real estate transactions and/or site investigations and closures. If the CTMRD is able to include these data in the program database, it may save significant taxpayer dollar by not requiring the same data to be collected twice.

Source Referrals

Referrals will be made from the CTMRD to NDEP for sites and/or source areas once adequate evidence has been collected. It is the intent of the RMP that most referrals will result in an appropriate remedial action by an identified responsible party under NDEP oversight. Once NDEP receives a referral, it will make a determination of the necessary action. The responsible parties will be held liable for environmental clean-up in a manner consistent with the governing statutes (i.e., NRS 540A and NRS 445A).

Note that in some rare cases where NDEP administrative and legal processes have been unsuccessful in identifying responsible party(ies), these sites and/or potential source areas with non-viable responsible parties may be returned to CTMRD for potential remedial actions.

Source Remedial Evaluations

For those potential source areas that the TWG determines do not have identifiable responsible parties or may not be adequately supported by identified responsible parties, the CTMRD will prepare a focused feasibility study, if resources are available, to:

- Summarize the information known about the site;
- Identify the potential impact of the site on public water supply and on other potentially completed exposure pathways involving humans;
- Develop site specific remediation goals which may include risk-based analyses;
- Identify candidate remedial actions that may best be applied to the source area and any related plume area, if appropriate;
- Screen the identified candidate remedial actions, based on implementability (i.e., constructability, reasonableness, technical feasibility, etc.), effectiveness (i.e., ability to manage identified risks to human health and public water supply, etc.), and cost (i.e., reasonable and economically feasible);

- Perform a benefit analysis related to identifying whether or not a proposed remedial action will provide benefit to a specific group of water users and/or property owners; and

- Recommend a remedial action(s).

This process may also require that the CTMRD collect more data to characterize a potential source area that will be the subject of the remedial evaluations.

The list of candidate remedial actions will be developed based on the results of the remedial technology and process option screening that was presented in the *Remedial Technologies Identification and Screening TM*. Table 2-7 presents the relevant results of those analyses.

Once a remedial action has been preliminarily identified, the CTMRD will need to provide information to NDEP and WCDHD regarding the proposed remedial action for various reasons. First, before any remedial action is initiated, the TWG will need to make recommendations to the BCC defining the nature and type of the source remedial action(s) that are consistent with the CTMRD. Based on these recommendations, the BCC will authorize funding for the remedial action(s) consistent with the resources of the County taxpayers and NRS 540A.265. Once funding is approved, NDEP and WCDHD may need to issue permits to the CTMRD for implementation of the remedial action(s). In addition, NDEP and WCDHD will need to have knowledge that the action is being implemented such that data management, progress reports, and other project correspondence can be tracked and, if needed, evaluated.

Evaluate Benefits

Before any remedial action is recommended for implementation to the BCC from the CTMRD, a benefit evaluation must take place. This benefit evaluation step will not be used to determine whether a remedial action will be performed. Rather, the step is a factor in determining what funds will be allocated to the remedial action (i.e., does the remedial action provide benefits to all water users within Remediation District boundaries or is the benefit limited to a portion of all users?). The objectives of the benefit evaluation will be to:

- Characterize the short-term and long-term cash flow associated with the proposed remedial action(s);

- Determine if the current accounts maintained by the County are adequate to support the proposed funding requirements;

- Identify the benefit(s) to water users and/or property owners related to the implementation of the proposed remedial action (s);

- Determine if additional benefit areas need to be developed to support the proposed remedial action; and
- Provide the Board of County Commissioners (BCC) with the information needed to commit current account funds or develop a revised ordinance for newly defined benefit areas.

The recommendation for implementing any particular remedial action will be made to the BCC based on a combination of the source remedial evaluations and the benefits evaluations.

Source Area Remediation

The RMP includes implementing active remedial measures on targeted historical source areas that are not included under enforcement actions with NDEP with the objective of protecting the CTM water quality for municipal, industrial, and domestic uses.

Key elements in the decision to implement remedial action(s) at a particular source area include:

- A determination by the TWG that no viable responsible party exists and therefore NDEP will not oversee the remediation;
- A determination that remedial actions will contribute to a reduction of the threat of substantial degradation of water quality posed by the source; and
- The availability of funds in the source remediation trust fund.

The decision to end, postpone or temporarily suspend any particular remedial action will be based, in part, on the availability of trust fund dollars, and potential impact of the continuation of a remedial action on waters within CTM that may be used of municipal, domestic, and/or industrial use.

The trust fund, which will be described in Section 5, will be used to fund capital improvements, operations and maintenance, and any other project-related expenses associated with remedy implementation. In some cases, the remedial action(s) will involve simple, short-term activities, such as soil removal and disposal. In other cases, remedial action(s) may include acquisition of easements, installation of facilities, and long-term operations of equipment and monitoring programs. Given the wide range of potential remedial actions that may be implemented as a result of the source area evaluations and investigations, implementation may only take a couple of months, or may require many years, even decades. Potential impacts of proposed remedial actions on cash flow out of the source area trust fund will be taken into account in the evaluation and selection of any remediation. Analyses will also be conducted to identify whether or not selected water users and/or property owners will benefit from the identified source area remedial action(s) (note, however, that the "benefit evaluation" will not be used as a factor in determining the need for remediation).

The operation and maintenance costs for most remedial actions may be significant, and will likely increase with time because of climbing electrical rates and the expectation that more remedial actions will be implemented. Although it will be the goal of the CTMRD to reduce operations and maintenance costs wherever possible, it is likely, given the widespread nature of contamination and the recalcitrant nature of PCE, that operation and maintenance costs related to source area remediation will increase over time until substantial progress is made in source control and removal.

3.6.3 Program Outreach, Education, and Administration Activities

Program outreach, education and administration include those activities related to the management of resources needed to implement the RMP components defined in this section.

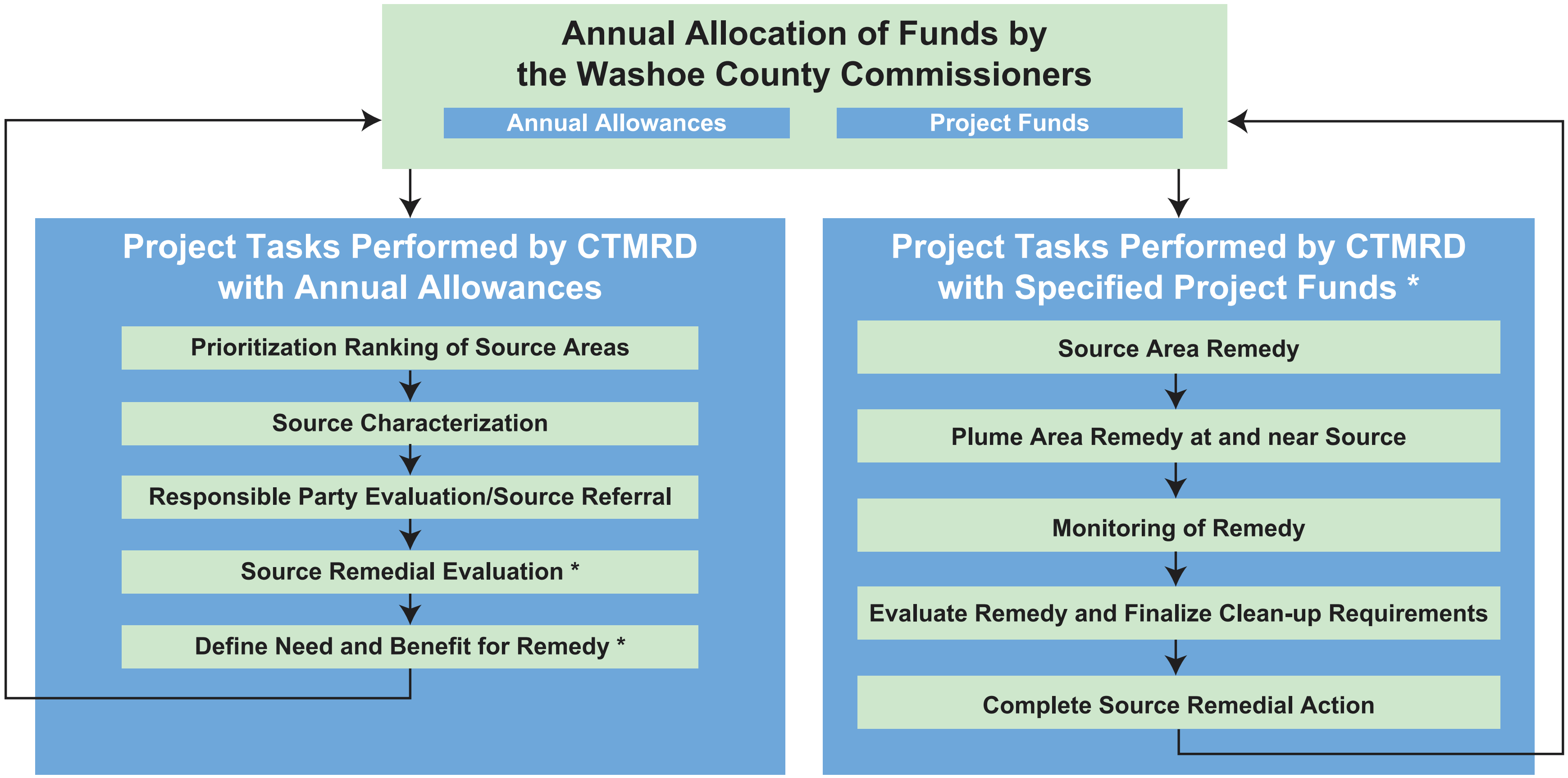
- **Public Outreach and Education** – The objective of this element is to perform activities related to:
  - Provide members of the community with educational information regarding the CTMRD, the RMP components, the management and expenditures of tax dollars, and the status of the project activities using media and public information channels.
  - Conduct occasional community workshops for promoting information exchanges and creating a forum for public feedback.
- Establish and maintain a CTMRD Public Advisory Group consisting of key project stakeholders and implementers (e.g., NDEP, WCDHD, TMWA, City of Reno, City of Sparks, area business interests, neighborhood advisory boards, citizen advisory boards, etc.) to:
  - Promote technology and information transfer;
  - Stimulate effective sharing of ideas;
  - Create means to exchange viewpoints on public policy associated with the implementation of the CTMRD and related matters; and
  - Generally allow for a direct feedback mechanism from various project stakeholders, community entities and program implementers to Washoe County and the BCC.

- **Project Administration Tasks** – The objective of these activities is to manage the resources of the County (both human and financial) with respect to implementation of remedial and programmatic activities. Project administration tasks include, but are not limited to, management of CTMRD staff, database and information management, fund management, tax bill development and billing support, and facilitation of institutional and intergovernmental communications.

Note that on an annual basis, the CTMRD program will be reviewed in terms of the appropriateness of activities and the funds spent and retained (e.g., trust funds) over the previous year. The objective of the review, which will occur with the aide of the CTMRD TWG, will be to identify:

- Available funding for source remediation.
- Available funding for design and construction of new treatment at public water supply well(s).
- Available funding for source prioritization, characterization, and remedial evaluations.
- Need for additional benefit areas within CTM related to specific source areas and groundwater plumes.

The review will result in the development of a group of resolutions and/or ordinances that will be brought to the BCC for consideration and action.



These tasks are performed every year within a budget specified by the Board of County Commissioners, allocated based on benefit to property owners

* These tasks occur only for sources with non-viable responsible parties

These tasks are performed in accordance with a specified project budget, on an as needed basis. Funding must be approved by the Board of County Commissioners, allocated based on benefit to property owners (these funds may be allocated on a project basis rather than on an annual basis)

Figure 3-1 PCE Source Management Process

CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District

Priority 1

		Yes	No
Q1:	Business with Know PCE Usage	☐	☐
Q2:	Evidence of Ongoing Discharge	☐	☐

Examples of businesses with known PCE usage: dry cleaners; metal plating shops; chemical manufacturing; paint shops; automobile repair shops.

If yes to both questions, then the Site is assigned a Priority of 1. Otherwise, move to next set of screening criteria.

Priority 2 and 3

		Yes	No
Q3:	Potential for current or past land use to handle PCE	☐	☐
Q4:	Within Recharge Zone of Public Water Supply Well (PWSW) (see figure)	☐	☐
Q5:	Distance to tributary well < 1 mile and concentration of PCE >50 µg/L	☐	☐
Q6:	Distance to tributary well > 1 mile Concentration of PCE > 100 µg/L	☐	☐

If yes to question 3 and 2 other questions, then the site is assigned a Priority of 2.
If yes to question 3 and 1 other question, then the site is assigned a Priority of 3.

Concentration (if not in recharge area of a PWSW):

		Yes	No
Q7:	Concentration of PCE > 770 µg/L	☐	☐

If Yes is entered, then the Site is assigned a Priority of 2. If a Site is not assigned a Priority of 1, 2 or 3, it is assigned a Priority of 4.

Note: Professional judgement will be utilized for all determinations

Figure 3-2 Prioritization Ranking Screening Criteria for Source Areas

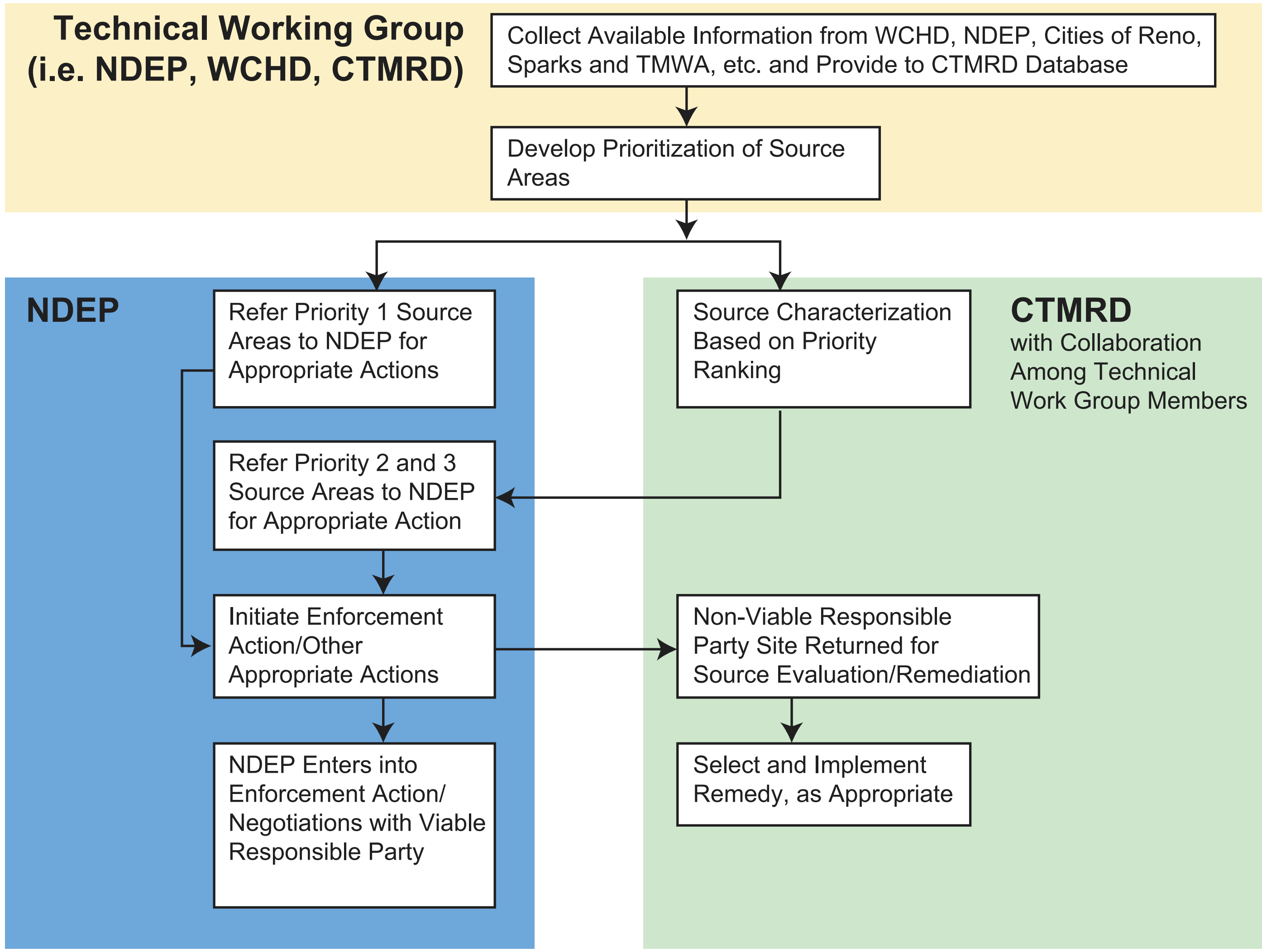


Figure 3-3 Intersections between CTMRD and NDEP in Implementing PCE Source Management Process

Section 4
Implementation Activities and Schedule

The conditions of PCE contamination within the CTM – extensive area of impact; multiple sources; consistent, low level of contamination – require an innovative approach for management and remediation. The RMP defines a "first of its kind" remediation program for the CTMRD. Implementation of the program will require not only the cooperative efforts of the Technical Working Group members, but also the involvement and input from a broad range of project stakeholders. The full range of program activities that make up Phase 2 of the CTMRD (Source Identification and Remediation Phase) includes the primary remediation program components identified in Section 3 as well as a series of program initiation activities that are required for successful implementation of the overall program.

The program initiation activities include "one time only" activities that are intended to establish operating agreements and policies and procedures among the TWG members. These policies and procedures establish the framework within which the various public entities and agencies will work together. This section describes the program initiation activities and identifies other relevant activities that will be conducted during the early stages of Phase 2 of the CTMRD. Further, this section provides a detailed implementation schedule for each element of Phase 2 of the CTMRD.

4.1 Program Initiation Activities

A number of program initiation, or set-up, activities have been identified, that need to be performed during the first months of the RMP implementation. The intent is to establish the roles and responsibilities of each of the key stakeholders (i.e., governmental entities, water purveyors), to assist the CTMRD in meeting its objectives and goals. The program initiation activities, which will be a District focus during the first year of RMP implementation, include development of a cooperative agreement with NDEP and WCDHD. Each of these sets of activities is described below.

4.1.1 Cooperative Agreement

A Cooperative Agreement needs to be developed to allow the members of TWG to coordinate relevant operations and process activities, establish roles and responsibilities, define communication protocols, and commit appropriate resources to the RMP implementation. The Cooperative Agreement, which will be developed in accordance with NRS 227.080 (Interlocal Cooperation Act), will establish the relationships among the signatories and guide the TWG's involvement in the implementation of the remediation program of the CTMRD. The Cooperative Agreement will also be used to define the ground rules for refining program goals and operating procedures over time. Protocols to be addressed include:

- **Regular Periods of Program Evaluation.** This issue relates to how the processes that make-up any particular program component are to be evaluated for effectiveness, efficiency, and applicability on a regular basis, so that the remediation management program maintains its focus and applicability over the span of its use.

- **Data Management and Reporting Protocols.** This issue relates to how the various entities will standardize data collection activities and project reporting requirements, and share and manage data. Given the number of entities involved in the implementation of the program, mechanisms may need to be created to ensure that relevant data is provided to the CTMRD as public and private entities collect information.

Table 4-1 presents a list of possible components of the TWG Cooperative Agreement.

Table 4-1 Possible Components of the Cooperative Agreement Among Members of the Technical Working Group
• Cap on Remedial Activities Costs per Annum • Use and Priority of Well Head Treatment • Agreement on Procedures to Implement the Remedial Activity Processes Defined in the Remediation Management Plan • Recognition of Limited Nature of Resources • Concept of Minimum Level of Funding (Based on fee collection) for CTMRD activities • Limits of Cost Escalation for Implementation of the Remediation Management Plan • Identification of Principle Parties and Roles Within the TWG • Agreement by NDEP to Take Appropriate Action at Sites with Responsible Parties upon Referral by CTMRD, pursuant to NRS 540A.280 • Acknowledge by Parties regarding the Collaborative Nature of the TWG Members • Agreement of the Role of Each Member of the TWG including: o Providing Guidance and Input to Board of County Commissioners o Coordinating Data Collection, Management and Review with the CTMRD o Providing Resources to Implement the Remediation Management Plan • Agreement on Use of NDEP Authorities to Provide Access to Private Properties • Definition of a Dispute Resolution Process • Definition of Person(s) • Confirmation of Safe Harbor Provisions of NRS 540A • Timing and Nature of TWG reviews of CTMRD work products

Following execution of the Cooperative Agreement, the TWG will work together to prepare the follow procedures and protocols for application to specific areas of RMP implementation:

- Create methodologies for prioritization ranking of potential source areas,

- Create review and comment processes for NDEP and WCDHD on CTMRD source characterization activities,

- Create protocols for source area referrals pursuant to NRS 540.280 (from CTMRD to NDEP),
- Create protocols for source area returns (from NDEP to CTMRD),
- Create review and comment processes for NDEP and WCDHD on CTMRD source remedial actions,
- Create protocols for TWG interactions with BCC,
- Agree to role of NDEP and WCDHD in support of public outreach and education.

4.1.2 Responsible Party Evaluation and Enforcement Protocols

Pursuant to NRS 540A.280, NDEP will take appropriate action(s) against a person (e.g., responsible party) that "has caused or contributed to the condition requiring remediation" when CTMRD acquires the necessary evidence to make the referral. However, the process by which this evidence will be referred to NDEP will need to be developed.

4.2 Other Relevant Activities

There are a number of other activities that will be conducted during the early stages of Phase 2 of the CTMRD. These activities, which are related to various aspects of the RMP implementation, include:

- **Continuing wellhead treatment on impacted water supply wells** – As previously indicated, treatment of CTM groundwater for public water supply is the highest priority of the CTMRD. Well head treatment for the removal of PCE from groundwater produced by TMWA drinking water supply wells is therefore of vital importance to the implementation of the RMP. Therefore, the CTMRD will continue to pay the debt service and operation and maintenance costs, in cooperation with TMWA.
- **Developing and implementing a groundwater monitoring program** – A groundwater monitoring program consistent with the needs of the CTMRD will be developed. Focused groundwater monitoring activities are warranted for purposes of evaluating natural attenuation of the PCE in the groundwater. Monitoring at this stage of the CTMRD may include installing additional monitoring wells, collecting water level data, collecting water quality data that will support MNA evaluations, and updating the database with the newly collected data.
- **Sampling in areas adjacent to sanitary servers** – Given the results of random sewer sampling, it is apparent that some businesses have used, and may continue to use, the local sanitary sewers for disposal of waste PCE. Of particular concern is whether or not the sanitary sewers leak ultimately contributing PCE laden

wastewater to the shallow groundwater system. To address this concern, the CTMRD will conduct focused sampling of soils and shallow groundwater at selected locations where past investigations have indicated the presence of PCE in local sanitary sewers.

- **Evaluating PCE Ban legislation** – Numerous states have effectively reduced the volume of waste PCE that may be generated by banning the use of PCE in all applications, since industrial and commercial substitutes are available on the market that do not cause as much environmental damage, or have the same detrimental health effects. To this point, the CTMRD will evaluate the process of developing a legislative ban on PCE usage in the County and the State.

- **Evaluating PCE/Dry Cleaner Funds** – Many states have attempted to create PCE and/or dry cleaner funds modeled after the underground storage tank funds used to clean-up leaking petroleum storage tanks at gasoline stations. Unfortunately, few states have succeeded in effectively producing a reliable funding mechanism for the clean-up of PCE contamination caused by small business, since the number of small businesses using PCE on a regular basis is significantly less than the number of underground storage tanks in most states. Nonetheless, the CTMRD will evaluate the options available to the County and the State regarding the development of such a fund.

- **Update and Implement a revised Community Relations Plan (CRP)** – As the CTMRD RMP is implemented, public outreach and education efforts will be needed to provide the public, interested community groups, and local and state legislators with updated information regarding project findings, remedial activities, and/or revised district fee structures, benefits, or funding needs. To this point, the community relations program needs to be updated, which integrates public information repositories, press releases, community workshops, and other outreach and education tasks with CTMRD activities. The various members of the TWG and PAG should be involved with the development and implementation of the CRP since "getting the word out", and maintaining a consistent message to the public, benefits all project stakeholders.

- **Review and update the TMWA Pumping Plan** – As additional data are collected by TMWA and the CTMRD to characterize the regional and local groundwater quality, and groundwater flow systems, the Pumping Plan for operation of TMWA's production wells relative to the control of PCE will be revisited and updated. Of particular concern is the identification and management of production from wells that have detectable concentrations of PCE that have, or may increase to levels greater than are allowed under the safe drinking water act. The Pumping Plan updates will include updating the database with newly collected data, conducting numerical modeling, as appropriate, and reviewing the results of any analyses conducted with TMWA to devise strategies and revised operational restrictions on groundwater production.

Table 4-2 summarizes the currently identified activities that need to be performed to initiate implementation of the Source Identification and Remediation Phase of the CTMRD.

Table 4-2
Summary of Activities Required to Implement Source Identification and Remediation Phase of the CTMRD

Activity	***Key Stakeholder Organization with Washoe County Department of Water Resources***					***Summary of Activity Requirements***
	NDEP	***WCDHD***	***City of Reno***	***City of Sparks***	***TMWA***	
PROGRAM INITIATION ACTIVITIES						
Prepare and Execute Cooperative Agreement	✔	✔				• Engagement methods • Relationships, roles • Resources allocations • Communications protocols • Information sharing • Reassignment protocol (from NDEP back to CTMRD)
CLEAN DRINKING WATER ACTIVITIES						
Wellhead Treatment		✔			✔	• Continue debt service and O&M
Pumping Plan Review Procedures					✔	• Data sharing • Modeling • Contingency plan development
REMEDIAL ACTIVITIES						
Groundwater Monitoring Program/MNA	✔	✔			✔	• Develop Scope • Receive and Evaluate Bids • Perform Monitoring • Disseminate Results • Coordinate Data Collection and Management Policies
Develop Policies and Protocols for Implementing Source Prioritization, Source Characterization, Source Referrals, and Source Remediation	✔	✔				• Define Data Collection and Management Procedures • Define Review and Comment Protocols • Define Reporting Methodologies • Define Communication Protocols
Responsible Party Evaluation and Enforcement Actions by NDEP	✔					• Responsible Party corrective actions • Responsible Party cost recovery
OTHER ACTIVITIES						
Characterization of Sanitary Sewer Impacts on Shallow Groundwater	✔	✔	✔	✔		• Develop Scope • Receive and Evaluate Bids • Perform Monitoring • Disseminate Results • Coordinate Data Collection and Management Policies
Evaluation of PCE Ban Legislation	✔	✔	✔	✔	✔	• Conduct Evaluation of Other State Programs • Evaluate Legislative Requirements
Evaluation of PCE/Dry Cleaner Fund	✔	✔	✔	✔	✔	• Conduct Evaluation of Other State Programs • Evaluate Legislative Requirements

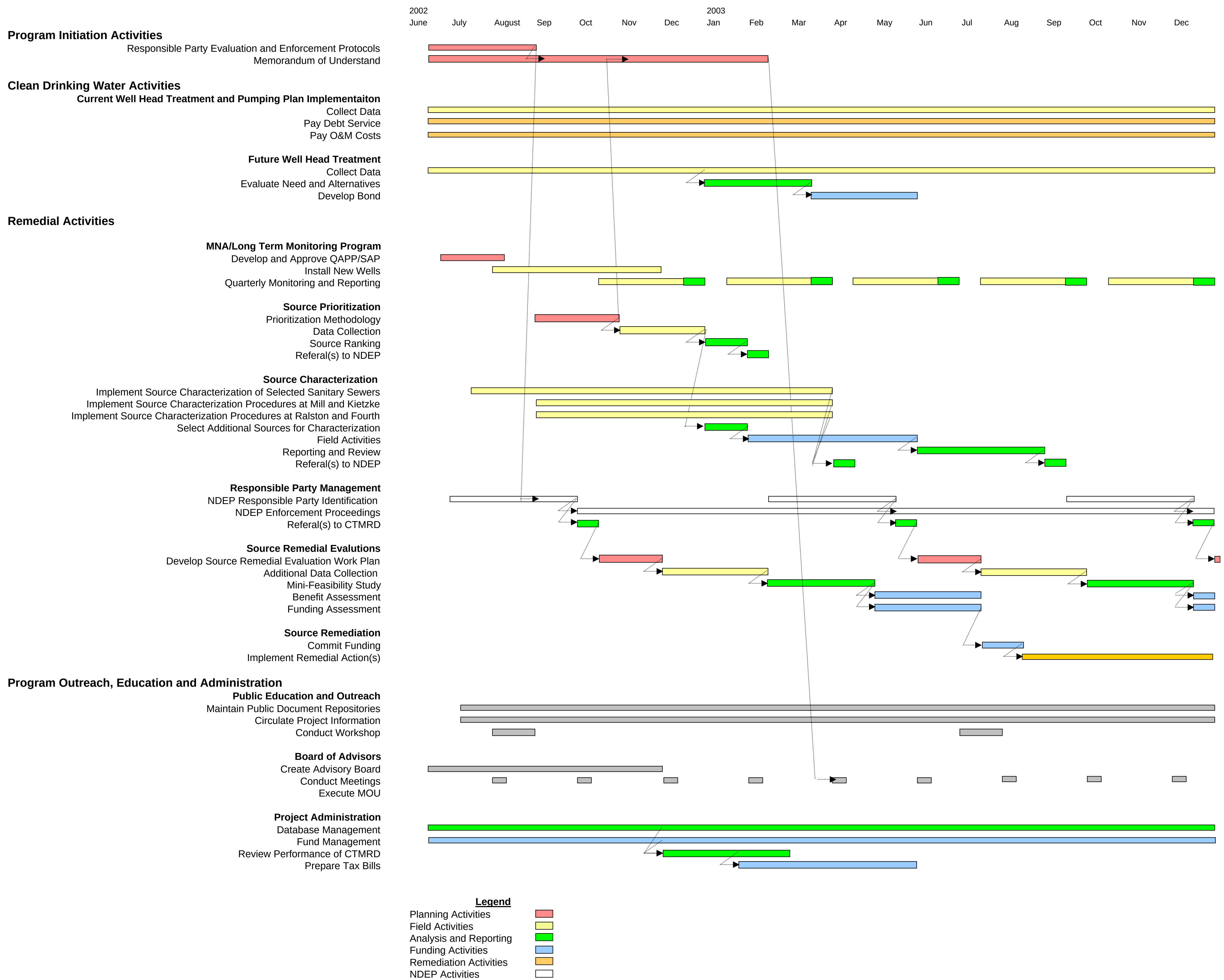


Figure 4-1
Remediation Plan Implementation Schedule
Central Truckee Meadows Remediation District

Section 5
Remediation Management Program Cost Summary

Section 3, *Remediation Management Plan Components*, describes the full range of actions proposed as part of Phase 2 (Source Identification and Remediation Phase) of the CTMRD to address the presence of PCE in soils and groundwater within the CTM. This section describes the individual remediation program components and provides a breakdown of the costs.

5.1 Remediation Management Program Cost Components

The CTMRD remediation program components will be funded through the use of annual funding accounts. These funding accounts will be created as either annual allowance accounts or trust fund accounts, as described in more detail below.

It is important to note that the Remediation Management Program costs are capped at the total costs indicated by the sum of the annual allowances and the trust funds, or about $2,400,000. Although the use of these funds, and the allocation of the funds to each of the annual allowances or trust funds from year to year may vary, the amount received by the CTMRD though the County's tax bill will remain the same from year to year (established as a minimum level of funding). Only under special circumstances approved by the BCC will the amount of funding to CTMRD change.

5.1.1 Annual Allowance Accounts

Annual allowance accounts will be utilized to fund activities that will occur every year, based on the priorities of the CTMRD, the need for a specific activity, and the availability of funds. Specific cost allowance funds are highlighted below:

- **Current Wellhead Treatment Facilities and Pumping Plan Implementation**. These expenditures would include debt service payment on bonds for construction of the existing water supply well treatment systems or operations and maintenance (O&M) costs associated with these systems, including replacement of treatment facilities. These costs would also include the continued implementation of the Pumping Plan agreed upon between the County and TMWA in 1998, which requires TMWA to pump the five wells with wellhead treatment year round to maintain hydraulic control of the deep aquifer system to a reasonable degree. It is anticipated that the Pumping Plan will be amended in the future so as to be consistent with CTMRD needs.

- **Source Management Elements** include source prioritization, characterization, feasibility studies, and analysis of benefits.

- **Project Outreach, Education and Administration Costs** include those costs that will be incurred by the County in the efforts to conduct and maintain public outreach and educational programs and for administration and management of the CTMRD. These funds will be used to support performing public outreach and educational programs including providing information repositories in public places, conducting public workshops, and implementing community outreach programs. These funds will also support employee salaries and expenses associated with database and information management, program communications within the CTMRD and with NDEP and WCDHD, budget and account management, billings, and associated contractor procurement.

5.1.2 Trust Fund Accounts

Trust funds will be maintained in interest bearing accounts that will be used to support large capital expenses and operation and maintenance programs, as needed. In any one year, a trust fund account may or may not be used to support specific CTMRD activities.

Trust fund accounts continue to receive monies from annual CTMRD contributions and from interest received through the interest bearing accounts. These funds are then dispersed through large single capital cost draws, or for ongoing operations and maintenance. These trust funds may also be used to reimburse entities that are not responsible for the PCE contamination, but who have performed remedial actions consistent with the CTMRD program.

During the implementation of the remediation program, parties responsible for the investigation and cleanup of particular PCE sources may be identified. If funds used to cover the cost of remedial actions by the CTMRD can be recovered from these responsible parties, as allowed under NRS 540A.280, monies will be reimbursed to the CTMRD and placed back into these trust funds.

Anticipated trust fund account expenditures are highlighted below:

- **Future Wellhead Treatment Facilities**. If PCE is detected in an existing water supply well without wellhead treatment, design and installation of a new groundwater treatment system may be required. The trust fund account would be the source of funds for this activity. Allocation of funding to this account is based on the assumption that one new well will require construction of wellhead treatment every three years.

- **Remediation of PCE Sources**. If a PCE source is identified as part of the Source Management Activities and is not managed through NDEP, trust fund monies will be used to cover the cost of design and installation of remediation systems or operations and maintenance of new remediation systems once an evaluation of remedial options and benefits is performed.

5.1.3 Cost Summary

A breakdown of costs based on the Remediation Management Program components described above is presented in Table 5-1.

Table 5-1
Remediation Management Plan Budget
Central Truckee Meadows Remediation District

Remediation Management Plan Program Element	*Cost and Type of Fund*			
	Estimated Cost		*Annual Allowance Cost Categories*	*Trust Fund Categories*
CLEAN DRINKING WATER ACTIVITIES				
Pumping Plan Implementation [1]				
Annual Bond Payment	$400,000		✔	
Annual O&M Costs	$300,000		✔	
Replacement of existing facilities	$300,000		✔	
Wellhead Treatment Trust [2]	$430,000			✔
Total		$1,430,000		
REMEDIAL ACTIVITIES				
Groundwater Monitoring/Monitored Natural Attenuation	$200,000		✔	
Source Area Remediation				
Source Prioritization	$30,000		✔	
Source Characterization	$170,000		✔	
Source Evaluations (mini-feasibility studies and benefit analyses)	$100,000		✔	
Source Remediation	$200,000			✔
Total		$700,000		
PROGRAM OUTREACH, EDUCATION, AND ADMINISTRATION				
Public Outreach and Education	$150,000		✔	
Project Administration	$120,000		✔	
Total		$270,000		
TOTAL PROGRAM COST		**$2,400,000**		

1 *Pumping Plan Implementation* includes costs for current wellhead treatment of TMWA water supply wells.
2 *Wellhead Treatment* applies to the design and construction of treatment facilities for production wells that are identified in the future to be contaminated.

5.2 Finance Issues and Costs

5.2.1 Transfer of Funds From One Account to Another

There may be some instances in which funds from one account may be transferred to another account. As an example, in the first year of implementation of Phase 2 (Source Identification and Remediation Phase) of the CTMRD, it is anticipated that additional funds may be needed to perform source evaluations and feasibility studies. To this end, some funds may be transferred from one allowance that has excess funds. In some circumstances (e.g., need for additional wellhead treatment of multiple water supply wells), funds may be transferred from the allowances to the trust funds or vice versa, except if balances in the allowances exist at the end of a year, then the surplus funds will be considered for transfer to an interest bearing account.

5.2.2 Reevaluation of Funding Needs and Program Audits

At regular intervals (once every 3 years or more often if necessary), the funding mechanisms of the CTMRD will be reviewed and evaluated. The evaluation would be based, in part, on a formal audit, which will be performed by an independent consulting firm qualified in standard accounting practice.

Section 6
Benefit Analysis

6.1 Introduction

An important element of the Work Plan Development and Implementation Phase was to define the allocation of costs for the Source Identification and Remediation Phase of the project. In accordance with the enabling legislation, NRS 540A, the BCC may recover the costs of developing and implementing the RMP by imposing an annual fee for properties within the CTMRD. This fee, which may be based on annualized water usage, is to be weighted and adjusted between parcels or properties within the Remediation District boundaries based on varying levels of contamination, impacts to property values resulting from the implementation of the RMP, or any other factors deemed appropriate and reasonable by the BCC. To date, the CTMRD has been funded through a fee based on water use for all entities within TMWA's wholesale and retail service area. The fee has been assessed as a line item on the annual tax bill.

This section defines three distinct benefit groups that will exist once the Source Identification and Remediation Phase of the CTMRD begins. Each of these groups receives a tangible benefit from the RMP components and activities. This section describes the three benefit groups and allocates the annual CTMRD costs (discussed in the previous section) among these benefit groups. The three benefit groups that have been identified include:

- Water users within the TMWA wholesale and retail service area;
- Residential property owners within the "area of potential impact"; and
- Non-residential property owners within the "area of potential impact".

A discussion of the location and benefit received for each of these entities is provided below.

6.2 Benefits to Water Users

Figure 6-1 shows the boundary of TMWA's wholesale and retail service area, including the areas served by Sun Valley General Improvement District, Reno-Parr Water Company, Panther Valley Water Company, and the Washoe County Utilities Division. Within this boundary area, there are water use parcels (i.e., parcels of property which have access to and utilize water from a public water supply) and non-water use parcels. Currently, non-water use parcels located within the fee area have not been included in the fee structure. Changes to the existing legislation during the next legislative session (2004) are being considered as a way of including non-water use parcels into the fee structure.

Within this area, there are approximately 85,300 water users. The primary benefit for the water user group is access to a clean and sustainable water supply.

Although wellhead treatment is clearly beneficial to those entities receiving the treated groundwater within Central Truckee Meadows, all water users within the boundaries identified in Figure 6-1 benefit from the long-term sustainability of this water resource, given that treated groundwater is used to support and supply a significant portion of TMWA's water system demands, thus freeing up water to users in the remaining portions of CTM and in the neighboring valleys. In fact, in some instances treated groundwater is used as make-up water for TMWA's and others groundwater recharge program.

6.3 Benefits to Property Owners Within Area of Potential Impact

The property owner benefit group consists of the owners of those properties that overlie the area that has been identified as potentially impacted by detectable concentrations of PCE in groundwater. Figure 6-2 depicts the "area of potential PCE impact".

There are two types of economic impacts to property owners that are typically associated with contamination such as that found in CTM:

1. Property values may decrease resulting from people not wanting to purchase impacted property or from buyers' fears of economic liability for possessing contaminated property. This type of impact affects both residential and commercial properties.

2. Liability to remediate exists for commercial and other non-residential property owners under NRS 445A, as well as under various Federal statutes, which defines actions that must be undertaken by a property owner if a hazardous substance (e.g., PCE) is present in soils or groundwater. In addition, property owner liability is strict and several as defined by federal regulations, even if the property owner did not cause the contamination (Federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or "Superfund"). This means that property owners may be held legally liable for cleanup costs although they have played no role in the contamination of their property. The costs that a property owner is responsible for characterizing the nature and extent of the contamination and performing corrective actions to concentration levels established by NDEP can be significant.

Several studies have attempted to address the effects of environmental cleanup on property values. The economist, Jane Kohlhase of City University of New York, who has studied housing markets associated with hazardous waste sites concluded: 1) until active cleanup of the site is initiated, property values for waste-affected areas are diminished relative to surrounding areas; 2) once active cleanup is initiated, public confidence is restored -- as are the diminished property values associated with the contamination; and 3) public confidence may be further increased by the knowledge that a contaminated site in cleanup may, in fact, be "cleaner" than sites not yet identified. The public, becoming increasingly aware and educated about environmental degradation and contamination, may in fact experience increased reassurance that their particular environmental issues are already being analyzed and addressed, and will therefore not pose some future (as yet unknown) health and economic risk.

Other investigators including Dotzer (1997), Simons, et.al. (1997 and 1999), Reichert et al. (1999), Young (1984), Bible, et.al. (2001), and Patchin (1994) have attempted to quantify the impacts of contamination and Superfund listing on property values. Noting that such valuations are influenced by regional employment, transportation, environmental economics, local economic climate, and the nature of the property's juxtaposition to the contamination, these investigators have developed ranges as follows:

Residential Devaluations	2 to 20 percent
Commercial Devaluations	21 to 94 percent

It should be noted that these devaluation ranges are primarily applicable to properties located adjacent to contaminated areas or CERCLA sites, and are not for properties within the contaminated area – as is the case in CTM.

Commercial and residential properties can also be differentiated based on the processes utilized to transfer ownership. Typically commercial property transactions are based in part on the results of due diligence assessments of property environmental conditions. The presence of groundwater and/or soil contamination can detrimentally impact property valuations. Without the Remediation District in place to protect innocent property owners from the cost of property devaluations and remediation costs, commercial entities could realize the 21 to 94 percent reduction in property value (as indicated above) since during the due diligence process, commercial properties within CTM typically will be identified as having groundwater contamination.

On the other hand, banks do not require environmental due diligence activities, beyond some seller disclosures, on residential properties. In addition, the state's environmental regulations are not typically applied to residential properties. To this end, residential properties are not at as much risk as commercial properties.

The existence of the CTMRD protects innocent property owners (i.e., property owners that did not cause or contribute to the contamination condition) from liability for the costs associated with characterization and remediation of the contamination – but this benefit is more applicable to commercial properties than residential. Given the differences in residential and non-residential property impacts associated with the presence of groundwater contamination within CTM (i.e., difference in "benefit" derived from the existence of the CTMRD), two distinct subgroups have been differentiated within the potentially contaminated area - residential property owners and non-residential property owners.

6.3.1 Benefits to Residential Property Owners Within the Area of Potential Impact

This group consists of the owners of residential properties that overlie the area of potential impact. The primary benefits to individuals within this group are:

- Ongoing actions to eliminate or reduce PCE-contaminated soils and groundwater underlying their property, and
- Protection of property values by avoiding a CERCLA listing, which studies have shown may contribute to a decreased property value (up to approximately 20% decrease).

6.3.2 Benefits to Non-residential Property Owners Within the Area of Potential Impact

This group consists of the owners of non-residential properties that overlie the area of potential impact. The primary benefits to individuals within this group are:

- Ongoing actions to eliminate or reduce PCE-contaminated soils and groundwater underlying their property,
- Protection of property values by avoiding a CERCLA listing, which studies have shown may contribute to a decreased property value (up to approximately 94% decrease), and
- Limitation from individual liability for remediation of PCE-contaminated soils and groundwater underlying their property.

6.4 Summary

Table 6-1 provides a summary of the three benefit groups within the CTMRD boundary area and the general allocation of annual Remediation District costs to these groups.

The specific value of the benefit, as indicated by the cost allocated to each benefit group and parcel or property, is controlled by the language in NRS 540A. Based on NRS 540A.265, the BCC is required to base the CTMRD fee on "a percentage of the total amount billed in the preceding calendar year to each parcel or property within the district for water by the provider of retail water service to the parcel or property". In addition, NRS 540A.265 stipulates that this fee may "be weighted and adjusted between parcels or properties within the district, if applicable, to reflect varying levels of effect of the contamination, varying levels of value resulting from remediation or other factors deemed relevant to the BCC."

Table 6-1
Benefit Group Summary
Central Truckee Meadows Remediation District

Remediation Management Plan Program Element	***Benefit Group***		
	All Water Users	***Property Owners***	
		Residential	***Non-Residential***
CLEAN DRINKING WATER ACTIVITIES			
Pumping Plan Implementation	✓		
Wellhead Treatment Trust	✓		
REMEDIAL ACTIVITIES			
Groundwater Monitoring/Monitored Natural Attenuation		✓	✓
Source Area Remediation		✓	✓
PROGRAM OUTREACH, EDUCATION, AND ADMINISTRATION			
Public Outreach and Education	✓	✓	✓
Project Administration	✓	✓	✓

Based on the discussions of benefit described in the above sections, the allocation of cost to those receiving benefit was as follows:

Table 6-2
Cost Allocation for Benefit Groups
Central Truckee Meadows Remediation District [1]

Remediation Program Components	***Water Users***	***Property Owners [2]***
Clean Drinking Water Activities	$ 1,430,000	$ 0
Remedial Activities	$ 0	$ 700,000
Program Outreach, Education and Administration	$ 135,000	$ 135,000
Total	**$ 1,565,000**	**$ 835,000**

[1] All costs are approximate - the basis of the costs listed in the table is provided in Section 5, *Remediation Management Program Cost Summary.*
[2] The allocation of costs between residential and non-residential property owners will be based on a fee that is weighted or adjusted, ranging from 2:1 to 4:1 of that fee associated with annualized water use.

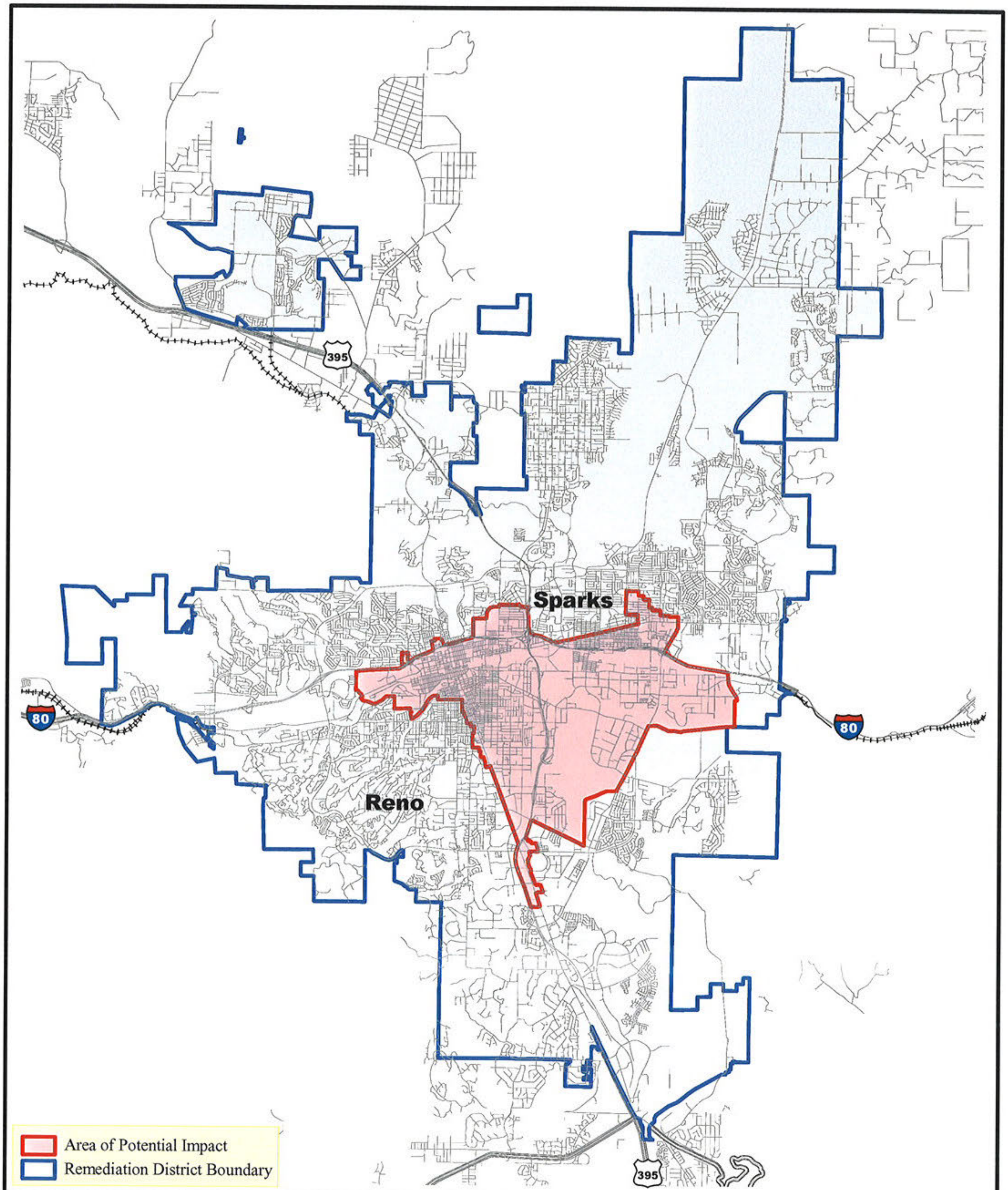


Figure 6-1 Central Truckee Meadows Remediation District

CTM
REMEDIATION
DISTRICT

Central Truckee Meadows Remediation District

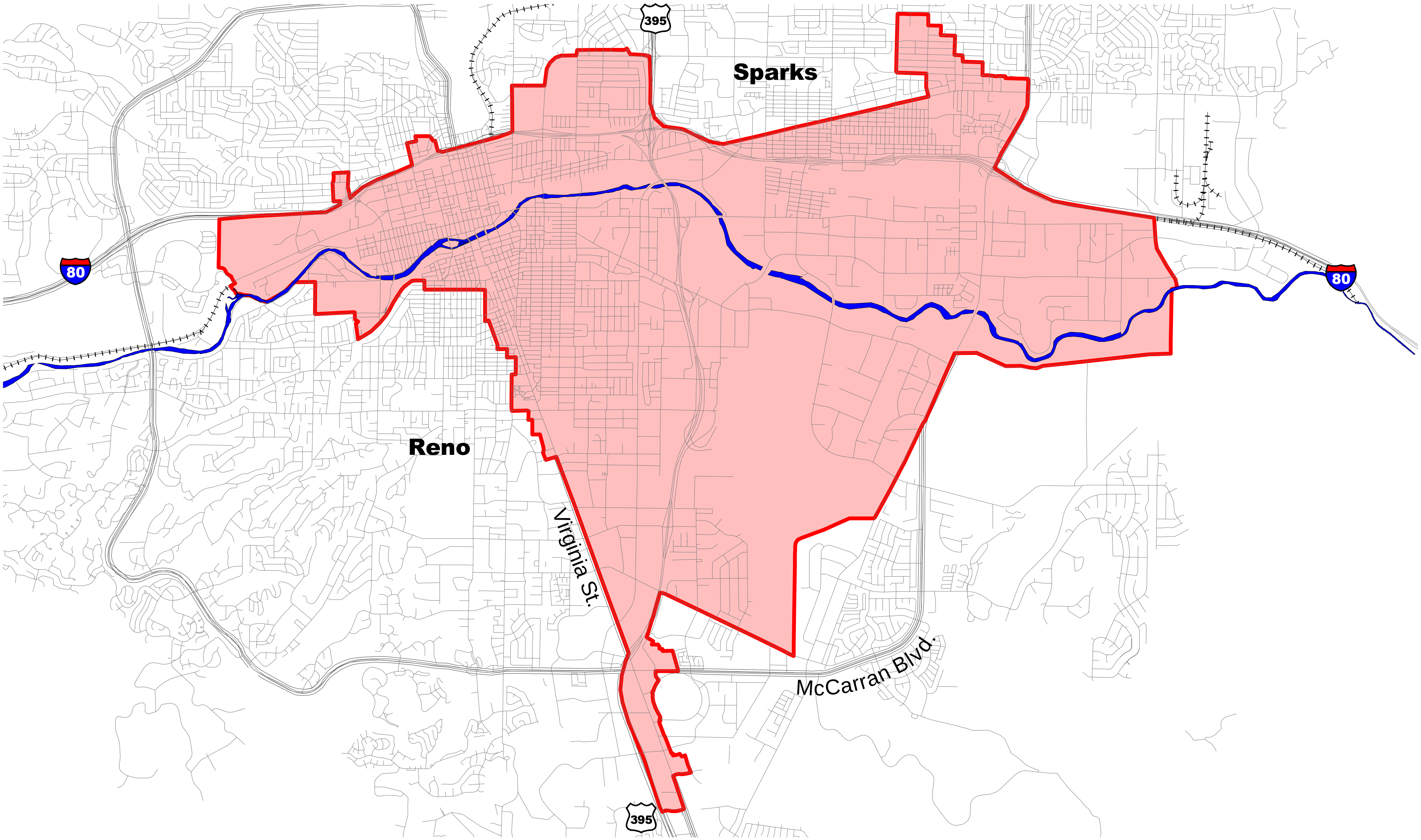
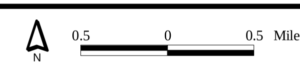
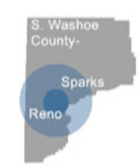


Figure 6-2 Area of Potential Impact



CTM REMEDIATION DISTRICT

Central Truckee Meadows Remediation District



Section 7
Management of the Central Truckee Meadows Remediation District

7.1 Introduction

When the BCC established the CTMRD, it identified the County DWR as the primary entity responsible for planning and implementation of the CTMRD. Although the County DWR owns these responsibilities, it is clear that numerous governmental entities will need to be involved in the practical implementation of the CTMRD given the various roles and responsibilities that exist within the state, county, and cities. Therefore, the success of the CTMRD to meet the goals and objectives set forth in Section 3, including to continue to fund treatment of the drinking water supply for the citizens of CTM and provide a limitation of liability for property owners, is incumbent upon the solid partnership between the County and the NDEP, WCDHD, TMWA, and the Cities of Reno and Sparks. Given the nature of the PCE in the groundwater (widespread, low level detections and the lack of identified sources areas), long-term management of the PCE contamination will be an important element of the remediation program. Collaboration among these "partners" as part of the long-term effort is crucial to the effective implementation of the remediation program because each entity has:

- Authority to implement some portion(s) of the RMP;
- Unique resources, responsibilities, and jurisdictional pressures that impact their contributions and performance in the implementation effort; and
- Information that can be shared and leveraged by the other project partners in various implementation efforts.

To this point, the objectives of the CTMRD management effort will be to:

- Include those entities that have information, responsibilities and/or roles in the direct implementation of the CTMRD;
- Share information and data with those entities that are either directly or indirectly impacted by the existence of the CTMRD; and
- Provide mechanisms for education and feedback both into and out of the CTMRD.

To date, collaborative efforts have occurred as part of the planning process in the form of workshops held with two groups of stakeholders – Technical Working Group (TWG) and the Public Advisory Group, or PAG (formerly known as the Technical Advisory Group, or TAG) – and in various other outreach and education efforts performed by the County (e.g., presentations to Citizen Advisory Boards, Reno and Sparks city councils, informal meetings with City staff and other business interests, etc.). The TWG and PAG are important insomuch as they represent meeting venues that were held on a regular basis, and they will, in some form, continue into the future. The TWG consists of the County DWR, NDEP, and WCDHD. The PAG consists of the TWG plus other project stakeholders such as the Cities of Reno and Sparks, TMWA, and downtown business interests.

Meetings between these entities will clearly need to continue into the future during the implementation of the CTMRD Source Identification and Remediation Phase, however, as indicated in Sections 3 and 4, these interactions will need to be formalized and more deliberate than in the past such that the objectives defined above can be achieved.

Two specific activities will occur to formalize communications. First, the Cooperative Agreement will include a statement of commitment by the NDEP, the CTMRD and WCDHD management to meet annually or on an as-needed basis to resolve RMP implementation issues that may arise, helping to guide the collaborative efforts of the TWG. Second, formal agreements will be developed among the various entities involved in activities related to implementation of the RMP. These agreements include the Cooperative Agreement among members of the TWG, data sharing agreements, and project-specific agreements. Each of the agreement types is described below:

- **Cooperative Agreement**. The members of the TWG will enter into a Cooperative Agreement. This agreement will be a long-term agreement that will define the relationships among the key project stakeholders and implementers.

- **Data Sharing Agreement** – The data sharing agreements are individual long-term agreements that will be established between the CTMRD and various other entities. The agreements would be developed with those entities responsible for generating, analyzing, and/or managing data related to groundwater use, groundwater quality, or PCE use within the CTMRD boundaries. As an example, the CTMRD is expected to develop an agreement for data sharing with TMWA, which collects pumping data and PCE concentration data for each of the operating water supply wells.

- **Project Agreements**. Project agreements will be short-term agreements related to issues that may arise in addressing a specific source or source-type. Project agreements will be developed between CTMRD and individual entities or individual property owners, as determined by the nature of a particular project. Examples include an agreement between the CTMRD and a property owner to address property access issues as part of an overall remedial action, or an agreement between the CTMRD and the City of Reno regarding the investigation of sanitary sewers.

In the following subsections the attributes and roles of each of the key project stakeholders are presented and key information sharing efforts are discussed.

7.2 Key Project Stakeholder Roles and Responsibilities

Proposed interactions among the public entities involved in implementation of the CTMRD program are depicted in Figure 7-1. An important element of the remediation program will be administration of the institutional processes associated with evaluating, managing, and remediating PCE source areas, as detailed in Section 3 of this RMP. Data from these institutional processes will be managed by the CTMRD. Based on these data, the CTMRD may provide notifications to or identify specific actions that would be needed by NDEP, WCDHD, TMWA, or the Cities of Reno and Sparks. Additionally, Figure 7-1 depicts information transfer arrows from NDEP WCDHD, TMWA, or the Cities of Reno and Sparks to the CTMRD.

7.2.1 Washoe County Department of Water Resources

On behalf of the Washoe County BCC, the Washoe County DWR serves as the public agency responsible for funding and managing the overall project. Responsibilities early in the project have included purchasing the wellhead treatment facilities for the five TMWA contaminated production wells, development of a work plan addressing all aspects of the CTMRD project, planning and implementation of an ongoing monitoring program, planning and implementation of the field investigation program, groundwater modeling/risk assessment, remedial technologies identification and screening, and preparation of this RMP. For implementation of the remediation program, County DWR will have overall responsibility for program administration, including information management, program communications within the Remediation District and with NDEP and WCDHD, public outreach and educational programs, budget and account management, billings, and associated contractor procurement. A key area of the County DWR responsibility is primary responsibility for administering the institutional processes associated with evaluating, managing, and remediating PCE source areas (see Section 3 of this RMP).

7.2.2 Nevada Division of Environmental Protection (NDEP)

NDEP serves as the representative of the State of Nevada on this project and is responsible for providing regulatory oversight in the performance of the work. As a member of the TWG, NDEP's objective has been to ensure consistency with Nevada State regulations. In terms of remediation program implementation, NDEP will work with County DWR and WCDHD in the administration of the institutional processes associated with evaluating, managing, and remediating PCE source areas. In addition, NDEP has responsibility for several programs that may have some influence on the remediation program implementation, such as the Leaking Underground Storage Tank Program (LUST), the Non-LUST Remediation Program, permitting for temporary construction dewatering systems, and permitting for permanent dewatering systems. Data and other information generated from these programs constitute important information for input into the CTMRD.

7.2.3 Washoe County District Health Department (WCDHD)

The WCDHD has also been involved in TWG meetings with the objective of ensuring consistency with WCDHD policies and requirements. WCDHD will work with the County DWR and NDEP in the administration of institutional processes. Similar to NDEP, WCDHD has responsibility for programs that may have some influence on the remediation program implementation, including an underground storage tank, safe drinking water, and air/vapor response programs.

7.2.4 Truckee Meadows Water Authority (TMWA)

Five TMWA water supply wells have been equipped with wellhead treatment systems for the removal of PCE. Operation and ongoing management of these five wells and other TMWA water supply wells, including aquifer recharge operations, has been recognized as another important consideration in the implementation of the CTMRD program. Currently, TMWA and County DWR have an agreement (i.e., the Pumping Plan) related to pumping of the water supply wells (TMWA, 1998). TMWA and the County DWR will continue to maintain and, when appropriate, upgrade the Pumping Plan as more data become available and conditions change.

In addition, TMWA may have other public water supply wells that require wellhead treatment in the future. TMWA will need to work with the County and NDEP to identify locations where future wellhead treatment will be necessary to protect the citizens of CTM from the potential impacts of PCE at these locations.

Finally, TMWA is required to provide the County with information regarding annual water use in their service area. This data transfer is required to support the tax bills prepared by the County. Data transfer will need to continue until such time that the County no longer needs the water-use information.

7.2.5 Cities of Reno and Sparks

The primary involvement of the Cities of Reno and Sparks relates to their ownership of property within the CTM. Both Cities also have active redevelopment programs ongoing within their respective downtown areas. Given that the downtown areas in both Reno and Sparks are underlain by PCE contaminated groundwater, the interaction of the CTMRD with the redevelopment efforts will be critical in the long-term management of the property and future construction efforts.

In addition, both cities own and operate the sanitary sewers that collect wastewater from all points within CTM, conveying the wastewater to the regional wastewater treatment plant. Given that the sanitary sewers have received PCE wastewater from various businesses in the past, and that illicit discharges appear to be continuing, both cities will need to work with the CTMRD to help manage and control these discharges. Since the sanitary sewers extend over such a large portion of the CTM, this effort will be of the utmost importance to the long-term effectiveness of any remedial program.

7.3 Data Management and Reporting Requirements

Information transfer is critical to the CTMRD for maintaining an understanding of conditions within the Truckee Meadows that may influence ongoing or future actions. Examples of information transfer to (and from) the CTMRD include, but are not limited to the following:

- Updates about ongoing cleanup actions at existing sources (NDEP and WCDHD);
- Potential new source areas (NDEP, WCDHD, and the Cities of Reno and Sparks);
- Updates on groundwater monitoring data or groundwater/soils investigation data (NDEP and WCDHD);
- Water supply well pumping data, including proposed modifications to pumping operations (TMWA);
- Aquifer recharge data (TMWA);
- Information from permitted temporary or permanent dewatering operations (NDEP); and
- Data from sanitary sewer actions (Cities of Reno and Sparks).

The County DWR maintains a graphical information system (GIS) database and environmental database associated with all groundwater monitoring data for 220 wells that have been installed within the Truckee Meadows. Included in the database are water level information, historical water quality data, sewer sampling data, and land use information. The County DWR will continue to maintain the database throughout the CTMRD project, and make it available to project stakeholders as the need arises.

The processes for information transfer have not been fully detailed. Input from all parties involved in the overall program is needed and will be developed through meetings of the TWG and the PAG, and will be formalized in a Cooperative Agreement.

The CTMRD will submit an annual report detailing CTMRD activities during the prior year. The annual report will address the following:

- Meetings among the TWG and PAG

- Public outreach efforts
- PCE source-area activities, including identification of new sources and prioritization, characterization, and remediation efforts related to potential source areas or source types
- Listing of source areas referred to NDEP
- Wellhead treatment activities, including evaluation of the pumping plan, identification of additional water supply wells threatened by the PCE plume
- Groundwater Monitoring Program Summary, including groundwater elevation and groundwater quality trends, pumping program evaluation, and results of groundwater modeling and other data analysis
- Further development of CTMRD policies and procedures
- Recommendations for changes/refinements to the RMP for the following year.

The annual report will be submitted to the BCC, NDEP, WCDHD, and will be available for review by the public.

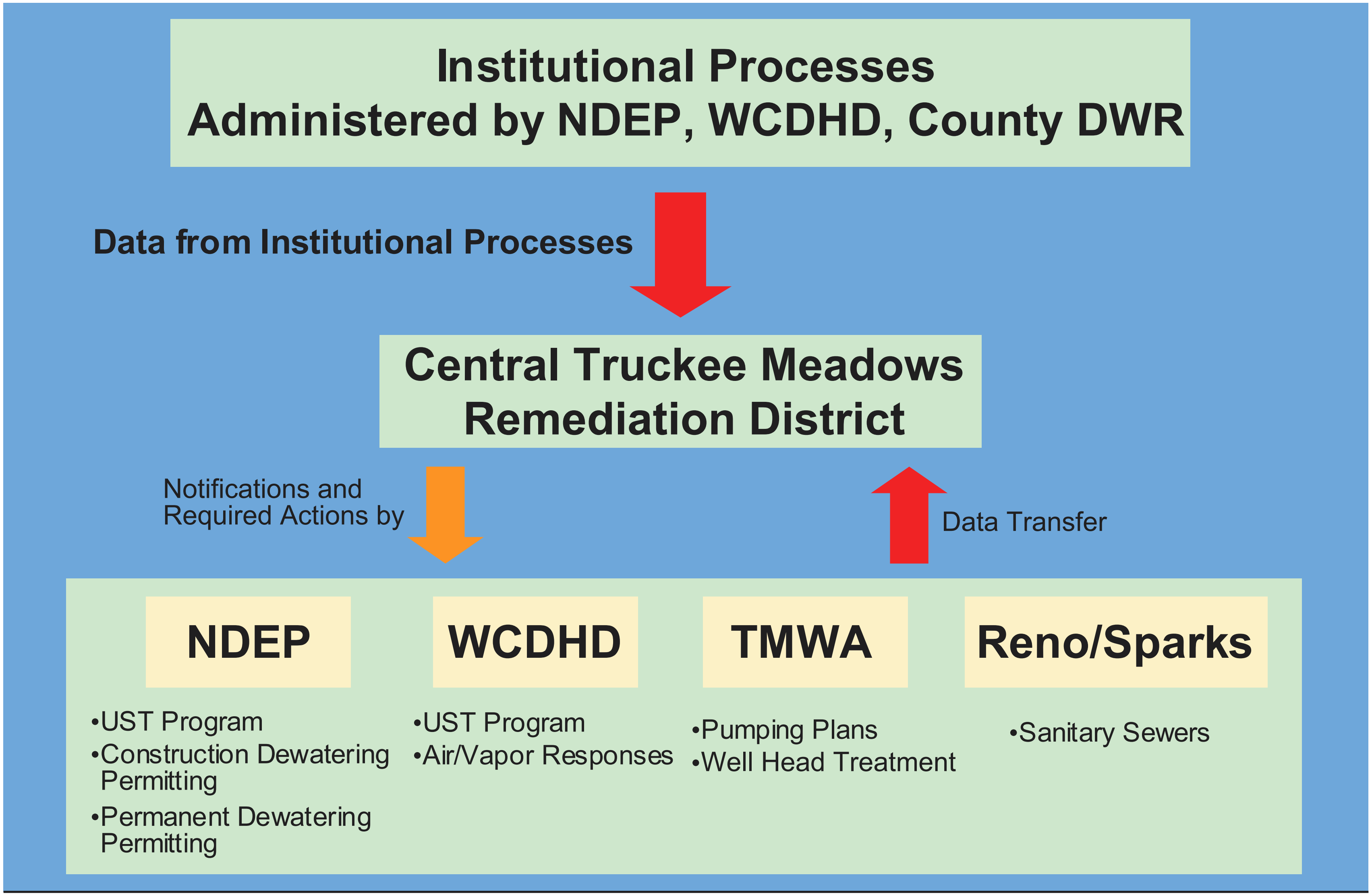


Figure 7-1 Institutional Processes

Section 8
Nevada Revised Statute 459,500 Jurat

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state, and local statutes, regulations, and ordinances.

Tracy Douvette
C.E.M. No. 1508
Expiration Date – March 8, 2004

24-Oct-02
Date

Section 9
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Appendix A

Letter from NDEP, Certification Letters from NDEP and WCDHD, and State of Nevada Revised Statute NRS 540A-250 Through NRS 540A.285

PETER G. MORROS, Director

L.H. DODGION, *Administrator*

(702) 687-4670
TDD 687-4678

ministration
ning Regulation and Reclamation
Water Pollution Control
Facsimile 687-5856

STATE OF NEVADA
BOB MILLER
Governor

Waste Management
Corrective Actions
Federal Facilities

Air Quality
Water Quality Planning
Facsimile 687-6396

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL PROTECTION

333 W. Nye Lane, Room 138
Carson City, Nevada 89706-0851

RECEIVED
SEP 10 1997
WASHOE COUNTY
DEPT. OF WATER RESOURCES

August 29, 1997

Mr. Grant Sims
Chairman
Washoe County Board of Commissioners
Post Office Box 11130
Reno, Nevada 89520

Dear Mr. Sims:

The Nevada Division of Environmental Protection has completed a second review of the revised Central Truckee Meadows Remediation District Final Work Plan (dated February 22, 1996), prepared by Camp Dresser & McKee, Inc.

Based on our review of this document, the proposed work to be performed is acceptable to the Division. Therefore, pursuant to Subsection 1 of Nevada Revised Statutes 540A.260, NDEP hereby approves the work plan as written.

If you have any questions concerning this matter, please contact Mr. Doug Zimmerman at (702) 687-4670, extension 3127.

Sincerely,

L. H. Dodgion, P.E.
Administrator

LHD:kmf
cc: Robert C. Kelso, NDEP
Madelyn Shipman, Esq., Washoe County Assistant District Attorney
Leonard Crow, Washoe County Community Development
John O. Swendseid, Esq., Swendseid & Stern

PETER G. MORROS, Director
L.H. DODGION, *Administrator*
687-4670
687-4678
Administration
Mining Regulation and Reclamation
Water Pollution Control
Facsimile 687-5856
Address Reply to:
Capitol Complex
Carson City, NV 89710

STATE OF NEVADA
BOB MILLER
Governor

Waste Management
Corrective Actions
Federal Facilities
Facsimile 885-0868
Air Quality
Water Quality Planning
Facsimile 687-6396
Located at:
333 W. Nye Lane
Carson City, NV 89710

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL PROTECTION

Capitol Complex
Carson City, Nevada 89710

August 2, 1995

WASHOE COUNTY
BOARD OF COMMISSIONERS
1001 E 9TH STREET
RENO NEVADA 89520

Dear Commissioners:

As you are aware, the Nevada Division of Environmental Protection, in cooperation with the City of Reno, Washoe County, Sierra Pacific Power Company and numerous private interests have been evaluating ways to address the presence of perchloroethylene or PCE in ground water underlying the Truckee Meadows. To date, significant efforts have been completed to delineate the magnitude and extent of the contamination and to proceed towards clean-up of this problem which has the potential of impacting all the residents of the Truckee Meadows. The Division is pleased with the progress which has been made through private and public partnerships without the intervention of enforcement actions or other regulatory tools which are traditionally used in matters such as this. Additionally, the passage and signing by Governor Miller of SB 489 of the 1995 session of the Nevada Legislature provides a alternative mechanism to Washoe County to address the PCE issue to the benefit of all residents.

The purpose of this letter is to certify, in accordance with SB 489 Section 29, subsection 1 that a condition exists within a region of Washoe County which is affecting the quality of water available for municipal, industrial and domestic use. It is my understanding of this legislation that upon receipt of this certification, the Board, in cooperation with the Health Officer and DEP will evaluate the existence and extent of the condition and establish appropriate boundaries for a remediation district.

I would also like to reiterate the Division's willingness to continue to participate in this process to secure a resolution to this problem in a timely and cost effective manner.

If further information is needed please contact Allen Biaggi, Chief of the Bureau of Corrective Actions at (702) 687-4670 extension 3021.

Sincerely,

L.H. Dodgion P.E.
Administrator

cc: Dave Rice, District Health Officer

DISTRICT HEALTH DEPARTMENT

AUG 1995 RECEIVED Washoe County Commissioners

August 9, 1995

Washoe County
Board of Commissioners
1001 East 9th Street
Reno, NV 89512

Dear Commissioners:

We certify to you in accordance with Senate Bill 489, Section 29, Subsection 1, that a condition exists within a region of Washoe County which is affecting the quality of water available for municipal, industrial, and domestic use. It is my understanding of this legislation that upon receipt of this certification, the Board of Commissioners, in cooperation with Administrators of the Nevada Division of Environmental Protection will evaluate the existence and extent of the condition and establish appropriate boundaries for a remediation district.

The Washoe County District Health Department, in cooperation with the Nevada Division of Environmental Protection (NDEP), City of Reno, Sierra Pacific Power Company, and numerous private interests, has been evaluating ways to address the presence of perchloroethylene (PCE) in groundwater underlying the Truckee Meadows. To date, significant efforts have been completed to delineate the magnitude and extent of the contamination and to proceed towards cleanup of this problem. We are pleased with the progress that has been made through private and public partnerships. The passage of Senate Bill 489 during the 1995 Legislative session provides an alternative mechanism to Washoe County in addressing the PCE issue.

We would like to reiterate the Health District's willingness to participate in this process of securing a resolution in a timely and cost effective manner.

Sincerely,

David E. Rice, M.P.H.
District Health Officer

AUG 11 1995

DER/CRC:jd

cc: Yvonne Sylva
Lew Dodgion

REMEDIATION OF QUALITY OF WATER

NRS 540A.250 Creation of district for remediation; recovery of expenses.

1. The board shall create a district for remediation of the quality of water if the county or district health officer or the administrator of the division certifies in writing to the board that a condition exists in an area of the region which is affecting or will affect the quality of water that is available for municipal, industrial or domestic use within the region.

2. Upon receipt of the certificate, the board shall proceed, in cooperation with the health officer and the division, to verify the existence and extent of the condition and establish the appropriate boundaries of the district. Money expended by the board for this purpose may be recovered, after the district is established, from the proceeds of bonds issued pursuant to NRS 540A.267 or from a fee or tax imposed pursuant to NRS 540A.265.

3. The district created pursuant to this section must include:

(a) The area where the condition which requires remediation is determined by the board to be present or for which remediation is determined by the board to be necessary, including any area to which the condition is expected to migrate unless remediation is carried out; and

(b) If the board determines that the condition which requires remediation affects the quantity or quality of drinking water within the region, the wholesale and retail service area of any provider of water that has used or uses for any portion of its supply wells located in the area described in paragraph (a).

(Added to NRS by 1995, 2657; A 1997, 656, 1335)

NRS 540A.260 Preparation and approval of plan for remediation; duty of board to determine costs of developing and carrying out plan; liability of owner or lessee of property.

1. Before creating a district for remediation pursuant to NRS 540A.250, the board shall prepare a plan for remediation which must be approved by the division.

2. The plan for remediation may include any action which is reasonable and economically feasible in the event of the release or threat of release of any hazardous substance into the environment which may affect the water quality in this state. Such action may include:

(a) Monitoring, assessing and evaluating the water which may be affected by the substance;

(b) Removing or disposing of the substance or remedying the condition of the water in any other manner; and

(c) Taking such actions as are necessary to prevent, minimize or mitigate damage to the affected water.

3. After the plan for remediation is approved by the division, the board shall determine, and may from time to time redetermine, the costs of developing and carrying out the plan for remediation. The costs may include all or part of:

(a) The cost of acquisition, construction, equipment or other improvement of real and personal property in developing and carrying out the plan for remediation;

(b) The cost of engineering and design in connection with developing and carrying out the plan for remediation;

(c) The cost of operation, maintenance, monitoring, administration, collection and other continuing charges in connection with developing and carrying out the plan for remediation;

(d) Any reimbursements as provided in subsection 2 of NRS 540A.250 or NRS 540A.270;

(e) Principal, interest and other charges due in connection with bonds or other borrowing incurred to pay the costs of developing and carrying out the plan for remediation;

(f) The cost of operation, maintenance, administration and other continuing charges in connection with carrying out the responsibilities of the district for remediation, including the cost to notify the general public of the plan for remediation and the activities of the district; and

(g) All other costs and expenses that the board determines are reasonably related to the development and carrying out of the plan for remediation or the financing thereof, or to the activities or responsibilities of the district for remediation.

4. An owner or lessee of property within the district who did not cause or contribute to the condition which the district was created to remedy is not subject to criminal or civil liability, including, without limitation, any liability for the cost of remediation or any related damage or injury caused by the condition, except to the extent of any unpaid assessments levied against the property.

5. No person, governmental agency or charitable organization, whether or not otherwise exempt from assessment or taxation, except the Federal Government, is exempt from an assessment levied pursuant to this section.

(Added to NRS by 1995, 2657; A 1997, 656, 1336)

NRS 540A.262 Prerequisites to determining, expanding or amending boundaries of district for remediation: Hearing; publication of notice of hearing; adoption of ordinance; certain bonds or financial obligations paid in full; territory not required to be contiguous.

1. Before determining the boundaries of a district for remediation, the board shall hold a hearing. It shall cause notice of the hearing to be published at least once not less than 15 days before the hearing in a display advertisement at least 3 by 5 inches in size in a newspaper of general circulation in the county. The notice must contain a description of the boundaries of the district by assessor's parcel number, or by metes and bounds or other legal description, or state that a description of the boundaries of the district is on file at the office of the county clerk for public examination.

2. After the hearing, the board shall make such adjustments to the proposed boundaries of the district as appear to the board to be necessary, but the boundaries may not be expanded to include any property not included in the proposed boundaries of the district described in the notice of hearing or filed with the county clerk unless another hearing is held, after notice given by publication in the manner provided in subsection 1. After the hearing and any adjustment to the boundaries of the district required by this section, the board shall designate the boundaries of the district by ordinance, which may not be adopted as if an emergency existed.

3. The board may from time to time amend the boundaries of the district. Any such amendment must be made by ordinance adopted after a hearing held in the manner provided in subsection 1. Notice of that hearing must be given by publication in the manner provided in subsection 1. The board may not amend the boundaries of the district to exclude any property if bonds have been issued or other financial obligations incurred for the district until those bonds or other financial obligations have been paid in full.

4. The territory of the district established pursuant to subsection 2 and, if applicable, expanded pursuant to subsection 3 need not be contiguous.

(Added to NRS by 1997, 1332)

NRS 540A.265 Determination of annual fee for properties within district for remediation; collection and enforcement of fee; duty of persons who sell water to provide board with list of clients; power of board to impose ad valorem tax on property within district in lieu of annual fee.

1. The board, by ordinance, which may not be adopted as if an emergency existed, may determine and from time to time redetermine the amount of an annual fee, to recover the costs of developing and carrying out the plan for remediation, to be imposed on the properties in the district for remediation. In making the determination, the board may apportion the fee on the basis of improved square footage, zoning, current or previous land use, area or any other factor determined relevant and equitable by the board. If the condition requiring remediation affects the quality or quantity of drinking water within the region, the fee must:

(a) Be based upon a percentage of the total amount billed in the preceding calendar year to each parcel or property within the district for water by the provider of retail water service to the parcel or property;

(b) Be weighted and adjusted between parcels or properties within the district, if applicable, to reflect varying levels of effect of the contamination, varying levels of value resulting from remediation or other factors deemed relevant by the board;

(c) For any parcel or property for which the fee is weighted or adjusted, not be less than one-half or more than twice the percentage established pursuant to paragraph (a); and

(d) For parcels or properties within the district where retail water service is not provided or for which a full calendar year's billing is unavailable, be based upon an estimated billing taking into account a partial year's billing extended to 12 months or an average of fees for parcels or properties with comparable zoning or uses.

2. A fee imposed pursuant to subsection 1 must be collected by the county treasurer with the general taxes of the county, and the payment therefor must be enforced in the same manner and with same remedies as are provided for the collection of general taxes.

3. If so requested by the county, all persons who sell water at wholesale or retail within the district shall furnish to the county, within 3 months after a request or at a later time specified by the board, a list identifying by assessor's parcel number each property for use on which water was sold and the amount billed with respect to each parcel for water during the year designated by the board. No charge may be made to the county for furnishing the list.

4. In lieu of the fee authorized by subsection 1, the board may constitute the district for remediation as a special taxing district and impose a general ad valorem tax on all taxable property in the district at a rate sufficient to pay the costs of developing and carrying out the plan for remediation. The board is the governing body of any special taxing district established pursuant to this subsection. The budget of any such special taxing district must be included as part of the budget of the county and its meetings must be held as part of the meetings of the board. Any tax imposed pursuant to this subsection is exempt from the limitations on taxes ad valorem stated in chapter 354 of NRS. No portion of any tax imposed pursuant to this subsection may be allocated to any redevelopment area or tax increment area whose boundaries overlap in whole or in part the district for remediation.

(Added to NRS by 1997, 1333)

NRS 540A.267 Power of board to issue bonds or otherwise become obligated to pay costs of developing and carrying out plan for remediation; bonds or other obligations secured by certain fees or taxes.

1. The board may issue bonds and otherwise borrow money in anticipation of the fees or taxes, or any combination thereof, collected pursuant to NRS 540A.265 to pay the costs of developing and carrying out the plan for remediation, including any of the costs mentioned in subsection 3 of NRS 540A.260.

2. The board may issue those bonds as, or may borrow money evidenced by, special obligations of the county secured solely by those fees or taxes, or any combination thereof, or general obligations of the county, whose payment is additionally secured by those fees or taxes, or any combination thereof.

3. The taxes or fees that are pledged as additional security for those general obligations are pledged revenues for the purposes of subsection 3 of NRS 350.020.

(Added to NRS by 1997, 1334)

NRS 540A.269 Applicability of chapters 332 and 338 of NRS to contract for plan for remediation; county ownership of property on which remediation equipment or improvements are located not required if certain conditions met.

1. Chapters 332 and 338 of NRS do not apply to a contract made by a person to accomplish the purposes of NRS 540A.250 to 540A.285, inclusive, or to a contract made by the county to carry out the plan for remediation with any provider of water service to the district for remediation.

2. The county need not own the property on which any remediation equipment or improvements are located or used, or acquire ownership of any remediation equipment or improvements whose cost is paid from money of the county, including proceeds of bonds issued pursuant to NRS 540A.267, if the board determines there are adequate contractual safeguards to ensure that the equipment or improvements are used to further the plan for remediation.

(Added to NRS by 1997, 1334)

NRS 540A.270 Reimbursement of expenses to identify, study and remedy condition if costs and expenses in conformity with plan; establishment of criteria for reimbursement; reimbursement subject to availability of proceeds from certain bonds, fees or taxes.

1. The board may reimburse a person, governmental agency or public utility for any expenses incurred in identifying, studying and remedying, or attempting in good faith to remedy, the condition before the district is created, or thereafter for costs and expenses that are in conformity with and further the plan for remediation or operation of the district. No reimbursement may be allowed for any expense that any person incurs in connection with disturbing the ground for the construction or improvement of property in the district unless the board determines that the cost or expense is in furtherance of the plan for remediation and is a cost or expense which would have been cost-effective and beneficial to incur to further the plan for remediation.

2. The board may establish criteria for the reimbursement of a person, governmental agency or public utility for expenses pursuant to subsection 1. The criteria must include adequate safeguards so that costs reimbursed include only the actual costs of the activities undertaken as provided in this section. No reimbursement may be provided for any cost incurred after the creation of the district unless before the cost is incurred by the person or entity seeking reimbursement, the amount is approved by the board and the board determines that the cost is in furtherance of the plan for remediation. The board may establish criteria with respect

to the amount of reimbursement for particular activities and with respect to the process to be followed in establishing reasonable costs for reimbursement, including, at the board's discretion, any requirement for bidding on any construction or any acquisition of equipment.

3. The reimbursement may be made only if money is available from the proceeds of bonds issued or from fees or taxes imposed pursuant to NRS 540A.250 to 540A.285, inclusive, which are not otherwise required to be expended for other purposes. Those sections do not constitute a requirement that the county make any reimbursements.

(Added to NRS by 1995, 2658; A 1997, 1338)

NRS 540A.280 State department of conservation and natural resources authorized to recover costs of remediation from person who caused or contributed to condition requiring remediation; priority of distribution of money recovered from responsible person; use of money distributed to board.

1. If, during an investigation to establish the boundary of a district for remediation, development of a plan for remediation or the carrying out of the plan, the board acquires evidence that a person has caused or contributed to the condition requiring remediation, the board shall provide this evidence to the division for appropriate action. In addition to any other action authorized by statute, the department may by legal action recover from the person responsible the costs of remediation incurred by the county or district. Any monetary recovery from the person responsible, excluding any money recovered as a penalty, must be distributed and applied in the following order of priority:

(a) To the department to pay the costs of recovery and to offset the costs of remediation incurred by the department; and

(b) To the board to offset the costs of remediation incurred by the county or district.

2. Any recovery distributed to the board must be used to reduce the fee or tax or to defray any increase in the fee or tax that would otherwise be charged against the parcels or properties within the district, as determined by the board.

3. As used in this section, "department" means the state department of conservation and natural resources.

(Added to NRS by 1995, 2658; A 1997, 1338)

NRS 540A.285 Determination by board conclusive and incontestable in absence of fraud or gross abuse of discretion; review of determination by district court.

1. A determination by the board pursuant to NRS 540A.250 to 540A.285, inclusive, including a determination of the boundaries of a district for remediation or any expansion thereof, determination of the costs of developing or carrying out a plan for remediation, determination of the apportionment of the fee to recover those costs pursuant to NRS 540A.265, determination of the amount of any fee or tax pursuant to NRS 540A.265, determination as to guidelines for the provision of any reimbursement of the cost of remediation pursuant to NRS 540A.270, determination of the amount of any reimbursements and any determinations made in connection with the issuance of bonds pursuant to NRS 540A.267, is conclusive and incontestable in the absence of fraud or gross abuse of discretion.

2. A property owner or other person who is aggrieved by a determination of the board pursuant to NRS 540A.250 to 540A.285, inclusive, may seek review of the determination in the district court in and for the county within 15 days after the board makes the determination. Such a review may not be sought after the expira-

tion of that period. If, in such an appeal, the court finds that the determination was a result of fraud or gross abuse of discretion, it shall remand the matter to the board for a new determination. If the court does not find the determination was a result of fraud or gross abuse of discretion, it shall uphold the action of the board.

(Added to NRS by 1997, 1334)

SUPPLYING OF WATER

NRS 540A.290 Property or facility of county: Transfer to or operation or management by largest supplier in region which is public utility. The board of county commissioners may sell or lease, to the largest supplier of water within the region which is a public utility, at a negotiated price, any property or facility used by the county to supply water within the region, or contract for the operation or management of the property or facility by the public utility.

(Added to NRS by 1995, 2658)

NRS 540A.300 Agreement between board and largest supplier in region which is public utility; compliance with regulations of public utilities commission of Nevada; withholding of certain information from board.

1. The board of county commissioners and the largest supplier of water within the region which is a public utility shall enter into an agreement which defines the respective areas within the region where the public utility and all systems for the supply of water which are controlled or operated by the board will provide retail water services. The agreement must resolve all issues related to service territories of the public utility and all systems for the supply of water which are controlled or operated by the board. An agreement executed pursuant to this subsection does not become effective until the public utilities commission of Nevada approves the terms of the agreement.

2. The agreement entered into pursuant to subsection 1 governs the provision of retail water services by the public utility and the board, unless the agreement is amended by the mutual agreement of the board and the public utility.

3. The public utility must comply with any applicable regulations of the public utilities commission of Nevada when providing water services within the region.

4. The public utility may withhold from the board at any time before an agreement is finalized pursuant to subsection 1 any information which is confidential, proprietary or which may cause a competitive disadvantage to the public utility if the information is disseminated.

(Added to NRS by 1995, 2658; A 1997, 2012)

NRS 540A.310 Duties of largest supplier in region which is public utility.

1. The largest supplier of water within the region which is a public utility shall provide wholesale water services in a manner consistent with its water resource plan as approved by the public utilities commission of Nevada.

2. The largest supplier of water within the region which is a public utility shall provide all wholesale water services to any system of water supply operated or controlled by the board of county commissioners from water resources recognized in its water resource plan as approved by the public utilities commission of Nevada, except to the extent that:

(a) There is an existing system or a system under construction for the provision of wholesale water services;

Appendix B

Technical Memorandum – Field Investigation Program Data Summary

Central Truckee Meadows Remediation District

Technical Memorandum
Field Investigation Program Data Summary

July 9, 2002

Technical Memorandum

Contents

Tables

Figures

Figures are located at the end of each section.

Section 1
Introduction

This *Technical Memorandum – Field Investigation Program Data Summary* (Technical Memorandum) was prepared by Camp Dresser & McKee Inc. (CDM) on behalf of the Washoe County Department of Water Resources (Washoe County). The work documented in this Technical Memorandum was performed as an element of the Central Truckee Meadows (CTM) Remediation District project. The primary objective of the CTM Remediation District project is to characterize and evaluate groundwater contamination in the CTM. In addition to the field investigation program, project elements include a human health and ecological risk analysis, groundwater flow modeling, remedial alternatives development and evaluation, and preparation of a remediation plan.

1.1 Background Information

Tetrachloroethene (PCE), an organic solvent used in a variety of commercial/industrial operations (e.g., commercial dry cleaning, paint manufacturing and distribution, auto repair) was initially found in groundwater within the limits of the city of Reno. Subsequent groundwater investigations have identified widespread occurrences of PCE and other volatile organic compounds (VOCs) in shallow groundwater. A detailed discussion regarding site history, geology and hydrology, and planning and development of the field investigation program is compiled in the *Final Updated Work Plan* (Final Work Plan) (CDM, 2001).

To address the presence of PCE in groundwater, the Nevada legislature established the Remediation District by enacting the State of Nevada Statue NRS 540A.250 through NRS 540A.285. The Remediation District was tasked to define the nature and extent of PCE in groundwater, to evaluate human health risks associated with the presence of PCE and to develop and implement remedial actions addressing PCE impacts to the drinking water supply.

The specific objectives of this Technical Memorandum are:

- To provide a concise summary of the full range of data generated as part of the field investigation program
- To identify data gaps to be addressed as part of future Remediation District work.

While PCE is the primary contaminant of concern, other potential contaminants were analyzed and evaluated. The data collected during the field investigation was utilized in the ongoing development of a hydrogeologic flow model and as the basis for an analysis of risk to human health and the environment. Finally, the results of the field investigation program, the groundwater modeling, and the risk analysis will be used to prepare a remediation plan that will identify the program(s) needed to mitigate the effects of PCE in the shallow and deep groundwater flow systems.

1.2 Technical Memorandum Organization

This Technical Memorandum consists of 4 sections. Section 1, *Introduction*, defines the purpose of the Technical Memorandum and provides background information. Section 2, *Field Investigation Program Activities*, describes the full range of field investigation activities performed. Section 3, *Results and Discussion*, presents and discusses the data generated during the field investigation program. This Technical Memorandum concludes with Section 4, *Conclusions*, which highlights the primary conclusions of the investigation and identifies data gaps requiring further investigation /evaluation as part of future Remediation District efforts.

Additionally, there are several appendix sections included as part of this Technical Memorandum, as listed below:

- Appendix A - Borehole Logs
- Appendix B - Geophysical Logs
- Appendix C - Slug Test Results
- Appendix D - Monitoring Well Summary Sheets

Section 2
Field Investigation Program Activities

2.1 Purpose and Objectives

The CTM Remediation District field investigation program was intended to provide the information needed to achieve a comprehensive understanding of conditions with the CTM study area related to the presence of PCE in groundwater. Data generated as part of the field investigation program were essential for performing the primary elements of the Remediation District project -- human health and environmental risk analysis, groundwater flow model, and development and evaluation of remedial alternatives. Specific objectives of the field investigation program are highlighted below:

- Confirm the nature of groundwater and soil contamination
- Delineate the lateral and vertical extent of groundwater contamination in the shallow aquifer
- Generate data to assist the Board of county Commissioners in defining the boundaries of the Remediation District
- Generate data to support assessment of current and future risk to human health and the environment
- Fill data gaps associated with geologic, hydrogeologic, and hydrologic characteristics within the CTM study area in order to development groundwater flow and contaminant transport models
- Generate data to support identification and evaluation of candidate remedial actions in the development of a comprehensive remediation plan.

The field investigation program consisted of 8 primary tasks, as identified below:

- Drilling and Groundwater Monitoring Well Installation and Development
- Soil Sampling
- Soil Gas Sampling
- Discrete-Depth Groundwater Sampling (during well drilling operations)
- Groundwater Monitoring Well Sampling
- Geophysical Logging
- Global Positioning System (GPS) Survey of Monitoring Well Locations

- Hydraulic Testing

A detailed description of the field investigation program, including planning and program development, field methods (standard operating procedures), sample collection techniques, and analytical procedures is presented in the Final Work Plan (CDM, 2001). This section provides a summary of the field investigation activities performed, highlighting deviations from the program as defined in the Final Work Plan. As part of the planning and development of the investigation program, eight distinct areas of investigation within the study area were defined. The field investigation program activities are presented in terms of the defined areas of investigation.

2.2 Drilling and Monitor Well Installation

A total of 36 monitoring wells were drilled and installed between March 6 and June 5, 2001, including twenty-three shallow wells and 13 deep wells. A break in the drilling program occurred on May 4, 2001. Based on the data collected to date and an assessment of program data collection needs, the County and CDM made some adjustments to the number and locations of groundwater monitoring wells remaining to be installed. Resuming on May 29, the drilling/well installation program was completed on June 5, 2001.

A listing of the wells installed as part of the field investigation program is provided in Table 2-1. The wells are listed in terms of discrete areas of investigation defined in the Final Work Plan (including Area A through Area H and Other Areas). Figure 2-1 shows the locations of the 36 monitoring wells.

Table 2-1
Groundwater Monitoring Well Installation Summary

Area	Shallow Wells	Deep Wells
A	CTM-1S CTM-28S	
B	CTM-2S CTM-29S	
C	CTM-3S CTM-5S CTM-6S CTM-7S CTM-31S CTM-37S CTM-40S	CTM-4D CTM-8D CTM-30D
D	CTM-9S CTM-11S CTM-13S CTM-39S	CTM-10D CTM-12D CTM-38D CTM-37D
E	CTM-14S CTM-15S	CTM-27D
F	CTM-16S CTM-18S	CTM-17D CTM-33D
G	CTM-19S CTM-20S	
H	CTM-21S	CTM-22D
Other	CTM-41S	CTM-23D CTM-25D

2.2.1 Overview of Drilling and Well Construction Operations

Sonic drilling was used for drilling of all of the monitoring wells. The Sonic drilling method provided for the collection of continuous soil core samples for lithologic evaluation of subsurface conditions and chemical and geotechnical analysis of soil samples. Boart Longyear was the drilling subcontractor for all drilling operations. CDM managed the drilling program. Washoe County staff and CDM staff provided oversight during drilling operations.

The depth of drilling for the soil borings varied between 24.5 (CTM-20S) and 347 feet (CTM-10D and CTM-12D) below ground surface (bgs). Groundwater was encountered at depths between 17.5 (CTM-20S) and 124 feet (CTM-40S) bgs.

All shallow and deep monitor wells were constructed of 2-inch diameter, flush-threaded polyvinyl chloride (PVC). The well screens consisted of 0.020-inch slotted PVC and were 20 feet in length, with the exception of well CTM-40S, which was constructed with 30 feet of screen. A threaded cap was installed on the bottom of the screen. Shallow wells (completion depth less than 100 feet bgs) were constructed using schedule 40 PVC, while deep wells (completion depth greater than 100 feet bgs) were constructed using schedule 80 PVC. Shallow wells were constructed such that approximately 5 feet of screen was installed above the water table and 15 feet of screen was installed below the water table. Centralizers were placed in the deep wells at approximately 20-foot intervals.

The filter pack consisted of 10-20 sieve-sized silica sand that was tremied in the well annulus to a minimum of five feet above the screen interval. The sand pack settled when the outer steel casing used during drilling was vibrated out of the borehole following installation of the filter pack. Additional sand was added as needed to maintain the filter pack a minimum of five feet above the top of the screen. A minimum of one foot of fine silica sand was placed above the filter pack in the deep wells to prevent leaching of bentonite into the screened interval. A minimum of four feet of bentonite pellets were placed in the well annulus above the filter pack and hydrated with approximately 5 gallons of water, when not in the saturated zone. The bentonite pellets were allowed to hydrate for a minimum of one half hour prior to placement of the surface seal.

For all wells, the surface seal consisted of a volclay and bentonite-cement grout tremied from the top of the bentonite pellets to the ground surface. The well surface completion consisted of a concrete pad and a 12-inch diameter steel protective vault with a flush-mounted cover. An expandable, lockable cap was placed on the PVC well casing. The top of the PVC well casing was notched to designate water level measurement location and for survey elevation purposes.

Well completion details are summarized in Table 2-2. Well completion logs are included as part of the borehole logs and are presented in Appendix A.

Table 2-2
Well Completion Details

Monitor Well ID	Date of Well Installation	Total Depth (ft bgs)	Borehole Diameter (inches)	Screen Interval/ Length of Screen (ft bgs)	Ground Surface Elevation (ft msl)	Top of PVC Elevation (ft msl)	Coordinates	
							Northing	Easting
CTM-1S	03/27/01	51	6	30.5 – 50.5 / 20	4539.11	4538.78	14,865,566.72	2,273,657.22
CTM-2S	03/29/01	50	6	29.5 – 49.5 / 20	4527.61	4527.31	14,863,908.59	2,274,253.41
CTM-3S	03/28/01	51	6	30.5 – 50.5 / 20	4515.23	4515.00	14,866,922.53	2,276,496.03
CTM-4D	04/09/01	180	6" to 100 ft / 4" to 179.5	159.5 – 179.5 / 20	4515.15	4514.85	14,866,913.75	2,276,498.34
CTM-5S	03/28/01	60	6	39.5 – 59.5 / 20	4526.22	4525.84	14,866,774.11	2,275,631.44
CTM-6S	03/20/01	43.5	6	23 – 43	4494.00	4493.43	14,866,906.43	2,279,451.30
CTM-7S	03/08/01	41	6	20.5 – 40.5	4483.77	4483.53	14,865,655.28	2,280,296.09
CTM-8D	03/06/01	261	6" to 100 ft / 4" to 261	240.5 – 260.5 / 20	4483.68	4483.28	14,865,660.94	2,280,295.91
CTM-9S	05/03/01	60.5	6	40 – 60 / 20	4457.83	4457.37	14,863,430.53	2,283,743.30
CTM-10D	04/27/01	347	6" to 173 ft / 4" to 347	326.5 – 346.5 / 20	4457.86	4457.58	14,863,421.27	2,283,739.71
CTM-11S	03/20/01	45.5	6	25 – 45 / 20	4441.40	4441.18	14,861,668.00	2,285,425.73
CTM-12D	03/29/01	347	6" to 100 ft / 4" to 347	326.5 - 346.5 / 20	4441.59	4441.27	14,861,656.17	2,285,428.69
CTM-13S	03/23/01	56	6	35.5 – 55.5 / 20	4450.31	4450.05	14,863,685.33	2,284,776.05
CTM-14S	03/21/01	25	6	4.5 – 24.5 / 20	4471.18	4470.79	14,860,981.17	2,278,705.46
CTM-15S	03/26/01	70.5	6	50 – 70 / 20	4482.31	4481.86	14,860,945.20	2,279,869.87
CTM-16S	03/15/01	40.5	6	20 – 40 / 20	4439.13	4438.79	14,858,163.43	2,282,372.40
CTM-17D	03/21/01	199.5	6" to 100 ft / 4" to 199.5	179 – 199 / 20	4424.88	4424.67	14,858,289.59	2,286,176.02
CTM-18S	03/19/01	35	6	14.5 – 34.5 / 20	4427.09	4426.63	14,859,840.54	2,286,510.29
CTM-19S	04/29/01	31	6	10.5 – 30.5 / 20	4409.21	4408.89	14,865,509.94	2,294,834.51
CTM-20S	03/15/01	24.5	6	4 – 24 / 20	4405.15	4404.95	14,860,467.98	2,294,992.76
CTM-21S	03/16/01	36.5	6	16 – 36 / 20	4460.78	4460.55	14,865,699.20	2,284,464.83
CTM-22D	04/19/01	252	6" to 127 ft / 4" to 252	231.5 – 251.5 / 20	4458.76	4458.38	14,865,920.43	2,283,755.43
CTM-23D	03/13/01	180.5	6" to 100 ft / 4" to 180.5	160 – 180 / 20	4417.76	4417.51	14,848,390.90	2,288,630.58
CTM-25D	03/15/01	177.5	6" to 100 ft / 4" to 177.5	157 – 177 / 20	4397.30	4397.15	14,852,490.57	2,293,011.41
CTM-27D	04/04/01	178.5	6" to 100 ft / 4" to 178.5	158 – 178 / 20	4471.11	4470.91	14,860,973.68	2,278,708.56
CTM-28S	03/30/01	44	6	23.5 – 43.5 / 20	4522.78	4522.46	14,865,635.47	2,275,613.82
CTM-29S	03/22/01	35.5	6	15 – 35 / 20	4520.72	4520.23	14,864,045.60	2,273,769.53
CTM-30D	04/12/01	152	6	131.5 – 151.5 / 20	4492.21	4491.8	14,865,293.44	2,278,837.66
CTM-31S	05/04/01	52	6	31.5 – 51.5 / 20	4512.01	4511.64	14,867,356.07	2,276,745.51
CTM-33D	05/02/01	199	6" to 100 ft / 4" to 199	178.5 – 198.5 / 20	4424.94	4424.59	14,858,545.21	2,285,129.76
CTM-37S	03/21/01	46	6	25.5 – 45.5 / 20	4478.74	4478.41	14,868,572.49	2,280,975.62
CTM-37D	05/31/01	85.5	6	65 – 85 / 20	4451.70	4451.39	14,865,257.35	2,284,801.76
CTM-38D	05/29/01	95.5	6	75 – 95 / 20	4429.10	4428.78	14,864,154.01	2,287,371.15
CTM-39S	06/01/01	38.5	6	18 – 38 / 20	4429.19	4428.82	14,864,147.45	2,287,368.05
CTM-40S	06/05/01	148.5	6	118 – 148 / 30	4594.07	4593.76	14,870,889.61	2,275,923.04
CTM-41S	06/04/01	52.5	6	32 – 52 / 20	4479.69	4479.39	14,861,204.29	2,279,643.38

Notes:
1. ft msl = feet mean sea level
2. ft bgs = feet below ground surface
3. All wells were installed using Sonic drilling methods.
4. All wells were constructed with 2" PVC casing. Wells drilled to depths less than 150 ft bgs were constructed using Schedule 40 PVC. Wells drilled to depths greater than 150 ft bgs were constructed using Schedule 80 PVC.

