GEOMATRIX

DRAFT REPORT
CONCEPTUAL ENGINEERING FOR REMOVAL OF SUNOL AND NILES DAMS

Alameda County, California

Prepared for:

San Francisco Public Utilities Commission
1155 Market Street, 7th Floor
San Francisco, California 94103

July 2003

Project No. 6959.021

Geomatrix Consultants

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Ms. Barbara Palacios
San Francisco Public Utilities Commission
1155 Market Street, 7th Floor
San Francisco, California 94103

Subject: Draft Report – Conceptual Engineering For Removal of Sunol and Niles Dams
Alameda County, California

Dear Ms. Palacios:

Geomatrix Consultants, Inc. (Geomatrix) and HDR Engineering, Inc. (HDR) are pleased to submit the enclosed revised draft report, which presents the findings of our geologic/geotechnical assessment and presents conceptual engineering recommendations for the removal of Sunol and Niles dams. The study, conducted by Geomatrix and HDR, involved reviewing available information, conducting site-specific field investigations, laboratory testing, and developing conceptual-level engineering recommendations for the removal of both dams. Our study also involved evaluating potential socioeconomic and community issues (performed by Mara Feeney & Associates), along with potential traffic impacts on the local communities (performed by CHS Consulting Group). This revised draft report incorporates the PUC's comments from review of our first draft report, dated June 2, 2003.

Geomatrix and HDR have appreciated this opportunity to work with you. Please contact the undersigned if you have any questions about this report. We will finalize the enclosed report upon receipt of the PUC's written review comments.

Sincerely yours,
GEOMATRIX CONSULTANTS, INC.

Faiz Makdisi, P.E.
Principal Engineer

Todd Crampton, C.E.G.
Senior Geologist

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EXECUTIVE SUMMARY

This report presents the findings and results of a geologic and geotechnical assessment and conceptual engineering study performed by Geomatrix Consultants, Inc. (Geomatrix) and HDR Engineering, Inc. (HDR) for the removal of Sunol and Niles Dams, located on Alameda Creek adjacent to Highway 84 in southern Alameda County. These dams are owned by the City and County of San Francisco and are maintained and operated by the San Francisco Public Utilities Commission (SFPUC). The dams were constructed between the mid-1800s and the early-1900s to provide water for various uses; however, neither dam is currently a component of the City's water system. Both dams have existing liability concerns and are known impediments to anadromous fish migration. The SFPUC is planning to remove both dams to address both the safety and fish migration issues.

The removal of Sunol and Niles dams involves many complex issues, including but not limited to environmental impacts, socioeconomic issues, and demolition/construction issues. The scope of our study involved evaluating the geologic/geotechnical conditions of the dam sites, conducting office and field studies (topographic surveys, field mapping and sediment sampling) to estimate the volume of sediments impounded behind (upstream of) the dams, conducting laboratory testing on the impounded sediments, developing sediment management strategies, developing creek diversion/dewatering systems, developing conceptual-level engineering for the removal of both dam, and evaluating potential traffic impact and community issues.

Our review and analysis of available information, combined with site-specific data collected for this study indicates there are about 7,000 to 13,000 cubic yards of sediment impounded behind Sunol Dam, with the impoundment extending about 1,300 to 1,500 feet upstream of the dam. We estimate that about 700 to 2,800 cubic yards are stored behind Niles Dam, with the impoundment extending about 500 feet upstream of the dam. Our analysis also indicates that the original (i.e., pre-dam) channel bottom of Alameda Creek was a maximum of about 6 feet below the top of Sunol Dam. At Niles Dam, we estimate a maximum height of about 5 feet between the main crest of the dam and the original channel bottom.

Vibracore sediment sampling was conducted at seven locations within about 100 feet upstream of Sunol Dam. The vibracore sampler, which was 10 feet long and 4 inches in diameter, was driven to a depth of about 10 feet below the bottom of the creek channel at each location. The recovered core samples (sediments) ranged between two to four feet in length. The recovered sediments consisted of well-graded gravelly sands with small cobbles. No sampling was conducted at the Niles Dam site, due to the poor recovery at Sunol Dam and existing information indicating that the sediments impounded behind Niles Dam are coarser than those at Sunol Dam.

Chemical analytical testing was performed on selected samples recovered from Sunol Dam. The test results indicate that PCBs, PNAs, pesticides, and TPH motor oil were not detected in any of the samples. TPH diesel was detected in two samples at low levels (1.2 milligrams per kilogram [mg/kg]); however, the testing laboratory indicated that the hydrocarbon pattern did not match its diesel standard. Therefore, TPH diesel is likely not present in these two samples. Metals were detected at low concentrations - well below regulatory criteria for disposal. The detected concentrations were also below accepted background concentrations (except for one detection of nickel just above background). These data, along with information we obtained from the Alameda County Flood and Water Control District and the Zone 7 Water Agency on dredging activities in the Alameda Creek watershed, suggest the sediments impounded behind both Sunol and Niles Dams likely are free of substances that are of an environmental concern, or have concentrations below regulatory limits.

The removal of both dams and associated sediments can be accomplished in an environmentally sensitive manner and within one season using conventional heavy construction equipment. The general approach for each dam consists of diverting the creek flows, notching the dam to drain the impoundment, removing sediments and the portions of the dam that are either a barrier to anadromous fish passage or a safety concern, and restoring the site. A suggested removal sequence has also been developed for each dam. Since the schedule and costs are dependent upon the volume of sediment to be removed, a range of volumes has been used to establish a range of costs.

At the Niles Dam site, the primary issue is how to access the site to perform the work, so three alternatives have been evaluated. Once on-site, the dam can be easily breached and the middle section removed. The section closest to Niles Canyon Road should be left in place since it helps deflect flows away from the stacked-rock retaining wall that supports Niles Canyon Road. The opposite section is outside of the normal creek flow, thus leaving it in place will not interfere with anadromous fish passage.

At the Sunol Dam site, the primary issue is the sediment removal in terms of a) the volume, b) how to remove it with minimum impact to the established riparian habitat, and c) how to divert the creek flows for a distance of approximately 1,500 to 2,000 feet. The approach developed in this report allows for a reduction in the amount of sediments that should be removed, attempts to minimize the environmental impacts by establishing access to load the dump trucks on the exposed gravel bed, and proposes that the original aqueduct be used to divert the creek flows.

Lastly for each dam, a number of recommendations have been developed, with the key recommendations summarized as follows:

Common

Within the proposed limits of ground disturbing activities, a tree and plant survey should be performed quantify the impacts and to develop appropriate mitigation measures.

Sunol Dam

During the summer of 2003 and 2004, perform field observations of the Great Blue Heron nesting sites to determine when they fledge.

If the existing aqueduct will be used to divert the creek flows, additional reconnaissance and data will be needed to define the scope of work.

Due to the proximity of the work to the Union Pacific Railroad (UPRR), the property lines near need to be established to determine what a Right of Entry (or other) permit may be required.

Niles Dam

The preferred alternative for construction access to this site is to use Niles Canyon Road. This will require close coordination with Caltrans to develop a viable traffic handling and control plan. This process is likely to take several months.

Further research is needed to document the contents and significance of the gravel-terraced area on the left bank (looking downstream) that was reportedly known as Joyland Park.

CONCEPTUAL ENGINEERING FOR REMOVAL OF SUNOL AND NILES DAMS
Alameda County, California

1.0 INTRODUCTION

This report presents the findings and results of a geologic and geotechnical assessment and conceptual engineering study performed by Geomatrix Consultants, Inc. (Geomatrix) and HDR Engineering, Inc. (HDR) for the removal of Sunol and Niles Dams, located on Alameda Creek adjacent to Highway 84 in southern Alameda County. These dams are owned by the City and County of San Francisco and are maintained and operated by the San Francisco Public Utilities Commission (SFPUC). The dams were constructed between the mid-1800s and the early-1900s to provide water for various uses; however, neither dam is currently a component of the City's water system. Both dams have existing liability concerns and are known impediments to anadromous fish migration. Removing the dams would allow the City to address both of these issues.

1.1 PURPOSE AND SCOPE

The purpose of this study is to provide conceptual-level engineering recommendations for removing Sunol and Niles Dams. Our scope of work consisted of the following tasks:

Task	Description
A	Prepare dam removal case studies report
B	Collect data and perform site investigations
C	Develop sediment management strategies
D	Develop creek diversion/dewatering systems
E	Develop a conceptual demolition plan
F	Prepare conceptual engineering report

The geologic/geotechnical issues were evaluated by Geomatrix; case studies, creek diversion/dewatering, and demolition issues were evaluated by HDR. Conceptual-level estimates of traffic impacts caused by the project were evaluated by CHS Consulting Group (CHS), and community relations and socioeconomic issues were evaluated by Mara Feeney & Associates.

1.2 REPORT ORGANIZATION

A number of issues related to the Alameda Creek Watershed that are relevant to the project, including previous studies, potential community issues, geology, historical mining activities, dredging activities, and creek flows are presented in Section 2. Sections 3 and 4 present the results of our site-specific studies and conceptual engineering and recommendations for removing Sunol and Niles dams, respectively. Section 5 describes the basis for our recommendations. References cited in this report are listed in Section 6.

This report contains four appendices (A through D). Appendix A contains the Case Histories report prepared by HDR. Appendix B contains a project memorandum on potential traffic impacts prepared by CHS. Appendix C contains field logs of vibracore borings explored for this study. Results of the laboratory testing program performed for this study are included in Appendix D.

1.3 PROJECT TEAM AND ACKNOWLEDGEMENTS

The key Geomatrix and HDR personnel who participated in this study included:

Dr. Faiz Makdisi – Principal Engineer (Geomatrix)
Mr. Wayne Edwards – Principal Engineer (HDR)
Mr. Jim Watson – Senior Engineer (HDR)
Mr. Todd Crampton – Senior Engineering Geologist (Geomatrix)
Ms. Peggy Peischl – Senior Environmental Engineer (Geomatrix)
Dr. Tim Mote – Senior GIS Analyst (Geomatrix)
Mr. Hans Abramson – Staff Geologist (Geomatrix)
Mr. A. Tom MacDougall – Staff Engineer (Geomatrix)

Other key personnel who participated in the study included:

Ms. Mara Feeney – Mara Feeney & Associates
Ms. Tracy Craig – Mara Feeney & Associates
Ms. Mary Walther Pryor – CHS Consulting Group

We appreciate the support and cooperation we received during this study from the SFPUC staff, and particularly Ms. Barbara Palacios, project manager for the SFPUC. Ms. Vic

Germany of Environmental Science Associates provided existing reports and drawings, along with invaluable input regarding potential environmental issues related to the project.

2.0 ALAMEDA CREEK WATERSHED

Alameda Creek watershed encompasses approximately 633 square miles of the Coast Ranges in the southeastern San Francisco Bay region (Figure 2-1). The watershed extends from Mount Diablo in the North to the Altamont Pass in the east, to Mount Hamilton in the South, and Niles Canyon to the West. It includes the Livermore-Amador Valley and the Sunol Valley, and it encompasses parts of Contra Costa, Alameda, and Santa Clara Counties. The watershed has several major tributaries, including Alameda Creek, Arroyo de la Laguna, Arroyo Valle, and Arroyo Mocho, all of which drain through Niles Canyon and the lower reach of Alameda Creek. In addition, the State Water Project via the South Bay Aqueduct delivers flows into Alameda Creek where it gets diverted by the Alameda County Water District downstream of Niles dam. Much of the upper watershed is managed as public parklands by the East Bay Regional Parks District, or protected for water supply by the SFPUC. The lower parts of the watershed, such as Livermore Valley, are widely developed and densely populated. There are three major flood control and water supply reservoirs in the watershed – above the Niles and Sunol dam sites, including the Calaveras and San Antonio Reservoirs which are owned by the SFPUC, and the Del Valle Reservoir, owned and operated by the State of California Department of Water Resources (DWR). At least 18 other man-made structures are documented in the watershed, including Sunol and Niles dams, all of which are either potential or known barriers to fish migration within Alameda Creek.

2.1 PREVIOUS STUDIES

We reviewed two unpublished consulting reports prepared by JRP Historical Consulting Services (2000) and Trihey & Associates (2000) for the City of San Francisco as part of the initial studies to evaluate the feasibility of removing Sunol and Niles dams. JRP Historical Consulting Services (2000) prepared a historic resources report, which documents the construction history and historical significance of the dams. The reader is referred to that report for details about the historical aspects of both dams. Pertinent information regarding the construction of the dams is summarized in Sections 3.1 and 4.1 of this report.

Trihey & Associates (2000) analyzed the impacts of dam removal on groundwater and riparian habitats adjacent to Alameda Creek. As part of their study, Trihey & Associates (2000) estimated the volumes of sediment impounded behind both dams, performed grain size analysis of the surficial sediments upstream of both dams, and developed a hydraulic model to quantify streamflows required to mobilize the impounded sediments.

Trihey & Associates (2000) surveyed cross sections and longitudinal profiles of Alameda Creek to characterize the existing channel conditions at both dam sites. The cross sections were surveyed at locations upstream and downstream of both dams, and the longitudinal profiles also extend upstream and downstream of the dams. Trihey & Associates (2000) used their survey data to estimate the original (natural) channel bed gradient at both sites, and to estimate the volume of sediment impounded behind both dams. In their analysis of sediment volumes, Trihey & Associates (2000) assumed the natural channel shape below the impounded sediment was a trapezoid.

At Niles Dam, Trihey & Associates (2000) estimated a natural channel gradient from their surveyed longitudinal profile of 0.0082 feet/foot. Using this slope value along with their cross section data, they estimated that about 2,200 cubic yards of sediment is stored behind Niles Dam, with the impounded sediments extending about 600 feet upstream of the dam. Gradation curves of the surficial sediment samples collected upstream of Niles Dam indicate that the diameter of the mean particle size ranges from about 3 to 8 millimeters (mm).

At Sunol Dam, Trihey & Associates (2000) estimated a natural channel gradient of 0.0047 feet/foot. Trihey & Associates (2000) estimated that about 42,150 cubic yards of sediment is stored behind Sunol Dam, with the impoundment extending about 2,500 feet upstream of the dam. Gradation curves of the surficial sediment samples collected upstream of Sunol Dam indicate that the diameter of the mean particle size ranges from about 4 to 6 millimeters (mm), although one sample had a median grain size of 10.5 mm. Based on the grain size data and their hydraulic model, Trihey & Associates (2000) concluded that the sediment impounded behind both Sunol and Niles dams would be transported downstream during normal and above normal runoff years.

2.2 COMMUNITY ISSUES (PREPARED BY MARA FEENEY & ASSOCIATES)

The Sunol area encompasses about 86 square miles and is located in Alameda County. The City of Sunol is bordered by Pleasanton to the north, Livermore and Santa Clara County to the east, Santa Clara County to the south, and Fremont, Castro Valley and Dublin to the west. The Pleasanton Ridge forms a line of hills above Sunol to the northeast. This area is protected as part of the East Bay Regional Park District (EBRPD) ridgelands. Niles Canyon Road

(Highway 84) winds through the small downtown section of Sunol from Interstate 680, west through Niles Canyon to Mission Boulevard in Fremont, along Alameda Creek.

Sunol has a current population of about 1,340 residents, of whom 87 percent are Caucasian, 7 percent are Hispanic, 2 percent are Asian, 2 percent are Native Hawaiian or other Pacific Islander, with the remaining 2 percent classified as two or more races.[1] The median household income is $88,353, the median value of a home is $515,200, and the average age of residents is between 35 and 65 years old.[2]

Most residents of Sunol live on one of two roads. Kilkare Road, which winds north up Kilkare Canyon along Sinbad Creek or Foothill Boulevard, which runs northeast up to Pleasanton Ridge Regional Park. The downtown portion of Sunol is located on Main Street directly off Kilkare Road and has a post office, the local elementary school, the historic Niles Canyon Railway, a café, a general store, an antique store, the historic Little Brown Church and a winery.

Prior to 2001, Sunol was located entirely in District 1 of Alameda County. During the 2001 redistricting, Sunol was split between Districts 1 and 2. Approximately three-quarters of Sunol is located in District 1 (the least populated areas south of Highway 84). According to the office of District 1 Supervisor Scott Haggerty, the priorities for this area are maintaining and enhancing the quality of life in rural Sunol and assisting in making agricultural pursuits economically viable.

District 2 consists of the most populated areas of Sunol, including Kilkare Road and Foothill Boulevard. According to the office of District 2 Supervisor Gail Steele, the priorities for this area are the development and implementation of traffic calming measures along Niles Canyon Road and maintaining and preserving the rural atmosphere and lifestyle of Sunol.

The Sunol Advisory Council was established in 1998 to advise the County on planning and land use issues. The Advisory Council consists of five appointed members, the majority of whom are long-term residents of Sunol and have a background in construction or planning. The Advisory Council does not meet regularly – meetings are arranged on an as-needed basis particularly when there is a large number of permit applications to review. Phil Cubicek, a

[1] Census 2000
[2] Ibid

Senior Planner with Alameda County, has been assigned to facilitate interactions with the Advisory Council.

The Sunol Glen School, located in downtown Sunol, provides instruction to about 185 kindergarten through eighth grade students. The school student body is classified as 87 percent Caucasian and 13 percent “other”. The school had an Academic Performance Index (API) of 820 (out of 1,000) for the 2002 school year.[3] In accordance with the School Accountability Act of 1999, the API is one of three components used to measure school performance, set academic growth targets, and monitor growth. The school also maintains an on-site daycare center that provides before- and after-school care for about 40 kindergarten through eighth grade students.

2.2.1 Local Parks and Wilderness Areas

The Sunol area includes several parks and wilderness areas that are operated by the EBRPD, as follows:

Sunol Wilderness is about 6,000 acres in size and provides recreation for naturalists, hikers, cyclists, and equestrians. It is open year-round for day and overnight use. Alameda Creek runs directly through a portion of this park.

Pleasanton Ridge is about 3,000 acres in size and runs from Kilkare Road to Highway 84. This area is open for day use only and provides recreation for naturalists, hikers, cyclists, and equestrians.

Ohlone Wilderness is about 8,000 acres in size and is located on the east side of Lake del Valle. This area is open for day and overnight use and provides recreation for naturalists, hikers, cyclists, and equestrians.

2.2.2 Community and Local Environmental Groups

The town of Sunol maintains a small town atmosphere and has been very successful in fighting off encroaching development. Several local groups remain active in preserving and enhancing Sunol’s resources. These groups are discussed briefly below.

Save Our Sunol is a local grassroots organization dedicated to the preservation and enhancement of the unique resources in the rural area of Sunol. Pat Stillman, a 32-year resident of Sunol, founded the group and currently serves as president. Save our Sunol has a

[3] School Accountability Report, 2001-2002

membership of 70 individuals. According to Pat Stillman, this group is very supportive of the dam removal project. Save our Sunol is currently involved in organizing community opposition to stop the proposed expansion of the Mission Valley Rock quarry which is located to the south of Highway 680.

Sunol Business Guild is a local organization consisting of local business owners dedicated to improving and maintaining the town of Sunol and supporting local non-profit organizations. The Guild currently has about 40 members and meets the second Tuesday of each month at 7:00 p.m.

The Community Club is Sunol Glen School's parent/teacher organization. This all volunteer group of about 50 individuals supports school activities, enrichment programs, and local volunteer efforts in support of a variety of causes.

2.2.3 Other Groups

Alameda Creek Fisheries Restoration Workgroup consists of representatives from various local, regional, state, and federal agencies, as well as private organizations. This group is working to modify the barriers along Alameda Creek to assist in the creation of a viable steelhead population. Currently, the group is working with the U.S. Army Corps of Engineers (COE) to conduct a detailed feasibility study to build four fish ladders and install two fish screens at the lower end of Alameda Creek. The workgroup is also monitoring the removal of the Sunol and Niles dams, analyzing various methods to allow steelhead to cross over a Pacific Gas & Electric (PG&E) natural gas pipeline that runs across Alameda Creek, and working on the Calaveras Dam diversion project. The group meets bi-monthly and consists of representatives from Alameda County Flood Control and Water Conservation District (ACFCWCD), ACFCWCD Zone 7 Water Agency (Zone 7), San Francisco Department of Public Works Department (SFDPW), San Francisco City Attorney's Office, Department of Fish and Game (DFG), COE, EBRPD, Caltrans, State Coastal Conservancy, Alameda County Supervisor District 1 and 2 offices, PG&E, Alameda Creek Alliance, National Oceanic and Atmospheric Administration (NOAA)/American Rivers, CH2M Hill, and the Center for Ecosystem Management and Restoration (CEMAR). CEMAR maintains a website that provides information on the workgroup including a copies of past workgroup meeting minutes. The website address is http://www.cemar.org/alamedacreek/index.html.

The Alameda Creek Alliance is a volunteer-based community group working to restore the natural ecosystems in the Alameda Creek watershed, including the creation of a viable steelhead population. The Director of this group is Jeff Miller, who works for the Alliance in a paid, half-time position. All other activities are conducted by a volunteer staff of about 400 individuals. The Alliance has a current mailing list of 1,300 individuals. According to Jeff Miller, the Alameda Creek Alliance supports the removal of the Sunol and Niles Dams and believes that no local groups or organizations would be opposed to the removal of the dams. Major projects that the Alliance is working on include the COE fish ladder and screen project, the SFPUC dam removal at Niles and Sunol, the PG&E gas pipeline project, and the Calaveras Reservoir and Alameda Dam diversion projects.

2.2.4 Roadwork Planned for Highway 84 in Sunol Area

In coordination with the Alameda County Transportation Authority, Caltrans is currently widening the intersection and constructing turning lanes between Mission Boulevard and Niles Canyon Road. Caltrans is also conducting realignment work at 880 and Mission Boulevard between Union City and Fremont, as well as between 680 and 580, between Pleasanton and Livermore near the Ruby Hills area. Caltrans will be doing seismic upgrades to a bridge located upstream of Niles Dam this summer. See memorandum from CHS in Appendix B.

The TriValley Transportation Council, in coordination with Caltrans, is working on a corridor wide study to expand from 2 lanes to 4 lanes, the section of Route 84 that runs from 580 to 680. This study is in the preliminary stages and the report will break up the work to be done in various phases.

2.2.5 Summary of Conversations

Ten individuals, representing Alameda County, EBRPD and local non-profit groups, were contacted for this community profile. The majority of individuals stated that Sunol is a very cohesive community that takes a lot of pride in, and is dedicated to the preservation of a rural lifestyle. All of the individuals were familiar with both dams, and several mentioned that the areas around the dams were used for recreational purposes by residents of nearby cities.

All individuals supported the restoration of a viable steelhead population to Alameda Creek, and most stated the community of Sunol would be supportive of this effect. The majority of individuals were strongly supportive of removing the Sunol and Niles Creek dams citing the following reasons: 1) They wanted the creek to be restored, as much as possible, to its natural habitat, 2) They supported the removal of fish barriers, and 3) Some individuals felt that the areas around the dams were used for recreational swimming to the detriment of full-time residents of Sunol and the Alameda Creek area.   Two individuals felt that removal of the dams was unnecessarily costly. They wanted other methods to be analyzed including a combination of backfilling the dams and using riprap to facilitate fish migration.

2.2.6 Preferred Methods of Communication

Every individual contacted stated they would like to be called on the telephone and informed of project milestones. They stated that because Sunol is a small town with a lot of community activists a few calls will go a long way in getting the word out. Additionally, several people stated they would like to see notices of public meetings posted in the local paper - The Valley Times. Individuals also stated that mailing out a one-page fact sheet, that includes an announcement of any public meetings, would ensure the town was informed. Five people suggested that information on the project, including project updates and milestones, be provided on the internet.

2.2.7 Individuals Contacted

The following individuals were contacted for this community profile:

Phil Cubicek – Alameda County Senior Planner

Chris Gray – Chief-of-Staff for Supervisor Scott Haggerty, Alameda County District 1

Supervisor Gail Steele – Alameda County District 2

Conover Smith – Chair, Sunol Advisory Council

Jim O'Laughlin – Past President (2002), Sunol Business Guild

Diane Everett – Principal/Superintendent, Sunol Glen School

Pat Stillman – President, Save our Sunol

Jeff Smith - Director, Alameda Creek Alliance

Lora Kilgor – ACFCWCD/Facilitator of Alameda Creek Fisheries Restoration Workgroup

Dan Reasor – Supervisor of Ohlone and Sunol Wilderness, EBRPD

2.3 GEOLOGY

The Alameda Creek Watershed encompasses over 630 square miles of the California Coast Ranges Geomorphic Province. The watershed generally comprises northwest-trending ridges and intervening valleys. Published geologic mapping by Wagner and others (1991) indicates bedrock in the southern half of the watershed consists predominantly of metagraywacke (i.e., metamorphosed sandstone), sandstone, and mélange of the Jurassic to Cretaceous [208 to 65 million years ago [Ma]] Franciscan Complex (Figure 2-2). The northeastern and southwestern margins of the watershed are predominantly underlain by sedimentary rocks of the Cretaceous-age (135 to 65 Ma) Great Valley Sequence. In the northernmost region of the watershed bedrock consists predominantly of Miocene [23 Ma to 5.3 Ma] to Pliocene [5 Ma to 1.6 Ma] marine and nonmarine sedimentary rocks (primarily mudstone and sandstone) of the San Pablo Group, the Contra Costa Group, and the Tassajara Formation. Quaternary (1.6 Ma to present) alluvium and alluvial terrace deposits locally overly the bedrock units within the watershed, particularly in the low-lying intermontane valleys and basins. Historical (mineral) mining activities in the watershed (discussed below) have occurred primarily in the Franciscan rocks.

Sunol and Niles Dams are located in the Niles Canyon reach of Alameda Creek (Figure 2-3). Niles Canyon is a relatively narrow, deeply-incised valley that meanders through the local Coast Ranges. Alameda Creek flows westward through the canyon and eventually discharges into San Francisco Bay. Geologic mapping published by the US Geological Survey (USGS) (Dibblee, 1980) indicates the geology of Niles Canyon is characterized by sedimentary rocks of the Upper Cretaceous (95 to 65 Ma) Panoche Formation, which is part of a thick sequence of Cretaceous-age (135 to 65 Ma) sedimentary rocks known collectively as the Great Valley Sequence (Figure 2-2). These rocks are overlain by Quaternary surficial deposits in and adjacent to the present-day channel of Alameda Creek. These Quaternary deposits are relatively more extensive in the vicinity of Sunol Dam, which is located near the head of Niles Canyon, along the northern margin of Sunol Valley.

The Panoche Formation exposed in the walls of Niles Canyon is generally well-bedded and composed predominantly of micaceous shale, with minor interbedded sandstones and local conglomerates (Dibblee, 1980). Bedding strikes northwest, parallel to structural grain of the Coast Ranges, dips steeply to the north and south, and is locally overturned. The Panoche Formation is locally folded and faulted, with the fold axes and faults generally striking parallel to bedding (northwest). Dibblee (1980) maps the axis of the Niles Syncline in the vicinity of Niles Dam and shows bedding to be inclined about 80º.

The dominant geologic structures in the area are the Hayward and Calaveras faults, which are major components of the San Andreas fault system. These northwest-striking, right-lateral strike-slip faults have been the source of numerous historic earthquakes and, hence, are known to be active[4]. The Hayward fault is about three miles to the west of Niles Dam, and the Calaveras fault lies about 2 miles to the east of Sunol Dam. The nearby Mission fault lies directly east of the Hayward fault and is located near the mouth of Niles Canyon. The Mission fault is lies in the step-over region between the Calaveras and Hayward faults, and is considered potentially active[1] by the California Geologic Survey (formerly the California Division of Mines and Geology) (Jennings, 1994). Several northwest-trending inactive (i.e., pre-Quaternary) faults, including the Stonybrook, Sheridan Canyon, Dresser, and Mill Creek fault, are mapped through Niles Canyon, between the Calaveras and Mission faults (Figure 2-3).

Published landslide mapping (Nilsen, 1975) indicates numerous relatively small landslides occur within Niles Canyon, some of which are in the general vicinity of both Sunol and Niles Dams (Figure 2-3). None of the landslides, however, are mapped on the slopes directly above the dams. Nilsen (1975) maps one questionable landslide on the steep slopes directly above the southwest side of the reservoir behind Sunol Dam. The slide occurs about 500 feet upstream of the dam and is mapped as being about 600 feet wide. At the Niles Dam site, the closest mapped landslide occurs in the high slopes north-northwest of the dam, on the northwest side of Highway 84. None of the mapped landslides appears to present a potential hazard to the dam sites.

2.4 HISTORICAL MINING ACTIVITIES IN THE WATERSHED

Published reports by the Department of Conservation Office of Mine Reclamation (OMR) (2000) and Davis (1950) indicate that historical mining activities in the Alameda Creek watershed fall into three broad categories; coal, strategic minerals (i.e. minerals having military importance), and construction materials. Of these categories, only the production of construction materials continues today. At the time of the OMR (2000) study, 15 operations producing construction materials, including aggregate, building stone, clay, and silica sand, were active. Coal mining in the watershed ceased around 1902, and the last of the mineral mines (for magnesium) halted in 1947, with the development of technology to extract magnesium from sea water. Other strategic minerals historically mined in the watershed included chromite and manganese oxides. The production of strategic minerals in the region was at its greatest during World Wars I and II.

[4] According to State of California definitions, *active* faults have a documented history of displacement within the past 11,000 years (the Holocene epoch) and *potentially active* faults have documented displacement with the past 1.6 million years (the Quaternary period).

OMR (2000) conducted a study of chemical and physical hazards posed by abandoned mine lands within the Alameda Creek watershed. Based on their field observations and the results of a statistical analysis, OMR (2000) concluded that the sampled abandoned mines in the watershed "do not pose a significant chemical threat to the environment". According to the OMR (2000), the USGS (2000), and Davis (1950), there is no record of mercury mining having occurred within the watershed.

2.5 DREDGING ACTIVITES IN THE WATERSHED

We contacted the ACFCWCD regarding dredging operations in Alameda Creek downstream of Niles Canyon. According to the ACFCWCD, they periodically dredge the creek channel in the Fremont area, downstream of Niles and Sunol dams. Recently (2002), they dredged a reach of Alameda Creek between Ardenwood and Decoto Roads in Fremont (Mebrahtu Gebre-Kidan, Associate Engineer, personal communication, March 2003). The ACFCWCD reported that sediment excavated from the Alameda Creek channel last year (2002) lacked any potentially hazardous substances. According to the ACFCWCD, Harding Lawson sampled the sediments prior to dredging that reach of the creek and analyzed the concentrations of several chemicals in the samples, comparing them to threshold limits set forth in Section 66261.24 of Title 22 CCR. According to Supervising Engineer-Scientist Rick Baker of the Alameda County Department of Environmental Health Services (Personal Communication, March 2003), all chemical concentrations were below established threshold limits. Dredge spoils (mainly sand and silt) were transported to a disposal site owned by the Alameda County Public Works District in Hayward, California.

We also contacted the ACFCWCD Zone 7 Water Agency (Zone 7) regarding dredging operations in the Alameda Creek watershed upstream of Sunol Dam. According to Senior Engineer Joe Seto at Zone 7 (personal communication on April 2003), within the past two years they have dredged at two sites: one located in Arroyo de la Laguna beneath the Interstate 680 crossing (approximately 2.7 miles upstream from Sunol Dam), and another farther upstream in Alamo Creek (which feeds into Arroyo de la Laguna) in the City of Dublin. At the Interstate 680 crossing, dredge spoils consisted primarily of gravel overlying thinner layers of sand and silt. According to Mr. Seto, these sediments were stockpiled at a location adjacent to the creek. At the Alamo Creek site, dredge spoils were predominantly silt. Spoils from Alamo Creek were transported to and disposed of at the Vasco Road Sanitary Landfill (Class III) in Livermore. Prior to dredging, the creek sediments were sampled (by Kleinfelder, 2001) and tested for the presence of potentially hazardous contaminants. The chemical analytical program for the sediments included: Total Recoverable Petroleum Hydrocarbons (TRPH) using

U.S. Environmental Protection Agency (EPA) Method 418.1; Volatile Organic Compounds (VOCs) using EPA Method 8260; Semi-Volatile Organic Compounds (SVOCs) using EPA Method 8270; and Title 22, California Code of Regulations (CCR) metals using the EPA Method 6010/7000 series (Kleinfelder, 2001). According to Kleinfelder (2001), the chemical analytical program results indicated the materials were classified as non-hazardous, non-designated waste.

Mr. Seto (personal communication July, 2003) also indicated that Kleinfelder (2003) performed chemical analyses on sediment samples recently collected from Alamo Creek in Dublin and from Altamont Creek in Livermore. Kleinfelder (2003a) reported that the chemical analytical program for the Alamo Creek samples included: Organochlorine pesticides using EPA Method 8081B; Chlorinated herbicides using EPA Method 8151A; and Title 22 CCR metals plus Boron using EPA Method 6010C/7000 series. Results of that chemical analytical program indicated the materials were classified as non-hazardous, non-designated waste that could be accepted by a Class III disposal facility. Kleinfelder (2003b) reported that the chemical analytical program for the Altamont Creek samples included: Volatile Organic Compounds (VOCs) using EPA Method 8260; Chlorinated herbicides using EPA Method 8151A; and Title 22 CCR metals plus Boron using EPA Method 6010/7000 series. Results of that chemical analytical program indicated the materials were classified as non-hazardous, non-designated waste that could be accepted by a Class III disposal facility. Kleinfelder (2003a;b) also reported that the sediment removed from both of these sites could be used as clean fill material if it meets applicable geotechnical engineering criteria for that use.

2.6 CREEK FLOWS

The Alameda Creek watershed consists of approximately 633 square miles, making it the largest local tributary to San Francisco Bay. The watershed consists of two drainage units, the Livermore and Sunol drainage units. The Livermore drainage unit is the northern and eastern portion of the watershed and comprises approximately 458 square miles. The major streams are Arroyo del Valle, Arroyo las Positas, Arroyo Mocho, and Alamo, San Ramon, and Tassajare creeks. Arroyo del Valle and Arroyo Mocho have the largest drainage areas. The State Department of Water Resources operates Lake del Valle, which is part of the State Water project and is located on Arroyo del Valle.

The Sunol drainage unit is the southern portion of the watershed and comprises approximately 175 square miles. The major streams are Alameda Creek, Arroyo Hondo, Calaveras Creek, San Antonio Creek, La Costa Creek, and Indian Creek. The City of San Francisco operates both the

Calaveras and San Antonio reservoirs, which are located on the Calaveras Creek and San Antonio Creek, respectively.

There are three reservoirs within the watershed that serve to limit the amount of flows released – especially during the summertime. These reservoirs are:

> Lake Del Valle, which has a total storage capacity of 77,100 acre-ft and normally stores between 25,000 to 40,000 maximum normal acre-ft of local runoff. The additional capacity is used to provide a flood control reserve.
>
> San Antonio reservoir, which has a storage capacity of 50,500 acre-feet with the ability to store both local runoff as well as imported water as part of the City of San Francisco's Hetch Hetchy water system.
>
> Calaveras reservoir, which has a 96,900 acre-ft capacity[5] to store local runoff from Arroyo Hondo, Calaveras and Alameda creeks. From Calaveras, water is blended with Hetch Hetchy water that serves the City and the 29 bay area water agencies[6].

Other features within the watershed include a turnout that is used by the State Water Project to release flows from the South Bay Aqueduct to Alameda County Water District. This turnout is north of San Antonio reservoir at Vallecitos Creek. Vallecitos Creek is a tributary of Arroyo de la Laguna, which joins with the main channel of Alameda Creek upstream of Sunol Dam and continues through Niles Canyon, past both Sunol and Niles dams, before being diverted by the district. During the summer, the deliveries range from 25 to 35 cubic feet per second (cfs). With advance notification and planning, the scheduling of these deliveries can and have been altered to allow reduced creek flows for up to one to two weeks.

USGS Gauging Station 11179000 is located on Alameda Creek (see Figures 2-1 and 2-3) near the Niles District of Fremont and has daily peak flow records dating back to April 1, 1891 and continuing through September 30, 2001. However for the purposes of this study, the peak daily flows since 1975 have been used to derive both the monthly averages and the associated standard deviation from the average. These data are provided graphically on Figure 2-4 and should be used by the contractor to establish and design the creek diversion system that will be

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[5] Present operating requirements limit this capacity to about 35% (approximately 30,000 acre-ft).

needed at each dam. Based on this data, the percentages for each month that the daily peak flow was recorded at less than or equal to 50 cfs for the key construction months were: June (72%), July (75%), August (80%), September (84%), October (90%). Similarly for 60 cfs, the distribution was June (87%), July (90%), August (95%), September (96%), October (95%). Given the construction duration and nature of the work, the design of the creek diversion system should not be less than 50 cfs and should not need to be greater than 60 cfs.

3.0 SUNOL DAM REMOVAL

3.1 DESCRIPTION OF DAM

Sunol Dam is located in the Niles Canyon reach of Alameda Creek at river mile 16.2 (Figures 2-1 and 2-3). Highway 84 (Niles Canyon Road) parallels the creek through Niles Canyon, and lies to the north of the dam. According to the U.S. Geological Survey (USGS) Niles 7.5 minute topographic quadrangle, Sunol Dam lies at an elevation of about 220 feet. The Union Pacific Railroad (UPRR, formerly owned by the Western Pacific Railroad) and the Niles Canyon Railroad (NCRR, formerly owned by the Southern Pacific Railroad), which generally run parallel to Alameda Creek in Niles Canyon, lie about 100 and 300 feet to the north, respectively, on either side of Highway 84. A commercial (garden) nursery occupies the low-lying, flat area along the north side of the dam and its upstream reservoir.

Sunol Dam is a concrete-gravity dam that was constructed around 1900 (JRP Historical Consulting Services, 2000). An available construction drawing of the dam (Drawing E29 – Longitudinal Section and Plan of Sunol Dam, dated May 25, 1910) indicates it has a main crest length of 135 feet, a crest width of 8 feet, a base width of 14 feet, and a foundation to crest height of about 28 feet (Figure 3-1). The drawing indicates that the channel bottom of Alameda Creek, directly along the upstream face of the dam after construction, was about 8.35 feet below the crest of the dam. It also shows the dam is founded on bedrock. The drawing shows the Sunol Aqueduct entering a forebay on the right abutment and flowing along the dam in a concrete conduit, just beneath and parallel to its crest. The aqueduct is connected upstream to the Sunol Water Temple. A fish ladder was originally constructed near the north abutment; however, currently only vestiges of it remain (JRP Historical Consulting Services, 2000). The current height from the dam crest to the downstream channel bottom in the plunge pool is estimated to be up to about 15 feet (Trihey & Associates, Inc., 2000). The US Geological

[6] The 29 agencies were formerly known as the Bay Area Water Users Association (BAWUA). This agency is currently restructuring and the new, legal, entity will be the Bay Area Water Supply and Conservation Agency (BAWSCA).

Survey 7.5 minute Niles, California quadrangle shows a gauging station at Sunol Dam; however, this station appears to be non-operational.

According to JRP Historical Consulting Services (2000), Sunol Dam was constructed in part to "hold back" groundwater in the upstream gravel deposits that occupy Sunol Valley. The Sunol filter galleries were built upstream around the same time as Sunol Dam to drain the water from the gravels and into the Sunol Aqueduct. Because of the dam's association to the upstream Sunol filter galleries, it meets the National Register's criteria A[7], B[8], and C[9] for listing in the National Registrar of Historic Places (JRP Historical Consulting Services, 2000).

As part of our study, a topographic map of the dam site was prepared from aerial photography by a professional land surveyor. As part of this task, a number of points on the dam were surveyed in the field to verify the as-built condition. The surveyed elevations are based on the National Geodetic Vertical Datum (NGVD) of 1929, also referred to as mean sea level, which is used as the vertical datum on most USGS maps. In general, the surveyed elevations are between 3 to 5 feet lower than the elevations shown on Drawing E29 (Figure 3-1). With the exception of a 25-foot-long concrete wall on the downstream side of the right abutment and chain-link fencing around the tops of both abutments, the historical drawing (E29) appears to accurately reflect the visible components of the dam.

3.2 SITE INVESTIGATIONS

3.2.1 Review of Aerial Photographs

Geomatrix reviewed several pairs of stereo aerial photographs covering the Sunol Dam site (Table 1). The main purpose of this review was to identify potential landslides and/or geologic features that could potentially affect removal of the dam. We attempted to document changes in the reservoir boundaries upstream of the dam; however, the limited scale (1:12,000) of the available photographs combined with the dense vegetation along the channel margins of Alameda Creek precluded our ability to clearly identify the reservoir boundaries.

Our review of available photographs did not reveal any obvious landslides or other geologic features of significance in the immediate vicinity of Sunol Dam. A broad, low, and relatively

[7] In 1976 the American Society of Civil Engineers (ASCE) designated the dam and infiltration galleries as Historic Civil Engineering Landmarks.

[8] Sunol dam and the filter galleries were built by Herman Schussler, Chief Engineer for the Spring Valley Water Company.

[9] The construction of the filter galleries of which the dam is a component, was the first of its kind to use subsurface water for municipal supply.

flat, alluvial (fluvial) terrace flanks the north side of the upstream reservoir. The south side of the reservoir is bordered by relatively steep, rocky slopes that are covered with dense trees and brush. The dense vegetation on these slopes greatly obscures the hillslopes, which precluded our identification of small-scale landslide features. We did, however, note a broad concavity in these slopes, in the general area where Nilsen (1975) mapped a questionable landslide. Local gravel/sand bars are evident both upstream and downstream of the dam in some photographs.

3.2.2 Geologic Mapping

Mr. Hans Abramson (Staff Geologist) of Geomatrix mapped the geology and geomorphic conditions of the Sunol dam site on March 12, 2003. The field mapping was done at a scale of 1 inch = 100 feet utilizing a topographic base map that was prepared for this study. The geologic/geomorphic conditions at the site are presented on Figure 3-2. A brief description of the pertinent geologic and geomorphic site conditions is presented below.

Sunol Dam is located at the northwest corner of Sunol Valley, approximately at the upstream end of Niles Canyon (Figures 2-1 and 2-3). The southwest side of Alameda Creek (the left bank) in this area is bordered by steep bedrock slopes that rise up to about 400 feet above the creek at and upstream of the dam. Interbedded shale and sandstone of the Upper Cretaceous (95 to 65 Ma) Panoche Formation is exposed nearly continuously along the base of these slopes. The northeast side of the creek is bordered by a broad alluvial-fill terrace of Quaternary age (1.6 Ma to present). The leading edge of this terrace (the right bank) forms a low scarp that rises an average of about 10 to 15 feet above the creek bed.

The bedrock exposed along the creek is composed of well-bedded sandstone and shale that is relatively hard and strong. Sandstone beds range from approximately 1 to 6 inches thick, are moderately hard to hard, strong, and moderately to slightly weathered. Shale beds are up to about 3 inches thick, moderately hard to hard, moderately strong, and moderately to slightly weathered. Bedding dips consistently to the south at inclinations ranging from about 22º to 61º. Downstream (northwest) of the dam, bedding dips moderately (35º to 61º) to the south-southwest, whereas upstream (southeast) of the dam, bedding dips gently (22º to 36º) to the south-southeast. This slight change in the orientation of the bedding coincides with a zone of closely fractured to crushed bedrock exposed in the headscarp of a shallow landslide (described below).

Joints and fractures observed in the bedrock outcrops generally exhibit random orientations, though one weakly defined set was identified with an average strike of N 38º E, dipping 68º to the NW. Joint/fracture spacing ranges from about 0.3 to 2 feet, and typically is more closely spaced in the shale beds. In general, most of the joints/fractures are not through-going, cutting through only a few beds at most. The most prominent discontinuities in the bedrock are the bedding planes themselves.

A shallow landslide occurs on the steep hillside directly upstream and adjacent to the left abutment (looking downstream). The headscarp of the landslide exposes bedrock and forms an irregular, arcuate feature that is approximately 70 feet wide. The top (crown) of the landslide is about 60-80 feet above the creek. The landslide appears to be about 5 feet deep, as measured orthogonal to the slope of the hill. A thin (~3 to 5 foot thick) deposit of colluvium/landslide debris mantles the central-lower part of the landslide and extends down from the base of the bedrock scarp to the creek. Bedrock exposed in the center of the headscarp consists predominantly of sandstone that is closely fractured to crushed. Prominent joint/fractures are oriented N 56º W, dipping 66º southwest, and N 48º E, dipping 69º NW. The closely fractured to crushed nature of the bedrock in this zone, along with the slight change in bedding orientations across this feature (described above) suggests an old (inactive) fault or shear zone may intersect the hillside at this site. However, given the overall structure and hardness of the bedrock in the left abutment, the landslide does not appear to present a significant stability issue/hazard to removing the dam.

The right abutment (looking downstream) of the dam appears to be founded on bedrock. Shale bedrock was observed at the base of the downstream side of the abutment, but a newer concrete wall extending upslope from the abutment appears to be at least partially founded on the artificial fill that comprises the roadway and/or railroad bed. An access road that runs parallel to the creek is built on a berm of artificial fill that ranges from about 5 to 10 feet thick and is approximately 100 feet wide. At the dam site the fill ranges from about 7 to 9 feet thick. Immediately north and east of the dam, the NCRR tracks are constructed on a fill berm that rises another 6 to 8 feet above the roadway. Directly downstream of the right abutment the fill was apparently emplaced on the soil of the natural alluvial-fill terrace deposit. Water was observed seeping out of the slope at several locations along this part of the slope, at the apparent contact between artificial fill and natural soil.

3.2.3 Sediment Sampling

Vibracore sampling of the impounded sediments behind (upstream) of Sunol Dam was conducted on February 10 and 11, 2003. The sampling was performed by Gregg Drilling & Testing, Inc., using a vibracore sampler with a 10-foot-long, 4-inch-diameter core barrel attached to the end of a 70-foot-long telescoping boom of a crane. The crane was positioned at two locations along the northeast side of the reservoir and used to collect seven cores (see Figure 3-2 for sample locations). Water depths at the sample locations ranged from about one to two feet. The sampler was driven (vibrated) to depths of about nine to 10 feet below the top of the sediments. Recovery ranged from about 2 to 4 feet, and averaged about 3 feet at each location. The recovered sediments consisted predominantly of well-graded gravely sands capped by a thin (up to 2 inch) layer of very soft silt and clay. The gravels are generally subrounded to well rounded, and range in size from pea gravel to small cobbles. Field logs of the vibracore borings are including in Appendix C; grain size distribution curves for selected samples from three of the vibracores are included in Appendix D.

3.2.4 Laboratory Testing

Selected samples from each of the seven vibracores collected at Sunol Dam were submitted for laboratory testing, for both environmental (chemical analytical) and geotechnical (grain size distribution) purposes. Appendix D describes the laboratory testing program in more detail and presents laboratory test results. A brief summary of the chemical analytical program results is presented below.

PCBs, PNAs, pesticides, and TPH motor oil were not detected in any of the samples. TPH diesel was detected in two samples at low levels (1.2 milligrams per kilogram [mg/kg] for B3-0.5-021003 and 1.1 mg/kg for B7-2.0-021103). However, the laboratory indicated that the hydrocarbon pattern did not match its diesel standard. Therefore, TPH diesel is likely not present in these two samples. Metals were detected at low concentrations - well below regulatory criteria for disposal (see Table D-2). The detected concentrations were also below accepted background concentrations (except for one detection of nickel just above background).

3.3 SEDIMENT MANAGEMENT

3.3.1 Sediment Volume Estimates

At Sunol Dam, historical cross section data (Drawings P-259 dated January 13, 1912 – 2 sheets) contained in the SFPUC's files consists of surveyed profiles that extend upstream of the dam for a distance of about 2,000 feet, and downstream of the dam for about 1,000 feet. These data indicate that the original channel bottom of Alameda Creek at the dam was at an average elevation of about 197 feet (Crystal Springs [CS] datum). The crest of the dam, as indicated on the drawing, is at elevation 201.35 feet (CS datum). The cross section data indicate that the channel of Alameda Creek was roughly trapezoidal in shape, having a relatively broad, flat bottom with steeply sloping sides. The channel sections directly upstream and downstream of the dam show the channel bottom was gently sloping down to northeast (right - looking downstream) side of the creek. This part of the channel (i.e., the thalweg) was about 1 to 2 feet deeper than the average elevation of the channel bottom, indicating a maximum height between the natural channel bottom and the crest of the dam in this area of about 5 to 6 feet. A construction drawing (No. E29 dated May 25, 1910) of the dam indicates the channel bottom along the upstream face of the dam was about 8 feet below the crest of the dam (elevation 193 CS datum). We speculate that the channel bottom was slightly deeper directly adjacent to the dam as a result of the excavation activities required to extend the dam's foundation down to bedrock.

To estimate the volume of sediment impounded behind Sunol Dam, we digitized the historical channel cross section data at the dam and extending upstream approximately 2,000 feet. The sections were used to develop a 3D model of the channel bottom and sides using SiteWorks™ software. The top surface of the impounded sediment was modeled from the spot elevations on the site topographic/bathymetric map prepared for this study, which were adjusted to the CS datum (the surveyed elevations are about +3 feet CS datum) for our analysis so they could be referenced to digitized cross sections. The upstream extent of the sediment is defined by the intersection of the top of the sediment and the original channel bottom. The resulting "wedge" of sediment was estimated to be about 7,000 cubic yards (cyd), with the impounded sediments extending approximately 1300 feet upstream of the dam.

We also estimated the sediment volume assuming the elevation of the dam crest represents the top of the impounded sediment. This approach represents a more conservative (i.e. higher) estimate of the sediment volume, which may be more appropriate for estimating project costs during this conceptual-level study. Under this scenario, the sediment volume is estimated to be about 13,000 cyd, with the impoundment extending about 1,500 feet upstream.

Both of these volume estimates are significantly lower than a previous estimate of about 42,150 cubic yards reported by Trihey & Associates (2000).

3.3.2 Removal Strategies

Based on the results of the laboratory testing we performed on sediments collected behind Sunol Dam, and on our communications with the ACFCWCD and Zone 7 regarding dredging of Alameda Creek and Arroyo de la Laguna, the sediments impounded behind Sunol Dam likely are free of potentially hazardous substances, or have concentrations well below regulatory limits for disposal.

Trihey and Associates (2000) recommended removing the sediment impounded behind Sunol Dam prior to its removal. They noted that any sediment left in place could potentially be deposited in the flood control channel downstream of Niles Dam, and that significant deposition could increase the risk of flooding along the lower reaches of the creek. Hydraulic modeling by Trihey & Associates (2000) indicates that during an average or above average rainfall year, the sediments upstream of Sunol Dam could be transported downstream. For these reasons, we recommend removing all of the sediments impounded behind Sunol Dam in conjunction with the partial removal of the dam. As discussed above, we estimate the volume of sediments impounded behind the dam to be about 7,000 to 13,000 cyd.

We propose two possible alternatives for disposal:

1. Remove and haul the sediments to a landfill that accepts earth materials, or
2. Remove and haul the sediments to a nearby commercial gravel and sand quarry that agrees to accept the material.

If the sediments are taken to a landfill, a nearby landfill that accepts earthen materials is the Vasco Road Sanitary Landfill in Livermore. The feasibility of the second alternative should be evaluated during the construction phase of the project, as the demand/supply of these materials at nearby quarries is likely to vary with time. Geomatrix contacted the Pleasanton office of RMC Pacific to inquire about the possibility of hauling and dumping the materials at their Pleasanton yard. According to plant manger Rich Bier (personal communication May 1, 2003) they would take the material free of charge if they inspected it and found it to be suitable for use as base rock. If it were not suitable for use as base rock but could be used for fill, they may allow the material to be dumped at their yard for a fee.

Both disposal alternatives will require testing and documentation to verify the materials are free of potentially hazardous substances, or have concentrations below regulatory limits. We recommend that additional sampling and testing of the materials be performed during the construction phase of the project. Additional samples should be collected from the excavated/stockpiled materials and tested, prior to off-hauling any of the materials. The final destination of the materials will depend on the results of the additional testing.

3.4 PROPOSED CREEK DIVERSION AND DEWATERING SYSTEMS

The sediments impounded by the dam that will be removed extend for a distance of approximately 1500 feet upstream from the dam (see Section 3.3.1). Thus, any creek diversion scheme will have to extend both upstream and downstream from this area. Two options were evaluated to address creek diversion with flows expected to be approximately 50 to 60 cfs. The first option consists of installing a small cutoff dam at the upstream end of the proposed work site and then installing a steel pipeline with flexible mechanical couplings down to below the dam (approximately 1,800 to 2,000 linear feet). This pipeline would have to be moved several times as the dam and sediment removal work progresses. The second option is to use the existing aqueduct to divert the creek flows. Since only a small section of the aqueduct is within the actual work site, using it would ensure that the diverted flows are not interrupted by the construction activities and should be less costly. Therefore the scope of work associated with this latter option is discussed in greater detail below.

A schematic of the existing aqueduct system within the Sunol Dam site showing the proposed modifications is provided in Figure 3-4. Modifications will have to be performed on both the downstream and upstream ends as follows:

<u>Downstream Modifications</u>

Modify the header box, which forms part of the left abutment (looking downstream) of the dam, to connect a temporary diversion pipe and to plug the opening that leads across the crest of the dam (See Figure 3-6).

Install approximately 200 ft of diversion pipe that will carry the creek flows downstream of the planned work site. Welded steel pipe with mechanical couplings would suffice. A portion of this pipeline will be buried with native gravels used to create a berm that will be used to a) create a downstream cutoff, b) provide equipment access to the left side (looking downstream) of the dam, and c) create a downstream settling basin which will be discussed in greater detail in Section 3.5.2.

<u>Upstream Modifications</u>

There are four structures shown on the original Alameda Creek System drawing D-328 (an excerpt serves as the basis for Figure 3-4) that can be modified to serve as an intake into the aqueduct for the diverted creek flows. Modifications will consist of installing a diversion pipe with a slide gate or provision to control and/or shut-off flows into the aqueduct. In lieu of installing a gravity system, pumps could be used. The pros and cons associated with each structure are as follows:

> The structures shown as BM #93 and BM #94 are closest to the upstream end of the proposed work site. BM#93 is downstream of the upper limit of sediments to be removed so approximately 300 feet of diversion pipe would be needed. BM#94 is approximately 2,400 feet upstream of the dam and would require approximately 120 feet of diversion pipe or channel to connect to the aqueduct. To allow the flows to naturally enter the aqueduct, a channel will need to be constructed for either the pipe or open channel option. However there is electric service at the old Chlorine Injection Building that could provide power for pumps to lift the water to the top of this structure instead of modifying one side of it. Also, it has been reported that both structures are located in an area where red-legged frogs are likely to be encountered (personal communications with Vic Germany [ESA] and Brian Sak [SFPUC]).
>
> The structure associated with "Forebay C" is the next upstream structure from BM#94. It is the next structure downstream from the "Concrete Manhole" that is presently being used to provide water to the golf course. It is the closest to the creek and in an area where the creek necks down. At one time, "Forebay C" appears to have had a pump house on top and there is electrical service within about 40 feet of this structure, so pumping could be an option. It is reportedly adjacent to, but not fully within the area identified as being a likely habitat for the red-legged frog (personal communication with Vic Germany [ESA] and Brian Sak [SFPUC]). A short channel, approximately 80 feet long, could be cut in the existing exposed gravel bed. Access can be provided by either the existing dirt road to the north with some minor tree removal and clearing work, or from the existing dirt road that appears to connect to the Sunol Water Temple and ends near the "Concrete Manhole" (next option).
>
> The structure shown as "Concrete Manhole" may be the easiest to modify and appears to be accessible from a dirt road that leads to the Sunol Water Temple. However it is located in an area where the channel is very broad and where water is currently pumped to the golf course. It is also further upstream from the proposed upstream limit of sediment removal.

Install a temporary cutoff dam to prevent flows from continuing down the creek channel. It should be located in close proximity to the existing structure that will be modified to serve as the intake to the aqueduct. This dam can be constructed from the native gravels and cobbles or by installing continuous, interlocking, sheetpiles. It needs to be built high enough to ensure that the creek flows will naturally flow into the modified aqueduct structure (if pumps are not used). Construction of this cutoff dam should be the last task performed prior to diverting the creek flows into the existing aqueduct.

For each of the four possible creek intake structures, the cutoff dam requirements are different and are briefly discussed as follows:

> A temporary cutoff dam supporting the use of either BM#93 or BM #94 would have to be built using continuous, interlocking, sheetpiles since there are no exposed gravel bars in this area. Initially gravels will have to be imported to serve as a work platform or bench to keep the equipment used to install the sheetpiles out of the flowing creek. This work platform would be extended as the line of sheetpiles is extended across the channel.
>
> A temporary cutoff dam supporting the use of the structure at "Forebay C" could be built using the gravels and cobbles that are present at this site. Since this location is where the creek necks down, the dam would be relatively small.
>
> A temporary cutoff dam supporting the use of the "Concrete Manhole" could be built using the gravels and cobbles that are present at this site. Since this location is on a large gravel bar, where the creek is wide, a relatively long cutoff dam will be needed. However diverting the creek flows at this location may impact the current pumping operations that supply water to the golf course.

Based on site considerations associated with each of the four structures, modifying the structure associated with "Forebay C" appears to be the preferred option because of the minimal environmental impacts, relative ease of access, and cost. However modifying BM #94 would allow the creek to continue to irrigate the vegetation along the creek banks up to the proposed work site.

