Appendix A

Alternative V — Rock Creek Project with Tailings Paste Deposition and Alternate Water Treatment (Preferred Alternative)

The major modifications distinguishing this alternative from Alternative IV are the deposition of tailings as a paste, an alternate water treatment system, an enclosed rail loadout facility, and relocation of the evaluation adit support facilities (see Figure 2-26). There is also a modification to the mill site and mine portal to improve mine to mill ore transport efficiency (see Figure 2-27). Table 2-12 lists the significant issues pertinent to this project and indicates which of the following sections addresses mitigating measures for those issues. Chapter 4 contains a more detailed discussion of how the mitigating measures would reduce or eliminate environmental impacts.

TABLE 2-12
Alternative V Modifications and Mitigations

Significant Issues	Categories							
	Mine Plan & Ore Processing	Tailings Disposal	Water Use & Manage-ment	Transpor-tation	Utilities	Employment	Reclama-tion	Monitoring & Mitigation Plans
Surface & Ground Water Quality		x	x	x	x		x	x
Fish, Wildlife, and T&E Species	x	x	x	x	x		x	x
Impoundment/Paste Facility Stability		x						
Socioeconomics	x							
Old Growth Ecosystem	x							
Wetlands and Non-wetland Waters of the U.S.	x	x						x
Public Access/Traffic Safety	x			x				
Aesthetic Qualities	x	x			x		x	

In addition, to the major modification mentioned above, Alternative V includes the following applicable modifications, mitigations, and monitoring plans from Alternatives III and/or IV as well as components from Alternative II. These items are listed below. The alternative shown in parentheses at the end of each bullet statement indicates the source of the modification or mitigation. A description of these items has been incorporated into the Alternative V description to provide the reader with a full description of this alternative and to reduce the amount of searching through the previous alternatives to determine what exactly was carried forward.

Modifications:

- Alternate mill and mine portal location at confluence of east and west forks of Rock Creek (Alternative IV) and subsequently shorter combined access road and utility corridor
- Alternate rail loadout location near Miller Gulch (Alternative III)
- Alternate location for wilderness air-intake adit (Alternative III)

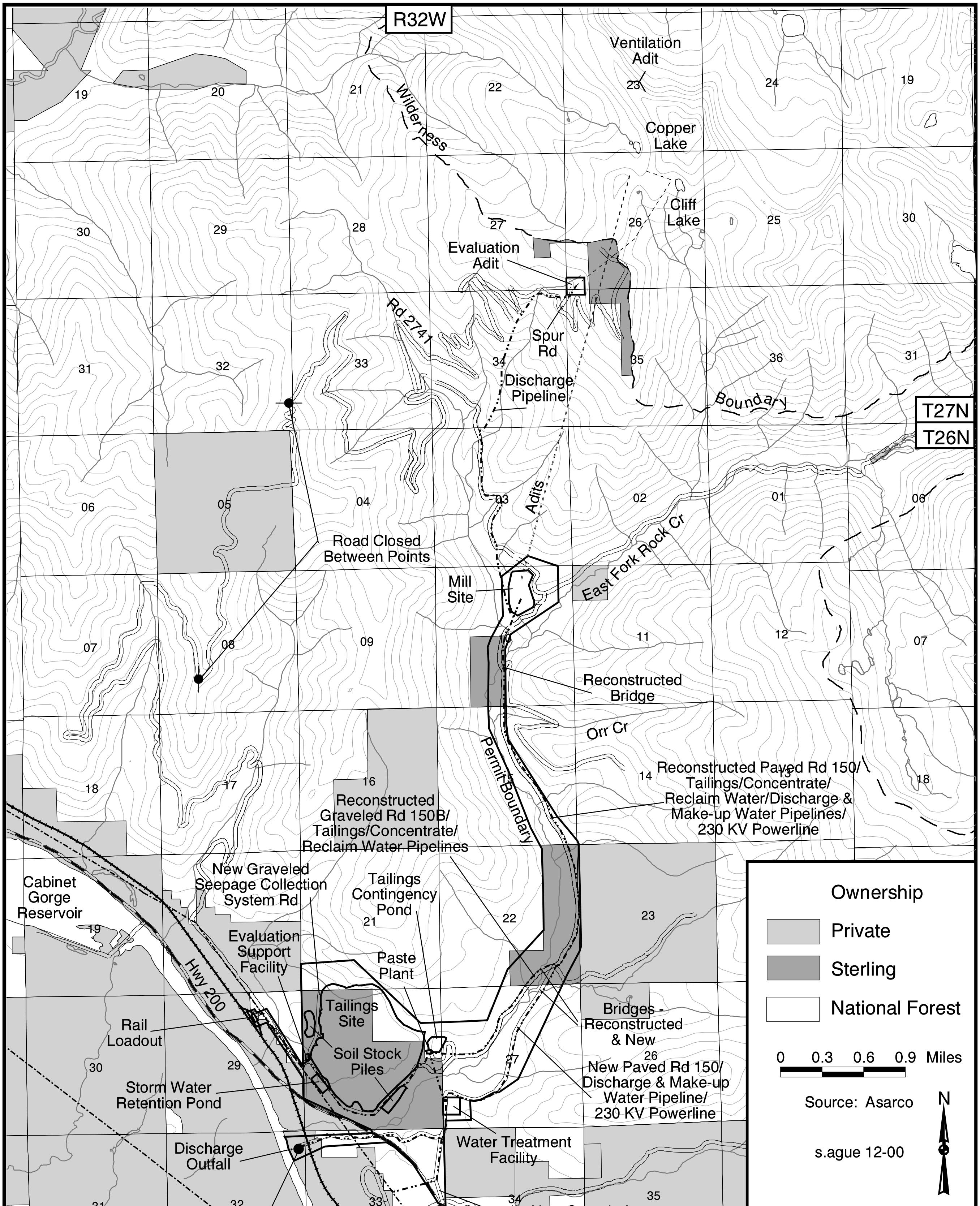
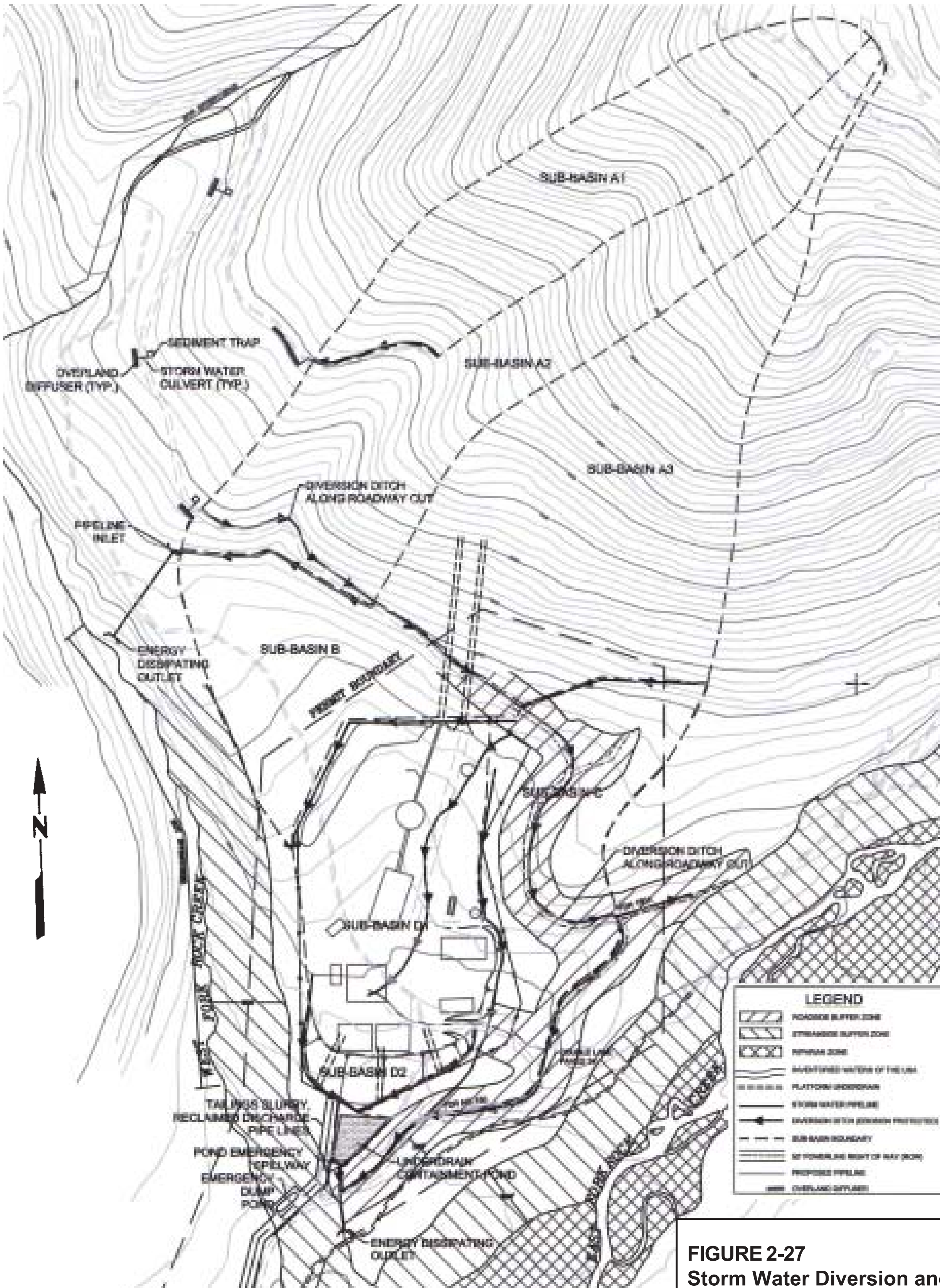