2.2.2 Program Modifications

This section highlights modifications in the well installation program as detailed in the Final Work Plan. Program modifications included elimination of monitoring wells from the program, addition of monitoring wells to the program, and monitoring wells placed in alternate locations. The discussion is presented in terms of the discrete areas of investigation.

Monitoring Wells Eliminated from the Program

Six wells proposed in the Final Work Plan were not installed. A listing of these wells and the rationale for eliminating them from the drilling program are provided below:

Area E

- CTM-32S was a proposed secondary monitoring point to be installed if concentrations of PCE detected in CTM-14S were greater than the maximum concentration limit (MCL) for PCE (5 µg/l). PCE concentrations in samples from CTM-14S were non-detect or below the MCL for PCE; therefore, CTM-32S was not installed.

Area G

- CTM-34D was a proposed secondary monitoring point to be installed if existing deep wells in the area could not be sampled for water quality. Two privately owned deep wells in the area were identified and sampled, eliminating the need to install CTM-34D.

Area H

- CTM-35S was a proposed secondary monitoring point to be installed if wells located near the Kietzke Lane production well showed PCE contamination in the shallow groundwater zone. Contamination above MCL was not detected in either CTM-21S or CTM-22D; therefore, CTM-35S was eliminated from the program.

- CTM-36D was to be installed if an existing deep well at the Nevada Institute of Mental Health could not be rehabilitated. The Nevada Institute of Mental Health well was rehabilitated; therefore, installation of CTM-36D was not necessary.

Other Areas

- CTM-24S was not needed because an existing shallow well, originally installed by the USGS, was located in proximity to the proposed location of CTM-24S.

- CTM-26S was originally proposed as a shallow well to be paired with deep well CTM-27D to be used to define vertical gradient in this area. CTM-27D was paired with CTM-14S to consolidate well locations. Therefore, the CTM-26S well location was eliminated.

Monitoring Wells Added to the Program

The wells listed in this section were installed to fill data gaps that were apparent following receipt of analytical results from wells installed early in the field program.

Area A

CTM-41S located on the corner of Ardmore Drive and Lakeside Drive

Area D

- CTM-37D located at the corner of Kietzke Lane and Roberts Street
- CTM-38D and CTM-39S located on Matley Lane near Mill Street

Other Areas

- CTM-40S located at the corner of Nevada Street and 9th Street

Monitoring Wells Placed in Alternate Locations

The locations of the wells listed in this section were modified from those defined in the Final Work Plan.

Area D

- CTM-11S/CTM-12D well pair was were placed in a crossgradient rather than a downgradient location relative to the Truckee Meadows Water Authority (TMWA) Mill Street water supply well. At the current locations, the wells served as key observation points during the aquifer pumping tests, provided vertical contaminant distribution and vertical gradient data, and will provide important data as part of the ongoing monitoring program.

Area F

- CTM-17D was placed upgradient, rather than downgradient, of the TMWA Corbett School well. At its present location, CTM-17D served as an observation point during aquifer pumping tests, provided vertical contaminant distribution and vertical gradient data, and will be a key well for future monitoring.

Area H

- CTM-21S was placed crossgradient, rather than upgradient, of the TMWA Kietze Lane water supply well. Data from CTM-21S contributed to elimination of a shallow well (CTM-35S) from the drilling program.

2.3 Monitoring Well Development

After installation, each monitoring well was developed using a submersible pump. Well development was performed a minimum of 24 hours after the well was constructed to allow the surface seal to cure. Well development continued until at least five casing volumes were removed, or sediment-free water was produced and water quality parameters (pH, conductivity, and temperature) stabilized. Washoe County personnel performed all well development activities. Well development activities were performed between March 26 and June 12, 2001.

2.4 Soil Sampling

During drilling and installation of the new groundwater monitoring wells, a number of types of soil samples were collected, as summarized below:

- Continuous core samples
- Undisturbed soil samples for analysis of geotechnical parameters
- Soil samples for environmental analysis

This section provides a description of the soil sampling activities.

2.4.1 Continuous Core Samples

Using the Sonic drilling method, continuous core samples were collected from each borehole. The sonic drilling method created a 6-inch diameter core from wells with depths up to 100-feet. For most wells with depths greater than 100 feet, a 4-inch diameter core was extracted.

The soil cores were extruded from the steel core barrels (core barrels varied from 10 to 20 feet in length) into plastic sleeves. For each core, the plastic sleeve was slit open and immediately screened using a PID. The core was then examined and logged by the site geologist. A representative sample of each core was stored in a core boxes for future reference. Photographs of the cores, labeled with the well identification and depth intervals, have been catalogued and are available for review from Washoe County. The site geologist maintained a detailed description of the soil encountered in the core on a borehole log. Completed borehole logs are included in Appendix A.

2.4.2 Soil Samples for Geotechnical Analysis

An undisturbed soil sample was collected and submitted to the laboratory for determination of physical properties. These samples were collected from the screened interval of each well using a split-spoon sampler with brass tube liners. The brass liners were capped following sample collection so that the sample remained undisturbed during transport. The samples were submitted to the laboratory for analysis of geotechnical parameters, including grain size distribution, dry bulk density, surface area, specific gravity, and moisture content. Immediately above or below the soil sample collected for geotechnical parameters, a soil sample was collected for analysis of total organic carbon (TOC).

2.4.3 Soil Samples for Environmental Analysis

Soil samples with visible signs of contamination (e.g., staining) and soil impacted by VOCs (based on the PID readings) were placed in a Ziploc-type plastic bag. An additional sample of these soils was placed in a sampling jar for possible environmental analysis (process for selecting soil samples for environmental analysis is described below). The soil sample in the Ziploc plastic bag was agitated and left in the sun or a warm location to allow volatilization. After approximately 15 minutes, the PID was used to take a headspace measurement by poking a hole through the seal of the plastic bag. The measurement was recorded on the borehole log. The purpose of the headspace analyses was to determine relative concentrations of volatile organics between soil samples. Results of headspace analyses were used to select soil samples for laboratory analysis. The soil samples with the highest PID readings were submitted to the fixed-base laboratory for analysis. A minimum of one soil sample and a maximum of three soil samples per borehole were submitted to the laboratory for VOC analysis. If none of the headspace analyses indicated the presence of VOCs, a soil sample collected near the water table was submitted for analysis.

Alpha Analytical was the certified analytical laboratory responsible for performing all of the environmental analytical work as part of the field investigation program. Laboratory chain-of-custody procedures were strictly followed on all environmental sampling. Soil samples were analyzed for VOCs using EPA Method 8260, including methyl tertiary butyl ether (MTBE).

2.4.4 Program Modifications

The soil sampling activities were performed consistent with the program as detailed in the Final Work Plan.

2.5 Soil Gas Investigation

Soil gas samples were collected from 15 shallow borehole locations as listed in Table 2-3. The purpose of the sampling was to assess the potential for release of VOCs in groundwater to soil gas. The soil gas sampling locations were in areas of known groundwater contamination. If groundwater VOCs is released into soil gas, there is the possibility of migration within the soil profile through cracks in building foundations and into indoor air. Soil gas data were used in the risk analysis to estimate the potential risk to inhabitants through the indoor air inhalation exposure pathway. Soil gas samples were analyzed for VOCs, including MTBE and vinyl chloride.

Table 2-3
Soil Gas Sample Locations

Area	Wells
A	CTM-1S CTM-28S
B	CTM-2S (profile)
C	CTM-3S CTM-5S CTM-6S CTM-7S
D	CTM-9S (profile) CTM-11S
E	CTM-14S
F	CTM-16S (profile) CTM-18S
G	CTM-19S CTM-20S
H	CTM-21S

Shallow (≤10 feet) soil gas samples were collected from the designated boreholes. Concurrent shallow groundwater grab samples were also collected from the boreholes to evaluate the use of soil gas technology as an indicator of groundwater contamination. At four of the sampling locations, soil gas samples were collected at multiple depths to enable soil gas profiling within the vadose zone. Sampling depths included shallow (≤10 feet), immediately above the water table, and at a mid-point between the water table and the shallow sample.

Once the borehole was drilled to the desired sampling depth, the outer steel casing was lifted approximately one foot to expose the soil interval to be sampled. Clean Teflon-lined tubing was then lowered to the sampling depth. The top of the drill string was sealed to prevent dilution of the soil gas sample by surface air. A hand-held sampling pump was attached to the end of the tubing and 2 to 3 times the volume of the tubing assembly was extracted. When a sufficient volume of soil vapor was drawn through the system, a carbon orbo tube was inserted between the tubing and pump inlet and a soil gas sample was collected. New tubing was used for each sample.

Program Modifications

The soil gas investigation was performed consistent with the program as detailed in the Final Work Plan.

2.6 Discrete-Depth Groundwater Sampling

Groundwater samples were collected from each borehole during drilling operations for environmental analysis. For shallow borings (i.e., less than 75 feet in depth), samples were collected from the first encountered groundwater. For boreholes greater than 75 feet in depth, discrete-depth groundwater samples were collected at 20-foot intervals in order to provide a vertical profile of dissolved VOCs in the aquifer.

At each targeted sampling depth, the drill rod was vibrated as it was withdrawn to expose approximately one foot of the desired soil interval. This allowed formation water to enter the steel outer casing. The groundwater sample was then collected using a disposable bailer and string. A new bailer and string was used for each sample collected. Enough water was removed during drilling operations that the groundwater in the steel outer casing was representative of the discrete depth being sampled. In some cases, the steel outer casing would be void of water until the casing was withdrawn to expose the soil at the bottom of the borehole.

Temperature, pH, electric conductivity, reduction/oxidation potential, and dissolved oxygen were measured in the field for each groundwater sample collected. All measurements were recorded in the field logbook. Groundwater samples were submitted to the laboratory under chain-of-custody documentation for analysis of VOCs using EPA Method 8260 including MTBE.

Program Modifications

Discrete-depth groundwater sampling was performed consistent with the program detailed in the Final Work Plan.

2.7 Completed Well Groundwater Sampling

Two rounds of groundwater sampling were performed by Washoe County personnel following construction completion and development for each of the groundwater monitoring wells installed as part of this field investigation program. The purpose of the initial samples was to obtain a baseline for water levels and water quality. Sampling concluded on July 12, 2001.

Depth to groundwater and the thickness of any free-phase product encountered was measured using an electronic water level indicator equipped with an oil/water interface probe. Measurements were made from the north side of the PVC casing.

Groundwater samples were collected following the procedures described below.

- Immediately after opening the well cap, a measurement of the well headspace was collected with a PID meter and recorded on the field form.
- The depth to water and thickness of any mobile light non-aqueous phase liquid (LNAPL) detected was measured with an electronic interface probe and recorded on a field form. The depth to the bottom of the well was measured and recorded on the field form. The casing volume or volume of the water column was calculated and the required purge volume, three casing volumes, was determined.
- The submersible pump used for purging and sampling was lowered to the depth corresponding to the middle of the screened interval. The well was pumped at a rate such that the water level was not drawn down to or below the pump intake.
- Each monitoring well was purged a minimum of three casing volumes. Water quality parameters (pH, conductivity, turbidity, temperature, and redox) were measured and recorded at a frequency of 10 percent of the total purge volume (e.g., every 10 gallons for a 100 gallon purge volume) using a Horiba water quality meter until parameters stabilized. The field parameters, volume purged, and time of measurement were recorded on the field form. Field monitoring well purge and sample forms are included in Appendix B.
- Purge water was contained and transported to a central staging area where it was transferred into a 6,000-gallon storage tank.
- A groundwater sample was collected as soon as possible after purging and final field measurements were completed using a purge pump. The sample was field-filtered with an in-line 0.45-micron filter and analyzed for iron using a Hach colorimetric field test kit.
- Samples were submitted under chain-of-custody documentation to the laboratory for analysis of VOCs including *cis*-1,2-dichloroethylene; MTBE and tentatively identified compounds (TICs); semi-VOCs; total iron and manganese; alkalinity; chloride; sulfate; TOC; carbonate; nitrate/nitrite; ethane, ethene, and methane; and dissolved iron.

All equipment was decontaminated prior to purging and sampling of each well.

Program Modifications

Groundwater monitoring well sampling was performed consistent with the program detailed in the Final Work Plan.

2.8 Geophysical Logging

Geophysical logging was performed by Welenco, a qualified subcontractor, following completion of the new monitoring wells. The objective of the geophysical logging was to refine the understanding of lithology within the CTM and to contribute to the development of the groundwater flow model. Geophysical logging, run through the PVC casing, was performed on 11 of the 12 deep groundwater monitoring wells installed as part of the program, as listed in Table 2-4.

Table 2-4
Geophysical Logging Locations

Area	Wells
C	CTM-4D CTM-8D CTM-30D
D	CTM-10D CTM-12D
E	CTM-27D
F	CTM-17D CTM-33D
H	CTM-22D CTM-23D CTM-25D

Gamma ray and induction logging was performed on July 31 and August 1, 2001. A description of each log type used is provided below.

- **Gamma Ray** – A natural gamma ray log records high-energy electromagnetic waves emitted by naturally occurring radioactive elements in earth materials. Natural gamma rays are at relatively higher levels in clay soil where radioactive elements tend to concentrate. Therefore, this method can provide a relative measure of the percent of clay in the soil profile.

- **Induction Log** – Introduces a current into the formation and measures the conductivity. The conductivity is influenced by total dissolved solids (TDS) in the formation. For example, clay has a higher conductivity than sand.

A discussion of the results of the geophysical logging is presented in Section 3. A copy of each geophysical log is presented in Appendix C.

Program Modifications

Geophysical logging activities were performed consistent with the program as detailed in the Final Work Plan.

2.9 Hydraulic Testing

Aquifer testing is a means of determining the hydraulic properties of an aquifer and associated confining beds. This testing involves a controlled withdrawal of groundwater (or sudden withdrawals of a weighted cylinder) and monitoring and recording of the resulting groundwater-level changes in observation wells. Hydraulic testing performed during the field investigation program consisted of two components:

- **Slug tests.** The slug tests provide hydraulic characterization at a local scale.
- **Aquifer pumping tests.** The aquifer pumping tests, which were performed utilizing existing TMWA water supply wells, provide hydraulic characterization on more of a regional scale.

Data generated during the hydraulic testing have served as valuable input into the groundwater flow model. A list of the monitoring wells that included as part of the hydraulic testing program is presented on Table 2-5.

Table 2-5
Hydraulic Testing Program

Slug Test Locations

CTM-1S	CTM-9S	CTM-18S
CTM-2S	CTM-11S	CTM-19S
CTM-3S	CTM-13S	CTM-20S
CTM-5S	CTM-14S	CTM-21S
CTM-6S	CTM-15S	CTM-28S
CTM-7S	CTM-16S	

Aquifer Pumping Test Locations

TMWA Wells	*Observations Wells*
Mill Street	CTM-11S, CTM-12D, MW-133m
High Street	CTM-7S, CTM-8D, MW-155
Corbett School	CTM-17D, MW-73
Kietzke Lane	CTM-21S, CTM-22D
Peckham Lane	CTM-23D, MW-76a

2.9.1 Slug Tests

The slug tests provide a rapid and easy means of estimating the hydraulic conductivity and transmissivity of an aquifer. Rising-head and falling-head slug tests were performed on 20 new shallow monitoring wells during the period June 18 through 21, 2001. Slug testing consisted of the sudden addition and withdrawal of a weighted cylinder of known volume from the aquifer. The resulting groundwater-level changes in the monitoring well were monitored and recorded using a pressure transducer and data logger. Slug test results are provided in Appendix D.

2.9.2 Aquifer Pumping Tests

The aquifer testing program was conducted utilizing TMWA water supply wells. Selected pumping wells were operating in accordance with a pumping program agreed upon between TMWA and Washoe County Department of Water Resources. The TMWA wells were operated on a daily basis over the 3-week period of the test (August 17 through September 14). Aquifer response was monitored using both data loggers and pressure transducers and manual water level measurements. Data loggers recorded water levels every 15 minutes.

2.9.3 Program Modifications

This section highlights modifications in the hydraulic testing program as detailed in the Final Work Plan. The Final Work Plan outlined the use of 3 methods for determining aquifer hydraulic characteristics - step-draw down tests, slug tests, and aquifer pumping tests. Step-draw down tests were not performed. Instead, hydraulic testing relied on slug tests and aquifer pumping tests. The slug tests data were provided useful data for all wells except four of the wells tested (discussion of slug test results is provided in Section 3).

Regarding the aquifer pumping tests, the test was modified to accommodate the current operations of the TMWA water supply wells. TMWA is currently operating the water supply wells under an agreement with Washoe County Department of Water Resources. Rather than pumping continuously for a specific duration (e.g., 72 hours), the wells are operated for only a portion of each day. Aquifer response was performed over a 3-week period of time.

2.10 Survey

Washoe County personnel using the Global Positioning System (GPS) surveyed the ground surface and measuring point (north side of PVC casing) of each of the new monitoring wells. One of the objectives of this surveying effort was to perform a quality control check of the GPS survey data that had been generated by County personnel. The results of the comparison were summarized in a letter to the County dated November 1, 2001.

New wells were resurveyed between September 5 and 11, 2001 by CFA, a licensed surveyor in the State of Nevada. The datum and horizontal coordinate system used was consistent with the County's database.

Program Modifications

The GPS survey activities were performed consistent with the program as defined in the Final Work Plan.

2.11 Investigation Derived Waste

The handling of investigation-derived waste (IDW) for this project included storage of drill cuttings, well purge waters, decontamination fluids, and disposal of contaminated personal protective and sampling equipment. All IDW was handled and stored in accordance with the provisions outlined in the Work Plan. Procedures were followed to assure that the requirements of the Washoe County District Health Department (WCDHD), Nevada Division of Environmental Protection (NDEP), and disposal facilities were met.

All solid wastes generated during investigation activities were contained on site in 55-gallon drums and moved on a daily basis to a centralized staging area. All drill cuttings and other solid wastes were placed in lined closed top roll-off bins located at the central staging area. A total of 5 roll-off bins were used to contain the waste generated during this field program.

A composite sample of the solids from each bin was collected and submitted for analysis of total petroleum hydrocarbons-purgeable (TPHp), TPH-extractable (TPHe), TCLP extraction for analysis of 11 VOCs, and TCLP extraction for analysis of 7 metals. Once analytical results were obtained, copies of the results were submitted to the WCDHD with a completed Waste Release Application. Analytical results were also be submitted to the disposal facility with a completed Waste Acceptance Application. Once the WCDHD reviewed and approved the Waste Release Application, a waste release manifest for each bin containing the analyzed soil was granted. The waste manifests were given to the waste disposal contractor and signed by the on-site geologist for transport the soil to the Reno Disposal Bioremediation Facility.

The majority of the water produced during field activities came from well development, equipment decontamination, and aquifer testing activities. Smaller amounts of water were produced during drilling and sampling of wells. Two 6,000-gallon polyethylene tanks were stationed at the staging area. Wastewater generated during field activities was containerized in either 55-gallon drums, lined catch basins, or small polyethylene tanks and transported to the staging area where it was transferred to the 6,000-gallon tanks.

After the storage tanks were at capacity, a water sample was collected from each tank and submitted to the laboratory for analysis of TPHp, TPHe, and VOCs. Based on the analytical results, Universal Environmental, a licensed environmental waste disposal contractor, pumped wastewater from the tanks to be disposed of at a licensed environmental waste facility in Redwood City, CA.

2.12 Decontamination

At the central staging area, a decontamination pad was constructed of heavy-gauge plastic sheeting and wood. The decontamination pad was designed with a collection system to capture decontamination fluids. All large drilling equipment was decontaminated by steam cleaning in this area. Smaller decontamination areas for personnel and portable equipment were set up at each drilling location. These smaller areas consisted of 5-gallon buckets used to contain decontamination water. All decontamination water was transported to the staging area and transferred into 6,000-gallon polyethylene tanks for storage.

All reusable field equipment used to collect, handle, or measure samples were decontaminated before coming into contact with any sample. The decontamination procedure matched the degree of contamination on the sampling tool. For example, steam cleaning was used to remove dirt from drilling equipment. Brushes, potable water, and Alconox were used to remove dirt from portable sampling equipment.

2.13 QA/QC Samples

This section describes the number of quality assurance/quality control (QA/QC) samples collected for each media characterized at the Site and the type of analyses performed on the samples. QA/QC samples were not collected for the soil samples because soil analytical results are not reproducible due to the heterogeneous nature of soil.

Four types of QA/QC samples were submitted to the laboratory to evaluate laboratory reproducibility and accuracy, effectiveness of equipment decontamination, and the quality of the data resulting from the field-sampling program. QA/QC samples included:

- Decontamination rinsate blanks;
- Trip blanks;
- Field duplicates; and
- Matrix spike/ matrix spike duplicates (MS/MSD).

Decontamination rinsate blanks were collected as part of the groundwater-sampling portion of the field program. Decontamination rinsate blanks were submitted to the laboratory for analysis of VOCs, including MTBE, at a frequency of 1/20 samples. The decontamination rinsate blanks consisted of analyte-free water collected by rinsing sampling equipment after equipment decontamination. This was done to test the effectiveness of equipment decontamination procedures. The decontamination rinsate blanks contained no detectable concentrations of the organic compounds analyzed.

The trip blank consisted of a sample bottle prepared by the laboratory with analyte-free water. The sample bottle is carried to the sampling site and remains with other field sample bottles during storage and transport. The trip blanks were analyzed for VOCs, including MTBE. A trip blank was submitted for analysis with each sample cooler transported to the laboratory. The trip blanks contained no detectable concentrations of the organic compounds analyzed.

Field duplicates consisted of split samples of groundwater at a single sample location, collected identically and consecutively over a minimum period of time. This type of field duplicate provides a measure of the total system variability (field and laboratory variance) including the variability component resulting from the inherent heterogeneity of the field sources. Field duplicates were collected at a frequency of 1/20 samples.

A sample matrix spike was prepared at the laboratory by adding a known amount of pure analyte to the environmental sample before extraction/digestion. The added analyte was the same as that being assayed in the environmental sample. Background and interferences having an effect on the actual sample analyte will have a similar effect on the spike compounds. The calculated percent recovery of the matrix spike is considered to be a measure of the relative accuracy of the total analytical method, i.e., sample preparation and analysis. A matrix spike duplicate was prepared from a second aliquot of the sample analyzed as the matrix spike to test for reproducibility. MS/MSD samples were analyzed at a frequency of 1/20 samples.

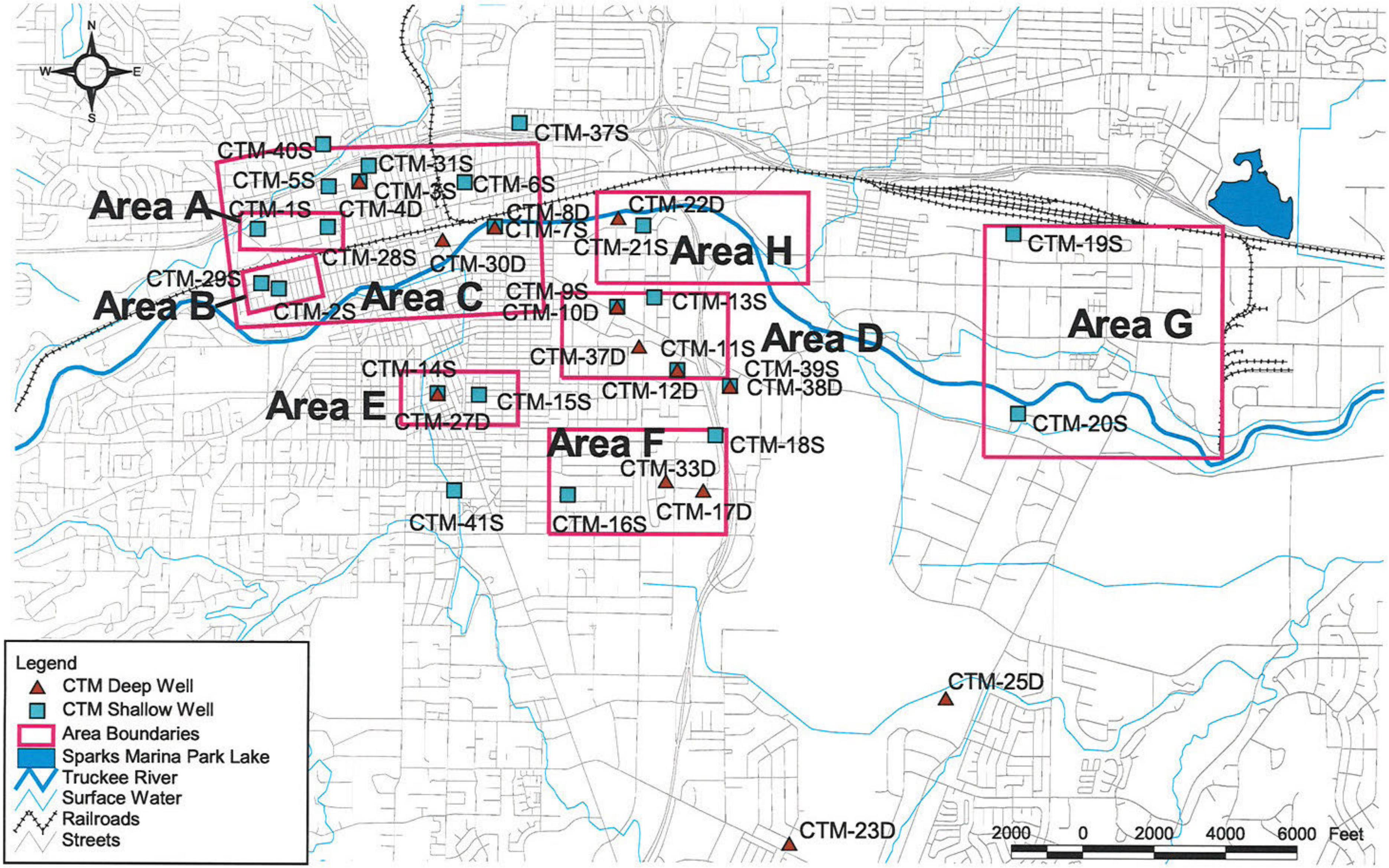

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Figure 2-1
Monitoring Well Location Map
Central Truckee Meadows Remediation District

Section 3
Results and Discussion

This section presents a summary of the data generated as part of the field investigation program and discussion/interpretation relative to the understanding of conditions (geologic, hydrogeologic, nature and extent of contamination) within the CTM.

3.1 Soils Analyses

Soils analyses performed as part of the field investigation program included in-field geologic logging, geotechnical analysis, and analysis for environmental parameters.

3.1.1 Geologic Logging/Geotechnical Analyses

Sonic drilling produced full core samples to allow detailed geologic logging. Based on these geological logging data detailed cross sections were prepared. Figure 3-1 depicts the locations of the three cross sections. The cross sections are presented on Figures 3-2 through 3-4 (cross sections A-A', B-B', and C-C' respectively).

Geotechnical and total organic carbon (TOC) analyses were performed on undisturbed soil samples. A sample was collected from each borehole at the depth interval designated for the monitoring well screen. A summary of the geotechnical and TOC analytical results is presented in Table 3-1.

The geotechnical data generally support the soil descriptions recorded in the field during drilling activities (see borehole logs in Appendix A). Differences in soil descriptions between the geotechnical results and the field observations were typically associated with an over estimate in the field of the silt content of the soil core samples (resulting from not differentiating between fine-grained sand and silt).

Prior to implementation of this field investigation program, lithologic data existed primarily for the shallow aquifer (less than 100 feet bgs). The 13 deep aquifer zone wells (installed between 85 and 350 feet bgs) expanded the understanding of lithology in the deeper portion of the aquifer and have influenced the ongoing development of the conceptual site model. As an example, it has been theorized that a discrete, low permeability zone separated the shallow water bearing zone from a deeper water bearing zone. The results of the in-field geologic logging and the geotechnical analyses do not appear to support the presence of this discrete, low permeability layer. The formation consists of interbedded poorly sorted gravely sand and silt, sand, silty sand, silt, and clayey silt. There are some clay beds but they are not thick or extensive enough to be a confining units.

Table 3-1
Summary of Geotechnical Analysis Results

Sample Location	Sample Depth (ft bgs)	Organic Content (%)	Moisture Content (%)	Dry Density (pcf)	Specific Gravity	Surface Area (ft^2/ft^3) X 1,000	Grain Size Distribution, % Retained: Gravel (>#4 sieve size) (>5 mm)	Grain Size Distribution, % Retained: Fine to Coarse Grained Sand (<#4 & >#200 sieve size) (<5 & >0.08 mm)	Grain Size Distribution, % Retained: Silt or Clay (<#200 sieve size) (<0.08 mm)	Borehole Log Description
CTM-1S	40	--	10.8	132.4	2.63	3.465	63.6	32	4.4	SAND: Decomposed Granite, Unconsolidated, 5-10% Rounded Cobbles.
	45	2.1	8.9	--	--	--	--	--	--	COBBLEY SAND: Rounded Cobbles with Very Coarse Grained Sand Matrix.
CTM-2S	42.5	4.2	16.7	--	--	--	--	--	--	GRAVEL and COBBLES: Poorly Graded Rounded Gravels, Cobbles, and Boulders, Clayey Silt Matrix, Wet, Decreasing Boulders with Depth.
	43	--	10.9	126.3	2.7	4.739	53	33.2	13.8	
CTM-3S	49	10.1	36.6	--	--	--	--	--	--	COBBLES and BOULDERS: Cobbles and Boulders with Silty Sand matrix. Wet.
	--	NS	NS	NS	NS	NS	NS	NS	NS	
CTM-4D	167	--	7.4	139.6	2.695	3.171	38	53.2	8.8	SANDY GRAVEL: Wet, Coarse Grained, Loose, Rounded, Cobbles to 2-inch Diam., Increasing with Depth.
	168	1.58	11.1	--	--	--	--	--	--	
CTM-5S	52	--	9.5	127.9	2.55	3.662	63.1	30.7	6.2	GRAVEL: Rounded Cobbles, Gravel, and Boulders. Sand Matrix.
	55	1.8	8.3	--	--	--	--	--	--	SANDY SILT: Stiff, Minor Clay.
CTM-6S	37	--	17.1	116.7	2.58	4.787	5.3	80.2	14.5	SILTY SAND: Sand with 5% Gravels, Wet.
	37.5	3.9	16.5	--	--	--	--	--	--	
CTM-7S	23	3.6	15.7	145.6	2.59	4.492	56.3	34.6	9.1	GRAVELLY SILTY SAND: Gravel and Sand with High Organics. 30% Silt, 50% Sand, 20% Gravel/Cobbles, Fine to Coarse Grained, Rounded to Subrounded, Poorly Sorted, Wet.
CTM-8D	236	--	18	114.9	2.66	2.795	13.6	82.9	3.5	SANDY SILT: Sand 10-20%, Silt 80%, Fine Grained Sand, Low Plasticity, Dry.
	237	9.2	36.4	--	--	--	--	--	--	
CTM-9S	58	--	11.9	125.1	2.62	4.913	55.5	32.9	11.6	SANDY SILTY GRAVEL: Wet, Silt Matrix, 45% Gravel, 10% Cobbles, 20% Sand, 20% Silt, 5% Clay.
	58.5	3.2	12	--	--	--	--	--	--	
CTM-10D	334.5	--	10.7	119.8	2.69	4.586	1.0	85.3	13.7	SILTY SAND: Stiff, Damp to Dry.
	335	1.8	11.3	--	--	--	--	--	--	
CTM-11S	41	--	9.9	123.4	2.61	1.642	71.7	24.9	3.4	SANDY GRAVEL: Minor Silt Component.
	42	2.1	17.7	--	--	--	--	--	--	
CTM-12D	336	2.59	14.3	--	--	--	--	--	--	SILTY SAND: 5-10% Silt, Fine to Coarse Grained Sand, Non-Plastic, Wet.
	337	--	25.7	98.1	2.7	4.871	0.0	93.6	6.4	

Table 3-1
Summary of Geotechnical Analysis Results

Sample Location	Sample Depth (ft bgs)	Organic Content (%)	Moisture Content (%)	Dry Density (pcf)	Specific Gravity	Surface Area (ft^3/ft^3) X 1,000	Grain Size Distribution, % Retained: Gravel (>#4 sieve size) (>5 mm)	Fine to Coarse Grained Sand (<#4 & >#200 sieve size) (<5 & >0.08 mm)	Silt or Clay (<#200 sieve size) (<0.08 mm)	Borehole Log Description
CTM-13S	39	1.7	27.1	--	--	--	--	--	--	GRAVELLY SILTY SAND: Medium Grained Sand with Gravel, Wet, Poorly Sorted, Subanguler, 50% Sand, 20-30% Silt, Low Plasticity.
	41.5	--	7.6	134.8	2.795	3.653	47.4	46	6.6	BOULDER
CTM-14S	15	2.7	19.3	--	--	--	--	--	--	SANDY GRAVEL: Wet, Little or no Fines.
	17	--	9.9	132.6	2.614	2.78	72.1	24.7	3.2	
CTM-15S	70	3.1	12.1	--	--	--	--	--	--	SILTY SANDY GRAVEL: Rounded Cobbles and Boulders, Silty Sand Matrix, Wet.
	72	--	18.2	103.5	2.638	4.263	18.7	61.9	19.4	
CTM-16S	34	2.0	10.8	--	--	--	--	--	--	SILTY GRAVELLY SAND: Fine Grained Sand, Gravel and Cobbles, Rounded, Wet.
	35	--	15.8	122.3	2.93	3.49	44.4	49.1	6.5	
CTM-17D	192	5.3	31.1	--	--	--	--	--	--	GRAVELLY SILTY SAND: 10-20% Silt, 15-25% Gravel, Fine to Coarse Grained Sand, Wet, Non-Plastic, Subrounded Gravel.
	193	--	20.2	105.5	2.9	5.222	2.3	86.5	11.2	
CTM-18S	34	7.3	16.9	--	--	--	--	--	--	SILTY SAND: Hard, Low Plasticity, Medium Grained Sand, 50% Silt, 50% Sand, Minor Cobbles.
	35	--	16.9	115.4	2.66	9.342	0.4	58.1	41.5	
CTM-19S	29	2.3	18.9	--	--	--	--	--	--	GRAVELLY SILTY SAND: 10-15% Gravel, 10-15% Silt, Fine to Very Coarse Grained Sand, Subrounded, Wet.
	30	--	11.7	121.5	2.67	3.04	55.6	42.5	1.9	
CTM-20S	22	2.0	17	129.6	2.93	4.096	0.2	90.1	9.7	SILTY SAND: Medium to Coarse Grained Sand, 10% Silt.
CTM-21S	36	--	11	120.6	2.64	5.336	2.7	77.2	20.1	SILTY SAND: Wet, Coarse Grained, 10% Silt.
	36.5	3	14.1	--	--	--	--	--	--	
CTM-22D	243.5	--	28.9	91.8	2.7	7.057	1.4	78.7	19.9	SILTY SAND: Sandy Silt to Silty Sand, 50% Fine Grained Sand, 40% Silt, Medium Plasticity, Very Stiff, <10% Clay, Damp.
	244	3.1	28.6	--	--	--	--	--	--	
CTM-23D	175	--	24.2	98.2	2.58	6.264	0.2	89.8	10	SANDY SILT: Stiff, Dense, Micaceous.
	176.5	1.9	17.3	--	--	--	--	--	--	
CTM-25D	166	--	22	105.8	2.8	5.825	0.0	84.7	15.3	SANDY SILT: 10-20% Fine To Medium Grained Sand, Micaceous, Stiff, Non-Plastic, Damp.
	168	1.2	16.2	--	--	--	--	--	--	
CTM-27D	168.5	--	27.6	94.4	2.7	5.297	2.3	85.7	12	SILTY GRAVEL and SAND: Wet, Medium Grained Sand, 40% Gravel, 40% Sand, 20% Silt.
	169	3.2	11.5	--	--	--	--	--	--	

Table 3-1
Summary of Geotechnical Analysis Results

Sample Location	Sample Depth (ft bgs)	Organic Content (%)	Moisture Content (%)	Dry Density (pcf)	Specific Gravity	Surface Area (ft^2/ft^3) X 1,000	Grain Size Distribution, % Retained: Gravel (>#4 sieve size) (>5 mm)	Fine to Coarse Grained Sand (<#4 & >#200 sieve size) (<5 & >0.08 mm)	Silt or Clay (<#200 sieve size) (<0.08 mm)	Borehole Log Description
CTM-28S	42	--	9.8	130.6	2.6	4.125	59	32.2	8.8	SILTY GRAVEL: Large Rounded Cobbles and Boulders in Silty Matrix.
	43	2.3	12.5	--	--	--	--	--	--	
CTM-29S	27	--	10.5	130.1	2.63	3.996	47.8	40.2	12	SANDY GRAVEL: Wet, 60% Gravel, 20% Sand, 5% Cobbles, 15% Silt, Trace of Clay.
CTM-30D	142	--	22	121.9	2.69	4.365	0.4	93.4	6.2	SAND: Well Sorted, Medium to Coarse Grained.
	143	2.5	15.6	--	--	--	--	--	--	
CTM-31S	47	1.3	15.3	--	--	--	--	--	--	SILTY SAND and GRAVEL: Fine to Coarse Grained, 40% Gravel and Cobbles, 40% Sand, 20% Silt, Dry, Angular to Subrounded Gravel, Wet, Intermittent Cobble Layers.
	48	--	10.5	126.7	2.638	5.649	16	59.8	24.2	
CTM-33D	187.5	--	25.1	97	2.68	1.549	27.4	72.5	0.1	SANDY GRAVEL: Wet, 55% Gravel, 40% Sand, <5% Silt.
	188	1.4	11.3	--	--	--	--	--	--	
CTM-37S	35	6.0	30	--	--	--	--	--	--	SAND and GRAVEL: Minor Silt, Wet, Loose, 50% Gravel, 50% Coarse Grained Sand.
	37	--	28	93.6	2.614	7.154	72.1	24.7	3.2	
CTM-37D	80	--	14.1	121.2	2.68	4.154	1.2	89.4	9.4	SANDY SILT: 10-20% Fine to Medium Grained Sand, Stiff, Wet.
	85	6.6	45.3	--	--	--	--	--	--	
CTM-38D	86.5	--	7.6	139.7	2.54	7.881	33.7	36.1	30.2	SILTY SANDY GRAVEL: Wet, Loose, 55% Gravel, 25% Sand, 20% Silt.
	87	1.4	12.6	--	--	--	--	--	--	
CTM-39S	35	--	17.4	111.9	2.68	2.871	28.7	63.2	8.1	GRAVELLY SAND: Coarse Grained, Small Rounded Gravel, Unconsolidated, Wet.
	40	1.1	19.9	--	--	--	--	--	--	
CTM-40S	136.5	--	12.9	135.2	2.66	8.433	1.1	71.4	27.5	GRAVELLY SAND: Wet, Loose to Dense, 60% Sand, 25% Gravel, 15% Silt.
	137	2.29	14.9	--	--	--	--	--	--	
CTM-41S	49	2.6	22.6	--	--	--	--	--	--	SILTY CLAYEY SAND: Medium Grained Sand, 70-80% Sand, 20-30% Clay.
	53	--	14.2	120.7	2.62	3.854	71.2	20.1	8.7	SANDY CLAY: Medium Grained Sand, Moderately Sorted, 40% Sand, 60% Clay.

Notes:
1. ft bgs = feet below ground surface
2. pcf = pounds per cubic foot
3. mm = millimeter
4. -- = Not Analyzed
5. NS = Not Sampled

3.1.2 Environmental Analysis

Selected soil samples were analyzed for VOCs, semi-volatile organic compounds, and metals. For the 52 soil samples analyzed, there were two detections above the analytical detection limits. The soil sample for CTM-3S had a detection of PCE at 0.035 milligrams per kilogram (mg/kg) at 42.5 feet below ground surface (bgs). CTM-12D had a detection of MTBE at 0.021 mg/kg at 50 feet bgs. The laboratory analytical results did not indicate above detectable levels of any other chemical constituents.

One of the underlying objectives of the soil environmental analyses was to identify potential PCE source areas. Residual contamination in soils could serve as an ongoing source of VOCs to the groundwater. The soils environmental analyses did not result in identification of substantial residual soils contamination in the areas of investigation.

3.2 Soil Gas Sampling

Soil gas samples were collected from 15 boreholes located overlying zones of known groundwater contamination. These data are being utilized to assess the potential for human health risk from inhalation of VOCs resulting from release of VOCs from groundwater to the soil gas and migration through foundation cracks to indoor air as a component of the human health and environmental risk analysis. Table 3-2 summarizes the results of soil gas sampling. PCE, benzene, toluene, ethylbenzene, xylene, and/or MTBE were detected above analytical detection limits in 9 of the 15 soil gas samples collected.

Table 3-2
Soil Gas Sample Analytical Results
(milligrams per cubic meter)

Location	Depth (ft bgs)	PCE	Benzene	Toluene	Ethyl-benzene	m,p-xylene	MTBE
CTM-1S	10	7.7	< 0.10	0.1	< 0.10	< 0.10	< 0.10
CTM-2S	10	< 0.20	0.16	< 0.10	< 0.10	< 0.10	< 0.10
	15	< 0.20	0.13	0.12	< 0.10	< 0.10	< 0.10
	20	0.21	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CTM-3S	10	< 0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CTM-5S	10	< 0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CTM-6S	10	< 0.20	0.25	0.39	< 0.10	0.11	< 0.10
CTM-7S	10	< 0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CTM-9S	10	< 0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
	31	< 0.20	< 0.10	< 0.10	< 0.10	< 0.10	1.3
	50	< 0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CTM-11S	10	< 0.20	0.12	0.92	0.16	0.41	< 0.10
	14	0.38	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
	18	< 0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CTM-14S	10	< 0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CTM-16S	9	< 0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CTM-18S	10	< 0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CTM-19S	10	< 0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CTM-20S	10	< 0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CTM-21S	10	< 0.20	0.1	< 0.10	< 0.10	< 0.10	< 0.10
CTM-28S	10	< 0.20	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

3.3 Discrete-Depth Groundwater Sampling

For shallow boreholes, discrete-depth groundwater samples from the first encountered groundwater. For boreholes greater than 75 feet deep, samples were collected from multiple depths in order to provide a vertical profile of VOCs in the aquifer. Table 3-3 provides a summary of VOCs detections during depth-discrete groundwater sampling. The wells are categorized in terms of the areas of investigation (Area A through Area H and Other Areas). Figures 3-5 through 3-7 graphically depict the results of the discrete depth sampling on cross sections A-A', B-B', and C-C', respectively.

Provided below is a summary of the detections of VOCs during the depth-discrete sampling efforts.

Area A

Above MCL concentrations of PCE were detected in shallow wells CTM-1S (5.6 µg/L) and CTM-28S (60 µg/L).

Area B

PCE was detected in CTM-2S at a concentration of 9.9 µg/L. Chloroform was also detected at a concentration of 2.3 µg/L.

Area C

- For the shallow wells, CTM-5S, CTM-6S, and CTM-31S had above MCL detections of PCE. Other detected compounds include chloroform (CTM-5S, CTM-31S, and CTM-40S); cis, 1,2-DCE (CTM-3S); and xylene (CTM-3S).

- *CTM-4D* - PCE was detected above the MCL (5 µg/L) at depths of 39 feet bgs (first water) to 113 feet bgs. The highest concentration was 44 µg/L at 92 feet bgs. Total depth (TD) of this well was 180 feet bgs. Chloroform and cis-1, 2-dichloroethene were also detected in samples collected from CTM-4D.

- *CTM-8D* - PCE was detected above the MCL from 96 feet bgs to 255 feet bgs (TD). The highest concentration was at 146 feet bgs at 97 µg/L. Groundwater was initially encountered at 74 feet bgs.

- *CTM-30D* - PCE was below the MCL for all discrete depth samples.

Area D

- For the shallow aquifer wells, PCE was the only compound detected above the MCL concentration (11 µg/L in CTM-39S).

- *CTM-10D* - PCE was detected above the MCL from 143 feet bgs to 350 feet bgs (TD). The highest concentrations were detected at 223 feet bgs (37 µg/L) and 350 feet bgs (50 µg/L).

Table 3-3
Detected Volatile Organic Compounds in Discrete Depth Samples

Area	Well	Depth (feet)	Sample Date	1,1,1-TCA	Chloroform	cis-1,2-DCE	MTBE	o-Xylene	PCE	Toluene	TCE
MCL (µg/l)				5	NA	7	NA	10,000	5	1,000	5
Shallow Well Results (µg/l)											
A	CTM-1S	37	3/27/01						5.6	<1	<1
	CTM-28S	32	3/30/01						60	<1	<1
B	CTM-2S	42	3/29/01		2.3				9.9	<1	<1
C	CTM-3S	44	3/27/01			3		1.4	1.5	<1	<1
	CTM-5S	47	3/28/01		1.4				7.4	<1	<1
	CTM-6S	35	3/20/01						36	<1	1.6
	CTM-31S	41	5/4/01		1.1				15	<1	<1
	CTM-37S	30	3/21/01						1.6	<1	<1
	CTM-40S	126.5	6/5/01		2.9				<1	<1	<1
D	CTM-9S	52	5/3/01						<1	<1	<1
	CTM-11S	40	3/20/01			2.4			3.8	<1	<1
	CTM-39S	35	6/1/01						11	<1	<1
E	CTM-14S	7	3/21/01						<1	<1	<1
	CTM-15S	60	3/26/01						<1	<1	<1
F	CTM-16S	26	3/15/01						9.9	<1	<1
G	CTM-19S	22	4/29/01						<1	<1	<1
	CTM-20S	22	3/15/01						<1	<1	<1
Other Areas	CTM-41S	38	6/4/01		1.1				<1	<1	<1
Deep Well Results (µg/l)											
C	CTM-4D	39	4/6/01						5.5	<1	<1
		57	4/6/01			3.5			10	<1	<1
		77	4/6/01			1.7			14	<1	<1
		92	4/6/01						44	<1	<1
		113	4/6/01		2.2				5.9	<1	<1
		137	4/6/01		2				3.6	<1	<1
		157	4/6/01		1.4				1.8	<1	<1
		180	4/9/01		1.5				1.2	<1	<1
	CTM-8D	26	3/2/01						<1	<1	<1
		52	3/2/01						<1	<1	<1
		74	3/2/01						1.5	<1	<1
		96	3/2/01						5.4	<1	<1
		120	3/2/01						5.5	<1	<1
		146	3/5/01						97	<1	<1
		170	3/5/01						38	<1	<1
	CTM-30D	134	4/11/01						1.6	<1	<1
		154	4/11/01						1.6	<1	<1
D	CTM-10D	63	4/23/01						<1	<1	<1
		83	4/23/01						<1	<1	<1
		103	4/23/01						<1	<1	<1
		123	4/23/01						<1	<1	<1
		243	4/25/01						14	<1	<2.5
		260	4/25/01						15	<1	<2.5
		283	4/25/01						18	<2	<5
		303	4/25/01						22	<1	<2.5
		320	4/25/01						27	<1	<2.5
		350	4/26/01		1.2				50	<1	1.1
	CTM-12D	165	3/26/01			1.7	27		6.2	<1	<1
		182	3/26/01			1.7	25		5.1	<1	<1
		197	3/26/01			1.3	22		3.5	<1	<1
		217	3/26/01				18		3.1	<1	<1
		297	3/28/01				5.4		5.8	<1	<1
		317	3/28/01				1		6	<1	<1
		346	3/28/01						3.5	<1	<1
	CTM-37D	50	5/31/01		1.1				<1	<1	<1
		70	5/31/01		3.2				<1	<1	<1
		85	5/31/01		2.3				<1	<1	<1

Table 3-3
Detected Volatile Organic Compounds in Discrete Depth Samples
(Cont.)

Area	*Well*	*Depth (feet)*	*Sample Date*	*1,1,1-TCA*	*Chloroform*	*cis-1,2-DCE*	*MTBE*	*o-Xylene*	*PCE*	*Toluene*	*TCE*
MCL (µg/l)				5	NA	7	NA	10,000	5	1,000	5
D	CTM-38D	33	5/29/01						13	<1	<1
		56	5/29/01						11	<1	<1
		75	5/29/01	1		1.8	29		26	<1	1.3
		98	5/29/01			1.5	25		16	<1	1
E	CTM-27D	7	4/2/01						<1	<1	<1
		33	4/2/01						<1	<1	<1
		56	4/2/01						<1	<1	<1
		77	4/3/01						<1	<1	<1
		97	4/3/01						<1	<1	<1
		117	4/3/01						<1	<1	<1
		136	4/3/01						<1	<1	<1
		157	4/4/01						<1	<1	<1
		180	4/4/01						<1	<1	<1
F	CTM-17D	32	3/19/01						1.4	<1	<1
		51	3/19/01						<1	<1	<1
		74	3/19/01						2.4	<1	<1
	CTM-33D	24	4/30/01						8.4	<1	<1
		45	4/30/01						5	<1	<1
		65	4/30/01						5.9	<1	<1
		85	4/30/01						3.3	<1	<1
		105	4/30/01						1.7	<1	<1
		125	5/1/01						2.6	<1	<1
		145	5/1/01						2.3	<1	<1
		166	5/1/01						2	<1	<1
		188	5/1/01						1.8	<1	<1
H	CTM-22D	27	4/17/01						<1	<1	<1
		47	4/17/01						<1	<1	<1
		67	4/17/01						<1	<1	<1
		87	4/17/01						<1	<1	<1
		107	4/17/01						<1	<1	<1
		127	4/18/01						<1	<1	<1
		147	4/18/01						<1	<1	<1
		167	4/18/01						<1	<1	<1
		187	4/18/01						2.7	<1	<1
		207	4/19/01						7.7	<1	2.6
		227	4/19/01						6.2	<1	2.1
		253	4/19/01						3.4	<1	1.1
Other Areas	CTM-23D	15	3/9/01						<1	<1	<1
		36.5	3/9/01						27	<1	<1
		56.5	3/9/01						21	<1	<1
		76.5	3/9/01						100	<1	<2.5
		96.5	3/9/01						310	<2	<5
	CTM-25D	36	3/7/01						<1	<1	<1
		54	3/7/01						<1	<1	<1
		75	3/7/01						<1	<1	<1
		97	3/7/01						<1	<1	<1
		117	3/8/01						<1	1.6	<1
		137	3/14/01						<1	<1	<1
		157	3/14/01						<1	<1	<1
		180	3/14/01						<1	<1	<1

- *CTM-12D* – PCE was detected above the MCL from the first encountered groundwater at 40 feet bgs to 182 feet bgs. From 182 feet bgs to TD (346 bgs), contamination levels remained at or near the MCL (3.1 to 6 µg/L). The highest concentrations were detected at 65 feet bgs (55 µg/L) and at 86 feet bgs (50 µg/L).

- *CTM-37D* – PCE was ND for all discrete depth samples. TD for this well was 85 feet bgs.

- *CTM-38D* – PCE was detected above the MCL in all discrete depth samples. The highest PCE concentration was 26 µg/L at a depth of 75 feet bgs. TD for this well was 98 feet bgs.

Area E

- *CTM-27D* – PCE was ND for all discrete depth samples.

Area F

- *CTM-16S* – PCE was detected at a concentration of 9.9 µg/L. No other compounds were detected in CTM-16S.

- *CTM-17D* – PCE was below the MCL from the first encountered groundwater at 32 feet bgs to TD (192 feet bgs) where a detection of 5 µg/L was observed.

- *CTM-33D* – The highest concentration of PCE (8.4 µg/L) occurred at the first sampling location (24 feet bgs). All other samples were at or below the MCL. TD for this well was 188 feet bgs.

Area G

There were no detections of PCE or other compound in Area G.

Area H

- *CTM-22D* – PCE was non-detect (ND) from 27 feet bgs to 167 feet bgs. The highest PCE detection occurred at 207 feet bgs (7.7 µg/L). TD of the well was 253 feet bgs. This well has artesian flow.

Other Areas

- *CTM-23D* – This well, which is located adjacent to the Peckham Lane production well, had the highest detection of PCE collected from a discrete depth sample -- 440 µg/L at a depth of 116.5 feet bgs. The next sample location (136.5 feet bgs) had a PCE concentration of 84 µg/L. The PCE concentration at TD (180 feet bgs) was 24 µg/L.

- *CTM-25D* – PCE was ND for all discrete depth samples.

Two conceptual models were described as part of the Final Work Plan. One was a vertical migration pathway through the production well gravel pack. The second was vertical migration through low permeability zones. Based on the results of discrete depth sampling (presences of PCE throughout the aquifer profile), vertical migration is the more likely scenario. Note however that the concept of a discrete low permeability zone separating a shallow water bearing zone from a deeper water bearing zone has been modified based on both in-field geologic logging and geotechnical analytical results.

3.4 Groundwater Sampling

All monitoring wells installed during this field investigation have had at least two rounds of post-development samples collected. Analytical data for these sampling events are presented in Table 3-4. Table 3-4 presents data only for detected groundwater constituents. Included in the table is a listing of the MCL for each constituent. Appendix E consists of summary sheets for each of the monitoring wells installed as part of the field investigation program. Included on the sheets are survey date of installation, survey data, well construction details, water level measurement data, and a summary of analytical data, including time trend plots. Appendix E contains a full listing of analytical results for all wells sampled as part of the ongoing monitoring program, including monitoring wells, which existed prior to the start of the field investigation program.

Figures 3-8 and 3-9 graphically present PCE contaminant distribution data. Figure 3-8 depicts the distribution of PCE in the shallow aquifer zone (based on the highest PCE detections in shallow wells). Figure 3-9 presents the distribution of PCE in the deep aquifer (based on the highest PCE detections in wells with depths greater than 100 feet bgs).

Figures 3-10 and 3-12 present the observed distribution of fuel-related constituents represented by the combined concentrations of benzene, toluene, ethylbenzene, and xylene (BTEX) in the shallow and deep aquifers.

Generally, the analytical data indicate widespread, low-level PCE contamination throughout the CTM study area. All of the PCE contamination has been bounded by wells that are non-detect or below the MCL for PCE except for Area D near the Mill Street TMWA water supply well. In Area D, the upgradient (westerly) extent of shallow PCE contamination has been bounded, but the downgradient (easterly) and cross gradient (both north and south) extent were not tightly bounded during this field efforts. The highest levels of PCE detected were at depths ranging from 65 to 170 feet bgs. These detects were primarily from discrete depth samples.

Of particular note is the identification of the two areas of highest contamination within the study area. The levels of contamination suggest potential "source" areas. These are located in the north of the well pair CTM-11S/12D and in the vicinity of CDM-28S. Further investigation in these two areas may be required to better delineate potential source areas. Further discussion of the contamination distribution conditions is provided in Section 4.

Table 3-4
Detected Volatile Organic Compounds in Monitoring Wells

Area	Well	Sample Date	PCE	TCE	Benzene	Toluene	Ethylbenzene	o-Xylene	m,p-Xylenes	MTBE	1,1,1-TCA	1,1,2-TCA	1,1-DCA	Chloroform	cis-1,2-DCE
	MCL (ug/L)		5	5	5	1,000	700	10,000	10,000	NA	5	NA	NA	NA	7
	Shallow Well Results (µg/l)														
A	CTM-1S	3/29/01	1.2												
		7/12/01				260									
	CTM-28S	4/2/01	**51**			1.4									
		4/9/01	**39**			15									
		5/24/01	**130**			2.7									
		6/28/01	**110**			130									
B	CTM-2S	4/9/01	**10**			22			1.1					2.5	
		7/12/01	**7.4**			300								3.1	
	CTM-29S	3/29/01	1.5												
		4/9/01	3.7			26			1.1						
		7/12/01				240									
C	CTM-3S	4/2/01	**7.7**			5.5									
		4/10/01	**7.6**			11			2.7						
		6/28/01	**8.3**			200									
	CTM-5S	4/2/01	**11**			1									
		6/28/01	**27**			77								3	
	CTM-6S	3/29/01	**28**	1.6											
		4/5/01	**20**	1.1		8.4			2.4						
		7/5/01	**25**			150									
	CTM-7S	3/27/01	2.8			1.6			2.7						
		7/5/01	4.5			130									
	CTM-31S	5/15/01	**18**			5.1								2.1	
		5/24/01	**22**			1.9								2.2	
		6/28/01	**21**			4.8								1.7	
	CTM-37S	3/28/01	2.8											1.1	
		4/5/01	3.8			1.2			1.9					1.3	
		7/12/01				250									
	CTM-40S	6/6/01	1.5			4.8								1	
		6/7/01													
		7/12/01				220									
D	CTM-9S	5/8/01	4.8			22	1.5	1.8	5.6					1.8	
		5/24/01				2									
		6/26/01	3.8			13								1	
	CTM-11S	4/5/01	**6**	1.5		8.2									3.5
		4/12/01	**9.8**	2		15			2.9	2.3					3.8
		7/10/01	**7.1**	2.3		46				9.8					3.1
	CTM-13S	3/28/01	**15**		1.9		1.5		4.2		**8.2**		11		
		3/29/01	**15**		2.5	3	2	1.5	6.6		**7.5**		10		
		5/24/01	**14**		2	2.4			1.5		**8**		7.8		
		6/21/01	**16**		4.7	3			1.3		**15**		4.3	1.8	

Table 3-4
Detected Volatile Organic Compounds in Monitoring Wells
(Cont.)

Area	Well	Sample Date	PCE	TCE	Benzene	Toluene	Ethylbenzene	o-Xylene	m,p-Xylenes	MTBE	1,1,1-TCA	1,1,2-TCA	1,1-DCA	Chloroform	cis-1,2-DCE
	MCL (ug/L)		*5*	*5*	*5*	*1,000*	*700*	*10,000*	*10,000*	*NA*	*5*	*NA*	*NA*	*NA*	*7*
D	CTM-39S	6/6/01	**13**												
		6/7/01	**12**			7.1			1.2						
		6/25/01	**13**			6.8									
E	CTM-14S	3/27/01													
		3/29/01	2.4			3.9	1.5	1.7	6.2						
		6/22/01				24									
	CTM-15S	3/27/01													
		3/29/01	2.7			2.3		1	3.6						
		6/22/01				2.3									
F	CTM-16S	3/29/01	**12**			5.9	1.8	2.1	7.4						
		6/27/01	**14**			5.6									
	CTM-18S	3/26/01	2.8												
		5/15/01	1.9			6									
		6/25/01	3.1			7.9									
G	CTM-19S	4/30/01													
		5/15/01	1.2			4.3									
		6/21/01				4.7									
	CTM-20S	3/27/01	2.2			1.5			2.8						
		6/21/01				1.8									
H	CTM-21S	3/26/01													
		4/5/01	2			1.8			2.7						
		7/5/01				**1400**									
Other Areas	CTM-41S	6/12/01												1.1	
		6/14/01												1.1	
		7/10/01				55									
	Deep Well Results (µg/L)														
C	CTM-4D	4/17/01				1								5.2	
		6/28/01	1.4			4.3								6.3	
	CTM-8D	3/28/01	**10**												
		7/5/01	**40**	2.6		210									
	CTM-30D	4/13/01	**28**			2									
		7/5/01	**25**			21						1.2			
D	CTM-10D	5/2/01	**41**	1.8		1.8									
		5/10/01	**29**	1.9											
		6/26/01	**41**	2		3.1									
	CTM-37D	6/1/01	3.1			1.2								4	
		6/7/01	1.8			3.9								3.9	
		7/11/01				160								3.4	
	CTM-12D	5/11/01	1.2			1.2									
		7/10/01	1.4			47									

Table 3-4
Detected Volatile Organic Compounds in Monitoring Wells
(Cont.)

Area	*Well*	*Sample Date*	*PCE*	*TCE*	*Benzene*	*Toluene*	*Ethylbenzene*	*o-Xylene*	*m,p-Xylenes*	*MTBE*	*1,1,1-TCA*	*1,1,2-TCA*	*1,1-DCA*	*Chloroform*	*cis-1,2-DCE*
	MCL (ug/L)		*5*	*5*	*5*	*1,000*	*700*	*10,000*	*10,000*	*NA*	*5*	*NA*	*NA*	*NA*	*7*
D	CTM-38D	6/6/01	**49**	2.1						100	2.3				3.1
		6/25/01	**55**	2.4		2.5				95	2.2				3.6
E	CTM-27D	4/6/01													
		4/10/01	1.4			5.7			1.1						
		6/22/01				3.6									
F	CTM-17D	4/9/01	**18**												
		4/10/01	**15**			8.3			1.4						
		7/11/01	4.2			63									
	CTM-33D	5/3/01	2.8			4.9									
		6/27/01	1.8			1.3									
H	CTM-22D	4/26/01	**21**			2.2									
		5/3/01	**30**			4.5			1.1						
		5/24/01	**23**			3.1								1.1	
		7/11/01	**20**			170									
Other Areas	CTM-23D	4/5/01							1.5						
		5/21/01				3.3									
		7/3/01	1			11									
	CTM-25D	4/13/01				1.7									
		7/3/01				87									

Notes: Concentrations in **bold** are greater than MCLs.

3.5 Groundwater Elevation

Groundwater elevation data were collected from monitoring wells throughout the CTM. Figures 3-12 and 3-13 graphically depict the groundwater elevation data. On a regional perspective, the general direction of groundwater flow is from west to east/southeast along the Truckee River. Regionally, flow tends to follow the pathway of the Truckee River, although there are components of both northeasterly to southeasterly flow. Of note is that groundwater flow trends at a local level have been observed to vary significantly from regional flow patterns, particularly in areas influenced by water supply well pumping or aquifer recharge activities. The groundwater contour maps for the two seasons are markedly similar, suggesting that seasonal variations were not significant during the period of measurement.

3.5.1 Hydraulic Gradient Evaluation for February 2001

Figure 3-12, depicting the regional groundwater contours for February 2001, shows a groundwater elevation change of 100 feet over a distance of approximately 20,000 feet (3.8 miles). The overall hydraulic gradient is 0.005. The hydraulic gradient is steeper to the west of Kirman Avenue, with a reduction in hydraulic head of 80 feet over 7,500 feet (1.4 miles) for a hydraulic gradient of 0.011. To the east of Kirman Avenue, there is a hydraulic head difference of 20 feet over a distance of 12,250 feet (2.3 miles), resulting in a calculated hydraulic gradient of 0.002. Between Locust Street on the east and Holcolmb Avenue on the west, the hydraulic gradient becomes steeper (reduction of 30 feet of hydraulic head over a distance of only 1,500 feet). The hydraulic gradient in this area was calculated to be 0.020.

3.5.2 Hydraulic Gradient Evaluation for August 2001

Figure 3-13 depicts the regional groundwater contours for August 2001. The evaluation for August includes the wells that were installed as part of the CTM Remediation District investigation and, therefore, was based on a greater number of control points. The overall hydraulic gradient was calculated to be 0.0045 (hydraulic head difference of 100 feet over a distance of 22,000 feet [4.2 miles]). The hydraulic gradient is steeper to the west of Yori Avenue than it is to the east. To the west of Yori Avenue, the hydraulic gradient is 0.009 (hydraulic head loss of 80 feet over a distance of 9,000 feet). To the east of Yori Avenue, the hydraulic gradient is 0.002 (20-foot hydraulic head loss over a distance of 12,750 feet). There is a small area of steeper hydraulic gradient from Park Street on the west to between Wells Avenue and Locust Street on the east. The hydraulic gradient was calculated to be 0.023 (hydraulic head decrease of 20 feet over a distance of 875 feet).

Hydraulic gradients for February and August 2001 are listed in Table 3-5. Gradients are steeper to the west and flatten-out to the east. This is expected as groundwater flows from areas of mountain recharge in the west into the Truckee Meadows basin to the east. Comparison of the data shows that the hydraulic gradients did not vary greatly between February (winter) and August (summer) for 2001. Further, the addition of water level data from CTM groundwater monitoring wells did not result in significant changes to the interpretation of regional groundwater flow.

Table 3-5
Hydraulic Gradients

Location	February 2001			August 2001		
	Head Change (feet)	Distance (feet)	Gradient (feet/feet)	Head Change (feet)	Distance (feet)	Gradient (feet/feet)
Full Basin	100	20,000	0.005	100	22,000	0.0045
Western Area	80	7,500	0.011	80	9,000	0.009
Eastern Area	20	12,250	0.002	20	12,750	0.002
Steepest Area	30	1,500	0.020	20	875	0.023

3.5.3 Vertical Hydraulic Gradients

Vertical hydraulic gradients were measured based on water level differences between shallow/deep well pairs. Figure 3-14 shows the well pairs and the associated vertical hydraulic gradients. Of note is the fact that all of the negative vertical gradients are associated with the well pairs having the shallower deep boring (i.e., borings with a completed depth on the order of 180 feet bgs). Well pairs with positive vertical gradients have the deep wells with depths ranging from 157 to 350 feet bgs. Generally, the deeper the well, the larger the vertical positive gradient.

3.6 Geophysical Logging

Geophysical logging was performed on a total of 11 deep monitoring wells. Geophysical logging data was considered in the development of the cross sections. The geophysical logging data reports are provided in Appendix C.

One of the objectives of the geophysical logging was to evaluate the existence of a clay layer thought to exist at a depth of about 100 feet bgs. The natural gamma logging response measures the gamma emissions from the formation and is tied to the clay content of the formation. Clays contain the bulk of the gamma producing elements, so as the clay content of the formation increases, the response measured by the gamma tool increases. The response of the gamma tool in the formation within the CTM was limited. These results supported the field observations, indicating that significant clay content does not exist at depth within the CTM study area.

The induction log measures the conductivity of the formation responding in part to the natural moisture content of the soil. The induction tool produces the best results in medium to high porosity formations. The induction log data were used to help distinguish formation boundaries and the nature and amount of interbedding within the formation for use in the groundwater model.

3.7 Hydraulic Testing

This section summarizes data for the two types of hydraulic testing performed as part of the field investigation program – slug tests and aquifer pumping tests. The slug tests, performed on 20 shallow monitoring wells, were useful for providing local hydraulic characterization information. The aquifer pumping tests, performed using 5 TMWA water supply wells, provided hydraulic characterization data on a more regional scale.

3.7.1 Slug Test Data Summary

Slug tests were performed on 20 shallow wells. Slug test data was used to calculate a range of hydraulic conductivity (K) values. Table 3-6 summarizes the results of slug test analyses. A graphical presentation of the slug test results is located in Appendix D. Analyses of data from four wells (CTM-1S, CTM-16S, CTM-20S, and CTM-28S) were not performed because these wells recovered instantly and reasonable estimates of K could not be obtained (i.e., results suggested very high K values).

Description of the approach used for analysis of the slug test data will be provided as part of the final technical memorandum. All analyses were performed with the following assumptions:

- Aquifer thickness of 100 feet and partial penetration.
- Drilled borehole diameter of 6 inches (0.5 feet)
- Diameter of screened zone of 2 inches (0.167 feet)
- Porosity of gravel pack of 0.3

3.7.2 Aquifer Pumping Test Data

In order to better understand the aquifer flow system in the Central Truckee Meadows, continuous data loggers were placed in monitoring wells in five locations near TMWA wells. These data loggers recorded the water level in the monitoring well every 15 minutes. Hourly pumping data was obtained for the same period for the TMWA water supply wells.

Data logger results and well pumping data are presented on Figures 3-15 through 3-19. For all of the wells, with the exception of Peckham water supply well (Figure 3-19), the water levels in the deeper monitoring wells were directly impacted by the pumping rate in the adjacent TMWA well(s). The aquifer pumping test using the Peckham well did not yield any useful information because the well was turned off during the entire period of the data logger operation. The aquifer response in the deep wells was also noticeable during periods when the TMWA wells were shut down. For example the water level in well CTM-8D responded approximately 10 ft to the shut off of the High and Morrill wells on August 27, 2001. Similar responses were observed in CTM-12D, CTM-22D, and CTM-17D during this same time period. Data logger information collected from the shallow water observation wells did not indicate a response during periods of TMWA water supply well pumping.

Table 3-6
Summary of Slug Test Analyses

	Bouwer & Rice Slug-In (ft/day)	Bouwer & Rice Slug-Out (ft/day)	Hvorslev Slug-In (ft/day)	Hvorslev Slug-Out (ft/day)
CTM-1S	*	*	*	*
CTM-2S	3.5	12.6	5.2	11.5
CTM-3S	7.5	18.2	44.5	19.5
CTM-5S	28.3	38.6	45	69.5
CTM-6S	6.6	10	7.9	9.7
CTM-7S	2	2.1	2.9	2.8
CTM-9S	0.3	1.5	0.4	1.8
CTM-11S	2.2	10.5	3	12.8
CTM-13S	10.5	10.4	12.6	15.4
CTM-14S	38.1	29.8	19.3	32.3
CTM-15S	16.3	9.5	14.7	13.4
CTM-16S	*	*	*	*
CTM-18S	3.7	6.6	4.2	9
CTM-19S	5.3	13.2	2.9	6
CTM-20S	*	*	*	*
CTM-21S	27.6	48.8	28.8	56.2
CTM-28S	*	*	*	*
CTM-29S	72.3	not analyzed	85.8	not analyzed
CTM-31S	50.4	50.4	44.1	44.5
CTM-37S	56.6	37.5	56.8	43

*Well recovered instantly and reasonable estimate of conductivity could not be obtained.

Portions of these data records have been used to perform a short-term transient calibration of the groundwater model. The results from this short-term transient calibration have been used in the calibration of the entire CTM groundwater flow model. The groundwater model calibration involves inputting actual pumping rates for the TMWA wells into the model. Aquifer responses at the observation wells are simulated and compared to the actual data logger records. Hydraulic parameters are then adjusted in an attempt to match the data logger records. The hydraulic properties that are varied as part of the calibration efforts include horizontal and vertical hydraulic conductivity, specific yield, and specific storativity.

3.8 Survey Data

Table 3-7 summarizes horizontal coordinate and elevation data for the groundwater monitoring wells. The center of the Christy box was used as the measuring point for all horizontal survey data. A conversion factor was used to convert the CFA ground coordinate data to the Modified Grid, Nevada State Plane Coordinate System, West Zone, NAD 83.

The center of the Christy box was used as the measuring point for all elevation data. After GPS data were collected, the cover of the Christy box was removed and the distance between the top of the PVC casing and ground surface was measured. This was accomplished by placing a straight edge across the top of the Christy box and measuring from the top of the north side of the PVC casing to the intersection with a straight edge.

Table 3-7
Central Truckee Meadows Remediation District
Summary of Elevation Horizontal and Survey Data for the CTM Groundwater Monitoring Wells

Well Designation	Elevation Data: Ground Surface Elevation (feet)	Elevation Data: Stick-up Depth (feet)	Elevation Data: Elevation depth (feet)	Horizontal Survey Data: Northing (Ground Coordinates)	Horizontal Survey Data: Easting (Ground Coordinates)	Horizontal Survey Data: Northing (State Plane)	Horizontal Survey Data: Easting (State Plane)
CTM-1S	4539.32	0.31	4539.01	2,274,106.975	14,868,509.470	2,273,656.929	14,865,566.995
CTM-2S	4527.64	0.29	4527.35	2,274,703.429	14,866,851.119	2,274,253.266	14,863,908.971
CTM-3S	4515.50	0.41	4515.09	2,276,946.496	14,869,865.575	2,276,495.889	14,866,922.831
CTM-4D	4515.42	0.29	4515.13	2,276,948.840	14,869,856.849	2,276,498.232	14,866,914.106
CTM-5S	4526.60	0.38	4526.22	2,276,081.620	14,869,717.241	2,275,631.184	14,866,774.526
CTM-6S	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CTM-7S	4483.97	0.24	4483.73	2,280,747.149	14,868,603.877	2,280,295.790	14,865,661.383
CTM-8D	4483.84	0.38	4483.46	2,280,747.451	14,868,598.154	2,280,296.091	14,865,655.661
CTM-9S	4457.96	0.46	4457.50	2,284,195.481	14,866,373.014	2,283,743.439	14,863,430.961
CTM-10D	4457.99	0.27	4457.72	2,284,191.912	14,866,363.761	2,283,739.870	14,863,421.710
CTM-11S	4441.80	0.32	4441.48	2,285,881.188	14,864,598.277	2,285,428.813	14,861,656.575
CTM-12D	4441.61	0.22	4441.39	2,285,878.367	14,864,610.074	2,285,425.992	14,861,668.370
CTM-13S	4450.52	0.25	4450.27	2,285,228.262	14,866,627.883	2,284,776.015	14,863,685.780
CTM-14S	4471.49	0.38	4471.11	2,279,156.256	14,863,923.056	2,278,705.211	14,860,981.488
CTM-15S	4482.55	0.44	4482.11	2,280,320.942	14,863,887.259	2,279,869.667	14,860,945.698
CTM-16S	4439.23	0.32	4438.91	2,282,824.022	14,861,104.937	2,282,372.251	14,858,163.927
CTM-17D	4425.14	0.28	4424.86	2,286,628.527	14,861,231.114	2,286,176.003	14,858,290.078
CTM-18S	4427.15	0.48	4426.67	2,286,962.665	14,862,782.296	2,286,510.075	14,859,840.953
CTM-19S	4409.21	0.31	4408.90	2,295,288.693	14,868,452.894	2,294,834.455	14,865,510.429
CTM-20S	4405.47	0.20	4405.27	2,295,446.848	14,863,409.835	2,294,992.579	14,860,468.369
CTM-21S	4460.93	0.22	4460.71	2,284,916.984	14,868,642.116	2,284,464.799	14,865,699.614
CTM-22D	4458.92	0.37	4458.55	2,284,207.365	14,868,863.402	2,283,755.320	14,865,920.856
CTM-23D	4417.97	0.22	4417.75	2,289,083.757	14,851,330.352	2,288,630.747	14,848,391.276
CTM-25D	4397.66	0.16	4397.50	2,293,465.531	14,855,430.761	2,293,011.654	14,852,490.874
CTM-27D	4471.40	0.20	4471.20	2,279,159.447	14,863,915.661	2,278,708.401	14,860,974.095
CTM-28S	4522.83	0.31	4522.52	2,276,064.146	14,868,578.337	2,275,613.713	14,865,635.848
CTM-29S	4521.02	0.49	4520.53	2,274,219.389	14,866,988.230	2,273,769.321	14,864,046.056
CTM-30D	4492.51	0.40	4492.11	2,279,288.598	14,868,236.250	2,278,837.527	14,865,293.829
CTM-31S	4512.27	0.36	4511.91	2,277,196.030	14,870,299.309	2,276,745.373	14,867,356.479
CTM-33D	4425.08	0.34	4424.74	2,285,582.067	14,861,486.810	2,285,129.750	14,858,545.724
CTM-37S	4479.04	0.31	4478.73	2,281,427.055	14,871,515.982	2,280,975.561	14,868,572.912
CTM-37D	4451.70	0.31	4451.39	2,284,801.761	14,865,257.354	2,284,349.599	14,862,315.522
CTM-38D	4429.10	0.32	4428.78	2,287,371.150	14,864,154.016	2,286,918.480	14,861,212.402
CTM-39S	4429.20	0.37	4428.83	2,287,368.053	14,864,147.455	2,286,915.383	14,861,205.842
CTM-40S	4594.08	0.31	4593.77	2,275,923.045	14,870,899.615	2,275,472.640	14,867,956.667
CTM-41S	4479.69	0.30	4479.39	2,279,643.375	14,861,204.291	2,279,192.234	14,858,263.261

Notes:
1. For monitoring well MW-76a (CTM-23S), the difference in elevation is based on ground surface elevation data.
2. 2. A conversion factor was used to convert ground coordinates to Modified Grid, Nevada State Plane Coordinate System, West Zone, NAD 83. Factor used for X and Y-coordinate data conversion: 1.000197939
3. "n/a" = data not available.

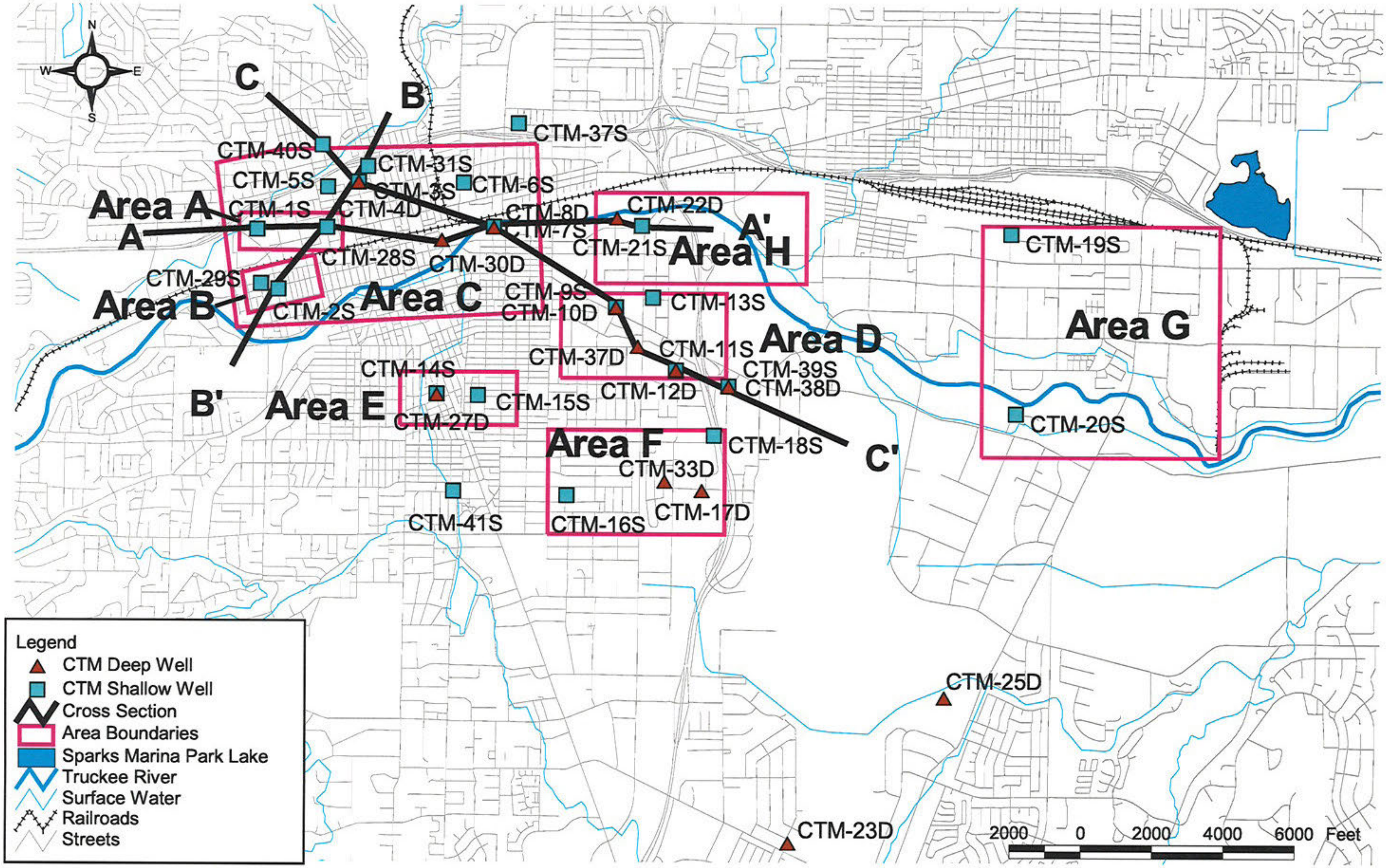

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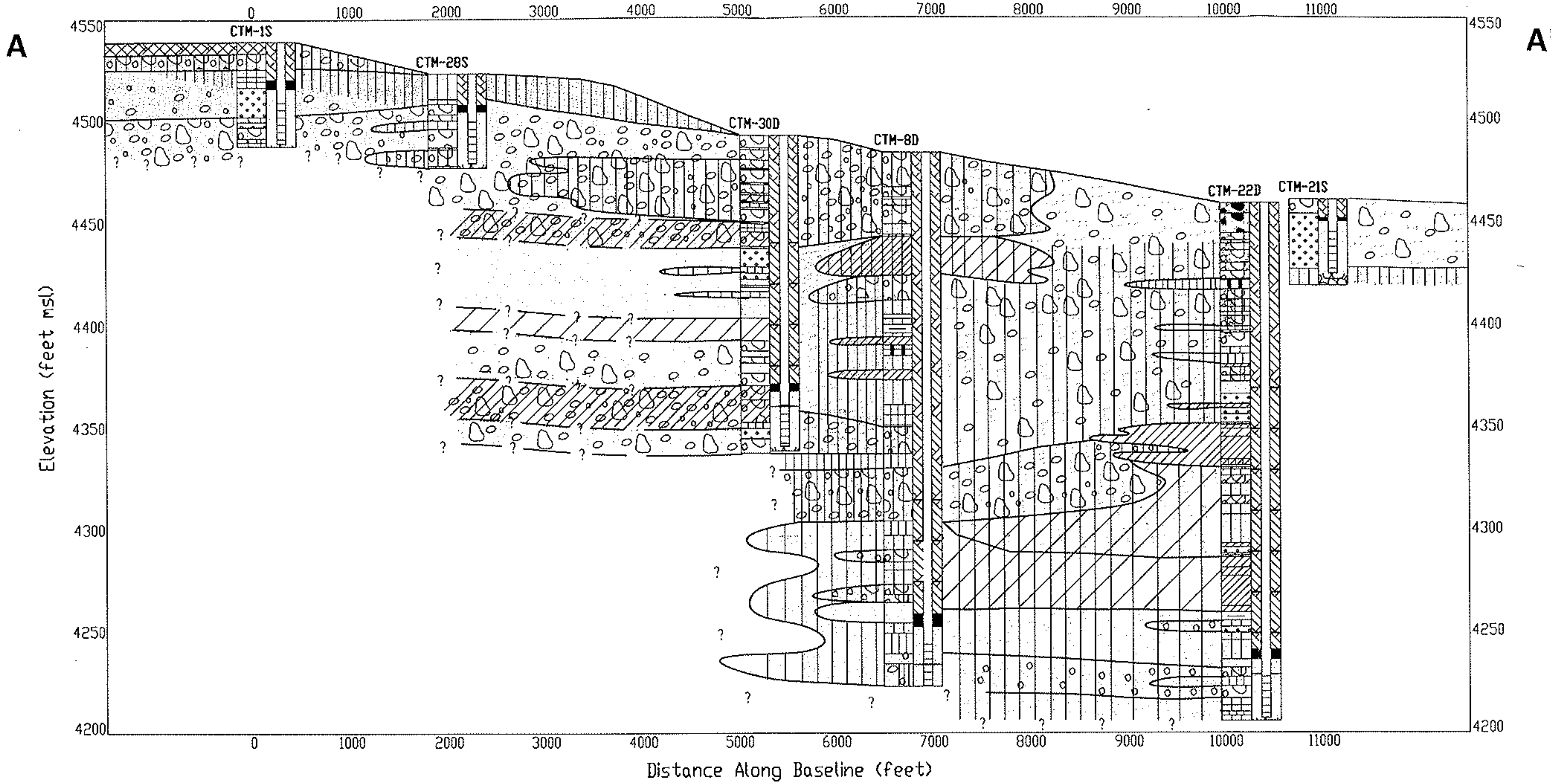
Figure 3-1
Cross Section Location Map
Central Truckee Meadows Remediation District



Borehole	Northing	Easting	Elevation	Depth (ft)
CTM-1S	14865567	2273657	4539.1	52.0
CTM-21S	14865699	2284465	4460.8	42.0
CTM-22D	14865920	2283755	4458.8	253.0
CTM-28S	14865635	2275614	4522.8	46.0
CTM-30D	14865293	2278838	4492.2	155.0
CTM-8D	14865661	2280296	4483.7	261.0

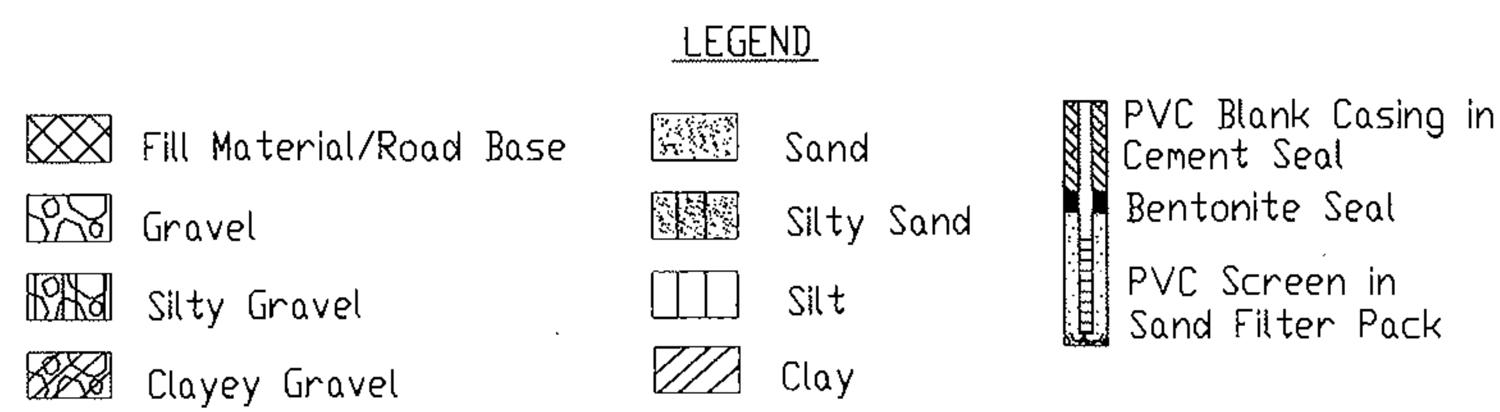
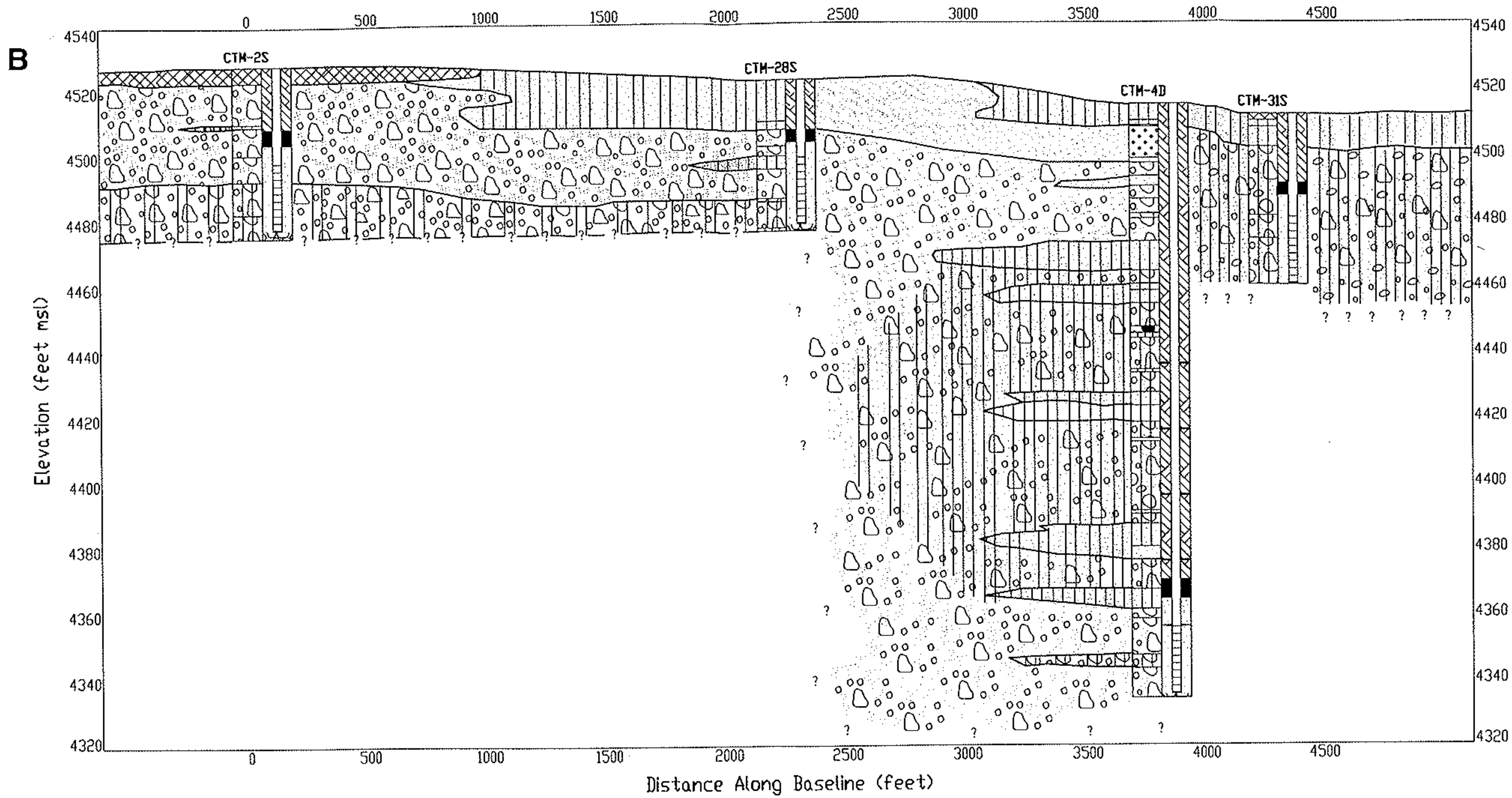


Figure 3-2
Cross Section A-A'
Central Truckee Meadows Remediation District



Borehole	Northing	Easting	Elevation	Depth (ft)
CTM-28S	14865635	2275614	4522.8	46.0
CTM-2S	14863909	2274253	4527.6	52.5
CTM-31S	14867356	2276746	4512.0	52.0
CTM-4D	14866914	2276498	4515.2	181.0

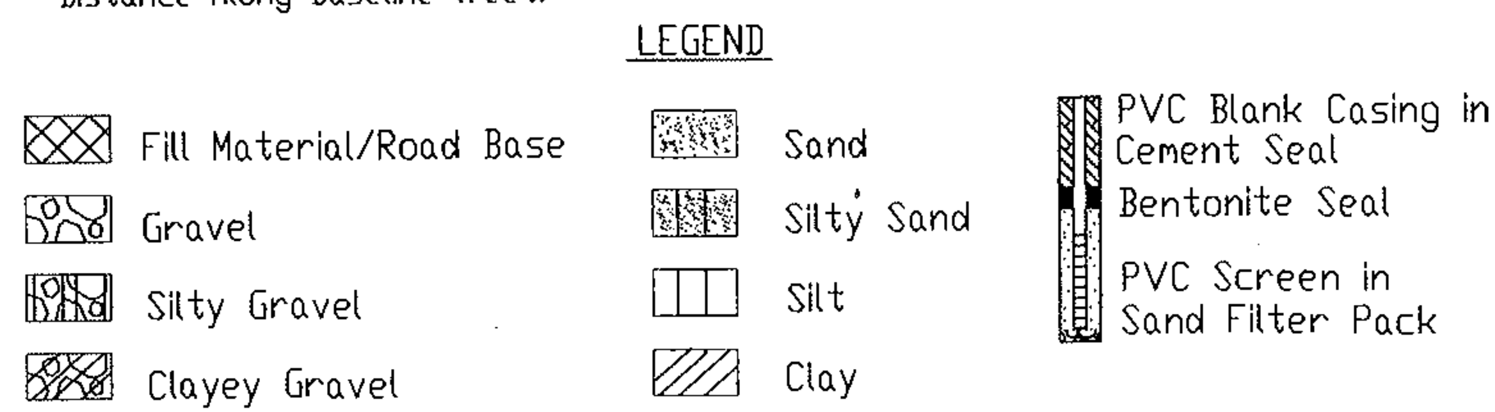
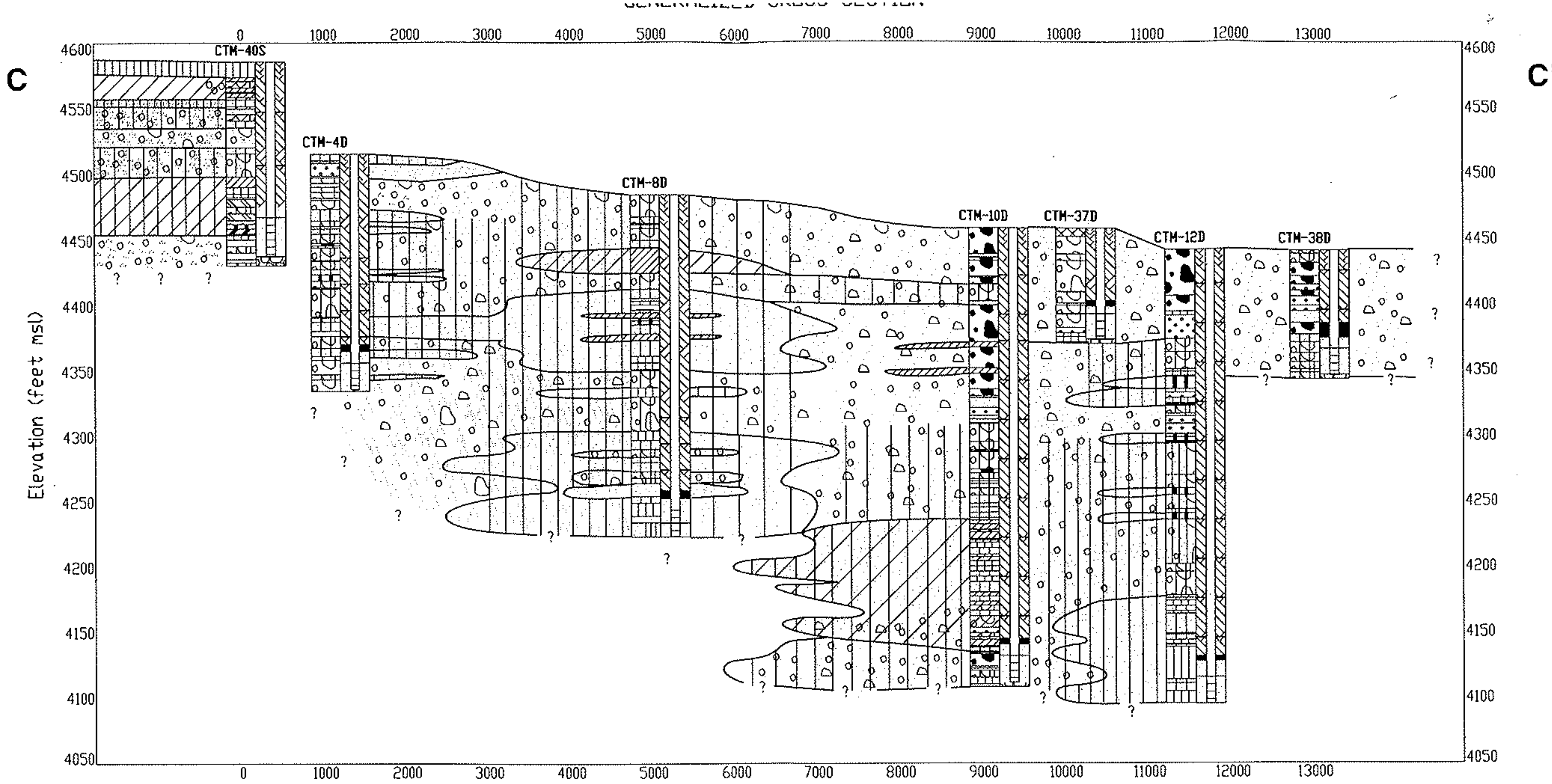


Figure 3-3
Cross Section B-B'
Central Truckee Meadows Remediation District

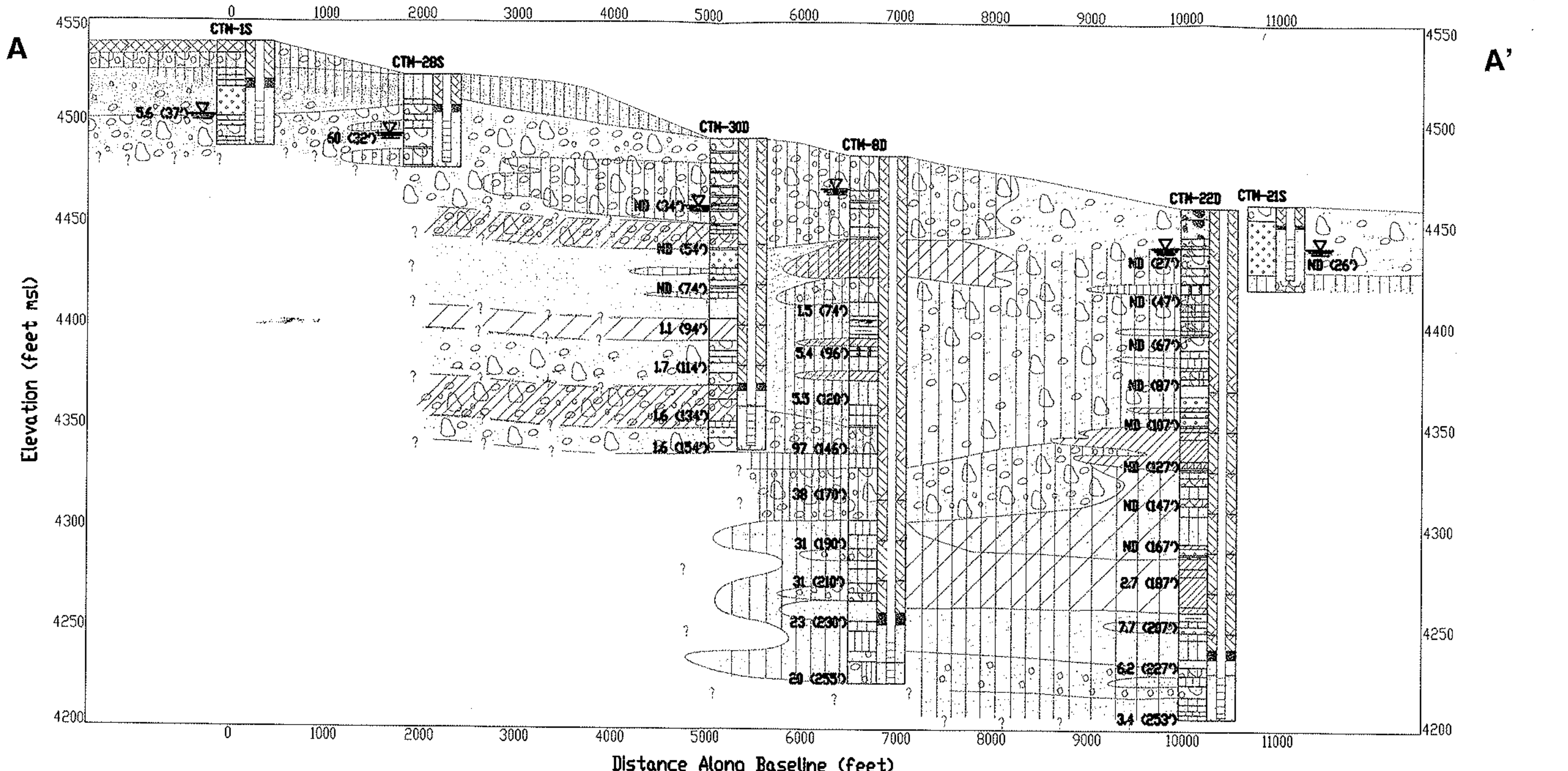


Borehole	Northing	Easting	Elevation	Depth (ft)
CTM-10D	14863421	2283740	4457.9	350.0
CTM-12D	14861656	2285429	4441.6	346.0
CTM-37D	14862371	2284340	4458.0	88.0
CTM-38D	14861218	2286926	4441.0	98.0
CTM-40S	14867974	2275781	4585.0	155.0
CTM-4D	14866914	2276498	4515.2	181.0
CTM-8D	14865661	2280296	4483.7	261.0

LEGEND

- Fill Material/Road Base
- Gravel
- Silty Gravel
- Clayey Gravel
- Sand
- Silty Sand
- Silt
- Clay
- PVC Blank Casing in Cement Seal
- Bentonite Seal
- PVC Screen in Sand Filter Pack