Since the dam site is associated with the Sunol Infiltration Galleries, we expect the gradient of the groundwater level to remain relatively flat. So that while the upstream temporary cutoff dam will divert the active creek flows, groundwater will still be entering the work site. If the creek diversion is upstream of the work site as proposed, a system to reduce and control the amount of groundwater entering the work site should also be installed at the upper end of the work site. Once the creek flows have been diverted, a row of continuous, interlocking, sheetpiles could be installed in the dry creek bed. Immediately downstream, groundwater-monitoring wells should also be installed. These wells should be large enough to allow a submersible pump to be lowered in the event that further reduction of groundwater in-flows is needed or to obtain raw water for other uses. Pumped water could either be discharged into a plastic-lined settling basin immediately downstream of these wells for other uses such as for dust-control along the access road, irrigation of the existing vegetation in the vicinity of the pumps, or if not turbid and as a last resort it could be discharged via an above ground, small diameter, pipeline into the aqueduct at BM#94.

Lastly, prior to starting work to modify the aqueduct, the proposed work areas need to be cleared by certified biologists for both aquatic and terrestrial animals. Reportedly, red-legged frogs may be encountered within the proposed limits of ground disturbing activities (personal communication with Vic Germany [ESA] and Brian Sak [SFPUC]).

3.5 CONCEPTUAL DESIGN OF DEMOLITION PLAN

Prior to diverting the creek flows, and starting work to remove the dam and sediments, the area needs to again be cleared by certified biologists for both aquatic and terrestrial animals in accordance with the CEQA Mitigation Monitoring and Reporting Program. It is likely that Pacific Lamprey juveniles and red-legged frogs may be encountered within the proposed limits of ground disturbing activities (personal communications with Brian Sak). In addition, approximately 700 to 1,000 feet upstream of the dam is a stand of Cottonwood trees that serves as a nesting site for the Great Blue Heron (personal communications with Vic Germany [ESA], Brian Pittman [ESA], and Mark Mueller [SFPUC]) that will have an impact on when the sediments within this area can be removed. However, during a June 27, 2003 site visit, no nests or birds were observed from the access road leading to Sunol Dam.

3.5.1 Extent of Dam Removal

The original dam was built in conjunction with the Sunol Infiltration Galleries so it is likely that the original dam is founded on rock that is significantly deeper than the original creek channel. To achieve the project objectives (i.e. provide fish passage and address liability concerns), the following work needs to be performed:

> Remove approximately the top seven feet of the crest of the dam and notch a localized zone down an additional three feet to ensure that a permanent low flow channel or thalweg is preserved (see Figure 3-3 and 3-11), which consists of approximately 204 cubic yards of reinforced concrete. It is intended that the removal extend down a couple of feet below what was the natural streambed channel prior to the original construction of the dam. Using this approach, the sediments will cover the remaining section of the

dam so that only portions of both abutments and retaining walls will remain visible (see Figure 3-12).

The historical drawings (circa 1912) that were used to establish the estimated volume of sediments to be removed (see Section 3.3.1) indicate that the original creek bed was approximately 5 feet below the present crest of the dam. To ensure that the project objectives will be achieved over the long term, removing an additional two feet across the crest, combined with removing an additional three feet for the low flow channel, or thalweg, should be conservative. However removing this additional amount of concrete will add cost to the project and will likely reduce the groundwater level in the upstream gravel bed by a comparable amount.

Remove the left (looking downstream) wing-wall down to the dam's crest and remove portions of the left abutment that do not provide any buttressing to the existing hillside and in a manner that will eliminate any elevated terraces or platforms that may attract people to climb or use (see Figure 3-10). This work represents approximately 253 cyd of concrete with little to moderate reinforcing steel expected near the concrete faces.

Remove portions of the header box and wing-walls on the right (looking downstream) abutment. Where the aqueduct conduit will now be visible, install either steel grating or a flap gate to prevent unauthorized access into the aqueduct while allowing it to drain (see Figure 3-10 through 3-12). This work represents approximately 243 cyd of reinforced concrete.

The plunge pool that has been created immediately downstream of the dam during periods of high creek flow needs to be filled in after the dam and entrapped sediments (upstream of the dam) have been removed. Material upstream of the dam could be stockpiled for this use instead of being hauled off-site.

The suggested construction sequence for the removal of the dam is provided in Figures 3-6 through 3-12 and the approximate limits of ground disturbing activities are shown in Figure 3-5.

3.5.2 Demolition Method

The key to completing the removal of both the dam and the sediments within one season will be to notch the dam as soon as the creek diversion system is in place. After the dam is notched, the removal of the dam and sediments needs to be performed concurrently. Figure 3-13 presents a conceptual schedule for this work could be performed.

3.5.2.1 Dam Removal

To notch the dam, access to the downstream face of the dam will be required. There are two options to get heavy equipment to the downstream face:

1. From the end of the dam access road, build an access ramp with about a 6% grade down to the creek. This will require initially importing fill until equipment can get down into the channel where native gravels and cobbles can be used to complete the ramp. The ramp will have to be built and then may need to be temporarily closed to allow for the installation of the diversion pipe. Once the ramp has been completed, a heavy timber deck or imported gravels would be needed to get the equipment across the creek to access the gravel bar on the left-hand (looking downstream) side.

2. Downstream of the dam, temporary access from Niles Canyon Road could be obtained by cutting a short access road underneath the UPRR bridge and taking advantage of the large, exposed, gravel bed the extends up to the plunge pool at the dam (see Figure 3-5).

Adjacent to Niles Canyon Road, there is an area that has sparse vegetation leading to the UPRR bridge pier. It is likely that this area was previously used by heavy equipment to gain access to this area. Immediately adjacent to the creek, the gradient is steep and portions of the bank have concrete debris that serves to armor the slope against erosion. However, it could serve as an accessway for track-mounted construction equipment. At the bridge pier, a culvert (and/or heavy timber decking) could be temporarily installed to gain access to the left-hand (looking downstream) side of the creek without having the equipment enter the active creek. An excavator with a bulldozer would be sufficient to build this access route – the same equipment that will be needed to remove the dam and fill in the plunge pool. Once this equipment is on-site and access is no longer needed, this temporary route would be removed and the area restored.

The exposed downstream gravel bar will be used for access and to construct a "padded up" work area to get an excavator with a hydraulic hammer attachment up to the face of the dam to notch it. In addition these gravels will be used to build the downstream cutoff/settling basin (using the existing plunge pool), and then be used to build (or complete) the ramp up to the dam access road (see Figure 3-6).

Welded-steel pipe with a slide gate is needed to control flows out of the downstream settling basin/plunge pool prior to or in conjunction with installing the downstream creek diversion pipe (see Section 3.4 for discussion). Straw bales and oil absorbent material should be installed upstream of the slide gate to prevent any turbid water that may be produced within the work site or any accidental fuel spills or oil leaks from directly entering Alameda Creek.

Prior to notching the dam, the aqueduct just upstream of the existing manhole on the left abutment (looking downstream) needs to be permanently plugged to prevent flows from entering the downstream segments of the aqueduct (See Figure 3-6). An excavator with a hydraulic hammer attachment would be needed to break open this section of the aqueduct to allow a concrete plug to be placed. The existing manhole (downstream of the proposed plug) should be removed and the opening plugged with reinforced concrete since the City has determined that access is no longer needed to inspect the downstream portion of the aqueduct. An alternative would be to install a locked manway in lieu of the proposed concrete plug.

Notching and removal of the dam can be accomplished using conventional heavy equipment consisting of an excavator with a hydraulic hammer attachment. Pre-drilling with controlled explosives is not expected to be as effective due to the amount of reinforcing steel expected to be encountered in the upper, aqueduct, section of the dam[10]. The initial notch should consist of a section approximately 15 to 20 feet wide and extending down approximately seven feet (see Figure 3-7) where the original/surviving drawings indicate that a construction joint may exist. Once the notch has been created, a short channel will be created until the sediment bed is exposed. An excavator situated on the exposed bed should be used to extend this channel upstream, as part of the sediment removal work, to attract groundwater.

Depending on how fast the impoundment drains, a second excavator with a hydraulic hammer can be added so that one is working to remove the upper portion of the crest (see Figures 3-9 and 3-10) while the other removes the right wing-wall and portions of the right abutment (see Figure 3-8). An excavator will be needed to load 10-cyd dump trucks with concrete debris. The trucks will use the dam access road and recently completed ramp to enter/exit the site. (See section 3.5.5 for a discussion of access to haul the concrete debris off-site).

[10] There are no surviving records of how much reinforcing steel was used to construct the dam. However the dam appears to have been built in two distinct sections – the lower mass-type portion and the upper, aqueduct, section. Given the age of this dam, we anticipate that the lower section will be relatively unreinforced or have minimal steel reinforcing that would be located near both the upstream and downstream faces. Because the upper section is a concrete conduit that also serves as the dam crest, it is likely that the primary structural elements (e.g. walls and crest) will have two curtains of reinforcing steel running in both directions and that the conduit invert slab will have a single curtain of reinforcing steel running in both directions. In addition it is likely that dowel-type reinforcing steel will be present between these two dam sections – especially on the upstream face of the dam. The rate of removal will be dependent upon the bar size, spacing, and orientation and will likely require using an oxygen-acetylene torch to cut individual bars to facilitate the demolition process.

The gravel work platform or bench that was originally created on the left abutment (looking downstream) will need to be extended towards the right abutment as the removal operation progresses in this direction. This work can be performed using an excavator and/or bulldozer.

As the removal progresses and the sediment removal tasks are underway, it will be prudent to again notch the dam down to the final elevation, approximately an additional three feet. This will allow the impoundment to continue to drain, which facilitates the sediment removal operation. This notch can be performed anywhere within the middle third to half of the dam crest and should be performed in-conjunction with the removal of the upper section of the dam (see Figure 3-10).

Near the right abutment (looking downstream), an approximate 30-foot-long section of the dam needs to be removed to a depth of approximately 10 feet from the original dam crest. This feature is intended to serve as the permanent low-flow channel or thalweg (see Figure 3-10).

After the main portions of the dam have been removed, the remaining part of the original plunge pool needs to be filled-in (See Figure 3-11). This can be accomplished using the native gravels either upstream or downstream of the dam. After the construction of the dam, during high flows the water flowing over the dam scoured out the downstream gravels to a level that is lower than the original streambed. The timber "rafts" shown on the downstream face of the dam on the surviving records (Figure 3-1) likely were installed to prevent excessive scour from occurring. Since the bottom of the plunge pool is now below the original streambed channel, consideration should be given to filling in the lowest zone with concrete debris from the dam and then using the native gravels from immediately upstream of the dam to fill in the remaining upper zones of the plunge pool.

Filling in the plunge pool can be accomplished using an excavator and bulldozer. If sufficient coarse sediments (boulders and cobbles) are left on the upstream face of the dam, a loader could dump this material over the lowered dam for final placement using a bulldozer. This would help to reduce the amount of sediment to be hauled off-site. As the plunge pool gets filled in, the dewatering pipe can be removed and salvaged since it is no longer needed. However the creek diversion pipe should not be removed until the sediment removal tasks are completed so that creek flows can be restored.

After the diversion pipe has been removed and salvaged, the downstream facing walls of the header box can be removed. The exposed downstream entrance to the aqueduct needs to be covered with either a steel grated structure or a flap-gate to prevent unauthorized access into this remaining feature. In addition the wall used for the fish ladder can also be removed (see Figure 3-11). Also the concrete structure that was modified/used upstream to divert the creek flows needs to be repaired and the site restored.

Depending on the future need for access to the dam site, the retaining wall connected to the header box can be lowered or removed (See Figure 3-11). These structures, which are above the normal creek channel, are expected to have two curtains of reinforcing steel running in each direction. An excavator with hydraulic hammer can remove these features. It should be noted that this wall does not interfere with fish passage and does not appear to pose a liability concern, so it does not have to be removed.

3.5.2.2 Dewatering & Diversion System Installation

Construction of the upstream gravel cut-off dam can be performed using an excavator and/or bulldozer. The short-height continuous row of sheetpiles can best be installed using an excavator fitted with a vibratory driving attachment. Initially an excavator or small bulldozer would be needed to build up a work platform or deck that is above the waterline. This deck could be built using a combination of gravels and/or heavy timbers to keep the equipment out of the active creek. As discussed in Section 2.6, coordinating the water deliveries to ACFCWCD would allow the creek flows to be reduced during this work, thereby lessening the amount of material needed to build the work platform. As the platform is advanced, the excavator will vibrate the sheetpiles into place. The final cutoff of the creek flows should not be performed until all of the modifications to the aqueduct have been completed. Construction of the diversion channel can be performed using a backhoe and/or small skid steer/bulldozer.

Modifications to both the header box and the existing upstream concrete structure will require an air compressor to power a jackhammer. Small construction tools and equipment will also be needed to perform the work. These can be transported to the site using light- to medium-weight vehicles (i.e. a pick-up truck).

The diversion and dewatering pipes can be installed with an excavator to establish the subgrade and with the use of slings to set the pipes, couplings, and fittings into place.

3.5.2.3 Sediment Removal

The best method to remove the sediments upstream of the dam will be to create a traffic pattern that minimizes having the trucks pass each other on the narrow roads leading to Niles Canyon Road. This approach will also allow larger, 20 cyd dump trucks to be used which will reduce the total number of truck trips required. Widening of the existing dam access road (in areas where there are no mature trees) should be done to allow trucks to be staged until it is time for them to be loaded. As the impoundment drains, the gravel bank that runs the entire length of the work site will become exposed. A grader or bulldozer will be needed to blade a road on these gravels for the dump trucks. Periodic passes with a water truck will reduce the amount of dust created as the sediments are loaded and hauled off-site. An excavator can be used to load each dump truck. Depending on how fast the impoundment drains, it may be possible to add additional excavators to load additional trucks simultaneously.

As the sediment removal work progresses within each reach or zone, a low flow channel will be created adjacent to the right bank (looking downstream), which is where the current one is.

To gain truck access to the creek channel, three "corridors" are planned that will connect to the existing dam access road. The first one should be located approximately 200 to 300 feet upstream of the dam crest, the second corridor should be approximately 1,300 feet, and the third corridor should be at the upstream end of the work site (approximately 2,400 feet). These corridors need to be wide enough to allow the trucks to turn, so an average width of 30 feet has been assumed for this conceptual layout (see Figure 3-5). Having three corridors will allow the work near the Great Blue Heron nesting site (personal communication with Brian Pittman, ESA) to be deferred until later in the season – after the young birds have fledged which may not occur until mid- to late July.

The duration needed to remove the sediments is dependent upon: 1) the final volume of sediment that needs to be removed, 2) traffic control requirements at the intersection of Niles Canyon road, 3) the narrow access roads, 4) environmental concerns- especially with the Heron, and 5) how rapidly the impoundment can be drained. Section 3.5.6 discusses possible off-site locations to haul off the sediments.

3.5.3 Construction and Staging Access

3.5.3.1 Staging Areas

The closest location that has suitable space to establish the construction office with provisions for employee parking, equipment and material storage, and utilities is at the entrance to the City's access road to the dam – across from the old chlorine injection building (see Figure 3-5). Preliminary information indicates the City and County of San Francisco owns this land and that it is currently being leased to a nursery. Also due to site and access limitations at Niles Dam, this location will also have to serve as the construction offices for the removal of Niles dam.

Therefore an area of approximately 400 feet long by 300 feet wide will be needed for the duration of the construction tasks.

3.5.3.2 Fuel Handling and Equipment Maintenance

These activities can be performed either in the construction yard area (preferred) or directly on-site if typical precautions are implemented to prevent spills or leakage of fuel, oils, or solvents.

3.5.3.3 Temporary Power and Telephone Service

The existing electrical service ends at the old Chlorine Injection Building that is adjacent to the proposed construction yard area. Additional power may be needed on the job site and would have to be provided by portable power generators. Communication with personnel on the actual work site should be by 2-way radio communication or cell-phone. This radio system will also be required to provide communication with personnel working at the Niles dam site.

3.5.4 Traffic Impacts

Where the site (nursery) access road intersects Niles Canyon Road, advance warning signs and flagmen will be required on Niles Canyon Road to allow construction vehicles to safely enter and exit the access road. Some work may also be needed to allow larger trucks to be able to make left-hand turns onto Niles Canyon Road (heading westbound). In addition, truck traffic entering/exiting Niles Canyon Road should avoid the peak commute periods associated with Niles Canyon Road. Given the scope of work, Caltrans will require a traffic control plan be approved before any work begins. CHS Consulting has provided additional information regarding traffic conditions along this roadway (see Appendix B).

3.5.5 Other Construction Issues

3.5.5.1 Site Access

A temporary access route from Niles Canyon Road to the downstream face of the dam should be considered since it will allow the dam to be notched as early as possible. The options are discussed in Section 3.5.2.

3.5.5.2 Work Adjacent to UPRR Main Line

At the end of the dam access road and where the proposed access ramp is planned, the work site will be in close proximity to the UPRR main line. Currently there is a fence separating part of the right-of-way from the dam access road. Downstream of the access road (i.e. where the access ramp is proposed), there are no fences so this land may belong to the UPRR. The UPRR requires that any work within 25 feet of their tracks have a flagger and typically requires all construction personnel to attend training when working close to their tracks. However the UPRR does not have any legal authority beyond their property line so the property lines within this are should be confirmed.

In addition if the contractor will be permitted to build a temporary accessway to the downstream face of the dam from Niles Canyon Road, since this route crosses under the UPRR bridge, a Right of Entry permit will be needed before any associated grading or site work can be started.

3.5.5.3 Disposal Options

<u>Concrete Debris</u>: The Ferma Corporation presently operates a concrete recycling facility near the town of Sunol - approximately 4 miles east on Niles Canyon Road from the dam site and adjacent to the NCRR. An alternative location would be to transport this debris to the Vasco Road Sanitary Landfill in Livermore, which is approximately 17 miles from the town of Sunol.

<u>Sediments</u>: Within the vicinity of the dam site, there are a number of quarry operations that may be willing to accept the sediments. The quarries to the east of the dam include: Niles Canyon Quarry (5550 Niles Canyon Road), Mission Valley Rock Company (7999 Athenour Way, Sunol), and RMC Pacific Materials (6527 Calaveras Road, Sunol). To the west of the dam, the Tri-City Rock (43157 Osgood Road, Fremont) is the closest.

3.6 COST ESTIMATES AND CONSTRUCTION SCHEDULE

3.6.1 Cost Estimate

RS Means Heavy Construction Cost Data has been used as the basis for estimating the cost to perform the work. Since most of this work consists of site work and demolition, a combination of approaches has been used to estimate the costs. For the demolition of the dam and some of the tasks associated with the sediment removal, the costs are based on the "bare" equipment monthly rental cost plus the "bare crew cost per day" combined with an estimated duration or production rate. For other tasks, the costs are based on the unit quantities multiplied by "bare unit costs". Due to the uncertainty regarding the volume of sediments to be removed, costs have been estimated based on a range of 7,000 and 13,000 cyd of sediment to be removed. These costs have then been adjusted using RS Means City Cost Index to reflect the cost of performing work in the bay area and they have been escalated by 3.3% per year to reflect construction in 2005. In addition 3.1% has been added to cover miscellaneous management and reporting requirements typical of projects of this type. Then both an overhead rate of 18%

and contractor's profit goal of 10% have been applied. Since this project is still in the conceptual phase, a 15% contingency has also been applied.

Volume of Sediment Removed (cyd):	13,000.	7,000.
Sub-Total Cost:	$ 3,334,100.	$ 2,465,100.
15% Contingency:	$ 500,100.	$ 370,000.
Total Estimated Cost:	**$ 3,834,200.**	**$ 2,835,100.**

The sub-total cost includes a proportion of the construction office that will be shared between both projects. The breakdown of costs by primary activities are:

Volume of Sediment Removed (cyd):	13,000	7,000
Common (e.g. share of the construction office, preparation of traffic control and erosion control plans):	20%	21%
Creek Diversion & Dewatering:	7%	10%
Dam Removal and Hauling Off-site (~700 cyd)	33%	37%
Sediment Removal and Hauling Off-site:	35%	26%
Site Work (e.g. clear & grub, access downstream of dam, revegetation allowance)	5%	6%
Total:	100%	100%

3.6.2 Construction Schedule

A detailed schedule has been developed using Microsoft Project assuming that the work will be performed under one contract (between Sunol and Niles), work within Alameda Creek can not begin until June 1st (due to creek flows and environmental constraints) and needs to be completed before October 15th, using a calendar that reflects Federal Holidays and 8 hour work shifts per day. The critical path consists of obtaining an approved traffic control plan, clearing the site which includes relocation of aquatic and terrestrial animals, diverting the creek flows into the aqueduct, notching the dam, removal of sediments, and revegetation of the key areas where ground-disturbing activities were performed. The milestone dates and durations for key tasks are as follows and the detailed schedule plan for the removal of Sunol dam is included in Figure 3-13:

Notice to Proceed:	2/1/05
Start Construction:	5/1/05
Complete Construction within Alameda Creek:	10/10/05
Complete all Construction	11/1/05

Install Creek Diversion System:	3 weeks
Dam Removal:	12 weeks
Sediment Removal (13,000 cyd):	16 Weeks

3.7 RECOMMENDATIONS

Based on the proposed dam and sediment removal activities, we recommend the following actions be taken either as part of the design phase or as part of the environmental permitting process:

1. Survey the trees and other vegetation within the area where ground-disturbing activities are planned (see Figure 3-5) – especially where the three access corridors are planned, to ensure that there are no critical issues and to quantify the extent of mitigation that may be warranted. This work should consist of tagging trees over 6-inch dbh (diameter at breast height) and locating them (as well as other critical vegetation) on the topographic map.

2. The sediment removal work will partially be dependent upon when the Great Blue Heron's fledge. During 2003 and 2004, biologists should field verify the approximate dates that this event occurs. This information will also be needed to obtain CA Department of Fish and Game approvals – especially to justify an earlier start date than may be considered "typical".

3. If the existing aqueduct will be used for creek diversions, then the aqueduct structures BM#93, the structure at "Forebay C", and "Concrete Manhole" should be located and as-built condition established to determine how they could be modified. In addition the capacity of the aqueduct to carry approximately 50 to 60 cfs should be evaluated. Once a structure has been selected, localized survey should be performed so that the pertinent features can be design and to refine/reduce the extent of ground disturbing activities. These structures are currently upstream of and outside of the original project boundary that was established for this study.

4. Any additional information regarding the design and/or construction of the dam would assist in developing better contract documents (i.e. plans and specifications) that will lead to obtaining a better estimate of the cost and production rate for removing the dam. A thorough search of the historical records might provide additional clues regarding the location, size, and spacing of reinforcing steel that might be encountered. In addition, any records of the construction joint as shown on drawing No. E29 would be helpful since this joint is approximately where the extent of removal is planned. However since the actual dam removal is not on the critical path and is less costly than the sediment removal costs,

conservative assumptions can be used to develop the contract documents in lieu of having to perform any additional field-testing or inspection.

5. To reduce the height of the dam that is proposed to be removed – either for cost or to minimize impacts to the upstream groundwater levels (see Section 3.5.1, item a), hydraulic modeling would need to be performed. A HEC-6 model (see the Case Study Technical Memorandum which is Appendix A to this report) using the historic creek flow data obtained from the USGS gauging station (see Section 2.6) would reveal the likely areas where scour and deposition within this reach of the creek may to occur. While this model will not provide definitive results, it would validate that the extent of the dam crest to be removed is prudent and reasonable.

6. To prepare adequate contract documents (i.e. plans and specifications), the extent that the left abutment (looking downstream) is to be removed without affecting the stability of the adjacent hillside should be better established. An analysis of the stability of the slope adjacent to the left abutment should be performed. In lieu of performing this study, less of the left abutment and retaining wall should be removed.

7. To obtain a better estimate of the volume of material needed to fill in the plunge pool, the bathymetry of the plunge pool should be performed and integrated into the survey work that has been prepared for the upstream portion of this project.

8. The retaining wall at the end of the dam access road does not interfere with fish-passage nor appear to present a safety issue so its removal is currently not included. If the City will no longer need to use some or all of this road, then the wall (and possibly part of the dam access road) could be removed. The City should decide whether or not to include this work with the removal of the dam.

9. For the proposed construction staging area, which is currently being used by the nursery, confirmation is needed that this land is indeed owned by the City. In addition any agreements between the nursery and the City should be reviewed to establish the feasibility and any costs associated with using this land.

10. Representatives of the local power and telecommunication companies should be contacted to discuss options (and estimated cost) for providing these services to the construction office.

11. The property lines adjacent to the dam need to be established to ensure that work will not be within UPRR right-of-way or property. Any work within their property will require

obtaining a Right of Entry from them. This permit would also be required if access from Niles Canyon Road to the downstream face of the dam will be pursued.

12. Revegatation is scheduled to be performed in the fall of 2005. Given the dynamic conditions of this watershed, winter creek flows are likely to alter the creek channel. In addition, environmental monitoring of revegetated areas will likely be required for a period of at least 2 years and may be required to extend up to 5 years. Therefore it would be reasonable to defer revegetation adjacent to the creek channel until spring of 2006. This would also allow the work to begin harvesting and propagating local specimens in 2004 instead of this year.

13. There is a pedestrian trail that goes from Niles Canyon Road, across the UPRR main line, ending at the creek banks immediately downstream of the dam site. Installing a section of fence or planting of blackberry type bushes (or even poison oak) should be considered to block access to the remnants of the dam.

4.0 NILES DAM REMOVAL

4.1 DESCRIPTION OF DAM

Niles Dam is located on Alameda Creek at river mile 12.8, near the downstream end of Niles Canyon (Figures 2-1 and 2-3). Highway 84 (Niles Canyon Road) parallels the creek through Niles Canyon, and lies directly adjacent to the dam site. According to the U.S. Geological Survey (USGS) Niles 7.5' topographic quadrangle, Niles Dam lies at an approximate elevation of 120 feet above sea level. The NCRR lies about 150 feet southeast of Niles Dam, on the slopes directly above the creek. The UPRR lies about 2,000 feet south of Niles Dam.

Niles Dam reportedly was constructed in 1887 atop a stone dam originally built in 1841 (JRP Historical Consulting Services, 2000). The original stone dam probably was founded on bedrock; however, there are no data available to confirm this. The current dam is composed of the original rock-fill base that was capped with concrete sometime around 1887 (JRP Historical Consulting Services, 2000). An available construction drawing of the dam (Drawing F263 – Structures on Niles Aqueduct, dated April 1914) indicates it has a crest length of about 120 feet, a width of about 8 feet, and a maximum foundation to crest height of about 8 feet (Figure 4-1). This drawing indicates the main crest was constructed in 1908. The drawing indicates the bottom of the Alameda Creek channel was about 6.5 feet below the north crest of the dam. The north crest is about 1 foot higher than the main crest, whereas the south crest is about 1.5 feet higher. A fish ladder, which apparently is non-functional, exists near the middle of the dam. The drawing also shows a conduit extending from the upstream side of the right abutment to a gate house tower on the downstream north bank of the creek, but these structures apparently no longer exist (they may have been removed for construction related to Highway 84). Trihey & Associates (2000) report that the height from the dam crest to the channel bottom on the downstream side is currently about 14 feet; however, based on our field observations this height probably is only about 6 to 8 feet.

Because of the dam's original construction is associated with activities related to Mission San Jose, it meets the National Register's criteria A[11] and B[12], for listing in the National Registrar of Historic Places (JRP Historical Consulting Services, 2000).

As part of our study, a topographic map of the dam site was prepared from aerial photography by a professional land surveyor. As part of this task, a number of points on the dam were surveyed in the field to verify the as-built condition (Figure 4-1). The surveyed elevations are based on NGVD 1929, also referred to as mean sea level, which is used as the vertical datum on most USGS maps.

4.2 SITE INVESTIGATIONS

4.2.1 Review of Aerial Photographs

Geomatrix reviewed several pairs of stereo aerial photographs covering the Niles Dam site (Table 1). The main purpose of this review was to identify potential landslides and/or geologic features that could potentially affect removal of the dam. We attempted to document changes in the reservoir boundary of the dam; however, the limited scale (1:12,000) of the available photographs combined with the dense vegetation along the channel margins of Alameda Creek precluded our ability to clearly identify the reservoir boundary.

Our review of available photographs did not reveal any obvious landslides or other geologic features of significance in the immediate vicinity of the dam. At the Niles Dam site, the canyon is relatively narrow and steep slopes occur on either side of Alameda Creek. Numerous erosion gullies are evident in the photographs on the slopes to the north of the dam; however, these features all lie above Highway 84 and do not appear to have the potential to impact the dam site or the stability of the creek banks. Nilsen (1975) maps two small landslides on the slopes in this area. No erosion features (i.e., gullies or landslides) were noted on the south side

[11] The original dam provided power for a flour mill that was used during both the Mexican and American eras.
[12] The original dam is associated with the life of Jose de Jesus Vallejo who was a significant person during that era.

of the site. A low, narrow fluvial terrace flanks the south side of the creek, along the base of the steeper, bedrock slopes above. The creek bed in this area appears to be very rocky.

4.2.2 Geologic Mapping

Mr. Hans Abramson (Staff Geologist) of Geomatrix mapped the geology and geomorphic conditions of the Niles dam site on April 22, 2003. The field mapping was performed at a scale of 1 inch = 60 feet on a topographic base map, utilizing an orthophoto map for reference, both of which were created for this study. The geologic/geomorphic conditions at Niles Dam are presented on Figure 4-2. A brief description of the pertinent geologic and geomorphic site conditions is presented below.

Niles Dam is located near the western end of Niles Canyon (Figure 2-3). The canyon is deeply incised and relatively narrow in this area, and steep canyon walls rise approximately 800 to 1,300 feet on both sides of Alameda Creek in the vicinity of the dam. The dam is located at the downstream end of a gentle meander in the creek, which is flanked by a low, gently-sloping alluvial terrace sequence on the inside of the meander (Figure 4-2). At the time of our mapping, the terraces surfaces were approximately 10-20 feet above the level of the creek This sequence of terraces includes a lower inset terrace approximately 10 feet above creek level, and a broader, higher terrace approximately 15-20 feet above the level of the creek.

There are few bedrock exposures in the vicinity of Niles Dam (Figure 4-2). In general, the steep canyon walls adjacent to the creek in this vicinity are mantled with colluvium and/or fill. The right (northwest) bank along this reach of Alameda Creek is generally formed by a low concrete/stone wall that retains the fill beneath Highway 84. One local bedrock outcrop was exposed on the right side of the channel approximately 1,000 feet upstream of the dam. On the higher slopes that rise above the terraces on the left (southeast) side of the creek, local bedrock outcrops are exposed in the cut slopes for the NCRR. The slopes below the railroad are mantled by artificial fill and are densely vegetated. As described in Section 3.1, the published mapping (Dibblee, 1980) in the vicinity of Niles Dam indicates the bedrock consists predominantly of micaceous shale with interbedded sandstone, and local conglomerate of the Upper Cretaceous (95 to 65 Ma) Panoche Formation. Our mapping of the limited bedrock exposures, in general, confirms the published mapping.

The NCRR cut slope exposures revealed thickly bedded (approximately 1 to 3 feet thick) and moderately- to steeply-dipping sandstone with minor interbedded shale. The sandstone is moderately hard, moderately strong, and moderately weathered; however, local beds have low hardness, are weak and deeply weathered. Fractures are generally moderately spaced (0.3 ft to 1 ft), tight to ¼ inch open, planar or irregular, rough, and locally stained with manganese oxide. Shale in the observed outcrops is less common than sandstone, comprising approximately 20-30% of the unit. The shale is laminated to very thinly bedded (beds range up to 0.1 ft thick) with local beds up to 0.3 feet thick, soft to low hardness, friable, and severely weathered. Fractures in the shale are very closely spaced (less than 0.1 ft), open or filled with sandy clay to ¼ inch width, irregular and wavy, and slightly rough. Bedding in the eastern (upstream) exposure strikes N80º E and dips 48º to the south, while bedding in the western (downstream) exposure strikes N10-20º W and dips 74-76º to the east.

The sandstone outcrop along the right edge (looking downstream) of the creek is thickly bedded, hard, strong, and little weathered. The orientation (strike and dip) of bedding exposed in the outcrop ranged from N69º W, 64º SW to N76º W, 59º SW. Fractures are widely spaced (1 to 3 feet apart) and are generally tight, planar, and slightly rough. The fractures are generally northeast-striking and steeply dipping to the northwest and to the southeast. Intersecting fracture surfaces are generally well rounded and the sandstone is slightly polished, indicating continued erosion by the creek.

The surfaces of the alluvial terraces on the southeast side of the creek have been extensively modified and are locally covered by a thin layer of artificial fill. Patches of asphalt associated with an old road, low stone walls, open pits, and exposed pipes show where roads, utilities, and other cultural features once existed (Figure 4-2). The terrace surface is generally composed of clayey sand with gravel and is littered with cobbles, local boulders, and local man-made debris. Exposures in two open pits show approximately 1-foot thickness of this artificial fill overlying native alluvium. The native alluvium is composed of sand with clay and sandstone cobbles that are subangular to rounded, and are up to 1.5 feet in diameter.

The stream channel deposits exposed in and around the active stream channel consist of slightly silty sand with cobbles and boulders. Generally sub-rounded cobble- and boulder-sized clasts of sandstone comprise the majority of the deposits (approximately 60-70%). The edges of the active stream include braided channels and gravel bars that support a riparian plant community in their upper sections. The bottoms of many of these braided channels were covered with a thin deposit of moist to wet silty sand at the time of our field mapping. The contact between channel deposits and terrace deposits is defined by this years high flood level and is marked by a line of debris, below which much of the fine vegetation is pushed over. The contact between channel deposits and artificial fill on the right (northwest) side of the creek is defined by the base of the retaining wall below Highway 84.

4.2.3 Sediment Sampling

At Niles Dam, field observations along with the grain size data from Trihey & Associates (2000) indicate that the sediments behind the dam are coarser than those at Sunol Dam. Given this information and the poor recovery obtained in the vibracores at Sunol Dam, sampling at Niles Dam was not attempted.

4.3 SEDIMENT MANAGEMENT

4.3.1 Sediment Volume Estimates

At Niles Dam, the available construction drawing (F 263, dated April 1914) includes a channel cross section along the upstream face of the dam and indicates the channel bottom was at most about 5 feet below the main crest of the dam. The section indicates the channel was generally trapezoidal in shape, with a gently sloping south side, a steeply sloping north side, and a relatively narrow (~ 26 feet wide), flat bottom. To our knowledge, no other historical cross section data are available for this reach of Alameda Creek.

The volume of sediment impounded behind Niles Dam was estimated using the available cross section along with the site topographic/bathymetric map prepared for this study. Spot elevations in Alameda Creek extending upstream from the dam were used to model the top of the sediment. The point where the top of the sediment intersects the estimated original channel bottom defines the upstream extent of the impounded sediment. Since there are no historical cross section data upstream of Niles Dam, we estimated the gradient of the original channel bottom to be 0.008 ft/ft using the USGS 10-meter-grid Digital Elevation Model. The width of the channel was estimated from the site topographic map. The volume of sediments was estimated to be about 700 cyd, with the impoundment extending about 500 feet upstream of the dam. This estimate is significantly lower than the 2,200 cyd estimated by Trihey & Associates (2000).

We also estimated the sediment volume assuming: 1) the elevation of the main crest of the dam represents the top of the impounded sediment, and 2) the width of the channel (~ 100 feet) on the historic drawing was constant upstream of the dam. This approach represents a more conservative (i.e. higher) estimate of the sediment volume, which may be more appropriate for estimating project costs. Under this scenario, the sediment volume is estimated to be about 2,800 cubic yards, with the impoundment extending about 500 feet upstream.

4.3.2 Removal Strategies

Based on the results of the laboratory testing we performed on sediments collected behind Sunol Dam, and on our communications with the ACFCWCD and Zone 7 regarding dredging of Alameda Creek and Alamo Creek (Arroyo de la Laguna), the sediments impounded behind Niles Dam likely are free of potentially hazardous substances, or have concentrations well below regulatory limits for disposal.

Trihey and Associates (2000) recommended leaving all of the sediment impounded behind Niles Dam, because of the relatively small volume of material. They noted, however, that any sediment left in place could potentially be deposited in the flood control channel downstream of Niles Dam, and that significant deposition could increase the risk of flooding along the lower reaches of the creek. Hydraulic modeling by Trihey & Associates (2000) indicates that during an average or above average rainfall year, the sediments upstream of Niles Dam could be transported downstream. For these reasons, we recommend removing all of the sediments impounded behind the dam prior to its removal. As discussed above, we estimate that between about 700 to 2,800 cubic yards of sediment volume are impounded behind Niles Dam.

We propose two possible alternatives for disposal:

1. Remove and haul the sediments to a landfill that accepts earth materials, or
2. Remove and haul the sediments to a nearby commercial gravel and sand quarry that agrees to accept the material.

If the sediments are taken to a landfill, a nearby landfill that accepts earthen material is the Vasco Road Sanitary Landfill in Livermore. The feasibility of the second alternative should be evaluated during the construction phase of the project, as the demand/supply of these materials at nearby quarries is likely to vary with time. Geomatrix contacted the Pleasanton office of RMC Pacific to inquire about the possibility of hauling and dumping the materials at their Pleasanton yard. According to plant manger Rich Bier (personal communication May 2003) they would take the material free of charge if they inspected it and found it to be suitable for use as base rock. If it was not suitable for base rock but could be used for fill, they may allow the material to be dumped at their yard for a fee.

Both disposal alternatives will require testing and documentation to verify the materials are free of potentially hazardous substances, or have concentrations below regulatory limits. We recommend that additional sampling and testing of the materials be performed during the construction phase of the project. Additional samples should be collected from the excavated/stockpiled materials and tested, prior to off-hauling any of the materials. The final destination of the materials will depend on the results of the additional testing.

4.4 PROPOSED CREEK DIVERSION AND DEWATERING SYSTEMS

To divert the creek flows that will normally be expected during the dam and sediment removal tasks (approximately 50 to 60 cfs), a narrow diversion channel or trench should be built along the left bank (looking downstream). This temporary channel or trench should be aligned to coincide with what appears to be an old low flow, or flood channel (approximately 30 feet in from the left bank of the creek (looking downstream) so it can easily be excavated using a backhoe and/or small excavator. Lining the channel with plastic sheeting will reduce seepage into the work site and improve the flow carrying capacity of the diversion channel. The plastic sheeting can be anchored with native cobbles and boulders. Since this channel will only be used for a short duration, the excavated materials can be stockpiled immediately adjacent to the channel, preferably on the left side (looking downstream). The alignment of the channel should be allowed to meander to minimize the amount of tree removal and/or trimming. A short segment of culvert should be installed near the upper end to allow equipment access across the diversion channel.

Immediately downstream of where the diversion channel will connect to Alameda Creek, a continuous row of interlocking short-height, sheetpiles needs to be installed across the normal channel bank to cutoff flow to the work area and allow creek flows to enter the diversion channel. Immediately downstream of the sheetpiles, dewatering pumps should be installed to reduce and control the amount of water entering the work site. These pumps should discharge into a small, plastic-lined, settling basin that is built-up from the existing gravels in the channel. The top elevation of this basin should be established slightly higher than the diversion channel to allow the filtered water to flow by gravity into the diversion channel. Placing straw bales at the end of the basin closest to the diversion channel will serve to act as a filter trapping the fines in the larger part of the settling basin and preventing them from entering the diversion channel.

In addition, immediately upstream of where the diversion channel re-enters Alameda Creek and just downstream of the existing dam, the native gravels and cobbles should be formed into a low-height dam with a small, gated, dewatering pipe. The purpose of this feature is to prevent any turbid water that may be produced within the work site or any accidental fuel spills or oil leaks from directly entering Alameda Creek. Straw bales and oil absorbent materials should be placed around the diversion pipe to serve as a filter.

The pertinent features of the proposed diversion and dewatering scheme are shown in Figure 4-3.

4.5 CONCEPTUAL DESIGN OF DEMOLITION PLAN

Aside from the environmental aspects, equipment access to the site is the most problematic issue associated with the removal of Niles Dam and the associated sediments. Further discussion on this issue is provided in Section 4.5.5.

4.5.1 Extent of Dam Removal

Prior to diverting flows to allow removal of the dam and sediments, the area needs to be cleared by certified biologists for both aquatic and terrestrial animals in accordance with the CEQA Mitigation Monitoring and reporting Program. It is likely that Pacific Lamprey juveniles and red-legged frogs may be encountered within the proposed limits of ground disturbing activities (personal communications with Brian Sak [SFPUC]). The prime habitat for the Alameda Whipsnake is reported (personal communications with Brian Pittman [ESA]) to be on the opposite side of Niles Canyon Road, which is outside the proposed work site.

To achieve the project objectives (i.e. provide fish passage and address liability concerns), only the middle segment of the dam (approximately 95 cyd of concrete and mortared rock) and the non-functioning fish ladder (approximately 12 cyd) need to be removed. This section should be removed down to its original foundation as shown on the original drawing. The dam is located in a bend in the creek, so the right abutment (looking downstream) helps to direct the main flows away from the stacked rock retaining wall that supports Niles Canyon Road. If the right abutment were to be removed, then more flow would naturally be directed towards this wall. Scour at the base of the wall could compromise the wall's stability, which would directly affect the ability of Niles Canyon Road to remain open to traffic in both directions. The left abutment is constructed of mortared rock so it may be apart of the original dam construction and is on the inside of the bend in the creek. It does not protrude into the main channel and therefore does not need to be removed.

Leaving the two abutments in place will require some armoring to prevent scour or undercutting of the leading edge. A small portion of the concrete fish ladder that was cast against the original right abutment should be left in place. In addition cobbles and boulders that are on site can be used to provide armoring without creating a barrier to fish passage.

The suggested construction sequence for the removal of the dam is provided in Figures 4-4 through 4-7.

4.5.2 Demolition Method

Removal of both the dam and the sediments can easily be performed within one season. Figure 4-9 presents a conceptual schedule for how this work could be performed.

4.5.2.1 Dam

Removal of the dam can be accomplished using conventional heavy equipment consisting of an excavator with a hydraulic hammer attachment. Due to the proximity of the dam to Niles Canyon road and due to the dams' construction, controlled blasting is not appropriate nor required. A loader or excavator will be needed to stockpile this debris until it can be loaded into dump trucks and hauled to a suitable disposal site (See section 4.5.5 for a discussion of access to haul the sediments off-site). Due to the size of the dam and its construction, we do not anticipate that it will take much effort to remove the dam and non-functioning fish ladder.

4.5.2.2 Dewatering & Diversion System Installation

Installation of the short-height continuous row of sheetpiles can best be installed using an excavator fitted with a vibratory driving attachment. Initially an excavator or small bulldozer would be needed to build up a work platform or deck that is above the waterline. This deck could be built using a combination of gravels and/or heavy timbers to keep the equipment out of the creek. As discussed in Section 2.6, coordinating the water deliveries to ACWD would allow the creek flows to be reduced during this work, thereby lessening the amount of material needed to build the work platform. We anticipate that some of the gravel will need to be imported initially, to create a work area immediately adjacent to the roadway. This will also serve as the beginnings of an access ramp (See Section 4.5.5). Then native gravels and cobbles could be used to advance the work platform into the creek and complete the access ramp. As the platform is advanced, the excavator will vibrate the sheetpiles into place. The final cutoff of the creek flows should not be performed until the diversion channel has been constructed (see discussion in Section 4.4, above). Construction of the diversion channel and downstream gravel cutoff dam can be performed using a backhoe and/or small skidsteer/bulldozer.

Another alternative that would minimize the amount of work in the creek would be to use a crane fitted with a vibratory driver. However the crane would have to be situated on Niles Canyon Road and with its outriggers extended, it would require closing the road in both directions until all of the sheetpiles have been installed. Given the current traffic conditions on Niles Canyon Road, it is unlikely that Caltrans would approve such a temporary closure.

4.5.2.3 Sediment Removal

Excavators in combination with small bulldozers and a loader will be needed to remove the sediments from the creek channel. Due to site access issues (see discussion under Section 4.5.5), if the dump trucks will be staged on Niles Canyon Road to be loaded, then the sediments will need to be stockpiled adjacent to the roadway. An alternative that is also discussed in Section 4.5.5 is to install a conveyor system to load rail cars on the NCRR right-of-way. However setting up and maintaining a conveyor system can be costly and would only be viable if the total cost to transport the material by rail and then by truck is less than the cost to implement a traffic control plan for the sediment removal tasks using the Niles Canyon Road.

4.5.3 Construction and Staging Access

4.5.3.1 Staging Areas

Due to the site access issues (see discussion in Section 4.5.5), the construction office and primary staging area should be at the same location as recommended for the Sunol dam removal (see Section 3.5.3). It is very unlikely that Caltrans will permit equipment or material storage along the limited shoulder of Niles Canyon Road. However within the dam site area, there is an exposed gravel terrace that is approximately 100 feet by 50 feet and where there is sparse tree cover. This area is above the normal waterline and could be used for equipment and material storage, small bins for garbage, recyclables, and any hazardous materials, as well as provide an area for the construction personnel (e.g. conduct tailboards, lunch area, store their personal belongings).

This central construction office should be the point of assembly for the construction personnel. As such, it would provide employee parking, the construction offices, phones, and utilities. A small bus or commuter type van(s) would then be used to transport employees to and from the Niles dam site at the beginning and end of each shift.

4.5.3.2 Fuel Handling and Equipment Maintenance

The only viable way to fuel the equipment and any temporary power generators will be from Niles Canyon Road using the short ramp discussed in Section 4.5.5. Due to the site limitations, equipment that will be used at the site should undergo any major or preventative maintenance at the central construction yard area or before it is delivered to reduce the potential for having to perform maintenance at the dam site, which would essentially delay progress.

4.5.3.3 Temporary Power and Telephone Service

While there are overhead electric distribution and telecommunication lines within the project site (see Section 4.5.5), because of the configuration, it is unlikely that the owners (presumably PG&E and/or SBC-Pacific Bell) would allow these lines to be "tapped" for temporary construction power and/or telephone. Therefore portable power – especially if lighting for night work may be used to load trucks staged on Niles Canyon Road (see Section 4.5.5) during non-peak traffic periods will be needed on-site. In addition, a radio system should be employed for communication between the dam site and the construction office adjacent to the Sunol dam site.

4.5.4 Traffic Impacts

Due to the proximity of the dam site to Niles Canyon Road, traffic will be disrupted by the tasks to remove the dam and accumulated sediments – even if alternative access routes are used. The primary issues are discussed in Section 4.5.5 Alternative C and CHS Consulting has provided addition information regarding traffic conditions along this roadway (see Appendix B).

4.5.5 Other Construction Issues

4.5.5.1 Site Access

Equipment access to the site is the most problematic issue associated with the removal of Niles dam and the associated sediments. The following three alternatives for site access have been evaluated:

<u>Access via Old Canyon Road (Alternative A)</u>: The distance from the intersection of Niles Canyon Road with Old Canyon road to the dam site is approximately 1.9 miles (see Figures 4-8 and 4-9). This road pre-dates Niles Canyon Road and used to connect to Palomares Road, which is upstream of the dam site. However where the road used to cross Alameda Creek, the bridge no longer exists and only the remnants of one pier remain.

About half of Old Niles Canyon road is maintained and paved as a two-way residential type street. This portion of the road could be used to bring in the equipment and dump trucks needed to remove the dam and haul off the debris and sediments. But the intersection with

Niles Canyon Road does not allow trucks with standard 40 feet trailers to be able to effectively make a right-hand turn (eastbound) onto Niles Canyon Road. This could pose a problem since most of the quarry operations that could accept the removed sediments are east of this intersection and so is the proposed construction office. However use of warning signs and flagmen could be employed to control traffic during times when trucks would need to make right-hand turns. Otherwise, all trucks would have to head westbound on Niles Canyon Road.

Beyond the maintained portion of the Old Niles Canyon Road, the road has not been serviced for years, if not decades. This road parallels and runs in-between both Alameda Creek and the NCR. It appears that this road was originally single-lane. So to prevent equipment from attempting to pass each other, a radio system with controls at each end would have to be implemented. At the dam site, the road is not clearly visible with only segments of the old pavement are exposed. Vegetation has established itself and is reclaiming the alignment so the roadway would likely need to be cleared for its full length and we anticipate that selective tree trimming and removal would also be required. In addition there are areas where the relatively steep gradient between the railroad and the creek exists that may require work in Alameda Creek to replace sections that have been eroded (see discussion under item B, below). In addition, the numerous potholes would have to be filled in.

Lastly, since this road only serves to provide access to the dam, once the dam has been removed, there should not be a need for an access road. So any improvements should be viewed as temporary and only for the duration of the removal work.

Access via the Niles Canyon Railroad[13] (NCRR) (Alternative B): This railroad is on the left-side of the dam (looking downstream) and has a yard area in Sunol where equipment and debris could be handled. Conceptual level conversations with a representative from this non-profit organization indicate that they would be willing to allow the use of their equipment including two side-dump cars and they could obtain additional cars if needed. They will not permit heavy equipment, either rubber-tired or track mounted, to cross the bridge immediately upstream of the dam site, so all equipment would have to be loaded onto flatbed cars and then transported to the site.

At the dam site, the railroad is approximately 35 feet higher than Alameda Creek, so handling of equipment would require construction of some form of a heavy timber platform and access

[13] The Niles Canyon Railroad operates along the right-of-way that is owned by Alameda County and the facilities are operated by the Pacific Locomotive Association.

ramp. A conveyor system could be used to load sediments and debris from the dam removal at the creek and dump it into the side-dump cars. The railroad would then transport these cars to their Sunol yard where some[14] or all of it would then be loaded onto trucks.

Conceptually, the NCRR would establish the cost to use the right-of-way and equipment based on the greater of either their actual costs or "competitive" with what they estimate the cost to truck the sediments from the dam site to be. Depending on how they estimate the trucking costs, this alternative could be cost effective while minimizing impacts to Niles Canyon Road.

<u>Access via Niles Canyon Road (Alternative C)</u>: Niles Canyon Road is a single-lane roadway in each direction with a few shoulders along the alignment. It serves as part of the commute corridor between Sunol and Fremont. Therefore the peak traffic times are in the weekday mornings and evenings. At the dam site, a stacked rock retaining wall separates the roadway from the dam and impoundment. There is a short length shoulders on the eastbound direction. In the westward direction there is a small gravel area that is not signed as a turnout, but is wide enough to allow a couple of small vehicles to park off the paved road. Reportedly, the prime habitat for the Alameda Whipsnake begins at the edge of this gravel area (personal communication with Brian Pittman [ESA]).

During non-peak times (either during the mid-day or evenings), Caltrans has and does allow limited road control. In fact, Caltrans past practices have been to completely closes sections Niles Canyon Road on a couple of days each year (typically on a Sunday) so they can remove brush and perform maintenance.

To remove the dam debris and sediments, the eastbound lane would have to be closed to allow trucks to be staged and loaded. Flagmen and a pilot car would be needed at each end of the road control to allow public vehicles to pass the construction site. In addition battery (and/or solar) powered flashing warning lights and signs would need to be placed well in advance of the work and due to the road alignment in the vicinity of the work site, extra signs and warning lights should be used (see Figure 4-3).

[14] NCR representative indicated that the larger material (boulders, cobbles, and possibly broken concrete) associated with the removal tasks the organization may want to use to buttress portions of the fill supporting segments of the railroad. Their main area of concern is where the railroad parallels Alameda Creek and the old road is in-between the railroad and the creek. So it is likely that the old roadway will need improvement and buttressing if it is going to be used to provide access to the dam site.

To reduce the traffic impacts, the loading tasks will have to be scheduled during the non-peak times and should take advantage of weekends – especially when Caltrans plans to completely close sections of this road and on other Sunday mornings so the material would need to be stockpiled adjacent to the roadway ahead of time. In addition, small 10-cyd dump trucks should be used instead of the larger double-trailers, and the number of loads/shift should be limited. Given the scope of work, Caltrans will require a traffic control plan be approved before any work begins.

4.5.5.2 Discussion of Access Alternatives

Initial Access: Getting the initial set of equipment onto the left bank (looking downstream) is critical to get the creek diversion channel built (see Section 4.4, above). This can only be accomplished by one of two options. The first option is to off-load the equipment from Niles Canyon Road (Alternative C) and (then assuming that water quality and/or the resource agencies will not allow the equipment to be driven across the shallow, active creek channel) either barging, building a heavy timber "roadway", or setting up a large crane on Niles Canyon Road to try to lift the equipment across the creek. The second option is to drive only this limited set of equipment in from the Old Niles Canyon Road (Alternative A) with limited tree trimming and without attempting to make any significant repairs to this abandoned roadway.

Frequent Access: Once the creek has been diverted, daily access will be needed to get construction personnel to and from the site. Near-daily access will be needed primarily to provide fuel and maintenance of the equipment. And bi-weekly access will be needed to remove garbage and debris, service the portapotties, etc. For these activities, access via the Old Niles Canyon Road (Alternative A) would create the least impact to traffic on Niles Canyon Road. However work to improve this old roadway may not be practical or prudent.

As an alternative, build up a ramp adjacent to the stacked-rock wall that can be used by small vehicles (e.g. pick-up or short-bed truck). This ramp could have a relatively steep slope of between 6% to 10% and have a pad level with the adjacent Niles Canyon Road that is large enough to allow a standard vehicle to wait unit traffic control will allow the vehicle to exit. To minimize the size of this ramp, the upstream sheetpile cutoff could be started near the stacked-rock wall with the sheetpiles extending up to about the elevation of the road so that the sheetpile will act as a retaining wall for the upper portion of the ramp. Initially some imported gravels would be needed to build this ramp. There is not enough room to allow vehicles to enter and exit from either direction on Niles Canyon Road. Since the primary yard area and haul route will be eastbound, the ramp should be placed to allow vehicles exiting the site to head east without having to cross over. A proposed site for the ramp is shown in Figure 4-3). After the ramp is no longer needed, an excavator working from Niles Canyon Road would remove it and load it into a dump truck to be hauled off-site.

Access to Remove Sediments and Debris: Removal of the dam debris and sediments can be accomplished using either Alternative C "Access via Niles Canyon Road" or by conveyor onto the railroad (Alternative B "Access via the Niles Canyon Railroad"). Alternative A should only be considered if the other two alternatives are not acceptable. For purposes of developing a project description, the area of ground disturbing activities includes the areas associated with both Alternative B and C (see Figure 4-3).

Overhead Utilities Present: Within the work site and directly above the dam itself are overhead telecommunications and electric distribution lines. While it appears that these lines are high enough to be out of the way of the construction work, caution should be exercised to prevent construction activities from coming in close contact or damaging these utilities. There is at least one joint utility pole (with no provisions for a pole mounted transformer, nor a splice box for the telecomm.) within the work site, so a temporary construction barricade should be placed approximately 5 feet from this pole as a reminder to stay clear. Also if construction activities will require equipment working within 10 feet of any electric distribution line, a qualified observer will be required to be present for the duration of these activities.

4.5.5.3 Disposal Options

Concrete Debris: The Ferma Corporation presently operates a concrete recycling facility near the town of Sunol - approximately 4 miles east on Niles Canyon Road from the dam site and adjacent to the NCRR. An alternative location would be to transport this debris to a landfill, either in Pleasanton or in Livermore. These landfills are approximately 10 miles and 17 miles from the town of Sunol, respectively.

Sediments: Within the vicinity of the dam site, there are a number of quarry operations that may be willing to accept the sediments. The quarries to the east of the dam include: Niles Canyon Quarry (5550 Niles Canyon Road), Mission Valley Rock Company (7999 Athenour Way, Sunol), and RMC Pacific Materials (6527 Calaveras Road, Sunol). To the west of the dam, the Tri-City Rock (43157 Osgood Road, Fremont) is the closest.

4.5.5.4 Other Construction Issues

Equipment: Due to the location of the work site, all equipment should have spark-arresting devices installed to prevent the possibility of an accidental fire.

Cleaning Niles Canyon Road: With the primary access and haul work being performed on Niles Canyon Road, dirt, gravels, and water (predominately associated with sediment removal tasks) will get deposited onto the roadway. After each shift, the segment of roadway adjacent to the dam site should be swept clean. The contractor may propose to "wash-down" this segment of road as an alternative, but this should be avoided to prevent introducing oils (or other chemicals typically found on roadways) from being introduced into the work site and potentially into the creek.

Dust Control: Within the work site and not including Niles Canyon Road, water collected in the settling basin can be used to control dust providing that the downstream cutoff is suitably sized to contain the flows until the fines have had time to settle out.

Joyland Park: According to a representative from the NCRR, the remnants of features observed during the site visit were once part of an area named Joyland Park. During the site visit, we observed a form of memorial or shrine near what appeared to be the remnants of a drinking fountain. Presently the conceptual removal plans are based on there not being anything of significance at this site since the park is not addressed in either the Final Alameda Watershed Management Plan, dated April 2001 or the JRP Historical Consulting Services report dated January 2003. In the absence of any additional information about this specific item, temporary construction barricades should be placed around the area and any construction plans adjusted accordingly to avoid disturbing this feature.