FIGURE 2-26
Alternative V
Rock Creek Project



Scale: 1" = 700' approx.

SOURCE: Water Management Plan, Hydrometrics, Inc., 1997

FIGURE 2-27
Storm Water Diversion and Collection Plan for Mill Area Rock Creek Project

Mitigations:

- Rock mechanics monitoring plan (subsidence control) (Alternative III)
- Rock mechanics and hydrogeologic sampling, testing and monitoring program to include rock geochemical testing program (Alternative III)
- Visual and sound mitigations for the mill site (Alternatives III and IV), and ventilation and evaluation adits (Alternative III)
- Technical panel review of final tailings storage facility design (paste facility under Alternative V) (Alternatives III and IV)
- Starter dams constructed with mine waste rock toe buttresses (Alternative III)
- More permeable areas within tailings storage facility sealed with excavated clays (Alternative III)
- A transportation management plan (Alternative III)
- Visual mitigations for the utility corridor and tailings impoundment site (paste facility site under Alternative V) (Alternative III)
- Revised grading and revegetation plans for the mill site to mitigate visual impacts (Alternative IV) and development of a vegetation management plan (Alternative III)
- Deeper soil salvage (24 to 36 inches) and replacement depths (average of 24 inches) to facilitate revegetation (Alternative III)
- 300-foot streamside buffer zone around mill (Alternative IV)
- 100-foot visual buffer between FDR No. 150 and mill site (Alternative IV)
- More detailed long-term reclamation monitoring plan than Alternative II (Alternative III)
- More detailed aquatics/fisheries, wildlife, threatened and endangered species monitoring and mitigation plans than under Alternative II (see Appendix K), including a sediment source reduction plan (see Alternative III) (see Erosion and Sediment Control)
- A comprehensive, long-term water monitoring plan which includes monitoring lake levels at Cliff and Copper lakes to be coordinated with subsidence control and fisheries/aquatics monitoring plans (Alternative III)
- An alert level and contingency/corrective action plan for each monitoring plan (Alternative III)
- Maintenance of the wastewater treatment system and possible long-term post-closure waste water treatment (Alternative III)

- Revisions to the applicant's wetlands mitigation and monitoring plans (Alternative III)
- All reasonable options to an air intake ventilation adit in the CMW would be pursued (Alternative III)
- Cultural monitoring during surface disturbing activities (Alternative III)

Evaluation Adit

The proposed evaluation adit would be driven prior to other work on the Rock Creek Project in an attempt to better understand the configuration of the ore body. During the mine production phase, this adit would serve as an additional ventilation (exhaust) opening and as a secondary escapeway, when the two adits met. Conventional mining methods would be employed during the 1-year evaluation adit construction period. Existing roads would provide access and an estimated 8.3 acres would be disturbed. While most of the pertinent information about the evaluation adit is included below, more details on the evaluation adit can be found in the Rock Creek Evaluation Adit License Application (ASARCO Incorporated 1992).

The adit portal would be located at about 5,755 feet elevation. About 59,000 tons of waste rock and 119,000 tons of ore would be excavated from the proposed adit (18 feet high by 18 feet wide with an estimated length of 6,592 feet at a decline of 10 percent). Unmineralized or barren waste rock would be end-dumped near the portal to form a flat-topped pile sloping downhill to its angle of repose. Mineralized material would be placed in a stockpile near the portal for later processing when the mill was in operation. A lined storm water containment pond would also be constructed on the portal pad.

Several facilities are proposed to be constructed for the evaluation adit (Figure 2-28). A few of these facilities would be located at the evaluation adit portal site. A 40-foot by 80-foot temporary steel shop building on a concrete slab would be constructed on top of the initial waste material removed from the adit. This building would provide warehouse space, indoor work space, a lunchroom, and lavatories. Two propane-fired generators (545 kW and 735 kW) would be located in a lean-to attached to this building to provide power during adit construction rather than the diesel generators proposed under Alternatives II-IV. An above-ground propane tank would be located near the shop building at the adit site. All exterior lights would be shielded or baffled from viewpoints in the Clark Fork Valley. Upon completion of the evaluation adit, all facilities would be either removed from the permit area or moved to the mill site for use during mining.

Excess water from the evaluation adit and the storm water containment pond overflow would be pumped through a temporary 6-inch polyethylene pipeline to a temporary wastewater treatment system at the lower support facilities site prior to discharge. This system would consist of a portable reverse osmosis unit and a pilot anoxic biotreatment system. (See the Water Use and Management section below for more detail on these systems.) Discharges must comply with MPDES limits. Sterling would install the portion of temporary mine water discharge pipeline between the evaluation adit and the support facilities site with a cable and winch instead of dragging it through the woods with a tractor. This would minimize vegetation clearing and erosion on the steep hillside below the evaluation adit. This pipe would be removed in a similar fashion when the mine reached the evaluation adit or through the reclamation of the evaluation adit whichever came first; the evaluation adit water would then be routed through the mine water drainage and collection system.

