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ASARCO

Water Resources Investigation ASARCO East Helena Plant Phase II Work Plan

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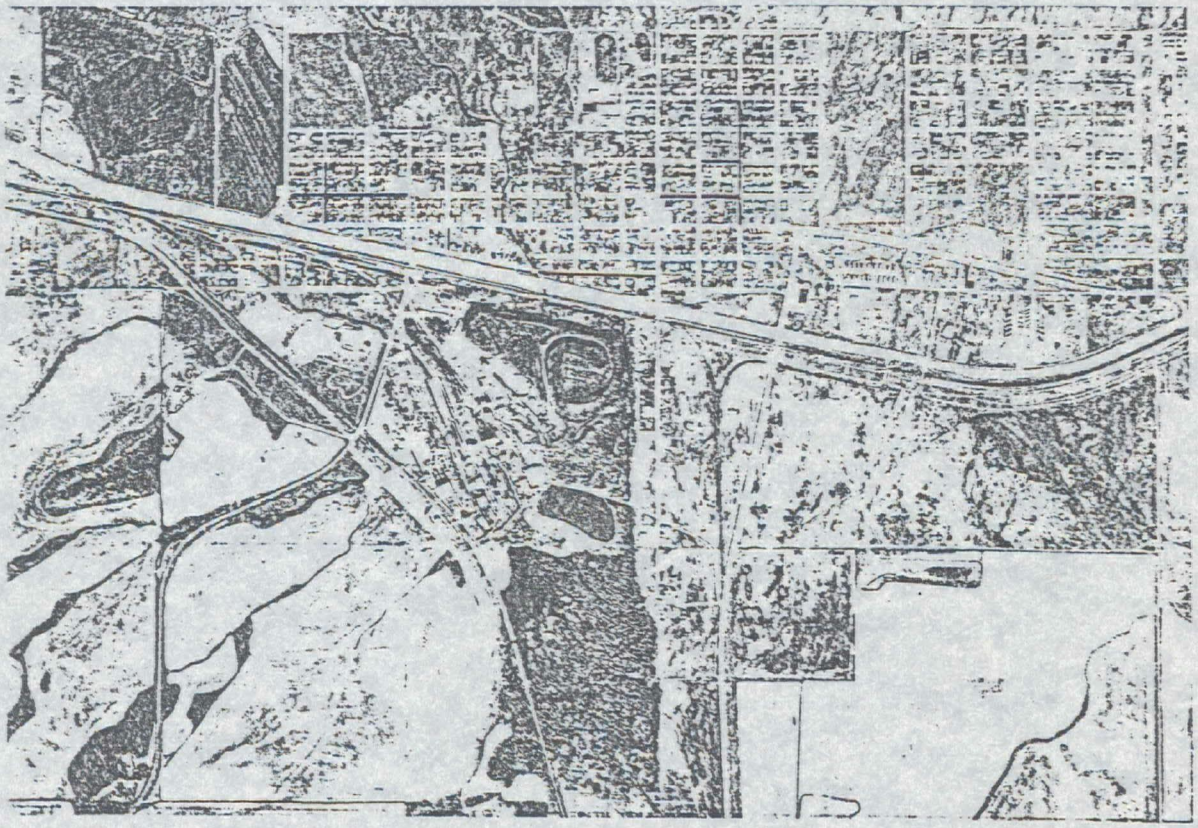
Prepared For:

ASARCO INCORPORATED
East Helena Plant



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WATER RESOURCES INVESTIGATION
ASARCO EAST HELENA PLANT - PHASE II
REMEDIAL INVESTIGATION WORK PLAN

for

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WATER RESOURCES INVESTIGATION
ASARCO EAST HELENA PLANT - PHASE II
REMEDIAL INVESTIGATION WORK PLAN

1.0 INTRODUCTION

A comprehensive draft report describing water resources of the ASARCO East Helena Plant site area was completed by Hydrometrics in February of 1986 (Hydrometrics, 1986). The water resources investigation was conducted as a background for preparation of a Montana Groundwater Pollution Control System (MGWPCS) permit application for the Montana Department of Health and Environmental Sciences and to fulfill the water resources portion of the Phase I work plan for the U. S. Environmental Protection Agency (EPA) Remedial Investigation (RI) for the East Helena Superfund site identified by the EPA.

The draft water resources monitoring report by Hydrometrics (1986) described results of studies conducted in accordance with the Water Resources Monitoring Plan (WRMP) developed for the project by Hydrometrics and approved by the EPA. This water resources investigation involved construction of numerous monitoring wells on and peripheral to the ASARCO East Helena plant property and sampling of surface waters, soils and sediment in the plant site area. The study also utilized numerous private wells located near the ASARCO plant for sampling of groundwater, particularly domestic wells in the East Helena area. Results of the investigation showed that a contaminant plume of shallow groundwater containing elevated concentrations of arsenic is present on the ASARCO property and this

plume extends northward from the plant site toward the community of East Helena. Based on results of the water resources investigation, the EPA determined that additional studies must be performed in order to complete the water quality investigation. The primary concern of the EPA is that present information is not sufficient to define the extent and fate of the arsenic plume present in the shallow groundwater downgradient of the ASARCO plant site. As agreed upon by the EPA, the recently completed hydrological investigation did not include the shallow aquifer in the area north of the ASARCO plant and did not include drilling of monitoring wells into deeper water-bearing zones.

This Phase II work plan directly addresses the additional water resources study requirements included in the EPA letter to ASARCO dated March 27, 1986. The primary objective of this Phase II investigation will be to provide an understanding of the depth, extent and fate of the arsenic-bearing groundwater plume downgradient of the ASARCO plant site and in the community of East Helena. This additional work will provide information needed to complete the Endangerment Assessment for the East Helena site. This investigation also will obtain all the information needed in the RI phase of this site study.

The Phase II water resources investigation will fully utilize information from the following documents:

1) Quality Assurance Program Plan ASARCO East Helena Plant Water Resources Investigation by Hydrometrics dated September 21, 1984.

2) Report on Water Resources Monitoring ASARCO East Helena Plant - DRAFT by Hydrometrics dated February 7, 1986.

The Quality Assurance Program Plan will be the basic quality assurance document for the Phase II study. Where new field or laboratory technical methods are used in the Phase II study or where existing methods are modified, a supplemental quality assurance document will be prepared to describe the new or modified techniques. The recently completed draft report on water resources monitoring will provide the basic hydrological background for the Phase II work. The Phase II results will be integrated with the draft water resources monitoring report to make one comprehensive project report.