Restrict Public Access: To prevent trespassing to both the dam and the adjacent terraced area (part of the terrace used to be called Joyland Park), the two primary accessways should have pedestrian barriers installed. The primary access is from the shoulder of Niles Canyon Road immediately next to the dam. Despite the position and enforcement of a "no parking" sign, people still enter the area from the road. While removal of the middle section of the dam will make it more difficult to cross the creek, additional barriers should be installed immediately adjacent to the road. We recommend that a combination of planting blackberry (or similar) vegetation with mortaring rock of varying size and heights could be installed to increase the difficulty to access and reduce the temptation to loiter in this area. The second access point is where Palomares Road is adjacent to the NCRR bridge (Farwell bridge). Ideally a locked gate at the bridge and crossing the tracks would stop the trespassing. However this will require coordination with the NCRR (which typically operates only on weekends). An alternative would be to install a length of chain link fencing with a lockable gate parallel to Palomares Road. A gate is needed to allow access by NCRR personnel.

4.6 COST ESTIMATES AND CONSTRUCTION SCHEDULE

4.6.1 Cost Estimate

RS Means Heavy Construction Cost Data has been used as the basis for estimating the cost to perform the work. Since most of this work consists of site work and demolition, a combination of approaches has been used to estimate the costs. For the demolition of the dam and some of the tasks associated with the sediment removal, the costs are based on the "bare" equipment monthly rental cost plus the "bare crew cost per day" combined with an estimated duration or production rate. For other tasks, the costs are based on the unit quantities multiplied by "bare unit costs". Due to the uncertainty regarding the volume of sediments to be removed, costs have been estimated based on a range of 700 and 2,800 cyd of sediment to be removed. These costs have then been adjusted using RS Means City Cost Index to reflect the cost of performing work in the bay area and they have been escalated by 3.3% per year to reflect construction in 2005. In addition 3.1% has been added to cover miscellaneous management and reporting requirements typical of projects of this type. Then both an overhead rate of 18% and contractor's profit goal of 10% have been applied. Since this project is still in the conceptual phase, a 15% contingency has also been applied.

Volume of Sediment Removed (cyd):	2,800.	700.
Sub-Total Cost:	$ 585,600.	$ 401,000.
15% Contingency:	$ 87,600.	$ 60,100.
Total Estimated Cost:	**$ 672,200.**	**$ 461,100.**

The sub-total cost includes a proportion of the construction office that will be shared between both projects. The breakdown of costs by primary activities are:

Volume of Sediment Removed (cyd):	2,800	700
Common (e.g. share of the construction office, preparation of traffic control and erosion control plans):	21%	18%
Creek Diversion & Dewatering:	15%	22%
Dam Removal and Hauling Off-site (~ 107 cyd)	19%	28%
Sediment Removal and Hauling Off-site:	30%	11%

Site Work (e.g. clear & grub, access downstream of dam, revegetation allowance)	15%	21%
Total:	100%	100%

4.6.2 Construction Schedule

A detailed schedule has been developed using Microsoft Project assuming that the work will be performed under one contract (between Sunol and Niles), work within Alameda Creek can not begin until June 1st) due to creek flows and environmental constraints) and needs to be completed before October 15th, using a calendar that reflects Federal Holidays and 8 hour work shifts per day. The critical path consists of obtaining an approved traffic control plan, clearing the site which includes relocation of aquatic and terrestrial animals, diverting the creek flows into the aqueduct, breaching the dam, removal of sediments, and revegetation of the key areas where ground-disturbing activities were performed. The milestone dates and durations for key tasks are as follows and the detailed schedule plan for the removal of Niles dam is included in Figure 4-10:

Notice to Proceed:	2/1/05
Start Construction:	5/1/05
Complete Construction within Alameda Creek:	8/9/05
Complete all Construction	9/19/05
Install Creek Diversion System:	3 weeks
Dam Removal:	4 weeks
Sediment Removal (3000 cyd):	4 Weeks

4.7 RECOMMENDATIONS

Based on the proposed dam and sediment removal activities, we recommend the following actions be taken either as part of the design phase or as part of the environmental permitting process:

1. Equipment access to the site will have the biggest impact on the construction cost and schedule. As part of the design phase, the three alternatives identified in this report should be further developed to be able to determine the preferred alternative for incorporation into the construction contract documents

   If access along the Old Niles Canyon Road may become the preferred approach for hauling out the dam debris and sediments, public outreach of the affected neighborhood should be implemented.

2. Using Niles Canyon Road to haul off the dam debris and sediments is likely to require work during non-traditional work schedules. Night work may be required by Caltrans to reduce traffic related impacts. So the environmental impacts associated with night work should be identified to ensure that the lights would not inadvertently attract an endangered or threatened species into the work site.

3. If use of Niles Canyon Road will be the preferred access route, Caltrans should be contacted to discuss the scope of work and to develop requirements that will need to be addressed in the traffic Control Plan. In addition contacting Caltrans to understanding when they completely close sections of this road will allow the Contractor to determine any positive or negative impacts associated with the dam and sediment removal work.

4. Survey the trees and other vegetation within the area where ground-disturbing activities are planned (see Figure 4-3) to ensure that there are no critical issues or mitigation that would be needed. In addition, this survey should extend along the alignment of the Old Niles Canyon Road (See Figures 4-8 and 4-9) for a width of approximately 12 to 15 feet. . This work should consist of tagging trees over 6-inch dbh (diameter at breast height) and locating them (as well as other critical vegetation) on the topographic map.

5. The owners (presumable PG&E & SBC/Pac-Bell) of the overhead utilities crossing through the work site should be contacted to inform them about the project and to determine the feasibility of tapping into their utilities for temporary construction power and/or communications.

6. Further research is needed to document the contents and significance of the gravel terraced area on the left bank (looking downstream) that was reportedly known as Joyland Park, and to determine what, if any, significance the observed memorial or shrine may (or may not) have.

7. Revegetation is scheduled to be performed in the late summer of 2005. Given the dynamic conditions of this watershed, winter creek flows are likely to alter the creek channel. In addition, environmental monitoring of revegetated areas will likely be required for a period of at least 2 years and may be required to extend up to 5 years. Therefore it would be reasonable to defer revegetation adjacent to the creek channel until spring of 2006. This would also allow the work to begin harvesting and propagating local specimens in 2004 instead of this year.

5.0 BASIS FOR RECOMMENDATIONS

In the performance of our professional services, Geomatrix, its employees, and its agents comply with the standards of care and skill ordinarily exercised by members of our profession practicing in the same or similar localities. This report may not provide all of the information that may be needed by a contractor to construct the project. No warranty, either express or implied, is made or intended in connection with the work performed by us, or by the proposal for consulting or other services, or by the furnishing of oral or written reports or findings. We are responsible for the conclusions and recommendations contained in this report, which are based on data related only to the specific project and locations discussed herein. In the event conclusions or recommendations based on these data are made by others, such conclusions and recommendations are not our responsibility unless we have been given an opportunity to review and concur with such conclusions or recommendations in writing.

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TABLE 1
LIST OF AERIAL PHOTOGRAPHS REVEWED FOR THIS STUDY

Conceptual Engineering for Removal of Sunol and Niles Dams
Alameda County, California

Reservoir Site	Flight Line	Frames	Scale	Date
Sunol	AV 253-25	46 & 47	1:12,000	5/10/1957
	ALA AV-3845-25	45 & 46	1:12,000	8/30/1990
	ALA AV-5200-27	47 & 48	1:12,000	10/16/1996
	ALA AV-8202-26	47 & 48	1:12,000	7/10/2002
Niles	AV 119-28	19 & 20	1:10,000	8/21/1954
	AV 337-11	78 & 79	1:9,600	7/8/1959
	AV 902-10	50 & 51	1:12,000	5/16/1969
	AV 1377-10	62 & 63	1:12,000	7/7/1977
	AV 2300-10	58 & 59	1:12,000	6/21/1983
	AV 3080-16	2 & 3	1:7,200	5/4/1987
	AV 4625-24	47 & 48	1:12,000	7/11/1994
	AV 8202-23	48 & 49	1:12,000	6/27/2002
	AV 8202-24	47 & 48	1:12,000	7/10/2002

APPENDIX A
CASE HISTORIES REPORT
(PREPARED BY HDR)

SFPUC Project No. CUW 248

Conceptual Engineering for
The Removal of Sunol and Niles Dams
Alameda Creek, California
Task 1: Case Study

Prepared for:

San Francisco Public Utilities Commission
Utilities Engineering Bureau
City and County of San Francisco
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MARCH 2003

TABLE OF CONTENTS

1. PURPOSE:

The purpose of this report is to assist in the planning and conceptual design of the removal of Sunol and Niles dams on Alameda Creek by providing information on recent dam removal projects that are of similar scale and/or environmental setting. Understanding how other dam owners approached their removal and the range of options they considered, both from a technical and environmental perspective, will provide a resource for the team to draw upon when developing the site-specific requirements associated with removing each of these two dams.

2. OVERVIEW - DAMS IN THE UNITED STATES

The United States Army Corps of Engineers has cataloged more than 75,000 dams that are 6 feet high or more and impound at least 50 acre-ft of water or that are greater than 25 ft high and impound at least 15 acre-ft.

Dams were (and are) built for many purposes:

Original Purpose:	Percentage
Recreation	31.3
Fire & Farm Ponds:	17.0
Flood Control	14.6
Irrigation	13.7
Water Supply	9.8
Tailings & Other	8.1
Hydroelectric	2.9
Navigation	0.3

Most Dams are locally owned:

Ownership:	Percentage
Private	58.1
Local Government	17.1
Undetermined	14.8
State Government	4.9
Federal Government	2.9
Public Utility	2.2

3. DAM REMOVAL

Dams have been removed or breached in 40 of the 50 states[1]. Twelve states have removed 10 or more dams. The top 5 states that have removed the most dams are Wisconsin (86), Pennsylvania (51), California (48), Ohio (39) and Tennessee (25). The inventory of over 500 dams that have been removed in the last few decades indicates that the median height and crest length are 15 ft and 170 ft, respectively.

The reasons for dam removal tend to fall into the following categories:

Environmental	43%	
Safety	30%	(Overtopping, foundation defects, piping & seepage)
Economics	18%	(Especially if fish passage must be provided)
Failures	6%	
Unauthorized Dam	4%	
Recreation	2%	

[1] The American Rivers Organization maintains a database that consists of approximately 500 dams that have been removed prior to 2002.

However, the cost of removal varies significantly depending on jurisdiction[2], the size and extent of removal, public support, and the environmental issues (e.g. $1,500 to remove Amish Dam in Pennsylvania to $ 3,200,000 to remove 2-Mile Dam in New Mexico). Furthermore, not all dam removals have been successful. For example, the removal of Fort Edward Dam in New York (in 1973) resulted in several tons of PCB-laden sediments that were trapped behind the dam being released downstream following the dam's removal.

LESSONS LEARNED:

FORT EDWARD DAM

- Estimate volume of sediment upstream of dam and potential impacts of sediment on downstream navigation, structures, and other river uses
- Where historic records of upstream activities indicate possible presence of pollutants in the river, test accumulated sediment upstream of dam for potential pollutants
- Investigate potential hazards and blockages in reservoir that become exposed with dam removal
- Determine clear and unambiguous conditions in removal authorizations.

The primary concerns with dam removal are:

- Sediment transport and floodplain dynamics.
- Declining water quality during drawdown,
- Invasion of the upstream portion of the river system by exotic species that were formerly blocked by the dam,
- Loss of wetland habitat,
- The release of toxins or excess nutrients from the sediment,
- Loss of historic and/or community value

Yet despite the costs and obstacles, the benefits associated with dam removal include:

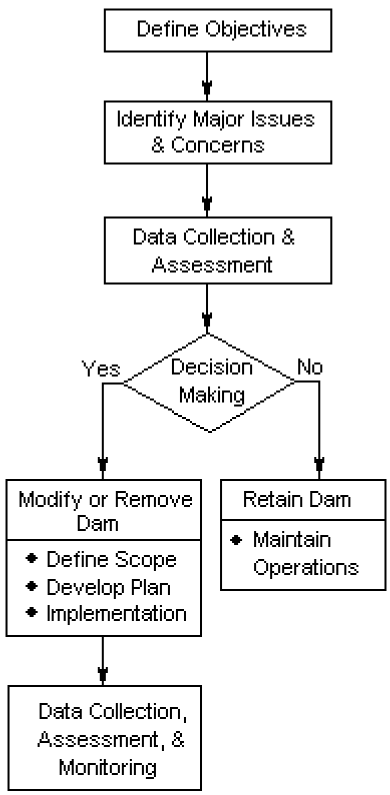
- Re-establishing fish passage
- Restoring threatened or endangered species
- Restoring river habitat
- Improving water quality
- Removing dam safety risks and associated liability costs
- Saving taxpayer dollars
- Improving aesthetics of the river
- Improving fishing opportunities
- Improving recreational boating opportunities
- Improving public access to the river, both up and downstream
- Recreating "new" land for parks or landowners
- Improving riverside recreation
- Improving tourism

[2] Pennsylvania Department of Environmental Protection (DEP) adopted procedures to streamline permitting procedures – typically 12 to 18 weeks (Removal of Seven Dams, Conestoga River, PA). The states of Massachusetts and New Hampshire have also implemented a similar process.

4. THE DECISION PROCESS

Because of the concerns, the decision process typically takes several years while the actual demolition or de-construction takes significantly less time – typically in the range of weeks to months for small dams[3].

The decision process that is being adopted consists of the following multi-step sequence that includes an "open" decision making process:



1. Define the goals and objectives.
2. Identify major issues and concerns
   - Safety and Security
   - Environmental
   - Legal and Administrative
   - Social
   - Economic
   - Management
3. Data Collection and assessment.

   The typical components that should be considered as part of the environmental assessment are:

   Physical & Chemical Components
   - River transect surveying
   - Bathymetric & sediment depth mapping
   - Hydraulic and hydrologic modeling
   - Sediment properties & erodibility characteristics
   - Inundated floodplain analysis
   - Sediment transport modeling
   - Sediment re-suspension due to wind
   - Sediment loading to the river below the dam
   - Surface water quality analysis
   - Groundwater impacts of drawdown
   - Sediment characteristics, toxics & seedbank analysis

   Biological & Ecological Components
   - Fish population assessment
   - Migratory fish populations analysis
   - Aquatic plant populations and management
   - Bird populations assessment
   - Endangered, threatened, special concern species
   - Floodplain forest succession modeling
   - Habitat assessment

   Societal Components:
   - Historic and or cultural significance
   - Impacts to local communities and the economy

---

3 Dam size is typically measured in terms of its storage in acre-ft with small ≤ 100, medium ≤ 10,000, large ≤ 1,000,000 and very large > 1,000,000.

4. Decision-making: <u>Full Retention</u> (*retain the dam and reservoir* with active management for fish and wildlife resources) or

   <u>Modification or Removal</u> (all or portion).

   (If the decision is to modify or remove the dam, then the next two steps are performed).

5. Modify or Remove Dam. The range of options typically considered are:

   <u>Modification</u> *Alter the dam* to achieve goals and objectives. In most cases, modifications are required in response to safety concerns or to facilitate or improve fish passage/migration. As the degree or cost to modify the dam increase, dam removal options become more viable.

   <u>Partial Retention</u> *Reduce the size of the impoundment* while restoring a portion of the impounded river. This is typically associated with partial breaching of the dam.

   <u>Partial Restoration</u> Restore river hydrology and floodplain function with *limited removal of structures* and alteration of topography. This is associated with either full or partial breaching of the dam.

   <u>Full Restoration</u> Restore river hydrology and floodplain function, flora and fauna and *remove all structures* and return topography to pre-construction conditions.

6. Data collection, assessment, and monitoring both during construction and afterwards.

5. CASE STUDIES

While there have been numerous dams removed, the documentation supporting their removal has not been consistently recorded. Furthermore where documentation exists, there are few dams similar to Sunol and Niles dams in terms of size (i.e. height and crest length), type of construction (concrete-gravity), and degree of historical significance. However, the following seven dam sites (some having more than one dam) were determined to be relevant case studies and the full case study text that has been reported by others have been included as appendices to this report:

- Old Berkshire Mill Dam (Massachusetts)
- McCormick-Saeltzer Dam (California)
- 2 Swim Dams, East Bay Regional Parks (California)
- Waterworks, Oak St. and Glenville (Linen Mill) Dams (Wisconsin)
- Alphonso Dam (Oregon)
- McGowan, McPherrin, Western Canal East, and Western Canal Main Dams (California)
- Jackson Street Dam (Oregon)

The pertinent issues associated with these dams have been summarized in the Comparison Table (Section 8) and the full case study (that were performed by others) have been included as appendices to this report.

While the above referenced projects have elements that are very similar and applicable to the Sunol and Niles dam removal project, there are lessons to be learned from other removal projects. The pertinent information from the following dams removal projects have also been included in the findings and lesson learned section of this report, but their full case studies have not been included in the Appendix – with the exception of the Fort Edwards Dam project.

- Lake Christopher Dam (earthen dam, 10 ft. high, 400 ft. crest length), Cold Creek (S. Lake Tahoe), California
- McGoldrick Dam (rock-fill, 6 ft high, 150 ft. crest length), Ashuelot River, New Hampshire.
- Matilija Dam (Concrete, 200 ft. high, 620 ft. crest length), Ventura River, Ventura California. *Removal studies are in progress.*
- Good Hope Dam (7 ft. high, 400 ft crest length), Conodoguinet Creek, Pennsylvania.
- Fort Edwards Dam (Concrete, 31 ft. high, 586 ft. crest length), Hudson River, in Fort Edward, New York)
- Anaconda Dam (rock-filled crib, 11 ft high, 327 ft. crest length), Naugatuck River in Connecticut.
- Platt's Mill Dam (rock-filled crib, 10 ft. high, 231 ft. crest length), Naugatuck River in Connecticut.
- Freight St Dam (rock-filled crib, Concrete, 4 ft. high, 150 ft. crest length), Naugatuck River in Connecticut.
- Grangeville Dam (arched concrete, 56 ft. high, 440-foot crest length), South Fork of the Clearwater in Idaho.

6. FINDINGS AND LESSONS LEARNED

Planning & Permitting:

A. Schedule: The average duration from identification of the need to remove a particular dam to the actual removal took 3 to 4 years. In some instances the process was significantly shorter and in others it took significantly longer. Reducing the time to complete the removal process occurred when:

- The State had established a streamlined permitting process for reviewing dam removal plans.
- The regulatory agencies and non-governmental organizations (NGOs) were involved early on in the process and collaborative working relationships with all of the stakeholders had been established.
- Removal of the dam had a positive impact on improving fish passage, but did not have an associated negative impact to endangered, threatened, and/or species of special concern, nor did it lead to degradation of sensitive wetlands and/or riparian habitat.
- There was no contamination found to be present in the impounded sediments.
- Studies of the key issues or environmental concerns had been performed.

B. Process: With the exception of states like Pennsylvania, Massachusetts, and New Hampshire that have adopted a streamlined process to facilitate dam removal, most permitting agencies have not adopted any changes to their process or procedures. Most permitting agencies do not differentiate between new construction and “deconstruction” or “reconstruction” which means that typically there are no compromises between short-term impacts associated with the removal and long term benefits associated with an unobstructed river.

> *Example 1:* For the removal of the Old Berkshire Mill Dam (MA), the permitting costs were twice the actual cost to remove the dam. In addition to the preparation of an environmental impact report, 11 permits were required before the actual work to remove the dam could begin.
>
> *Example 2:* Agency approvals for the removal of the 2 Swim Dams (CA) required that the work be performed during a timeframe where the physical work would minimize environmental impacts and water quality requirements were no different than if the project consisted of new construction.
>
> *Example 3:* Both an Environmental Impact Statement (NEPA) and Report (CEQA) had to be completed before the McGowan, McPherrin, Western Canal East, and Western Canal Main Dams (California) could be removed. Impacts associated with the removal work required that mitigation measures be incorporated into the plans.

B. Non-Governmental Organization (NGO) Involvement: Lack of community or local support can impact dam removal plans and delay their removal.

> *Example 1:* Some residents felt that the prior use of the Waterworks, Oak St. and Glenville (Linen Mill) dams were inexplicably linked to the sense of community and therefore were not initially in favor of removing the dams. Support for the removals was obtained based on an agreement to add an interpretive component with a river walk to document and illustrate the role of the dams in relation to the growth of the community.
>
> *Example 2:* Removal of Lake Christopher Dam (S. Lake Tahoe, CA) was delayed about one year when residents learned that trees had to be removed and that a diversion ditch, that the residents used, would be relocated.

C. Resource Agency Involvement: Delays occurred when there were resource agencies that had not been involved early on or where collaborative working relationships had not been developed.

> *Example – Agency Not Involved Initially:* Removal of McGoldrick dam (New Hampshire) was delayed because the State Historic Preservation Office (SHPO) had not been involved early on in the project. SHPO determined that historical review was necessary prior to any removal could begin.

Example – Collaborative Working Relationship with Agencies: While the removal of the Old Berkshire Mill Dam (MA) still had to obtain 11 permits, because the agencies had been involved early on, they agreed to expedite their respective reviews which allowed the removal to stay on schedule.

D. Post-removal Activities: Monitoring after the dam removal work has been completed has been required on almost all dam removal projects. The duration ranges from two to five years.

Impacts to Existing Habitat:

Most of the dam removal projects have focused on improving passage for anadromous fish that are listed at either a federal and/or state level. In some instances a dam removal had to also address other environmental issues that may be similar to issues including:

A. No loss of Wetland Habitat:

Example: Only one of the case studies evaluated (Old Berkshire Mill) forecast a net increase in wetlands following its removal, which is typically an exception to dam removal. A subsequent phone conversation with one of the engineers involved in this project indicates that the forecast increase was based on the amount of newly exposed surface area combined with expected high organic content in the sediments that would become exposed. No measurements have been taken to verify that any increase actually has occurred and due to actual site conditions, there may not have been any net increase in wetlands. However the main objective was to ensure that there was no net loss of wetlands and they believe that this objective has been achieved.

B. Minimize Impact to Riparian Habitat:

Example: The removal of the 2 Swim Dams (CA) included mitigation to the riparian habitat using a planting ratio of 3 replacements to 1 removed.

C. Minimize Impacts to Other Species:

Example 1: The primary purpose of the removal of McGowan, McPherrin, Western Canal East, and Western Canal Main Dams (Butte River California) was to improve fish passage for steelhead and spring-run Chinook salmon. However water diverted by these dams was also used to flood adjacent rice fields, which also attracts numerous migrating waterfowl. The removal plans had to include provisions to ensure that there would be sufficient water to continue to flood these fields so that waterfowl migrations would not be impacted.

Example 2: Current studies to remove Matilija Dam (CA) have indicated that red-legged frogs are likely to be present and therefore mitigation measures will most likely be required. However due to the size and complexity of the issues surrounding the removal of this dam, no strategy has yet been developed and presently there is no reliable schedule for when this dam may be removed. Furthermore, conversations with representatives from American Rivers and other consulting firms have not identified a dam removal case study where this issue was encountered and had been resolved.

Sediment Issues:

A. Sediment Transport Modeling: Analytical models of sediment transport (e.g. HEC-6[4]) are not considered accurate in predicting downstream impacts. If some level of sediment transport is going to be a component of this dam removal project, understanding and quantifying the concerns of downstream "users" (e.g. Alameda County Flood Control and Conservation District, and the Alameda Creek Restoration Workgroup) should be performed.

Example 1: Evaluations - not using HEC-6 – associated with the removal of Fort Edwards Dam (NY) did not identify any significant impacts associated with allowing the river flows to gradually redistribute the impounded sediments. However these sediments clogged the shipping channels and the state of New York had to remove 615,000 cyds from 1974 to 1976 to restore navigable channel.

Example 2: Removal of Good Hope Dam (PA) cost $38,000 but an additional $200,000 was spent on riparian restoration and mitigation for infrastructure that was affected by the removal.

Example 3: Removal of Old Berkshire Mill Dam cost $133,000 with an additional $360,000 spent to protect utilities and an upstream bridge.

NOTE: Analytical models using HEC-6 have been performed, typically on the larger dam removal projects. The results have been mixed and recent studies have documented instances where actual sediment transport and re-deposition have been different than predicted by analytical models. These studies have also recommended that additional work is needed to refine the accuracy of the model before it can yield more reliable and accurate results than can be obtained by using the more costly physical model.

B. Sediment Sampling & Characterization: Sampling to characterize the sediments entrapped behind the dam should be performed to establish estimated volumes, gradation and transport potential, and estimate if there is the likelihood that toxic chemicals or minerals may be present. The extent of this work varied by project. In general, more sampling and laboratory tests were performed on projects where a) removal was planned after the mid-1970's (i.e. after the removal of Fort Edwards Dam), b) sediment transport was considered an essential or key component of the removal process, c) large volumes of entrapped sediments were present, and/or d) it was very likely that there may be toxic chemicals and/or minerals present in the entrapped sediments based on known upstream industrial and/or mining operations.

[4] HEC-6 is a one-dimensional movable boundary open channel flow numerical model designed to simulate and predict changes in river profiles resulting from scour and/or deposition over moderate time periods (typically years, although applications to single flood events are possible). It was developed and is maintained by the U.S. Army Corps of Engineer's Hydraulic Engineering Center (HEC).

Where sediment removal was determined early on to be the preferred approach and the potential for toxins or heavy metals was considered to be low, the scope of the sediment sampling and characterization work tended to be less extensive. But where there was a potential for toxic chemicals and/or minerals to be present, additional sampling and testing was also performed during the sediment removal operation.

> *Example 1:* The proposed removal of Matilija Dam (CA) has identified approximately 6,000,000 cyd. of uncontaminated sediments. The estimated cost to remove them range from $22 million to $180 million depending on method or removal and disposal location which far exceeds the cost to remove the dam.
>
> *Example 2:* Removal of Fort Edwards Dam (NY) did not adequately characterize the sediments. Polychlorinated biphenyls (PCBs) that had accumulated behind the dam were released when the dam was removed. In 1997 and 1998, the State of New York had to remove over 180,000 cyd. of contaminated sediments.
>
> *Example 3:* Evaluations performed on sediments impounded behind the Old Berkshire Mill Dam (MA) revealed the presence of dioxins and furons. Because of these findings, the sediments were removed in the dry and deposited above the normal high water line on another part of the site.
>
> *Example 4:* Sediment sampling and laboratory test results that was performed prior to the removal of Anaconda Dam (CT) did not identify any toxic chemicals or minerals. During the removal, a concentrated layer contaminated with motor oils was found.
>
> *Example 5:* Results of sediment sampling work that was performed prior to the removal of Platt's Mill Dam (CT) did not identify any contamination. However past upstream uses revealed that heavy industry had occurred so that it was likely that contaminants could have been introduced into the Naugatuck River. So the project included a contingency plan for the removal of a small amount of contaminated soil. During the sediment removal work, a small pocket of contaminated soil was found and the contingency plan was implemented without creating a significant delay or impact to the completion of the project.
>
> *Example 6:* For all of the case studies listed in the Comparison Table, the impounded sediment volumes were estimated and the nature of the sediments were characterized to develop appropriate sediment management strategies. As a result there were no surprises or sediment related problems associated with removal of each dam.

C. <u>Off-Site Sediment Disposal</u>: In California, off-site disposal has to comply with the Surface Mine and Reclamation Act (SMARA).

> *Example:* Removal of McCormick-Saeltzer Dam (CA) evaluated off-site disposal of the impounded sediments, but it was decided that on-site

disposal was more cost effective due the shorter haul distance verses the cost to transport the aggregate to a processing facility.

D. On-Site Sediment Disposal: On-site disposal of some or all of the accumulated sediments can be a practical and cost effective option.

Example: Sediments removed from behind both of the 2 Swim Dams (CA) were placed above ordinary high water. While the volumes were relatively small, this approach helped to reduce the cost to remove these dams, which are also within the Alameda Creek Watershed.

Removal Planning:

A. Focus on the Objective: Given all of the issues that need to be evaluated as part of the dam removal, it is easy to overlook certain aspects of the project goals and objectives.

Example: A small, dam on the Mad River in Connecticut was removed to improve fish passage and river restoration. The channel design consisted of a 100-ft wide riprap-lined channel. Under certain low-flow conditions, fish passage is hindered because no low-flow channel was included into the design.

B. Extent of Removal: Complete removal of all pertinent features may not be required nor be the preferred alternative given the historic significance and/or past use/purpose of the dam.

Example 1: The lower 4-ft of Old Berkshire Mill Dam (MA) was left in place. The level at which the removal stopped was considered to be lower than the expected post-removal channel invert, so full restoration would have been more costly and would not have produced any additional improvement to providing fish passage.

Example 2: The lower portion of Jackson Street Dam (OR) was left in place – in part to protect an underground utility that was left in place. V-shaped weirs were built downstream to create short-height "steps" that the fish could still pass over.

C. Contingency Planning: Despite the amount of engineering studies and planning, actual field conditions may vary to an extent that the plans and/or specifications need to be modified. Development of contingency plans and establishing good working relationships with the agencies is essential to minimizing impacts to the completion of the project.

Example 1: Removal of Old Berkshire Mill Dam (MA) included the construction of a low-flow channel. Sediment removal work exposed a large boulder directly on the alignment of this channel. Due to the good working relationship that had been established with the agencies, the alignment was quickly changed and a change order was avoided.

Example 2: During the removal of Freight St. Dam (CT), workers found that the dam's core had been reinforced with steel sheetpiles instead of reinforcing steel. Coring through the dam could have identified this feature, but would have been expensive. The project included a cost item in the estimate to account for the potential presence of areas that would be difficult to remove. Work was completed without any delays.

In addition, access to the site was difficult due to a high retaining wall on one side and a steep embankment on the other side. A vehicle accident forced the need to construct an emergency access downstream of the dam and across a short section of the cobbled riverbed. Because of the good working relationship with the agencies, this temporary access road was converted into the primary access road for the remainder of the project – in part because this road was viewed by the agencies as creating less of an impact than the other alternatives.

D. Contracting Strategies: Not all dam removal projects were completed using the traditional design then construct approach.

Example: The McCormick-Saeltzer dam removal project pursued a “partnering” contract at the 50% design stage that allowed some work to begin in advance of obtaining the Finding of No Significant Impact (FONSI) and allowed the proposed construction methods to be factored into the plans and the environmental assessment.

Method of Removal:

A. General Approach: Notching the dams first will reduce the water/reservoir impoundment and allow more of the construction to be performed in drier conditions.

Example: Removal of most of the dams evaluated in this report (Alphonso, 2 Swim Dams, Old Berkshire, and McCormick-Saeltzer) where sediments were to be removed from the channel, started with cutting a notch in the dam to reduce the impoundment. This allowed most of the sediment removal operation to be performed in the dry, which helped to reduce water quality issues as well as the need to have equipment working in the active stream channel.

B. Removal Schedule: Timing of the removal needs to commence when it will cause the minimum disruption and impact to native species present or likely to be present – especially those listed as endangered, threatened, and/or a species of special concern.

This was common to all of the case studies evaluated.

C. Equipment: To remove concrete-gravity type dam, conventional equipment consisting of excavators with a hydraulic hoe-ram attachment have been used and should be suitable for the removal of Sunol and Niles dams.

Example 1: Conventional equipment was used on all of the dams evaluated in these case studies. This equipment consisted of excavators with a hydraulic hoe-ram attachment to break up the dam into small enough pieces that it could then be hauled off by dump trucks.

Example 2: Portions of the Waterworks dam (WI) used heavy equipment to remove most of the dam. However in areas where extensive reinforcement was encountered, conventional explosives were used.

Example 3: Removal of Grangeville Dam (ID) was removed by an initial explosive blast using 5 tons of dynamite followed by further dismantling using heavy equipment. The explosives were used to breach the dam in August. Winter flows were sufficient to disperse the sediments downstream and there were no reports of adverse impacts to the fish habitat due to the natural sediment transport.

D. Site Dewatering: Dewatering /diversion systems should be installed in advance of any work to remove the actual dam. During this process it is likely that biologists will be needed to remove any species that may be present within the construction area. Where upstream, gated, reservoirs were present, flow limits should be established to reduce the risk associated with working within the riverbanks, which should also reduce construction bid prices.

Example 1: Removal of McCormick-Saeltzer (CA) dam included an agreement by the upstream operators to limit flows from Whiskeytown dam to less than 150 cfs. during the work in the channel. This helped to reduce construction risks and costs.

Example 2: Removal of Old Berkshire Dam (MA) required that cut-off berms be constructed both upstream and downstream of the work site. Culverts were installed to bypass the normal creek flows. Dewatering wells were placed in the upstream end to reduce the amount of groundwater.

Example 3: Jackson St (OR) used concrete dividers to create an artificial channel to divert stream flows around the work site.

In all of the case studies evaluated, the selection of the dewatering or diversion systems employed was based on the actual site conditions/constraints and the method selected for removing the dam and addressing the entrapped sediment.

E. Construction Phasing: Depending on the strategy adopted to address the accumulated sediment and to minimize impacts to endangered, threatened, or species of special concern, construction may need to proceed in multiple phases – not in one continuous operation.

Example 1: Removal of the Waterworks, Oak St. and Linen Mill (WI) was carried out in different seasons. Linen Mill Dam, which was the downstream most dam, was the last one to be removed.

Example 2: The Old Berkshires Mill was removed in two seasons. The first season consisted of breaching the dam with some sediment removal and the second season completed the sediment removal work.

F. Construction Associated with Removal: Removal may also have a component of "new construction".

> *Example 1:* Jackson St (OR) added downstream short-height weirs to allow fish passage in a series of "steps" over a pre-existing, buried, utility.
>
> *Example 2:* Old Berkshire Dam included using cobbles and boulders to create "riffles" that would help provide pools of the fish to rest.

Other:

A. Funding: If federal funds will be used to assist in removal of the dam, then the federal requirements (NEPA ~ Environmental Impact Statement) will be required in conjunction with the state requirements (CEQA ~ Environmental Impact Report). Presently the City of San Francisco has obtained a CalFed grant to assist in the removal process, which means that the project will only have to address the CEQA requirements.

> *Example:* Federal funds were used to remove McGowan, McPherrin, Western Canal East, and Western Canal Main Dams (CA). Therefore both an Environmental Impact Report and Environmental Impact Statement were prepared.

7. CONCLUSION

A. General:

1. Achieving Project Objectives: We do not anticipate any significant obstacles or barriers that would prevent the removal of this dam to allow fish passage and to address the safety related concerns associated with each dam.
2. Method of Removal: Removal using conventional heavy equipment appears to be the appropriate method providing that the environmental and sediment issues can be adequately addressed.
3. Historic Significance: Both dams have been determined to be historically significant (for different reasons) which will require State Historic Preservation Office (SHPO) approval of the removal plans. Therefore possible mitigation measures should be explored and factored into the conceptual level removal plans.

B. Sediment Management: A strategy needs to be developed to address the myriad of issues associated with the entrapped sediments. Specifically;

1. Sediment Characterization: The level of sediment sampling and testing is dependent upon the strategy that will be adopted for the removal of these dams.
2. Upstream Mining or Past-Uses: A preliminary evaluation (see Appendix 11) has determined a low probability of toxic mineral concentrations being produced within the watershed due to past mining activities. Tests on some of the sediment samples should be performed to independently determine what if any heavy metals are likely to be present.

3. Sediment Transport: Sediment transport options should be evaluated. Downstream agencies and users should be consulted to determine the viability of this option. If this option appears to be preferred, then the extent of the current sediment sampling program should be re-evaluated to ensure that the level of effort is commensurate with the project strategy for addressing this issue.

4. Off-Site Sediment Disposal: Given the close proximity of both dam sites to existing aggregate production facilities/quarries and low probability of toxic chemicals or minerals, hauling the entrapped sediments to one of these off-site locations may be the preferred alternative for sediment disposal. Additional work should be performed to understand the governing regulations – including but not limited to the Surface Mining and Reclamation Act (SMARA) of 1975 and current revisions (January 2000).

C. Unique to the Removal of Sunol Dam:

1. Aqueduct Integral With Dam: The aqueduct crossing over Alameda Creek is an integral feature of Sunol dam, originally to supply water to downstream users . If downstream water deliveries are still required or will be required in the future, then an alternative method for ensuring deliveries will need to be developed and incorporated into the dam removal plans.

2. Upstream Groundwater: One of the reported reasons for constructing Sunol dam appears to have been to backup the groundwater table in the gravel beds to increase the yield of the Sunol Infiltration Galleries. We were unable to find any case studies where an impact to the upstream groundwater was identified as an issue. However in discussions regarding this possible connection, SFPUC representatives have determined that upstream quarry operations have altered the groundwater such that the removal of the dam will not have an upstream impact.

3. Extent of Removal: Early drawings of the dam indicate that its foundation is much deeper than the pre-construction channel invert. Therefore complete removal may actually create a greater environmental impact than partial or complete breaching of the dam.

D. Unique to the Removal of Niles Dam:

1. Extent of Removal: Current information indicates the original rock-type dam was later capped with concrete and that the associated historic significance has focused on this original dam. Therefore partial or complete breaching of the dam may be preferred to complete removal.

2. On-Site Sediment Disposal: The left bank (looking downstream) appears to be a suitable location above the ordinary high water level where some of the sediments could be placed instead of removing to an off-site location.

8. CASE STUDY – COMPARISON TABLE

Dam Name (Owner)	Old Berkshire Mill Dam (Crane Paper Co)	McCormick-Saeltzer Dam (Townsend Flat Water Ditch Co)	2 Swim Dams (East Bay Regional Parks)	Waterworks (City of Baraboo), Oak St. & Linen Mill (Alliant Energy) Dams	Alphonso Dam (Abandoned)	McGowan, McPherrin, Western Canal East, and Western Canal Main Dams (West Central Water Dist)	Jackson Street Dam (Rogue River Valley Irrigation District)
State & River	MA - East Branch of the Housatonic River	CA (Shasta County) - Clear Creek (a tributary to the Sacramento River)	CA - below Calaveras Dam in the upper portion of Alameda Creek	WI - Baraboo River	OR - Evans Creek	CA - Butte Creek (a tributary to the Sacramento River)	OR (Medford)- Bear Creek (a tributary to the Rouge River)
Type of Dam(s)	Concrete gravity (replaced a timber crib) State Jurisdiction - 1st dam in state to be removed	Concrete and Timber Crib (Not State Jurisdictional)	Concrete gravity (Not State Jurisdictional) Upper / Lower	Concrete gravity (FERC Jurisdiction) Water-works / Oak St. / Linen Mill	Concrete gravity	Concrete gravity	Concrete gravity
Dam Size:	Height: 14 ft. Length: 130 ft.	Height: 18 ft. Average Length: 185 ft.	Height: 4 ft. / 4 ft. Length: 63 ft. / 88 ft.	Height: 9 ft. / 8 ft. / 8 ft. Length: 220 ft. / 270 ft. / 155 ft	Height: 10 ft. Length: 56 ft.	Height: 6 ft to 12 ft. Length: 10 ft to 100 ft.	Height: 11 ft. Length: 120 ft.
Year Built & Removed	Built: 1915 Removed: Nov. 2000	Built: 1908 Removed: Oct. 2000	Built: 1960's Removed: Sept. 2001	Built: 1848 / 1885 / 1898 Removed: 1998 / 2000 / 2001	Built: 1890's Removed: July 1999	Built: 1900's Removed: 1998	Built: 1960 Removed: 1998
Reason for Removal:	Dam safety concerns (scour at toe of dam due to damaged outlet works).	Fish passage - additional 12 miles of spawning habitat.	Fish passage and to address a public safety concern.	Safety concerns and to improve fish passage for 10 species	Fish passage – additional 12 miles of spawning habitat.	Fish passage – additional 25 miles of spawning habitat.	Fish passage – additional ¼ mile of spawning habitat & to address water quality and aesthetics problem (algae blooms)
Outside Funding (if applicable):		Funding by US Bureau of Reclamation	Included a small grant.		US Bureau of Land Management	US Dept of Interior: feasibility study & 1/3 removal, CA Urban Water Agency: 1/3 removal.	State of Oregon (Lottery funds), US Bureau of Reclamation, & Oregon Trout (non-profit)
Decision Process	3 years w/ state sponsored facilitator	4 years from the time alternatives were developed.	6 to 9 months	4 years before the first dam was removed.	3 years	Several years	13 years and used a consensus-based approach
Environmental	Environmental Impact Report	Finding of No Significant Impact (Aug. 7, 2000)	Initial Study/Mitigated Neg. Declaration (Feb. 2000)	Environmental Impact Statement	Environmental Assessment (Feb 1999)	Environmental Impact Statement /Report	Environmental Assessment
A. Listed Species (Federal or State):	No federally or state listed or species of special concern.	Migration of Steelhead and Chinook salmon (Federally and State listed as threatened)	Red-legged frog (0.02 acres affected) and other native species had to be relocated prior to the start of construction.	None listed. The Natural Heritage Inventory lists Blue Sucker, Western Sand Darter, Silver Chub, and Speckled Chub being present downstream.	Migration of Steelhead and Chinook salmon (Federally and State listed as threatened)	Migration of Steelhead and Chinook salmon (Federally and State listed as threatened).	Migration of Steelhead and Chinook salmon (Federally and State listed as threatened)
B. Wetlands / Riparian:	<u>Forecast</u> wetlands increase of 0.86 acres. Required to monitor & remove invasive species	Not an issue	Mitigation of riparian habitat was required at 3:1 (replacement to removed) ratio	Not an issue due to river gradient		Not Applicable	
C. Historic:	Timber crib dam: Photo record and map, salvage & display gate operators	Determined that it did not meet State Historic Preservation Office	Determined that there was nothing of significance	Interpretation of the role of the dams in relation to the growth of the community.		No significant findings	Did not qualify
D. Sediment:	• Volume & gradation estimated. • Sediments tested for possible presence of dioxins and furans • HEC – 6 to model and assess sediment transport potential	• Borings to estimate gradation and volume. • Sediment testing program –presence of Mercury. 57 samples w/in pool, 1 exceeded threshold, but was less than EPA limit.	Sediments were removed. However volumes were very small.	▪ Sediment transport and timing issues were studied to avoid interference with fish spawning. ▪ <u>Oak St</u>: Coal Tar Contamination identified and Alliant Energy is responsible for remediation.	• Sediment volume and gradation determined. • Sediment testing for toxics and heavy metals (none found).	• Sediment volume and gradation determined. • Sediment testing for toxics and heavy metals (none found).	• Sediment volume and gradation determined.
Other:	Revise FEMA maps for post-breach conditions	Accelerated schedule led to "partnering" contract for removal at 50% design		HEC – 2 Flood studies performed for post-dam conditions			

CASE STUDY – COMPARISON TABLE (Sheet 2 of 2)

Dam Name (Owner)	**Old Berkshire Mill Dam (Crane Paper Co)**	**McCormick-Saeltzer Dam (Townsend Flat Water Ditch Co)**	**2 Swim Dams (East Bay Regional Parks)**	**Waterworks (City of Baraboo), Oak St. & Linen Mill (Alliant Energy) Dams**	**Alphonso Dam (Abandoned)**	**McGowan, McPherrin, Western Canal East, and Western Canal Main Dams (West Central Water Dist)**	**Jackson Street Dam (Rogue River Valley Irrigation District)**
Permits:	USACE 401 and 404, NPDES, State Wetlands Protection, State dam safety, permit to re-use concrete rubble.	USACE 401 (RWQCB), 402, 404.	USACE 401 (RWQCB Conditional Waiver), 404 (Qualified for USACE National Permits 27 & 33), CADF&G 1601.	USACE 401 and 404		USACE 401 (RWQCB Conditional Waiver), 404 (Qualified for USACE National Permits 27 & 33), CADF&G 1601.	
Amount of Removal:	Full Breach, *not total removal* (lower 4 ft. left in place for economics)	Full removal. Small volume of sediment left in place.	Full removal	Full removal (all three)	Full removal	Full removal	Partial removal
Removal Method:	Installed berms and culverts within the channel to divert river flows. Excavator with 9-ton hydraulic hoe-ram used to remove concrete. Heavy equipment used to remove sediments.	• Built a diversion channel and flows were controlled at Whiskeytown dam to < 150 cfs. • Sheetpiles & de-watering pumps at upstream end. • Heavy equipment used w/ sediment removed in the dry.	Heavy equipment	• Dams were notched to drain impoundment • Heavy equipment was used to remove most of the structure. • Explosives were used in areas with high reinforcement.	• Notch cut in dam to de-water site so equipment could work in the dry. • Heavy equipment was used to remove the dam. • Exposed soils were stabilized with a grass mix seed	• Site de-watered to allow equipment to work in the dry. • Heavy equipment to remove the dam.	• Concrete dividers installed to divert flows away from work site. • Heavy equipment was used to remove the sediments and dam. • V-shaped weirs were built downstream to create "steps" for fish passage.
Sediment:	Sediments were removed in the dry and re-graded and stabilized on-site.	Sediments were removed and placed on-site. *NOTE: If aggregates were sold, compliance with Surface Mining and Reclamation Act (SMARA) would have been required*	Sediments were placed above the ordinary high-water line, due to the very small volumes associated with each dam.	▪ Waterworks: Sediments were left in place to become trapped at Linen Mill. ▪ Linen Mills (lowest & last dam removed): sediments left in place to be transported downstream by winter flows. ▪ Oak St: Contaminated sediments were disposed of at an off-site location.	Sediments left in place to be transported downstream by winter flows.	Sediments left in place to be flushed downstream by winter flows	Sediment was removed and taken to a landfill
Removal Schedule:	Summer 2000: Partial breach & demobilize. Summer 2001: Remove remainder of dam and site restoration.	July through Oct 2002. 1st Phase = work in advance of the FONSI and 2nd phase = sediment and dam removal	Less than 6 weeks to remove both.	Waterworks: Dec. 1997 Oak St: Fall 2000 Linen Mills: Oct 2001	July 1999 (2 days)	Timing had to avoid fish migration and continuing full diversions to agricultural users.	July to September 1998
Cost	$864,000 - includes engineering, construction, and upstream utilities protection. An additional $100,000+/- is needed for additional dam demolition (exposed sections on the bank) and site clean up (Forecast 2003).	$3,500,000 ($2,800,000 construction, $309,000 sediment characterization, $400,000 engineering design, contract admin, construction management, environmental compliance)	Construction Costs = $50,000	Construction Costs = $218,500. (Waterworks only)	Construction Costs = $55,000	Total Cost = $9,130,000.	Total Cost = $1,200,000.

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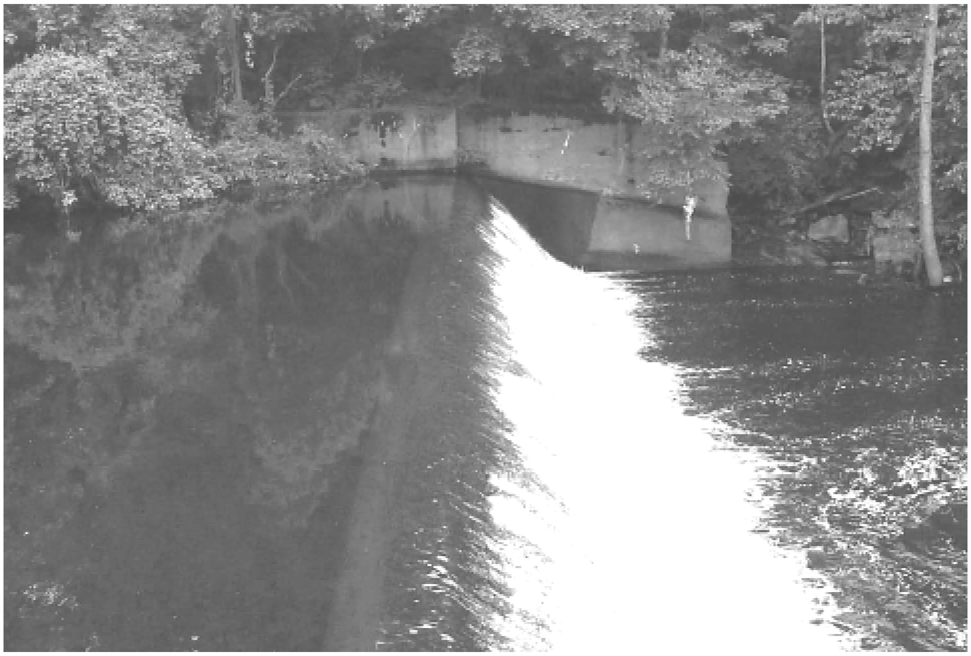
10. APPENDICIES

APPENDIX 1: Old Berkshire Mill Dam, East Brach of Housatonic River MA

DESIGN, PERMITTING, AND CONSTRUCTION OF THE BREACHING OF



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ABSTRACT

The Old Berkshire Mill Dam was a small, run-of-the-river, concrete structure on the East Branch of the Housatonic River in Dalton, Massachusetts. The Dam, which originally impounded water for use in a nearby mill, no longer served its original purpose. After the failure of the outlet works, the owner, Crane & Co., Inc. (Crane), retained an engineering team to examine potential alternatives for correcting the safety deficiencies at the Dam. The recommended alternative was dam decommissioning by means of a full breach of the structure. The owner chose to pursue dam decommissioning for reasons of short-term cost, reduction of long-term liability, and environmental stewardship.

The Commonwealth of Massachusetts has recently begun an initiative to restore river habitat by selective breaching of dams. The Old Berkshire Mill Dam project was used as a pilot project for developing policies and procedures for this initiative. The design and permitting of the project was a collaborative effort between the owner, the engineer, resource managers, regulators and other stakeholders. The breaching of the Dam was the first project of its type in Massachusetts, to be successfully permitted and constructed under current environmental regulations. The high degree of cooperation between the various parties involved in the project resulted in a design that was considered to be beneficial to both public safety and the environment and considered acceptable to both the owner and regulators. However, the extensive process of meetings, permitting, and design development resulted in substantial "up-front" costs to the owner. The breaching of the Old Berkshire Mill Dam offers an example of how a dam

decommissioning project can be successful, and this paper provides indications of how the process may be improved, particularly from the owner's perspectives.

INTRODUCTION

The Old Berkshire Mill Dam (the Dam) was built circa 1915 as a run-of-the-river, concrete gravity dam on the East Branch of the Housatonic River in Dalton, MA (see Figure 1 for photo.) The Dam was constructed to provide hydropower to drive the papermaking machinery in the adjacent Old Berkshire Mill. The concrete dam replaced a timber crib dam, which served the same purpose and was left substantially in place upstream of the 1915 structure. The mill was originally constructed in 1801 by Zenas Crane, founder. Crane owned the Old Berkshire Mill Dam, as well as a series of two dams upstream and three dams downstream. The site locus is shown on Figure 2.

Old Berkshire Mill Dam Old Berkshire Mill Dam was a 130-foot-long concrete structure, which impounded roughly 10 acre-feet of water. The hydraulic height of the Dam, measured to the spillway crest, was approximately 14 feet, and the structural height of the gatehouse/abutment structure was about 22 feet. Based on Massachusetts Office of Dam Safety regulations (310 CMR 10.00), the Dam was classified as Intermediate in size. A dam break model and downstream inundation mapping indicated a Significant hazard classification.

The Dam included an ogee-shaped spillway that was 114 feet long and two 4-foot by 4- foot, low-level outlet sluiceways. The sluiceways were designed to be controlled via two gates on the upstream face of the river outlet structure, which was in the river channel adjacent to the right abutment. The gates were operated manually from the top of the gate structure, accessed from the right abutment. A wingwall extending upstream from the right abutment forms a small forebay area in the impoundment. An intake in the wingwall, controlled via 18-inch sluice gates, allowed water to be diverted into a headrace channel for use at the nearby mill. The channel had been unused for many years and was partially filled. The remains of the timber crib dam, which pre-dated the concrete structure, were buried in the sediment approximately 10 feet upstream of the Dam. The size, geometry, and function of the Dam (including the associated timber crib) were typical of the mill dams built in western Massachusetts around the turn of the last century. A plan view of the Dam site prior to breaching is shown on Figure 3.

Particular to the site are two additional structures, which are located within 150 feet upstream of the Dam. The Housatonic Street bridge spanned the impoundment. The bridge, which is owned by the Town of Dalton, is a relatively modern two-lane, steel truss bridge seated on stone abutments which pre-date the Dam. Just upstream of the bridge is a 24-inch water supply pipeline owned by the nearby City of Pittsfield. The cast iron, flexible joint pipe crossed under the impoundment and was exposed above bottom in several places.

In September of 1997, a routine inspection by Crane personnel noted excessive flow through the outlet works, a lowering of the upstream impoundment and sediment laden flow through the sluiceway. A local engineering firm, Foresight Land Services (FLS), was brought in to assist in stabilizing the situation. FLS in turn contracted GZA. The cause of the flow was found to be deterioration and failure of the concrete frame supporting the gate structures. As an interim measure, a sheetpile and steel plate cofferdam was installed upstream of the outlet works to reduce the flow through the sluiceways and allow observation of the gates. Once the situation had been stabilized, GZA and FLS were contracted by Crane to inspect and evaluate the condition of the Dam.

INVESTIGATION AND ANALYSIS OF ALTERNATIVES

In 1998, GZA conducted a visual inspection of the Dam and performed analyses to evaluate the stability and hydraulic adequacy of the structure. Based on the results of the studies, several deficiencies were identified. A conceptual report was then prepared which examined possible alternatives for addressing the deficiencies. Since the Dam no longer served its original function, and in concert with Crane's stated goal of seeking opportunities for proactive environmental stewardship, dam decommissioning was evaluated further.

Evaluation of Existing Conditions at the Dam

In addition to deterioration of the outlet works, several other deficiencies were identified. Much of the concrete on the downstream face of the ogee spillway section and, in particular, on the abutment / training walls, was deteriorated and spalled. A large depression was found at the toe of the Dam that likely had been created or at least enlarged by scour caused by the hydraulic jump at the base of the ogee spillway. The downstream concrete apron was undermined at this location. The hydraulic analysis indicated that the spillway design flood (100-year return period) would overtop the right abutment/training wall and subsequently overtop the headrace canal earthfill dike.

Uncertainties regarding the spillway foundation conditions also created concerns regarding the stability of the structure against sliding during heavy floods. Costly borings to further evaluate these issues were postponed until a decision was made regarding the viability of dam decommissioning.

Finally, the vulnerability of the upstream infrastructure was noted. The East Branch of the Housatonic River is a swift flowing, high gradient river in the vicinity of the Dam. The water supply pipeline and bridge abutments were constructed after the completion of the Dam or one of its timber crib predecessors. Were the Dam to fail or to be fully breached, a possibility existed of scour damage to both structures.

Conceptual Alternatives

In developing and evaluating conceptual alternatives, four primary objectives were considered: (1) Protection of public safety and the environment. (2) Protection of the upstream water supply pipeline and bridge. Damage to these structures would have significantly impacted the surrounding community and exposed the Dam owner to potential liability. (3) Minimization of short term and long-term costs and liabilities since the Dam was no longer of economic benefit. (4) Environmental improvement. Crane, a family-owned, paper company that has been a part of the local community for 200 years, has a vested interest in improving the environmental, recreational, and aesthetic conditions at the Dam site.

Five conceptual alternatives for addressing the identified deficiencies and meeting the above stated objectives were evaluated.

No Action: Under this alternative, all additional remedial actions beyond the initial stabilization would have been deferred. A monitoring plan would be developed to regularly re-evaluate the condition of the Dam. This alternative was judged to be the least costly to the owner and the least disruptive to the environment, in the short term.

Repair: The "Repair Alternative" would address the main issue, the failed outlet works and other identified deficiencies. Repairing the Dam would allow the impoundment to be maintained and, therefore, likely result in only minimal impacts to the environment. The conceptual repair program included the following items:

1) Repair river outlet works structure;
2) Raise training walls to prevent overtopping of the headrace canal dike during design storm;
3) Restore deteriorated concrete;
4) Address possible seepage under outlet structure through foundation grouting (if necessary);
5) Fill scour hole at the toe of the dam to address undermining of concrete apron; and,
6) Install passive tie-down anchors, if needed, after evaluation of condition of foundation interface.

Dam Decommissioning:
The remaining three alternatives considered each fall under the general heading of "Dam Decommissioning." Dam Decommissioning is a term being used in Massachusetts to denote any of a series of structural alterations to a dam resulting in the removal of that dam from the state inventory. In general, the conceptual options for dam decommissioning considered for the Old Berkshire Mill Dam were designed to modify the Dam such that it did not meet the minimum statutory definition of a dam. The Massachusetts Dam Safety regulations state that a dam is any structure which could endanger property or safety "which is greater than six feet in height or impounds more than 15 acre feet of water."3

In general, the considerations which drove the conceptual decommissioning designs were: a) Quantity and quality of sediment to be managed; b) Quantity of concrete to be demolished and removed; c) Ability to pass the 100-year design storm without significant backwater; and, d) Environmental impacts and permitting requirements. The environmental issues, several of which were instrumental to the final design, were simply cataloged during conceptual design and then dealt with in a comprehensive manner during the preliminary design and permitting process.

Partial Breach: A partial breach would cut a large "notch" into the spillway, but leave the rest of the Dam in place. The outlet structure and some portion of the ogee spillway nearest to it would be removed down close to the original streambed elevation to create a wide "notch" in the Dam. This would allow normal river flows to pass through without being impounded or restricted by the remaining structure. The breach notch would be essentially for the full height of the Dam and would conform in shape and width to the upstream channel.

Full Breach: A full breach involves demolishing the outlet structure, spillway, and wingwalls to at or below the proposed final site grade. There would be no restriction of flows in the channel during flood events. A low-flow channel would be created to allow for fish passage events, while higher flows will pass through a normal-flow channel. Some concrete could be left in place, but all below final grades. If an overbank area is created through stabilization of impoundment sediments, then would be no need to completely remove that concrete which would be at or below grade. In the overbank area, therefore, concrete from the lowest portion of the former dam could be left in place and provided with enough sediment cover such that it would not be visible. In the river channel, all concrete would be removed down to proposed channel bottom grades. The remaining concrete would form a stable channel bed, and the placement of boulders and cobbles to form riffles would give the area a more natural look.