Figure 3-4
Cross Section C-C'
Central Truckee Meadows Remediation District

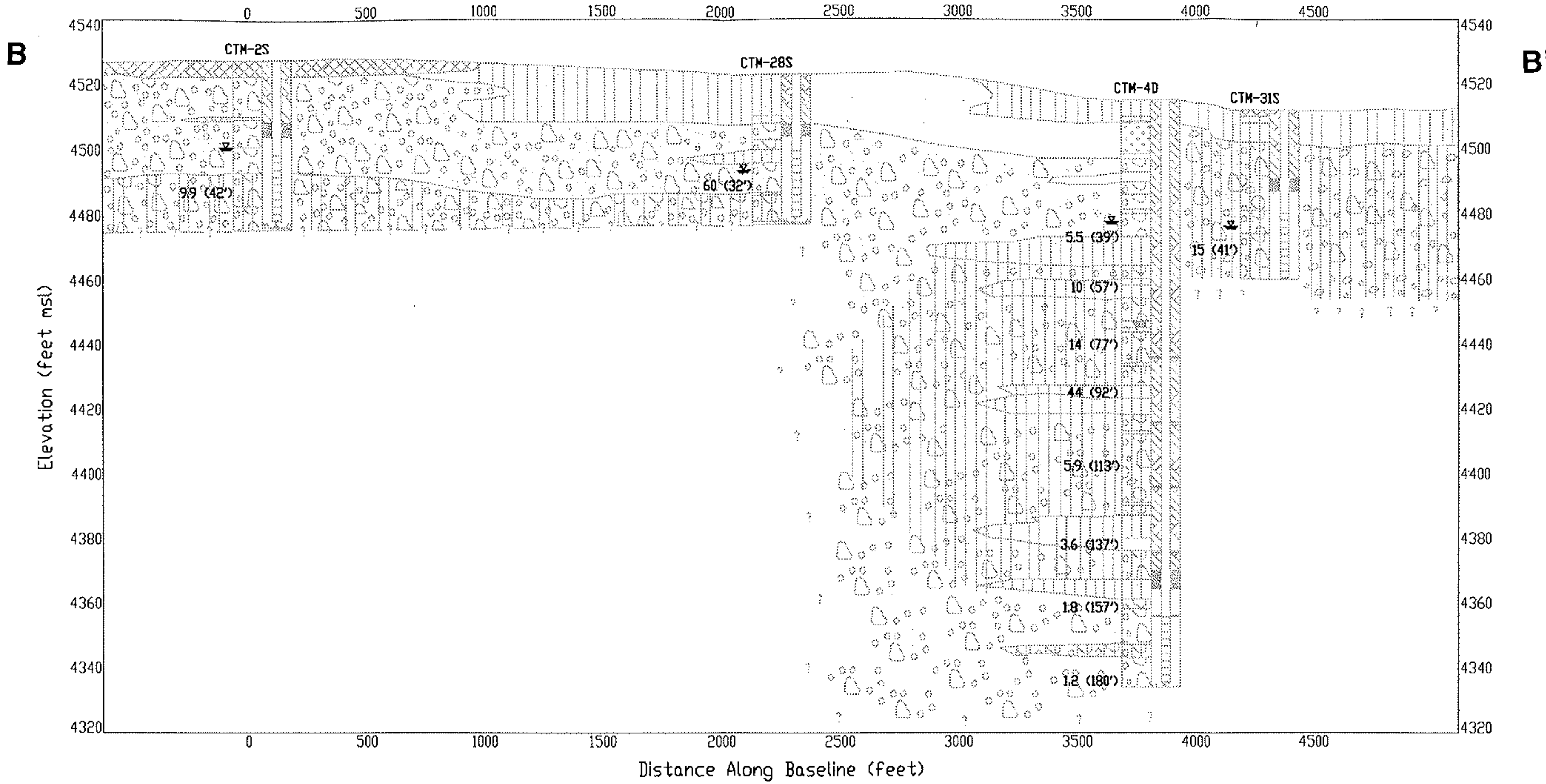


LEGEND

Borehole	Northing	Easting	Elevation	Depth (ft)
CTM-1S	14865567	2273657	4539.1	52.0
CTM-21S	14865699	2284465	4460.8	42.0
CTM-22D	14865920	2283755	4458.8	253.0
CTM-28S	14865635	2275614	4522.8	46.0
CTM-30D	14865293	2278838	4492.2	155.0
CTM-8D	14865661	2280296	4483.7	261.0

Fill Material/Road Base
Gravel
Silty Gravel
Clayey Gravel
Sand
Silty Sand
Silt
Clay
9.9 (42') Discrete-Depth Groundwater PCE Concentration (ug/l) (Sample Depth (ft))
Water Level
PVC Blank Casing in Cement Seal
Bentonite Seal
PVC Screen in Sand Filter Pack

Figure 3-5
Discrete Depth Sample Results
Cross Section A-A'
Central Truckee Meadows Remediation District

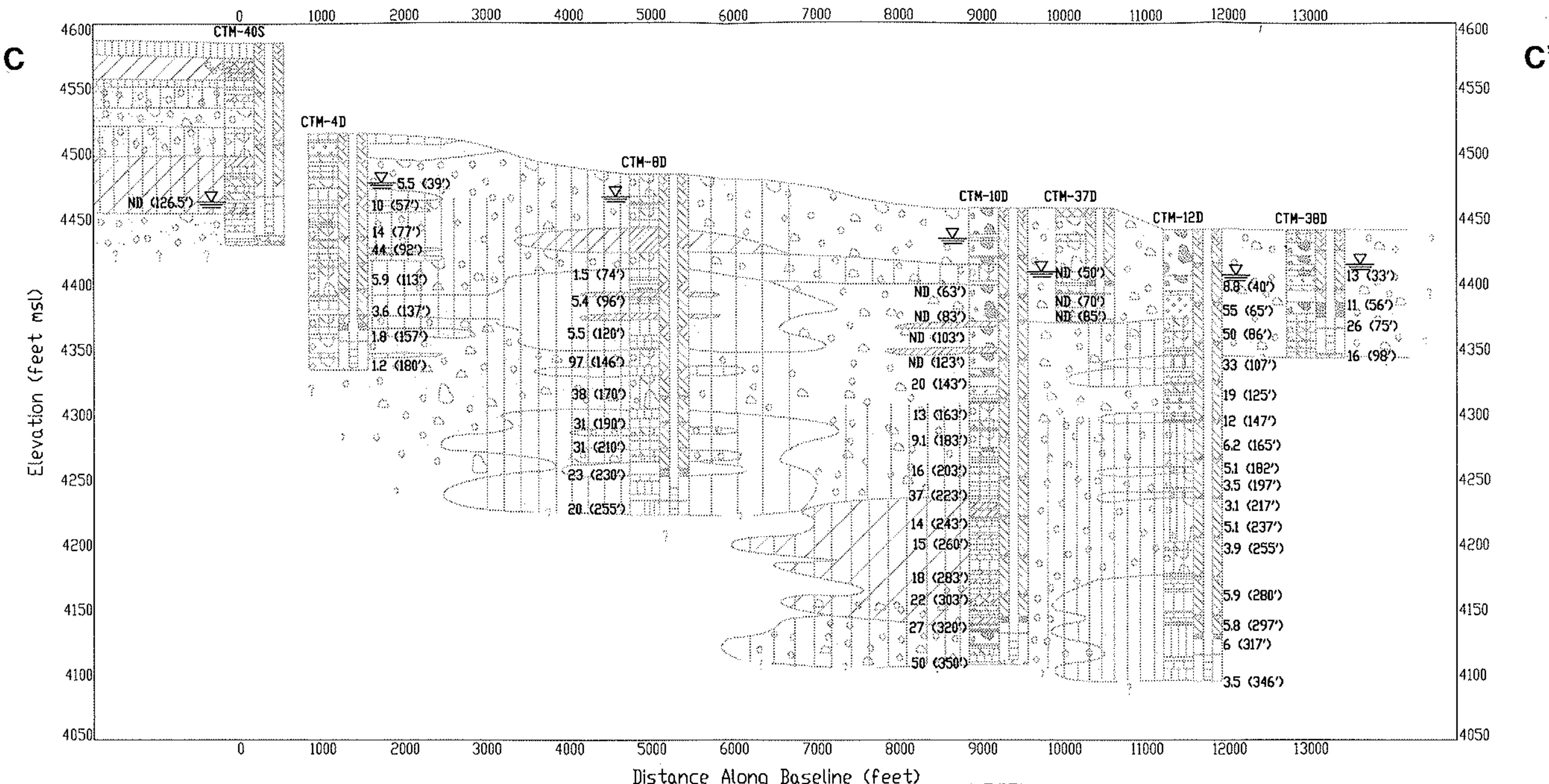


Borehole	Northing	Easting	Elevation	Depth (ft)
CTM-28S	14865635	2275614	4522.8	46.0
CTM-2S	14863909	2274253	4527.6	52.5
CTM-31S	14867356	2276746	4512.0	52.0
CTM-4D	14866914	2276498	4515.2	181.0

LEGEND

Fill Material/Road Base
Gravel
Silty Gravel
Clayey Gravel
Sand
Silty Sand
Silt
Clay
9.9 (42') Discrete-Depth Groundwater PCE Concentration (ug/l) (Sample Depth (ft))
Water Level
PVC Blank Casing in Cement Seal
Bentonite Seal
PVC Screen in Sand Filter Pack

Figure 3-6
Discrete Depth Sample Results
Cross Section B-B'
Central Truckee Meadows Remediation District



Borehole	Northing	Easting	Elevation	Depth (ft)
CTM-10D	14863421	2283740	4457.9	350.0
CTM-12D	14861656	2285429	4441.6	346.0
CTM-37D	14862371	2284340	4458.0	88.0
CTM-38D	14861218	2286926	4441.0	98.0
CTM-40S	14867974	2275781	4585.0	155.0
CTM-4D	14866914	2276498	4515.2	181.0
CTM-8D	14865661	2280296	4483.7	261.0

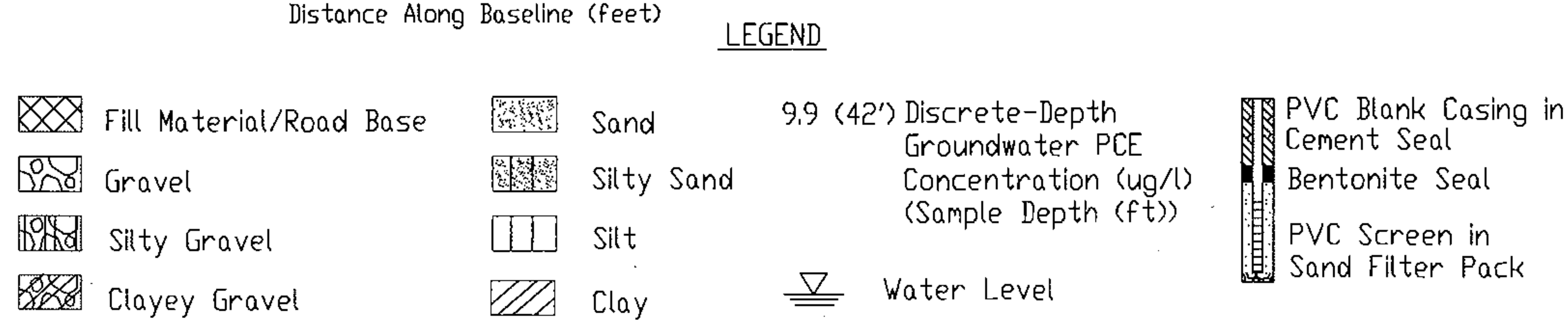


Figure 3-7
Discrete Depth Sample Results
Cross Section C-C'
Central Truckee Meadows Remediation District

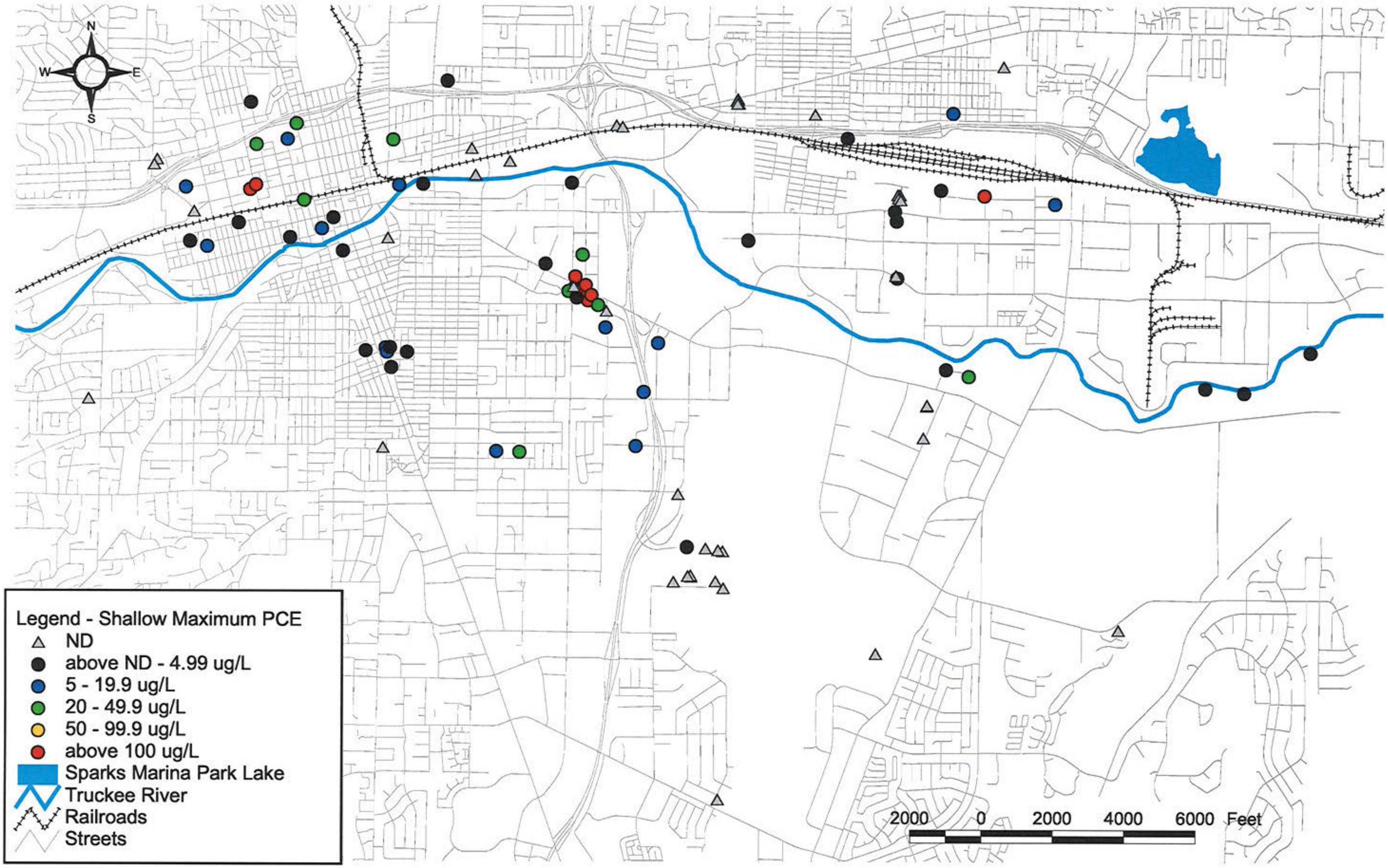


Figure 3-8
PCE Contamination Distribution - Shallow Aquifer
Central Truckee Meadows Remediation District

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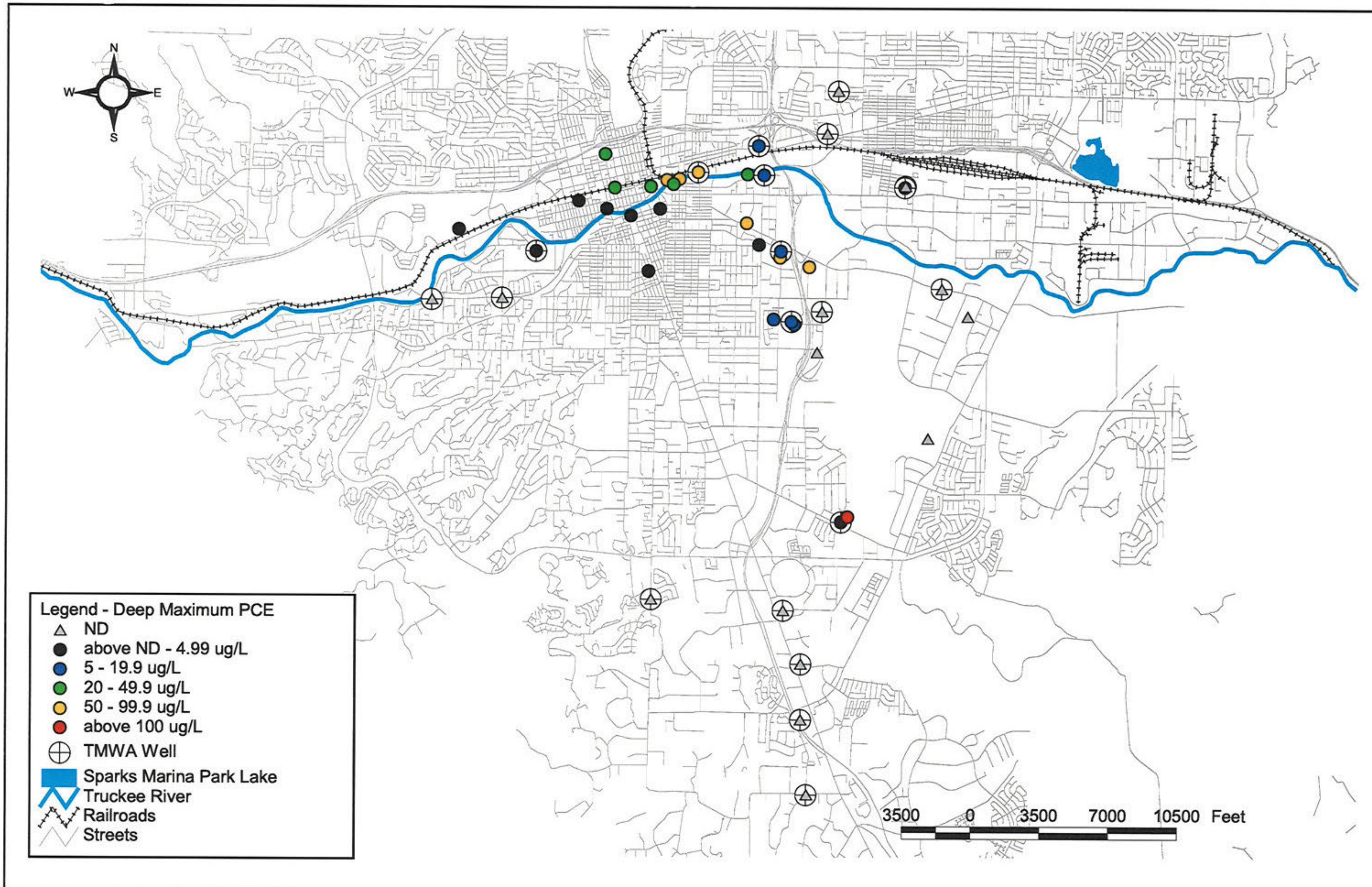

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Figure 3-9
PCE Contamination Distribution - Deep Aquifer
Central Truckee Meadows Remediation District

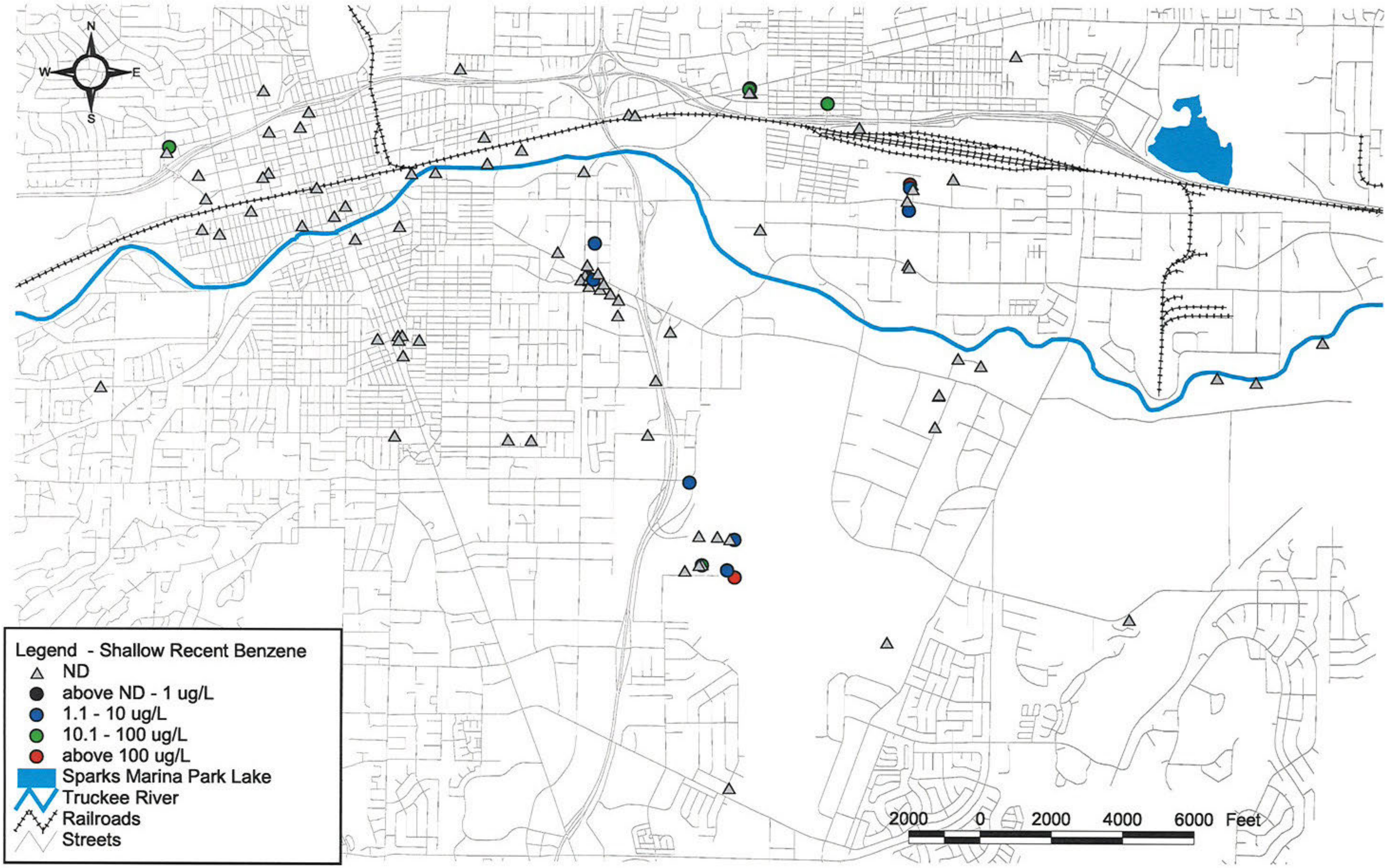

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Figure 3-10
Benzene Concentration in Shallow Monitoring Wells
Central Truckee Meadows Remediation District

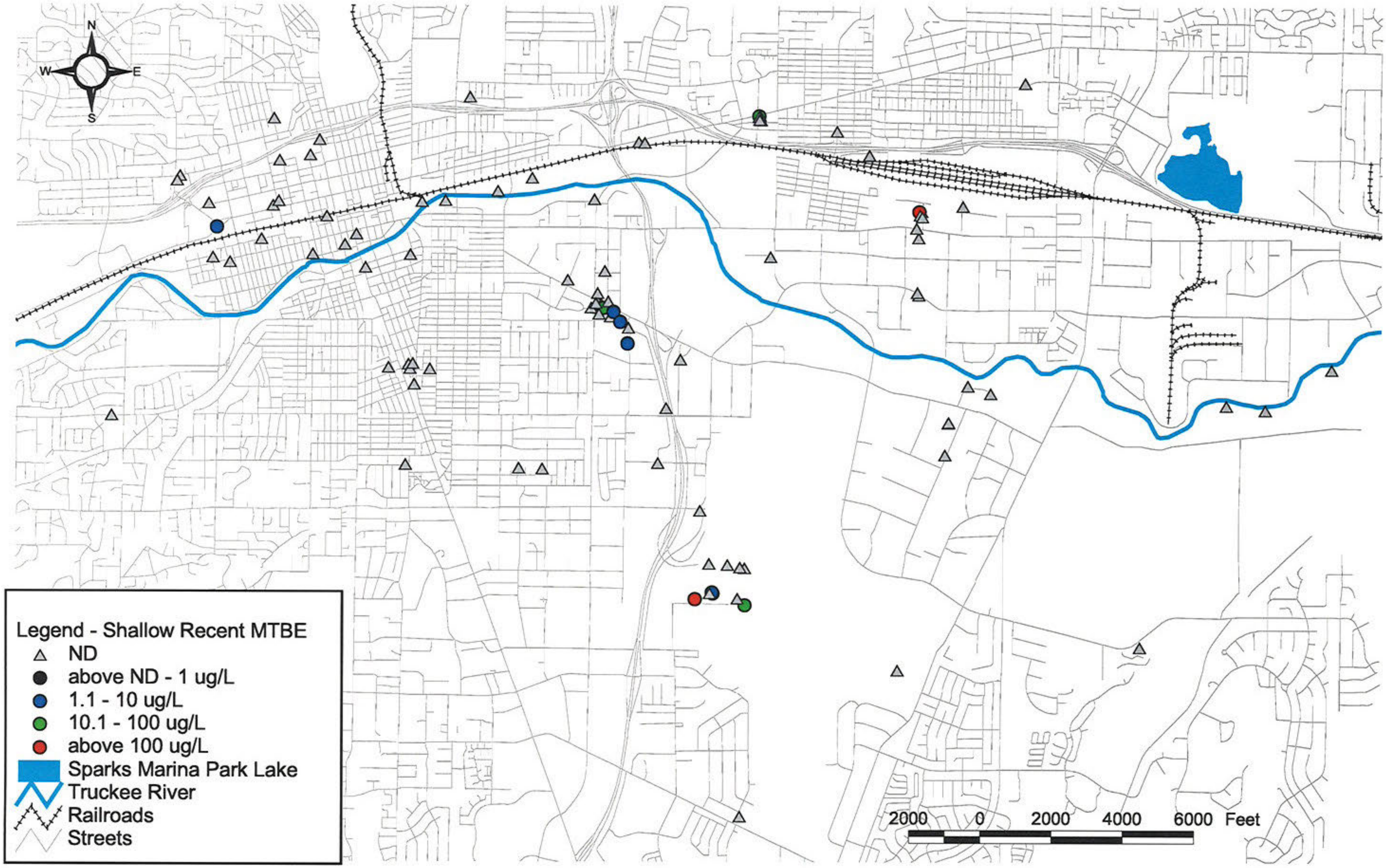

Figure 3-11
MTBE Concentration in Shallow Monitoring Wells
Central Truckee Meadows Remediation District

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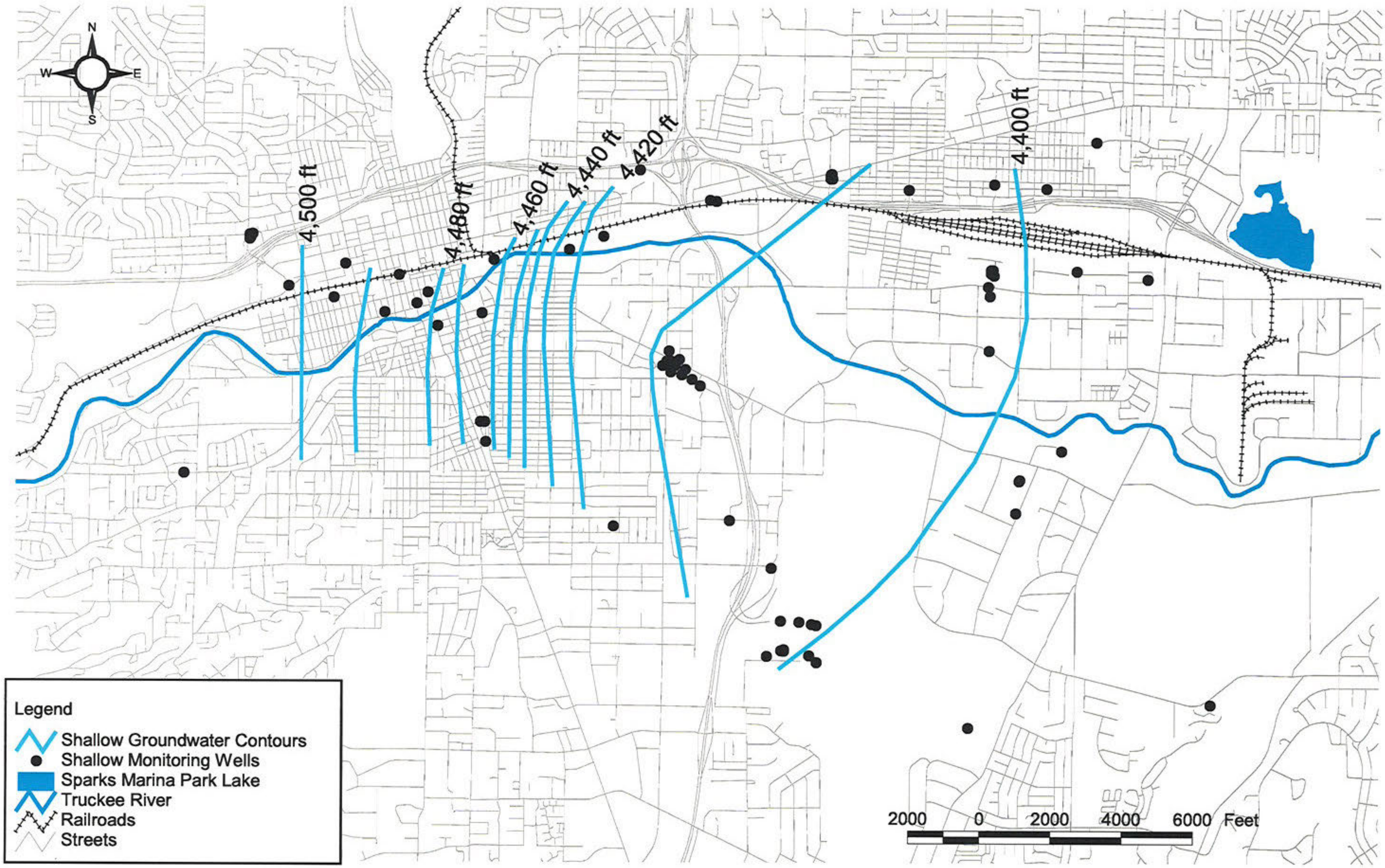

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Figure 3-12
Groundwater Contour Map, February 2001
Central Truckee Meadows Remediation District

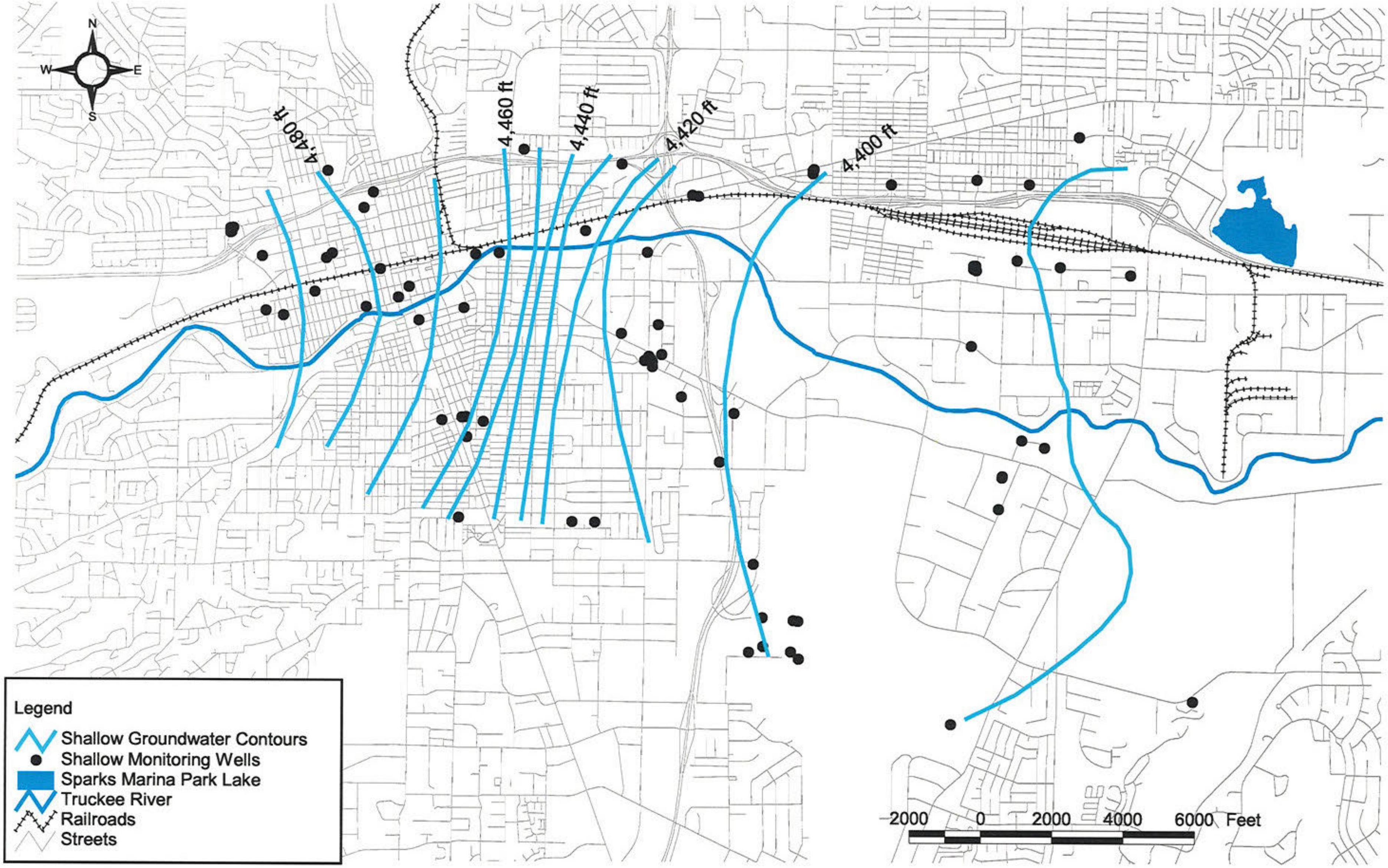

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Figure 3-13
Groundwater Contour Map, August 2001
Central Truckee Meadows Remediation District

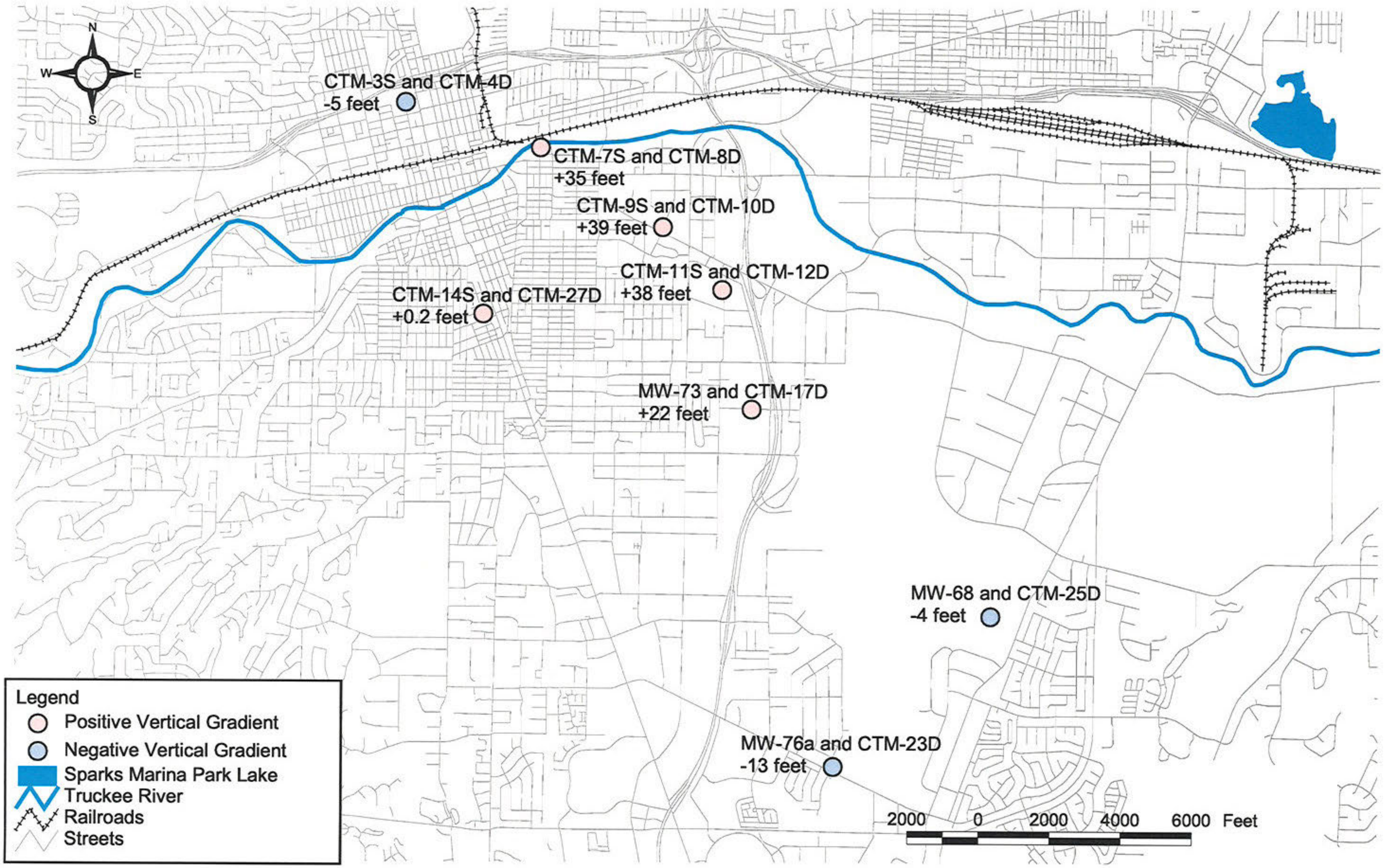

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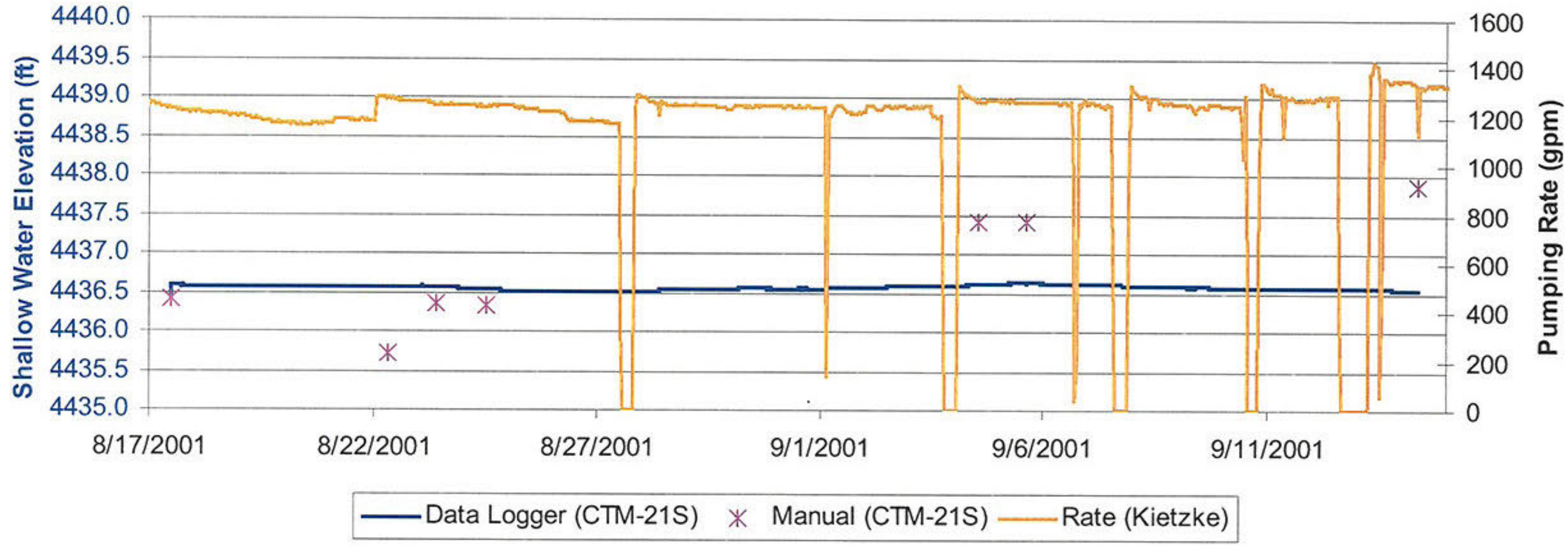
Figure 3-14
Groundwater Vertical Gradient
Central Truckee Meadows Remediation District



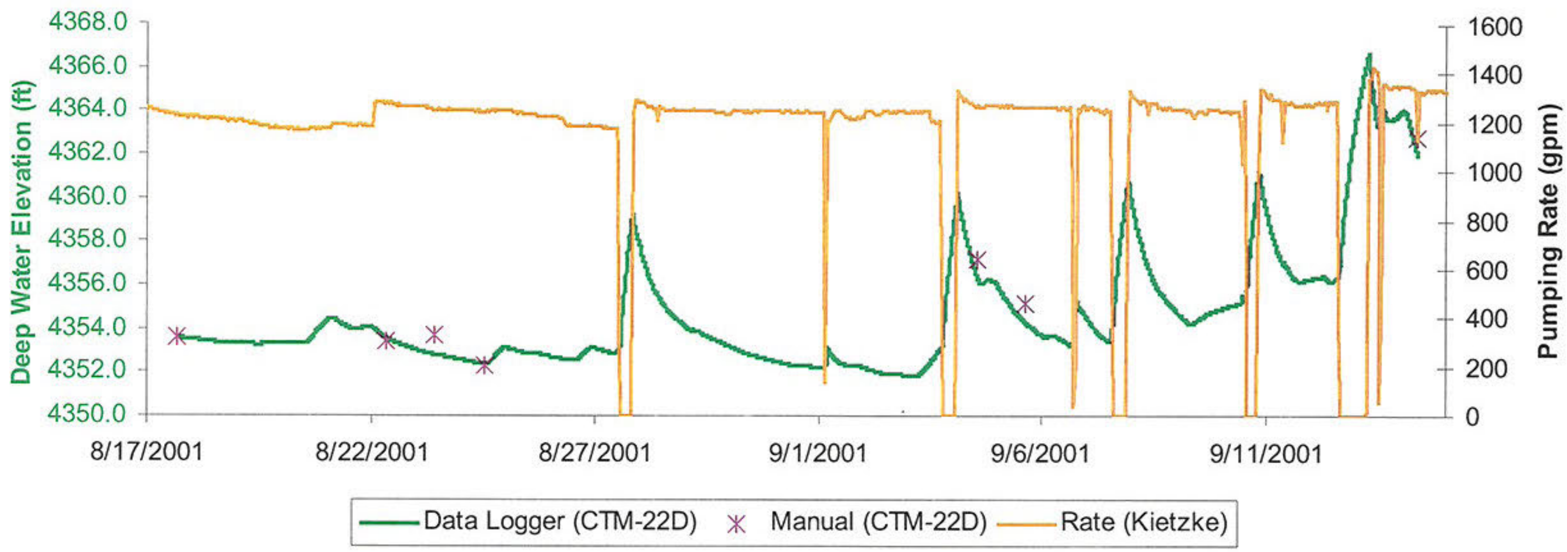
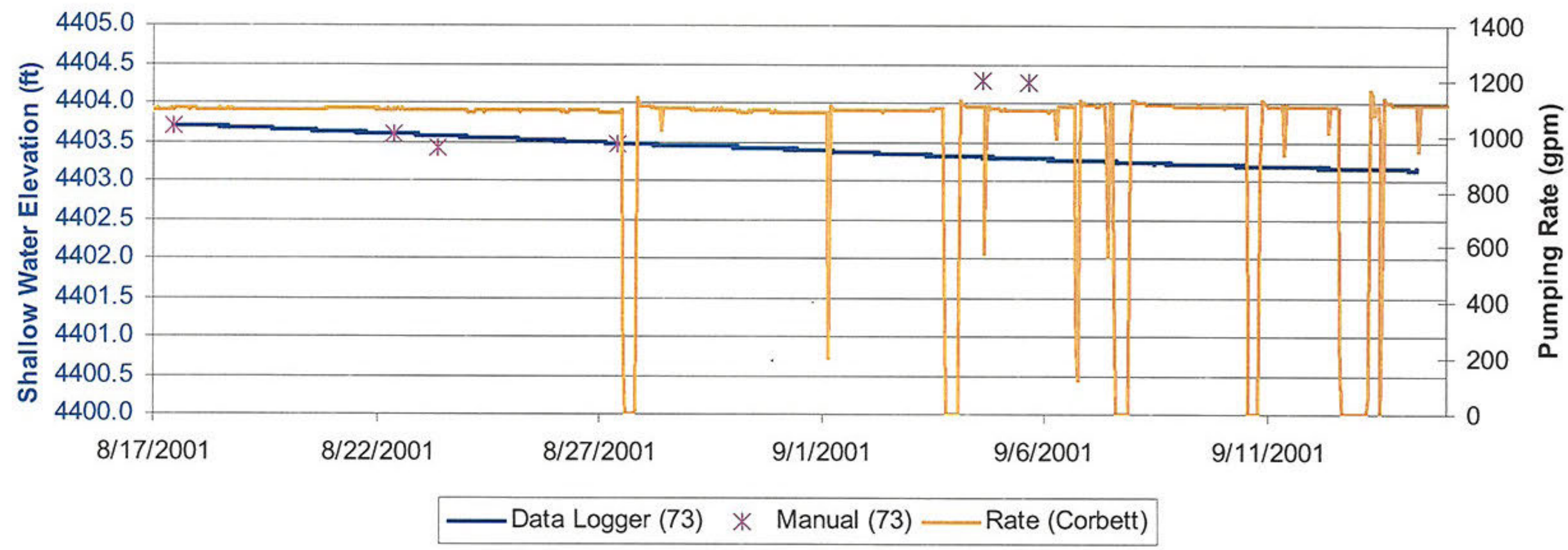


Figure 3-15
Data Logger Results Near Kietzke Well
Aquifer Pumping Test

CDM



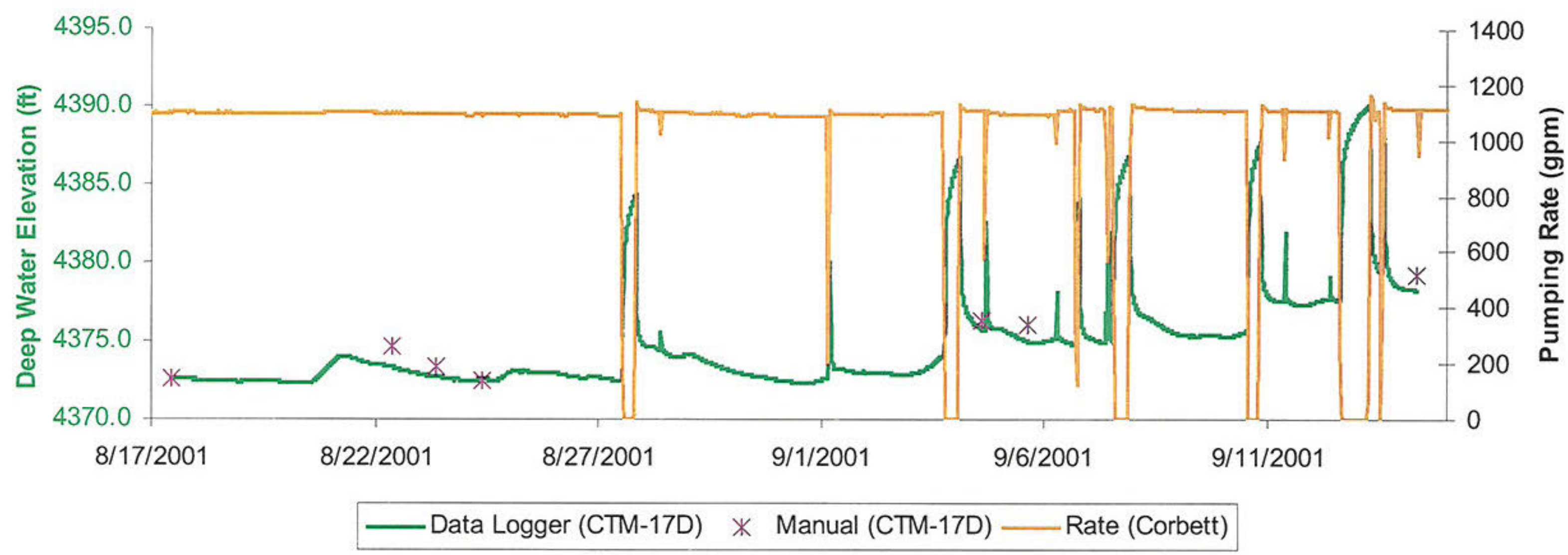
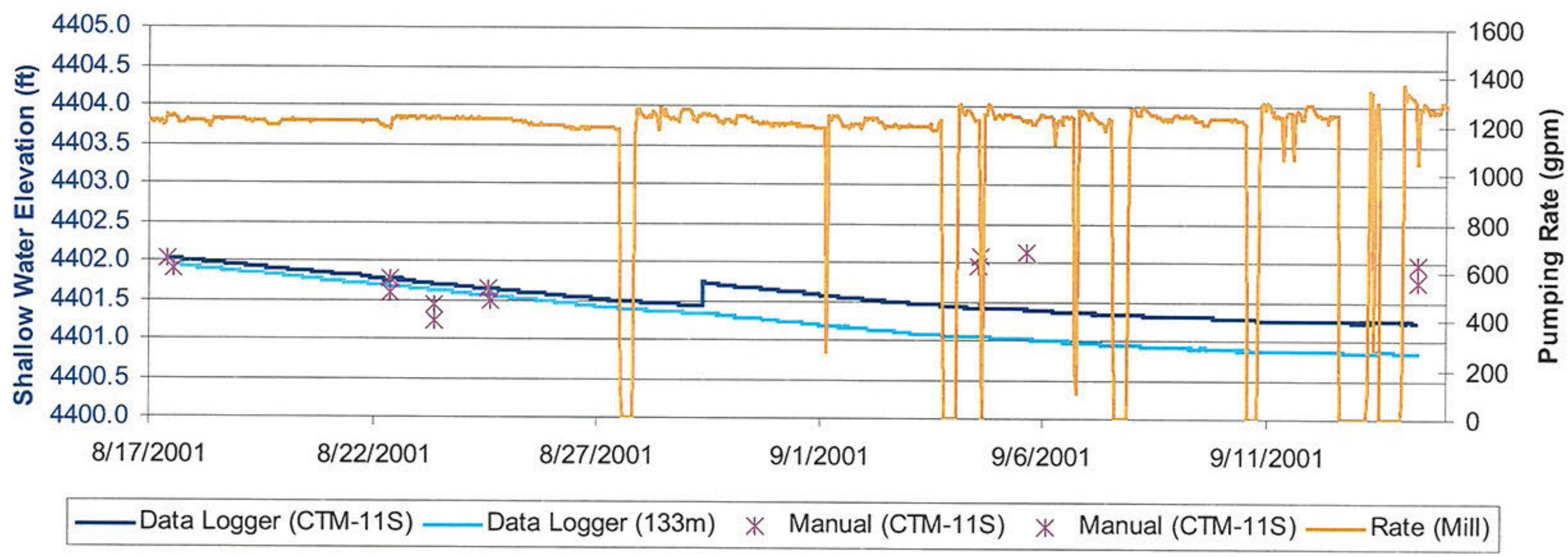
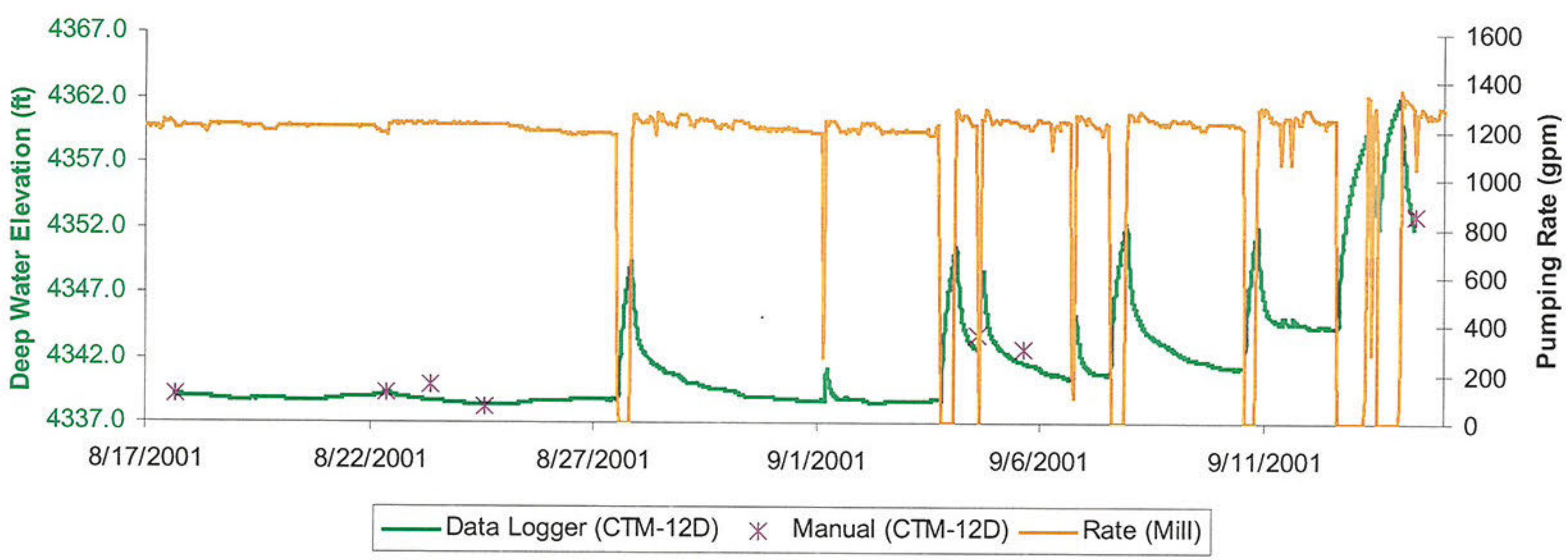


Figure 3-16
Data Logger Results Near Corbett Well
Aquifer Pumping Test

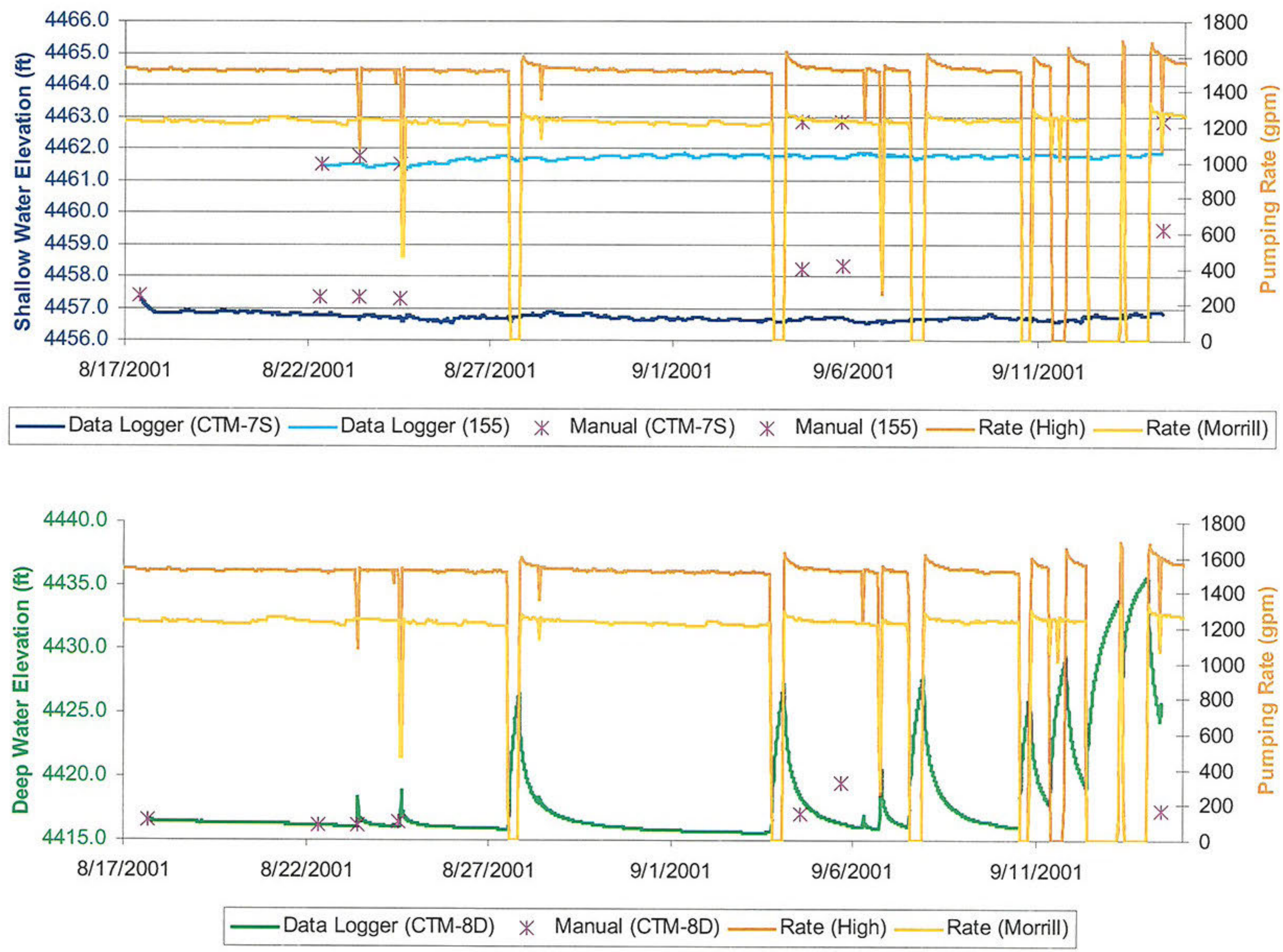
CDM





CDM

Figure 3-17
Data Logger Results Near Mill Well
Aquifer Pumping Test



CDM

Figure 3-18
Data Logger Results Near High and Morrill Wells
Aquifer Pumping Test

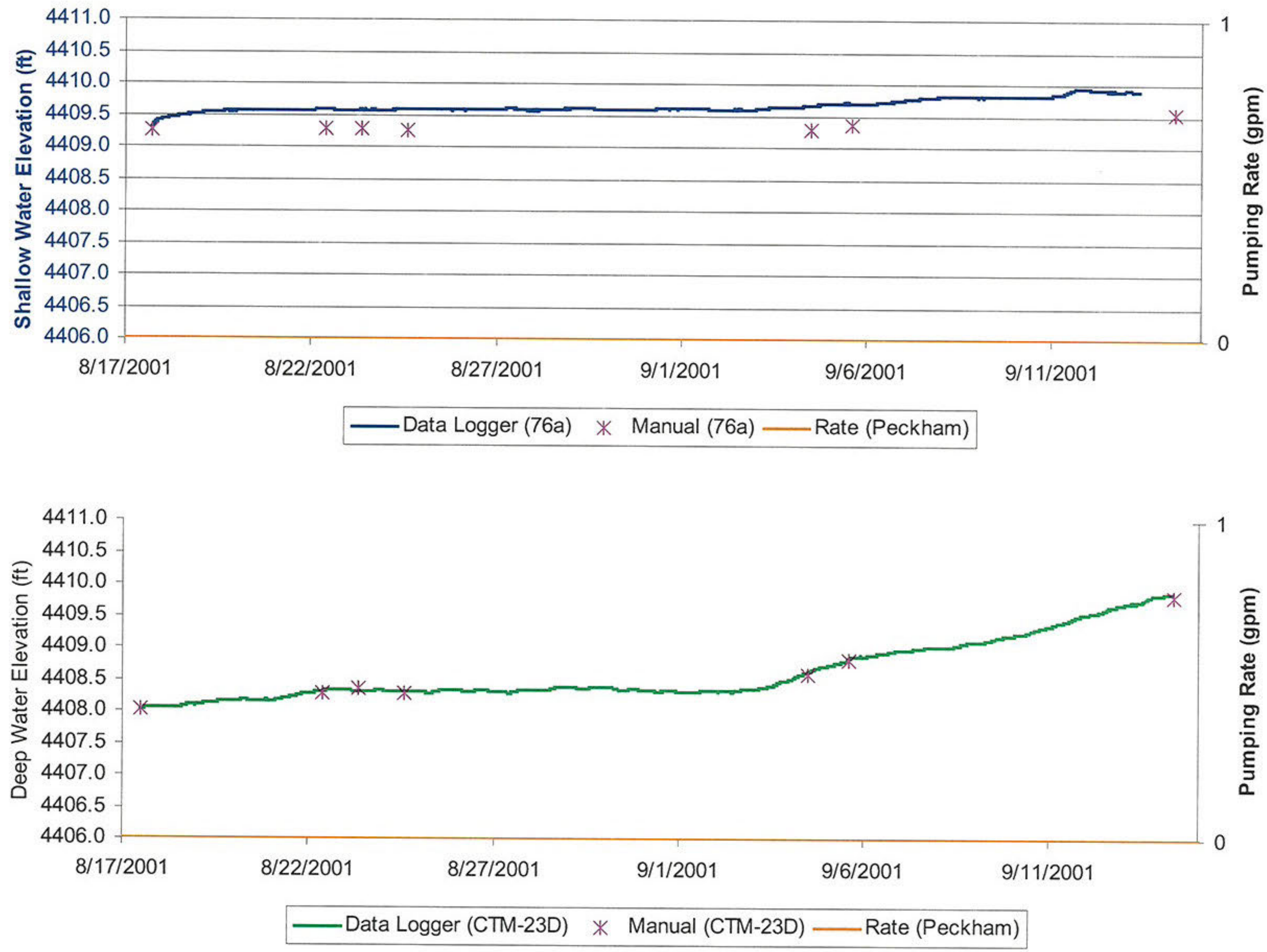


Figure 3-19
Data Logger Results Near Peckham Well
Aquifer Pumping Test

Section 4
Conclusions

The primary objectives of the field investigation program were to delineate the lateral and vertical extent of PCE contamination and to achieve a more refined understanding of geologic, hydrogeologic, hydrologic characteristics within the CTM study area. Data generated during the field investigation effort have provided information critical for the analysis of risk to human health and the environment and in the development of the groundwater flow model. The discussion presented in this section highlights the primary findings derived from the results of the field investigation program. The results of the field investigation highlighted a number of gaps in our understanding of conditions with the CTM. These data gaps are discussed in terms of the ongoing detailed planning and implementation of remedial actions within the CTM.

4.1 General Findings

The environmental sampling programs presented and discussed in this Technical Memorandum can be summarized as follows:

- The understanding of the extent of PCE contamination in the shallow and the deep aquifer zones has been enhanced by data collected as part of the field program. PCE contamination is widespread throughout the study area and throughout the aquifer profile. The PCE detections occurred at generally low-levels; however, localized areas of high PCE concentrations have been identified.

- The zone of PCE contamination has been bounded by wells that are non-detect or below the MCL for PCE except for Area D (near the Mill Street TMWA water supply well) and in Other Areas at the southern end of the study area (CTM-23D detection).

- The discrete depth sampling results indicated the highest levels of PCE were found at depths ranging from 65 ft bgs to 200 ft bgs. For the shallow aquifer, the highest PCE detection in the newly installed wells was in Area A (130 μg/L in CTM-28S). For the deep aquifer, the highest PCE detections occurred in Area F (310 μg/L in CTM-23D) and in Area C (97 μg/L in CTM-8D).

- Two potential PCE "source" areas may have been identified based on the highest levels of PCE detections. The potential source areas are Area A, including CTM 28-S and existing wells 18b and 18c, and Area C, including the existing wells 133j, 133h, 133k, 133l (maximum PCE concentrations ranging from 216 to 1,108 μg/L).

- Other contaminants identified include fuel constituents, including benzene and MTBE.

- Lithologic or geophysical logs of the deep wells do not support the existence of a pervasive clay layer at approximately 100 feet bgs. These observations are based in large part on the continuous core produced during the sonic drilling procedures.

- Two conceptual models were developed for the Final Work Plan. One was a vertical migration pathway through the production well gravel pack. The other was vertical migration through low permeability zones. Based on the results of the discrete depth sampling, the vertical migration through the aquifer is the more likely scenario. However, it is important to note that a discrete low permeability zone separating a shallow water bearing zone from a deeper water bearing zone does not appear to be supported by the soil cores observed during drilling activities. The formation is interbedded poorly sorted gravelly sand and silt, sand, silty sand, silt, and clayey silt. There are some clay beds, but they are not thick or extensive enough to be considered a confining unit.

- Vertical hydraulic gradients in wells in the middle of the Truckee Meadows (south of the Truckee River and west of Highway 395) are positive or upward. Vertical gradients in well pairs to the south and east of the Airport and north of the Truckee River have a negative vertical gradient. Of note is the fact that all of the negative vertical gradients are associated with the well pairs with the shallower deep boring (180 feet bgs). Wells with positive vertical gradients have deep wells ranging from 157 to 350 feet bgs. In general, the deeper the well, the larger the vertical positive gradient.

- Additional data points installed during this field effort support the general groundwater flow direction from west to east. Flow trends appear to follow the pathway of the Truckee River and there are components of both northeasterly to southeasterly flow. Gradients are steeper to the west and flatten-out to the east. This is expected as groundwater flows from areas of mountain from recharge in the west into the Truckee Meadows basin to the east.

4.2 Data Gaps

This section highlights several areas requiring further investigation.

- The field investigation identified two areas within the CTM that may contain "sources" of PCE. Further investigation in these two areas may be required to better delineate potential source areas. In addition, further investigation is needed at the southern end of the study area to assess the high level of contamination identified in the vicinity of CTM-23D.

- Bound the extent of PCE contamination in Area D. The upgradient (westerly) extent of shallow PCE contamination has been defined. However, the extent of PCE contamination in the downgradient (easterly) and cross gradient (both north and south) direction was not established during this field effort.

- Sanitary sewer sampling performed by the Washoe County Department of Water Resources identified the presence of PCE in sewer pipelines. These may be serving as ongoing sources of PCE to the groundwater. Ongoing monitoring of these conditions is warranted.

Appendix A
Borehole Logs

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-1S

Client: Washoe County Dept. of Water Resources

Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Drilling Contractor: Boart Longyear

Drilling Method/Rig: Sonic/Roto-Sonic 150

Drillers: Nathan Jackson

Drilling Date: Start: 3/27/01 **End:** 3/27/01

Borehole Coordinates:

N 14,865,566.72 E 2,273,657.22

Development Date: Start 3/29/01 **End** 3/29/01

Casing Elevation (ft.): 4538.78

Total Depth (ft.): 52

Depth to Initial Water Level (ft. BGS): 37

Development Method: Pumping

Field Screening Instrument: PID

Logged By: D. Dragan

Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
							Protective Casing
						4538.8 / 0	*Ground Surface*; Morrison Flush-Mount Traffic Vault, 12-inch diam.
			FILL	Surface: Asphalt **FILL:** Rock and Soil.			
SO		0.0				4533.8 / 5	Cement Seal. (4533.8 / 5.0)
			GM	**SILTY GRAVEL:** Sand-Silt Mixture, Brown, Dry.			
SG/SO	CTM-SG-MW1S-10A-032701	0.0				4528.8 / 10	Sch. 40 PVC, 2-inch diam. Blank Casing (4528.8 / 10.0)
			SM	**SILTY SAND:** Sand-Silt Mixture, Brown, Dry.			
SO		0.0				4523.8 / 15	
			SM	**SILTY SAND:** Sand-Silt Mixture, Brown, Moist, Stiff.			
						4518.8	Bentonite Pellets (4519.8 / 19.0)

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-1S

Client: Washoe County Dept. of Water Resources

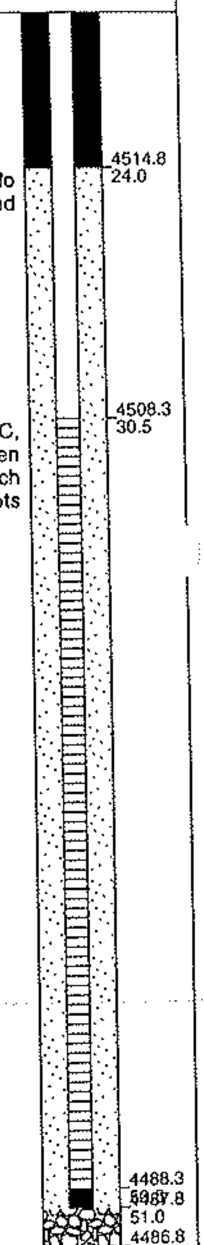
Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
SO		0.0	GM	**COBBLES and GRAVELS:** Light Gray, Silt Matrix, Dry.	4518.8 20
SO	CTM-SO-MW1S-22-032701		SW	**GRAVELLY SAND:** Medium to Coarse Grained, Unconsolidated Sand, 5-10% Small Rounded Cobbles, Dry, Brown, Loose.	4513.8 25
SO		1.0			4508.8 30
					4503.8 35
SO		0.0			
GW	CTM-GW-MW1S-37-032701		GM	**BOULDERS and COBBLES:** Silty Matrix, Pulverized Rock Cuttings.	4498.8 40
SS	CTM-SO-MW1S-40-032701	0.0	SW	**SAND:** Decomposed Granite, Unconsolidated, 5-10% Rounded Cobbles.	
			GP	**COBBLEY SAND:** Rounded Cobbles with Very Coarse Grained Sand Matrix.	4493.8 45
SO	CTM-SO-MW1S-45-032701	0.0			
			GM	**COBBLES and BOULDERS:** Less Rounded than Above, Angular Rock Fragments, Sandy Silt Matrix, Pink/Reddish.	4488.8 50
SO		<1.0	GP	**COBBLES:** Rounded with Very Coarse Grained Sand Matrix.	
					4483.8 55
					4478.8

Well Construction Detail



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

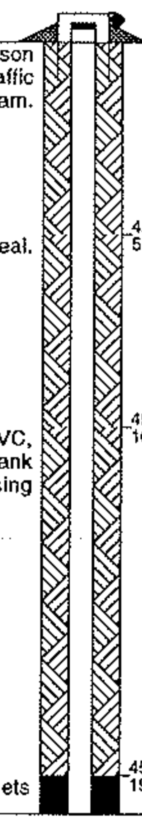
MONITORING WELL DETAIL
CTM-2S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/29/01 **End:** 3/29/01
Borehole Coordinates:
N 14,863,908.59 E 2,274,253.41
Development Date: Start 3/30/01 **End** 3/30/01

Casing Elevation (ft.): 4527.31
Total Depth (ft.): 52.5
Depth to Initial Water Level (ft. BGS): 27
Development Method: Pumping
Field Screening Instrument: PID
Logged By: D. Dragan
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
							Protective Casing
						4527.3	*Ground Surface*
			FILL	Surface: Asphalt **FILL**		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
SO		0.0	GP	**GRAVEL and COBBLES:** Poorly Graded Rounded Gravels, Cobbles, and Boulders with Sand Matrix.		4522.3 / 5	Cement Seal. 4522.3 / 5.0
SG/SO SO	CTM-SG-MW2S-10A-032901 CTM-SO-MW2S-10-032901	0.0				4517.3 / 10	Sch. 40 PVC, 2-inch diam. Blank Casing. 4517.3 / 10.0
SG/SO	CTM-SG-MW2S-15A-032901	0.0				4512.3 / 15	
			SM	**SILTY SAND:** Medium to Coarse Grained, Dark Brown with Tan Yellow Speckled Grains, Moist.			
			GP	**GRAVEL and COBBLES:** Poorly		4507.3	Bentonite Pellets 4508.3 / 19.0



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-2S

Client: Washoe County Dept. of Water Resources

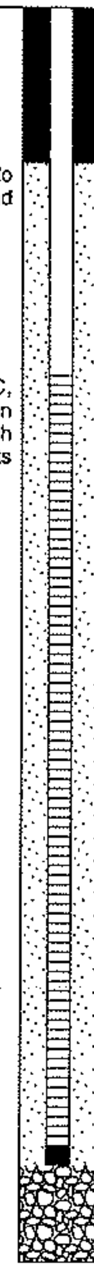
Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
					4507.3
SG/SO	CTM-SG-MW2S-20A-032901	1.0	GP	Graded Rounded Gravels, Cobbles, and Boulders with Sand Matrix.	20
SO		6.0			4502.3 25
			GP-GM	**GRAVEL and COBBLES:** Poorly Graded Rounded Gravels, Cobbles, and Boulders, Reddish Brown Sandy Silt Matrix, Wet, Appears to be a Weathered Zone at the Groundwater Interface.	
SO		4.0			4497.3 30
SO		3.0	GM-GC	**GRAVEL and COBBLES:** Poorly Graded Rounded Gravels, Cobbles, and Boulders, Brown Clayey Silt Matrix, Streaks of Iron Staining, Wet, Decreasing Boulders with Depth.	4492.3 35
SO		2.0			4487.3 40
GW	CTM-GW-MW2S-42-032901				
SO	CTM-SO-MW2S-42.5-032901				
SS	CTM-SO-MW2S-43-032901				
SO		0.0	GP	Increasing Gravel with Depth, Sand Matrix.	4482.3 45
SO		0.0			4477.3 50
					4472.3 55
					4467.3

Well Construction Detail



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/6/01

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-3S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/27/01 **End:** 3/28/01
Borehole Coordinates:
N 14,866,922.53 E 2,276,496.03
Development Date: Start 4/2/01 **End** 4/2/01

Casing Elevation (ft.): 4515.00
Total Depth (ft.): 50
Depth to Initial Water Level (ft. BGS): 37
Development Method: Pumping
Field Screening Instrument: PID
Logged By: D. Dragan
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
							Protective Casing
						4515.0	*Ground Surface*
			FILL	Surface: Asphalt **FILL:** Silty topsoil.		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
						4510.0 5	Cement Seal. 4510.0 5.0
			SP	**SAND:** Poorly graded sand with 5-10% rounded gravels. Coarse grained, brown, dry.			
SG/SO	CTM-SG-MW3S-10A-032701	0.0				4505.0 10	Sch. 40 PVC, 2-inch diam. Blank Casing 4505.0 10.0
SO	CTM-SO-MW3S-12.5-032701						
SO		2.0				4500.0 15	
			GM-SM	**SILTY SAND:** Silty sand with gravel and cobbles. Turning from brown to gray with depth. Dry.			
						4495.0	4495.0

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

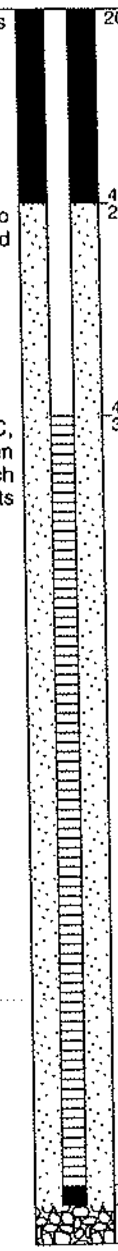
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-3S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
					4495.0
SO		3.0	GM-SM	**SILTY SAND:** Increasing cobbles and boulders, rock cores, pulverized rock with depth. Turning light tan with depth. Dry.	20
					4490.0 25
SO		2.0			
			GM	**COBBLES and BOULDERS:** Large rounded cobbles and boulders with silty sand matrix.	
					4485.0 30
SO		8.1			
					4480.0 35
SO		9.0			
SO	CTM-SO-MW3S-36.5-032701	11.0			
					4475.0 40
			GM	**COBBLES and BOULDERS:** Large rounded cobbles and boulders with silty sand matrix. Wet cuttings. Strong smell of oil and dark black specs in cuttings.	
GW	CTM-SO-MW3S-42.5-032701				
GW	CTM-GW-MW3S-44-032701		GM	**COBBLES and BOULDERS:** Large rounded cobbles and boulders with silty sand matrix. Wet cuttings. Visible oil on cuttings. Heavy creosote smell.	4470.0 45
SO		4.0			
SO	CTM-SO-MW3S-49-032801		CL	**SILTY CLAY:** Brown, stiff clay. 3/28/01 drill pipe came out with 1 to 1-1/2 ft oil sludge on pipe. Stop drilling to avoid drilling through a low permeable zone.	4465.0 50
SO		0.0			
					4460.0 55
					4455.0

Well Construction Detail



Bentonite Pellets — 20.0; 4490.0 / 25.0
10x20 Colorado Silica Sand
Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots — 4484.5 / 30.5
4464.5 / 50.5; 4464.0 / 51.0; 4463.0 / 52.0

CTM MW CTM2001.GPJ CDM_CORP.GDT 9/6/01

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-4D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Phillip Cramer
Drilling Date: Start: 4/5/01 **End:** 4/9/01
Borehole Coordinates:
N 14,866,913.75 E 2,276,498.34
Development Date: Start 4/17/01 **End** 4/17/01

Casing Elevation (ft.): 4514.85
Total Depth (ft.): 181
Depth to Initial Water Level (ft. BGS): 37.1
Development Method: Pumping
Field Screening Instrument: PID
Logged By: J.Benedict/D. Dragon
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
							Protective Casing
						4514.9	Ground Surface
			SM	Surface: Asphalt **SILTY SAND:** Hand Augered. Light olive brown. Medium plasticity. Damp to dry. Low to soft stiffness. 65% sand, 5% gravel, 30% silt.		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
						4509.9	
SO		3.0	SM-MH	**SANDY SILT:** Dark Brown Silty Sand to Sandy Silt. Medium Plasticity, Damp, Medium to Low Strength, Low Stiffness. 45% Sand, 5% Gravel (Rounded), 50% Silt.		5	Cement Seal. 4509.9 5.0
			BOULDER	**BOULDER**			
			SW	**SAND:** Tan Brown to Brown, Coarse Grained Sand, 70% Sand, 20% Fine Gravel, 5% Gravel, 5% Fine Grained Sand-Silt, Loose, Dry To Damp.			
						4504.9	
SO		1.0				10	Sch. 80 PVC, 2-inch diam. Blank Casing 4504.9 10.0
						4499.9	
SO		0.0				15	
			SP	**SAND:** Tan Brown, Coarse Grained Sand with Gravel, Loose, Dry to Damp.			
			GP	**GRAVEL and COBBLES:** Tan Brown to Yellow Brown, Rounded Cobbles and Gravel, Loose, Dry to Damp, 30%		4494.9	4494.9

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- HA - Hand Auger
- AR - Air Rotary
- DTR - Dual Tube Rotary
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- MR - Mud Rotary
- RC - Reverse Circulation
- CT - Cable Tool
- JET - Jetting
- D - Driving
- DTC - Drill Through Casing

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- SO - Soil from Core
- GW - Groundwater Sample
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-4D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)	Well Construction Detail
					4494.9	
SO		0.0	GP	Cobbles, 40% Gravel, >25% Sand, <5% Silt.	20	Volclay Grout Seal. 20.0
			SP	**GRAVELLY SAND:** Ochre Brown, Coarse Grained Sand to Gravelly Sand, Loose, Dry. Orange Iron Staining.		
SI					4489.9	
SO		0.0	GP	**SANDY GRAVEL:** Ochre Brown, Some Cobbles, Loose, Dry. Iron Staining. 30% Rounded Gravel, 35% Rounded Cobbles and Boulders, 30% Sand, <5% Fines.	25	
			GP	**BOULDER:** Light Gray, Boulder Zone, Aphanitic Basaltic Boulders, Loose, Dry.	4484.9	
SO		0.0			30	
			GP	**GRAVEL and BOULDER:** Dark Grayish Brown, Gravelly Boulder Zone, Very Loose, Boulders are Predominantly Composed of Aphanitic Basalt, Core Recovery Low - pushing boulders.	4479.9	
SO		1.0	GP	**GRAVEL and BOULDER:** Dark Grayish Brown, Gravelly Boulder Zone, Very Loose, Boulders are Predominantly Composed of Aphanitic Basalt, Core Recovery Low - pushing boulders. 35 feet - Oil Staining. Wet at 36 feet.	35	
GW	CTM-GW-MW4D-39-040601				4474.9	
SO	CTM-SL-MW4D-40-040601	22			40	
			SM	**SILTY SAND:** Damp, Hard, Low Plasticity, Fine Grained Sand, Yellowish Brown. 60% Silt, 40% Fine Sand. From 42 to 44 feet, 20% Coarse Sand, Grading to Fine Sand with Depth.	4469.9	
SO		0.0			45	
					4464.9	
SO		0.0			50	
			GM	**SILTY SANDY GRAVEL:** Oil Sheen on Cuttings, Light Gray, Coarse Gravel, Coarse Grained Sand, 50% Gravel, 40% Sand, 10% Silt, Wet, Loose.	4459.9	
SO	CTM-SL-MW4D-55-040601	11	ML	**SANDY CLAYEY SILT:** Hard, Damp, No Oil Staining, Light Yellowish Brown, 30% Sand, 40% Silt, 30% Clay.	55	
GW	CTM-GW-MW4D-57-040601		SM	**SILTY SAND:** Medium Grained Sand with Silt, Loose, Wet, Gray Brown with Red Brown Streaks, Well Sorted, 70% Sand, 35% Silt.	4454.9	

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-4D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)	Well Construction Detail
					4454.9	
SO		4.0	SM		60	
			GM	**GRAVEL, SAND, and SILT:** Medium Dense, Ribbons of Moderate Plasticity, Wet, Subrounded Gravel, Medium to Coarse Grained Sand, Yellowish Brown.		
SO		0.0			4449.9 65	
			GM	**GRAVELLY SAND:** Medium Dense, Ribbons of Moderate Plasticity, Wet, Subrounded Gravel, Medium to Coarse Grained Sand, Yellowish Brown.		
SO		0.0	ML	**SILT:** Silt with Fine Grained Sand, Light Gray to Brown, Damp, Firm, Moderate Plasticity, 50% Sand, 50% Silt.	4444.9 70	
			GW	**SANDY GRAVEL:** Loose, Wet Coarse Grained Sand, Fine Grained Subrounded Gravel, Poorly Sorted, Light Red Brown.		
SO		0.0			4439.9 75	
GW	CTM-GW-MW4D-77-040601					
						Centralizer 4435.9 79.0 4435.4 79.5
SO		0.0			4434.9 80	
			ML	**SILT:** Silt with Fine Grained Sand, Light Gray to Brown, Damp, Firm, Moderate Plasticity, 50% Sand, 50% Silt.		
			GW	**SANDY GRAVEL:** Loose, Wet, Coarse Grained Sand, Subrounded Gravel, Poorly Sorted, Light Red Brown.		
SO		0.0			4429.9 85	
			SM	**SILTY SAND:** Fine Grained Sand, Dry, Hard, Low Plasticity, Yellowish Brown, 50% Sand, 50% Silt.		
SO		0.0			4424.9 90	
GW	CTM-GW-MW4D-92-040601		MH	**DIATOMACEOUS:** Damp, Firm, White.		
SO		0.0			4419.9 95	
			SM-SP	**SILTY GRAVELLY SAND:** Wet, Loose, Coarse Grained Sand, Dark Gray Brown, 40% Gravel, 50% Sand, 10% Silt.		4415.9 99.0 4415.4
					4414.9	

CTM MW CTM2001.GPJ CDM_CORP.GDT 9/6/01

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-4D

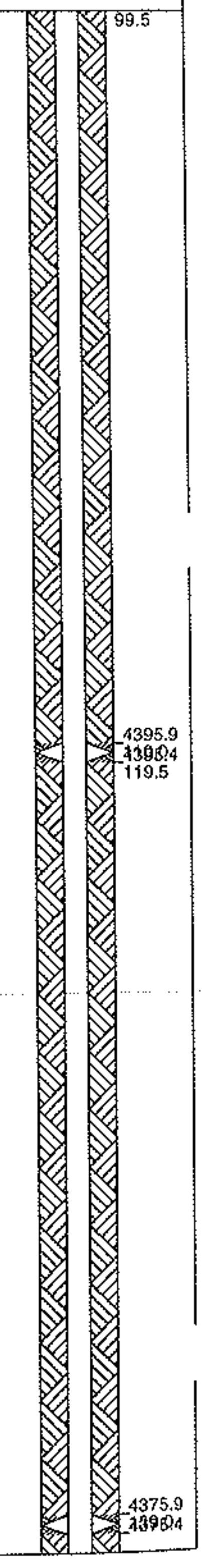
Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)
SO		0.0
SO		0.0
SO		0.0
GW	CTM-GW-MW4D-113-040601	
SO		1.0
SO		1.0
SO		2.0
SO		4.0
SO		3.0
GW	CTM-GW-MW4D-137-040601	

Stratum Designation	Material Description
SM-SP	
SW	**SAND:** Medium Grained Sand, Dark Gray Brown.
SM-SP	**SILTY GRAVELLY SAND:** Wet, Loose, Coarse Grained Sand, Dark Gray Brown, 40% Gravel, 50% Sand, 10% Silt.
SM	**SILTY CLAYEY SAND:** Fine Grained Sand, 40% Sand, 40% Silt, 20% Clay, Damp, Hard, Moderately Plastic, Yellowish Orange.
GM	**SILTY SANDY GRAVEL:** Wet, Loose, Coarse Grained Sand, Yellowish Light Brown, 50% Gravel, 30% Sand, 20% Silt.
SM	**SILTY SAND with CLAY:** Stiff, Damp, Light Brown with Yellow Orange Streaks, Low to Moderate Plasticity, 50% Fine Grained Sand, 30% Silt, 20% Clay.
SP	**SAND:** Fine Grained, Well Sorted, Little or No Fines, Rusty Dark Red with Light Brown Streaks Grading to Gray Brown with Depth, Loose, Damp, 80 to 90% Sand, 10% Silt.
GM	**SILTY SANDY GRAVEL:** Damp,

Elev.	Depth (ft.)
4414.9	100
4409.9	105
4404.9	110
4399.9	115
4394.9	120
4389.9	125
4384.9	130
4379.9	135
4374.9	

Well Construction Detail



CAMP DRESSER & McKEE

CDM

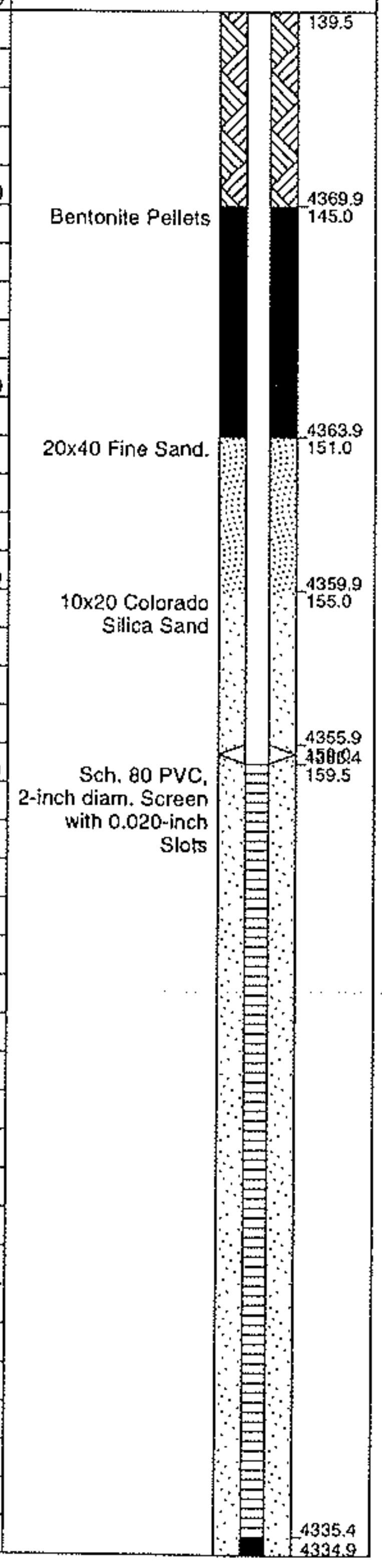
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-4D

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4374.9
SO	CTM-SL-MW4D-140-040601	11	GM	Loose, Medium Grained Sand, Brownish Gray, 40% Gravel, 40% Sand, 20% Silt.	140
SO		9.0			4369.9 / 145
			SM	**SILTY SAND:** Firm, Damp, Light Gray Brown, Moderate Plasticity, 50% Fine Grained Sand, 50% Silt.	4364.9 / 150
			GP	**SANDY GRAVEL:** Dry, Coarse to Medium Grained, Subrounded, Loose, Gray, 40% Sand, 60% Gravel.	4359.9 / 155
GW	CTM-GW-MW4D-157-040601		GP	**SANDY GRAVEL:** Wet, Coarse Grained, Loose, Brown, Rounded, Cobbles to 2-inch Diam., Increasing with Depth.	4354.9 / 160
SO		20			4349.9 / 165
SS	CTM-SO-MW4D-167-040901				
SO	CTM-SO-MW4D-168-040901		GM	**SILTY SANDY GRAVEL:** Moist, Brown, Medium Stiff, Rounded.	
SO		7.0			4344.9 / 170
			GP	**SANDY GRAVEL:** Dry, Gray, Rounded, Coarse Grained, Cobbles.	
SO		0.0			4339.9 / 175
					4334.9

Well Construction Detail



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-4D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
						4334.9	
SO/GW	CTM-GW-MW4D-180-040901	2.0	GP			180	179.5 [illegible] 181.0
						4329.9 / 185	
						4324.9 / 190	
						4319.9 / 195	
						4314.9 / 200	
						4309.9 / 205	
						4304.9 / 210	
						4299.9 / 215	
						4294.9	

CTM MW CTM2001.GPJ CDM_CORP.GDT 9/6/01

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-5S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/28/01 **End:** 3/28/01
Borehole Coordinates:
N 14,866,774.11 E 2,275,631.44
Development Date: Start 4/2/01 **End** 4/2/01

Casing Elevation (ft.): 4525.84
Total Depth (ft.): 62
Depth to Initial Water Level (ft. BGS): 47
Development Method: Pumping
Field Screening Instrument: PID
Logged By: D. Dragon
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
							Protective Casing
						4525.8	*Ground Surface*
			SM	Surface: Asphalt FILL: Brown Sandy Silty Topsoil.		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
SO		0.0				4520.8 / 5	Cement Seal. 4520.8 / 5.0
			SM	SILTY SAND: Brown, Fine Grained Silty Sand.			
SG/SO	CTM-SG-MW5S-10A-032801	0.0				4515.8 / 10	Sch. 40 PVC, 2-inch diam. Blank Casing 4515.8 / 10.0
SO		0.0				4510.8 / 15	
			GM	SILTY SANDY GRAVEL: Rounded Cobbles and Gravels with Brown Silty Sand Matrix, Dry, Unconsolidated.		4505.8	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-5S

Client: Washoe County Dept. of Water Resources

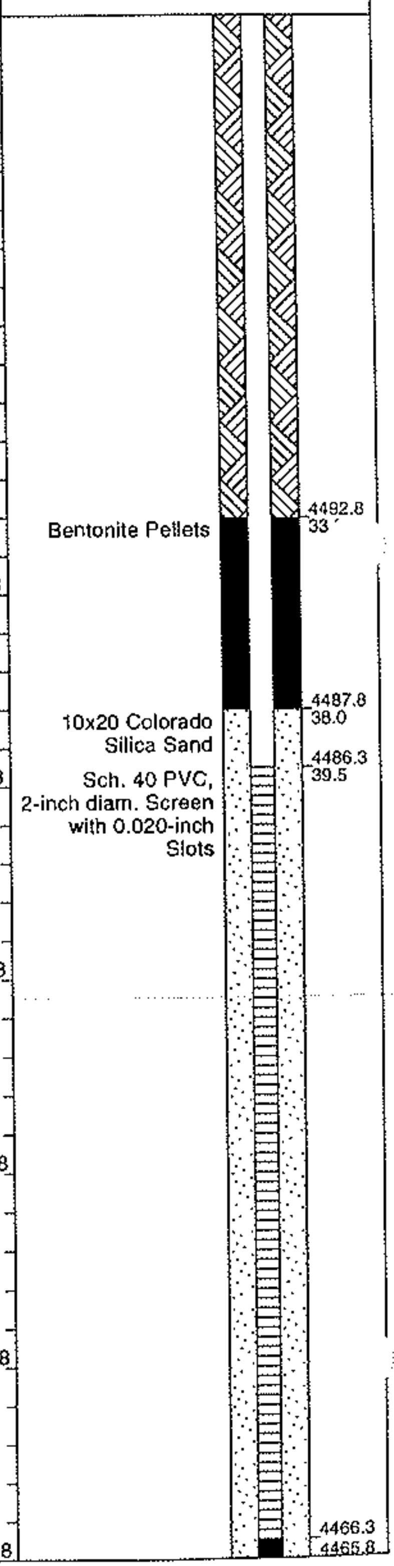
Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4505.8
SO	CTM-SO-MW5S-20-032801	3.0	GM		20
					4500.8
SO		0.0	GM	**SILTY SANDY GRAVEL:** Rounded Cobbles and Gravels with Brown Silty Sand Matrix, Dry, Unconsolidated, Increasing Cobble and Boulder Size with Depth, Rock Cores, pulverized rock samples, slow drilling.	25
					4495.8
SO		0.0			30
					4490.8
SO		0.0	ML	**SANDY SILT:** Brown, Stiff.	35
			BOULDER	**BOULDER**	
					4485.8
			GP	**GRAVEL:** Rounded Cobbles, Gravel, and Boulders. Sand Matrix.	40
					4480.8
SO		0.0			45
GW	CTM-GW-MW5S-47-032801				
					4475.8
SO		0.0			50
SS	CTM-SO-MW5S-52-032801				
			ML	**SANDY SILT:** Brown, Stiff, Minor Clay.	
					4470.8
SO	CTM-SO-MW5S-55-032801	0.0			55
			GP	**GRAVEL:** Rounded Cobbles, Gravel, and Boulders. Sand Matrix.	
					4465.8

Well Construction Detail



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-5S

Client: Washoe County Dept. of Water Resources

Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
						4465.8	
SO		0.0	GP			60	59.5 / 60.0
			SM	**SILTY SAND:** Tan, Fine to Medium Grained Sand.			4463.8 / 62.0
						4460.8 / 65	
						4455.8 / 70	
						4450.8 / 75	
						4445.8 / 80	
						4440.8 / 85	
						4435.8 / 90	
						4430.8 / 95	
						4425.8	

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

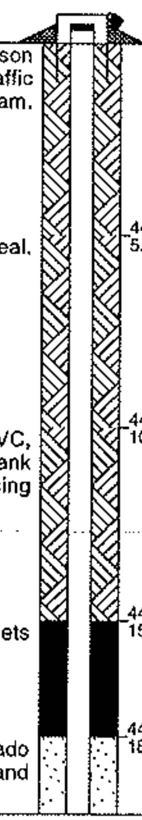
MONITORING WELL DETAIL
CTM-6S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/20/01 **End:** 3/20/01
Borehole Coordinates:
N 14,866,906.43 E 2,279,451.30
Development Date: Start 3/29/01 **End** 3/29/01

Casing Elevation (ft.): 4493.43
Total Depth (ft.): 44
Depth to Initial Water Level (ft. BGS): 28
Development Method: Pumping
Field Screening Instrument: PID
Logged By: J. Benedict
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)	Well Construction Detail
						Protective Casing
					4493.4	*Ground Surface*
			GW	Surface: Asphalt **SANDY GRAVEL:** Hand Augered to Six Feet, Gravel-Sand-Cobble Mix, Loose, Tan Gray, Rounded Cobbles and Gravel, Dry.	0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
SO		2.0			4488.4 5	Cement Seal. (4488.4 / 5.0)
			GW	**SANDY GRAVEL:** Tan Brown, Loose, Cobble-Gravel-Sand Mix, <5% Silt Component, 30% Cobbles, 45% Gravel, 20-25% Sand, Dry (Damp at 16 feet).		
SO/SG	CTM-SG-MW6S-10A-032001	2.0			4483.4 10	Sch. 40 PVC, 2-inch diam. Blank Casing (4483.4 / 10.0)
SO		3.0			4478.4 15	Bentonite Pellets (4478.4 / 15.0)
SO	CTM-SL-MW6S-16-032001					
			GW	**SANDY GRAVEL:** Whitish Tan, Loose, Cobble-Gravel-Sand Mix, Weathered Cobbles, Damp.		10x20 Colorado Silica Sand (4475.4 / 18.0)
			GW	**SANDY GRAVEL:** Dark Brown, Loose,	4473.4	



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- HA - Hand Auger
- AR - Air Rotary
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- MR - Mud Rotary
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- CT - Cable Tool
- JET - Jetting
- D - Driving
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SAMPLING TYPES:
- SG - Soil Gas
- SO - Soil from Core
- GW - Groundwater Sample
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: Date:

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-6S

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4473.4
SO		5.0	GW	Damp, Cobble-Gravel-Sand Mix, 5% Silt Matrix, Iron Staining.	20
			GM	**SILTY GRAVEL:** Poorly Sorted Gravel in Silty Matrix, Trace Clay, Ochre Brown with Iron Staining, Damp, Medium Stiff, Low Plasticity. Grades to Silty Sand at 23 feet where it is a Consolidated Core. Fine portions are Damp.	
			GW	**SANDY GRAVEL:** Ochre Brown Gravelly Sandstone grading to a Tan Brown Gravel with Depth (60% Gravel, 40% Fine Sand), Loose, Unconsolidated.	
SO		2.0			4468.4 / 25
			SM	**SILTY SAND:** Brown, Damp, Loose to Weakly Consolidated, Low Plasticity, Low Strength, Wet at 30 feet.	
SO		1.0			4463.4 / 30
			GM	**SILTY SANDY GRAVEL:** Poorly Sorted Gravel with Silt-Sand Matrix, Loose, Damp, Brown to Dark Brown, Matrix has Very Low Plasticity.	
			SM	**SILTY SAND:** Sand with 5% Gravels, Loose, Wet.	
SO/GW	CTM-GW-MW6S-35-032001	1.0			4458.4 / 35
SS	CTM-SL-MW6S-37-032001				
SO	CTM-SL-MW6S-37.5-032001		SM	**GRAVELLY SILTY SAND:** Brown Gravelly Sandstone with intermittent Silty Lenses that are slightly more Consolidated (poorly graded sand with gravel). Ochre and Reddish Iron Staining associated with Finer Grained Matrix.	
SO		1.0			4453.4 / 40
SO		2.0			4448.4 / 45
					4443.4 / 50
					4438.4 / 55
					4433.4

Well Construction Detail

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-7S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/8/01 **End:** 3/8/01
Borehole Coordinates:
N 14,865,655.28 E 2,280,296.09
Development Date: Start 3/27/01 **End** 3/27/01

Casing Elevation (ft.): 4483.53
Total Depth (ft.): 41
Depth to Initial Water Level (ft. BGS): 29.5
Development Method: Pumping
Field Screening Instrument: PID
Logged By: B. Richmond
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
						Protective Casing
					4483.5	*Ground Surface*
			SM	Surface: Gravel	0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
				GRAVELLY SILTY SAND: Backfill Material along River Bank. Mix of Gravel and Sand with High Organics. 30% Silt, 50% Sand, 20% Gravel/Cobbles, Fine to Coarse Grained, Brown Tan, Rounded to Subrounded, Poorly Sorted, Dry to First Water at 17 feet.		
SO		1.0			4478.5 / 5	Cement Seal. 4478.5 / 5.0
SG/SO	CTM-SG-MW7S-10A-030801	4.0			4473.5 / 10	Sch. 40 PVC, 2-inch diam. Blank Casing 4473.5 / 10.0
						Bentonite Pellets 4471.0 / 12.5
SO		5.0			4468.5 / 15	
						10x20 Colorado Silica Sand 4467.5 / 16.0
SO	CTM-SL-MW7S-17-030801					
			SM	**SILTY SAND:** 40% Silt, 60% Sand,	4463.5	

EXPLANATION OF ABBREVIATIONS

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- HSA - Hollow Stem Auger
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SAMPLING TYPES:
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- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-7S

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)	Well Construction Detail
					4463.5	
SO		7.0	SM	Moist, Firm, Brownish Gray, Low Plasticity.	20	Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots; 4463.0 / 20.5
SS	CTM-SL-MW7S-23-030801		SM	**GRAVELLY SILTY SAND:** Mix of Gravel and Sand with High Organics. 30% Silt, 50% Sand, 20% Gravel/Cobbles, Fine to Coarse Grained, Brown Tan, Rounded to Subrounded, Poorly Sorted, Wet.		
SO		6.0			4458.5 / 25	
SO/GW	CTM-GW-MW7S-30-030801	5.0			4453.5 / 30	
			SM	**GRAVELLY SILTY SAND:** 30% Gravel, 40% Sand, 30% Silt, Wet, Brownish Red, Low Plasticity, Loose.		
SO		4.0			4448.5 / 35	
			SM	**SILTY SAND:** 60% Sand, 40% Silt, Damp, Brownish Red, Firm, Moderately Plastic.		
SO		4.0			4443.5 / 40	4443.0 / 4042.5 / 41.0
					4438.5 / 45	
					4433.5 / 50	
					4428.5 / 55	
					4423.5	

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

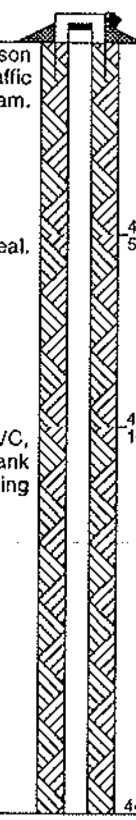
MONITORING WELL DETAIL
CTM-8D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/1/01 **End:** 3/6/01
Borehole Coordinates:
N 14,865,660.94 E 2,280,295.91
Development Date: Start 3/26/01 **End** 3/26/01