For administrative and technical purposes, the investigation is separated into eight interrelated study elements that together will provide an understanding of the relationship of water resources and the ASARCO East Helena plant area. These study elements are:

IDENTIFICATION AND CHARACTERIZATION OF AQUIFERS
GROUNDWATER QUALITY AND CONTAMINANT PLUME
SURFACE WATER AND GROUNDWATER USE
INTERRELATIONSHIP OF SURFACE WATER AND GROUNDWATER
PLANT FACILITIES AND MANAGEMENT PRACTICES
GROUNDWATER AND SURFACE WATER EXPOSURE PATHWAYS
QUALITY ASSURANCE AND QUALITY CONTROL
REPORTS AND DATA HANDLING

Each of these study elements is described in this work plan and the methodology for completion of each element is explained.

2.0 IDENTIFICATION AND CHARACTERISTICS OF AQUIFERS

The shallow aquifer beneath and immediately peripheral to the East Helena plant site was identified and characterized during the recently completed Phase I water resources investigation. Investigation of the shallow aquifer during the Phase I study, however, was restricted to the plant site area and additional information is needed to determine the lateral and vertical extent of this aquifer downgradient of the ASARCO plant. The lateral extent of this aquifer needs to be defined sufficiently to understand its relationship to the contaminant plume. A delineation of the complete extent of this shallow aquifer is not necessary for this remedial investigation. The shallow aquifer underlies an extensive area in the Helena Valley and only the portion of this aquifer in the vicinity of the arsenic plume will be investigated.

The next water-bearing zone beneath the shallow aquifer also must be delineated and its hydrogeological characteristics determined. For purposes of this report, this water-bearing zone will be referred to as the "intermediate" aquifer. The Phase I study evaluated the shallow aquifer but no monitoring wells were completed into the intermediate aquifer. Evaluation of the intermediate aquifer will include drilling, construction and sampling of monitoring wells on the East Helena plant site and north of the plant site in East Helena.

The additional monitoring well network will consist of a planned 12 primary monitoring wells and an estimated 8 secondary wells as shown on Exhibit 1 (last page of this plan). The primary wells will be drilled first and the secondary wells will be drilled as required. The primary wells include 6 shallow wells and 6 intermediate wells and the secondary wells include 4 shallow and 4 intermediate wells. Locations of the monitoring wells and the drilling sequence are based on the present understanding of the area hydrostratigraphy developed in Phase I. Emphasis will be on delineation of the arsenic-bearing plume in the shallow groundwater system in the vicinity of the community of East Helena and determination of the arsenic distribution (if present) in the intermediate aquifer.

The strategy for monitoring well siting will be as follows:

1) Existing private wells will be inventoried and sampled in the area thought to be underlain by or peripheral to the arsenic plume. Water samples from these wells will be tested for parameters shown in the Special Analysis schedule on Table 1.

2) Primary monitoring well final locations will be selected based on results of private well testing and results of the Phase I hydrological study. Tentative locations are on Exhibit 1.

TABLE 1. PARAMETERS TO BE TESTED IN WATER SAMPLE

STANDARD ANALYSIS*

Specific Electrical Conductivity (field and lab)	Sulfate (SO_4)
pH (field and lab)	Arsenic (As)
Static Water Level (stage if a stream)	Lead (Pb)
Total Dissolved solids (TDS)	Zinc (Zn)
Dissolved Oxygen	Cadmium (Cd)
Temperature	Iron (Fe)
	Bicarbonate (HCO_3)

SPECIAL ANALYSIS

Specific Electrical Conductivity (field and lab)	Calcium (Ca)	Bicarbonate (HCO_3)
Total Dissolved Solids (TDS)	Magnesium (Mg)	Carbonate (CO_3)
Static Water Level	Sodium (Na)	Sulfate (SO_4)
pH (field and lab)	Potassium (K)	Chloride (Cl)
Dissolved Oxygen		
Temperature		

Arsenic (As)	Copper (Cu)	Lead (Pb)	Zinc (Zn)
Cadmium (Cd)	Iron (Fe)	Manganese (Mn)	

* All metals will be measured as dissolved in groundwater samples, and as dissolved and total in surface water samples. For surface water samples, flow will be measured and dissolved oxygen will not be measured.

3) Primary wells will be drilled sequentially so results of each well can be used to assist in location of the next well. Samples of groundwater will be obtained for special analysis as soon as each well is completed. To accelerate the process of subsequent well site selection, the ASARCO laboratory will provide results of selected parameters (arsenic, sulfate, and SC) within about two days after the laboratory receives the sample. This will allow selection of subsequent well sites (both primary and secondary) without waiting for all analytical results and completion of all laboratory QA/QC documentation.

4) Secondary monitoring wells will be located based on results of Special Analysis (Table 1) of water from primary monitoring wells. To accelerate the process of site selection for secondary monitoring wells, results of tests of selected parameters (arsenic, sulfate and SC) from the Special Analysis list (Table 1) will be obtained from the laboratory within two days after the laboratory receives the sample.

Tentative locations of the primary shallow and intermediate monitoring wells are shown on Exhibit 1; however, actual locations will depend on access to property, location of utilities and other site considerations. General locations for the secondary monitoring wells also are shown on Exhibit 1. The number, depth and locations of these wells will entirely depend on results of drilling and testing the

primary wells. Early results of primary well data will be jointly reviewed by EPA and ASARCO to determine the location, type and number of secondary well installations.

Specific objectives of each of the monitoring wells are:

SHALLOW AQUIFER
PRIMARY WELLS

PROPOSED MONITORING WELL	PURPOSE
DH-12	Provide better hydrogeological data on the shallow aquifer in plant area where high sulfate concentrations are present in groundwater.
EH-50	Define the contaminant plume.
EH-51	Define the contaminant plume.
EH-52	Define the contaminant plume.
EH-53	Define the contaminant plume.
EH-54	Define the contaminant plume.

SHALLOW AQUIFER
SECONDARY WELLS

PROPOSED MONITORING WELL	PURPOSE
EH-55	Locate contaminant plume if primary wells do not provide sufficient definition.
EH-56	Locate contaminant plume if primary wells do not provide sufficient definition.
EH-57	Locate contaminant plume if primary wells do not provide sufficient definition.
EH-58	Locate contaminant plume if primary wells do not provide sufficient definition.

INTERMEDIATE AQUIFER
PRIMARY WELLS

PROPOSED MONITORING WELL	PURPOSE
DH-13	Determine hydrogeology of intermediate aquifer. (Well pair with DH-12)
DH-14	Determine hydrogeology of intermediate aquifer. (Well pair with DH-4)
DH-15	Determine hydrogeology of intermediate aquifer. (Well pair with DH-10)
EH-100	Determine hydrogeology of intermediate aquifer. (Well pair with EH-50)
EH-101	Determine hydrogeology of intermediate aquifer. (Well pair with EH-51)
EH-102	Determine hydrogeology of intermediate aquifer. (Well pair with EH-52)

INTERMEDIATE AQUIFER
SECONDARY WELLS

PROPOSED MONITORING WELL	PURPOSE
EH-103	Locate contaminant plume if primary wells do not provide sufficient definition.
EH-104	Locate contaminant plume if primary wells do not provide sufficient definition.
EH-105	Locate contaminant plume if primary wells do not provide sufficient definition.
EH-106	Locate contaminant plume if primary wells do not provide sufficient definition.