Total Removal: Total removal of the Dam would result in essentially the same river channel configuration as the full breach option. The difference is that the total removal option calls for the complete demolition and removal of all concrete and manmade works from the river. All engineered and constructed material, whether visible or not, would be removed, to the extent practicable, leaving little or no evidence of the presence of a dam.

PRELIMINARY DESIGN

The preliminary design process encompassed a variety of technical and non-technical aspects. The first step involved Crane's decision to further evaluate decommissioning of the Dam. GZA then developed a design concept which was presented to federal, state and local regulatory officials and other stakeholders for discussion and comments. The objective was to build support for the project prior to proceeding with relatively costly environmental permitting. Based on the feedback, Crane re-evaluated its decisions regarding the direction of the project and GZA revised its designs which were then represented to the stakeholders. This iterative process resulted in extra time and expense, but was essential towards building a consensus and winning final approval for the project from the owner, regulators and stakeholders.

Decision-Making

Based on the conceptual design report, the Crane management team decided to pursue dam decommissioning. Crane examined the pros and cons of each of the alternatives and weighed the estimated costs and benefits. Table 1 summarizes the compatibility of each of the proposed alternatives with the four project objectives.

Together, Crane and GZA decided that Full Breaching of the dam was the decommissioning alternative that would best achieve Crane's project objectives. From a cost standpoint, it was superior to Total Removal and it was judged preferable to Partial Breaching, based on aesthetic considerations. The Project Team, therefore, went forward with the initial permit applications for Full Breaching.

Design

The initial design proposed by GZA involved removing concrete from the entire width of the Dam down to within four feet of the base of the Dam. The four-foot dimension was driven by a desire to be well below the six-foot threshold contained in the statutory definition of a dam. The concrete rubble would be re-used on-site. The sandy sediment in the impoundment would be excavated in the dry and reused elsewhere on Crane property. Protection of the upstream bridge and water supply pipeline would be accomplished through riprap armor.

Stakeholder Discussions

Massachusetts utilizes a process defined by the Massachusetts Environmental Protection Act (MEPA) to make decisions regarding projects which have potentially significant impacts on the environment. Because the Old Berkshire Mill Dam was the first dam to ask for authorization for decommissioning under MEPA and other Massachusetts statutes, the project garnered much interest and attention. The Massachusetts Secretary of Environmental Affairs had recently authorized the creation of the River Restore program. This program has, as one of its goals, to advocate and assist with the removal of dams4. The Commonwealth, therefore, wished to use the Dam as a pilot project. This was a mixed blessing in many ways for the Project Team. On the one hand, the regulatory bodies were very involved and had a cooperative interest in the success of the project, but on the other, the scrutiny of most aspects of the project was intense as there was no regulatory precedent.

The major effect of proceeding under the MEPA process was that an Environmental Impact Report (EIR) was required. The MEPA regulations explicitly state that an EIR is required for the “Structural alteration of an existing dam that causes an Expansion of 20% or any decrease in impoundment Capacity.”5 Since the proposal was to eliminate the impoundment, the project definitely met this criterion. Due to the first-of-its-kind nature of the project, separate Draft and Final EIRs were required.

The EIR requirement was somewhat onerous to Crane because it greatly increased both the duration and expense of the project. However, the process did provide a platform for all of the various stakeholders to come together and discuss the issues. The MEPA office defined the scope of the EIR to include 14 topics:

1) Project Description
2) Project Alternatives
3) Wetlands
4) Fisheries
5) Sediment Management
6) Streambed/bank Stabilization
7) Upstream Water Pipeline

8) Upstream Bridge
9) Flooding
10) Historic / Cultural Resources
11) Public Access
12) Downstream Project Coordination
13) Permits
14) Mitigation

These topics covered a wide spectrum of issues and interests, some generic to all dam decommissioning projects (e.g., sediment management) and some specific to this project (e.g., the upstream water pipeline). The Project Team felt it was, therefore, important to meet with as many of the stakeholders as possible to try to come to an early consensus on what issues were most important, what permits would be required, and what the final design concept would be. The Project Team met several times with local, state and federal regulators and other stakeholders, such as the local regional planning agency. Meetings were held both at the regulators' offices and at Crane's facilities near the Dam site. The Project team believed that it was important for regulators to see the Dam and get a sense of its scale. This turned out to be one of the most important factors in building support for the project. Meetings with regulators were coordinated through the state River Restore office. Because of the potential for competing interests and conflicting needs, both between Crane and regulators and between regulators from different agencies, the Commonwealth also provided a mediator with experience in environmental issues to assist in resolving conflicts and to help keep the project moving forward.

The initial meetings with the regulators were somewhat discouraging to the design team. The primary result of the first meeting was a requirement for additional chemical testing of the sediment upstream of the dam. The state Department of Environmental Protection was concerned about the possible presence of dioxins and furans in the sediment since these compounds have typically been associated with the paper industry. This requirement was discouraging to Crane because they do not and have not used the processes responsible for generating dioxins and furans, therefore, they did not feel the need to do additional chemical testing beyond that which had already been completed. In addition, Crane suspected that some of the regulators were merely interested in gathering data for use in a major environmental remediation project downstream of the site. Crane also felt that if previously unknown substances where found to be present in the sediment, Crane might be held responsible for the cost of remediation, regardless of who was responsible for the contamination. Crane, therefore, paused and re-evaluated the costs and benefits associated with the project.

Iterative Process

Based on the requirement for further sediment testing, the Project Team again went through a decision-making process. It was eventually decided that Crane would pay for additional sediment testing provided it was allowed the final say in the design of the sediment testing program. The testing indicated that dioxins and furans were not an issue at the site. Some other compounds were found to be present in low levels. GZA recommended that sediment not be transported off site, but re-graded and stabilized. This led to a second grading design, which was presented to regulators and stakeholders.

This process was repeated several times as different regulatory agencies gradually came to consensus regarding the desired outcomes of the project and the Crane/GZA/FLS Project Team strived to complete preliminary design development. Several contradictory agendas were encountered during the course of finalizing the approach to breaching the Dam. The fisheries agencies were interested in eliminating the impoundment and restoring the river to a free flowing condition, while other agencies were concerned with protecting the wetlands created by the impoundment. One state agency wanted to insure that the river would be navigable after the Dam breach, while the Historic Commission initially wanted to preserve in-place the timber crib dam buried upstream of the concrete dam. The local authorities responsible for the upstream water pipeline and bridge were in favor of heavy riprap armor to protect their assets, while the wildlife biologists were opposed to riprap.

FINAL DESIGN

The final design was similar in concept to the one originally proposed in that it was a Full Breach, but a number of details were changed in order to meet those needs identified during the preliminary design process. Each of the EIR scope items were addressed specifically in order to attempt to produce the maximum amount of benefit to the maximum number of stakeholders:

1) Project Description: A project description was provided to document the prebreach Dam and to provide the public with an understanding of the breaching project.

2) Project Alternatives: Project Alternatives were discussed in the EIR to demonstrate that a number of concepts had been examined. In effect, this was merely a restatement of the iterative process, which had already taken place.

3) Wetlands: Wetlands near the Dam were delineated. An actual increase in wetlands would likely result from the lowering of the impoundment. Crane agreed to seed these new areas and police against invasive species.

4) Fisheries: The breach section and upstream channel were designed to produce water depths and velocities hospitable to the target fish species.

5) Sediment Management: Sediment from the impoundment to be excavated and placed into overbank area within river channel. HEC-6 model created to predict sediment transport. Turbidity monitoring during construction.

6) Streambed/Bank Stabilization: Overbank and other areas to be stabilized with bio-engineering methods, including brush layering and willow fascines.

7) Upstream Water Pipeline: Mechanically placed riprap to be used to stabilize pipeline in place. This work to be completed before breaching the Dam.

8) Upstream Bridge: Mechanically placed riprap to be used to stabilize bridge

9) Flooding: Post-breach Flood Insurance Maps redrawn using HEC-RAS model abutments. This work to be completed before breaching the Dam. and provided to municipalities. Flood elevations reduced.

10) Historic/Cultural Resources: Upstream timber crib dam to be exposed during construction and archeologist contracted for recordation.

11) Public Access: Crane to allow passive public access to site from Crane property.

12) Downstream Project Coordination: Downstream river remediation project

13) Permits: All necessary permits to be obtained prior to beginning project. Key manager to be notified at key junctures during the breaching project. agencies agree to expedited reviews.

14) Mitigation: Environmental impact during construction to be minimized. Crane agrees to monitor site following completion of project.

The proposed Full Breach design is illustrated by Figures 4 through 10. Figure 4 shows the proposed post-breach grading plan. Figures 5 and 6 show longitudinal sections along the long axis of the dam and upstream bridge, respectively. Figure 7 is a profile through the river flowline (low flow and normal channels) in the project area. Figures 8, 9, and 10 show existing vs. proposed sections at the dam through the low flow, normal flow and overbank sections, respectively.

PERMITTING

The design process and the MEPA review served to familiarize many of the permit issuing agencies with the project. Early feedback from these agencies allowed most of their concerns to be addressed in permit applications. While representatives of the permitting agencies participating in the design process generally supported the project, many times these were not the same individuals responsible for processing the permit application. This led to the need for educating a whole new group of people about the specifics and merits of the project. Even then, the statutory review periods for many of the permits were quite long - up to 6 months. This would have been a serious obstacle to the project, but the agencies agreed to expedited review in order to move the project along.

One key issue in the permitting process was establishing that the project had “minimal impacts.” This rather subjective criterion is a key to establishing which kinds of permits are applicable and whether or not they will be issued. While it was established early on that the breaching project is a “proactive restoration project,” the language in many regulations is simply unequipped to make allowances for these types of projects. Therefore, it was necessary to attempt to demonstrate that the project would have “minimal impacts” for the purpose of securing several permits. While most regulators agreed that the breaching project deserved preferential treatment under the regulations, stating a major change to a river, albeit one considered environmentally beneficial, is a “minimal impact” was somewhat disingenuous.

In the end, eleven separate permits were required to breach the Old Berkshire Mill Dam:

1. Certificate of the Secretary of Environmental Affairs on the Final Environmental Impact Report.

2. Wetlands Protection Act Order of Conditions (Drawdown) from Dalton Conservation Commission.

3. Wetlands Protection Act Order of Conditions (Breaching) from Dalton Conservation Commission.

4. Section 404 Dredge and Fill Permit for riprap placement (w/Memorandum of Understanding from Massachusetts Historic Commission) from USACE.

5. Section 404 Dredge and Fill Permit for breaching(w/Memorandum of Understanding from Massachusetts Historic Commission) from USACE.

6. Section 401 Water Quality Certification for riprap placement from DEP.

7. Section 401 Water Quality Certification for breaching from DEP.

8. Chapter 91 Waterways License from DEP.

9. NPDES Stormwater Discharge Associated with Construction Activity Notice of Intent (Under NPDES General Permit) from USEPA.

10. Chapter 253 Dam Safety Permit from DEM for work on a dam in Massachusetts.

11. Beneficial Use Determination from DEP for Concrete Rubble Re-use.

CONSTRUCTION

The two-phase construction process was the most straightforward part of the entire project. The first phase involved protection of the upstream water supply pipeline and bridge abutments, and the second phase encompassed the breaching of the Dam. A local contractor began construction in late July, 2000, when flows are historically lower. The contractor modified the sluiceways at the Dam and used berms and culverts within the river channel to control river flows. This allowed the contractor to work in the dry within the river banks.

Locally quarried stone was mechanically placed over the water supply pipeline and on the bridge abutments and then hand "chinked." A hydraulic hoe-ram was mounted on an excavator for the concrete demolition work. The excavator worked in the dry from within the former impoundment. The old concrete was quite tough, but generally broke into pieces of less than 12-inch average diameter. This allowed the rubble to be directly placed into a portion of the downstream scour hole with only minor additional work to remove the light surficial steel reinforcement. Occasional heavy rains and associated river flows caused some delays.

Once sufficient progress had been made in demolishing the Dam, an event was organized for the ceremonial breaching of the Dam and "freeing" of the river. Over fifty people, including the owner, engineer, regulators, local and state politicians, and the community attended the ceremony. The Massachusetts Secretary of Environmental Affairs presented Crane with an award recognizing its commitment to environmental leadership and then raised a barrier to send the river back into its original channel.

A condition of the permits issued for the project stated that all operations in the river had to cease by the end of November, 2000. By that time, the protection of the upstream infrastructure was complete and the Dam partially breached (see Figure 11 for photo.) The contractor demobilized for the winter. The permits allow work to resume in July.

DISCUSSION

The Breaching of the Old Berkshire Mill Dam is considered to be a successful project by the owner, engineer, regulators, and other stakeholders. However, as a test case for future dam decommissioning projects in Massachusetts (and elsewhere), several important questions have been raised which should be resolved. In many ways, the Old Berkshire Mill Dam was an ideal candidate for dam decommissioning, i.e., the Dam was small, the owner of the Dam also owned the land both upstream and downstream of the Dam, sediment quality was reasonably good, and there were no opponents to the project. In future projects, which are not so clear cut, there will be a number of issues which will need resolution:

- What are the key criteria to be used in designing a dam decommissioning project? (public safety, environmental restoration, etc.)

- Must an owner pay for environmental improvements as opposed to environmental restoration?

- What defines the "original" or baseline condition of an area which has been developed for a significant period of time?

- How much of a dam must be removed in order for a dam to be considered to have been decommissioned?

- Who sets priorities when various interests conflict?

- How much should an owner expect to pay for decommissioning a dam? $100,000

This last issue will certainly be foremost in the minds of most owners thinking about decommissioning dams. If the experience of Crane at Old Berkshire Mill Dam is indicative, many owners may feel that dam decommissioning needs to be more affordable and less complicated from a permitting perspective. The costs to date for the breaching project break down as follows:

1. Initial Stabilization of Gatehouse with Cofferdam: $ 57,000

2. Engineering Investigations and Conceptual Report: $100,000

3. Consensus Building, Design, Permitting and Construction Engineering of Breaching: $238,000

4. Phase I Construction (Utilities Protection): $336,000

5. Phase II Construction (Breaching – to date): $133,000

Total (as of February, 2001): $864,000
Total (excluding Utility & Bridge Abutment Protection): $528,000

CONCLUSIONS

The breaching of the Old Berkshire Mill Dam demonstrates that dam decommissioning is viable in Massachusetts when owners, engineers, regulators, and other stakeholders work together to fashion a design and plan for implementation. A decommissioning project can be a "win/win" proposition for all stakeholders. The owners, dam safety officials, resource managers, regulators, environmentalists, and the local community can all derive benefits from a well-planned dam decommissioning project.

However, the amount of oversight applied to the Old Berkshire Mill Dam Project significantly lengthened the duration of the project and the expense to the owner. Many, if not most, private and municipal owners would not be able to bear such an expense. One of the most logical applications of dam decommissioning is for small dams, beyond their design life, with safety deficiencies that the owner cannot afford to repair. Yet an owner who does not have the resources to properly maintain even a small structure, will likely also not have the resources to see a dam decommissioning project all the way through a process similar to that of the Old Berkshire Mill Dam project.

The Commonwealth of Massachusetts has shown that they recognize that the financial burden placed on an owner by an intensive permitting process is a serious disincentive to dam decommissioning. An ad hoc, interagency dam decommissioning task force is currently studying the issue and is using lessons learned from the Old Berkshire Mill Dam to attempt to generate new policies.

The experience of Crane & Co., Inc. with the breaching of the Old Berkshire Mill Dam shows that dam decommissioning can be an attractive alternative to dam owners faced with aging infrastructure which no longer serves its original purpose. When dam decommissioning is pursued for sound engineering and economic reasons, rather than driven by political or ideological agendas, the interests of owners, the public, and other stakeholders can and do coincide. Engineers and dam owners should be actively participating in the process of generating dam decommissioning policy at both the state and national level. By assuming our rightful place as leaders in the debate surrounding dam decommissioning, we can bring sound engineering judgment and our wealth of experience to the table. We can help to insure that, where it makes sense, dams are decommissioned in a way that provides maximum benefits, and, where decommissioning does not make sense, our structures remain as proud monuments to American engineering prowess.

APPENDIX 2: Saeltzer Dam, Clear Creek CA

TEN MILES TO WHISKEYTOWN - THE REMOVAL OF SAELTZER DAM

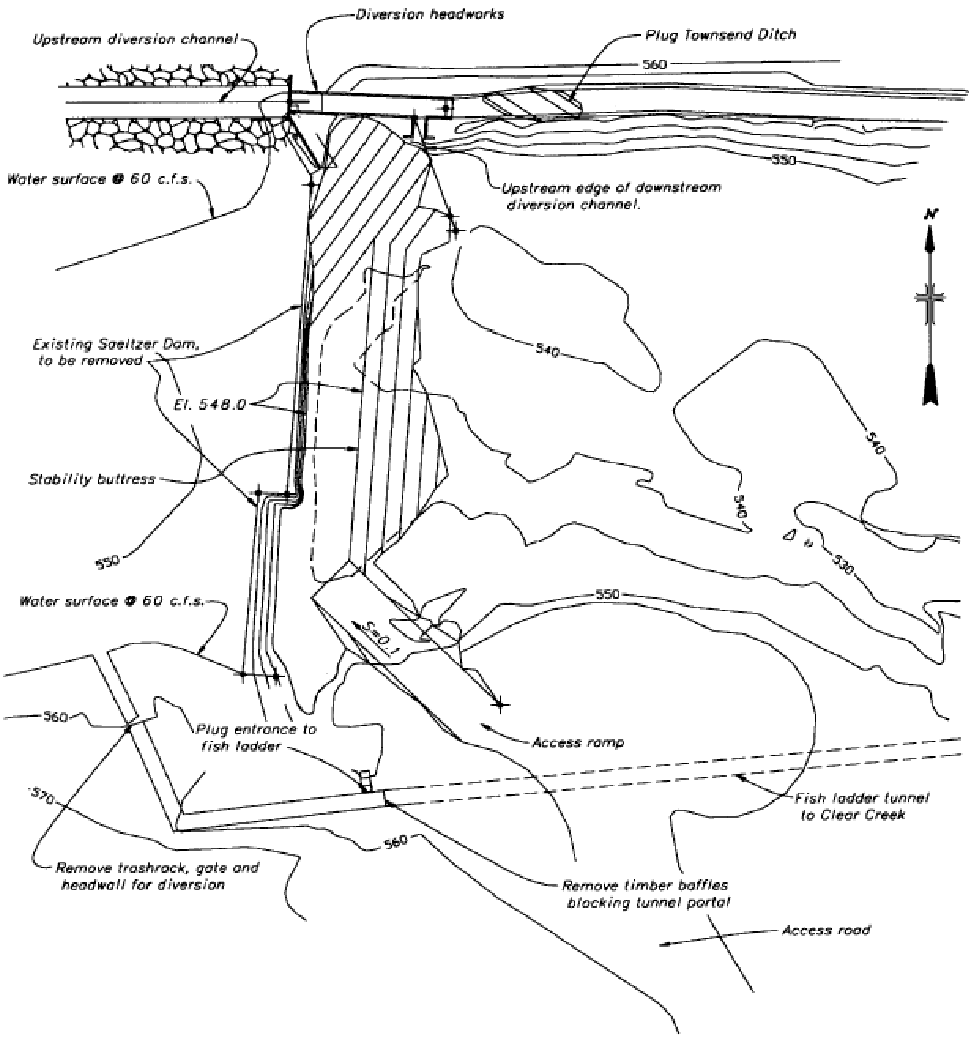

Figure 1. – Plan view of Saeltzer Dam and stability buttress.

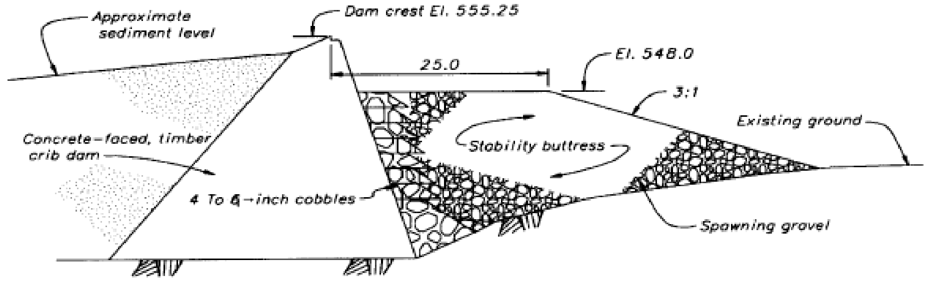

Figure 2. – Cross-section of Saeltzer Dam and stability buttress.

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ABSTRACT: Saeltzer Dam was located on Clear Creek in Shasta County, California, approximately six miles from the confluence with the Sacramento River and ten miles below Whiskeytown Dam. Removal of the 20-foot-high concrete and timber crib gravity structure was required to permit anadromous fish passage to the middle reach of Clear Creek, for access to valuable spawning and rearing habitat especially suitable for spring-run chinook salmon. An agreement with the dam's owner to purchase the dam and associated water rights and to provide replacement water from other sources eliminated the flow diversion requirement at the site and allowed the project to proceed. This paper details the dam removal project from planning and design, through construction and site restoration.

INTRODUCTION: Widespread concern for the anadromous fisheries on the Sacramento River and its tributaries in recent years has spawned dam removal and restoration projects on Butte Creek, Battle Creek, and Clear Creek. Saeltzer Dam on Clear Creek was recognized by Federal, State, and local agencies as a major impediment to the migration of Federal and State listed threatened species, the spring-run chinook salmon, and the Federally-listed steelhead trout, to 10 miles of valuable spawning and rearing habitat below the Bureau of Reclamation's (Reclamation's) Whiskeytown Dam. In 1992, Reclamation was authorized and directed under Public Law 102-575, the Central Valley Project Improvement Act (CVPIA), to implement a program that would increase the anadromous fish populations in the Central Valley rivers and streams within 10 years. Known as the Anadromous Fish Restoration Program, the Fish and Wildlife Service (FWS) became the lead agency responsible for its development. Section 3406(b)(12) of the CVPIA identified necessary restoration actions for increasing salmonid populations in Clear Creek, including the improvement of stream access and habitat above Saeltzer Dam.

Various dam removal and fish passage alternatives were the subject of separate technical studies performed in 1997 by the California Department of Water Resources (DWR) and by a private consultant for the dam's owner, the Townsend Flat Water Ditch Company (TFWDC). In January 2000, Reclamation issued a reconnaissance report for dam removal and for several structural alternatives to improve fish passage while maintaining agricultural diversions at the site. Federal, State, and local agencies agreed that optimum accessibility to upstream spawning and rearing habitat would only be achieved with dam removal. By March 2000, an "Agreement in Principle" had been reached between Reclamation, the California Department of Fish and Game (DFG), and TFWDC for the removal of Saeltzer Dam and the provision of replacement water from alternative sources. Preparations then began in earnest for decommissioning the dam, including the development of final designs and specifications for dam removal and of the required environmental documents and permit applications.

HISTORICAL SETTING: Saeltzer Dam was located just south of Redding, California, on Clear Creek, 6.2 river miles upstream from the creek's confluence with the Sacramento River, and about 10 miles downstream from Whiskeytown Dam, a feature of the Central Valley Project constructed by Reclamation in 1963. Saeltzer Dam was a composite gravity structure consisting of a reinforced concrete wall anchored to a timber crib structure, ranging in height from about 3 feet to 20 feet (average 15 feet), with a crest length of about 185 feet at elevation 555. The dam had a crest width of from 2 to 3 feet, with an upstream slope of about 1:1 (H:V) and a downstream slope ranging from about 1/2:1 on the left side to about 1:1 on the right side. The total volume of the existing dam was approximately 2,000 yd3. Although the right side of the dam was offset about 12 feet upstream from the rest of the dam and had been described as the "spillway," the crest elevation was fairly uniform across the entire length of the dam. A steep bedrock gorge located just downstream of the dam served to compound fish passage problems at the site.

The existing dam was completed in 1912 by Rudolph Saeltzer at the site of an older masonry dam. A reinforced concrete base was reportedly constructed on bedrock between the north and south abutments to a height of 3.5 feet and a width of 14 inches. An 8-inch-thick concrete wall was constructed above the concrete base to the required height for the overflow crest. The timber crib structure was reported to have a maximum 15-foot base width and a sloping upstream face covered with two layers of wooden planks to contain the interior gravel or rubble fill. Sacks of cement, reinforcing iron, wood logs and planks, and gravel were used in the dam's construction by local craftsmen and unskilled labor. In 1964, the southernmost portion of the dam (right abutment section) failed during high winter flows and was replaced the following summer with a mass concrete structure. By 1997, the physical condition of the dam was considered to be very poor, with extensive concrete deterioration and cracking visible, and evidence of numerous leaks and concrete repairs. However, the dam did not qualify for State jurisdiction due to its height of less than 25 feet and its storage capacity of less than 50 acre-feet (estimated at about 5 acre-feet). In recent years, at least three fatalities were recorded at the dam when persons attempting to cross the dam crest were swept off their feet and thrown to the jagged rocks below.

Normal diversions of around 30 ft3/s were made to the Townsend Ditch through a diversion headworks structure located on the north (left) abutment of the dam, operated and maintained by TFWDC. The headworks structure consisted of reinforced concrete walls supporting two cast iron slide gates. A small debris screen protected the gated openings on the upstream side. The gates opened directly into the upstream end of the ditch, which was concrete-lined for about 60 feet and earth-lined for the remainder of its 6.4-mile-long course before terminating in Olney Creek to the north. A fish screen was installed by DFG on the Townsend Ditch in 1992, just downstream of a gated wasteway structure (or fish return), to prevent a potential "take" of anadromous fish into the ditch.

To provide for fish passage at the site, a large fish ladder was constructed by DFG on the south (right) abutment of the dam in 1958. The fish ladder consisted of a 370-foot-long concrete-lined tunnel with step-pools and a 130-foot-long upstream concrete portal structure, extending from just below the steep bedrock gorge to the pool behind the dam. Very few fish were recorded above the dam in the following years, so the structure was modified by DFG in 1992 to help attract fish into the ladder and to the upstream pool. The tunnel portion paralleling the steep channel section within the downstream gorge was sealed off with stoplogs and essentially abandoned, and a new entrance closer to the dam and above the gorge was constructed. Despite these apparent improvements, less than 1 percent of the spring-run salmon in Clear Creek were found to have successfully passed upstream of the dam in 1999.

Diversion releases to the Townsend Ditch were used primarily for irrigation of alfalfa fields and fruit orchards in the Girvan area between the 1920s and 1940s. Dredge mining operations first developed in the area downstream of the dam and north of Clear Creek in the 1920s and 1930s, followed by gravel mining operations, which occasionally used water from the ditch for washing gravel in the Clear Creek bottoms area. (J. F. Shea Sand and Gravel Company and Westside Aggregates are two current gravel mining operators in the area.) Since the 1970s, the ditch supplied agricultural water for irrigation of 225 to 260 acres of hay and for watering up to 300 head of livestock. By 1997, TFWDC and its shareholders reported the demand for water diversions at the dam had significantly diminished and that a more efficient means of diverting and conveying water was desired.

PROPOSED PROJECT OBJECTIVES : Clear Creek is the first major tributary to the Sacramento River below Reclamation's Shasta Dam, and originates in the mountains between Trinity and Shasta Reservoirs. Native spring-run chinook salmon are listed as threatened under both the Federal and State Endangered Species Acts, while Central Valley steelhead trout are also listed as threatened under the Federal Act. Both species require cold water for survival during the hot summer months, but have spawned in the lower 6 miles of Clear Creek for nearly a century with warmer water temperatures, contributing to their population decline. In recent years, a spawning gravel injection program by the Western Shasta Resource Conservation District (WSRCD), and increased releases from Whiskeytown

Dam by Reclamation, have been utilized to improve spawning and rearing conditions in the lower reach, but at significant cost and with limited success. Overcoming obstacles for fish migration and spawning at Saeltzer Dam was considered a priority under the CVPIA, the CALFED Ecosystem Restoration Program Plan (ERPP), and the Clear Creek Coordinated Resource Management and Planning Group (CRMP) Program. Federal and State biologists estimated that as many as 2,000 spring-run chinook salmon and 2,000 steelhead trout could spawn in the middle reach of Clear Creek once the dam was removed.

- The Saeltzer Dam Fish Passage and Flow Protection Project was established to meet the following project objectives:

- Provide fish passage - Access to upstream habitat within the middle reach of Clear Creek (between Saeltzer and Whiskeytown Dams) is a critical restoration element for both chinook salmon and steelhead trout.

- Protect instream flows - Adequate quantity and quality of stream flows, for channel maintenance and colder water temperatures, are imperative for the life stages of chinook salmon and steelhead trout.

- Provide sediment transport - Removal of the dam would restore natural sediment transport to the lower reach of Clear Creek, reducing downstream channel degradation and replenishing spawning substrates.

- Improve aquatic and terrestrial communities - A natural stream channel for Clear Creek would improve the habitat for anadromous fish as well as for all other dependent aquatic and terrestrial communities.

- Maintain water supply - An alternative source of agricultural water for downstream users must be provided to eliminate the point of diversion at Saeltzer Dam.

- Improve public safety - Dam removal would eliminate a public safety hazard which has resulted in serious injuries and deaths in the past.

- Eliminate dam failure potential - Continuing deterioration of Saeltzer Dam without removal would represent a significant risk of sudden failure and associated downstream environmental impacts.

PRECONSTRUCTION ACTIVITIES

Legal Agreements: The preliminary studies concluded that removal of Saeltzer Dam was technically, economically, and environmentally feasible. Negotiations with the property owners (TFWDC and DFG) resulted in an "Agreement in Principle" in March 2000 which provided the framework for subsequent negotiations for implementation of the project. A final agreement was signed on August 18, 2000 to implement the project and establish the respective responsibilities of the parties. Under the agreement, TFWDC and its shareholders, the Centerville Community Services District (15 percent share) and the McConnell Foundation (85 percent share) agreed to release right title and interest in Saeltzer Dam and any remaining pre-1914 water rights, in exchange for the diversion of up to 6,000 acre-feet of water per year through existing Central Valley Project facilities in Shasta County, plus a total monetary settlement of $2,500,000. The associated property easements were to revert to DFG, for eventual transfer to the Bureau of Land Management (BLM). In addition, Reclamation agreed to ensure that future releases from Whiskeytown Dam would be at least equivalent to releases made pursuant to an existing unsigned agreement (up to 50 ft3/s from January through October and 70 to 100 ft3/s from November to

December) to provide minimum flows to the mouth of Clear Creek for improved hydraulic conditions and lower water temperatures. Additional water would be made available from FWS for releases from Whiskeytown Dam to Clear Creek in accordance with Section 3406 (b)(2) of the CVPIA.

Environmental Compliance Process: An inventory and evaluation of Saeltzer Dam (also known as McCormick-Saeltzer Dam) was completed in February 1999 by JRP Historical Consulting Services, as part of the planning process for the project. This study was conducted in accordance with Section 106 of the National Historic Preservation Act (NHPA) and with consultation from the State Historic Preservation Officer (SHPO), following evaluation criteria established by the National Register of Historic Places (NRHP). This study concluded that Saeltzer Dam did not appear to meet the criteria for listing by NRHP. SHPO concurred with this determination on May 8, 2000.

Actions necessary for the removal of Saeltzer Dam included full compliance with all Federal and State environmental regulations, as provided by the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). Reclamation served as the lead agency for NEPA, with DFG the lead agency for CEQA. A Joint Environmental Assessment/Initial Study (EA/IS) was prepared for NEPA/CEQA compliance, to assess the impacts of the potential environmental effects of the project. Agencies and the general public were given opportunities to provide input for the decision making process. Public meetings were held on April 25 and June 22, 2000. The Public Draft EA/IS was prepared by North State Resources, Inc. and circulated for a 30- day public review period between June 12 and July 13, 2000. The project area included Saeltzer Dam, the Townsend Ditch, the downstream gorge, and approximately 83 acres of stream channel. The proposed action included the removal of Saeltzer Dam and impounded sediments without altering the downstream gorge, eliminating the water diversion to the Townsend Ditch, and restoring the existing site and access roads to natural conditions. Stated project benefits included the addition of 190,000 ft2 of chinook spawning habitat and 206,000 ft2 of steelhead spawning habitat for normal streamflow.

Project design was closely coordinated between Reclamation and Federal and State resource agencies in an effort to avoid or minimize potential impacts. Specific measures incorporated by the project included the timing of construction to minimize impacts to anadromous fish, the maintenance of downstream flows by the incorporation of flow bypass structures, and the exclusive use of spawning gravel within the stream channel for the construction of channel crossings, an upstream cofferdam, and a downstream stability buttress. A coordinated Biological Opinion was issued by NMFS in compliance with Section 7 of the Federal Endangered Species Act (ESA) and consistent with Section 2090 of the California Endangered Species Act (CESA). As a result of the finding by Reclamation and declaration by DFG that the project would not constitute a major Federal action significantly affecting the environment, a Finding of No Significant Impact/Negative Declaration was signed on August 7, 2000. With this action, neither the preparation of an Environmental Impact Statement (EIS) nor project mitigation was required.

Permits required under the Clean Water Act included Section 404 Nationwide permits (NP 27 for wetland and riparian restoration, and NP 33 for temporary construction, access, and dewatering) from the U.S. Army Corps of Engineers (COE) for the discharge of dredged or fill material into waters of the United States, and both a Section 402 General National Pollutant Discharge Elimination System (NPDES) permit and a Section 401 Water Quality certification from the State Central Valley Regional Water Quality Control Board (RWQCB), consistent with the State's Basin Plan Objectives. Monitoring of water turbidity and settleable solids in Clear Creek was required above and below the construction site, with maximum allowable limits of 15 Nephelometric Turbidity Units (NTUs) above background turbidity and total settleable solids of 0.1 milliliter per liter (ml/L) at 500 feet downstream of the project. Point source and non-point source storm water discharges from the construction site would be regulated by the RWQCB through a Storm Water Pollution Prevention (SWPP) plan, utilizing best management practices. A streambed alteration permit was required from DFG under Section 1601 of the California Fish and Game Code for activities within the 100-year floodplain. Construction equipment was not permitted to be operated within the live stream except as necessary to construct temporary crossings and cofferdams. Revegetation and stabilization of disturbed areas outside the stream channel was required for erosion control, including the use of sediment traps, filter fabric, and straw bales. A Spill Prevention Control and Countermeasures (SPCC) plan was required for the use of construction equipment at the site, to minimize the risk of an uncontrolled spill and contamination of the creek.

Sediment Characterization: The proposed project included the excavation and removal of sediments and other fluvial materials that were deposited behind Saeltzer Dam over the years. Some of the fluvial materials may have been previously exposed to mercury used to separate gold-bearing minerals during historic mining and dredging activities. Gold was first discovered in Clear Creek in 1848, about 1.5 miles upstream of the dam site, and the stream channel and floodplain were dredged extensively throughout the late 1800s and early 1900s. At certain levels, mercury is highly toxic to aquatic life and can pose a public health concern.

An extensive sediment sampling and testing program was performed concurrently with the environmental compliance activities. URS Corporation sampled and tested sediments within areas upstream and downstream of Saeltzer Dam. The sediment sample size for estimation of mean concentrations of metals in sediment, and for determining whether concentrations are below hazardous limits, was based on a statistical analysis in accordance with Environmental Protection Agency (EPA) standards. Of the total 57 sediment samples collected and tested within the reservoir pool, none exceeded the maximum allowable concentrations for mercury: the Total Threshold Limit Concentration (TTLC) of 20 mg/Kg, and the Soluble Threshold Limit Concentration (STLC) of 0.20 mg/Kg. If any samples had exceeded these limits, the contaminated sediment would have been considered a hazardous waste requiring excavation, treatment, storage, and disposal. In addition to regulatory levels, the National Oceanic and Atmospheric Administration Effect Range-Low (NOAA ERL) freshwater sediment benchmarks, as recommended by the California EPA, were selected with the intention to protect the eco-habitat. This represented the lowest "effect" level for mercury, at 0.15 mg/Kg. One sample taken from the upper layer of reservoir sediments near the dam exceeded this eco-benchmark for total mercury at 0.60 mg/Kg, but most samples were not detectable at 0.04 mg/Kg. Any sediments with mercury concentrations above the NOAA ERL benchmark, but below the TTLC and STLC limits, could be buried onsite but outside the floodplain.

The sediment characterization study also provided estimates of the total volume and gradation of sediments within the reservoir pool (Areas 1 and 2). Unconsolidated alluvial deposits within the pool consisted primarily of poorly to moderately graded, medium- to coarse-grained sands with varying amounts of gravel and some cobbles with very little silt. The total thickness of the alluvial materials ranged between 2 and 14 feet (based on 41 borings), with an estimated total sediment volume of 16,500 yd3. The existing channel through the reservoir is relatively broad (100 feet near the upstream end and 190 feet near the dam) and fairly flat-bottomed. Bedrock is exposed near the south (right) shore where the sediment thins to zero. Evidence of significant bedding or depositional sequences was not observed, suggesting moderately high energy deposition in the pool with little opportunity for sorting of materials. Grain-size distributions of sediments located upstream (Area 3) and downstream (Area 4) of the reservoir produced similar results, although somewhat coarser materials (gravels and cobbles) were found nearer the upstream end of the reservoir and more than 1,000 feet below the downstream gorge.

Excessive levels of fine sediments (less than 1 mm) could clog downstream spawning gravels, reducing the permeability of the gravel and preventing the intragravel flow of oxygen and metabolic wastes from fish embryos needed for incubation and emergence. To evaluate the potential biological impacts of releasing sediments to the downstream channel, a grain-size distribution analysis was performed. Of the 21 reservoir samples (Areas 1 and 2), 13 had greater than 30 percent material finer than 1 mm, with apparently random spatial distributions within both the upper and lower alluvial sand units.

Design and Procurement: Reclamation's Mid-Pacific (MP) Regional Office requested design services for removal of Saeltzer Dam from the Technical Service Center (TSC) in Denver in March 2000, less than two months following issuance of the project's reconnaissance report. A design team was established and a meeting was held with MP Regional Office personnel to discuss the project features, design data and permitting requirements, and potential contracting methods. Since the project schedule had been accelerated significantly and due to the constrained and compressed construction window for dam removal, the Small and Disadvantaged Minority Contractor Program (under the 8A Program with the Small Business Administration) was used. AFA Construction, an 8A contractor with recent work experience for the MP Region, was selected to "partner" with the Reclamation design team under a negotiated procurement contract. A purchase order was issued to the contractor following a site visit on May 9 to help develop a diversion plan for the project and to prepare a technical and cost proposal package. Based on preliminary estimates, a project value between $1 million and $3 million was identified, depending upon the extent of hazardous material impacts. See Figures 1 and 2 for plan and section views.

A 50-percent design briefing was held for AFA Construction in Redding on May 30 to discuss the draft specifications and project drawings, which included a Phase I diversion plan and a Phase II dam and sediment removal plan. A phased approach was adopted due to the permitting requirements, which limited the early work to areas outside the stream channel. A Section 401 certification was issued by RWQCB on May 25 for explorations within Clear Creek and the reservoir pool, to allow the sediment characterization study by URS Corporation (for Reclamation) to proceed.

The initial technical and cost proposals from AFA Construction were received on June 5 for Reclamation review, based on the preliminary designs and specifications. Further revisions to the designs resulted in a second round of negotiations on June 19 and delivery of the final specifications package on June 22. The final contractor proposal for Phase I work was received on June 26 and the Phase I contract was awarded on July 6. Again due to the permitting requirements, the Phase I work was split up into two parts, with site mobilization, clearing and grubbing, and selective demolition of the existing fish ladder structure comprising Part 1 (for work under an existing DFG maintenance permit), and partial construction of the temporary diversion channel and upstream cofferdam (outside the stream channel) comprising Part 2 (requiring NEPA compliance). A stream channel crossing was constructed at the upper end of the reservoir pool by WSRCD under a pre-existing permit for the placement of clean spawning gravel within Clear Creek, to facilitate construction. Phase I work began on August 3 with the mobilization of construction equipment to the project site.

The technical requirements for Phase II work were also split up into two parts. Part 1 work included completion of the temporary diversion channel and upstream cofferdam, selective demolition of the diversion headworks structure, and construction of a downstream stability buttress for the dam. Part 2 work included the excavation and disposal of reservoir sediments, demolition of the dam, permanent closure of the existing fish ladder, and site restoration. These requirements were amended on July 10, resulting in a revised contractor proposal on July 14, further negotiations with Reclamation, and a final contractor proposal for Phase II work on July 24. Part 1 of the Phase II contract was awarded on August 15, following project concurrence by NMFS for ESA compliance, issuance of the Nationwide 404 permits by COE, signing of the Finding of No Significant Impact (FONSI) by Reclamation, State Clearinghouse action on the Negative Declaration at the request of DFG, issuance of a streambed alteration permit by DFG, and submittal of a Notice-of-Intent (NOI) to RWQCB to comply with a State General NPDES permit for construction dewatering of less than 4 months duration. The final agreement with TFWDC was signed on August 18 and ownership of the dam and diversion headworks was transferred to Reclamation, which allowed Part 1 of the Phase II work to begin. TFWDC remained responsible for maintenance or abandonment of the ditch.

The final Section 401 Water Quality certification was issued by the State RWQCB on September 8, establishing the water quality and reservoir sediment sampling and testing requirements for the project. With these requirements known, and with the final excavation limits for the reservoir sediment established by Reclamation, a revised cost proposal for Part 2 work was submitted by the contractor on September 25 and the Phase II contract was amended to include all remaining project work on September 29. Since the excavated sediments were to remain onsite, and were not to be sold, compliance with the Surface Mine and Reclamation Act (SMARA) was not required.

CONSTRUCTION PERFORMANCE

Streamflow Diversion: Streamflow diversion was performed in stages. The initial diversion was achieved by selective demolition of the existing fish ladder on the right abutment to increase its flow capacity. Demolition of the concrete headwall, removal of the slide gate, timber baffles, and concrete piers, clearing and grubbing of the approach channel, and closure of the side outlet near the downstream toe of the dam was completed by August 21 to begin diversion of the streamflow through the existing tunnel and away from the crest of the dam. The streamflow during this period was limited to approximately 50 ft3/s, controlled by releases from Whiskeytown Dam and the minimum allowable for that time of year.

Removal of the dam and reservoir sediment required the construction of a temporary diversion channel that would completely bypass the reservoir area. The design capacity of 150 ft3/s, mandated by FWS to meet downstream temperature and flow requirements for fall-run chinook salmon, required a 12-foot bottom width and 2.5:1 sideslopes for the estimated 700-foot-long upstream channel, with flow depths of less than 3 feet. The alignment for the upstream channel along the north shore (left abutment) was surveyed on August 1, followed by preliminary channel excavation above the groundwater table using a dozer and excavator, and installation of 12-inch vertical pumped wells to bedrock along the right side of the channel on 50-foot centers. In order to further reduce potential inflow to the reservoir area following unwatering, Government-furnished steel sheetpiles were to be driven to bedrock at the upstream cofferdam and stream channel crossing location, and 8-inch pumped wells were to be installed downstream of the sheetpile cutoff on about 21-foot centers. All work outside the stream channel was completed on August 22. Commencement of the instream work was delayed until issuance of the Section 401 Water Quality certification on September 8.

The upstream diversion channel was completed with the placement of a compacted clay liner on a filter fabric (to prevent potential migration of clay materials into the alluvium), and the placement of a surface layer of spawning gravel or cobbles (to prevent channel erosion). A transition section to the diversion headworks structure required steeper sideslopes lined with riprap on clay. Pumped flow from the vertical wells was released into the Townsend Ditch, which had been plugged and breached about 1 mile downstream for diversion into two percolation ponds constructed on BLM land, for treatment of settleable solids prior to returning to Clear Creek. A diversion channel crossing was constructed using two 71- by 42-inch corrugated metal pipes (CMP), with interior wood shoring, to provide construction access to the reservoir area. A trashrack was installed at the CMP inlet and grouted riprap was used for slope protection.

The downstream diversion channel extended from the existing diversion headworks structure and concrete flume to the Clear Creek channel below the dam, and consisted of excavated depressions in the bedrock and the placement of large riprap to create a series of six steps or jump pools for fish passage. The diversion channel was to be at least as effective for fish passage as the existing fish ladder it was to replace. The upstream plug within the Townsend Ditch had to be heavily armored to divert the flow into the
downstream channel.

Construction of the upstream sheetpile cutoff and cofferdam resumed on September 21 with the enlargement of the stream channel crossing and the installation of steel sheets to average depths of 16 to 21 feet within the stream channel. On September 23, the final sheetpiles were driven through the small CMP culverts in the upstream cofferdam and a sandbag plug at the upstream end of the diversion channel was breached, diverting the Clear Creek flow into the completed diversion channel. The streamflow was increased gradually from 50 ft3/s to 150 ft3/s over a 4-day period by adjusting the releases from Whiskeytown Dam, to meet the downstream flow requirement by October 1.

Dam and Sediment Removal: A large downstream stability buttress, consisting of clean spawning gravel over a cobble drainage blanket, was specified to provide a work pad across the stream channel and to ensure stability of the deteriorated dam during sediment removal activities. Construction of the stability buttress began on August 28 with the placement of cobbles from stockpiled materials on the right abutment near the dam. The buttress was constructed in lifts as materials became available, and was completed to elevation 548 by September 23.

Initial pumping of water from the reservoir was allowed to pass over the dam crest to Clear Creek until excavation activities began. A fish rescue was performed on September 28 after the reservoir had been drawn down to within a few feet of the bottom. After the installation of a vertical sump in the reservoir sediment and completion of the unwatering system for the sheetpile cutoff on September 29, all pumped flow was diverted into the Townsend Ditch for release to the downstream percolation ponds. Although subsequent performance of the percolation ponds was less than anticipated (due to higher pumped flowrates and lower infiltration rates), water quality testing of the effluent entering Clear Creek for turbidity and mercury was found to produce acceptable results. Various combinations of 4-, 6-, and 8-inch pumps were used for reservoir unwatering purposes.

From October 5 through October 19, the subcontractor (Nordic Construction) excavated the reservoir sediments from the main stream channel and from a smaller side channel. The excavation was performed primarily using a John Deere 450LC excavator with a 3 yd3 bucket to load two Cat D350E end dumps. During that period, 12,500 yd3 of material was removed and hauled to an onsite disposal area above the floodplain to the south of the reservoir area. Side slopes in alluvium were laid back to 3:1. Original removal estimates of up to 25,000 yd3 of sediment were not realized due to the existence of bedrock in the stream channel at generally higher elevations than expected. In accordance with the specifications, the downstream stability buttress was gradually excavated as well during this period, to avoid a differential loading on the dam.

During the sediment excavation, soil confirmation samples were taken of every other 500 yd3 of material removed, and at 12 locations within the reservoir area at the bedrock contact, by URS Corporation in accordance with the requirements of the Section 401 certification. All samples were sent to a private laboratory for chemical analysis, with only one sample found to exceed the NOAA ERL eco-limit of 0.15 mg/Kg for mercury. Four additional samples were collected at the bedrock contact within 5 feet of the original sample (which had tested at 0.2 mg/Kg), and three additional samples were collected from the excavated material stockpile in question, with all test results below the eco-limit. This permitted the disposal of all excavated sediments within the onsite disposal area.

The demolition of the dam was performed between October 17 and October 27, except for the portion of the left abutment concrete and Townsend Ditch headwall required for streamflow diversion. The original portion (left side) of the dam was removed first, and consisted of upstream and downstream reinforced concrete slabs with an earthen and timber core. The newer portion (right side) of the dam, constructed in 1964 following a partial dam breach, consisted of mass concrete. An excavator with a bucket and thumb attachment was first used to remove the upstream slab and timber cribbing from the left side of the dam, and was then used to haul out all the debris from the dam. Two excavators with hydraulic hoe ram attachments were used to demolish the remaining mass concrete. The waste concrete, reinforcing steel, timber, and earth materials were required to be sorted prior to disposal at a local landfill.

Site Restoration: After all laboratory test results had been received and approved, the excavated sediment piles within the disposal areas were spread out and shaped to natural-looking contours. Topsoil from a local commercial source was placed over much of the granular sediment to promote vegetation. Silt fences, straw bales, seeding, and mulching were used for erosion control, and the access roads were obliterated. Restoration of all disturbed areas on the south side of the channel was completed by November 11. The percolation pond areas on BLM land were also restored during this period using a wide-track dozer.

Between November 2 and November 5, the remaining portions of the stability buttress were shaped and rockfill was placed on the lower crest and flatter downstream slope for overtopping protection. This would provide a small detention pond for the collection of eroded materials from the upstream channel until a larger flushing flow could safely wash out the temporary structure and impounded sediments through Clear Creek to the Sacramento River. Approximately 2,400 yd3 of gravel, cobbles, and rockfill were left in the stream channel for the detention structure. A concrete wall was added to the upstream end of the fish ladder structure on the south bank (right abutment) to seal off the tunnel.

The steel sheetpiles were removed from outside the stream channel beginning November 2 and hauled from the site. A temporary channel was constructed through the upstream cofferdam by driving two rows of sheetpiles, with four steel H-piles at the downstream end to provide an overflow weir of stacked 4- by 12-inch timbers. On November 6, two upstream sheetpiles and the downstream timbers were gradually removed to divert the streamflow back to the natural channel over the next 24 hours. This allowed the diversion channel to be unwatered for backfilling and regrading over the following two weeks. The Townsend Ditch headwall and last remaining portion of the dam's left abutment were removed using the Cat excavator with bucket and thumb attachment, and the remaining portion of the concrete flume was buried using local materials, with riprap placed as slope protection along the stream channel. By November 19, all diversion channel and contractor use areas on the north side of the channel had been restored and graded for drainage. Final seeding and mulching was completed on December 4.

POST-REMOVAL ACTIVITIES

Channel Scour Studies: Surveys performed by Reclamation following excavation of the reservoir sediments revealed bedrock elevations along the stream channel were up to 8 feet higher than originally anticipated, and that remaining sediment deposits were likely less than 2 feet thick. Given a distance of 1,500 feet from the excavation to an upstream bedrock control point, and an average channel width of 65 feet, about 6,000 yd3 of sediment was estimated to be available for future erosion (including about 60 percent sand). This estimated volume was considered by Stillwater Sciences (for CALFED) to be too small for their proposed sediment transport model to accurately discern a difference from the background sediment transport volume of sand at the site, estimated at 3,100 yd3 per year.

Because of the small volume of sediment remaining upstream of the dam, the risk of adverse effects associated with downstream transport of coarse sediment following dam removal was considered to be extremely low. In addition, total suspended sediment concentrations were not expected to be either large or of long enough duration to harm adult and juvenile salmonids. In order to further reduce potential risks to salmonids and salmonid habitat, a flushing flow of 1,200 ft3/s was recommended to be released from Whiskeytown Dam for approximately one day either in conjunction with a natural storm event or as a single pulse flow. This was intended to move the remaining fine sediments (less than 2 mm in size) through the system quickly to minimize the deposition or transport of sand as bedload.

The reservoir site was closely monitored by Reclamation during flood events and on a weekly basis throughout the following winter and spring to ensure that remaining sediments within the stream channel did not cause excessive turbidity or harm to the downstream fisheries. The modified stability buttress or detention structure was designed to control the release of fine sediments until a large winter runoff event caused a breach of the structure and rapid release of the impounded sediments. DFG personnel were to measure sediment deposits within artificial redds (clean gravel sites constructed to simulate egg pockets) located upstream and downstream of the reservoir site.

Detention Structure Breach: Clear Creek flows ranged between 1,000 and 1,200 ft3/s over a 2-day period in February 2001, and again in March 2001, without significant effects on the detention structure. Since the structure would soon impede fish passage, Reclamation proposed the removal of the rockfill from the crest and downstream slope to permit a breach at lower flows prior to the expected spring run. The proposed work would be performed in four stages. The first stage would require equipment to operate in the flow to remove the 3-foot-thick rockfill layer on the embankment crest from the south (right) half of the structure. This would lower the water level behind the embankment about 2 feet and confine the overtopping flow to the south side. The second stage would remove the rockfill armoring from the downstream slope on the north (left) side, steepening the slope from 4:1 to 3:1. The third and fourth stages would remove the remaining rockfill from the crest on the north side, working from downstream to upstream. All requirements of the Section 401 Water Quality certification for Clear Creek would be enforced (including turbidity and total mercury concentration), and erosion control measures would be reestablished upon completion. This work was successfully completed by DWR by March 15, with a reduced streamflow of 50 ft3/s.

CONCLUSION: Removal of Saeltzer Dam and 12,500 yd3 of impounded sediment was successfully completed in October 2000 to provide fish passage to the middle reach of Clear Creek and to meet all other project objectives. The streamflow was diverted through a temporary channel constructed outside the reservoir area to permit unwatering of the reservoir to minimize potential water quality impacts. Mercury concentrations within the excavated sediments were found to be within allowable limits for onsite disposal. Environmental permits for the project were generally issued when needed for the ongoing work without significant impacts to the overall project schedule.

The entire project from design through construction was completed within 8 months for a total cost of about $3,500,000, including $2,800,000 for the construction contract, $309,000 for the URS sediment characterization and sampling contract, and $400,000 for non-contract costs (engineering design, contract administration, construction management, and environmental compliance). An additional $2,500,000 was paid to TFWCD for their water rights and property interests. Project funds were provided by Reclamation (through the CVPIA Restoration Fund), the State DFG, The Packard Foundation (through The Nature Conservancy), and the Metropolitan Water District (through the California Urban Water Agencies). Additional assistance was provided by DWR, WSRCD, and CALFED.

REFERENCES

U.S. Bureau of Reclamation, “Reconnaissance Report for Removal of Saeltzer Dam, Including Diversion Flow Alternatives - Clear Creek, California,” Technical Service Center, Denver, Colorado, January 2000.

North State Resources, Inc., “Joint Environmental Assessment/Initial Study - Saeltzer Dam Fish Passage and Flow Protection Project,” U.S. Bureau of Reclamation, Northern California Area Office, Shasta Lake City, California, Public Draft, June 2000.

North State Resources, Inc., “Joint Environmental Assessment/Initial Study - Saeltzer Dam Fish Passage and Flow Protection Project,” U.S. Bureau of Reclamation, Northern California Area Office, Shasta Lake City, California, Final Draft, July 2000.

URS Corporation, "Sediment Characterization Report - Saeltzer Dam - Clear Creek - Redding, California," U.S. Bureau of Reclamation, Technical Service Center, Denver, Colorado, July 28, 2000.

Memorandum to Mona Jefferies-Soniea and Matt Brown, from Christian Braudrick, Subject: "Saeltzer Dam Sediment Transport Modeling," Stillwater Sciences, Berkeley, California, December 7, 2000.

APPENDIX 3: Two Swim Dams, Alameda Creek CA

No formal case study gas been prepared for these two dams. The current information by American Rivers states:

> "In the Alameda Creek watershed in the East Bay near San Francisco, American Rivers is working with a stakeholder forum made up of the Alameda Creek Alliance and county, state, and federal agencies to develop a plan and secure funding to restore steelhead runs to this creek, mainly through the removal of several dams that block their migration."
>
> "The ongoing efforts to restore steelhead to Alameda Creek has become a matter of pride for many residents of the area as well as local government officials, who had been resistant until it became clear their community was excited by the notion of bringing steelhead back."

Information listed in this report came from:

- A review of the Reqional Water Quality Control Board's Conditional Waiver
- California Department of Fish and Game 1601 Lake and Streambed Alteration Permit
- Initial Study/Mitigated Negative Declaration for the Alameda Creek Dam Removal and restoration Project, Sunol Regional Wilderness, Alameda Creek, CA (February 2000)
- Conversations with Peter Alexander, Fisheries Specialist, East Bay Regional Park District

APPENDIX 4: Waterworks Dam, Baraboo River WI

Friends of the Earth, American Rivers, and Trout Unlimited

BARABOO RIVER
REMOVAL OF THE WATERWORKS DAM IN WISCONSIN

DAM REMOVAL BENEFITS: IMPROVED MIGRATORY AND RESIDENT FISH HABITAT, REVITALIZED RIVERFRONT, IMPROVED THREATENED SPECIES

SUMMARY: A stretch of the Baraboo River runs free for the first time in 140 years, following the 1997 removal of the defunct Waterworks Dam in downtown Baraboo, Wisconsin. Two other small dams within a five-mile stretch historically known as the "Baraboo Rapids" will come down within three years as part of the same fish passage project. Removal of the series of dams, all between 9 and 20 feet high, is expected to dramatically improve the sport fishery, and will allow state threatened and federal species of concern, including the lake sturgeon and prehistoric paddlefish, to return to waters they once inhabited for spawning. Recently published studies document dramatic improvements already in the water quality and fisheries at this site, including the smallmouth bass sport fishery. Local paddlers are increasing their use of the river for recreational purposes, and revitalization of the waterfront is underway, including plans for a new Riverwalk, which promises to literally reconnect the city's downtown to the river.