Casing Elevation (ft.): 4483.28
Total Depth (ft.): 261
Depth to Initial Water Level (ft. BGS): 17
Development Method: Pumping
Field Screening Instrument: PID
Logged By: K. Dierberger/B. Richmond
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
							Protective Casing
						4483.3	Ground Surface
			SM	Surface: Gravel **GRAVELLY SILTY SAND:** 30% Silt, 50% Sand, 20% Gravel and Cobbles, Fine to Very Coarse Grained, Dry, Brown, Organic Material (roots), Loose, Rounded to Subrounded, Poorly Sorted, No Organic Material Below 4 feet.		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
SO		3.0				4478.3 / 5	Cement Seal. 4478.3 / 5.0
SO		3.0				4473.3 / 10	Sch. 80 PVC, 2-inch diam. Blank Casing 4473.3 / 10.0
SO		3.0				4468.3 / 15	
SO	CTM-SL-MW8D-17-030101		SM	**GRAVELLY SILTY SAND:** 30% Silt, 50% Sand, 20% Gravel and Cobbles, Fine to Very Coarse Grained, Wet, Brown, Loose, Rounded to Subrounded,		4463.3	4463.3



EXPLANATION OF ABBREVIATIONS

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- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-8D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)	Well Construction Detail
					4463.3	
SO		3.0	SM	Poorly Sorted.	20	Volclay Grout Seal. 20.0
			SM	**SILTY SAND:** Loose, Wet, Poorly Sorted.		
			SM	**GRAVELLY SILTY SAND:** 30% Silt, 50% Sand, 20% Gravel and Cobbles, Fine to Very Coarse Grained, Wet, Brown, Loose, Rounded to Subrounded, Poorly Sorted.		
SO		1.0			4458.3 / 25	
GW	CTM-GW-MW8D-26-030201		GM	**SILTY SANDY GRAVEL:** 20-30% Silt, 20-30% Sand, 50% Gravel and Cobbles, Fine to Very Coarse Grained, Wet, Brown, Loose, Rounded to Subrounded, Poorly Sorted. 27.5 - 28 feet: Silt Stringer, Moist, Hard, Stiff, Moderately Plastic. 30 - 30.5 feet: Silt Stringer, as above.		
SO		3.0			4453.3 / 30	
SO		2.0	SM	**GRAVELLY SILTY SAND:** Stiff, Brown, Moderately Plastic, Damp, Fine to Very Coarse Grained, Poorly Sorted, 40-50% Silt, 40-50% Sand, 10-20% Gravel.	4448.3 / 35	
SO		2.0	CL	**CLAYEY SILT with SAND:** Stiff, Moderately Plasticity, Moist, Fine to Medium/Coarse Grained, Brown with some Gray Mottling.	4443.3 / 40	
			CL	**CLAYEY SILT with SAND:** Stiff, Plastic, Moist, Fine to Medium Grained, Brown with some Gray Mottling.		
SO		2.0			4438.3 / 45	
SO		2.0			4433.3 / 50	
GW	CTM-GW-MW8D-52-030201					
SO		1.0			4428.3 / 55	
					4423.3	

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-8D

Client: Washoe County Dept. of Water Resources

Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
					4423.3	
SO		2.0	SM	**GRAVELLY SILTY SAND:** 30-40% Silt, 30-40% Sand, Fine to Coarse Grained, Loose, Brown, Wet, Poorly Sorted, 20-30% Gravel, Rounded to Subrounded.	60	
SO		2.0			4418.3 / 65	
SO		2.0			4413.3 / 70	
			SM	**SILTY SAND:** 20-30% Silt, Fine to Medium Coarse Grained Sand, Loose, Wet, Dark Brown/Gray, Coarser Grained Sand with Depth.		
GW	CTM-GW-MW8D-74-030201					
SO		3.0			4408.3 / 75	
			ML	**SILT:** Stiff, Low Plasticity, Dry, Reddish Brown.		
SO		2.0			4403.3 / 80	
			SM	**SILTY SAND:** 20-30% Silt, Fine to Medium Coarse Grained Sand, Loose, Wet, Dark Brown/Gray.		
			ML	**SILT:** Stiff, Low Plasticity, Dry, Reddish Brown.		
SO		2.0			4398.3 / 85	
			SM	**SILTY SAND:** 20-30% Silt, Fine to Medium Coarse Grained Sand, Loose, Wet, Dark Brown/Gray.		
SO		2.0	CL	**CLAYEY SILT with SAND:** Stiff, Moderately Plasticity, Moist, Fine to Medium/Coarse Grained, Brown with some Gray Mottling.	4393.3 / 90	
			MH	**DIATOMACEOUS:** Silty Diatomaceous Earth, Grayish White, Damp, Loose, No Plasticity.		
SO		2.0			4388.3 / 95	
GW	CTM-GW-MW8D-96-030201		MH	**SILTY CLAY:** Plastic, 50% Silt, 50% Clay, Brown, Some Diatomaceous Mottling, Moist, Stiff.		
			SM	**SILTY SAND:** 20-30% Silt, Fine to	4383.3	

CTM MW CTM2001.GPJ CDM_CORP.GDT 9/6/01

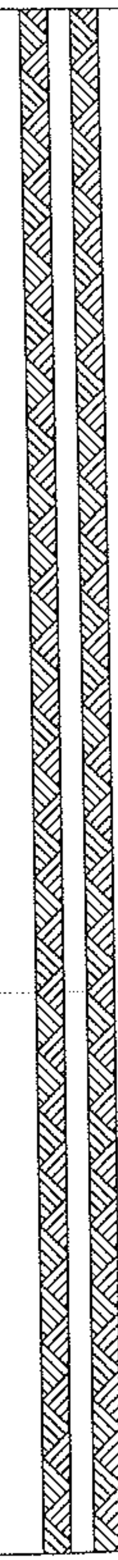
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-8D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		3.0	SM	Medium Coarse Grained Sand, Loose, Wet, Dark Brown/Gray.	4383.3 / 100
SO		3.0	CL	**SILTY CLAY:** Very Stiff, Plastic, Moist, Brown, Dense, Clay (50-70%), Silt (30-50%).	4378.3 / 105
SO		3.0	SM	**SILTY SAND:** 20-30% Silt, Fine to Medium Coarse Grained Sand, Loose, Wet, Dark Brown/Gray.	4373.3 / 110
SO		3.0			4368.3 / 115
GW/SO	CTM-GW-MW8D-120-030201	2.0	ML	**SANDY SILT:** Sand (20-30%), Fine to Medium Coarse Grained, Moist, Moderately Stiff, Low Plasticity, Brownish Gray.	4363.3 / 120
SO		2.0	ML	**SILT:** Sand (10%), Fine Grained, Stiff, Low Plasticity, Brownish Gray, Damp.	4358.3 / 125
SO		1.0	ML	**SANDY SILT:** Sand (20%), Gravel (10%), Fine Grained, Stiff, Low Plasticity, Brownish Gray, Damp.	4353.3 / 130
SO		1.0	GM	**SILTY SANDY GRAVEL:** Clay (10%), Silt (20-30%), Sand Fine to Med Grained (20-30%), and Gravel, Loose, Moist, Brownish Gray, Medium Plasticity.	4348.3 / 135
					4343.3

Well Construction Detail



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/6/01

CAMP DRESSER & McKEE

CDM

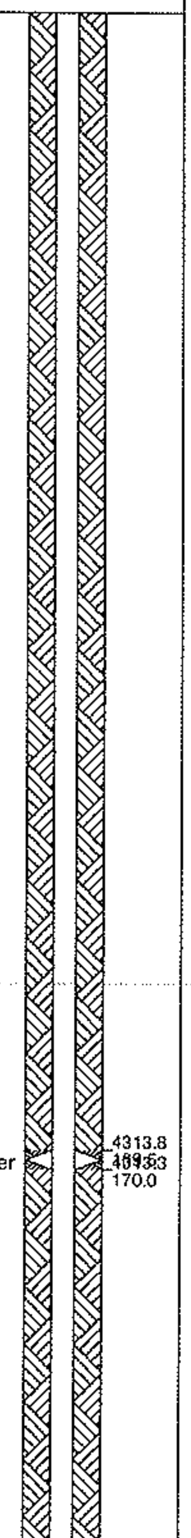
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-8D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		1.0	GM		4343.3 / 140
SO		1.0			4338.3 / 145
GW	CTM-GW-MW8D-146-030501				
			ML	**SANDY SILT:** Sand (10-20%), Fine to Medium Grained, Damp, Stiff, Low Plasticity, Brownish Gray.	
SO		2.0			4333.3 / 150
			GM	**SILTY SANDY GRAVEL:** Clay (10%), Silt (20-30%), Sand Fine to Med Grained (20-30%), and Gravel, Loose, Moist, Reddish Brown, Medium Plasticity.	
SO		1.0			4328.3 / 155
SO		2.0			4323.3 / 160
SO		2.0			4318.3 / 165
GW/SO	CTM-GW-MW8D-170-030501	2.0			4313.3 / 170
					4308.3 / 175
					4303.3

Well Construction Detail



CAMP DRESSER & McKEE
CDM
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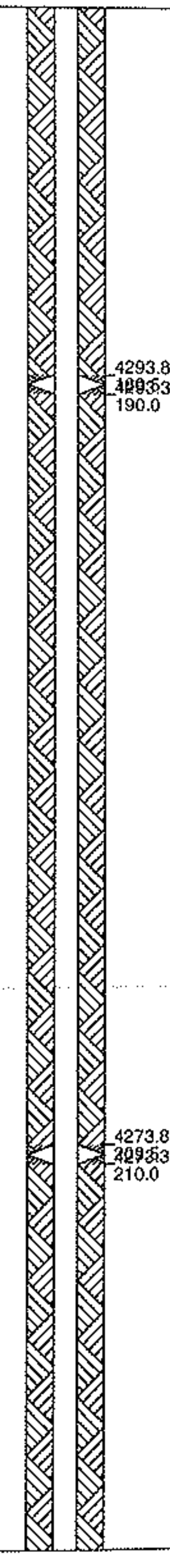
MONITORING WELL DETAIL
CTM-8D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
			ML	**SANDY SILT:** Sand (20-30%), Fine to Medium Grained, Damp, Stiff, Moderate Plasticity, Brown.	4303.3 / 180
SO		0.0			4298.3 / 185
			SM	**SILTY SAND:** 20-30% Silt, Fine to Medium Grained Silt, Coarse Grained Sand, Stiff, Low Plasticity, Grayish Brown, Moist.	
GW/SO	CTM-GW-MW8D-190-030601	0.0			4293.3 / 190
			GM	**SILTY SAND and GRAVEL:** 10-20% Silt, 40-50% Fine to Coarse Grained Sand, Rounded to Subrounded Gravel, Poorly Sorted, Loose, Eet, Grayish Brown, Low Plasticity.	
SO		3.0			4288.3 / 195
SO		2.0	SM	**SILTY SAND:** Silt 10-20%, Fine to Medium Grained Sand, Well Sorted, Damp, Firm, Moderately Plasticity, Brownish Gray.	4283.3 / 200
			SM	**SILTY SAND:** 10-20% Silt, Fine to Medium Grained Sand, Well Sorted, Dry, Hard, Low Plasticity, Brownish Gray.	
SO		2.0			4278.3 / 205
GW/SO	CTM-GW-MW8D-210-030601	2.0			4273.3 / 210
			GM	**SILTY SAND and GRAVEL:** 30%-40% Silt, 40% Sand, Medium to Fine Grained, Subrounded Gravel, Damp, Firm, Brownish Gray.	
SO		2.0			4268.3 / 215
			GM	**SILTY SAND and GRAVEL:** 10-20% Silt, 50% Sand, Medium to Coarse Grained, Gravel Rounded to Subrounded, Damp, Low Plasticity, Brownish Gray, Soft.	4263.3

Well Construction Detail



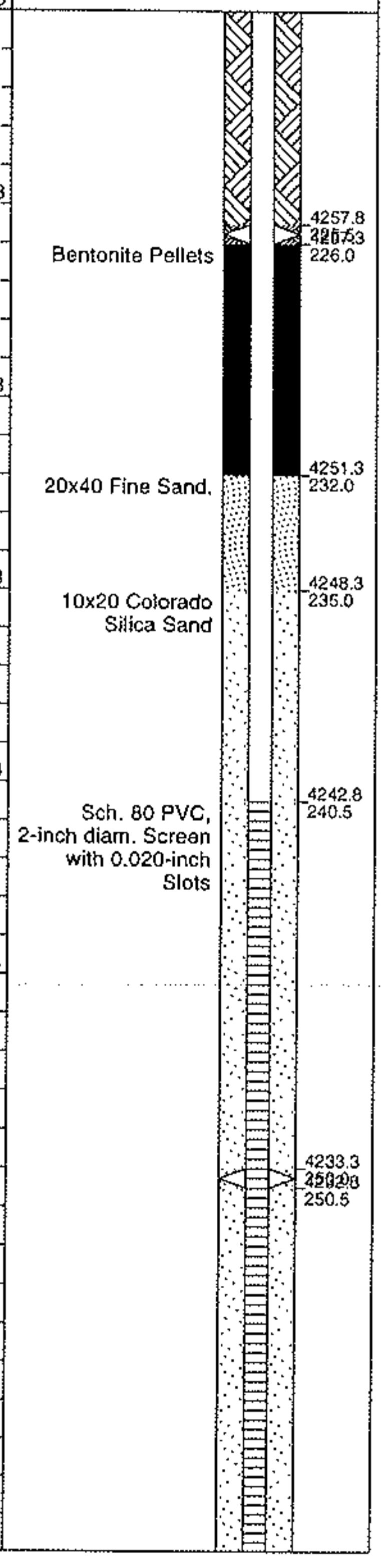
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-8D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		3.0	SP	**SAND:** 70-80% Sand, Medium to Coarse Grained, Poorly Sorted, Thin Ribbons of Sandy Silt, Small Layers of Gravel and Well Sorted Pebbles, Reddish Brown.	4263.3 / 220
SO		2.0			4258.3 / 225
GW/SO	CTM-GW-MW8D-230-030601	4.0	SM	**SILTY SAND:** Sand 70%, Silt 20-30%. Sand Fine to Medium Grained, Firm to Soft, Brownish Gray, Low to Medium Plasticity. Ribbon of Silty Sand at 230 feet, Well Sorted Sand.	4253.3 / 230
SO		3.0	ML	**SANDY SILT:** Sand 10-20%, Silt 80%, Hard, Fine Grained Sand, Brownish Light Tan, Low Plasticity, Dry.	4248.3 / 235
SS	CTM-SL-MW8D-236-030601				
SO	CTM-SL-MW8D-237-030601				
					4243.3 / 240
			SP	**GRAVELLY SAND:** Medium to Coarse Grained Sand (90%), Gravel (10%), Brownish Gray, Loose.	4238.3 / 245
			SP-SM	**GRAVELLY SILTY SAND:** Sand 60-70%, Gravel 10%, Silt 10%, Brownish Gray, Hard Silt Ribbons, Low Plasticity.	4233.3 / 250
GW	CTM-GW-MW8D-255-030601				4228.3 / 255
					4223.3

Well Construction Detail



CAMP DRESSER & McKEE

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7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-8D

Client: Washoe County Dept. of Water Resources | **Project Name:** Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada | **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
						4223.3	
			SP-SM			260	4222.8 260.5 4222.3 261.0
						4218.3 265	
						4213.3 270	
						4208.3 275	
						4203.3 280	
						4198.3 285	
						4193.3 290	
						4188.3 295	
						4183.3	

CAMP DRESSER & McKEE

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7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-9S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Phillip Cramer
Drilling Date: Start: 5/3/01 **End:** 5/3/01
Borehole Coordinates:
N 14,863,430.53 E 2,283,743.30
Development Date: Start 5/8/01 **End** 5/8/01

Casing Elevation (ft.): 4457.37
Total Depth (ft.): 62
Depth to Initial Water Level (ft. BGS): 49
Development Method: Pumping
Field Screening Instrument: PID
Logged By: J. Benedict
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
						Protective Casing
					4457.4	*Ground Surface*
			FILL	Surface: Asphalt	0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
			GW	**GRAVEL with SAND:** Tan Brown to Brown Gravel with Sand, Loose, Dry, 45% Gravel, 10% Cobbles, 40% Sand, 5% Silt.		
SO		1.0			4452.4 / 5	Cement Seal. 4452.4 / 5.0
SG/SO	CTM-SG-MW9S-10-050301	1.0			4447.4 / 10	Sch. 40 PVC, 2-inch diam. Blank Casing 4447.4 / 10.0
			GW	**GRAVEL with SAND:** Olive Brown, No Cobbles, Dry, Loose, 50% Gravel, 45% Sand, 5% Silt.		
SO		1.0			4442.4 / 15	
			SP	**GRAVELLY SAND:** Tan Brown, Loose, Damp, 30% Gravel, 5% Cobbles, 60% Sand, <5% Silt.		
			GW	**SANDY GRAVEL:** Olive Brown,	4437.4	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: Date:

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-9S

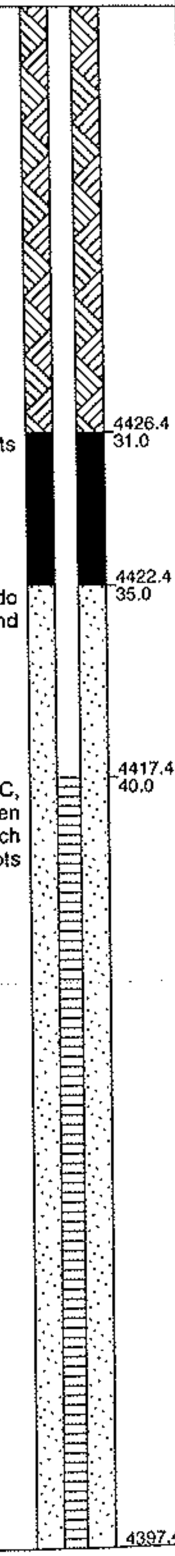
Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)
SO		1.0
SO		1.0
SO		1.0
SG	CTM-SG-MW9S-31-050301	
SO		1.0
SO		1.0
SO	CTM-SL-MW9S-42-050301	27
SO		1.0
SG/SO	CTM-SG-MW9S-50-050301	1.0
GW	CTM-GW-MW9S-52-050301	1.0
SO		1.0
SO	CTM-SL-MW9S-58-050301	1.0
SS	CTM-SL-MW9S-58.5-050301	

Stratum Designation	Material Description
GW	Loose, Dry, 55% Gravel, 5% Cobbles, 35% Sand, 5% Silt.
SW	**GRAVELLY SAND:** Coarse Grained Sand with Gravel, Damp.
GW	**SANDY GRAVEL:** Olive Brown, Loose, Dry, 55% Gravel, 5% Cobbles, 35% Sand, 5% Silt.
GM	**SANDY SILTY GRAVEL:** Brown, Loose, Moist, Intermittent Iron Staining in Silt Matrix, 45% Gravel, 10% Cobbles, 20% Sand, 20% Silt, 5% Clay.
GM	**SANDY SILTY GRAVEL:** Tan to Olive Brown, Loose, Wet, Intermittent Iron Staining in Silt Matrix, 45% Gravel, 10% Cobbles, 20% Sand, 20% Silt, 5% Clay.

Elev.	Depth (ft.)
4437.4	20
4432.4	25
4427.4	30
4422.4	35
4417.4	40
4412.4	45
4407.4	50
4402.4	55
4397.4	

Well Construction Detail



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/6/01

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-9S

Client: Washoe County Dept. of Water Resources

Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
SO		1.0	GM			4397.4 / 60	60.0 4396.9 / 60.5 / 4395.4 / 62.0
			GM-GC	**SANDY SILTY GRAVEL:** Light Olive Brown, Loose, Wet, 45% Gravel, 10% Cobbles, 5% Sand, 30% Silt, 10% Clay, Medium Plasticity.			
						4392.4 / 65	
						4387.4 / 70	
						4382.4 / 75	
						4377.4 / 80	
						4372.4 / 85	
						4367.4 / 90	
						4362.4 / 95	
						4357.4	

CTM MW CTM2001.GPJ CDM_CORP.GDT 9/6/01

CAMP DRESSER & McKEE

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7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-10D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Phillip Cramer
Drilling Date: Start: 4/23/01 **End:** 4/27/01
Borehole Coordinates:
N 14,863,421.27 E 2,283,739.71
Development Date: Start 5/2/01 **End** 5/2/01

Casing Elevation (ft.): 4457.58
Total Depth (ft.): 350
Depth to Initial Water Level (ft. BGS): 24
Development Method: Pumping
Field Screening Instrument: PID
Logged By: J.Benedict/E.Evans/D.Dragon
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
							Protective Casing
						4457.6 / 0	Ground Surface
			GW	Surface: Asphalt **SANDY GRAVEL:** Brown Sandy Cobbles and Boulders, Rounded with Gravel, Sand Matrix.			Morrison Flush-Mount Traffic Vault, 12-inch diam.
SO		4.0				4452.6 / 5	Cement Seal. 4452.6 / 5.0
SO	CTM-SO-MW10D-10-042301	4.0				4447.6 / 10	Sch. 80 PVC, 2-inch diam. Blank Casing 4447.6 / 10.0
SO		4.0				4442.6 / 15	
						4437.6	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-10D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
					4437.6	
SO		6.0	SP	**SAND:** Brown, Coarse Sand with 5% Rounded Gravels.	20	
			GW	**SANDY GRAVEL:** Brown Sandy Cobbles and Boulders, Rounded with Gravel, Coarse Grained Sand Matrix. Increased Sand with Depth.	4432.6	Volclay Grout Seal. 4434.6 / 23.0
SO		3.0	GW	**SANDY GRAVEL:** Brown Sandy Cobbles and Boulders, Rounded with Gravel, Coarse Grained Sand Matrix. Increased Cobbles and Boulders with Depth.	25	
SO	CTM-SO-MW10D-28-042301	14			4427.6	
SO		6.0			30	
					4422.6	
SO		4.0			35	Centralizer 4421.6 / 36.5
			SP	**GRAVELLY SAND:** Coarse Grained Sand, Small Gravels with 5% Silt, Brown, Moist, Stiff.		
SO	CTM-SO-MW10D-38-042301	15	GW	**SANDY GRAVEL:** Brown Sandy Cobbles and Boulders, Rounded with Gravel, Coarse Grained Sand Matrix.	4417.6	
SO		4.0			40	
			SP	**GRAVELLY SAND:** Coarse Grained Sand, Small Gravels with 5% Silt, Brown, Moist, Stiff.	4412.6	
SO		6.0			45	
					4407.6	
SO		3.0			50	
					4402.6	
SO		3.0			55	
			SP	**GRAVELLY SAND:** Brown, Medium to Coarse Grained Sand, <1% Silt and Small Rounded Gravel.		
			GW	**SANDY GRAVEL:** Brown, Coarse	4397.6	

CAMP DRESSER & McKEE
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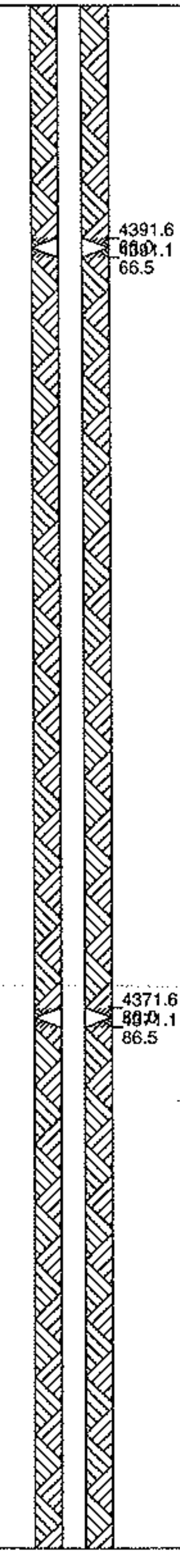
MONITORING WELL DETAIL
CTM-10D

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4397.6 / 60
SO		3.0	GW	Grained Sand Matrix with Gravel and Cobbles. Heavy Iron Staining at 81 feet.	
GW	CTM-GW-MW10D-63-042301				
SO		4.0			4392.6 / 65
SO		3.0			4387.6 / 70
SO		1.0			4382.6 / 75
SO		1.0			4377.6 / 80
GW	CTM-GW-MW10D-83-042301				
SO		3.0			4372.6 / 85
			SC	**CLAYEY SILTY SAND:** Gray, Minor Rounded Gravels.	
SO		2.0			4367.6 / 90
			GW	**SANDY GRAVEL:** Coarse Grained Sand, Gravel and Cobbles, Minor Silt in Matrix. Intermittent Iron Staining.	
SO		2.0			4362.6 / 95
					4357.6

Well Construction Detail



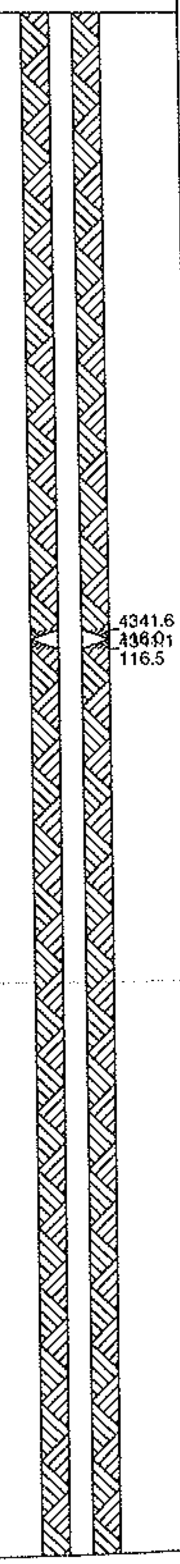
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-10D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		9.0	GW		4357.6 / 100
GW	CTM-GW-MW10D-103-04230				
					4352.6 / 105
			CL	**CLAYEY SANDY SILT:** Brown, Stiff, Small Sandy Silty Gravel lense at 110 feet.	
					4347.6 / 110
SO		3.0			
			GW	**SANDY GRAVEL:** Coarse Grained Sand, Gravel and Cobbles.	
					4342.6 / 115
SO		1.0			
					4337.6 / 120
SO		1.0			
GW	CTM-GW-MW10D-123-04230		GW	**SANDY GRAVEL:** Coarse Grained Sand, Gravel and Cobbles, Tan Brown, Loose, Wet.	
SO		3.0			4332.6 / 125
SO	CTM-SL-MW10D-126-042401	12			
			ML	**SILT:** Tan Brown to Ochre Brown, Damp, Very Stiff, Low Plasticity, Iron Staining.	
			SP	**SAND:** Brown, Medium Grained Sand, Loose, Wet, 95% Sand, 5% Silt.	4327.6 / 130
SO		4.0			
					4322.6 / 135
SO		4.0			
			SW	**GRAVELLY SAND:** Brown, Gravelly Sand to Sandy Gravel, Gravelly Zone at 140 feet, Loose, Wet, 40% Gravel, 55% Sand, <5% Silt.	
					4317.6

Well Construction Detail



CAMP DRESSER & McKEE

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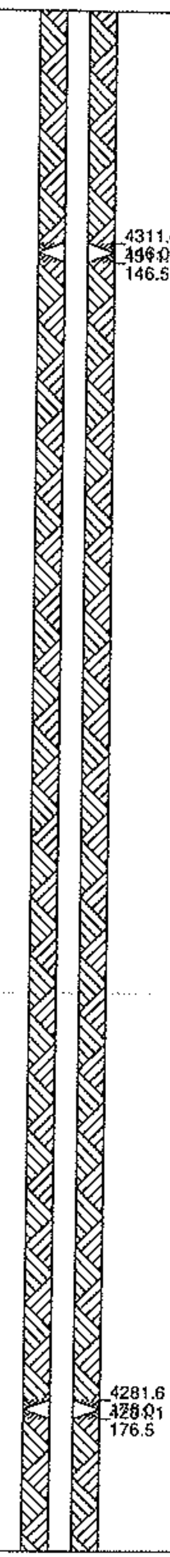
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-10D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		6.0	SW		4317.6 / 140
GW	CTM-GW-MW10D-143-04240	12	SW	**GRAVELLY SAND:** Orange Brown, Medium Grained Sand to Gravelly Sand, Wet, Loose, 10% Gravel, 88% Sand, 2% Silt.	
SO	CTM-SL-MW10D-145-042401	6.0			4312.6 / 145
			SW	**GRAVELLY SAND:** Orange Brown, Medium Grained Sand to Gravelly Sand, Wet, Loose, 35% Gravel, 60% Sand, 5% Silt.	
			ML	**SANDY SILT:** Silt to Sandy Silt Lense, Tan Brown, Stiff, Damp, Medium Plasticity, Strong Orange Iron Staining at Base of Lense.	
SO		7.0	GM	**SANDY GRAVEL:** Ochre Brown, Sandy Gravel to Gravelly Sand, Loose, Damp to Wet, 35-45% Gravel, 40-50% Sand, 10-15% Silt. Intermittent Reddish Orange Iron Staining associated with Weathered Fragments of Coarse Granite.	4307.6 / 150
SO	CTM-SL-MW10D-152-042401	9.0			
SO		9.0			4302.6 / 155
SO		4.0			4297.6 / 160
GW	CTM-GW-MW10D-163-04240		GM	**SILTY SANDY GRAVEL:** Ochre Brown, Sandy Gravel to Gravelly Sand, Loose, Damp to Wet, 35-45% Gravel, 40-50% Sand, 20-25% Silt. Intermittent Reddish Orange Iron Staining associated with Weathered Fragments of Coarse Granite.	
SO		4.0			4292.6 / 165
			ML	**CLAYEY SILT:** Tan Brown, Very Stiff, Damp.	
SO		6.0	GM	**SILTY SANDY GRAVEL:** Ochre Brown, Sandy Gravel to Gravelly Sand, Loose, Damp to Wet, 35-45% Gravel, 40-50% Sand, 20-25% Silt. Intermittent Reddish Orange Iron Staining associated with Weathered Fragments of Coarse Granite.	4287.6 / 170
			GM	**SANDY GRAVEL:** Yellowish Brown to Tan Brown, Sandy Gravel with Interbedded Sand Layers, Loose, Wet, Gravel is Rounded, 50% Gravel, 5% Cobbles, 35% Sand, 10% Silt. Gravel becoming Subrounded at 180.5 feet.	
SO		4.0			4282.6 / 175
					4277.6

Well Construction Detail



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL

CTM-10D

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
					4277.6	
SO		7.0	GM		180	
GW	CTM-GW-MW10D-183-04240					
			GP	**COBBLES**	4272.6	
SO		4.0			185	
			GM	**SILTY SANDY GRAVEL:** Dark Orange Brown, 45% Gravel, 10% Cobbles, 35% Sand, 15-20% Silt, Loose, Wet, Low to Medium Plasticity.	4267.6	
SO		4.0			190	
			SM	**SILTY SAND:** Tan Brown to Orange Brown, Fine Grained, 90% Sand, 10% Silt, Loose, Wet.		
			SM	**SILTY SAND:** Tan Brown to Orange Brown, Fine Grained, 60% Sand, 40% Silt, Stiff, Medium to Low Plasticity.	4262.6	
SO		3.0	SM	**SILTY SAND:** Brown, Medium Grained, Loose, Wet, 85% Sand, 15% Silt, Plasticity.	195	
			GM	**SILTY SANDY GRAVEL:** Tan Brown to Ochre Brown, Interbedded Strata of Sandy Silt, Silty Gravel and Sand, Medium Stiff, Damp to Wet.	4257.6	
SO		3.0			200	
GW	CTM-GW-MW10D-203-04240	4.0				
			SP	**SAND:** Light Brown, Medium Grained, Loose, Wet, 90% Sand, 5% Gravel, <5% Silt.	4252.6	
SO		3.0			205	4251.6 206.0 4251.1 206.5
					4247.6	
SO		3.0	SM	**SILTY SAND:** Orange Brown, Fine Grained, Damp, Soft, Low Plasticity.	210	
			ML	**SANDY SILT:** Light Brown, 80% Silt, 15% Fine Grained Sand, 5% Clay, Very Stiff to Hard, Dry, Low Plasticity.	4242.6	
SO		3.0			215	
			SP	**SAND:** Olive Brown, Loose, Wet, 90% Sand, 5% Gravel, 5% Silt.		
					4237.6	

CTM MW CTM2001.GPJ CDM_CORP.GDT 9/6/01

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
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MONITORING WELL DETAIL
CTM-10D

Client: Washoe County Dept. of Water Resources

Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
SO		3.0	SP		4237.6 / 220
			SM	**SILTY SAND:** Olive, Stiff, Damp, Low Plasticity.	
GW	CTM-GW-MW10D-223-04240		SC	**CLAYEY SAND:** Gray to Brown Gray, Medium Grained Sand to Clayey Sand, 70-80% Sand, 20-30% Soft Clay.	4232.6 / 225
			CL	**SILTY CLAY:** Brown, Stiff to Medium Stiff.	4227.6 / 230
			ML	**SANDY SILT:** Brown to Tan/Brown, Fine Grained Sand, Well Sorted.	
			CL	**SILTY CLAY:** Brown to Gray, Stiff, Dry and Crumbly, Iron and Dark Gray Staining.	4222.6 / 235
			SC	**CLAYEY SAND:** Gray, Fine Grained, Clay Matrix, 80% Sand, 20% Clay.	
			CL	**SILTY CLAY:** Brown, Stiff, Dry.	4217.6 / 240
			CL	**SILTY CLAY:** Brown to Brown Gray, 60-90% Silt, 10% Fine Grained Well Sorted Sand, 0-30% Clay.	
GW	CTM-GW-MW10D-243-04250				
SO		5.0	SM	**SILTY SAND:** Well Sorted, Medium Grained Sand, Fine Grained Sand and Silt, Brown Gray to Olive Gray, 70% Sand, 20-25% Silt, 0-10% Silty Clay.	4212.6 / 245
SO	CTM-SL-MW10D-246-042501	19			
SO		17	CL	**SILTY CLAY:** Brown, Moist, Stiff to Medium Stiff.	4207.6 / 250
			SC	**CLAYEY SAND and SILT:** Sand and Silt 75%, Clay 25%, Brown, Stiff.	
SO		3.0	CL	**SILTY CLAY:** Brown, Stiff, Hard.	4202.6 / 255
			ML	**CLAYEY SILT:** Brown to Ochre Brown, 75% Silt, 25% Clay.	4197.6

Well Construction Detail: 4221.6 / 236.01 / 236.5

CTM MW CTM2001.GPJ CDM_CORP.GDT 9/6/01

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-10D

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
					4197.6	
GW SO	CTM-GW-MW10D-260-04250 CTM-SL-MW10D-260-042501	19	ML		260	
			SM	**SILTY SAND:** Medium to Coarse Grained, Well Sorted Sand with Brown Silty Clay, Clay Slightly Moist to Stiff.	4192.6	
SO		2.0			265	4191.6 266.01 266.5
			ML	**CLAYEY SILT:** 85-95% Silt, 5-15% Silty Clay, Brown, 10% Fine Grained Sand.	4187.6	
SO		8.0	SM	**SILTY SAND:** Poorly to Moderately Sorted, Brown to Ochre Brown, Coarse to Fine Grained Sand, 70% Sand, 20% Silt, 10% Clay.	270	
					4182.6	
SO		11			275	
			CL	**SILTY CLAY:** Brown, Hard, Stiff.	4177.6	
SO		14			280	
			SM	**SILTY SAND:** Olive Gray, Fine Grained Sand and Silt, Well Sorted, 50% Sand, 40% Silt, 10% Clay, Dry.		
GW	CTM-GW-MW10D-283-04250				4172.6	
SO		5.0	CL	**SILTY CLAY:** Tan Brown, Dry, Hard.	285	
SO	CTM-SL-MW10D-288-042501	14	CL	**GRAVELLY CLAY:** Dark Brown, 25% Gravel, 75% Clay, Hard, Dry.	4167.6	
SO		12			290	
			SM	**SILTY SAND:** Coarse Grained, Ochre Brown, Well Sorted, 80% Sand.	4162.6	
SO		2.0			295	4161.6 296.01 296.5
			CL	**GRAVELLY SANDY CLAY:** Brown, Fine to Coarse Grained Sand, 25% Gravel, 25% Sand, 15% Silt, 35% Clay, Dry, Hard.	4157.6	

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MONITORING WELL DETAIL

CTM-10D

Client: Washoe County Dept. of Water Resources

Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		11	CL		4157.6 / 300
GW	CTM-GW-MW10D-303-04250	5.0			
SO		5.0	SW	**GRAVELLY SAND:** Medium to Coarse Grained Sand with Gravel. Sand is Olive Gray, Well Sorted. 90-95% Sand, 5-10% Gravel.	4152.6 / 305
			GC	**SANDY CLAYEY GRAVEL:** Poorly Sorted Gravel, Fine Grained Sand, Olive Gray, Hard, Dry, 50% Gravel, 25% Sand, 25% Clay.	
SO		3.0			4147.6 / 310
			SM	**SAND and SILT:** Brown Gray, Fine Grained, Well Sorted, 5% Gravel, 5% Clay, Dry, Hard, 90% Sand and Silt.	
			CL	**SILTY CLAY:** Brown, Hard, Dry. Becomes Wet and Plastic at 318 feet.	
SO		3.0			4142.6 / 315
SO	CTM-SL-MW10D-319-042501	19	CL	**GRAVELLY CLAY:** Dry.	
GW	CTM-GW-MW10D-320-04250	8.0	SM	**SILTY SAND:** Fine to Medium Grained, Gray, 60% Sand, 40% Silt.	4137.6 / 320
			GM	**GRAVEL, SAND, SILT:** Poorly Sorted Gravels, Sand, Silt and Dark Brown to Dark Gray Clay, Dry.	
			SM	**SILTY SAND:** Tan Brown to Ochre Brown, Fine Grained Sand with Silt, Orange Iron Staining, Damp, Firm, Non-Plastic, 80% Sand, 20% Silt.	
SO		1.0	GP	**SANDY GRAVEL:** Dark Olive Brown, Loose, Wet, 35% Gravel (Rounded), 30% Sand, 15% Silt.	4132.6 / 325
SO		1.0			4127.6 / 330
SS	CTM-SL-MW10D-334.5-042601	3.0	SM	**SILTY SAND:** Yellow Brown, Stiff, Damp, Dry.	
SO	CTM-SL-MW10D-335-042601	3.0			4122.6 / 335
			OL	**CLAYEY SILT:** Dark Charcoal Gray, Unoxidized Clayey Silt, Ashy with possible Organics (upper 0.7 feet) transitioning to a Dark Gray Silty Gravel, Medium Plasticity, Firm, Stiff.	
			GM-GP	**SANDY GRAVEL:** Ochre Brown, Iron	4117.6

Well Construction Detail

- Bentonite Pellets — 4144.6 / 313.0
- 20x40 Fine Sand. — 4139.6 / 318.0
- 10x20 Colorado Silica Sand — 4136.6 / 321.0
- 4131.6 / 326.0; 4131.1 / 326.5
- Sch. 80 PVC, 2-inch diam. Screen with 0.020-inch Slots

CAMP DRESSER & McKEE

CDM

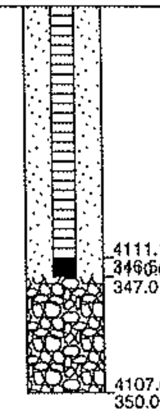
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-10D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
SO		1.0	GM-GP	Staining in upper 1 foot, Wet, Loose, 60% Gravel, 25% Sand, 15% Silt.	4117.6 / 340
			ML	**SILTY CLAY:** Greenish Black, Unoxidized, Ashy, Intermittent Black Streaks in upper 2 feet, Slightly Damp, Very Stiff, Medium to High Plasticity, Low Strengh suggests mostly Silt.	
SO		3.0			4112.6 / 345
			SP	**SAND:** Greenish Black, Fine Grained, Well Sorted, Wet, Loose to Firm.	
SO/GW	CTM-GW-MW10D-350-04260	1.0			4107.6 / 350
					4102.6 / 355
					4097.6 / 360
					4092.6 / 365
					4087.6 / 370
					4082.6 / 375
					4077.6

Well Construction Detail



CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-11S

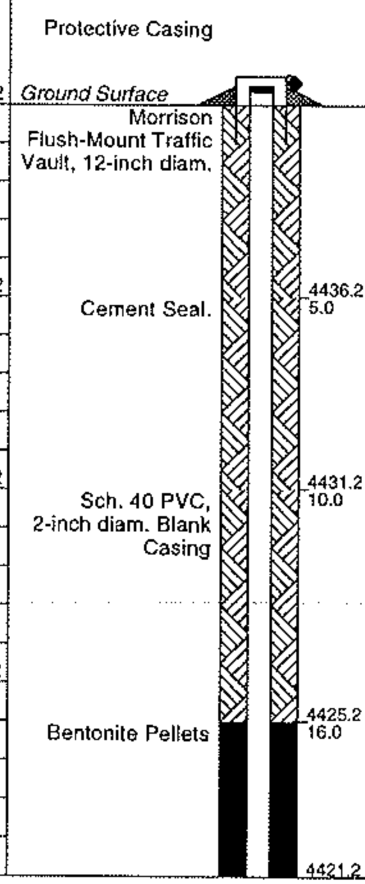
Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: **Start:** 3/19/01 **End:** 3/20/01
Borehole Coordinates:
N 14,861,668.00 E 2,285,425.73
Development Date: **Start** 4/5/01 **End** 4/5/01

Casing Elevation (ft.): 4441.18
Total Depth (ft.): 48
Depth to Initial Water Level (ft. BGS): 32.5
Development Method: Pumping
Field Screening Instrument: PID
Logged By: B. Richmond/ J. Benedict
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
			GM	Surface: Asphalt **GRAVEL and SAND:** Dry, Loose, Brownish Gray, Poorly Sorted, 40% Gravel, 40% Sand, 20% Cobbles and Fines. Damp Soil at 17.5 feet, no water below.	4441.2 / 0
SO		0.0			4436.2 / 5
SG/SO	CTM-SG-MW11S-10A-031901	0.0			4431.2 / 10
SG	CTM-SG-MW11S-14A-031901				
SO		3.0			4426.2 / 15
SG	CTM-SG-MW11S-18A-031901				4421.2

Well Construction Detail



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- HA - Hand Auger
- AR - Air Rotary
- DTR - Dual Tube Rotary
- FR - Foam Rotary
- MR - Mud Rotary
- RC - Reverse Circulation
- CT - Cable Tool
- JET - Jetting
- D - Driving
- DTC - Drill Through Casing

SAMPLING TYPES:
- SG - Soil Gas
- SO - Soil from Core
- GW - Groundwater Sample
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-11S

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
					4421.2	
SO		4.0	GM		20	10x20 Colorado Silica Sand; 20.0
					4416.2 / 25	Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots; 4416.2 / 25.0
SO		1.0	GW	**SANDY GRAVEL:** Dry, Loose, Brownish Gray, Poorly Sorted, 40% Gravel, 30% Sand, 30% Cobbles.		
			GW	**SANDY GRAVEL:** Damp, Loose, Brownish Gray, Poorly Sorted, 40% Gravel, 30% Sand, 30% Cobbles.		
			GW	**SANDY GRAVEL:** Dry, Loose, Reddish Brown Iron Staining in Matrix forming a very weak cement, Poorly Sorted, 40% Gravel, 30% Sand, 30% Cobbles.	4411.2 / 30	
SO		2.0	GW	**SANDY GRAVEL:** Dry, Loose, Brownish Gray, Poorly Sorted, 40% Gravel, 30% Sand, 30% Cobbles.		
					4406.2 / 35	
SO	CTM-SL-MW11S-35-032001	2.0				
			SW	**SAND:** Dark Brown, 10% Gravel, Loose, Black and Tan Pepper Textures and Appearance.		
					4401.2 / 40	
GW/SO	CTM-GW-MW11S-40-032001	3.0	GW	**SANDY GRAVEL:** Dark Brown to Dark Gray, Loose, Minor Silt Component.		
SS	CTM-SL-MW11S-41-032001					
SO	CTM-SL-MW11S-42-032001					
					4396.2 / 45	4396.2; 4395.7; 45.5
SO		1.0				
			SC	**CLAYEY SAND:** Tan-Brown, Weakly Consolidated Clayey Matrixed Sand to Light Tan Brown Silty Clay to Fine Silt Lens.		4393.2 / 48.0
			ML	**SILTY CLAY:** Tan Brown, Moderately Stiff, Medium Plasticity.		
SO		3.0	SC	**CLAYEY SAND:** Tan-Brown, Weakly Consolidated Clayey Matrixed Sand to Light Tan Brown Silty Clay to Fine Silt Lens.	4391.2 / 50	
					4386.2 / 55	
					4381.2	

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

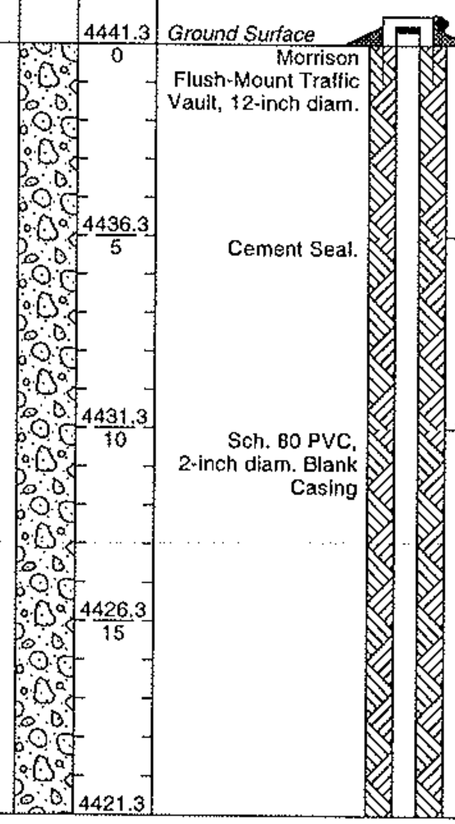
MONITORING WELL DETAIL
CTM-12D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Phillip Cramer
Drilling Date: Start: 3/22/01 **End:** 3/29/01
Borehole Coordinates:
N 14,861,656.17 E 2,285,428.69
Development Date: Start 5/11/01 **End** 5/11/01

Casing Elevation (ft.): 4441.27
Total Depth (ft.): 346
Depth to Initial Water Level (ft. BGS): 35
Development Method: Pumping
Field Screening Instrument: PID
Logged By: K. Dierberger
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
							Protective Casing
						4441.3 / 0	Ground Surface; Morrison Flush-Mount Traffic Vault, 12-inch diam.
			GW	Surface: Asphalt **SANDY GRAVEL:** Cobbles and Boulders, 30-40% Fine to Very Coarse Grained Sand, Subrounded to Subangular Gravel/Cobbles, Dry to Damp, Brown and Light Gray.			
SO		0.0				4436.3 / 5	Cement Seal. (4436.3 / 5.0)
SO		1.0				4431.3 / 10	Sch. 80 PVC, 2-inch diam. Blank Casing (4431.3 / 10.0)
SO		0.0				4426.3 / 15	
						4421.3	



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
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- SSA - Solid Stem Auger
- HA - Hand Auger
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- D - Driving
- DTC - Drill Through Casing

SAMPLING TYPES:
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- SO - Soil from Core
- GW - Groundwater Sample
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- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: Date:

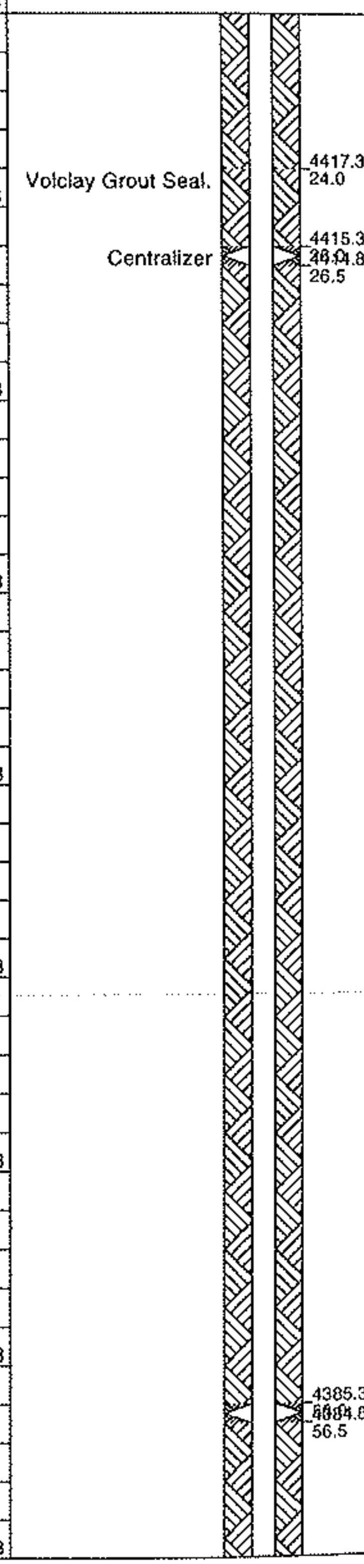
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-12D

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4421.3 / 20
SO		0.0	GW		
SO		1.0			4416.3 / 25
SO		0.0			4411.3 / 30
SO	CTM-SL-MW12D-35-032301	1200	GW	**SANDY GRAVEL:** Cobbles and Boulders, 30-40% Fine to Very Coarse Grained Sand, Subrounded to Subangular Gravel/Cobbles, Wet, Grayish Brown.	4406.3 / 35
GW/SO	CTM-GW-MW12D-40-032301	428			4401.3 / 40
SO		30			4396.3 / 45
			ML	**SILT:** Light Brown, Stiff, Non-Plastic, Minor Rust Mottling, Dry to Damp.	
SO	CTM-SL-MW12D-50-032301	122	SW	**GRAVELLY SAND:** 20-25% Gravel and Cobbles, Subrounded to Rounded, Fine to Very Coarse Grained Sand, Loose, Wet, Poorly Sorted, Brownish Gray.	4391.3 / 50
SO		26			4386.3 / 55
					4381.3

Well Construction Detail



CAMP DRESSER & McKEE
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7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-12D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4381.3
SO		5.0	SW		60
GW/SO	CTM-GW-MW12D-65-032301	5.0			4376.3 / 65
			GM	**SILTY SANDY GRAVEL:** 15-20% Silt, Non-Plastic, 20-25% Fine to Very Coarse Grained Sand, Subrounded to Rounded Gravel and Cobbles, Loose, Wet, Grayish Brown.	
SO		11			4371.3 / 70
SO		12			4366.3 / 75
			GM	**SILTY SANDY GRAVEL:** 20-25% Silt, Non-Plastic, 20-25% Fine to Very Coarse Grained Sand, Subrounded to Rounded Gravel and Cobbles, Loose, Wet, Grayish Brown.	
SO	CTM-SL-MW12D-80-032301	368			4361.3 / 80
SO		234			4356.3 / 85
GW	CTM-GW-MW12D-86-032301				
SO		45			4351.3 / 90
			ML	**GRAVELLY SANDY SILT:** 5-15% Fine to Very Coarse Grained Sand, 5-10% Gravel, Subrounded to Subangular, Stiff, Non-Plastic, Grayish Brown, Dry to Damp.	
			ML	**SANDY SILT:** Minor Clay (5%), Stiff, Moderately Plastic, 10-15% Fine Grained Sand, <1% Small Gravel, Dry to Damp, Grayish Brown with Rust Mottling.	
SO		29			4346.3 / 95
			GM		
			MH	**SILTY SANDY GRAVEL:** 20-25% Silt, Non-Plastic, 20-25% Fine to Very Coarse Grained Sand, Subrounded to Rounded Gravel and Cobbles, Loose,	4341.3

Well Construction Detail

4355.3
4354.8
86.5

CAMP DRESSER & McKEE

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7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-12D

Client: Washoe County Dept. of Water Resources | **Project Name:** Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada | **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
						4341.3	
SO		19	MH	Wet, Grayish Brown. **SANDY SILT:** 20-25% Fine Grained Sand, Stiff, Moderately Plastic, Miceceous, Mottled Light Brown, Brown and Gray, Dry.		100	
SO		14				4336.3 105	
			SM	**SILTY SAND:** 20-30% Silt, Fine to Medium Grained Sand, Loose, Non-Plastic, Wet, Grayish Brown.			
GW	CTM-GW-MW12D-107-03230						
			SP	**SAND:** Fine to Very Coarse Grained, Loose, Wet, Well Sorted, Brownish Gray.			
SO		12				4331.3 110	
			ML	**GRAVELLY SANDY SILT:** 35-40% Fine to Coarse Grained Sand, 15-20% Gravel, Subround to Rounded, Loose, Non-Plastic, Wet, Grayish Brown.			
SO		1.0				4326.3 115	4325.3 4324.8 / 116.0 116.5
			SM	**SILTY SAND:** 20-30% Silt, Fine to Medium Grained Sand, Loose, Non-Plastic, Wet, Grayish Brown.			
			MH	**SANDY SILT:** 20-25% Fine Grained Sand, Stiff, Moderately Plastic, Micaceous, Mottled Light Brown, Brown and Gray, Dry.			
			GM	**SILTY SANDY GRAVEL:** 15-20% Silt, Non-Plastic, 20-25% Fine to Very Coarse Grained Sand, Subrounded to Rounded Gravel and Cobbles, Loose, Wet, Grayish Brown.			
SO		27				4321.3 120	
GW/SO	CTM-GW-MW12D-125-03230	24	ML-SM	**GRAVELLY SAND and SILT:** 25-30% Silt, 25-30% Fine to Coarse Grained Sand, Stiff, Moderately Plastic, Subrouned to Rounded, Wet, Grayish Brown.		4316.3 125	
			SW	**GRAVELLY SAND:** 20-25% Gravel and Cobbles, Subrounded to Rounded, Fine to Very Coarse Grained Sand, Loose, Wet, Poorly Sorted, Brownish Gray.			
SO		4.0				4311.3 130	
			ML	**SANDY SILT:** Minor Clay (5%), Stiff, Moderately Plastic, 10-15% Fine Grained Sand, <1% Small Gravel, Dry to Damp, Grayish Brown with Rust Mottling.			
			SW	**GRAVELLY SAND:** 20-25% Gravel and Cobbles, Subrounded to Rounded, Fine to Very Coarse Grained Sand, Loose, Wet, Poorly Sorted, Brownish Gray.			
SO		6.0				4306.3 135	
						4301.3	

CAMP DRESSER & McKEE

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Reno, NV 89511

MONITORING WELL DETAIL
CTM-12D

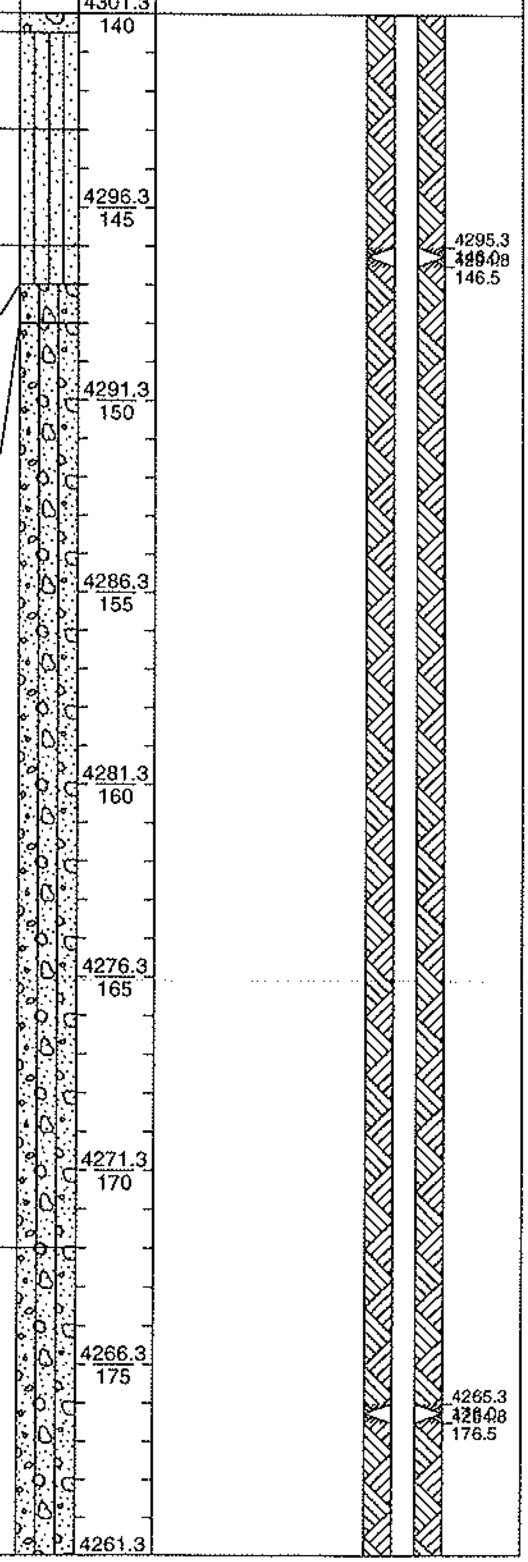
Client: Washoe County Dept. of Water Resources

Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
						4301.3	
SO		1.0	SW			140	
			ML	**SANDY SILT:** 15-20% Fine Grained Sand, Stiff, Plastic, Light Brown with Mottled Rust, Damp.			
			ML	**SANDY SILT:** 15-20% Fine Grained Sand, Stiff, Plastic, Dark Gray with Mottled Rust, Damp.		4296.3	
SO		2.0				145	4295.3 146.0 4294.8 146.5
			ML	**SANDY SILT:** 15-20% Fine Grained Sand, Stiff, Plastic, Grayish Brown with Mottled Rust, Damp.			
GW	CTM-GW-MW12D-147-03230		ML-SM				
			ML-SM	**GRAVELLY SAND and SILT:** 25-30% Silt, 25-30% Fine to Coarse Grained Sand, Loose, Non-Plastic, Wet, Subrounded to Rounded Gravel and Cobbles, Grayish Brown with Intermittent Rust Staining.		4291.3	
SO		0.0				150	
				GRAVELLY SAND and SILT: 5-10% Silt, 30-35% Fine to Coarse Grained Sand, Loose, Non-Plastic, Wet, Subrounded to Rounded Gravel and Cobbles, Grayish Brown with Intermittent Rust Staining.		4286.3	
SO		1.0				155	
						4281.3	
SO		1.0				160	
						4276.3	
GW/SO	CTM-GW-MW12D-165-03260	3.0				165	
						4271.3	
SO		1.0				170	
			ML-SM	**GRAVELLY SAND and SILT:** 25-30% Silt, 25-30% Fine to Coarse Grained Sand, Loose, Non-Plastic, Wet, Subrounded to Rounded Gravel and Cobbles, Grayish Brown with Intermittent Rust Staining.		4266.3	
SO		3.0				175	4265.3 176.0 4264.8 176.5
						4261.3	



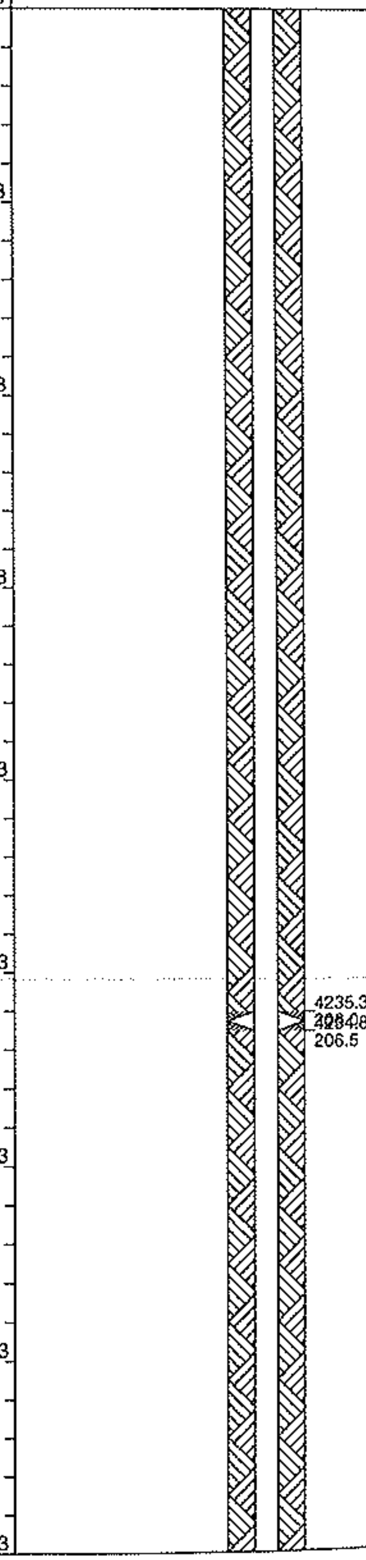
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-12D

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4261.3
SO		5.0	ML-SM		180
GW	CTM-GW-MW12D-182-03260		MH	**SANDY SILT:** 10-20% Fine to Coarse Grained Sand, Stiff, Non-Plastic, Dry to Damp, Micaceous, Grayish Brown.	
SO		2.0			4256.3 / 185
			ML-SM	**GRAVELLY SAND and SILT:** 25-30% Silt, 25-30% Fine to Coarse Grained Sand, Loose, Non-Plastic, Wet, Subrounded to Rounded Gravel and Cobbles, Grayish Brown with Intermittent Rust Staining.	
SO		5.0			4251.3 / 190
SO		2.0			4246.3 / 195
GW	CTM-GW-MW12D-197-03260				
			SM	**SILTY SAND:** 20-25% Silt, Slightly Stiff, Non-Plastic, Fine to Coarse Grained Sand, Grayish Brown, Wet.	
SO		3.0			4241.3 / 200
			MH	**SANDY SILT:** 20-25% Fine Grained Sand, Stiff, Micaceous, Non-Plastic, Grayish Brown, Dry to Damp.	
SO		8.0			4236.3 / 205
			SM	**GRAVELLY SAND and SILT:** 25-30% Silt, 25-30% Fine to Coarse Grained Sand, Loose, Non-Plastic, Wet, Subrounded to Rounded Gravel and Cobbles, Grayish Brown with Intermittent Rust Staining.	
SO		18			4231.3 / 210
SO		4.0			4226.3 / 215
GW	CTM-GW-MW12D-217-03260				
					4221.3

Well Construction Detail



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-12D

Client: Washoe County Dept. of Water Resources

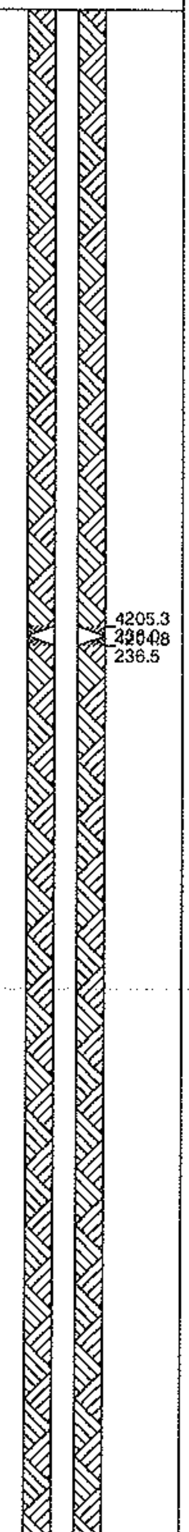
Project Name: Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4221.3
SO		0.0	SM		220
SO		2.0			4216.3 / 225
SO		2.0			4211.3 / 230
SO		2.0			4206.3 / 235
GW	CTM-GW-MW12D-237-03260				
SO		1.0	GM	**SILTY SANDY GRAVEL:** 15-20% Silt, Stiff, Loose, 15-25% Fine to Very Coarse Grained Sand, Silt is Cemented, Subangular to Subrounded Gravel and Cobbles, Grayish Brown, Dry to Damp, Non-Plastic.	4201.3 / 240
SO		5.0			4196.3 / 245
			GM	**SILTY SANDY GRAVEL:** 20-30% Silt, Stiff, Loose, 25-30% Fine to Very Coarse Grained Sand, Silt is Cemented, Subangular to Subrounded Gravel and Cobbles, Grayish Brown, Dry to Damp, Non-Plastic.	
SO		3.0			4191.3 / 250
GW/SO	CTM-GW-MW12D-255-03270	64			4186.3 / 255
					4181.3

Well Construction Detail



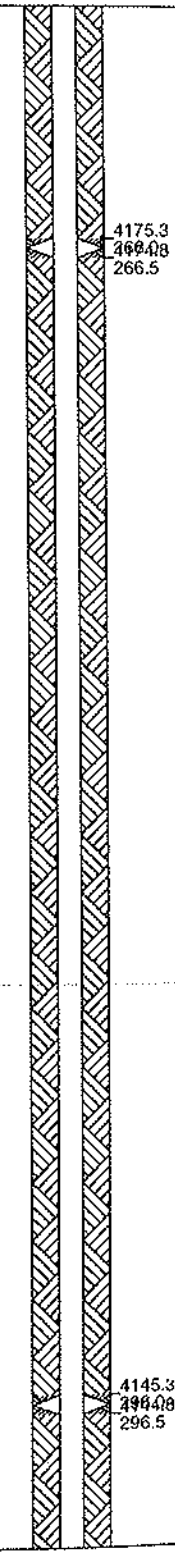
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-12D

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
					4181.3
SO		2.0	GM		260
			ML	**SANDY SILT:** 10-15% Fine to Coarse Grained Sand, Stiff, Non-Plastic, Grayish Brown with Rust Staining, Dry.	4176.3 / 265
			SM	**SILTY SAND:** 5-10% Silt, Fine to Coarse Grained Sand, Loose, Non-Plastic, Grayish Brown, Wet.	
			ML	**SANDY SILT:** 5-15% Fine to Medium Grained Sand, Stiff, Non-Plastic, Brownish Gray, Dry.	4171.3 / 270
SO		1.0			
			SM	**SILTY SAND:** 5-10% Silt, Fine to Coarse Grained Sand, Loose, Non-Plastic, Wet, Reddish Brown, Intermittent Gravel/Cobbles (<1%).	4166.3 / 275
SO		1.0			
			ML	**SANDY SILT:** 5-15% Fine to Medium Grained Sand, Stiff, Non-Plastic, Brownish Gray, Dry.	
			SM	**SILTY SAND:** 5-10% Silt, Fine to Coarse Grained Sand, Micaceous, Loose, Non-Plastic, Wet, Reddish Brown, Intermittent Gravel/Cobbles (<1%).	4161.3 / 280
GW/SO	CTM-GW-MW12D-280-03270	1.0			
SO		1.0			4156.3 / 285
SO		2.0			4151.3 / 290
			ML	**SANDY SILT:** 5-15% Fine to Medium Grained Sand, Stiff, Non-Plastic, Brownish Gray, Dry.	
			SM	**SILTY SAND:** 5-10% Silt, Fine to Coarse Grained Sand, Micaceous, Loose, Non-Plastic, Wet, Reddish Brown, Intermittent Gravel/Cobbles (<1%).	4146.3 / 295
SO		1.0			
GW	CTM-GW-MW12D-297-03280				
			ML	**SANDY SILT:** 5-15% Fine to Medium Grained Sand, Stiff, Non-Plastic, Brownish Gray, Dry.	4141.3

Well Construction Detail



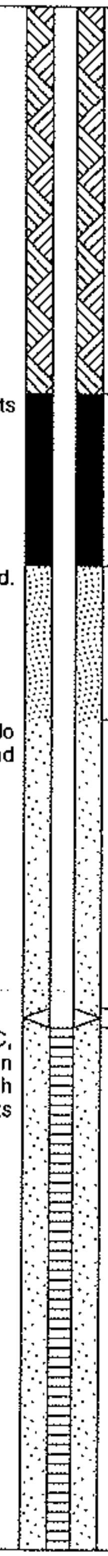
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-12D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		1.0	ML		4141.3 / 300
			SM	SILTY SAND: 5-10% Silt, Fine to Coarse Grained Sand, Micaceous, Loose, Non-Plastic, Wet, Reddish Brown, Intermittent Gravel/Cobbles (<1%).	
			ML	SANDY SILT: 5-15% Fine to Medium Grained Sand, Stiff, Non-Plastic, Brownish Gray, Dry.	
			SM	SILTY SAND: 5-10% Silt, Fine to Coarse Grained Sand, Micaceous, Loose, Non-Plastic, Wet, Reddish Brown, Intermittent Gravel/Cobbles (<1%).	
			ML	SANDY SILT: 5-15% Fine to Medium Grained Sand, Stiff, Non-Plastic, Dark Gray, Dry.	
SO		1.0			4136.3 / 305
SO		1.0			4131.3 / 310
SO		2.0			4126.3 / 315
GW	CTM-GW-MW12D-317-03280				
SO		0.0			4121.3 / 320
SO		4.0			4116.3 / 325
			SM	SILTY SAND: 20-25% Silt, Fine to Coarse Grained Sand, Loose, Non-Plastic, Dark Gray, Wet.	
SO		4.0			4111.3 / 330
			SM	SILTY SAND: 5-10% Silt, Fine to Coarse Grained Sand, Loose, Non-Plastic, Dark Gray, Wet.	
SO		1.0			4106.3 / 335
SO	CTM-SL-MW12D-336-032801				
SS	CTM-SL-MW12D-337-032801		ML	SANDY SILT: 5-15% Fine to Medium Grained Sand, Stiff, Non-Plastic, Dark Gray, Dry.	
					4101.3

Well Construction Detail



CAMP DRESSER & McKEE

CDM

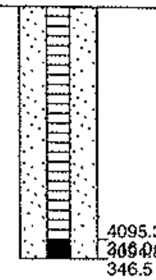
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-12D

Client: Washoe County Dept. of Water Resources | **Project Name:** Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada | **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
						4101.3	
SO		1.0	ML			340	
SO		1.0				4096.3 / 345	
GW	CTM-GW-MW12D-346-03280						
						4091.3 / 350	
						4086.3 / 355	
						4081.3 / 360	
						4076.3 / 365	
						4071.3 / 370	
						4066.3 / 375	
						4061.3	



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/6/01

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

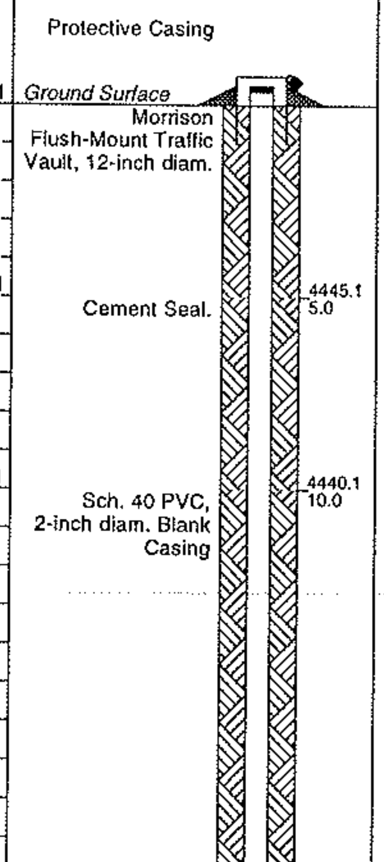
MONITORING WELL DETAIL
CTM-13S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/23/01 **End:** 3/23/01
Borehole Coordinates:
N 14,863,685.33 E 2,284,776.05
Development Date: Start 3/28/01 **End** 3/28/01

Casing Elevation (ft.): 4450.05
Total Depth (ft.): 56
Depth to Initial Water Level (ft. BGS): 39
Development Method: Pumping
Field Screening Instrument: PID
Logged By: B. Richmond
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
			SP	Surface: Asphalt **GRAVELLY SAND:** Very Loose, Dry, Dark Brown, Granite Cobbles, 70% Sand, Poorly Sorted, 10% Silt, Subrounded.	4450.1 / 0
SO		0.0			4445.1 / 5
			SW	**SAND:** Medium Grained, Well Sorted, Dry, Dark Brown, Very Loose, Little or no Fines.	
SO		0.0	GW	**SANDY GRAVEL:** Very Loose, Dry, Coarse Gravel, Dark Grayish Brown, Poorly Sorted, Subangular to Subrounded.	4440.1 / 10
SO		0.0			4435.1 / 15
					4430.1



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- HA - Hand Auger
- AR - Air Rotary
- DTR - Dual Tube Rotary
- FR - Foam Rotary
- MR - Mud Rotary
- RC - Reverse Circulation
- CT - Cable Tool
- JET - Jetting
- D - Driving
- DTC - Drill Through Casing

SAMPLING TYPES:
- SG - Soil Gas
- SO - Soil from Core
- GW - Groundwater Sample
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

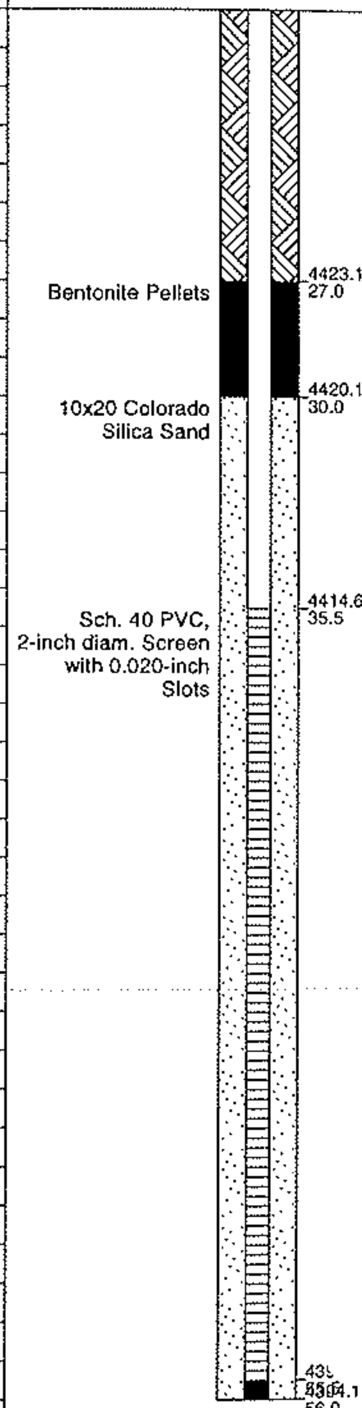
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-13S

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
					4430.1
SO		0.0	GW		20
			Boulder	**BOULDER**	
			SW	**GRAVELLY SAND:** Coarse Grained Sand with Gravel, Very Loose, Damp, Dark Brown Gray, Poorly Sorted, Subrounded, Little Fines, 70% Sand.	4425.1
SO		0.0			25
			Boulder	**BOULDER**	
			SW	**GRAVELLY SAND:** Coarse Grained Sand with Gravel, Very Loose, Damp, Dark Brown Gray, Poorly Sorted, Subrounded, Little Fines, 70% Sand.	4420.1
SO		0.0			30
					4415.1
SO		0.0			35
			SM	**GRAVELLY SILTY SAND:** Coarse Grained Sand with Gravel, Loose, Damp, Dark Brown Gray, Poorly Sorted, Subrounded, 70% Sand, 20-30% Silt, Low Plasticity.	
GW	CTM-GW-MW13S-39-032301		SM		
SO	CTM-SL-MW13S-39-032301				4410.1
SO		38			40
SO	CTM-SL-MW13S-41-032301		Boulder	**GRAVELLY SILTY SAND:** Medium Grained Sand with Gravel, Loose, Wet, Light Brownish Gray, Poorly Sorted, Subanguler, 50% Sand, 20-30% Silt, Low Plasticity.	
SS	CTM-SL-MW13S-41.5-032301		SM	**BOULDER**	
				GRAVELLY SILTY SAND: Medium Grained Sand with Gravel, Loose, Wet, Light Brownish Gray, Poorly Sorted, Subanguler, 50% Sand, 20-30% Silt, Low Plasticity.	4405.1
SO		0.0			45
			SM	**SILTY SAND:** Light Brownish Red, Low Plasticity, Oxidized, Fine Grained, Hard.	
			SM	**GRAVELLY SILTY SAND:** Medium Grained Sand with Gravel, Loose, Wet, Light Brownish Gray, Poorly Sorted, Subanguler, 50% Sand, 20-30% Silt, Low Plasticity.	4400.1
SO		0.0			50
					4395.1
SO		0.0			55
					4390.1

Well Construction Detail



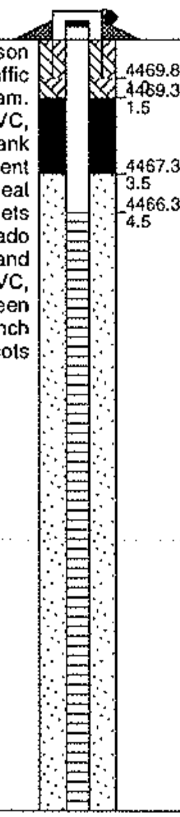
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-14S

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Casing Elevation (ft.): 4470.79
Drilling Method/Rig: Sonic/Roto-Sonic 150
Total Depth (ft.): 26.5
Drillers: Nathan Jackson
Depth to Initial Water Level (ft. BGS): 7
Drilling Date: Start: 3/21/01 **End:** 3/21/01
Development Method: Pumping
Borehole Coordinates:
Field Screening Instrument: PID
N 14,860,981.17 E 2,278,705.46
Logged By: B. Richmond
Development Date: Start 3/27/01 **End** 3/27/01
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
						4470.8	Protective Casing; *Ground Surface*
			SM	Surface: Asphalt **GRAVELLY SILTY SAND:** Damp, Dark to Light Brown, Firm, 30% Gravel, 50% Sand, 20% Silt.		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.; Sch. 40 PVC, 2-inch diam. Blank Casing in Cement Seal; Bentonite Pellets; 10x20 Colorado Silica Sand; Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots
SO		4.0				4465.8 / 5	
~~GW~~	~~CTM-GW-MW14S-7-032101~~		ML	**SANDY CLAY**			
SO	CTM-SL-MW14S-7-032101		SP	**GRAVELLY SILTY SAND:** Damp, Dark to Light Brown, Firm, 30% Gravel, 50% Sand, 20% Silt.			
			SM	**SILTY SAND:** 70% Coarse Sand, 30% Silt, Light Brown, Wet, Low Plasticity, Firm.			
SG	CTM-SG-MW14S-10A-032101	0.0				4460.8 / 10	
			GP	**SANDY GRAVEL:** Light Brown, Wet, Little or no Fines.			
SO	CTM-SL-MW14S-15-032101	0.0				4455.8 / 15	
SS	CTM-SL-MW14S-17-032101					4450.8	



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
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MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: Date:

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-14S

Client: Washoe County Dept. of Water Resources

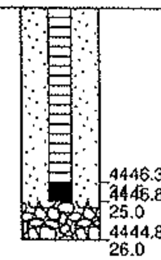
Project Name: Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4450.8
SO		1.0	GP		20
			Boulder	**BOULDER**	
			SM	**SILTY SAND:** Light Brown, Low Plasticity, Soft, 70% Coarse Grained Sand, 30% Silt.	
					4445.8 / 25
SO		1.0			
					4440.8 / 30
					4435.8 / 35
					4430.8 / 40
					4425.8 / 45
					4420.8 / 50
					4415.8 / 55
					4410.8

Well Construction Detail



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

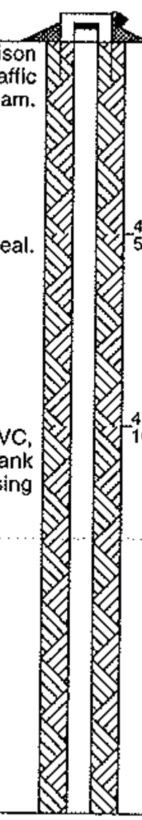
MONITORING WELL DETAIL
CTM-15S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/26/01 **End:** 3/26/01
Borehole Coordinates:
N 14,860,945.20 E 2,279,869.87
Development Date: Start 3/27/01 **End** 3/27/01

Casing Elevation (ft.): 4481.86
Total Depth (ft.): 73
Depth to Initial Water Level (ft. BGS): 57
Development Method: Pumping
Field Screening Instrument: PID
Logged By: D. Dragan
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
							Protective Casing
						4481.9	*Ground Surface*
			SM	Surface: Asphalt **SILTY SAND:** Hand Augered, Minor amount Clay Matrix - possibly fill material.		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
SO		0.0				4476.9 5	Cement Seal. 4476.9 5.0
			GM	**SILTY SANDY GRAVEL:** Rounded Cobbles and Boulders, Silty Brown Sand Matrix, Dry.			
SO	CTM-SO-MW15S-10-032601	0.0				4471.9 10	Sch. 40 PVC, 2-inch diam. Blank Casing 4471.9 10.0
SO		0.0				4466.9 15	
						4461.9	



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
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- MR - Mud Rotary
- RC - Reverse Circulation
- CT - Cable Tool
- JET - Jetting
- D - Driving
- DTC - Drill Through Casing

SAMPLING TYPES:
- SG - Soil Gas
- SO - Soil from Core
- GW - Groundwater Sample
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-15S

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
			GM		4461.9 / 20	
					4456.9 / 25	
SO		0.0	GM	**SILTY SANDY GRAVEL:** Rounded Cobbles and Boulders, Silty Brown Sand Matrix, Damp.	4451.9 / 30	
			SM	**SILTY SAND:** Rounded Gravel (<5%), Tanish Brown, Loose, Fine Grained Sand, Damp.		
SO		0.0			4446.9 / 35	
			GM	**SILTY SANDY GRAVEL:** Rounded Cobbles and Boulders, Silty Brown Sand Matrix, Damp.		
SO		0.0			4441.9 / 40	Bentonite Pellets (4441.9 / 40.0)
SO		0.0			4436.9 / 45	10x20 Colorado Silica Sand (4436.9 / 45.0)
					4431.9 / 50	Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots (4431.9 / 50.0)
					4426.9 / 55	
					4421.9	

CTM MW CTM2001.GPJ CDM_CORP.GDT 9/6/01

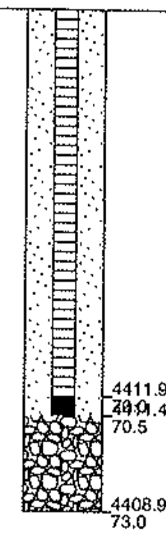
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-15S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
GW	CTM-GW-MW15S-60-032601		GM		4421.9 / 60
			SP	**GRAVELLY SAND:** Loose, Tan Brown.	4416.9 / 65
			GM	**SILTY SANDY GRAVEL:** Rounded Cobbles and Boulders, Silty Brown Sand Matrix, Wet.	
SO	CTM-SO-MW15S-70-032601	0.0			4411.9 / 70
SS	CTM-SO-MW15S-72-032601		SW-SM	**SAND:** Coarse Grained, 5% Fine Sand/Silt.	
					4406.9 / 75
					4401.9 / 80
					4396.9 / 85
					4391.9 / 90
					4386.9 / 95
					4381.9

Well Construction Detail



CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-16S

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Casing Elevation (ft.): 4438.79
Drilling Method/Rig: Sonic/Roto-Sonic 150
Total Depth (ft.): 40
Drillers: Nathan Jackson
Depth to Initial Water Level (ft. BGS): 26
Drilling Date: Start: 3/15/01 **End:** 3/15/01
Development Method: Pumping
Borehole Coordinates:
N 14,858,163.43 E 2,282,372.40
Field Screening Instrument: PID
Logged By: D. Dragan
Development Date: Start 3/29/01 **End** 3/29/01
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4438.8 Ground Surface
			ML	Surface: Asphalt **SANDY SILT:** Tan, Possibly Backfill, Dry, Hand Augered to 6 feet.	0
SO		0.0			4433.8 / 5
SG	CTM-SG-MW16S-9A-031501				
SO		1.0			4428.8 / 10
SO	CTM-SL-MW16S-10.5-031501		ML	**GRAVELLY SANDY SILT:** Dry, Light Gray, 20% Cobbles and Gravels.	
			SM	**SILTY SAND:** Tan, Fine Grained Sand, Dry.	4423.8 / 15
			SM-SP	**SILTY GRAVELLY SAND:** Brown, Fine Grained Sand, 20% Gravel and Cobbles, Dry.	
			SM-SP	**SILTY GRAVELLY SAND:** Gray, Fine Grained Sand, 20% Gravel and	4418.8

Well Construction Detail

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: Date:

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-16S

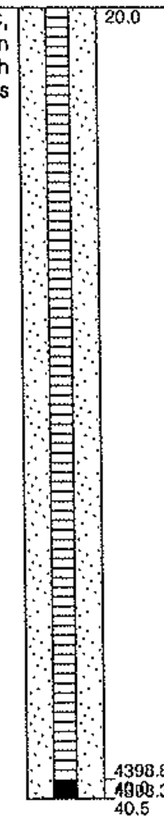
Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
					4418.8
SG/SO	CTM-SG-MW16S-20A-031501	2.0	SM-SP	Cobbles, Rounded, Dry.	20
					4413.8 / 25
GW	CTM-GW-MW16S-26-031501		SM-SP	**SILTY GRAVELLY SAND:** Olive Gray, Fine Grained Sand, Gravel and Cobbles, Rounded, Wet.	
					4408.8 / 30
SO		0.0			
			SM-SP	**SILTY GRAVELLY SAND:** Olive Gray, Clay, Fine Grained Sand, Gravel and Cobbles, Rounded, Wet.	
SO	CTM-SL-MW16S-34-031501		CL	**SANDY GRAVELLY SILT:** Olive Gray, Clayey Silty Sand with Gravels and Cobbles.	
SS	CTM-SL-MW16S-35-031501	1.0	SM-SP	**SILTY GRAVELLY SAND:** Olive Gray, Clay, Fine Grained Sand, Gravel and Cobbles, Rounded, Wet.	4403.8 / 35
					4398.8 / 40
SO		1.0			
					4393.8 / 45
					4388.8 / 50
					4383.8 / 55
					4378.8

Graphic Log

Well Construction Detail

Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

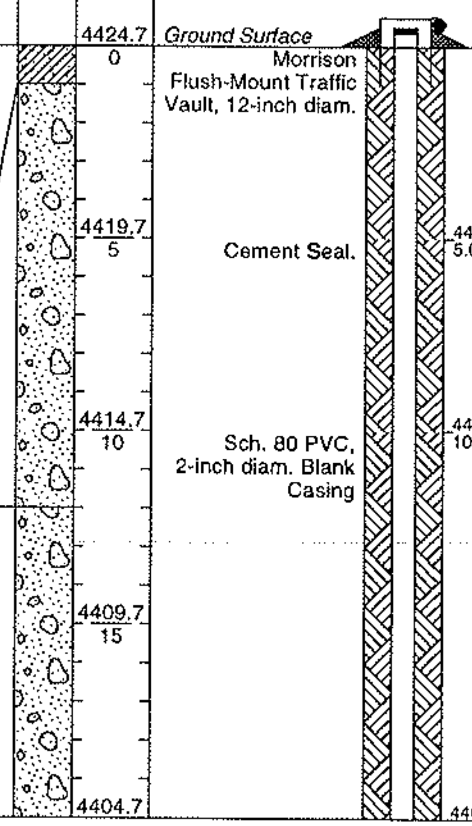
MONITORING WELL DETAIL
CTM-17D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Phillip Cramer
Drilling Date: Start: 3/19/01 **End:** 3/21/01
Borehole Coordinates:
N 14,858,289.59 E 2,286,176.02
Development Date: Start 4/9/01 **End** 4/9/01

Casing Elevation (ft.): 4424.67
Total Depth (ft.): 201
Depth to Initial Water Level (ft. BGS): 26
Development Method: Pumping
Field Screening Instrument: PID
Logged By: K. Dierberger
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)	Well Construction Detail
						Protective Casing
					4424.7	*Ground Surface*
			ML	Surface: Lawn	0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
			SP	**SANDY SILTY CLAY:** 30-40% Fine To Medium Grained Sand, 20% Silt, Plastic Clay, Stiff, Brown, Grass Roots, Moist, 1% Gravel.		
				GRAVELLY SAND: 10-20% Gravel, Subrounded to Subangular, Fine to Coarse Grained Sand, Brown, Dry, Loose.		
SO		1.0			4419.7 / 5	Cement Seal. (4419.7 / 5.0)
SO		1.0			4414.7 / 10	Sch. 80 PVC, 2-inch diam. Blank Casing (4414.7 / 10.0)
			SP	**GRAVELLY SAND:** 20-30% Gravel and Cobbles, Subrounded to Subangular, Fine to Coarse Grained Sand, Brown, Damp to Moist at 20 feet, Loose.		
SO		2.0			4409.7 / 15	
					4404.7	4404.7



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
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MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
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SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-17D

Client: Washoe County Dept. of Water Resources

Project Name: Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)	Well Construction Detail
					4404.7	
SO		1.0	SP		20	Volclay Grout Seal. 20.0
			SP	**SAND:** Medium to Very Coarse Grained, Grayish Brown, Wet, Well Sorted, Loose.		
					4399.7	
SO		0.0			25	
					4394.7	
SO		2.0			30	
GW	CTM-GW-MW17D-32-031901					
SO	CTM-SL-MW17D-32-031901					
			ML	**CLAYEY SILT:** 5-10% Clay, Stiff, Damp, Moderately Plastic, Well Sorted, Brown with Black Mottling Grading to Dark Gray.	4389.7	
SO		2.0			35	
			SM	**SILTY SAND:** 5-15% Silt, Fine to Medium Grained Sand, Grayish Brown, Wet, Loose.		
			CL	**SILTY CLAY:** Plastic, Stiff, 5-10% Silt, Dark Gray, Dry, <1% Gravel.		
			SM-GM	**CLAYEY SILTY SAND and GRAVEL:** 5-15% Clay, Stiff, Plastic, 5-15% Silt, 15-25% Medium to Very Coarse Grained Sand, Subrounded to Subangular Gravel and Cobbles, Brown, Moist.	4384.7	
SO		1.0			40	
					4379.7	
SO		1.0	SM-GM	**SILTY SAND and GRAVEL:** Stiff, Plastic, 5-15% Silt, 15-25% Medium to Very Coarse Grained Sand, Subrounded to Subangular Gravel and Cobbles, Brown, Wet.	45	
					4374.7	
SO		0.0			50	
GW	CTM-GW-MW17D-51-031901					
					4369.7	
SO		2.0			55	
					4364.7	

CTM MW CTM2001.GPJ CDM_CORP.GDT 9/7/01

CAMP DRESSER & McKEE

CDM

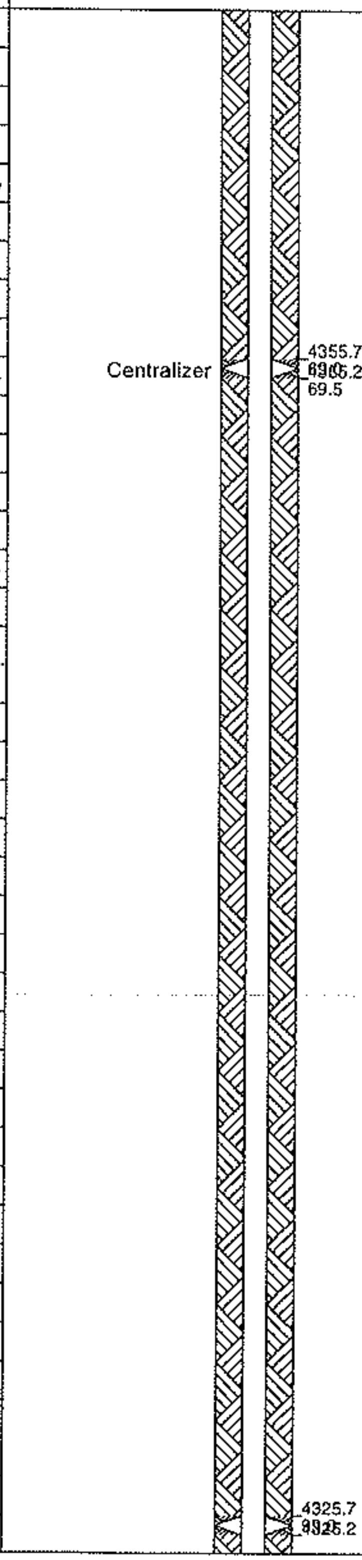
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-17D

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4364.7
SO		0.0	SM-GM		60
			SM	**SILTY SAND:** 5-10% Silt, Fine to Very Coarse Grained Sand, 1% Gravel, Loose, Wet, Grayish Brown.	
SO		1.0			4359.7 / 65
			SM	**SILTY SAND:** 5-10% Silt, Fine to Very Coarse Grained Sand, 10-15% Gravel, Loose, Wet, Grayish Brown.	
			SP-SM	**SILTY GRAVELLY SAND:** Loose, 10-20% Silt, 10-20% Gravel and Cobbles, Fine to Very Coarse Grained Sand, Grayish Brown, Wet, Subangular to Subrounded Gravel, Intermittent Iron Staining.	
SO		2.0			4354.7 / 70
GW	CTM-GW-MW17D-74-031901				
SO		1.0			4349.7 / 75
SO		0.0			4344.7 / 80
SO		2.0			4339.7 / 85
SO		1.0			4334.7 / 90
GW	CTM-GW-MW17D-94-031901				
SO		1.0			4329.7 / 95
					4324.7

Well Construction Detail



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/7/01

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-17D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
					4324.7	
SO		1.0	SP-SM		100	99.5
SO		1.0			4319.7 / 105	
SO	CTM-SL-MW17D-110-032001	5.0			4314.7 / 110	
SO		2.0			4309.7 / 115	
GW	CTM-GW-MW17D-117-03200					
SO		7.0			4304.7 / 120	
				No Sample Recovery.		
SO		3.0	SM	**SILTY SAND:** 10-20% Silt, Fine to Coarse Grained Sand, Loose, Wet, Grayish Brown.	4299.7 / 125	
			SP-SM	**GRAVELLY SILTY SAND:** 10-20% Silt, 10-20% Gravel and Cobbles, Fine to Very Coarse Grained Sand, Grayish Brown, Loose, Subangular to Subrounded Gravel, Wet with Intermittent Dry Intervals.		4295.7
			SP-SM			129.0 / 4295.2
			SP-SM			129.5
SO		2.0			4294.7 / 130	
			SP-SM	**GRAVELLY SILTY SAND:** 10-20% Silt, 10-20% Gravel and Cobbles, Fine to Very Coarse Grained Sand, Grayish Brown, Loose, Subangular to Subrounded Gravel, Dry.		
			SP-SM			
GW	CTM-GW-MW17D-132-03200		SM			
			ML	**GRAVELLY SILTY SAND:** 10-20% Silt, 10-20% Gravel and Cobbles, Fine to Very Coarse Grained Sand, Grayish Brown, Loose, Subangular to Subrounded Gravel, Wet with Intermittent Dry Intervals.		
SO		7.0			4289.7 / 135	
			SP-SM	**GRAVELLY SILTY SAND:** 10-20% Silt, 10-20% Gravel and Cobbles, Fine to Very Coarse Grained Sand, Grayish Brown, Loose, Subangular to	4284.7	

CAMP DRESSER & McKEE

CDM

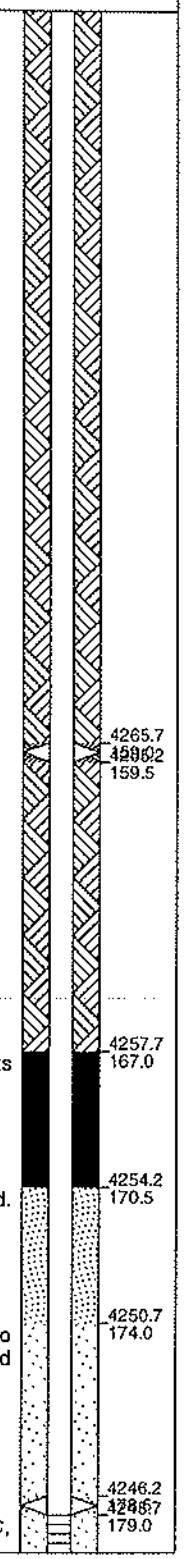
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-17D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO	CTM-SL-MW17D-140-032001	10	ML	Subrounded Gravel, Dry.	4284.7 / 140
				GRAVELLY SILTY SAND: 10-20% Silt, 10-20% Gravel and Cobbles, Fine to Very Coarse Grained Sand, Grayish Brown, Loose, Subangular to Subrounded Gravel, Wet with Intermittent Dry Intervals.	
SO		3.0	SP-SM	**SILTY SAND:** 5-10% Silt, Fine Grained Sand, 1% Gravel, Loose, Non-Plastic, Wet, Grayish Brown.	4279.7 / 145
			ML	**SANDY SILT:** 10-20% Fine Grained Sand, Stiff, Non-Plastic, Dry, Grayish Brown.	
SO		8.0		**GRAVELLY SILTY SAND:** 10-20% Silt, 10-20% Gravel and Cobbles, Fine to Very Coarse Grained Sand, Grayish Brown, Loose, Subangular to Subrounded Gravel, Moist to Wet.	4274.7 / 150
				SANDY SILT: 20-30% Fine to Medium Grained Sand, Stiff, Damp, Rust Colored Banding, Grayish Brown, Non-Plastic.	
GW	CTM-GW-MW17D-154-03200		SP-SM	**GRAVELLY SILTY SAND:** 10-20% Silt, 20-30% Gravel and Cobbles, Fine to Very Coarse Grained Sand, Loose, Subangular to Subrounded Gravel, Brown, Wet.	
SO		2.0	SM		4269.7 / 155
			SM	**SANDY SILT:** 20-30% Fine to Medium Grained Sand, Stiff, Damp, Rust Colored Banding, Grayish Brown, Non-Plastic.	
SO		3.0	SP-SM	**GRAVELLY SILTY SAND:** 10-20% Silt, 20-30% Gravel and Cobbles, Fine to Very Coarse Grained Sand, Loose, Subangular to Subrounded Gravel, Brown, Wet.	4264.7 / 160
			ML	**SILTY SAND:** 5-15% Silt, Fine to Coarse Grained Sand, Loose, Grayish Brown, Wet.	
				SILTY SAND: 5-15% Silt, Fine to Coarse Grained Sand, Loose, Reddish Brown, Wet.	
SO		6.0	SM	**GRAVELLY SILTY SAND:** 10-20% Silt, 10-20% Gravel, Fine to Very Coarse Grained Sand, Loose, Subrounded Gravel, Wet, Grayish Brown.	4259.7 / 165
			SM	**SANDY SILT:** 10-25% Fine to Medium Grained Sand, Stiff, Dry, Brown, Non-Plastic.	
SO		2.0	ML	**SILTY SAND:** 5-15% Silt, Fine to Coarse Grained Sand, Loose, Grayish Brown, Wet.	4254.7 / 170
				SILTY SAND: 20-30% Silt, Fine to Medium Coarse Grained Sand, Stiff, Non-Plastic, Moist, Brown with Dark Gray Mottling.	
GW	CTM-GW-MW17D-173-03200				
SO		3.0		**SANDY SILT:** 5-10% Sand, Fine Grained, Very Stiff, Non-Plastic, Dry, Dark Gray to Dark Greenish Gray.	4249.7 / 175
			ML	**SANDY SILT:** 10-20% Sand, Fine	4244.7

Well Construction Detail



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

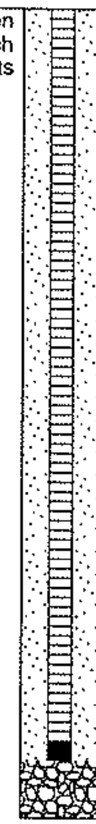
MONITORING WELL DETAIL
CTM-17D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
					4244.7
SO		4.0	SM	Grained, Very Stiff, Non-Plastic, Moist, Dark Gray to Dark Greenish Gray, <1% Wood Fragments.	180
			SP-SM	**SILTY SAND:** 20-30% Silt, Fine to Medium Coarse Grained Sand, Stiff, Non-Plastic, Moist, Brown with Rust Mottling.	
				GRAVELLY SILTY SAND: 10-20% Silt, 10-20% Gravel, Fine to Very Coarse Grained Sand, Loose, Subrounded Gravel, Wet, Grayish Brown.	
SO		1.0			4239.7 / 185
			ML	**SANDY SILT:** 5-15% Fine Grained Sand, Stiff, Non-Plastic, Dry, Brown with Rust Colored Mottling.	
			ML	**SANDY SILT:** 20-30% Fine Grained Sand, Stiff, Non-Plastic, Damp, Brown with Rust Colored Mottling.	
SO		1.0			4234.7 / 190
GW	CTM-GW-MW17D-192-032001		SP-SM	**GRAVELLY SILTY SAND:** 10-20% Silt, 15-25% Gravel, Fine to Coarse Grained Sand, Loose, Wet, Non-Plastic, Reddish Brown and Grayish Brown, Subrounded Gravel.	
SO	CTM-SL-MW17D-192-032001				
SS	CTM-SL-MW17D-193-032001				
SO		3.0			4229.7 / 195
			ML	**SANDY SILT:** 5-15% Fine Grained Sand, Stiff, Non-Plastic, Dry, Brown with Rust Colored Mottling.	
			SP-SM	**GRAVELLY SILTY SAND:** 10-20% Silt, 15-25% Gravel, Fine to Coarse Grained Sand, Loose, Wet, Non-Plastic, Reddish Brown and Grayish Brown, Subrounded Gravel.	
SO		1.0			4224.7 / 200
					4219.7 / 205
					4214.7 / 210
					4209.7 / 215
					4204.7

Well Construction Detail

2-inch diam. Screen with 0.020-inch Slots



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/7/01

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

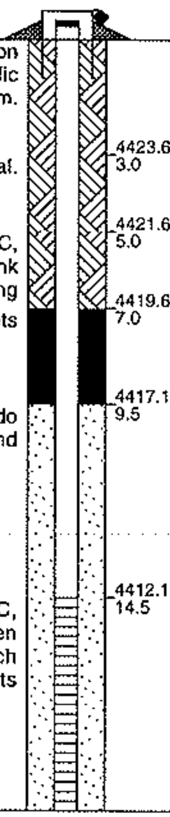
MONITORING WELL DETAIL
CTM-18S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/19/01 **End:** 3/19/01
Borehole Coordinates:
N 14,859,840.54 E 2,286,510.29
Development Date: Start 3/26/01 **End** 3/26/01