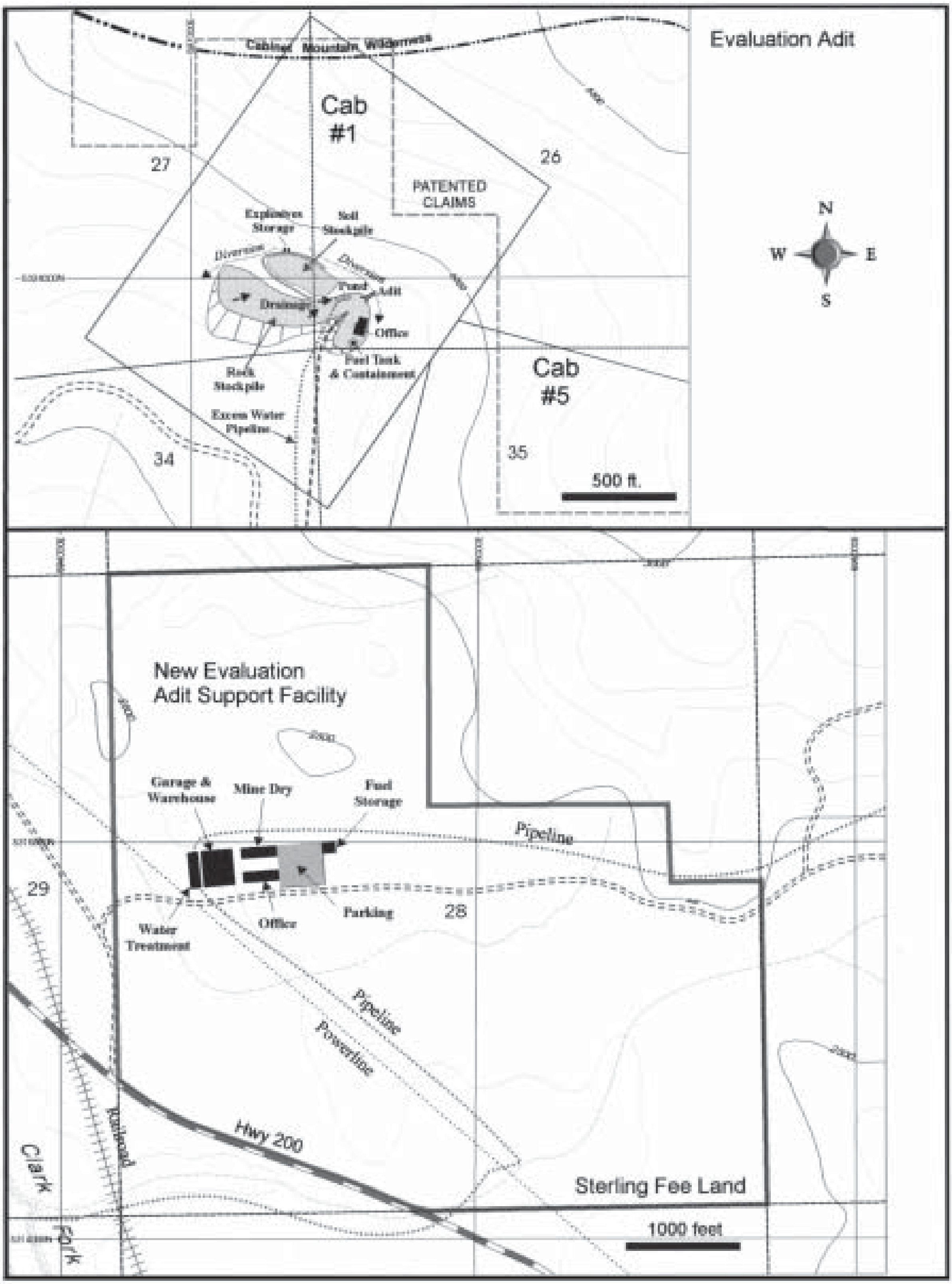


FIGURE 2-28
Evaluation Adit and Support Facilities
Rock Creek Project

Source: ASARCO, Incorporated 1999.

Additional support facilities would be located within the paste facility footprint (see Figure 2-28) rather than in Section 22 as proposed under Alternatives II-IV. These include: an office situated in a 12-foot by 60-foot trailer or other similar structure; a changehouse/dry set up in another trailer; a garage and warehouse located in a pre-engineered steel building on a concrete slab; a graded, graveled employee parking lot; and a soil stockpile. A 500-gallon above-ground gasoline storage tank in a lined containment structure would be located near the garage and warehouse. The support facilities site would be supplied with electrical power from a local distribution line.

Extensive data collection, sampling and monitoring would be required during the construction of the evaluation adit. Rock geochemical characterization, monitoring and mitigations are discussed in the Acid Rock Drainage and Metals Leaching Plan in Appendix K. This plan includes provisions for waste rock handling during adit construction as well as contingency needs should premature project closure occur before mine construction and development begins. The evaluation adit data collected and evaluated through this plan and rock mechanics and hydrological data collected through the Evaluation Adit Data Evaluation Plan (EADEP) would be used to modify mine designs and operations to keep impacts at or below the levels disclosed in Chapter 4.

Mine Plan

Mine and Mill Operations. The mine plan would remain the same as described for Alternatives II through IV. The entire mill complex, including the mine portals, surface conveyor, SAG mill, office building, shop, sewage treatment plant and warehouse, would be located at the confluence of the east and west forks of Rock Creek as described for Alternative IV. However, the mine portal would be moved to the west side of FDR No. 150 just north of the coarse ore storage (see Figure 2-27). This aligns the adits with the mill facilities and eliminates two transfer points on the ore conveyor belt system. There would be no mine facilities on the east side of FDR No. 150 at the confluence mill site other than storm water control features. This alternative mine/mill site, as shown on Figure 2-27, would be located above the 10-foot flood stage (about 100-year flood event) with a minimum 300-foot buffer between the mill site and the east and west forks of Rock Creek to create a riparian buffer zone. It would be sited on cut-and-fill pads located at the toe of the southwest facing ridge at the confluence. The layout would afford a reasonably compact mill site arrangement.

Mill Site and Mine Adit Construction. The portal location would be placed at an elevation of 3,040 feet and would be within the mill site. Each of the access adits would be about 15,530 feet long and about 1 million tons of waste rock would be produced during their construction. The waste rock would be used in part to construct the mill site pad, potentially raising the ground level at the mill site by a maximum of 50 feet. This elevated pad would increase mill site visibility from surrounding Forest Service roads and wilderness viewpoints that are located above the mill site. A maximum pad height of 50 feet and retention of a minimum 100-foot vegetative buffer around the pad would help limit mill site visibility from the portion of FDR No. 150 that surrounds the site. Additional rock excavated from the adits beyond that needed to construct the pad would be used for foundation material at the tailings paste facility. Hauling of waste rock from the adits to the tailings paste facility site would only occur between August 1 and March 31 as a mitigation to impacts on harlequin ducks. There would be no separate waste rock dumps under this alternative. Directional grouting prior to blasting would be used during adit construction to minimize seepage into the adits during construction and mine operation. Monitoring of ground water and rock mechanics and geochemical rock characterization would continue during adit and mine construction as described in Appendix K.