THE RIVER: The Baraboo flows over 100 miles from its headwaters near Hillsboro to its confluence with the Wisconsin River. Its watershed encompasses 650 square miles, or about 415,000 acres. Through its course, the river drops over 150 feet in elevation; 45 feet of that gradient occurs in a four- to five-mile

HABITAT, IMROVED WATER QUALITY, TAXPAYER SAVINGS: stretch through the City of Baraboo. Historically known as the "Baraboo Rapids," such a concentration of steep gradient is rare in southern Wisconsin. The Baraboo served as an important "nursery" for fish from the larger Wisconsin River, a major tributary to the Mississippi River. Early white settlers recognized the river's drop for its potential to generate mechanical power. From the middle to late 19th century, dams were the life and economic engine that drove the local economy, powering grist, lumber, and other essential milling enterprises.

THE IMPACT PRIOR TO REMOVAL: The name Baraboo comes from the French "Riviere a la Barbeau," meaning "Sturgeon River" and the Native American name, "Ocoochery," meaning "plenty of fishes." But this abundance of fish and fish species began to disappear after the dams were built. Together, the Waterworks, Oak Street, and Linen Mills Dams transformed the "Baraboo Rapids" from a fast-moving stream with riffles and diverse and healthy fish populations into a series of sluggish impoundments supporting primarily carp and black crappie. Prior to removal of the Waterworks Dam, studies conducted by the Wisconsin Department of Natural Resources (DNR) showed ten species of fish below the lowermost dam that were not present above the others, indicating that the dams were blocking fish passage. Unobstructed movement is important to many fish species, including smallmouth bass, walleye, catfish, lake sturgeon, and paddlefish, and to other forms of aquatic life, including mussels, which depend on fish to move around. In addition, the dams served no flood control function; in fact, in high-water situations, the already-elevated water levels of the impoundment led to flooding on adjacent properties.

THE REMOVAL DECISION & PROCESS: For the Waterworks Dam, the question of removal was triggered by public safety concerns. The old structure failed a 1994 safety inspection due to major deterioration and inadequate spillway capacity. The City of Baraboo, ordered to repair or remove it, began to explore its options.

DAM REMOVAL FACTS:

- Height: 9 ft; Length: 220 ft
- Impoundment: 47 acres
- Built: 1848
- Historic purpose: power for mills
- Owner: City of Baraboo
- Regulatory jurisdiction: state DNR
- Estimated cost of repair: $694,600 - $1,091,500 range of options
- Cost of removal: $213,770
- Removed: 1998
- Removal method: heavy equipment and explosives

Initially, there was much resistance to the idea of removal. As in most small communities that grew up around a dam, emotional attachments to the impoundment and the dam ran high. But repair cost estimates ranged from three to five times more than removal estimates. By removing the dam, the city could permanently eliminate its current and future liability for less than one-third the cost of repairing the dam. City officials determined it was not fiscally prudent to repair the structure and voted to remove it. While economics were the key determining factor, the restoration would not have been possible without the support of Mayor Dean Steinhorst and other community leaders who had the foresight to recognize environmental and other community benefits potentially associated with dam removal.

The most vocal opponent to removal was a non-profit business located on the impoundment that effectively delayed the removal process on several occasions and increased costs for the city, but eventually dropped their opposition. Historical assessments determined that adverse impacts from the removal would be minimal, and mitigation measures were worked out that included historical interpretation of the role of the three dams in the growth of the community.

Meanwhile, the Oak Street and Linen Mill Dams were each producing a small amount of hydropower, and both were in need of repairs. The Federal Energy Regulatory Commission (FERC) claimed jurisdiction over the dams. While the state's scrutiny had been limited to public safety, the federal agency's review of dams addresses a wide array of public interest criteria, including environmental considerations. As part of the FERC licensing process, expensive studies could be requested on the dams' impacts on fish and wildlife, recreation and water quality, and to this expense would be added any needed repairs and upgrades for the two dams. The dams, which produced only a miniscule amount of hydropower and were already marginally economical, were becoming an economic burden on the owner, who became increasingly amenable to the idea of removal. City officials were interested in removal of the Oak Street Dam in particular. With it gone, the city will save an estimated $300,000 when making much-needed road repairs to Water Street, gateway to the main tourist attraction in Baraboo—Circus World Museum, the former winter quarters of the Ringling Brothers Circus.

The River Alliance of Wisconsin, a statewide citizen advocacy organization for rivers, served as a catalyst for the Baraboo River restoration project. Because of the potential high quality and scale of the river restoration, the non-governmental organization raised funds from a variety of sources to begin a fish passage demonstration project. The effort evolved into a collaborative project involving the private owner of the two hydro dams, the City of Baraboo, the state, and non-governmental groups, including the River Alliance and the Baraboo River Canoe Club.

Public education played an important role in gaining support for removal of Waterworks and the other dams. Lack of funding precluded a comprehensive, pro-active education effort. Nonetheless, project collaborators identified public education needs on a continuing basis and provided information designed to help improve the decision-making process for the public officials, local community leaders, and federal and state agencies involved, as well as concerned citizens.

Flooding and sediment transport issues were considered in timing the removal of the Waterworks Dam, and an effort was made to avoid interference with fish spawning. The dam was breached in December 1997 and the impoundment was drawn down. The Baraboo River Canoe Club sponsored several river cleanups to remove debris from the newly exposed mudflats; the first cleanup immediately followed the drawdown. The bulk of the dam was removed with a backhoe-mounted jackhammer. Due to use of heavy reinforced steel in the dam below the riverbed, explosives experts helped complete removal of the structure. Dam rubble (and timber and rock from earlier versions of the dam at that site) were used to stabilize the banks. The dam was completely removed by late April. The mudflats were extremely fertile and contained ample seed. Without benefit of artificial seeding, the former impounded area began to "green up" within two weeks, and within six weeks the banks were fully vegetated.

REMOVAL BENEFITS:

- Dramatic improvements to sport fishery
- Rare riffle habitat restoration
- Community revitalization & expected urban riverfront restoration
- Public safety hazard elimination
- Taxpayer savings

RESTORATION OF THE RIVER: Positive changes in river habitat were evident very soon after the removal of the Waterworks Dam. When spring floods completely submerged the lowermost dam (allowing fish to pass over it), fisheries biologists identified sturgeon at the former Waterworks Dam site. Eighteen months after the removal, the number of fish species above the former dam site had more than doubled from 11 to 24 species, according to a Wisconsin DNR survey. The survey also indicated that water quality had improved —
numbers of smallmouth bass, a species that cannot tolerate poor water quality, had increased from only 3 to 87 in the former impoundment. Three-quarters of a mile of high-quality riffle habitat, rare in southern Wisconsin rivers, has been restored to its free-flowing condition. Some other communities in Wisconsin that have removed small dams have enjoyed an increase in recreational opportunities, especially canoeing, that have attracted visitors and resulted in important economic development opportunities. These and other improvements promise to serve as an economic boost to this small town, and once again make the river an integral part of the community.

FUTURE EFFORTS TO RESTORE THE RIVER: By 2003, both the Oak Street and the Linen Mill Dams will be removed. The Oak Street Dam removal, originally scheduled for 1998, was delayed due to contaminated sediment found upstream. The contaminant was identified as coal tar, a byproduct of the coal gasification process used across the Midwest in the late 1800s. Alliant Energy (formerly Wisconsin Power & Light), which purchased the site in 1913, is assuming financial responsibility for the cleanup, which is expected to be completed shortly. Removal of the Oak Street Dam is scheduled for this winter (1999- 2000).

Linen Mill is the lowermost and will be the last of the three dams to be removed. Sediment flushed downstream from the removal of the two upper dams, on top of a century's worth of sediment already trapped behind the dam, may present a challenge. Resource managers are already discussing alternatives for handling the sediment.

LaValle Dam, approximately 30 miles up river from the City of Baraboo, has recently been purchased by a private nongovernmental organization. The new owner is planning to remove the dam in 2001. With the removal of the four dams, the entire main stem of the Baraboo River will flow freely for the first time in more than a century.

The River Alliance recently initiated the Baraboo Riverfront Sustainability Project, a partnership between city, state, and private organizations to coordinate the restoration and revitalization of the river corridor. The organizations plan to work with the local community to plan river-related development, including wayside public parks, an area dedicated to the history of the dams and the river, and the revitalization of the riverside historic district.

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THE SIGNIFICANCE OF THIS REMOVAL: The Baraboo River restoration has been called a model for both its natural resource benefits and its collaborative process. The public-private partnership involves many stakeholders, including the private owner of the two hydropower dams, city and state officials, and non-governmental organizations. When all four dams—the three blocking the Baraboo Rapids and the LaValle Dam upstream—are finally removed, 120 miles of the Baraboo will be restored to free-flowing conditions. Research indicates that this may be the longest main stem stretch of river ever restored in the United States through dam removal.

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APPENDIX 5: Linen Mill Dam, Baraboo River WI

Environmental Assessment of the Glenville (Linen Mill) Dam Removal

Draft

Prepared by the Wisconsin Department of Natural Resources for the
U.S. Fish and Wildlife Service, Division of Federal Aid, Region 3

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Environmental Assessment of the Glenville (Linen Mill) Dam Removal

1. Purpose and Need

1.1 Purpose: The purpose of this draft environmental assessment is to determine the actions that may be taken by the U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources to determine the future of the Glenville (Linen Mill) Dam.

1.2 The Environmental Assessment Process: This document is the Draft Environmental Assessment (EA) for a project that involves the removal of the Glenville (Linen Mill) Dam on the Baraboo River, in the Town of Greenfield, in Sauk County. The project is partially funded by the Federal Aid in Wildlife Restoration Program (Wildlife Conservation Restoration Subprogram) that is administered by the U.S. Fish and Wildlife Service and the Department of Natural Resources. Because of the funding source, the project must comply with both the National Environmental Policy Act (NEPA) and the Wisconsin Environmental Policy Act (WEPA) including Chapter NR 150, of the Wisconsin Administrative Code.

This Draft EA has been prepared to meet both Federal and State laws that require full public disclosure of projects that may affect the quality of the human environment.

The purpose of a Draft EA is to disclose, explain, and evaluate the environmental effects of a proposed government action to the decision-makers and the public. The Draft EA describes and evaluates alternatives to the proposed course of action. The Draft EA is circulated for public review and comment to assure public participation in the process. A public informational meeting will be held during the public review period to provide an opportunity for the public to obtain information about and to comment on the project. The public will be notified of the meeting time and place. The public review period also gives interested and/or affected persons a chance to review and discuss the project, alternatives, and potential impacts.

1.3 Need: Under authority of Chapter 31, of Wisconsin Statutes and NR 333 of Wisconsin Administrative Code, the Glenville (Linen Mill) Dam was inspected by the Department of Natural

Resources and it was determined that the dam would need substantial repairs or a complete reconstruction to bring it into compliance with this statute and code. According to the report from their regularly scheduled inspection, the Wisconsin Department of Natural Resources Dam Safety Engineer cited undermining and deterioration of the concrete spillway, as main reasons why the dam is unsafe. Any actions taken to address this situation would have to address the overall structural integrity of the dam, fish passage, concerns over impacts to historic properties, and be economically feasible. Therefore this project is directed toward meeting several needs: safety problems associated with the current dam (abandonment or repair), fish migration on the Baraboo River, and aquatic habitat improvement.

1.4 Decisions That Need to Made: Upon completion of the public review the Regional Director (Region 3, USFWS) will make a decision on the alternative selected and whether or not a finding of no significant impact (FONSI) can be determined.

1.5 Background: The Baraboo River flows approximately 120 miles from its headwaters near Hillsboro to its confluence with the Wisconsin River south of Portage. Its watershed encompasses 650 square miles, or about 415,000 acres and drops over 150 feet in elevation. This concentration of relatively steep gradient was recognized by early white settlers for its potential to generate mechanical power and in 1837 settlers began constructing on the Baraboo River. The dams that were built on the Baraboo River system date to the water power era, which began in the 1840s and 1850s. These dams were authorized under the Milldam Act, which dates to early statehood. This Act encouraged the development of dams for waterpower for logging and milling purposes. Before dams were constructed on the Baraboo River, the river had healthy fish populations with seasonal spawning runs of lake sturgeon, walle ye, sauger, bigmouth buffalo, freshwater drum and other species. Riffle habitats, where many of the dams were built, provided critical spawning sites for these fish. The impoundments' slow current and deep pools allowed sediment from the watershed's developing agricultural lands to settle on the river bottom, covering once-productive aquatic habitat for invertebrates and the fish they support. Dams on the Baraboo River system are perhaps the major limiting factor to achieving healthy fish populations for those migratory species including fish populations of the Wisconsin River. Mussel populations have also suffered because of impediment to fish movement. Fish serve as hosts for mussel larvae and are a major influence on their distribution in a river system. There were four major dams on the Baraboo River and three of them have been removed (Waterworks, LaValle and Oak Street—see below).

The owner of the dam has applied to abandon the dam. The dam is currently in bad repair and would require expensive repairs to bring it into compliance with state and federal dam safety codes and statutes. The State of Wisconsin has a contract with the owner of the dam that allows the state to remove the dam, if this proposed alternative is selected.

1.5.1 Removal of the Waterworks Dam (removed in 1997: The Waterworks Dam, a municipal dam owned by the City of Baraboo was removed in 1997. The original dam was constructed circa 1860 under the Milldam Act. The dam was located near the city limits in southeast portion of the city and downstream from the Circus World Museum (see regional map). After numerous public meetings and successful negotiations between the City, WDNR, State Historical Society and the Circus World Museum, a decision was finally made to remove the Waterworks dam, on the condition that certain steps to mitigate the loss of the historic appearance the impounded river provided. In December 1997 breaching of the dam began, with final removal occurring in April 1998. By removing the Waterworks Dam, the City of Baraboo has permanently eliminated a major current and future liability, for less than one-third the cost of repairing the structure. The City was paying $5,000 annually in liability insurance for the dam and its associated structures. Positive changes in the habitat were immediately evident and additional monitoring is expected to show increased fishery benefits. Three-quarters of a mile of high-quality riffle habitat, rare in southern Wisconsin rivers, has been restored to its free-flowing condition following removal of the Waterworks Dam.

1.5.2 Removal of the Oak Street Dam (removed in 2000): A Corps of Engineers inspection report (1980) states that the former Oak Street dam was originally constructed in 1885 of timber and rock and was used to generate power for a flour mill and for a towel mill factory beginning in 1910. The McArthur family owned the former dam since 1898 and also owns the Glenville (Linen Mill) Dam on the Baraboo River located approximately 1.5 miles downstream of the Oak Street Dam (see regional map). The dam had an impoundment of 64 - 195 acre-feet, surface area of 16 - 38 acres and a length of 0.8 miles. A steep river gradient is present at the dam site, and water will move through the area at a velocity higher than most areas along the river. During initial monitoring of this site before the dam was removed, coal tar deposits were discovered in the bed of the river. Alliant Energy removed the deposits at a cost of over $600,000. In addition to the removal of the dam and the work done on the powerhouse, bank stabilization and habitat enhancement was also accomplished. This should add to the benefits to the aquatic environment that are achieved by the removal of the dam.

1.5.3 The LaValle Dam (removed in 2001): The Sand County Foundation purchased the dam and mill, located in the Village of LaValle, from the former owner in 1999, for the purpose of removing the dam and restoring the river to a natural state (see regional map). The LaValle Dam was removed in March of 2001. During the previous year, staff from the Department, the Sand County Foundation, Sauk County, and the US Fish and Wildlife Service had met with residents of LaValle to reach consensus on a plan for mitigation of the loss of the millpond after the dam removal. Restoration of the lakebed will follow this plan and should be complete by July 2002.

1.5.4 The Glenville (Linen Mill) Dam: The Glenville (Linen Mill) Dam is located at the downstream side and just east of the City of Baraboo, 45 miles northeast of Madison in Section 6, T11N, R7E. The dam was originally constructed in 1898 and has been modified, rebuilt, and rehabilitated several times since it was originally constructed. The length of the maximum pool upstream of the dam is approximately 1.5 miles and the size of the pool is 7 acres. The dam consists of a small powerhouse, a large uncontrolled spillway and a small auxiliary spillway. The original use of the dam was to provide power for a linen mill. It presently is used to produce a small amount of electrical power. The structural portions of the facility consist of timber, concrete, masonry, rock and gravel fill, and earth. After inspection by the Department, the dam was found to have problems with its structural integrity and is not in compliance with Chapter 31, of Wisconsin Statutes and NR 333 of Wisconsin Administrative Code. As with the other dams, the Glenville (Linen Mill) Dam needs substantial repairs or a complete reconstruction to bring it into compliance with this statute and code. This dam is the last remaining blockage to fish migration, being the lowermost dam. If this blockage to fish migration, is removed, then fish can access the entire Baraboo River. The Wisconsin Department of Natural Resources has a contract with the owner which includes an option to remove the dam.

2. Alternatives, Including the Proposed Action

2.1 Alternative Not Considered for Detailed Analysis: Besides the alternatives listed below, another alternative was considered for detailed analysis. The option of letting the structure remain in place and simply modifying the spillway to enable the river to flow freely through the structure was considered. This was rejected because the decaying dam structure would still be in place and would still need major repairs to bring the structure into compliance with statutes and codes and would still represent a significant financial burden for the owner. Leaving the spillway in place and allowing the water to flow through would represent a serious safety problem.

2.2 Alternatives Carried Forward for Detailed Analysis

2.2.1 Alternative A (Proposed Action) – Remove Dam and Restore the River Channel: The proposed action includes removing the Glenville (Linen Mill) Dam and restoring and enhancing habitat in the newly formed river channel. In addition, the owner of the dam did not wish to make costly repairs that would bring this dam into compliance with statutes and codes that regulate the safety aspects of this dam. Therefore, from an ecological and financial perspective, removal of the dam and restoration of the river channel is the desired alternative.

The Glenville (Linen Mill) Dam was constructed in 1898 under the Mill Dam Act of timber, rock, and gravel. In 1912, a new concrete flume and retaining wall was constructed. In 1928, additional repairs were made and a new powerhouse was installed. It still produces a relatively small amount of electrical power (100 KW capacity generator). The current structure consists of a 86 long fixed crest spillway with buttress supports and a small concrete chute auxiliary spillway.

If this alternative is chosen, the actions below will occur: The dam spillway will be breached in a manner so that sediment moving downstream from the impounded area is minimized. The sediments in the impounded area have been sampled for laboratory analysis. If contamination is present, the affected area will be isolated and the material will be removed in compliance with the environmental remediation standards of NR 700, of Wisconsin Administrative Code.

Trees and brush will be cleared and a temporary gravel road constructed to access the right side (right and left is referred looking downstream) of the dam. The dam fixed crest spillway will be first breached at the right side next to the auxiliary spillway. The initial breach will be accomplished in a manner so that sediment moving downstream from the impounded area is minimized.

After the water level of the impoundment is lowered, the demolition of the fixed crest spillway will be approached from the left side next to the powerhouse. The rock fill of the timber structure on the upstream side of the support concrete wall will be rearranged to form a pad for the backhoe to easily traverse across the river along the upstream side of the spillway. A concrete wall will be constructed at the downstream side of the powerhouse to block the opening of the turbine pit exit. Part of the rock fill materials will then be placed against the foundation walls and pillars of the powerhouse to buttress the foundation against erosion and undermining.

From there, demolition will proceed to the right, forming the final river channel configuration as materials are removed and/or used in channel stabilization. The clean, sandy deposits located immediately upstream of the spillway will be evaluated for removal and if removed, they will be incorporated into the bank structure and other aspects of the site restoration. A small tributary stream referred to as "Babbling Brook" enters the river immediately upstream of the spillway. The entry point (Babbling Brook) will be evaluated and the tributary may be aligned slightly to allow high flows to merge with the river without bank erosion, scour, and/or adverse impacts to habitat. Excess material will be trucked off site for disposal at an approved landfill (approved under NR 500, of Wisconsin Administrative Code).

The area in front of the powerhouse (upstream) and the downstream side of the powerhouse will be filled in with suitable soil materials (meets engineering standards and specifications). Riprap will be placed along the 7 newly formed and disturbed riverbanks for stabilization. The temporary access road will be removed and all
disturbed areas topsoiled and seeded for erosion control and a natural appearance.

The spillway removal will require modifications to the outfall structure for the City of Baraboo Wastewater Treatment Plant. The existing outfall elevation is set for the current water level in the millpond. When the water level decreases as a result of the elimination of the impounded area below the dam (if the dam is removed), earthwork, including grading and riprap placement, will be required to assure that the discharge from the plant will flow into the river efficiently without erosion or scour. The

City of Baraboo will be coordinating the work with the Department of Natural Resources. Information about the outfall area has been submitted to relevant tribal organizations for review of cultural and sacred sites. If ground disturbance is needed then a review for impact on historic properties by the SHPO will be conducted in compliance with federal regulations. This outfall site has also been screened for impact to endangered and threatened species. Documentation will be provided to the Fish and Wildlife Service as needed.

Given the nature of the site, it is highly unlikely explosives will be used to remove concrete below the bed of the river. If they are used, they will be used by licensed operators in cooperation with the Town of Greenfield to ensure that the timing of their use is compatible with residents and businesses. These activities will be conducted in accordance with DNR manual code (9187.6) and Wisconsin Administrative Code (NR 231).

The powerhouse and mill building will remain intact. Borrow sites will be screened for endangered and threatened species and historic properties. Prior to any site disturbance, compliance documents will be obtained by the Wisconsin Department of Natural Resources and provided to the Fish and Wildlife Service as needed. This work will be conducted in cooperation with the Wisconsin State Department of Transportation. They have requested that appropriate spoil material (riprap) be used to protect the State Highway 113 bridge, located immediately downstream of the dam structure (within the project area). This work or any work that pertains to State Highway 113, would have their approval before proceeding.

2.2.1.1 Significance of Risk/Unknowns (This section required by WEPA): There are no significant unknowns associated with this project. The results of dam removals are highly predictable. Pre-dam hydrology and stream morphology is restored. Hundreds of dams have been removed in the State of Wisconsin within the regulatory guidelines in Chapter 31 of the Wisconsin Statutes

2.2.1.2 Significance of Precedent (This section required by WEPA): This action is not precedent setting. The benefits to habitat and water quality from dam removal are well documented in the scientific literature. Removal of this dam will demonstrate there are alternatives to repair and maintenance of aging dam structures. Removal of this dam will improve aquatic habitat and protect public rights in navigable waters.

2.2.1.3 Land Ownership Issues: A land use agreement with the Wisconsin Department of Transportation may be needed to do work within the highway right of way, where it crosses the river.

2.2.1.4 Authorities and Approvals (list local, state and federal permits or approvals required): Army Corps of Engineers GP/LOP - General Permit/Letter of Permission required for dam removal and stream stabilization

Wisconsin Department of Natural Resources – Permit issuance under Section 31.185, of Wisconsin Statutes to transfer ownership of the dam to DNR contingent on removal. Manual Code Approval plans and specifications for removal and site restoration under Section 31.12, of Wisconsin Statutes, Public Information Meeting-(Opportunity for Hearing) under Section 31.253, Wisconsin Statutes, WEPA Compliance (Wisconsin Environmental Policy Act – NR 150, Wisconsin Administrative Code)

Town of Greenfield and Sauk County - Revise and amend the shoreland wetland and flood plain zoning maps and ordinances as necessary. The Department will conduct the analysis pertaining to these changes. Sauk County and the Town of Greenfield will incorporate these changes into their flood plain ordinance through the amendment process. No measurable changes in the flood profile are expected to occur.

Wisconsin Department of Transportation – Approval required to work on state owned right of way, easement and property

United States Fish and Wildlife Service (Federal Aid in Wildlife Restoration Act) – Selection of alternatives and FONSI determination National Environmental Policy Act

Compliance with the Endangered Species Act

Compliance with Section 106 of the National Historic Preservation Act

2.2.2 Alternative B – (No Action): The "no action" alternative includes keeping the dam and millpond in place as is. An inspection of the Glenville (Linen Mill) Dam noted several structural deficiencies and severe deterioration of the structural integrity of the dam. For this reason, a schedule for completing rehabilitation of the dam to meet Wisconsin State Dam Safety standards was not imposed on the dam owner. The cost to rehabilitate or rebuild the dam was estimated to be at a minimum $200,000. This is based on other dam construction projects and included engineering and contingencies. These projects include the dam removal and reconstruction projects in the Wisconsin villages and cities of Evansville, Baraboo (Waterworks and Oak Street), Cazenovia, and Afton. These dams are similar in the size and type of construction (i.e. structural height of 6-10 feet and impounded area) to the Glenville (Linen Mill) Dam. Moreover, these dams were built during the period when many mill dams were constructed (1840-1900) in Wisconsin and all have similar structural problems associated with aging. Repairs to correct the problems with these aging structures are usually not cost effective; communities have found it to be more economical to remove the dam or completely rebuild it.

Approval of plans according to Section 31.12, of Wisconsin Statutes for the removal and abandonment of the dam is pending. State approval of the application from the present owner of the dam cannot be denie d if all of the conditions imposed as part of the plan approval are met. These primary conditions include insuring that the plan for abandonment includes constructing a stabilized river channel, following erosion control measures, and properly disposing of demolition material. If the dam is not abandoned and removed, the present owner or new owner of the spillway section will be required to rehabilitate the dam. In addition, it will be necessary to reconstruct the north end of the spillway to structurally separate the forebay of the powerhouse and the powerhouse/mill building, which is now under separate ownership, from the dam. This will be necessary to maintain the non-dam status of these structures.

Pursuing the "no action" alternative would create a large financial liability for the owner and the dam would still serve to block fish migration and there would be no benefit to the aquatic resources of the Baraboo River. The negative environmental impact of the dam will remain in perpetuity, because the dam will need to be rehabilitated to meet state dam safety standards. The impounded area which has poor water quality and large amounts of silt (average depth of 3 feet), would continue to have poor water quality into the future, would provide a limited fishery for sport fish and serve as a carp "nursery" for the rest of the river

2.2.3 Alternative C – Repair the Dam and Install Fish Passage: This alternative will require retaining the dam as described in the "no action" alternative. In order to negate some of the negative impacts of maintaining the dam, a fish passage could be constructed to allow movement of fish through the dam structure under normal to low flood conditions. Under flood conditions, the dam becomes inundated and some degree of fish movement occurs. However, this iunudation of the dam is highly unpredictable and may not coincide with annual fish spawning migrations. Thus, the dam still is a major impediment to fish migration.

Construction of a fish passage would be a major structural undertaking and would require almost complete reconstruction of the dam. The physical site conditions for constructing a fish passage are very restrictive. A state highway and bridge is located approximately 100 feet downstream of the dam. The property adjacent to the north side of the dam is under private ownership with commercial buildings.

Immediately downstream of the dam is a large deep “fishing hole” and is heavily used by local anglers. Due to the physical size and configuration of a warm water fish passage, it would have a major impact on the highway bridge and the downstream “fishing hole”.

Because of the location of the highway and associated bridge immediately downstream there are major physical constraints to the installation of fish passage that would add great costs to its construction. The actual fish passage channel may have to be incorporated into the highway embankment and/or the bridge structure itself would have to be modified.

Based on cost estimates for construction of fish passage structures for other dams (such as the dam at Brodhead, Wisconsin on the Sugar River which ranged from $250,000 to $500,000) and rivers of similar size, the cost of a fish passage at this site would be approximately $250,000. This would be in addition to costs associated with dam reconstruction, which would be more costly than rehabilitation as described in the “no action” alternative.

3. Affected Environment

3.1 Physical Environment: With a gradient of 1.59 feet per mile (see Appendix), the Baraboo River drops over 150 feet in elevation from its source to its mouth. Prior to building dams on the Baraboo River, rocky riverbed with riffle -pool-run habitat, and fastmoving reaches were more common. Riparian corridor along the Baraboo River is the dominant natural feature within the project area. Islands are located in the river channel above the dam. The river banks are approximately four feet high (impounded conditions) along much of the river channel within the project boundary. The river channel in the project area (see map) is approximately 3-5 feet deep and has a substrate of sand and rubble. The bottom substrate of the riverbed consists of fine silty material that overlays medium to coarse-grained sands with areas of gravel, cobble, and possibly boulders in some areas.

The impounded area above the dam is approximately 7 acres in size and the average depth is 1-4 feet. It is surrounded by a variety of wetland vegetation. Soundings indicate that the bed in the millpond is made up of sand, and characteristic sediment of the Baraboo River floodplain in the area.

Soils in the floodplain riparian corridor are level, poorly drained fluvaquents. Most of the areas are long and narrow with a wide range of soil characteristics. Surface layers range from a silt loam to sand and organic. Hydric units including Adrian, Houghton, Marshan, and Palms are found within this mapping series. Permeability of the fluvaquent unit is moderate to high, but frequent flooding and a higher water table keep the soils wet.

The dam spillway core is a rock filled timber crib structure with timber gates originally built in 1898. The length of the maximum pool upstream of the dam is approximately 1.5 miles and the size of the pool is 7 acres. Eventually the timber control gates were replaced with concrete and the timber crib spillway was capped over the concrete. The fixed crest spillway is 86 feet long.

3.2 Biological Environment

3.2.1 Habitat/Vegetation: The Baraboo River originates near Hillsboro in Vernon County, Wisconsin, and flows southeasterly through central Wisconsin before joining the Wisconsin River just downstream (south) in Columbia County, Wisconsin (see Figures B in the Appendix). The headwaters of the Baraboo River begin in the “Driftless Area” and join the Wisconsin River in the “Central Plain” region near Portage. Glacial drift consisting of sand and gravel is abundant in the area, with alluvial sand and gravel filling the Baraboo Valley. Land use along the river system is dominated by agriculture.

Agricultural fields extend throughout the watershed and end at the river corridor, where a narrow forested line abuts the riverbank. Beginning at Reedsburg, Wisconsin, and extending upstream along the Baraboo River and most tributaries is a narrow shrub and timber swamp wetland corridor. The Baraboo River Corridor has many types of relict plant and forest communities listed along tributaries, such as the Floodplain Forest and Wet-Mesic Prairie, in addition to Pine and Hemlock Relicts.

3.2.2 Threatened, Endangered and Candidate Species: There are no federally threatened, endangered or candidate species present in the project area. The Natural Heritage Inventory (NHI) lists four state listed fish species as present in the Wisconsin River downstream from the dam site.

These species are as follows:

- Cycleptus elongatus (blue sucker)
- Etheostoma clarum (western sand darter)
- Macrhybopsis storeriana (silver chub)
- Macrhybopis aestivalis (speckled chub)

It is highly unlikely these species are present at the dam site but it is possible that they will migrate (at specific times of the year) into project area following dam removal and as habitat conditions change The NHI also lists numerous plant species in the Baraboo Hills at Devils Lake State Park and in the general vicinity of the project site. Borrow sites outside of the project area will be reviewed for threatened and endangered species as these sites are identified.

3.2.3 Other Wildlife Specie: The dominant sport fishery of the Baraboo River in the vicinity of the Glenville (Linen Mill) Dam includes northern pike, smallmouth bass, and channel catfish. Panfish are common, and rough and forage fish are abundant. Upstream areas in the Baraboo River are not fully populated by all of the species present in the system. A survey by Wisconsin Department of Natural Resources fisheries staff found that 10 species were present below the lower dam in Baraboo that were not found above. Fish populations below the dams were more typical of healthy riverine communities (darters, redhorse, etc.) while the impounded sections contained high populations of carp. The dams prevent the Baraboo River from serving as a nursery area for the Wisconsin River fishery.

Common wildlife (mammal) species in the vicinity of the Glenville (Linen Mill) Dam include muskrat, mink, raccoon, muskrat, gray and fox squirrel, chipmunk, coyote, and occasionally river otter. Common bird species include Robin, Catbird, House Wren, Kingfisher, Great Blue Heron, Red-winged Blackbird, flycatchers, Wood Ducks and marsh wrens. The dominant vegetation communities/habitat types present in the project area are floodplain forest, shallow marsh, and fresh wet meadow. Dominant Species types among the vegetation communities are as follows:

Floodplain: Tree species include Green Ash (Fraxinus pennsylvanica), Black Ash (Fraxinus negundo), American elm (Ulmus americana L.), Willow spp. (Salix spp.), Cottonwood (Populus deltoides), Oak spp. (Quercus spp.), Box elder (Acer negundo). Shrub types include Willow spp. (Salix spp.), young Green ash (Fraxinus pennsylvanica), buckthorn, wild grape, dogwood, and sumac. Herbaceous layer inlcude Reed Canarygrass (Phalaris arundinacea), grass spp. (Poa spp.), Cattail, Carex lacustris, Carex spp., goldenrods (Solidago spp.).

3.3 Land Use: The Glenville (Linen Mill) Dam is in the Town of Greenfield and located near the City of Baraboo. The surrounding area is mixed woodland and agricultural (including hobby farms). There are several businesses located in the old mill building.

3.4 Cultural/Paleontological Resources: The State Historic Protection Officer (SHPO) has determined that the Glenville (Linen Mill) Dam and its associated complex does not have historic significance hence there would be no impact to any historical properties within the project area (see appendix). All actions described within this document are within this project boundary. Borrow sites outside of the project area will be reviewed by SHPO if these sites are needed.

3.5 Local Social/Economic Conditions: The 1990 population of Sauk County was 46,975. Baraboo is the largest city in the County with a population of 9,203 (1990). Baraboo and Reedsburg are service centers for the surrounding area. Waterfowl hunting and canoeing are listed as important recreational functions. There are no prime agricultural lands in the immediate vicinity of the dam.

4. Environmental Consequences

4.1 Alternative A (Proposed Action) – Remove the Dam and Restore the River Channel

4.1.1 Fishery Impacts – Cumulative: The removal of the Glenville (Linen Mill) Dam will take away a barrier to fish migration that prevents several species of fish from reaching spawning areas in the upper reaches of the Baraboo River. This system wide impact of removing the three upstream dams will not be fully realized until the Glenville (Linen Mill) Dam (the last dam on the entire river) is removed. With no obstructions to movement, native fish populations will reestablish the traditional migratory patterns and regain access to critical habitats. Several fish species such as lake sturgeon, smallmouth bass, walleye, sauger, and channel catfish will be able to access the upper reaches of the river and exploit historic spawning habitat.

The upstream distribution of a number of fish species on the Baraboo River terminates at or near the Glenville (Linen Mill) Dam. These species included musky, three redhorse species (silver, golden and shorthead), channel catfish, stonecat, three species rare in the Baraboo (warmouth, blackside darter and slenderhead darter) and walleye.

Additionally, 1-4 specimens of three species usually limited to the river below the Glenville (Linen Mill) Dam (gizzard shad, spotted sucker and freshwater drum) were collected in small number below the Glenville (Linen Mill) Dam following heavy flooding in June 2000. With the removal of the dam, the main stem of the Baraboo River will be free flowing for it's entire length. As to direct and tangible benefits to humans, we will likely see improved fishing, especially for smallmouth bass, sauger, walleye, northern pike, white and yellow bass, and channel and flathead catfish. Fish populations that have been fragmented since the construction of the Glenville (Linen Mill) and other dams will be reconnected. Genetic health of species that had fragmented populations because of the dams blocking fish movement will be improved.

4.1.2 Site Specific Fishery and Habitat Impacts: At the dam site proper, the fish habitat will be improved immediately with the pla cement of rock riprap and restoration of the pre-dam, stream profile. The channel in the vicinity of the former dam will scour and the substrate will tend to become more rocky and thus the habitat will improve. Fish species such as smallmouth bass and walleye will regain access to spawning, feeding and nursery areas that have been unavailable to them since the construction of this dam.

Rock-riffle substrates that are covered by silt, as a result of the impoundment, will recover and provide quality habitats to native riverine fishes such as smallmouth bass. Increase in the amount of rock-riffle habitat would benefit macroinvetebrate species diversity and increase mayfly and caddisfly populations. Non-native species, such as carp, and native species that are indicative of poor water quality and degraded habitats, such as black bullhead and green sunfish, will become less common as conditions improve for desirable riverine species.

Some areas affected by the dam impoundment will change. The river channel will be narrower upstream. The floodplain downstream of the dam will not be affected. Additional benefits to the fish population should occur through time and a comprehensive study is underway on the effects of the Baraboo River dam removals to document the changes to fishery and aquatic ecosystem. Preliminary findings indicate a positive response in the fish and aquatic insect populations.

Temporary stockpiling of sand for later removal and transport out of the area from the bottom of the impoundment will occur on the south bank and immediately upstream of the current dam structure and will cover an area less than one acre in size. No other appreciable impacts to the adjacent banks are expected to occur.

4.1.3 Impact on Mussel Populations: The dam removal will improve conditions for mussel fauna of the Baraboo by exposing them to fish hosts and they will have access to additional stream habitats. Mussel species diversity and population levels should increase. The opportunity for glochidia (larval mussels) to be transported upstream through various species of fish hosts will be greatly enhanced by the dam removal.

4.1.4. Impact on Water Quality: Because the existing impounded area upstream from the dam will be eliminated, it will no longer serve as a carp nursery for the system. The impounded area upstream from the dam which is very eutrophic will be replaced by a higher quality flowing river reach. In addition, the impounded area upstream from the dam will no longer contribute water with low dissolved oxygen to the river system.

4.1.5 Safety: Removal of the dam would solve the current problem of the present unsafe condition of the dam.

4.1.6 Impact on Flooding Downstream: If the Glenville (Linen Mill) Dam is removed, the flooding of areas downstream will not increase to any noticeable degree. The Glenville (Linen Mill) Dam, is a "run of the river" dam and has no significant impact on the volume of water flowing in the river as a whole and does not function as flood control or flood storage structure. The dam becomes submerged at the less than the 10-year storm and the hydraulic analysis included in the appendix indicates that the dam during more frequent and smaller flood events has no measurable effect on flows. During larger events like the 25-year storm the flow reduction, from the dam, is as small as 0.5%, with no storage capacity. As a result, removal of the dam will not have any noticeable effect on the upstream or downstream flow and stage during major floods

Data and an analysis to support this assessment is covered in the attached appendix.

4.1.7 Cultural Resources: There are no historical properties in the project area. Borrow sites outside of the project area will be reviewed by SHPO once these sites are identified.

4.1.8 Endangered/Threatened Species: There are no listed, endangered or threatened species that would be impacted by this action. Borrow sites outside of the project area will be reviewed for endangered and threatened species once these sites are identified.

4.2 Alternative B - No Action - Repair the Dam Only

4.2.1 Fishery Impacts – Cumulative: This alternative would mean that the dam is repaired. The greatest environmental impact of this alternative is that the dam would continue to serve as a barrier to fish movement and fragment the river ecosystem. Several species of fish, such as walleye, sauger, lake sturgeon, fresh water drum and smallmouth bass are limited in their seasonal spawning movements because they cannot access the river above the Glenville (Linen Mill) Dam. Leaving the dam in place would continue to have a negative impact on the fishery of the Baraboo River.

4.2.3 Mussel Populations: Mussel species and population would remain the same. Because the fish cannot move upstream above the dam, the mussel population of the upper river would not improve because fish host species cannot freely access the upper river and serve as vectors for population establishment.

4.2.4 Impact on Water Quality: As it currently exists, the impounded area upstream from the dam has a negative impact on water quality. The impounded area upstream from the dam impoundment would continue to have poor water quality because of its fertility (eutrophication) and because of the higher population of carp. Since the impoundment is very fertile, it could suffer from algae blooms which in turn suppress oxygen levels. Carp keep the sediments stirred up and this further distributes nutrients in the water column and has a negative impact on the river as whole. The impoundment serves as a prime breeding area for carp, which will move into the Baraboo River proper.

4.2.2 Site Specific Fishery and Habitat Impacts: Leaving the dam in place with repairs being made to bring it into compliance with safety standards would not allow for any habitat improvement work to be done. The riffle habitat that would be permanently exposed if the dam is removed would instead remain covered over with deposited sediment in the impounded area. Fish species requiring riffle habitat for spawning and cover would continue to be negatively impacted. Macroinvertebrate populations would continue to have low diversity and favor species that require sediment dominated substrate. The tailwater area would remain below the dam where fish concentrate at the limit of their upstream migration and thereby attracts anglers.

4.2.5 Safety: According to state safety standards the dam is currently unsafe. Under this alternative, the dam would remain in place and repairs would be made by the current owner to bring the dam into compliance with current safety standards.

4.2.6 Impact on Flooding Downstream: The Glenville (Linen Mill) Dam, is a “run of the river” dam and has no significant impact on the volume of water flowing in the river as a whole and does not function as flood control or flood storage structure. Runoff from a rainfall event is not retained by this dam---the impounded area behind this dam is maintained at a constant level. Data and an analysis to support this assessment is covered in the attached appendix.

4.2.7 Cultural Resources: There are no historical properties in the project area.

4.2.8 Endangered/Threatened Species: There are no listed, endangered or threatened species that would be impacted by this action.

4.2 Alternative C – Repair the Dam and Install Fish Passage

4.3.1 Fishery Impacts – Cumulative: Under this alternative, fish passage would be installed at the dam (which would also have to receive major repairs as are described above). It cannot be predicted if fish passage would enable the full range of fish species that currently cannot ascend the river and are blocked by the current dam structure to reach spawning areas above the dam. It could be termed as a partial restoration of the river ecosystem.

4.3.2 Site Specific Fishery and Habitat Impacts: Habitat improvement work at the dam site could not be done with the dam structure repaired to meet safety standards. A fish passage structure would facilitate fish movement, but this improvement would only address one of a number of adverse impacts that the structure has on the aquatic environment. The riffle habitat (currently submerged) would not be permanently exposed if the dam remains and, diverse habitats present in free flowing rivers would not be restored at the dam site. Coarse substrate would instead remain covered with sediment deposits in the impounded area. Fish species requiring riffle habitat for spawning and cover would continue to be negatively impacted. Macroinvertebrate populations would continue to have low diversity and favor species that require sediment dominated susbtrate. Installation of fish passage at the dam would involve a very minor disturbance of terrestrial habitat. This disturbance would be in the immediate vicinity of the dam site.

4.3.3 Mussel Populations: Mussel populations would be partially benefited by the installation of fish passage. It is expected that mussel populations would be benefited to the extent that fishes could utilize the fish passage that would be installed. As fish species make their upstream migrations, larval mussels are carried to upstream areas to new habitats.

4.3.4 Impact on Water Quality: With the installation of fish passage, including repair of the dam, the impounded area upstream from the dam would remain in place. As it currently exists, the impounded area upstream from the dam has a negative impact on water quality. The impoundment would continue to have poor water quality because of its fertility (eutrophication) and because of the high population of carp. Since the impoundment is very fertile, it may suffer from algae blooms which in turn suppress oxygen levels. Carp keep the sediments stirred up and this further distributes nutrients in the water column and has a negative impact on the river as a whole. The impoundment serves as a prime breeding area for carp, which inhabit other parts of the Baraboo River.

4.3.5 Safety: According to state safety standards the dam is currently unsafe. Under this alternative, the dam would remain in place and repairs would be made by the current owner to bring the dam into compliance with current safety standards.

4.3.6 Impact on Flooding Downstream: The Glenville (Linen Mill) Dam, is a “run of the river” dam and has no significant impact on the volume of water flowing in the river as a whole and does not function as flood control or flood storage structure. The dam does not store water to control flooding ---the impounded area behind this dam is maintained at a constant level. Data and an analysis to support this assessment are covered in the attached appendix.

4.3.7 Cultural Resources: There are no historical properties in the project area. Borrow sites outside of the project area will be reviewed by SHPO once these sites are identified.

4.3.8 Endangered/Threatened Species: There are no listed, endangered or threatened species that would be impacted by this action. Borrow sites outside of the project area will be reviewed for endangered and threatened species once these sites are identified.

4.4 Environmental Justice: None of the alternatives will have a negative impact on the human environment. None of the alternatives will have a negative impact on a minority population or ethnic group. None of the alternatives will negatively impact the economically disadvantaged.

5. List of Preparers

Name
Andy Morton
Konstantine Margosky
Ron Grasshoff
Jeff Schure
Tom Pellett
Dave Marshall

6. Consultation and Coordination With the Public and Others List of agencies, groups and individuals contacted regarding the project The removal of the Glenville (Linen Mill) Dam is part of a much larger

effort that is focused on the restoration of the Baraboo River System as a whole. Listed below is a summary of the meetings and contacts with the public concerning this project.

Date Meeing/Event/Action
8/91 FERC notifies owner that the dam needs to be relicensed

12/94 Fishery survey of the Baraboo River conducted by WDNR

6/97-12/98 Negotiations with previous owner to buy rights to remove the dam

12/99-present At least 15 Tours of dam removals for state and federal agency personnel, interest groups, and concerned citizens have been given

1999-present
Corps of Engineers Approval of 206 Aquatic Restoration Plan for the Baraboo River Research Study on the effects of dam removal on aquatic resources including fish populations, fish movement, and aquatic insects.

Wisconsin DNR 7/00 Initiation of research project studying impact of dam removal on fauna of the Baraboo River

6/99-1/00 Corps of Engineers Historical Analysis and DOE - Because it was planned that federal funding (COE 206 funding) was to be used to remove the Glenville Dam, the COE was the designated lead federal agency. They submitted a DOE (Historical Resources) to SHPO. The public was involved in this process.

5/01 Lower Wisconsin Integrated Plan Open House held at Baraboo, Wisconsin. A display covering the Baraboo River Restoration (including removal of the Glenville Dam) was present at the meeting.

8/01 Public informational meeting (proposed) on the dam removal and river restoration project

22 1. Removal of the Linen Mill (Glenville) Dam Hydraulic analysis Project: Removal of the Linen Mill Dam

Hydraulic analysis

1. Purpose: The overall goal of this analysis is to determine the effect of the proposed removal of the Linen Mill Dam on flood flows of the Baraboo River downstream from the structure.

2. Description of the dam: The Linen Mill Dam is located east of the City of Baraboo, in Section 6, Township 11 North, Range 7 East, just upstream from the State Highway 113. The dam was originally constructed in 1898 and then has been modified, rebuilt, and rehabilitated several times. The dam consists of a fixed crest spillway with buttresses on the downstream face, a small concrete shoot auxiliary spillway and a powerhouse. The original use of the dam was to provide power for a linen mill. It presently is used to generate a small amount of electrical power. The dam was constructed of rock filled timber structure backed up with a 16-inch thick concrete wall and a concrete apron. The February 18, 1987 DNR dam safety inspection found the dam structurally unsound and not in compliance with Chapter 31, of Wisconsin Statutes and Chapter NR 333 Wisconsin Administrative Code.

3. Description of the proposed removal: Trees and brush will be cleared and a temporary gravel road constructed to access the right side (right and left is referred looking downstream) of the dam. The dam fixed crest spillway will be first breached at the right side next to the auxiliary spillway. The initial breach

will be accomplished in a manner so that sediment moving downstream from the impounded area is minimized.

After the water level of the impoundment is lowered, the demolition of the fixed crest spillway will be approached from the left side next to the powerhouse. The rock fill of the timber structure on the upstream side of the support concrete wall will be rearranged to form a pad for the backhoe to easily traverse across the river along the upstream side of the spillway. A concrete wall will be constructed at the downstream side of the powerhouse to block the opening of the turbine pit exit. Part of the rock fill materials will be then placed against the foundation walls and pillars of the powerhouse to buttress the foundation against erosion and undermining.

From there, demolition will proceed to the right, forming the final river channel configuration as materials are removed and/or used in channel stabilization. The clean, sandy deposits located immediately upstream of the spillway, if removed, will be incorporated into the site restoration. Excess material will be trucked off site for disposal at an approved landfill.

The areas of the millrace in front of the powerhouse head gates and at the downstream side of the powerhouse will be filled in with suitable soil materials. A heavy riprap will be placed along the newly formed and disturbed riverbanks for stabilization. The temporary access road will be removed and all disturbed areas topsoiled and seeded for erosion control and natural appearance.

4. Background for the hydraulic analysis: The adopted Flood Insurance Study (FIS) dated March 7, 2001 was used to obtain the information for the hydraulic analysis. The following components of the analysis were obtained and/or determined from the HEC-2 hydraulic model of the Baraboo River in Sauk County:

a. Geometrical characteristics of the Linen Mill Dam and it's impoundment, including the channel and overbank storage upstream from the dam;

b. Hydraulic parameters of the Linen Mill Dam, including the spillway rating curve for the series of flows up to the predicted 500-year flood event of 10500 cubic feet per second (cfs). The downstream boundary conditions at State Highway 113 for the series of flows below the predicted 10-year event of 5200 cfs were determined through the normal depth channel analysis with the energy grade slope estimated on the basis of the 10-year event.

To determine the effect of the Linen Mill Dam impoundment storage on flood flows a single storm event occurred in July 1993 was selected. The 1-hour interval flow values recorded at the USGS gaging station # 05405000 were obtained. The USGS gage # 0540500 is located near the city of Baraboo downstream from the Linen Mill Dam. The drainage area at the station is 609.00 square miles. The recorded flood event peaked on July 18, 1993 at 1:00 PM at 6,344 cfs, which can be compared to a deterministic 25-year event storm.

3. Summary: The original HEC-2 hydraulic model clearly demonstrates that the Linen Mill Dam submerges prior to a 10-year storm event with the difference in water surface elevations upstream and downstream from the dam less than one foot. Routing a single storm event of about 4% probability of occurring in any given year through the dam impoundment resulted in reduction of the peak flow of 32.6 cfs or about 0.5% . The time of peak at the dam matches the time of peak of the inflow into the lake, which indicates no detention of flow in the impoundment. The channel and overbank storage upstream from the Linen Mill Dam is not significant to measurably affect flood flows.

2. Letter From State Historical Society of Wisconsin

APPENDIX 6: Alphonso Dam, Evans Creek OR

American Rivers

EVANS CREEK REMOVAL OF THE ALPHONSO DAM IN OREGON

DAM REMOVAL BENEFITS: IMPROVED MIGRATORY AND RESIDENT FISH HABITAT, IMPROVED THREATENED SPECIES HABITAT

SUMMARY: The Alphonso Dam was built on Evans Creek in Oregon in the 1890s to divert water for irrigation. Throughout its lifetime, the dam prevented or delayed migratory and resident fish passage upstream. Although a fish ladder was installed during the 1970s, fish were not attracted to it and did not use it. Over time, the dam's impoundment filled with sediment, and eventually the owner abandoned the structure. The federal Bureau of Land Management (BLM) decided to remove the defunct dam as a means to restore historic fish passage conditions in that section of Evans Creek. The dam was demolished in July of 1999. Its removal will enable the threatened coho salmon and other fish species to migrate once again up the East Fork of Evans Creek and reach an additional 12 miles of spawning and rearing habitat for the first time in 100 years.

THE RIVER: Evans Creek begins as two forks in southwestern Oregon: the East Fork, near Shady Cove, and the West Fork, near Canyonville. The East Fork travels for about 14 miles and the West Fork for about 12 miles before the two converge. After the confluence, Evans Creek travels another 14 miles before discharging into the Rogue River, which flows into the Pacific Ocean. Migratory fish found in Evans Creek include native steelhead trout and coho and chinook salmon. The coho salmon is a federally-threatened species, and the steelhead trout is being considered for listing as threatened. Resident fish found in the creek include cutthroat trout and sculpin.

The East Fork of Evans Creek contains seven irrigation diversion dams and three major culverts. Of these, the Alphonso Dam imposed the largest barrier. Depending on the flow, the structures delay or completely block upstream fish passage.

THE IMPACT PRIOR TO REMOVAL: The Alphonso Dam was located on the East Fork of Evans Creek in a V-shaped bedrock-constrained canyon two miles upstream from the confluence of the forks. The dam was reportedly built in the 1890s by farmers and ranchers for irrigation. It was 10 feet high, 56 feet long, and 3 feet wide and was made of aggregate material and concrete. The impounded water behind the dam extended for a distance of approximately 550 feet, with an average width of 41 feet. By the time it was removed, the impoundment had filled with sediment and rocks, and the dam had been abandoned by its owner.

For approximately 100 years, the Alphonso Dam prevented or delayed migratory and resident fish passage upstream, resulting in the decline of the fishery. Recognizing a need for fish passage, the Rogue Flyfishers Club installed a fish ladder at the dam in the 1970s. Unfortunately, fish were not attracted to the ladder and did not use it. The ladder was particularly ineffective for coho salmon, which typically have difficulty getting past blockages.

DAM REMOVAL FACTS:

- Height: 10 ft; Length: 56 ft
- Impoundment: 200 acre-ft
- Built: 1890s
- Historic purpose: irrigation diversion
- Owner: abandoned
- Regulatory jurisdiction: BLM
- Estimated cost of repair: not examined
- Cost of removal: $55,000
- Removed: July 1999
- Removal method: heavy equipment

THE REMOVAL DECISION AND PROCESS: The BLM removed the Alphonso Dam as part of its ongoing effort to increase the population of the threatened coho salmon. Although the actual removal of the dam took place over only two days, July 19 and 20, 1999, the BLM spent three years working with other state and federal agencies to plan the project. Preparations included notifying stakeholders of the proposed project and getting their input, considering various removal methods, and performing an environmental assessment.

Prior to removing the dam, the BLM conducted several tests on the accumulated sediment in the impoundment, including tests for toxic substances, such as heavy metals. Because none were found, the BLM concluded that it would not be harmful for accumulated sediment to wash downstream after the dam was removed.

The first step in the dam removal was cutting a notch in the center portion of the dam to drain the impoundment. The dam was then demolished using heavy equipment, and the resulting debris was hauled away to a disposal area. During demolition, extensive efforts were made to minimize equipment operation within the stream channel. However, as a precautionary measure, spill containment booms were placed in the channel. After demolition, to help stabilize soils, all exposed impoundment areas were seeded with a grass mix and then mulched.

REMOVAL BENEFITS:

- Restored 12 miles of spawning and rearing habitat for migratory fish
- Restored resident fish habitat
- Improved habitat for threatened coho salmon

RESTORATION OF THE RIVER: During the winter of 1999 and 2000, the BLM expects the creek to flush out the sediment that had accumulated behind the dam. Fish will then be able to migrate easily up the East Fork of Evans Creek and reach an additional 12 miles of spawning and rearing habitat. According to the BLM environmental assessment, this is expected to increase the overall survival of fish in the East Fork, in part by reducing the migratory stress on adults, causing egg survival rates to improve. In addition, juveniles will be able to travel to better feeding and rearing spots, thus improving their survival rate.

FUTURE EFFORTS TO RESTORE THE RIVER: The BLM is working with a private land owner, as well as the Evans Creek Watershed Council, the Middle Rogue Steelheaders, the Oregon Department of Fish and Wildlife, and the Oregon Water Trust to remove the Williams-Waylon Dam on the mainstem of Evans Creek. This dam is in the middle of coho salmon and steelhead trout migration routes. At four feet high, it does not completely block fish movement upstream, but it does significantly delay it. Until recently, the dam was used by private landowners to divert water for irrigation. However, the Oregon Water Trust worked with the owners to find alternative irrigation methods and/or points of diversion, and consequently the dam is no longer in use. The Oregon Water Trust is now receiving technical and financial assistance from the BLM for the dam removal. The BLM is also looking into removing a dam on a tributary to the East Fork of Evans Creek. This dam completely blocks steelhead trout migration to upstream spawning and rearing grounds.

Both the Williams-Waylon Dam and the dam on the tributary to the East Fork of Evans Creek are on private property. However, the BLM is authorized to enter into agreements with willing owners to conduct work on private lands if that work will benefit biological resources on public lands. In the cases at hand, removal of the dams on private property would allow coho salmon and steelhead trout to more easily migrate to spawning and rearing grounds on upstream public lands.

FOR MORE INFORMATION PLEASE CONTACT: Jayne LeFors at Bureau of Land Management - Medford District (541) 770-2364 Jayne_LeFors@blm.gov
Sara Johnson at Trout Unlimited (608) 231-9950 johnson@tu.org

THE SIGNIFICANCE OF THIS REMOVAL: The Alphonso Dam removal is a good example of a public agency cooperating with a private owner on a project that benefits both parties, as well as the threatened fish species that make use of Evans Creek. It is also a good example of a pro-active dam removal carried out for the express purpose of restoring migratory and resident fish passage. BLM officials, encouraged by the success of the project thus far, are hopeful that dam removal will be used as a tool for restoring other streams in the Evans Creek watershed.

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APPENDIX 7: McGowan, McPherrin, Western Canal East, and Western Canal Main Dams, Butte Creek CA

American Rivers

DAM REMOVAL BENEFITS: IMPROVED MIGRATORY FISH HABITAT, IMPROVED WILDLIFE HABITAT, IMPROVED ENDANGERED SPECIES HABITAT

 

SUMMARY: Removal of four water diversion dams and 12 unscreened water diversions are resulting in dramatic improvements to 25 miles of chinook salmon habitat in the Sacramento Valley's Butte Creek. The collaborative effort includes one of northern California's largest irrigation districts, rice growers and other agricultural interests, government resource agencies, and other stakeholders. The group worked together to solve individual and mutual problems, with a primary goal of restoring the fisheries. The project is making important progress toward protecting chinook salmon, which are listed as threatened under California's Endangered Species Act. In 1987, only 14 spring-run chinook salmon were found spawning in Butte Creek. The removal of four small dams and other river restoration efforts contributed to a record spring 1998 run of more than 20,000 adult chinooks.

THE RIVER: Butte Creek is considered a keystone for preserving and recovering the spring run of chinook salmon, which once numbered in the hundreds of thousands in the Sacramento River system, but had dwindled to less than 10,000 returning adults in an average year. Before dams were constructed, the spring-run chinook was California's most abundant salmon species, and the stock that sustained a now-extinct inland fishery. Some 700,000 salmon used to spawn in 40-odd streams, and 21 turn-of-the-century canneries processed the fish. The recent restoration efforts took place along the middle reach of Butte Creek, which is one of only four Sacramento River tributaries with remaining populations of spring-run chinook salmon. Along Butte Creek's valley reach, several irrigation diversion dams have been built. Upstream of these diversions is a gorgeous, deeply incised volcanic canyon that provides prime spawning habitat.

