Molycorp

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Supplemental Site Characterization Plan for the Washington, Pennsylvania Site

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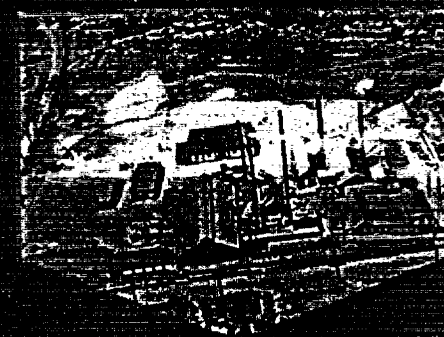

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MALCOLM PIRNIE

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Introduction

SECTION 1

1.1 Purpose and Objectives

The purpose of the supplemental site characterization at the Molycorp Washington facility is to collect additional data necessary to develop a technically sound site closure plan that addresses both radiological and non-radiological issues in a manner acceptable to regulatory agencies and the public. Implementation of the closure plan is intended to result in unrestricted release of the property (radiological issues), termination of the site's Nuclear Regulatory Commission (NRC) Source Materials License, and closure of non-radiological issues such that the site may be used in the future for purposes consistent with current zoning and surface features.

The supplemental site characterization is designed to collect the data needed to attain the following objectives:

- For Combined Radiological/Non-radiological Issues:
  - Determine the nature and geographic location, concentration and volume of contaminant residues in soil.
  - Determine the vertical and horizontal extent of any impacts to groundwater.
  - Provide necessary information to make a decision on the optimal regulatory framework under which to submit the site closure plan.
  - Determine if any offsite contamination exists adjacent to site property lines.

- For Radiological Specific Issues:

  - Develop volume estimates based on unrestricted release concentration criteria for each alternative considered for remediation of radiological material.

  - Better define the concentration, volume and distribution of thorium and other radionuclides which may be present at the site, including buried uranium containing slag.

  - Determine if thorium series and uranium series are separate or co-mingled.

  - Establish equilibrium status of uranium 238 (U-238) and thorium 232 (Th-232) and their daughter products and determine relative mix of uranium and thorium.

  - Determine the extent of radiological contamination below the water table.

  - Provide input for pathway-to-dose or risk assessment models for determining site-specific Derived Concentration Guideline Levels (DCGL).

- For Non-radiological Specific Issues:

  - Define extent of soil impacted with manufactured gas plant (MGP) Tar, including area and thickness, in order to evaluate remedial alternatives, including excavation and offsite disposal.

  - Evaluate suitability of non-radiologically contaminated, non-native material (overburden) to be left on site.

- General Requirements

  - Identify surface and subsurface characteristics of the site including: geology, surface and groundwater hydrology, and surficial materials classification.

- Perform necessary biological / ecological characterization of the site.

1.2 Site Background

1.2.1 Site Location and Description

Molycorp's Washington Facility is located in Canton Township, Washington County, Pennsylvania. The site is approximately 73 acres. Active portions of the site consisted of approximately 20 acres with the main process areas bounded to the north by a fence line with Findlay Refractories Company and to the south by Caldwell Avenue. Employee vehicle parking, equipment and miscellaneous storage were located south of Caldwell Avenue. The eastern boundary is the former CSX and Baltimore and Ohio (B&O) railway line adjacent to Green Street. Chartiers Creek serves as the western boundary of the former manufacturing areas. Interstate 70 (I-70) runs along the southeastern area of the site. Former Building 39 was located south of Caldwell Avenue. A former thoriated slag pile area and tar ponds also were located south of Caldwell Avenue. A site location map is provided in Figure 1-1, a site plan is shown in Figure 1-2 and an aerial photograph of the site taken in 2003 is presented in Figure 1-3.

The main plant area was purchased by The Railway Spring and Manufacturing Company in 1902. This parcel was owned by the Railway Spring and Manufacturing Company (later known as the Railway Spring Company or the Car Springs Company) until it was sold to the Electric Reduction Company in 1916. The Molybdenum Corporation of America (in 1974 the name was changed to Molycorp, Incorporated) was formed from the Electric Reduction Company in 1920. Manufacturing operations by the Electric Reduction Company (and successors) originally were conducted in buildings constructed prior to the 1916 purchase of the site. The original building configuration is depicted in Figure 1-4. These buildings survived until the late 1970's.

Over time, the plant expanded westward as low lying areas were filled with byproduct slags and new buildings were constructed. Construction activities to support facility upgrading were performed over the years as needed. A total of 42 buildings were constructed on the facility property, however, not all of the buildings were present at the same time as obsolete buildings were replaced by newer buildings. Profiles of the buildings including date of construction and major activities carried out are provided in Appendix A. The final plant configuration area circa 1995 is shown in Figure 1-4. All of the main plant site buildings were demolished in 2002 with only the guard building and truck scales remaining in place.

Additional properties were acquired by Molycorp from time to time throughout the lifetime of the operating facility in anticipation of future expansion. Two notable acquisitions of property south of Caldwell Avenue took place in 1976: the Morris Farm property (Area 7B in Figure 1-2) and a parcel (Area 5 and 7A, Figure 1-2) which originally was owned by Hazel-Atlas Glass Company, who operated an MGP nearby. A byproduct of this gasification process was tar. As discussed subsequently, this MGP is thought to have been the source of tar present in a building foundation which exists in the southwestern corner of Area 7A and/or in tar ponds in Area 5 on this southern parcel.

Wetlands are found in small areas around the site. The largest of which is 1.3-acres. It and the others are described in the IFC Kaiser Engineers, Inc. (IFC Kaiser) 1997 Washington Facility Environmental Report.

Ground elevations for the site range from 1010 feet above mean sea level (msl) to 1125 feet msl. The former production facility sits on an alluvial floodplain that has been filled in over the life of its industrial occupation. Areas of vegetation exist along Chartiers Creek, the embankment for I-70, and the vacant land south of Caldwell Avenue.

Storm water in the main site area was collected in two storm lines that convey water west to two outfalls in Chartiers Creek. The southern storm sewer line is reported to collect groundwater from a french drain system that was installed during the construction of two acid tanks formerly located in the southeastern corner of the former production area. Currently storm water is allowed to percolate into former building footprints.

1.2.2 Site History

To better understand this complex site and to facilitate characterization and ultimately remediation activities, the site has been divided into ten main areas of interest:

Area 1	Process Plant Area
Area 2	North Slag Area
Area 3	South Slag Area
Area 4	Tylerdale Connecting Railroad
Area 5	MGP Tar Pond Area
Area 6	Streams
Area 7	Hill Area
Area 8	Cox Plus
Area 9	Green Street
Area 10	Offsite Areas

1.2.2.1 Manufacturing Operations (Areas 1, 2 and 3)

Table 1-1 lists significant events in the history of Molycorp operations at the site. Molycorp manufactured several product types at the site over its operating history, including:

- Molybdenum trioxide powder
- Ferromolybdenum metal
- Ferrotungsten metal
- Ferrocolumbium metal
- Calcium boride
- Other rare earth and transition elements

The majority of the products generated consisted of molybdenum trioxide powder, ferromolybdenum metal, and ferrotungsten metal, with smaller quantities of the remaining products. Primary processes that were used to manufacture these products included roasters for converting molybdenum disulfide concentrates to molybdenum trioxide powder and ferroalloy furnaces to produce ferromolybdenum, ferrotungsten and ferrocolumbium. Supplemental processes were used to enhance product recovery and/or to control offgases / reduce waste. Eight partially closed Resource Conservation and Recovery Act (RCRA) impoundments along the west side of the property were utilized for these supplemental processes.

Ferrotungsten was produced at the site from the 1920's into the 1970's. Over this time several mines provided concentrates as feed material. Although the exact quantities in the various feed concentrates are unknown, it is expected that some slags resulting from this process contained uranium.

In 1963, the Molybdenum Corporation of America obtained a Source Materials License (License SMB-744) from the Atomic Energy Commission (AEC) (later the NRC) because of the processing of concentrates that contained 0.05 percent (or higher) of uranium and/or thorium. Between 1964 and 1970, Molycorp produced ferrocolumbium alloy from concentrate produced from ore mined in Araxa, Brazil. Slag from the production of the ferrocolumbium alloy was in the form of refractory glass/ceramic slag containing thorium.

Waste slags from the ferroalloy operations normally were used as fill on the plant property. Although the largest quantity of fill consisted of non-radioactive ferromolybdenum slags, thoriated slags associated with ferrocolumbium production and ferrotungsten slags possibly containing uranium also were deposited on the property.

1.2.2.2 Tylerdale Connecting Railroad (Area 4)

Area 4 is a railroad right-of-way that separates Area 5 to the south form Area 3 to the north and bisects Area 7 with Area 7B to the north and Area 7A to the south. In the past, a Tylerdale rail line was located in Area 4. The rail line and associated structures have been removed and the area now is vegetated.

1.2.2.3 MGP Tar Areas (Areas 5 & 7A)

Historical information on the tar present on the site is sketchy. Table 1-2 summarizes information regarding the history of activities related to Area 5 (MGP Tar Ponds) and Area 7A (Foundation) up until the time the property was purchased by Molycorp, around 1976. Figure 1-5 shows the approximate location of several features discussed in this historical review.

The available historical data does not definitively resolve a number of issues and, consequently, leaves these issues open to informed speculation:

- Foundation History – Part 1: The statements by the employee interviewed by Vijay Wagh could not be independently verified. These statements indicated that the Foundation was once a glass-making plant and that in order to provide gas for this plant, coal was "cooked in a vat" to generate gas. Records have not been found from Hazel-Atlas or its successors indicating the past existence of a glass-making operation where the Foundation is located. Such an operation does not appear on any Sanborn maps, but there are no Sanborn maps from 1925 to 1947. Such an operation could have been built, operated and closed between 1925 and 1947 and, consequently, not appear on any Sanborn maps.

- Foundation History – Part 2: It is possible that the operation at the Foundation used materials provided by the Tylerdale Connecting Railroad. The B&O Railroad is about 40 feet below the foundation and the approach to this railroad is almost a sheer drop. The Tylerdale Connecting Railroad is about 65 feet below the foundation, but the approach to this railroad is more gradual. The Tylerdale Connecting Railroad ran to the southwest to a coal mine.

- Gas Holder: One explanation for the 16-18 foot pit filled with tar that PennDOT encountered during the construction of I-70 is that this was the foundation for a below-grade gas holder. The first indication that this gas holder existed is the 1925 Sanborn map that shows a gas holder to the northwest of the Pennsylvania Atlas Chemical Company. Gas holders built after 1900 usually were aboveground and did not have a below ground foundation. One explanation for the belowground foundation is that the gas holder may have been built earlier by Hazel-Atlas (around 1900) and used to store natural gas, so as to level out pressure fluctuations in the gas supplied to the Hazel No. 2 facility. This gas holder, which is about 300 feet to the west of the nearest building at the Hazel No. 2 facility, may have been considered too far away to constitute a fire hazard and therefore not be shown on earlier Sanborn maps.

The historical review leaves several issues unresolved and it appears that further historical research will not resolve these issues. First, the building and operations associated with the Foundation are not known with any certainty. Second, the purpose of the tar ponds is not known, although they may have served as settling basins for tar-water mixtures from the offsite Pennsylvania Atlas Chemical Company, a MGP in the Foundation area or both. The tar-water mixture would have been sent to the ponds where the tar would settle to the bottom, since it is denser than water. Third, when the gas holder was constructed and whether or not it had a belowground foundation is not known with any certainty, although the recollections of the Penn DOT employee suggest that it had a belowground foundation.

1.2.2.4 Streams (Area 6)

There are two surface water bodies which traverse the site: Sugar Run and Chartiers Creek. Chartiers Creek enters the site (Area 5) from the southwest and crosses the property to run along the western boundaries of Areas 3 and 2. Average streamflow as Chartiers Creek enters the site is approximately 8,000 gallons per minute. The Creek continues to the northeast and ultimately discharges into the Ohio River. Chartiers Creek is impacted by tar seeps in Area 5.

Sugar Run enters the site (Area 7B) from the west and discharges into Chartiers Creek in Area 5. Average streamflow as Sugar Run enters the site is 1,200 gallons per minute. Sugar Run is believed to be unaffected by site-related industrial activities and/or tar seeps.

1.2.2.5 Hill Area (Area 7B)

Area 7B is the portion of Area 7 (Figure 1-2) that is north of Area 4. Area 7B was formerly an active farm (Morris Farm) that was acquired by Molycorp close in time to the acquisition in 1976 of the southern part of Area 7. There is no record of non-agricultural activity occurring on Area 7B. Area 7B is open land including forested and grassy areas.

1.2.2.6 Cox Plus (Area 8)

The Cox Plus area is located west of Chartiers Creek. There is no historical evidence that Area 8 was used for any industrial use. The only known use of the property was as the site of a house trailer. Area 8 is open land including forested and grassy areas.

1.2.2.7 Green Street (Area 9)

The Green Street area is located east of Area 1. Historical evidence, including photographs and aerial photographs, indicates that Area 9 was a residential area continuously since at least the early 1900's. There is no historical evidence that Area 9 was used as a process area or disposal area. Currently, the area consists of vacant land housing a trailer which currently serves as the Molycorp site office.

1.2.2.8 Offsite Areas (Area 10)

Offsite areas of potential concern in this investigation include:

- Vicinity of the abutment of the small bridge over Chartiers Creek near the southwest corner of Area 2; and
- Area adjacent to the northeast corner of Area 3 where a temporary rail line was installed in 1979-1981 to allow receipt of raw materials during demolition and reconstruction activities in the main plant area.

1.2.3 Land Use

Land use for the site is approximately 30% heavy industrial (i.e., the portion of the site that is north of Caldwell Avenue and east of Chartiers Creek) and 70% open land including forested and grassy areas. The site is bounded by transportation, residential and heavy industrial areas to the east, heavy industrial areas to the north, residential areas to the west and transportation and residential areas to the south. According to the current zoning map (Canton Township Zoning Map, 11/08/2000), zoning designations for the site include medium density residential for the approximately 65% of the site that is located west of Chartiers Creek and mixed use (including light industrial, heavy industrial, highway commercial and medium density residential) for the approximately 35% of the site that is located east of Chartiers Creek.

1.2.4 Previous Investigations

From 1980 to the present, numerous investigations have been conducted at the site. As a result, a substantial body of characterization data exists on the environmental condition of the site. Table 1-3 lists the previous investigations of the site that were considered in preparing this characterization plan. In the course of preparing this plan, data from past investigations were assembled in a georeferenced, relational database containing more than 15,000 datapoints. The database structure facilitates visualizations, geostatistics and volume calculations. Past investigations are discussed in Section 2.1.

1.2.5 Regulatory Highlights (Source Materials)

In 1963, the Molybdenum Corporation of America obtained a Source Materials License (License SMB-744) from the AEC (later known as the NRC) because of the processing of ores that contained 0.05 percent (or higher) of uranium and/or thorium. Between 1964 and 1970, Molycorp produced ferrocolumbium alloy from concentrates derived from ore mined in Araxa, Brazil that was delivered to the Washington Facility. Slag from the production of the ferrocoloumbium alloy was in the form of a refractory glass/ceramic containing thorium.

In 1966, Molycorp initiated discussions with the Pennsylvania Department of Health and AEC in pursuit of an on-site burial permit. A formal application was submitted in 1967. About this time period, Applied Health Physics, Inc. conducted a series of leaching studies on the ferrocolumbium slags. These studies indicated that the radioactive materials were fixed and would not leach into the groundwater in excess of prescribed limits. No action was taken by the state or the AEC on the request for an on-site burial permit (Foster Wheeler).

In June of 1971, an AEC compliance inspection revealed that thorium-bearing slags had been buried on-site. It was speculated that the burial occurred during a large scale clean-out of settling basins and regrading of the plant site by a private contractor who was unaware of restrictions on landfilling ferrocolumbium slags. Subsequently, AEC issued a Notice of Violation (NOV) and requested Molycorp to excavate these materials and dispose of them in accordance with AEC regulations.

In 1972, Molycorp excavated soil containing relatively high concentrations of thorium-bearing slag, and shipped approximately 14 truckloads of this soil/slag material to a disposal facility in New York State. However, that facility later refused to accept any additional material because it was, in the facility manager's words, "of insignificant contamination, and too large a volume" to bury at a site with limited disposal space. As a consequence, in 1973 the remaining thoriated slag material that was to be shipped offsite was instead consolidated into a single storage pile south of Caldwell Avenue and covered with a foot-thick layer of clean fill and vegetation.

An NRC contractor, Oak Ridge Associated Universities (ORAW), conducted a radiological survey of the site in 1985, which identified elevated levels of thorium in the dikes which separated the surface impoundments, and indicated the potential of subsurface thoriated slags in the western portion of the site. Subsequently, the Washington Facility was listed in NRC's 1990 Site Decommissioning Management Plan (SDMP) list.

Molycorp renewed its NRC license for the Washington County facility in 1992. Because the facility had appeared on the 1990 SDMP list, this license renewal included an amendment incorporating a schedule for characterizing and decommissioning the site. Since that time, a number of decommissioning reports and plans have been submitted to the NRC including:

- Site Characterization Plan for License Termination of the Washington, PA Facility (May 1994)

- Site Characterization Report for License Termination of the Washington, PA Facility (January 1995)
- Decommissioning Plan for the Washington, PA Facility (July 1995)
- Washington Facility Environmental Report (April 1997)
- Washington, PA Facility Decommissioning Plan, Part 1 Revision (June 1999)
- Washington, PA Facility Decommissioning Plan, Part 2 Revision (July 2000)

The Site Characterization Plan explained how Molycorp would test and analyze the property to determine the presence and location of the thorium-bearing slag. As called for in the Site Characterization Plan, Molycorp drilled over 400 core borings and generated more than 12,000 soil measurements. Furthermore, Molycorp drilled 19 groundwater wells, and took 64 groundwater samples. Through this process, Molycorp created a three-dimensional picture of areas with elevated thorium levels. The findings of that study were reported in the 1995 Site Characterization Report.

Based on the findings of the Site Characterization Report, Molycorp prepared an initial Decommissioning Plan that was submitted to the NRC in late 1995. This plan proposed removing any material that had a level of thorium above 30 pCi/g. The plan did not address contamination below structures.

In 1996, Molycorp excavated approximately 4,000 cubic yards of material that was located along its northern property boundary. This thorium-bearing slag and soil was stored in covered roll-off containers on Molycorp's property. In 2000, the thoriated slag was transported offsite and disposed at the Envirocare facility in Utah.

In 1999, the NRC advised Molycorp of the results of its review of the 1995 decommissioning plan. As a result of the NRC's review, in June of 1999, Molycorp submitted to the NRC the Part I Revision to the Decommissioning Plan, which changed the remediation goal from 30 pCi/g to 10 pCi/g. The plan also described how Molycorp would excavate the thorium-bearing slag in various areas of the property.

In July of 2000, Molycorp submitted the Part 2 Revision to the Decommissioning Plan that addressed a proposal to construct an onsite disposal cell for material that exceeded SDMP Action Criteria (10 pCi/g). The Decommissioning Plan Part 2 Revision was never approved. Molycorp has since abandoned its plans to construct the onsite cell and now intends to close the site in a manner that results in unrestricted release with respect to radiological issues.

NRC has issued a series of amendments to Molycorp's Materials License (No. SMB-1393). The most recent amendment is No. 6, which was issued on May 1, 2002. The amendment specifies conditions that must be met as part of decommissioning the site.

1.2.6 Remedial Actions

Six principal remedial actions have occurred at the site including:

- Excavation of Buried Thorium-bearing Slag
- MGP Tar Ponds Remediation
- Impoundments Closure
- Northern Property Boundary Remediation
- Slag Pile Removal
- Building Demolition

Each of these remedial actions is described in the following subsections.

1.2.6.1 Excavation of Buried Thorium-bearing Slag

In 1971, an AEC compliance inspection identified that thorium-bearing slags had been buried on-site. The AEC issued a NOV and requested Molycorp to take remedial action including excavation and disposal of the buried slags. In 1972, Molycorp authorized Applied Health Physics to excavate, sample, concentrate as much as possible and ship these materials to the Nuclear Fuel Services disposal facility in West Valley, New York. Disposal was terminated when disposal site officials reportedly determined that the slag was of insufficient contamination to bury and wasted valuable disposal space. The solution implemented in 1973 was to consolidate the remaining slag on-site into a pile located south of Caldwell Avenue and east of Chartiers Creek.

1.2.6.2 MGP Tar Ponds Remediation

In 1980, Molycorp engaged SRW to investigate the tar pond areas south of Caldwell Avenue. Molycorp had purchased the property earlier in anticipation of future expansion. The investigation included drilling 8 test borings, installation of 6 well points, collection of 20 soil samples for geotechnical analyses, collection of 6 surface water samples for general water quality analyses, and collection of 6 groundwater samples for water quality analyses. The report concluded that tar probably extends under the I-70 embankment, and is mixed with fill under the embankment. Tar was determined to be approximately 1.5 to 2 feet thick in the north and south pond areas. Tar also was observed in and along Chartiers Creek. Soil materials beneath the tar were of low permeability indicating a low rate of fluid movement into lower layers. Exceedences of surface water quality standards and/or concentration increases were observed for ammonia nitrogen, phenols, and total organic carbon (TOC) in Chartiers Creek. Groundwater sample results yielded phenol and TOC concentrations higher beneath the ponds when compared to groundwater samples collected from the embankment area.

SRW prepared a tar pond closure plan in January 1984. The closure plan recommended excavation of tar from the north tar pond area and placement of the material behind a compacted bermed area at the south pond. The south tar pond area would be covered with a geotextile fabric and compacted soil cap, and revegetated. Supporting work would include construction of access roads, stream crossings, culverts, arch bridges, and diversion ditches.

A letter to the Pennsylvania Department of Environmental Resources (PADER) was prepared by SRW on October 8, 1985 to address surface tar cleanup, tar seeping along the I-70 embankment, and surface water and groundwater monitoring requirements during the upcoming tar closure project. The letter indicated a soil cover; and surface water and groundwater monitoring would be performed. Three surface water and three groundwater samples from newly installed wells were proposed in the letter. The letter also indicated that the closure activities were scheduled for late 1985 and early 1986 (SRW, 1985).

Tar from the northern pond area ultimately was removed and placed in the south tar pond area in the mid-1980s. Information regarding the details of the completed effort are unavailable. Monitoring was suspended by DER based upon field test borings.

1.2.6.3 Impoundment Closure

Historically, wash water and slag from ore processing activities were allowed to flow into surface depressions/ponds located on the western portion of the facility during the first half of the 20th century. These depressions/ponds were upgraded to 8 holding ponds in the late 1960's. Each holding pond area was reported to be 80 feet long and 30 feet wide. A clay dike was constructed along the western edge of the holding ponds in 1969 to restrict any possible flow of leachate into Chartiers Creek. The holding ponds were lined with a clay and PVC liner. Originally the holding ponds were used for the recovery of molybdenum disulfide solids from the wet scrubber system on the roasters. Beginning in 1976, baghouse/scrubbers were used to capture the molybdenum disulfide. The holding ponds were retained for spill control and for containing acid plant flushing solutions.