The overall objective of the monitoring wells are:

1) Delineation of the extent of the shallow and intermediate aquifers with emphasis on the area underlain by the arsenic plume. The lateral extent of the delineation will be sufficient to include the plume. The existance, extent and

integrity of a stratigraphic layer of low permeability beneath the shallow aquifer also will be investigated.

2) Provide data on groundwater quality.

3) Provide information on water levels, areas of groundwater discharge and recharge, and aquifer hydraulic characteristics.

2.1 SHALLOW MONITORING WELL CONSTRUCTION

Construction of shallow monitoring wells will be the same as used during the Phase I investigation. Monitoring wells will be drilled using a forward rotary rig with top drive hammer. Construction of shallow monitoring wells will be as shown in Figure 1. Well casing will be NSF approved Schedule 40 PVC with flush joints and threaded couplings. In the target monitoring zone, factory slotted casing or screen will be used. When feasible, the target zone will be perforated to intercept the upper 5 to 10 feet of the saturated zone with consideration given to well development and expected water table fluctuations.

Wells will be constructed with a temporary 8-inch steel casing. To avoid any possibility of surface contamination, at least five feet of 10 to 12-inch ID steel casing will be installed and sealed for each borehole. During the drilling, split spoon samples will be taken at five-foot intervals on selected zones in selected wells. When possible, any fine-grained materials encountered during drilling will be sampled using Shelby tubes.

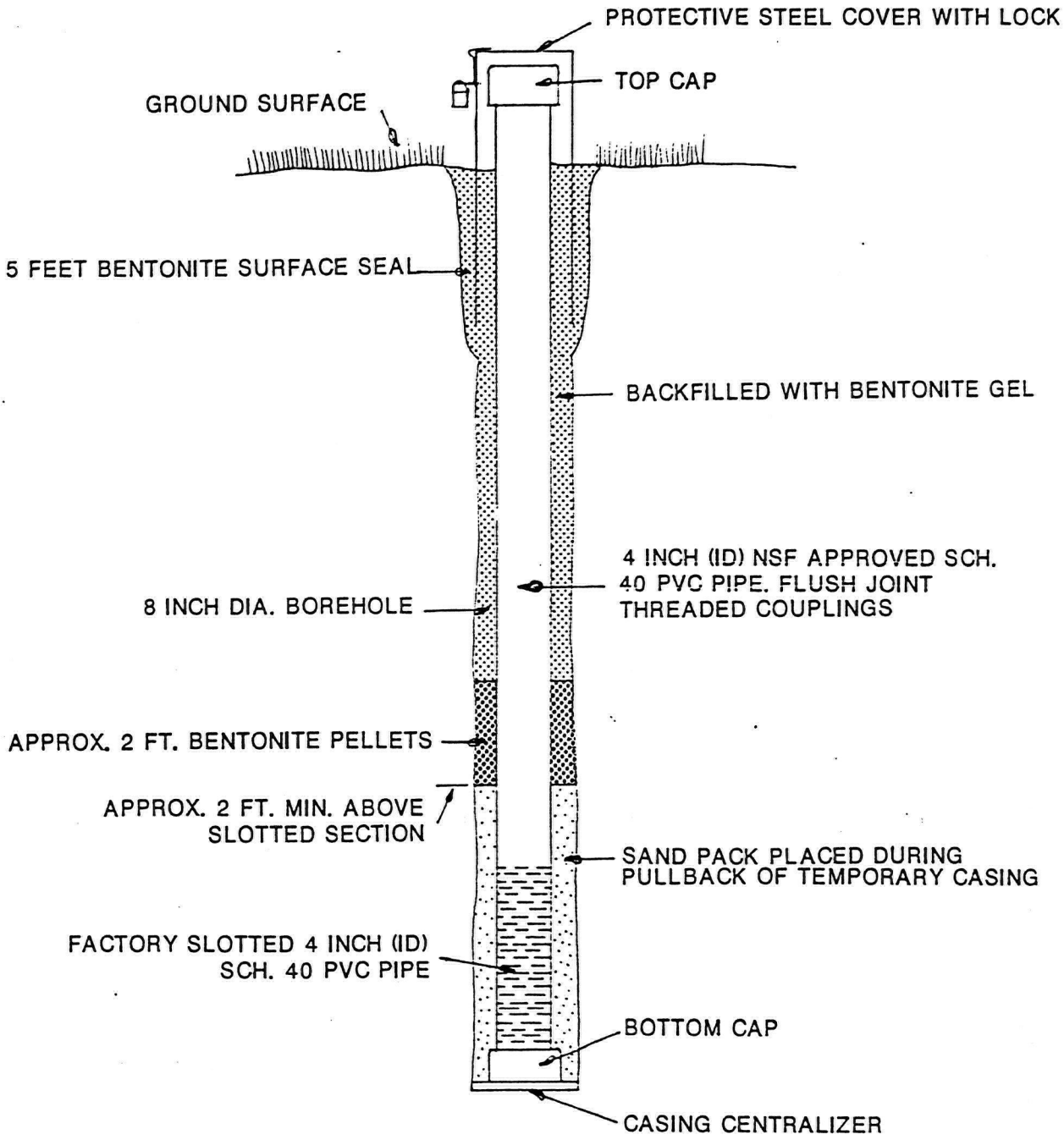

FIGURE 1

TYPICAL SHALLOW MONITORING WELL CONSTRUCTION

Wells DH-13, DH-14, EH-100, EH-101 and EH-102 will be sampled at 5 foot intervals or at a minimum each layer of coarse or fine materials encountered. Selection of any additional wells and intervals to be tested will be determined in consultation with EPA during drilling and will be dependent on subsurface variability encountered. It is estimated that about 50 percent of the wells will be cored using the split spoon or Shelby tube. Selected samples representative of major stratigraphic layers encountered during drilling will be sent to the laboratory for analysis. Physical parameters to be tested on split spoon samples will be: particle size, cation exchange capacity and trace elements. Elements to be measured are arsenic, cadmium, copper, iron, lead, manganese and zinc. In addition, soil cores jointly selected by ASARCO and the EPA will be analyzed using a selective metal extraction technique as described by Sondag, 1981 and Chao, 1984). All shallow monitoring wells will be developed with a bailer to ensure all drilling debris has been removed and a good hydraulic connection has been established with the water-bearing zone. All monitoring well construction will be supervised by an experienced hydrogeologist from Hydrometrics.

As shown in Figure 1, shallow well construction will include the following steps:

1) Installation of a 5-foot long, 10 to 12-inch ID surface casing to avoid any contamination from shallow soils. This casing will be sealed with bentonite.