THE IMPACT PRIOR TO REMOVAL: Spring-run chinook was once California's most abundant salmon species, but with the extensive construction of dams and diversions following World War I, the chinook population began to decline. The undoing of the state's natural hydrologic regime through dams and water withdrawals led to an inexorable decline of these fish.

During the 1987 to 1992 drought, the total state population of spring-run chinook was estimated at fewer than 500 fish. Pure spring-run chinook stock spawned in only three or four small Sacramento River tributaries, one of which was Butte Creek. The creek's spring-run chinook are listed as threatened under California's Endangered Species Act, and are candidates for the federal Endangered Species List.

In 1993, the rains came again. Two years later, many spring-run chinook were returning to Butte Creek. At the end of the run, state biologists had counted at least 7,500 outmigrating juvenile fish—the most since World War II, and more than twice the number in all other streams combined. These outmigrants were the source for the record 1998 runs.

DAM REMOVAL FACTS:

- Height: 6 to 12 ft
- Length: 10 to 100 ft
- Built: early 1900s
- Historic purpose: irrigation diversion dams
- Owner: water districts and private landowners
- Regulatory jurisdiction: state
- Estimated cost of repair: not examined
- Estimated cost of removal & associated work: $9.5 million
- Actual cost of removal & associated work: $9.13 million
- Removed: 1998

An interesting agricultural dilemma served as a catalyst for restoration efforts on Butte Creek. Rice farmers need to remove rice stalks from the previous year's crop before they can plant the next one. Rice stalks are especially tough and do not readily decompose, so many of California's rice growers were burning them. In 1991, air pollution problems resulted in a decision to phase-out rice-straw burning over the next 10 years. Growers turned to another alternative for straw removal—flooding fields after harvesting the rice. By flooding the fields in the fall when temperatures are still warm, the decomposition of the rice stalks is accelerated, and winter and spring rains finish the job. Another benefit of this approach is that ducks, geese, and shorebirds on the Pacific Flyway's migration route stop to eat and drink in the flooded fields.

Although the state's waterfowl division was enthusiastic about flooding the fields, the state's fisheries division was clearly concerned. The flooding of the fields resulted in impacts to the salmon population, including outmigrating juvenile salmon being drawn into the unscreened water diversions.

THE REMOVAL DECISION & PROCESS: The potential federal listing of spring-run chinook salmon as a threatened or endangered species, coupled with the amazing turn-around at Butte Creek, got the attention of many water users. If the springrun chinook were listed, commercial fishermen would not be able to fish because the spring-run chinook feed off the coast with the fall-run chinook, and are impossible to differentiate from each other until it's too late. A spring-run chinook listing might also shut down pumps for Southern California's water supply, half of which comes from Northern California. San Joaquin Valley agriculture interests had similar fears of a listing.

The Western Canal Water District, which had had a positive experience with the removal of the six-foot high Point Four Dam from Butte Creek in 1993, stepped forward and offered to help ease the problem. The District proposed to remove two small diversion dams—the Western Canal Main and Western Canal East Channel Dams. These two dams blocked Butte Creek and had antiquated fish passage structures. The District's dams were designed to keep an introduced source of water from going downstream, and to allow gravity flow of water out of the other side of the creek to the District's 30,000 acres. The District's plan was to create an alternative water diversion system using relatively inexpensive piping. The District proposed to run its additional source of water in pipes under Butte Creek instead of damming the creek to pump the water across. The project would be fish friendly, and would result in increased and more reliable flows for rice farmers and associated managed wetlands.

California Fish and Game biologists sensed a larger opportunity in the Western Canal Water District's proposal to remove its two dams. The state agency concluded that by joining some lateral canals and working out some water exchanges, more dams could be removed from Butte Creek.

Seeking to avoid a spring-run chinook listing, the US Department of Interior (DOI) funded a feasibility study of the Butte Creek restoration efforts, even though none of the facilities were in its immediate service area. The study concluded that the proposals of the California Fish and Game and the Western Canal Water District made sense, and expanded the project to include other restoration efforts.

The final Butte Creek restoration effort—implemented in 1998—included removal of four dams—the two dams owned by the Western Canal Water District, McGowan Dam, and McPherrin Dam. It also involved other alterations to the system, including elimination of at least 12 unscreened water diversions. The final cost for implementing the full project was $9.13 million, including all stages of design, permitting, environmental documentation, construction, construction management, and environmental impact mitigation. The Western Canal Water District, DOI (through the Central Valley Project Improvement Act), and California Urban Water Agencies each provided one third of the funding for the effort.

REMOVAL BENEFITS:

- Restored fish passage for imperiled chinook salmon
- Eliminated impact of water diversions on outmigrating juvenile fish
- Increased reliability and amount of water available for agriculture and waterfowl management

One of the most challenging aspects of the project was working within the allowable construction windows related to threatened and endangered species, and continuing full water deliveries to agricultural users during construction. From a construction perspective, the two most significant challenges were the dewatering of construction sites and the dispersed nature of the facilities and construction sites over an area of 60 square miles. These and other factors resulted in a complex design, a challenging construction schedule, and the need for constant coordination among all parties.

RESTORATION OF THE RIVER: The Butte Creek salmon populations have already made an impressive recovery from the 14 spring-run chinook that were found spawning in Butte Creek in 1987. The 1998 restoration efforts restored approximately 25 miles of Butte Creek to free, unimpeded flow for the first time since the 1920s. The imperiled chinook salmon have already returned to the unimpeded river and benefited from the restoration efforts. Because of the three year salmon lifecycle, it is too early to determine definitively the results of this restoration effort, but early results are promising—the spring run of 1998 consisted of
more than 20,000 adult chinooks.

Recent improvements in ocean conditions hold even more promise for the migratory chinook. Ocean productivity occurs in cycles—roughly every 20 to 40 years, ocean upwellings cause an increased abundance of food to be available for fish. Fisheries biologists have seen an upwelling in 1999 along the entire Pacific Coast, as evidenced in part by sport and commercial fish catches being higher in size and higher in number. These ocean condition improvements are expected to result in more and bigger chinook returning to Butte Creek to spawn. Coupled with the improved spawning habitat from the dam removals, the future looks even more promising for the threatened spring-run chinook.

FUTURE EFFORTS TO RESTORE THE RIVER
Researchers are assessing the possibility of removing, or at least modifying, two hydropower dams owned by Pacific Gas and Electric Company that block salmon access to the pristine upper canyon reach of Butte Creek above this restoration project.

THE SIGNIFICANCE OF THIS REMOVAL The Butte Creek restoration project is significant both because of its river basin-wide scale and because of its collaborative nature and innovative cost-sharing partnership. Consensus building and cooperation among the agricultural, urban and environmental communities, as well as creative funding partnerships, were essential to the success of the project. This project may mark the first time in the American West that dam removals were inspired for combined agricultural and environmental reasons.

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APPENDIX 8: Jackson Street Dam, Bear Creek OR

Friends of the Earth, American Rivers, and Trout Unlimited
REMOVAL OF THE JACKSON STREET DAM IN OREGON

DAM REMOVAL BENEFITS: IMPROVED MIGRATORY FISH HABITAT, IMPROVED WATER QUALITY, REVITALIZED DOWNTOWN RIVERFRONT

 

SUMMARY: The Jackson Street Dam was built in 1960 on Bear Creek in Medford, Oregon to divert water from Bear Creek into the irrigation canals of the Rogue River Valley Irrigation District (RRVID). The construction of the dam resulted in a partial barrier to migratory fish, loss of stream habitat, and an algae-filled impoundment located in Medford's largest city park. In the early 1980s, the City of Medford, state and local government agencies, environmental groups, and the RRVID reached consensus that removing Jackson Street Dam was the most cost-effective solution to fixing the problems caused by the dam. However, the solution had to devise an equally feasible and cost-efficient diversion alternative for the RRVID. Funding, planning, and implementing the Jackson Street Dam removal required a multi-stakeholder collaborative effort that was by no means a simple task. But in the end, the decision to remove Jackson Street Dam benefited all of the involved parties—as well as Bear Creek and the migratory fish species that reside there.

THE RIVER: Bear Creek is a major tributary of the Rogue River flowing through the City of Medford in southern Oregon. Approximately 100,000 people reside in the lower part of the Bear Creek watershed and the land use in this area is largely agricultural and urban. The former dam was located within a Medford City park, which is part of the larger Bear Creek Greenway that extends for 21 miles along the river through five urban areas. Bear Creek and its tributaries provide habitat for migratory fish species, such as coho salmon, chinook salmon, and steelhead, as well as resident fish species. Of these species, steelhead are the most abundant migratory fish in Bear Creek, with several hundred adults returning annually to spawn. Of the migratory fish historically found in Bear Creek, coho salmon are the species that have been most negatively affected by blockage and habitat degradation. Because of these impacts, coho are rarely found in Bear Creek and its tributaries and are now listed under the Endangered Species Act as a threatened species.

THE IMPACT PRIOR TO REMOVAL: The Jackson Street Dam, which was 11 feet tall and 120 feet long, was located at river mile 11 of Bear Creek and was the first major barrier to fish passage encountered by migratory fish as they moved upstream from the main stem Rogue River. Jackson Street Dam created an impediment to fish migration due to poorly designed fish passage facilities. This was further complicated by irrigation withdrawals from the impoundment and low flows during migration periods. The dam did have a fish ladder that was designed for upstream fish passage, but due to construction flaws it either blocked or delayed fish. Downstream fish passage was also a significant problem at the dam because the fish screen and bypass system constructed to keep fish out of the RRVID's irrigation canal were outdated and did not meet criteria established by the National Marine Fisheries Service (NMFS). Further, the dam and slow-moving reservoir were thought to hinder fish movement and to increase their exposure to predators.

In addition to hindering fish passage, Jackson Street Dam created water quality and aesthetic problems. Bear Creek has among the worst water quality of streams its size in Oregon and has not met water quality standards of the federal Clean Water Act since the State of Oregon began monitoring the stream in 1977. Dams, land use, irrigation withdrawals, stream channel modifications, drought, and water treatment plants all contribute to the degradation of Bear Creek. However, since 1978 local government agencies have been successful in reducing fecal bacteria and sediment loads in Bear Creek. Before Jackson Street Dam was breached in 1998, these water quality improvements were negated by the sedimentation, increased water temperatures, and algae growth caused by the Jackson Street Dam's reservoir. In addition, the silt- and debris-filled reservoir was also an eyesore—and source of stench—in downtown Medford.

DAM REMOVAL FACTS:

- Height: 11 ft; Length: 120 ft
- Built: 1960
- Purpose: irrigation diversion
- Owner: Rogue River Valley Irrigation District
- Regulatory jurisdiction: state
- Estimated cost of repair: not examined
- Cost of removal: $1.2 million
- Removed: July - September 1998
- Removal method: breaching

THE REMOVAL DECISION & PROCESS: Because the Jackson Street Dam provided the RRVID with a cost-effective and mechanically functional irrigation diversion system, any plans to remove the dam had to provide the irrigation district with an equally beneficial method of water diversion. After 13 years of using a consensus-based approach, a solution was found that satisfied all of the involved parties—before the Jackson Street Dam could be removed, a new less damaging diversion structure had to be built to replace it. The new diversion device was approximately one-fourth the height of the old one (about 3 feet), located 1,200 feet upstream of the old dam site, and would be removed at the end of each irrigation season when most upstream migration occurs. When it was in place, the new diversion was designed to allow steelhead, chinook, and coho to move up and downstream much more easily—and designed so that little water would back up behind it. The new diversion system was also equipped with fish screens designed to keep fish out of the irrigation canal.

The total cost of removing the Jackson Street Dam was $1.2 million. Primary funding for the project was provided by the State of Oregon, which used state lottery proceeds from its watershed enhancement program, and by the City of Medford, which used funds from its urban renewal program. Oregon Trout, a state non-profit organization, and the US Bureau of Reclamation provided additional funding for the removal. Removing the Jackson Street Dam was the lowest cost alternative for achieving the project's objectives.

The removal of Jackson Street Dam took place from July to September 1998. The initial step in the removal process was to provide a dry workplace by using concrete dividers to channel Bear Creek around the dam. Because a fiber optic cable ran underneath the reservoir, the Jackson Street Dam could not be completely removed. In order to ensure that migratory fish could pass the remaining three-foot structure, two V-shaped concrete weirs were built at intervals below the dam to provide a gradual height increase. Once this was completed, the sediment trapped behind the dam was removed and disposed in a landfill. The old fish screen was also removed and the obsolete section of the irrigation pipeline was abandoned. For the two years following removal, volunteer community groups will restore the newly exposed stream banks through landscaping and planting native trees.

REMOVAL BENEFITS:

- Restored 1/4 mile of aquatic habitat

- Improved up & downstream fish passage
- Improved water quality
- Enhanced aesthetics at site
- Diminished debris and stench associated with reservoir
- Aided with urban riverfront revitalization
- Allowed an irrigation district to upgrade its fish passage facilities

RESTORATION OF THE RIVER: The breaching of Jackson Street Dam restored the 1/4 mile of streambed formerly inundated by the reservoir and improved both upstream and downstream fish passage for migratory fish. The upstream fish passage was improved by replacing a poorly designed fish ladder with an easily passable series of one-foot drops. The same one-foot drops also provide restored downstream passage as the fish no longer have to negotiate the reservoir, fish screen, and bypass system. Already, coho salmon—the fish species in Bear Creek most impacted by dams—and other species have been found upstream of the former dam site.

During the irrigation season, the new diversion structure that was constructed upstream of the original dam site has a short, well-designed fish ladder that provides effective upstream passage for adult fish and well-designed fish screens that provide effective downstream passage for juvenile fish. From October through April when water is not needed for irrigation, the new diversion structure is removed and Bear Creek flows freely. This is especially beneficial to juvenile chinook salmon, which move downstream primarily in April before the start of the irrigation season.

When the new diversion structure is in place, the new reservoir is five to ten percent the surface area of the old reservoir. The new stream channel creates much better downstream passage conditions for migratory fish than the old reservoir—and it may also provide some rearing habitat as the stream banks and riparian vegetation are restored. Upstream passage is also improved due to the cooler water and reduced poaching opportunities created by the new stream channel.

In addition to fish passage and habitat restoration, the City of Medford now enjoys a revitalized stretch of river devoid of the sediment, trash, and stench associated with the Jackson Street reservoir. This restoration of a river in a downtown city park comes at a particularly exciting time for Medford, whose economy is currently booming as it transitions away from agriculture and forestry to more diversified industries. The Jackson Street Dam removal project provides an excellent model for urban stream restoration—and how riverfront restoration can revitalize our nation's cities and towns.

FUTURE EFFORTS TO RESTORE THE RIVER: Bear Creek is also undergoing other restoration projects that will help restore the historic migratory fish habitat of this river. The Phoenix Dam located upstream of the former Jackson Street Dam site at river mile 15 and the Oak Street Dam located further upstream at river mile 23 are also irrigation diversions on Bear Creek that cause major impediments to migratory fish passage. Through the Bureau of Reclamation's Rogue River Basin Fish Passage Improvement Program, these two dams are being retrofitted with fish ladders and screens in order to meet NFMS standards. This will result in greatly improved passage at these two dams that will give migratory fish more access to their historic habitat.

Another dam on Bear Creek that entirely blocks fish passage is the Emigrant Dam (further upstream at river mile 26), which is a large water storage and flood control reservoir. Emigrant Dam blocks 20 to 40 percent of historic steelhead habitat and a smaller percentage of coho and chinook habitat on Bear Creek. Unfortunately, no fish passage is currently planned for this site.

THE SIGNIFICANCE OF THIS REMOVAL: The removal of Jackson Street Dam is an important step in restoring fish passage not only in the Bear Creek watershed, but the entire state of Oregon. It was the first concrete irrigation dam removed in the Rogue River Basin—and the first Oregon dam ever removed in order to restore coho salmon, a threatened species under the federal Endangered Species Act. Perhaps more important is this dam removal's significance as a model for future removals. The cooperative spirit that the various community groups brought to the negotiation table—and their willingness to overcome long-standing differences—is the reason that this dam was removed. The Jackson Street Dam removal not only restored migratory fish habitat and improved water quality, but it created an equally effective and efficient irrigation diversion replacement and contributed to the urban revitalization of downtown Medford. The diligence and persistence of the groups involved in the effort to remove the Jackson Street Dam paid off for all when this dam was removed in July of 1998. US Secretary of the Interior, Bruce Babbitt, was right when he said "It's a little dam, but it's a big win for this community"—further, it's a big win for this country.

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APPENDIX 9: Fort Edward Dam, Hudson River NY

LESSONS LEARNED FROM THE FORT EDWARD DAM REMOVAL
Friends of the Earth, American Rivers

HUDSON RIVER REMOVAL OF THE FORT EDWARD DAM IN NEW YORK DAM REMOVAL LESSONS LEARNED

SUMMARY: In the history of dam removals, the Fort Edward Dam experience is in many ways a testimony of what not to do. Fort Edward Dam was built in 1898 on the Hudson River, approximately 54 miles upstream of Albany, New York. By 1969, the condition of the dam was poor, and engineering studies showed that repair or replacement of the project was uneconomical. The owner, Niagara Mohawk Power Corporation, decided in 1971 to remove the structure to avert the danger of dam failure. Unfortunately, inadequate research and engineering analyses were conducted prior to removal of the dam in 1973. As a result, several tons of PCB-laden sediments from behind the dam were released downstream following dam removal, adversely affecting navigation, fish and wildlife, water quality, flood control, and public health. Large-scale cleanup and Corporation restoration efforts were required to address the serious environmental and economic damage resulting from the Fort Edward Dam removal. While this dam removal is clearly not a success story, it does provide valuable lessons to help ensure that future dam removals do not repeat the mistakes made on the Hudson River.

DAM REMOVAL FACTS:

- Height: 31 ft; Length: 586 ft
- Impoundment: 195 acres
- Built: 1898
- Purpose: hydropower
- Generating capacity: 2.85 MW
- Owner: Niagra Mohawk Power
- Regulatory jurisdiction: FERC
- Estimated cost of replacement $3,947,250
- Cost of removal: $464,000 (does not include cleanup costs)
- Removed: 1973
- Removal Method: heavy construction equipment

THE RIVER: The source of the Hudson River is Lake Tear of the Clouds in the High Peaks region of the Adirondack Mountains. From there, the river flows in a southerly direction for 315 miles to Battery Park at the southern tip of Manhattan, draining nearly 14,000 square miles. The area surrounding the river in the vicinity of Fort Edward Dam is urban and industrial, with numerous manufacturing plants that produce a variety of products. The river is used heavily for navigation and shipping and as a water supply source for numerous communities along the river.

IMPACTS PRIOR TO REMOVAL: Fort Edward Dam was a timber crib dam originally built in 1898. It was 586 feet long with a maximum height of 31 feet and impounded approximately 195 acres along 2.5 miles of the Hudson River. The accompanying 98-foot long powerhouse with four turbine generators had a total capacity of 2.85 megawatts. The dam was owned by the Niagara Mohawk Power Corporation, an investor-owned electric and gas utility and was one of six dams under a license by the Federal Power Commission (now the Federal Energy Regulatory Commission). In 1969, Niagara Mohawk conducted an engineering evaluation of the aging Fort Edward Dam and concluded that the poor condition of the dam made the project a public safety hazard. Fearing an imminent dam failure, a dike was constructed on the southwest end to protect the dam from flood flows. Even with this modification, Fort Edward Dam remained a significant threat to people and property downstream of the dam.

REMOVAL DECISION & PROCESS: Engineering studies conducted in the early 1970s showed that repair or replacement of the Fort Edward Dam and continued electrical generation were uneconomical. These studies concluded that the cost of new construction and turbine generator modifications were far greater than the value of the dam. Niagara Mohawk determined that retirement was the most cost-effective solution to the safety problems associated with the dam, so the company developed a removal plan. In 1972, Niagara Mohawk applied for and received a Stream Protection Permit for the removal from the New York State Department of Environmental Conservation (NYSDEC). The Federal Power Commission conducted one of its first Environmental Impact Statements on the proposed removal of Fort Edward Dam. Pursuant to this review, the Commission approved the removal in 1973. Local communities in the area near the dam were consulted, and they too consented to the removal of Fort Edward Dam.

Various stipulations were required by NYSDEC in allowing the removal to take place. Dikes were constructed in the disposal areas to prevent water contamination during demolition. Some water quality deterioration was predicted, but considered acceptable. The New York State Department of Health was consulted regarding mosquito breeding control in the exposed riverbeds. The permit mandated that Niagara Mohawk cooperate with the paper mill located next to the powerhouse in order to maintain the quality of the mill's water supply. In addition, because Lock #7 of the Champlain section of the New York State Barge Canal was located immediately downstream of the dam site, the permit required that the dam removal cause no unreasonable interference with navigation.

Niagara Mohawk's removal plan anticipated the presence of very little silt behind the dam. Approximately 3,200 cubic yards of sediment (considered to be a small amount) were to be removed before breaching the dam. The removal was expected to expose approximately 100 acres of former reservoir bottom, which would be allowed to recover naturally.

The actual removal process took approximately two months during late summer 1973. The stone-filled timber crib dam, 3,400 cubic yards of sediment, the power house units, the bridge across the forebay, and the concrete spillway were removed using heavy construction equipment. Some scrap materials were deposited in the old forebay, which was covered with topsoil and planted with grass. Total project costs were $464,000, and the operation seemed to have been finished without a hitch.

However, in the subsequent months and years, significant navigation and water quality problems arose due to poor analysis of the amount and content of sediments behind the dam. Removal released an estimated 30,000 cubic yards of bedload materials from the former impoundment in 1974, with the amount increasing in subsequent years. In addition, as the river's water level dropped 20 feet at the dam site following removal, approximately 90 previously submerged stone-filled timber cribs historically used in river log drives were discovered in the river upstream of the dam site. With exposure to air and new river currents, these cribs began to deteriorate, causing navigation problems. Although the cribs had been exposed during previous drawdowns, their existence was not considered during the planning for dam removal.

The accumulation of silt and stone cribs in the Hudson River's navigation channel effectively closed all shipping in 1974 in that stretch of the river. The east channel was blocked to navigation, the west channel was significantly reduced in depth, and around Lock #7 the river was reduced to a depth of four feet. The sediment deposits also clogged a marina, a recreational park, several industrial sites, and other downstream areas. The reduced channel capacity caused by the increased sediment load also created a serious flood hazard for the village of Fort Edward.

In addition, the removal created unanticipated water quality problems. The sediment deposits and restricted water flow posed a public health hazard due to the stagnation of untreated raw sewage that flowed into the Hudson River. Even more problematic was the discovery of polychlorinated biphenyl

(PCB) contaminants in the river sediments moving downstream. These PCBs originated from the electrical manufacturing plants upstream of the dam site and had accumulated behind the dam. The removal re-released these contaminated sediments and dispersed them downstream at an unsafe level, requiring extensive cleanup efforts.

RESTORATION OF THE RIVER: Litigation over the serious environmental and economic damage resulting from the Fort Edward Dam removal was filed in the New York Court of Claims. While settlement discussions to resolve the legal issues were being held among all involved parties, numerous cleanup and restoration efforts were undertaken.

To address the blockage of the navigation channel, the State of New York requested assistance from the US Army Corps of Engineers. From 1974 to 1976, New York dredged 615,000 cubic yards of sediment in order to restore and keep open the navigation channel, as well as to lessen the flood danger. Routine, smaller-scale dredging has been utilized in subsequent years to maintain this river stretch as a navigation channel.

The significant water quality problems created by PCB-contaminated sediments released from behind the dam and directly released into the river at the upstream electrical manufacturing plants led to extensive cleanup and restoration efforts by state and federal agencies. From 1974 to 1977, sediment samples were taken and monitored by the US Environmental Protection Agency (EPA), NYSDEC, and a private consultant. In 1976, New York State closed the Hudson River for fishing, decimating a $40 million striped bass fishery. In 1977 and 1978, approximately 180,000 cubic yards of contaminated sediments were removed from the river by the state. And in 1983 the EPA declared a significant stretch of the river a federal Superfund site due to the PCB contamination. EPA and NYSDEC continue to evaluate options for addressing this extensive PCB contamination. Full remediation has yet to be completed.

LESSONS LEARNED

- Where historic records of upstream activities indicate possible presence of pollutants in the river, test accumulated sediment upstream of dam for potential pollutants
- Determine volume of sediment upstream of dam and potential impacts of sediment on downstream navigation, structures, and other river uses
- Investigate potential hazards and blockages in reservoir that become exposed with dam removal
- Determine clear and unambiguous conditions in removal authorizations

THE SIGNIFICANCE OF THIS REMOVAL: Fort Edward Dam provides valuable lessons on some steps to take in planning a dam removal to ensure that mistakes made in the Fort Edward removal are not repeated. Pursuant to hearings conducted by the Federal Power Commission, the dam owner, the Commission, and state and local officials were found not to have exercised due diligence in planning for and completing the dam removal. The Commission also made the following recommendations for future dam removal decisions:

  - Precise and unambiguous conditions in the authorizations for dam removals are necessary to avoid differing interpretations;
  - Conditions should be prescribed that require adequate investigations to be made of the entire area retained by the dam; and
  - The effect of lowering the level above the dam removal site must be evaluated; specifically, susceptibility to erosion or movement of materials in and near the riverbed.

The problems encountered in the Fort Edward Dam removal resulted not only from mismanagement, but also from a lack of experience in major dam removals. As the Federal Power Commission concluded in 1978, “Any license for dam removal in the future will be drafted differently, with the lessons of Fort Edward in mind.”

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APPENDIX 10: PARTIAL LIST OF CALIFORNIA DAMS HEIGHT > 6 FT AND REMOVED BEFORE 2001

River	Project Name	Year Removed	Height	Length
Clear Creek	McCormick-Saeltzer Dam	2000	20	185
Butte Creek	McGowan Dam	1998	6	
Butte Creek	McPherrin Dam	1998	12	
Butte Creek	Western Canal East Channel Dam	1998	10	
Butte Creek	Western Canal Main Dam	1998	10	
Guadalupe River	unnamed small dam #1	1998		
Guadalupe River	unnamed small dam #2	1998		
Cold Creek	Lake Christopher Dam	1994	10	400
Butte Creek	Point Four Dam	1993	6	
	C-Line Dam #1	1993	56	
Wildcat Creek	unnamed dam #1	1992	6	
Wildcat Creek	unnamed dam #2	1992	6	
Lost Man Creek	Upper Dam	1989	7	57
	Happy Isles Dam	1987	8	
Rock Creek	Rock Creek Dam	1985	12	63
	Rogers Dam	1983	40	
	Bear Valley Dam	1982	15	
Mad River	Sweasey Dam	1970	55	
Canyon Creek	Red Hill Mining Co. Dam	1951	30	
Trinity River	Quinn Dam	1951	14	
Redding Creek	Clarissa V. Mining Dam	1950	20	
Salmon River	Bennett-Smith Dam	1950	10	
Scott River	Barton Dam	1950	12	25
Trinity River	North Fork Placers Dam	1950	15	
Beaver Creek	Three C. Picket Dam	1949		
Horse Creek	Big Nugget Mine Dam	1949	12	40
Swillup Creek	Moser Dam	1949		
Trinity River	Todd Dam	1949	14	
White s Gulch	Smith Dam	1949	8	25
Indian Creek	D.B. Fields Dam	1947	6	
Kidder Creek	Altoona Dam	1947	12	60
Indian Creek	D.B. Fields/Johnson Dam	1946		
Salmon River	Bonally Mining Co. Dam	1946	11	177

River	Project Name	Year Removed	Height	Length
Trinity River	Trinity Cty. Water & Power Co. Dam	1946	10	
Rush Creek	Anderline Dam	1936	20	
Canyon Creek	Henry Danninbrink Dam	1927		
Hayfork Creek	Hessellwood Dam	1925	10	
Hayfork Creek	Russell (Hinkley) Dam	1922	11	
Big Creek	Big Creek Mfg. Dam		14	
Indian Creek	Minnie Reeves Dam		20	
Monkey Creek	Trout Haven Dam			
Salt Creek	Salt Creek Dam		10	
Trinity River	Lone Jack Dam		24	
	Arco Pond Dam		10	
	Hagmmaier North Dam		30	
	John Muir #1 Dam			
	Lower Murphy Dam		6	
	Upper Murphy Dam		25	

APPENDIX 11: CONCEPTUAL EVALUATION OF UPSTREAM MINING ACTIVITIES IN ALAMEDA CREEK WATERSHED

According to the State of California's Office of Mine Reclamation (2000) and Davis (1950), historical mining activities in the Alameda Creek Watershed have consisted mostly of producing clay, sand, and rock for construction and manufacturing purposes. However a number of Manganese, Magnesite[5], and Chromite[6] mines – predominately around Arroyo Mocho - were in production from the 1880's up to about the 1950 when production ceased. Also no mercury mining has occurred within the watershed (OMR, 2000; Davis, 1950).

The State (2000) conducted a stdy of chemical (and physical) hazards posed by abandoned mine lands within Alameda Creek Watershed. Based on their site observations combined with a statistical analysis, the state concluded that there is a "very low probability that abandoned mine sites pose a significant chemical threat to the environment."[7].

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5 Manganese Oxide, and Magnesite can be an environmental hazard

6 Chromium in hexavalent form is a known carcinogen

7 California Abandoned Mines, Volume II, Page 31, dated June 2000.

APPENDIX B
TRANSPORTATION SETTING
(PREPARED BY CHS)

CHS Consulting Group

MEMORANDUM

DATE: May 13, 2003

TO: Jim Watson, HDR Engineering
Todd Crampton, Geomatrix

FROM: Mary Walther Pryor

RE: Sunol & Niles Dams Removal – Transportation Setting

This memo discusses the existing traffic and roadway conditions in the vicinity of the Sunol and Niles dam sites, as well as planned changes for the roadways in the area. It also provides information regarding additional data needs to complete the transportation operational assessment for the trucking activities associated with the removal of the two dams.

State Route 84 (SR 84) is the primary roadway in the vicinity of the two dams. The Niles Dam is located near the intersection of Niles Canyon Road and Palomares Road. The Sunol Dam is located to the west of the town of Sunol adjacent to Niles Canyon Road. Between Mission Boulevard in Fremont and Interstate 680 in Sunol, SR 84 is named Niles Canyon Road, and has one lane in each direction. There are few roads that intersect with SR 84 in this area, and those intersections are controlled by stop signs on the minor streets. SR 84 provides a connection between I-680 in Sunol with I-880 in Fremont. The following roadways are designated as SR 84 between the interstate highways: Niles Canyon Road, Mission Boulevard, Mowry Avenue, Peralta Boulevard, Fremont Boulevard, and Thornton Avenue.

A 1994 Caltrans Traffic Operations Report for Mission Boulevard, *the most recent analysis available from Caltrans for the area*, found that during the AM and PM peak periods the intersection of Mission Boulevard and Niles Canyon Road was congested. The report suggests that SR 84 is congested in the peak periods (7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM) because it provides access between I-680 and I-880.[1] During the non-peak hours, the report notes that traffic on Mission Boulevard moves at or above the posted speed limits. A recent field visit during the midday period found that traffic volumes were moderate and traffic flowed smoothly on Niles Canyon Road between Mission Boulevard and I-680 in Sunol. However, new traffic volume counts would be required in the vicinity of the dam removal projects in order to assess the trucking activity's impacts on existing traffic conditions.

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[1] *Traffic Operations Report: Mission Boulevard*, Technical Report 4-Ala-238,3.3/9.3 4185-233020, May 1994, p. 3.

In addition to providing information about traffic congestion on SR 84, the Mission Boulevard Traffic Operations Report also provides truck volume data. The following table summarizes the truck traffic volumes at the intersection of Niles Canyon Road and Mission Boulevard in 1990, *the most recent available detailed data.*

1990 Truck Traffic Volumes for Niles Canyon Road

	Niles Canyon Road East of Mission			
	Eastbound		Westbound	
	AM	PM	AM	PM
Total Trucks	12	26	49	27
2 Axles	3	11	9	20
3 Axles	7	2	14	0
4 Axles	0	4	4	0
5+ Axles	2	9	22	7
Percent Trucks	1.7%	1.8%	5.4%	3.7%

Source: Caltrans

Caltrans has several projects in construction or planning phases in the vicinity of the Niles and Sunol dams. The influence these projects may have on the dam removal's transportation operations are discussed below.

Mission Boulevard Spot Improvements

Caltrans is currently implementing spot improvements at and in the vicinity of Mission Boulevard/Niles Canyon Road intersection. Construction in the area is scheduled to continue for up to three years. Current projections estimate that the improvements will be completed in 2005. The improvement project will widen westbound Niles Canyon Road to four lanes from Old Canyon Road to Mission Boulevard. When completed, the westbound approach of Niles Canyon Road to Mission Boulevard will have two left turn lanes, one through lane, and one right turn lane. Mission Boulevard will also be widened to three lanes in each direction.

Traffic conditions at the intersection of Niles Canyon Road and Mission Boulevard were documented in the 1994 Traffic Operations Report[2], the most recent operations report available from Caltrans. The following table summarizes the Levels of Service for the various scenarios analyzed in the report. The report was written based on the assumption that the spot improvements would have been completed by 2000. Although the improvements are currently under construction, no more recent analysis has been conducted by Caltrans. The analysis shows that traffic conditions in 1990 were very poor (at LOS F) in the PM peak period (generally 4:00 PM to 6:00 PM). By 2000 without the spot improvement program which is currently being implemented, traffic conditions in

[2] *Traffic Operations Report: Mission Boulevard*, Technical Report 4-Ala-238,3.3/9.3 4185-233020, May 1994.

the AM peak period (generally 7:00 AM to 9:00 AM) would worsen to LOS F, and LOS F conditions would continue for the PM peak period. With the spot improvements, traffic conditions would improve, and would continue to operate at acceptable conditions during the AM and PM peak periods at least until 2010.

Levels of Service and Volume to Capacity Ratios for Niles Canyon Road and Mission Boulevard Intersection

	1990 Existing Conditions		2000 No Build		2000 With Spot Improvements		2010 With Spot Improvements		2010 With Spot Improvements and SR 84 Realignment (I-880 to Mission Blvd)	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
LOS	D	F	F	F	C	C	D	D	D	D
V/C Ratio	0.80	1.22	1.09	1.32	0.76	0.75	0.87	0.88	0.86	0.86

Source: Caltrans

The analysis for the Mission Boulevard Spot Improvements project indicates that during the morning and afternoon peak periods, vehicles would form long queues at the intersection of Mission Boulevard and Niles Canyon Road.[3] On westbound Niles Canyon Road, the long queue would likely extend beyond Old Canyon Road which is the access road to the Niles dam. As traffic volumes in the area appear to be lower during the midday period, the project sponsor should consider scheduling trucking activity for non-peak hours.

Retrofit of Alameda Creek Bridge

Caltrans plans to seismically retrofit the Alameda Creek Bridge on SR 84 (Niles Canyon Road). The bridge is located east of Palomares Road, approximately 1.5 to 2 miles east of Niles Dam. This project will begin in May or June of 2003, and is expected to take one year to complete. Caltrans' project manager for this project has indicated that the project will not change the capacity of SR 84 for any extended period of time. Flag persons will be used to direct trucks to and from the site.

Given the minimal impact of the retrofit project on the roadway operations and its distance from the intersection of Old Canyon Road and Niles Canyon Road, no conflicts between the dam removal projects and the retrofit project are anticipated.

[3] The Traffic Operations Report does not include the LOS calculations which would provide additional information about the extent of traffic congestion for each of the intersection approaches. However, given that the analysis shows a volume to capacity ratio above 1, it is assumed that vehicle queues would develop at this intersection.

impede traffic on Niles Canyon Road and pose safety concerns. The project sponsor may consider restricting debris removal trucking to the midday period, between approximately 9:00 AM and 4:00 PM.

During off-peak periods, traffic volumes on Niles Canyon Road is lighter and trucks from Old Canyon Road might be able to find sufficient gaps to enter the main road safely. The traffic signal at the intersection with Mission Boulevard meters the eastbound traffic. However, gaps in the westbound traffic are unpredictable. Depending upon the estimated number of truck trips required for the project, employing a flag-person may be an effective strategy to facilitate access to and from Old Canyon Road.

SFPUC Roadway

Several large potholes were observed at the western end of the roadway, and it is unclear if the pavement extends directly to the site. This existing roadway is not wide enough to accommodate the turning radius necessary for the debris removal trucks to turn around or make a 3-point U-turn. Given the narrow width of the roadway, trucks would not be able to pass each other between the dam site and Old Canyon Road. As such, a two-person radio system should be employed if this road is used for debris removal. Improvements to this roadway may be necessary for demolition work and debris removal, depending on the scale of the project and the volume of debris. Further study will be necessary to determine the feasibility of providing an improved area sufficient for the trucks to turn around near the Niles Dam, rather than at the end of Old Canyon Road.

Alternative Access Points

An alternative debris removal option under consideration would be to load trucks directly on SR 84. Niles dam is located immediately adjacent to Niles Canyon Road which runs along the northern bank of Alameda Creek. This site has been proposed as a truck loading location. This alternative is problematic as the roadway does not have sufficient shoulder space to permit access to the dam site without using one lane of SR 84. As such, loading trucks at this location would require narrowing the width of SR 84 to one lane and allowing one-way only traffic.

It is unclear if this alternative would be feasible or not, as 24-hour traffic counts are not available. Traffic tube counts would be required to assess the impact of the project on SR 84.[4] These counts would provide information regarding the traffic volumes and patterns at the proposed site. The extent of the impacts would be based on the traffic volumes as well as the daily duration of the truck loading activity, and the number of days expected to complete the debris removal. Conducting the debris removal during the overnight hours would most likely limit the impact on traffic flow. Extensive advance warning signs and flag persons would be necessary for the duration of the trucking operations.

Outdated topographic maps show a short roadway and bridge connecting the dam site to SR 84. However, during a field visit, only the ruined footings of the bridge were visible.

New traffic counts would be required to accurately assess the dam removal project's impacts on existing traffic conditions.

4 Caltrans has been contacted regarding the existence of Caltrans guidelines for traffic impacts associated with lane closures. At the time of this memo, this information has not been provided.

Sunol Dam Site Access

The Sunol dam is located to the west of the town of Sunol, adjacent to the western corner of a wholesale nursery. Access to the dam site is provided through the nursery's internal roadways and a SFPUC private roadway which can only be reached through the nursery. The SFPUC roadway and nursery are separated by a fence.

Preliminary information regarding the removal of the dam and sediment suggests that approximately 18,000 to 27,000 cyd of material would be removed from the Sunol site. This equates to approximately 900 to 1,350 truck trips from the site, if 20 cyd capacity trucks are used. If the trucking operations were conducted over a three-month time frame, seven days a week, approximately ten to fifteen truck trips per day would occur. New traffic counts would be required to accurately assess the dam removal project's impacts on existing traffic conditions.

Nursery Driveway

The commercial nursery's driveway provides the only direct access to Niles Canyon Road from the dam site. The driveway is not fully improved, but is used regularly by trucks and private vehicles.

The intersection of the driveway and Niles Canyon Road presents some safety concerns. In particular, the sight distance looking west may be insufficient for large trucks to safely turn left onto Niles Canyon Road. This is due to the downward slope and northward curve of SR 84 to the west of the nursery driveway. In addition, as traffic is not metered signals or stop signs in the vicinity of the driveway, trucks may face challenges in finding sufficient gaps in traffic to safely turn onto SF 84. This issue would be exacerbated if double-load trucks are used for debris removal. Given these conditions, the use of an advance warning system and flag persons would be advised, particularly if trucks are routed to the west of the site.

SFPUC Roadway

A removable section of the nursery's fence provides access to the SFPUC roadway. The fence which surrounds the site is used to keep wildlife out of the nursery.

The SFPUC roadway is approximately twelve feet wide, paved and in good condition. It is not wide enough to accommodate two-way truck traffic. However, as the areas on both sides of the roadway are flat and free of trees and bushes, it may be feasible to allow two-way truck traffic with minimal improvements. Further investigation would be necessary to determine the feasibility of turning trucks at the dam site.

The area near the gate on the inside of the nursery grounds appears to have adequate space for truck staging and turning.

Many newts were observed on this roadway during a site visit in February. A biologist should be consulted to avoid conflict with the newts' migration.

Summary

The following bullet points summarize the preliminary opportunities and constraints for the trucking activity associated with the removal of the Niles and Sunol dams.

Niles Dam

- Two options exist for trucking debris from the Niles Dam site: 1) the SFPUC roadway and Old Canyon Road, and 2) directly from SR 84 adjacent to the dam site.
- The SFPUC roadway to the south of Alameda Creek may need improvements to provide direct access to the Niles Dam site, and to permit trucks to turn around near the dam.
- The end of Old Canyon Road near the entrance to the SFPUC roadway may provide sufficient space for truck staging activities, but may raise neighborhood opposition.
- Trucking activity should be limited to the midday period to avoid congestion-related issues at the intersection of Niles Canyon Road and Mission Boulevard.
- The spot improvements currently under construction at the intersection of Niles Canyon Road and Mission Boulevard may conflict with trucking activity, depending on the schedules for both projects. Detailed schedules are not available at this time.
- A flag person located at the intersection of Niles Canyon Road and Old Canyon Road may be appropriate to ensure safe access to the roadways for trucks.
- SR 84 would be reduced to one lane during the debris removal process if trucks are loaded from SR 84. An advance warning system and flag persons would be required to use the site adjacent to the dam on SR 84, as the shoulder has insufficient width to accommodate truck loading activities.
- Traffic counts would be needed to assess the impacts of reducing SR84 to one lane at the Niles Dam site for the debris removal process.
- If the SR 84 site is used, trucking activities should probably be limited to the overnight hours to avoid conflicts with traffic.

Sunol Dam

- The SFPUC roadway is in good condition between the nursery and the gate to the dam site.

- The area between the SFPUC roadway and Niles Canyon Road is on private property owned by a nursery. The project sponsor should consult with the nursery to prepare an access plan and schedule that meets both parties' needs, including debris removal truck staging, trucking activities, and preventing wildlife access to the nursery.
- An advance warning system and flag person should be implemented to ensure safe truck access to and from the nursery driveway and Niles Canyon Road.

Additional Data Needs

In order to conduct the traffic operations analysis for the dam removals' trucking activities, the following data would be required to better understand existing conditions:

- Current midday traffic volume counts at the intersection of Old Canyon Road and Niles Canyon Road,
  or
- Current 24-hour machine traffic volume counts on Niles Canyon Road adjacent to Niles Dam.

- Current midday traffic volume counts at the intersection of Niles Canyon Road and Nursery driveway.

SR 84 Widening East of I-680

Caltrans is in the preliminary planning phase of widening SR 84 east of I-680 to I-580. Given that the construction activities of this project will be located east of I-680 and the project is still in the planning stage, it is unlikely that the dam removal project and the widening project would influence each other.

Niles Dam Site Access

The Niles dam is located to the south of Niles Canyon Road and west of the intersection of Palomares Road. Access to the dam site is provided via a SFPUC private roadway along the south side of Alameda Creek, approximately three-quarters of a mile from the end of Old Canyon Road. The SFPUC road is approximately fifteen feet wide, and provides for one-way travel only. The road is constructed between a raised railway trestle to the south and the Alameda Creek bed to the north. This configuration does not allow for widening the road without significant effort. The SFPUC roadway begins at the end of Old Canyon Road, where there is a locked gate across the roadway. Old Canyon Road in turn connects to Niles Canyon Road approximately 800 feet east of Mission Boulevard.

Preliminary information regarding the removal of the dam and sediment suggests that approximately 2,120 to 5,200 cubic yards (cyd) of material would be removed from the Niles site. This equates to approximately 106 to 260 truck trips from the site, if 20 cyd capacity trucks are used. If the trucking operations were conducted over a one-month time frame, seven days per week, approximately four to nine truck trips per day would occur.

Old Canyon Road

Old Canyon Road is a two lane, two way residential street. Old Canyon Road ends at the SFPUC access road entrance. This area has sufficient shoulder space for truck staging and turning for the debris removal operation. The project sponsor should communicate with the local residents regarding their plans for using Old Canyon Road prior to the start of the project, particularly if plans call for using the end of Old Canyon Road for truck staging. As this alternative may raise neighborhood opposition, the feasibility of staging trucks near the dam site should be evaluated.

The intersection of Old Canyon Road, Sycamore Street, and Niles Canyon Road presents some safety concerns. Sycamore Street and Old Canyon Road converge at the intersection with Niles Canyon Road. Vehicles traveling on Old Canyon Road and Sycamore Street must stop at the intersection, but those on Niles Canyon Road do not. The convergence of Sycamore and Old Canyon Road has a large paved area with limited roadway demarcation. As a result, drivers may be confused about vehicles' destinations and right of way.

Old Canyon Road intersects Niles Canyon Road at an acute angle in the westbound direction. As a result, when making the northbound left turn from Old Canyon Road, gaining a clear sightline for westbound Niles Canyon Road traffic can be challenging. Traffic on Old Canyon Road is controlled by a stop bar, but a posted stop sign is currently missing.

As Niles Canyon Road has high traffic volumes during peak period, trucks would expect to encounter significant delays in making the left turn from Old Canyon Road to Niles Canyon Road if the debris removal operation is conducted during peak periods. The movement of trucks could also

APPENDIX C
FIELD LOGS OF VIBRACORE BORINGS

Log of Boring No. B-1

PROJECT: SUNOL AND NILES DAM REMOVAL	Log of Boring No. B-1
BORING LOCATION: ALAMEDA CREEK - SUNOL DAM	ELEVATION AND DATUM:
DRILLING CONTRACTOR: GREGG DRILLING AND TESTING	DATE STARTED: 2·10·03 / DATE FINISHED: 2·10·03
DRILLING EQUIPMENT: TELESCOPING CRANE	TOTAL DEPTH: 10 FT. / MEASURING POINT: GROUND SURFACE (EST.)
DRILLING METHOD: VIBRACORE (3.92" DIA. 10-FT-LONG BARREL)	DEPTH WHERE FREE WATER FIRST ENCOUNTERED: N/A
SAMPLING METHOD:	DEPTH TO WATER AT COMPLETION (Date/Time): N/A
~~HAMMER~~ WEIGHT: 300 lbs / DROP: N/A	LOGGED BY: T. MACDOUGALL

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	MATERIAL DESCRIPTION		REMARKS
				SILTY FINES (MUCK)		SAMPLES TO LAB:
1		■		SANDY GRAVEL (SW), DARK GRAY, SUBANGULAR TO SUBROUNDED COARSE GRAVEL, FINE TO COARSE SAND	1	B1 - 1.25 - 021003
2		■		GRADES COARSER	2	B1 - 1.75 - 021003
3				BOTTOM OF RECOVERED SAMPLE	3	RECOVERED 3 FEET
4					4	
5					5	
6					6	No RECOVERY
7				FIELD LOG	7	
8					8	
9					9	
10					10	
11					11	
12					12	
13					13	
14					14	
15					15	
16					16	
17					17	

GT-1 (03/97)

PROJECT: SUNOL AND NILES DAM REMOVAL	**Log of Boring No. B-2**	
BORING LOCATION: ALAMEDA CREEK - SUNOL DAM	ELEVATION AND DATUM:	
DRILLING CONTRACTOR: GREGG DRILLING AND TESTING	DATE STARTED: 2.10.03	DATE FINISHED: 2.10.3
DRILLING EQUIPMENT: TELESCOPING CRANE	TOTAL DEPTH: 10 FT.	MEASURING POINT: GROUND SURFACE (EST.)
DRILLING METHOD: VIBRACORE (3.92" DIA. 10-FT-LONG BARREL)	DEPTH WHERE FREE WATER FIRST ENCOUNTERED: N/A	
SAMPLING METHOD:	DEPTH TO WATER AT COMPLETION (Date/Time): N/A	
~~HAMMER~~ WEIGHT: 300 lbs / DROP: N/A	LOGGED BY: T. MACDOUGALL	

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	MATERIAL DESCRIPTION	REMARKS
0				SILTY FINES (MUCK)	SAMPLES TO LAB:
1				SANDY GRAVEL W/ CLAY (SW)	
2		■		GRADES COARSER	B2-1.75-021003
3		■			B2-3.0-021003
4				BOTTOM OF RECOVERED SAMPLE	RECOVERED 3.75 FEET
5					
6					
7				FIELD LOG	NO RECOVERY
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

GT-1 (03/97)

Project No. #6959.021 | **Geomatrix Consultants** | Figure #

Soil Boring Field Log.pdf

PROJECT: SUNOL AND NILES DAM REMOVAL

Log of Boring No. B-3

BORING LOCATION: ALAMEDA CREEK - SUNOL DAM	ELEVATION AND DATUM:
DRILLING CONTRACTOR: GREGG DRILLING AND TESTING	DATE STARTED: 2·10·03 — DATE FINISHED: 2·10·03
DRILLING EQUIPMENT: TELESCOPING CRANE	TOTAL DEPTH: 10 FT. — MEASURING POINT: GROUND SURFACE (EST.)
DRILLING METHOD: VIBRACORE (3.92" DIA. 10-FT-LONG BARREL)	DEPTH WHERE FREE WATER FIRST ENCOUNTERED: N/A
SAMPLING METHOD:	DEPTH TO WATER AT COMPLETION (Date/Time): N/A
~~HAMMER~~ WEIGHT: 300 lbs — DROP: N/A	LOGGED BY: T. MACDOUGALL

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	MATERIAL DESCRIPTION	REMARKS SAMPLES TO LAB:
				SILTY FINES (MUCK)	B3-0.5-021003
1				SANDY GRAVEL W/ CLAY (SW)	B3-1.5-021003
2				GRADES COARSER	B3-2.0-021003
				BOTTOM OF RECOVERED SAMPLE	RECOVERED 2.25 FEET
3					
4					
5					
6					NO RECOVERY
7					
8				FIELD LOG	
9					
10					
11					
12					
13					
14					
15					
16					
17					

GT-1 (03/97)

Project No. # 6959.021 | Geomatrix Consultants | Figure #

Soil Boring Field Log.pdf

PROJECT: SUNOL AND NILES DAM REMOVAL	Log of Boring No. B-4	
BORING LOCATION: ALAMEDA CREEK - SUNOL DAM	ELEVATION AND DATUM:	
DRILLING CONTRACTOR: GREGG DRILLING AND TESTING	DATE STARTED: 2.10.03	DATE FINISHED: 2.10.03
DRILLING EQUIPMENT: TELESCOPING CRANE	TOTAL DEPTH: 10 FT.	MEASURING POINT: GROUND SURFACE (EST.)
DRILLING METHOD: VIBRACORE (3.92" DIA. 10-FT-LONG BARREL)	DEPTH WHERE FREE WATER FIRST ENCOUNTERED: N/A	
SAMPLING METHOD:	DEPTH TO WATER AT COMPLETION (Date/Time): N/A	
~~HAMMER~~ WEIGHT: 300 lbs — DROP: N/A	LOGGED BY: T. MACDOUGALL	

DEPTH (feet)	Sample No.	Sample	Blows/Foot	MATERIAL DESCRIPTION		REMARKS
				SILTY FINES (MUCK)		SAMPLES TO LAB:
1		■		SANDY GRAVEL (SW)	1	B4 - 1.0 - 021003
2				GRADES COARSER	2	
3		■			3	B4 - 3.0 - 021003
				BOTTOM OF RECOVERED SAMPLE		RECOVERED 3.25 FEET
4					4	
5					5	
6					6	NO RECOVERY
7				FIELD LOG	7	
8					8	
9					9	
10					10	
11					11	
12					12	
13					13	
14					14	
15					15	
16					16	
17					17	

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Project No. # 6959.021	Geomatrix Consultants	Figure #

Soil Boring Field Log.pdf

PROJECT: SUNOL AND NILES DAM REMOVAL	**Log of Boring No.** B-5	
BORING LOCATION: ALAMEDA CREEK - SUNOL DAM	ELEVATION AND DATUM:	
DRILLING CONTRACTOR: GREGG DRILLING AND TESTING	DATE STARTED: 2.11.03	DATE FINISHED: 2.11.03
DRILLING EQUIPMENT: TELESCOPING CRANE	TOTAL DEPTH: 10 FT.	MEASURING POINT: GROUND SURFACE (EST.)
DRILLING METHOD: VIBRACORE (3.92" DIA. 10-FT-LONG BARREL)	DEPTH WHERE FREE WATER FIRST ENCOUNTERED: N/A	
SAMPLING METHOD:	DEPTH TO WATER AT COMPLETION (Date/Time): N/A	
~~HAMMER~~ WEIGHT: 300 lbs — DROP: N/A	LOGGED BY: T. MACDOUGALL	

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	MATERIAL DESCRIPTION	REMARKS
0				MUCK	SAMPLES TO LAB:
1				SANDY GRAVEL (SW)	
2		■		GRADES COARSER	B5-1.75-021103
3		■			B5-3.5-021103
4					
4.4				BOTTOM OF RECOVERED SAMPLE	RECOVERED 4.4 FEET
5					
6					
7				FIELD LOG	NO RECOVERY
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

Log of Boring No. B-6

PROJECT: SUNOL AND NILES DAM REMOVAL	Log of Boring No. B-6
BORING LOCATION: ALAMEDA CREEK - SUNOL DAM	ELEVATION AND DATUM:
DRILLING CONTRACTOR: GREGG DRILLING AND TESTING	DATE STARTED: 2-11-03 / DATE FINISHED: 2-11-03
DRILLING EQUIPMENT: TELESCOPING CRANE	TOTAL DEPTH: 10 FT. / MEASURING POINT: GROUND SURFACE (EST.)
DRILLING METHOD: VIBRACORE (3.92" DIA. 10-FT-LONG BARREL)	DEPTH WHERE FREE WATER FIRST ENCOUNTERED: N/A
SAMPLING METHOD:	DEPTH TO WATER AT COMPLETION (Date/Time): N/A
~~HAMMER~~ WEIGHT: 300 lbs / DROP: N/A	LOGGED BY: T. MACDOUGALL

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	MATERIAL DESCRIPTION	REMARKS
0				MUCK	SAMPLES TO LAB:
1		■		SANDY GRAVEL (SW)	B6-1.5-021103
2				GRADES COARSER	
3		■			B6-3.0-021103
4				BOTTOM OF RECOVERED SAMPLE	RECOVERED 3.6 FEET
5					
6					
7				FIELD LOG	NO RECOVERY
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

PROJECT: SUNOL AND NILES DAM REMOVAL	**Log of Boring No.** B-7	
BORING LOCATION: ALAMEDA CREEK - SUNOL DAM	ELEVATION AND DATUM:	
DRILLING CONTRACTOR: GREGG DRILLING AND TESTING	DATE STARTED: 2.11.03	DATE FINISHED: 2.11.03
DRILLING EQUIPMENT: TELESCOPING CRANE	TOTAL DEPTH: 10 FT.	MEASURING POINT: GROUND SURFACE (EST.)
DRILLING METHOD: VIBRACORE (3.92" DIA. 10-FT-LONG BARREL)	DEPTH WHERE FREE WATER FIRST ENCOUNTERED: N/A	
SAMPLING METHOD:	DEPTH TO WATER AT COMPLETION (Date/Time): N/A	
~~HAMMER~~ WEIGHT: 300 lbs · DROP: N/A	LOGGED BY: T. MACDOUGALL	

DEPTH (feet)	Sample No.	Sample	Blows/Foot	MATERIAL DESCRIPTION	REMARKS
0				MUCK	SAMPLES TO LAB:
1				SANDY GRAVEL (SW)	
2		■		GRADES COARSER	B7-2.0-021103
3					
4		■			B7-3.75-021103
4.25				BOTTOM OF RECOVERED SAMPLE	RECOVERED 4.25 FEET
5–10					NO RECOVERY
11					
12					
13					
14					
15					
16					
17					

FIELD LOG

Project No. # 6959.021	**Geomatrix Consultants**	GT-1 (03/97) Figure #

Soil Boring Field Log.pdf

APPENDIX D
LABORATORY TESTING PROGRAM

APPENDIX D
LABORATORY TESTING PROGRAM

Conceptual Engineering for Removal of Sunol and Niles Dams
Alameda County, California

Introduction

This appendix presents the analytical program and laboratory reports for the chemical analysis of samples collected during the field program. The samples were analyzed by Severn Trent Laboratories, Inc., STL San Francisco, a state-certified laboratory located in Pleasanton, California. Copies of the laboratory reports and chains of custody are included in this appendix.

Geotechnical laboratory testing for this study consisted of grain-size analysis to aid in the consideration of sediment disposal alternatives (i.e., for assessing whether or not the excavated materials would be suitable for commercial uses). Grain-size distribution curves for selected samples collected during the field program are included at the end of this appendix.

Analytical Methods

A summary of the samples collected and the chemical analytical program is presented in Table D-1. The chemical analytical program included the following methods:

> TPH as diesel and motor oil (TPHd and TPHmo) by Environmental Protection Agency (EPA) Method 8015 modified following a silica gel cleanup by EPA Method 3630A modified;
>
> CAM 17 metals by EPA Methods 6010B and 7471A;
>
> Polynuclear aromatics (PNAs) by EPA Method 8270C-SIM;
>
> Polychlorinated biphenyls (PCBs) by EPA Method 8082; and
>
> Organochlorine pesticides by EPA Method 8081.