After enactment of the RCRA in 1980, Molycorp submitted a Part A permit to obtain interim status to use the holding ponds as surface impoundments. Molycorp later submitted a Part B permit application. PADER denied use of the impoundments as a RCRA unit because a double liner/leachate system was not in place, the impoundment bottoms were too close to the water table, and the impoundments were within the 100-year floodplain.

SRW prepared a plan to address RCRA groundwater monitoring and proposed the installation of four monitoring wells (M1-M4) in the vicinity of the holding ponds. The monitoring wells were installed in 1983 (SRW, 1984).

The impoundments continued to be used for spill control/acid plant flushing solutions which were not classified as a hazardous materials. The United States Environmental Protection Agency (USEPA) subsequently terminated interim status for all unpermitted surface impoundments in 1989, and no hazardous material could be placed in these units after that time (RSA, Vail, Molycorp, 1994).

A closure plan for the eight holding ponds/impoundments was prepared in 1992 and revised in 1994. The plan was developed with the objective of removing the impoundments and their contents. Materials intended to be removed included liquids and sludges, rip rap, the PVC liner, and the clay liner. The plan also contained a detailed impoundment process history.

The eight surface impoundments were partially closed as an interim remedial action in June 1995 by Foster Wheeler (Foster Wheeler, 1995b). The interim remedial action included removal of all impoundment materials with the exception of the clay liner. It was believed that the clay liner should be left in place until decommissioning activities are performed as part of the final decommissioning of the facility because it provided a barrier against groundwater infiltration.

This interim remedial action included removal and sampling of rip-rap, sludges, the sand bed, and the PVC liners. The impoundment area subsequently was backfilled with clean fill and a HDPE liner. Sampling results of all removed materials are contained in a final closure report prepared by Foster Wheeler in October 1995 and revised in 1996 (Foster Wheeler 1996b). The clay liner and associated berm which remained in place were subjected to toxic characteristic leaching procedure (TCLP) analyses for characterization purposes. Copper, sulfate, and manganese were detected at concentrations above the threshold limit for hazardous waste definition. Selenium was detected in one sample above the threshold limit.

1.2.6.4 Northern Property Boundary Remediation

A remedial action was performed in 1996 along the northern boundary of the facility and adjacent property (Findlay Refractories property). Results of that effort were reported in a radiological status report submitted by Foster Wheeler in December 1996. The work included excavation and removal of materials containing thorium, radium, and uranium isotopes. Excavated materials consisting of slag were scanned with a sodium iodide (NaI) scintillation counter and segregated into appropriate piles. Contaminated material above the threshold criteria was transferred to rolloff containers, and samples of the containers were collected for on-site gamma spectroscopy. A total of 194 rolloffs were filled during the effort. Oil-related contamination associated with a removed building foundation also was found on the adjacent property. The building had been reported to be used for the storage of oil in the past (Foster Wheeler, 1996c). In 2000, the contaminated material was transported offsite and disposed at the Envirocare facility in Utah.

A final status survey was conducted by Foster Wheeler to demonstrate that the radiological conditions on and in the immediate proximity of the Findlay Refractories/Molycorp property line satisfy the release criteria and that the area is considered acceptable for unrestricted use.

1.2.6.5 Slag Pile Removal

In 2000 and 2001, the contaminated slag pile that was built in the mid-1970's and was located south of Caldwell Avenue and east of Chartiers Creek, was removed. Approximately 10,000 cubic yards of material were shipped offsite for proper disposal at the Envirocare facility in Utah.

1.2.6.6 Building Demolition

In 2002, Molycorp contracted MACTEC, Inc. to decommission the 21 buildings that remained on the site. The project included demolition and disposal of all aboveground structures and buildings. Except for the guardhouse and scales, all existing structures (buildings, tanks, dryers, baghouses, utilities) were removed from the site by the end of 2002. Building foundations were removed except for Building 2 and 2W. Wastes created by the demolition activities were identified, segregated and shipped to appropriate waste disposal facilities.

Final status surveys of the building materials were conducted in accordance with the requirements listed in NUREG/CR 5849, "Manual for Conducting Radiological Surveys in Support of License Termination", RSI's "Decommissioning Plan for the Washington, PA Facility, Part 1 Revision", Molycorp's "U.S. Nuclear Regulatory Commission Material License, Amendment No. 5, SMB-1393", and MACTEC's "Survey Plan for Determining the Final Status of Buildings at the Molycorp Site".

Table 1-1

Environmentally Significant Events in the History of Manufacturing at the Washington Site

Date	Event
1902	Main Plant Area purchased by the Railway Spring and Manufacturing Company.
1916	Electric Reduction Company purchased the site.
1920	Molybdenum Corporation of America formed from the Electric Resuction Company (in 1974 the name was changed to Molycorp, Incorporated).
1963	NRC license obtained to produce ferroscolumbium
1968	Eight surface impoundments installed
1969	Ferrocolumbium slag used as fill over large areas of the site
1970	NPDES permit obtained
1971	NRC requests site cleanup
1976	Areas 5 and 7A purchased – coal tar present
1976	Area 7B Morris Farm purchased
1976 – 1981	Slag Fill in Morris Farms part of Area 5
1978	Ferrocolumbium slag cleanup completed
1980	Building demolition and reconstruction completed
1980	RCRA Part A permit application filed
1981 - 1986	Slag Fill in Area 5E
1982	Sulfuric acid plant online
1985	Tar pond remediation conducted; RCRA Part B permit denied

Table 1-1

Environmentally Significant Events in the History of Manufacturing at the Washington Site

1991	Facility placed on stand-by
1992	NRC requests decommissioning
1994	Site characterization conducted
1995	Surface impoundments Phase I closure completed
2001	Slag pile excavated and shipped offsite for disposal
2002	Building demolition completed

Table 1-2

Historical Information of the MGP/Tar present at the Washington Site

Date	Event
1887 - 1902	A search of Brown's directory indicates that a small coal gas operation was present in Washington from 1887 to 1902. Reportedly it was abandoned in 1903 due to competition from natural gas. The 1896 Sanborn map shows an MGP on the north side of East Maiden between Lincoln and East Avenue. It was called the Washington Gas Company and is present on the 1900 Sanborn map, but not the 1904 Sanborn map. This MGP is thousands of feet east of Areas 5 and 7.
1900 - 1950	An internal Molycorp document entitled "Project History" indicates that a coal gasification plant was operated in the vicinity of the Foundation from around 1900 through possibly 1950. Tar from this facility "flowed downhill from the plant through wooden trenches and pipes to one of three unlined tar ponds."
1902	The Hazel-Atlas Glass Company built Hazel No. 2, a glass-making operation, to the west of Griffith Avenue, north of the Baltimore and Ohio Railroad around 1902. The Hazel No. 2 facility is not on the 1896 or 1900 Sanborn maps, but appears on the 1904 Sanborn map. The facility apparently replaces the American Tin Plate Company, originally the Washington Steel and Tin Plate Works, which appears on the 1896 and 1900 Sanborn maps.
1914 – 1925	Between 1914 and 1925, the Pennsylvania Atlas Chemical Company was built. The 1925 Sanborn map shows the facility to the west of the Hazel No. 2 facility, east of Chartiers Creek and north of the Baltimore and Ohio Railroad. A 100 ft. diameter iron gas holder with a 200,000 cu. ft. capacity is shown to the northwest of the facility. This facility is listed as producing gas and its by-products.
1915	Meeting minutes from the Hazel-Atlas board indicate that building an MGP to supply gas to Hazel No. 2 was discussed on November 27, 1915. The minutes of June 27, 1916 indicate the board approved a contract with Smith Gas Engineering Company of Lexington, Ohio to design and build a "gas producer plant to supply clean gas to Hazel No. 2 Factory." The minutes of February 13, 1917 indicate that gas production had started at Hazel No. 2.

Table 1-2, continued

Historical Information of the MGP/Tar present at the Washington Site

Date	Event
1916	Minutes from the Hazel-Atlas board dated June 27, 1916 discuss the cost of retaining walls and moving railroad spurs when constructing the gasification operation. There is a massive retaining wall just to the east of the two existing tanks on the former Hazel No. 2 property and there were railroad spurs on the property where the Hazel No. 2 facility was located. There is no apparent retaining wall in the Foundation area and no evidence from aerial photos that a railroad spur ran to the Foundation. Thus, the initial gasification operations appear to have been located in the same general area as the Pennsylvania Atlas Chemical Company.
1922	Meeting minutes from the Hazel-Atlas board indicate that contracts had been prepared with Combustion Utilities Corporation by July 29, 1922 to build the Pennsylvania Atlas Chemical Company gas producer plant. Problems with the plant are noted in meeting minutes from January 28, 1926, but Combustion Utilities Corporation apparently continued to run the plant until at least 1931. The facility is not shown on the 1947 Sanborn map. Two tanks, labeled oil tanks, are on the property, but they are not in the same locations as tanks shown on the 1925 Sanborn map. These two tanks appear to still exist on this property.
1950	On July 8, 2003, discussions were held with Gerry Johnson an individual who worked at the Hazel-Atlas Hazel No. 2 facility for a number of years starting around 1950. Gerry Johnson indicated that nothing was operating in the Foundation area at this time, but that there was a tank and three other structures around the Foundation. Gerry Johnson believed that these structures were eventually stripped by vandals.
1954	The 1954 USGS map shows three ponds to the west of Hazel No. 2, one to the south of Chartiers Creek, one immediately north of Chartiers Creek and a small pond north of this pond. The foundation does not appear on this map. The Tylerdale Connecting Railroad, which runs east to west between Caldwell Avenue and the Baltimore and Ohio Railroad, appears to end at a "mine dump" at Lincoln Hill about 6,000 ft. southwest of the foundation. This was reportedly an operating coal mine around 1900. Interstate 70 is not on this map.

Table 1-2, continued

Historical Information of the MGP/Tar present at the Washington Site

Date	Event
1969	The 1969 USGS map shows Interstate 70, the southern pond and the foundation. It shows the service road from Caldwell Avenue that runs south through the former pond area north of Chartiers Creek, then east through a tunnel under I-70 to the area where the Pennsylvania Atlas Chemical Company formerly was located. It also shows two tanks on this property that apparently are the two tanks currently on this property.
1955 – 1960 (?)	Drawings for Interstate 70 from Penn DOT show a rectangular symbol labeled "Coal Tar" under the footprint for Interstate 70, to the north of the tunnel associated with the service road that runs under the interstate. This rectangle is in the general vicinity of where the iron gas holder is located on the 1925 Sanborn map. The drawings also indicate that one "Pond with Tar Base" is located immediately west of Interstate 70 in the general area of the North Tar Pond and a second "Pond with Tar Base" is located west of Interstate 70 in the general area of the South Tar Pond.
1980	Vijay Wagh, formerly an assistant plant manager for Molycorp at the Washington, PA facility, talked to a former Hazel-Atlas Hazel No. 2 employee around 1980. This individual indicated that the Foundation was once a glass-making plant and that in order to provide gas for this plant, coal was "cooked in a vat" to generate gas. Periodically, the vat would be tapped and tar would be allowed to flow by gravity down the hill to the pond area. This individual indicated that the gas-making operation began around 1900 and lasted 12 to 13 years.
1983	An internal Molycorp memorandum from George Dawes to Lars Hansen dated October 17, 1983 summarizes a meeting between Molycorp personnel and Penn DOT personnel. At this meeting, M. Jones of Penn DOT indicated that when Interstate 70 was constructed in the late 1950s, a 16-18 foot deep pit of tar was encountered within the footprint of the road. Penn DOT filled the pit with rocks to provide the stability needed for constructing the road. This action caused the tar to overflow into a pond near the pit that Penn DOT claims already contained tar. This pit may have been a below ground foundation for the iron gas holder and the pond presumably was the North Tar Pond.

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Table 1-3

Listing of Documents Reviewed

Report Title	Summary of Activities
SRW, March 3, 1980; Sampling and Study of Subsurface Conditions Tar Pond Area Washington, Pennsylvania (SRW, 1980)	• Drilled 8 test borings in the tar pond area • Installed 6 well points • Performed geotechnical analyses on 20 soil samples • Collected 6 surface water and 6 groundwater samples for water quality
SRW, February 2, 1982; Groundwater Monitoring Plan Holding Pond Area, February 2, 1982 (SRW, 1982)	• Proposed plan for installation of 4 monitoring wells (M1-M4)
SRW, January 4, 1984; Tar Pond Closure Plan Molycorp, Incorporated, Washington, Pennsylvania (SRW, 1984)	• Prepared an engineered closure plan for the tar areas for submittal to the PADEP • Site reconnaissance and supporting activities • Excavated 4 test pits in potential borrow areas
SRW, October 8, 1985; Proposed Construction and Monitoring Activities, Molycorp Tar Pond Closure (SRW 1985)	• Addressed additional surface tar cleanup and placement in the south pond • Address tar seepage along I-70 embankment • Identified surface water and groundwater monitoring requirements
Radiological Site Assessment Program; Manpower Education, Research and Training Division; Oak Ridge Associated Universities; Radiological Survey of Molybdenum Corporation of America, Washington, Pennsylvania, Preliminary Report, June 1985 (ORAU, 1985)	• Investigated western third of facility and area south of Caldwell Avenue • Performed radiological surface scans, direct measurements, and radionuclide concentrations in numerous soil samples, surface water and sediment (1 upstream and downstream, 2 storm sewer outfalls), 4 groundwater (MI-M4), and associated buildings
RSA, December 27, 1990; A Subsurface Survey for Thorium Content at the Molycorp Plant site in Washington, Pennsylvania (RSA, 1990)	• Radiological study of western portion of facility focusing on vertical profiling of 8 impoundment areas • Performed 400 surface measurements • Drilled 32 soil borings and performed subsurface measurements at 6 inch depths in all and 5 existing wells (M1-M5) • Collected soil samples for lab radiological analyses to support calibration
Remcor, December 23, 1991; DRAFT Interim Report Ground Water Assessment and Recovery System Design (Remcor, 1991)	• 17 monitoring wells (M5-M18; 2 well clusters at M-9, M-15 and M-18) • 6 soil samples for geotechnical analysis • 30 soil samples for thorium analysis • 2 rounds of groundwater samples in 17 new and existing wells for metals and geochemistry analysis

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Table 1-3

Listing of Documents Reviewed

Report Title	Summary of Activities
Molycorp, August 31, 1992, Revised September 30, 1994; Plan for Closure of Eight Surface Impoundments at Molycorp's Washington, Pennsylvania Facility (RSA, Vail, Molycorp, 1994)	• Planning document for removing 8 impoundments and their contents • Average yearly groundwater sample results from M1-M4 indicated contamination • Chartiers Creek surface water sample results from 1991 indicated downstream molybdenum contamination • Selenium in impoundments samples close to RCRA hazardous waste
RSA and Vail Engineering, August 5, 1993; Molycorp Plan for Site Characterization in Support of Decommissioning of the Molycorp Inc. Washington, Pennsylvania Facility, Volume 1: Report Text and Appendix a-j, Volume 2: Appendix k (RSA, Vail, 1993)	• Detailed plan for upcoming site characterization to support NRC decommissioning / delicensing • Focused on thorium based contamination from ore processing and associated slag
Foster Wheeler Environmental Corporation, January 1995; Site Characterization Report for License Termination of the Washington, Pennsylvania Facility, Volume 1: Section 1-6, Volume 2: Appendicies a-o less g,n; Volume 3: g.m. (Foster Wheeler, 1995a)	• Reported site characterization activities performed in 1994 • Site characterization included, drilling 418 borings, installation of 17 wells, radiological survey, soil, groundwater, storm sewer, surface water and sediment sampling. Pumping test performed to support modeling
Foster Wheeler Environmental Corporation, June 1995; Workplan for The Closure of Eight Surface Impoundments (Foster Wheeler, 1995b)	• Defined procedures for the removal of 8 impoundments
Foster Wheeler Environmental Corporation, October 1995, Final Closure Report for Eight Surface Impoundments at the Washington, PA Facility (Foster Wheeler, 1995, revised May 1996)	• TCLP metals analyses of clay liner and impoundment berm material
Foster Wheeler Environmental Corporation, July 1995; Decommissioning Plan for the Washington, Pennsylvania Facility (Foster Wheeler, 1995c)	• Decommission plan as required by NRC • Plan included removal of all soil / slag above 30pC/g • Onsite disposal cell would be located in coal tar foundation area, coal tar to be relocated to south coal tar area
Foster Wheeler Environmental Corporation, December 1996; Final Radiological Status Report for the Removal Action Conducted Along the Northern Boundary of the Molycorp, Incorporated Property, Washington, Pennsylvania (Foster Wheeler, 1996c)	• Removal action performed in northern border of property and adjacent property to support sewer line construction • Contaminated slag in excess of 5pCi/g removed and placed in 184 rolloffs with NaI screening and gamma spectroscopy analyses
ICF Kaiser, April 1997; Washington Facility Environmental Report, Volume 1: Text, Volume 2: Appendices (ICF Kaiser, 1997)	• Environmental report required by NRC to comply with desire to dispose of material from both facilities at the Washington facility • Included overview and evaluation of 3 on-site alternatives, off-site disposal and no action

Table 1-3

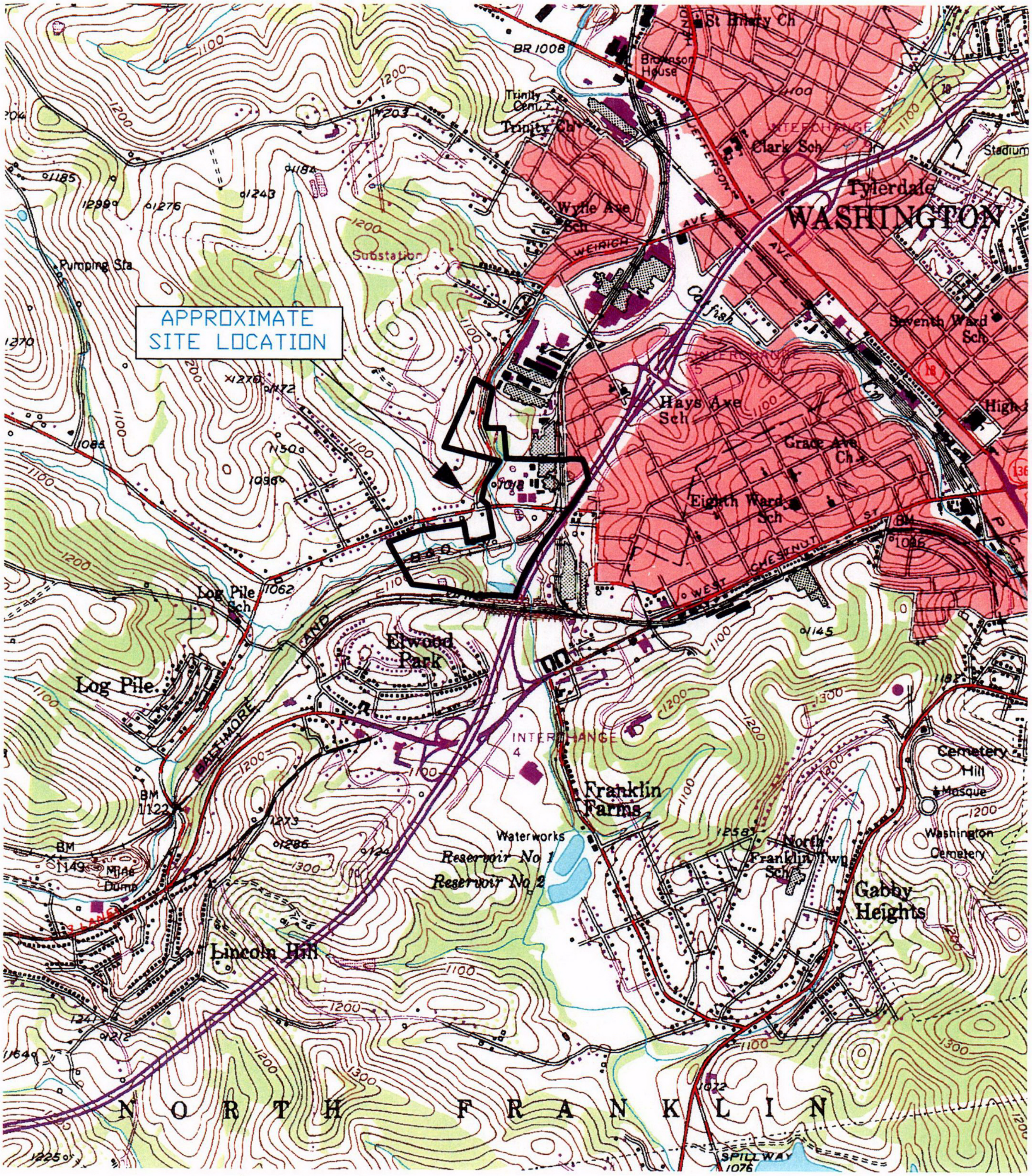
Listing of Documents Reviewed

Report Title	Summary of Activities
Dade Moeller & Associates and Edward A. Emmett, 1997; Review of Decommissioning Plan for the Molycorp Washington Pennsylvania Site and Discussion of Associated Health Impacts on the Community and Evaluation of Potential Health Risks of Human Exposure to Radiation From Thorium Bearing Slag Associated with the Molycorp, Washington, Pennsylvania Site (Moeller and Emmett, 1997)	• Decommission plan review and evaluation of thorium health effects
Radiological Services, Inc., June 30, 1999; Washington, Pennsylvania Facility Decommissioning Plan, Part 1 Revision (RSI,1999)	• Decommissioning plan for removal of material in excess of 10pCi/g
Splitstone and Associates, March 2000, Geostatistical Analysis and Estimation of Contaminated Soil Volume at the Molycorp Washington, Pennsylvania Site (Splitstone and Associates, 2000)	• Geostatistical analysis report to determine soil volumes for thorium concentration ranges using probability kriging
Hutchinson Group, April 2000, Geophysical Investigation of the Molycorp Facility, Washington, PA	• Geophysical investigation of Areas 5, 7 and part of 8 to identify locations of possible former oil and gas wells
CEC, May 2000, Findings of Search for Historic Oil/Gas Wells, Molycorp Facility, Washington, Pennsylvania	• Test pits were excavated in located identified as anomalies in the April 2000 geophysical report by the Hutchinson Group.
Radiological Services, Inc., March 2001; Assessment of Uranium Content and Radioactive Decay Series Equilibrium in Soil at the Molycorp Washington, Pennsylvania Facility (RSI, 2001)	• Evaluated degree of equilibrium of thorium and uranium • 5 samples collected from 3 to 6 borings for thorium / uranium series radionuclides
MFG, February 2002; Overburden Slag Investigation Report, Molycorp, Incorporated, Washington, Pennsylvania Plant (MFG, 2002)	• Characterization of overburden material to determine if it can be used as fill • 20 borings were drilled with metals radiological, VOC, SVOC, TCLP, and SPLP analyses • Exceedences SHS noted in metals analyses • No VOC/SVOC exceedences • SPLP results exceeded SHS • TCLP results indicated non hazardous
MFG, March 2002, Supplemental Characterization Monitoring Plan for Groundwater, Surface Water and Sediment, Molycorp, Inc. Washington, Pennsylvania	• Monitoring plan to satisfy Condition 15A of Amendment No. 5 of Materials License SMB-1393
Harding ESE, May 2002, Report to Summarize Sampling Activities, Washington, Pennsylvania Site	• Samples from 17 existing wells, 4 sediment samples and 4 surface water samples were collected from Chartiers Creel and analyzed for isotopes of uranium, thorium and radium

Table 1-3

Listing of Documents Reviewed

Report Title	Summary of Activities
Tetra Tech NUS, Inc., August 2002, Peer Review and Data Gap Analysis of Facility Characterization Data at Molycorp's Washington, Pensylvania Facility (TT-NUS, 2002)	• Summarizes and evaluates past investigations and remedial actions at the site • Identifies data gaps and recommends additional investigation to address data gaps
MACTEC, Inc., July 2002, Final Status Survey Report for Building 1 at the Molycorp Site, Washington, PA	• Final status surveys of the building materials were conducted for 21 buildings that were demolished in 2002



SCALE: 1:24,000

WASHINGTON WEST,
PENNSYLVANIA QUAD
1954/1969

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FIGURE 1-1 SITE LOCATION MAP

MOLYCORP, INC.