Mill Site Mitigations. Aesthetic impacts of the mill and mine-related facilities would be minimized because Sterling would be required to implement the following mitigations:

- plant or retain a vegetative buffer of sufficient width between FDR No. 150 and mill site (minimum 100-foot buffer), the waste water treatment facility, and the substation in the lower Rock Creek drainage for visual screening;
- treat and/or paint permanent (life-of-mine) structures within the project area to visually blend with the surrounding landscape;
- shield or baffle exterior lights from viewpoints in the Clark Fork Valley;
- operate all surface and mill equipment so that sound levels do not exceed 55 dBA measured 250 feet from the mill;
- replace above-ground vehicle back-up beepers with discriminating back-up alarms that sense movement behind a vehicle if allowed by OSHA.

Mine Ventilation and Wilderness Air-Intake Adit. Electric ventilation fans would initially use the conveyor adit for intake and the service adit for exhaust. However, Sterling would use the evaluation adit for air exhaust ventilation during the operation phase once the mine intercepted the evaluation adit and might possibly require a separate air-intake ventilation adit in the wilderness towards the end of mine life. Intake and exhaust ventilation fans in the exploration and mine adits would be adjusted so that they generate less than 82 dBA measured 50 feet downwind from the portal entrances.

If in the future, monitoring showed a need to provide additional ventilation for mine personnel health and safety as required by the Mine Safety and Health Administration (MSHA) rules and regulations, it may be necessary to drive an adit to the surface in the wilderness to provide an additional air intake and a secondary escapeway from the mine about year 20 of mine operation. The air-intake ventilation adit would be driven from the underground workings; there would be no need for the creation of a waste rock dump at the adit portal in the wilderness. Fans would be located no closer than 200 feet underground from the wilderness adit opening. A process would be developed to ensure locating an air-intake ventilation adit in the CMW would be the last choice among potential ventilation options. Other options could include an upgrade of the existing ventilation system and closure of portions of the exhausted underground workings. If Sterling and the agencies determine that other methods of expanding ventilation capacities are reasonable Sterling would implement other ventilation techniques prior to being permitted to construct the wilderness adit/portal. If it was deemed necessary to construct the air-intake ventilation adit in the CMW, Sterling would conduct a detailed study verified by a site visit with the agencies prior to excavation to evaluate variations in topography and rock formations. Other site-selection criteria would consider possible post-closure use of the adit for bat habitat. The agencies would evaluate the compatibility of this post-mine use with restoration of premining appearance and configuration to address visual impacts. For purposes of analysis in this EIS, the agencies have assumed that the air-intake ventilation adit would be located about 400 feet north of the west ridge of Saint Paul Peak and would disturb about 800 square feet. The wilderness air-intake ventilation adit would be located so as to minimize visual impacts and reduce noise impacts to 45 dBA (measured 50 feet from the ventilation portal). If necessary to achieve this level, specially designed low-noise fan blades or active noise-suppression equipment would be used. Sterling would contact the Forest Service prior to construction for approval of final siting and construction methods.

Mine Plan. The room-and-pillar system of mining is used for most flat-lying or nearly flat-lying ore deposits where the ground is hard and firm, and where artificial means of support would be too costly. Room-and-pillar is one of four common types of open stope (underground excavation) methods.

In room-and-pillar mining, some ore is left unmined to give support to the mine roof. The slot-pillar system is similar to room-and-pillar. Rather than a regular pattern of rooms and square pillars, a slot pillar is longer in one direction, creating a system of rectangular pillars and rooms. This design is used when more ground support is needed. Generally, a regular pattern of pillars is more efficient than an irregular one, and the size and spacing of support pillars varies depending on local ground conditions (Earll et al. 1976).

Sterling proposes to use a combination of room-and-pillar and slot-pillar designs[10]. The majority of the mine layout would use a regular pattern of rooms and pillars. A design layout similar to the Troy Mine is proposed. The determination of when to use a regular pattern versus a slot pillar approach would be made after examining local ground conditions and rock mechanics data.

Sterling would be required to provide an updated preliminary mine design for agency review and approval prior to exploration and mine start-up. The agencies would conduct a second review of the mine design to determine its suitability for actual conditions during mine adit construction. Specifics of this review would focus on general design approach, design criteria and methodology, rock mechanics test data from the Rock Creek deposit,[11] proposed room-and-pillar sizing and layout, identification of zones of rock instability and potential subsidence, and mitigations for these areas. Given the expected changes in planning any underground mine development, Sterling would submit updated detailed mine plans for agency review prior to entering areas where mining could have deleterious environmental impacts if adequate precautions were not taken. This would ensure development was meeting the environmental objectives and intentions of the original design. Approval of the mine plan would be contingent on demonstrating that the risk to Copper and Cliff lakes and the potential for subsidence would be minimized, based on hydrogeologic and applicable engineering analyses. Secondary pillar recovery would not be allowed.

The average depth of the ore body is 900 feet below the surface except where the ore approaches the outcrop interfaces. In order to protect against surface subsidence, hydrofracturing and leakage to the surface, Sterling would be required to leave a minimum of 450 feet of overburden over the mine workings particularly near the ore outcrops located in the northeast and southeast portions of the orebody and in Copper Gulch. Additionally, Sterling would not be allowed to mine closer than 1,000 feet from the outcrops and would not cross the Moran Fault (MT DEQ 2001). These limits would be modified based on site-specific rock mechanics and hydraulic information gathered as a result of the ongoing mining operation and the required Rock Mechanics Monitoring Plan.

A buffer of 1,000 feet around Cliff Lake, ore outcrop zones, the Copper Lake fault, and the Moran Fault would remain unmined until the hydrogeology of this area is better characterized through the monitoring process. In the Copper Lake Fault area where ore thicknesses exceed 100 feet, Sterling proposes to leave a large barrier pillar between the fault zone and the active mine area. The function of the barrier pillar would be to provide stability in this area of large ore horizon thickness and potential

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[10] The pillars would be 45 feet square and drives and cross-cuts 45 feet wide. Ore recovery is projected at 65-75 percent. As ore thickness increased and/or overburden decreased more ground support may be necessary. Again, using a design from the Troy Mine, Sterling proposes to use a slot-pillar approach. The pillars would be 30 feet wide while the drives would be 50 feet wide. The overall length of the slot pillar would vary but could be on the order of several hundred feet long. Ore recovered using this approach is reduced (10 percent at Troy Mine), however ground support is improved.

[11] Rock mechanics data would initially be obtained during construction of the evaluation adit as outlined in the Rock Mechanics Monitoring Plan and the Evaluation Adit Data Evaluation plan described briefly in this document and in more detail in Appendix K of the final EIS.

poor ground conditions. The dimensions and location of the barrier pillar(s) would be determined after assessing local ground conditions.

In areas where the proposed ore extraction thickness exceeded the capacity of designed pillars, Sterling proposes to use a horizontal pillar to facilitate extraction over the entire ore height. A horizontal pillar is a section of unmined material left in place between two rooms stacked one on top of another (see Figure 2-9). Using a design from the Troy Mine, Sterling expects to use this approach when ore thicknesses exceed 75 feet.[12] Although ore recovery would be reduced to 52 percent from 75 percent using this design, it would allow for ore extraction over the entire ore column.