2) Drilling to the desired depth using 8-inch ID steel casing.

3) Installation of 4-inch ID Schedule 40 PVC casing inside the 8-inch steel casing.

4) Packing the annulus between the 4-inch PVC casing and the borehole with properly sized silica sand. The sand pack will be placed during the withdrawal of the 8-inch steel casing. The pack will extend from the bottom of the borehole to approximately two feet above the sand/gravel pack. This will allow for any future settling.

5) Backfill the annulus between the 4-inch PVC casing and the borehole with a bentonite gel above the sand pack.

6) Install a steel protective cover with locking lid.

All wells will be carefully developed by methods that will not induce or entrain air into the aquifer. Bailing and pumping with a submersible pump will be conducted to minimize disturbance to the groundwater geochemistry.

2.2 INTERMEDIATE MONITORING WELL CONSTRUCTION

Drilling of intermediate monitoring wells will be by a forward rotary rig with top drive hammer. Construction of these wells will be as shown in Figure 2. Well casing will be NSF approved Schedule 40 PVC with bell joints. In the target monitoring zone, factory slotted casing or screen will be used. When feasible, the target zone will be perforated to intercept the upper 5 to 10 feet of the aquifer.

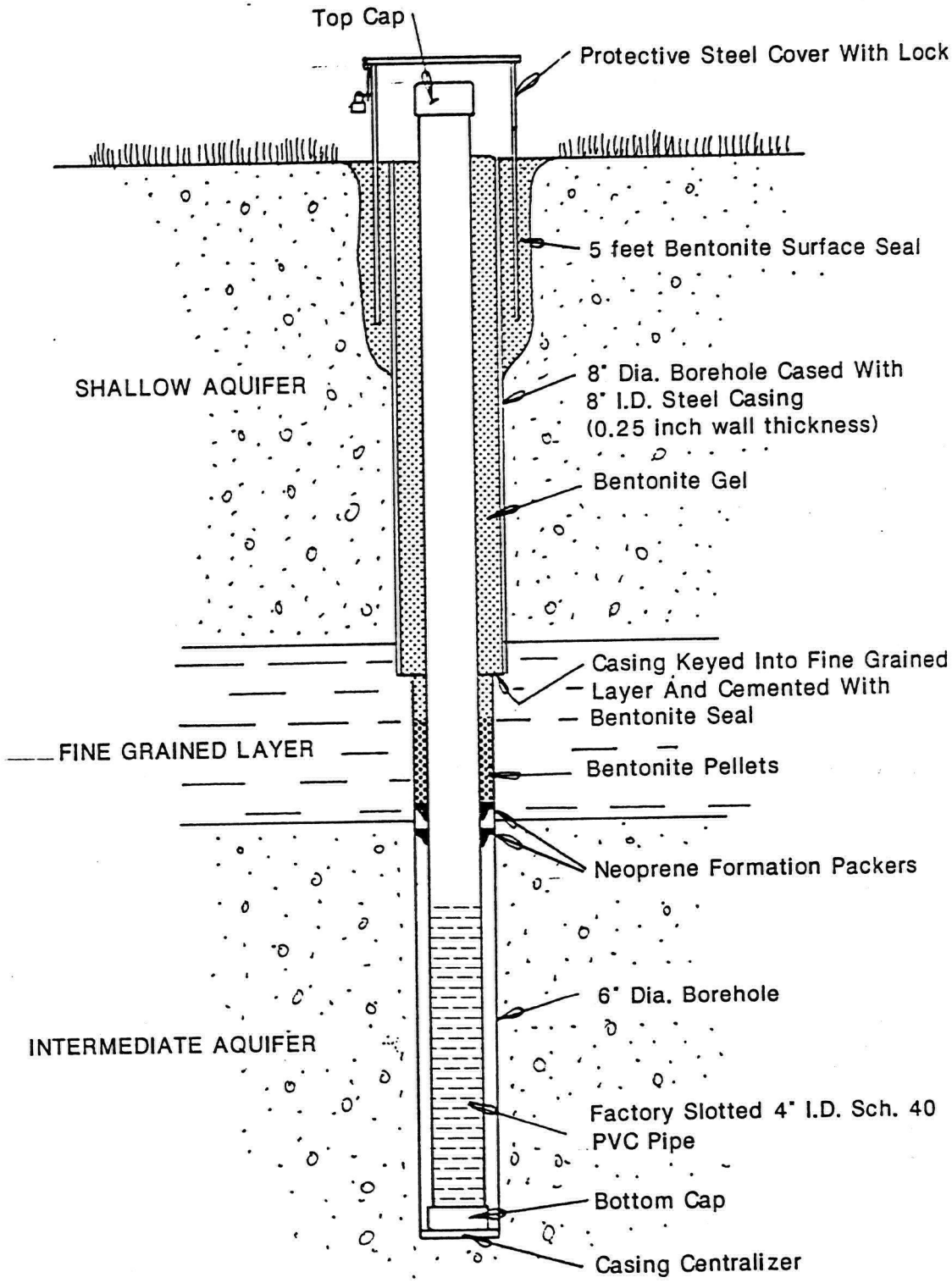

FIGURE 2

TYPICAL INTERMEDIATE MONITORING WELL CONSTRUCTION

The intermediate wells will be constructed as follows:

1) A 5-foot long section of 12-inch ID steel casing will be installed and sealed with bentonite to avoid contamination from shallow soils.

2) Drilling, using an 8-inch ID steel casing, will extend into the low permeability, fine-grained material underlying the shallow aquifer. This casing will be driven several feet into this low permeability material.

3) The bottom of the 8-inch casing will be sealed using bentonite or cement placed in the hole bottom.

4) A 6-inch diameter hole will be drilled beneath the bottom of the 8-inch casing. The 6-inch hole will extend to the target zone in the intermediate aquifer. If the hole remains open, a 4-inch ID NSF approved PVC casing with screen will be inserted into the 6-inch drill hole. The casing will have one or more neoprene packers and, above the packers, the annulus will be sealed with bentonite pellets and bentonite gel. If the 6-inch drill holes cave, then 6-inch casing will be driven during drilling and the well will be completed by withdrawal of the steel casing to expose the 4-inch PVC screen and casing to the aquifer. The remainder of the completion will be as previously described.

5) A steel protective cover with locking lid will be installed.

2.3 WELL DEVELOPMENT

Well development will involve gentle surging and bailing to remove drilling debris and establish a good hydraulic contact with the aquifer. Additional development may be accomplished by pumping with a submersible pump to ensure turbidity of the groundwater is acceptable for sampling.

2.4 AQUIFER TESTING

Wells selected in coordination with the EPA will be tested to determine their hydraulic characteristics. It is estimated that about half the newly drilled monitoring wells will be tested to measure aquifer hydraulic parameters. If possible, selected domestic or municipal wells may also be pumped along with measurement of monitoring well water levels to help determine aquifer hydraulic characteristics.