AUGUST 2003

C01

AREA	DESCRIPTION
1	PROCESS PLANT
2	SLAG NORTH
3	SLAG SOUTH
4	TYLERDALE CONNECTING RR
5	TAR AREA
6	STREAMS
7	HILL AREA
8	COX PLUS
9	GREEN STREET
10	OFFSITE AREAS

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FIGURE 1-2 SITE PLAN

C02

MOLYCORP, INC.

AUGUST 2003

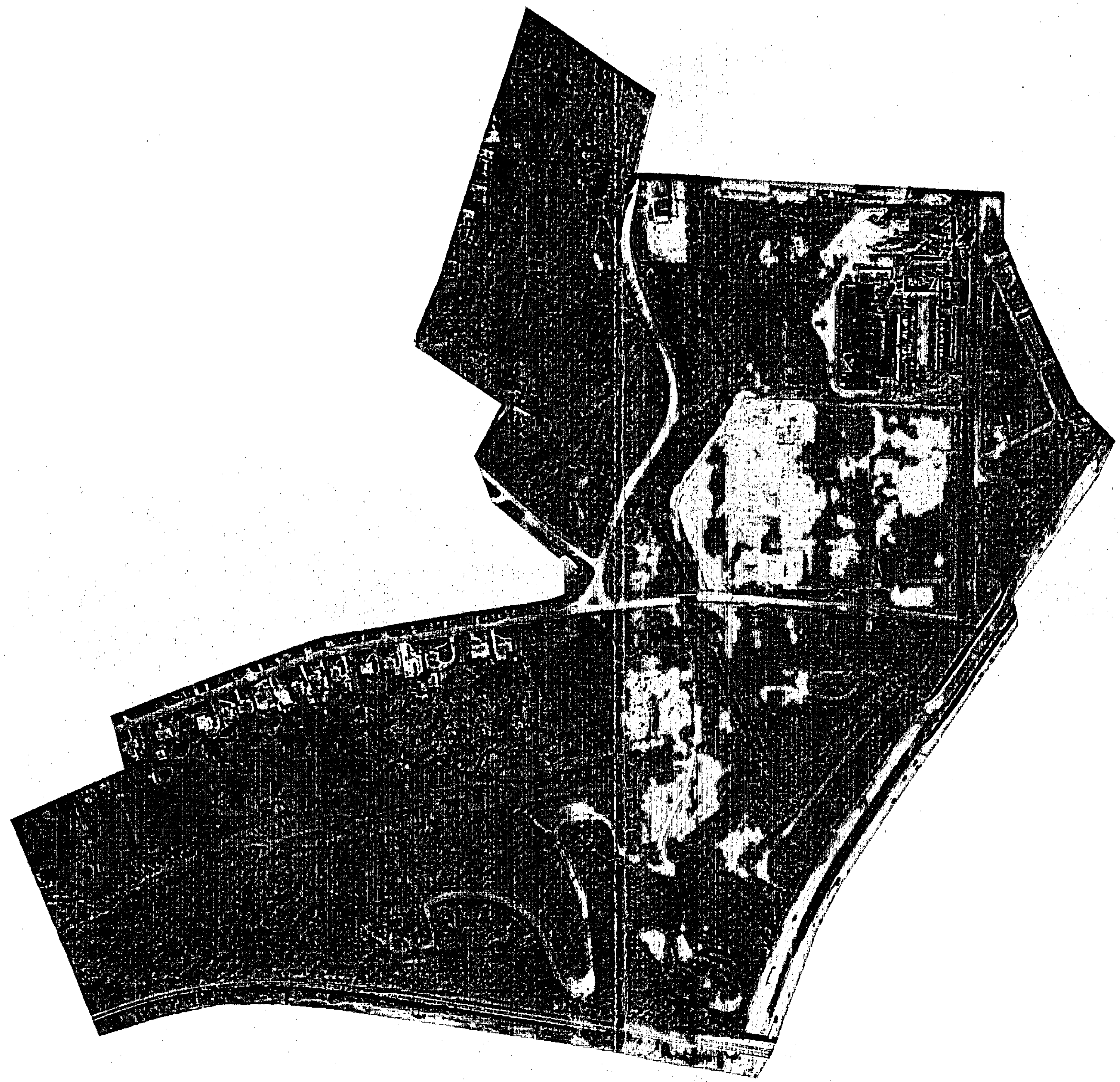

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FIGURE 1-3 2003 AERIAL MAP

MOLYCORP, INC.

AUGUST 2003

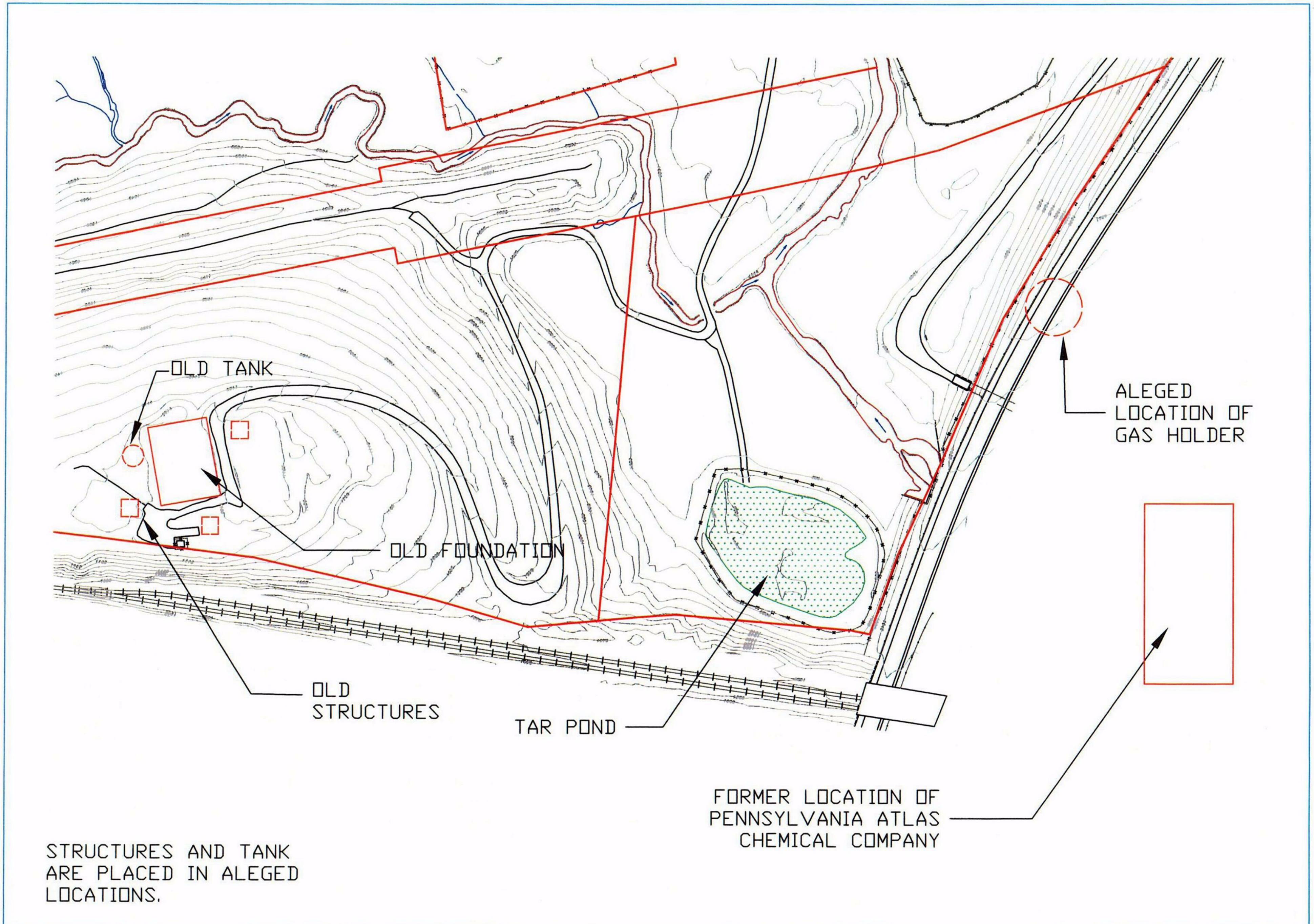

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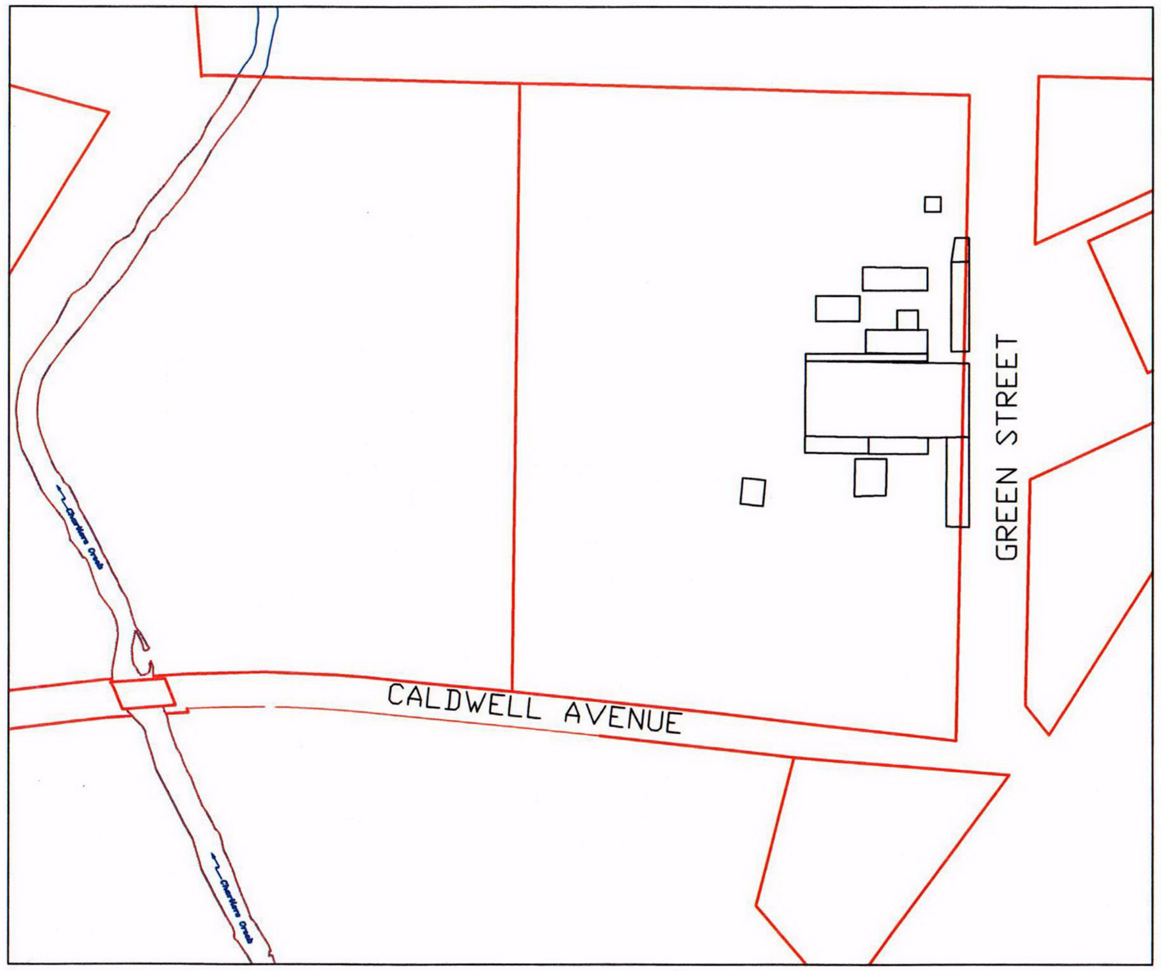
FIGURE 1-5 TAR DRAWING

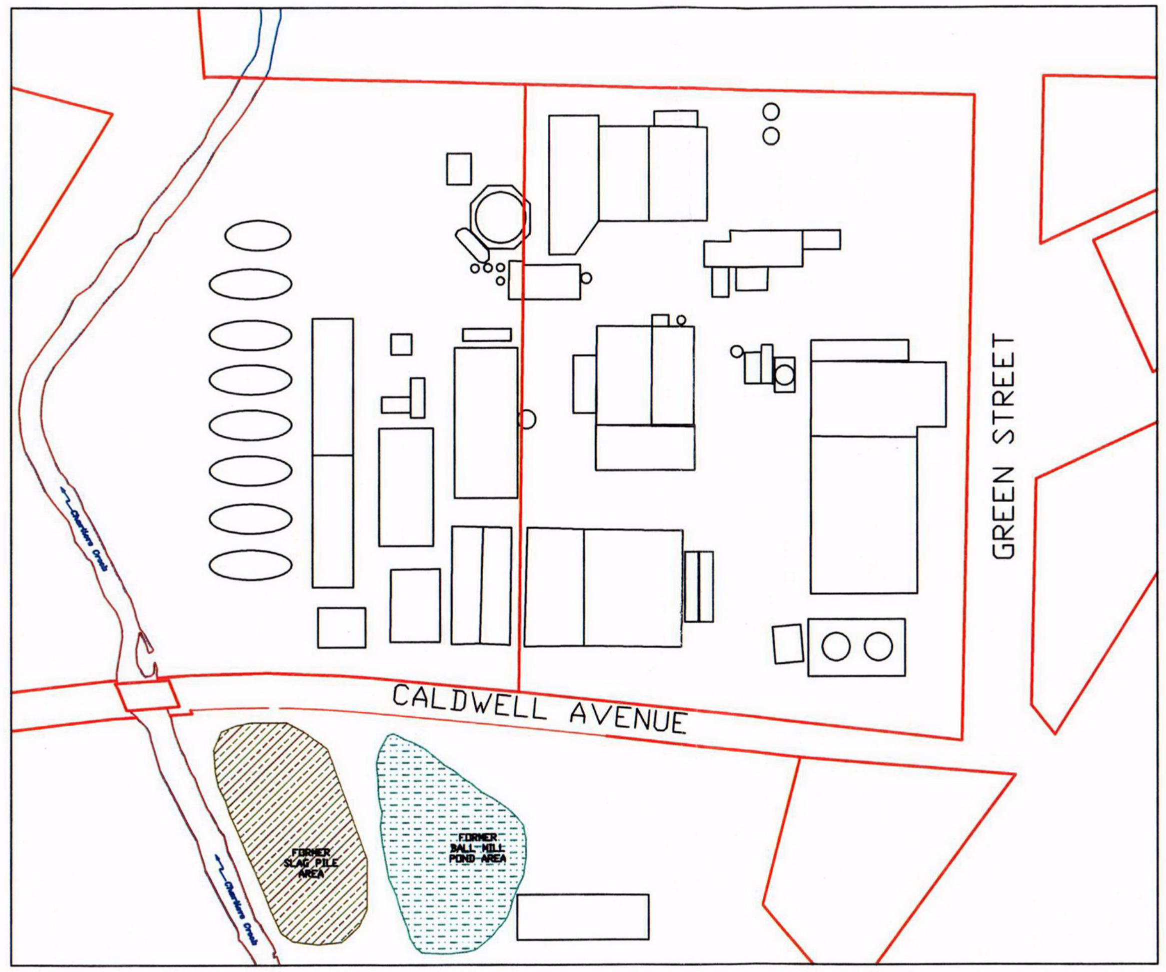
MOLYCORP, INC.

AUGUST 2003

C03



ORIGINAL BUILDING CONFIGURATION AT PURCHASE (1916)



FINAL BUILDING CONFIGURATION PRIOR TO DEMOLITION

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4812GSP

FIGURE 1-4

BUILDING CONFIGURATIONS

MOLYCORP, INC.

AUGUST 2003

C04

Summary of Existing Site Information

SECTION 2

2.1 Summary of Previous Investigations

Numerous investigations have been conducted at the site to address various environmental issues. For the most part, these investigations have been concerned with identifying areas that have been impacted by radiological materials; however, some non-radiological investigations have been completed as well. Surface and subsurface soil samples have been collected as part of radiation surveys; groundwater monitoring wells have been installed to monitor groundwater quality in the area of the processing plant; soil and groundwater samples have been collected as part of the site characterization and decommissioning process; and samples of overburden fill material have been analyzed to determine chemical composition. More limited investigations have been conducted to address the MGP tar present in Areas 5 and 7A. Previous investigations carried out for the various areas of the site are discussed below.

2.1.1 Areas 1, 2, and 3 - Process Plant, North Slag, and South Slag Areas

Area 1, the Process Plant, is the partially paved portion of the site that formerly contained the roasters, acid plant, and other buildings that housed various processes that were carried out on site. This area contains the original location of site operations. Area 2, the North Slag Area, also was a processing area where pyrochlore concentrates were processed. Slag fill, some of it radioactive, was placed in this area prior to construction of the buildings. Area 3, the South Slag Area, is an area where slag generated by the manufacturing process was deposited or buried. This area of the site was largely undeveloped during the entire life of the manufacturing process but did contain a building that was utilized for parts storage. Additionally, the western portion of this area is where the thoriated slag pile existed as well as a pond which contained ball milled slag.

ORAU performed a radiological survey of the facility in 1985. The western third of the property, as well as the area south of Caldwell Avenue, were the focus of this investigation. Work performed included surface radiation scans, direct radiation measurements, and radionuclide sampling of surface soils at numerous locations utilizing a grid to identify sampling location. Surface water and sediment samples from Chartiers Creek, sediment samples from two storm drains, and groundwater samples from Monitoring Wells M1 through M4 also were collected. Results of this investigation indicated that there was widespread surface thorium contamination.

Radiation Surveillance Associates, Inc. (RSA) was retained by Molycorp in 1990 to perform a radiation survey on the western third of the facility, specifically focusing on the vertical profiling of thorium levels in the vicinity of the eight RCRA holding ponds/impoundments. The survey included approximately 400 measurement of the gamma radiation field at one meter above the ground surface. Additionally, 32 soil boring were completed and down-hole gamma logging measurements were collected every six inches from ground surface to the bottom of the boring at bedrock. Radiation measurements also were taken in the 4 existing monitoring wells. In general, subsurface thorium concentrations were found to be above the surface soil concentrations in most samples, and there was a considerable lateral variation in radiation levels. Radiation levels usually decreased to background levels by a depth of nine feet.

In 1991 Remcor performed a facility wide groundwater investigation. This investigation included installation of 17 monitoring wells (identified as M5 through M18 with two well clusters at M-9, M-15, and M-18) across Areas 1 and 2, installation of 2 staff gages, collection of 6 soil samples for geotechnical analyses, and collection of 30 soil samples for thorium analysis. Two rounds of groundwater samples were collected from the 17 newly installed monitoring wells and 4 existing wells as a part of this investigation. Groundwater samples were analyzed for general water quality parameters including pH, acidity, specific conductance, total dissolved solids (TDS), total suspended solids (TSS), TOC, total organic halogens (TOX), phenol, sulfate, nitrogen, chloride, carbonate, bicarbonate, metals, and molybdenum. Results of the analysis indicated that pH in the center of the facility was elevated, sulfate was elevated in the majority of the wells, and molybdenum concentrations downgradient of the holding ponds and Building 26 and in the vicinity of the M-15 monitoring well cluster were elevated. Several other metals also were detected in the groundwater samples at elevated concentrations. Thorium analytical results were provided in the report with all detections below 10 pCi/g.

In response to an October 29, 1992 NRC comment letter, which questioned the procedure for converting the down-hole measurements to subsurface soil concentrations, RSA prepared a second report in 1992. The second report contained justification regarding the approaches used in RSA's 1990 investigation and specific response to the NRC comments. Also included in the 1992 report were laboratory radiological analysis for soil samples that were reported but not provided in the 1990 RSA report.

A site characterization plan to support decommissioning of the facility was prepared in August 1993. The plan defined affected areas from a radiological perspective associated with thorium-based contamination. The defined affected areas included the western third of the facility property, the area south of Caldwell Avenue, and the ground surface of buildings 29 and 34 and areas beneath Buildings 33, 35, 36, 38, 39, and 42.

Foster Wheeler Environmental Corporation and RSA performed site characterization field activities during the spring, summer, and fall of 1994 in accordance with the site characterization plan and associated NRC comments. This site characterization focused on radiological investigations related to thorium-based materials, with limited sampling for non-radiological parameters to be used as indicator parameters. The field investigation included the completion of over 400 soil borings (SB1 through SB410 and offsite borings) throughout Areas 1, 2, and 3, installation of an additional 17 monitoring wells (MW19 through MW29, UG2, UG3, and UG4) and 2 pumping wells (PW1 and PW2), and the performance of a radiological survey. In addition, soil, surface water, sediment, storm sewer, and groundwater samples were collected and analyzed. A pumping test also was performed to support groundwater modeling activities for the facility.

The radiological survey consisted of down-hole gamma logging by lowering a sodium iodide detector into each of the soil borings and collecting a count measurement at 6-inch intervals. A second technique, gamma spectroscopy of soil samples was employed to create a "quality assurance" database. The second technique involved the analysis, at 6-inch intervals, by an on-site gamma spectrometer for reportedly 20% of the split spoon samples collected during the site characterization.

Two rounds of groundwater samples from all available monitoring wells on the facility property and surface water (locations CR1 through CR4 in Chartiers Creek) were collected and analyzed for metals, molybdenum, chloride, phenols, sulfate, TDS, TOC, TOX, and radionuclides. Sediment samples were collected from locations SD1 through SD7 and analyzed for thorium. Storm sewer samples also were collected from 7 locations (001-01 though 001-05, 002-01, and 002-02) and were analyzed for metals, molybdenum, chloride, phenols, sulfate, TDS, and pH.