Conventional drilling, blasting, rock bolting, and mucking methods would be used underground. Broken ore would be processed by an underground crusher and then transported to the surface via conveyor belt for further processing. A surface conveyor belt would transport ore from the adit portal to the mill. A maximum of 2,500 cubic yards of ore mined during the construction period would be stockpiled at the mill site for treatment following construction of mill facilities. Waste rock generated underground during the production period would be stored in mined-out areas.

Seasonal storage of mine water within underground mine workings is proposed to regulate outflow through the water treatment system. By year 27, a 207.7-million-gallon reservoir would be established in worked out portions of the mine to handle maximum water storage requirements. This would equate to a maximum storage capacity of about 64 acres with water 10 feet deep. The area and volume required for storage would be increased throughout the mine life on an as-needed basis by modifying the mining method to create the storage areas. The ore in the storage areas would be mined using conventional methods except that barrier pillars would be left in place along either side of the storage area.

Rock geochemical characterization, monitoring and mitigations, for determining suitability of waste rock to be used for mill pad construction, road gravel, and paste facility toe buttresses and finger drains, are discussed in the Acid Rock Drainage and Metals Leaching Plan in Appendix K. This plan includes provisions for waste rock handling during operation as well as contingency needs should premature project closure occur. The evaluation adit geochemical data collected and evaluated through this plan and rock mechanics and hydrological data collected through the EADEP would be used to modify mine designs and operations to keep impacts at or below the levels disclosed in Chapter 4. The facilities, designs and plans must be approved prior to mine construction and operation.

Reduced-emission diesel engines would be used in place of standard diesel engines underground. Electric underground ore trucks would also be used. These modifications would reduce concentrations of noxious gases released to the atmosphere and underground workings.

Surface Disturbance

A total of about 482 acres would be disturbed within the permit area of 1560 acres under Alternative V (see Table 2-2). Land encompassed by the proposed permit boundary is 48 percent privately held and 52 percent NFS lands. The Forest Plan would be amended so that management allocations on 147 acres would be consistent with the intended use.

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[12] Vertical pillars would be 30 feet wide, rooms 50 feet wide, and the horizontal pillar 40 feet thick. In this manner a 200-foot thick ore horizon could be mined with two 80-foot-tall rooms with the intervening 40-foot horizontal pillar.

Ore Production Schedule

Ore production scheduling would be similar to that described for Alternative IV (see Table 2-11). Sterling would develop an underground mine that would produce 10,000 tons of ore per day, or 3.5 million tons per year. Ore reserves are estimated to range between 136 and 144 million tons averaging 1.65 troy ounces per ton of silver and 0.68 percent copper. About 65 percent of the ore body would likely be mined, with about 35 percent remaining as pillars and other structural support. Actual underground conditions would govern the amount of ore removed.

Based on these figures, Sterling would mine and mill between 88 million tons and 108 million tons of ore giving the mine an anticipated production life of 25 to 30 years and a total project life of 33 to 37 years depending upon the actual amount of ore reserves and the ore extraction rate (see Table 2-11). Based on milling efficiencies at the Troy Mine, Sterling anticipates a milling efficiency of 85 percent. That is, about 85 percent of the copper minerals and silver in the mined ore would report to the concentrate, while 15 percent would remain in the tailings.

Ore Processing and Shipment

The ore-processing facility or mill would remain generally the same as is described for the proposed action, Alternative II, but would be located at the confluence of the east and west forks of Rock Creek as described for Alternative IV. The primary difference from the other action alternatives is that there would be no tailings thickener facility at the mill site due to the change in tailings disposal (see Paste Deposition of Tailings below). The thickener would not be necessary as the tailings would be dewatered at the paste production plant adjacent to the tailings paste facility. However, the emergency dump pond and the storm water pond would be enlarged to provide additional water storage (see Figure 2-27).

Sterling modified the milling operation to reduce particulate emissions under Alternative V. The surface dry milling operation or secondary crushing would be replaced with a semi-autogeneous (SAG) mill, a fully wet milling operation. Concentrate would be sent from the mill to the rail loadout facility as a slurry in a 3-inch HDPE-lined steel pipe with leak detection sensors and buried in the same corridor as the tailings and water pipelines. The rail-loadout process including concentrate dewatering, drying, and storage and railcar loading would take place within an enclosed building. Covered railcars would eliminate the use of a tackifier that would have been needed to minimize dust generation during transport to the smelter. Approximately 13 railcars of concentrate per week would be removed from the site. Reclaimed concentrate water would be piped to the paste plant and then to the mill for reuse.

Paste Deposition of Tailings

Facility Design. The conceptual tailings paste facility design has undergone an engineering review for feasibility and stability (Klohn-Crippen 1998). The tailings paste facility design would be finalized as additional site information was obtained from the final design investigation process. Technical review of the final design would be made by a technical review panel established by the agencies. Review would encompass the technical aspects of design including the short- and long-term stability of the tailings storage facility. If supplemental rock and tailings characterization data and geochemical testing showed a potential for acid generation not presently anticipated, the review would also include consideration of some form of a seepage-inhibiting layer or liner beneath the impoundment. The technical review panel would assist in the development of the QA/QC protocols. The panel would ensure that any environmental impacts associated with final design remained within the scope of those impacts identified in the final EIS. If the final design generated additional impacts and they could not be mitigated to remain within this scope, then further MEPA/NEPA documentation would be required. The agencies would have to review and approve the final design prior to construction.