Data Quality Review

The purpose of the quality assurance/quality control (QA/QC) procedures is to assess the quality of the data by evaluating the accuracy, precision, and completeness of the data. The laboratory analyzed method blanks, laboratory control sample/laboratory control sample duplicate (LCS/LCSD), and matrix spike/matrix spike duplicate (MS/MSD) samples to provide internal quality control. The QA/QC results are discussed below.

Data Precision

Data precision is evaluated by comparing analytical results from duplicate samples. The evaluation is based on calculating the relative percent difference (RPD) between the duplicates. The laboratory analyzed method blanks, LCS/LCSD, and prepared and analyzed MS/MSD samples from laboratory batch samples to evaluate the precision of the analytical methods.

For the MS/MSD sample analyzed with the samples collected on February 10, 2003, the calculated RPD for Aroclor 1016 was 30.1 percent (30.1%), just above the QC limit of 30%. The results for the other spike compound (Aroclor 1260) were acceptable. The PCB data did not require qualification. All other laboratory internal QA/QC data were within criteria.

Data Accuracy

Data accuracy is assessed by the analysis of LCS/LCSD and MS/MSD samples, based on recoveries, and expressed as a percent of the true or known concentration. Surrogate recoveries may also be used to assess accuracy.

During laboratory internal QA/QC analysis of MS/MSD samples associated with the February 11, 2003 primary samples, the spike recoveries for antimony and mercury were below the QC limits due to matrix interference. Antimony and mercury were not detected in any of the primary samples. In accordance with the National Functional Guidelines for Inorganic Data Review (USEPA, 2002), the associated analytical results for these two compounds are flagged with a "UJ" on Table D-1. The "UJ" qualifier indicates that the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

TPHd data for samples B3-0.5-021003 and B7-2.0-021103 were qualified by the laboratory as having a hydrocarbon pattern that did not match the laboratory's diesel standard. Differences in spectral signature are typically due to weathering and/or the presence of other hydrocarbon types in the subsurface. The affected data are flagged in the Table D-1.

All other laboratory internal QA/QC data were within criteria.

Data Completeness

The laboratory performed all requested analyses, and the analytical results are considered valid. The data generated are considered complete.

Summary of Data Quality Review

The laboratory quality control results indicate that the sampling and analysis were conducted as required by the analytical methods. The results of the testing show good precision and accuracy in the procedures. Overall, the results of the data quality review indicate that the test results in this report are of sufficient quality to support the conclusions presented.

Discussion of results

The data indicate that PCBs, PNAs, pesticides, and TPHmo were not detected in any of the samples. TPHd was detected in two samples at low levels (1.2 milligrams per kilogram [mg/kg] for B3-0.5-021003 and 1.1 mg/kg for B7-2.0-021103). However, the laboratory indicated that the hydrocarbon pattern did not match its diesel standard. Therefore, TPHd is likely not present in these two samples. Various metals were detected at low concentrations—well below their respective Total Threshold Limit Concentrations (TTLC) (Table D-2). The detected concentrations were also below accepted background concentrations (except for one detection of nickel just above background).

TABLE D-1
SUMMARY OF CHEMICAL ANALYTICAL RESULTS

Conceptual Engineering for Removal for Sunol and Niles Dams
Alameda County, California

Concentrations in milligrams per kilogram (mg/kg)

Sample (boring number-sample depth-sample date)	TPHd	TPHmo	CAM 17 Metals																	PNAs	PCBs	Pesticides
			Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	Mercury			
B1-1.25-02113	<1.0 [1]	<50	<2.0	**2.1**	**41**	<0.50	**1.2**	**27**	**5.3**	**7.3**	**3.4**	<1.0	**37**	<2.0	<1.0	<1.0	**15**	**27**	<0.050	<5.0	<50	Note 3
B1-2.25-021003	<1.0	<50	<2.0	**4.4**	**57**	<0.50	**1.7**	**26**	**6.2**	**13**	**3.3**	<1.0	**37**	<2.0	<1.0	<1.0	**22**	**32**	<0.050	<5.0	<50	Note 3
B2-1.75-021003	<1.0	<50	<2.0	---[4]	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<5.0	<50	Note 3
B2-3.0-021003	<1.0	<50	<2.0	**2.5**	**38**	<0.50	**1.2**	**18**	**6.8**	**6.3**	**2.6**	<1.0	**30**	<2.0	<1.0	<1.0	**16**	**26**	<0.050	<5.0	<50	Note 3
B3-0.5-021003	**1.2** [5]	<50	<2.0	**2.6**	**40**	<0.50	**1.3**	**24**	**5.2**	**7.7**	**4.1**	<1.0	**30**	<2.0	<1.0	<1.0	**18**	**27**	<0.050	<5.0	<50	Note 3
B3-1.5-021003	<1.0	<50	<2.0	**3.5**	**50**	<0.50	**1.4**	**18**	**5.1**	**8.5**	**3.8**	<1.0	**30**	<2.0	<1.0	<1.0	**16**	**29**	<0.050	<5.0	<50	Note 3
B3-2.0-021103	<1.0	<50	<2.0	**1.9**	**34**	<0.50	**1.2**	**16**	**5.2**	**7.9**	**3**	<1.0	**29**	<2.0	<1.0	<1.0	**20**	**25**	<0.050	<5.0	<50	Note 3
B4-1.0-021003	<1.0	<50	<2.0	**2.3**	**41**	<0.50	**1.2**	**27**	**5.1**	**8.6**	**2.8**	<1.0	**36**	<2.0	<1.0	<1.0	**16**	**27**	<0.050	<5.0	<50	Note 3
B4-3.0-021003	<1.0	<50	<2.0	**2.3**	**34**	<0.50	**1.2**	**19**	**4.5**	**11**	**3.0**	<1.0	**28**	<2.0	<1.0	<1.0	**13**	**26**	<0.050	<5.0	<50	Note 3
B5-1.75-021103	<1.0	<50	2.0UJ[2]	**2.1**	**58**	<0.50	**1.2**	**27**	**5.5**	**8.4**	**3.7**	<1.0	**39**	<2.0	<1.0	<1.0	**16**	**30**	0.050UJ	<5.0	<50	Note 3
B5-3.5-021103	<1.0	<50	2.0UJ	**1.3**	**38**	<0.50	**0.97**	**22**	**4.3**	**11**	**2.1**	<1.0	**19**	<2.0	<1.0	<1.0	**12**	**19**	0.050UJ	<5.0	<50	Note 3
B6-1.5-021103	<1.0	<50	2.0UJ	**2.3**	**51**	<0.50	**1.1**	**23**	**4.9**	**7.9**	**3.3**	<1.0	**33**	<2.0	<1.0	<1.0	**14**	**31**	0.050UJ	<5.0	<50	Note 3
B6-3.0-021103	<1.0	<50	2.0UJ	**1.9**	**39**	<0.50	**1.2**	**19**	**4.8**	**7.8**	**1.9**	<1.0	**32**	<2.0	<1.0	<1.0	**17**	**22**	0.050UJ	<5.0	<50	Note 3
B7-2.0-021103	**1.1** [5]	<50	2.0UJ	**3.0**	**50**	<0.50	**1.4**	**39**	**8.6**	**7.6**	**2.8**	<1.0	**140**	<2.0	<1.0	<1.0	**14**	**25**	0.050UJ	<5.0	<50	Note 3
B7-3.75-021103	<1.0	<50	2.0UJ	**2.0**	**38**	<0.50	**1.2**	**22**	**5.8**	**7.9**	**3.3**	<1.0	**35**	<2.0	<1.0	<1.0	**14**	**24**	0.050UJ	<5.0	<50	Note 3

Notes:
1. "<" indicates compound not detected above the laboratory reporting limit shown.
2. UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
3. Reporting limits vary. See laboratory reports.
4. Not tested.
5. Hydrocarbon reported does not match the laboratory diesel standard.

Abbreviations:
TPHd = total petroleum hydrocarbons as diesel (EPA Method 8015 Modified).
TPHmo = total petroleum hydrocarbons as motor oil (EPA Method 8015 Modified).

CAM 17 = antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc (EPA Methods 6010B and 7471A).
PNAs = Polynuclear aromatics (EPA Method 8270C-SIM).
PCBs = Polychlorinated

TABLE D-2

COMPARISON OF CHEMICAL ANALYTICAL RESULTS -- METALS

Conceptual Engineering for Removal of Sunol and Niles Dams

Alameda County, California

Compound	TTLC[1] (mg/kg[2])	Background Concentrations[3] (mg/kg)	Range of Results (mg/kg)
Antimony	500	5.5	<2.0[4]
Arsenic	500	19.1	1.3 - 4.4
Barium	10,000	323.6	34 - 58
Beryllium	75	1.0	<0.50
Cadmium	100	2.7	0.97 - 1.7
Chromium	2,500	99.6	16 - 39
Cobalt	8,000	22.2	4.3 - 8.6
Copper	2,500	69.4	7.3 - 13
Lead	1,000	16.1	1.9 - 4.1
Mercury	20	0.4	<0.050
Molybdenum	3,500	7.4	<1.0
Nickel	2,000	119.8	19 - 140
Selenium	100	5.6	<2.0
Silver	500	1.8	<1.0
Thallium	700	27.1	<1.0
Vanadium	2,400	74.3	12 - 22
Zinc	5,000	106.1	19 - 32

Notes:

1 TTLC = Total Threshold Limit Concentration.

2 mg/kg = milligrams per kilogram.

3 *Protocol for Determining Background Concentrations of Metals in Soil at Lawrence Berkeley National Laboratory (LBNL)* , Lawrence Berkeley National Laboratory, University of California, August 1995.

4 < = compound not detected above the stated laboratory reporting limit.

Organochlorine Pesticides Analysis

Geomatrix Consultants

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Project: 6959.021

Received: 02/10/2003 18:00

Samples Reported

Sample Name	Date Sampled	Matrix	Lab #
B1-1.25-021003	02/10/2003 13:00	Soil	1
B1-2.25-021003	02/10/2003 13:00	Soil	2
B2-1.75-021003	02/10/2003 14:00	Soil	3
B2-3.0-021003	02/10/2003 14:00	Soil	4
B3-0.5-021003	02/10/2003 14:50	Soil	5
B3-1.5-021003	02/10/2003 14:50	Soil	6
B3-2.0-021003	02/10/2003 14:50	Soil	7
B4-1.0-021003	02/10/2003 15:20	Soil	8
B4-3.0-021003	02/10/2003 15:20	Soil	9

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Organochlorine Pesticides Analysis

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B1-1.25-021003**	Lab ID:	2003-02-0159 - 1
Sampled:	02/10/2003 13:00	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
Dieldrin	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
Endrin	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
Heptachlor	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
beta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
delta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
Toxaphene	ND	100	ug/Kg	1.00	02/12/2003 14:08	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/12/2003 14:08	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 14:08	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	77.0	50-125	%	1.00	02/12/2003 14:08	
Decachlorobiphenyl (Pest/8081)	77.3	46-142	%	1.00	02/12/2003 14:08	

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Organochlorine Pesticides Analysis

Geomatrix Consultants
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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B1-2.25-021003**	Lab ID:	2003-02-0159 - 2
Sampled:	02/10/2003 13:00	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
Dieldrin	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
Endrin	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
Heptachlor	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
beta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
delta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
Toxaphene	ND	100	ug/Kg	1.00	02/12/2003 15:41	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/12/2003 15:41	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 15:41	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	85.2	50-125	%	1.00	02/12/2003 15:41	
Decachlorobiphenyl (Pest/8081)	82.2	46-142	%	1.00	02/12/2003 15:41	

Organochlorine Pesticides Analysis

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B2-1.75-021003**	Lab ID:	2003-02-0159 - 3
Sampled:	02/10/2003 14:00	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
Dieldrin	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
Endrin	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
Heptachlor	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
beta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
delta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
Toxaphene	ND	100	ug/Kg	1.00	02/12/2003 16:12	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/12/2003 16:12	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 16:12	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	72.4	50-125	%	1.00	02/12/2003 16:12	
Decachlorobiphenyl (Pest/8081)	77.2	46-142	%	1.00	02/12/2003 16:12	

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Organochlorine Pesticides Analysis

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B2-3.0-021003**	Lab ID:	2003-02-0159 - 4
Sampled:	02/10/2003 14:00	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
Dieldrin	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
Endrin	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
Heptachlor	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
beta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
delta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
Toxaphene	ND	100	ug/Kg	1.00	02/12/2003 20:19	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/12/2003 20:19	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 20:19	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	59.3	50-125	%	1.00	02/12/2003 20:19	
Decachlorobiphenyl (Pest/8081)	75.6	46-142	%	1.00	02/12/2003 20:19	

Organochlorine Pesticides Analysis

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B3-0.5-021003**	Lab ID:	2003-02-0159 - 5
Sampled:	02/10/2003 14:50	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
Dieldrin	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
Endrin	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
Heptachlor	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
beta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
delta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
Toxaphene	ND	100	ug/Kg	1.00	02/12/2003 20:50	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/12/2003 20:50	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 20:50	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	75.1	50-125	%	1.00	02/12/2003 20:50	
Decachlorobiphenyl (Pest/8081)	74.7	46-142	%	1.00	02/12/2003 20:50	

Organochlorine Pesticides Analysis

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B3-1.5-021003**	Lab ID:	2003-02-0159 - 6
Sampled:	02/10/2003 14:50	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
Dieldrin	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
Endrin	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
Heptachlor	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
beta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
delta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
Toxaphene	ND	100	ug/Kg	1.00	02/12/2003 21:21	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/12/2003 21:21	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 21:21	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	83.5	50-125	%	1.00	02/12/2003 21:21	
Decachlorobiphenyl (Pest/8081)	80.5	46-142	%	1.00	02/12/2003 21:21	

Organochlorine Pesticides Analysis

Geomatrix Consultants
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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B3-2.0-021003**	Lab ID:	2003-02-0159 - 7
Sampled:	02/10/2003 14:50	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
Dieldrin	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
Endrin	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
Heptachlor	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
beta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
delta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
Toxaphene	ND	100	ug/Kg	1.00	02/12/2003 21:52	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/12/2003 21:52	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 21:52	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	82.3	50-125	%	1.00	02/12/2003 21:52	
Decachlorobiphenyl (Pest/8081)	80.4	46-142	%	1.00	02/12/2003 21:52	

Organochlorine Pesticides Analysis

Geomatrix Consultants

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Project: 6959.021

Received: 02/10/2003 18:00

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B4-1.0-021003**	Lab ID:	2003-02-0159 - 8
Sampled:	02/10/2003 15:20	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
Dieldrin	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
Endrin	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
Heptachlor	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
beta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
delta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
Toxaphene	ND	100	ug/Kg	1.00	02/12/2003 22:23	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/12/2003 22:23	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 22:23	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	69.7	50-125	%	1.00	02/12/2003 22:23	
Decachlorobiphenyl (Pest/8081)	68.8	46-142	%	1.00	02/12/2003 22:23	

SEVERN TRENT STL

Organochlorine Pesticides Analysis

Geomatrix Consultants
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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B4-3.0-021003**	Lab ID:	2003-02-0159 - 9
Sampled:	02/10/2003 15:20	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
Dieldrin	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
Endrin	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
Heptachlor	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
beta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
delta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
Toxaphene	ND	100	ug/Kg	1.00	02/12/2003 22:54	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/12/2003 22:54	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 22:54	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	79.4	50-125	%	1.00	02/12/2003 22:54	
Decachlorobiphenyl (Pest/8081)	80.9	46-142	%	1.00	02/12/2003 22:54	

Organochlorine Pesticides Analysis

Geomatrix Consultants

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Project: 6959.021

Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3550/8081

Test(s): 8081

Method Blank

Soil

QC Batch # 2003/02/11-02.13

MB: 2003/02/11-02.13-001

Date Extracted: 02/11/2003 12:48

Compound	Conc.	RL	Unit	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	02/12/2003 12:35	
Dieldrin	ND	2.0	ug/Kg	02/12/2003 12:35	
Endrin aldehyde	ND	2.0	ug/Kg	02/12/2003 12:35	
Endrin	ND	2.0	ug/Kg	02/12/2003 12:35	
Endrin ketone	ND	2.0	ug/Kg	02/12/2003 12:35	
Heptachlor	ND	2.0	ug/Kg	02/12/2003 12:35	
Heptachlor epoxide	ND	2.0	ug/Kg	02/12/2003 12:35	
4,4`-DDT	ND	2.0	ug/Kg	02/12/2003 12:35	
4,4`-DDE	ND	2.0	ug/Kg	02/12/2003 12:35	
4,4`-DDD	ND	2.0	ug/Kg	02/12/2003 12:35	
Endosulfan I	ND	2.0	ug/Kg	02/12/2003 12:35	
Endosulfan II	ND	2.0	ug/Kg	02/12/2003 12:35	
alpha-BHC	ND	2.0	ug/Kg	02/12/2003 12:35	
beta-BHC	ND	2.0	ug/Kg	02/12/2003 12:35	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	02/12/2003 12:35	
delta-BHC	ND	2.0	ug/Kg	02/12/2003 12:35	
Endosulfan sulfate	ND	2.0	ug/Kg	02/12/2003 12:35	
4,4`-Methoxychlor	ND	2.0	ug/Kg	02/12/2003 12:35	
Toxaphene	ND	100	ug/Kg	02/12/2003 12:35	
Chlordane (Technical)	ND	50	ug/Kg	02/12/2003 12:35	
alpha-Chlordane	ND	2.0	ug/Kg	02/12/2003 12:35	
gamma-Chlordane	ND	2.0	ug/Kg	02/12/2003 12:35	
Surrogates(s)					
2,4,5,6-Tetrachloro-m-xylene	87.3	50-125	%	02/12/2003 12:35	
Decachlorobiphenyl (Pest/8081)	75.9	46-142	%	02/12/2003 12:35	

Organochlorine Pesticides Analysis

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Project: 6959.021 Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3550/8081 Test(s): 8081

Laboratory Control Spike **Soil** **QC Batch # 2003/02/11-02.13**

LCS	2003/02/11-02.13-002	Extracted: 02/11/2003	Analyzed: 02/12/2003 13:06
LCSD	2003/02/11-02.13-003	Extracted: 02/11/2003	Analyzed: 02/12/2003 13:37

Compound	Conc. ug/Kg		Exp.Conc.	Recovery		RPD	Ctrl.Limits %		Flags	
	LCS	LCSD		LCS	LCSD	%	Rec.	RPD	LCS	LCSD
Aldrin	15.4	13.7	16.7	92.2	82.0	11.7	37-136	25		
Dieldrin	16.5	14.5	16.7	98.8	86.8	12.9	58-135	35		
Endrin	16.8	14.8	16.7	100.6	88.6	12.7	58-134	35		
Heptachlor	15.9	14.0	16.7	95.2	83.8	12.7	40-136	20		
4,4`-DDT	15.2	13.8	16.7	91.0	82.6	9.7	55-132	35		
gamma-BHC (Lindane)	14.9	13.4	16.7	89.2	80.2	10.6	37-137	35		
Surrogates(s)										
2,4,5,6-Tetrachloro-m-xylene	42.9	38.8	50	85.7	77.6		50-125	0		
Decachlorobiphenyl	41.0	38.5	50	82.0	76.9		46-142	0		

SEVERN TRENT STL

Organochlorine Pesticides Analysis

Geomatrix Consultants

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Project: 6959.021 Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3550/8081 Test(s): 8081

Matrix Spike (MS / MSD) **Soil** **QC Batch # 2003/02/11-02.13**

B1-1.25-021003 >> MS Lab ID: 2003-02-0159 - 001

MS: 2003/02/11-02.13-004 Extracted: 02/11/2003 Analyzed: 02/12/2003 14:39
Dilution: 1.00

MSD: 2003/02/11-02.13-005 Extracted: 02/11/2003 Analyzed: 02/12/2003 15:10
Dilution: 1.00

Compound	Conc. ug/Kg			Spk.Level	Recovery			Limits %		Flags	
	MS	MSD	Sample	ug/Kg	MS	MSD	RPD	Rec.	RPD	MS	MSD
Aldrin	15.3	16.0	ND	16.6	92.2	96.4	4.5	37-136	25		
Dieldrin	15.9	16.2	ND	16.6	95.8	97.6	1.9	58-135	35		
Endrin	16.1	16.1	ND	16.6	97.0	97.0	0.0	58-134	35		
Heptachlor	16.3	16.3	ND	16.6	98.2	98.2	0.0	40-136	20		
4,4`-DDT	14.4	14.2	ND	16.6	86.7	85.5	1.4	55-132	35		
gamma-BHC (Lindane)	15.3	16.2	ND	16.6	92.2	97.6	5.7	37-137	35		
Surrogate(s)											
2,4,5,6-Tetrachloro-m-xylen	43.0	44.6		50	86.0	89.2		50-125	0		
Decachlorobiphenyl	39.5	41.2		50	79.0	82.4		46-142	0		

PNA analysis by 8270C/SIM GC/MS

Geomatrix Consultants
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Project: 6959.021 Received: 02/10/2003 18:00

Samples Reported

Sample Name	Date Sampled	Matrix	Lab #
B1-1.25-021003	02/10/2003 13:00	Soil	1
B1-2.25-021003	02/10/2003 13:00	Soil	2
B2-1.75-021003	02/10/2003 14:00	Soil	3
B2-3.0-021003	02/10/2003 14:00	Soil	4
B3-0.5-021003	02/10/2003 14:50	Soil	5
B3-1.5-021003	02/10/2003 14:50	Soil	6
B3-2.0-021003	02/10/2003 14:50	Soil	7
B4-1.0-021003	02/10/2003 15:20	Soil	8
B4-3.0-021003	02/10/2003 15:20	Soil	9

PNA analysis by 8270C/SIM GC/MS

Geomatrix Consultants

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B1-1.25-021003**	Lab ID:	2003-02-0159 - 1
Sampled:	02/10/2003 13:00	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Fluorene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Chrysene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/13/2003 18:13	
Surrogates(s)						
2-Fluorobiphenyl	66.0	30-115	%	1.00	02/13/2003 18:13	
p-Terphenyl-d14	69.4	18-137	%	1.00	02/13/2003 18:13	

PNA analysis by 8270C/SIM GC/MS

Geomatrix Consultants
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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B1-2.25-021003**	Lab ID:	2003-02-0159 - 2
Sampled:	02/10/2003 13:00	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Fluorene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Chrysene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/13/2003 18:39	
Surrogates(s)						
2-Fluorobiphenyl	72.9	30-115	%	1.00	02/13/2003 18:39	
p-Terphenyl-d14	77.0	18-137	%	1.00	02/13/2003 18:39	

SEVERN TRENT STL

PNA analysis by 8270C/SIM GC/MS

Geomatrix Consultants
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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B2-1.75-021003**	Lab ID:	2003-02-0159 - 3
Sampled:	02/10/2003 14:00	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Fluorene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Chrysene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/13/2003 19:06	
Surrogates(s)						
2-Fluorobiphenyl	65.8	30-115	%	1.00	02/13/2003 19:06	
p-Terphenyl-d14	93.9	18-137	%	1.00	02/13/2003 19:06	

PNA analysis by 8270C/SIM GC/MS

Geomatrix Consultants
Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B2-3.0-021003**	Lab ID:	2003-02-0159 - 4
Sampled:	02/10/2003 14:00	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Fluorene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Chrysene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/13/2003 19:33	
Surrogates(s)						
2-Fluorobiphenyl	72.5	30-115	%	1.00	02/13/2003 19:33	
p-Terphenyl-d14	78.3	18-137	%	1.00	02/13/2003 19:33	

PNA analysis by 8270C/SIM GC/MS

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B3-0.5-021003**	Lab ID:	2003-02-0159 - 5
Sampled:	02/10/2003 14:50	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Fluorene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Chrysene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/13/2003 20:00	
Surrogates(s)						
2-Fluorobiphenyl	73.7	30-115	%	1.00	02/13/2003 20:00	
p-Terphenyl-d14	82.9	18-137	%	1.00	02/13/2003 20:00	

PNA analysis by 8270C/SIM GC/MS

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B3-1.5-021003**	Lab ID:	2003-02-0159 - 6
Sampled:	02/10/2003 14:50	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Fluorene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Chrysene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/13/2003 20:26	
Surrogates(s)						
2-Fluorobiphenyl	68.7	30-115	%	1.00	02/13/2003 20:26	
p-Terphenyl-d14	76.0	18-137	%	1.00	02/13/2003 20:26	

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B3-2.0-021003**	Lab ID:	2003-02-0159 - 7
Sampled:	02/10/2003 14:50	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Fluorene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Chrysene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/13/2003 20:53	
Surrogates(s)						
2-Fluorobiphenyl	69.2	30-115	%	1.00	02/13/2003 20:53	
p-Terphenyl-d14	76.1	18-137	%	1.00	02/13/2003 20:53	

PNA analysis by 8270C/SIM GC/MS

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B4-1.0-021003**	Lab ID:	2003-02-0159 - 8
Sampled:	02/10/2003 15:20	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Fluorene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Chrysene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/13/2003 21:20	
Surrogates(s)						
2-Fluorobiphenyl	66.8	30-115	%	1.00	02/13/2003 21:20	
p-Terphenyl-d14	78.1	18-137	%	1.00	02/13/2003 21:20	

PNA analysis by 8270C/SIM GC/MS

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B4-3.0-021003**	Lab ID:	2003-02-0159 - 9
Sampled:	02/10/2003 15:20	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Fluorene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Chrysene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/13/2003 21:46	
Surrogates(s)						
2-Fluorobiphenyl	68.9	30-115	%	1.00	02/13/2003 21:46	
p-Terphenyl-d14	77.7	18-137	%	1.00	02/13/2003 21:46	

PNA analysis by 8270C/SIM GC/MS

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Project: 6959.021 Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3550B/8270C-SIM Test(s): 8270C-SIM

Method Blank **Soil** **QC Batch # 2003/02/12-01.40**

MB: 2003/02/12-01.40-013 Date Extracted: 02/12/2003 08:34

Compound	Conc.	RL	Unit	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	02/13/2003 15:32	
Acenaphthylene	ND	5.0	ug/Kg	02/13/2003 15:32	
Acenaphthene	ND	5.0	ug/Kg	02/13/2003 15:32	
Fluorene	ND	5.0	ug/Kg	02/13/2003 15:32	
Phenanthrene	ND	5.0	ug/Kg	02/13/2003 15:32	
Anthracene	ND	5.0	ug/Kg	02/13/2003 15:32	
Fluoranthene	ND	5.0	ug/Kg	02/13/2003 15:32	
Pyrene	ND	5.0	ug/Kg	02/13/2003 15:32	
Benzo(a)anthracene	ND	5.0	ug/Kg	02/13/2003 15:32	
Chrysene	ND	5.0	ug/Kg	02/13/2003 15:32	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	02/13/2003 15:32	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	02/13/2003 15:32	
Benzo(a)pyrene	ND	5.0	ug/Kg	02/13/2003 15:32	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	02/13/2003 15:32	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	02/13/2003 15:32	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	02/13/2003 15:32	
Surrogates(s)					
2-Fluorobiphenyl	79.2	30-115	%	02/13/2003 15:32	
p-Terphenyl-d14	95.8	18-137	%	02/13/2003 15:32	

SEVERN TRENT STL

Submission #: 2003-02-0159

PNA analysis by 8270C/SIM GC/MS

Geomatrix Consultants

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2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3550B/8270C-SIM

Test(s): 8270C-SIM

Laboratory Control Spike **Soil** **QC Batch # 2003/02/12-01.40**

LCS	2003/02/12-01.40-017	Extracted: 02/12/2003	Analyzed: 02/13/2003 17:19
LCSD	2003/02/12-01.40-018	Extracted: 02/12/2003	Analyzed: 02/13/2003 17:46

Compound	Conc. ug/Kg		Exp.Conc.	Recovery		RPD	Ctrl.Limits %		Flags	
	LCS	LCSD		LCS	LCSD	%	Rec.	RPD	LCS	LCSD
Acenaphthene	246	253	332	74.1	76.0	2.5	50-150	30		
Phenanthrene	251	256	332	75.6	76.9	1.7	50-150	30		
Pyrene	272	294	332	81.9	88.3	7.5	50-150	30		
Chrysene	260	267	332	78.3	80.2	2.4	50-150	30		
Benzo(a)pyrene	233	240	332	70.2	72.1	2.7	50-150	30		
Surrogates(s)										
2-Fluorobiphenyl	7.61	7.89	10	76.1	78.9		30-115			
p-Terphenyl-d14	7.85	8.25	10	78.5	82.5		18-137			

PCBs

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Samples Reported

Sample Name	Date Sampled	Matrix	Lab #
B1-1.25-021003	02/10/2003 13:00	Soil	1
B1-2.25-021003	02/10/2003 13:00	Soil	2
B2-1.75-021003	02/10/2003 14:00	Soil	3
B2-3.0-021003	02/10/2003 14:00	Soil	4
B3-0.5-021003	02/10/2003 14:50	Soil	5
B3-1.5-021003	02/10/2003 14:50	Soil	6
B3-2.0-021003	02/10/2003 14:50	Soil	7
B4-1.0-021003	02/10/2003 15:20	Soil	8
B4-3.0-021003	02/10/2003 15:20	Soil	9

PCBs

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B1-1.25-021003**	Lab ID:	2003-02-0159 - 1
Sampled:	02/10/2003 13:00	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	83.0	50-125	%	1.00	02/12/2003 07:24	
Decachlorobiphenyl (PCB/8082)	86.5	46-142	%	1.00	02/12/2003 07:24	

PCBs

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Project: 6959.021

Received: 02/10/2003 18:00

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B1-2.25-021003**	Lab ID:	2003-02-0159 - 2
Sampled:	02/10/2003 13:00	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	87.6	50-125	%	1.00	02/12/2003 07:44	
Decachlorobiphenyl (PCB/8082)	96.3	46-142	%	1.00	02/12/2003 07:44	

PCBs

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B2-1.75-021003**	Lab ID:	2003-02-0159 - 3
Sampled:	02/10/2003 14:00	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 05:47	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 05:47	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 05:47	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 05:47	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 05:47	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 05:47	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 05:47	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	79.3	50-125	%	1.00	02/12/2003 05:47	
Decachlorobiphenyl (PCB/8082)	82.1	46-142	%	1.00	02/12/2003 05:47	

SEVERN TRENT STL

PCBs

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B2-3.0-021003**	Lab ID:	2003-02-0159 - 4
Sampled:	02/10/2003 14:00	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 06:07	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 06:07	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 06:07	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 06:07	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 06:07	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 06:07	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 06:07	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	67.0	50-125	%	1.00	02/12/2003 06:07	
Decachlorobiphenyl (PCB/8082)	84.1	46-142	%	1.00	02/12/2003 06:07	

PCBs

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B3-0.5-021003**	Lab ID:	2003-02-0159 - 5
Sampled:	02/10/2003 14:50	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 06:26	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 06:26	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 06:26	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 06:26	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 06:26	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 06:26	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 06:26	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	82.8	50-125	%	1.00	02/12/2003 06:26	
Decachlorobiphenyl (PCB/8082)	81.4	46-142	%	1.00	02/12/2003 06:26	

PCBs

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B3-1.5-021003**	Lab ID:	2003-02-0159 - 6
Sampled:	02/10/2003 14:50	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 07:24	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	87.4	50-125	%	1.00	02/12/2003 07:24	
Decachlorobiphenyl (PCB/8082)	75.8	46-142	%	1.00	02/12/2003 07:24	

PCBs

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B3-2.0-021003**	Lab ID:	2003-02-0159 - 7
Sampled:	02/10/2003 14:50	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 07:44	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	85.8	50-125	%	1.00	02/12/2003 07:44	
Decachlorobiphenyl (PCB/8082)	79.9	46-142	%	1.00	02/12/2003 07:44	

PCBs

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B4-1.0-021003**	Lab ID:	2003-02-0159 - 8
Sampled:	02/10/2003 15:20	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 08:04	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 08:04	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 08:04	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 08:04	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 08:04	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 08:04	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 08:04	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	76.0	50-125	%	1.00	02/12/2003 08:04	
Decachlorobiphenyl (PCB/8082)	70.7	46-142	%	1.00	02/12/2003 08:04	

PCBs

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B4-3.0-021003**	Lab ID:	2003-02-0159 - 9
Sampled:	02/10/2003 15:20	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 08:24	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 08:24	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 08:24	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 08:24	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 08:24	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 08:24	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 08:24	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	85.0	50-125	%	1.00	02/12/2003 08:24	
Decachlorobiphenyl (PCB/8082)	76.1	46-142	%	1.00	02/12/2003 08:24	

PCBs

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Project: 6959.021

Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3550/8082

Test(s): 8082

Method Blank

Soil

QC Batch # 2003/02/11-01.14

MB: 2003/02/11-01.14-001

Date Extracted: 02/11/2003 12:58

Compound	Conc.	RL	Unit	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	02/12/2003 05:47	
Aroclor 1221	ND	50	ug/Kg	02/12/2003 05:47	
Aroclor 1232	ND	50	ug/Kg	02/12/2003 05:47	
Aroclor 1242	ND	50	ug/Kg	02/12/2003 05:47	
Aroclor 1248	ND	50	ug/Kg	02/12/2003 05:47	
Aroclor 1254	ND	50	ug/Kg	02/12/2003 05:47	
Aroclor 1260	ND	50	ug/Kg	02/12/2003 05:47	
Surrogates(s)					
2,4,5,6-Tetrachloro-m-xylene	85.2	50-125	%	02/12/2003 05:47	
Decachlorobiphenyl (PCB/8082)	82.6	46-142	%	02/12/2003 05:47	

PCBs

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Project: 6959.021 Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3550/8082 Test(s): 8082

Laboratory Control Spike **Soil** **QC Batch # 2003/02/11-01.14**

LCS	2003/02/11-01.14-002	Extracted: 02/11/2003	Analyzed: 02/12/2003 06:07
LCSD	2003/02/11-01.14-003	Extracted: 02/11/2003	Analyzed: 02/12/2003 06:26

Compound	Conc. ug/Kg		Exp.Conc.	Recovery		RPD	Ctrl.Limits %		Flags	
	LCS	LCSD		LCS	LCSD	%	Rec.	RPD	LCS	LCSD
Aroclor 1016	56.9	53.1	66.6	85.4	79.7	6.9	65-135	30		
Aroclor 1260	62.9	58.5	66.6	94.4	87.8	7.2	65-135	30		
Surrogates(s)										
2,4,5,6-Tetrachloro-m-xylene	43.6	41.0	50	87.2	82.0		50-125	0		
Decachlorobiphenyl	46.7	44.4	50	93.3	88.8		46-142	0		

SEVERN TRENT STL

PCBs

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Project: 6959.021 Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3550/8082 Test(s): 8082

Matrix Spike (MS / MSD) **Soil** **QC Batch # 2003/02/11-01.14**

B1-2.25-021003 >> MS Lab ID: 2003-02-0159 - 002

MS: 2003/02/11-01.14-004 Extracted: 02/11/2003 Analyzed: 02/12/2003 08:04
Dilution: 1.00

MSD: 2003/02/11-01.14-005 Extracted: 02/11/2003 Analyzed: 02/12/2003 08:24
Dilution: 1.00

Compound	Conc. ug/Kg			Spk.Level	Recovery			Limits %		Flags	
	MS	MSD	Sample	ug/Kg	MS	MSD	RPD	Rec.	RPD	MS	MSD
Aroclor 1016	58.7	43.5	ND	66.4	88.4	65.3	30.1	65-135	30		rpd
Aroclor 1260	65.0	64.0	ND	66.4	97.9	96.1	1.9	65-135	30		
Surrogate(s)											
2,4,5,6-Tetrachloro-m-xylen	44.0	26.9		50	88.0	53.7		50-125	0		
Decachlorobiphenyl	47.6	45.9		50	95.3	91.9		46-142	0		

CAM 17 Metals

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Project: 6959.021 Received: 02/10/2003 18:00

Samples Reported

Sample Name	Date Sampled	Matrix	Lab #
B1-1.25-021003	02/10/2003 13:00	Soil	1
B1-2.25-021003	02/10/2003 13:00	Soil	2
B2-3.0-021003	02/10/2003 14:00	Soil	4
B3-0.5-021003	02/10/2003 14:50	Soil	5
B3-1.5-021003	02/10/2003 14:50	Soil	6
B3-2.0-021003	02/10/2003 14:50	Soil	7
B4-1.0-021003	02/10/2003 15:20	Soil	8
B4-3.0-021003	02/10/2003 15:20	Soil	9

CAM 17 Metals

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B1-1.25-021003**	Lab ID:	2003-02-0159 - 1
Sampled:	02/10/2003 13:00	Extracted:	2/11/2003 20:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/11-04.15 2003/02/12-01.16

Analysis Flag: . (See Legend and Note Section)

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 10:30	
Arsenic	2.1	1.0	mg/Kg	1.00	02/12/2003 10:30	
Barium	41	1.0	mg/Kg	1.00	02/12/2003 10:30	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 10:30	
Cadmium	1.2	0.50	mg/Kg	1.00	02/12/2003 10:30	
Chromium	27	1.0	mg/Kg	1.00	02/12/2003 10:30	
Cobalt	5.3	1.0	mg/Kg	1.00	02/12/2003 10:30	
Copper	7.3	1.0	mg/Kg	1.00	02/12/2003 10:30	
Lead	3.4	1.0	mg/Kg	1.00	02/12/2003 10:30	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 10:30	
Nickel	37	1.0	mg/Kg	1.00	02/12/2003 10:30	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 10:30	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 10:30	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 10:30	
Vanadium	15	1.0	mg/Kg	1.00	02/12/2003 10:30	
Zinc	27	1.0	mg/Kg	1.00	02/12/2003 10:30	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 12:34	

CAM 17 Metals

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Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B1-2.25-021003**	Lab ID:	2003-02-0159 - 2
Sampled:	02/10/2003 13:00	Extracted:	2/11/2003 20:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/11-04.15 2003/02/12-01.16

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 10:34	
Arsenic	4.4	1.0	mg/Kg	1.00	02/12/2003 10:34	
Barium	57	1.0	mg/Kg	1.00	02/12/2003 10:34	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 10:34	
Cadmium	1.7	0.50	mg/Kg	1.00	02/12/2003 10:34	
Chromium	26	1.0	mg/Kg	1.00	02/12/2003 10:34	
Cobalt	6.2	1.0	mg/Kg	1.00	02/12/2003 10:34	
Copper	13	1.0	mg/Kg	1.00	02/12/2003 10:34	
Lead	3.3	1.0	mg/Kg	1.00	02/12/2003 10:34	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 10:34	
Nickel	37	1.0	mg/Kg	1.00	02/12/2003 10:34	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 10:34	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 10:34	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 10:34	
Vanadium	22	1.0	mg/Kg	1.00	02/12/2003 10:34	
Zinc	32	1.0	mg/Kg	1.00	02/12/2003 10:34	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 12:36	

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Submission #: 2003-02-0159

CAM 17 Metals

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B2-3.0-021003**	Lab ID:	2003-02-0159 - 4
Sampled:	02/10/2003 14:00	Extracted:	2/11/2003 20:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/11-04.15 2003/02/12-01.16

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 10:38	
Arsenic	2.5	1.0	mg/Kg	1.00	02/12/2003 10:38	
Barium	38	1.0	mg/Kg	1.00	02/12/2003 10:38	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 10:38	
Cadmium	1.2	0.50	mg/Kg	1.00	02/12/2003 10:38	
Chromium	18	1.0	mg/Kg	1.00	02/12/2003 10:38	
Cobalt	6.8	1.0	mg/Kg	1.00	02/12/2003 10:38	
Copper	6.3	1.0	mg/Kg	1.00	02/12/2003 10:38	
Lead	2.6	1.0	mg/Kg	1.00	02/12/2003 10:38	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 10:38	
Nickel	30	1.0	mg/Kg	1.00	02/12/2003 10:38	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 10:38	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 10:38	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 10:38	
Vanadium	16	1.0	mg/Kg	1.00	02/12/2003 10:38	
Zinc	26	1.0	mg/Kg	1.00	02/12/2003 10:38	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 12:37	

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CAM 17 Metals

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Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B3-0.5-021003**	Lab ID:	2003-02-0159 - 5
Sampled:	02/10/2003 14:50	Extracted:	2/11/2003 20:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/11-04.15 2003/02/12-01.16

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 10:59	
Arsenic	2.6	1.0	mg/Kg	1.00	02/12/2003 10:59	
Barium	40	1.0	mg/Kg	1.00	02/12/2003 10:59	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 10:59	
Cadmium	1.3	0.50	mg/Kg	1.00	02/12/2003 10:59	
Chromium	24	1.0	mg/Kg	1.00	02/12/2003 10:59	
Cobalt	5.2	1.0	mg/Kg	1.00	02/12/2003 10:59	
Copper	7.7	1.0	mg/Kg	1.00	02/12/2003 10:59	
Lead	4.1	1.0	mg/Kg	1.00	02/12/2003 10:59	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 10:59	
Nickel	30	1.0	mg/Kg	1.00	02/12/2003 10:59	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 10:59	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 10:59	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 10:59	
Vanadium	18	1.0	mg/Kg	1.00	02/12/2003 10:59	
Zinc	27	1.0	mg/Kg	1.00	02/12/2003 10:59	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 12:38	

CAM 17 Metals

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B3-1.5-021003**	Lab ID:	2003-02-0159 - 6
Sampled:	02/10/2003 14:50	Extracted:	2/11/2003 20:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/11-04.15 2003/02/12-01.16

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 11:03	
Arsenic	3.5	1.0	mg/Kg	1.00	02/12/2003 11:03	
Barium	50	1.0	mg/Kg	1.00	02/12/2003 11:03	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 11:03	
Cadmium	1.4	0.50	mg/Kg	1.00	02/12/2003 11:03	
Chromium	18	1.0	mg/Kg	1.00	02/12/2003 11:03	
Cobalt	5.1	1.0	mg/Kg	1.00	02/12/2003 11:03	
Copper	8.5	1.0	mg/Kg	1.00	02/12/2003 11:03	
Lead	3.8	1.0	mg/Kg	1.00	02/12/2003 11:03	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 11:03	
Nickel	30	1.0	mg/Kg	1.00	02/12/2003 11:03	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 11:03	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 11:03	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 11:03	
Vanadium	16	1.0	mg/Kg	1.00	02/12/2003 11:03	
Zinc	29	1.0	mg/Kg	1.00	02/12/2003 11:03	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 12:42	

CAM 17 Metals

Geomatrix Consultants
Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B3-2.0-021003**	Lab ID:	2003-02-0159 - 7
Sampled:	02/10/2003 14:50	Extracted:	2/11/2003 20:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/11-04.15 2003/02/12-01.16

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 11:07	
Arsenic	1.9	1.0	mg/Kg	1.00	02/12/2003 11:07	
Barium	34	1.0	mg/Kg	1.00	02/12/2003 11:07	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 11:07	
Cadmium	1.2	0.50	mg/Kg	1.00	02/12/2003 11:07	
Chromium	16	1.0	mg/Kg	1.00	02/12/2003 11:07	
Cobalt	5.2	1.0	mg/Kg	1.00	02/12/2003 11:07	
Copper	7.9	1.0	mg/Kg	1.00	02/12/2003 11:07	
Lead	3.0	1.0	mg/Kg	1.00	02/12/2003 11:07	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 11:07	
Nickel	29	1.0	mg/Kg	1.00	02/12/2003 11:07	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 11:07	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 11:07	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 11:07	
Vanadium	20	1.0	mg/Kg	1.00	02/12/2003 11:07	
Zinc	25	1.0	mg/Kg	1.00	02/12/2003 11:07	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 12:43	

CAM 17 Metals

Geomatrix Consultants
Attn.: Tom MacDougall

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Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B4-1.0-021003**	Lab ID:	2003-02-0159 - 8
Sampled:	02/10/2003 15:20	Extracted:	2/11/2003 20:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/11-04.15 2003/02/12-01.16

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 11:11	
Arsenic	2.3	1.0	mg/Kg	1.00	02/12/2003 11:11	
Barium	41	1.0	mg/Kg	1.00	02/12/2003 11:11	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 11:11	
Cadmium	1.2	0.50	mg/Kg	1.00	02/12/2003 11:11	
Chromium	27	1.0	mg/Kg	1.00	02/12/2003 11:11	
Cobalt	5.1	1.0	mg/Kg	1.00	02/12/2003 11:11	
Copper	8.6	1.0	mg/Kg	1.00	02/12/2003 11:11	
Lead	2.8	1.0	mg/Kg	1.00	02/12/2003 11:11	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 11:11	
Nickel	36	1.0	mg/Kg	1.00	02/12/2003 11:11	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 11:11	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 11:11	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 11:11	
Vanadium	16	1.0	mg/Kg	1.00	02/12/2003 11:11	
Zinc	27	1.0	mg/Kg	1.00	02/12/2003 11:11	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 12:44	

SEVERN TRENT STL

Submission #: 2003-02-0159

CAM 17 Metals

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B4-3.0-021003**	Lab ID:	2003-02-0159 - 9
Sampled:	02/10/2003 15:20	Extracted:	2/12/2003 09:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/12-01.15 2003/02/12-01.16

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 20:30	
Arsenic	2.3	1.0	mg/Kg	1.00	02/12/2003 20:30	
Barium	34	1.0	mg/Kg	1.00	02/12/2003 20:30	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 20:30	
Cadmium	1.2	0.50	mg/Kg	1.00	02/12/2003 20:30	
Chromium	19	1.0	mg/Kg	1.00	02/12/2003 20:30	
Cobalt	4.5	1.0	mg/Kg	1.00	02/12/2003 20:30	
Copper	11	1.0	mg/Kg	1.00	02/12/2003 20:30	
Lead	3.0	1.0	mg/Kg	1.00	02/12/2003 20:30	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 20:30	
Nickel	28	1.0	mg/Kg	1.00	02/12/2003 20:30	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 20:30	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 20:30	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 20:30	
Vanadium	13	1.0	mg/Kg	1.00	02/12/2003 20:30	
Zinc	26	1.0	mg/Kg	1.00	02/12/2003 20:30	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 12:45	

CAM 17 Metals

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3050B

Test(s): 6010B

Method Blank

Soil

QC Batch # 2003/02/11-04.15

MB: 2003/02/11-04.15-018

Date Extracted: 02/11/2003 20:33

Compound	Conc.	RL	Unit	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	02/12/2003 09:42	
Arsenic	ND	1.0	mg/Kg	02/12/2003 09:42	
Barium	ND	1.0	mg/Kg	02/12/2003 09:42	
Beryllium	ND	0.50	mg/Kg	02/12/2003 09:42	
Cadmium	ND	0.50	mg/Kg	02/12/2003 09:42	
Chromium	ND	1.0	mg/Kg	02/12/2003 09:42	
Cobalt	ND	1.0	mg/Kg	02/12/2003 09:42	
Copper	ND	1.0	mg/Kg	02/12/2003 09:42	
Lead	ND	1.0	mg/Kg	02/12/2003 09:42	
Molybdenum	ND	1.0	mg/Kg	02/12/2003 09:42	
Nickel	ND	1.0	mg/Kg	02/12/2003 09:42	
Selenium	ND	2.0	mg/Kg	02/12/2003 09:42	
Silver	ND	1.0	mg/Kg	02/12/2003 09:42	
Thallium	ND	1.0	mg/Kg	02/12/2003 09:42	
Vanadium	ND	1.0	mg/Kg	02/12/2003 09:42	
Zinc	ND	1.0	mg/Kg	02/12/2003 09:42	

CAM 17 Metals

Geomatrix Consultants

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Project: 6959.021 Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3050B Test(s): 6010B

Method Blank **Soil** **QC Batch # 2003/02/12-01.15**

MB: 2003/02/12-01.15-025 Date Extracted: 02/12/2003 09:33

Compound	Conc.	RL	Unit	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	02/12/2003 20:09	
Arsenic	ND	1.0	mg/Kg	02/12/2003 20:09	
Barium	ND	1.0	mg/Kg	02/12/2003 20:09	
Beryllium	ND	0.50	mg/Kg	02/12/2003 20:09	
Cadmium	ND	0.50	mg/Kg	02/12/2003 20:09	
Chromium	ND	1.0	mg/Kg	02/12/2003 20:09	
Cobalt	ND	1.0	mg/Kg	02/12/2003 20:09	
Copper	ND	1.0	mg/Kg	02/12/2003 20:09	
Lead	ND	1.0	mg/Kg	02/12/2003 20:09	
Molybdenum	ND	1.0	mg/Kg	02/12/2003 20:09	
Nickel	ND	1.0	mg/Kg	02/12/2003 20:09	
Selenium	ND	2.0	mg/Kg	02/12/2003 20:09	
Silver	ND	1.0	mg/Kg	02/12/2003 20:09	
Thallium	ND	1.0	mg/Kg	02/12/2003 20:09	
Vanadium	ND	1.0	mg/Kg	02/12/2003 20:09	
Zinc	ND	1.0	mg/Kg	02/12/2003 20:09	

CAM 17 Metals

Geomatrix Consultants
Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 7471A Test(s): 7471A

Method Blank **Soil** **QC Batch # 2003/02/12-01.16**

MB: 2003/02/12-01.16-017 Date Extracted: 02/12/2003 04:48

Compound	Conc.	RL	Unit	Analyzed	Flag
Mercury	ND	0.050	mg/Kg	02/12/2003 12:27	

CAM 17 Metals

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3050B Test(s): 6010B

Laboratory Control Spike **Soil** **QC Batch # 2003/02/11-04.15**

LCS	2003/02/11-04.15-019	Extracted: 02/11/2003	Analyzed: 02/12/2003 09:46
LCSD	2003/02/11-04.15-020	Extracted: 02/11/2003	Analyzed: 02/12/2003 09:50

Compound	Conc.	mg/Kg	Exp.Conc.	Recovery		RPD	Ctrl.Limits %		Flags	
	LCS	LCSD		LCS	LCSD	%	Rec.	RPD	LCS	LCSD
Antimony	101	99.1	100.0	101.0	99.1	1.9	80-120	20		
Arsenic	98.2	96.5	100.0	98.2	96.5	1.7	80-120	20		
Barium	97.4	96.0	100.0	97.4	96.0	1.4	80-120	20		
Beryllium	100.0	98.1	100.0	100.0	98.1	1.9	80-120	20		
Cadmium	96.7	95.7	100.0	96.7	95.7	1.0	80-120	20		
Chromium	95.1	94.4	100.0	95.1	94.4	0.7	80-120	20		
Cobalt	96.8	96.4	100.0	96.8	96.4	0.4	80-120	20		
Copper	101	98.8	100.0	101.0	98.8	2.2	80-120	20		
Lead	97.6	96.0	100.0	97.6	96.0	1.7	80-120	20		
Molybdenum	96.1	95.8	100.0	96.1	95.8	0.3	80-120	20		
Nickel	97.1	96.0	100.0	97.1	96.0	1.1	80-120	20		
Selenium	95.1	93.8	100.0	95.1	93.8	1.4	80-120	20		
Silver	97.6	96.2	100.0	97.6	96.2	1.4	80-120	20		
Thallium	94.1	92.9	100.0	94.1	92.9	1.3	80-120	20		
Vanadium	100	98.5	100.0	100.0	98.5	1.5	80-120	20		
Zinc	97.5	96.6	100.0	97.5	96.6	0.9	80-120	20		

CAM 17 Metals

Geomatrix Consultants

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2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3050B Test(s): 6010B

Laboratory Control Spike **Soil** **QC Batch # 2003/02/12-01.15**

LCS	2003/02/12-01.15-026	Extracted: 02/12/2003	Analyzed: 02/12/2003 20:14
LCSD	2003/02/12-01.15-029	Extracted: 02/12/2003	Analyzed: 02/12/2003 20:26

Compound	Conc.	mg/Kg	Exp.Conc.	Recovery		RPD	Ctrl.Limits %		Flags	
	LCS	LCSD		LCS	LCSD	%	Rec.	RPD	LCS	LCSD
Antimony	97.6	97.8	100.0	97.6	97.8	0.2	80-120	20		
Arsenic	97.1	97.1	100.0	97.1	97.1	0.0	80-120	20		
Barium	95.2	95.8	100.0	95.2	95.8	0.6	80-120	20		
Beryllium	95.6	96.8	100.0	95.6	96.8	1.2	80-120	20		
Cadmium	94.4	95.0	100.0	94.4	95.0	0.6	80-120	20		
Chromium	95.6	96.3	100.0	95.6	96.3	0.7	80-120	20		
Cobalt	95.8	96.4	100.0	95.8	96.4	0.6	80-120	20		
Copper	96.4	97.0	100.0	96.4	97.0	0.6	80-120	20		
Lead	95.7	96.3	100.0	95.7	96.3	0.6	80-120	20		
Molybdenum	97.0	97.6	100.0	97.0	97.6	0.6	80-120	20		
Nickel	94.7	95.4	100.0	94.7	95.4	0.7	80-120	20		
Selenium	93.9	93.8	100.0	93.9	93.8	0.1	80-120	20		
Silver	95.8	96.3	100.0	95.8	96.3	0.5	80-120	20		
Thallium	92.9	92.9	100.0	92.9	92.9	0.0	80-120	20		
Vanadium	97.7	98.5	100.0	97.7	98.5	0.8	80-120	20		
Zinc	94.7	95.4	100.0	94.7	95.4	0.7	80-120	20		

CAM 17 Metals

Geomatrix Consultants

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2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 7471A

Test(s): 7471A

Laboratory Control Spike

Soil

QC Batch # 2003/02/12-01.16

LCS 2003/02/12-01.16-018 Extracted: 02/12/2003 Analyzed: 02/12/2003 12:28

LCSD 2003/02/12-01.16-019 Extracted: 02/12/2003 Analyzed: 02/12/2003 12:29

Compound	Conc. mg/Kg		Exp.Conc.	Recovery		RPD	Ctrl.Limits %		Flags	
	LCS	LCSD		LCS	LCSD	%	Rec.	RPD	LCS	LCSD
Mercury	0.536	0.524	0.500	107.2	104.8	2.3	85-115	20		

CAM 17 Metals

Geomatrix Consultants

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2101 Webster Street, 12th Floor
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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Legend and Notes

Analysis Flag

.