Radiological survey results indicated shallow soil contamination in the northeastern corner of the property, in the north central portion of the property, near the impoundments, and in the southern parcel across Caldwell Avenue. The majority of the thorium contamination was found at shallow depths (typically less than 5 feet and mostly less than 10 feet beneath the ground surface).

The subsurface investigation conducted as part of the site characterization produced a database of 12,499 measurements of surficial and subsurface thorium concentrations. Based on the results of the down-hole gamma and gamma spectroscopy measurements three conclusions were formulated concerning thorium contamination in the former manufacturing area at the subject site: 1) the thoriated material is distributed randomly, 2) the major portion of the thoriated material is close to the surface in irregularly shaped bands, and 3) no migration has taken place vertically or horizontally.

Groundwater sample results indicated that molybdenum concentrations generally increased from east to west across the plant area to greater than 285 milligrams per liter (mg/l) in monitoring well M5. Molybdenum groundwater sample results also were elevated in upgradient monitoring well UG2 which was installed along a rail spur in the vicinity of former Building 2/2W. Elevated molybdenum concentrations (98 and 126 mg/l) were identified in Bedrock Well BR1 during the two rounds of groundwater sampling. Selenium concentrations were highest in monitoring well M15S at a level of 0.204 mg/l during the first round of groundwater sampling.

Thorium was detected at low concentrations in wells located in the northern portion of the facility including monitoring wells M6, M12, M14, M15S, M18S, and M25. The highest concentration of thorium 230 was detected at a concentration of 3 pCi/l. Uranium and radium isotopes also were detected in the 1 to 2 pCi/l range. Based on these concentrations, Foster Wheeler concluded that groundwater is not a significant pathway for radionuclide transport.

Surface water sample results indicated no significant impacts from site activities. None of the samples had concentrations of thorium or uranium above laboratory reporting limits. Only radium was detected at concentrations ranging from 5 to 6 pCi/l in the surface water samples collected from Chartiers Creek. Metals were detected; however, the results were reported to not be statistically significant. Further, Foster Wheeler concluded that no significant thorium impact was evident in the sediment samples collected from Chartiers Creek. Storm sewer sample results indicated the presence of molybdenum at elevated concentrations that increased downstream within each storm sewer line.

In response to a request from NRC, RSI performed an evaluation of the degree of equilibrium of uranium and thorium at the facility. The evaluation that was performed was summarized in a report prepared in March 2001. The evaluation included the collection and analysis for uranium and thorium series radionuclides of five composite samples in January 2000 from archived split spoon samples from the 1994 site characterization conducted by Foster Wheeler. The report concluded that uranium/thorium ratios in the soils are variable, the principal thorium and uranium series members are in equilibrium, and radium 226 (Ra-226) is not in equilibrium.

In 2001 MFG Inc. conducted an investigation to characterize the northwest area (Area 2) of the facility and the area south of Caldwell Avenue (Area 3) to determine appropriate means of managing the overburden materials that exist above the radiologically contaminated slag. The investigation included installation of 20 soil borings utilizing split spoon sampling techniques. Each sample was scanned for the presence of radioactivity and the presence of volatile organic compounds (VOCs). Selected soil samples were collected and analyzed for metals which have established Pennsylvania Act 2 standards, plus molybdenum. Five of the samples were analyzed for VOCs and semi-volatile organic compounds (SVOCs). All of the samples submitted to the laboratory also were analyzed for radiological parameters. After receipt of the metals analyses results, the samples that yielded the highest concentrations of the eight RCRA metals also were subjected to the TCLP (5 total) and/or synthetic precipitation leachate procedure (SPLP) (6 total) analyses.

Arsenic and vanadium exceeded the surface soil statewide health standards (SHS) at some locations in the MFG investigation, with arsenic the predominant exceedence (SBs 8, 9, 11, 16, and 20). There were no exceedences of the SHS for subsurface soils. Arsenic, boron, lead, and selenium exceeded the soil to groundwater SHS in samples collected from SBs 1, 6, 8, 9, 11, 15, and/or 18. The majority of the exceedences were for boron. VOCs and SVOCs were detected (borings SB 2, 6, 9, 11, and 18); however, none of the results exceeded the Act 2 SHS and the majority of detections were SVOCs. The TCLP results were below the regulatory limit for a characteristic hazardous waste. SPLP results exceeded the Act 2 medium-specific concentrations (MSCs) for non-residential used aquifers for boron, selenium, vanadium, arsenic, and lead for samples collected from borings SB 1, 2, 8, 11, 15, and 16. The MFG report concluded that the materials overlying the radiological contaminated slag could be returned to the site if properly addressed, provided that exposure pathways are eliminated by appropriate capping, and that appropriate evaluations are performed in accordance with Act 2.

During March 2002, Harding ESE collected groundwater samples from Monitoring Well M2, M4, M8, M10, M13, M18, M20, MW24, MW25, MW26, MW27, MW28, MW29, MW31, UG4, BR1, and BR2 for isotopic analyses of radium, thorium, and uranium. Additionally, surface water and sediment samples were collected from Chartiers Creek and analyzed for the same parameters as the groundwater samples. None of the radioisotopes were identified in any of the water samples at a concentration greater than 2.5 pCi/l, with the majority of the results being identified at concentrations below 1 pCi/l. None of the sediment radioisotopes were reported in excess of 1.6 pCi/g. Groundwater samples collected from Monitoring Wells BR1 and M4 also were analyzed for dissolved molybdenum and cobalt. Cobalt was not detected in either of the groundwater samples above the laboratory reporting limit while molybdenum was detected at concentrations of 63.7 (BR1) and 16.2 mg/l (M4).

Despite the extensive studies performed in Areas 1, 2 and 3 several issues remain unsolved and will be addressed in the supplemental site characterization. These include the following:

- The existing down-hole gamma logging measurements may not be sufficiently quantitative to permit accurate estimation of contaminated soil volumes.

- Previous investigations were unable to address areas beneath buildings.
- Previous investigations focused on thorium contamination. Consequently, there is insufficient information to determine uranium concentration in soil.
- The relative mix of uranium and thorium is undetermined.
- The equilibrium status of uranium and its daughter products remains unresolved. There is conflicting information with respect to the equilibrium status of Ra-226 existing.
- Data on nonradiological contaminants in the overburden and in the radiologically impacted fill needs to be supplemented.

2.1.2 Area 4 – Tylerdale Connecting Railroad

This portion of the site consists of a former right-of-way for the Tylerdale Connecting Railroad that bisects Area 7 (Hill Area). This portion of the site was never used in the manufacturing process or as a disposal area and, as such, no radiological material related to Molycorp's activities is expected to found in this area of the site. However, some low level radioactive material in the form of colored glass and/or refracting brick used or produced by the Hazel-Atlas Glass Company has been found on the southern slope of the railroad right of way. Two monitoring wells were installed in this portion of the site by ICF Kaiser as a part of their 1996 evaluation of potential impacts (both radiological and non-radiological) relating to various alternatives for decommissioning the facility. No soil or groundwater samples were collected during this investigation.

2.1.3 Areas 5 and 7A – Manufactured Gas Plant Tar Areas

Areas 5 and 7A consist of the areas of the site that have been historically referred to as the "North Coal Tar Pond Area", "South Coal Tar Pond Area", and the portion of Area 7 that is south of Area 4, the Tylerdale Connecting Railroad right of way. These areas have been impacted by tar that most probably was produced as a by-product by one or more manufactured gas plants previously located on or near the site.

After Molycorp purchased the property that included Areas 5 and Area 7A in 1976, Molycorp conducted a number of investigations and performed a variety of actions. Around 1980, Molycorp retained SRW to study the Tar Ponds in Area 5. SRW completed 8 borings, 4 in the North Tar Pond area (3 in the portion of the tar pond west of the service road and one in the portion of the tar pond between the service road and I-70) and 4 in the South Tar Pond area. SRW also delineated visually the extent of tar impacts in the North Tar Pond, the South Tar Pond and Chartiers Creek. Figure 2-1 shows the location of the borings and the approximate delineation of the two tar ponds. Table 2-1 summarizes the results of the borings.

In the North Tar Pond, SRW indicated a distinct tar layer 1.5 to 2 feet thick existed at boring SRW-7. A distinct tar layer was not found in boring SRW-1. Borings SRW-1, SRW-2, SRW-3 and SRW-7 indicate that tar is present in the soil below 2 feet to a depth of 10 to 16 feet below the surface. In the South Tar Pond area, SRW indicated that there were distinct tar layers 1.5 to 2 feet deep in borings SRW-6 and SRW-8. At SRW-6, tar impacts were observed to 14 feet, while no tar impacts were noted in SRW-8 below 1.5 ft. No tar impacts were noted in borings SRW-4 and SRW-5, both next to Chartiers Creek.

Around 1985, SRW conducted a response action on the tar ponds. A dike was constructed around the South Tar Pond, and tar-impacted soil was removed from much of the North Tar Pond, an area outside the newly constructed diked area, and portions of Chartiers Creek, and placed in the diked area. Tar-impacted soil between the service road and I-70 was not removed because of concerns about undermining the interstate roadway and tar-impacted soil near an underground sewer to the west of the service road was not removed because of concerns about damaging the sewer line. Also, all of the tar-impacted sediment in Chartiers Creek could not be removed. Figure 2-1 shows the location of the diked area and the tar-impacted soil and sediment outside the diked area that was identified by SRW following the response action. After consolidation of the tar-impacted material in the diked area, this area was covered with an impermeable geotextile membrane which in turn was covered with a layer of soil. However, over time, the soil settled, ripping the membrane in a number of locations and displacing tar which subsequently has up welled to the surface. Also, slag was placed in the northern portion of the North Tar Pond and then covered with soil. Some slag and soil was also placed in the remainder of the excavated area in the North Tar Pond.

Following the response actions, SRW completed borings for three wells, GW-1, GW-2 and GW-3, but tar was detected in the borehole for GW-1 and GW-2. Consequently, a well was completed only at GW-3. This well has never been sampled. DER subsequently dropped the monitoring requirement.

Around 1997, Molycorp contracted ICF Kaiser to develop a design for increasing the height of the dike to accommodate about 3,000 cu. yards of tar-impacted material from Area 7A. Following this consolidation, the diked area was to be capped. To develop this design, ICF Kaiser installed seven soil borings and completed four test pits (Figure 2-1). Two of the borings and one test pit were placed just outside the diked area. The remaining borings and test pits were placed along the surface of the dike. In the two borings outside the dike, evidence of tar impacts were noted from 1.5 ft. to at least 4 ft. in one boring and from 3.5 ft. to at least 8 ft. in the other boring. Under the diked area, tar impacts to 15 feet were noted in some places.

Around 2000, Molycorp retained Civil and Environmental Consultants, Inc. (CEC) to search for historical oil and natural gas wells in Areas 5 and 7A. CEC hired the Hutchinson Group, Ltd. to perform a geophysical investigation. As part of this investigation, three test pits were completed in Area 5, all around the South Tar Pond (CEC-TP-A1, CEC-TP-C1 and CEC-TP-E in Figure 2-1). Test pits CEC-TP-C1 and CEC-TP-E were placed along Chartiers Creek, while test pit CEC-TP-A1 is located up the hill to the west of the South Tar Pond. These test pits were dug approximately two feet deep and no evidence of tar impacts were encountered in any of the test pits.

According to drawings and aerial photographs provided by Molycorp, a concrete foundation with dimensions of approximately 100 ft. by 150 ft. was located in Area 7A. This foundation had concrete walls that were approximately 20 to 24 inches thick. Approximately 5 feet of the walls was below the ground surface and five feet was above the ground surface. This structure reportedly had approximately a foot of liquid tar at the bottom. In 1986, Molycorp pushed in the walls above the surface and filled in the foundation with soil.

Tar eventually upwelled to the surface around the foundation walls and reportedly flowed into wooded areas downgradient from the foundation. A collection trench was dug around the wall to collect the upwelling tar. Also, a tar seep formed on the eastern side, so Molycorp excavated this soil, forming a small depression which is evident on the current site contour map.

During their 1996 environmental investigation, ICF Kaiser installed but never sampled three monitoring wells. ICF Kaiser also identified 15 groundwater seeps located to the south of the former foundation, along the B&O Railroad right-of-way. As with the monitoring wells, none of these seeps were sampled.

As part of the investigation to locate historical oil and gas wells, four test pits were excavated to the east of the foundation, down the slope toward Area 5 (CEC-TP-A2, CEC-TP-B1, CEC-TP-B2 and CEC-TP-C2 in Figure 2-1). These test pits were about 2 feet deep. There was no evidence of tar impacts in any of these test pits.

2.1.4 Area 6 – Streams

Surface water and sediment samples have been collected from Chartiers Creek in the past during investigations to address concerns related to the manufacturing areas (Areas 1, 2, and 3) and MGP Tar Pond Area (Area 5) areas. These sampling events have been discussed previously in this chapter.

2.1.5 Area 7B

This portion of Area 7 consists of the land north of Area 4, the Tylerdale Connecting Railroad. This area currently abuts private homes, many of which have extended their yards onto Molycorp's property for access to Sugar Creek. Prior to Molycorp purchasing the land in 1976, it was a farm. No manufacturing or processing activities have ever occurred here. As a result, no previous investigations have been conducted in this portion of the site.

2.1.6 Area 8 - Cox Plus

The Cox Plus area is located to the west and on the other side of Chartiers Creek from the former manufacturing area. This portion of the site was never used in the manufacturing process or as a disposal area. The only known use was as the location of a house trailer. No previous investigations have been conducted in this area.

2.1.7 Area 9 - Green Street

The Green Street area consists of parcels of land located to the east of the former manufacturing area. Historical information indicates that residential homes have been situated on these parcels of land since before the Electrical Reduction Company purchased the Washington facility from the Railway Spring Company in 1916. As a result, there is no reason to believe that fill or other materials associated with the site ever were placed on these parcels of land. No previous investigations have been completed in this area.

2.1.8 Area 10 - Offsite Areas

The offsite parcel of land located to the east of Area 3, and the northern edge of Caldwell Street, that includes the abutments for the small bridge over Chartiers Creek have been designated as the offsite areas. Soil borings were installed in the vicinity of the parcel east of Area 3 during the 1994 Foster Wheeler site characterization. Thorium concentrations above 10 pCi/g were measured by the down-hole gamma logging technique in several of the soil borings completed in this vicinity.

2.2 Geology and Hydrogeology

The site is located in Canton Township, Washington County, Pennsylvania. The Washington County area is situated in the Pittsburgh Low Plateau Section of the Appalachian Plateaus Physiographic Province. This section of Pennsylvania typically consists of flat lying to gently folded sedimentary units that have been regionally elevated and dissected by dendritic stream erosion. The subject site itself is located primarily on fill material that was placed over top of Chartiers Creek alluvium which in turn overlies claystone and other sedimentary rocks of Pennsylvanian and Permian ages. Subsequent discussion of the geology and hydrogeology of the Molycorp Washington site is based on interpretation of several site investigations completed by various entities since 1991. These investigations include:

- Interim Report - Groundwater Assessment and Recovery System Design by Remcor, Inc., 12/23/1991
- Site Characterization Report for License Termination of the Washington, PA Facility by Foster Wheeler Environmental Corporation, January 1995
- Washington Facility Environmental Report by ICF Kaiser, April 1997
- Overburden Slag Investigation Report by MFG, Inc. February 2002
- Supplemental Characterization monitoring Plan for Groundwater, Surface Water, and Sediment by MFG, Inc., March 2002

Local geologic and hydrogeologic conditions of the site are more pertinent to site characterization than those of the region. Therefore, the following discussion provides only a brief summary of regional geologic conditions to provide a general perspective. A more detailed discussion of site conditions is provided in support of the proposed investigation.

2.2.1 Regional Geology and Hydrogeology

2.2.1.1 Site Location and Description

Bedrock structures in this portion of Washington County have been influenced by the Washington anticline; the axial trace of this north plunging structure is located approximately ½ mile to the northwest of the Molycorp site. Further, the axial trace of the south plunging Finney Syncline, which is located approximately 1 mile to the southeast of the subject site, also has influenced the bedrock geology. As a result, the bedrock beneath the site is gently folded with a general trend of north 23-30 degrees east, resulting in a gentle dip to the northwest, towards the Finney Syncline. No major faults have been mapped in the area surrounding the site (ICF Kaiser, 1997).

Bedrock formations in Washington County consist of cyclical sequences of relatively flat lying sandstone, shale, limestone, claystone, and conglomerate which were deposited during the Pennsylvanian and Permian ages. These units contain rich coal seams and numerous gas and oil deposits. Recent alluvium, in and adjacent to streambeds, consists of unconsolidated clays, silts, sands, gravels, and cobbles.

Bedrock immediately beneath the subject site consists of the Permian age Washington Formation and the underlying Pennsylvanian-Permian age Waynesburg Formation of the Dunkard Group. The Washington Formation, which ranges in thickness from approximately 160 to 234 feet, consists of alternating beds of shale and sandstone with several coal beds and thin-bedded, discontinuous limestone members. Most of the sandstones that comprise this formation are light gray, medium-grained, and cross-bedded while the limestone units generally are gray and finely crystalline. The limestone units may also be argillaceous with interbedded gray shale.

The Pennsylvanian-Permian age Waynesburg Formation, ranging in thickness from approximately 100 to 245 feet, stratigraphically underlies the Washington Formation and is comprised of cyclical sequences of sandstone, shale, limestone, and siltstone with some claystone and coal. Although the Waynesburg Formation is lithologically similar to the rest of the Dunkard Group, it tends to be somewhat sandier, has few, if any, redbeds, and its coal beds are thicker and more persistent. The limestone typically is gray, argillaceous, and interbedded with claystone, while the sandstone units generally are light gray, very fine to medium grained, and crossbedded. The shale unit typically is gray and locally calcareous.

2.2.1.2 Regional Hydrogeology

Groundwater in Washington County occurs in both artesian and water table aquifers, with well yields ranging from less than one to over 350 gallons per minute (gpm).

Where present, alluvium deposits are made up of weathered rock material that has been transported and deposited by the flowing stream water. These deposits are composed of poorly to well sorted clay particles to boulder size rocks that are well rounded by the action of the flowing water. Well yields in the alluvial deposits depend primarily on the permeability and thickness of the saturated deposits. Few wells are known to be completed in the local alluvial deposits; however, two known wells reportedly produce 200 and 350 gpm and are 28 and 63 feet deep, respectively. (Newport, 1973)

Directly under the alluvial deposits at the site is the Washington Formation which typically is a poor water producing unit since soft shale units having particularly low well yields comprise the majority of this formation. As a result of the cyclic nature of bedding in the bedrock units, perched lenses of water above the water table may be present. Regional well yields for this formation range from less than one to 70 gpm, with a median well yield of 2 gpm.

The Waynesburg Formation underlies the Washington Formation and like the Washington Formation, also is generally a poor water producing unit. The few fractures that are present and their small size within the formation is a limiting factor on well yields. The mean reported yield for wells completed in the Waynesburg Formation regionally is 10 gpm.

2.2.2 Site Geology

Site geologic and hydrogeologic conditions as presented here are based on reported data from several site investigations, which in total included drilling and monitoring over 400 soil borings; monitoring well installation, sampling, and hydraulic testing; and groundwater mapping and modeling. Discussion of site geology is divided into two sections: the lowland section which contains Chartiers Creek and the main production areas of the site, and the upland section which consists of the hill adjacent to the production area on the southern edge of the subject site. The lowland geology description is based largely on soil borings completed during the Site Characterization Study performed by Foster Wheeler in 1994, while the upland description is based on the 1996 investigation conducted by ICF Kaiser.

2.2.2.1 *Topography*

The site consists of 73 acres of contiguous land owned by Molycorp, Inc. located in Canton Township, Washington County, Pennsylvania. Most of the site area is relatively flat and located east of and within the floodplain of the northward-flowing Chartiers Creek. It is on these lowlands where most of the former industrial facilities were located and where most of the contamination has been found and investigated.

The southwestern portion of the site contains a steep hillside bounded to the north by Sugar Creek, to the east by Sugar and Chartiers Creek, to the south by an active railroad line and to the west by residential property. Elevations increase in this portion of the site from approximately 1020 feet MSL along Sugar Creek in the north up to 1125 feet MSL at the top of a steep hill to the south.

2.2.2.2 *Lowland Section*

The geology of the lowland section of the site has been well characterized by more than 400 soil borings drilled to depths ranging from 4.3 to 36 feet below ground surface (ft bgs). The lowland area lies on the alluvial floodplain of Chartiers Creek and is known to contain both natural and anthropogenic materials (fill) with a maximum total thickness of 22 feet. Portions of the lowland area are covered with asphalt and/or concrete from the former manufacturing facilities. The composition, thickness, and extent of each of the units previously identified are summarized below.

Fill Material – The uppermost lowland area unit at the site is fill material composed of a mixture of slag and spent refractory bricks, with mixed natural sand gravel, silt, and clay. Some of the fill material contains radiological contaminants which have been vitrified to a glass-like form. The fill has been found at all boring locations throughout the manufacturing areas of the site and its thickness ranges from 2 to 12 feet, with an average thickness of 7 feet.

Clay Unit - Beneath the fill is a clay-rich alluvium unit that is poorly sorted with silt, sand, and gravel. The thickness of this unit ranges from 0 to 16 feet and may serve as an aquitard, slowing downward migration of groundwater throughout much of the site.

However, the clay unit does have variable concentrations of silt, sand, and gravel and was found not to be continuous beneath the entire lowland portion of the site.

Sand and Gravel Unit – Beneath the clayey alluvium lies a more course-grained alluvium referred to as the sand and gravel unit. This layer is described as containing the same natural constituents as the clayey alluvium but with greater percentages of sand and gravel and less clay and silt than that of the overlying clay unit.

Bedrock – Bedrock encountered in the lowland section of the site has been identified as claystone of the Pennsylvanian-Permian age Waynesburg Formation. Claystone composition and texture is similar to that of shale but lacks the fine lamination or fissility typical of shale. The bedrock surface was encountered in most of the soil borings completed in this area of the site. As a result, the depth to bedrock (ranging from 15 to 22 ft bgs) is well documented; however, the composition and degree of fracturing of the bedrock is not well know since only two monitoring wells were completed into the bedrock in the lowland section of the site. Boring logs for Monitoring Well BR-1 describe the bedrock sequence as claystone from 17 to 18.5 ft bgs, interbedded shale and sandstone from 18.5 to 24 ft bgs, coal from 24 to 26 ft bgs, and sandstone and shale to the bottom of the boring at 35 ft bgs. The rock quality designation of the cores retrieved from Monitoring Well BR-1 was 13, indicating a high percentage of fractures within the local bedrock.