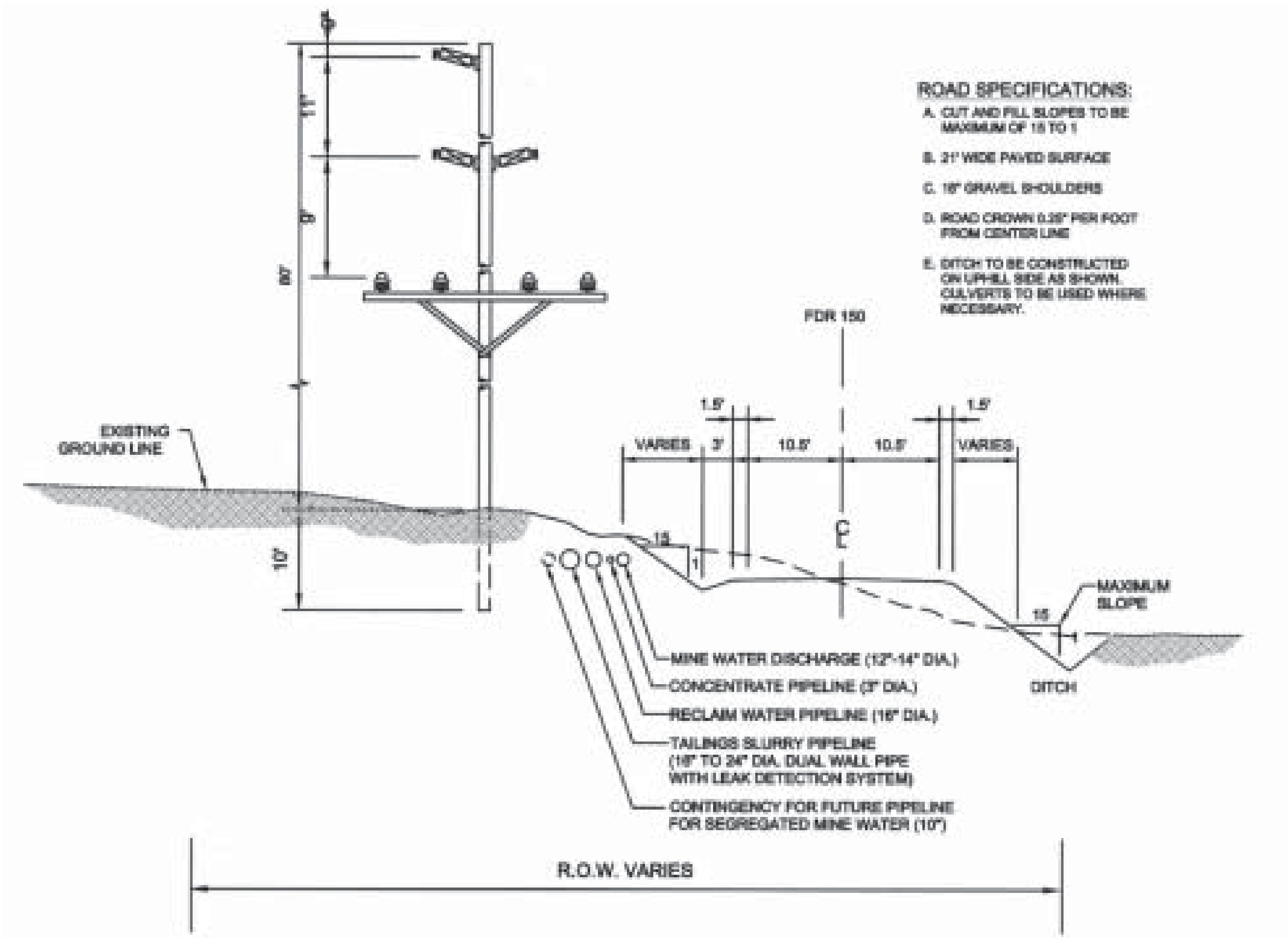
Tailings Transport. Tailings would be transported 4.1 miles from the mill to the paste plant as a slurry (30 percent tailings, 70 percent water) in a 16- to 24-inch, urethane-lined, steel pipeline (a double-walled pipeline) with leakage detection devices. This pipeline, the 16-inch return process water line (which would also be used as the make-up water line), and the concentrate pipeline would be buried at least 24 inches deep (see Figure 2-29). Burying the pipelines will provide better protection from vandalism, eliminate the visible presence of the pipelines, and facilitate concurrent reclamation in the pipeline corridor along most of the route between the mill and the paste plant. The pipelines would be visible at the three above ground crossings of Rock Creek, West Fork of Rock Creek, and Engle Creek. All lines would be encased in a larger steel pipe at creek crossings adjacent to or near bridge crossings to guard against the unlikely event of a leak or rupture.

Paste Production. In general, the tailings would be delivered to the paste plant and dewatered to make a paste with a known proportion of water (approximately 20 percent by weight). This paste would be applied to the ground surface after sediment and erosion control features are in place and soil has been salvaged, and the foundation has been prepared as described under Alternatives III and IV including the use of excavated clays to seal permeable areas of footprints.

The paste plant building, approximately 80-feet by 80-feet by 110-feet high, would be located on the hillside adjacent to the tailings paste facility site. The building would be built into the hillside and painted to help reduce its visual impact. Trees and vegetation surrounding the paste plant would be retained or planted to help visually blend the plant site with adjacent hillsides. Sterling would conduct a site study verified by a visit with the Agencies prior to final siting of the plant and access road to select a location that would reduce plant visibility and avoid harlequin duck habitat to the extent possible.

The paste plant would be designed to receive, dewater, mix, and pump 10,000 tons of tailings per day, 365 days per year. The paste process schematic is shown in figures 2-30 and 2-31. The tailings slurry would be deposited into a tailings surge tank and then fed into two cyclone/separators. The cyclone underflow, composed of the coarser tailings, would be discharged into a coarse tails storage tank (25-foot-diameter by 50-foot-high) and could be discharged at a rate of 50 tons per hour (tph). The overflow, composed of primarily finer tailings, would be fed through a distributor box into one or more of the four 32-foot-diameter by 60-foot-high paste dewatering tanks. The tailings would be discharged from each tank at a rate of 67 tph. Maximum discharge rate could reach 90 tph to allow for maintenance of one tank while continuing paste production in the other three tanks.

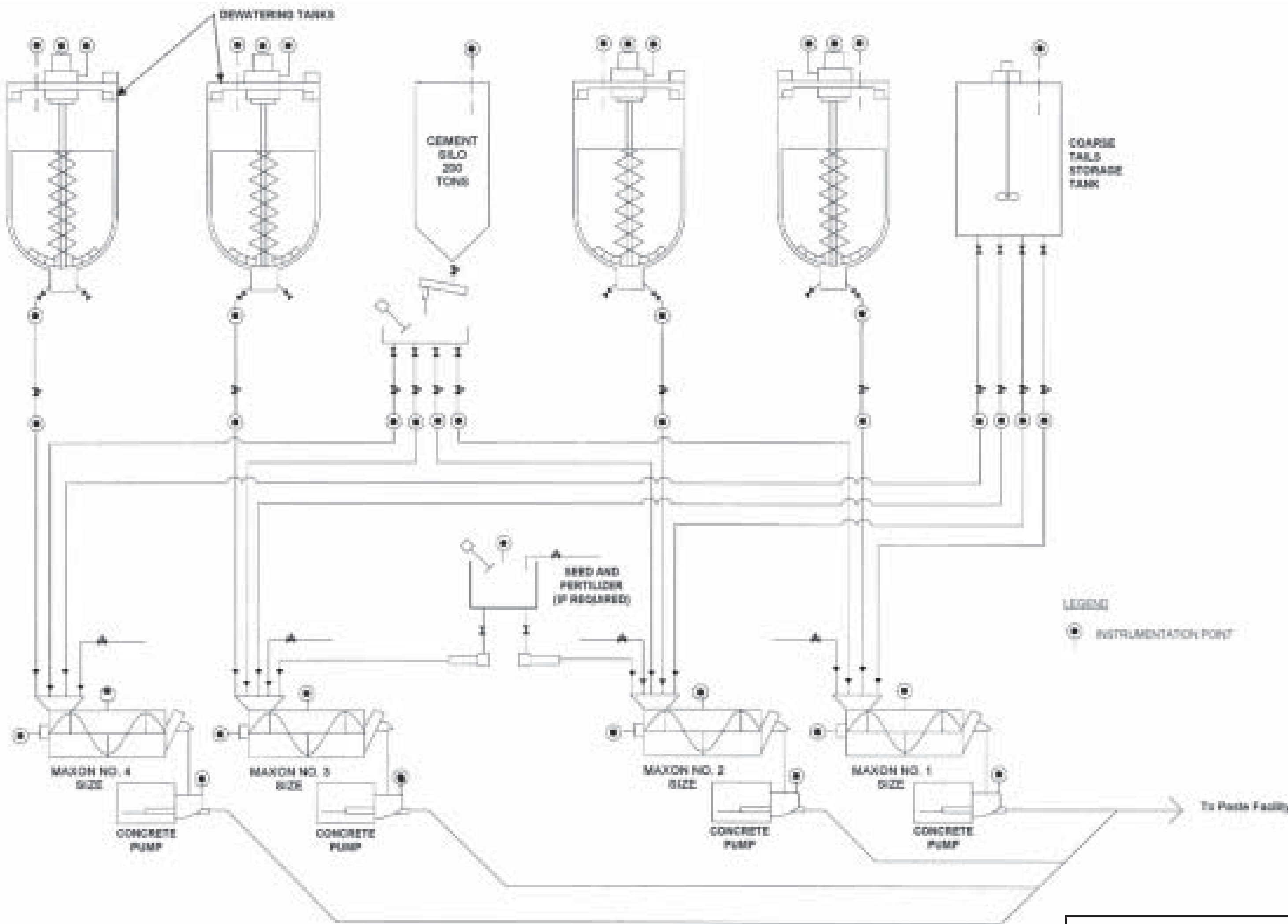
Process water for paste production would come from the water discharged from the paste dewatering tanks. Process water would be stored in a 30,000-gallon tank; excess water would be pumped back to the mill for reuse or discharged from the mill to the waste water treatment facility for disposal.