Aquifer testing of the monitoring wells can be accomplished utilizing several techniques. Wells that yield sufficient water will be tested by pumping at a constant rate and observing drawdown during pumping. Nearby monitoring wells completed in shallow and intermediate zones will be used as observation wells during testing and drawdown, and recovery in these wells will be monitored. Upon completion of pumping, recovery of water levels in the pumped well will be measured. Water levels will be measured using electric tape or a Sinco Model 56401 pressure transducer. Constant drawdown data will then be analyzed using standard straight line or curve matching techniques. Wells with insufficient water to allow pumping will be tested using a slug removal technique. Hydraulic data will be obtained by measuring

water level recovery (residual drawdown) following the instantaneous removal of a known volume ("slug") of water. Detailed aquifer testing and data analysis procedures are in the QAPP (Quality Assurance Program Plan).

3.0 GROUNDWATER QUALITY AND CONTAMINANT PLUME

The Phase I investigation identified an arsenic plume in the shallow aquifer. This plume underlies a portion of the ASARCO plant site and extends northward from the plant site. The vertical extent of the arsenic plume was not defined and the extent of the plume in the shallow aquifer north of the ASARCO plant site was not investigated. The study area for the Phase I investigation included numerous private wells in the community of East Helena; however, these wells are completed in strata deeper than the shallow aquifer. Groundwater from these wells contained little arsenic and an arsenic plume was not identified in the East Helena area.

The Phase II investigation is designed to determine both the northward extent of the arsenic plume in the shallow aquifer and whether or not the arsenic-bearing groundwater has migrated vertically into the intermediate aquifer. An additional subtask to be completed is to better define concentrations of arsenic in groundwater upgradient of the ASARCO plant. A more comprehensive understanding of "background" arsenic concentrations will assist in evaluating the overall arsenic distribution in the hydrogeological system. To accomplish these objectives, the following groundwater sampling and evaluation will be conducted:

1) All new primary monitoring wells will be sampled four times: summer/fall (after construction), late fall, winter/spring and spring/summer, and the water tested for the parameters on the Special Analysis list on Table 1. All new secondary monitoring wells will be sampled after construction in the late fall, and sampled in spring and early summer. Water samples of secondary wells will also be tested for parameters on the Special Analysis list.

2) Existing monitoring wells will be sampled once in the fall 1986 and once in the spring of 1987 and the water tested for the parameters on the Standard Analysis list on Table 1. Fall sampling will be as concurrent as possible with sampling of new monitoring wells. Spring sampling of existing monitoring wells will also be concurrent with new primary and secondary well sampling.

3) Approximately 10 to 15 private wells in or near the community of East Helena will be sampled once in the summer of 1986 prior to drilling of the primary monitoring wells and the water tested for the parameters on the Standard Analysis list on Table 1. These wells will be sampled again in the spring of 1987.

4) All municipal water supply wells that are used or potentially will be used by the community of East Helena will be sampled four times on the same schedule and for the same parameters as the new primary monitoring wells.

5) The Hulst well, located west of the ASARCO plant area, will be sampled three times (summer/fall, fall and winter/spring) to determine if arsenic is a problem at this site. Previous samples of this well showed arsenic was present in the groundwater but no known arsenic sources are present near the well and there is no obvious explanation for the arsenic. Additional samples plus laboratory quality control samples will provide a good understanding of the actual concentration of arsenic in groundwater at this site.

6) There are concentrations of arsenic in groundwater reported between the ASARCO plant site and Montana City that exceed Federal Primary Drinking Water Standards. Information on arsenic concentrations in groundwater in this area will be obtained from records of the Montana Department of Health and Environmental Sciences, the U. S. Geological Survey and other agencies. If needed, selected wells in this area will be sampled to determine arsenic background concentrations.

These groundwater data will allow identification and definition of the arsenic plume and will determine seasonal variations in water quality in groundwater at the new monitoring well locations and private wells not previously tested.

3.1 DIRECTION AND RATE OF CONTAMINANT MOVEMENT

Based on surveyed well elevations and measured depths to water in wells, the elevation of the water table can be determined. These data

will be used to construct a groundwater potentiometric map for both the shallow and intermediate groundwater systems. Based on this map, the direction of groundwater movement will be determined.

Aquifer tests will be conducted to determine aquifer transmissivity using selected monitoring wells. Based on porosities estimated from aquifer lithology, the volume of groundwater flow and velocity of movement will be calculated. This information, together with data on arsenic geochemistry, will be used to evaluate the transport of arsenic in the groundwater system.

The vertical aspect of groundwater movement also will be evaluated. It is not known whether strata in the study area are layered forming a distinct shallow aquifer and an intermediate aquifer separated by fine-grained, low permeability materials or if the strata are complexly layered and interfingered. Monitoring well drilling, water levels and water chemistry will provide information on vertical components in the groundwater flow system. The three instrumented well pairs (described in Section 5.0) also will provide data on hydraulic interconnection of the identified water-bearing zones.

3.2 CONTAMINANT GEOCHEMISTRY

The transport of arsenic, copper, cadmium, lead and zinc are potentially of interest in the aquifer groundwater system because of their presence in the ASARCO plant process. Based on the Phase I

investigation, however, the only contaminant plume identified in the groundwater was for arsenic. There has been considerable work on the hydrochemistry of arsenic but reactions during transport in groundwater are complex and poorly understood. Clearly, the best means to evaluate arsenic movement in an aquifer is to directly measure the distribution of arsenic. This investigation will provide the needed data on arsenic distribution and concentration in groundwater. Another aspect of this evaluation is predicting future movement of arsenic if the hydrochemical system is not in a steady state condition. In this investigation, it is assumed that arsenic both in groundwater and in the aquifer matrix may not be in a steady state and future movement of arsenic must be predicted. To assist in predicting future arsenic transport, the following will be completed:

1) A comprehensive literature review of arsenic transport in groundwater.

2) Estimation of redox potential based on measurement of the arsenic trivalent and pentavalent oxyanions in the system and the ratio of ferric and ferrous oxides in selected wells.

3) Analysis of earth material from the aquifers to measure iron and arsenic concentrations.

4) Assess groundwater transport of arsenic based on species present and potential precipitation, ion-exchange and adsorption mechanisms.

It must be recognized that arsenic transport predictions are difficult to make from aquifer lithology and hydrochemistry. However, an attempt to predict arsenic transport will be made consistant with the available information.