2.2.2.3 Upland Section

To date only limited investigation has been completed in the upland section of the site, with the investigation concentrating on the hill area located to the southwest of the former manufacturing area. This investigation, described in ICF Kaiser's April 1997 report entitled Washington Facility Environmental Report, consisted of installation of five monitoring wells and mapping of rock outcrops. Only a limited amount of alluvial deposits, maximum thickness of 14 feet, were identified above bedrock in this portion of the subject site.

Based on boring logs contained in the ICF Kaiser report, it appears that the near surface stratigraphic sequence in the upland section consists of slightly to highly weathered iron-stained mudstones and carbonaceous shale. The carbonaceous shale coal that was identified between a depth of 16.2 to 24.3 ft bgs in test boring TB-01 may be the Washington Coal. The strata beneath this coal layer consists primarily of cross-bedded, laminated fine to medium grained sandstone which in turn is underlain by the Little Washington Coal. Beneath the Little Washington Coal is a sequence dominated by unweathered to slightly weathered shale and shaely limestone containing the occasional sandstone lens. Beneath this sequence is the Waynesburg "A" Coal and a sequence consisting of hard, gray, unfractured limestone and shale.

2.2.3 Site Hydrogeology

Discussion of the hydrogeology at the site has been divided into two sections consistent with the previous geological discussion. The lowland section is the area of the site adjacent to Chartiers Creek and contains the main production areas of the former plant site, while the upland section consists of the southwest hill on the southern edge of the site. As with the geological description, the lowland hydrogeology description is based largely on results and interpretations reported in the 1995 Foster Wheeler Site Characterization Study. Information regarding the upland hydrogeology is based on results and interpretations contained in the 1997 ICF Kaiser Environmental Report.

2.2.3.1 Lowland Hydrogeology

The unsaturated zone has been determined generally to be less than four feet thick in the lowland section of the site and primarily consists of fill material. However, in some portions of the lowland area, the water table does fall below the base of the fill material and the upper portion of the underlying clayey alluvium is unsaturated. As previously mentioned, the clayey alluvium layer generally serves as a confining layer; but there are numerous places where there is an interconnection between the water table and the deeper sand and gravel layer.

Potentiometric maps that have been prepared indicate that the horizontal hydraulic gradient is towards Chartiers Creek, with an average gradient of 0.03 feet per foot (ft/ft). Because of the presence of the clay alluvium layer separating the fill material and the sand and gravel unit, a three-foot difference has been noted in nested monitoring wells that monitor each zone. Using the average thickness of the clay alluvial layer, 10 feet, the vertical downward hydraulic gradient has been calculated to be approximately 0.3 ft/ft.

Hydraulic testing, in the form of two constant-rate pumping tests and seventeen slug tests were performed to ascertain additional information regarding the hydraulic characteristics in the lowland area of the site. Pumping test results indicate that the transmissivities of the fill material range from 118 square feet per day (ft^2/day) to 196 ft^2/day with a storage coefficient ranging from 0.062 to 0.064. Based on this information and the measured saturated thickness of the fill material (5 to 10 feet), a hydraulic conductivity ranging from approximately 13 to 27 feet per day (ft/day) was calculated.

2.2.3.2 Upland Hydrogeology

All of the monitoring wells that were installed in this portion of the site were completed in bedrock. No perched water zones were observed in the limited thickness of alluvium that was encountered during drilling. Packard tests, segregating only a portion of the monitoring well to conduct a hydraulic test, were performed on the various bedrock units encountered in the monitoring wells. Based on the results of these packard tests, it was determined that the hydraulic conductivity in the upland bedrock units ranges from impermeable ($<3.5 \times 10^{-8}$ ft/day) for units that were either not fractured or only showed minor evidence of fracturing to 3.7 ft/day for fractured horizons.

Table 2-1
Summary of SRW Soil Boring Results

Boring	Location	Depth (ft)	Comments
North Tar Pond			
SRW-1	Near I-70	25	Tar impacts observed to 16 ft.
SRW-7	Within Pond	20.5	Tar layers to 4.5 ft.; evidence of tar impacts to 13 ft.
SRW-2	Near Creek	21.5	Tar layers to 9 ft.; evidence of tar to 14 ft.
SRW-3	Near Creak	19	Traces of tar to 12 ft.
South Tar Pond			
SRW-6	Within Pond	20	Tar layers to 2 ft.; evidence of tar impacts to 14 ft.
SRW-8	Edge of Pond	20.5	Tar layers to 1.5 ft.; no record of tar impacts below 1.5 ft.
SRW-4	Near Creek	18.5	No record of tar impacts
SRW-5	Near Creek	17	No record of tar impacts

Table 2-2
Summary of ICF Kaiser Soil Boring and Test Pit Results

Boring/Test Pit	Surface Elevation (ft)	Depth (ft)	Comments
Outside Pond			
ICF-SB06	1017	9.1	Evidence of tar impacts (tar, black staining, hydrocarbon odor) from 1.5 ft. to at least 4 ft.
ICF-SB07	1021	10	Evidence of tar impacts (tar residue, black tar staining, hydrocarbon odor) from 3.5 to at least 8 ft.
ICF-TP02	1020	4	No evidence of tar impacts noted
Inside Pond			
ICF-SB05	1026	16	Gray and black mottling from 6 to at least 12 ft.
ICF-YP01	1026	3	Evidence of tar impacts (tar, tar seams, strong hydrocarbon odor) from 1 to 3 ft.
ICF-TP03	1026	2	No evidence of tar impacts noted
ICF-SB04	1025	4.9	Black staining from 2-4 ft.
ICF-SB01	1025	20	Evidence of tar (black staining and hydrocarbon odor) at 0-2 ft. and 11.7 to 15 ft.
ICF-TP04	1025	2	Evidence of tar impacts from 0-2 ft.
ICF-SB02	1026	9.6	Gray mottling from 0-2 ft., otherwise no evidence of tar impacts noted.
ICF-SB03	1026	20	No evidence of tar impacts noted

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Potential Land Use, Receptors and Exposure Pathways

SECTION 3

3.1 Current and Potential Future Site Use

3.1.1 Land Use

Land use for the site is approximately 30% heavy industrial (i.e., the portion of the site that is north of Caldwell Avenue and east of Chartiers Creek) and 70% open land including forested and grassy areas. The site is bounded by transportation, residential and heavy industrial areas to the east, heavy industrial areas to the north, residential areas to the west and transportation and residential areas to the south. According to the current zoning map (Canton Township Zoning Map, 11/08/2000), zoning designations for the site include medium density residential for the approximately 65% of the site that is located west of Chartiers Creek and mixed use (including light industrial, heavy industrial, highway, commercial and medium density residential) for the approximately 35% of the site that is located east of Chartiers Creek.

As shown in Figure 3-1, much of the site lies within the 100-year floodplain of Chartiers Creek and thereby restricts redevelopment of low elevation areas of the site. It is likely that the use of the areas within the floodplain will remain the same in the future – essentially a semi-natural floodplain habitat.

Based on site zoning and hydrology, potential future land uses are likely to be limited to:

- Industrial/Commercial Land Use
- Residential Land Use

- Floodplain Habitat

3.1.2 Surface Water System

Chartiers Creek and Sugar Run, which is a tributary to Chartiers Creek, are fairly small streams, although Chartiers Creek becomes a more substantial surface water body farther downstream. Sugar Run flows through Areas 4, 5 and 7. The portions of Areas 4, 5 and 7 near Sugar Run have experienced little industrial activity, except for the deposition of ferromolybdenum slag in a region where Areas 4 and 5 meet. Potential discharges to Sugar Run from Areas 4, 5 and 7 are surface runoff and groundwater recharging the stream.

Chartiers Creek flows onto the site through a tunnel under I-70 and into Area 5, flows to the northwest between the North Tar Pond and South Tar Pond and then flows north along the western bank of the North Tar Pond. The stream continues north, flowing briefly through Area 4, forming the boundary between Areas 3 and 7, flowing under Caldwell Avenue and forming the boundary between Areas 2 and 8. Upstream of Area 5, to the east of I-70, Chartiers Creek flows along the border of the former Pennsylvania Atlas Chemical Company. Throughout Area 5 and into Area 4, tar is visible at locations on the stream bank and, in some cases, in the sediment. There are potentially some locations in Area 5 where tar will still seep into the stream during warmer weather. At all locations where Chartiers Creek flows through the site, shallow groundwater is believed to flow into Chartiers Creek. Stormwater from the remainder of the site discharges to the streams via natural channels and can carry surficial soils into the streams.

3.2 Potential Contaminant Receptors

This section identifies potential receptors and their exposure pathways for different land uses. The exposure pathways identified in this section are discussed in more detail in Section 3.3.

3.2.1 Industrial/Commercial Land Use

Potential Land Use, Receptors and Exposure Pathways

The following groups of individuals are identified as potential receptors under a future industrial/commercial land use scenario:

- <u>Construction Workers</u>: These are individuals who would be engaged in redeveloping portions of the site for industrial or commercial purposes and would be involved in excavating and moving soil. Construction workers could experience direct contact exposures to chemicals in surface soil, unsaturated subsurface soil and saturated subsurface soil, and direct contact exposures to shallow groundwater.

- <u>Outdoor Workers</u>: These are individuals who would work outdoors after portions of the site are redeveloped. Examples include gardeners and landscapers. Outdoor workers could experience direct contact exposures to chemicals in surface soil.

- <u>Indoor Workers</u>: These are individuals who would work indoors after portions of the site are redeveloped. Indoor workers could experience inhalation exposures to chemicals as a result of vapor intrusion into a building.

- <u>Trespassers</u>: These are individuals who would not be authorized to be on the property after it is redeveloped, a typical example being older children who might visit redeveloped portions of the site from time to time. Trespassers could experience direct contact exposures to chemicals in surface soil.

- <u>Excavators</u>: These are individuals who could perform excavation work on portions of the site after they are redeveloped and could include utility workers who maintain subsurface utilities and construction workers who maintain or modify buildings and other structures in the redeveloped area with underground foundations, pipes, vessels, tanks, etc. Excavators could experience direct contact exposures to chemicals in surface soil, unsaturated subsurface soil and saturated subsurface soil, and direct contact exposures to shallow groundwater.

3.2.2 Residential Land Use

The following groups of individuals are identified as potential receptors under a future residential land use scenario:

- Construction Workers: These are individuals who would be engaged in redeveloping portions of the site for residential purposes and would be involved in excavating and moving soil. Construction workers could experience direct contact exposures to chemicals in surface soil, unsaturated subsurface soil and saturated subsurface soil, and direct contact exposures to shallow groundwater.

- Residents: These are individuals who would live on portions of the site after they are redeveloped. Residents could experience direct contact exposures to chemicals in surface soil and, on much rarer occasions, direct contact exposures to chemicals in unsaturated subsurface soil and saturated subsurface soil. Residents could also experience inhalation exposures to chemicals as a result of vapor intrusion into the home. Residents include children.

- Resident Farmers: These are individuals who would live on portions of the site after they are redeveloped and raise livestock and/or grow crops for consumption. Exposure pathways include those listed above for residents as well as ingestion of chemicals that adhere to or are incorporated into plant and animal products produced on the areas redeveloped for agricultural uses.

- Excavators: These are individuals who could perform excavation work on portions of the site after they are redeveloped and could include utility workers who maintain subsurface utilities, and construction workers who maintain or modify the home, multiple occupancy building and/or other structures on the redeveloped area with underground features. Excavators could experience direct contact exposures to chemicals in surface soil, unsaturated subsurface soil and saturated subsurface soil, and direct contact exposures to shallow groundwater.

3.3.3 Floodplain Habitat

The following groups of individuals are identified as potential receptors under a future floodplain habitat land use scenario:

- Visitors: These are individuals, principally children, who could visit the floodplain area for recreational activities. Visitors could experience direct contact exposures to chemicals in surface soil.

- Excavators: These are individuals who could perform excavation work in the floodplain area and could include utility workers who maintain subsurface utilities and construction workers who maintain roads through the floodplain area. Excavators could experience direct contact exposures to chemicals in surface soil and unsaturated subsurface soil and, possibly, direct contact exposures to saturated subsurface soil and shallow groundwater.

- Terrestrial Ecological Receptors: These are plants and animals that would inhabit the floodplain habitat provided by the site. Portions of the floodplain area already provide such habitat. The floodplain area has not entirely reverted to a floodplain habitat because vegetation is periodically cut down in some parts of the floodplain area in anticipation of investigation and possible remediation activities.

3.2.4 Surface Water System

The potential receptors in Chartiers Creak and Sugar Run are:

- Human Receptors: Potential human receptors for the two streams include older children who may play along the stream bank or within streams. In addition, anglers have been observed on rare occasions on the site. It is not known whether the streams support fish that are large enough to eat.

- Ecological Receptors: Potential ecological receptors for the streams are aquatic plants and animals that live in the streams. Other ecological receptors are terrestrial animals that use the streams as a source of food and water.

3.3 Exposure Pathways

This section describes the exposure pathways identified in the preceding section in more detail.

3.3.1 Direct Contact Exposures to Soil

These are exposures associated with soil include the following exposure pathways:

- incidental or accidental ingestion of soil
- dermal contact with soil
- inhalation of chemicals volatilized from soil into the air
- inhalation of chemicals associated with soil that have been emitted into the air

3.3.2 Vapor Intrusion into a Home or Building

This exposure pathway involves the inhalation of chemicals that seep into a home or building from the subsurface. This pathway arises if chemicals are present in unsaturated soil or groundwater below the home or building and these chemicals volatilize into the soil gas, migrate with the soil gas to the basement or foundation slab, and subsequently seep into the home or building through cracks in the basement floor or walls or the foundation slab.

3.3.3 Direct Contact Exposures to Surface Water or Groundwater

These are exposures associated with individuals playing or working in surface water or individuals working in excavations that uncover groundwater and include the following exposure pathways:

- incidental or accidental ingestion of water
- dermal contact with water
- inhalation of chemicals volatilized from water into the air

3.3.4 Direct Contact Exposures to Sediment

These are exposures associated with individuals playing or working in surface water bodies and include the following exposure pathways:

- incidental or accidental ingestion of sediment
- dermal contact with sediment

3.3.5 Direct Contact Exposures to Agricultural Products Grown Onsite

These are exposures associated with individuals that make up part of their diets with products grown on the site and include the following exposure pathways:

- ingestion of plant products grown in contaminated soil
- ingestion of animal products grown onsite using feed derived from potentially contaminated sources or grazing on grasses grown in contaminated soil

3.3.6 Radiation Exposure from Soil

This exposure pathway involves exposure to residual radiation in the soil at the site.

3.3.7 Use of Groundwater as a Source of Drinking Water

Currently, water for drinking and other purposes is supplied to the site by the local municipality. Residences and businesses near the site also receive water from the local municipality for drinking and other purposes.

Groundwater under the site is currently not used as a source of drinking water or for other purposes. If portions of the site are redeveloped for industrial, commercial or residential purposes, water will be supplied by the local municipality. Therefore, all potential exposure pathways associated with the use of groundwater are incomplete.

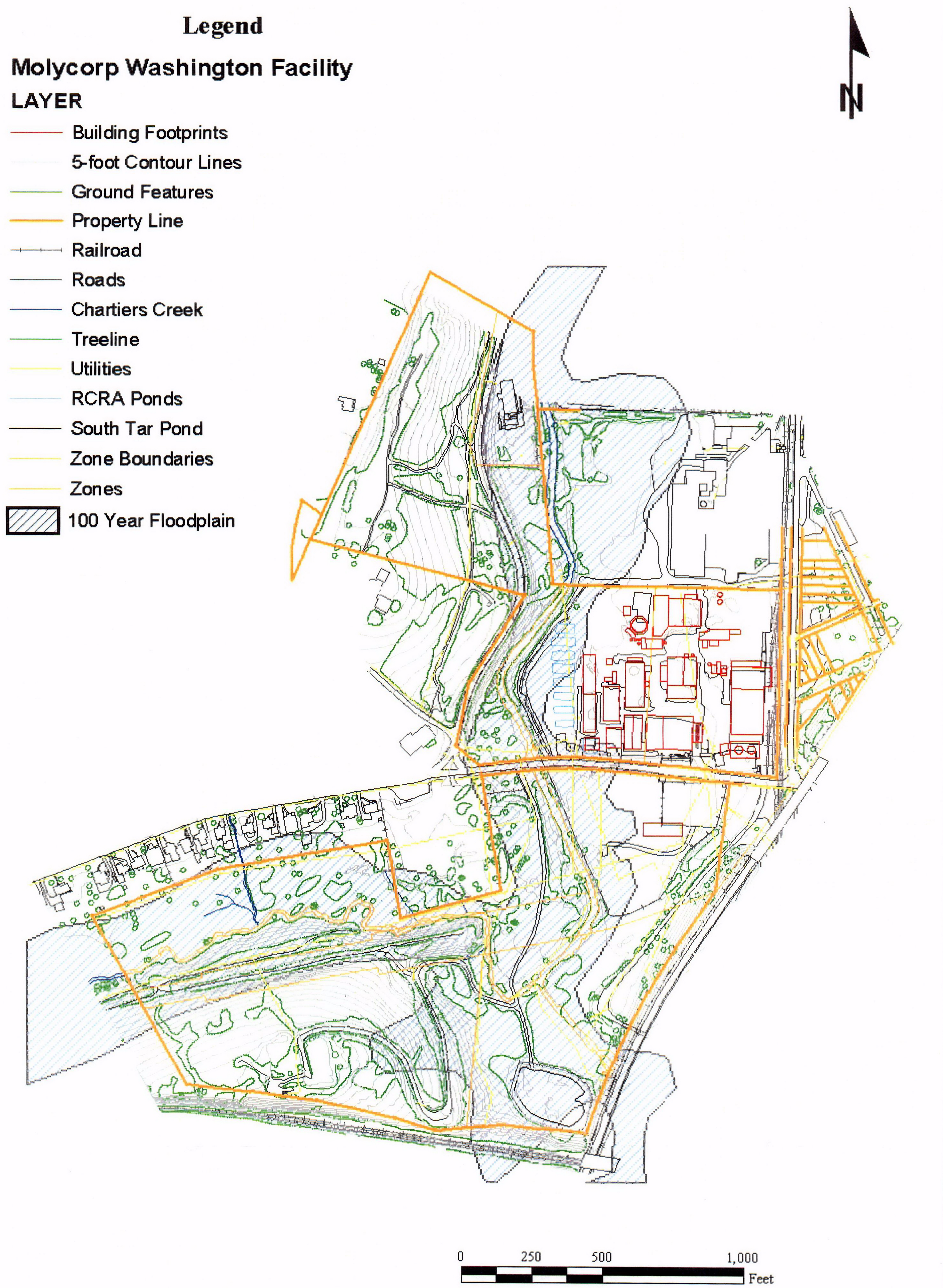

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Figure 3-1 100 Year Floodplain

Molycorp, Inc.

August 2003

C05

Supplemental Characterization Plan

SECTION 4

Constituents of concern at the Molycorp Washington Site consist of radiological materials, non-radiological contaminants, and tar. Some of these constituents coexist in portions of the site and exist separately in other areas. Soils and slags in large portions of the site have been impacted while other areas are unaffected by industrial operations. Similarly, groundwater and surface water have been impacted in some areas of the site and not in others.

As previously discussed, a number of characterization efforts have been completed at the site to address concerns related to specific portions of the site. In developing the current characterization plan, it was desired to maximize use of the large body of data produced in these earlier investigations. Consequently, a comprehensive relational database has been designed and deployed to incorporate the data sets generated in previous investigations. This database has been utilized to guide design of the supplemental characterization set forth herein.

The new database structure incorporates radiological, chemical, tar, geologic, hydrologic, geotechnical, and spatial and geographic information. All newly acquired data will be integrated into the database as the characterization proceeds and will be used to guide adjustments in the investigation as deemed necessary.

4.1 Areas 1, 2 & 3 (Main Plant Areas)

Radiological concerns, primarily thorium, have been the main focus of previous investigations in these areas. However, several issues remain unresolved with respect to radiological characterization:

- Although extensive thorium characterizations utilizing downhole gamma logging measurement are available, they may not be sufficient to develop accurate quantitative volume estimates.
- Uranium concentrations and distributions have not been systematically investigated.
- Secular equilibrium of the uranium chain series has not been established. Conflicting information exists with respect to the equilibrium status of Ra-226.
- Subsurface characterization in footprints of former buildings has not been performed.

The supplemental investigation described below has been designed to address these unresolved issues.

Non-radiological issues in these areas relate to the metals contents of both radiologically impacted and non-radiologically impacted slags throughout the three areas, and possibly some solvent and/or PCB contamination associated with past manufacturing operations—primarily in Areas 1 and 2. Overburden (non-radioactive) characterizations have been performed in Areas 2 and 3 by MFG in 2002. That investigation will be supplemented to include chemical characterization of overburden in Area 1 and similar characterization of radiologically impacted slags in all three areas.

This section describes the planned field investigations for Areas 1, 2 & 3, including the location of borings and groundwater monitoring wells, and the radiological and chemical analysis of soil/slag and groundwater samples (Figures 4-1 and 4-2).

4.1.1 Walk Over Gamma Survey

A 100% coverage walk over survey for detection of gross gamma radiation will be performed in Areas 1, 2 & 3. An additional 10-meter buffer zone on the outside of the site fence also will be surveyed. The survey will provide a gross gamma profile in units of counts per minute (cpm) for the surface of the site.

The area of the site to be surveyed will be defined by standard 10-meter by 10-meter grids. A survey meter equipped with a 2-inch by 2-inch sodium iodide (NaI) detector (e.g., Ludlum Model 2221 Portable Scaler Ratemeter with a Model 44-10 Detector) will be used to perform the survey. Each grid will be surveyed as follows:

- A background count rate (cpm) at 1-meter above the grid surface will be measured and recorded.
- The entire surface of the grid will be scanned by passing the detector slowly across the surface at a rate of lateral motion not to exceed 0.5 meters per second. The face of the detector should be as close to the surface as reasonable, no greater than 10 centimeters from the surface.
- The minimum, maximum and observed average count rate will be recorded for each grid.
- In addition, a 1-minute fixed time contact reading may be taken at each grid node.

Results of the survey will be used to generate a gross gamma radiation profile (in units of cpm) of the impacted areas of the site and the 10-meter buffer zone outside the site fence. This profile may be useful in considering the need to reposition proposed boring locations.

Information developed from the walk over survey may be regarded as a qualitative indication of surface and/or subsurface radioactive material. Quantitative information is complicated by the potential non-homogenous mix of the natural decay chains of uranium and thorium found on site.

4.1.2 Soil/Slag Investigations

4.1.2.1 Area 1

For purposes of designing the sampling and analysis plan, Area 1 has been subdivided into an eastern portion (1A) and a western portion (1B).