NOTE:
1. All Pipelines would be installed with leak detection systems.

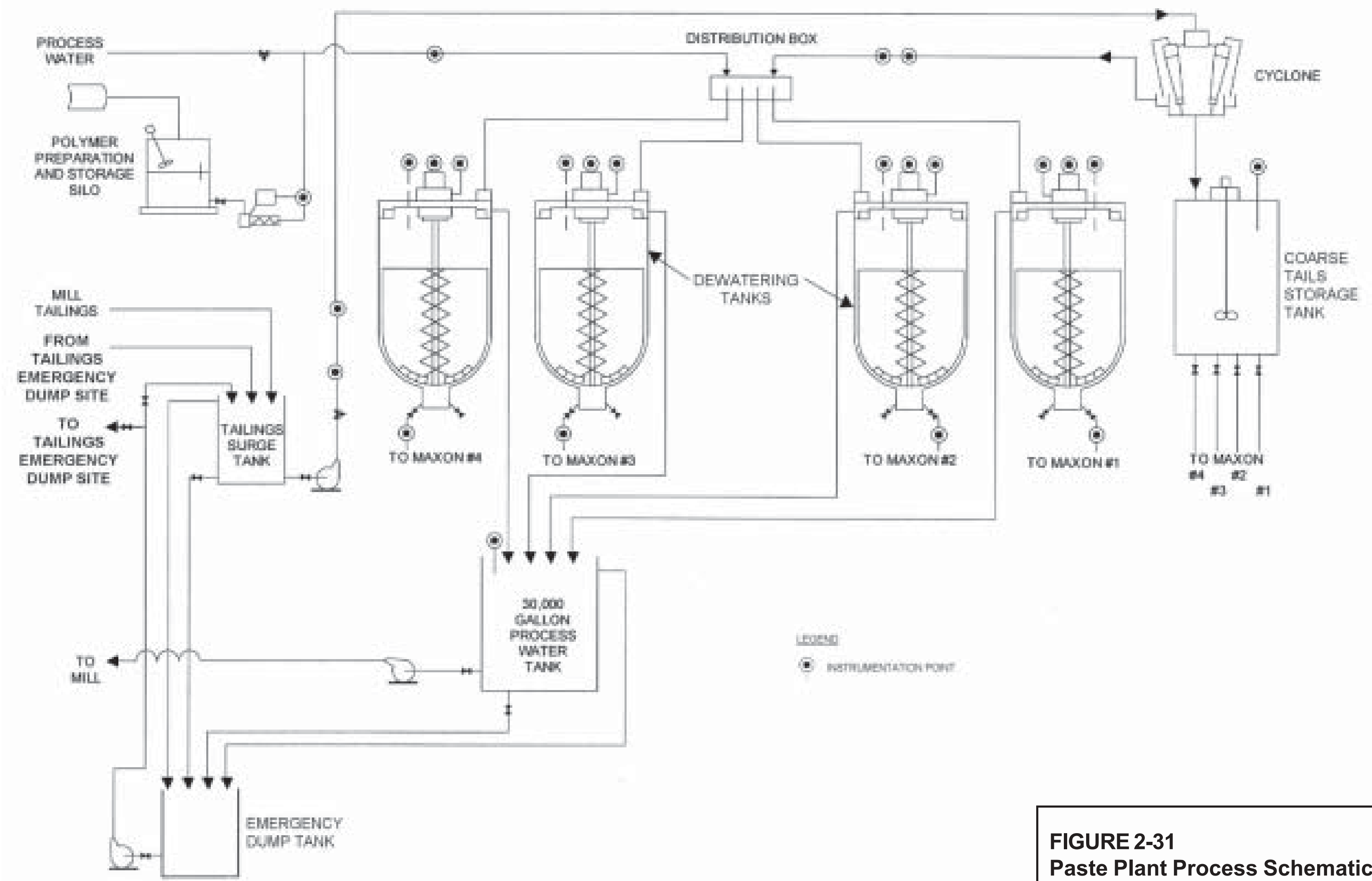
SOURCE: Water Management Plan, Hydrometrics, Inc., 1997

FIGURE 2-29
Pipeline Corridor Drawing
Rock Creek Project



SOURCE: Golder Associates Ltd., Evaluation of Surface Paste Placement, 1996

FIGURE 2-30
Paste Plant Process Schematic - Paste Production and Mixing
Rock Creek Project



SOURCE: Golder Associates Ltd., Evaluation of Surface Paste Placement, 1996

FIGURE 2-31
Paste Plant Process Schematic - Dewatering of Tailings Slurry
Rock Creek Project

The success of the paste process is dependent on the strict control of paste parameters such as moisture content. Prior to the implementation of a paste program, Sterling would be required to develop and submit for Agency approval a comprehensive paste plant operations manual. This manual would address plant operations, paste parameter tolerances, contingencies for paste not meeting specifications, monitoring of the paste production process, and reporting to the Agencies. The technical advisory board empaneled to assist with the design review of the paste impoundment would assist in the development of the QA/QC protocols.

The full plant tailings paste would be produced by combining the fine tailings paste from the dewatering tanks, the coarser tailings in the coarse tails storage tank, and additional process water as needed. Supplemental material such as a binder (Portland cement[13], fly ash, or slag cement) or seed and/or fertilizer to facilitate reclamation would be added as needed. Each dewatering tank would have a separate mixer capable of handling the maximum discharge from the dewatering tank plus the coarse material from the storage tank. The paste production would be monitored and regulated so that the resultant paste would have a consistency comparable to concrete exhibiting a 7-inch slump; this means positive displacement pumps would transport the paste via a high-pressure pipeline to the disposal location at the tailings paste facility.

The dewatering tanks would be designed to allow for continuous feed of tailings and production of paste even when one tank was off line for maintenance or repairs. The surge capacity of the dewatering tanks and the coarse tailings agitated storage tank would allow the paste production system to be shut down for 7 hours without stopping the tailings slurry feed from the mill or before using a tailings slurry feed containment site adjacent to the plant. In addition, each mixer has a surge capacity of 15 tons or approximately 10 minutes of down time for one mixer/pump pair without shutting down the paste production process.

A 7-acre contingency tailings slurry feed containment site would be placed near the paste production plant to contain approximately 6 days of tailings production should the paste production plant be totally disabled or in the event of a major failure beyond the control of the plant design (see Figure 2-26). This facility would be designed using traditional slurry impoundment design methods with a dam or embankment and would be lined with low permeability native materials (clay-type soils) and a synthetic liner to control seepage. The tailings stored in the containment pond would be dredged from the pond and reintroduced into the plant for disposal as a paste after the plant resumed operation. A paste plant shutdown of more than 6 days would result in the suspension of milling.