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Samples Reported

Sample Name	Date Sampled	Matrix	Lab #
B1-1.25-021003	02/10/2003 13:00	Soil	1
B1-2.25-021003	02/10/2003 13:00	Soil	2
B2-1.75-021003	02/10/2003 14:00	Soil	3
B2-3.0-021003	02/10/2003 14:00	Soil	4
B3-0.5-021003	02/10/2003 14:50	Soil	5
B3-1.5-021003	02/10/2003 14:50	Soil	6
B3-2.0-021003	02/10/2003 14:50	Soil	7
B4-1.0-021003	02/10/2003 15:20	Soil	8
B4-3.0-021003	02/10/2003 15:20	Soil	9

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants
Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B1-1.25-021003**	Lab ID:	2003-02-0159 - 1
Sampled:	02/10/2003 13:00	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	ND	1.0	mg/Kg	1.00	02/12/2003 17:43	
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 17:43	
Surrogates(s)						
o-Terphenyl	89.7	60-130	%	1.00	02/12/2003 17:43	

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B1-2.25-021003**	Lab ID:	2003-02-0159 - 2
Sampled:	02/10/2003 13:00	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	ND	1.0	mg/Kg	1.00	02/12/2003 18:20	
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 18:20	
Surrogates(s)						
o-Terphenyl	84.3	60-130	%	1.00	02/12/2003 18:20	

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B2-1.75-021003**	Lab ID:	2003-02-0159 - 3
Sampled:	02/10/2003 14:00	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	ND	1.0	mg/Kg	1.00	02/12/2003 18:57	
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 18:57	
Surrogates(s)						
o-Terphenyl	79.1	60-130	%	1.00	02/12/2003 18:57	

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants
Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B2-3.0-021003**	Lab ID:	2003-02-0159 - 4
Sampled:	02/10/2003 14:00	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	ND	1.0	mg/Kg	1.00	02/12/2003 19:34	
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 19:34	
Surrogates(s)						
o-Terphenyl	85.2	60-130	%	1.00	02/12/2003 19:34	

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants
Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B3-0.5-021003**	Lab ID:	2003-02-0159 - 5
Sampled:	02/10/2003 14:50	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	1.2	1.0	mg/Kg	1.00	02/12/2003 20:12	ndp
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 20:12	
Surrogates(s)						
o-Terphenyl	91.4	60-130	%	1.00	02/12/2003 20:12	

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants

Attn.: Tom MacDougall

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Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B3-1.5-021003**	Lab ID:	2003-02-0159 - 6
Sampled:	02/10/2003 14:50	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	ND	1.0	mg/Kg	1.00	02/12/2003 20:48	
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 20:48	
Surrogates(s)						
o-Terphenyl	88.6	60-130	%	1.00	02/12/2003 20:48	

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants
Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B3-2.0-021003**	Lab ID:	2003-02-0159 - 7
Sampled:	02/10/2003 14:50	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	ND	1.0	mg/Kg	1.00	02/12/2003 21:26	
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 21:26	
Surrogates(s)						
o-Terphenyl	97.3	60-130	%	1.00	02/12/2003 21:26	

SEVERN TRENT STL

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants
Attn.: Tom MacDougall

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Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B4-1.0-021003**	Lab ID:	2003-02-0159 - 8
Sampled:	02/10/2003 15:20	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	ND	1.0	mg/Kg	1.00	02/12/2003 22:03	
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 22:03	
Surrogates(s)						
o-Terphenyl	82.7	60-130	%	1.00	02/12/2003 22:03	

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants
Attn.: Tom MacDougall

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Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/10/2003 18:00

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B4-3.0-021003**	Lab ID:	2003-02-0159 - 9
Sampled:	02/10/2003 15:20	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	ND	1.0	mg/Kg	1.00	02/12/2003 22:40	
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 22:40	
Surrogates(s)						
o-Terphenyl	96.6	60-130	%	1.00	02/12/2003 22:40	

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants
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Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3550/8015M Test(s): 8015M
Method Blank **Soil** **QC Batch # 2003/02/11-04.10**
MB: 2003/02/11-04.10-003 Date Extracted: 02/11/2003 08:36

Compound	Conc.	RL	Unit	Analyzed	Flag
Diesel	ND	1	mg/Kg	02/11/2003 21:55	
Motor Oil	ND	50	mg/Kg	02/11/2003 21:55	
Surrogates(s)					
o-Terphenyl	96.9	60-130	%	02/11/2003 21:55	

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Batch QC Report

Prep(s): 3550/8015M Test(s): 8015M

Laboratory Control Spike **Soil** **QC Batch # 2003/02/11-04.10**

LCS	2003/02/11-04.10-001	Extracted: 02/11/2003	Analyzed: 02/11/2003 20:41
LCSD	2003/02/11-04.10-002	Extracted: 02/11/2003	Analyzed: 02/11/2003 21:18

Compound	Conc. mg/Kg		Exp.Conc.	Recovery		RPD	Ctrl.Limits %		Flags	
	LCS	LCSD		LCS	LCSD	%	Rec.	RPD	LCS	LCSD
Diesel	35.3	37.0	41.6	84.9	88.7	4.4	60-130	25		
Surrogates(s)										
o-Terphenyl	20.3	20.8	20.0	101.4	103.9		60-130	0		

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants

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2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/10/2003 18:00

Legend and Notes

Result Flag

ndp

Hydrocarbon reported does not match the pattern of our Diesel standard

2003-02-0159 #1904

Chain-of-Custody Record

016181

Date: 2/10/03 | Page 1 of 1

Project No.: 6959 021

Samplers (Signature:) Allen T. MacDougall

Date	Time	Sample Number	EPA Method 8021 (Full Scan)	EPA Method 8021 (Hal. VOCs only)	EPA Method 8021 (BETX only)	EPA Method 8260	EPA Method 8270 (Full Scan)	EPA Method 8270 SIM (PAHS only)	Method 8015m (Gasoline)	Method 8015m (Diesel)	Method 8015m (Motor Oil)	Silica Gel Cleanup	8082	8081	CAM 17				Soil (S), Water (W) Vapor (V), or Other (o)	Filtered	Preserved	Cooled	No. of Containers	Additional Comments
2/10/03	13:00	B1-1.25-021003						X		X	X	X	X	X	X				S			X		
2/10/03	13:00	B1-2.25-021003						X		X	X	X	X	X	X				S			X		
	14:00	B2-1.75-021003						X		X	X	X	X	X					S			X		
	14:00	B2-3.0-021003						X		X	X	X	X	X	X				S			X		
	14:50	B3-0.5-021003						X		X	X	X	X	X	X				S			X		
	14:50	B3-1.5-021003						X		X	X	X	X	X	X				S			X		
	14:50	B3-2.0-021003						X		X	X	X	X	X	X				S			X		(B3-2.5-021003)
	15:20	B4-1.0-021003						X		X	X	X	X	X	X				S			X		
	15:20	B4-3.0-021003						X		X	X	X	X	X	X				S			X		

Laboratory: STL SF

Turnaround Time: Standard

Results to: T. MacDougall

Total No. of Containers: 9

Relinquished by (Signature): Allen T. MacDougall	Date: 2/10/03	Relinquished by (Signature):	Date:	Relinquished by (Signature):	Date:	Method of Shipment: Direct Carry
Printed Name: Allen T. MacDougall	Time: 18:00	Printed Name:	Time:	Printed Name:	Time:	Laboratory Comments and Log No.: 5.7°C
Company: Geomatrix		Company:		Company:		
Received by: ~~Lauree Gallego~~	Date:	Received by:	Date:	Received by: M. Villanueva	Date: 2/10/03	
Printed Name: ~~Lauree Gallego~~	Time:	Printed Name:	Time:	Printed Name: M-VILLANUEVA	Time: 18:00	
Company: ~~AT LABS~~		Company:		Company: STL SF		

Geomatrix Consultants
2101 Webster Street, 12th Floor • Oakland, CA 94612
Phone: 510-663-4100 Fax: 510-663-4141

SEVERN TRENT STL

STL San Francisco

Sample Receipt Checklist

Submission #:2003- 02 - 0159

Checklist completed by: (initials) DSH Date: 02/11/03

Courier name: ☐ STL San Francisco ☑ Client ____________

Custody seals intact on shipping container/samples	Yes____ No____ Not Present ✓
Chain of custody present?	Yes ✓ No____
Chain of custody signed when relinquished and received?	Yes ✓ No____
Chain of custody agrees with sample labels?	Yes____ No ✓ (1)
Samples in proper container/bottle?	Yes ✓ No____
Sample containers intact?	Yes ✓ No____
Sufficient sample volume for indicated test?	Yes ✓ No____
All samples received within holding time?	Yes ✓ No____
Container/Temp Blank temperature in compliance (4° C ± 2)?	Temp: 5.7 °C Yes ✓ No____
Water - VOA vials have zero headspace?	No VOA vials submitted ✓ Yes____ No____

(if bubble is present, refer to approximate bubble size and itemize in comments as **S** (small ~O), **M** (medium ~ O) or **L** (large ~ O)

Water - **pH acceptable upon receipt?** ☐ Yes ☐ No

☐ **pH adjusted**– Preservative used: ☐ HNO_3 ☐ HCl ☐ H_2SO_4 ☐ NaOH ☐ ZnOAc

For any item check-listed "No", provided detail of discrepancy in comment section below:

Comments: (1) Sample per CoC "B3-2.0-021003" is labeled "B3-2.5-021003" – logged in per CoC

Project Management [Routing for instruction of indicated discrepancy(ies)]

Project Manager: (initials) ________ Date: ____/____/03

Client contacted: ☐ Yes ☐ No

Summary of discussion:

Corrective Action (per PM/Client): called client on 2/12/03 @ 12:15 per Tom should be 2.0

AS

PCBs

Geomatrix Consultants
Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Samples Reported

Sample Name	Date Sampled	Matrix	Lab #
B5-1.75-021103	02/11/2003 10:45	Soil	1
B5-3.5-021103	02/11/2003 10:45	Soil	2
B6-1.5-021103	02/11/2003 11:15	Soil	3
B6-3.0-021103	02/11/2003 11:15	Soil	4
B7-2.0-021103	02/11/2003 11:50	Soil	5
B7-3.75-021103	02/11/2003 11:50	Soil	6

PCBs

Geomatrix Consultants
Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B5-1.75-021103**	Lab ID:	2003-02-0176 - 1
Sampled:	02/11/2003 10:45	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	93.0	50-125	%	1.00	02/12/2003 08:43	
Decachlorobiphenyl (PCB/8082)	104.3	46-142	%	1.00	02/12/2003 08:43	

PCBs

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B5-3.5-021103**	Lab ID:	2003-02-0176 - 2
Sampled:	02/11/2003 10:45	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	93.9	50-125	%	1.00	02/12/2003 09:02	
Decachlorobiphenyl (PCB/8082)	103.8	46-142	%	1.00	02/12/2003 09:02	

PCBs

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/11/2003 13:55

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B6-1.5-021103**	Lab ID:	2003-02-0176 - 3
Sampled:	02/11/2003 11:15	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 09:22	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 09:22	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 09:22	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 09:22	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 09:22	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 09:22	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 09:22	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	90.1	50-125	%	1.00	02/12/2003 09:22	
Decachlorobiphenyl (PCB/8082)	99.7	46-142	%	1.00	02/12/2003 09:22	

PCBs

Geomatrix Consultants
Attn.: Tom MacDougall

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Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B6-3.0-021103**	Lab ID:	2003-02-0176 - 4
Sampled:	02/11/2003 11:15	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 09:42	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 09:42	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 09:42	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 09:42	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 09:42	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 09:42	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 09:42	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	89.7	50-125	%	1.00	02/12/2003 09:42	
Decachlorobiphenyl (PCB/8082)	99.6	46-142	%	1.00	02/12/2003 09:42	

PCBs

Geomatrix Consultants

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Oakland, CA 94612
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Project: 6959.021 | Received: 02/11/2003 13:55

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B7-2.0-021103**	Lab ID:	2003-02-0176 - 5
Sampled:	02/11/2003 11:50	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 08:43	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	92.9	50-125	%	1.00	02/12/2003 08:43	
Decachlorobiphenyl (PCB/8082)	84.1	46-142	%	1.00	02/12/2003 08:43	

SEVERN TRENT STL

PCBs

Geomatrix Consultants
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Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550/8082	Test(s):	8082
Sample ID:	**B7-3.75-021103**	Lab ID:	2003-02-0176 - 6
Sampled:	02/11/2003 11:50	Extracted:	2/11/2003 12:58
Matrix:	Soil	QC Batch#:	2003/02/11-01.14

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Aroclor 1221	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Aroclor 1232	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Aroclor 1242	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Aroclor 1248	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Aroclor 1254	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Aroclor 1260	ND	50	ug/Kg	1.00	02/12/2003 09:02	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	107.9	50-125	%	1.00	02/12/2003 09:02	
Decachlorobiphenyl (PCB/8082)	95.4	46-142	%	1.00	02/12/2003 09:02	

PCBs

Geomatrix Consultants

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 3550/8082 Test(s): 8082

Method Blank **Soil** **QC Batch # 2003/02/11-01.14**

MB: 2003/02/11-01.14-001 Date Extracted: 02/11/2003 12:58

Compound	Conc.	RL	Unit	Analyzed	Flag
Aroclor 1016	ND	50	ug/Kg	02/12/2003 05:47	
Aroclor 1221	ND	50	ug/Kg	02/12/2003 05:47	
Aroclor 1232	ND	50	ug/Kg	02/12/2003 05:47	
Aroclor 1242	ND	50	ug/Kg	02/12/2003 05:47	
Aroclor 1248	ND	50	ug/Kg	02/12/2003 05:47	
Aroclor 1254	ND	50	ug/Kg	02/12/2003 05:47	
Aroclor 1260	ND	50	ug/Kg	02/12/2003 05:47	
Surrogates(s)					
2,4,5,6-Tetrachloro-m-xylene	85.2	50-125	%	02/12/2003 05:47	
Decachlorobiphenyl (PCB/8082)	82.6	46-142	%	02/12/2003 05:47	

PCBs

Geomatrix Consultants

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 3550/8082 Test(s): 8082

Laboratory Control Spike **Soil** **QC Batch # 2003/02/11-01.14**

LCS 2003/02/11-01.14-002 Extracted: 02/11/2003 Analyzed: 02/12/2003 06:07

LCSD 2003/02/11-01.14-003 Extracted: 02/11/2003 Analyzed: 02/12/2003 06:26

Compound	Conc. ug/Kg		Exp.Conc.	Recovery		RPD	Ctrl.Limits %		Flags	
	LCS	LCSD		LCS	LCSD	%	Rec.	RPD	LCS	LCSD
Aroclor 1016	56.9	53.1	66.6	85.4	79.7	6.9	65-135	30		
Aroclor 1260	62.9	58.5	66.6	94.4	87.8	7.2	65-135	30		
Surrogates(s)										
2,4,5,6-Tetrachloro-m-xylene	43.6	41.0	50	87.2	82.0		50-125	0		
Decachlorobiphenyl	46.7	44.4	50	93.3	88.8		46-142	0		

Organochlorine Pesticides Analysis

Geomatrix Consultants
Attn.: Tom MacDougall

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Samples Reported

Sample Name	Date Sampled	Matrix	Lab #
B5-1.75-021103	02/11/2003 10:45	Soil	1
B5-3.5-021103	02/11/2003 10:45	Soil	2
B6-1.5-021103	02/11/2003 11:15	Soil	3
B6-3.0-021103	02/11/2003 11:15	Soil	4
B7-2.0-021103	02/11/2003 11:50	Soil	5
B7-3.75-021103	02/11/2003 11:50	Soil	6

Organochlorine Pesticides Analysis

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B5-1.75-021103**	Lab ID:	2003-02-0176 - 1
Sampled:	02/11/2003 10:45	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
Dieldrin	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
Endrin	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
Heptachlor	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
beta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
delta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
Toxaphene	ND	100	ug/Kg	1.00	02/12/2003 23:24	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/12/2003 23:24	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 23:24	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	80.8	50-125	%	1.00	02/12/2003 23:24	
Decachlorobiphenyl (Pest/8081)	76.2	46-142	%	1.00	02/12/2003 23:24	

Organochlorine Pesticides Analysis

Geomatrix Consultants
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Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B5-3.5-021103**	Lab ID:	2003-02-0176 - 2
Sampled:	02/11/2003 10:45	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
Dieldrin	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
Endrin	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
Heptachlor	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
beta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
delta-BHC	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
Toxaphene	ND	100	ug/Kg	1.00	02/12/2003 23:55	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/12/2003 23:55	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/12/2003 23:55	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	89.7	50-125	%	1.00	02/12/2003 23:55	
Decachlorobiphenyl (Pest/8081)	85.6	46-142	%	1.00	02/12/2003 23:55	

SEVERN TRENT STL

Organochlorine Pesticides Analysis

Geomatrix Consultants

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Project: 6959.021

Received: 02/11/2003 13:55

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B6-1.5-021103**	Lab ID:	2003-02-0176 - 3
Sampled:	02/11/2003 11:15	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
Dieldrin	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
Endrin	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
Heptachlor	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
beta-BHC	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
delta-BHC	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
Toxaphene	ND	100	ug/Kg	1.00	02/13/2003 00:26	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/13/2003 00:26	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/13/2003 00:26	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	89.6	50-125	%	1.00	02/13/2003 00:26	
Decachlorobiphenyl (Pest/8081)	86.2	46-142	%	1.00	02/13/2003 00:26	

Organochlorine Pesticides Analysis

Geomatrix Consultants

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Project: 6959.021

Received: 02/11/2003 13:55

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B6-3.0-021103**	Lab ID:	2003-02-0176 - 4
Sampled:	02/11/2003 11:15	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
Dieldrin	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
Endrin	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
Heptachlor	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
beta-BHC	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
delta-BHC	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
Toxaphene	ND	100	ug/Kg	1.00	02/13/2003 00:57	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/13/2003 00:57	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/13/2003 00:57	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	74.4	50-125	%	1.00	02/13/2003 00:57	
Decachlorobiphenyl (Pest/8081)	73.3	46-142	%	1.00	02/13/2003 00:57	

SEVERN TRENT STL

Submission #: 2003-02-0176

Organochlorine Pesticides Analysis

Geomatrix Consultants

Attn.: Tom MacDougall

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Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B7-2.0-021103**	Lab ID:	2003-02-0176 - 5
Sampled:	02/11/2003 11:50	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
Dieldrin	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
Endrin	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
Heptachlor	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
beta-BHC	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
delta-BHC	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
Toxaphene	ND	100	ug/Kg	1.00	02/13/2003 01:28	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/13/2003 01:28	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/13/2003 01:28	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	85.4	50-125	%	1.00	02/13/2003 01:28	
Decachlorobiphenyl (Pest/8081)	80.2	46-142	%	1.00	02/13/2003 01:28	

SEVERN TRENT STL

Organochlorine Pesticides Analysis

Geomatrix Consultants
Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
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Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550/8081	Test(s):	8081
Sample ID:	**B7-3.75-021103**	Lab ID:	2003-02-0176 - 6
Sampled:	02/11/2003 11:50	Extracted:	2/11/2003 12:48
Matrix:	Soil	QC Batch#:	2003/02/11-02.13

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
Dieldrin	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
Endrin aldehyde	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
Endrin	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
Endrin ketone	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
Heptachlor	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
Heptachlor epoxide	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
4,4`-DDT	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
4,4`-DDE	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
4,4`-DDD	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
Endosulfan I	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
Endosulfan II	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
alpha-BHC	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
beta-BHC	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
delta-BHC	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
Endosulfan sulfate	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
4,4`-Methoxychlor	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
Toxaphene	ND	100	ug/Kg	1.00	02/13/2003 01:59	
Chlordane (Technical)	ND	50	ug/Kg	1.00	02/13/2003 01:59	
alpha-Chlordane	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
gamma-Chlordane	ND	2.0	ug/Kg	1.00	02/13/2003 01:59	
Surrogates(s)						
2,4,5,6-Tetrachloro-m-xylene	81.2	50-125	%	1.00	02/13/2003 01:59	
Decachlorobiphenyl (Pest/8081)	77.5	46-142	%	1.00	02/13/2003 01:59	

Organochlorine Pesticides Analysis

Geomatrix Consultants

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 3550/8081 Test(s): 8081

Method Blank **Soil** **QC Batch # 2003/02/11-02.13**

MB: 2003/02/11-02.13-001 Date Extracted: 02/11/2003 12:48

Compound	Conc.	RL	Unit	Analyzed	Flag
Aldrin	ND	2.0	ug/Kg	02/12/2003 12:35	
Dieldrin	ND	2.0	ug/Kg	02/12/2003 12:35	
Endrin aldehyde	ND	2.0	ug/Kg	02/12/2003 12:35	
Endrin	ND	2.0	ug/Kg	02/12/2003 12:35	
Endrin ketone	ND	2.0	ug/Kg	02/12/2003 12:35	
Heptachlor	ND	2.0	ug/Kg	02/12/2003 12:35	
Heptachlor epoxide	ND	2.0	ug/Kg	02/12/2003 12:35	
4,4`-DDT	ND	2.0	ug/Kg	02/12/2003 12:35	
4,4`-DDE	ND	2.0	ug/Kg	02/12/2003 12:35	
4,4`-DDD	ND	2.0	ug/Kg	02/12/2003 12:35	
Endosulfan I	ND	2.0	ug/Kg	02/12/2003 12:35	
Endosulfan II	ND	2.0	ug/Kg	02/12/2003 12:35	
alpha-BHC	ND	2.0	ug/Kg	02/12/2003 12:35	
beta-BHC	ND	2.0	ug/Kg	02/12/2003 12:35	
gamma-BHC (Lindane)	ND	2.0	ug/Kg	02/12/2003 12:35	
delta-BHC	ND	2.0	ug/Kg	02/12/2003 12:35	
Endosulfan sulfate	ND	2.0	ug/Kg	02/12/2003 12:35	
4,4`-Methoxychlor	ND	2.0	ug/Kg	02/12/2003 12:35	
Toxaphene	ND	100	ug/Kg	02/12/2003 12:35	
Chlordane (Technical)	ND	50	ug/Kg	02/12/2003 12:35	
alpha-Chlordane	ND	2.0	ug/Kg	02/12/2003 12:35	
gamma-Chlordane	ND	2.0	ug/Kg	02/12/2003 12:35	
Surrogates(s)					
2,4,5,6-Tetrachloro-m-xylene	87.3	50-125	%	02/12/2003 12:35	
Decachlorobiphenyl (Pest/8081)	75.9	46-142	%	02/12/2003 12:35	

Organochlorine Pesticides Analysis

Geomatrix Consultants
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Project: 6959.021 Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 3550/8081 Test(s): 8081

Laboratory Control Spike **Soil** **QC Batch # 2003/02/11-02.13**

LCS 2003/02/11-02.13-002 Extracted: 02/11/2003 Analyzed: 02/12/2003 13:06
LCSD 2003/02/11-02.13-003 Extracted: 02/11/2003 Analyzed: 02/12/2003 13:37

Compound	Conc. ug/Kg		Exp.Conc.	Recovery		RPD	Ctrl.Limits %		Flags	
	LCS	LCSD		LCS	LCSD	%	Rec.	RPD	LCS	LCSD
Aldrin	15.4	13.7	16.7	92.2	82.0	11.7	37-136	25		
Dieldrin	16.5	14.5	16.7	98.8	86.8	12.9	58-135	35		
Endrin	16.8	14.8	16.7	100.6	88.6	12.7	58-134	35		
Heptachlor	15.9	14.0	16.7	95.2	83.8	12.7	40-136	20		
4,4`-DDT	15.2	13.8	16.7	91.0	82.6	9.7	55-132	35		
gamma-BHC (Lindane)	14.9	13.4	16.7	89.2	80.2	10.6	37-137	35		
Surrogates(s)										
2,4,5,6-Tetrachloro-m-xylene	42.9	38.8	50	85.7	77.6		50-125	0		
Decachlorobiphenyl	41.0	38.5	50	82.0	76.9		46-142	0		

PNA analysis by 8270C/SIM GC/MS

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Samples Reported

Sample Name	Date Sampled	Matrix	Lab #
B5-1.75-021103	02/11/2003 10:45	Soil	1
B5-3.5-021103	02/11/2003 10:45	Soil	2
B6-1.5-021103	02/11/2003 11:15	Soil	3
B6-3.0-021103	02/11/2003 11:15	Soil	4
B7-2.0-021103	02/11/2003 11:50	Soil	5
B7-3.75-021103	02/11/2003 11:50	Soil	6

PNA analysis by 8270C/SIM GC/MS

Geomatrix Consultants

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B5-1.75-021103**	Lab ID:	2003-02-0176 - 1
Sampled:	02/11/2003 10:45	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Fluorene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Chrysene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/13/2003 22:13	
Surrogates(s)						
2-Fluorobiphenyl	66.5	30-115	%	1.00	02/13/2003 22:13	
p-Terphenyl-d14	80.5	18-137	%	1.00	02/13/2003 22:13	

PNA analysis by 8270C/SIM GC/MS

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B5-3.5-021103**	Lab ID:	2003-02-0176 - 2
Sampled:	02/11/2003 10:45	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Fluorene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Chrysene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/13/2003 22:40	
Surrogates(s)						
2-Fluorobiphenyl	71.9	30-115	%	1.00	02/13/2003 22:40	
p-Terphenyl-d14	83.1	18-137	%	1.00	02/13/2003 22:40	

PNA analysis by 8270C/SIM GC/MS

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Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B6-1.5-021103**	Lab ID:	2003-02-0176 - 3
Sampled:	02/11/2003 11:15	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Fluorene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Chrysene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/13/2003 23:07	
Surrogates(s)						
2-Fluorobiphenyl	67.3	30-115	%	1.00	02/13/2003 23:07	
p-Terphenyl-d14	81.6	18-137	%	1.00	02/13/2003 23:07	

PNA analysis by 8270C/SIM GC/MS

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Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B6-3.0-021103**	Lab ID:	2003-02-0176 - 4
Sampled:	02/11/2003 11:15	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Fluorene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Chrysene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/13/2003 23:33	
Surrogates(s)						
2-Fluorobiphenyl	74.2	30-115	%	1.00	02/13/2003 23:33	
p-Terphenyl-d14	85.2	18-137	%	1.00	02/13/2003 23:33	

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Project: 6959.021

Received: 02/11/2003 13:55

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B7-2.0-021103**	Lab ID:	2003-02-0176 - 5
Sampled:	02/11/2003 11:50	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Fluorene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Anthracene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Pyrene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Chrysene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/14/2003 00:01	
Surrogates(s)						
2-Fluorobiphenyl	68.6	30-115	%	1.00	02/14/2003 00:01	
p-Terphenyl-d14	80.2	18-137	%	1.00	02/14/2003 00:01	

PNA analysis by 8270C/SIM GC/MS

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Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550B/8270C-SIM	Test(s):	8270C-SIM
Sample ID:	**B7-3.75-021103**	Lab ID:	2003-02-0176 - 6
Sampled:	02/11/2003 11:50	Extracted:	2/12/2003 08:34
Matrix:	Soil	QC Batch#:	2003/02/12-01.40

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Acenaphthylene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Acenaphthene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Fluorene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Phenanthrene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Anthracene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Fluoranthene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Pyrene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Benzo(a)anthracene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Chrysene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Benzo(a)pyrene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	1.00	02/14/2003 00:27	
Surrogates(s)						
2-Fluorobiphenyl	68.2	30-115	%	1.00	02/14/2003 00:27	
p-Terphenyl-d14	82.7	18-137	%	1.00	02/14/2003 00:27	

SEVERN TRENT STL

PNA analysis by 8270C/SIM GC/MS

Geomatrix Consultants

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 3550B/8270C-SIM

Test(s): 8270C-SIM

Method Blank **Soil** **QC Batch # 2003/02/12-01.40**

MB: 2003/02/12-01.40-013

Date Extracted: 02/12/2003 08:34

Compound	Conc.	RL	Unit	Analyzed	Flag
Naphthalene	ND	5.0	ug/Kg	02/13/2003 15:32	
Acenaphthylene	ND	5.0	ug/Kg	02/13/2003 15:32	
Acenaphthene	ND	5.0	ug/Kg	02/13/2003 15:32	
Fluorene	ND	5.0	ug/Kg	02/13/2003 15:32	
Phenanthrene	ND	5.0	ug/Kg	02/13/2003 15:32	
Anthracene	ND	5.0	ug/Kg	02/13/2003 15:32	
Fluoranthene	ND	5.0	ug/Kg	02/13/2003 15:32	
Pyrene	ND	5.0	ug/Kg	02/13/2003 15:32	
Benzo(a)anthracene	ND	5.0	ug/Kg	02/13/2003 15:32	
Chrysene	ND	5.0	ug/Kg	02/13/2003 15:32	
Benzo(b)fluoranthene	ND	5.0	ug/Kg	02/13/2003 15:32	
Benzo(k)fluoranthene	ND	5.0	ug/Kg	02/13/2003 15:32	
Benzo(a)pyrene	ND	5.0	ug/Kg	02/13/2003 15:32	
Indeno(1,2,3-c,d)pyrene	ND	5.0	ug/Kg	02/13/2003 15:32	
Dibenzo(a,h)anthracene	ND	5.0	ug/Kg	02/13/2003 15:32	
Benzo(g,h,i)perylene	ND	5.0	ug/Kg	02/13/2003 15:32	
Surrogates(s)					
2-Fluorobiphenyl	79.2	30-115	%	02/13/2003 15:32	
p-Terphenyl-d14	95.8	18-137	%	02/13/2003 15:32	

PNA analysis by 8270C/SIM GC/MS

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Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 3550B/8270C-SIM Test(s): 8270C-SIM

Laboratory Control Spike **Soil** **QC Batch # 2003/02/12-01.40**

LCS 2003/02/12-01.40-017 Extracted: 02/12/2003 Analyzed: 02/13/2003 17:19

LCSD 2003/02/12-01.40-018 Extracted: 02/12/2003 Analyzed: 02/13/2003 17:46

Compound	Conc. ug/Kg		Exp.Conc.	Recovery		RPD	Ctrl.Limits %		Flags	
	LCS	LCSD		LCS	LCSD	%	Rec.	RPD	LCS	LCSD
Acenaphthene	246	253	332	74.1	76.0	2.5	50-150	30		
Phenanthrene	251	256	332	75.6	76.9	1.7	50-150	30		
Pyrene	272	294	332	81.9	88.3	7.5	50-150	30		
Chrysene	260	267	332	78.3	80.2	2.4	50-150	30		
Benzo(a)pyrene	233	240	332	70.2	72.1	2.7	50-150	30		
Surrogates(s)										
2-Fluorobiphenyl	7.61	7.89	10	76.1	78.9		30-115			
p-Terphenyl-d14	7.85	8.25	10	78.5	82.5		18-137			

CAM 17 Metals

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Project: 6959.021 Received: 02/11/2003 13:55

Samples Reported

Sample Name	Date Sampled	Matrix	Lab #
B5-1.75-021103	02/11/2003 10:45	Soil	1
B5-3.5-021103	02/11/2003 10:45	Soil	2
B6-1.5-021103	02/11/2003 11:15	Soil	3
B6-3.0-021103	02/11/2003 11:15	Soil	4
B7-2.0-021103	02/11/2003 11:50	Soil	5
B7-3.75-021103	02/11/2003 11:50	Soil	6

CAM 17 Metals

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B5-1.75-021103**	Lab ID:	2003-02-0176 - 1
Sampled:	02/11/2003 10:45	Extracted:	2/12/2003 09:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/12-01.15 2003/02/12-01.16

Analysis Flag: . (See Legend and Note Section)

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 20:57	
Arsenic	2.1	1.0	mg/Kg	1.00	02/12/2003 20:57	
Barium	58	1.0	mg/Kg	1.00	02/12/2003 20:57	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 20:57	
Cadmium	1.2	0.50	mg/Kg	1.00	02/12/2003 20:57	
Chromium	27	1.0	mg/Kg	1.00	02/12/2003 20:57	
Cobalt	5.5	1.0	mg/Kg	1.00	02/12/2003 20:57	
Copper	8.4	1.0	mg/Kg	1.00	02/12/2003 20:57	
Lead	3.7	1.0	mg/Kg	1.00	02/12/2003 20:57	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 20:57	
Nickel	39	1.0	mg/Kg	1.00	02/12/2003 20:57	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 20:57	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 20:57	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 20:57	
Vanadium	16	1.0	mg/Kg	1.00	02/12/2003 20:57	
Zinc	30	1.0	mg/Kg	1.00	02/12/2003 20:57	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 12:51	

CAM 17 Metals

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/11/2003 13:55

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B5-3.5-021103**	Lab ID:	2003-02-0176 - 2
Sampled:	02/11/2003 10:45	Extracted:	2/12/2003 09:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/12-01.15 2003/02/12-01.16

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 21:27	
Arsenic	1.3	1.0	mg/Kg	1.00	02/12/2003 21:27	
Barium	38	1.0	mg/Kg	1.00	02/12/2003 21:27	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 21:27	
Cadmium	0.97	0.50	mg/Kg	1.00	02/12/2003 21:27	
Chromium	22	1.0	mg/Kg	1.00	02/12/2003 21:27	
Cobalt	4.3	1.0	mg/Kg	1.00	02/12/2003 21:27	
Copper	11	1.0	mg/Kg	1.00	02/12/2003 21:27	
Lead	2.1	1.0	mg/Kg	1.00	02/12/2003 21:27	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 21:27	
Nickel	19	1.0	mg/Kg	1.00	02/12/2003 21:27	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 21:27	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 21:27	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 21:27	
Vanadium	12	1.0	mg/Kg	1.00	02/12/2003 21:27	
Zinc	19	1.0	mg/Kg	1.00	02/12/2003 21:27	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 12:53	

SEVERN TRENT STL

CAM 17 Metals

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Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B6-1.5-021103**	Lab ID:	2003-02-0176 - 3
Sampled:	02/11/2003 11:15	Extracted:	2/12/2003 09:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/12-01.15 2003/02/12-01.16

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 21:31	
Arsenic	2.3	1.0	mg/Kg	1.00	02/12/2003 21:31	
Barium	51	1.0	mg/Kg	1.00	02/12/2003 21:31	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 21:31	
Cadmium	1.1	0.50	mg/Kg	1.00	02/12/2003 21:31	
Chromium	23	1.0	mg/Kg	1.00	02/12/2003 21:31	
Cobalt	4.9	1.0	mg/Kg	1.00	02/12/2003 21:31	
Copper	7.9	1.0	mg/Kg	1.00	02/12/2003 21:31	
Lead	3.3	1.0	mg/Kg	1.00	02/12/2003 21:31	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 21:31	
Nickel	33	1.0	mg/Kg	1.00	02/12/2003 21:31	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 21:31	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 21:31	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 21:31	
Vanadium	14	1.0	mg/Kg	1.00	02/12/2003 21:31	
Zinc	31	1.0	mg/Kg	1.00	02/12/2003 21:31	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 12:56	

CAM 17 Metals

Geomatrix Consultants
Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B6-3.0-021103**	Lab ID:	2003-02-0176 - 4
Sampled:	02/11/2003 11:15	Extracted:	2/12/2003 09:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/12-01.15 2003/02/12-01.16

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 21:34	
Arsenic	1.9	1.0	mg/Kg	1.00	02/12/2003 21:34	
Barium	39	1.0	mg/Kg	1.00	02/12/2003 21:34	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 21:34	
Cadmium	1.2	0.50	mg/Kg	1.00	02/12/2003 21:34	
Chromium	19	1.0	mg/Kg	1.00	02/12/2003 21:34	
Cobalt	4.8	1.0	mg/Kg	1.00	02/12/2003 21:34	
Copper	7.8	1.0	mg/Kg	1.00	02/12/2003 21:34	
Lead	1.9	1.0	mg/Kg	1.00	02/12/2003 21:34	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 21:34	
Nickel	32	1.0	mg/Kg	1.00	02/12/2003 21:34	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 21:34	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 21:34	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 21:34	
Vanadium	17	1.0	mg/Kg	1.00	02/12/2003 21:34	
Zinc	22	1.0	mg/Kg	1.00	02/12/2003 21:34	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 12:58	

CAM 17 Metals

Geomatrix Consultants
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Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B7-2.0-021103**	Lab ID:	2003-02-0176 - 5
Sampled:	02/11/2003 11:50	Extracted:	2/12/2003 09:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/12-01.15 2003/02/12-01.16

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 21:38	
Arsenic	3.0	1.0	mg/Kg	1.00	02/12/2003 21:38	
Barium	50	1.0	mg/Kg	1.00	02/12/2003 21:38	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 21:38	
Cadmium	1.4	0.50	mg/Kg	1.00	02/12/2003 21:38	
Chromium	39	1.0	mg/Kg	1.00	02/12/2003 21:38	
Cobalt	8.6	1.0	mg/Kg	1.00	02/12/2003 21:38	
Copper	7.6	1.0	mg/Kg	1.00	02/12/2003 21:38	
Lead	2.8	1.0	mg/Kg	1.00	02/12/2003 21:38	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 21:38	
Nickel	140	1.0	mg/Kg	1.00	02/12/2003 21:38	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 21:38	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 21:38	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 21:38	
Vanadium	14	1.0	mg/Kg	1.00	02/12/2003 21:38	
Zinc	25	1.0	mg/Kg	1.00	02/12/2003 21:38	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 12:59	

CAM 17 Metals

Geomatrix Consultants

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Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3050B 7471A	Test(s):	6010B 7471A
Sample ID:	**B7-3.75-021103**	Lab ID:	2003-02-0176 - 6
Sampled:	02/11/2003 11:50	Extracted:	2/12/2003 09:33 2/12/2003 04:48
Matrix:	Soil	QC Batch#:	2003/02/12-01.15 2003/02/12-01.16

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	1.00	02/12/2003 21:42	
Arsenic	2.0	1.0	mg/Kg	1.00	02/12/2003 21:42	
Barium	38	1.0	mg/Kg	1.00	02/12/2003 21:42	
Beryllium	ND	0.50	mg/Kg	1.00	02/12/2003 21:42	
Cadmium	1.2	0.50	mg/Kg	1.00	02/12/2003 21:42	
Chromium	22	1.0	mg/Kg	1.00	02/12/2003 21:42	
Cobalt	5.8	1.0	mg/Kg	1.00	02/12/2003 21:42	
Copper	7.9	1.0	mg/Kg	1.00	02/12/2003 21:42	
Lead	3.3	1.0	mg/Kg	1.00	02/12/2003 21:42	
Molybdenum	ND	1.0	mg/Kg	1.00	02/12/2003 21:42	
Nickel	35	1.0	mg/Kg	1.00	02/12/2003 21:42	
Selenium	ND	2.0	mg/Kg	1.00	02/12/2003 21:42	
Silver	ND	1.0	mg/Kg	1.00	02/12/2003 21:42	
Thallium	ND	1.0	mg/Kg	1.00	02/12/2003 21:42	
Vanadium	14	1.0	mg/Kg	1.00	02/12/2003 21:42	
Zinc	24	1.0	mg/Kg	1.00	02/12/2003 21:42	
Mercury	ND	0.050	mg/Kg	1.00	02/12/2003 13:00	

CAM 17 Metals

Geomatrix Consultants

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Project: 6959.021 Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 3050B Test(s): 6010B

Method Blank **Soil** **QC Batch # 2003/02/12-01.15**

MB: 2003/02/12-01.15-025 Date Extracted: 02/12/2003 09:33

Compound	Conc.	RL	Unit	Analyzed	Flag
Antimony	ND	2.0	mg/Kg	02/12/2003 20:09	
Arsenic	ND	1.0	mg/Kg	02/12/2003 20:09	
Barium	ND	1.0	mg/Kg	02/12/2003 20:09	
Beryllium	ND	0.50	mg/Kg	02/12/2003 20:09	
Cadmium	ND	0.50	mg/Kg	02/12/2003 20:09	
Chromium	ND	1.0	mg/Kg	02/12/2003 20:09	
Cobalt	ND	1.0	mg/Kg	02/12/2003 20:09	
Copper	ND	1.0	mg/Kg	02/12/2003 20:09	
Lead	ND	1.0	mg/Kg	02/12/2003 20:09	
Molybdenum	ND	1.0	mg/Kg	02/12/2003 20:09	
Nickel	ND	1.0	mg/Kg	02/12/2003 20:09	
Selenium	ND	2.0	mg/Kg	02/12/2003 20:09	
Silver	ND	1.0	mg/Kg	02/12/2003 20:09	
Thallium	ND	1.0	mg/Kg	02/12/2003 20:09	
Vanadium	ND	1.0	mg/Kg	02/12/2003 20:09	
Zinc	ND	1.0	mg/Kg	02/12/2003 20:09	

CAM 17 Metals

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Project: 6959.021

Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 7471A

Test(s): 7471A

Method Blank

Soil

QC Batch # 2003/02/12-01.16

MB: 2003/02/12-01.16-017

Date Extracted: 02/12/2003 04:48

Compound	Conc.	RL	Unit	Analyzed	Flag
Mercury	ND	0.050	mg/Kg	02/12/2003 12:27	

CAM 17 Metals

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 3050B Test(s): 6010B

Laboratory Control Spike **Soil** **QC Batch # 2003/02/12-01.15**

LCS	2003/02/12-01.15-026	Extracted: 02/12/2003	Analyzed: 02/12/2003 20:14
LCSD	2003/02/12-01.15-029	Extracted: 02/12/2003	Analyzed: 02/12/2003 20:26

Compound	Conc. mg/Kg		Exp.Conc.	Recovery		RPD	Ctrl.Limits %		Flags	
	LCS	LCSD		LCS	LCSD	%	Rec.	RPD	LCS	LCSD
Antimony	97.6	97.8	100.0	97.6	97.8	0.2	80-120	20		
Arsenic	97.1	97.1	100.0	97.1	97.1	0.0	80-120	20		
Barium	95.2	95.8	100.0	95.2	95.8	0.6	80-120	20		
Beryllium	95.6	96.8	100.0	95.6	96.8	1.2	80-120	20		
Cadmium	94.4	95.0	100.0	94.4	95.0	0.6	80-120	20		
Chromium	95.6	96.3	100.0	95.6	96.3	0.7	80-120	20		
Cobalt	95.8	96.4	100.0	95.8	96.4	0.6	80-120	20		
Copper	96.4	97.0	100.0	96.4	97.0	0.6	80-120	20		
Lead	95.7	96.3	100.0	95.7	96.3	0.6	80-120	20		
Molybdenum	97.0	97.6	100.0	97.0	97.6	0.6	80-120	20		
Nickel	94.7	95.4	100.0	94.7	95.4	0.7	80-120	20		
Selenium	93.9	93.8	100.0	93.9	93.8	0.1	80-120	20		
Silver	95.8	96.3	100.0	95.8	96.3	0.5	80-120	20		
Thallium	92.9	92.9	100.0	92.9	92.9	0.0	80-120	20		
Vanadium	97.7	98.5	100.0	97.7	98.5	0.8	80-120	20		
Zinc	94.7	95.4	100.0	94.7	95.4	0.7	80-120	20		

CAM 17 Metals

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Project: 6959.021

Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 7471A

Test(s): 7471A

Laboratory Control Spike

Soil

QC Batch # 2003/02/12-01.16

LCS 2003/02/12-01.16-018 Extracted: 02/12/2003 Analyzed: 02/12/2003 12:28

LCSD 2003/02/12-01.16-019 Extracted: 02/12/2003 Analyzed: 02/12/2003 12:29

Compound	Conc.	mg/Kg	Exp.Conc.	Recovery		RPD	Ctrl.Limits %		Flags	
	LCS	LCSD		LCS	LCSD	%	Rec.	RPD	LCS	LCSD
Mercury	0.536	0.524	0.500	107.2	104.8	2.3	85-115	20		

CAM 17 Metals

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Project: 6959.021 | Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 3050B | Test(s): 6010B

Matrix Spike (MS / MSD) | **Soil** | **QC Batch # 2003/02/12-01.15**

B5-1.75-021103 >> MS | Lab ID: 2003-02-0176 - 001

MS: 2003/02/12-01.15-038 | Extracted: 02/12/2003 | Analyzed: 02/12/2003 21:01 | Dilution: 1.00

MSD: 2003/02/12-01.15-041 | Extracted: 02/12/2003 | Analyzed: 02/12/2003 21:23 | Dilution: 1.00

Compound	Conc. mg/Kg			Spk.Level	Recovery			Limits %		Flags	
	MS	MSD	Sample	mg/Kg	MS	MSD	RPD	Rec.	RPD	MS	MSD
Antimony	46.1	44.3	ND	99.0	46.6	46.5	0.2	75-125	20	mso	mso
Arsenic	91.3	87.8	2.09	99.0	90.1	90.0	0.1	75-125	20		
Barium	147	142	58.0	99.0	89.9	88.2	1.9	75-125	20		
Beryllium	90.1	86.2	ND	99.0	91.0	90.5	0.6	75-125	20		
Cadmium	86.6	82.9	1.19	99.0	86.3	85.8	0.6	75-125	20		
Chromium	121	111	26.7	99.0	95.3	88.6	7.3	75-125	20		
Cobalt	91.8	88.7	5.50	99.0	87.2	87.4	0.2	75-125	20		
Copper	101	96.7	8.36	99.0	93.6	92.8	0.9	75-125	20		
Lead	89.7	86.5	3.71	99.0	86.9	87.0	0.1	75-125	20		
Molybdenum	86.0	81.7	ND	99.0	86.9	85.8	1.3	75-125	20		
Nickel	128	120	39.4	99.0	89.5	84.7	5.5	75-125	20		
Selenium	83.4	80.3	ND	99.0	84.2	84.3	0.1	75-125	20		
Silver	89.2	84.6	ND	99.0	90.1	88.9	1.3	75-125	20		
Thallium	80.9	78.0	ND	99.0	81.7	81.9	0.2	75-125	20		
Vanadium	107	102	15.5	99.0	92.4	90.9	1.6	75-125	20		
Zinc	116	112	30.2	99.0	86.7	85.9	0.9	75-125	20		

CAM 17 Metals

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Project: 6959.021 Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 7471A Test(s): 7471A

Matrix Spike (MS / MSD) **Soil** **QC Batch # 2003/02/12-01.16**

SS-1-3-1.7 >> MS Lab ID: 2003-02-0154 - 004

MS: 2003/02/12-01.16-021 Extracted: 02/12/2003 Analyzed: 02/12/2003 12:32
Dilution: 1.00

MSD: 2003/02/12-01.16-022 Extracted: 02/12/2003 Analyzed: 02/12/2003 12:33
Dilution: 1.00

Compound	Conc.	mg/Kg		Spk.Level	Recovery			Limits %		Flags	
	MS	MSD	Sample	mg/Kg	MS	MSD	RPD	Rec.	RPD	MS	MSD
Mercury	0.615	0.617	0.307	0.490	62.9	62.0	1.4	85-115	20	mso	mso

CAM 17 Metals

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Project: 6959.021

Received: 02/11/2003 13:55

Legend and Notes

Analysis Flag

.

Result Flag

mso

MS/MSD spike recoveries were out of QC limits due to matrix interference.
Precision and Accuracy were verified by LCS/LCSD.

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants
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Project: 6959.021 Received: 02/11/2003 13:55

Samples Reported

Sample Name	Date Sampled	Matrix	Lab #
B5-1.75-021103	02/11/2003 10:45	Soil	1
B5-3.5-021103	02/11/2003 10:45	Soil	2
B6-1.5-021103	02/11/2003 11:15	Soil	3
B6-3.0-021103	02/11/2003 11:15	Soil	4
B7-2.0-021103	02/11/2003 11:50	Soil	5
B7-3.75-021103	02/11/2003 11:50	Soil	6

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B5-1.75-021103**	Lab ID:	2003-02-0176 - 1
Sampled:	02/11/2003 10:45	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	ND	1.0	mg/Kg	1.00	02/12/2003 22:40	
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 22:40	
Surrogates(s)						
o-Terphenyl	75.6	60-130	%	1.00	02/12/2003 22:40	

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants
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Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B5-3.5-021103**	Lab ID:	2003-02-0176 - 2
Sampled:	02/11/2003 10:45	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	ND	1.0	mg/Kg	1.00	02/12/2003 23:16	
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 23:16	
Surrogates(s)						
o-Terphenyl	88.1	60-130	%	1.00	02/12/2003 23:16	

Submission #: 2003-02-0176

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants
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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021

Received: 02/11/2003 13:55

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B6-1.5-021103**	Lab ID:	2003-02-0176 - 3
Sampled:	02/11/2003 11:15	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	ND	1.0	mg/Kg	1.00	02/12/2003 23:56	
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 23:56	
Surrogates(s)						
o-Terphenyl	78.0	60-130	%	1.00	02/12/2003 23:56	

TEPH w/ Silica Gel Clean-up

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Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B6-3.0-021103**	Lab ID:	2003-02-0176 - 4
Sampled:	02/11/2003 11:15	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	ND	1.0	mg/Kg	1.00	02/13/2003 00:33	
Motor Oil	ND	50	mg/Kg	1.00	02/13/2003 00:33	
Surrogates(s)						
o-Terphenyl	89.4	60-130	%	1.00	02/13/2003 00:33	

TEPH w/ Silica Gel Clean-up

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Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B7-2.0-021103**	Lab ID:	2003-02-0176 - 5
Sampled:	02/11/2003 11:50	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	1.1	1.0	mg/Kg	1.00	02/12/2003 23:16	ndp
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 23:16	
Surrogates(s)						
o-Terphenyl	89.7	60-130	%	1.00	02/12/2003 23:16	

TEPH w/ Silica Gel Clean-up

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Project: 6959.021 Received: 02/11/2003 13:55

Prep(s):	3550/8015M	Test(s):	8015M
Sample ID:	**B7-3.75-021103**	Lab ID:	2003-02-0176 - 6
Sampled:	02/11/2003 11:50	Extracted:	2/11/2003 08:36
Matrix:	Soil	QC Batch#:	2003/02/11-04.10

Compound	Conc.	RL	Unit	Dilution	Analyzed	Flag
Diesel	ND	1.0	mg/Kg	1.00	02/12/2003 23:56	
Motor Oil	ND	50	mg/Kg	1.00	02/12/2003 23:56	
Surrogates(s)						
o-Terphenyl	88.7	60-130	%	1.00	02/12/2003 23:56	

TEPH w/ Silica Gel Clean-up

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Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 3550/8015M Test(s): 8015M
Method Blank **Soil** **QC Batch # 2003/02/11-04.10**
MB: 2003/02/11-04.10-003 Date Extracted: 02/11/2003 08:36

Compound	Conc.	RL	Unit	Analyzed	Flag
Diesel	ND	1	mg/Kg	02/11/2003 21:55	
Motor Oil	ND	50	mg/Kg	02/11/2003 21:55	
Surrogates(s)					
o-Terphenyl	96.9	60-130	%	02/11/2003 21:55	

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants

Attn.: Tom MacDougall

2101 Webster Street, 12th Floor
Oakland, CA 94612
Phone: (510) 663-4100 Fax: (510) 663-4141

Project: 6959.021 Received: 02/11/2003 13:55

Batch QC Report

Prep(s): 3550/8015M Test(s): 8015M

Laboratory Control Spike **Soil** **QC Batch # 2003/02/11-04.10**

LCS	2003/02/11-04.10-001	Extracted: 02/11/2003	Analyzed: 02/11/2003 20:41
LCSD	2003/02/11-04.10-002	Extracted: 02/11/2003	Analyzed: 02/11/2003 21:18

Compound	Conc. mg/Kg		Exp.Conc.	Recovery		RPD	Ctrl.Limits %		Flags	
	LCS	LCSD		LCS	LCSD	%	Rec.	RPD	LCS	LCSD
Diesel	35.3	37.0	41.6	84.9	88.7	4.4	60-130	25		
Surrogates(s)										
o-Terphenyl	20.3	20.8	20.0	101.4	103.9		60-130	0		

TEPH w/ Silica Gel Clean-up

Geomatrix Consultants

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Oakland, CA 94612
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Legend and Notes

Result Flag

ndp

Hydrocarbon reported does not match the pattern of our Diesel standard

2003-02-0176

71914

Chain-of Custody Record

017297

Date: 2/11/03 Page 1 of 1

Project No.: 6959.021

Samplers (Signature:) Allan T. MacDougall

Date	Time	Sample Number	EPA Method 8021 (Full Scan)	EPA Method 8021 (Hal. VOCs only)	EPA Method 8021 (BETX only)	EPA Method 8260	EPA Method 8270 (Full Scan)	EPA Method 8270 SIM (PAHS only)	Method 8015m (Gasoline)	Method 8015m (Diesel)	Method 8015m (Motor Oil)	Silica Gel Cleanup	8082	8081	CAM 17				Soil (S), Water (W) Vapor (V), or Other (o)	Filtered	Preserved	Cooled	No. of Containers	Additional Comments
2/11/03	10:45	B5-1.75-021103						X		X	X	X	X	X	X				S			X		
	10:45	B5-3.5-021103																						
	11:15	B6-1.5-021103																						
	11:15	B6-3.0-021103																						
	11:50	B7-2.0-021103																						
	11:50	B7-3.25-021103																						

Laboratory: STL SF

Turnaround Time: STANDARD

Results to: T. MacDougall

Total No. of Containers 6

Relinquished by (Signature): Allan T. MacDougall
Date: 2/11/03
Printed Name: Allan T. MacDougall
Time: 13.55
Company: Geomatrix

Relinquished by (Signature):
Date:
Printed Name:
Time:
Company:

Relinquished by (Signature):
Date:
Printed Name:
Time:
Company:

Method of Shipment: Direct carry

Received by:
Date:
Printed Name:
Time:
Company:

Received by:
Date:
Printed Name:
Time:
Company:

Received by: C Rowley
Date: 02/11/03
Printed Name: ROWLEY
Time: 1355
Company: STL

Laboratory Comments and Log No.:

Geomatrix Consultants
2101 Webster Street, 12th Floor • Oakland, CA 94612
Phone: 510-663-4100 Fax: 510-663-4141

SEVERN TRENT STL

STL San Francisco

Sample Receipt Checklist

Submission #:2003- 02 **-** 0176

Checklist completed by: (initials) MW Date: 02 / 11 /03

Courier name: ☐ STL San Francisco ☑ Client ________________

Custody seals intact on shipping container/samples	Yes____	No____	Not Present ✓
Chain of custody present?	Yes ✓	No____	
Chain of custody signed when relinquished and received?	Yes ✓	No____	
Chain of custody agrees with sample labels?	Yes ✓	No____	
Samples in proper container/bottle?	Yes ✓	No____	
Sample containers intact?	Yes ✓	No____	
Sufficient sample volume for indicated test?	Yes ✓	No____	
All samples received within holding time?	Yes ✓	No____	
Container/Temp Blank temperature in compliance (4^{o} C ± 2)? Temp 6.0 °C	Yes ✓	No____	
Water - VOA vials have zero headspace? No VOA vials submitted ✓	Yes____	No____	

(if bubble is present, refer to approximate bubble size and itemize in comments as **S** (small ~O), **M** (medium ~ O) or **L** (large ~ O)

Water - **pH acceptable upon receipt?** ☐ Yes ☐ No

☐ **pH adjusted–** Preservative used: ☐ HNO_3 ☐ HCl ☐ H_2SO_4 ☐ NaOH ☐ ZnOAc

For any item check-listed "No", provided detail of discrepancy in comment section below:

Comments:

Project Management [Routing for instruction of indicated discrepancy(ies)]

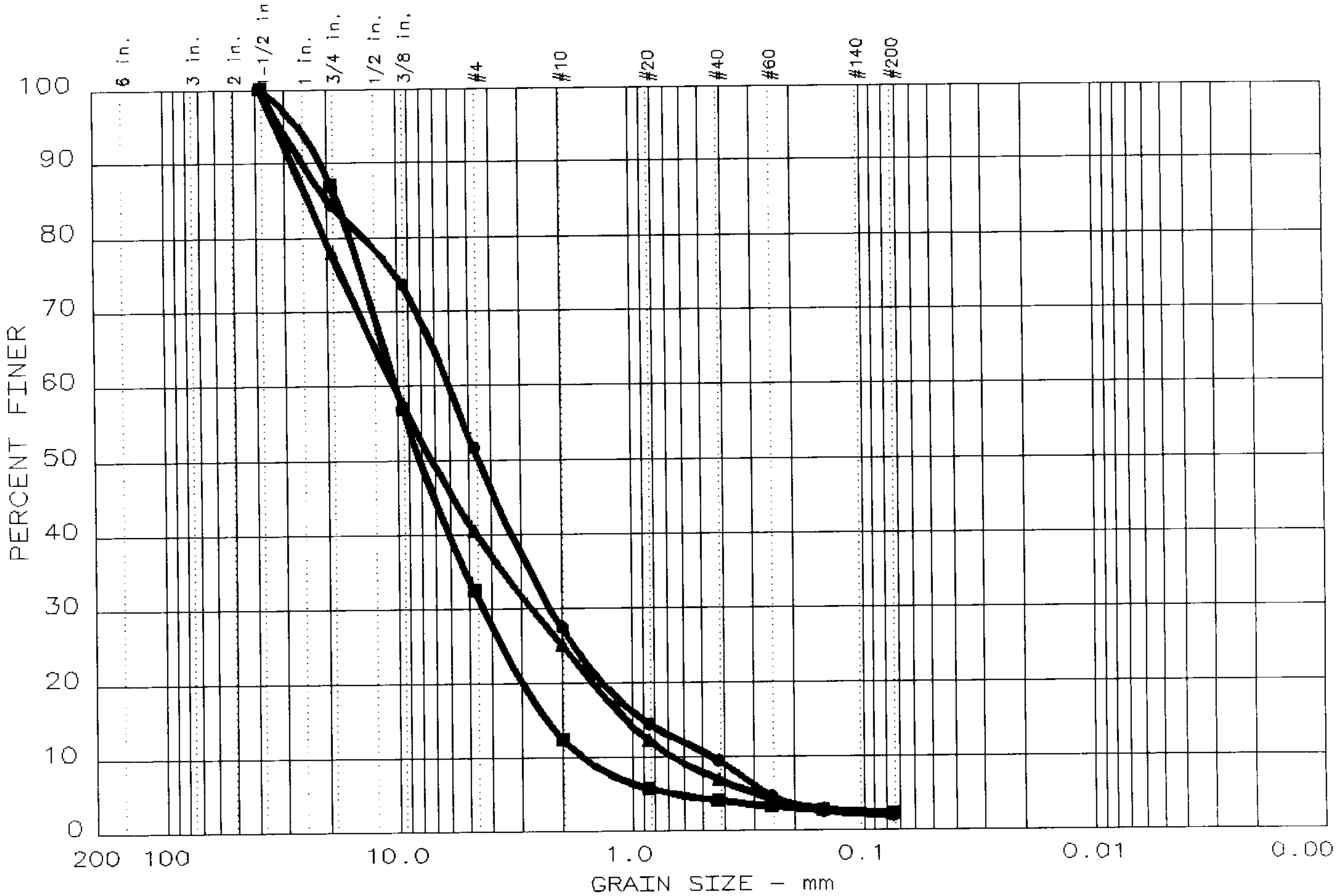
Project Manager: (initials) ________ Date: _____/_____/03

Client contacted: ☐ Yes ☐ No

Summary of discussion:

Corrective Action (per PM/Client):

PARTICLE SIZE ANALYSIS (ASTM D 422-63)



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	0.0	48.3	49.6	2.1		SW		
▲	0.0	59.5	38.3	2.2		GW		
■	0.0	67.6	30.1	2.3		GW		

SIEVE inches size	PERCENT FINER ●	▲	■
1.5	100.0	100.0	100.0
0.75	84.4	78.0	87.0
0.375	73.6	57.4	56.8
	GRAIN SIZE		
D_{60}	6.03	10.45	10.23
D_{30}	2.24	2.69	4.37
D_{10}	0.45	0.67	1.64
	COEFFICIENTS		
C_c	1.84	1.02	1.14
C_u	13.3	15.5	6.2

SIEVE number size	PERCENT FINER ●	▲	■
4	51.7	40.5	32.4
10	27.4	25.1	12.5
20	14.5	12.2	5.7
40	9.5	6.9	4.0
60	4.6	4.2	3.2
100	2.6	2.9	2.8
200	2.0	2.2	2.3

Sample information:

● B-2
Well graded, f-c SAND w/gravel.

▲ B-4
Well graded, sub-rnd. GRAVEL w/sand.

■ B-7
Well graded, sub-rnd. GRAVEL w/sand.

Remarks:

Soil Mechanics Lab

Project No.: 6959.021
Project:
Date: 3-18-03
Data Sheet No. ____