Area 1A Description. The original manufacturing buildings were located in the eastern area and remained intact until approximately 1979 at which time, they were demolished and new structures were constructed atop the same locations. These original buildings predate Molycorp (and predecessors) and existed throughout the time period when radioactive slags were produced at the facility. Moreover, it is believed that little or no radioactive fill was placed in this area of the process plant. Therefore, it is unlikely that extensive subsurface radioactive materials contamination exists in this portion of the plant. This hypothesis is supported by previous surveys including the extensive downhole gamma investigations carried out by Foster Wheeler in 1994. The only evidence of thorium contamination observed was in the northern portion (1A-1 in Figure 4-2) of Area 1A where thorium contamination was reported to be in the 5-10 pCi/g range in four locations and west of Building 2 (1A-2) where thorium was present in excess of 10 pCi/g in several locations. All of the remaining soil borings reported in the 1994 investigation of Area 1A contained less than 5 pCi/g of thorium.

Subsequent to demolition of buildings and structures in 2002, final status surveys in building footprints in this area demonstrated the absence of near surface radiological contamination. These areas previously had been inaccessible to subsurface investigations.

In view of historical knowledge and previous downhole gamma survey information, the supplemental subsurface radiological investigation in Area 1A has been designed to focus on development of subsurface information in previously uninvestigated building/structure foundation areas, and in sub areas 1A-1 and 1A-2 where thorium contamination previously was observed or suspected. Additional borings are proposed to confirm previous downhole gamma observations on the absence of thorium contamination in the remainder of the area. In addition, analyses of core borings will be designed to identify and quantify uranium and radium if present in the area. A total of 20 borings are proposed in 1A.

Area 1B Description. Historical information does not support the absence of contamination in the western section of Area 1 (1B). Moreover, previous investigations detected radiological contamination in this section of the process plant. Thorium contamination was found to exist in this area in the 1994 site characterization and elevated readings were evident in the footprints of buildings 1, 37, 31, 21, and 22 subsequent to their demolition in 2002. Therefore, a systematic pattern of borings will be placed in former building footprints and in areas between to define contamination in this area. A total of 28 borings are proposed as shown in Figure 4-2.

Area 1 Investigation Plan. All borings in Area 1 will be advanced utilizing 2 ¼-inch inside diameter (ID) hollow stem augers, to auger refusal and continuous split spoon cores will be obtained from each location. A standard boring log will include a physical description of each core at depth. Cores then will be scanned with a NaI detector to develop a gross gamma radiation profile of the core. This radiation profile will be qualitative in nature because of the non-homogenous mixture of uranium and thorium in the subsurface. However, the information will be useful in understanding subsurface radiation conditions especially as quantitative laboratory information on the radionuclide mix becomes available.

Cores also will be scanned with a photoionization detector (PID) for the presence of organic vapors.

Based upon the radiological core scanning results and guidance from the data manager, one, two or three sections (1-foot to 1-meter in length) of each core will be selected for radiological analysis. Each selected section will be separated from the core, mixed and forwarded to the laboratory for analysis. At the laboratory, a sub-sample will be obtained from 10% of the core samples for isotopic uranium and isotopic thorium determinations by alpha spectroscopy. All core samples will be dried and sealed in gas tight containers. Gamma spectroscopy determinations of U-238 and Th-232 chain components then will be performed on all samples (Table 4-1). Additionally, at least 25% of the samples will be recounted after 21 days to quantitatively determine Ra-226 (from radon and daughters).

This approach is intended to provide relatively rapid reporting of data on uranium and thorium to guide field investigations as they proceed. In addition, it will provide quantitative information on Th-232 chain and U-238 chain equilibrium, the relative mix of Th and U, and the equilibrium status of Ra-226 with respect to the U-238 decay chain. In addition, this data will help define radiologically impacted zone below the water table.

Radiological core scanning results also will be utilized to identify non-radiologically impacted overburden in each core sample to the extent that such overburden exists. Up to two samples of overburden will be selected from ten of the core borings in Area 1: one from the 0-2 foot interval and one from an interval immediately above the interface with the radiologically affected zone. Two additional samples from the radiologically impacted zone in each of the same cores also will be selected. All of these samples will be analyzed for the following metals: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, tin, vanadium and zinc by USEPA SW-846 Method 6010 except for mercury which will be analyzed by USEPA SW-846 Method 7241. This list encompasses all of the metals for which Pennsylvania Act 2 standards exist plus molybdenum.

Based upon organic vapor concentrations, detected by the PID, or in the absence of PID detections, from random locations, five samples from the overburden zone and five samples from radiologically impacted zones will be selected for VOC, SVOC, and PCB analysis. In addition, three samples from each of the two zones will be selected for TCLP (SW-846 Method 1311) and Synthetic Precipitation Leachate Procedure (SPLP) (SW-846 Method 1312) extractions. TCLP extracts will be analyzed for RCRA metals and the SPLP extracts will be analyzed for the same Act 2 metals plus molybdenum by the same procedures as listed above.

All soil cuttings not used in chemical or radiological analysis will be labeled and archived on-site for possible future use.

4.1.2.2 Area 2

This area, west of the original process plant area (Area 1), was a lowland containing ponds of various configurations throughout much of the operating history of the facility. Over the years, this area was filled with various slag byproducts of the manufacturing operations. As the plant expanded westward, buildings were erected above the fill in this area. Eight surface impoundments were constructed along the western boundary near Chartiers Creek in 1968. These impoundments were partially closed in 1995 and backfilled with clean soils.

Given the historical development of this portion of the plant, widespread radiological contamination would be expected throughout the area. This has been confirmed by previous radiological surveys including the extensive characterization study carried out in 1994. In addition, elevated activity levels were evident in the footprints of Buildings 26, 29, 32 and 34 subsequent to their demolition in 2002. Therefore, a systematic pattern of borings will be placed in former building footprints, in areas between, and in the former impoundments to define contamination in this area. A total of 38 borings are proposed for this area as shown on Figures 4-1 and 4-2.

The protocol for obtaining, scanning, sampling and analyzing cores described for Area 1 will be utilized in Area 2 with the modifications noted below.

Because a prior investigation conducted by MFG has addressed the chemical characteristics of the overburden in this area, their work will not be repeated. Rather, two overburden samples in proximity to locations sampled and analyzed in the MFG study will be analyzed for the same suite of Act 2 metals plus molybdenum for reference purposes. Twenty samples from ten borings in the radiologically impacted zone in Area 2 will be analyzed for metals. Five samples from the radiologically impacted zone also will be analyzed for VOCs, SVOCs and PCBs. In addition, three samples will be selected for TCLP and SPLP extractions and appropriate metals analysis.

4.1.2.3 Area 3

This area south of Caldwell Avenue was the site of a former pile containing thoriated slag. The pile was located in the western part of the area adjacent to Chartiers Creek. To the east of the former pile location, is the site of a former pond that received ball milled slag in the form of a slurry. Farther east, in the central portion of the site is the former location of Building 39 that was utilized to store spare parts.

The 1994 characterization revealed widespread thorium contamination throughout the area with the exception of a zone in the southeastern section and another zone in the northeastern portion of the area both of which were reported to have thorium concentrations below 10 pCi/g.

MFG conducted an overburden investigation in this area at the same time as the one conducted for Area 2.

The proposed investigation consists of placing 33 borings in Area 3 as shown on Figures 4-1 and 4-2. These borings will be placed systematically to focus most heavily on the zones of known contamination (e.g., former slag pile, former ball mill pond) and are placed more sparsely in areas believed to be relatively clean based upon available downhole gamma information.

Planned boring, scanning, sampling and analytical protocols are identical to those described for Area 2.

4.1.3 Groundwater Monitoring

As previously discussed, an extensive groundwater monitoring system had been installed in Areas 1, 2 and 3 over the course of several prior investigations. However, due to construction activities associated with demolition of buildings in these areas, a number of the existing monitoring wells were reported to be destroyed. In order to determine which monitoring wells had been destroyed and which were available for use in this supplemental characterization, a site walkover was performed to locate and inspect previously existing monitoring wells.

Several of the monitoring wells could not be located and were assumed to have been destroyed based on the general condition of the areas adjacent to the approximate locations of the monitoring wells in question. These wells included monitoring wells MW-8, MW-11, MW-13, MW-14, MW-15, MW-15S, MW-17, and MW-20. Additionally, Monitoring Well UG-2, which was installed along the B&O Railroad spur line to the east of Area 1 was backfilled with bentonite and was considered destroyed. Several other wells (MW-7, MW-9, MW-9S, MW-12, MW-18S, MW-23, and UG-3) could not be located due to being concealed by vegetative cover, soil and fill material, or stacked PVC pipes. An attempt will be made to locate and properly abandon the old wells that are not usable in this characterization.

Monitoring wells that were located were inspected in an attempt to determine what re-development or repairs would be required to ensure their integrity. The inspection consisted of checking to see if an expandable locking cap was present at each well head, depth to groundwater and total depth measurements, condition of the bottom of the well, and the condition of the PVC riser pipe, steel outer casing, lock, and concrete drainage pad. Any wells that required maintenance were noted and maintenance activities will be completed prior to any new monitoring activities.

4.1.3.1 Monitoring Well Installation

A total of thirteen new groundwater monitoring wells are proposed to be installed in Areas 1, 2, and 3, three of which will be completed in bedrock. Of these thirteen new monitoring wells, four will be installed to replace monitoring wells that were destroyed or damaged during preliminary site decommissioning. In addition, two monitoring wells, an overburden (fill) and a bedrock well will be installed to the east of Area 1 in Area 9. The purpose of these wells is to provide background information on the quality of groundwater entering the former process area from the east. Tentative locations of these new and replacement wells are illustrated on Figures 4-1 and 4-2; however, the exact location of the wells will be determined in the field based on observations made during soil boring activities.

The bedrock monitoring wells are being installed to ensure that there has been no vertical migration of any of the contaminants of concern.

Additionally, a bedrock monitoring well is being installed to the West of Area 2, across Chartiers Creek, in Area 8. This well is being installed to ensure contamination from the site has not impacted bedrock groundwater quality downgradient from the former manufacturing area. Further the new bedrock well is being installed adjacent to a shallow, overburden well to determine the rate of vertical migration and to determine if Chartiers Creek acts as a hydrogeologic divide.

Groundwater monitoring wells will be installed in accordance with field practices utilizing 4 ¼-inch ID hollow stem augers with soil samples being collected every two-feet with split-spoon samplers. A detailed description of soil sampling and monitoring well installation procedures are presented in the Field Procedures (FP) manual contained in Appendix B. Each monitoring well will be completed with 10-feet of 0.01 inch slotted PVC well screen and an appropriate length of PVC riser pipe to extend 3 feet above the ground surface. Each screened section will be installed to assure that at least 2-feet of screen is above the water table. Once all of the monitoring wells have been installed, each well will be developed in accordance with the well development procedures provided in the FP manual (Appendix B).

4.1.3.2 Sampling and Analysis

All of the previously existing wells as well as the newly installed wells will be purged using low-flow sampling techniques prior to sampling. Purging will continue until the field parameters (i.e., pH, temperature, specific conductivity, oxidation-reduction potential, and dissolved oxygen have stabilized to the guidelines detailed in the FP manual (Appendix B). Once the wells have been sufficiently purged to ensure that a representative groundwater sample will be obtained, samples will be collected and analyzed for the parameters detailed in Table 4-2. These parameters include VOCs, SVOCs, Act 2 total metals, molybdenum and gross alpha. If gross alpha is detected above 5 pCi/l above background in any of the samples, those samples will be submitted for analysis of radium 228, radium 226, and isotopic uranium. However, if gross alpha is not detected above 5 pCi/l above background at least 25% of the groundwater samples will be selected for analysis of radium 228, radium 226, and isotopic uranium, Furthermore, samples for polychlorinated biphenyls (PCBs) analysis will be collected from two monitoring wells in Areas 1 and 2 to assure that no release of PCBs has occurred from transformers that were previously on site.

4.2 Area 4 (Tylerdale Connecting Railroad)

Area 4, which consists of the former Tylerdale Connecting Railroad right-of-way, effectively bisects Area 7 into a northern and southern portion. The tracks previously located in this area have been removed and natural vegetation has begun to reclaim the land. Since this area was an active rail line during much of the production era at Molycorp, it is unlikely that the manufacturing process impacted this area. However, refractory brick and glass manufactured at the Hazel-Atlas Glass Manufacturing Plant has been identified along the southern slope of the right-of-way adjacent to the access road in Area 7. Some of this glass was colored with carnolite, a yellowish/greenish uranium ore, resulting in the glass being slightly radioactive albeit in a vitrified form. This debris material is believed to be naturally occurring radioactive material (NORM) or technically enhanced NORM (TENORM) and was not licensed material. Two samples of the material will be taken and analyzed by gamma spectroscopy to establish the average concentration of uranium and/or thorium inherent in the material. In addition, NORM in the form of refractory brick is located in this area. Two samples of the brick also will be analyzed by gamma spectroscopy to determine the average concentration of uranium and/or thorium.

Based on the historical use for this area, few previous investigations were conducted in this area of the site. In 1996, ICF Kaiser installed two bedrock monitoring wells in the railroad right-of-way; however, no soil (overburden) or groundwater samples were collected for chemical analysis. Previously, Foster Wheeler had installed two soil borings and collected down hole gamma readings.

4.2.1 Soil Investigation

In an attempt to determine if past railroad activities have adversely impacted the area, surface soil (0-2 feet) samples will be collected from three locations. The collected samples will be analyzed for VOCs, SVOCs, PCBs and Act 2 metals. Since historical data indicates that no licensed material had been stored or disposed of in this area of the site, no radiological sampling will be conducted.

4.2.2 Groundwater Monitoring

No new groundwater monitoring wells are proposed for Area 4; however, the two existing bedrock monitoring wells will be redeveloped using the same procedures that will be used to develop the newly installed monitoring wells in the other areas of the site. Following redevelopment activities and the synoptic water level measurements of all site wells, each of these monitoring wells will be sample using low flow techniques and analyzed for VOCs, SVOCs, Act 2 total metals, PCBs, and gross alpha. If gross alpha is detected above 5 pCi/l above background in any of the samples, those samples will be submitted for analysis of radium 228, radium 226, and isotopic uranium. However, if gross alpha is not detected above 5 pCi/l above background one of the groundwater samples will be selected for analysis of radium 228, radium 226, and isotopic uranium.

4.3 Area 5 (Tar Ponds)

Most of Area 5 lies in the floodplain of Chartiers Creek. This area is zoned for mixed use, which includes residential and nonresidential uses. However, since this area lies in the floodplain of Chartiers Creek and is bordered by I-70 to the east, a railroad embankment to the south and a steep hill to the west, redevelopment of this area is probably greatly limited. Thus, it is likely that the use of this area will remain the same in the future – essentially a semi-natural floodplain habitat. Water is supplied to the site by the local municipality, so groundwater on the site is not used as a source of drinking water and would not be used as a source of drinking water in the future.

This section describes the planned field investigation for Area 5, including the location of soil borings and groundwater monitoring wells, and the chemical analysis of soil and groundwater samples. For the purpose of developing the sampling and analysis plan for Area 5, this area has been subdivided into five smaller sub-areas (Figure 4-3):

Area 5A (South Tar Pond)

Area 5B (North of the South Tar Pond) – the area to the north of the South Tar Pond extending to Chartiers Creek and Sugar Run

Area 5C (Eastern North Tar Pond) – the portion of the North Tar Pond to the east of the service road, between the service road and I-70

Area 5D (Western North Tar Pond) – the portion of the North Tar Pond to the west of the service road

Area 5E (Across the Creeks) – the property across Chartiers Creek and Sugar Run from the Tar Pond area

4.3.1 Soil Borings and Soil Samples

This section describes the proposed soil borings and soil samples for chemical characterization. Not all soil samples will be analyzed for the same parameters. Table 4-1 presents the number of soil samples that will be subjected to various chemical analyses. The rationale for the proposed sampling and analysis program is discussed below.

Area 5A (South Tar Pond). Tar-impacts have been noted throughout the unsaturated soil in the South Tar Pond. Also, tar-impacts have been noted in the saturated zone in soil borings by SRW and ICF Kaiser. Based on these observations, the general approach for characterizing soil in the South Tar Pond is:

Characterize unsaturated soil to allow remediation options to be evaluated.

Characterize the nature and extent of possible impacts in saturated soil.

The proposed soil boring program for the South Tar Pond involves the following:

Complete five geoprobe soil borings in the South Tar Pond to refusal.

Characterize possible impacts in each boring based on field observations (sight and smell).

Collect one representative sample of unsaturated soil for chemical analysis, including remediation parameters.

Collect three samples, one each from the three soil borings with the most impacted saturated soil based on field observations, and submit the samples for chemical analysis.

In each boring, determine the deepest point where there is visual evidence of impacts and collect a sample about 6 inches deeper for chemical analysis.

Table 4-1 summarizes the analyses proposed for the soil samples collected from the South Tar Pond.

Area 5B (North of the South Tar Pond). Tar-impacts have been noted in unsaturated and saturated soil by SRW and ICF Kaiser in soil borings immediately outside the South Tar Pond. However, no evidence of impacts were noted in two soil borings completed along the creeks, SRW-4 and SRW-5. In at least one location along the bank of Chartiers Creek, tar appears to be seeping out, so there may be some subsurface tar impacts near the creek. Non-radioactive ferromolybdenum slag used to construct the access road in this area has not been characterized.

The observations of tar occurrence could be explained by two hypotheses concerning subsurface conditions. According to the first hypothesis, subsurface tar impacts are highly localized around the South Tar Pond and the border with I-70. The seep of tar into Chartiers Creek could be the result of Chartiers Creek being re-routed by Penn DOT when I-70 was constructed. In their report, SRW suggests that the original North Tar Pond may have extended a bit further to the south and Penn DOT may have re-routed Chartiers Creek through a portion of this pond. If this were the case, the tar seeping into Chartiers Creek could be manifestations of the southern edge of the original North Tar Pond. According to the second hypothesis, subsurface tar impacts are more widespread throughout this sub-area and any tar seeping into Chartiers Creek from this sub-area is indicative of this widespread impact.

Currently, there is insufficient data to determine if either (or neither) of these hypotheses is correct. As such, the general approach for characterizing soil North of the South Tar Pond is to complete soil borings to determine the areal and vertical extent of potential surface and subsurface impacts so as to determine if either of these hypotheses is correct.

In addition, there are limited data on the chemical characteristics of the ferromolybdenum slag material used to build the access road. Also, it is possible that surface soil in this sub-area is relatively free of tar impacts, even in places where there may be tar impacts in the subsurface. Thus, chemical analysis of surface soil is needed to assess potential exposures and risks associated with possible future land uses.

Prior to installing any soil borings, a systematic walk over will be conducted for this sub-area and locations where there is visible evidence of tar on the surface it will be noted on a map. Also, any areas where tar is seeping from the South Tar Pond or the embankment of I-70 will be noted on a map. Finally, any areas where tar possibly is seeping into Chartiers Creek will be noted on a map.

Initially, soil borings will be installed at four locations along Chartiers Creek, two locations in the access road and at one upgradient location to the west of the South Tar Pond. At two locations along the creek, the borings will be completed as wells with an overburden well and bedrock well at one of these locations and an overburden well at the other location. At the upgradient location to the west of the South Tar Pond, borings will be completed as overburden and bedrock wells. The proposed field activity for each of these borings is as follows:

Complete each soil boring to auger refusal.

Characterize possible impacts in each soil boring based on field observations (sight and smell).

If there is field evidence of impacts in the top 2 feet, do not collect a surface soil (0-2 feet) sample. Otherwise, collect a surface soil (0-2 feet) sample for chemical analysis.

For subsurface characterization:

If there is field evidence of impacts below 2 feet, then:

- Collect a sample from the most impacted zone for chemical analysis.
- Determine the deepest point where there is field evidence of impacts and collect a sample about 6 inches deeper for chemical analysis.

If there is no field evidence of impacts below 2 feet, then:

- Collect a sample from the water table for chemical analysis.
- Collect a sample from the bottom of the boring for chemical analysis.

An additional 19 soil borings will be completed in this sub-area for field characterization. If there is evidence of tar seeping into Chartiers Creek, one boring will be completed near each seep to investigate subsurface conditions at these locations. Each soil boring will be completed to refusal and possible impacts in each boring will be characterized based on field observations (sight and smell). Results of this field characterization will be used to qualitatively delineate the areal and vertical extent of possible impacts. In particular, two locations with the highest saturated zone impacts based on field observations will be identified and locations with no evidence of impacts in the saturated zone also will be noted.

After this qualitative characterization has been completed, six additional soil borings will be completed: two at the locations with the highest observed saturated zone impacts and four at locations with no evidence of impacts in the saturated zone. The latter should define the edge of impacts in the saturated zone based on field observations. The proposed sampling program for each of these borings is as follows:

Complete each soil boring to refusal.

Characterize possible impacts in each soil boring based on field observations (sight and smell).

If there is field evidence of impacts in the top 2 feet, do not collect a surface soil (0-2 feet) sample. Otherwise, collect a surface soil (0-2 feet) sample for chemical analysis.

For subsurface characterization:

If there is field evidence of impacts below 2 feet, then:

- Collect a sample from the most impacted zone for chemical analysis.
- Determine the deepest point where there is field evidence of impacts and collect a sample about 6 inches deeper for chemical analysis.

Otherwise, if there is no field evidence of impacts below 2 feet, then:

- Collect a sample from the water table interface for chemical analysis.
- Collect a sample from the bottom of the boring for chemical analysis.

Up to five additional surface soil samples (0-2 feet) will be collected from unimpacted locations (based on field observations) to provide spatial coverage in this sub-area. These samples will be chemically analyzed.

To characterize the chemical composition of the ferromolybdenum slag material that was used as the foundation for the access road to the South Tar Pond, two soil borings will be completed in the access road. Each boring will be completed to auger refusal and two samples will be collected for chemical analysis. A sample of the slag material and a sample of native soil directly beneath the slag will be collected and analyzed for Act 2 metals plus molybdenum.

Table 4-1 summarizes the analyses proposed for the soil samples collected from Area 5B. Locations where overburden and bedrock wells are installed together are considered the same location, so samples for chemical analysis will be collected from only one of the borings to characterize a particular depth increment.

Area 5C (Eastern North Tar Pond). Tar-impacts were noted in unsaturated and saturated soil by SRW in a soil boring from this sub-area. However, the nature and extent of possible impacts to the north along I-70 have not been determined. Consequently, the general approach for this sub-area is to characterize the nature of impacts in the portion of this sub-area where there was historical evidence of impacts and determine the extent of possible impacts to the north along I-70.

Prior to installing any soil borings, a systematic walk over will be conducted and locations of visible tar on the surface will be noted on a map. Also, areas where tar is seeping from I-70 will be mapped.

One soil boring will be installed where tar impacts previously were noted (in the general vicinity of SRW-1) to investigate potential impacts at this location. Proposed field activities for this boring are as follows:

Complete the soil boring to refusal.

Characterize possible impacts in the soil boring based on field observations (sight and smell).

Collect three soil samples from the boring:

- One surface soil (0-2 feet) sample for chemical analysis.
- One subsurface soil sample from the most impacted portion of the boring for chemical analysis.
- Determine the deepest point where there is field evidence of impacts and collect one sample about 6 inches deeper for chemical analysis.