Casing Elevation (ft.): 4426.63
Total Depth (ft.): 35
Depth to Initial Water Level (ft. BGS): 19
Development Method: Pumping
Field Screening Instrument: PID
Logged By: B. Richmond
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)	Well Construction Detail
						Protective Casing
					4426.6	*Ground Surface*
			FILL	Surface: Asphalt **FILL:** Backfill Material for Street, Gravel, Sand, Cobbles, Light Grayish Brown.	0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
			SP	**GRAVELLY SAND:** 70% Sand, 30% Gravel, Loose, Light Brown, Increasing Dampness with Depth, Poorly Sorted, Increasing Cobble Size with Depth.		Cement Seal. (4423.6 / 3.0)
SO		1.0			4421.6 / 5	Sch. 40 PVC, 2-inch diam. Blank Casing (4421.6 / 5.0)
						Bentonite Pellets (4419.6 / 7.0)
SG/SO	CTM-SG-MW18S-10A-031901	1.0			4416.6 / 10	10x20 Colorado Silica Sand (4417.1 / 9.5)
SO		2.0			4411.6 / 15	Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots (4412.1 / 14.5)
SO	CTM-SL-MW18S-18-031901				4406.6	



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
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GW - Groundwater Sample
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OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

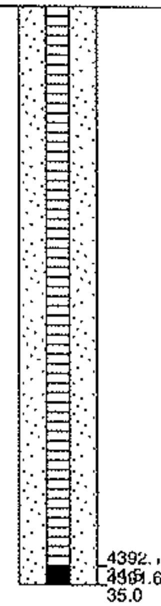
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-18S

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
GW/SO	CTM-GW-MW18S-20-031901	1.0	SP	**GRAVELLY SAND:** Poorly Sorted, Minor amount of Silt, 60% Sand, 30% Gravel, 10% Fines, Dark Brown, Wet.	4406.6 / 20
			GP	**SANDY GRAVEL:** Poorly Sorted, Little or No Fines, Coarse to Medium Grained Sand, Minor Cobbles, Dark Brown Gray, Wet.	4401.6 / 25
SO		1.0			4396.6 / 30
			ML	**SILTY SAND:** Hard, Low Plasticity, Light Brown with Rust Streaks, Medium Grained Sand, 50% Silt, 50% Sand, Minor Cobbles.	
SO	CTM-SL-MW18S-34-031901				
SS	CTM-SL-MW18S-35-031901	1.0			4391.6 / 35
					4386.6 / 40
					4381.6 / 45
					4376.6 / 50
					4371.6 / 55
					4366.6

Well Construction Detail



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-19S

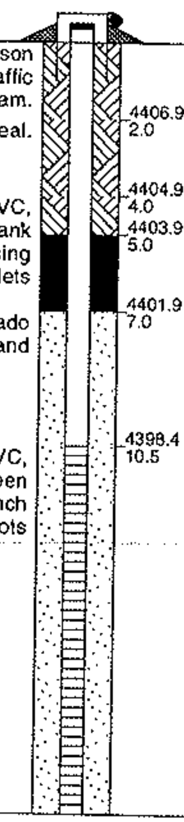
Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Phillip Cramer
Drilling Date: Start: 4/29/01 **End:** 4/29/01
Borehole Coordinates:
N 14,865,509.94 E 2,294,834.51
Development Date: Start 5/15/01 **End** 5/15/01

Casing Elevation (ft.): 4408.89
Total Depth (ft.): 32
Depth to Initial Water Level (ft. BGS): 16
Development Method: Pumping
Field Screening Instrument: PID
Logged By: K. Dierberger
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
			ML	Surface: Asphalt **GRAVELLY SANDY SILT:** Damp, Slightly Plastic, Soft, Brown, 20-25% Fine to Medium Grained Sand, 10-15% Gravel, 1% Organic Material.	4408.9 / 0
SO		0.0			4403.9 / 5
			SP	**GRAVELLY SAND:** 40% Gravel, Fine to Coarse Grained Sand, Loose, Subrounded to Subangular, Dry, Gray to Light Brown.	
SG/SO	CTM-SG-MW19S-10-042901A	0.0			4398.9 / 10
SO		1.0	ML	**GRAVELLY SANDY SILT:** 10-15% Gravel, 30-40% Fine to Coarse Grained Sand, Non-Plastic, Soft, Subrounded, Damp to Wet, Brown.	4393.9 / 15
SO	CTM-SL-MW19S-16-042901				
					4388.9

Well Construction Detail



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
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SAMPLING TYPES:
- SG - Soil Gas
- SO - Soil from Core
- GW - Groundwater Sample
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: Date:

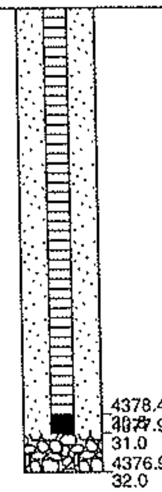
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-19S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4388.9
SO		1.0	SP-SM	**GRAVELLY SILTY SAND:** 10-15% Gravel, 10-15% Silt, Loose, Fine to Very Coarse Grained Sand, Subrounded, Wet, Brown.	20
GW	CTM-GW-MW19S-22-042901		ML	**GRAVELLY SANDY SILT:** 10-15% Gravel, 30-40% Fine to Coarse Grained Sand, Non-Plastic, Soft, Subrounded, Damp to Wet, Brown.	
			SP-SM		4383.9
SO		1.0		**GRAVELLY SILTY SAND:** 10-15% Gravel, 10-15% Silt, Loose, Fine to Very Coarse Grained Sand, Subrounded, Wet, Brown.	25
SO	CTM-SL-MW19S-29-042901				4378.9
SS	CTM-SL-MW19S-30-042901	0.0	ML	**GRAVELLY SANDY SILT:** 10-15% Gravel, 30-40% Fine to Coarse Grained Sand, Non-Plastic, Soft, Subrounded, Damp to Wet, Brown.	30
					4373.9 / 35
					4368.9 / 40
					4363.9 / 45
					4358.9 / 50
					4353.9 / 55
					4348.9

Well Construction Detail



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-20S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/15/01 **End:** 3/15/01
Borehole Coordinates:
N 14,860,467.98 E 2,294,992.76
Development Date: Start 3/27/01 **End** 3/27/01

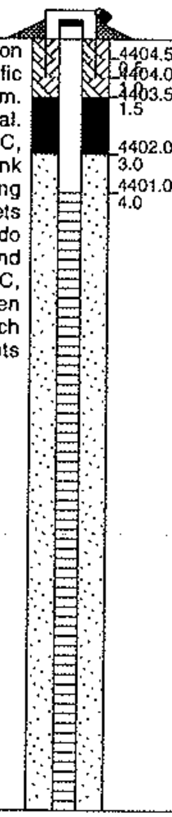
Casing Elevation (ft.): 4404.95
Total Depth (ft.): 26
Depth to Initial Water Level (ft. BGS): 17.5
Development Method: Pumping
Field Screening Instrument: PID
Logged By: D. Dragan
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
			FILL	**ROAD BASE:** Compacted Gravel and Cobbles.	4405.0 / 0
			TOPSOIL	**FILL:** Dark Brown Silty Topsoil.	4400.0 / 5
SO		1.0	SM	**SILTY SAND:** Light Brown, Fine Grained, 80% Sand, 20% Silt.	4395.0 / 10
SG/SO	CTM-SG-MW20S-10A-031501	1.0	GP	**SANDY GRAVEL:** Brown, Cobbles 2-inch diam., Increased Cobble Size with Depth, Wet.	
SO	CTM-SL-MW20S-13.5-031501				4390.0 / 15
SO		1.0			4385.0

Well Construction Detail

Protective Casing

Ground Surface



Morrison Flush-Mount Traffic Vault, 12-inch diam.
Cement Seal.
Sch. 40 PVC, 2-inch diam. Blank Casing
Bentonite Pellets
10x20 Colorado Silica Sand
Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: Date:

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

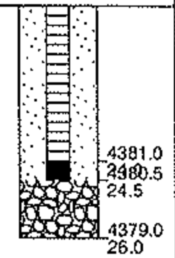
MONITORING WELL DETAIL
CTM-20S

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4385.0
SO		2.0	SM	**SILTY SAND:** Medium to Coarse Grained Sand, 10% Silt.	20
GW	CTM-GW-MW20S-22-031501				
SO	CTM-SL-MW20S-22-031501				
			SM	**SILTY SAND:** Tan/Yellow/Orange, Fine Grained Sand, 10% Silt.	4380.0
SO		1.0			25
					4375.0 / 30
					4370.0 / 35
					4365.0 / 40
					4360.0 / 45
					4355.0 / 50
					4350.0 / 55
					4345.0

Well Construction Detail



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

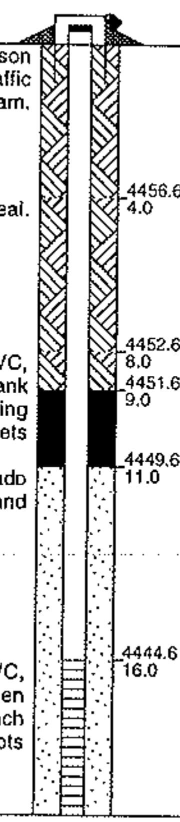
MONITORING WELL DETAIL
CTM-21S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/16/01 **End:** 3/16/01
Borehole Coordinates:
N 14,865,699.20 E 2,284,464.83
Development Date: Start 3/26/01 **End** 3/26/01

Casing Elevation (ft.): 4460.55
Total Depth (ft.): 42
Depth to Initial Water Level (ft. BGS): 23
Development Method: Pumping
Field Screening Instrument: PID
Logged By: D. Dragon
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
							Protective Casing
						4460.6	*Ground Surface*
			GM	Surface: Asphalt **ROAD BASE:** Hand Augered, Backfill Dirt, Cobbles, Sand.		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
							Cement Seal. (4456.6 / 4.0)
						4455.6 / 5	
			SP	**GRAVELLY SAND:** Sandy Cobbles and Boulders, Rounded.			Sch. 40 PVC, 2-inch diam. Blank Casing (4452.6 / 8.0)
							Bentonite Pellets (4451.6 / 9.0)
SO/SG	CTM-SG-MW21S-10A-031601	<1				4450.6 / 10	
							10x20 Colorado Silica Sand (4449.6 / 11.0)
SO	CTM-SL-MW21S-21S-031601						
SO		1.0				4445.6 / 15	
							Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots (4444.6 / 16.0)
						4440.6	



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
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MR - Mud Rotary
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CT - Cable Tool
JET - Jetting
D - Driving
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SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-21S

Client: Washoe County Dept. of Water Resources

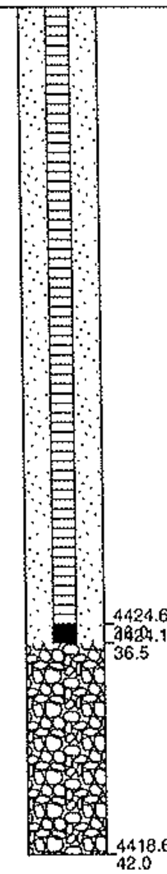
Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
			SP		4440.6 / 20
SO		1.0			4435.6 / 25
GW	CTM-GW-MW21S-26-031601				
SO		1.0			4430.6 / 30
			SM	**SILTY SAND:** Brown, Wet, Coarse Grained, 10% Silt.	4425.6 / 35
SO		2.0			
SS	CTM-SL-MW21S-36-031601				
SO	CTM-SL-MW21S-36.5-031601				
					4420.6 / 40
					4415.6 / 45
					4410.6 / 50
					4405.6 / 55
					4400.6

Well Construction Detail



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

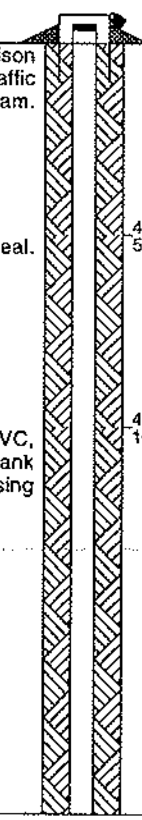
MONITORING WELL DETAIL
CTM-22D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Phillip cramer
Drilling Oate: Start: 4/17/01 **End:** 4/19/01
Borehole Coordinates:
N 14,865,920.43 E 2,283,755.43
Development Date: Start 5/3/01 **End** 5/3/01

Casing Elevation (ft.): 4458.38
Total Depth (ft.): 253
Depth to Initial Water Level (ft. BGS): 20
Development Method: Pumping
Field Screening Instrument: PID
Logged By: J. Benedict/E. Evans
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
							Protective Casing
						4458.4	*Ground Surface*
			GP	Surface: Asphalt **SANDY GRAVEL:** Coarse Grained, Dark Brown, 40% Gravel, 25% Cobbles, 30% Sand, <5% Silt, Damp, Loose.		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
SO		2.0	GP	**SANDY GRAVEL:** Coarse Grained, Light Brown, 40% Gravel, 25% Cobbles, 30% Sand, <5% Silt, Damp, Loose.		4453.4 5	Cement Seal. 4453.4 5.0
SO		2.0				4448.4 10	Sch. 80 PVC, 2-inch diam. Blank Casing 4448.4 10.0
SO		2.0	GP	**SANDY GRAVEL:** Damp, Fine Grained Silty/Sandy Matrix, Reddish to Orange Iron Staining, 45% Gravel, 20% Cobbles, 20% Sand, 15% Silt to Clay, Loose.		4443.4 15	
SO	CTM-SL-MW22D-17-041701						
			GM	**SILTY SANDY GRAVEL:** Dark Gray Brown to Dark Reddish Brown, Silty Orange Hematitic Zone, 45% Gravel,		4438.4	



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
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WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-22D

Client: Washoe County Dept. of Water Resources | **Project Name:** Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada | **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
						4438.4	
SO		2.0	GM GM	15% Cobbles, 15% Sand, 25% Silt, Loose, Damp. **SILTY SANDY GRAVEL:** Dark Olive Brown, Wet, Loose, Low Plasticity, 35% Cobbles, 35% Gravel, 10% Sand, 20% Silt with clay.		20	Volclay Grout Seal. 4437.4 / 21.0
			GM	**SILTY SANDY GRAVEL:** Yellowish Brown, Wet, Loose, Low Plasticity, 35% Cobbles, 35% Gravel, 10% Sand, 20% Silt with clay.		4433.4	
SO		2.0				25	
GW	CTM-GW-MW22D-27-041701						
			GM	**SILTY SANDY GRAVEL:** Light Olive Brown, Loose to Weak Competence (core holds together), Non-Plastic, Wet, 45% Gravel, 5% Cobbles, 35% Coarse Grained Sand, 15% Silt.		4428.4	
SO		2.0				30	
			GM	**SILTY SANDY GRAVEL:** Tan Brown, Low Plasticity, Damp to Wet, Silty Zones show Competency and a Reddish Brown Color, 45% Gravel, 15% Cobbles, 15% Sand, 20-25% Silt.		4423.4	
SO		2.0				35	
			SM MH	**SILTY SAND:** Dark Yellowish Brown, Wet, Loose. **SILT:** Dark Yellowish Brown to Yellowish Brown, Fine Grained, Stiff, Medium to High Plasticity, Orange Iron Staining, Micaceous, Damp.		4418.4	
SO		2.0				40	
			GM	**SILTY SANDY GRAVEL:** Reddish to Orange Brown, Poorly Graded, Loose, Damp, 50% Gravel, 5% Cobbles, 25% Sand, 10% Silt, Orange/Red Iron Staining.		4413.4	
SO		2.0				45	
GW	CTM-GW-MW22D-47-041701		GM	**SILTY SANDY GRAVEL:** Brown-Ochre Brown, 60% Gravel, 20% Sand, 20% Silt with Clay.		4408.4	
SO		4.0				50	
			GM	**SILTY SANDY GRAVEL:** Dark Reddish Brown, Damp, Loose to Soft, Low-Medium Plasticity, 50% Gravel, 5% Cobbles, 10% Sand, 25% Silt.			
			SP	**GRAVELLY SAND:** Ochre Brown, Poorly Graded, 70% Sand, 25% Gravel, 5% Silt, Loose, Wet.		4403.4	
SO		1.0	GM	**SILTY SANDY GRAVEL:** Dark Brown to Dark Reddish Brown, Loose, Damp, 50% Gravel, 5% Cobbles, 35% Sand, 10% Silt, Finer Grained with Depth.		55	
						4398.4	

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-22D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
SO		0.0	ML	**SANDY SILT:** Tan Brown, Damp, Stiff.	4398.4 / 60	
			SM	**SILTY SAND:** Dark Ochre Brown, Coarse Sandstone with Silt, Wet, Loose.		
			GM	**SILTY SANDY GRAVEL:** Olive Brown, Poorly Graded, Loose, Wet-Damp, 60% Gravel, 5% Cobbles, 25% Sand, 10% Silt.		
SO		3.0			4393.4 / 65	
GW	CTM-GW-MW22D-67-041701					
SO		2.0	SM	**SILTY SAND:** Dark Yellowish Brown, Medium Plasticity, Stiff, Damp, 5% Gravel, 50% Sand, 35% Silt.	4388.4 / 70	
			ML	**CLAYEY SILT:** Light Olive Brown, Very Fine Grained, Very Stiff, Very High Dry Strength, Damp, 60% Silt, 40% Clay, Medium Plasticity.		
SO		2.0			4383.4 / 75	
			ML	**GRAVELLY SILT:** Olive Brown, Gradational Zone from Clayey Silt to Gravelly Silt, Medium Plasticity, Very Stiff, High Dry Strength.		
SO		1.0	GM	**SILTY SANDY GRAVEL:** Ochre Brown, Poorly Graded, 45% Gravel, 5% Cobbles, 30% Sand, 25% Silt, Damp to Wet, Loose with Zone of Stiff Silt, Low Plasticity.	4378.4 / 80	
			GM	**SILTY SANDY GRAVEL:** Dark Grayish Brown, Poorly Graded, 45% Gravel, 5% Cobbles, 30% Sand, 25% Silt, Damp to Wet, Loose with Zone of Stiff Silt, Low Plasticity.		
SO		2.0			4373.4 / 85	
GW	CTM-GW-MW22D-87-041701		SP	**GRAVELLY SAND:** Olive Brown, Poorly Graded, Loose, Wet, 35% Gravel, 50% Coarse Grained Sand, 10% Cobbles, 5% Silt.		
SO		0.0			4368.4 / 90	Centralizer 4368.4 / 90.0 4367.9 / 90.5
			SP	**SAND:** Moderately to Poorly Graded, Medium to Coarse Grained, Moderately Rounded.		
SO		2.0			4363.4 / 95	
			CL	**SILTY CLAY:** Tan-Gray, Slightly Stiff.		
					4358.4	

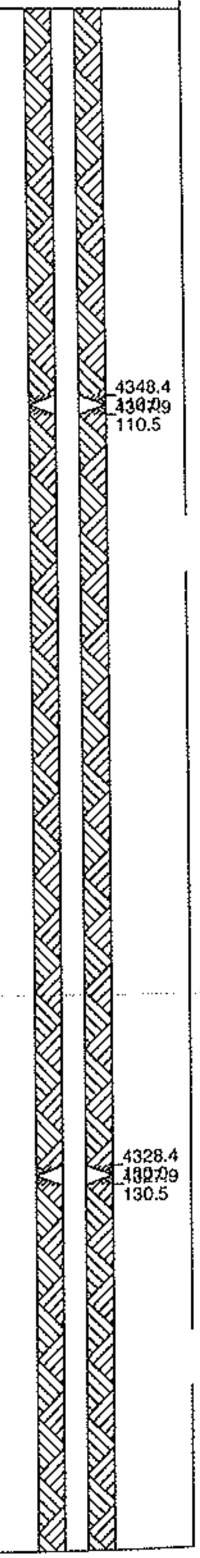
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-22D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		1.0	SW	**SAND:** Fine to Medium Grained, Well Sorted, Gray.	4358.4 / 100
			SP	**GRAVELLY SAND:** Poorly Sorted, Coarse to Fine Grained Sand, Brown Gray, 25% Gravel, 50% Coarse Sand, 25% Fine Sand.	
SO		1.0			4353.4 / 105
GW	CTM-GW-MW22D-107-04170		CL	**SILTY CLAY:** Tan-Gray, Stiff, Damp.	
			ML	**CLAYEY SILT:** Tan Brown, Clayey Sand to Clayey Silt.	
SO		3.0	SC	**CLAYEY SAND:** Poorly Sorted, <15% Gravel, 60% Clayey Sand, 20-25% Coarse Sand, Tan.	4348.4 / 110
			CL	**SILTY CLAY:** Tan to Ochre Brown, Slightly Plastic, Dry, Stiff.	
SO		3.0			4343.4 / 115
SO		2.0			4338.4 / 120
SO		3.0	CL-ML	**SILTY CLAY:** Firm, Dry, Stiff, Silty Clay to Clayey Silt, Yellow Brown to Olive Brown, Orange/Brown Staining.	4333.4 / 125
GW	CTM-GW-MW22D-127-04180				
			SP	**GRAVELLY SAND:** Poorly Sorted, Coarse Grained, Light Brown, Soft, Wet, 60% Sand, 10% Gravel, 10% Fine Grained Sand, 20% Clay.	
			GM-GC	**SILTY CLAYEY COBBLES:** Blue-Gray Andesite Cobbles and Blue Gray Silty Clay, Dry.	
SO		3.0	SM	**SILTY SAND:** Medium to Coarse Grained, 80% Sand, 20% Silt, Brown to Bown/Gray.	4328.4 / 130
			GC	**CLAYEY GRAVEL:** Poorly Sorted, Andesite Cobbles, Dry, Hard Silt, Olive Brown-Gray, 30% Cobbles, 20% Gravel, 50% Clay.	
SO	CTM-SL-MW22D-135-041801	17			4323.4 / 135
			SM	**SILTY SAND:** Olive Gray, Fine to Medium Grained, Well Sorted.	
					4318.4

Well Construction Detail



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/7/01

CAMP DRESSER & McKEE

CDM

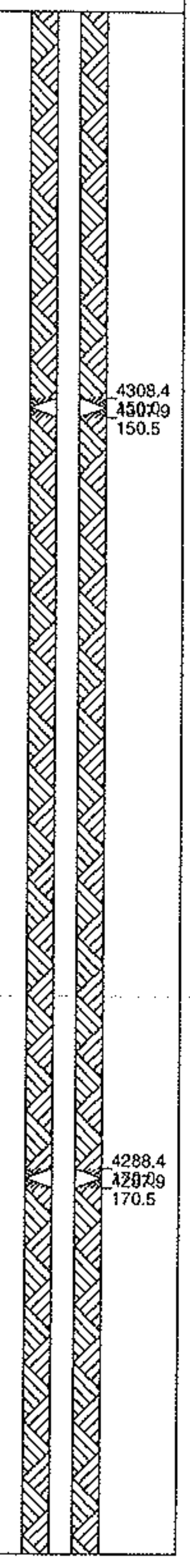
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-22D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		1.0	SM		4318.4 / 140
			GC	**CLAYEY GRAVEL:** Olive Gray, 25% Gravel, 50-75% Silty Clay, Dry, Hard.	
SO		<1.0			4313.4 / 145
GW	CTM-GW-MW22D-147-04180		SM	**SILTY SAND:** Moderately Sorted, Coarse Grained to Fine Grained Sand, Brown to Olive Gray, 80% Sand, 20% Silty Clay, Minor Small Gravel Stringers.	
SO		0.0			4308.4 / 150
			SM	**SILTY SAND:** Well Sorted, Fine to Medium Grained, Light Gray Ochre, 90% Sand 10% Silt.	
SO		0.0			4303.4 / 155
SO		<1.0			4298.4 / 160
SO		<1.0			4293.4 / 165
			CL	**SILTY CLAY:** Brown/Gray, Dry, Hard, Ochre Staining.	
GW	CTM-GW-MW22D-167-04180				
			SW	**SAND:** Well Sorted, Medium to Fine Grained, Brown to Orange Brown.	
SO		3.0			4288.4 / 170
			CL	**SILTY CLAY:** Tan Brown, Dry, Slightly Plastic, Hard, Silt Stringers.	
			MH	**DIATOMACEOUS:** Tan, Slightly Moist and Spongy to Touch, Sediment and Diatomaceous Earth.	
			CL	**SILTY CLAY:** Tan Brown, Dry, Slightly Plastic, Hard, Silt Stringers.	
SO		6.0			4283.4 / 175
			ML	**CLAYEY SILT:** Brown to Olive Brown.	
					4278.4

Well Construction Detail



CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-22D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
					4278.4	
SO		6.0	ML		180	
			CL	**SILTY CLAY:** Dry, Tan-Gray, Hard to Very Stiff, Yellow Orange Mineral Alteration Streaking, Slightly Plastic.		
SO		8.0			4273.4 / 185	
GW	CTM-GW-MW22D-187-04180					
SO		2.0			4268.4 / 190	4268.4 / 4267.9 / 190.5
SO		<1.0			4263.4 / 195	
			ML	**CLAYEY SILT:** Silt to Clayey Silt, Olive Gray with Minor Orange Streaks, Stiff, 90% Silt, 10-20% Clay.		
SO		<1.0	CL	**SILTY CLAY:** Dry, Slightly Plastic, Tan, Moderately Stiff.	4258.4 / 200	
			SM	**SILTY SAND:** Dark Brown to Brown, Fine Grained Sand, Well Sorted, 80-90% Sand, 10-20% Silt.		
SO		1.5			4253.4 / 205	
GW	CTM-GW-MW22D-207-04190		SW	**SAND:** Brown, Medium to Coarse Grained, Loose, Damp.		
SO		1.0	SM	**SILTY SAND:** Tan Brown to Olive Brown, Fine Grained, Soft, Loose to Medium Dense, Damp.	4248.4 / 210	4248.4 / 4247.9 / 210.5
			SM	**SILTY SAND:** Dark Grayish Brown to Dark Yellow Brown, Medium Grained, Loose, Damp, 90% Sand, 10% Silt, Minor Gravel.		
SO		2.0			4243.4 / 215	
						Bentonite Pellets 4240.4 / 218.0
					4238.4	

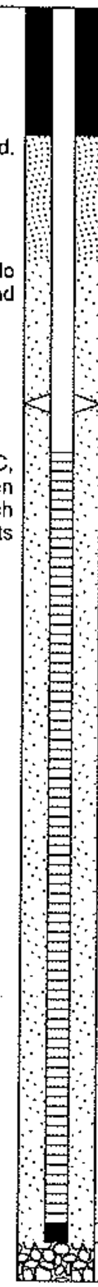
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-22D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		1.0	SM		4238.4 / 220
			SP	**GRAVELLY SAND:** Dark Yellowish Brown, Coarse Grained Sand with Gravel, Loose, Wet, 20% Gravel, 70% Sand, 10% Silt.	
SO		1.0			4233.4 / 225
GW	CTM-GW-MW22D-227-04190		GP	**SANDY GRAVEL:** Dark Grayish Brown, Poorly Graded, 60% Rounded Gravel, 30% Sand, 10% Silt, Loose, Wet.	
SO		1.0			4228.4 / 230
			ML	**SANDY SILT:** Pale Olive to Light Yellow Brown, 60% Silt, 40% Fine Grained Sand, Minor Medium Grained Interbedded Sand, Low to Medium Plasticity, Stiff, Damp, Ochre Iron Staining.	
SO		1.0			4223.4 / 235
			GP	**SANDY GRAVEL:** Brown, Poorly Graded, Loose, Wet, 60% Gravel, 35% Sand, <5% Silt.	
SO		1.0			4218.4 / 240
			SM	**SILTY SAND:** Tan Brown, Sandy Silt to Silty Sand, 50% Fine Grained Sand, 40% Silt, Medium Plasticity, Very Stiff, <10% Clay, Damp.	
SS	CTM-SL-MW22D-243.5-04190				
SO	CTM-SL-MW22D-244-041901				
SO		1.0			4213.4 / 245
			SM	**SILTY SAND:** Dark Gray Brown to Charcoal Gray, 80% Sand, 20% Silt, Loose, Wet.	
			ML	**CLAYEY SILT:** Dark Olive Gray, 70% Silt, 20% Clay, Trace Sand, Slightly Damp, Very Stiff, Low Plasticity.	
SO		1.0			4208.4 / 250
			SM	**SILTY SAND:** Dark Olive Gray, 60% Medium Grained Sand, 35% Fine Grained Sand, 5% Silt, Competent but Loose, Damp to Wet, Minor Iron Staining.	
GW	CTM-GW-MW22D-253-04190				
					4203.4 / 255
					4198.4

Well Construction Detail



CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-23D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/9/01 **End:** 3/13/01
Borehole Coordinates:
N 14,848,390.90 E 2,288,630.58
Development Date: Start 4/5/01 **End** 4/5/01

Casing Elevation (ft.): 4417.51
Total Depth (ft.): 186
Depth to Initial Water Level (ft. BGS): 7.5
Development Method: Pumping
Field Screening Instrument: PID
Logged By: B. Richmond/D. Dragon
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
							Protective Casing
						4417.5	*Ground Surface*
			ML	Surface: Sand and Gravel **SANDY SILT:** 50% Silt, 35% Sand, 20% Organics (roots), Brown to Black, Loose.		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
SO		2.0				4412.5 5	Cement Seal. 4412.5 5.0
SO	CTM-SL-MW23D-7-030901		SM	**GRAVELLY SILTY SAND:** 50% Sand, 30% Silt, 20% Gravel, Loose, Wet, Brownish Gray.			
SO		0.0	SM	**SAND and SILT:** 50% Silt, 50% Coarse to Medium Grained Sand, Brown Gray, Wet, Firm to Moderately Firm, Low Plasticity.		4407.5 10	Sch. 80 PVC, 2-inch diam. Blank Casing 4407.5 10.0
GW/SO	CTM-GW-MW23D-15-030901	1.0				4402.5 15	
			SP-SM	**GRAVELLY SILTY SAND:** 50% Sand, 30% Silt, 20% Gravel, Loose, Wet, Brownish Reddish Gray.		4397.5	Volclay Grout Seal. 4399.5 18.0

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- HA - Hand Auger
- AR - Air Rotary
- DTR - Dual Tube Rotary
- FR - Foam Rotary
- MR - Mud Rotary
- RC - Reverse Circulation
- CT - Cable Tool
- JET - Jetting
- D - Driving
- DTC - Drill Through Casing

SAMPLING TYPES:
- SG - Soil Gas
- SO - Soil from Core
- GW - Groundwater Sample
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

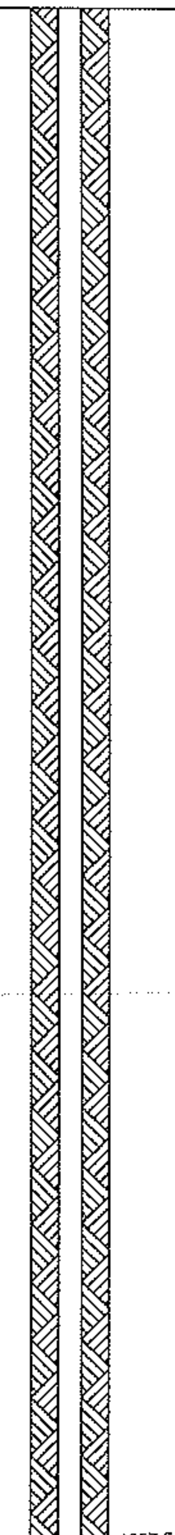
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-23D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4397.5
SO		1.0	SP-SM		20
SO		1.0			4392.5 / 25
			SM	**SANDY SILT:** 60% Sand, 40% Silt, Soft, Low Plasticity, Brownish Gray, Wet to Damp.	
SO		1.0			4387.5 / 30
				No Sample Return.	
SO		1.0			4382.5 / 35
GW	CTM-GW-MW23D-36.5-030901		ML	**SANDY SILT:** 60% Silt, 40% Fine Grained Sand, Hard, Dry, Brownish Tan Gray.	
SO		1.0			4377.5 / 40
			SM	**SILTY SAND:** 80% Sand, 20% Silt, Loose, Reddish Brown, Wet.	
SO		2.0			4372.5 / 45
			ML	**SANDY SILT:** 60-70% Silt, 20-30% Sand, Hard, Damp, Brownish Tan, Low Plasticity.	
SO		3.0			4367.5 / 50
			CL	**SILTY SANDY CLAY:** 10% Sand, 10% Silt, 70% Clay, Reddish Brown, High Plasticity, Hard.	
SO		1.0			4362.5 / 55
GW	CTM-GW-MW23D-56.5-030901		SM	**SILTY SAND:** 40% Silt, 60% Sand, Thin Ribbons of Hard Sandy Silt, Brownish Gray, Loose, Intermittent Oxidation.	
					4357.5

Well Construction Detail



CAMP DRESSER & McKEE

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7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-23D

Client: Washoe County Dept. of Water Resources

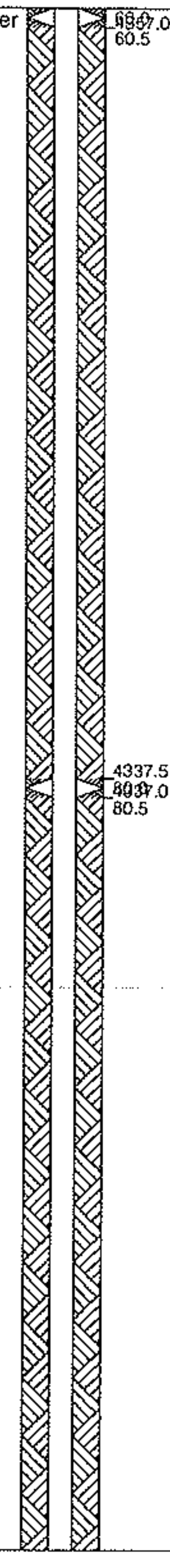
Project Name: Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4357.5
SO		1.0	SM		60
SO		1.0			4352.5 / 65
			SP	**SAND:** Coarse Grained Sand, Little or No Fines, Dark Brown, Loose, Wet, Well Sorted, Increasing Gravel with Depth (5-10%).	
SO		1.0			4347.5 / 70
SO		1.0			4342.5 / 75
GW	CTM-GW-MW23D-76.5-030901				
SO		2.0			4337.5 / 80
					4332.5 / 85
					4327.5 / 90
					4322.5 / 95
GW	CTM-GW-MW23D-96.5-030901		ML	**SANDY SILT:** <20% Sand, Small Lenses of Darker Organic Silts, Gray Blue, Grading to Increasing Sand at 100 feet.	
					4317.5

Well Construction Detail



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/7/01

CAMP DRESSER & McKEE

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7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-23D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
SO		1.0	ML	**SANDY SILT:** <20% Sand, Gray Blue.		4317.5 / 100	
SO		1.0	ML	**SANDY SILT:** Grading from 10% Sand to 20-30% Sand at 106 feet, Gray Blue.		4312.5 / 105	
SO		1.0	ML	**SANDY SILT:** 6-inch Layer of Silty Greenish Medium Grained Sand at 112.5 feet, 60% Sand.		4307.5 / 110	
SO		1.0				4302.5 / 115	
GW	CTM-GW-MW23D-116.5-031201						
			SM	**SILTY SAND:** 60% Sand, 20% Silt, Brown.		4297.5 / 120	
			SM	**SILTY SAND:** Unconsolidated, Medium To Coarse Grained Sand, 10% Silt, Increasing Coarse Sand with Depth.		4292.5 / 125	
			SM	**SILTY SAND:** Medium to Coarse Grained, Poorly Graded, Black, 90% Sand, 10% Silt.		4287.5 / 130	4287.5 / 4287.0 / 130.0 / 130.5
			ML	**SANDY SILT:** Greenish, 20% Sand Grading to Less than 10% Sand.		4282.5 / 135	
SO		3.0					
GW	CTM-GW-MW23D-136.5-031201		ML	**SANDY SILT:** Medium to Coarse Grained Sand, Unconsolidated, Increasing Stiff Gray Silty Sand with Depth, 60% Silt, 40% Sand.			
			ML	**SANDY SILT:** Low Plasticity, Gray, 20-40% Fine Grained Sand.		4277.5	

CAMP DRESSER & McKEE

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Reno, NV 89511

MONITORING WELL DETAIL
CTM-23D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		1.0	ML		4277.5 / 140
					4272.5 / 145
			SM	**SILTY SAND:** Brown, Fine Grained Sand, 20% Silt.	
SO		1.0			4267.5 / 150
			SM	**SILTY SAND:** 40% Silt.	
			SM-SP	**SILTY GRAVELLY SAND:** 1 to 2-inch Diam. Cobbles, Brown.	
SO		2.0			4262.5 / 155
GW/SO	CTM-GW-MW23D-160-031201	4.0			4257.5 / 160
SO		3.0			4252.5 / 165
			SM	**SILTY SAND:** Tan Brown, Fine Grained Sand, 20-40% Silt, Micaceous.	
SO		5.0			4247.5 / 170
			ML	**SANDY SILT:** Stiff, Brown, Dense, Micaceous.	
SS	CTM-SL-MW23D-175-031201	4.0			4242.5 / 175
SO	CTM-SL-MW23D-176.5-031201				
					4237.5

Well Construction Detail

CAMP DRESSER & McKEE

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7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-23D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
						4237.5	
GW	CTM-GW-MW23D-180-03120		ML			180	
						4232.5 / 185	
						4227.5 / 190	
						4222.5 / 195	
						4217.5 / 200	
						4212.5 / 205	
						4207.5 / 210	
						4202.5 / 215	
						4197.5	

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

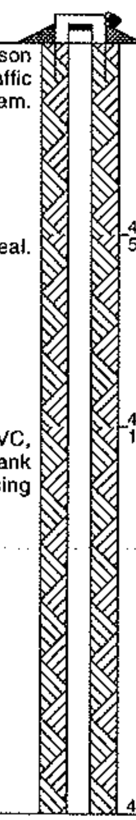
MONITORING WELL DETAIL
CTM-25D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Philip Cramer
Drilling Date: Start: 3/6/01 **End:** 3/15/01
Borehole Coordinates:
N 14,852,490.57 E 2,293,011.41
Development Date: Start 4/13/01 **End** 4/13/01

Casing Elevation (ft.): 4397.15
Total Depth (ft.): 182
Depth to Initial Water Level (ft. BGS): 15
Development Method: Pumping
Field Screening Instrument: PID
Logged By: K. Dierberger
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
					4397.2	Protective Casing; *Ground Surface*
			SM	Surface: Gravelly Sand **SILTY SAND:** Fill, 10% Silt, Fine To Coarse Grained Sand, 20% Subrounded Gravel, Loose, Dry, Brown, Non-Plastic.	0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
			ML	**SANDY SILT:** 20-30% Fine To Medium Grained Sand, Dark Brown, Stiff, Non-Plastic, Dry.		
SO		2.0	ML	**SANDY SILT:** 5-10% Fine Grained Sand, Stiff, Plastic, Damp, Brown.	4392.2 / 5	Cement Seal. (4392.2 / 5.0)
			SM	**SILTY SAND:** 20-30% Silt, Fine To Coarse Grained Sand, Stiff, Non-Plastic, Grayish Brown, Moist, Poorly Sorted, <1% Gravel.		
SO		2.0			4387.2 / 10	Sch. 80 PVC, 2-inch diam. Blank Casing (4387.2 / 10.0)
			SM	**SILTY SAND:** 5-10% Silt, Fine To Coarse Grained Sand, Loose, Wet, Grayish Brown, <1% Cobbles and Gravel.		
GW/SO	CTM-GW-MW25D-15-030601	3.0			4382.2 / 15	
					4377.2	4377.2



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-25D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)	Well Construction Detail
					4377.2	
SO		2.0	OH	**SILTY CLAY:** 5-10% Silt, Stiff, Grayish Brown, Plastic, Damp.	20	Volclay Grout Seal. 20.0
			ML	**SANDY SILT:** 10-25% Fine To Medium Coarse Grained Sand, Stiff, Moderate To Low Plasticity, Grayish Brown, Damp.		
SO		3.0			4372.2 25	
						Centralizer 4370.2 27.0 4369.7 27.5
SO		3.0			4367.2 30	
			SM	**SILTY SAND:** 5-10% Silt, Fine To Coarse Grained Sand, Loose, Wet, Grayish Brown, <1% Cobbles and Gravel.		
SO		1.0			4362.2 35	
GW	CTM-GW-MW25D-36-030701		ML	**SANDY SILT:** 10-25% Fine To Medium Coarse Grained Sand, Stiff, Moderate To Low Plasticity, Grayish Brown, Damp.		
SO		1.0			4357.2 40	
			SM	**SILTY SAND:** 5-10% Silt, Fine To Coarse Grained Sand, Loose, Wet, Grayish Brown, <1% Cobbles and Gravel.		
SO		2.0	ML	**SANDY SILT:** 10-25% Fine To Medium Coarse Grained Sand, Stiff, Moderate To Low Plasticity, Grayish Brown, Damp, Intermittent Stringers of White Material (Gypsum? or Diatomaceous?).	4352.2 45	
SO		2.0			4347.2 50	
GW	CTM-GW-MW25D-54-030701					
SO		2.0			4342.2 55	
					4337.2	

CAMP DRESSER & McKEE

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7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-25D

Client: Washoe County Dept. of Water Resources

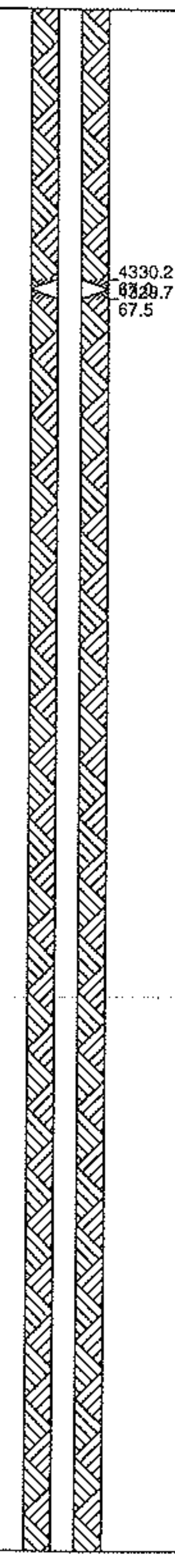
Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		4.0	ML		4337.2 / 60
SO		2.0			4332.2 / 65
			ML	**SANDY SILT:** 10-25% Fine To Medium Coarse Grained Sand, Stiff, Moderate To Low Plasticity, Grayish Brown, Damp, Intermittent Stringers of White Material (Gypsum? or Diatomaceous?), Intermittent Layers of Fine Grained Sand that is Reddish Brown.	
			GM	**SILTY SANDY GRAVEL and COBBLES:** 10-20% Silt, 30-40% Fine To Very Coarse Grained Sand, Subrounded Gravel and Cobbles, Loose, Wet, Gray, Poorly Sorted.	
SO		3.0			4327.2 / 70
GW/SO	CTM-GW-MW25D-75-030701	1.0	OL	**SANDY SILT:** 10-15% Fine Grained Sand, Moderately Stiff, Non-Plastic, Moist, Well Sorted, Brown with Gray To Black Stringers (Organic Material?).	4322.2 / 75
SO		3.0			4317.2 / 80
			SM	**SILTY SAND:** 10-25% Silt, Loose, Moist, Grayish Brown, Non-Plastic, Fine To Coarse Grained Sand, Intermittent Silt Stringers with Fine Grained Sand (Organic Material?).	
SO		3.0			4312.2 / 85
SO		2.0			4307.2 / 90
			GM	**SILTY SANDY GRAVEL and COBBLES:** 10-20% Silt, 30-40% Fine To Very Coarse Grained Sand, Subrounded Gravel and Cobbles, Loose, Wet, Gray, Poorly Sorted.	
SO		2.0			4302.2 / 95
GW	CTM-GW-MW25D-97-030701				
					4297.2

Well Construction Detail



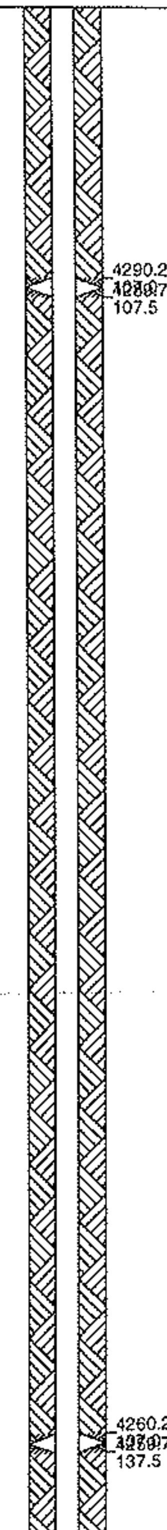
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-25D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4297.2
SO		1.0	GM		100
					4292.2
SO		2.0			105
					4287.2
SO		2.0			110
					4282.2
SO		1.0			115
GW	CTM-GW-MW25D-117-03080		ML	**SANDY SILT:** 10-15% Fine Grained Sand, Moderately Stiff, Non-Plastic, Moist, Well Sorted, Grayish Brown.	
					4277.2
SO		1.0			120
					4272.2
SO		1.0			125
			ML	**SANDY SILT:** 20-25% Fine Grained Sand, Moderately Stiff, Non-Plastic, Moist, Well Sorted, Grayish Brown.	
			ML	**SANDY SILT:** 40-50% Fine Grained Sand, Moderately Stiff, Non-Plastic, Moist, Well Sorted, Gray.	
					4267.2
SO		3.0			130
			SM	**SILTY SAND:** 10% Silt, Loose, Fine To Coarse Grained Sand, Wet, Dark Gray, 1-10% Gravel, Rounded to Subrounded.	
					4262.2
SO		1.0			135
GW	CTM-GW-MW25D-137-03140				
					4257.2

Well Construction Detail



CAMP DRESSER & McKEE

CDM

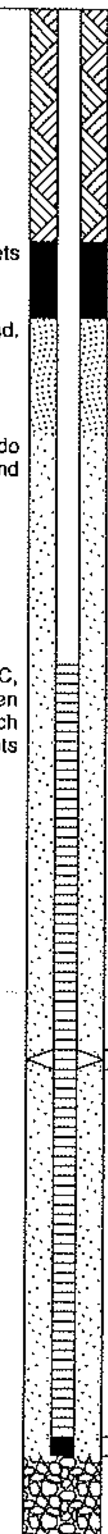
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-25D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		2.0	SM		4257.2 / 140
SO		2.0			4252.2 / 145
SO		2.0			4247.2 / 150
SO		1.0			4242.2 / 155
GW	CTM-GW-MW25D-157-03140		SM	**SILTY SAND:** Micaceous, Fine To Coarse Grained, 10-20% Silt, Loose, Grayish Green, Wet.	
SO		1.0			4237.2 / 160
			ML	**SANDY SILT:** 10-20% Fine To Medium Grained Sand, Micaceous, Stiff, Non-Plastic, Damp, Grayish Green.	
SO		1.0			4232.2 / 165
SS	CTM-SL-MW25D-166-031401				
SO	CTM-SL-MW25D-168-031401				
SO		1.0			4227.2 / 170
SO		2.0			4222.2 / 175
			SM	**SILTY SAND:** Micaceous, Fine To Coarse Grained, 10-20% Silt, Loose, Grayish Green, Wet.	4217.2

Well Construction Detail



CAMP DRESSER & McKEE

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7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-25D

Client: Washoe County Dept. of Water Resources

Project Name: Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
						4217.2	
GW	CTM-GW-MW25D-180-031401					180	
							4215.2 / 182.0
						4212.2 / 185	
						4207.2 / 190	
						4202.2 / 195	
						4197.2 / 200	
						4192.2 / 205	
						4187.2 / 210	
						4182.2 / 215	
						4177.2	

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-27D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Philip Cramer
Drilling Date: Start: 04/02/01 **End:** 04/04/01
Borehole Coordinates:
N 14,860,973.68 E 2,278,708.56
Development Date: Start 4/6/01 **End** 4/6/01

Casing Elevation (ft.): 4470.91
Total Depth (ft.): 180
Depth to Initial Water Level (ft. BGS): 7
Development Method: Pumping
Field Screening Instrument: PID
Logged By: B. Richmond/ J. Benedict
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)
						4470.9
			SM-SP	Surface: Asphalt **GRAVELLY SILT and SAND:** Moist, Moderately Stiff, Low Plasticity, Light Brown, 40% Silt, 40% Sand, 20% Gravel.		0
SO		0.0	SM-SP	**GRAVELLY SILTY SAND:** Damp, Loose, Light Brown With Dark Gray, 50% Sand, 30% Silt, 20% Gravel.		4465.9 5
GW SO	CTM-GW-MW27D-7-040201 CTM-SL-MW27D-7-040201		SM-SP	**GRAVELLY SILTY SAND:** Wet, Loose, Coarse Grained Sand, Cobbles up to 8-inch Diam., Light to Dark Brown, 80% Sand and Gravel, 20% Silt.		
SO		0.0				4460.9 10
SO		0.0				4455.9 15
			SP	**GRAVELLY SAND:** Poorly Sorted, Coarse Grained Sand and Gravel, 5 to 8-inch Diam. Cobbles, 10% Silt, 50% Gravel, 40% Sand, Light Brownish Gray, Wet, Loose.		
						4450.9

Well Construction Detail

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-27D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4450.9 / 20
SO		0.0	SP		
			SM-SP	**GRAVELLY SILTY SAND:** Medium Grained Sand, Wet, Loose, 60-70% Sand, 20% Gravel, 10-20% Silt, Brownish Gray, Poorly Sorted.	4445.9 / 25
SO		0.0			
					4440.9 / 30
SO		0.0			
GW	CTM-GW-MW27D-33-040201		GP	**SANDY GRAVEL:** Gravel with Alternating Coarse Grained Sand Layers, 10% Fine Grained Sand, Gray Brown, Wet, Very Loose.	
					4435.9 / 35
SO		1.0			
			BOULDER	**BOULDER**	
			SM	**SILTY SAND:** Medium to Coarse Grained Sand with 20-25% Silt, Damp, Loose, Reddish Brown.	
					4430.9 / 40
SO		1.0			
			GM	**SANDY SILTY GRAVEL:** 60% Gravel, 40% Fine Grained Sand and Silt, Moderately Hard, Light Gray, Brown, Wet.	4425.9 / 45
SO		0.0			
			BOULDER	**BOULDER:** Ryolite, Red.	
					4420.9 / 50
SO		0.0	SP	**SAND:** Coarse Grained Sand, Little Or No Fines, Wet, Very Loose, Dark Gray.	
			GM	**SILTY SANDY GRAVEL:** Wet, Loose, Medium Grained Sand, 3 to 7-inch Diam. Cobbles, Top Foot is Reddish Brown, Grades To Yellow Orange Brown with Depth, 50% Gravel, 30% Sand, 20% Silt.	
					4415.9 / 55
SO		0.0			
GW	CTM-GW-MW27D-56-040201				
					4410.9

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-27D

Client: Washoe County Dept. of Water Resources

Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
SO		1.0	GM		4410.9 / 60	
			GM	**SILTY SANDY GRAVEL:** Damp, Moderately Dense, Medium Grained Sand, 3 to 7-inch Diam. Cobbles, Yellow Orange Brown, 50% Gravel, 30% Sand, 20% Silt.		
			GM	**SILTY SANDY GRAVEL:** 50% Gravel, 30% Silt, 20% Sand, Grade Wet To Dry, Yellowish Orange, Wet is Hard, Dry Is Loose, 3 to 6-inch Diam. Cobbles.		
SO		3.0			4405.9 / 65	
			GM	**SILTY SANDY GRAVEL:** 50% Gravel, 20% Silt, 30% Coarse Grained Sand, Wet, Yellowish Orange, Hard, 3 to 6-inch Diam. Cobbles.		
SO		2.0	BOULDER	**BOULDER:** Granite.	4400.9 / 70	
			GM	**SILTY SANDY GRAVEL:** 50% Gravel, 20% Silt, 30% Coarse Grained Sand, Wet, Yellowish Orange, Hard, 3 to 6-inch Diam. Cobbles.		
			GM	**SILTY GRAVEL:** Gravel is Subrounded, Wet, Loose, 8 to 10-inch Diam. Cobbles, Olive Gray, 30-40% Silt, 70% Gravel.		
			SM	**GRAVELLY SILTY SAND:** Coarse Grained Sand, 60% Sand, 20% Gravel, 10-20% Silt, Light Brown with Orange Staining, Wet, Medium Dense To Loose, Gravel Subrounded.	4395.9 / 75	
GW	CTM-GW-MW27D-77-040301		SM	**SILTY GRAVELLY SAND:** Olive Gray to Olive Brown, Poorly Graded Gravel With Cobbles (>10% Fines), 40% Sand, 30% Gravel, 20% Cobbles, 10% Silt, Wet, Loose to Medium Dense in Zones with Increase Silt.		
SO		0.0			4390.9 / 80	Centralizer 4390.9 80.4 80.5
SO		0.0			4385.9 / 85	
			SP	**GRAVELLY SAND:** Olive Gray to Olive Brown, Coarse Grained Gravelly Sand to Sandy Gravel, Poorly Graded, Loose to Medium Dense, Wet, Rounded Gravel, 50% Sand, 35% Gravel, 10% Cobbles, 5% Silt.		
SO		0.0			4380.9 / 90	
			GP	**SANDY GRAVEL:** Olive Gray to Olive Brown, Coarse Grained, Poorly Graded, Loose to Medium Dense, Wet, Rounded Gravel, 40% Sand, 25% Gravel, 30% Cobbles, 5% Silt.		
SO		0.0			4375.9 / 95	
			SP	**GRAVELLY SAND:** Ochre Brown, Loose to Medium Dense, Wet to Damp, 50% Sand, 35% Rounded Gravel, 5% Cobbles, 10% Silt.		
GW	CTM-GW-MW27D-97-040301					
					4370.9	4370.9

CAMP DRESSER & McKEE

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7025 Longley Lane, Ste 20
Reno, NV 89511

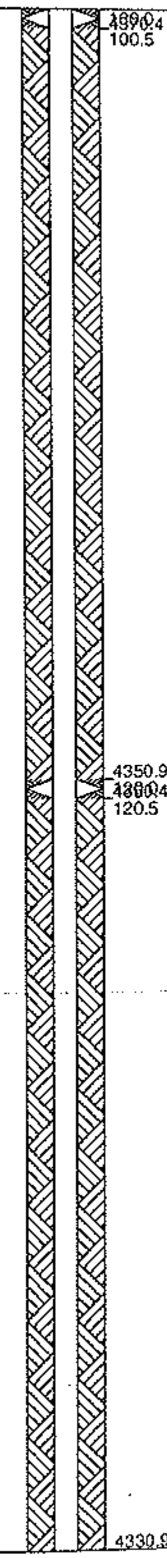
MONITORING WELL DETAIL
CTM-27D

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4370.9
SO		0.0	SP		100
			SP	**GRAVELLY SAND:** Ochre Brown, Loose to Medium Dense, Wet to Damp, 40% Sand, 35% Rounded Gravel, 15% Cobbles, 10% Silt.	4365.9
SO		0.0			105
					4360.9
SO		1.0	GM	**SANDY SILTY GRAVEL:** Ochre Brown, Loose to Medium Dense, Wet, Matrix has Low to Medium Plasticity, Gravel and Cobbles are Rounded, 35% Sand, 35% Gravel, 15% Cobbles, 10-15% Silt With Clay.	110
					4355.9
SO		2.0			115
			GM	**SILTY SANDY GRAVEL:** Ochre Brown to Olive Brown, Medium Dense, Little to No Cobbles, Silty to Weakly Clayey, Matrix is Variably Iron Stained to Ochre or Charcoal Gray (where More Clayey), Damp but not Wet, Matrix Fines Have Low To Medium Plasticity, 35% Gravel, 5% Cobbles, 40% Sand, 20% Silt And Clay.	
GW	CTM-GW-MW27D-117-04030				
					4350.9
SO		0.0			120
					4345.9
SO		1.0			125
			GM	**SILTY SANDY GRAVEL:** Ochre Brown to Olive Brown, Loose to Medium Dense, Little to No Cobbles, Silty to Weakly Clayey, Matrix is Variably Iron Stained to Ochre or Charcoal Gray (where More Clayey), Dry to Damp, Matrix Fines have Low Plasticity, 35% Gravel, 10% Cobbles, 35% Sand, 20% Silt And Clay.	4340.9
SO		0.0			130
					4335.9
SO		1.0			135
GW	CTM-GW-MW27D-136-04030				
					4330.9

Well Construction Detail



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-27D

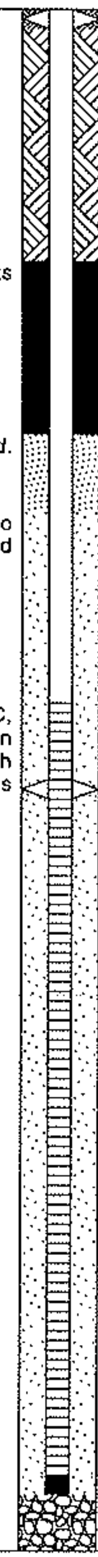
Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Elev. / Depth (ft.)
SO		0.0	4330.9 / 140
SO		0.0	4325.9 / 145
SO		0.0	4320.9 / 150
SO		0.0	4315.9 / 155
GW	CTM-GW-MW27D-157-040401		
SO		0.0-	4310.9 / 160
SO		0.0	4305.9 / 165
SS	CTM-SL-MW27D-168.5-040401		
SO	CMT-SL-MW27D-169-040401		
SO		0.0	4300.9 / 170
SO		1.0	4295.9 / 175
			4290.9

Stratum Designation	Material Description
GM	**SILTY SANDY GRAVEL:** Tan Brown to Ochre Brown, Sitly Matrix is Medium Stiff, Zones with Less Silt is Loose And Wet, Silty Matrix has Medium Plasticity, 40% Gravel, 10% Cobbles, 30% Sand, 20% Silt.
GM	**SILTY SANDY GRAVEL:** Yellowish Orange Brown, Wet, Loose, Medium Grained Sand, Subrounded Gravel, 40% Gravel, 20% Silt, 40% Sand, Silt Matrix is Moderately Plasticity.
ML-SM	**GRAVELLY SILT and SAND:** 40% Silt, 40% Fine Grained Sand, 20% Gravel, Moderately Plasticity, Wet, Medium Stiff, Yellow Gray with Streaks of Yellow Orange, Subrounded.
SP	**GRAVELLY SAND:** Minor Silt, Light Grayish Brown, Loose, Wet, 60% Coarse Grained Sand, 35% Subrounded Gravel, 5% Silt.
GM	**GRAVELLY SILTY SAND:** Light Gray Brown, Medium Dense, 30% Silt, 40% Medium Grained Sand, 30% Subrounded Gravel, Band of Silty Sand at 163-164 feet that is Moderately Plasticity, Medium Stiff, and Yellow Orange.
GM	**SILTY GRAVEL and SAND:** Olive Gray, Wet, Loose, Medium Grained Sand, 40% Gravel, 40% Sand, 20% Silt, Loose.
GM	**SILTY GRAVEL:** Well Sorted, Rounded, 20% Silt, 80% Gravel.
ML	**SILT:** Soft, Moderately Plastic.
GM	**SILTY GRAVEL and SAND:** Olive Gray, Wet, Loose, Medium Grained Sand, 40% Gravel, 40% Sand, 20% Silt, Loose.
GM	**SILTY GRAVEL and SAND:** Oxidized Reddish Brown, Wet, Loose, Medium

Graphic Log

Well Construction Detail



CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-27D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
						4290.9	
GW	CTM-GW-MW27D-180-04040			Grained Sand, 40% Gravel, 50% Sand, 10% Silt, Loose.		180	180.0
						4285.9 / 185	
						4280.9 / 190	
						4275.9 / 195	
						4270.9 / 200	
						4265.9 / 205	
						4260.9 / 210	
						4255.9 / 215	
						4250.9	

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-28S

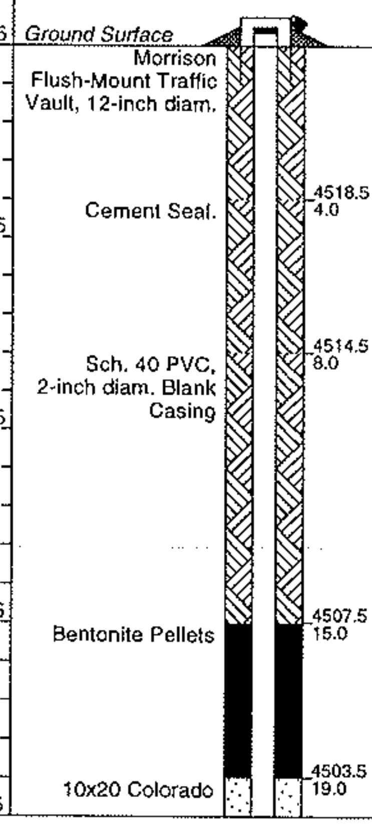
Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/29/01 **End:** 3/30/01
Borehole Coordinates:
N 14,865,635.47 E 2,275,613.82
Development Date: Start 4/2/01 **End** 4/2/01

Casing Elevation (ft.): 4522.46
Total Depth (ft.): 46
Depth to Initial Water Level (ft. BGS): 29.5
Development Method: Pumping
Field Screening Instrument: PID
Logged By: D. Dragon
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4522.5
			SM	Surface: Asphalt **SILTY SAND:** Brown, Coarse to Medium Grained.	0
					4517.5 / 5
SG	CTM-SG-MW28S-10A-032901	0.0			4512.5 / 10
			SM	**SILTY GRAVELLY SAND:** Brown, Slightly Silty Sand and Gravel, Rounded Gravels.	
SO	CTM-SO-MW28S-15-033001	0.0	GM	**SILTY SANDY GRAVEL:** Large Rounded Cobbles and Boulders in Silty Sand Matrix.	4507.5 / 15
					4502.5

Well Construction Detail



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-28S

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
SO		0.0	GM	**SILTY SANDY GRAVEL:** Decreasing Boulder Content, Large Rounded Cobbles and Boulders in Silty Sand Matrix.	4502.5 / 20	Silica Sand
			SM	**SILTY SAND:** Fine to Coarse Grained, Brown.		4499.0 / 23.5 Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots
SO		0.0			4497.5 / 25	
			GM	**SILTY SANDY GRAVEL:** Large Rounded Cobbles and Boulders in Silty Sand Matrix.		
SO		0.0			4492.5 / 30	
GW	CTM-GW-MW28S-32-033001					
SO		<1.0			4487.5 / 35	
			GC	**SILTY CLAYEY GRAVEL:** Large Rounded Cobbles and Boulders in Silty Clayey Matrix, Brown, Wet.		
			GM	**SILTY GRAVEL:** Large Rounded Cobbles and Boulders in Silty Matrix.		
SO		0.0			4482.5 / 40	
SS	CTM-SO-MW28S-42-033001					
SO	CTM-SO-MW28S-43-033001					4479.0 / 4478.5 / 44.0
SO		0.0	CL	**SILTY CLAY:** Stiff.	4477.5 / 45	4476.5 / 46.0
					4472.5 / 50	
					4467.5 / 55	
					4462.5	

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-29S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/22/01 **End:** 3/22/01
Borehole Coordinates:
N 14,864,045.60 E 2,273,769.53
Development Date: Start 3/29/01 **End** 3/29/01

Casing Elevation (ft.): 4520.23
Total Depth (ft.): 36
Depth to Initial Water Level (ft. BGS): 18.2
Development Method: Pumping
Field Screening Instrument: PID
Logged By: J. Benedict
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)	Well Construction Detail
						Protective Casing
					4520.2	*Ground Surface*
			SP-GP	Surface: Asphalt **SAND and GRAVEL:** Hand Augered, Tan Brown, Loose, Dry, 50% Sand, 50% Gravel.	0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
			SP-SM	**GRAVELLY SILTY SAND:** Brown to Ochre Brown, 5-10% Gravel, Stiff, Very Low Plasticity, Dry, Ceramic Pipe (fill?).		Cement Seal. (4516.2 / 4.0)
SO		0.0	SP	**GRAVELLY SAND:** Light Brown, 5% Cobbles, 30% Gravel, 55% Sand, <10% Silt, Loose, Dry.	4515.2 5	Sch. 40 PVC, 2-inch diam. Blank Casing (4515.2 / 5.0) Bentonite Pellets (4514.2 / 6.0)
SO	CTM-SL-MW29S-10-032201	2.0		No Sample Return.	4510.2 10	10x20 Colorado Silica Sand (4510.2 / 10.0)
			SP	**GRAVELLY SAND:** Light Gray Brown, 50% Sand, 35% Gravel, 10% Cobbles, 5% Silt, Loose.		
SO		1.0	SP	**GRAVELLY SAND:** Light Gray Brown, 50% Sand, 35% Gravel, 10% Cobbles and Boulders, 5% Silt, Loose.	4505.2 15	Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots (4505.2 / 15.0)
			GP	**SANDY GRAVEL:** Gray Brown, Loose, Wet, 60% Gravel, 20% Sand, 15% Cobbles, 5% Silt.	4500.2	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- HA - Hand Auger
- AR - Air Rotary
- DTR - Dual Tube Rotary
- FR - Foam Rotary
- MR - Mud Rotary
- RC - Reverse Circulation
- CT - Cable Tool
- JET - Jetting
- D - Driving
- DTC - Drill Through Casing

SAMPLING TYPES:
- SG - Soil Gas
- SO - Soil from Core
- GW - Groundwater Sample
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CTM MW CTM2001.GPJ CDM_CORP.GDT 9/7/01

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

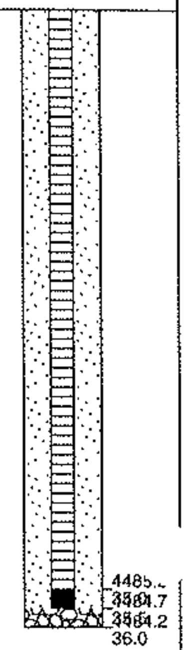
MONITORING WELL DETAIL
CTM-29S

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
					4500.2 20
SO		0.0	GP		
GW	CTM-GW-MW29S-25-032201	0.0			4495.2 25
SS	CTM-SL-MW29S-27-032201		GP	**SANDY GRAVEL:** Gray Brown, Loose, Wet, 60% Gravel, 20% Sand, 5% Cobbles, 15% Silt with Trace of Clay.	
SO	CTM-SL-MW29S-27.5-032201				
SO		0.0	SM	**SILTY SAND:** Olive Brown, Minor Gravel and Clay, Very Soft, Weak Consolidation, Iron Staining of Ochre Color in Finer Matrix, Wet, Very Low Plasticity.	4490.2 30
			ML	**CLAYEY SANDY SILT:** Dark Yellowish Orange, Medium Stiff to Stiff, Medium Plasticity, 20-35% Sand, 60-70% Silt, 5-15% Clay, Damp.	
SO		0.0			4485.2 35
					4480.2 40
					4475.2 45
					4470.2 50
					4465.2 55
					4460.2

Well Construction Detail



CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

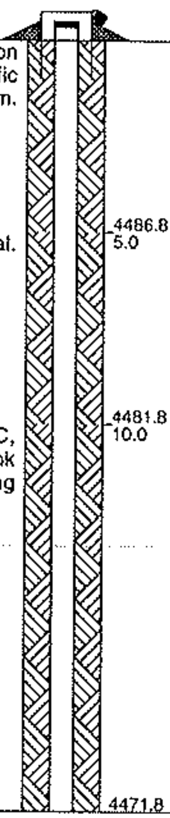
MONITORING WELL DETAIL
CTM-30D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Philip Cramer
Drilling Date: Start: 4/10/01 **End:** 4/12/01
Borehole Coordinates:
N 14,865,293.44 E 2,278,837.66
Development Date: Start 4/13/01 **End** 4/13/01

Casing Elevation (ft.): 4491.80
Total Depth (ft.): 155
Depth to Initial Water Level (ft. BGS): 34
Development Method: Pumping
Field Screening Instrument: PID
Logged By: D. Dragan/E. Evans
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
						Protective Casing
					4491.8	*Ground Surface*
			GP	Surface: Asphalt **SANDY GRAVEL:** Poorly Sorted Cobbles and Gravels with Coarse to Fine Grained Sand.	0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
SO		2.0			4486.8 / 5	Cement Seal. 4486.8 5.0
			SM	**SILTY SAND:** Olive Gray.		
			GP	**SANDY GRAVEL:** Poorly Sorted Cobbles and Gravels with Coarse to Fine Grained Sand.		
SO	CTM-SO-MW30D-9.5-041001					
SO		<1.0			4481.8 / 10	Sch. 80 PVC, 2-inch diam. Blank Casing 4481.8 10.0
			GM	**SILTY CLAYEY SAND and GRAVEL:** Brown, 30% Gravel.		
SO	CTM-SO-MW30D-13-041001					
SO		18			4476.8 / 15	
			CL	**SILTY CLAY:** Brown.		
			BOULDER	**BOULDER:** Andesite, Light Gray Silt Matrix.		
			GM	**SILTY CLAYEY SAND and GRAVEL:** Brown, Moist, Silty Clay Matrix.		
					4471.8	4471.8



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- HA - Hand Auger
- AR - Air Rotary
- DTR - Dual Tube Rotary
- FR - Foam Rotary
- MR - Mud Rotary
- RC - Reverse Circulation
- CT - Cable Tool
- JET - Jetting
- D - Driving
- DTC - Drill Through Casing

SAMPLING TYPES:
- SG - Soil Gas
- SO - Soil from Core
- GW - Groundwater Sample
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: Date:

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-30D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
					4471.8	
SO		1.0	GM		20	Volclay Grout Seal. 20.0
			BOULDER	**BOULDER:** Andesite, Light Gray Silt Matrix.		
			GM	**SANDY SILTY GRAVEL:** Cobbles with Poorly Sorted Gravels, 10-15% Brown Clay.		
SO		0.0			4466.8 / 25	
			GM	**SILTY CLAYEY SAND and GRAVEL:** Reddish Gray and Ochre Brown, Silty Sandy Clay Matrix, 25-35% Sand.		
			GC	**CLAYEY SANDY GRAVEL:** Ochre, 50% Gravel, 30% Sand, 20% Clay.		
SO		0.0			4461.8 / 30	
			COBBLES	**COBBLES**		
			SM	**SILTY SAND:** Gray to Orange, Fine Grained Sand and Silt.		
GW	CTM-GW-MW30D-34-041001					
					4456.8 / 35	
SO		0.0	SW	**SAND:** Gray, Fine Grained, Well Sorted.		
			GM	**SANDY SILTY CLAYEY GRAVEL:** Poorly Sorted, Dry, Tan Gray, 30-40% Fine Grained Sand.		
					4451.8 / 40	
			BOULDER	**BOULDER:** Basalt.		
			CL	**GRAVELLY CLAY:** Cobbles and Gravel with Silty Clay Matrix, Dry, Tan/Gray, Hard, 80% Clay.		
					4446.8 / 45	
			CL	**SILTY CLAY:** Tan/Gray, Stiff, Slightly Plastic.		
			GM-GC	**CLAYEY SANDY GRAVEL:** Brown to Ochre, Poorly Sorted.		
					4441.8 / 50	
						Centralizer 4439.8 / 4439.3 / 52.5
GW	CTM-GW-MW30D-54-041101		GP	**SANDY GRAVEL:** 50% Gravel and Cobbles, 30% Sand.		
					4436.8 / 55	
			SW	**SAND:** Well Sorted, Fine to Medium Grained Sand.		
					4431.8	

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MONITORING WELL DETAIL
CTM-30D

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Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
			SW		4431.8 / 60
			ML	**SANDY SILT:** Very Fine Grained Sand to Silt, Yellow Orange Staining.	4426.8 / 65
			SW	**SAND:** Well Sorted, Fine to Medium Grained Sand.	
			SP-SM	**GRAVELLY SAND and SILT:** Poorly Sorted, Gray.	4421.8 / 70
			SW	**SAND:** Fine Grained, Well Sorted.	
GW	CTM-GW-MW30D-74-041101		SP-SM	**GRAVELLY SAND and SILT:** Poorly Sorted, Gray.	4416.8 / 75
			SM	**SILTY SAND:** Tan, Very Fine Grained, Minor Clay.	
			SP	**SAND:** Coarse Grained, Moderately Sorted, Tan to Gray.	4411.8 / 80
					4406.8 / 85
			OL	**CLAY:** Soft to Stiff, Tan.	4401.8 / 90
GW	CTM-GW-MW30D-94-041101				4396.8 / 95
					4391.8

Well Construction Detail

4419.8
4419.3
72.5

4399.8
4399.3
92.5

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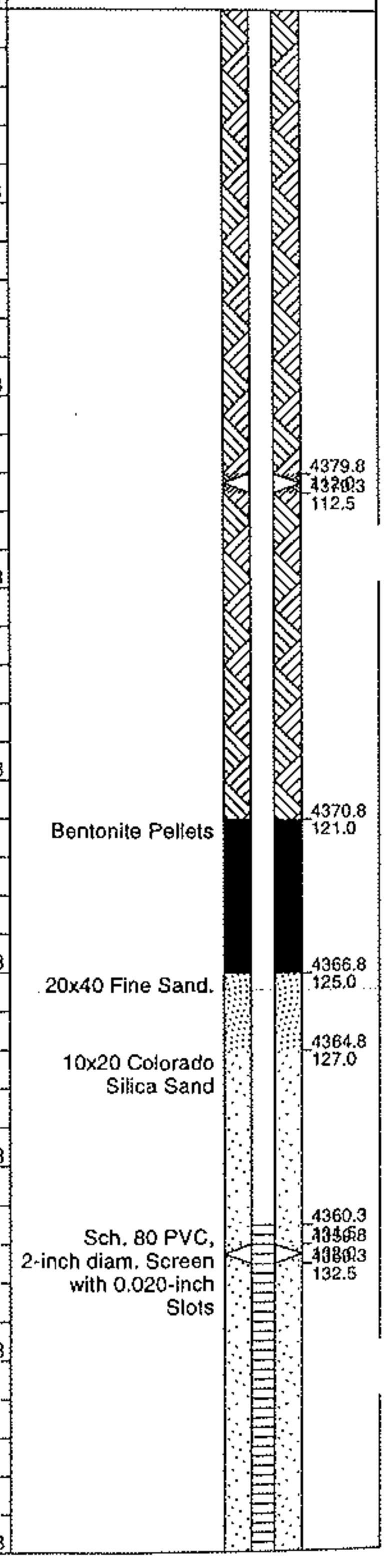
MONITORING WELL DETAIL
CTM-30D

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4391.8
SO		<1.0	GP	**SANDY GRAVEL:** Poorly Sorted Gravel and Coarse Grained Sand.	100
					4386.8
SO		<1.0	SP	**GRAVELLY SAND:** Poorly Sorted, Coarse Grained Sand, 15% Gravel.	105
			GM	**SANDY SILTY GRAVEL:** Poorly Sorted, Coarse Grained Sand, Cobbles, Yellow Orange, Clay Lense at 109 feet.	
					4381.8
SO		<1.0			110
			SP	**GRAVELLY SAND:** Poorly to Moderately Sorted, 15% Gravel.	
GW	CTM-GW-MW30D-114-041101				
					4376.8
SO		<1.0			115
			GP	**SANDY GRAVEL:** Poorly Sorted, Coarse to Medium Grained Sand.	
					4371.8
SO		5.0			120
			GC	**CLAYEY GRAVEL:** 30% Clay, Brown, Hard, Intermittent Silty Clay Layers, Dry.	
					4366.8
SO		12			125
SO	CTM-SO-MW30D-126-041101				
			GC-GM	**SILTY CLAYEY GRAVEL:** Poorly Sorted, Coarse Grained Sand, Silty Clay, 25-40% Gravel, Brown, Hard to Very Soft.	
					4361.8
SO		5.0			130
GW	CTM-GW-MW30D-134-041101				
					4356.8
SO		3.0			135
					4351.8

Well Construction Detail



CAMP DRESSER & McKEE

CDM

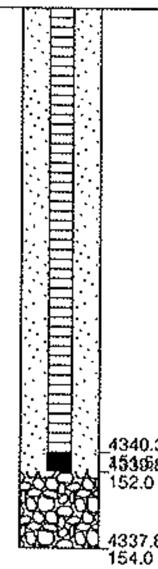
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-30D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		2.0	ML	**GRAVELLY SILTY CLAY:** Hard, Dry, Gray, 20% Gravel.	4351.8 / 140
SS	CTM-SO-MW30D-142-041101				
SO	CTM-SO-MW30D-143-041101		SW	**SAND:** Well Sorted, Medium to Coarse Grained, Gray.	4346.8 / 145
			GM	**SANDY SILTY GRAVEL:** Poorly Sorted, 10% Small Cobbles, Gray, Dry, Stiff.	
SO		2.0			4341.8 / 150
GW	CTM-GW-MW30D-154-04110				
SO		2.0			4336.8 / 155
					4331.8 / 160
					4326.8 / 165
					4321.8 / 170
					4316.8 / 175
					4311.8

Well Construction Detail



CAMP DRESSER & McKEE
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7025 Longley Lane, Ste 20
Reno, NV 89511

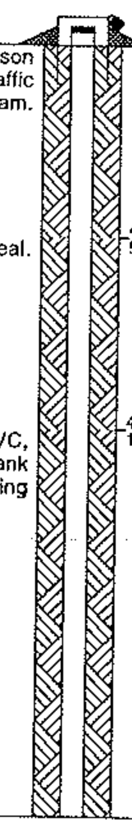
MONITORING WELL DETAIL
CTM-31S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Philip Cramer
Drilling Date: Start: 5/4/01 **End:** 5/4/01
Borehole Coordinates:
N 14,867,356.07 E 2,276,745.51
Development Date: Start 5/15/01 **End** 5/15/01

Casing Elevation (ft.): 4511.64
Total Depth (ft.): 52
Depth to Initial Water Level (ft. BGS): 36.2
Development Method: Pumping
Field Screening Instrument: PID
Logged By: B. Richmond
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
							Protective Casing
			GW	Surface: Asphalt **GRAVEL:** Backfill Gravel For Road Bed.		4511.6 / 0	*Ground Surface* Morrison Flush-Mount Traffic Vault, 12-inch diam.
			SM	**SILTY SAND:** Coarse to Medium Grained, Dry, Loose, 70% Sand, 35% Silt, Light Brown.			
SO		7.0	SM	**SILTY SAND:** Damp, Medium Dense, Fine Grained, 60% Sand, 40% Silt, Light Brown.		4506.6 / 5	Cement Seal. 4506.6 / 5.0
SO		4.0	GM-SM	**SILTY SAND and GRAVEL:** Fine to Coarse Grained, 40% Gravel and Cobbles, 40% Sand, 20% Silt, Light Gray Brown, Dry, Loose, Angular to Subrounded Gravel, Damp, Intermittent Cobble Layers.		4501.6 / 10	Sch. 40 PVC, 2-inch diam. Blank Casing 4501.6 / 10.0
SO		4.0				4496.6 / 15	
						4491.6	



EXPLANATION OF ABBREVIATIONS

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- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
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- CT - Cable Tool
- JET - Jetting
- D - Driving
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SAMPLING TYPES:
- SG - Soil Gas
- SO - Soil from Core
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- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: Date:

CAMP DRESSER & McKEE

CDM

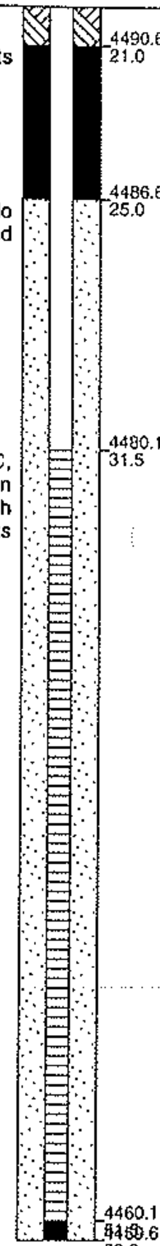
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-31S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)
SO		3.0	GM-SM		4491.6 / 20
SO		4.0			4486.6 / 25
SO		4.0			4481.6 / 30
			GM-SM	**SILTY SAND and GRAVEL:** Fine to Coarse Grained, 40% Gravel and Cobbles, 40% Sand, 20% Silt, Olive Gray, Dry, Loose, Angular to Subrounded Gravel, Damp, Intermittent Cobble Layers.	
SO		9.0			4476.6 / 35
SO	CTM-SL-MW31S-37-050401				
			GM-SM	**SILTY SAND and GRAVEL:** Fine to Coarse Grained, 40% Gravel and Cobbles, 40% Sand, 20% Silt, Olive Gray, Dry, Loose, Angular to Subrounded Gravel, Wet, Intermittent Cobble Layers.	
SO		1.0			4471.6 / 40
GW	CTM-GW-MW31S-41-050401				
SO		4.0			4466.6 / 45
SO	CTM-SL-MW31S-47-050401				
SS	CTM-SL-MW31S-48-050401				
SO		6.0			4461.6 / 50
					4456.6 / 55
					4451.6

Well Construction Detail



CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

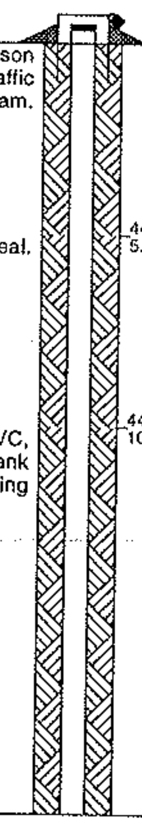
MONITORING WELL DETAIL
CTM-33D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Phillip Cramer
Drilling Date: Start: 4/30/01 **End:** 5/2/01
Borehole Coordinates:
N 14,858,545.21 E 2,285,129.76
Development Date: Start 5/3/01 **End** 5/3/01

Casing Elevation (ft.): 4424.59
Total Depth (ft.): 200
Depth to Initial Water Level (ft. BGS): 24
Development Method: Pumping
Field Screening Instrument: PID
Logged By: B. Richmond
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
							Protective Casing
			GM	Surface: Asphalt **SANDY SILTY GRAVEL:** Poorly Sorted with Cobbles and Boulders, Olive Gray.		4424.6 0	*Ground Surface* Morrison Flush-Mount Traffic Vault, 12-inch diam.
						4419.6 5	Cement Seal. 4419.6 5.0
			SP-SM	**GRAVELLY SILTY SAND:** Poorly Sorted, 25-35% Gravel and Cobbles, 50% Sand, 15-25% Silt.			
			SW	**SAND:** Moist, Coarse Grained.		4414.6 10	Sch. 80 PVC, 2-inch diam. Blank Casing 4414.6 10.0
			BOULDER	**BOULDER:** Diorite.			
			SC	**CLAYEY SAND:** Well Sorted, Coarse Grained, 0-10% Friable Dark Gray Clay starting at 16 feet, Dry, 90-100% Sand, Moist.			
SO	CTM-SL-MW33D-15-043001					4409.6 15	
			GC	**CLAYEY SAND and GRAVEL:** Poorly Sorted, Moist, Dark Gray, Very Soft Clay, 40% Gravel, 40% Sand, 20% Clay.			
			SW			4404.6	



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DRILLING METHODS:
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OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-33D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
						4404.6	
			SW	**SAND:** Well Sorted, Medium to Coarse Grained, Brown to Brown Gray, Very Moist.		20	
			SP	**GRAVELLY SAND:** Well Sorted, Medium to Coarse Grained, Brown to Brown Gray, Very Moist, Large Cobbles.			Volclay Grout Seal. 4402.6 22.0
GW	CTM-GW-MW33D-24-043001		SW	**SAND:** Well Sorted, Medium to Coarse Grained, Brown to Brown Gray, Wet.		4399.6 25	
			CL	**GRAVELLY SILTY CLAY:** Dark Gray, Hard, Dry, Friable, Large Boulders.		4394.6 30	Centralizer 4394.6 30.0 4394.1 30.5
			GC	**CLAYEY SANDY GRAVEL:** Poorly Sorted, Dark Gray, 40-50% Gravel, 10% Cobbles, 30-40% Sand, 0-20% Clay, Moist to Wet.		4389.6 35	
			GC	**CLAYEY SANDY GRAVEL:** Poorly Sorted, Dark Gray, 40-50% Gravel, 20% Cobbles, 30-40% Sand, 0-20% Clay, Moist to Very Moist.		4384.6 40	
			GC	**CLAYEY SANDY GRAVEL:** Poorly Sorted, Dark Gray, 40-50% Gravel, 10% Cobbles, 30-40% Sand, 0-20% Clay, Moist to Wet.			
			SW	**SAND:** Well Sorted, Medium to Coarse Grained, Brown to Brown Gray, Wet.			
GW	CTM-GW-MW33D-45-043001		GC	**CLAYEY SANDY GRAVEL:** Poorly Sorted, Dark Gray, 60-70% Rounded Gravel, Wet.		4379.6 45	
			SP	**GRAVELLY SAND:** Poorly Sorted, Wet, Very Little Clay, 5-25% Gravel, 75-95% Coarse to Medium Grained, Olive Gray to Brown Gray.		4374.6 50	
			GC	**CLAYEY SANDY GRAVEL:** Very Poorly Sorted, Large Cobbles, Very Soft Brown Clay, From 50 to 53 feet 50-60% Large Cobbles, Very Coarse Grained, Wet.		4369.6 55	
						4364.6	4364.6

CAMP DRESSER & McKEE
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7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-33D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
SO		3.0	GC		4364.6 / 60	60.0 / 4364.1 / 60.5
			GM	**SILTY SANDY GRAVEL:** Poorly Sorted, Large Cobbles, Very Coarse Grained, Wet.		
GW	CTM-GW-MW33D-65-043001	1.5			4359.6 / 65	
			CL	**SANDY GRAVELLY CLAY:** Clay is Dry And Friable To Moist, Stiff, Brown to Dark Gray, 50-60% Clay, 20-40% Gravel, 0-30% Sand, Moist.		
SO		6.0			4354.6 / 70	
SO		3.0	GC	**CLAYEY SAND and GRAVEL:** Poorly Sorted, Brown Clay, Wet, 30-50% Gravel, 50% Sand, 0-20% Clay, Wet.	4349.6 / 75	
SO		3.0			4344.6 / 80	
			GC	**SANDY CLAYEY GRAVEL:** Poorly Sorted, Medium to Fine Grained, Clay is Dry and Friable to Moist and Stiff, Rust Brown, Ochre to Gray, Alteration of Pyroclastic Fragments.		
GW	CTM-GW-MW33D-85-043001	5.0			4339.6 / 85	
			GC	**CLAYEY SANDY GRAVEL:** Poorly Sorted, Moist, Soft Brown Clay, 30% Cobbles, 20% Gravel, 30% Sand, 20% Clay, Increasing Clay Content at 91 feet.		
SO		9.0			4334.6 / 90	4334.6 / 90.0 / 4334.1 / 90.5
			GC	**CLAYEY SANDY GRAVEL:** Poorly Sorted, Brown to Dark Gray, Soft To Stiff. Increase in Gravel and Sand at 96 to 97 feet.		
SO		5.0			4329.6 / 95	
			GC-SC	**CLAYEY GRAVEL and SAND:** Poorly Sorted, Brown Gray, Wet, Soft, 25-50% Gravel, 25-50% Sand, 0-25% Clay.		
					4324.6	

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MONITORING WELL DETAIL
CTM-33D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
					4324.6	
SO		3.0	GC-SC		100	
			GC	**CLAYEY SANDY GRAVEL:** Poorly Sorted, Wet to Slightly Sticky to Soft Clay, Light Gray becoming Tan Brown with Depth, 40% Gravel, 15% Cobbles, 10% Sand Increasing with Depth, 25% Silt, 10% Clay.		
GW	CTM-GW-MW33D-105-04300				4319.6 / 105	
SO		0.0			4314.6 / 110	
			SM	**SILTY SAND:** Tan Brown with Ochre Brown Streaks (Iron Staining), Sitly Sand to Fine Grained Sand, Damp, Loose, Soft, 80% Sand, 15% Silt, <5% Clay, Low to Medium Plasticity.		
SO		0.0			4309.6 / 115	
			GP	**SANDY GRAVEL:** Olive Brown to Ochre Brown, Loose, Wet to Saturated, 60% Gravel, 25% Sand, 10% Silt, <5% Clay, Rounded Gravel.		
SO		4.0			4304.6 / 120	4304.6 / 4304.1 / 120.5
GW	CTM-GW-MW33D-125-05010	1.0	GM	**SILTY SANDY GRAVEL:** Olive Brown, 60% Gravel, 15% Sand, 20% Silt, 5% Clay, Damp, Low Plasticity, Loose to Soft.	4299.6 / 125	
			GM	**SILTY SANDY GRAVEL:** Olive Brown to Ochre Brown, Loose, Dry, 60% Gravel, 10% Cobbles, 10% Sand, 15% Silt, <5% Clay.		
SO		1.0			4294.6 / 130	
			GM	**SILTY SANDY GRAVEL:** Olive Brown, 65% Gravel, 25% Sand, 10% Silt, Loose, Wet, Red and Orange Iron Staining.		
SO		1.0			4289.6 / 135	
			ML	**CLAYEY GRAVELLY SILT:** Tan Brown, 15% Gravel, 50% Silt, 35% Clay, Medium Plasticity, Very Stiff, Moist.		
			GM		4284.6	

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MONITORING WELL DETAIL
CTM-33D

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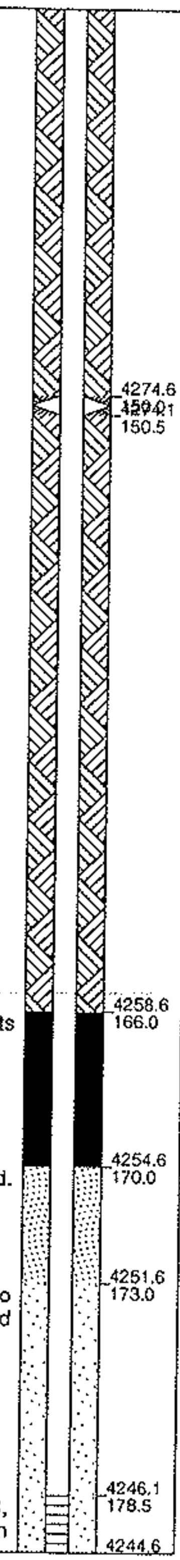
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		1.0	GM	**SILTY SANDY GRAVEL:** Olive Brown, Loose, Wet, 50% Gravel, 40% Sand, 10% Silt.	4284.6 / 140
GW	CTM-GW-MW33D-145-05010	1.0			4279.6 / 145
			SP	**GRAVELLY SAND:** Olive Brown, Loose, Very Wet, 60% Coarse Grained Sand, 35% Gravel, <5% Silt.	
SO		1.0			4274.6 / 150
			ML	**CLAYEY SILT:** Green Black, Unoxidized with Streaks of Black Iron Staining, Medium Plasticity, Damp, Very Stiff.	
			GP	**SANDY GRAVEL:** Olive Brown, 70% Gravel, 28% Sand, Trace Silt.	
SO		1.0			4269.6 / 155
			ML	**SILT:** Dark Green Gray, Fine Grained, Damp, Very Stiff, Low to Medium Plasticity.	
SO		3.0	ML	**SILT:** Olive Brown, Fine Grained, Damp, Very Stiff, Low to Medium Plasticity.	4264.6 / 160
			GM	**SILTY GRAVEL:** Olive Brown, Fine Grained Clayey Silt Matrix, Damp, Medium Stiff, Medium Plasticity, Upper 1 foot Strong Ochre Iron Staining, 55% Gravel, 5% Sand, 40% Silt.	
SO		1.0			4259.6 / 165
GW	CTM-GW-MW33D-166-05010	1.0			
			GP	**SANDY GRAVEL:** Light Yellow Brown to Light Olive Brown, Loose, Wet, 70% Gravel, 25% Sand, 5% Silt.	
SO		1.0			4254.6 / 170
SO		1.0			4249.6 / 175
			GP	**SANDY GRAVEL:** Dark Yellowish	4244.6

Well Construction Detail



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/7/01

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-33D

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada **Project Number:** 8432-30734

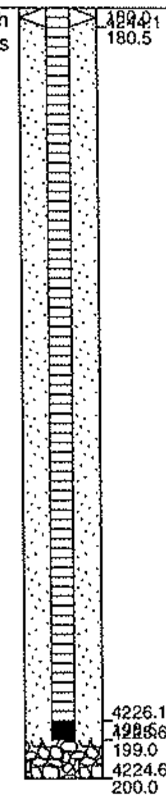
Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description
SO		1.0	GP	Brown, Loose, Wet, 55% Gravel, 40% Sand, <5% Silt.
SO		0.0		
SS GW SO	CTM-SL-MW33D-187.5-050101 CTM-GW-MW33D-188-05010 CTM-SL-MW33D-188-050101	0.0 0.0		
SO		0.0	GM	**SANDY SILTY GRAVEL:** Olive Brown to Reddish Brown, Loose, Damp, Medium to Low Plasticity, 40% Gravel, 5% Cobbles, 20% Sand, 30% Silt, <5% Clay.
SO		1.0		
			GW	**GRAVEL:** Well Rounded, Coarse Grained.

Graphic Log

Elev. / Depth (ft.): 4244.6 / 180; 4239.6 / 185; 4234.6 / 190; 4229.6 / 195; 4224.6 / 200; 4219.6 / 205; 4214.6 / 210; 4209.6 / 215; 4204.6

Well Construction Detail

with 0.020-inch Slots



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/7/01

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

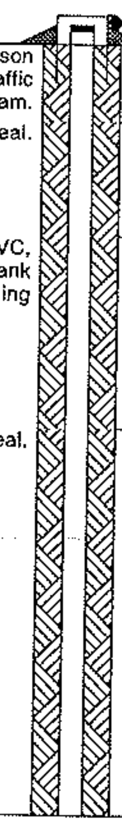
MONITORING WELL DETAIL
CTM-37D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 5/30/01 **End:** 5/31/01
Borehole Coordinates:
N 14,862,371.27 E 2,284,339.71
Development Date: Start 6/7/01 **End** 6/7/01

Casing Elevation (ft.): 4451.39
Total Depth (ft.): 88
Depth to Initial Water Level (ft. BGS): 50
Development Method: Pumping
Field Screening Instrument: PID
Logged By: D. Dragon
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
							Protective Casing
			FILL	**ROAD BASE:** Cobbles, Boulders, Topsoil.		4451.4 / 0	Ground Surface; Morrison Flush-Mount Traffic Vault, 12-inch diam.
SO		1.5					Cement Seal. (4449.4 / 2.0)
						4446.4 / 5	Sch. 80 PVC, 2-inch diam. Blank Casing (4446.4 / 5.0)
			GP	**SANDY GRAVEL:** Poorly Graded, Rounded, Cobbles and Boulders, Brown to Reddish Brown to Gray, Dry, Unconsolidated.			
SO	CTM-SO-MW37D-8-053001						
						4441.4 / 10	Volclay Grout Seal. (4441.4 / 10.0)
SO		3.0					
						4436.4 / 15	
						4431.4	



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
- HSA - Hollow Stem Auger
- SSA - Solid Stem Auger
- HA - Hand Auger
- AR - Air Rotary
- DTR - Dual Tube Rotary
- FR - Foam Rotary
- MR - Mud Rotary
- RC - Reverse Circulation
- CT - Cable Tool
- JET - Jetting
- D - Driving
- DTC - Drill Through Casing

SAMPLING TYPES:
- SG - Soil Gas
- SO - Soil from Core
- GW - Groundwater Sample
- NX - 2.1" Rock Core
- GP - Geoprobe
- HP - Hydro Punch
- SS - Split Spoon
- ST - Shelby Tube
- WS - Wash Sample

OTHER:
- AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

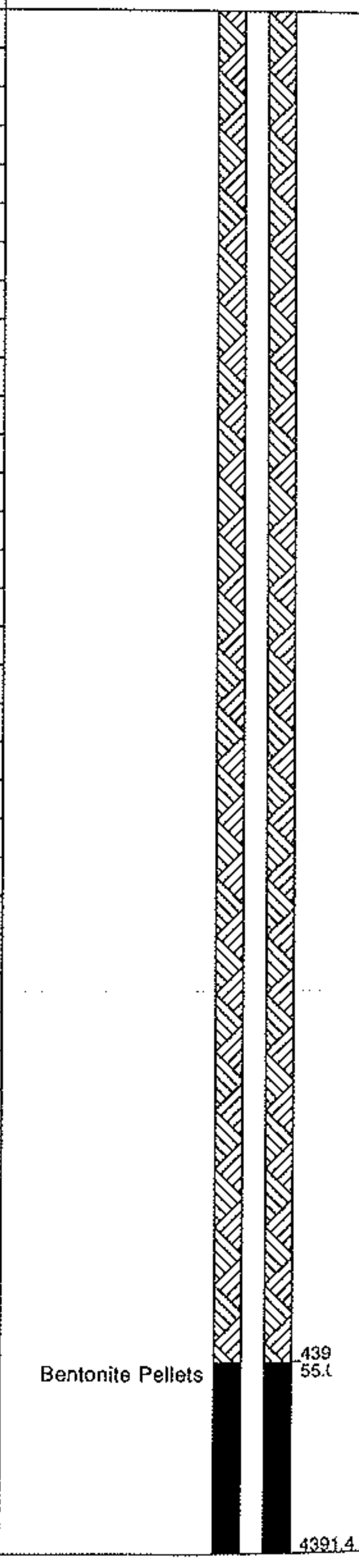
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-37D

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
			GP	**SANDY GRAVEL:** Cobbles and Boulders up to 12-inch Diam., Pulverized Granite and Volcanic Boulders.	4431.4 / 20
SO		3.0			
			GP	**SANDY GRAVEL:** Cobbles and Boulders up to 12-inch Diam., Pulverized Granite and Volcanic Boulders, Well Sorted, Well Rounded, Moist at 37.5 feet.	4426.4 / 25
SO		1.0			4421.4 / 30
					4416.4 / 35
SO		0.0			
					4411.4 / 40
SO		0.0			4406.4 / 45
			SM	**SILTY SAND:** Brown to Gray, Medium to Coarse Grained, Slightly Silty, Unconsolidated, Moist.	
GW	CTM-GW-MW37D-50-053101	0.0	GP	**SANDY GRAVEL:** Cobbles and Boulders up to 12-inch Diam., Pulverized Granite and Volcanic Boulders, Well Sorted, Well Rounded, Moist.	4401.4 / 50
					4396.4 / 55
			GM	**SILTY SANDY GRAVEL:** Light Brown, Rounded.	
			GP	**SANDY GRAVEL:** Cobbles and	4391.4

Well Construction Detail



CAMP DRESSER & McKEE

CDM

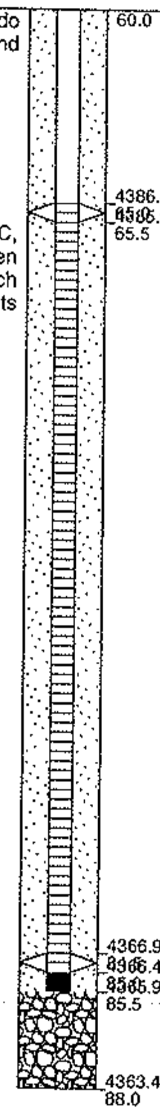
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-37D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
			GP	Boulders up to 12-inch Diam., Pulverized Granite and Volcanic Boulders, Well Sorted, Well Rounded, Moist.	4391.4 / 60
			SP-SM	**GRAVELLY SILTY SAND:** Well Graded, 5% Clay, Brown, Rounded.	4386.4 / 65
			GM	**SILTY SANDY GRAVEL:** Well Sorted, Rounded, Iron Staining.	
GW	CTM-GW-MW37D-70-053101	0.0			4381.4 / 70
SO		0.0			4376.4 / 75
			SM	**SILTY SAND:** Medium to Coarse Grained, Slightly Silty, 5% Small Rounded Gravel.	
SS	CTM-SL-MW37D-80-053101	1.0	ML	**SANDY SILT:** 10-20% Fine to Medium Grained Sand, Stiff, Wet, Brown.	4371.4 / 80
			ML	**SANDY SILT:** 5% Fine Grained Sand, Stiff, Low Plasticity, Brown, Wet.	
GW	~~CTM-GW-MW37D-85-053101~~	~~0.0~~			4366.4 / 85
SO	CTM-SL-MW37D-85-053101				
			SM	**SILTY SAND:** 5-10% Silt, Wet, Loose, Fine to Coarse Grained Sand.	
					4361.4 / 90
					4356.4 / 95
					4351.4

Well Construction Detail



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/7/01

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-37S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 3/21/01 **End:** 3/21/01
Borehole Coordinates:
N 14,868,572.49 E 2,280,975.62
Development Date: Start 3/28/01 **End** 3/28/01

Casing Elevation (ft.): 4478.41
Total Depth (ft.): 46
Depth to Initial Water Level (ft. BGS): 30
Development Method: Pumping
Field Screening Instrument: PID
Logged By: B. Richmond
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
							Protective Casing
						4478.4	*Ground Surface*
			SP	Surface: Asphalt **GRAVELLY SAND:** Gravel Road Base, Dry, Dark Brown, 60% Sand, 40% Gravel.		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
			SM	**SILTY SAND:** Dry, Hard to Stiff, Dark Brown to Red Rusty Brown, Low Plasticity, 60% Sand, Medium Grained, 40% Silt.			
SO		1.0				4473.4 5	Cement Seal. 4473.4 / 5.0
SO		2.0				4468.4 10	Sch. 40 PVC, 2-inch diam. Blank Casing 4468.4 / 10.0
			GP	**SANDY GRAVEL:** Dry, Light Gray with Brown, 60% Gravel, 30% Sand, 10% Cobbles, Loose.			
SO		1.0				4463.4 15	
			BOULDER	**BOULDER:** Multiple Granite Boulders, Broken and Powdered, Light Gray to White.			Bentonite Pellets 4461.4 / 17.0
						4458.4	4458.4

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: Date:

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-37S

Client: Washoe County Dept. of Water Resources

Project Name: Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada

Project Number: 8432-30734

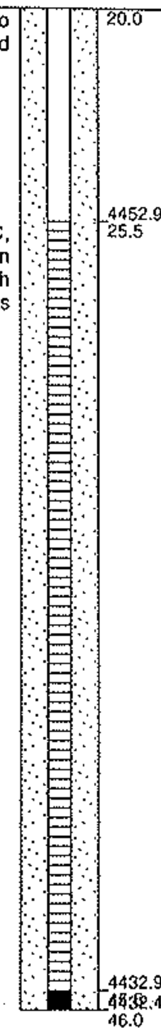
Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4458.4 / 20
SO	CTM-SL-MW37S-20-032101		SP	**GRAVELLY SAND:** Little or No Fines, Dark Brown, Wet, Loose.	
			BOULDER	**BOULDER:** Boulder and Cobbles, Granite, Light Gray.	
			SM	**SILTY SAND:** Dark Brown, Wet, Moderately Plasticity, Cobbles, Soft.	4453.4 / 25
SO		6.0			
			GP-SP	**SAND and GRAVEL:** Little or No Fines, Wet, Loose, Dark Brown, 50% Gravel, 50% Coarse Grained Sand.	4448.4 / 30
GW	CTM-GW-MW37S-30-032101				
			GP-SP	**SAND and GRAVEL:** Minor Silt, Wet, Loose, Dark Brown, 50% Gravel, 50% Coarse Grained Sand.	4443.4 / 35
SO	CTM-SL-MW37S-35-032101				
SS	CTM-SL-MW37S-37-032101				4438.4 / 40
			SM	**SILTY SAND:** Red Oxidized, Coarse Grained Sand with 20% Silt, Loose, Wet.	4433.4 / 45
					4428.4 / 50
					4423.4 / 55
					4418.4

Graphic Log

Well Construction Detail

10x20 Colorado Silica Sand

Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots



CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

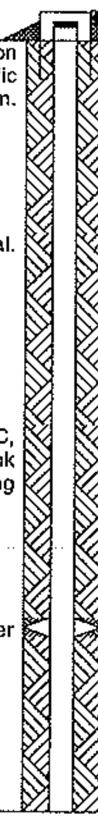
MONITORING WELL DETAIL
CTM-38D

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 5/29/01 **End:** 5/29/01
Borehole Coordinates:
N 14,861,218.00 E 2,286,925.73
Development Date: Start 6/6/01 **End** 6/6/01

Casing Elevation (ft.): 4428.78
Total Depth (ft.): 98
Depth to Initial Water Level (ft. BGS): 26
Development Method: Pumping
Field Screening Instrument: PID
Logged By: J. Benedict
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
						4428.8	Protective Casing *Ground Surface*
			GP	Surface: Asphalt **SANDY GRAVEL:** Minor Silt, Road Base Fill, Damp, Dark Brown.		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
			GP	**SANDY GRAVEL:** Tan Brown, Dry, Loose, 35% Gravel, 15% Cobbles, 45% Sand, <5% Silt.			
SO		0.0				4423.8 / 5	Cement Seal. 4423.8 5.0
SO		1.0	GW	**GRAVEL and COBBLES:** 50% Gravel, 40% Cobbles, 10% Silt and Sand, Loose, Dry, Tan Brown to Rock Flour Gray.		4418.8 / 10	Sch. 80 PVC, 2-inch diam. Blank Casing 4418.8 10.0
SO		1.0				4413.8 / 15	Centralizer 4413.8 15.0 4413.3 15.5
						4408.8	



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: Date:

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-38D

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.

Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
						4408.8	
SO		0.0	GP GP	**SANDY GRAVEL:** Tan Olive, Loose, Moist, 45% Gravel, 5% Cobbles, 40% Sand, 10% Silt.		20	
SO		1.0				4403.8 25	
SO	CTM-SL-MW38D-26.5-052901		SP	**SAND:** Olive Gray, Wet, Loose, 5% Gravel, 90% Sand, 5% Silt.			
SO		0.0				4398.8 30	
			GP	**SANDY GRAVEL:** Olive Green, Wet, Loose, 65% Gravel, 5% Cobbles, 25% Sand, 5% Silt.			
GW	CTM-GW-MW38D-33-052901						
SO		0.0	SP	**SAND:** Olive Brown, Coarse Grained, Wet, Loose, 95% Sand, 3% Gravel, 2% Silt.		4393.8 35	
SO		0.0				4388.8 40	
			SP	**GRAVELLY SAND:** Olive Brown, Wet, Loose, 25% Gravel, 70% Sand, 5% Silt.			
SO		0.0				4383.8 45	4383.8 4383.3 45.5
			SP	**GRAVELLY SAND:** Olive Brown, 85% Coarse Grained Sand, 15% Gravel, Wet, Loose.			
SO		0.0				4378.8 50	
SO		0.0	GP	**SANDY GRAVEL:** Olive Brown, Wet, Loose, 50% Gravel, 10% Cobbles, 35% Sand, 5% Silt.		4373.8 55	Bentonite Pellets 437[illegible] 55.[illegible]
GW	CTM-GW-MW38D-56-052901						
						4368.8	

CTM MW CTM2001.GPJ CDM_CORP.GDT 9/7/01

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-38D

Client: Washoe County Dept. of Water Resources

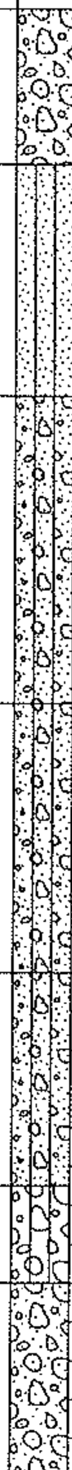
Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

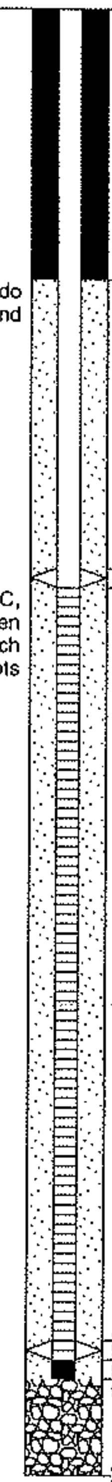
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
					4368.8 / 60
SO		0.0	GP		
			SM	**SILTY SAND:** Olive Brown, Fine Grained Sand, 90% Sand, 10% Silt, Wet, Firm to Loose.	
SO		0.0			4363.8 / 65
SO		0.0	GM	**SANDY SILTY GRAVEL:** Olive Brown, Damp, Firm to Loose, 45% Gravel, 5% Cobbles, 20% Sand, 30% Silt, Medium Plasticity.	4358.8 / 70
GW	CTM-GW-MW38D-75-052901	0.0			4353.8 / 75
			GM	**SILTY SANDY GRAVEL:** Olive Green, Damp, Loose to Firm, Medium Plasticity, 55% Gravel, 5% Cobbles, 20% Sand, 20% Silt.	
SO		1.0			4348.8 / 80
SO		1.0	GM	**SILTY SANDY GRAVEL:** Tan Brown to Ochre Brown, Wet, Loose, 55% Gravel, 25% Sand, 20% Silt.	4343.8 / 85
SS	CTM-SL-MW38D-86.5-052901				
SO	CTM-SL-MW38D-87-052901				
SO		0.0			4338.8 / 90
			GM	**SILTY GRAVEL:** Gravel and Cobbles in a Silty Matrix, Tan Brown.	
			GP	**SANDY GRAVEL:** Olive Brown, Fine Grained Sand, Loose to Firm, Wet, 60% Gravel, 5% Cobbles, 25% Sand, 10% Silt, Low Plasticity.	
SO		0.0			4333.8 / 95
GW	CTM-GW-MW38D-98-052901				
					4328.8

Graphic Log



Well Construction Detail



CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-39S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 6/1/01 **End:** 6/1/01
Borehole Coordinates:
N 14,861,200.00 E 2,286,925.73
Development Date: Start 6/6/01 **End** 6/6/01

Casing Elevation (ft.): 4428.83
Total Depth (ft.): 40
Depth to Initial Water Level (ft. BGS): 35
Development Method: Pumping
Field Screening Instrument: PID
Logged By: D. Dragon
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
							Protective Casing
						4428.8	*Ground Surface*
				Surface: Asphalt No Sample Collected.		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
							Cement Seal. (4425.8 / 3.0)
						4423.8 / 5	Sch. 40 PVC, 2-inch diam. Blank Casing (4423.8 / 5.0)
							Bentonite Pellets (4420.8 / 8.0)
						4418.8 / 10	
							10x20 Colorado Silica Sand (4415.8 / 13.0)
						4413.8 / 15	
			GP	**SAND GRAVEL and COBBLES:** Pulverized Rocks and Boulders, Well Rounded, Dry.			Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch (4410.8 / 18.0)
						4408.8	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

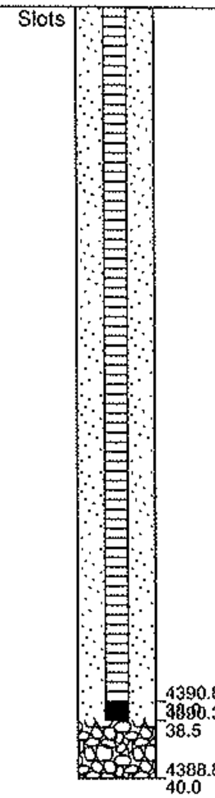
CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-39S

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		0.0	GP		4408.8 / 20
			GP	**SAND GRAVEL and COBBLES:** Pulverized Rocks and Boulders, Well Rounded, Moist.	
SO		1.0			4403.8 / 25
			SP	**GRAVELLY SAND:** Olive Gray, Medium to Coarse Grained Sand, 80% Sand.	4398.8 / 30
			GP	**SAND GRAVEL and COBBLES:** Pulverized Rocks and Boulders, Well Rounded, Wet.	
			SP	**GRAVELLY SAND:** Coarse Grained, Small Rounded Gravel, Unconsolidated, Wet.	
~~GW~~	~~CTM-GW-MW39S-35-060101~~				4393.8 / 35
SS	CTM-SO-MW39S-35-060101				
SO	CTM-SO-MW39S-40-060101				4388.8 / 40
					4383.8 / 45
					4378.8 / 50
					4373.8 / 55
					4368.8

Well Construction Detail



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/7/01

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-40S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 6/4/01 **End:** 6/5/01
Borehole Coordinates:
N 14,867,974.11 E 2,275,781.44
Development Date: Start 6/7/01 **End** 6/7/01

Casing Elevation (ft.): 4593.77
Total Depth (ft.): 155
Depth to Initial Water Level (ft. BGS): 124
Development Method: Pumping
Field Screening Instrument: PID
Logged By: J. Benedict/E. Evans
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)	Well Construction Detail
							Protective Casing
						4593.8	Ground Surface
			ML	Surface: Asphalt **SANDY SILT:** Light Gray to Tan Gray, Well Sorted, Rounded, Fine Grained Sand, Increased Silt Content Starting at 10 feet.		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
SO		1.5				4588.8 / 5	Cement Seal. (4588.8 / 5.0)
SO		1.5				4583.8 / 10	Sch. 40 PVC, 2-inch diam. Blank Casing (4583.8 / 10.0)
			CL	**SILTY CLAY:** Brown, Dry, Hard, Friable.			
SO		1.5	GC	**CLAYEY and SILTY GRAVEL:** Poorly Sorted, Cemented to Friable, Brown to Gray, Hard, Dry.		4578.8 / 15	
						4573.8	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-40S

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)	Well Construction Detail
					4573.8	
SO		1.5	CL	**SILTY CLAY:** Brown, Hard, Dry.	20	
			GC	**WHITE ASH or TUFF with GRAVEL:** Dry.		
			CL	**SILTY CLAY:** Brown, Hard, Dry.	4568.8	
SO		9.0			25	
			GC	**GRAVELLY CLAY:** Poorly Sorted, Dry, Gray to Tan Gray, Hard.		Volclay Grout Seal. 4566.8 27.0
			SM	**SILTY SAND:** Brown, Moderately Sorted.	4563.8	
SO		1.5			30	
			GC	**CLAYEY and SILTY GRAVEL:** Poorly Sorted, Brown to Gray, Hard, Dry, Clay Matrix.	4558.8	
SO		5.0			35	
			SP	**GRAVELLY SAND:** Poorly Sorted to Moderately Sorted, Coarse Grained, Brown, 65-85% Sand, 15-35% Gravel.		Centralizer 4555.8 4555.3 38.5
					4553.8	
SO		1.5	GC	**CLAYEY SAND and GRAVEL:** Poorly Sorted, Cobbles, Dry, Hard, Brown to Rust Brown, Cemented.	40	
					4548.8	
SO		3.0	SM	**SILTY SAND:** Brown to Rust Brown, Dry, Dense, Moderately Cemented.	45	
					4543.8	
SO		1.5	GP	**SANDY GRAVEL:** Buff Gray, Weakly Endurated, Silty Sand Matrix, Dry, Dense, 55% Gravel, Rounded, 45% Fine Grained Sand.	50	
					4538.8	
SO		0.0			55	
					4533.8	

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-40S

Client: Washoe County Dept. of Water Resources

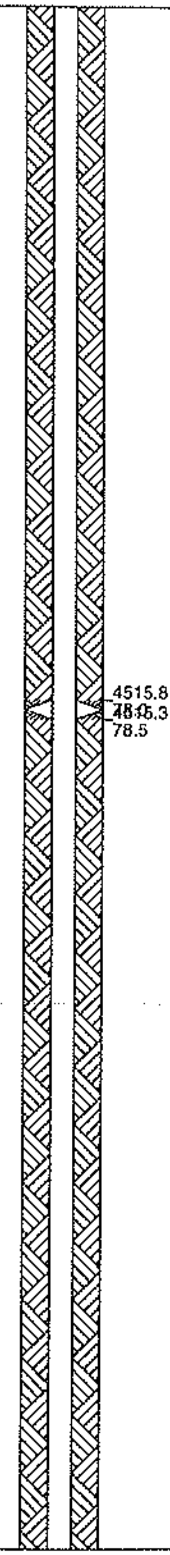
Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)
SO		0.0	GP		4533.8 / 60
SO		0.0	SM	**SILTY SAND:** Ochre Brown, Silty Sand with Gravel, 10% Gravel, 70% Sand, 20% Silt, Moist, Loose to Weakly Endurated.	4528.8 / 65
SO		1.5	GM	**SANDY SILTY GRAVEL:** Tan Brown, Gravel with Silt Matrix, 65% Gravel, 5% Cobbles, 10% Sand, 20% Silt, Dry, Firm Matrix with Low Strength.	4523.8 / 70
SO		1.5			4518.8 / 75
SO		0.0			4513.8 / 80
SO		1.5			4508.8 / 85
			ML	**CLAYEY SILT:** Gray Brown to Dusky Brown, Clayey Silt with Gravel, Damp, Very Stiff, Orange Iron Staining on Gravel, 68% Fine Grained Silt, 15% Sand, 10% Small Gravel, 7% Clay.	
SO		1.5			4503.8 / 90
SO		0.0	ML	**SANDY CLAYEY SILT:** Brown, Moderate to Low Plasticity, Friable, Stiff, Damp/Moist, 80% Fine Grained Silt/Clay, 20% Fine Grained Sand and Gravel.	4498.8 / 95
					4493.8

Well Construction Detail



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/7/01

CAMP DRESSER & McKEE
CDM
7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-40S

Client: Washoe County Dept. of Water Resources
Project Name: Central Truckee Meadows Remediation Dist.
Project Location: Reno, Nevada
Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. / Depth (ft.)	Well Construction Detail
					4493.8	
SO		0.0	CL	**SILTY CLAY:** Medium Plasticity, Soft, Damp.	100	
			SW	**SAND:** Loose, Dark Brown, Damp.		
			ML-CH	**CLAYEY SILT or SILTY CLAY:** Mottled Gray Brown to Ochre Brown, Soft to Firm, Medium to High Plasticity.	4488.8	
SO	CTM-SL-MW40S-105-060501	0.0			105	
					4483.8	4483.8 / 110.0
SO		0.0	GM	**SILTY SANDY GRAVEL:** Tan Brown, Loose, Moist, Endurated/Cemented Silty Matrix, 45% Gravel, 35% Sand, 20% Silt.	110	20x40 Fine Sand. 4482.8 / 111.0; 10x20 Colorado Silica Sand
					4478.8	
SO		0.0	CL-CH	**GRAVELLY SILTY CLAY:** Brown, Stiff, Moist, Medium Plasticity to High Plasticity, 85% Silty Clay, 15% Sand and Gravel.	115	4476.3 / 4475.8 / 118.0; Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots
					4473.8	
SO		0.0	SW	**SAND:** Tan Brown, Fine Sand, Loose, Damp.	120	
			MH	**DIATOMACEOUS:** White Diatomaceous Earth, Gritty, Damp, Firm, Possibly an Ash Rather than Diatomaceous.	4468.8	
SO		0.0			125	
GW	CTM-GW-MW40S-126.5-060501		CH	**CLAY:** Light Brown to Tan Brown, Damp, Very Stiff, Moderate to High Plasticity.		
					4463.8	
SO		0.0	GP	**SANDY GRAVEL:** Tan Brown, Wet, Loose, 50% Gravel, 45% Sand, 5% Silt.	130	
			ML	**SILT:** Tan Brown, Silt to Fine Grained Sand, Damp, Firm to Friable, Low Plasticity.		
					4458.8	
SO		0.0	SP	**GRAVELLY SAND:** Dark Gray Brown, Wet, Loose to Dense, 60% Sand, 25% Gravel, 15% Silt.	135	
SS	CTM-SL-MW40S-136.5-060501					
SO	CTM-SL-MW40S-137-060501					
					4453.8	

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-40S

Client: Washoe County Dept. of Water Resources

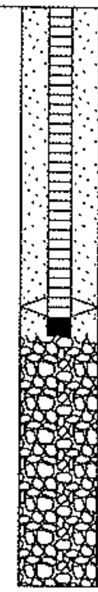
Project Location: Reno, Nevada

Project Name: Central Truckee Meadows Remediation Dist.

Project Number: 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. / Depth (ft.)
SO		0.0	GM	**SILTY GRAVEL:** Dark Gray Brown, Damp to Wet, Stiff, Fairly Tight, 60% Gravel, 10% Sand, 30% Silt.		4453.8 / 140
SO		0.0		No Sample Return.		4448.8 / 145
SO		0.0	SW	**SAND:** Tan Brown, Loose Wet, 97% Medium Grained Sand, 3% Silt.		4443.8 / 150
			GP	**SANDY GRAVEL:** Tan Brown, Loose, Wet, 60% Gravel, 30% Sand, 10% Silt.		
SO		0.0				4438.8 / 155
						4433.8 / 160
						4428.8 / 165
						4423.8 / 170
						4418.8 / 175
						4413.8

Well Construction Detail



CTM MW CTM2001.GPJ CDM_CORP.GDT 9/7/01

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

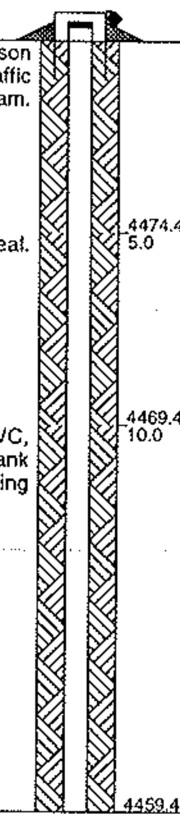
MONITORING WELL DETAIL
CTM-41S

Client: Washoe County Dept. of Water Resources
Project Location: Reno, Nevada
Project Name: Central Truckee Meadows Remediation Dist.
Project Number: 8432-30734

Drilling Contractor: Boart Longyear
Drilling Method/Rig: Sonic/Roto-Sonic 150
Drillers: Nathan Jackson
Drilling Date: Start: 6/4/01 **End:** 6/4/01
Borehole Coordinates:
N E
Development Date: Start 6/12/01 **End** 6/12/01

Casing Elevation (ft.): 4479.39
Total Depth (ft.): 55
Depth to Initial Water Level (ft. BGS): 38
Development Method: Pumping
Field Screening Instrument: PID
Logged By: E. Evans
Top of Riser Elevation (ft.):

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
							Protective Casing
						4479.4	*Ground Surface*
			FILL	Surface: Asphalt **ROAD BASE**		0	Morrison Flush-Mount Traffic Vault, 12-inch diam.
			BOULDER	**BOULDER:** Gray Andesite Boulder, Pulverized Sample.		4474.4	
SO		1.5	SP	**GRAVELLY SAND:** Poorly Sorted, Fine to Medium Grained Sand, Brown to Yellow Brown, 60% Sand, 30% Gravel, 10% Cobbles, Dry.		5	Cement Seal.
			GP	**COBBLES BOULDERS and GRAVEL:** Poorly Sorted, Gray to Brown, Dry, 60-70% Cobbles.		4469.4	
SO		0.0				10	Sch. 40 PVC, 2-inch diam. Blank Casing
			SP	**GRAVELLY SAND:** Poorly Sorted, Brown, Fine to Medium Grained Sand, 60-75% Sand, 25-40% Gravel, Moist.		4464.4	
SO		0.0	BOULDER	**BOULDER:** Black Gray, Andesite/Basalt Boulder.		15	
				No Sample Return.			
			SP	**GRAVELLY SAND:** Poorly Sorted, Coarse Grained Sand, 50-60% Sand,		4459.4	



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
SG - Soil Gas
SO - Soil from Core
GW - Groundwater Sample
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

7025 Longley Lane, Ste 20
Reno, NV 89511

MONITORING WELL DETAIL
CTM-41S

Client: Washoe County Dept. of Water Resources **Project Name:** Central Truckee Meadows Remediation Dis..

Project Location: Reno, Nevada **Project Number:** 8432-30734

Sample Type	Sample Identification	Field Instrument Reading (ppm)	Stratum Designation	Material Description	Elev. Depth (ft.)	Well Construction Detail
					4459.4	
SO		0.0	SP	25-30% Gravel, 10-20% Cobbles, Dry.	20	Bentonite Pellets; 20.0
			CL	**SILTY CLAY:** Dry, Hard, Friable, Brown and Rust Colored Organic Material Staining, Clay is Yellow Brown to Orange Brown.	4454.4	
SO		0.0			25	
			SP-SC	**CLAYEY SILTY SAND:** Dry, Brown, Dry Gray Clay with Minor Gravel, 70% Silty to Medium Grained Sand, 20-30% Dry Clay.		4452.4 27.0; 10x20 Colorado Silica Sand
			SP-SC	**CLAYEY GRAVELLY SAND:** Moist, Poorly Sorted, Medium to Coarse Grained Sand, Brown, Friable Clay with Large Diam. Gravel.	4449.4	
SO		0.0	BOULDER	**BOULDERS and COBBLES:** Gray, Andesite to Granite Andesite, Fine Gray Rock Flour.	30	4447.4 32.0; Sch. 40 PVC, 2-inch diam. Screen with 0.020-inch Slots
			SC-GC	**CLAYEY SAND and GRAVEL:** Brown, Red/Brown Tuff or Pyroclastic Gravel, Coarse Grained Sand, Dry Friable Clay from Tuff Alteration.	4444.4	
SO		0.0	SC-GC	**CLAYEY SANDY GRAVEL:** Moist, Gray Brown, Coarse Grained Sand, Soft Non-Competant Clay, 50% Gravel, 25% Cobbles.	35	
SO	CTM-SL-MW41S-36-060401					
GW	CTM-GW-MW41S-38-060401		GC	**SILTY CLAYEY SANDY GRAVEL:** Dry, Friable Clay, Brown to Tan.	4439.4	
SO		3.0	BOULDER	**BOULDER and COBBLES:** Andesite Boulders/Cobbles.	40	
			GC	**CLAYEY GRAVEL:** Brown to Brown/Gray, 50-60% Gravel, 35-45% Silty Clay, Stiff, Moist, 5-15% Large Diam. Cobbles.	4434.4	
SO		8.0			45	
			SC	**SILTY CLAYEY SAND:** Brown, Medium Grained Sand, Moderately Sorted, 70-80% Sand, 20-30% Clay.	4429.4	
SO	CTM-SL-MW41S-49-060401					
SO		2.0			50	
			CL	**SANDY CLAY:** Brown, Medium Grained Sand, Moderately Sorted, 40% Sand, 60% Clay.		4427.4; 4426.9; 52.5
SS	CTM-SL-MW41S-53-060401				4424.4	4424.4
					55	55
					4419.4	

Appendix B
Geophysical Logs

welenco

INDUCTION / GAMMA RAY

FILING NO.	
COMPANY	CAMP DRESSER & McKEE INC.
WELL	MW-8D
FIELD	CENTRAL TRUCKEE MEADOWS (CTM)
COUNTY	WASHOE
STATE	NEVADA
LOCATION:	
SEC	
TWP	
RGE	
OTHER SERV:	NONE
JOB NO.	34543

PERMANENT DATUM: GROUND LEVEL ELEV: N/A

LOG MEASURED FROM G.L. 0 FT ABOVE PERM DATUM

DRILLING MEASURED FROM G.L.

ELEVATION:
KB.
DF.
GL.

DATE	07-31-2001		07-31-2001			
TYPE OF LOG	INDUCTION		GAMMA RAY			
RUN NO.	ONE		ONE			
DEPTH - DRILLER	261'		261'			
DEPTH - LOGGER	257'		257'			
BOTTOM LOGGED INT	254'		256'			
TOP LOGGED INT	0'		0'			
TYPE FLUID IN HOLE	WATER/DRY		WATER/DRY			
FLUID LEVEL	65'		65'			
MAX TEMP DEG F	N/A		N/A			
OPERATING RIG TIME	N/A		N/A			
EQUIP. LOCATION	L17	BFL	L17	BFL		
OPERATOR	BOBINSKI		BOBINSKI			
WITNESSED BY	TIM BOYER		TIM BOYER			

RUN NO.	BORE HOLE RECORD BIT	FROM	TO	CASING RECORD SIZE	TYPE	FROM	TO
				2" O.D.	PVC	G.L.	BOTTOM

EQUIPMENT DATA

LOG TYPE	INDUCT. CON	INDUCT. RES	GAMMA RAY
RUN NO.	ONE		ONE
TOOL MODEL NO.	GEONICS	COMPUTER	SLIMHOLE
TOOL SERIAL NO.	01	GENERATED	T-53
DIAMETER	1.45"	FROM	1.25"
DETECTOR TYPE	COIL	INDUCT. CON	SCINT.
DETECTOR LENGTH	20"		1"
UNITS/DIV.	10 mMhos/m	2.5 Ohmm	20 API
SENSITIVITY	N/A	N/A	50/781
TIME CONSTANT	N/A	N/A	4 SEC
ZERO DIV L OR R	0	0	0
SPEED-FPM	25	25	13
DATA SAMPLES/FT	5	5	5
FORMATION FACTOR	N/A	N/A	N/A
PUMP RATE-GPM	N/A	N/A	N/A
PUMP RATE-GPM			
PUMP RATE-GPM			

SOURCE TYPE	STRENGTH	SPACING	MODEL NO	SERIAL NO.
N/A				

PERFORATIONS: 240.5 - 260.6'

REMARKS:

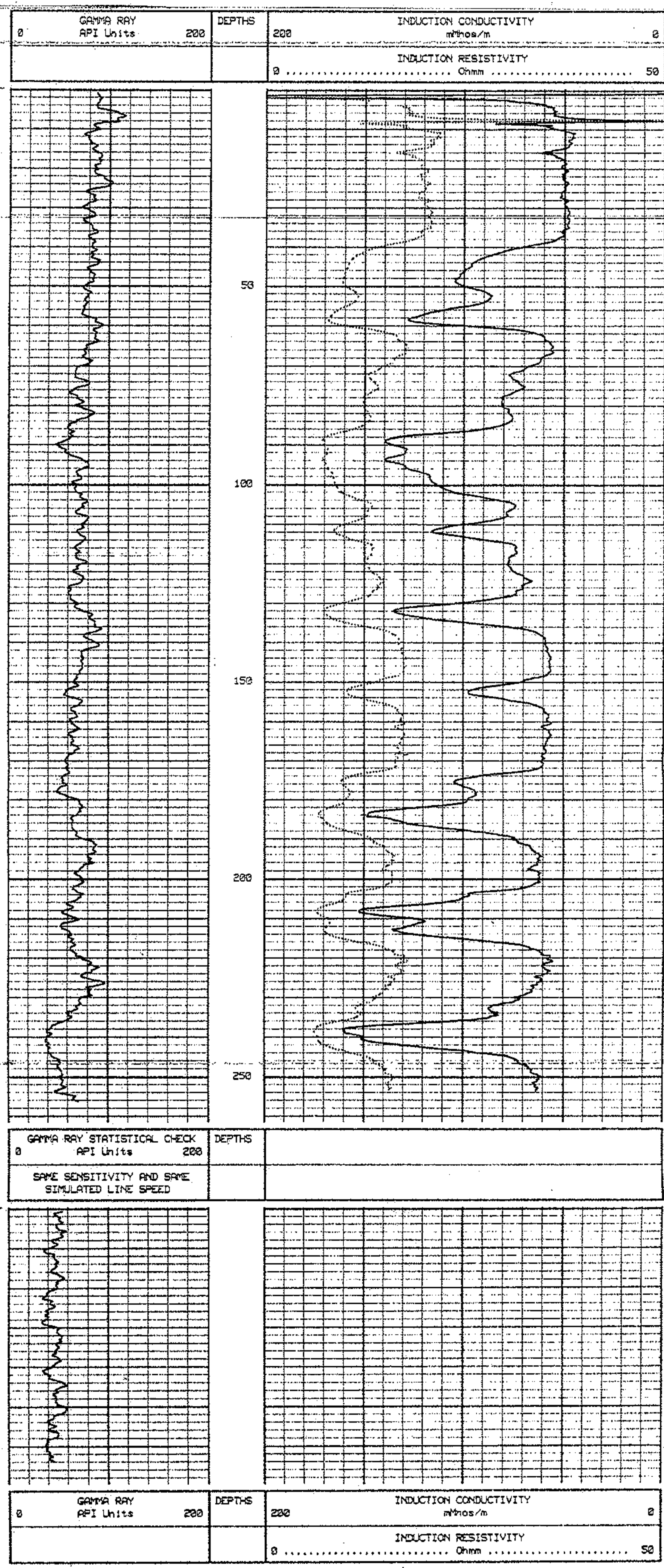
NOTICE:
All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

WELENCO, INC.

INDUCTION CONDUCTIVITY mMhos/m 0 200

DEPTHS

GAMMA RAY API Units 0 200


GAMMA RAY
API Units
0
200
DEPTHS
INDUCTION CONDUCTIVITY
mMhos/m
200
0
INDUCTION RESISTIVITY
0 .... Ohmm 50
50
100
150
200
250
GAMMA RAY STATISTICAL CHECK
API Units
0
200
DEPTHS
SAME SENSITIVITY AND SAME SIMULATED LINE SPEED
GAMMA RAY
API Units
0
200
DEPTHS
INDUCTION CONDUCTIVITY
mMhos/m
200
0
INDUCTION RESISTIVITY
0 .... Ohmm 50

welenco

INDUCTION / GAMMA RAY

FILING NO.	COMPANY CAMP DRESSER & McKEE INC. WELL MW-4D FIELD CENTRAL TRUCKEE MEADOWS (CTM) COUNTY WASHOE STATE NEVADA
JOB NO. 34543	LOCATION: SEC ____ TWP ____ RGE ____
	OTHER SERV: NONE

PERMANENT DATUM: GROUND LEVEL ELEV: N/A

LOG MEASURED FROM G.L. 0 FT ABOVE PERM DATUM

DRILLING MEASURED FROM G.L.

ELEVATION: KB. ____ DF. ____ GL. ____

DATE	07-31-2001	07-31-2001	
TYPE OF LOG	INDUCTION	GAMMA RAY	
RUN NO.	ONE	ONE	
DEPTH - DRILLER	181'	181'	
DEPTH - LOGGER	180'	180'	
BOTTOM LOGGED INT	177'	179'	
TOP LOGGED INT	0'	0'	
TYPE FLUID IN HOLE	WATER/DRY	WATER/DRY	
FLUID LEVEL	35'	35'	
MAX TEMP DEG F	N/A	N/A	
OPERATING RIG TIME	N/A	N/A	
EQUIP. / LOCATION	L17 / BFL	L17 / BFL	
OPERATOR	BOBINSKI	BOBINSKI	
WITNESSED BY	TIM BOYER	TIM BOYER	

RUN	BORE HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	TYPE	FROM	TO
				2" O.D.	PVC	G.L.	BOTTOM

EQUIPMENT DATA

LOG TYPE	INDUCT. CON	INDUCT. RES	GAMMA RAY
RUN NO.	ONE		ONE
TOOL MODEL NO.	GEONICS	COMPUTER	SLIMHOLE
TOOL SERIAL NO.	01	GENERATED	T-53
DIAMETER	1.45"	FROM	1.25"
DETECTOR TYPE	COIL	INDUCT. CON	SCINT.
DETECTOR LENGTH	20"		1"
UNITS/DIV.	10 mMhos/m	2.5 Ohmm	20 API
SENSITIVITY	N/A	N/A	50/781
TIME CONSTANT	N/A	N/A	4 SEC
ZERO DIV L OR R	0	0	0
SPEED-FPM	25	25	13
DATA SAMPLES/FT	5	5	5
FORMATION FACTOR	N/A	N/A	N/A
PUMP RATE-GPM	N/A	N/A	N/A
PUMP RATE-GPM			
PUMP RATE-GPM			

SOURCE TYPE	STRENGTH	SPACING	MODEL NO	SERIAL NO.
N/A				

PERFORATIONS: 159.5 - 179.5'

REMARKS:

NOTICE:
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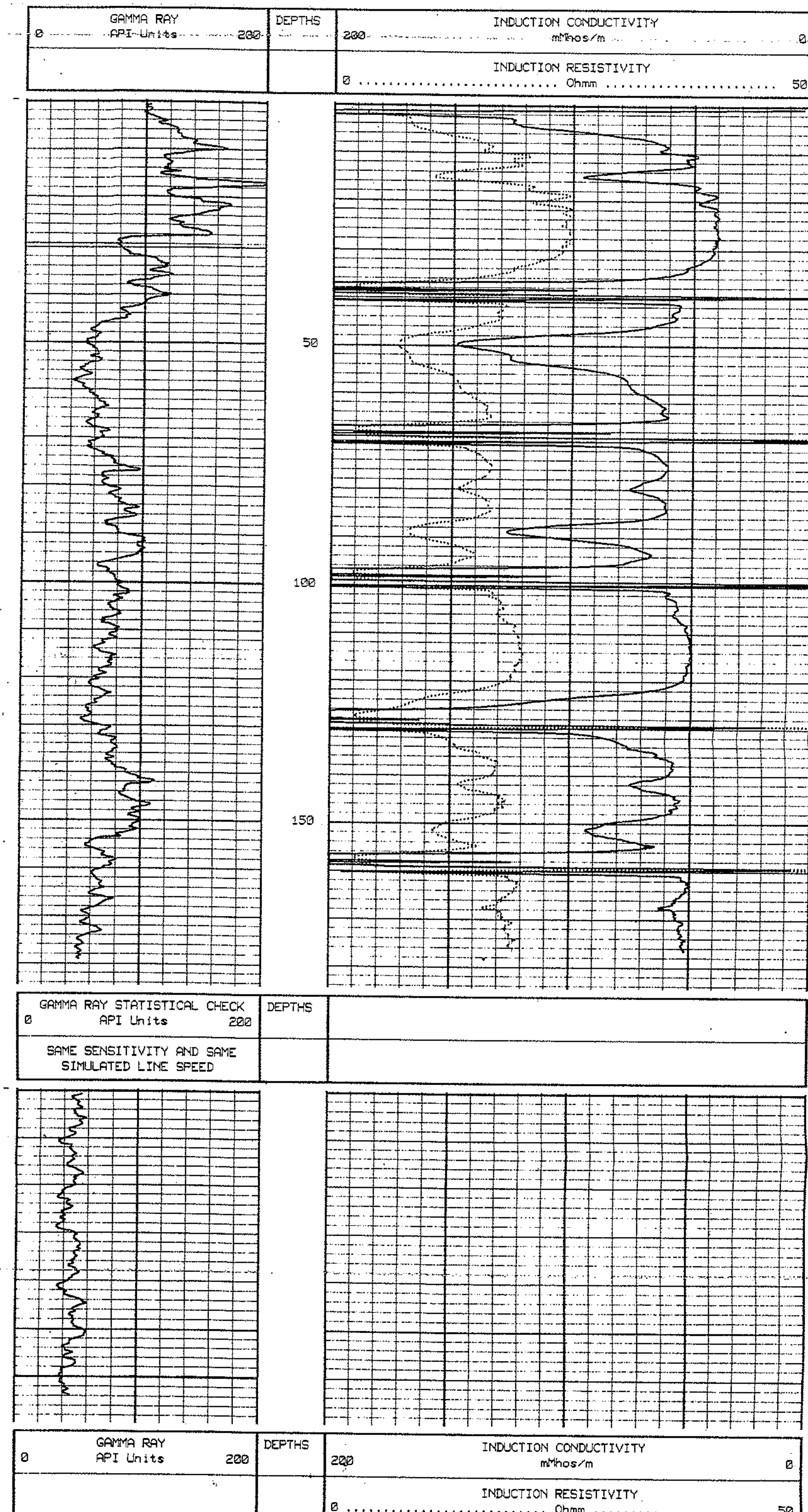
WELENCO, INC.

INDUCTION CONDUCTIVITY mMhos/m 0 200
DEPTHS
GAMMA RAY 0 200


GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50
50
100
150
GAMMA RAY STATISTICAL CHECK
0 API Units 200
DEPTHS
SAME SENSITIVITY AND SAME
SIMULATED LINE SPEED
GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50

welenco

INDUCTION / GAMMA RAY

FILING NO.	COMPANY: CAMP DRESSER & McKEE INC.
	WELL: MW-10D
	FIELD: CENTRAL TRUCKEE MEADOWS (CTM)
	COUNTY: WASHOE STATE: NEVADA
JOB NO. 34543	LOCATION: SEC ____ TWP ____ RGE ____
	OTHER SERV: NONE

PERMANENT DATUM: GROUND LEVEL ELEV: N/A

LOG MEASURED FROM G.L. 0 FT ABOVE PERM DATUM

DRILLING MEASURED FROM G.L.

ELEVATION: KB. ____ DF. ____ GL. ____

DATE	07-31-2001	07-31-2001	
TYPE OF LOG	INDUCTION	GAMMA RAY	
RUN NO.	ONE	ONE	
DEPTH - DRILLER	350'	350'	
DEPTH - LOGGER	347'	347'	
BOTTOM LOGGED INT	343'	346'	
TOP LOGGED INT	0'	0'	
TYPE FLUID IN HOLE	WATER/DRY	WATER/DRY	
FLUID LEVEL	110'	110'	
MAX TEMP DEG F	N/A	N/A	
OPERATING RIG TIME	N/A	N/A	
EQUIP. / LOCATION	L17 / BFL	L17 / BFL	
OPERATOR	BOBINSKI	BOBINSKI	
WITNESSED BY	TIM BOYER	TIM BOYER	

RUN	BORE HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	TYPE	FROM	TO
				2" O.D.	PVC	G.L.	BOTTOM

EQUIPMENT DATA

LOG TYPE	INDUCT. CON	INDUCT. RES	GAMMA RAY
RUN NO.	ONE		ONE
TOOL MODEL NO.	GEONICS	COMPUTER	SLIMHOLE
TOOL SERIAL NO.	01	GENERATED	T-53
DIAMETER	1.45"	FROM	1.25"
DETECTOR TYPE	COIL	INDUCT. CON	SCINT.
DETECTOR LENGTH	20"		1"
UNITS/DIV.	10 mMhos/m	2.5 Ohmm	20 API
SENSITIVITY	N/A	N/A	50/781
TIME CONSTANT	N/A	N/A	4 SEC
ZERO DIV L OR R	0	0	0
SPEED-FPM	25	25	13
DATA SAMPLES/FT	5	5	5
FORMATION FACTOR	N/A	N/A	N/A
PUMP RATE-GPM	N/A	N/A	N/A
PUMP RATE-GPM			
PUMP RATE-GPM			

SOURCE TYPE	STRENGTH	SPACING	MODEL NO	SERIAL NO.
N/A				

PERFORATIONS: 326.5 - 346.5'

REMARKS:

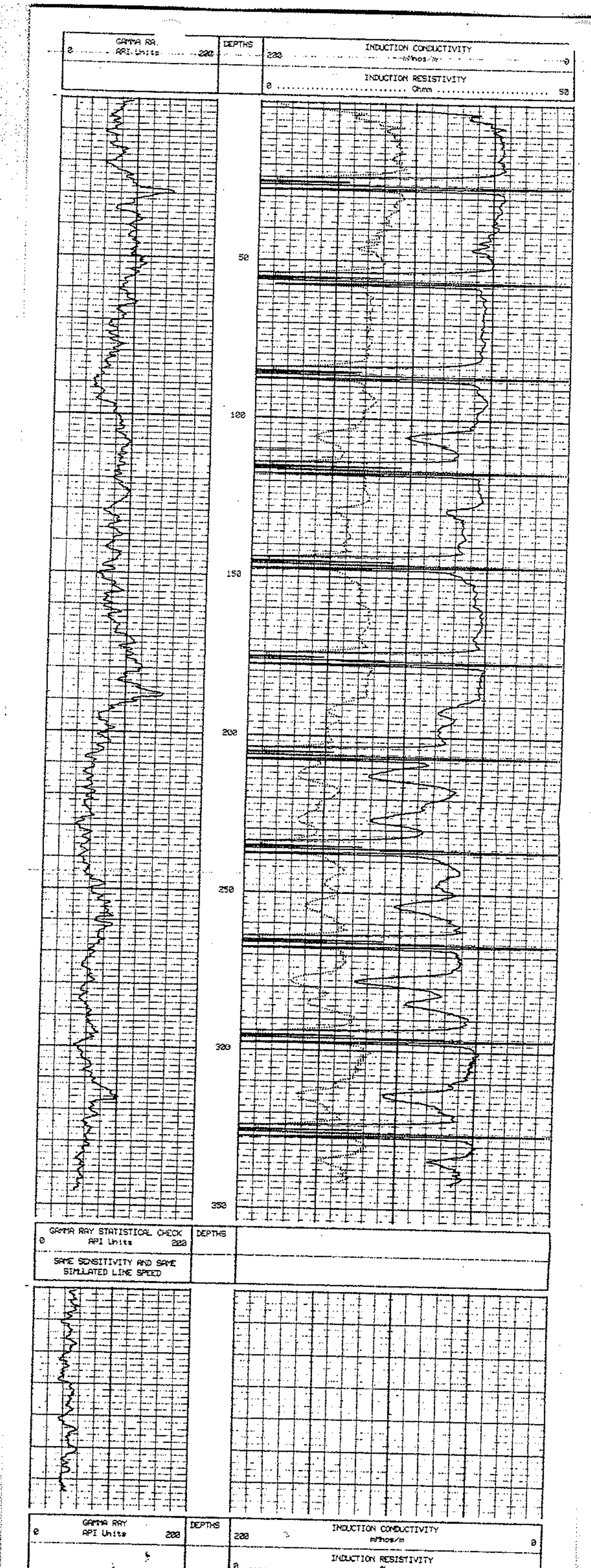
NOTICE:
All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

WELENCO, INC.

INDUCTION CONDUCTIVITY

DEPTHS

GAMMA RAY
API Units


GAMMA RAY
API Units
0 200
DEPTHS
INDUCTION CONDUCTIVITY
mMhos/m
200 0
INDUCTION RESISTIVITY
Ohmm
0 50
50
100
150
200
250
300
350
GAMMA RAY STATISTICAL CHECK
API Units
0 200
SAME SENSITIVITY AND SAME
SIMULATED LINE SPEED
DEPTHS
GAMMA RAY
API Units
0 200
DEPTHS
INDUCTION CONDUCTIVITY
mMhos/m
200 0
INDUCTION RESISTIVITY
Ohmm
0 50

welenco

INDUCTION / GAMMA RAY

FILING NO.		
	COMPANY	CAMP DRESSER & McKEE INC.
	WELL	MW-12D
	FIELD	CENTRAL TRUCKEE MEADOWS (CTM)
	COUNTY	WASHOE STATE NEVADA

LOCATION:

SEC ____ TWP ____ RGE ____

OTHER SERV: NONE

JOB NO. 34543

PERMANENT DATUM: GROUND LEVEL ELEV: N/A

LOG MEASURED FROM G.L. 0 FT ABOVE PERM DATUM

DRILLING MEASURED FROM G.L.

ELEVATION: KB. ____ DF. ____ GL. ____

DATE	07-31-2001	07-31-2001	
TYPE OF LOG	INDUCTION	GAMMA RAY	
RUN NO.	ONE	ONE	
DEPTH - DRILLER	346'	346'	
DEPTH - LOGGER	345'	345'	
BOTTOM LOGGED INT	341'	344'	
TOP LOGGED INT	0'	0'	
TYPE FLUID IN HOLE	WATER/DRY	WATER/DRY	
FLUID LEVEL	99'	99'	
MAX TEMP DEG F	N/A	N/A	
OPERATING RIG TIME	N/A	N/A	
EQUIP. LOCATION	L17 BFL	L17 BFL	
OPERATOR	BOBINSKI	BOBINSKI	
WITNESSED BY	TIM BOYER	TIM BOYER	

RUN	BORE HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	TYPE	FROM	TO
				2" O.D.	PVC	G.L.	BOTTOM

EQUIPMENT DATA

LOG TYPE	INDUCT. CON	INDUCT. RES	GAMMA RAY
RUN NO.	ONE		ONE
TOOL MODEL NO.	GEONICS	COMPUTER	SLIMHOLE
TOOL SERIAL NO.	01	GENERATED	T-53
DIAMETER	1.45"	FROM	1.25"
DETECTOR TYPE	COIL	INDUCT. CON	SCINT.
DETECTOR LENGTH	20"		1"
UNITS/DIV.	10 mMhos/m	2.5 Ohmm	20 API
SENSITIVITY	N/A	N/A	50/781
TIME CONSTANT	N/A	N/A	4 SEC
ZERO DIV L OR R	0	0	0
SPEED-FPM	25	25	13
DATA SAMPLES/FT	5	5	5
FORMATION FACTOR	N/A	N/A	N/A
PUMP RATE-GPM	N/A	N/A	N/A
PUMP RATE-GPM			
PUMP RATE-GPM			

SOURCE TYPE	STRENGTH	SPACING	MODEL NO	SERIAL NO.
N/A				

PERFORATIONS: 326 - 346'

REMARKS:

NOTICE:
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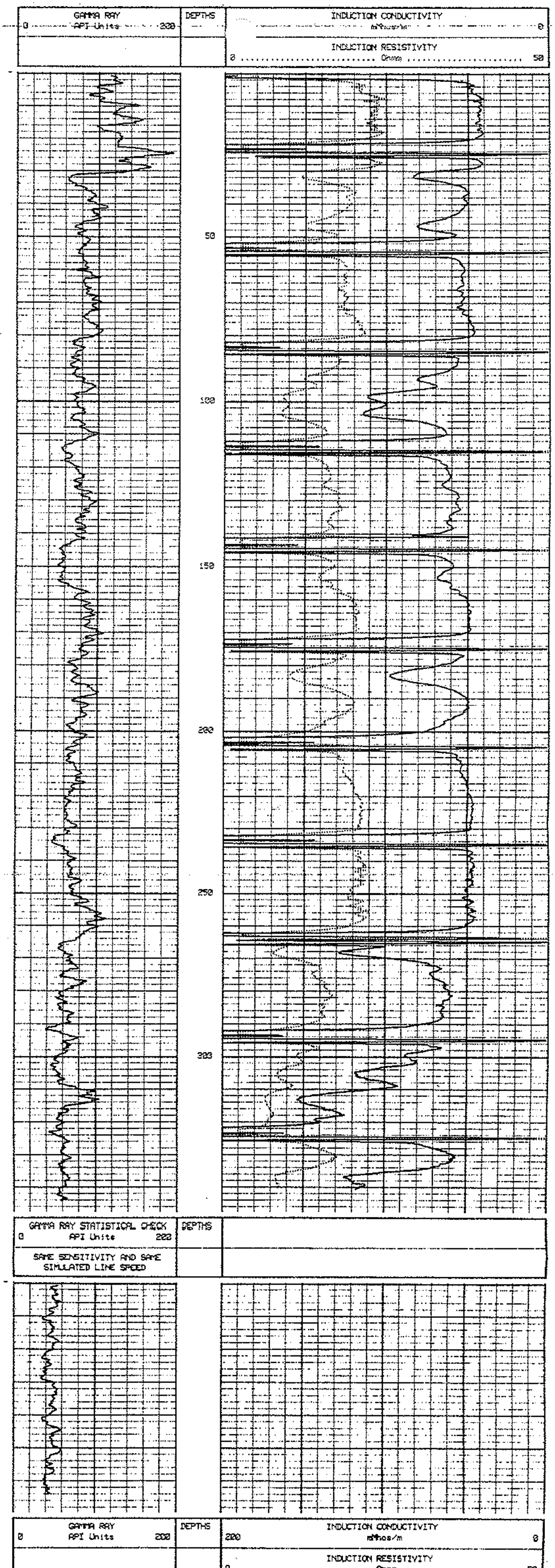
WELENCO, INC.

INDUCTION CONDUCTIVITY

DEPTHS

GAMMA RAY


GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50
50
100
150
200
250
300
GAMMA RAY STATISTICAL CHECK
0 API Units 200
SAME SENSITIVITY AND SAME SIMULATED LINE SPEED
DEPTHS
GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50

welenco

INDUCTION / GAMMA RAY

FILING NO.	COMPANY CAMP DRESSER & McKEE INC. WELL MW-17D FIELD CENTRAL TRUCKEE MEADOWS (CTM) COUNTY WASHOE STATE NEVADA
JOB NO. 34543	LOCATION: SEC ____ TWP ____ RGE ____
OTHER SERV: NONE	

PERMANENT DATUM: GROUND LEVEL ELEV: N/A

LOG MEASURED FROM G.L. 0 FT ABOVE PERM DATUM

DRILLING MEASURED FROM G.L.

ELEVATION:
KB. ____
DF. ____
GL. ____

DATE	08-01-2001		08-01-2001		
TYPE OF LOG	INDUCTION		GAMMA RAY		
RUN NO.	ONE		ONE		
DEPTH - DRILLER	201'		201'		
DEPTH - LOGGER	197'		197'		
BOTTOM LOGGED INT	193'		196'		
TOP LOGGED INT	0'		0'		
TYPE FLUID IN HOLE	WATER/DRY		WATER/DRY		
FLUID LEVEL	49'		49'		
MAX TEMP DEG F	N/A		N/A		
OPERATING RIG TIME	N/A		N/A		
EQUIP. LOCATION	L17	BFL	L17	BFL	
OPERATOR	BOBINSKI		BOBINSKI		
WITNESSED BY	TIM BOYER		TIM BOYER		

RUN NO.	BORE HOLE RECORD BIT	FROM	TO	CASING RECORD SIZE	TYPE	FROM	TO
				2" O.D.	PVC	G.L.	BOTTOM

EQUIPMENT DATA

LOG TYPE	INDUCT. CON	INDUCT. RES	GAMMA RAY
RUN NO.	ONE		ONE
TOOL MODEL NO.	GEONICS	COMPUTER	SLIMHOLE
TOOL SERIAL NO.	01	GENERATED	T-53
DIAMETER	1.45"	FROM	1.25"
DETECTOR TYPE	COIL	INDUCT. CON	SCINT.
DETECTOR LENGTH	20"		1"
UNITS/DIV.	10 mMhos/m	2.5 Ohmm	20 API
SENSITIVITY	N/A	N/A	50/781
TIME CONSTANT	N/A	N/A	4 SEC
ZERO DIV L OR R	0	0	0
SPEED-FPM	25	25	13
DATA SAMPLES/FT	5	5	5
FORMATION FACTOR	N/A	N/A	N/A
PUMP RATE-GPM	N/A	N/A	N/A
PUMP RATE-GPM			
PUMP RATE-GPM			

SOURCE TYPE	STRENGTH	SPACING	MODEL NO	SERIAL NO.
N/A				

PERFORATIONS: 179 - 199'

REMARKS:

NOTICE:

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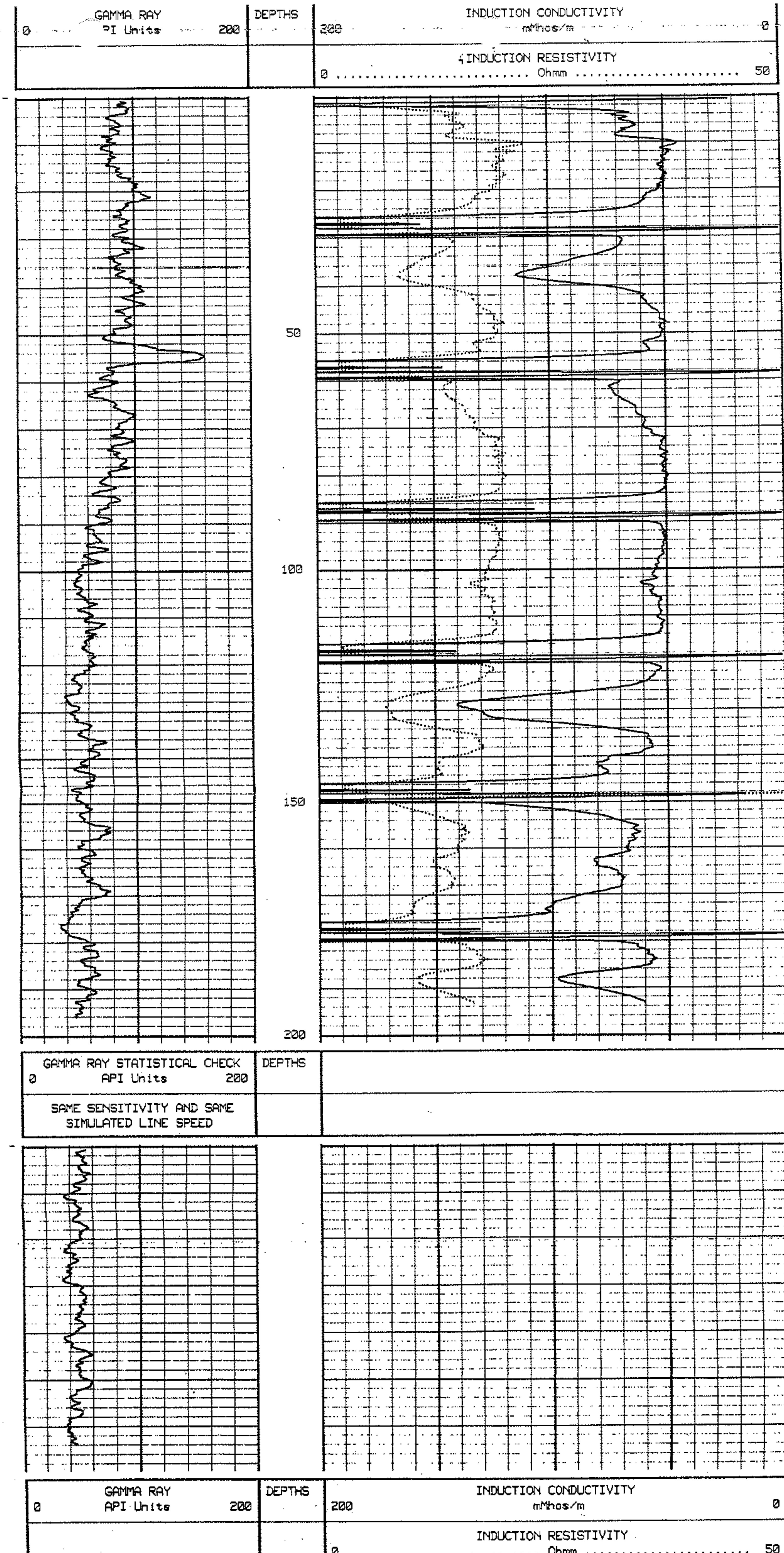
WELENCO, INC.

INDUCTION CONDUCTIVITY

DEPTHS

GAMMA RAY


GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50
50
100
150
200
GAMMA RAY STATISTICAL CHECK
0 API Units 200
SAME SENSITIVITY AND SAME
SIMULATED LINE SPEED
DEPTHS
GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50

welenco

INDUCTION / GAMMA RAY

FILING NO.	COMPANY: CAMP DRESSER & McKEE INC.
	WELL: MW-22D
	FIELD: CENTRAL TRUCKEE MEADOWS (CTM)
	COUNTY: WASHOE STATE: NEVADA
JOB NO. 34543	LOCATION: SEC ____ TWP ____ RGE ____

OTHER SERV: NONE

PERMANENT DATUM: GROUND LEVEL ELEV: N/A

LOG MEASURED FROM G.L. 0 FT ABOVE PERM DATUM

DRILLING MEASURED FROM G.L.

ELEVATION: KB. ____ DF. ____ GL. ____

DATE	07-31-2001		07-31-2001			
TYPE OF LOG	INDUCTION		GAMMA RAY			
RUN NO.	ONE		ONE			
DEPTH - DRILLER	253'		253'			
DEPTH - LOGGER	251'		251'			
BOTTOM LOGGED INT	247'		250'			
TOP LOGGED INT	0'		0'			
TYPE FLUID IN HOLE	WATER/DRY		WATER/DRY			
FLUID LEVEL	100'		100'			
MAX TEMP DEG F	N/A		N/A			
OPERATING RIG TIME	N/A		N/A			
EQUIP. LOCATION	L17	BFL	L17	BFL		
OPERATOR	BOBINSKI		BOBINSKI			
WITNESSED BY	TIM BOYER		TIM BOYER			

RUN NO.	BORE HOLE RECORD BIT	FROM	TO	CASING RECORD SIZE	TYPE	FROM	TO
				2" O.D.	PVC	G.L.	BOTTOM

EQUIPMENT DATA

LOG TYPE	INDUCT. CON	INDUCT. RES	GAMMA RAY
RUN NO.	ONE		ONE
TOOL MODEL NO.	GEONICS	COMPUTER	SLIMHOLE
TOOL SERIAL NO.	01	GENERATED	T-53
DIAMETER	1.45"	FROM	1.25"
DETECTOR TYPE	COIL	INDUCT. CON	SCINT.
DETECTOR LENGTH	20"		1"
UNITS/DIV.	10 mMhos/m	2.5 Ohmm	20 API
SENSITIVITY	N/A	N/A	50/781
TIME CONSTANT	N/A	N/A	4 SEC
ZERO DIV L OR R	0	0	0
SPEED-FPM	25	25	13
DATA SAMPLES/FT	5	5	5
FORMATION FACTOR	N/A	N/A	N/A
PUMP RATE-GPM	N/A	N/A	N/A
PUMP RATE-GPM			
PUMP RATE-GPM			

SOURCE TYPE	STRENGTH	SPACING	MODEL NO	SERIAL NO.
N/A				

PERFORATIONS: 231 - 251'

REMARKS:

NOTICE:
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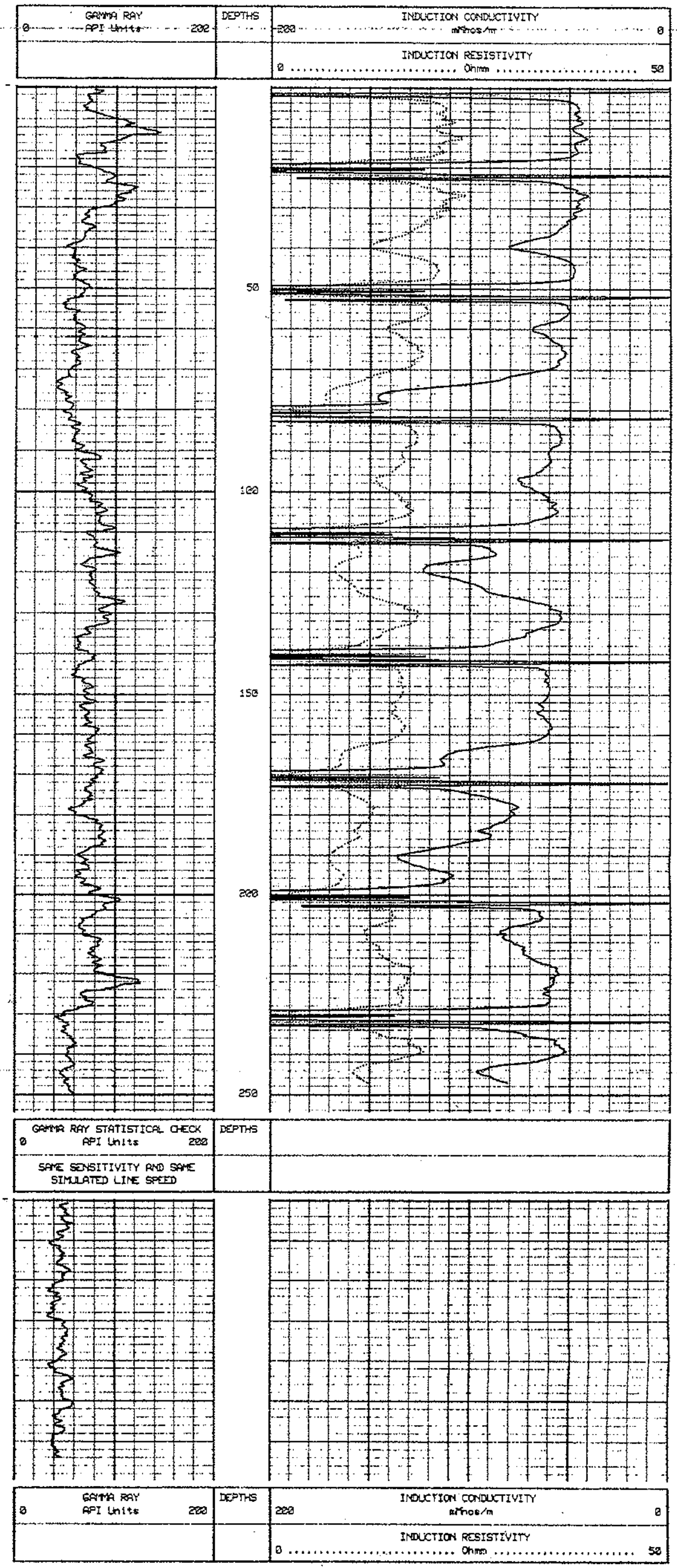
WELENCO, INC.

INDUCTION CONDUCTIVITY

DEPTHS

GAMMA RAY


GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50
50
100
150
200
250
GAMMA RAY STATISTICAL CHECK
0 API Units 200
DEPTHS
SAME SENSITIVITY AND SAME
SIMULATED LINE SPEED
GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50

welenco

INDUCTION / GAMMA RAY

FILING NO.	COMPANY: CAMP DRESSER & McKEE INC. WELL: MW-23D FIELD: CENTRAL TRUCKEE MEADOWS (CTM) COUNTY: WASHOE STATE: NEVADA
JOB NO. 34543	LOCATION: SEC ____ TWP ____ RGE ____

OTHER SERV: NONE

PERMANENT DATUM: GROUND LEVEL ELEV: N/A

LOG MEASURED FROM G.L. 0 FT ABOVE PERM DATUM

DRILLING MEASURED FROM G.L.

ELEVATION: KB. ____ DF. ____ GL. ____

DATE	08-01-2001	08-01-2001	
TYPE OF LOG	INDUCTION	GAMMA RAY	
RUN NO.	ONE	ONE	
DEPTH - DRILLER	186'	186'	
DEPTH - LOGGER	179'	179'	
BOTTOM LOGGED INT	175'	178'	
TOP LOGGED INT	0'	0'	
TYPE FLUID IN HOLE	WATER/DRY	WATER/DRY	
FLUID LEVEL	9'	9'	
MAX TEMP DEG F	N/A	N/A	
OPERATING RIG TIME	N/A	N/A	
EQUIP. / LOCATION	L17 / BFL	L17 / BFL	
OPERATOR	BOBINSKI	BOBINSKI	
WITNESSED BY	TIM BOYER	TIM BOYER	

RUN NO.	BORE HOLE RECORD BIT	FROM	TO	CASING RECORD SIZE	TYPE	FROM	TO
				2" O.D.	PVC	G.L.	BOTTOM

EQUIPMENT DATA

LOG TYPE	INDUCT. CON	INDUCT. RES	GAMMA RAY
RUN NO.	ONE		ONE
TOOL MODEL NO.	GEONICS	COMPUTER	SLIMHOLE
TOOL SERIAL NO.	01	GENERATED	T-53
DIAMETER	1.45"	FROM	1.25"
DETECTOR TYPE	COIL	INDUCT. CON	SCINT.
DETECTOR LENGTH	20"		1"
UNITS/DIV.	10 mMhos/m	2.5 Ohmm	20 API
SENSITIVITY	N/A	N/A	50/781
TIME CONSTANT	N/A	N/A	4 SEC
ZERO DIV L OR R	0	0	0
SPEED-FPM	25	25	13
DATA SAMPLES/FT	5	5	5
FORMATION FACTOR	N/A	N/A	N/A
PUMP RATE-GPM	N/A	N/A	N/A
PUMP RATE-GPM			
PUMP RATE-GPM			

SOURCE TYPE	STRENGTH	SPACING	MODEL NO	SERIAL NO.
N/A				

PERFORATIONS: 160 - 180'

REMARKS:

NOTICE:
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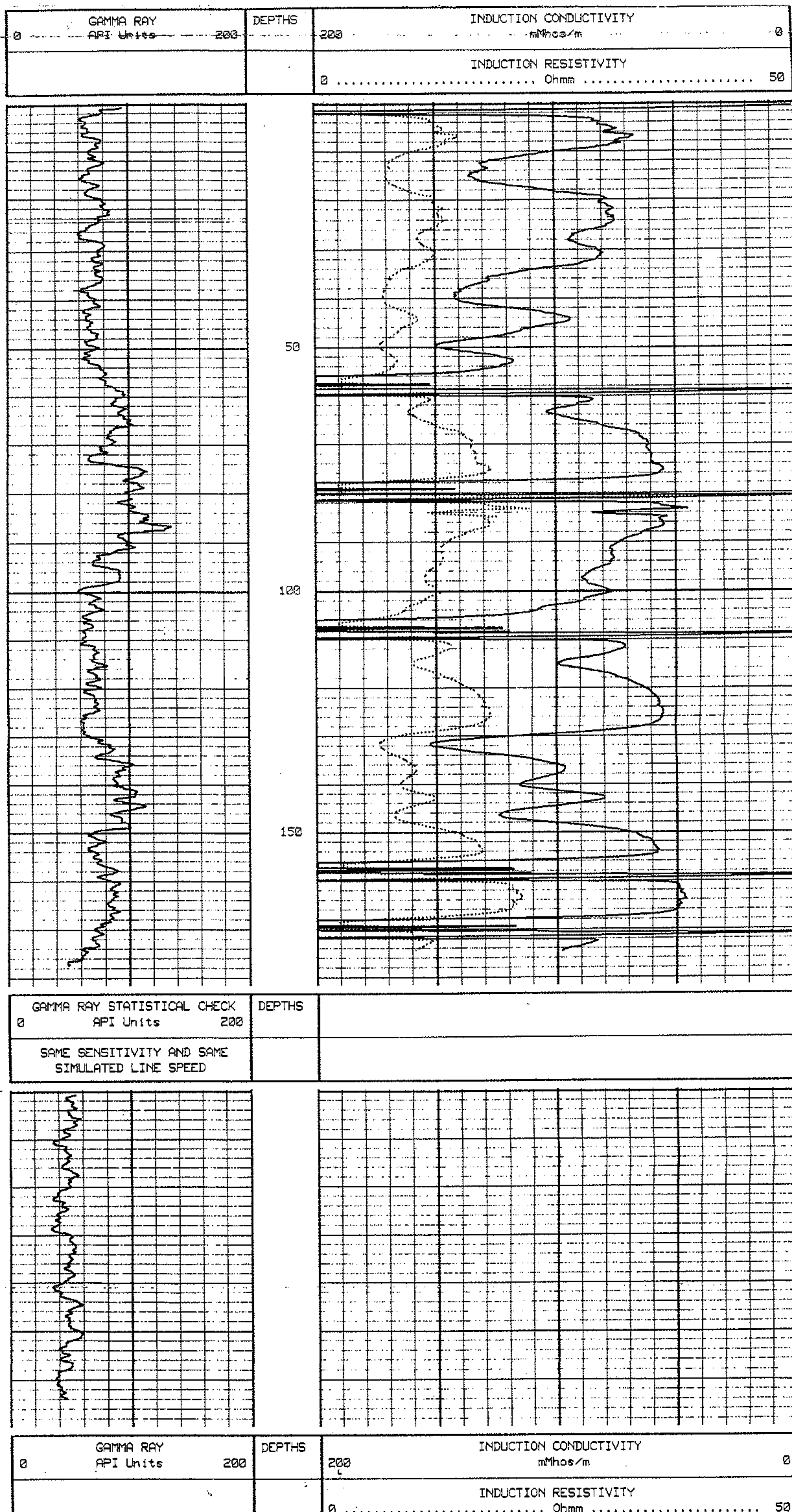
WELENCO, INC.

INDUCTION CONDUCTIVITY

DEPTHS

GAMMA RAY



GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50
50
100
150
GAMMA RAY STATISTICAL CHECK
0 API Units 200
SAME SENSITIVITY AND SAME SIMULATED LINE SPEED
DEPTHS
GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50

welenco

INDUCTION / GAMMA RAY

FILING NO.	COMPANY CAMP DRESSER & McKEE INC.
	WELL MW-25D
	FIELD CENTRAL TRUCKEE MEADOWS (CTM)
	COUNTY WASHOE STATE NEVADA
JOB NO. 34543	LOCATION: SEC ____ TWP ____ RGE ____
	OTHER SERV: NONE

PERMANENT DATUM: GROUND LEVEL ELEV: N/A

LOG MEASURED FROM G.L. 0 FT ABOVE PERM DATUM

DRILLING MEASURED FROM G.L.

ELEVATION: KB. ____ DF. ____ GL. ____

DATE	08-01-2001	08-01-2001	
TYPE OF LOG	INDUCTION	GAMMA RAY	
RUN NO.	ONE	ONE	
DEPTH - DRILLER	182'	182'	
DEPTH - LOGGER	176'	176'	
BOTTOM LOGGED INT	172'	175'	
TOP LOGGED INT	0'	0'	
TYPE FLUID IN HOLE	WATER/DRY	WATER/DRY	
FLUID LEVEL	4'	4'	
MAX TEMP DEG F	N/A	N/A	
OPERATING RIG TIME	N/A	N/A	
EQUIP. | LOCATION	L17 | BFL	L17 | BFL	
OPERATOR	BOBINSKI	BOBINSKI	
WITNESSED BY	TIM BOYER	TIM BOYER	

RUN	BORE HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	TYPE	FROM	TO
				2" O.D.	PVC	G.L.	BOTTOM

EQUIPMENT DATA

LOG TYPE	INDUCT. CON	INDUCT. RES	GAMMA RAY
RUN NO.	ONE		ONE
TOOL MODEL NO.	GEONICS	COMPUTER	SLIMHOLE
TOOL SERIAL NO.	01	GENERATED	T-53
DIAMETER	1.45"	FROM	1.25"
DETECTOR TYPE	COIL	INDUCT. CON	SCINT.
DETECTOR LENGTH	20"		1"
UNITS/DIV.	10 mMhos/m	2.5 Ohmm	20 API
SENSITIVITY	N/A	N/A	50/781
TIME CONSTANT	N/A	N/A	4 SEC
ZERO DIV L OR R	0	0	0
SPEED-FPM	25	25	13
DATA SAMPLES/FT	5	5	5
FORMATION FACTOR	N/A	N/A	N/A
PUMP RATE-GPM	N/A	N/A	N/A
PUMP RATE-GPM			
PUMP RATE-GPM			

SOURCE TYPE	STRENGTH	SPACING	MODEL NO	SERIAL NO.
N/A				

PERFORATIONS: 157 - 177'

REMARKS:

NOTICE:
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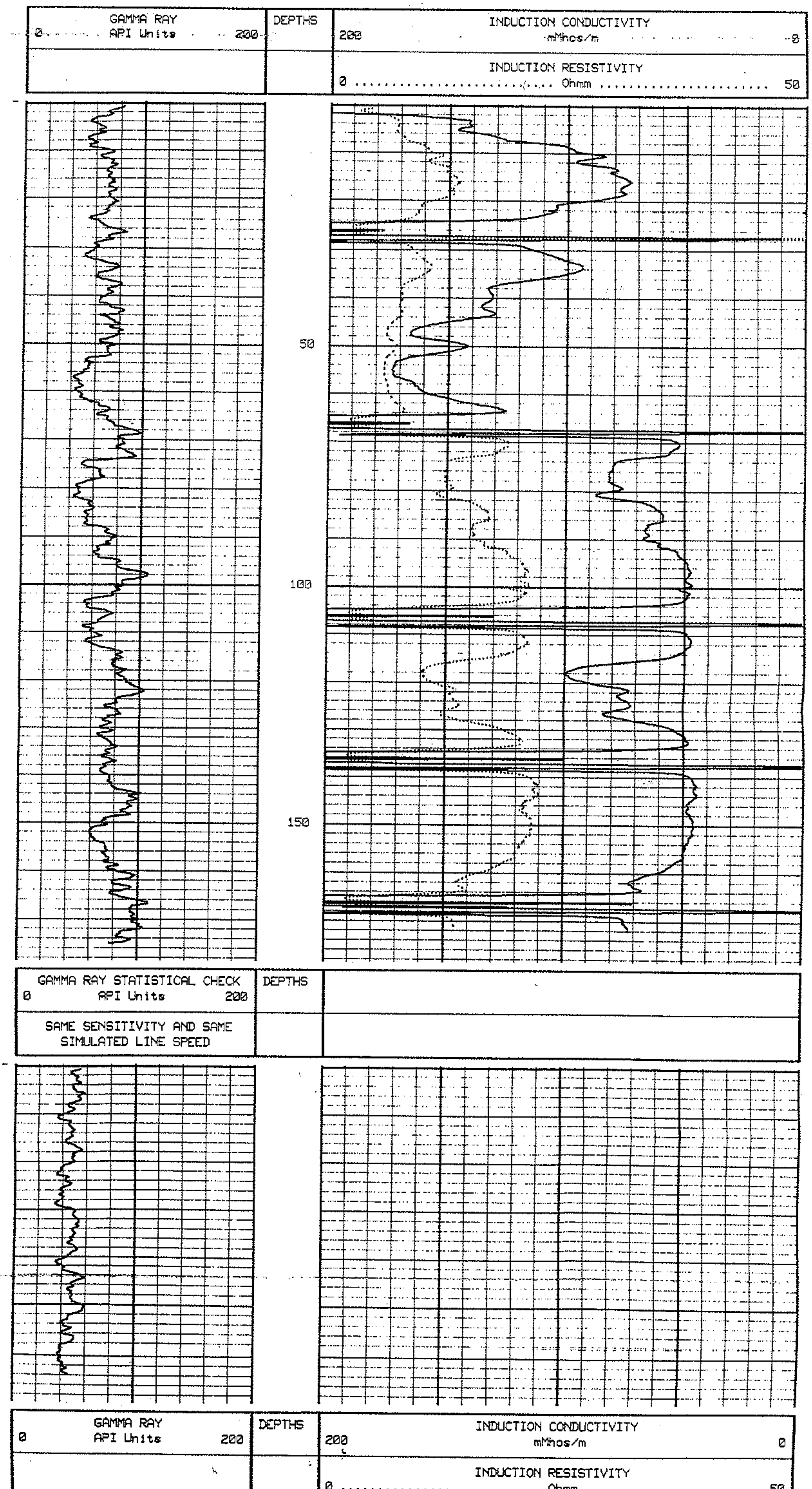
WELENCO, INC.

INDUCTION CONDUCTIVITY
DEPTHS
GAMMA RAY



GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50
50
100
150
GAMMA RAY STATISTICAL CHECK
0 API Units 200
SAME SENSITIVITY AND SAME
SIMULATED LINE SPEED
DEPTHS
GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50

welenco

INDUCTION / GAMMA RAY

FILING NO.

COMPANY: CAMP DRESSER & McKEE INC.
WELL: MW-27D
FIELD: CENTRAL TRUCKEE MEADOWS (CTM)
COUNTY: WASHOE STATE: NEVADA

LOCATION:

OTHER SERV: NONE

JOB NO. 34543

SEC ______ TWP ______ RGE ______

PERMANENT DATUM: GROUND LEVEL ELEV: N/A

LOG MEASURED FROM G.L. 0 FT ABOVE PERM DATUM

DRILLING MEASURED FROM G.L.

ELEVATION:
KB.
DF.
GL.

DATE	07-31-2001	07-31-2001	
TYPE OF LOG	INDUCTION	GAMMA RAY	
RUN NO.	ONE	ONE	
DEPTH - DRILLER	180'	180'	
DEPTH - LOGGER	177'	177'	
BOTTOM LOGGED INT	173'	176'	
TOP LOGGED INT	0'	0'	
TYPE FLUID IN HOLE	WATER/DRY	WATER/DRY	
FLUID LEVEL	5'	5'	
MAX TEMP DEG F	N/A	N/A	
OPERATING RIG TIME	N/A	N/A	
EQUIP. LOCATION	L17 BFL	L17 BFL	
OPERATOR	BOBINSKI	BOBINSKI	
WITNESSED BY	TIM BOYER	TIM BOYER	

RUN NO.	BORE HOLE RECORD BIT	FROM	TO	CASING RECORD SIZE	TYPE	FROM	TO
				2" O.D.	PVC	G.L.	BOTTOM

EQUIPMENT DATA

LOG TYPE	INDUCT. CON	INDUCT. RES	GAMMA RAY
RUN NO.	ONE		ONE
TOOL MODEL NO.	GEONICS	COMPUTER	SLIMHOLE
TOOL SERIAL NO.	01	GENERATED	T-53
DIAMETER	1.45"	FROM	1.25"
DETECTOR TYPE	COIL	INDUCT. CON	SCINT.
DETECTOR LENGTH	20"		1"
UNITS/DIV.	10 mMhos/m	2.5 Ohmm	20 API
SENSITIVITY	N/A	N/A	50/781
TIME CONSTANT	N/A	N/A	4 SEC
ZERO DIV L OR R	0	0	0
SPEED-FPM	25	25	13
DATA SAMPLES/FT	5	5	5
FORMATION FACTOR	N/A	N/A	N/A
PUMP RATE-GPM	N/A	N/A	N/A
PUMP RATE-GPM			
PUMP RATE-GPM			

SOURCE TYPE	STRENGTH	SPACING	MODEL NO	SERIAL NO.
N/A				

PERFORATIONS: 157.5 - 177.5'

REMARKS:

NOTICE:

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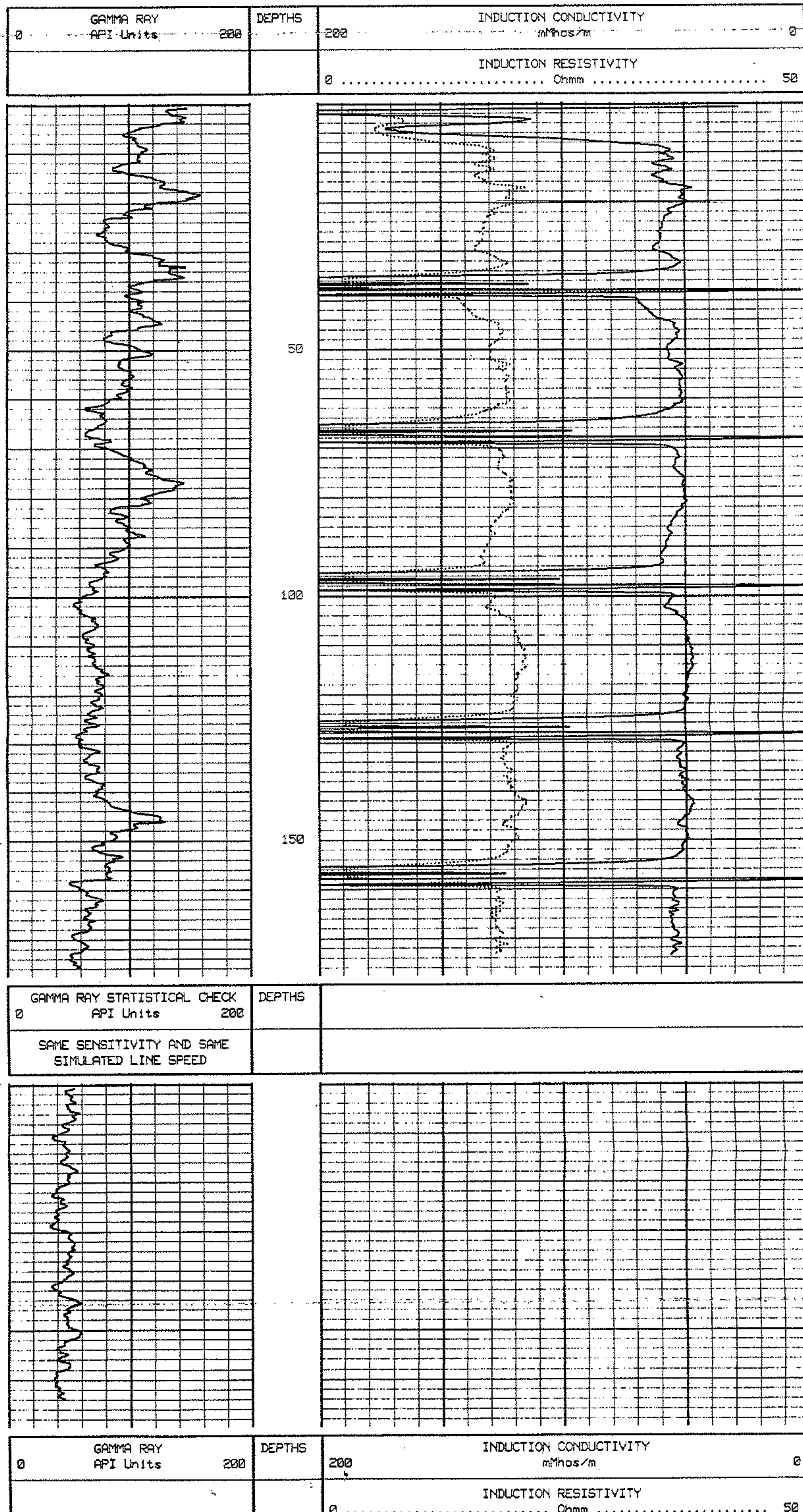
WELENCO, INC.

INDUCTION CONDUCTIVITY

DEPTHS

GAMMA RAY


GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50
50
100
150
GAMMA RAY STATISTICAL CHECK
0 API Units 200
SAME SENSITIVITY AND SAME
SIMULATED LINE SPEED
DEPTHS
GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 Ohmm 50

welenco

INDUCTION / GAMMA RAY

FILING NO.	COMPANY CAMP DRESSER & McKEE INC.
	WELL MW-30D
	FIELD CENTRAL TRUCKEE MEADOWS (CTM)
	COUNTY WASHOE STATE NEVADA
JOB NO. 34543	LOCATION: SEC TWP RGE
	OTHER SERV: NONE

PERMANENT DATUM: GROUND LEVEL ELEV: N/A

LOG MEASURED FROM G.L. 0 FT ABOVE PERM DATUM

DRILLING MEASURED FROM G.L.

ELEVATION: KB. DF. GL.

DATE	07-31-2001		07-31-2001		
TYPE OF LOG	INDUCTION		GAMMA RAY		
RUN NO.	ONE		ONE		
DEPTH - DRILLER	154'		154'		
DEPTH - LOGGER	151'		151'		
BOTTOM LOGGED INT	148'		150'		
TOP LOGGED INT	0'		0'		
TYPE FLUID IN HOLE	WATER/DRY		WATER/DRY		
FLUID LEVEL	29'		29'		
MAX TEMP DEG F	N/A		N/A		
OPERATING RIG TIME	N/A		N/A		
EQUIP. LOCATION	L17	BFL	L17	BFL	
OPERATOR	BOBINSKI		BOBINSKI		
WITNESSED BY	TIM BOYER		TIM BOYER		

RUN	BORE HOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	TYPE	FROM	TO
				2" O.D.	PVC	G.L.	BOTTOM

EQUIPMENT DATA

LOG TYPE	INDUCT. CON	INDUCT. RES	GAMMA RAY
RUN NO.	ONE		ONE
TOOL MODEL NO.	GEONICS	COMPUTER	SLIMHOLE
TOOL SERIAL NO.	01	GENERATED	T-53
DIAMETER	1.45"	FROM	1.25"
DETECTOR TYPE	COIL	INDUCT. CON	SCINT.
DETECTOR LENGTH	20"		1"
UNITS/DIV.	10 mMhos/m	2.5 Ohmm	20 API
SENSITIVITY	N/A	N/A	50/781
TIME CONSTANT	N/A	N/A	4 SEC
ZERO DIV L OR R	0	0	0
SPEED-FPM	25	25	13
DATA SAMPLES/FT	5	5	5
FORMATION FACTOR	N/A	N/A	N/A
PUMP RATE-GPM	N/A	N/A	N/A
PUMP RATE-GPM			
PUMP RATE-GPM			

SOURCE TYPE	STRENGTH	SPACING	MODEL NO	SERIAL NO.
N/A				

PERFORATIONS: 131.5 - 151.5'

REMARKS:

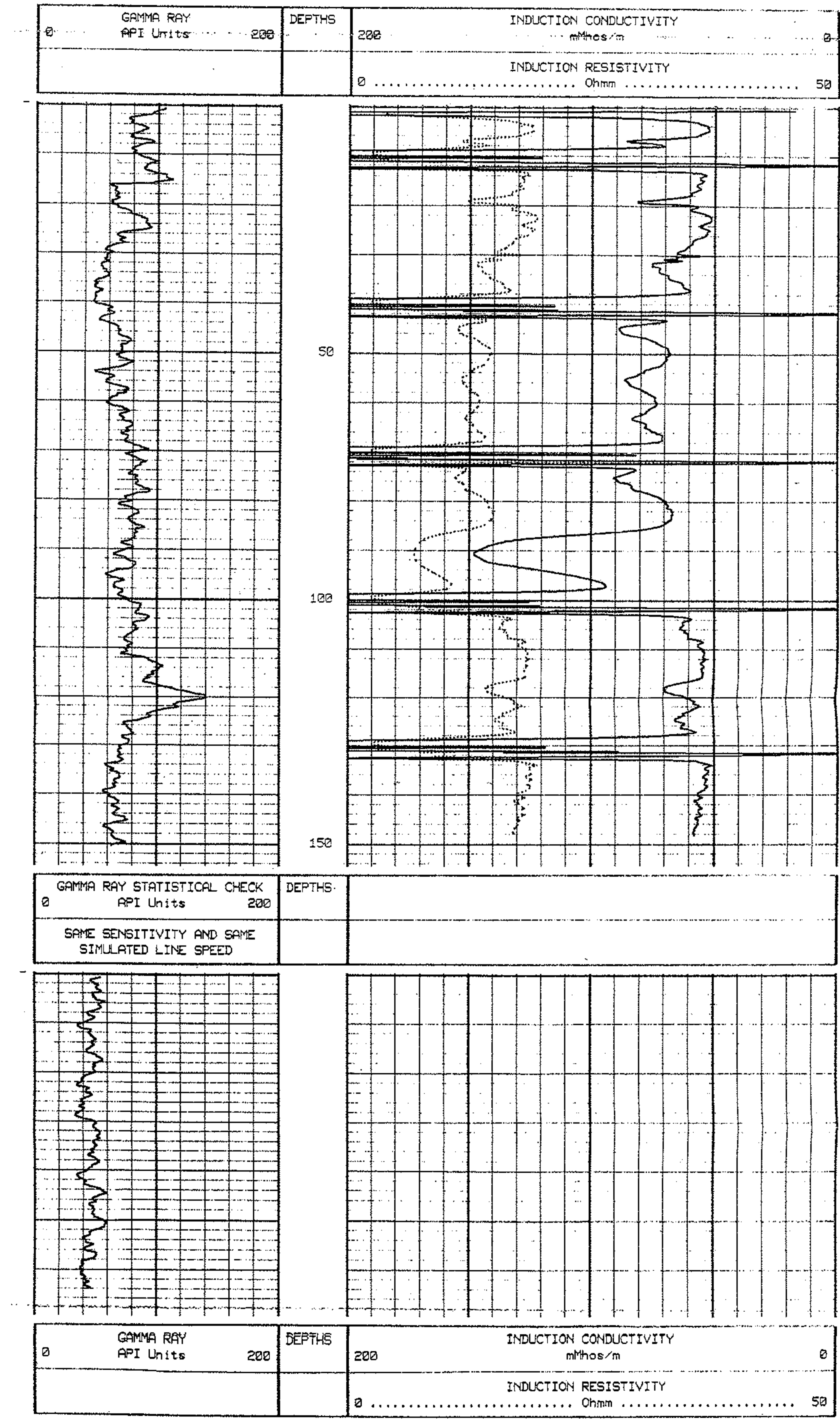
NOTICE:
All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

WELENCO, INC.

INDUCTION CONDUCTIVITY

DEPTHS

GAMMA RAY



GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 .... Ohmm 50
50
100
150
GAMMA RAY STATISTICAL CHECK
0 API Units 200
DEPTHS
SAME SENSITIVITY AND SAME SIMULATED LINE SPEED
GAMMA RAY
0 API Units 200
DEPTHS
INDUCTION CONDUCTIVITY
200 mMhos/m 0
INDUCTION RESISTIVITY
0 .... Ohmm 50

welenco

INDUCTION / GAMMA RAY

FILING NO.

JOB NO. 34543

COMPANY CAMP DRESSER & McKEE INC.
WELL MW-33D
FIELD CENTRAL TRUCKEE MEADOWS (CTM)
COUNTY WASHOE STATE NEVADA

LOCATION:

SEC TWP RGE

OTHER SERV: NONE

PERMANENT DATUM: GROUND LEVEL ELEV: N/A
LOG MEASURED FROM G.L. 0 FT ABOVE PERM DATUM
DRILLING MEASURED FROM G.L.

ELEVATION:
KB.
DF.
GL.

DATE	08-01-2001		08-01-2001		
TYPE OF LOG	INDUCTION		GAMMA RAY		
RUN NO.	ONE		ONE		
DEPTH - DRILLER	200'		200'		
DEPTH - LOGGER	198'		198'		
BOTTOM LOGGED INT	194'		197'		
TOP LOGGED INT	0'		0'		
TYPE FLUID IN HOLE	WATER/DRY		WATER/DRY		
FLUID LEVEL	FULL		FULL		
MAX TEMP DEG F	N/A		N/A		
OPERATING RIG TIME	N/A		N/A		
EQUIP. LOCATION	L17	BFL	L17	BFL	
OPERATOR	BOBINSKI		BOBINSKI		
WITNESSED BY	TIM BOYER		TIM BOYER		

RUN NO.	BORE HOLE RECORD BIT	FROM	TO	CASING RECORD SIZE	TYPE	FROM	TO
				2" O.D.	PVC	G.L.	BOTTOM

EQUIPMENT DATA

LOG TYPE	INDUCT. CON	INDUCT. RES	GAMMA RAY
RUN NO.	ONE		ONE
TOOL MODEL NO.	GEONICS	COMPUTER	SLIMHOLE
TOOL SERIAL NO.	01	GENERATED	T-53
DIAMETER	1.45"	FROM	1.25"
DETECTOR TYPE	COIL	INDUCT. CON	SCINT.
DETECTOR LENGTH	20"		1"
UNITS/DIV.	10 mMhos/m	2.5 Ohmm	20 API
SENSITIVITY	N/A	N/A	50/781
TIME CONSTANT	N/A	N/A	4 SEC
ZERO DIV L OR R	0	0	0
SPEED-FPM	25	25	13
DATA SAMPLES/FT	5	5	5
FORMATION FACTOR	N/A	N/A	N/A
PUMP RATE-GPM	N/A	N/A	N/A
PUMP RATE-GPM			
PUMP RATE-GPM			

SOURCE TYPE	STRENGTH	SPACING	MODEL NO	SERIAL NO.
N/A				

PERFORATIONS: 178.5 - 198.5'

REMARKS:

NOTICE:

All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

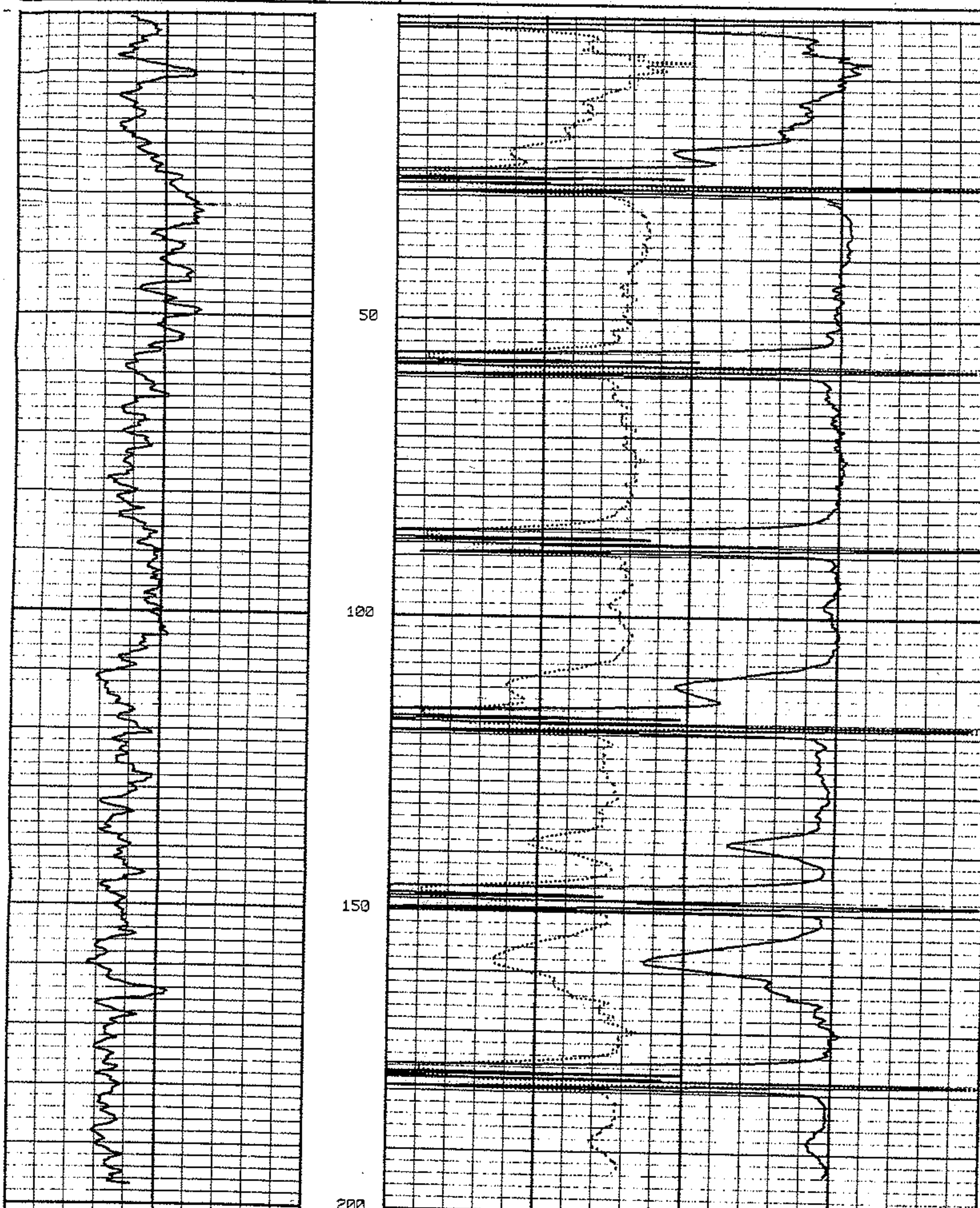
WELENCO, INC.