4.0 SURFACE WATER AND GROUNDWATER USE

As part of the project Endangerment Assessment, a comprehensive understanding of exposure pathways and receptors is needed. For surface water, the use of Prickly Pear Creek water for irrigation is a potential exposure pathway that should be evaluated. Based on records from the U. S. Soil Conservation Service (SCS), the Prickly Pear Creek Water Users Association, the U. S. Bureau of Reclamation and the Montana Department of Natural Resources and Conservation and other groups, the land irrigated by water from Prickly Pear Creek will be delineated. Also, the typical quality and quantity of water supplied to these lands will be assessed. This assessment will be based on water quality data obtained during the Phase I investigation and on information obtained from the proposed synoptic runs in Prickly Pear Creek (Section 5.0). The other exposure pathway involving irrigation is use of well water on home gardens. This aspect will be part of the groundwater use inventory.

Groundwater use has been evaluated for some areas near the ASARCO plant site and in portions of East Helena. A more extensive groundwater use inventory will be made to include the area potentially underlain by the arsenic plume. The groundwater use evaluation will

involve a well inventory which will obtain information on well characteristics, location, depth, pumpage, water use, yield and existing groundwater quality data. The well inventory effort will be concurrent with drilling of monitoring wells so the appropriate inventory area can be defined. There are many private wells in the East Helena area and the inventory of wells and groundwater use must be related to the area underlain by the arsenic plume.

The overall objective of this work will be to assess the use of or potential use of contaminated groundwater by people near or downgradient of the ASARCO plant site.

5.0 INTERRELATIONSHIP OF SURFACE WATER AND GROUNDWATER

An understanding of the interrelationship of surface water and groundwater is needed to evaluate exposure pathways. Identification of areas of groundwater recharge and discharge and the direction and rate of groundwater movement are elements in the evaluation of surface water/groundwater interrelationships. The major concern in the ASARCO plant area is the interrelationship between the arsenic plume and water in Prickly Pear Creek and between the groundwater and water in ponds and catchment basins on the ASARCO plant site.

The following will be used in evaluation of the surface water/groundwater interrelationship:

1) The potentiometric map (Section 3.0) will provide information on areas of groundwater recharge and discharge and on the direction of groundwater movement.

2) The geological characteristics of the area also will provide information on the movement of groundwater and areas of groundwater recharge and discharge.

3) Water quality data from both surface water and groundwater will define some interrelationships since the quality of water is affected by flow between surface water and groundwater.

4) Synoptic runs (seepage runs) will be conducted on Prickly Pear Creek three times (fall, spring and summer) to better define stream segments where losses or gains of streamflow occur. These synoptic runs will include 8 to 14 stream stations between PPC-3 (above Upper Lake) and a point about 0.5 miles downstream of PPC-9 (north of East Helena). These synoptic runs will include water quality sampling and measurement of flow. A water sample also will be obtained from Lower Lake during each synoptic runs. Parameters to be tested for each station during these synoptic runs are on the Standard Analysis list in Table 1.

5) Three well pairs, consisting of one well in the shallow aquifer and one well in the intermediate aquifer, will be instrumented with continuous water level recorders. Well pairs will include one near Prickly Pear Creek, one near the center of the ASARCO plant site and one in East Helena north of Highway 12. In addition, one site on Prickly Pear Creek near the ASARCO plant area and near an instrumented well pair will be instrumented with a continuous water level recorder. Comparison of water level records will help determine the interrelationship between aquifers and between groundwater and Prickly Pear Creek.

6) Surface water drainage of the ASARCO plant site will be examined to determine if any water leaves the plant site and to delineate onsite ponding of runoff in catchment basins. Additionally, the catchment areas will be observed to determine how frequently they contain water and to assess the fate of water that enters these basins. If water collects in the catchment basins during the Phase II study, a water sample will be obtained and tested for parameters on the Special Analysis list. Assessment of infiltration will be made using an infiltrometer to provide information on potential groundwater recharge from catchment basins.

Based on this work, the interrelationship between surface water and groundwater will be evaluated.

6.0 PLANT FACILITIES AND MANAGEMENT PRACTICES

A description of plant facilities and process water systems containing contaminated water will be expanded from the Draft Phase I Water Resources Report. To evaluate all possible sources of surface water or groundwater contamination, the description of plant facilities and management practices will include identification, description of quantity, (including volumes of slag piles and process water ponds), and use and manner of handling of onsite substances that could cause potential groundwater contamination. This will include review of available historical aerial photography of the plant site to determine the historical placement of ore piles and other potential contaminants. Additionally, substances produced onsite such as acid that could potentially cause groundwater contamination also will be described. The overall objective of this task is to identify, describe and evaluate plant activities and facilities that may cause contamination of soil, groundwater or surface water systems. A specific facility that will be evaluated as part of this task will be the slag storage piles.

The slag piles have been identified as a potential source of contamination in the Phase I report but it has not been determined whether these piles actually cause any contamination of water resources. The slag piles potentially could cause contamination of water due to percolation of precipitation (rain and snowmelt) through the piles and the subsequent movement of this water into the underlying groundwater. Testing of the underlying groundwater or soil

to determine contamination from the slag piles, however, would be difficult. Contaminants in the groundwater or soil could originate from a number of sources and the contribution from the slag pile could not be separated from contributions from other sources.

A more promising approach to a slag pile contamination study would be to directly measure the infiltration and percolation into the slag pile and directly measure changes in water quality. This could be accomplished as follows:

1) Select an area in the slag pile that is typical in location and slag deposition.

2) Remove a 2 to 3 meter layer of slag from a 5 meter by 5 meter area.

3) Place an impervious membrane such as a 36-mil reinforced hypalon in the excavation with a designed slope and a collection sump. Replace the slag. All necessary precautions to prevent puncture of the impervious membrane will be taken including a layer of sand or a geotextile beneath the liner and hand replacement of portions of the slag.

4) Check the collection sump after each rainfall or snowmelt event to determine the actual movement of water through the slag and the chemical composition of the water. Water

quality will be tested using parameters on the Special Analysis list.

5) Remove and measure water collected in the sump to allow testing of the next water that percolates through the pile.

This would provide a simple, direct measure of the production of contaminated water by the slag piles at the East Helena site. A test site will be constructed on both the fumed and unfumed slag piles. Testing would last for one year to observe seasonal variations.

7.0 GROUNDWATER AND SURFACE WATER EXPOSURE PATHWAYS

Groundwater and surface water exposure pathways must be identified and delineated to allow preparation of the Endangerment Assessment and for the feasibility study. Use of groundwater and surface water in the area will be determined as described in Section 4.0. This information, together with delineation of the contaminant plume (Section 3.0), will allow determination of potential receptors of contaminants.

Pathways to be evaluated include those associated with surface water used for irrigation and groundwater used in the East Helena area for both private and public water supplies. Delineation of exposure pathways also will require evaluation of the geochemistry of contaminants in groundwater to identify mechanisms that affect mobility and concentration. This analysis will focus on arsenic and will include an evaluation of the hydrochemistry of arsenic in the groundwater system.

Another aspect of the evaluation of exposure pathways will be an assessment of the potential degradation of water quality by transport of contaminants from surface soils to surface water and groundwater. The method for evaluation of this potential contaminant transport is described in Section 5.0.