A second boring will be completed north of this boring. In this boring, possible impacts will be characterized based on field observations (sight and smell). If there is no evidence of impacts based on field observations, no additional soil borings will be completed in this sub-area. If there is evidence of potential impacts, additional borings will be completed north of this boring between the service road and I-70 until a boring is completed with no evidence of impacts based on field observations.

Table 4-1 summarizes the analyses proposed for the soil samples collected from the Eastern North Tar Pond sub-area.

Area 5D (Western North Tar Pond). Tar-impacts were noted by SRW in a soil boring in the middle of this sub-area (SRW-7) and in soil borings along Chartiers Creek (SRW-2 and SRW-3). Tar impacts were noted to an approximate depth of ten feet into the saturated zone.

Tar impacted surficial soil (i.e., unsaturated soil) was removed from the center of this sub-area (around soil boring SRW-7) in 1985 and the area was covered with a layer of slag approximately one foot thick which in turn was covered by soil. At several locations along the service road and at one or more locations along the bank of Chartiers Creek, tar seeps have been noted. Also, a 24-inch diameter drainage pipe running from Area 5C, under the service road from Area 5C to Area 5D has tar in it. In the northern portion of this sub-area, non-radioactive ferromolybdenum slag was deposited from 1985 to 1991, raising the grade.

These observations suggest that subsurface impacts are widespread in this sub-area and that tar is migrating from Area 5C to this sub-area through seeps along the service road and tar discharging through the drainage pipe. Tar also appears to be seeping into Chartiers Creek at one or more locations. Because of the removal action conducted in 1985, much of the surface soil in this area could be unimpacted.

Based on this overview of this sub-area, the objectives for characterizing soil in the Western North Tar Pond are to:

Characterize surface soil to determine if it is impacted.

Characterize subsurface conditions across the sub-area, but particularly in the vicinity of the service road and along the bank of Chartiers Creek.

Characterize the slag material deposited in this area.

Prior to installing any soil borings, a systematic walk over will be conducted and locations where there is visible evidence of tar on the surface will be mapped. Also, areas where tar is seeping from the service road will be noted. Finally, any areas where tar is possibly seeping into Chartiers Creek will be noted on a map.

Soil borings will be completed at five locations along the border with Chartiers Creek. At one of these locations, the boring will be completed as an overburden monitoring well. The northern-most boring along Chartiers Creek will need to be relocated further to the north if there is evidence of impacts in the soil boring based on field observations. In addition, two soil borings will be completed in the area where slag was deposited, one soil boring will be installed along the border with the service road and two borings will be installed in the center of the former removal area. At this last location, the borings will be completed as overburden and bedrock wells. The proposed field activities for each of these borings is as follows:

Complete each soil boring to refusal.

Characterize possible impacts in each soil boring based on field observations (sight and smell).

If there is field evidence of impacts in the top 2 feet, do not collect a surface soil (0-2 feet) sample. Otherwise, collect a surface soil (0-2 feet) sample for chemical analysis.

For subsurface characterization:

If there is field evidence of impacts below 2 feet, then:

- Collect a sample from the most impacted zone for chemical analysis.
- Determine the deepest point where there is field evidence of impacts and collect a sample about 6 inches deeper for chemical analysis.

Otherwise, if there is no field evidence of impacts below 2 feet, then:

- Collect a sample from the water table interface for chemical analysis.
- Collect a sample from the bottom of the boring for chemical analysis.

If there is evidence of tar seeping into Chartiers Creek, one boring will be completed near each seep to characterize subsurface conditions. Possible impacts in each boring will be characterized based on field observations (sight and smell).

Eight additional surface soil samples (0-2 feet) will be collected from the area between the service road and Chartiers Creek to provide spatial coverage in this sub-area. If there is evidence of impacts based on field observations, the sample will be relocated to another location until an unimpacted sample is obtained. Eight surface soil samples will be chemically analyzed.

To characterize the non-radioactive ferromolybdenum slag that was placed as fill, two soil borings will be completed in this sub-area. The soil borings tentatively have been located between the North Tar Pond and Area 3 as illustrated on Figure 4-3. Each boring will be advanced to refusal and a sample of the slag material will be collected and submitted for analysis of Act 2 total metals plus molybdenum.

Table 4-1 summarizes the analyses proposed for the soil samples collected from Area 5D. As discussed previously, locations where an overburden well and bedrock well are co-installed are considered the same location with respect to collecting soil samples to characterize various depth increments.

Area 5E (Across the Creeks). This area was part of the 1976 Morris Farm purchase. Non-radioactive ferromolybdenum slag fill was placed in this area in the 1976-1985 period. There is no historical record of tar impacts in this area. However, because tar generally is denser than water, it is theoretically possible that tar could have migrated in the saturated zone from the Western North Tar Pond sub-area under Chartiers Creek to the saturated zone in this sub-area. Consequently, information is needed on subsurface conditions to determine if tar has migrated under Chartiers Creek.

Prior to installing any soil borings, a systematic walk over will be conducted and locations where there is visible evidence of tar on the surface will be noted on a map. Since there is no historical evidence of tar impacts in this sub-area, such visible evidence of tar impacts is not expected.

The field program for this sub-area will involve completing one soil boring along Chartiers Creek. The proposed field activities for the boring is as follows:

Complete each soil boring to refusal.

Characterize possible impacts based on field observations (sight and smell). As discussed above, evidence of tar impacts is not expected in the unsaturated soil.

For characterization of the saturated zone:

If there <u>is</u> field evidence of impacts in the saturated zone, then:

- Collect a sample from the most impacted zone for chemical analysis.
- Determine the deepest point where there is field evidence of impacts and collect a sample about 6 inches deeper for chemical analysis.

If there is <u>no</u> field evidence of impacts in the saturated zone, then:

- Collect a sample from the water table interface for chemical analysis.

- Collect a sample from the bottom of the boring for chemical analysis.

If there is evidence of tar impacts in the saturated zone, additional soil borings will be completed to delineate the extent of these impacts. However, the number and placement of such borings will be determined in the field.

To characterize the non-radioactive ferromolybdenum slag that was deposited in this portion of the site from 1976 through 1985, three soil borings will be installed. Each boring will be completed to auger refusal and samples of the slag material and the native soil directly beneath the slag will be analyzed for Act 2 metals plus molybdenum.

4.3.2 Groundwater Monitoring

In order to determine the tar impact on groundwater quality in Area 5, eight groundwater monitoring wells will be installed. Five of the wells will be installed to monitoring conditions in the alluvial aquifer (water table) while the remaining three will be completed in bedrock to determine if tar constituents have migrated vertically to this aquifer system. The tentative locations of the monitoring wells are illustrated on Figures 4-1 and 4-3, but the exact location will be dictated by field conditions and results of the soil boring activities.

The eight groundwater monitoring wells will be installed in accordance with accepted practices utilizing hollow stem augers with samples being collected every two-feet with split-spoon samplers. Detailed descriptions of soil sampling and monitoring well installation procedures are presented in Appendix B. Each monitoring well will be completed with 10-feet of 0.01 inch slotted PVC well screen and an appropriate length of PVC riser pipe to reach 3 feet above the ground surface. Each screened section will be installed to ensure that at least 2-feet of screen is above the water table.

Once all of the monitoring wells have been installed, Malcolm Pirnie personnel will develop each well in accordance with the well development procedures provided in the FP manual (Appendix B). Subsequent to well development, a synoptic round of groundwater measurements will be collected and each monitoring well, (including monitoring well GW-3 installed by SRW) will be purged using low-flow sampling techniques. Purging will continue until field measurements (i.e. pH, temperature, conductivity, oxidation-reduction potential, and dissolved oxygen) have stabilized. Once the wells have been sufficiently purged to ensure that a representative groundwater sample will be obtained, samples will be collected and analyzed for the parameters detailed in Table 4-2. These parameters include BTEX, CN, PAH, phenolics, RCRA metals and gross alpha. If gross alpha is detected above 5 pCi/l above background in any of the samples, those samples will be submitted for analysis of radium 228, radium 226, and isotopic uranium. However, if gross alpha is not detected above 5 pCi/l above background one of the groundwater samples will be selected for analysis of radium 228, radium 226, and isotopic uranium.

4.4 Area 6 (Streams)

Chartiers Creek and Sugar Run, which is a tributary to Chartiers Creek, are fairly small streams, although Chartiers Creek becomes a more substantial surface water body much farther downstream. Sugar Run flows through Areas 4, 5 and 7. The portions of Areas 4, 5 and 7 near Sugar Run have experienced little industrial activity, except for the deposition of slag in a region where Areas 4 and 5 meet. Potential discharges to Sugar Run from Areas 4, 5 and 7 are surface runoff and groundwater recharge.

Chartiers Creek flows through a tunnel under I-70 and into Area 5. The stream flows to the northwest between the North Tar Pond and South Tar Pond, then flows north along the western bank of the North Tar Pond. The stream continues north, flowing briefly through Area 4, forming the boundary between Areas 3 and 7, flowing under Caldwell Avenue and forming the boundary between Areas 2 and 8. Chartiers Creek continues to the northeast and ultimately discharges to the Ohio River.

Upstream of Area 5, to the east of I-70, Chartiers Creek flows along the border of the former Pennsylvania Atlas Chemical Company. Throughout Area 5 and into Area 4, tar is visible at locations on the stream bank and, in some cases, in the sediment. There potentially are some locations in Area 5 where tar will still seep into the stream during warmer weather. At all locations where Chartiers Creek flows through the site, shallow groundwater is believed to flow into Chartiers Creek.

In 1994 and 1997, surface water samples were collected from upstream and downstream locations both in Chartiers Creek and Sugar Run. Analytical results of samples collected in Chartiers Creek indicated the presence of several metals, including molybdenum, selenium and magnesium at slightly elevated concentrations. Radionuclides, including Ra-228, Ra-226, U-234 and U-238, also were detected at low levels in both Chartiers Creek and Sugar Run surface water samples.

Sediment samples were collected from upstream and downstream locations both in Chartiers Creek and Sugar Run. Analytical results of samples collected in Chartiers Creek indicated the presence of Th-232 at low concentrations. Low concentrations of Ra-228 were detected in the Sugar Run sediment samples.

4.4.1 Systematic Walkover

Prior to collecting any surface water and sediment samples from Chartiers Creek and Sugar Run, a systematic walkover will be conducted for both streams. Starting at a downstream location on Chartiers Creek and walking upstream, the stream bank will be observed and any evidence of impacts (e.g., tar) will be noted on a map. Also, any evidence of pipes ending at the creek or crossing the creek will be noted on a map. If there are flows from the pipe, this will be noted. In addition, areas with significant sediment deposition will be noted on a map and all sediment will be scanned for visual evidence of impacts. Periodically during the walk, the sediment will be stirred up to allow the observation of tar or other impacts just below the sediment surface. Any evidence of such impacts will be noted on a map. The walkover of Chartiers Creek will extend a couple hundred feet upstream of the site, to the southeast of I-70. A similar walk over will be conducted of Sugar Run extending a couple hundred feet upstream, to the west of the site property boundary.

Following the walkover of the two streams, the field observations will be evaluated to determine if there are stretches of the stream with continuous impacts, particularly evidence of tar impacts in sediment in Areas 4 and 5.

4.4.2 Surface Water and Sediment Sampling

To determine if site-related contaminants are present in surface water and sediments of the two streams that traverse the site (Sugar Run and Chartiers Creek), multiple samples of these media will be collected from both streams. A total of 13 surface water/sediment sampling locations have been selected along the approximately 4,000 feet of total on-site stream channel to provide characterization of upstream, on-site, and downstream conditions (Figure 4-1). Actual sample locations will be adjusted in the field based on the walkover. Where possible, sampling locations will be in close proximity to stream sampling locations used in prior studies. To obtain data on background conditions, three of the surface water and sediment samples will be collected upstream of the site in Chartiers Creek. All of the proposed surface water and sediment samples will be collected on the same day to provide more comparative results. Surface water samples will be collected at the same locations as corresponding sediment samples and at the same time. Sample collection procedures are provided in Appendix B (Procedures S04 and S05).

4.4.3 Proposed Sample Analyses

All of the surface water and sediment samples will be analyzed for VOCs, SVOCs, and Act 2 metals plus molybdenum. In addition, all surface waters will be analyzed for Gross alpha radiation. Any surface water samples with 5 pCi/l above background or greater of gross alpha radiation also will be submitted for analysis of Radium 228, Radium 226, and Isotopic Uranium. Furthermore, eight of the sediment samples (all from within Chartiers Creek) will be submitted for analysis by gamma spectroscopy – U-238, U-234, U-235, Th-232, Th-228, Ra-226, and Ra-228 with ingrowth. Eight sediment samples (three from Sugar Run and 5 from Chartiers Creek) will be submitted for analysis of PCBs. A summary of proposed analyses for surface water and sediment samples is provided in Tables 4-1 and 4-2.

4.4.4 Stream Flow Measurement

Stream flow measurements will be made at six profile locations, two in Sugar Run and four in Chartiers Creek (Figure 4-1). The number and locations of these profiling sites were selected to most efficiently characterize the water flow onto, within, and exiting the site property. Procedures for collection of the field data and reduction of that data are provided in detail in Appendix B (Field Procedure # M01). Permanent staff gages will be installed at each of the stream flow measurement locations so that if more than one round of flow measurements are collected, flow can be estimated in the future based solely on water elevations at the staff gages.

4.5 Area 7A (Foundation)

Area 7A is the southern portion of the hill area which contains an old foundation. The area currently is not used, is surrounded by forest, and probably would revert to forest except that vegetation in the area periodically is cut in anticipation of investigation and possible remediation. While currently unused, this area is zoned for residential use. There is very limited access to this area currently. Residential areas exist to the south, but this area is separated from these residences by B&O railroad tracks.

This section describes the field investigation for Area 7A, including the location of test pits, soil borings and groundwater monitoring wells, and the chemical analysis of soil and groundwater samples. For the purpose of developing the sampling and analysis plan, this area has been divided into two smaller sub-areas:

- Old Foundation
- Low Lying Sub-Area – the area to the west of the Old Foundation which is at a slightly lower elevation where an aboveground tank may have been located

4.5.1 Test Pits, Soil Borings and Soil Samples

The Old Foundation is located on a plateau. Prior to excavating any test pits or installing any soil borings, a systematic walk over will be conducted for the entire plateau and locations where there is visible evidence of tar on the surface will be noted on a map.

The remainder of this section describes the proposed test pits, soil borings and soil samples for the Foundation area. As with Area 5, not all soil samples will be analyzed for the same parameters. While Table 4-1 summarizes the number of soil samples that will be subjected to each analysis. The rationale for collecting soil samples and their analysis is provided in the discussion below.

Old Foundation. As discussed previously, the Old Foundation had concrete walls approximately 20 to 24 inches thick, with approximately 5 feet of the walls aboveground and five feet below ground. Approximately one foot of tar was on the bottom of the Old Foundation. Around 1986, Molycorp knocked in the portion of the walls above the surface and filled in the Old Foundation with soil. As the soil settled, tar seeped up to the surface and began flowing over the walls in some locations. Subsequently, Molycorp dug a trench around the Old Foundation to collect tar that might flow over the walls. Molycorp also excavated some tar impacted soil outside of the wall and placed it inside the Old Foundation.

The Old Foundation has not been investigated previously. Thus, the general approach for characterizing soil in and around the Old Foundation is to:

- Characterize material within the Old Foundation to allow remediation options to be evaluated.

- Determine the limits of tar-impacted soil around the Old Foundation.

- Collect sufficient soil analytical data to allow remediation options to be developed that would either allow this sub-area to be redeveloped or revert to a forest habitat.

To characterize soil within the Old Foundation, a composite sample will be collected of moderately to heavily impacted surface soil in the Old Foundation. This sample will be submitted for chemical analysis.

To characterize the extent of tar impacts outside the Old Foundation, seven test pits will be excavated to approximately 8 to 10 feet in this area. The proposed field activities for each test pit are:

- Extend the test pit in a direction away from the Old Foundation until un-impacted soil is encountered from the bottom to the top of the test pit based on field observations (sight and smell).

- Collect two samples at the end of the test pit with no impacts (i.e., the end away from the Old Foundation), one surface soil sample (0-2 feet) and one subsurface soil sample from the bottom of the test pit.

- Submit both samples for chemical analysis.

Table 4-1 summarizes the analyses proposed for the soil samples collected from the Old Foundation sub-area.

Low Lying Sub-Area. There is an area west of the Old Foundation which is at a lower elevation than the Old Foundation and may have been the location of a tank based on recollections of a former Hazel-Atlas employee. This area has not been characterized, so the objective of the field program in this sub-area will be to characterize the nature and extent of possible impacts.

Five soil borings will be installed in this area. The proposed field activities for each of these borings is as follows:

- Beginning closest to the Old Foundation and working outward, complete each soil boring to refusal.
- Characterize possible impacts in each soil boring based on field observations (sight and smell).
- If there is evidence of impacts in a soil boring at any depth, relocate the soil boring until there is no evidence of impacts based on field observation.
- From up to five soil borings without any evidence of impacts based on field observations, collect one surface soil sample (0-2 feet) and one subsurface soil sample from the bottom of the boring.
- Submit both soil samples for chemical analysis.

Table 4-1 summarizes the analyses proposed for the soil samples collected from the Low Lying Sub-Area.

4.5.2 Groundwater Monitoring

No new groundwater monitoring wells are proposed for this portion of the site; however, ICF Kaiser installed three bedrock monitoring wells in 1996 as part of their environmental investigation. Each of these monitoring wells will be re-developed using the same procedures that will be used to develop each of the newly installed monitoring wells. Following re-development activities and the synoptic water level measurements of all site wells, each of these monitoring wells will be sampled using low flow techniques and analyzed for VOCs, SVOCs, Act 2 metals, and gross alpha. If gross alpha is detected above 5 pCi/l above background in any of the samples, those samples will be submitted for analysis of radium 228, radium 226, and isotopic uranium. However, if gross alpha is not detected above 5 pCi/l above background one of the groundwater samples will be selected for analysis of radium 228, radium 226, and isotopic uranium.

4.6 Area 7B (Hill Area North)

Area 7B is the portion of Area 7 north of Area 4 that formerly was an active farm (Morris Farm). It was acquired by Molycorp close in time to the acquisition in 1976 of the southern part of Area 7. There is no record of non-agricultural activity occurring on Area 7B. No structures exist in Area 7B, rather it is open land including forested and grassy areas. The northern boundary of Area 7B is a residential neighborhood located on Weirich Avenue. Residents of several of the homes in this neighborhood maintain lawns beyond their property lines well into Area 7B. A power line right-of-way and Sugar Run transect the area from west to east. All of Area 7B lies in the floodplains of Sugar Run and Chartiers Creek.

The only activity planned for this area is to conduct an environmental site assessment in general accordance with ASTM E1527, *Standard Practice for Environmental Site Assessments: Phase 1 Environmental Site Process* to confirm that Area 7B was not impacted by past activities in other areas of the site.

4.6.1 Environmental Site Assessment (ESA)

The ESA will be conducted is in general accordance with ASTM E1527, *Standard Practice for Environmental Site Assessments: Phase 1 Environmental Site Process.* The purpose of the ESA is to identify 'recognized environmental conditions' using an appropriate, but not exhaustive, assessment through inquiries and observations of property conditions and of readily available information. Inquiries are directed toward identifying the presence or likely presence of hazardous substances and petroleum on the property under conditions which would indicate an existing release, a past release or a material threat of a release of such hazardous substances or petroleum into the soils, groundwater or surface water of the property.

The ESA scope will consist of the following activities:

Review of Information: Malcolm Pirnie will review information provided by Molycorp or from other readily available sources, including maps, government files, environmental reports and observations made during a site reconnaissance that will help identify recognized environmental conditions related to the property, including, for example:

- Historical uses of the property;
- Current practices and uses (this does not include an assessment of compliance with environmental regulations);
- Current and, if readily available, historical uses of adjacent lands which may impact the property;
- Facilities and property features;
- Aerial photographs and city fire insurance maps, if readily available; and,
- Observable geologic and hydrologic features of the property and the vicinity.

Malcolm Pirnie will use a vendor to provide electronic databases of federal and state lists which will be searched to identify relevant information regarding the property and vicinity. The databases include lists of sites subject to enforcement and investigation activities by environmental agencies, or which have permitted facilities.

Malcolm Pirnie will review readily available state and local files for information related to the property. The custodians of government files will be contacted for information, if any, including but not limited to:

- Environmental enforcement and response records;
- Local building and environmental/health records;
- Underground storage tank registration and leak response records; and
- Local electrical utility (if transformers are observed on the property);

Site Reconnaissance: Malcolm Pirnie will visit the property to visually observe the property features for indications of recognized environmental conditions.

Interviews: Malcolm Pirnie will interview an on-site person familiar with the facility operations regarding information about the property. If government file information indicates significant regulatory agency involvement with the property, we will attempt to contact those state agency personnel with knowledge of the property.

4.7 Area 8 (Cox Plus)

Area 8, located in the northwest corner of the site, is bounded on the east by Chartiers Creek, on the south by Caldwell Avenue and on the west by a residential neighborhood on Point View Drive. Area 8 is open land (primarily forested with some grassy areas) except for a paved road (Weirich Avenue), which runs north to south and bisects Area 8. Area 8 slopes upward to the west at a 15 percent grade. A power line right-of-way and several unpaved footpaths cross Area 8. There are no structures located in Area 8. Reportedly, a trailer home with a septic tank formerly was located in Area 8. Except for Weirich Avenue, Area 8 currently is unused and there are no reports of previous industrial activity or waste disposal in Area 8. Additionally, Chartiers Creek should serve as a hydrologic barrier to prevent potential groundwater contaminants from other parts of the site from impacting Area 8.

Two activities are planned to investigate this area:

- Install one boring in the vicinity of the former septic tank/house trailer site, if it can be located; and
- Conduct an environmental site assessment in general accordance with ASTM E1527, *Standard Practice for Environmental Site Assessments: Phase 1 Environmental Site Process* to confirm that Area 8 was not impacted by past activities in other areas of the site.

4.7.1 Soil Boring

One soil boring will be installed in this area. The proposed field activities for the boring are as follows:

- Conduct a walkover of Area 8 to identify the former location of the former septic tank/house trailer. Adjacent to this area, complete one soil boring to refusal.

- Characterize possible impacts in the soil boring based on field observations (sight and smell).
- Collect one surface soil sample (0-2 feet) and one subsurface soil sample from the most visibly impacted depth (or the bottom of the boring if no impacts are observed).
- Analyze both soil samples for uranium and thorium (background data), VOCs and SVOCs.

4.7.2 Environmental Site Assessment (ESA)

The ESA will be conducted in general accordance with ASTM E1527, *Standard Practice for Environmental Site Assessments: Phase 1 Environmental Site Process*. The purpose of the ESA is to identify 'recognized environmental conditions' using an appropriate, but not exhaustive, assessment through inquiries and observations of property conditions and of readily available information. Inquiries are directed toward identifying the presence or likely presence of hazardous substances and petroleum on the property under conditions which would indicate an existing release, a past release or a material threat of a release of such hazardous substances or petroleum into the soils, groundwater or surface water of the property.