INDUCTION CONDUCTIVITY

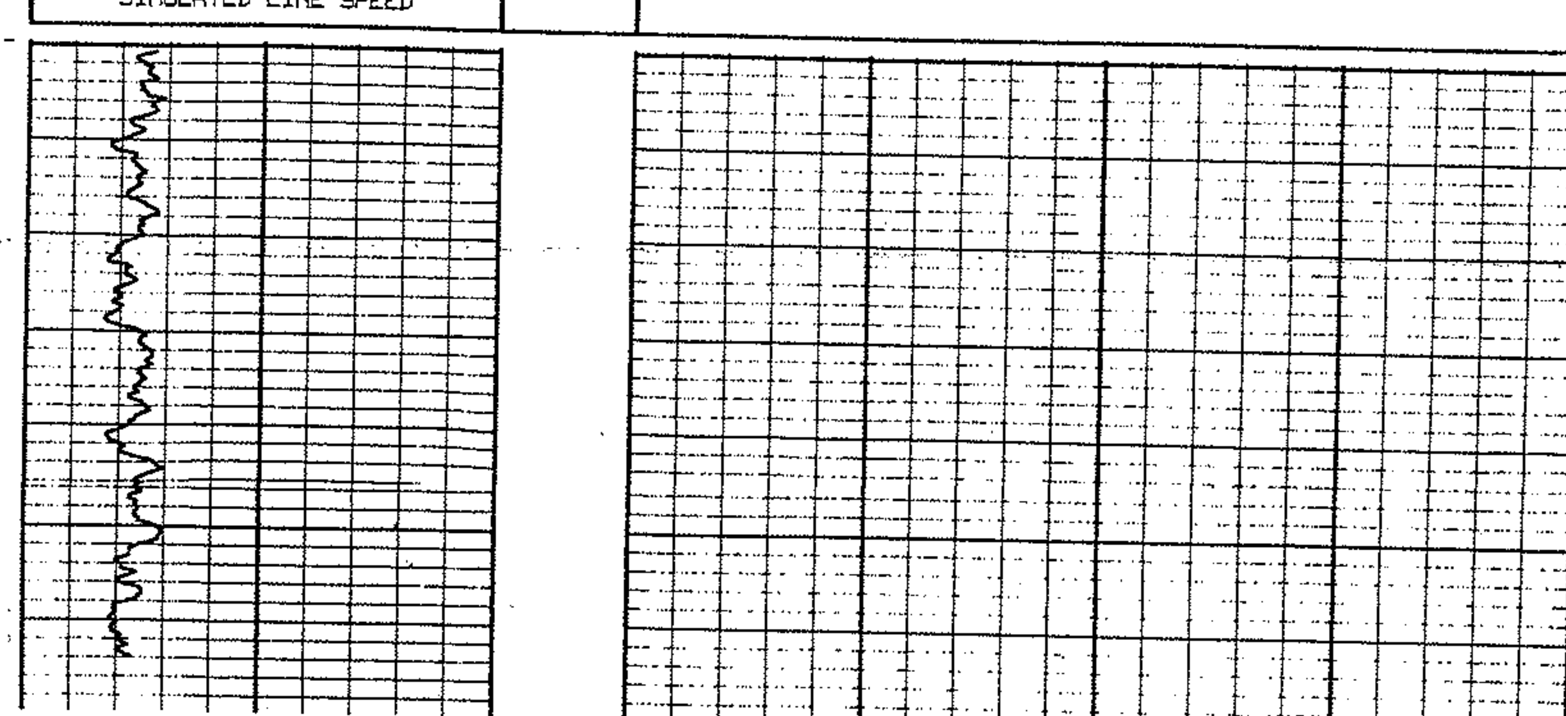
DEPTHS

GAMMA RAY

GAMMA RAY 0 API Units 200	DEPTHS	INDUCTION CONDUCTIVITY 200 mMhos/m 0
		INDUCTION RESISTIVITY 0 .... Ohmm 50

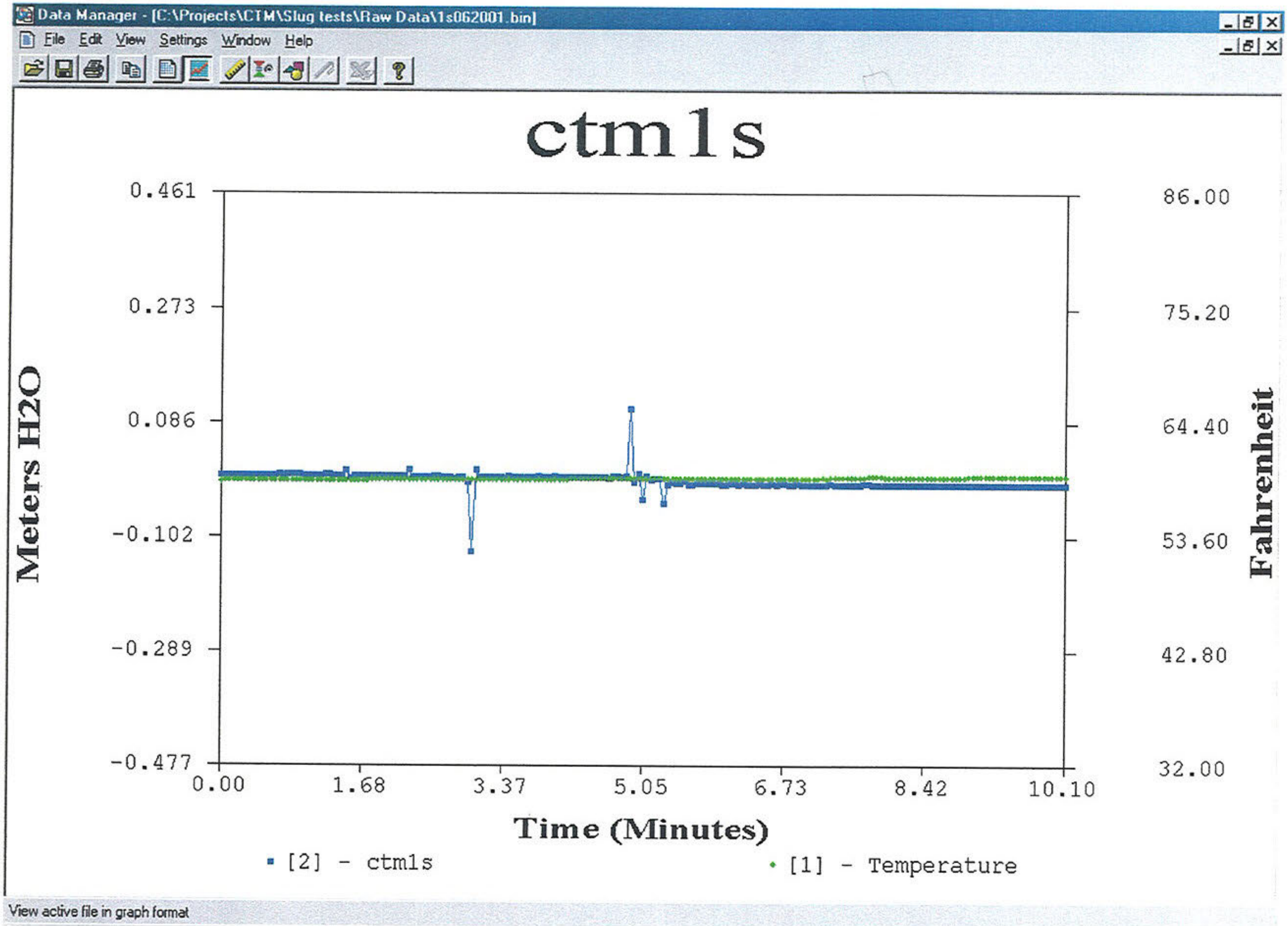


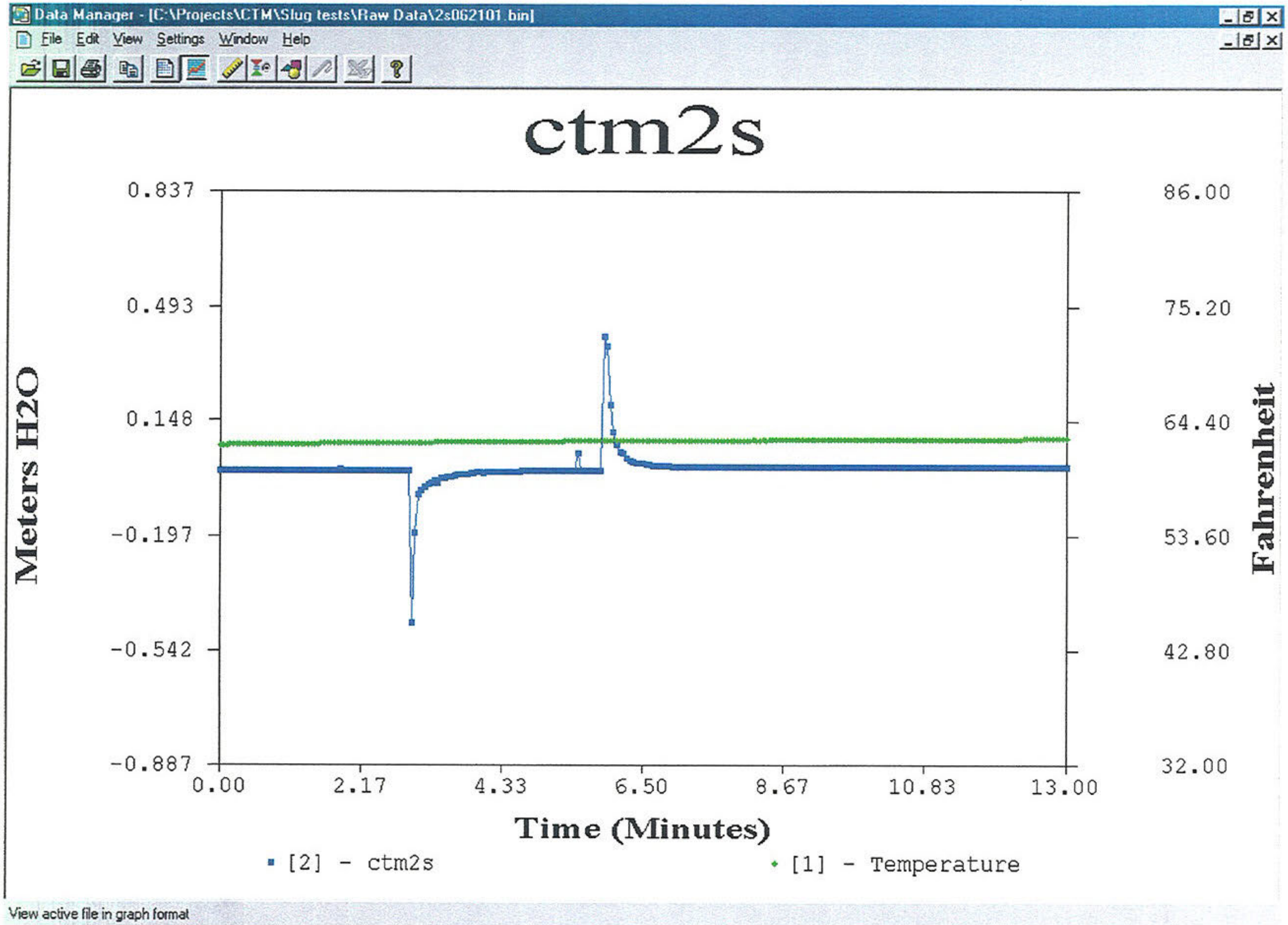
GAMMA RAY STATISTICAL CHECK 0 API Units 200	DEPTHS	
SAME SENSITIVITY AND SAME SIMULATED LINE SPEED		

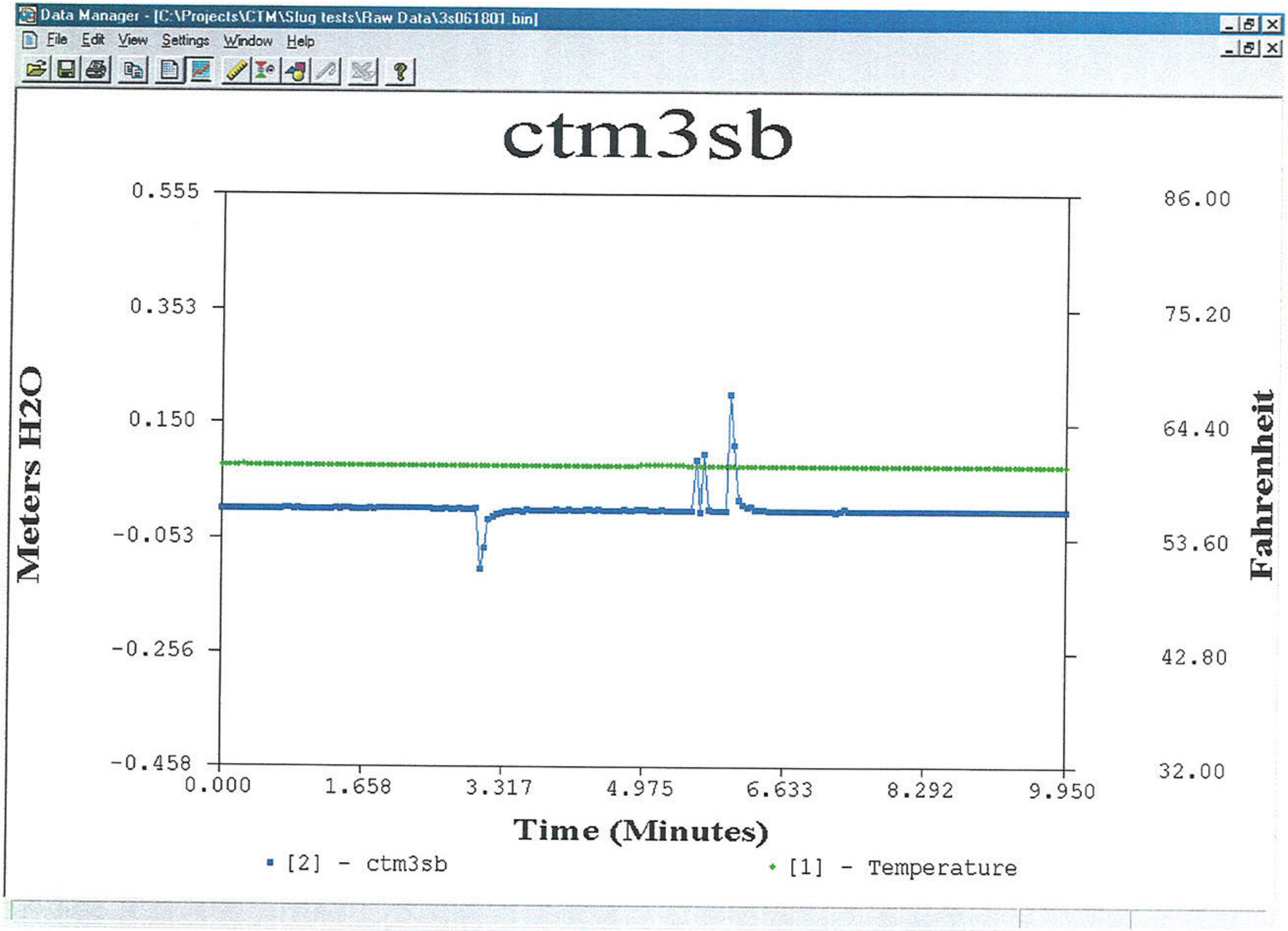


GAMMA RAY 0 API Units 200	DEPTHS	INDUCTION CONDUCTIVITY 200 mMhos/m 0
		INDUCTION RESISTIVITY 0 .... Ohmm 50

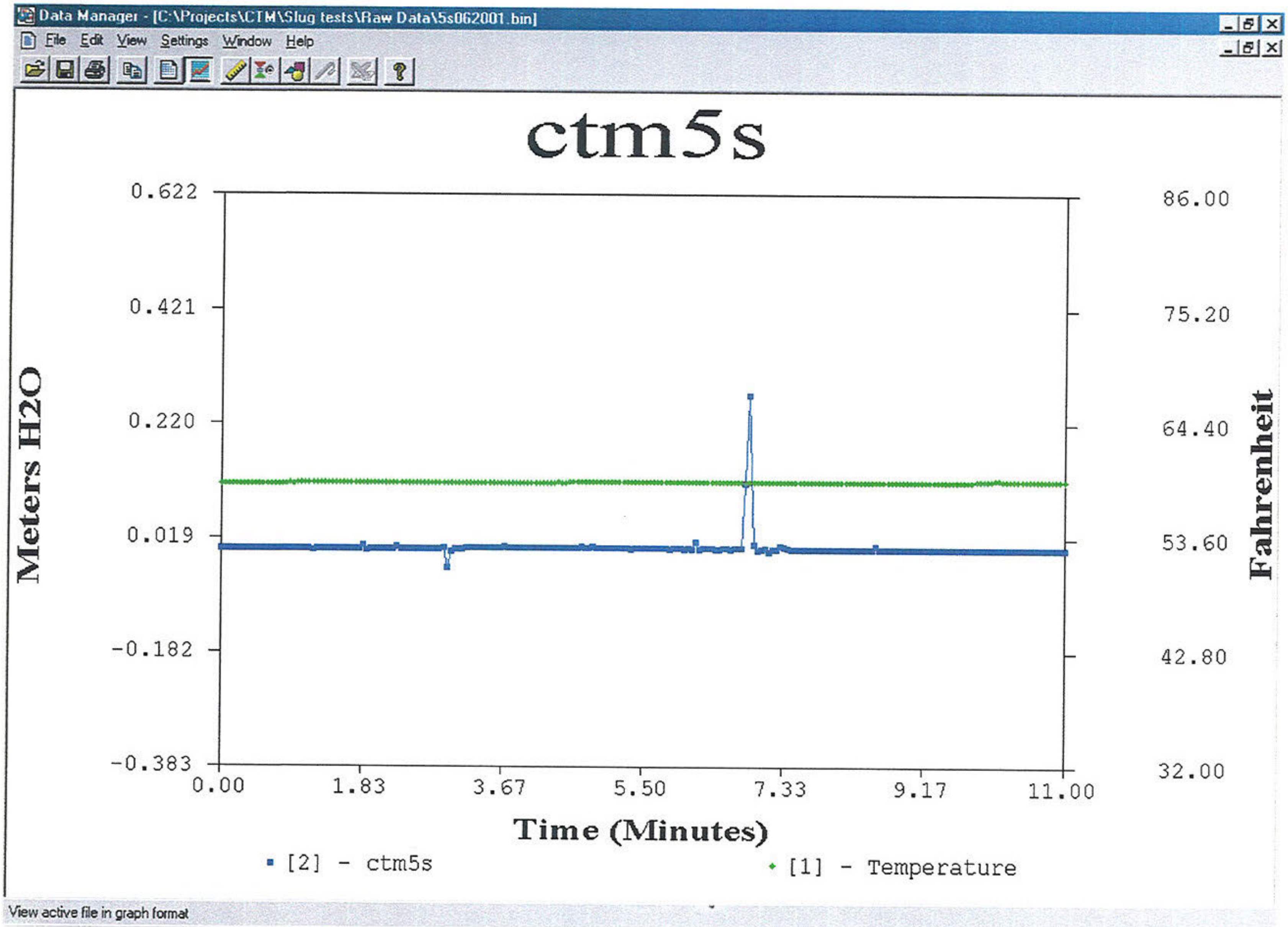
Appendix C
Slug Test Results

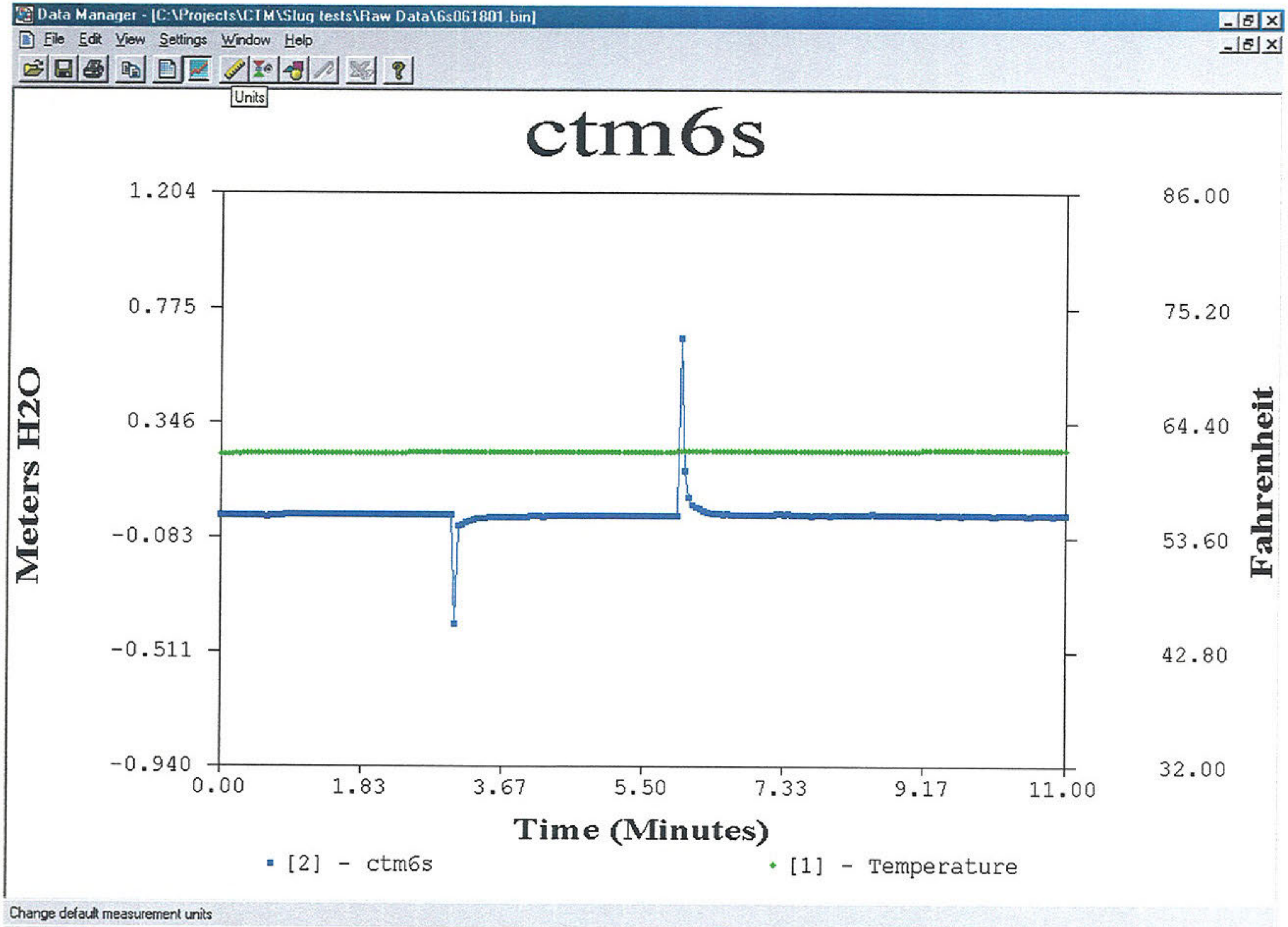

Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\1s062001.bin]
File Edit View Settings Window Help
ctm1s
Meters H2O
0.461
0.273
0.086
-0.102
-0.289
-0.477
Fahrenheit
86.00
75.20
64.40
53.60
42.80
32.00
0.00
1.68
3.37
5.05
6.73
8.42
10.10
Time (Minutes)
[2] - ctm1s
[1] - Temperature
View active file in graph format

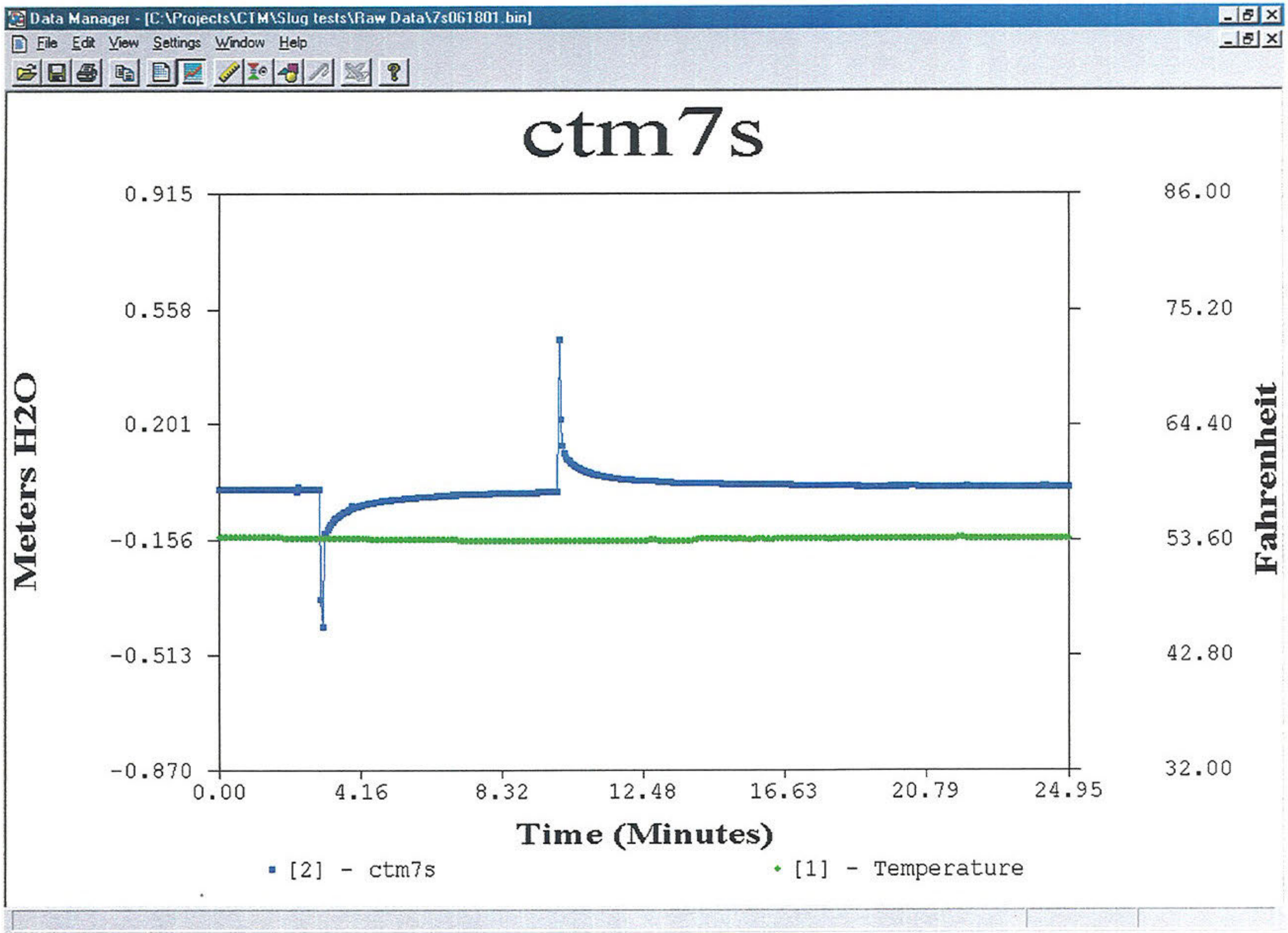

Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\2s062101.bin]
File Edit View Settings Window Help
ctm2s
0.837
0.493
0.148
-0.197
-0.542
-0.887
Meters H2O
86.00
75.20
64.40
53.60
42.80
32.00
Fahrenheit
0.00
2.17
4.33
6.50
8.67
10.83
13.00
Time (Minutes)
[2] - ctm2s
[1] - Temperature
View active file in graph format

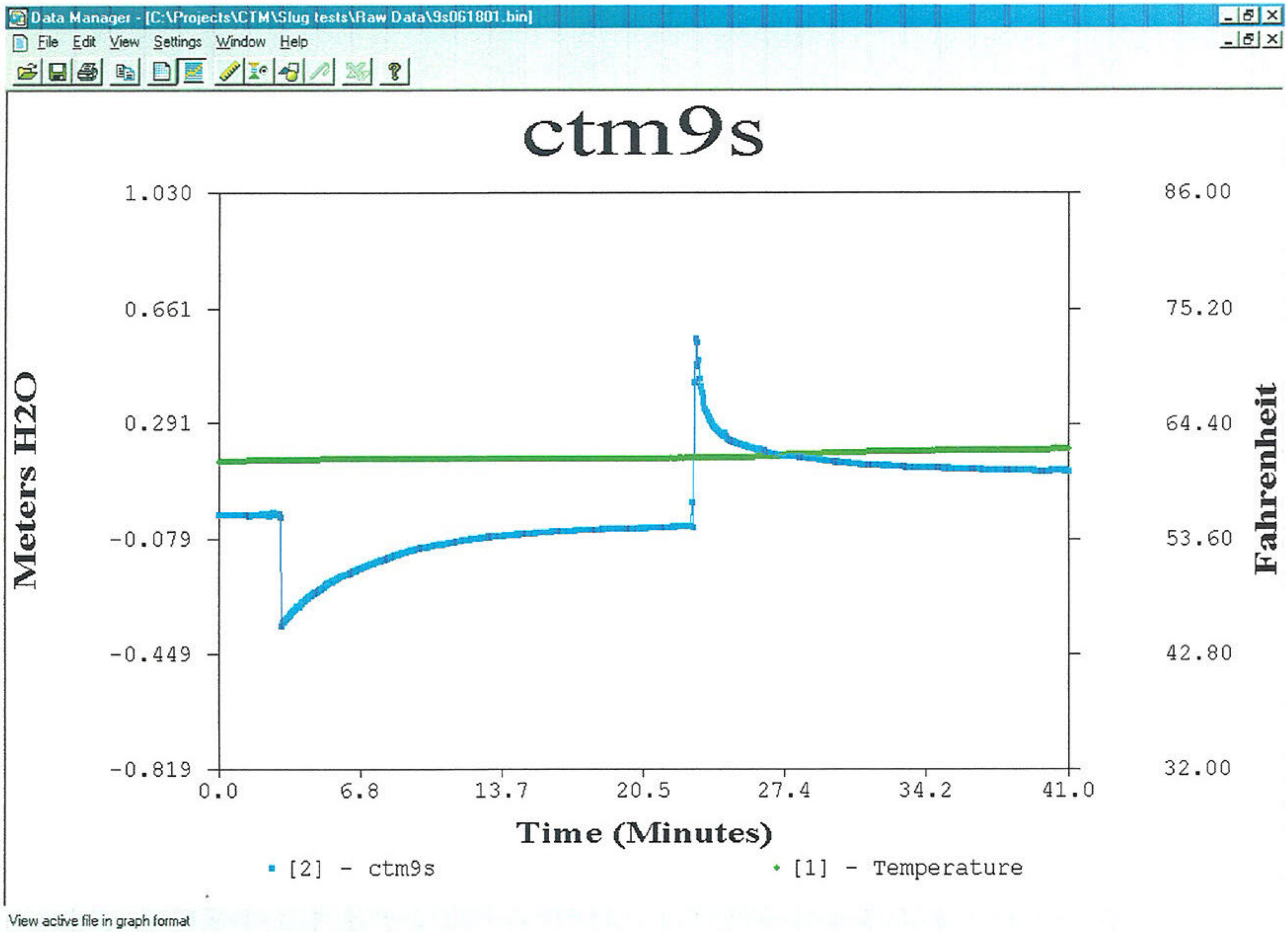


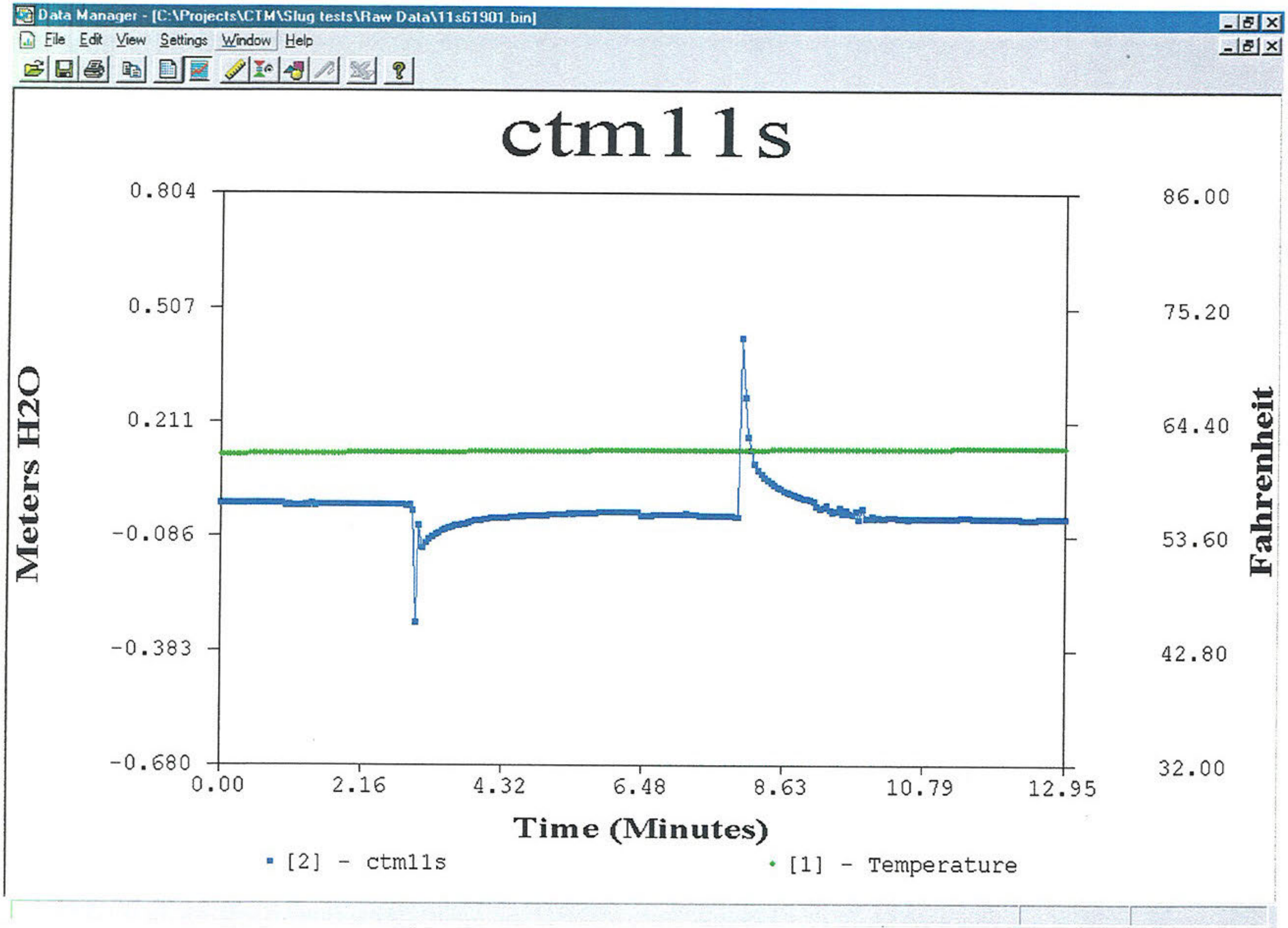
Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\3s061801.bin]
File Edit View Settings Window Help
ctm3sb
0.555
0.353
0.150
-0.053
-0.256
-0.458
Meters H2O
86.00
75.20
64.40
53.60
42.80
32.00
Fahrenheit
0.000
1.658
3.317
4.975
6.633
8.292
9.950
Time (Minutes)
[2] - ctm3sb
[1] - Temperature

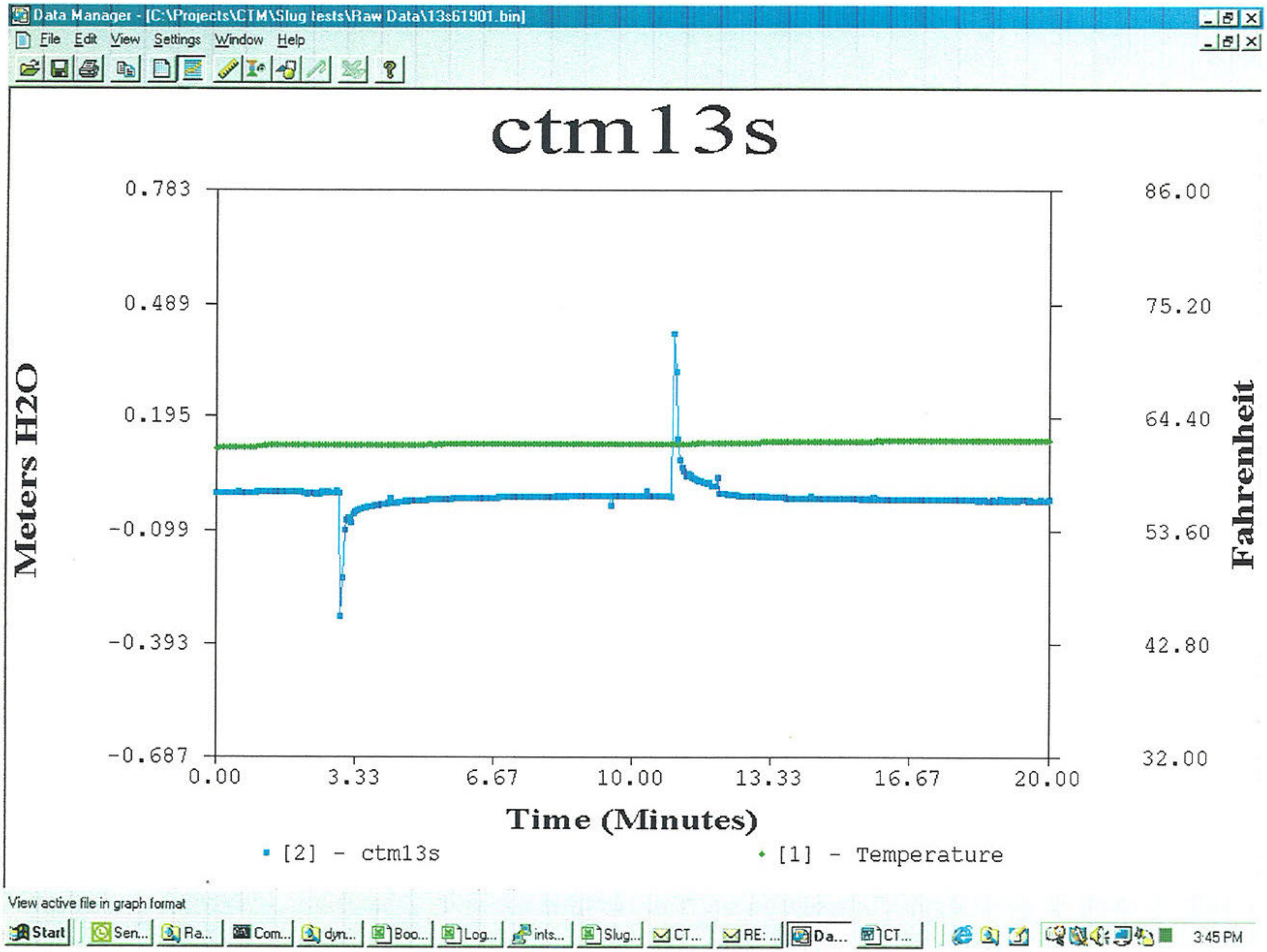

Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\5s062001.bin]
File Edit View Settings Window Help
ctm5s
0.622
0.421
0.220
0.019
-0.182
-0.383
Meters H2O
0.00
1.83
3.67
5.50
7.33
9.17
11.00
Time (Minutes)
86.00
75.20
64.40
53.60
42.80
32.00
Fahrenheit
[2] - ctm5s
[1] - Temperature
View active file in graph format

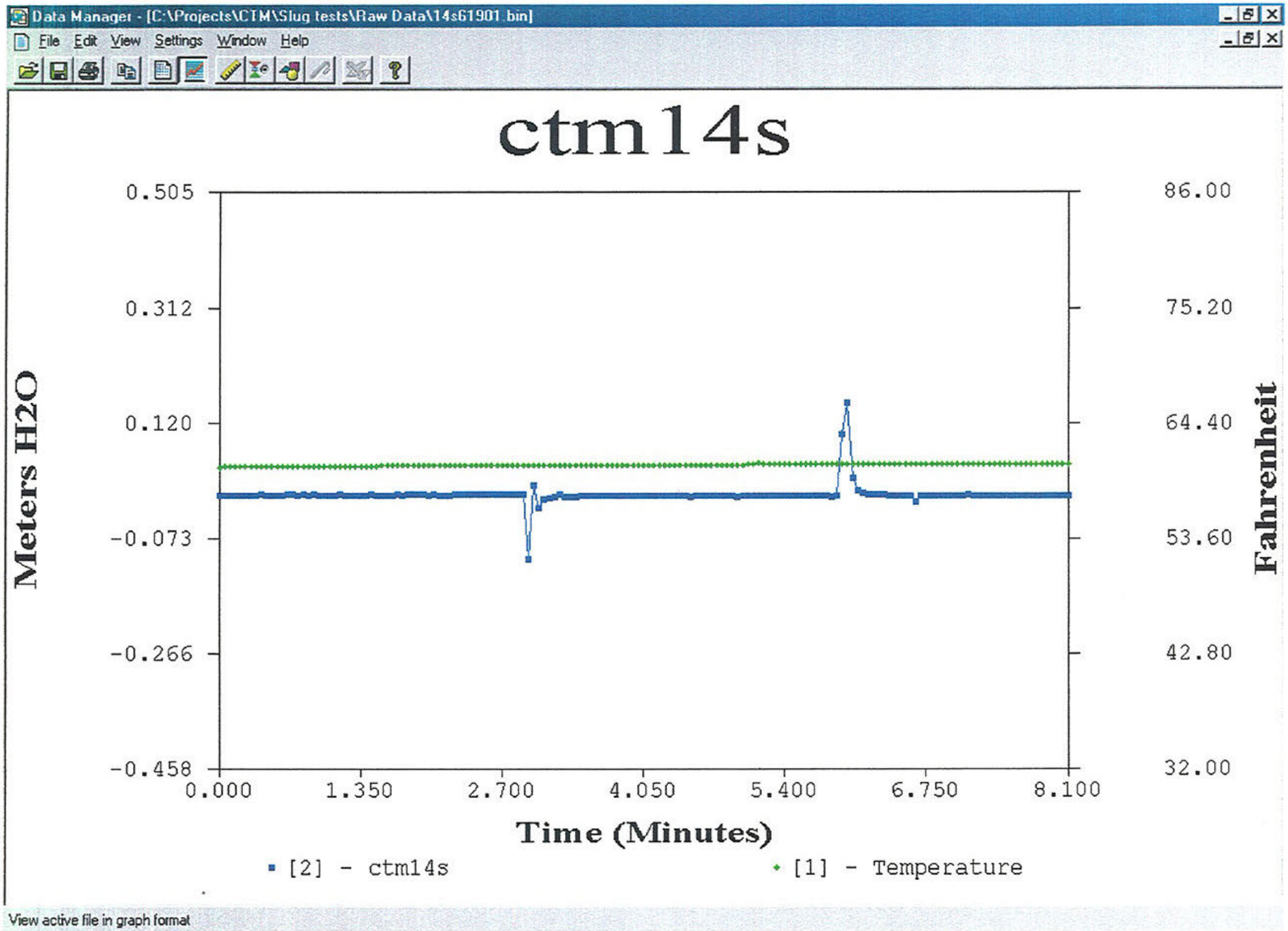

Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\6s061801.bin]
File Edit View Settings Window Help
Units
ctm6s
1.204
0.775
0.346
-0.083
-0.511
-0.940
Meters H2O
86.00
75.20
64.40
53.60
42.80
32.00
Fahrenheit
0.00
1.83
3.67
5.50
7.33
9.17
11.00
Time (Minutes)
[2] - ctm6s
[1] - Temperature
Change default measurement units

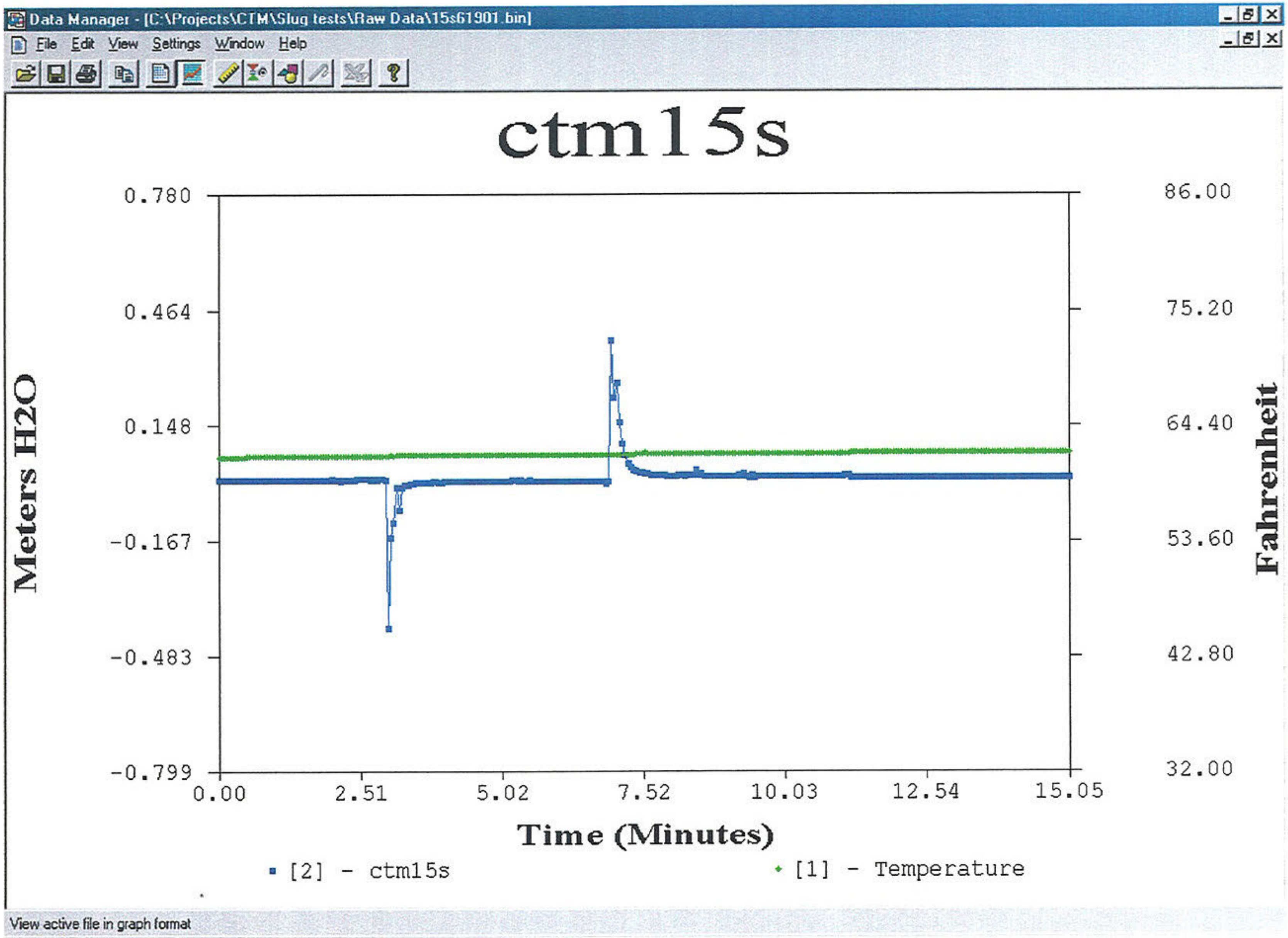

Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\7s061801.bin]
File Edit View Settings Window Help
ctm7s
0.915
0.558
0.201
-0.156
-0.513
-0.870
Meters H2O
86.00
75.20
64.40
53.60
42.80
32.00
Fahrenheit
0.00
4.16
8.32
12.48
16.63
20.79
24.95
Time (Minutes)
[2] - ctm7s
[1] - Temperature

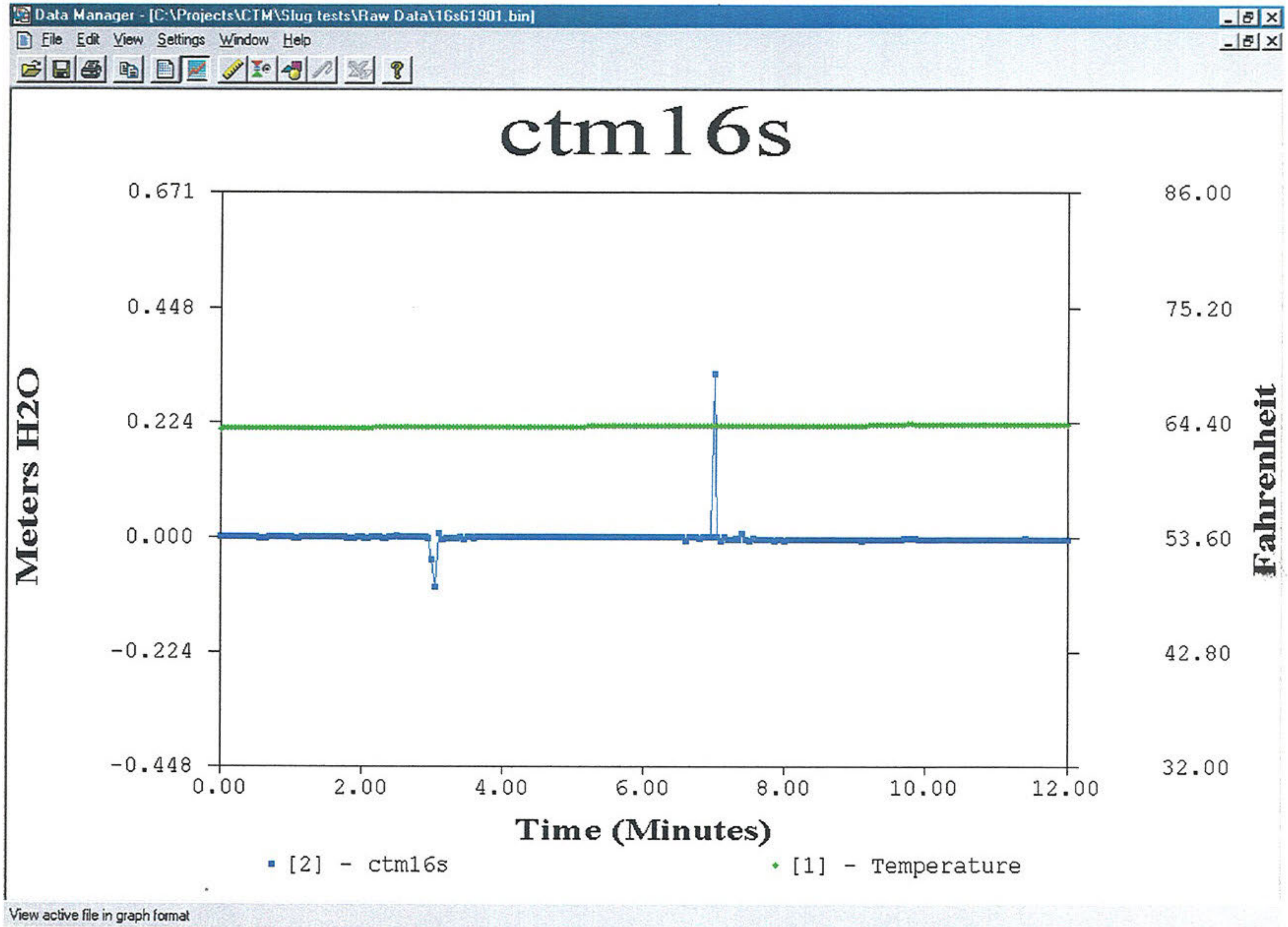

Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\9s061801.bin]
File Edit View Settings Window Help
ctm9s
1.030
0.661
0.291
-0.079
-0.449
-0.819
Meters H2O
86.00
75.20
64.40
53.60
42.80
32.00
Fahrenheit
0.0
6.8
13.7
20.5
27.4
34.2
41.0
Time (Minutes)
[2] - ctm9s
[1] - Temperature
View active file in graph format

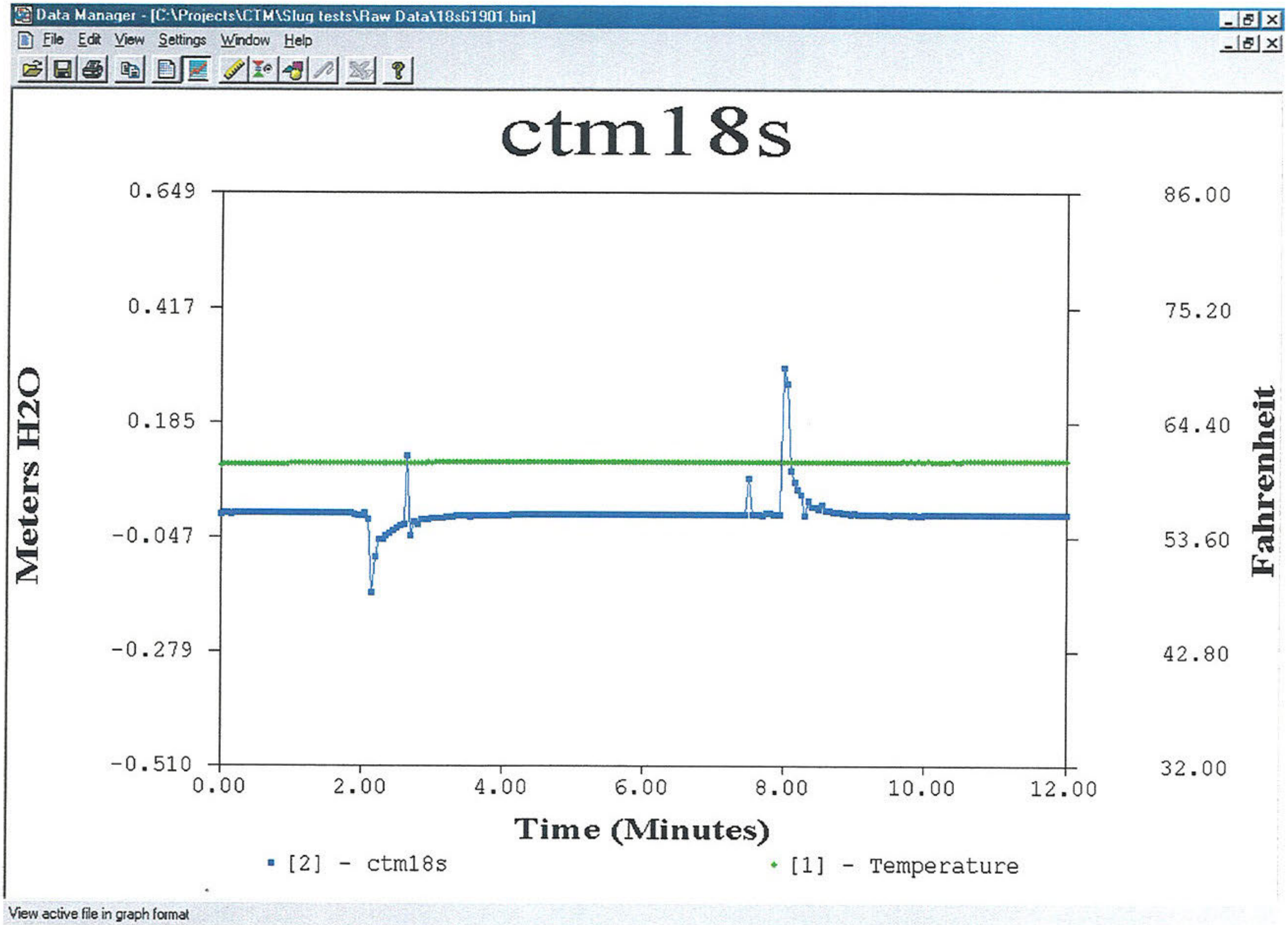

Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\11s61901.bin]
File Edit View Settings Window Help
ctm11s
0.804
0.507
0.211
-0.086
-0.383
-0.680
Meters H2O
86.00
75.20
64.40
53.60
42.80
32.00
Fahrenheit
0.00
2.16
4.32
6.48
8.63
10.79
12.95
Time (Minutes)
[2] - ctm11s
[1] - Temperature


Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\13s61901.bin]
File Edit View Settings Window Help
ctm13s
0.783
0.489
0.195
-0.099
-0.393
-0.687
Meters H2O
86.00
75.20
64.40
53.60
42.80
32.00
Fahrenheit
0.00
3.33
6.67
10.00
13.33
16.67
20.00
Time (Minutes)
[2] - ctm13s
[1] - Temperature
View active file in graph format
Start
3:45 PM


Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\14s61901.bin]
File Edit View Settings Window Help
ctm14s
0.505
0.312
0.120
-0.073
-0.266
-0.458
Meters H2O
86.00
75.20
64.40
53.60
42.80
32.00
Fahrenheit
0.000
1.350
2.700
4.050
5.400
6.750
8.100
Time (Minutes)
[2] - ctm14s
[1] - Temperature
View active file in graph format


Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\15s61901.bin]
File Edit View Settings Window Help
ctm15s
0.780
0.464
0.148
-0.167
-0.483
-0.799
86.00
75.20
64.40
53.60
42.80
32.00
0.00
2.51
5.02
7.52
10.03
12.54
15.05
Meters H2O
Fahrenheit
Time (Minutes)
[2] - ctm15s
[1] - Temperature
View active file in graph format

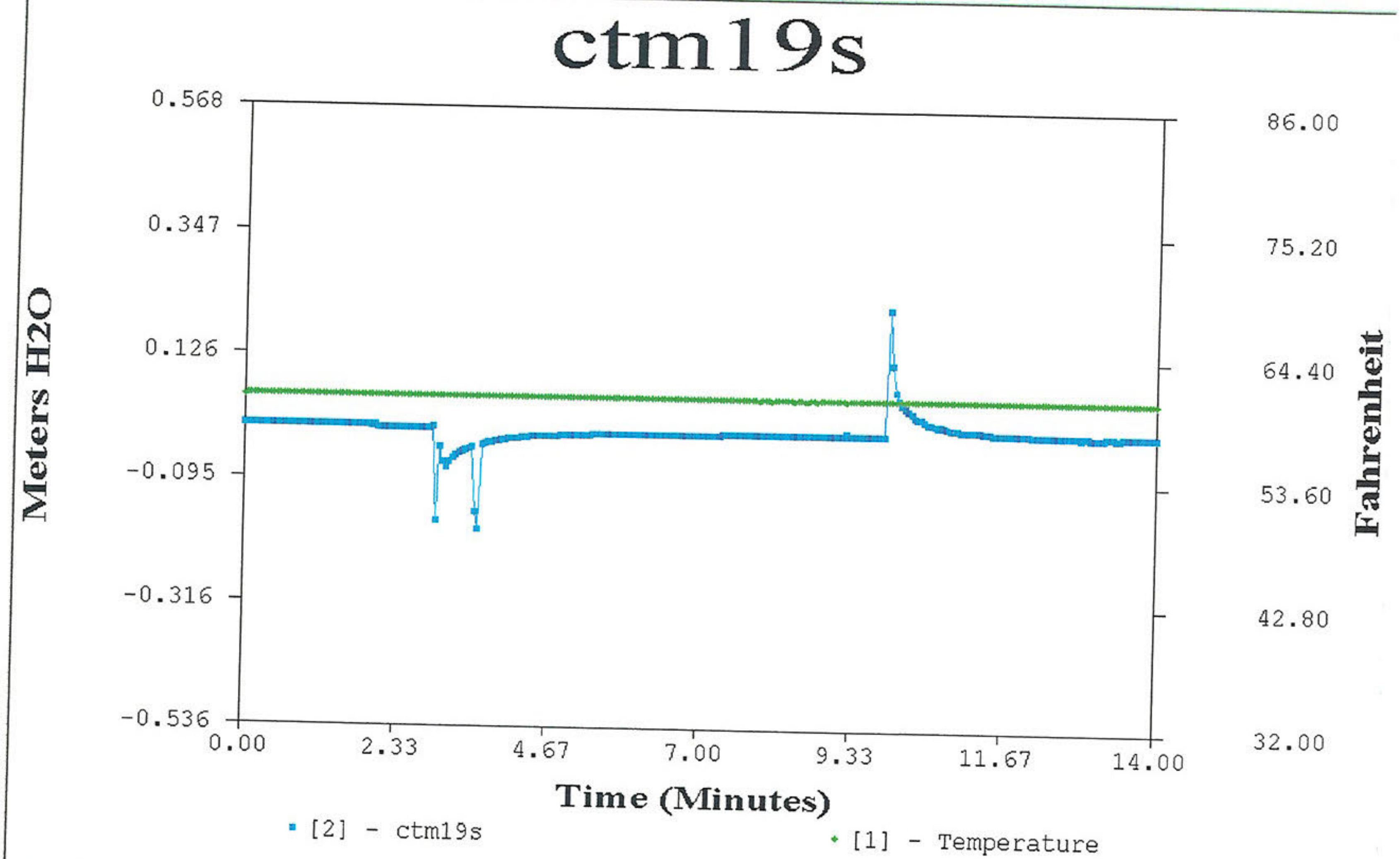

Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\16s61901.bin]
File Edit View Settings Window Help
ctm16s
0.671
0.448
0.224
0.000
-0.224
-0.448
Meters H2O
86.00
75.20
64.40
53.60
42.80
32.00
Fahrenheit
0.00
2.00
4.00
6.00
8.00
10.00
12.00
Time (Minutes)
[2] - ctm16s
[1] - Temperature
View active file in graph format



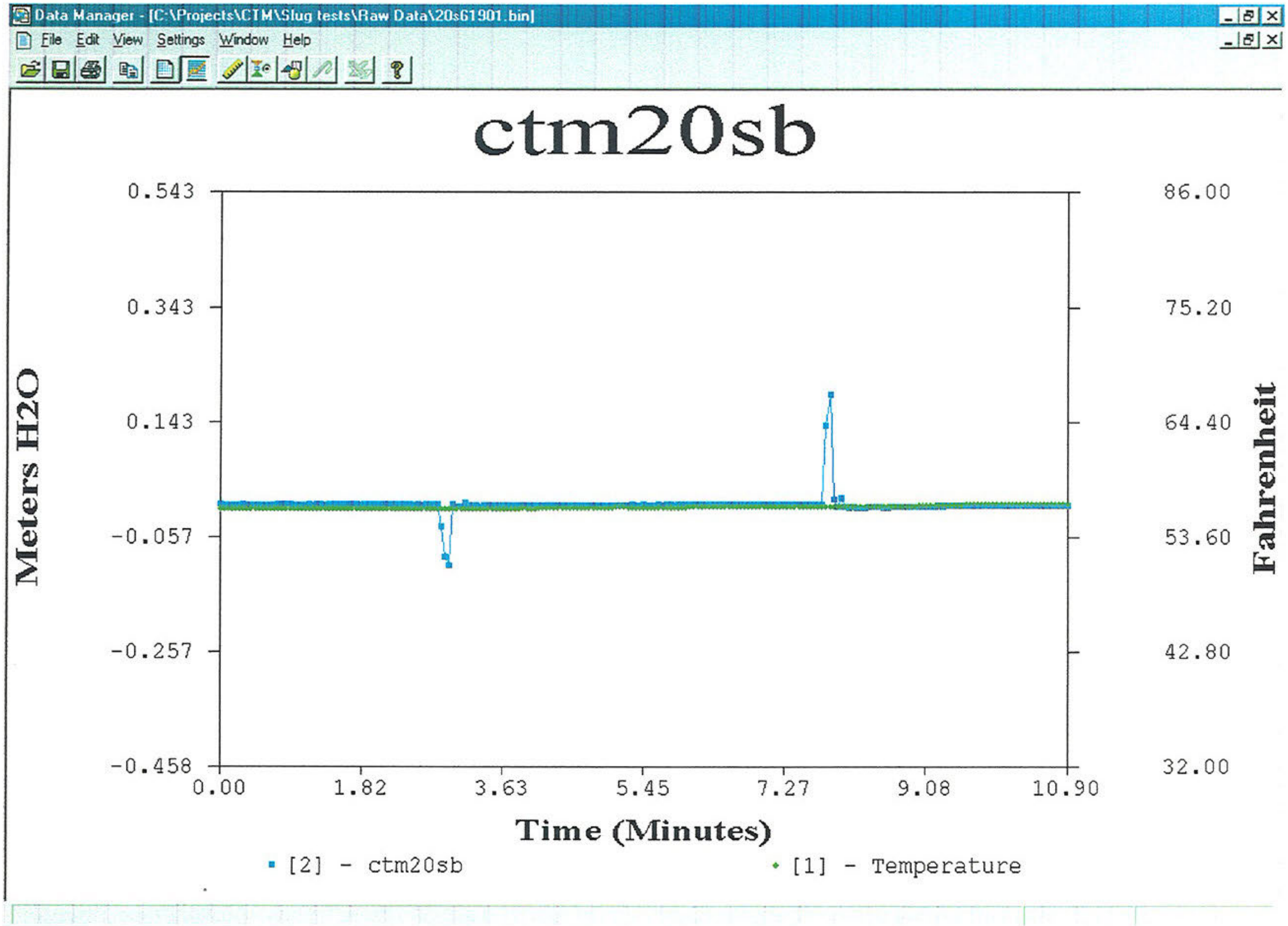
Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\18s61901.bin]
File Edit View Settings Window Help
ctm18s
Meters H2O
0.649
0.417
0.185
-0.047
-0.279
-0.510
Fahrenheit
86.00
75.20
64.40
53.60
42.80
32.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
Time (Minutes)
[2] - ctm18s
[1] - Temperature
View active file in graph format

Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\19s61901.bin]

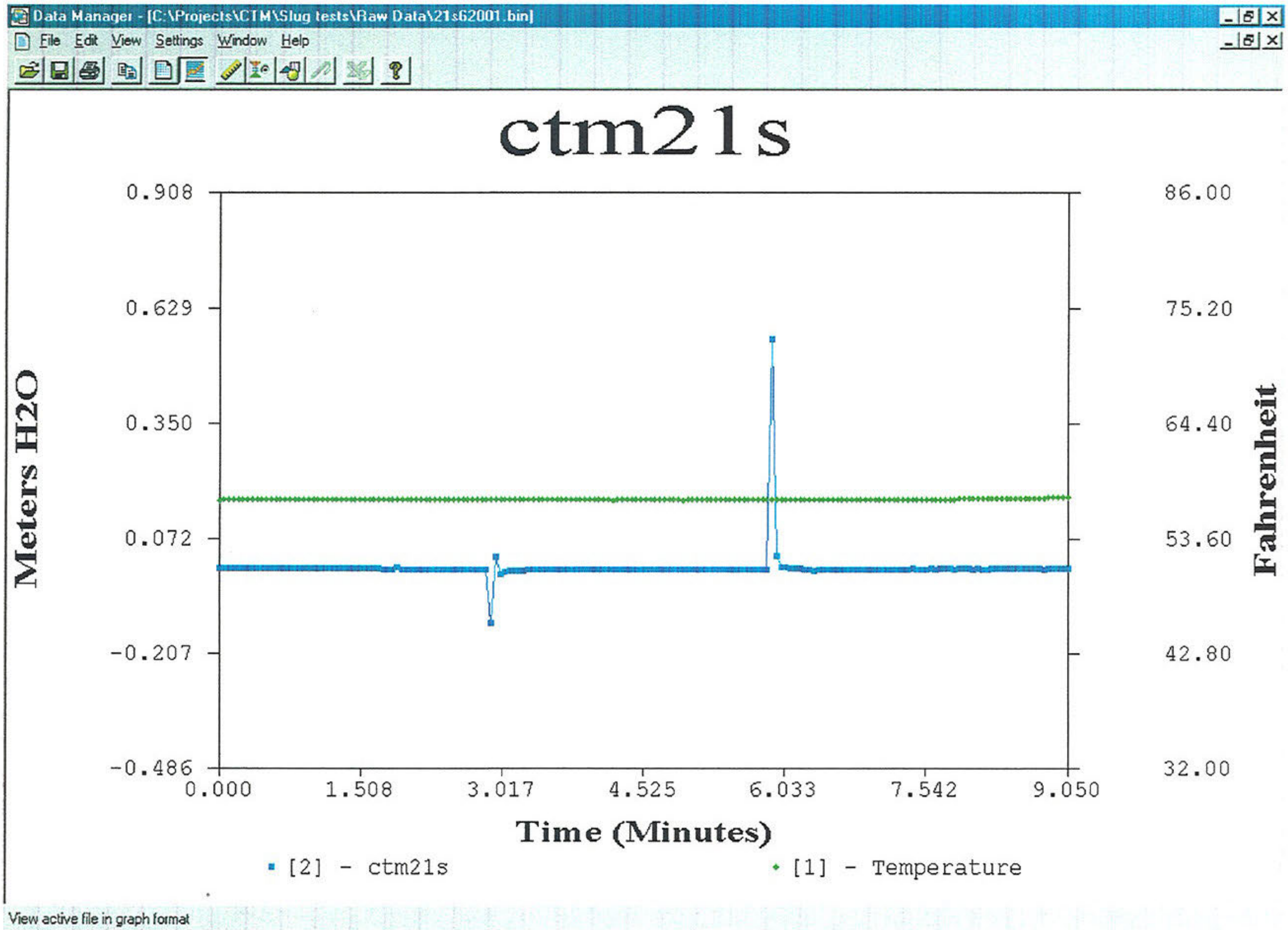
File Edit View Settings Window Help



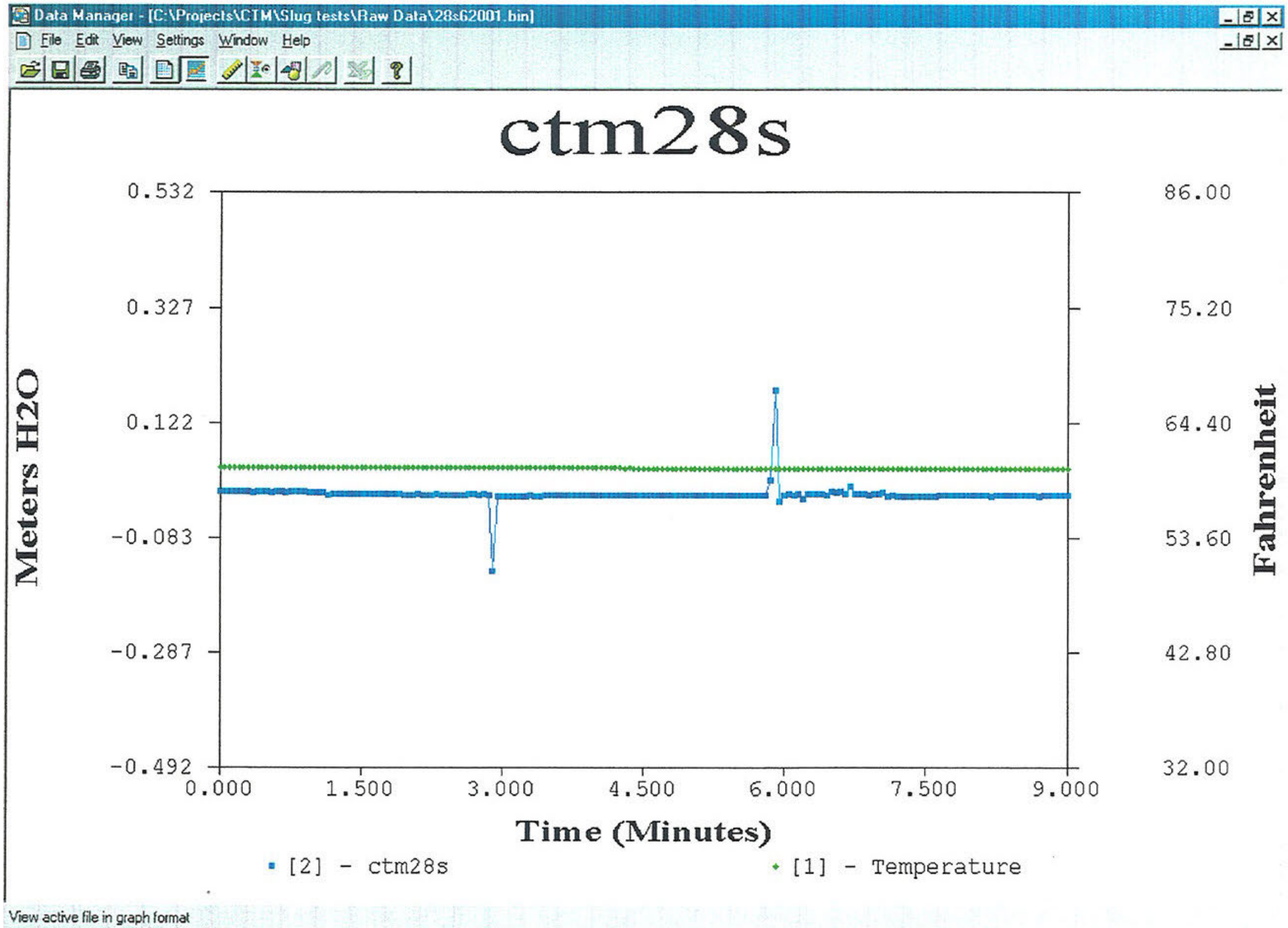
View active file in graph format

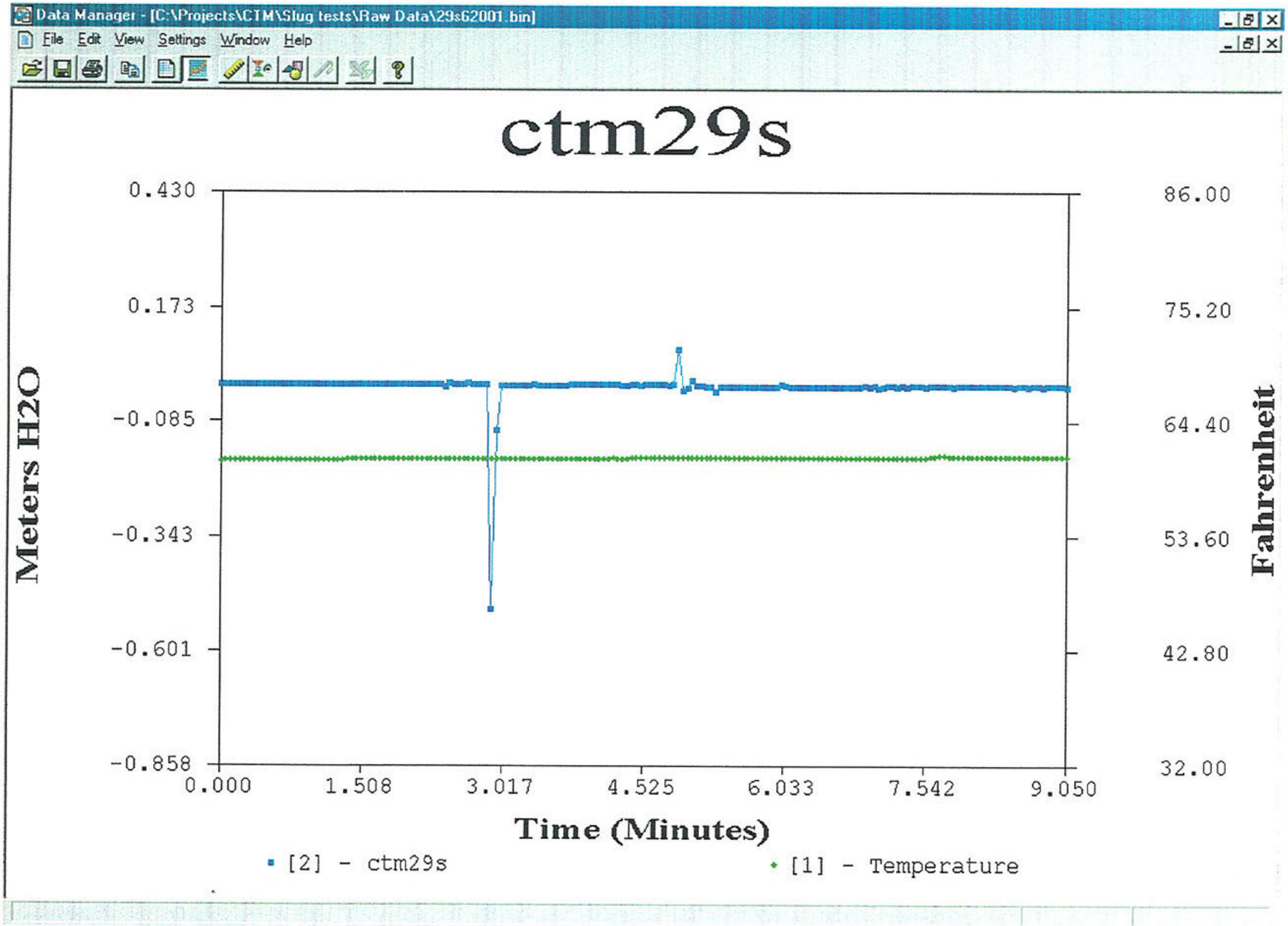


Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\20s61901.bin]
File Edit View Settings Window Help
ctm20sb
Meters H2O
0.543
0.343
0.143
-0.057
-0.257
-0.458
0.00
1.82
3.63
5.45
7.27
9.08
10.90
Time (Minutes)
86.00
75.20
64.40
53.60
42.80
32.00
Fahrenheit
[2] - ctm20sb
[1] - Temperature



Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\21s62001.bin]
File Edit View Settings Window Help
ctm21s
0.908
0.629
0.350
0.072
-0.207
-0.486
86.00
75.20
64.40
53.60
42.80
32.00
0.000
1.508
3.017
4.525
6.033
7.542
9.050
Meters H2O
Fahrenheit
Time (Minutes)
[2] - ctm21s
[1] - Temperature
View active file in graph format


Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\28s62001.bin]
File Edit View Settings Window Help
ctm28s
0.532
0.327
0.122
-0.083
-0.287
-0.492
86.00
75.20
64.40
53.60
42.80
32.00
0.000
1.500
3.000
4.500
6.000
7.500
9.000
Meters H2O
Fahrenheit
Time (Minutes)
[2] - ctm28s
[1] - Temperature
View active file in graph format


Data Manager - [C:\Projects\CTM\Slug tests\Raw Data\29s62001.bin]
File Edit View Settings Window Help
ctm29s
0.430
0.173
-0.085
-0.343
-0.601
-0.858
Meters H2O
86.00
75.20
64.40
53.60
42.80
32.00
Fahrenheit
0.000
1.508
3.017
4.525
6.033
7.542
9.050
Time (Minutes)
[2] - ctm29s
[1] - Temperature

Appendix D
Monitoring Well Summary Sheets

CTM-1S

Date of Installation	3/27/01

Location

Northing	14865566.99
Easting	2273656.93

Well Details (feet AMSL)

Measuring Datum	4539.11
Top of Screen	4508.28
Base of Screen	4488.28

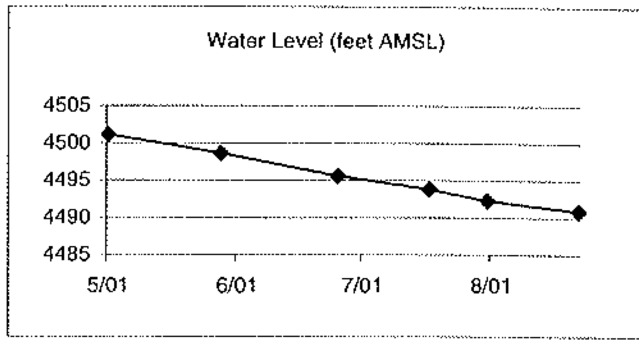
Water Level (feet AMSL)

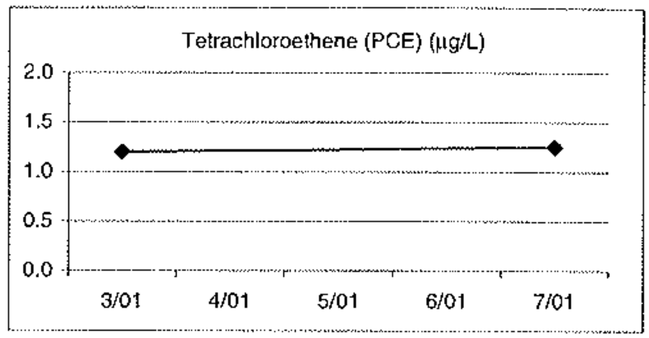
Sample Date	Water Level
5/23/01	4501.15
6/19/01	4498.63
7/17/01	4495.55
8/8/01	4493.77
8/22/01	4492.29
9/13/01	4490.88

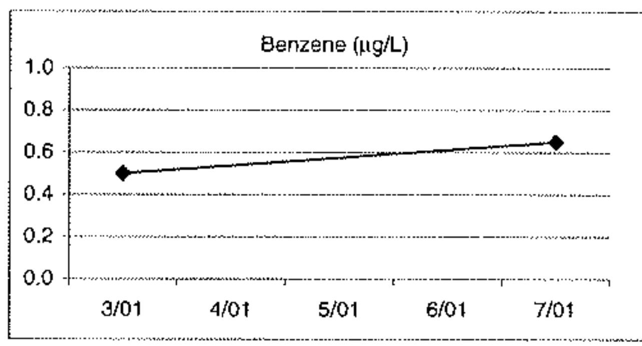
Analytical Data (mg/L)

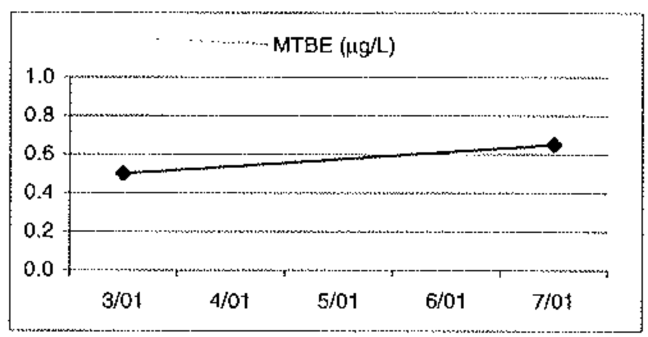
Sample Date	PCE	Benzene	MTBE
3/29/01	1.20	<1	<1
7/12/01	<2.5	<1.3	<1.3

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-2S

Date of Installation	3/29/01

Location

Northing	14863908.59
Easting	2274253.41

Well Details (feet AMSL)

Measuring Datum	4527.61
Top of Screen	4497.81
Base of Screen	4477.81

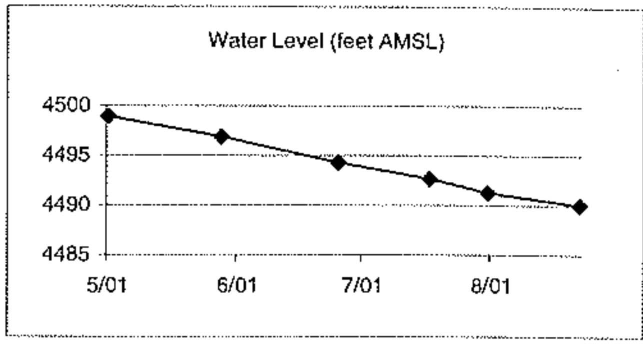
Water Level (feet AMSL)

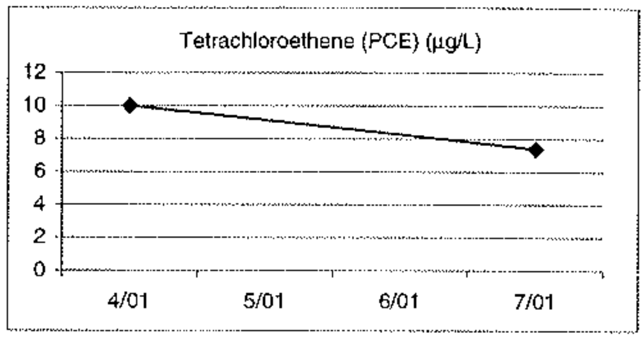
Sample Date	Water Level
5/23/01	4498.93
6/19/01	4496.89
7/17/01	4494.28
8/8/01	4492.65
8/22/01	4491.27
9/13/01	4490.03

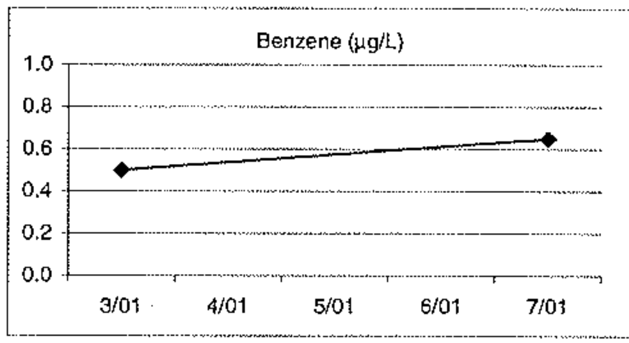
Analytical Data (mg/L)

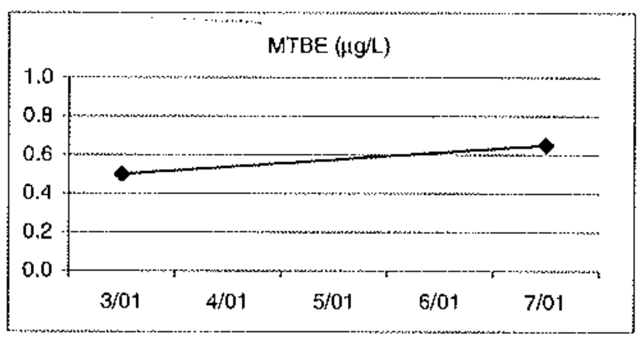
Sample Date	PCE	Benzene	MTBE
4/9/01	10.00	<1	<1
7/12/01	7.40	<1.3	<1.3

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-3S

Date of Installation	3/28/01

Location

Northing	14866922.53
Easting	2276496.03

Well Details (feet AMSL)

Measuring Datum	4515.23
Top of Screen	4484.50
Base of Screen	4464.50

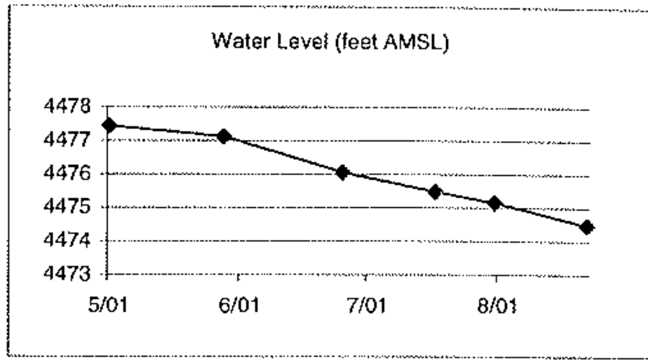
Water Level (feet AMSL)

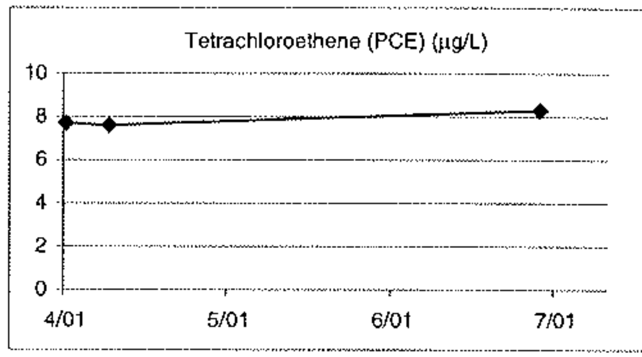
Sample Date	Water Level
5/23/01	4477.44
6/19/01	4477.12
7/17/01	4476.05
8/8/01	4475.48
8/22/01	4475.16
9/13/01	4474.48

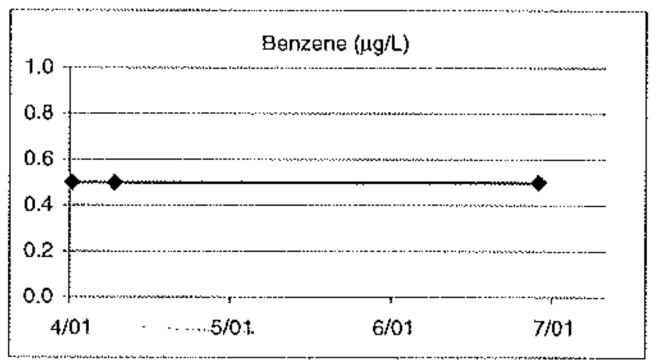
Analytical Data (mg/L)

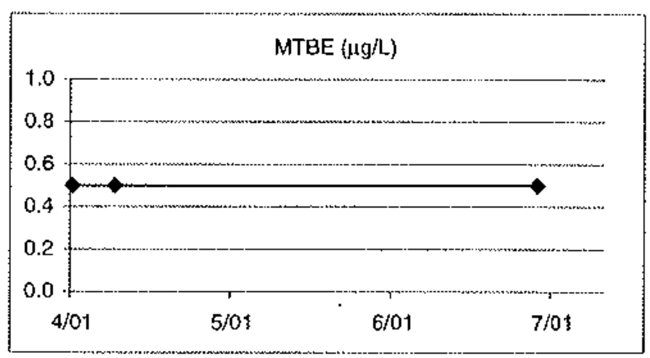
Sample Date	PCE	Benzene	MTBE
4/2/01	7.70	<1	<1
4/10/01	7.60	<1	<1
6/28/01	8.30	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-4D

Date of Installation	4/9/01

Location

Northing	14866913.75
Easting	2276498.34

Well Details (feet AMSL)

Measuring Datum	4515.15
Top of Screen	4355.35
Base of Screen	4335.35

Water Level (feet AMSL)

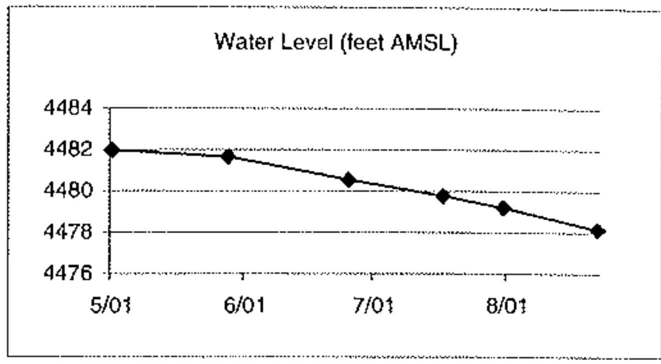
Sample Date	Water Level
5/23/01	4481.97
6/19/01	4481.66
7/17/01	4480.55
8/8/01	4479.77
8/22/01	4479.21
9/13/01	4478.15

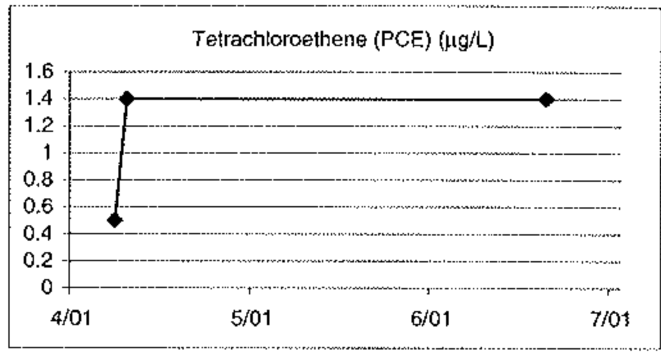
Analytical Data (mg/L)

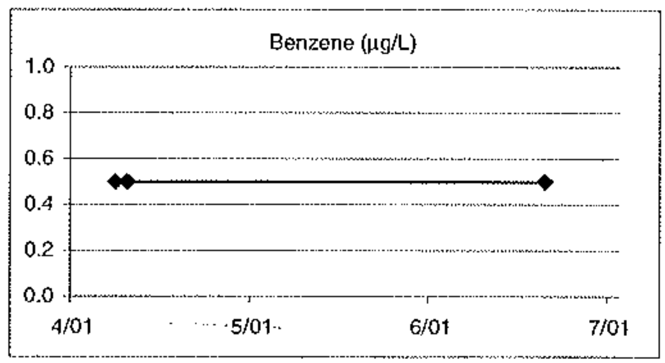
Sample Date	PCE	Benzene	MTBE
4/17/01	<1	<1	<1
4/19/01	1.40	<1	<1
6/28/01	1.40	<1	<1

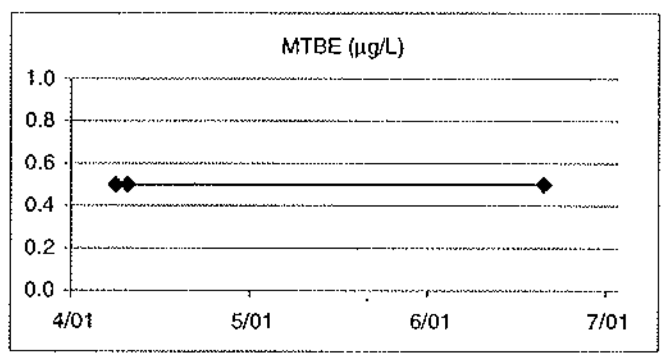
Notes:

1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-5S

Date of Installation	3/28/01

Location

Northing	14866774.11
Easting	2275631.44

Well Details (feet AMSL)

Measuring Datum	4526.22
Top of Screen	4486.34
Base of Screen	4466.34

Water Level (feet AMSL)

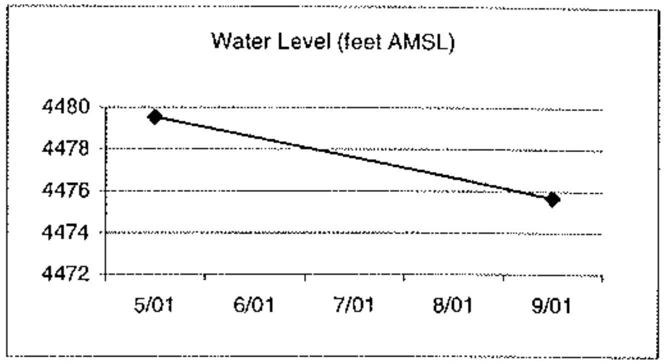
Sample Date	Water Level
5/25/01	4479.53
9/13/01	4475.66

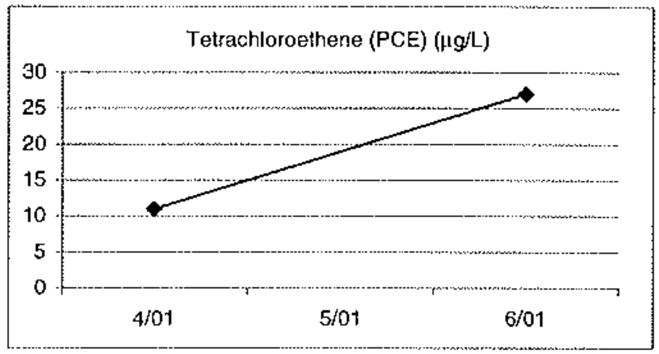
Analytical Data (mg/L)

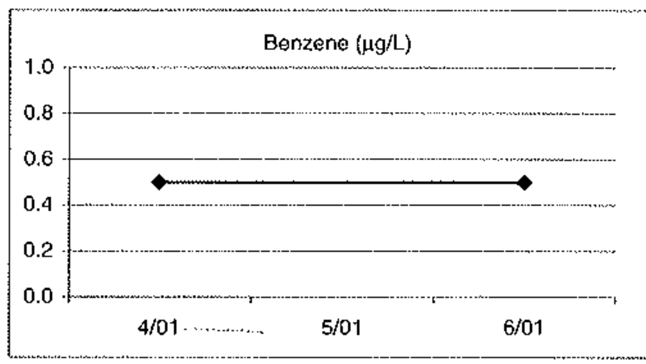
Sample Date	PCE	Benzene	MTBE
4/2/01	11.00	<1	<1
6/28/01	27.00	<1	<1

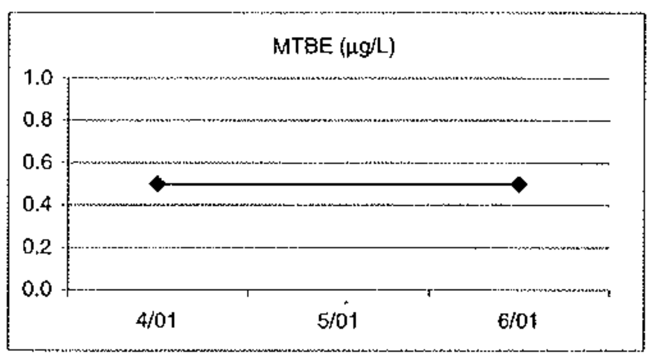
Notes:

1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-6S

Date of Installation	3/20/01

Location

Northing	14866906.43
Easting	2279451.30

Well Details (feet AMSL)

Measuring Datum	4494.00
Top of Screen	4470.43
Base of Screen	4450.43

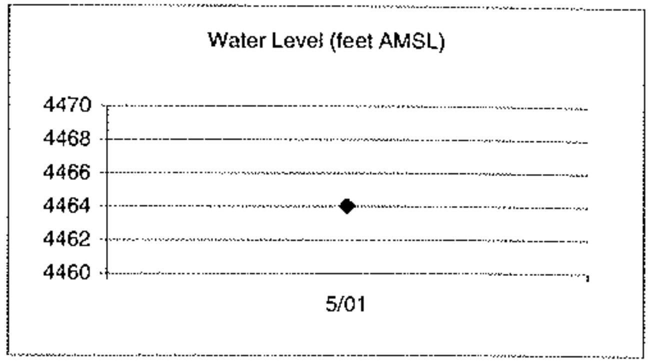
Water Level (feet AMSL)

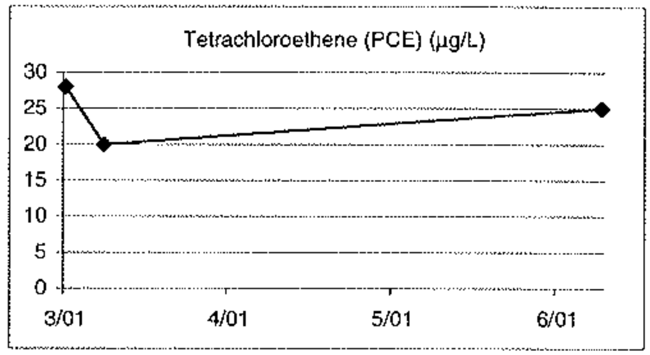
Sample Date	Water Level
5/23/01	4464.03

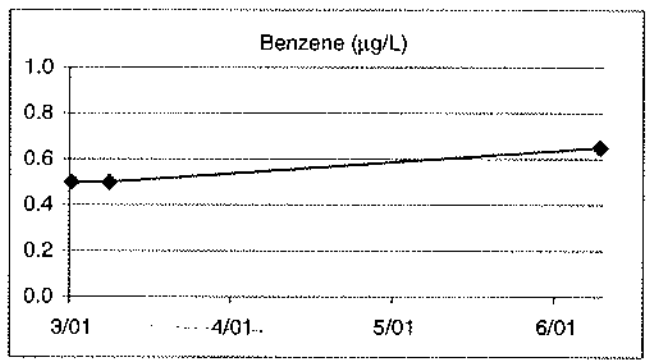
Analytical Data (mg/L)

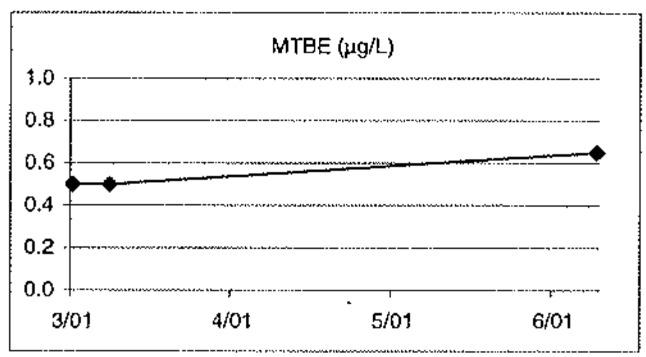
Sample Date	PCE	Benzene	MTBE
3/29/01	28.00	<1	<1
4/5/01	20.00	<1	<1
7/5/01	25.00	<1.3	<1.3

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-7S

Date of Installation	3/8/01

Location

Northing	14865655.28
Easting	2280296.09

Well Details (feet AMSL)

Measuring Datum	4483.77
Top of Screen	4463.03
Base of Screen	4443.03

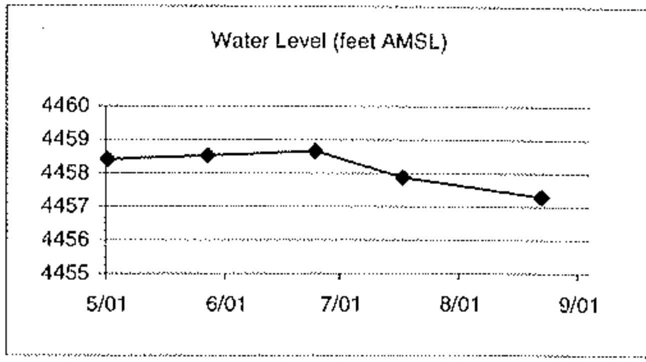
Water Level (feet AMSL)

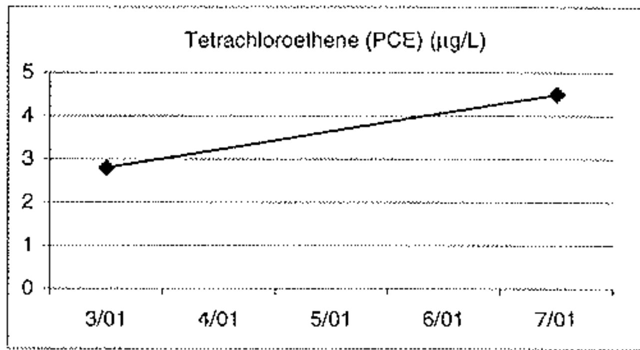
Sample Date	Water Level
5/23/01	4458.41
6/18/01	4458.53
7/16/01	4458.66
8/8/01	4457.87
9/13/01	4457.29

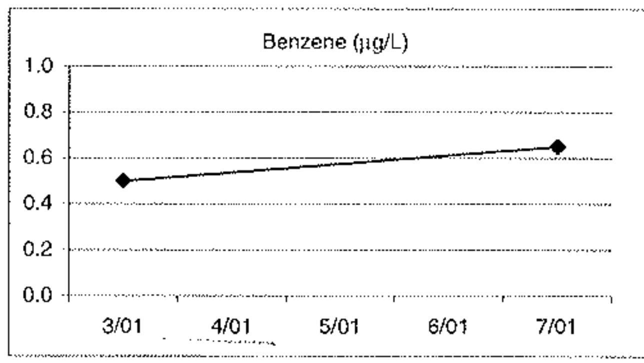
Analytical Data (mg/L)

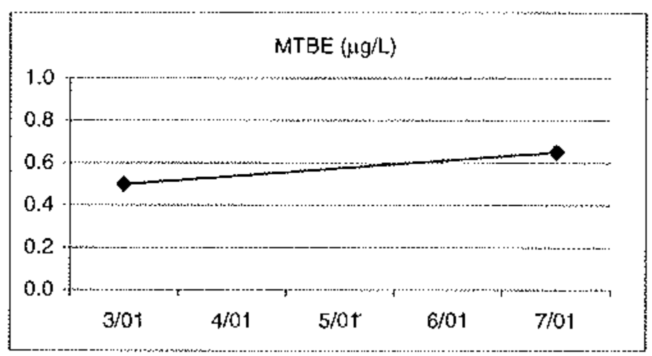
Sample Date	PCE	Benzene	MTBE
3/27/01	2.80	<1	<1
7/5/01	4.50	<1.3	<1.3

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-8D

Date of Installation	3/6/01

Location

Northing	14865660.94
Easting	2280295.91

Well Details (feet AMSL)

Measuring Datum	4483.68
Top of Screen	4242.78
Base of Screen	4222.78

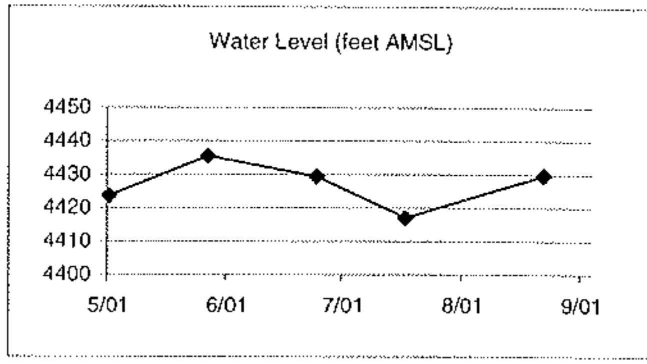
Water Level (feet AMSL)

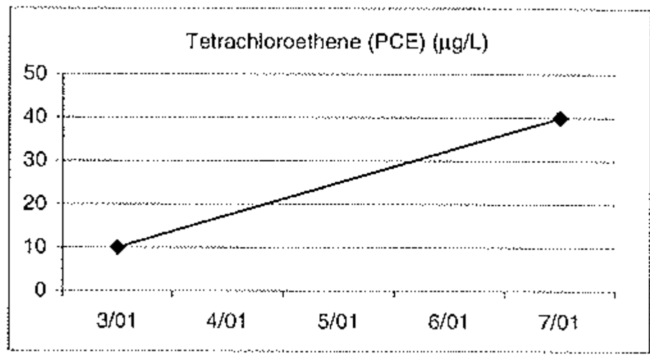
Sample Date	Water Level
5/23/01	4423.64
6/18/01	4435.46
7/16/01	4429.39
8/8/01	4417.05
9/13/01	4429.66

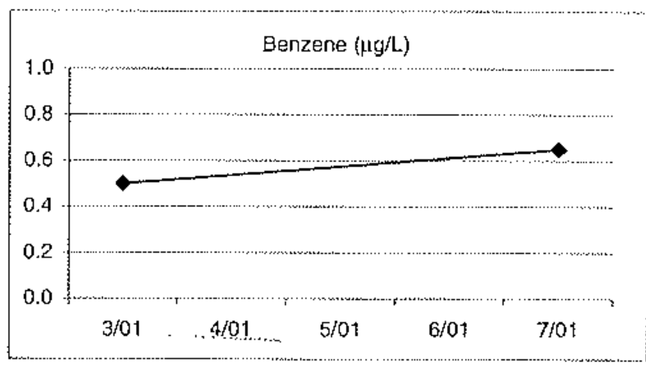
Analytical Data (mg/L)

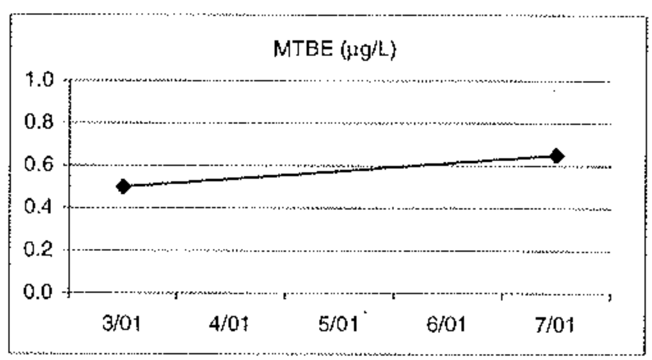
Sample Date	PCE	Benzene	MTBE
3/26/01	10.00	<1	<1
7/5/01	40.00	<1.3	<1.3

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-9S

Date of Installation	5/3/01

Location

Northing	14863430.53
Easting	2283743.30

Well Details (feet AMSL)

Measuring Datum	4457.83
Top of Screen	4417.37
Base of Screen	4397.37

Water Level (feet AMSL)

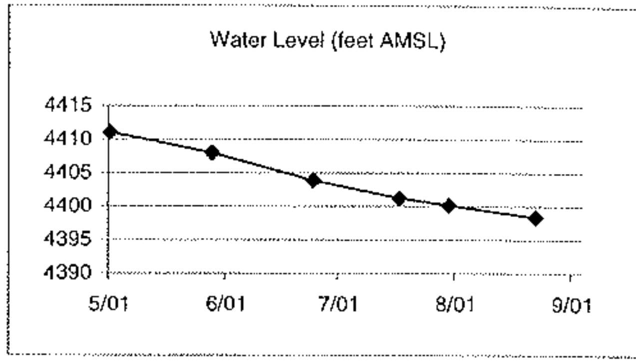
Sample Date	Water Level
5/23/01	4411.04
6/19/01	4407.99
7/16/01	4403.85
8/8/01	4401.21
8/21/01	4400.15
9/13/01	4398.36

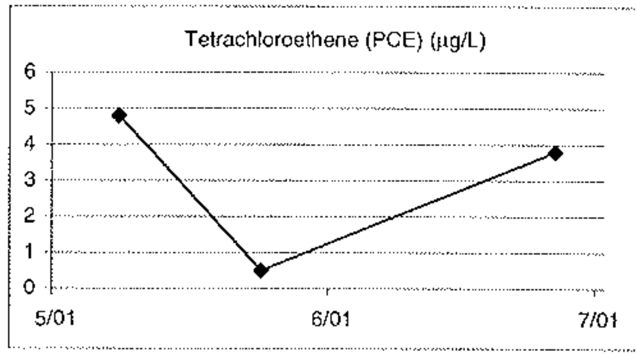
Analytical Data (mg/L)

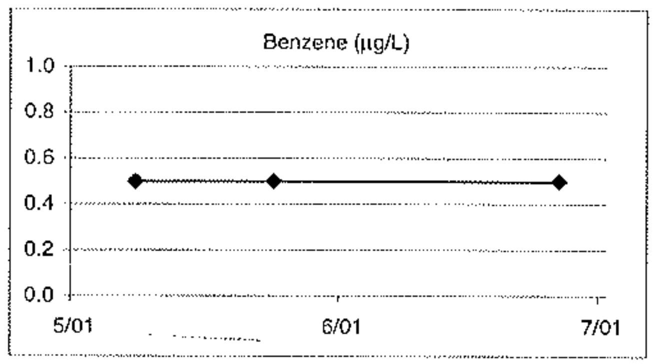
Sample Date	PCE	Benzene	MTBE
5/8/01	4.80	<1	<1
5/24/01	<1	<1	<1
6/26/01	3.80	<1	<1

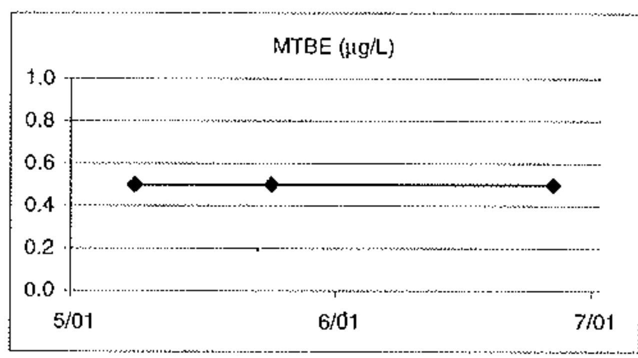
Notes:

1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-10D

Date of Installation	4/27/01

Location

Northing	14863421.27
Easting	2283739.71

Well Details (feet AMSL)

Measuring Datum	4457.86
Top of Screen	4131.08
Base of Screen	4111.08

Water Level (feet AMSL)

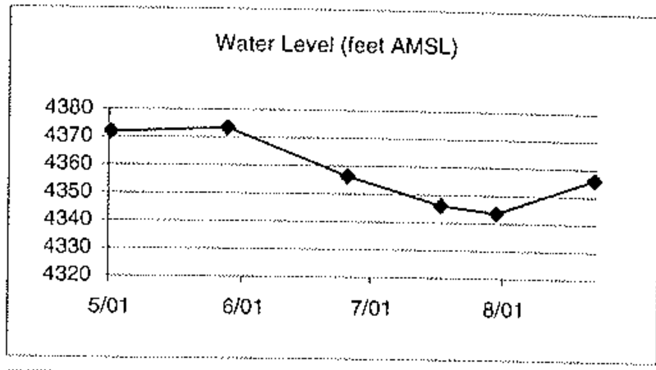
Sample Date	Water Level
5/23/01	4371.91
6/19/01	4373.36
7/17/01	4356.27
8/8/01	4346.06
8/21/01	4343.57
9/13/01	4356.23

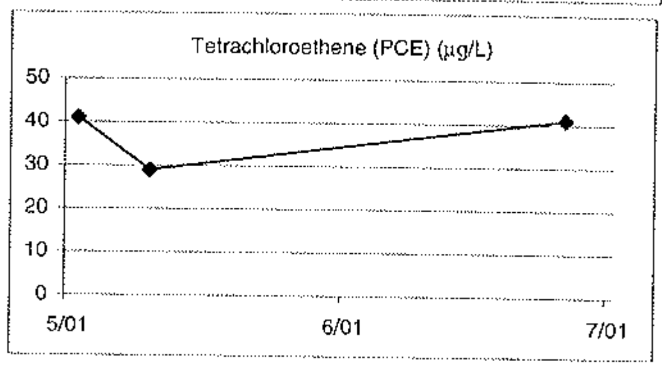
Analytical Data (mg/L)

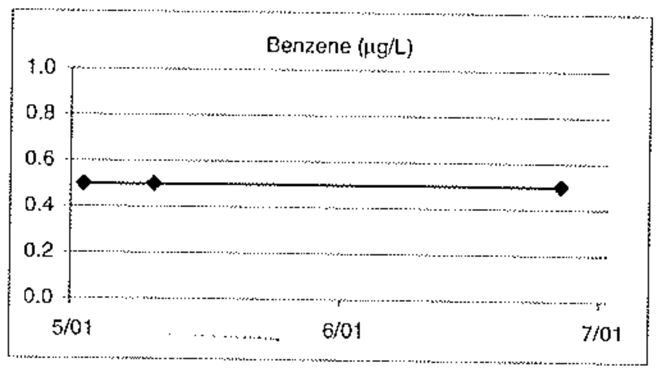
Sample Date	PCE	Benzene	MTBE
5/2/01	41.00	<1	<1
5/10/01	29.00	<1	<1
6/26/01	41.00	<1	<1

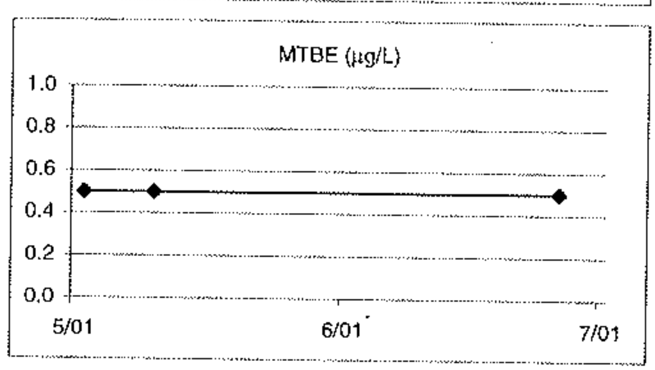
Notes:

1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-11S

Date of Installation	3/20/01

Location

Northing	14861668.00
Easting	2285425.73

Well Details (feet AMSL)

Measuring Datum	4441.40
Top of Screen	4416.18
Base of Screen	4396.18

Water Level (feet AMSL)

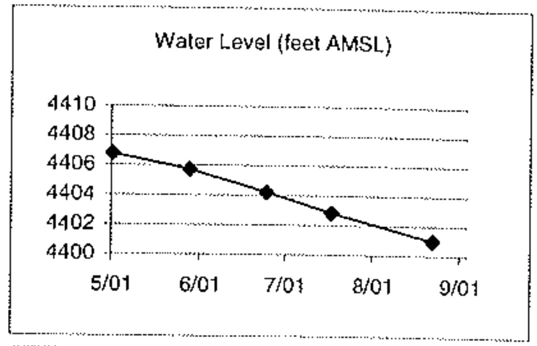
Sample Date	Water Level
5/23/01	4406.77
6/19/01	4405.73
7/16/01	4404.2
8/8/01	4402.84
9/13/01	4400.99

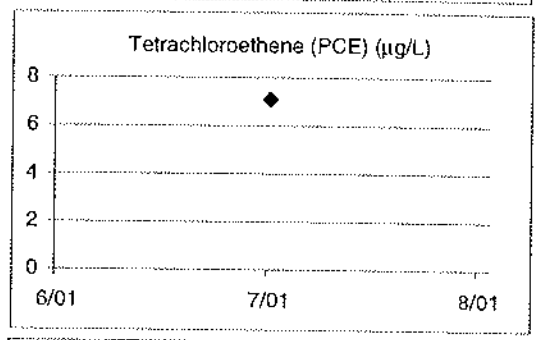
Analytical Data (mg/L)

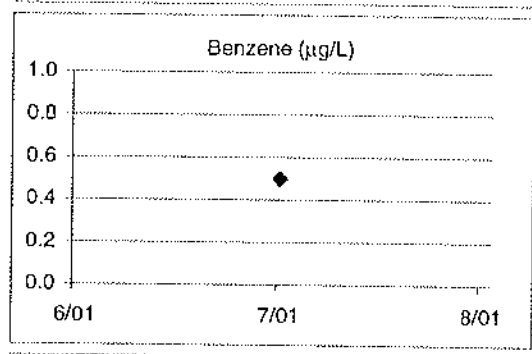
Sample Date	PCE	Benzene	MTBE	1,2-cis-DCE
7/10/01	7.10	<1	9.80	3.10

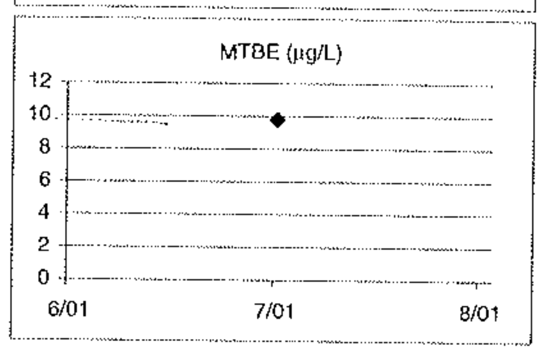
Notes:

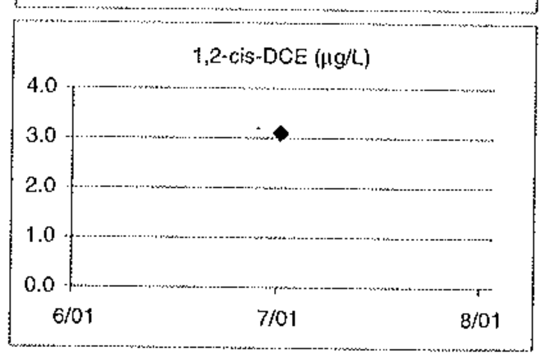
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.