8.0 QUALITY ASSURANCE AND QUALITY CONTROL

As part of the Phase I water resources investigation, a comprehensive Quality Assurance Program Plan (QAPP) was prepared and the plan was approved by the EPA. This plan described personnel responsibilities and organization, quality assurance activities, field operating procedures, standard laboratory procedures, the health and safety plan, decontamination of sampling equipment and sample documentation. This same plan will be used for the Phase II study and the management and field personnel will be the same for Phase II as for Phase I. Any new procedures or modifications of existing procedures will be described and included in an addendum to the original project QAPP.

All field procedures used in the Phase I investigation are described in detail in the QAPP and the ASARCO laboratory also developed a quality assurance plan for the laboratory analytical program. The ASARCO laboratory will provide analytical support for the Phase II work. The following briefly summarizes some of the field procedures to be used during the Phase II investigation.

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maximum error of 0.05 foot. Water levels will be measured each sampling period in all onsite wells and in those offsite wells where access to the well bore is available.

Water levels in ponds, Prickly Pear Creek and ditches will be measured by use of a staff gage or measurement from an established reference point. Relative elevations of all groundwater monitoring sites will be determined to within 0.2 feet by surveying. Mapped locations will be determined by measurement of distance to known landmarks.

8.3 FLOWS

Flow from the seep at the slag pile will be measured by filling a container of known volume and measuring the time required for filling if there is a flow. Flow in streams or ditches will be determined by using a Gurley-type flow meter or a Marsh-McBirney Inc. (MMI) Model 201 analog meter. The stream will be divided into subsections and the width, depth and water velocity in each section measured. Total streamflow will be determined by adding the flows of all subsections. This technique is in accordance with U. S. Geological Survey flow measurement methods.

8.4 QUALITY ASSURANCE AND LABORATORY ANALYSIS

All technical efforts and field work in this program will be in coordination with EPA. All samples will be sent to the ASARCO laboratory in Salt Lake City for chemical analysis and analytical procedures will be in accordance with techniques from 40 CFR 136 or 40

CFR 141, or equivalent methods. Quality assurance for the water analysis will be achieved by the following:

1) Blanks (pure distilled water) will be filtered and acidified in the field and sent to the laboratory for analysis for metals.

2) Unidentified duplicates of samples will be submitted to the ASARCO laboratory.

3) Splits of selected samples will be submitted to the EPA laboratory for analysis.

4) Standard distilled water matrix spikes and natural water matrix spikes of selected parameters will be submitted to the ASARCO laboratory for analysis.

Approximately 10 to 30 percent of the samples tested will be quality control samples. In addition to these external quality controls, the laboratory will maintain a documented record of internal quality control for each parameter tested.

Within four hours of sampling, the specific electrical conductivity (SC) of each field sample will be tested in either the ASARCO plant laboratory in East Helena or in Hydrometrics' laboratory by Hydrometrics' personnel. These measurements will be compared to

analytical results from the ASARCO laboratory in Salt Lake City. Sample pH, temperature and DO (dissolved oxygen) will be measured onsite during sampling.

Detailed sample control and chain-of-custody procedures are included in ASARCO's quality assurance program. These procedures are in accordance with those recommended by the EPA (1982). Generally, the procedures are:

1) Sample identification and labeling in the field and maintenance of a field data record.

2) Collection and custody of the field sample in accordance with the QAPP.

3) Transfer of custody and shipment recorded on standard record documents and samples protected by locked and sealed containers.

The overall objective of sample control and chain-of-custody procedures is to assure the validity of the data and to document the handling, transport and integrity of all samples collected.

9.0 REPORTS AND DATA MANAGEMENT

A technical report will be prepared that presents all data and information obtained during the investigation. The report will describe the investigation and will present study results using

appropriate maps, graphs and tabulations, and will provide a detailed discussion of all study elements. Information from the Phase II investigation will be integrated with the Phase I report and one comprehensive project report will be prepared. The Phase II report also will include information that addresses comments and questions from the EPA on the Phase I report.

Management of data also will be an important element of this hydrogeological investigation. All data will be entred into Hydrometrics' data system and integrated with data from the Phase I investigation. This will allow evaluation and validation of all project data including water levels, water quality analysis, streamflows, soil analysis and aquifer test results. The data management system is designed to evaluate data and determine the need for retesting or resampling.

10.0 PROJECT TIME SCHEDULE

This project will begin as soon as authorized by ASARCO, Inc. It is anticipated that project field work will begin in late July 1986. The project will require approximately 18 months for completion. The project time schedule is shown on Figure 3.

As shown on the project time schedule, there is an overlap between laboratory analysis and well sampling activities. The reason for