The ESA scope will consist of the following activities:

Review of Information: Malcolm Pirnie will review information provided by Molycorp or from other readily available sources, including maps, government files, environmental reports and observations made during the site reconnaissance that will help identify recognized environmental conditions related to the property, including, for example:

- Historical uses of the property;
- Current practices and uses (this does not include an assessment of compliance with environmental regulations);
- Current and, if readily available, historical uses of adjacent lands which may impact the property;
- Facilities and property features;

- Aerial photographs and city fire insurance maps, if readily available; and,
- Observable geologic and hydrologic features of the property and the vicinity.

Malcolm Pirnie will use a vendor to provide electronic databases of federal and state lists which will be searched to identify relevant information regarding the property and vicinity. The databases include lists of sites subject to enforcement and investigation activities by environmental agencies, or which have permitted facilities.

Malcolm Pirnie will review readily available state and local files for information related to the property. The custodians of government files will be contacted for information, if any, including but not limited to:

- Environmental enforcement and response records;
- Local building and environmental/health records;
- Underground storage tank registration and leak response records; and
- Local electrical utility (if transformers are observed on the property);

Site Reconnaissance: Malcolm Pirnie will visit the property to visually observe the property features for indications of recognized environmental conditions.

Interviews: Malcolm Pirnie will interview an on-site person familiar with the facility operations regarding information about the property. If government file information indicates significant regulatory agency involvement with the property, we will attempt to contact those state agency personnel with knowledge of the property.

4.8 Area 9 (Green Street)

Area 9 is the Green Street area located east of Area 1. Historical evidence, including photographs and aerial photographs, indicates that Area 9 has been a residential area since at least the early 1900's. There is no historical evidence that Area 9 was used as a process area or disposal area. Currently Area 9 is open land (primarily grassy areas and scrub/shrub with a few trees). Area 9 is relatively flat except at its southern end where it slopes up steeply as part of the embankment to I-70. The only structure in Area 9 is an office trailer, which is connected to water, sewer and electric utilities. The trailer is located within a fenced area that also includes a gravel parking lot.

The activity planned for this area is to conduct an environmental site assessment in general accordance with ASTM E1527, *Standard Practice for Environmental Site Assessments: Phase 1 Environmental Site Process* to confirm that Area 9 was not impacted by past activities in other areas of the site.

4.8.1 Environmental Site Assessment (ESA)

The ESA will be conducted in general accordance with ASTM E1527, *Standard Practice for Environmental Site Assessments: Phase 1 Environmental Site Process*. The purpose of the ESA is to identify 'recognized environmental conditions' using an appropriate, but not exhaustive, assessment through inquiries and observations of property conditions and of readily available information. Inquiries are directed toward identifying the presence or likely presence of hazardous substances and petroleum on the property under conditions which would indicate an existing release, a past release or a material threat of a release of such hazardous substances or petroleum into the soils, groundwater or surface water of the property.

The ESA scope will consist of the following activities:

Review of Information: Malcolm Pirnie will review information provided by Molycorp or from other readily available sources, including maps, government files, environmental reports and observations made during the site reconnaissance that will help identify recognized environmental conditions related to the property, including, for example:

- Historical uses of the property;
- Current practices and uses (this does not include an assessment of compliance with environmental regulations);
- Current and, if readily available, historical uses of adjacent lands which may impact the property;
- Facilities and property features;

- Aerial photographs and city fire insurance maps, if readily available; and,
- Observable geologic and hydrologic features of the property and the vicinity.

Malcolm Pirnie will use a vendor to provide electronic databases of federal and state lists which will be searched to identify relevant information regarding the property and vicinity. The databases include lists of sites subject to enforcement and investigation activities by environmental agencies, or which have permitted facilities.

Malcolm Pirnie will review readily available state and local files for information related to the property. The custodians of government files will be contacted for information, if any, including but not limited to:

- Environmental enforcement and response records;
- Local building and environmental/health records;
- Underground storage tank registration and leak response records; and
- Local electrical utility (if transformers are observed on the property);

Site Reconnaissance: Malcolm Pirnie will visit the property to visually observe the property features for indications of recognized environmental conditions.

Interviews: Malcolm Pirnie will interview an on-site person familiar with the facility operations regarding information about the property. If government file information indicates significant regulatory agency involvement with the property, we will attempt to contact those state agency personnel with knowledge of the property.

4.9 Area 10 (Offsite Areas)

The offsite areas are comprised of the area in the vicinity of the abutments to the small bridge on Caldwell Avenue that crosses Chartiers Creek and the parcel of land located between the B&O Railroad and east of Area 3. There are no records of slag or processed material ever being produced or stored in either of these areas; however during the 1994 site characterization, thorium was identified at a concentration greater than 10 pCi/g in areas adjacent to and in these two off-site areas. As a result additional soil boring activities will be conducted to further define the lateral and vertical extent of contamination in these areas of the site.

The proposed investigation will consist of the installation of four soil borings around the bridge abutments and five soil borings in the area to the east of Area 3 (Figure 4-2). The borings will be field located based on the results of the gamma walkover that will be conducted in this portion of the site prior to any intrusive investigation work. Planned boring, scanning, sampling, and analytical protocols are identical to those described for Areas 2 and 3.

To further define background conditions at the site, an overburden groundwater monitoring well will be installed in the offsite area to the east of Area 3. The well will be located in a region found to be free of thorium contamination in the 1994 downhole gamma investigation. During monitoring well installation, split spoon samples will be collected, scanned, and sampled following the same protocol described for monitoring wells that will be installed in Areas 1, 2, and 3. The soil samples will be analyzed for radiological compounds, VOCs, SVOCs, molybdenum and Act 2 metals. Subsequent to the completion of the monitoring well, it will be developed following the procedures outlined in the FP manual provided in Appendix B. A groundwater sample will be collected, once the well has been adequately purged, and analyzed for VOCs, Act 2 total metals, gross alpha, radium 228, radium 226, and isotopic uranium.

4.10 Site-Wide Hydrogeology

Numerous environmental investigations have been completed for various portions of the site to address a variety of environmental issues. Many of these investigations included subsurface characterization of the fill/slag and other horizons of the overburden as well as the groundwater within the overburden. In particular, much information exists relative to the hydrogeologic conditions of the overburden at the former active facility areas (Areas 1, 2, and 3). However, only two monitoring wells and/or soil borings have been installed into the bedrock in this area of the site resulting in only sketchy hydrogeologic data relative to bedrock conditions. Furthermore, the other areas of the site, in particular Areas 5 and 7A, have been investigated only minimally with very specific goals in mind, i.e., locating tar for remediation. Therefore the amount of hydrogeologic information outside of the three main plant areas and of the bedrock beneath the overburden is very limited. A more complete understanding of the site-wide hydrogeologic conditions is necessary to develop a conceptual site model. As part of the planned Supplemental Site Characterization, several site-wide tasks are planned to collect this needed hydrogeologic information. These site-wide hydrogeologic tasks include:

- Installation of overburden and bedrock groundwater monitoring wells
- In-Situ Hydrologic conductivity testing
- Site-Wide Water Elevation Measurements and Mapping
- Stream Flow Measurement

4.11 Site-Wide Geology

Over 400 soil borings and 30 monitoring wells have been installed in Areas 1, 2, and 3 during the various investigations that have been conducted at the site. During these investigations, the fill/slag and native soil/alluvium where thoroughly described and several cross-sections of Areas 1, 2, and 3 were generated from this data. As a result, the geologic conditions (i.e., depth to bedrock, fill thickness, composition of alluvial deposits, etc.) under the former manufacturing areas is well understood. Despite this detailed work, some additional information still is required to fully understand the geology of Areas 1, 2, and 3, as well as the other areas that comprise the site. For instance, only a total of seven borings have been completed into bedrock, with five of those borings being installed in Areas 4 and 7A (Figure 2-1). Furthermore, very little information is known about the thickness of fill material, alluvial deposits, or depth to bedrock in Area 5. In order to fully understand the geologic conditions at the site and to develop a site-wide conceptual model that will play an integral role in developing remedial options for the site, a more complete understanding of the geology at the site is needed. The additional soil borings and monitoring wells which will be installed during this Supplemental Site Characterization will provide a better understanding of site-wide geologic conditions and how the different areas are geologically interrelated.

4.12 Ecological Assessment

As part of the site-specific standard for Act 2, the Technical Guidance Manual (TGM, PADEP, 2002) provides an eight step site-specific ecological risk assessment process. The first two steps of this eight step process, the Initial Screen, will be implemented at this site as part of the supplemental site characterization. The two steps in the Initial Screen are Step 1: Fundamental Components and Step 2: Preliminary Exposure Estimate and Risk Characterization.

The results of the Initial Screen will be used to determine which of the following courses of action should be taken at the site with respect to ecological risks:

- the Initial Screen is adequate to determine that no substantial ecological risk exists and, consequently, no additional action is needed;
- the Initial Screen indicates that the potential exists for ecological risks and, consequently, the ecological risk assessment should be continued (i.e., it should proceed to Steps 3 through 8) to reduce the uncertainty in the evaluation of ecological risk and determine either:
  - no substantial ecological risk exists and, consequently, no additional action is needed; or
  - ecological risks are substantial and the more detailed ecological risk assessment should be used to develop site-specific clean-up goals; or
- the Initial Screen indicates there is the potential for substantial impact to ecological receptors and, consequently, site activity should proceed to remediation that can eliminate or reduce exposure to an acceptable level.

4.12.1 Step 1: Fundamental Components

The activities that will be conducted in this step include describing the environmental setting; identifying constituents of potential ecological concern (CPECs); identifying species and habitats of concern; conducting a site visit; and selecting species or habitats of concern as assessment endpoints. As part of this step, a request will be made to the

Washington County Conservation District to conduct a Pennsylvania Natural Diversity Inventory (PNDI) database search to identify whether any species of concern, habitats of concern and/or exceptional values wetlands occur on or in the vicinity of the site. In addition, a qualified biologist will conduct a site visit to evaluate potential receptors and chemical migration pathways and complete a checklist for ecological risk assessment (USEPA, 1997). The site visit will be made when surface water and sediment samples are being collected. CPECs will be identified for different site media based on a review of available analytical results.

The outcome of this step will be ecological conceptual site model that identifies CPECs, migration routes for CPECs, critical ecological receptors, and potentially complete exposure pathways for ecological receptors. The evaluation will focus on potential receptors and exposure pathways for three features of the site: the stream system (Area 6), the floodplain areas adjacent to the streams (parts of Areas 2, 3, 4, 5, 7 and 8) and the wooded or forested upland areas (principally Area 7). For each of these features, assessment endpoints will be determined

4.12.1 Step 2: Preliminary Exposure Estimate and Risk Assessment

For the second step, preliminary exposure estimate and risk assessment, the TGM allows for the use of community-based analysis such as the Rapid Bioassessment Protocols for Fish and Aquatic Macroinvertebrates (USEPA, 1999) and/or the Hazard Quotient Method (USEPA, 1997). Depending on the outcome of the site visit and the results of sediment analytical data, an aquatic macroinvertebrate community survey may be performed for the site. The elements of an aquatic macroinvertebrate community survey and the hazard quotient method are described below.

4.12.2.1 Aquatic Macroinvertebrate Community Survey

The site visit discussed above will be conducted at the same time that surface water and sediment samples are being collected. Approximately 5-6 samples will be collected within the tar impacted and unimpacted areas of Chartiers Creek and 2-3 sampling stations will be collected within Sugar Run. Benthic samples will be collected from locations where sediment samples are collected for chemical analysis. All of these benthic samples will be collected, preserved and archived for future analysis. Based on a review of the sediment and surface water analytical data it may or may not be necessary to analyze some or all of the benthic samples.

The benthic macroinvertebrate community survey results can be used to determine whether the streams are adversely affected by the presence of stressors in the streams related to past site activities, such as the presence of tar in the stream channel. The results could also serve as baseline data on the benthic community prior to any remedial activities, and could be utilized to make comparisons to benthic macroinvertebrate populations after remedial actions are performed.

4.12.2.2 Hazard Quotient Method

In the hazard quotient method, measurement endpoints are identified for assessment endpoints and estimates of exposure and ecotoxicity are determined for each measurement endpoint. For some measurement endpoints, the estimate of exposure will be concentrations measured in a specific medium (e.g., surface soil, surface water or sediment). For other measurement endpoints, the estimate of exposure will be a dose calculated for a species associated with the measurement endpoint. In most instances, the form of the exposure estimate will depend on the form of the data available for developing estimates of ecotoxicity for the measurement endpoint. In some cases, the ecotoxicity data is available in the form of a concentration; in other cases, the ecotoxicity data is available in the form of a dose. For this evaluation, a documented and/or best conservatively estimated no-observed-adverse-effect-level (NOAEL) will be used as a screening ecotoxicity value, whether in the form of a concentration or a dose.

The hazard quotient method compares estimates of exposure to estimates of ecotoxicity by calculating hazard quotients (HQ). For each CPEC relevant to a particular measurement endpoint, the HQ is calculated as the ratio of the estimate of exposure (i.e., exposure concentration or dose) to the estimate of ecotoxicity (i.e., the screening ecotoxicity value as either a concentration or dose). An HQ of less than one for a particular CPEC indicates that the CPEC is unlikely to cause adverse ecological effects (USEPA, 1997) for the assessment endpoint that the HQ is intended to evaluate.

Table 4-1
Proposed Analytical Program for Soil, Slag and Sediment Samples
Washington Pennsylvania Site

Parameter	Method	Area 1A	Area 1B	Area 2	Area 3	Area 4	Area 5A	Area 5B	Area 5C	Area 5D	Area 5E	Area 6	Area 7A	Area 7B	Area 8	Area 9	Area 10A	Area 10B	# of Samples
Volatile Organic Compounds	8260B	5	5	5	5	3	-	-	-	-	-	15	-	-	2	1	-	-	41
Semi-Volatile Organic Compounds	8270C	5	5	5	5	3	-	-	-	-	-	15	-	-	2	1	-	-	41
BTEX	8260B	-	-	-	-	-	9	42	3	36	4	-	23	-	-	-	-	-	117
PAHs	8310 with 2nd column conf.	-	-	-	-	-	9	42	3	36	4	-	23	-	-	-	-	-	117
Acid Extractable Phenolics	8270C	-	-	-	-	-	3	13	-	8	-	-	5	-	-	-	-	-	29
Total Cyanide	9012A	-	-	-	-	-	9	42	3	36	4	-	23	-	-	-	-	-	117
Weak Acid Dissociable Cyanide	ASTM 4500-I	-	-	-	-	-	9	42	3	36	4	-	23	-	-	-	-	-	117
Total Organic Carbon	9060	-	-	-	-	-	2	9	-	7	-	7	4	-	-	-	-	-	29
Polychlorinated Biphenyls	8082	5	5	5	-	3	-	-	-	-	-	-	-	-	-	-	-	-	18
RCRA Metals	6010B and 7471 (Hg)	-	-	-	-	-	9	25	3	15	-	-	23	-	-	-	-	-	75
Act 2 Metals plus Mo	6010B and 7471 (Hg)	20	20	22	22	3	-	17	-	21	10	15	-	-	-	1	-	-	151
SPLP Metals	6010/7470	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	12
TCLP Metals	6010/7470	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	12
Gamma Spec - U238, U234, U235, Th232, Th228, Ra 226, RA 228(1)	901.1M	44	58	76	66	4	-	-	-	-	-	-	-	-	2	1	12	8	271
Gamma Spec - U238, U234, U235, Th232, Th228, Ra 226, Ra 228 with ingrowth(2)	901.1M	11	17	19	16	-	-	-	-	-	-	8	-	-	-	-	3	-	74
Isotopic U alpha spec	ASTM D3972-90M	4	6	8	7	-	-	-	-	-	-	-	-	-	-	-	-	-	25
Isotopic Th alpha spec	ASTM D3972-90M	4	6	8	7	-	-	-	-	-	-	-	-	-	-	-	-	-	25

(1) U-238 and U-234 (equilibrium) inferred from the Th-234 identified activity. Th-232, Th-228 and Ra-228 (equilibrium) inferred from Ac-228 identified activity

(2) Ra-226 inferred from Bi-214 and Pb-214 identified activity after sample is sealed and has had 21-days to ingrow progeny.

Table 4-2
Proposed Analytical Program for Groundwater and Surface Water Samples
Washington Pennsylvania Site

Parameter	Method	Area 1A	Area 1B	Area 2	Area 3	Area 4	Area 5A	Area 5B	Area 5C	Area 5D	Area 5E	Area 6	Area 7A	Area 7B	Area 8	Area 9	Area 10A	Area 10B	# of Samples
Volatile Organic Compounds	8260B	5	5	11	9	2	-	-	-	-	-	-	3	-	-	-	-	-	35
Semi-Volatile Organic Compounds	8270SIM	5	5	11	9	2	-	-	-	-	-	-	3	-	-	-	-	-	35
BTEX	8021	-	-	-	-	-	-	6	-	3	-	15	-	-	2	2	1	-	29
PAHs	8310 with 2nd column conf.	-	-	-	-	-	-	6	-	3	-	15	-	-	2	2	1	-	29
Acid Extractable Phenolics	8270C	-	-	-	-	-	-	6	-	3	-	-	3	-	-	-	-	-	12
Weak Acid Dissociable Cyanide	ASTM 4500-I	-	-	-	-	-	-	6	-	3	-	-	3	-	-	-	-	-	12
Polychlorinated Biphenyls	8082	2	-	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-	7
RCRA Metals	6010/7470	5	5	11	9	2	-	6	-	3	-	15	-	-	2	2	1	-	61
Act 2 Metals plus Mo	6010/7470	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	3
Gross alpha	900	5	5	11	9	2	-	6	-	3	-	15	3	-	2	2	1	-	64
Ra 228	904	2	1	4	3	-	-	1	-	1	-	1	1	-	-	-	-	-	14
Ra 226	903.1	2	1	4	3	-	-	1	-	1	-	1	1	-	-	-	-	-	14
Isotopic U	ASTM D3972-90M	2	1	4	3	-	-	1	-	1	-	1	1	-	-	-	-	-	14

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Investigation Report

SECTION 5

5.0 Investigation Report

After completing the characterization activities, Malcolm Pirnie will prepare a report presenting the findings of the supplemental site characterization. The supplemental characterization report (SCR) will integrate information from prior characterization efforts with information obtained from the supplemental characterization efforts.

The SCR will include the following:

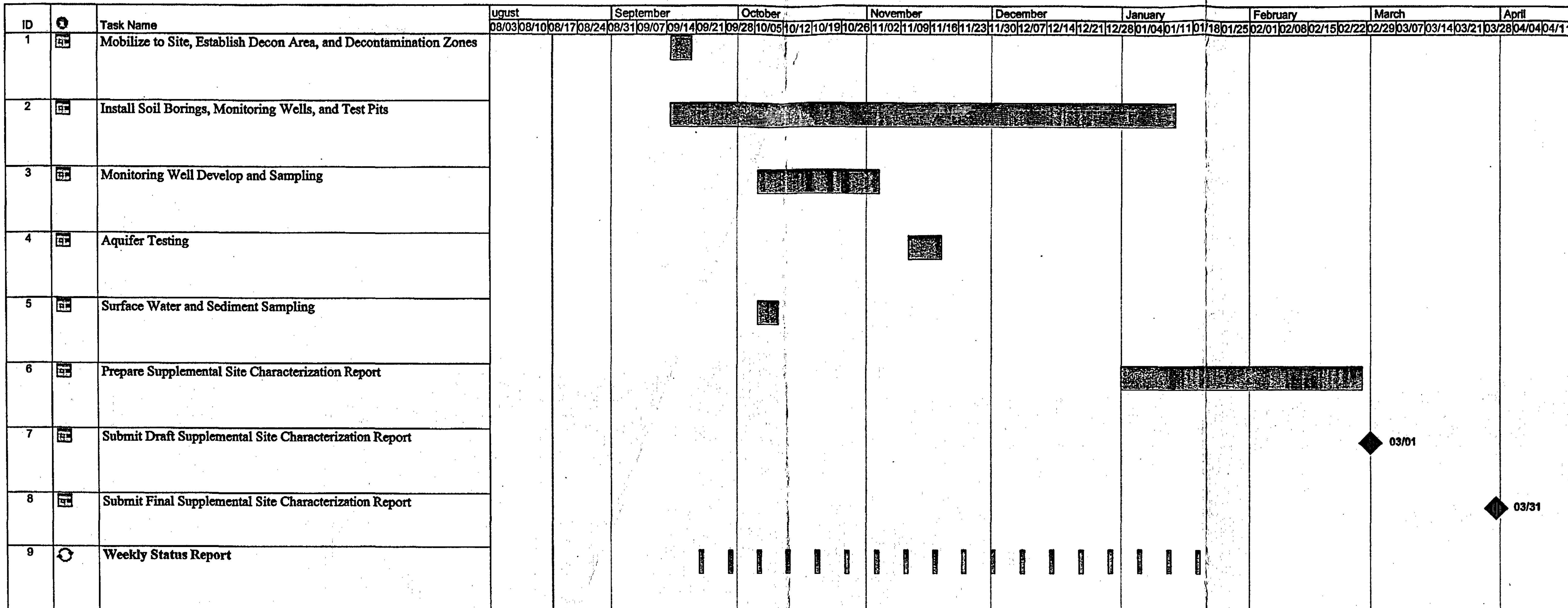
- Identification of constituents of concern in site soils/slags, groundwater, surface water and sediments.
- Maps of the site showing areas classified as impacted or non-impacted.
- Maps of the site showing the spatial variations in residual radioactivity concentrations in impacted areas.
- Identification of areas where thorium series and uranium series isotopes have been identified independently and where they have been comingled.
- Conclusions regarding the equilibrium status of uranium-238 and thorium-232 and their daughter products.
- Identification of residual radioactivity below the groundwater table.
- Radiological characterization of the bedrock near the western boundary of Area 2.

- Characterization of non-radioactive slags presents in areas of the site including metals and industrial chemicals.
- Maps of the geographic boundaries of tar impacts on soils and groundwater in Areas 5 and 7.
- Information on the impacts of residual radioactivity, metals, industrial chemicals, and tars on site streams and sediments.
- Depiction of site-wide hydrogeologic conditions including direction of groundwater flow, hydraulic gradient, aquifer permability and porosity.
- Definition of site-wide geologic conditions and the geological interrelationships of various site areas.
- Initial evaluation of the ecological impact of constituents of potential concern association with the site.

Project Schedule

SECTION 6

The project timeline is provided in Figure 6-1.



Project: Supplemental Site Charactert
Date: Mon 08/18/03

Task | Progress | Summary | External Tasks | Deadline

Split | Milestone | Project Summary | External Milestone

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Figure 6-1 Project Schedule
Molycorp, Inc. August 2003

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SECTION 7

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