CTM-12D

Date of Installation	3/29/01

Location

Northing	14861656.17
Easting	2285428.69

Well Details (feet AMSL)

Measuring Datum	4441.59
Top of Screen	4114.77
Base of Screen	4094.77

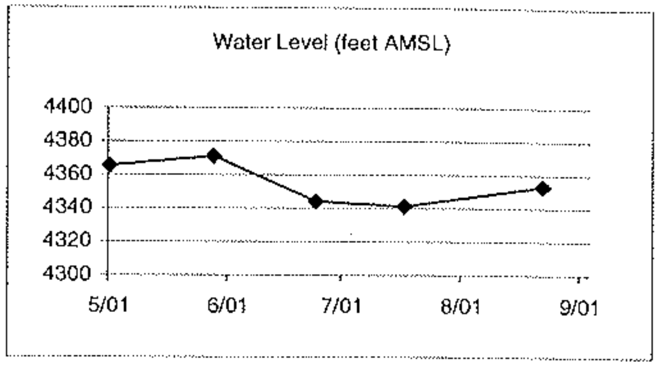
Water Level (feet AMSL)

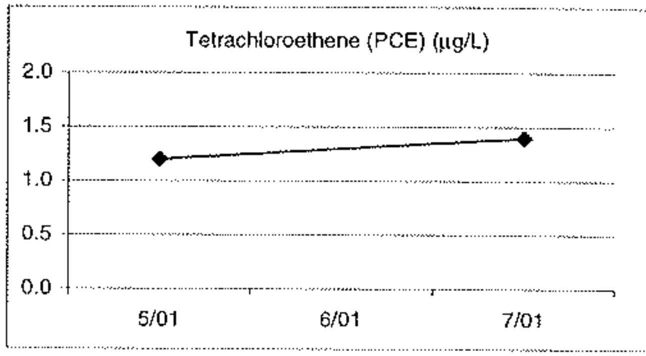
Sample Date	Water Level
5/23/01	4365.43
6/19/01	4371.17
7/16/01	4344.09
8/8/01	4341.21
9/13/01	4353.19

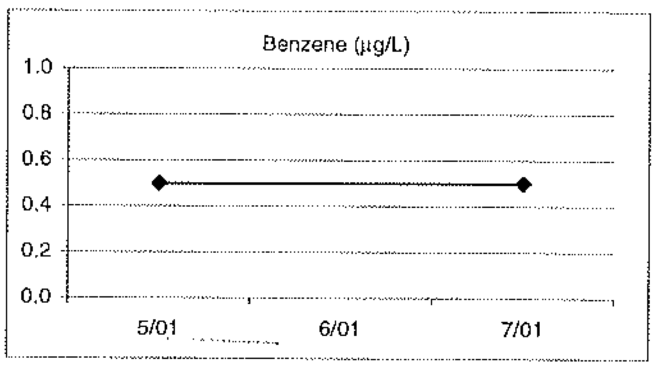
Analytical Data (mg/L)

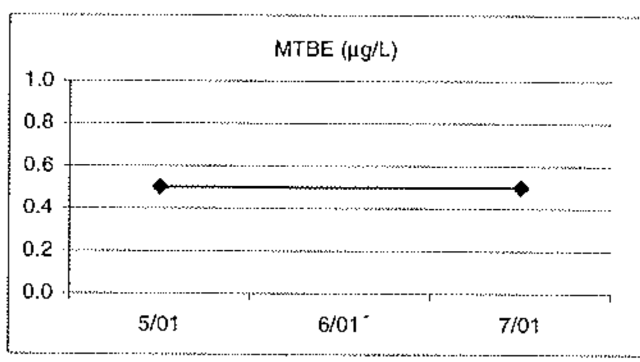
Sample Date	PCE	Benzene	MTBE
5/11/01	1.20	<1	<1
7/10/01	1.40	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-13S

Date of Installation	3/23/01

Location

Northing	14863685.33
Easting	2284776.05

Well Details (feet AMSL)

Measuring Datum	4450.31
Top of Screen	4414.55
Base of Screen	4394.55

Water Level (feet AMSL)

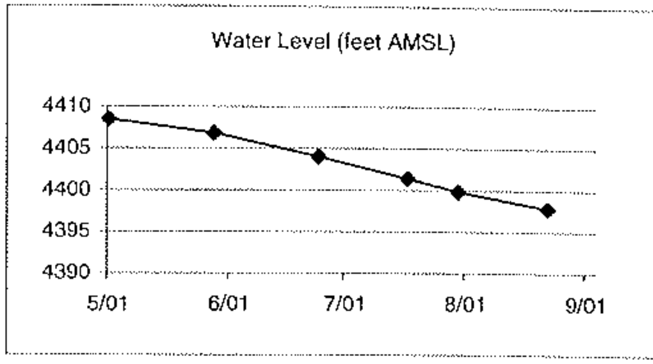
Sample Date	Water Level
5/23/01	4408.48
6/19/01	4406.83
7/16/01	4404.01
8/8/01	4401.37
8/21/01	4399.82
9/13/01	4397.81

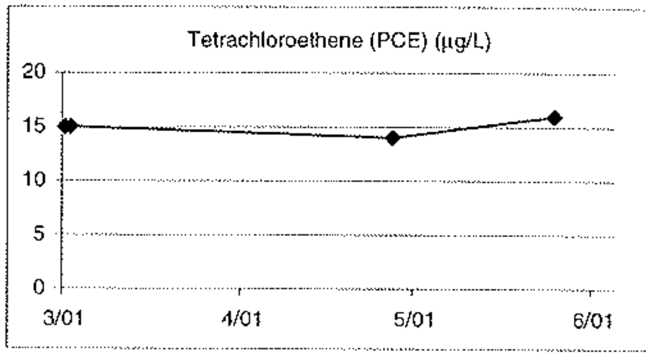
Analytical Data (mg/L)

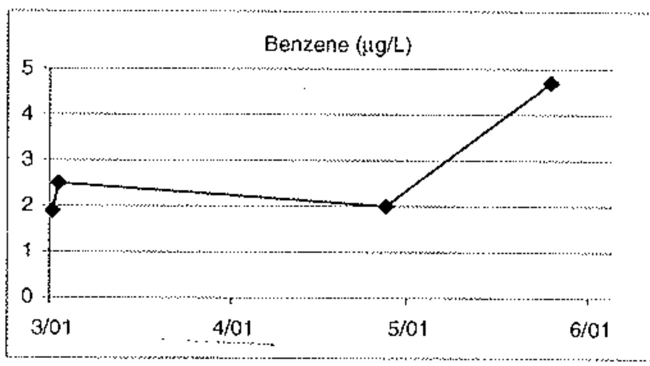
Sample Date	PCE	Benzene	MTBE
3/28/01	15.00	1.90	<1
3/29/01	15.00	2.50	<1
5/24/01	14.00	2.00	<1
6/21/01	16.00	4.70	<1

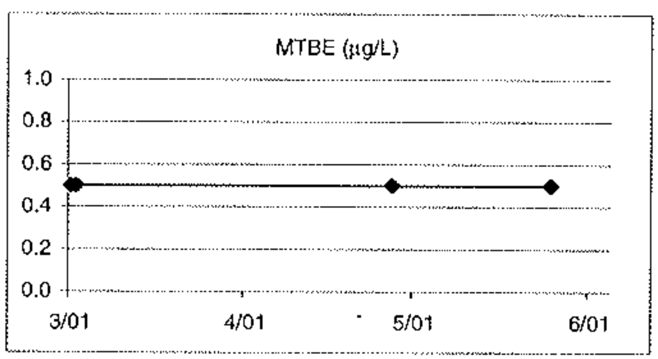
Notes:

1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-14S

Date of Installation	3/21/01

Location

Northing	14860981.17
Easting	2278705.46

Well Details (feet AMSL)

Measuring Datum	4471.18
Top of Screen	4466.29
Base of Screen	4446.29

Water Level (feet AMSL)

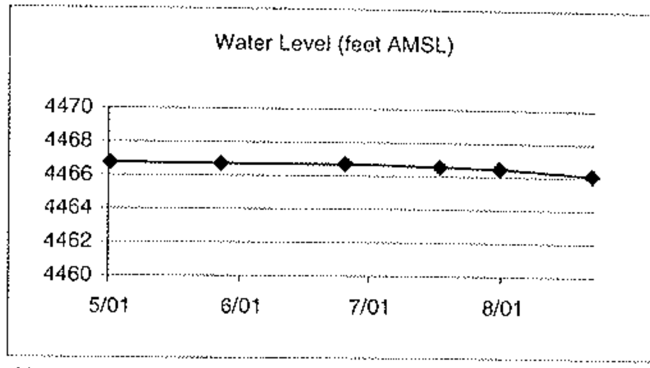
Sample Date	Water Level
5/23/01	4466.77
6/18/01	4466.7
7/17/01	4466.7
8/8/01	4466.56
8/22/01	4466.48
9/13/01	4466.11

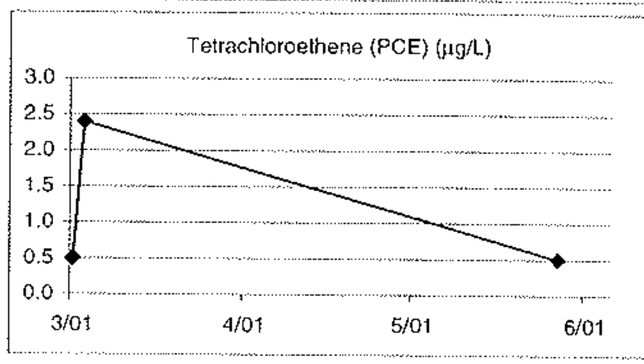
Analytical Data (mg/L)

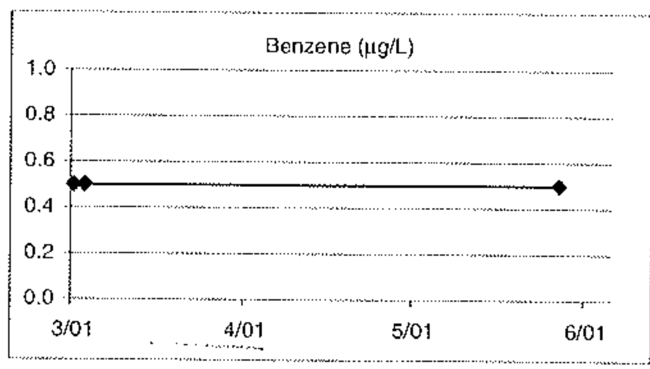
Sample Date	PCE	Benzene	MTBE
3/27/01	<1	<1	<1
3/29/01	2.40	<1	<1
6/22/01	<1	<1	<1

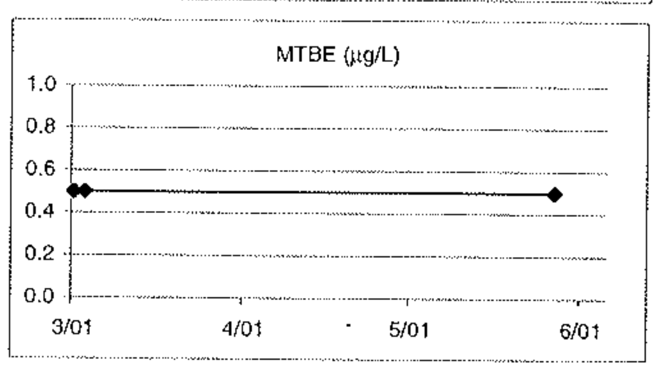
Notes:

1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-15S

Date of Installation	3/26/01

Location

Northing	14860945.20
Easting	2279869.87

Well Details (feet AMSL)

Measuring Datum	4482.31
Top of Screen	4431.86
Base of Screen	4411.86

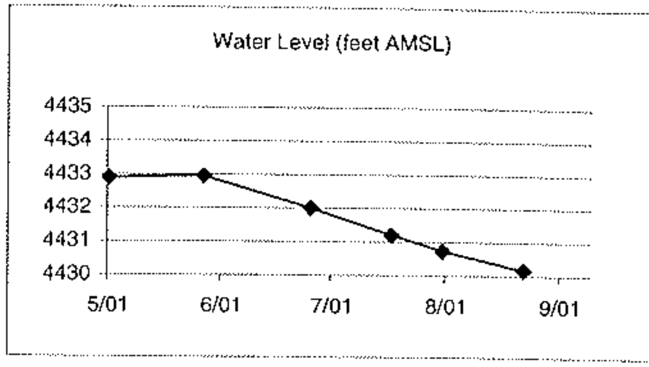
Water Level (feet AMSL)

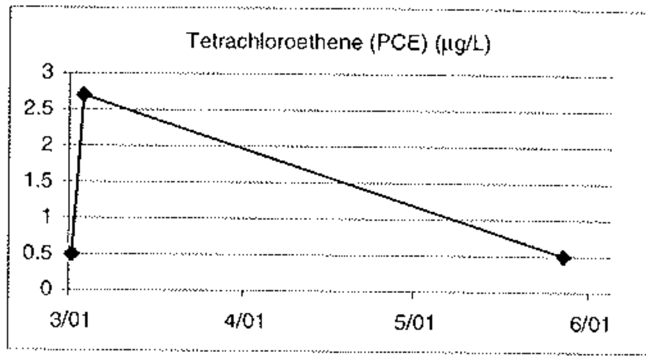
Sample Date	Water Level
5/23/01	4432.9
6/18/01	4432.95
7/17/01	4432
8/8/01	4431.2
8/22/01	4430.73
9/13/01	4430.17

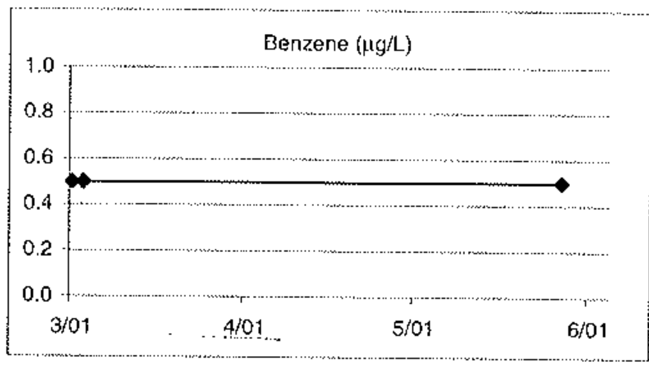
Analytical Data (mg/L)

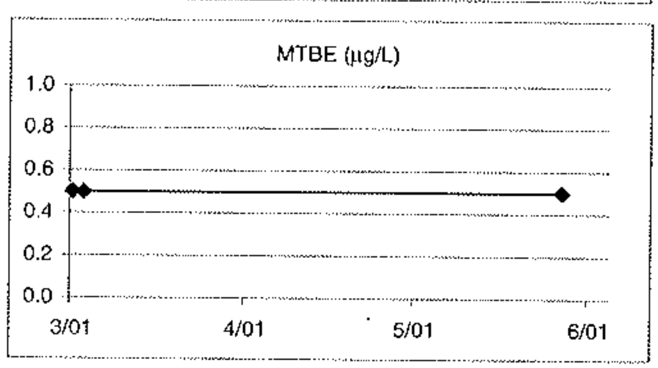
Sample Date	PCE	Benzene	MTBE
3/27/01	<1	<1	<1
3/29/01	2.70	<1	<1
6/22/01	<1	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-16S

Date of Installation	3/15/01

Location

Northing	14858163.43
Easting	2282372.40

Well Details (feet AMSL)

Measuring Datum	4439.13
Top of Screen	4418.79
Base of Screen	4398.79

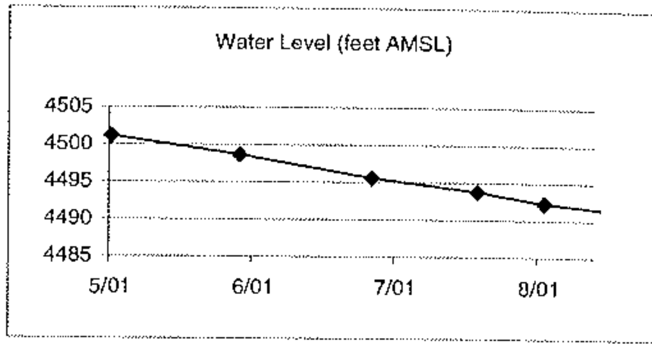
Water Level (feet AMSL)

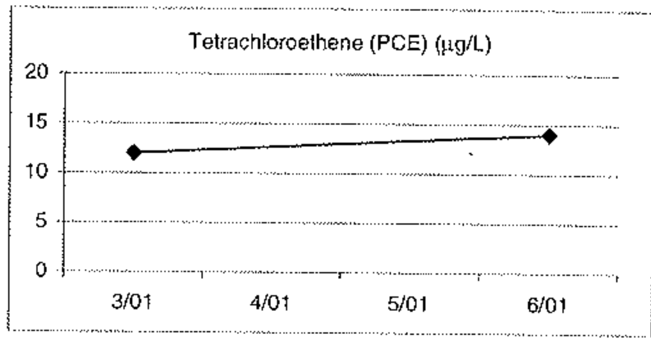
Sample Date	Water Level
5/23/01	4501.15
6/19/01	4498.63
7/17/01	4495.55
8/8/01	4493.77
8/22/01	4492.29
9/13/01	4490.88

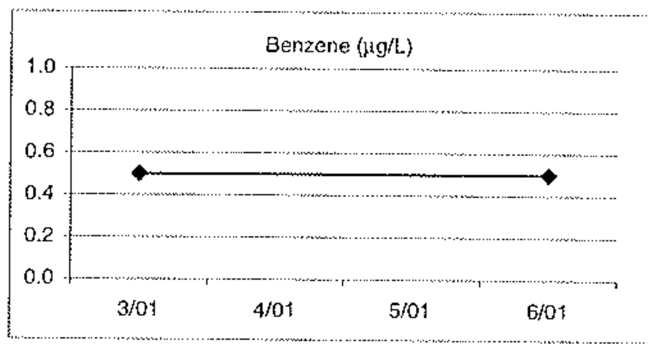
Analytical Data (mg/L)

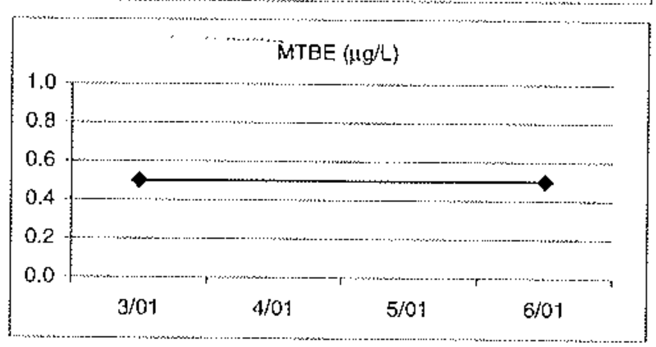
Sample Date	PCE	Benzene	MTBE
3/29/01	12.00	<1	<1
6/27/01	14.00	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-17D

Date of Installation	3/21/01

Location

Northing	14858289.59
Easting	2286176.02

Well Details (feet AMSL)

Measuring Datum	4424.88
Top of Screen	4245.67
Base of Screen	4225.67

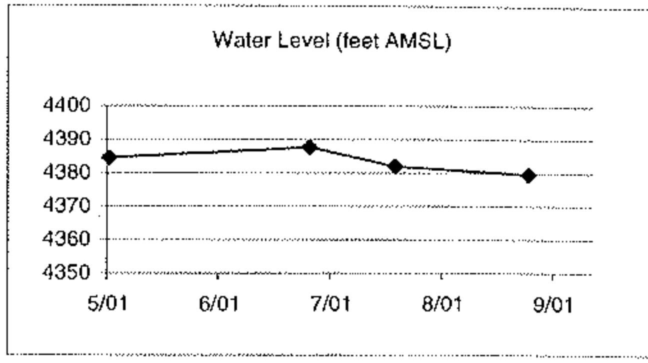
Water Level (feet AMSL)

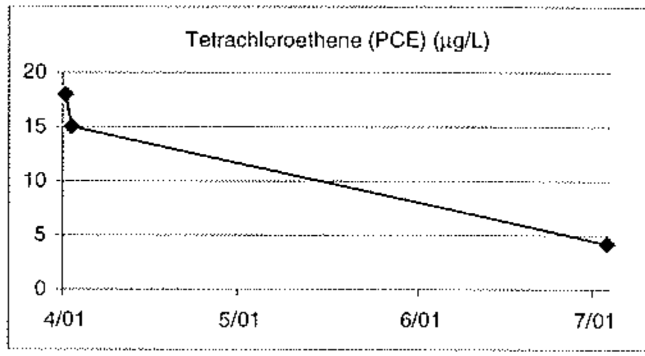
Sample Date	Water Level
5/23/01	4384.47
7/16/01	4387.64
8/8/01	4381.87
9/13/01	4379.56

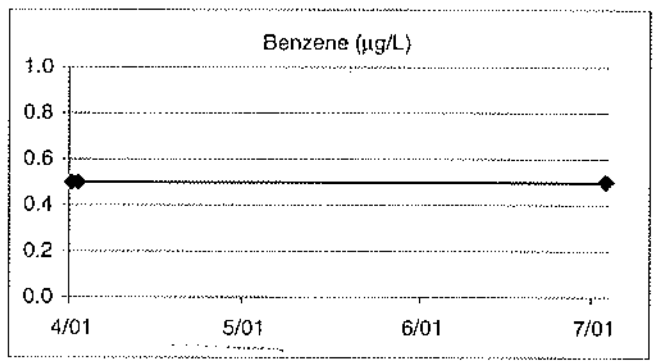
Analytical Data (mg/L)

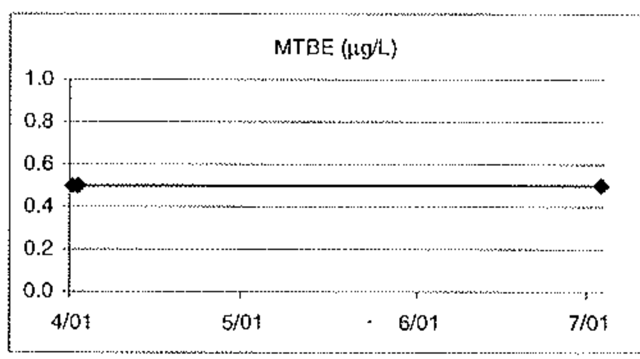
Sample Date	PCE	Benzene	MTBE
4/9/01	18.00	<1	<1
4/10/01	15.00	<1	<1
7/11/01	4.20	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-18S

Date of Installation	3/19/01

Location

Northing	14859840.54
Easting	2286510.29

Well Details (feet AMSL)

Measuring Datum	4427.09
Top of Screen	4412.13
Base of Screen	4392.13

Water Level (feet AMSL)

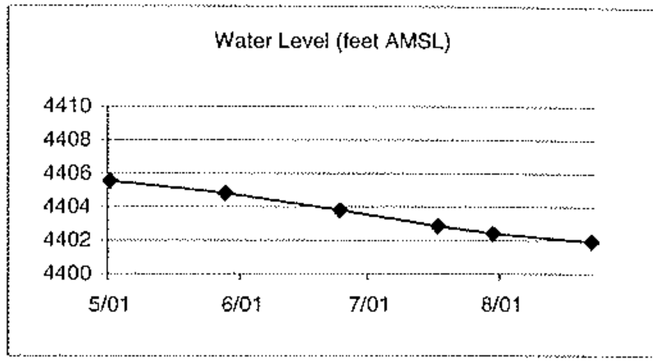
Sample Date	Water Level
5/23/01	4405.54
6/19/01	4404.82
7/16/01	4403.79
8/8/01	4402.86
8/21/01	4402.41
9/13/01	4401.93

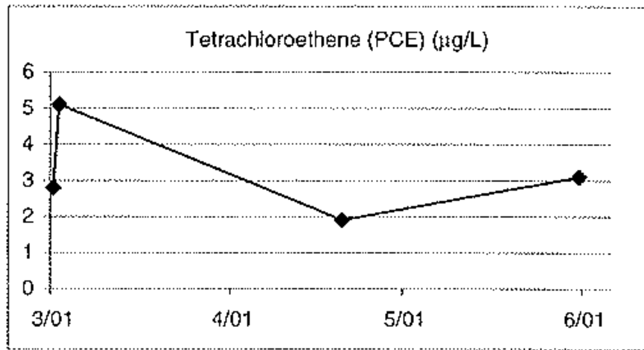
Analytical Data (mg/L)

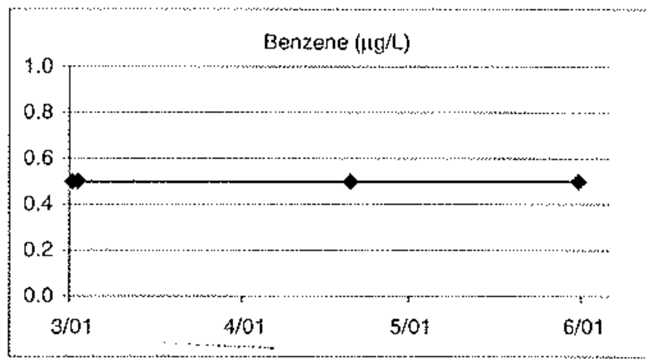
Sample Date	PCE	Benzene	MTBE
3/26/01	2.80	<1	<1
3/27/01	5.10	<1	<1
5/15/01	1.90	<1	<1
6/25/01	3.10	<1	<1

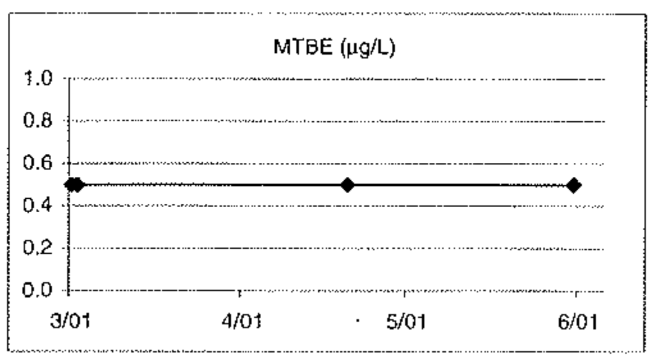
Notes:

1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-19S

Date of Installation	4/29/01

Location

Northing	14865509.94
Easting	2294834.51

Well Details (feet AMSL)

Measuring Datum	4409.21
Top of Screen	4398.39
Base of Screen	4378.39

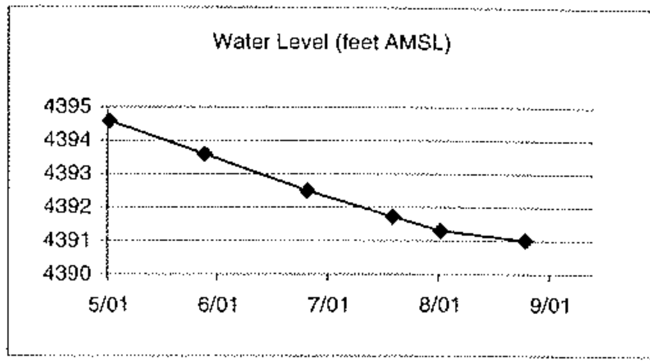
Water Level (feet AMSL)

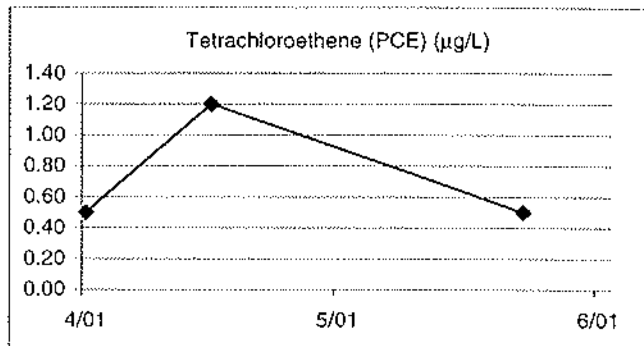
Sample Date	Water Level
5/23/01	4394.59
6/18/01	4393.59
7/16/01	4392.5
8/8/01	4391.72
8/21/01	4391.3
9/13/01	4391.01

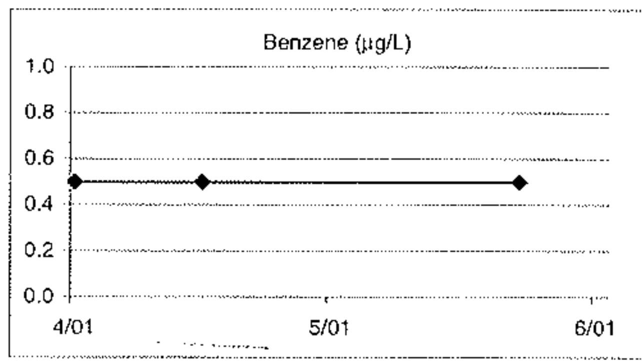
Analytical Data (mg/L)

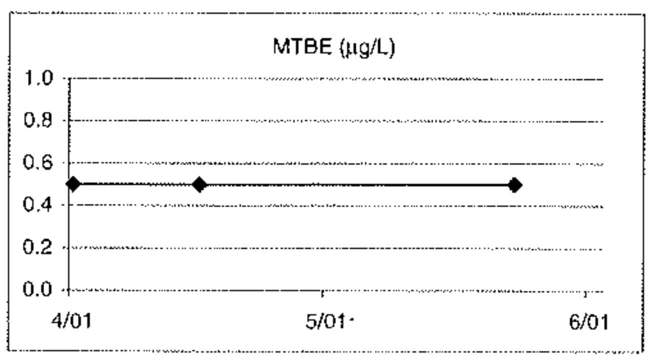
Sample Date	PCE	Benzene	MTBE
4/30/01	<1	<1	<1
5/15/01	1.20	<1	<1
6/21/01	<1	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-20S

Date of Installation	3/15/01

Location

Northing	14860467.98
Easting	2294992.76

Well Details (feet AMSL)

Measuring Datum	4405.15
Top of Screen	4400.95
Base of Screen	4380.95

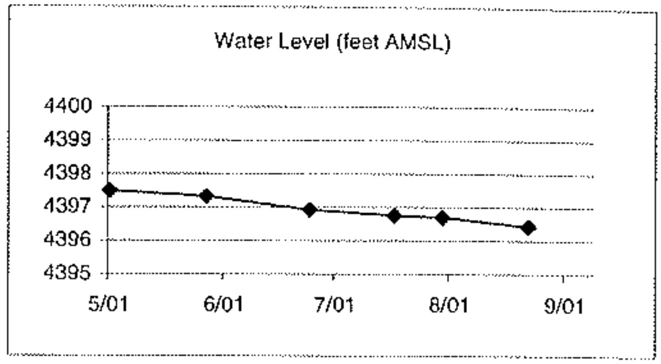
Water Level (feet AMSL)

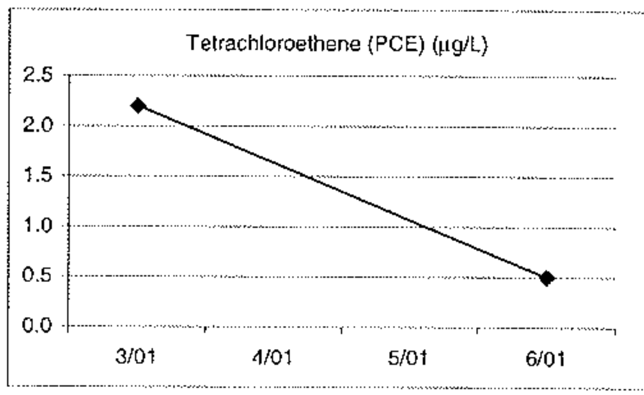
Sample Date	Water Level
5/23/01	4397.5
6/18/01	4397.32
7/16/01	4396.93
8/8/01	4396.75
8/21/01	4396.7
9/13/01	4396.44

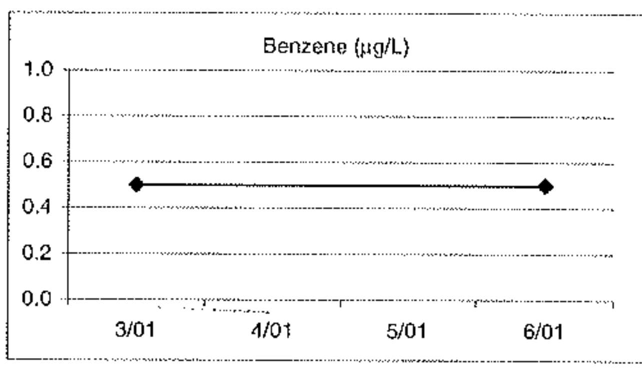
Analytical Data (mg/L)

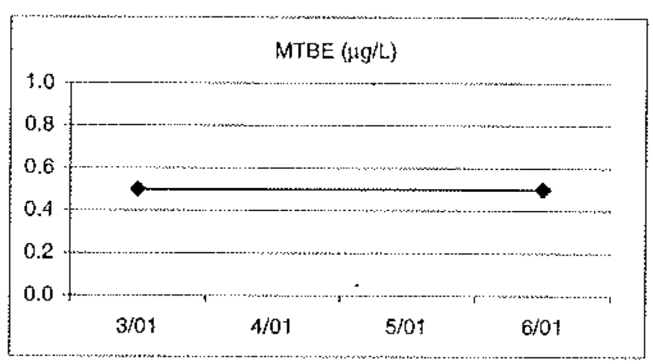
Sample Date	PCE	Benzene	MTBE
3/27/01	2.20	<1	<1
6/21/01	<1	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-21S

Date of Installation	3/16/01

Location

Northing	14865699.20
Easting	2284464.83

Well Details (feet AMSL)

Measuring Datum	4460.78
Top of Screen	4444.55
Base of Screen	4424.55

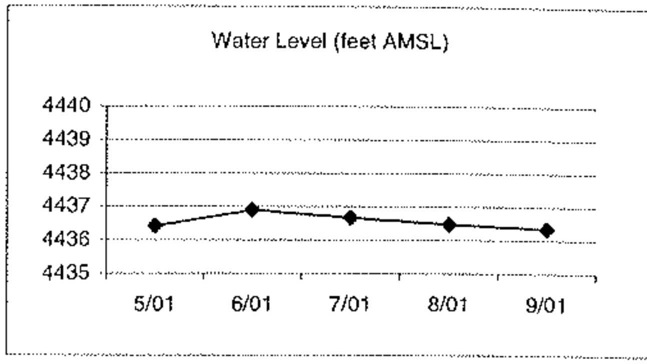
Water Level (feet AMSL)

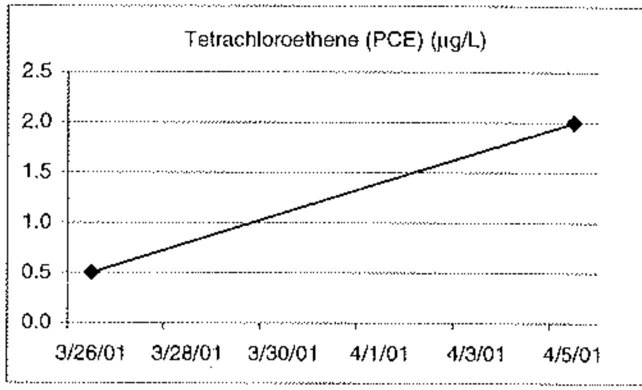
Sample Date	Water Level
5/23/01	4436.42
6/18/01	4436.9
7/16/01	4436.67
8/8/01	4436.47
9/13/01	4436.35

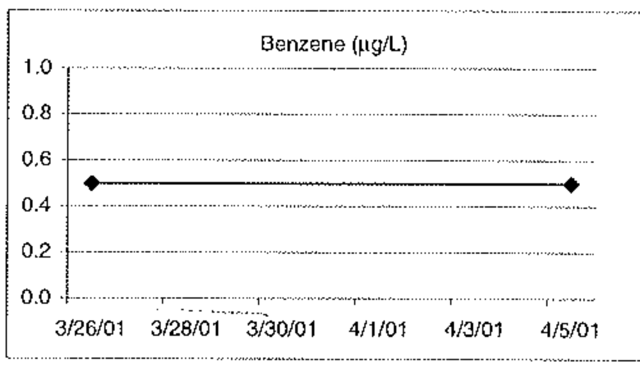
Analytical Data (mg/L)

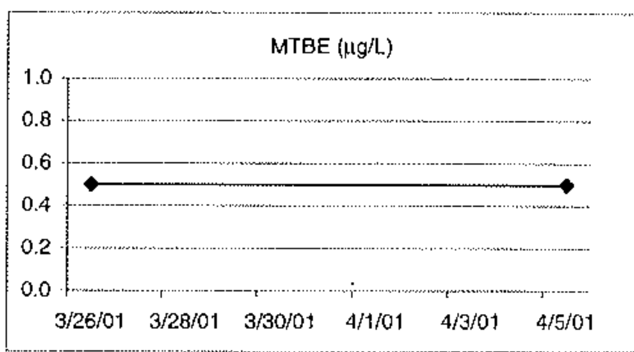
Sample Date	PCE	Benzene	MTBE
3/26/01	<1	<1	<1
4/5/01	2.00	<1	<1
7/5/01	<25	<13	<13

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.
3. Reporting limits for 7/5/01 were high due to matrix interferences and it would be misrepresentative to present the data graphically.









CTM-22D

Date of Installation	4/19/01

Location

Northing	14865920.43
Easting	2283755.43

Well Details (feet AMSL)

Measuring Datum	4458.76
Top of Screen	4226.88
Base of Screen	4206.88

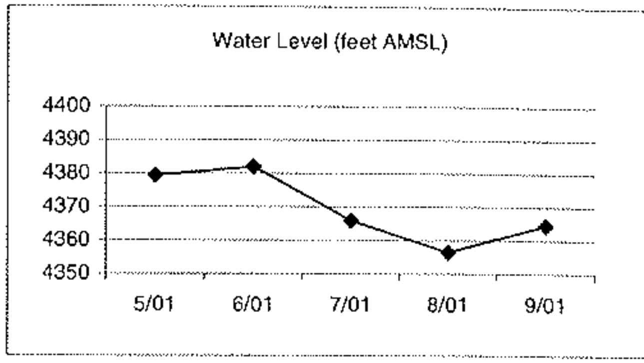
Water Level (feet AMSL)

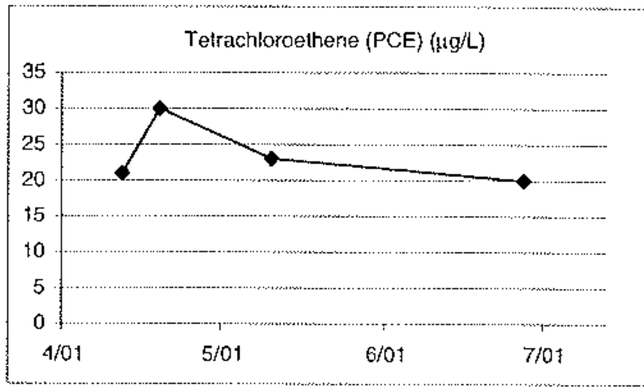
Sample Date	Water Level
5/23/01	4379.4
6/18/01	4381.99
7/16/01	4365.85
8/8/01	4356.43
9/13/01	4364.5

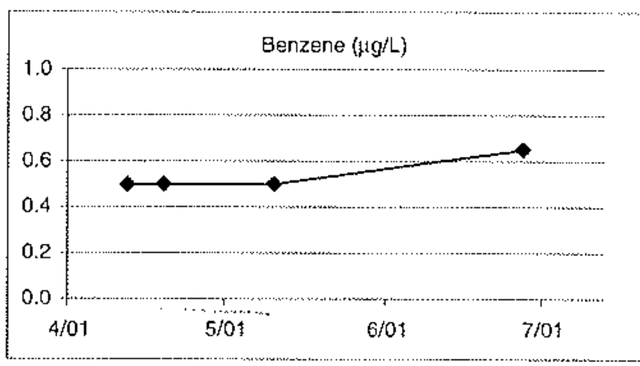
Analytical Data (mg/L)

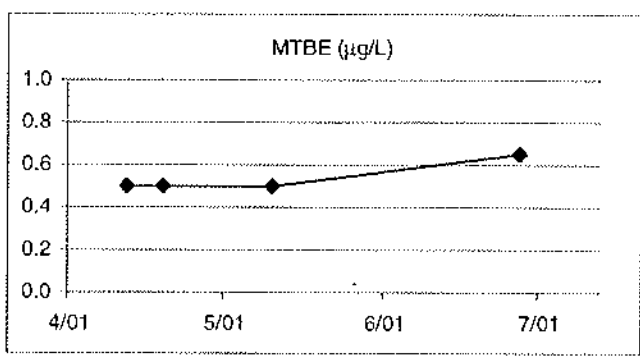
Sample Date	PCE	Benzene	MTBE
4/26/01	21.00	<1	<1
5/3/01	30.00	<1	<1
5/24/01	23.00	<1	<1
7/11/01	20.00	<1.3	<1.3

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-23D

Date of Installation	3/13/01

Location

Northing	14848390.90
Easting	2288630.58

Well Details (feet AMSL)

Measuring Datum	4417.76
Top of Screen	4257.51
Base of Screen	4237.51

Water Level (feet AMSL)

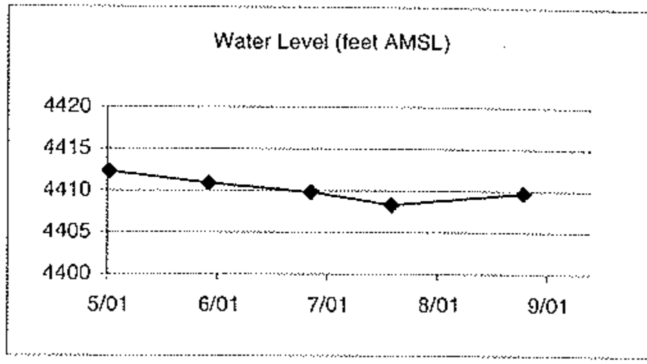
Sample Date	Water Level
5/23/01	4412.28
6/19/01	4410.88
7/17/01	4409.81
8/8/01	4408.3
9/13/01	4409.73
9/13/01	4409.73

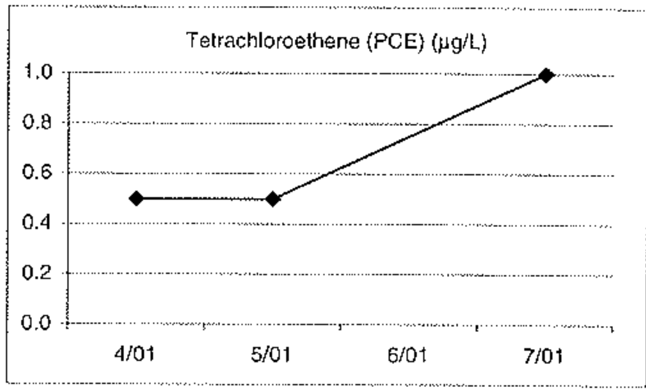
Analytical Data (mg/L)

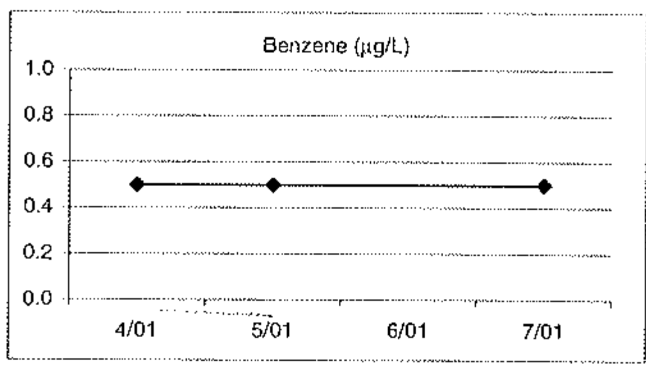
Sample Date	PCE	Benzene	MTBE
4/5/01	<1	<1	<1
5/21/01	<1	<1	<1
7/3/01	1.00	<1	<1

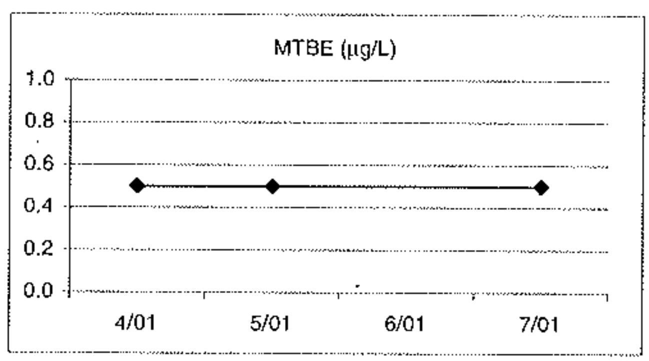
Notes:

1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-25D

Date of Installation	3/15/01

Location

Northing	14852490.57
Easting	2293011.41

Well Details (feet AMSL)

Measuring Datum	4397.30
Top of Screen	4240.15
Base of Screen	4220.15

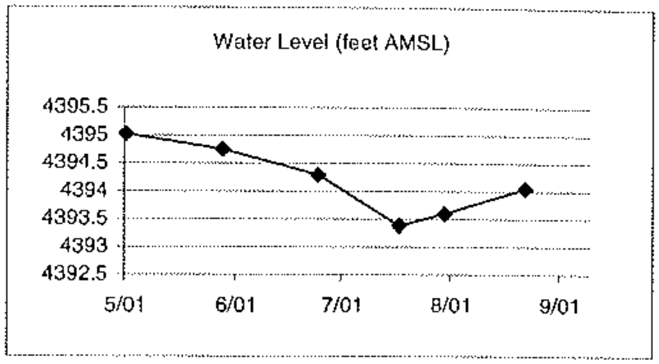
Water Level (feet AMSL)

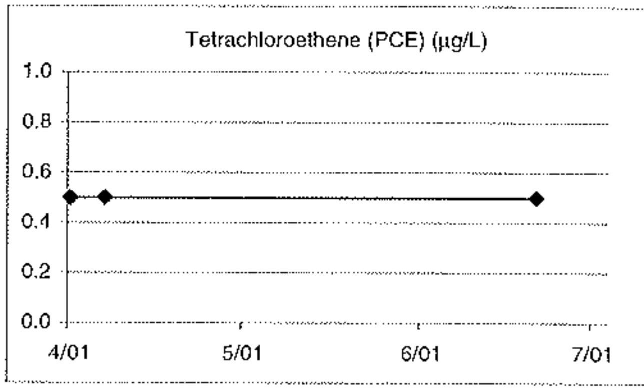
Sample Date	Water Level
5/23/01	4395.02
6/19/01	4394.75
7/16/01	4394.29
8/8/01	4393.38
8/21/01	4393.6
9/13/01	4394.05

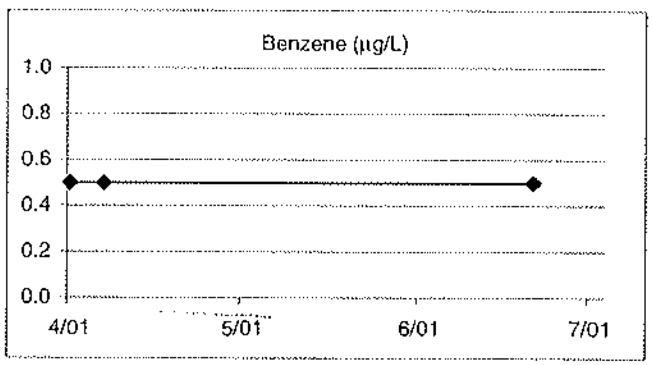
Analytical Data (mg/L)

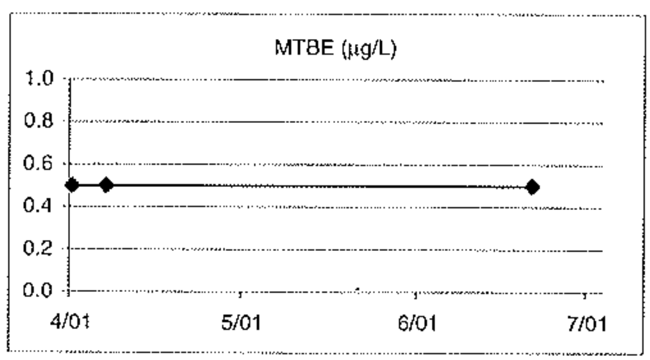
Sample Date	PCE	Benzene	MTBE
4/13/01	<1	<1	<1
4/19/01	<1	<1	<1
7/3/01	<1	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-27D

Date of Installation	4/4/01

Location

Northing	14860973.68
Easting	2278708.56

Well Details (feet AMSL)

Measuring Datum	4471.11
Top of Screen	4312.91
Base of Screen	4292.91

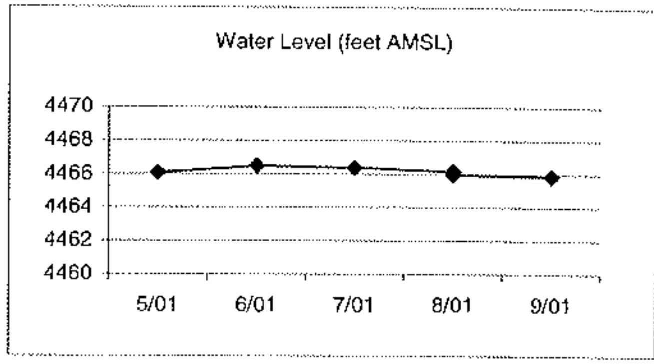
Water Level (feet AMSL)

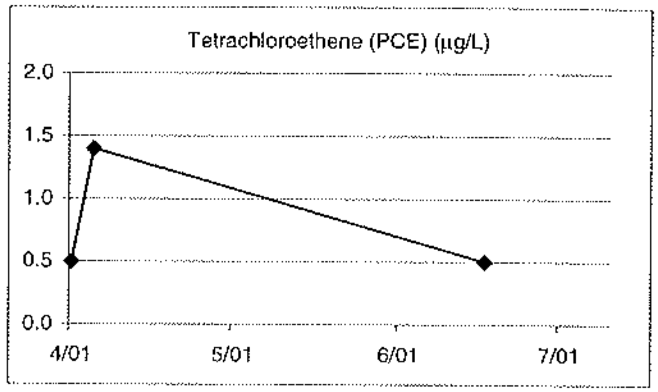
Sample Date	Water Level
5/23/01	4466.06
6/18/01	4466.48
7/17/01	4466.38
8/8/01	4466.14
8/22/01	4465.96
9/13/01	4465.88

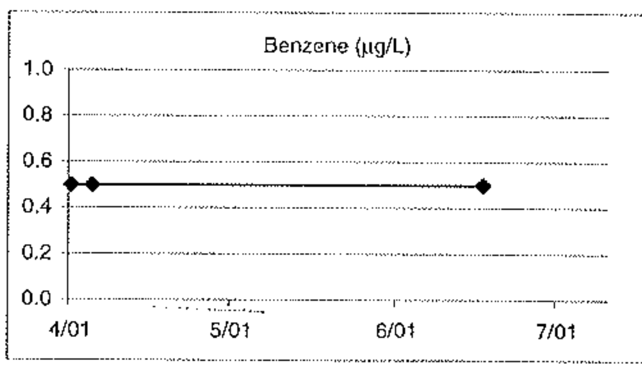
Analytical Data (mg/L)

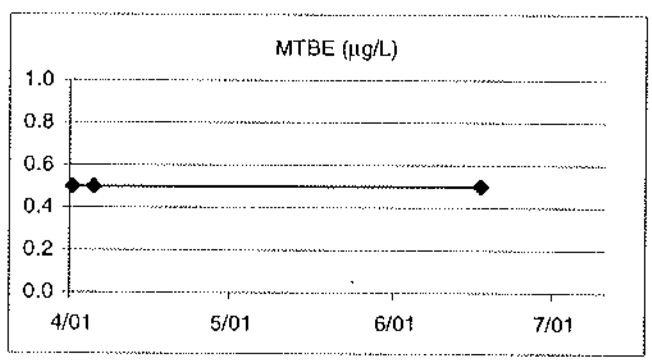
Sample Date	PCE	Benzene	MTBE
4/6/01	<1	<1	<1
4/10/01	1.40	<1	<1
6/22/01	<1	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-28S

Date of Installation	3/30/01

Location

Northing	14865635.47
Easting	2275613.82

Well Details (feet AMSL)

Measuring Datum	4522.78
Top of Screen	4498.96
Base of Screen	4478.96

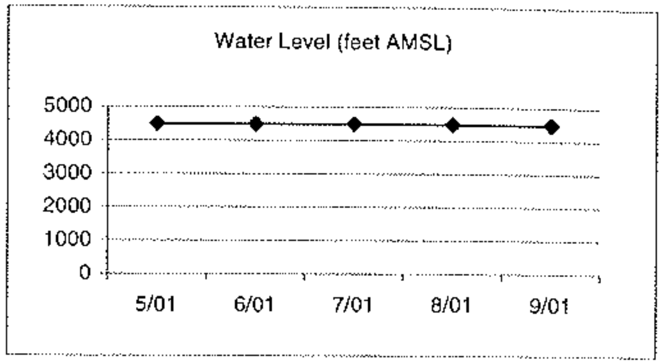
Water Level (feet AMSL)

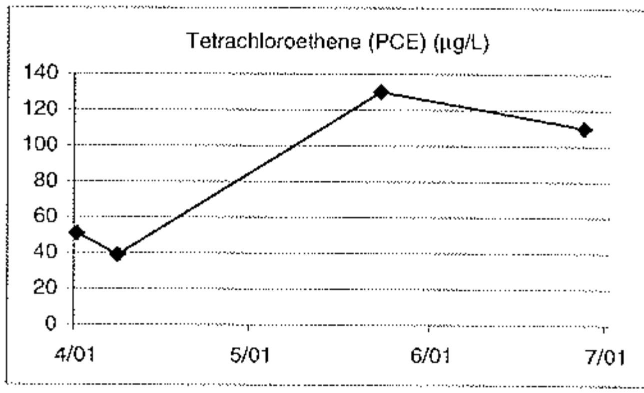
Sample Date	Water Level
5/23/01	4491.62
6/20/01	4490.37
7/17/01	4487.43
8/8/01	4485.72
8/22/01	4484.44
9/13/01	4482.26

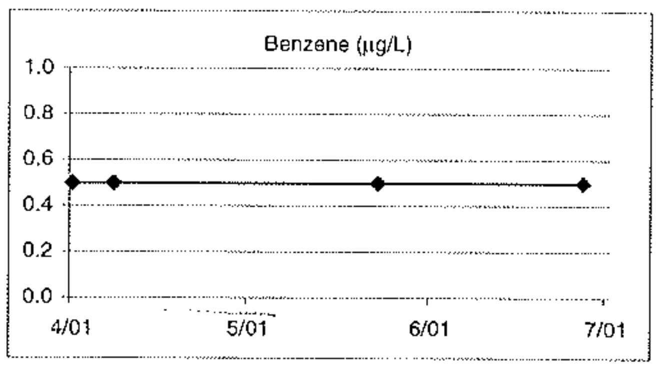
Analytical Data (mg/L)

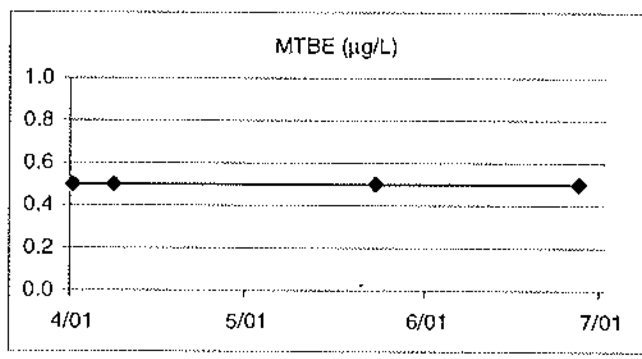
Sample Date	PCE	Benzene	MTBE
4/2/01	51.00	<1	<1
4/9/01	39.00	<1	<1
5/24/01	130.00	<1	<1
6/28/01	110.00	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-29S

Date of Installation	3/15/01

Location

Northing	14864045.60
Easting	2273769.53

Well Details (feet AMSL)

Measuring Datum	4520.72
Top of Screen	4505.23
Base of Screen	4485.23

Water Level (feet AMSL)

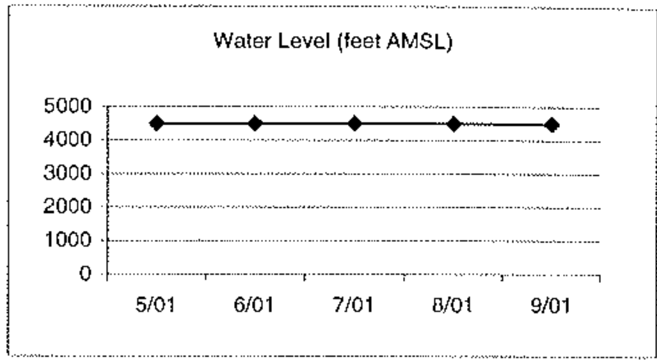
Sample Date	Water Level
5/23/01	4501.32
6/19/01	4500.29
7/17/01	4497.77
8/8/01	4496.36
8/22/01	4494.84
9/13/01	4493.05

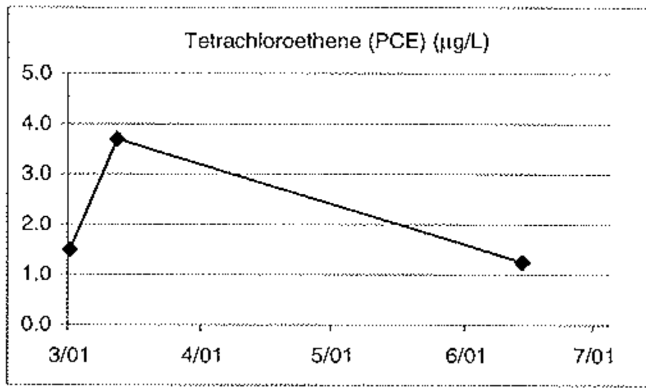
Analytical Data (mg/L)

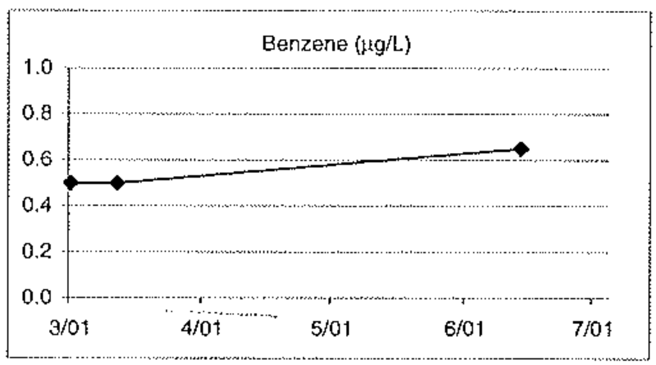
Sample Date	PCE	Benzene	MTBE
3/29/01	1.50	<1	<1
4/9/01	3.70	<1	<1
7/12/01	<2.5	<1.3	<1.3

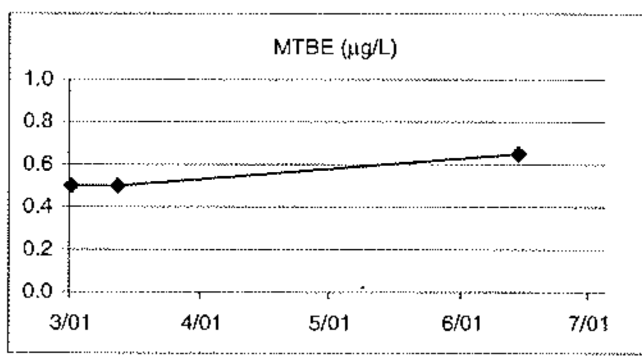
Notes:

1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-30D

Date of Installation	4/12/01

Location

Northing	14865293.44
Easting	2278837.66

Well Details (feet AMSL)

Measuring Datum	4492.21
Top of Screen	4360.30
Base of Screen	4340.30

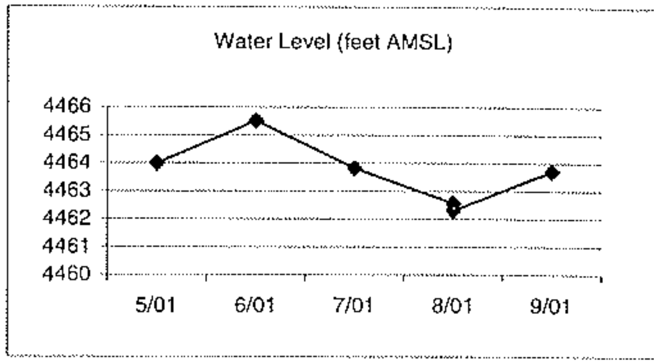
Water Level (feet AMSL)

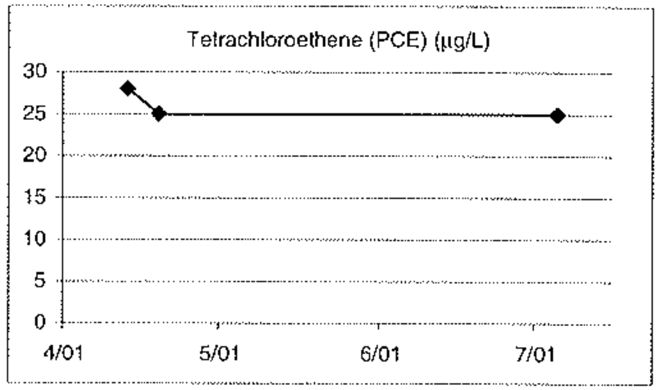
Sample Date	Water Level
5/23/01	4463.99
6/18/01	4465.52
7/16/01	4463.82
8/8/01	4462.57
8/21/01	4462.3
9/13/01	4463.71
9/13/01	4463.71

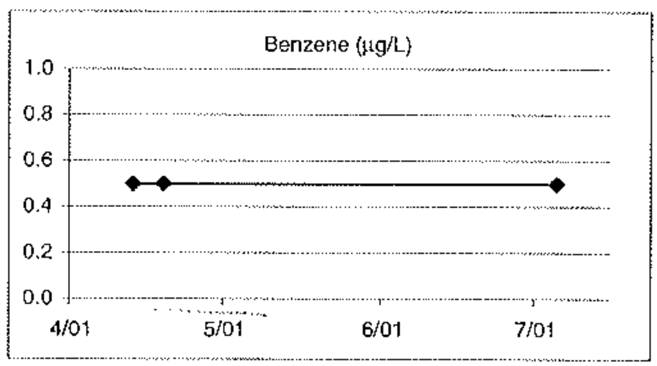
Analytical Data (mg/L)

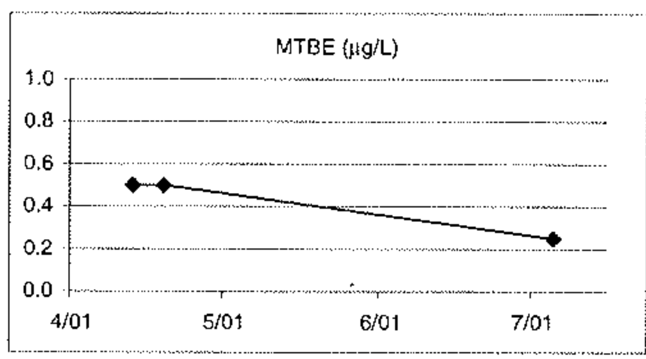
Sample Date	PCE	Benzene	MTBE
4/13/01	28.00	<1	<1
4/19/01	25.00	<1	<1
7/5/01	25.00	<1	<0.5

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-31S

Date of Installation	5/4/01

Location

Northing	14867356.07
Easting	2276745.51

Well Details (feet AMSL)

Measuring Datum	4512.01
Top of Screen	4480.14
Base of Screen	4460.14

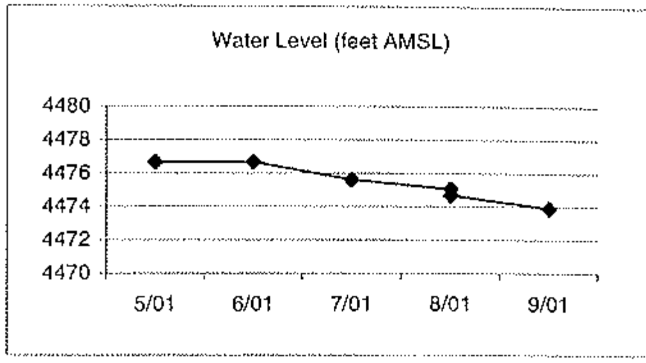
Water Level (feet AMSL)

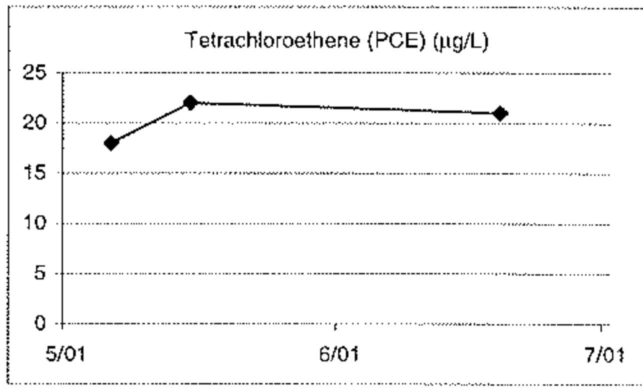
Sample Date	Water Level
5/23/01	4476.64
6/19/01	4476.67
7/17/01	4475.6
8/8/01	4475.04
8/22/01	4474.69
9/13/01	4473.92

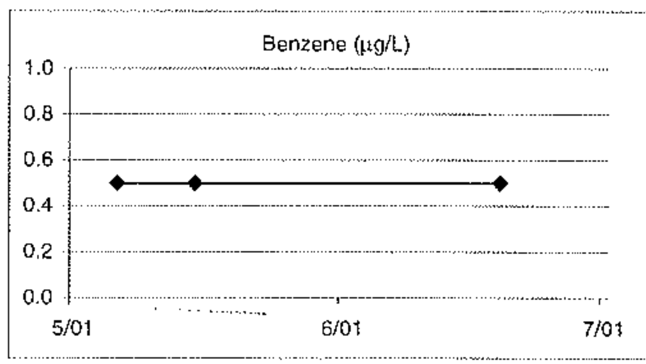
Analytical Data (mg/L)

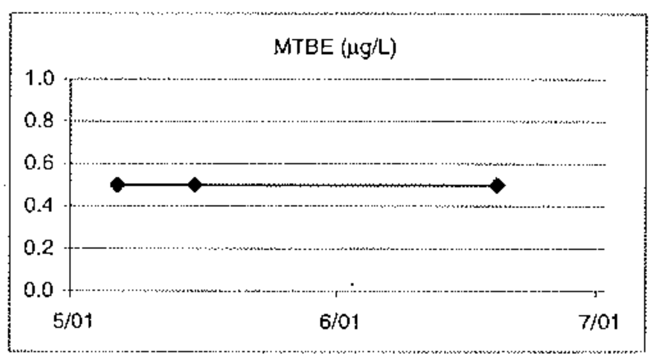
Sample Date	PCE	Benzene	MTBE
5/15/01	18.00	<1	<1
5/24/01	22.00	<1	<1
6/28/01	21.00	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-33D

Date of Installation	5/2/01

Location

Northing	14858545.21
Easting	2285129.76

Well Details (feet AMSL)

Measuring Datum	4424.94
Top of Screen	4246.09
Base of Screen	4226.09

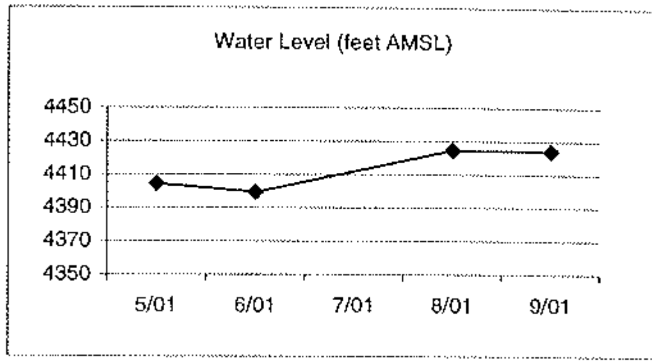
Water Level (feet AMSL)

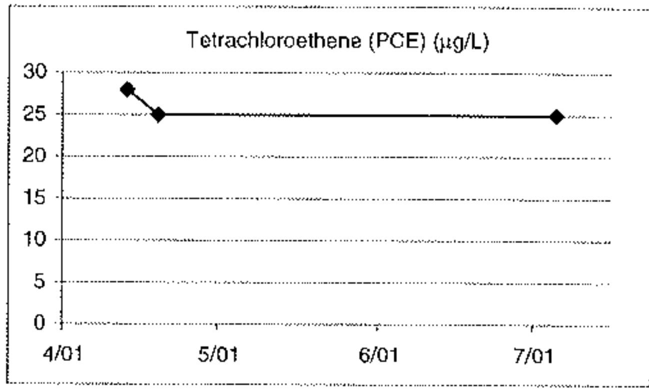
Sample Date	Water Level
5/23/01	4404.42
6/20/01	4399.31
8/8/01	4424.61
8/21/01	4424.32
9/13/01	4424.15

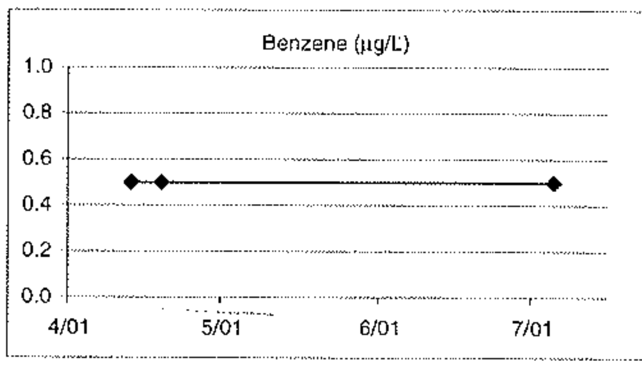
Analytical Data (mg/L)

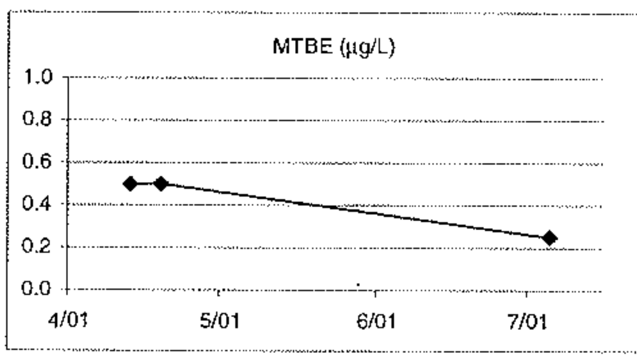
Sample Date	PCE	Benzene	MTBE
5/3/01	2.80	<1	<1
6/27/01	1.80	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-37S

Date of Installation	3/21/01

Location

Northing	14868572.49
Easting	2280975.62

Well Details (feet AMSL)

Measuring Datum	4478.74
Top of Screen	4452.91
Base of Screen	4432.91

Water Level (feet AMSL)

Sample Date	Water Level
5/23/01	4458.09
6/20/01	4459.58
7/17/01	4458.87
8/8/01	4457.67
8/22/01	4457.44
9/13/01	4454.76

Analytical Data (mg/L)

Sample Date	PCE	Benzene	MTBE
3/28/01	2.80	<1	<1
4/5/01	3.80	<1	<1
7/12/01	<2.5	<1.3	<1.3

Notes:
1. "<" indicates that the analytical result was below the detection limit.
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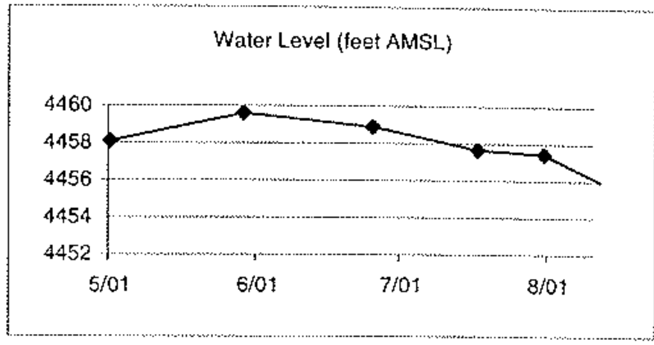
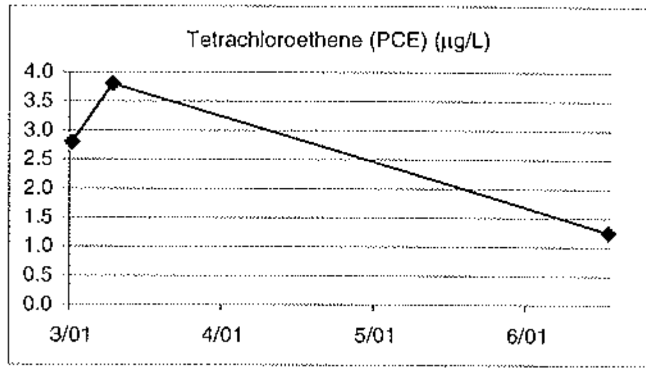
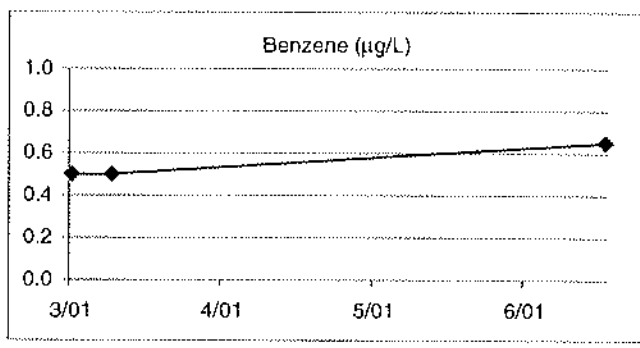
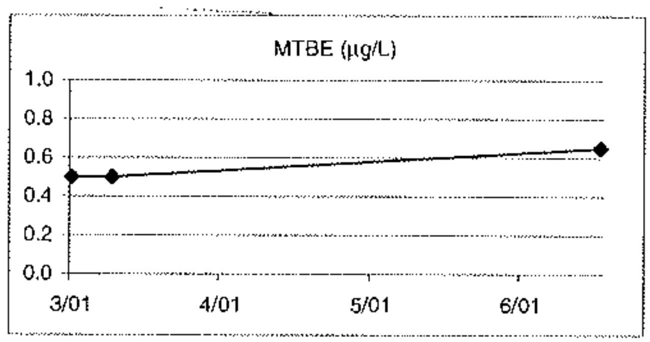








CTM-37D

Date of Installation	5/31/01

Location

Northing	14865257.35
Easting	2284801.76

Well Details (feet AMSL)

Measuring Datum	4451.70
Top of Screen	4386.39
Base of Screen	4366.39

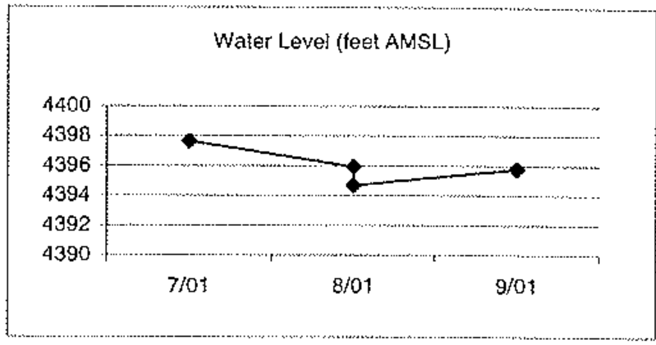
Water Level (feet AMSL)

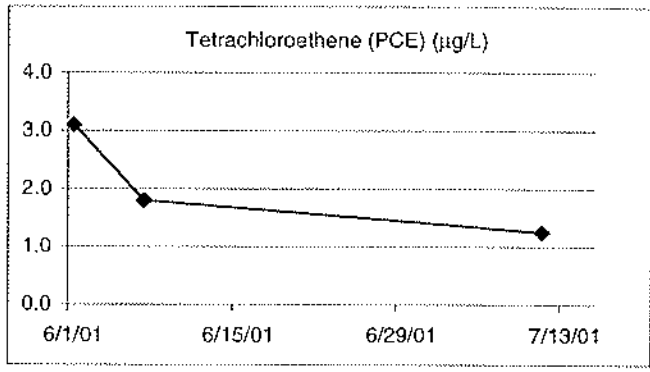
Sample Date	Water Level
7/16/01	4397.64
8/8/01	4395.94
8/22/01	4394.67
9/13/01	4395.79

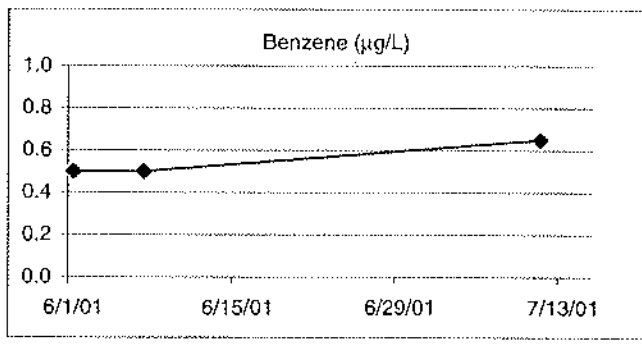
Analytical Data (mg/L)

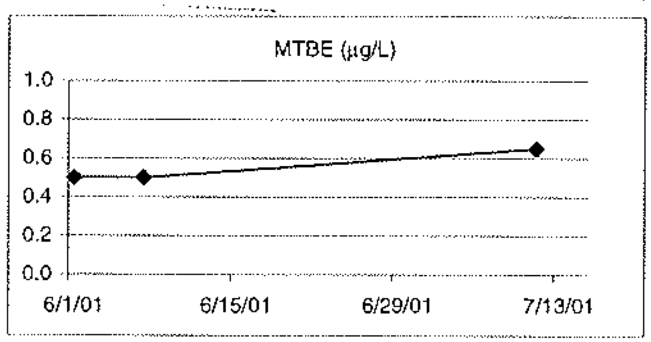
Sample Date	PCE	Benzene	MTBE
6/1/01	3.10	<1	<1
6/7/01	1.80	<1	<1
7/11/01	<2.5	<1.3	<1.3

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-38D

Date of Installation	5/29/01

Location

Northing	14864154.01
Easting	2287371.15

Well Details (feet AMSL)

Measuring Datum	4429.10
Top of Screen	4353.78
Base of Screen	4333.78

Water Level (feet AMSL)

Sample Date	Water Level
6/20/01	4404.63
7/16/01	4402.36
8/8/01	4400.95
8/21/01	4400.37
9/13/01	4400.18

Analytical Data (mg/L)

Sample Date	PCE	Benzene	MTBE	1,2-cis-DCE
6/6/01	49.0	<1	100.0	3.1
6/25/01	55.0	<1	95.0	3.6
6/7/01	45.0	<1	85.0	

Notes:
1. "<" indicates that the analytical result was below the detection limit.
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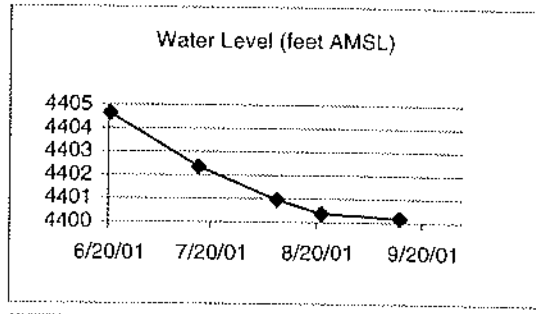
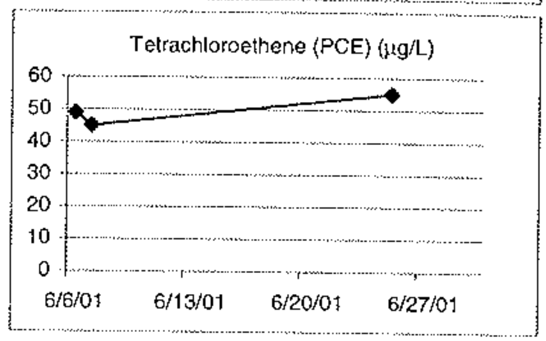
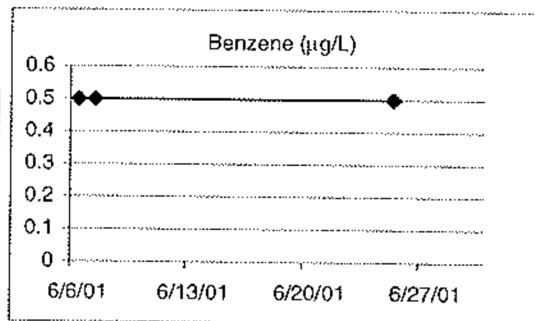
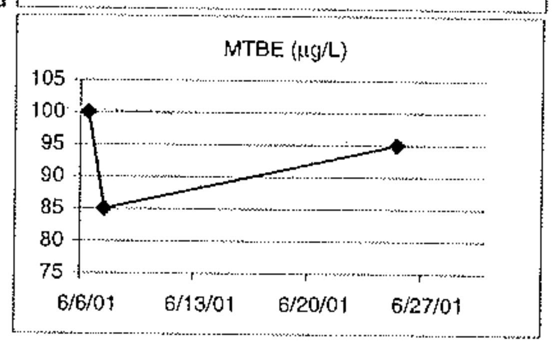
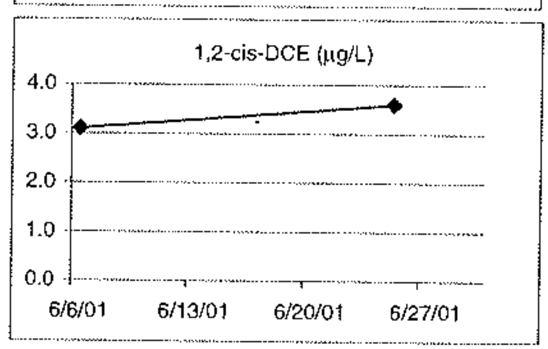










CTM-39S

Date of Installation	6/1/01

Location

Northing	14864147.45
Easting	2287368.05

Well Details (feet AMSL)

Measuring Datum	4429.19
Top of Screen	4410.82
Base of Screen	4390.82

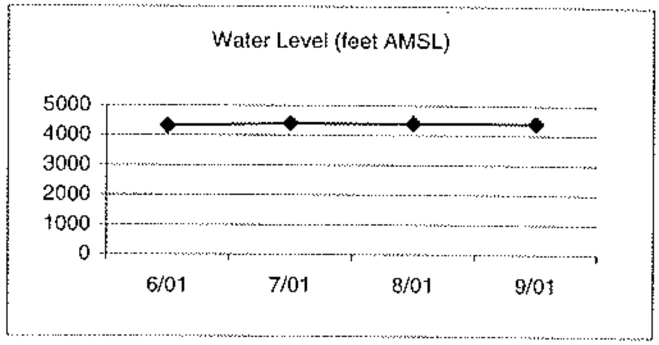
Water Level (feet AMSL)

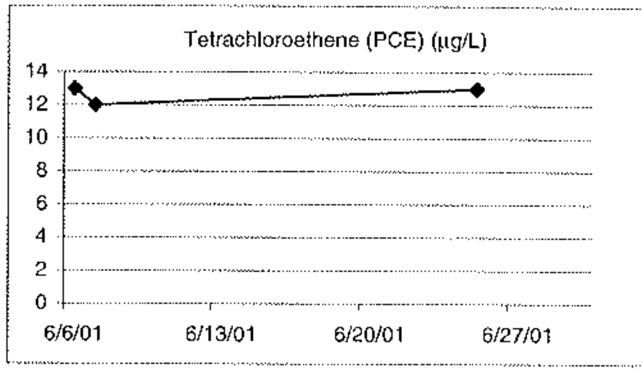
Sample Date	Water Level
6/20/01	4316
7/16/01	4403.49
8/8/01	4402.28
8/21/01	4401.72
9/13/01	4401.12

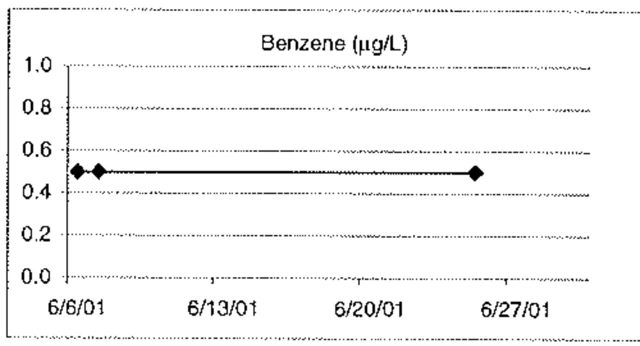
Analytical Data (mg/L)

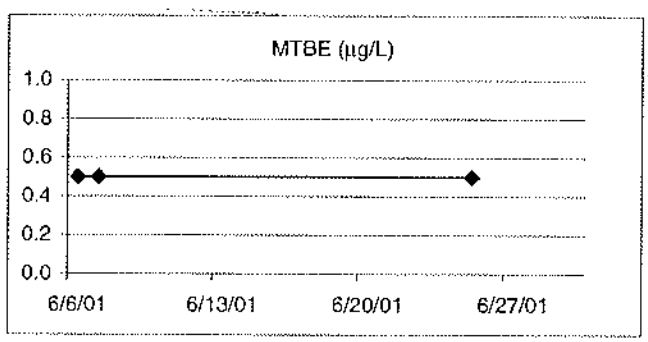
Sample Date	PCE	Benzene	MTBE
6/6/01	13.00	<1	<1
6/7/01	12.00	<1	<1
6/25/01	13.00	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-40S

Date of Installation	6/5/01

Location

Northing	14870889.61
Easting	2275923.04

Well Details (feet AMSL)

Measuring Datum	4594.07
Top of Screen	4475.76
Base of Screen	4445.76

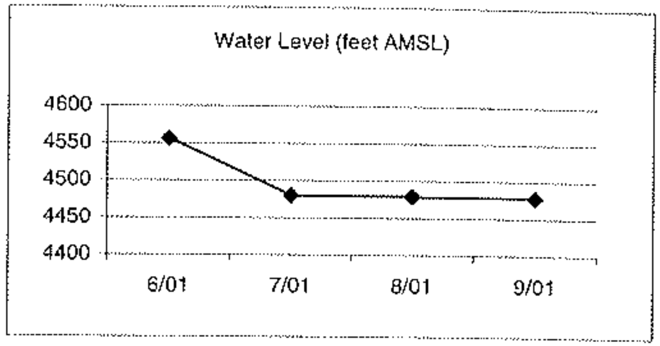
Water Level (feet AMSL)

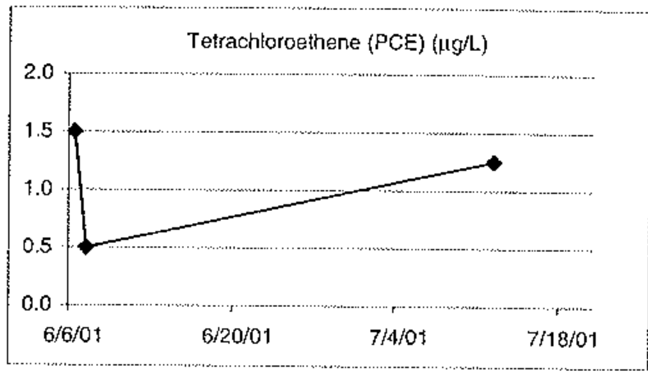
Sample Date	Water Level
6/20/01	4556.12
7/17/01	4480.11
8/8/01	4479.4
8/22/01	4478.82
9/13/01	4478.01

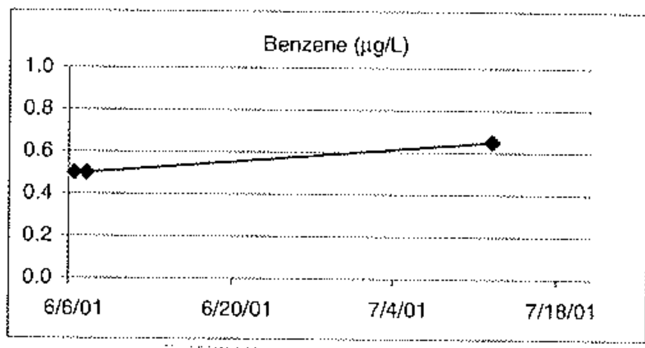
Analytical Data (mg/L)

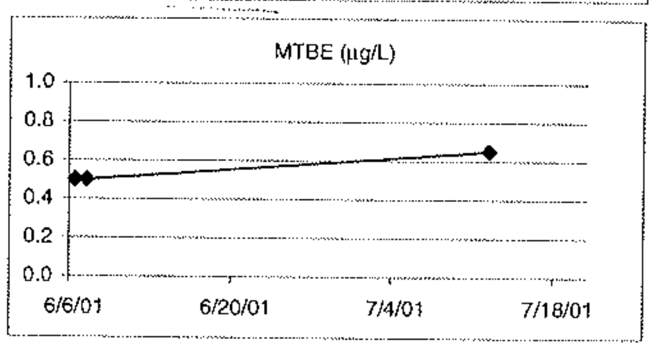
Sample Date	PCE	Benzene	MTBE
6/6/01	1.50	<1	<1
6/7/01	<1	<1	<1
7/12/01	<2.5	<1.3	<1.3

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.









CTM-41S

Date of Installation	6/4/01

Location

Northing	14861204.29
Easting	2279643.38

Well Details (feet AMSL)

Measuring Datum	4479.69
Top of Screen	4447.39
Base of Screen	4427.39

Water Level (feet AMSL)

Sample Date	Water Level
7/17/01	4442.15
8/8/01	4442.21
8/22/01	4442.06
9/13/01	4441.98

Analytical Data (mg/L)

Sample Date	PCE	Benzene	MTBE
6/12/01	<1	<1	<1
6/14/01	<1	<1	<1
7/10/01	<1	<1	<1

Notes:
1. "<" indicates that the analytical result was below the detection limit.
2. Non-detect analytical results are presented in the plots as one half the detection limit.