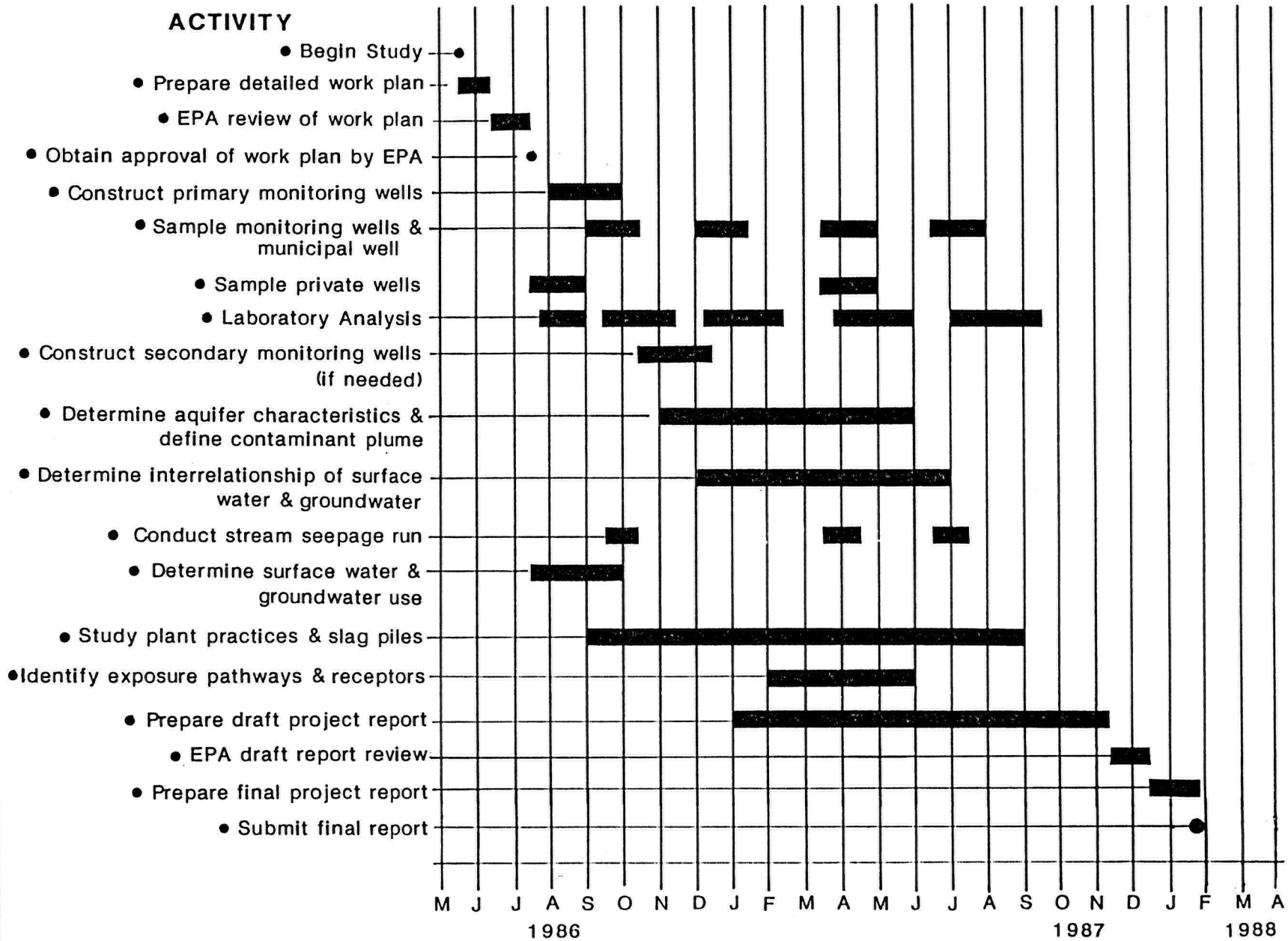

FIGURE 3 PROJECT TIME SCHEDULE

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this is the groundwater sampling time period actually will be about one week within the six-week period shown. Laboratory analysis will begin as soon as the samples are received. Similarly, the times for construction of primary monitoring wells and sampling are overlapped. The total time required to complete monitoring well construction is uncertain and it is planned to sample all the newly constructed monitoring wells within a period of a few days after the wells are completed.

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DA-101 0.005 mg/l

EK 51
0.97 mg/l As

45 Secs

DA-14
0.03 mg/l

DA-4
10 mg/l
in mass

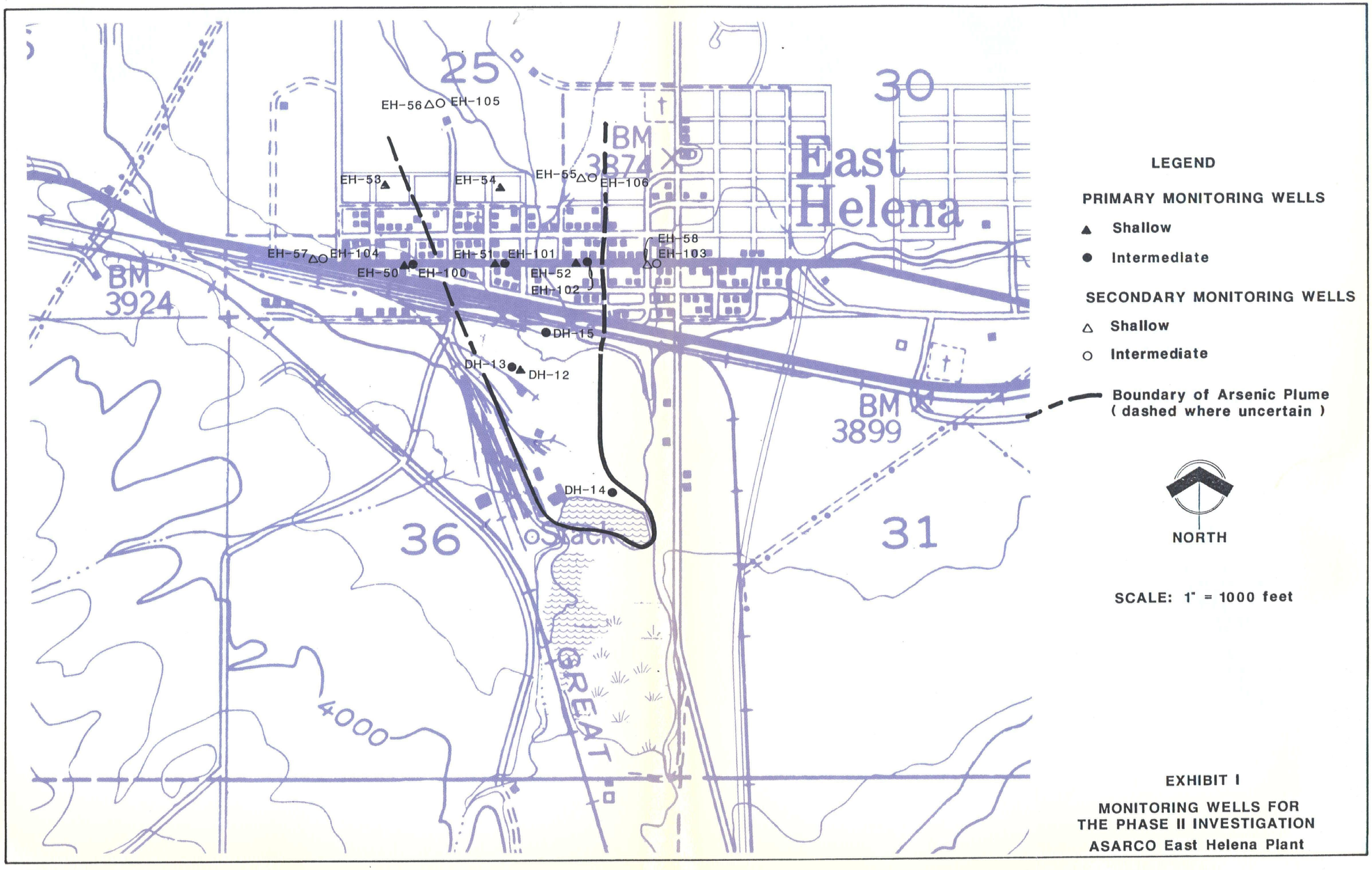

EXHIBIT I

MONITORING WELLS FOR
THE PHASE II INVESTIGATION
ASARCO East Helena Plant

letter bound in the work plan. This should provide the users of this plan a complete record of the response and comment process.

Call me if you have any questions.

Sincerely,

Beth Bauch for

John D. Lucero
Site Manager

DE/ASARC7/044/jm
cc: Dick Glanzman/CH2M HILL, Denver
Jim Schwing/CH2M HILL, Denver
Larry Holm/CH2M HILL, Redding
Doug Skie/EPA-8MO, Helena
Vicki Kohonoski/CH2M HILL, Reston
Chuck Feast/CH2M HILL, Boise