Tailings Paste Deposition. The location of the paste plant was selected to utilize a hillside location adjacent to the paste facility for convenient tailings materials handling and disposal. The paste plant design provides operational flexibility and avoids duplication in pump transport. Positive displacement pumps with a combined design capacity of approximately 680 dry tph would be used in an arrangement that would allow one pump to be shut down for either preventative or unscheduled maintenance. The paste would be pumped to the paste delivery system.

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[13] Addition of cement to the tailings paste would be dependent upon the results of geochemical data collected from the evaluation adit (see Acid Rock Drainage and Metals Leaching Plan and the Evaluation Adit Data Evaluation Plan in Appendix K for more detail). Any requirement for cement as a means to prevent or minimize acid rock drainage could further be modified over time as a result of continued geochemical testing during mine operation. Cement could also be required if the technical review panel determined during final design reviews it was necessary for stability purposes.

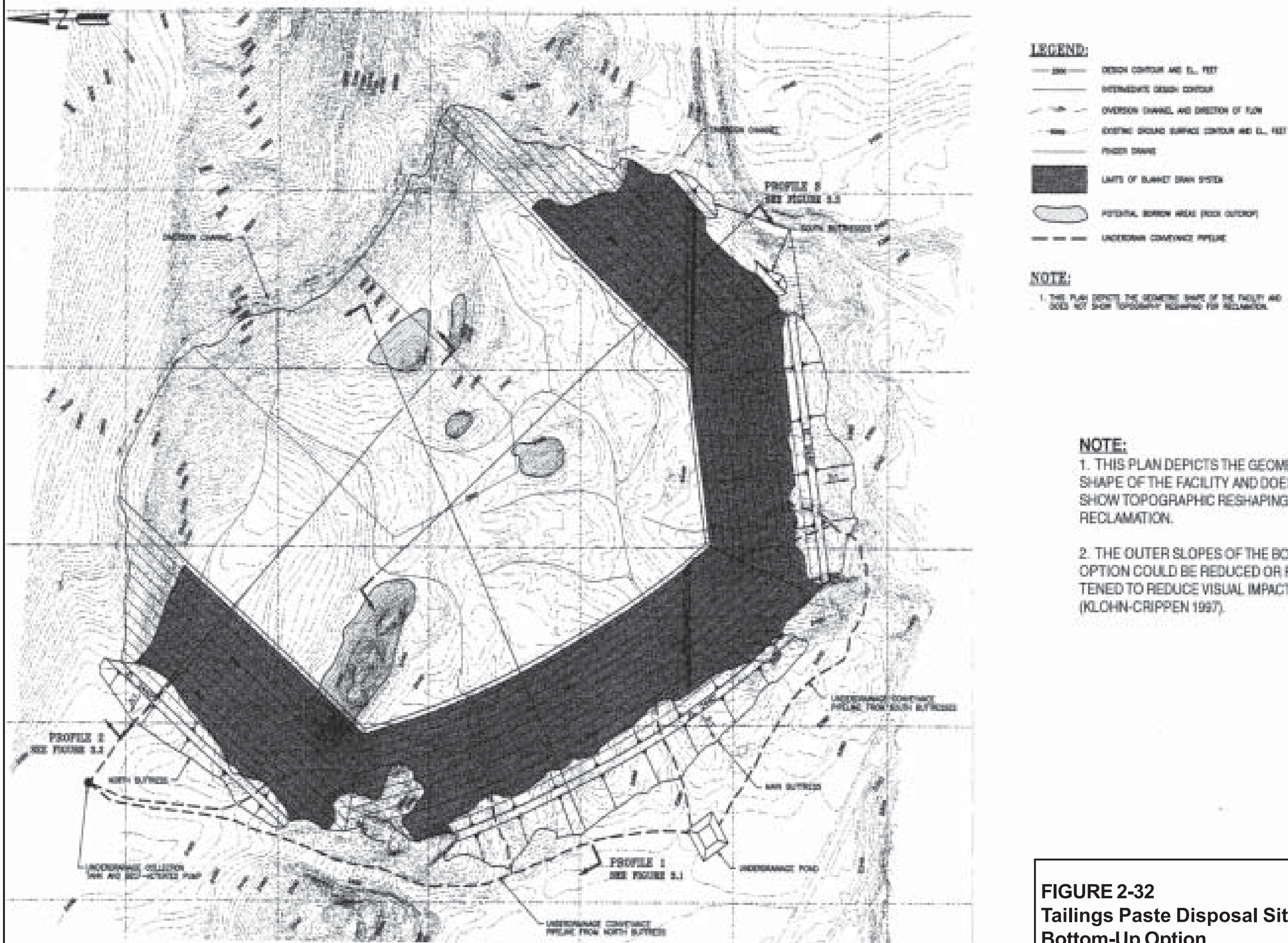
There are two primary paste deposition options for Alternative V and one combined paste deposition option. These options are named according to the direction in which the paste is deposited and the landform is built (see Figures 2-32, 2-33, and 2-34). These options are termed Bottom-Up option (Alternative V-a), Top-Down option (Alternative V-b), and Combined option (Alternative V-c).

The Bottom-Up option would initially involve spigotting paste from the lower elevations and moving the spigot point upslope. The Top-Down option would result in deposition of the paste by spigotting the paste from the upper-most slopes and moving the spigot point towards the highway; the deposit would gradually progress to the southern most portion of the deposit site. Under the Combined option the direction of paste deposit and spigot location would depend on the method being used at the time as described for the Bottom-Up and Top-Down options. The combined option would be used on a seasonal basis each year or alternate between a number of years with each of the first two options. The tailings paste facility would encompass approximately 324 acres for the paste facility and another 44 acres for associated features, such as soil stockpiles, under all options but acreage would vary slightly based on the final approved design.

A series of toe buttresses would be required for all options to assist in containing the paste on the downslope sides, improving slope stability, and retaining sediment eroding off the slopes. Under these conceptual designs, the buttresses would reach an ultimate height of approximately 80 feet (elevation of 2440 feet), but the actual height would depend upon engineering behavior of foundation soils to be analyzed in more detail in the final design. The toe buttresses would be located in approximately the same location as the starter-dams for the tailings impoundment designs in Alternatives II through IV. The buttresses would be built during initial stages of mine development as rock was salvaged from within the proposed paste deposit footprint or became available during adit construction. The buttresses would consist predominantly of rockfill totaling approximately 1,360,000 cubic yards. The rockfill could be obtained from rock outcrops within the deposit site, borrow areas within the deposit site, and waste rock produced from mine adit development (see Table 2-13 for preliminary estimates of materials obtained from these sources). Waste rock from the adits would be hauled to the tailings paste facility site and used immediately for buttress construction to avoid rehandling this material or the need for a waste rock dump at the mill site. The waste rock could only be hauled between August 1st and March 31 to minimize impacts to harlequin ducks.

TABLE 2-13
Preliminary Volumes of Paste Facility Toe-Buttress Waste Rock Requirements

Source	Quantity (Cubic Yards)
Rock Outcrops	480,000
Borrow Areas	130,000
Mine Waste	750,000
Total	**1,360,000**

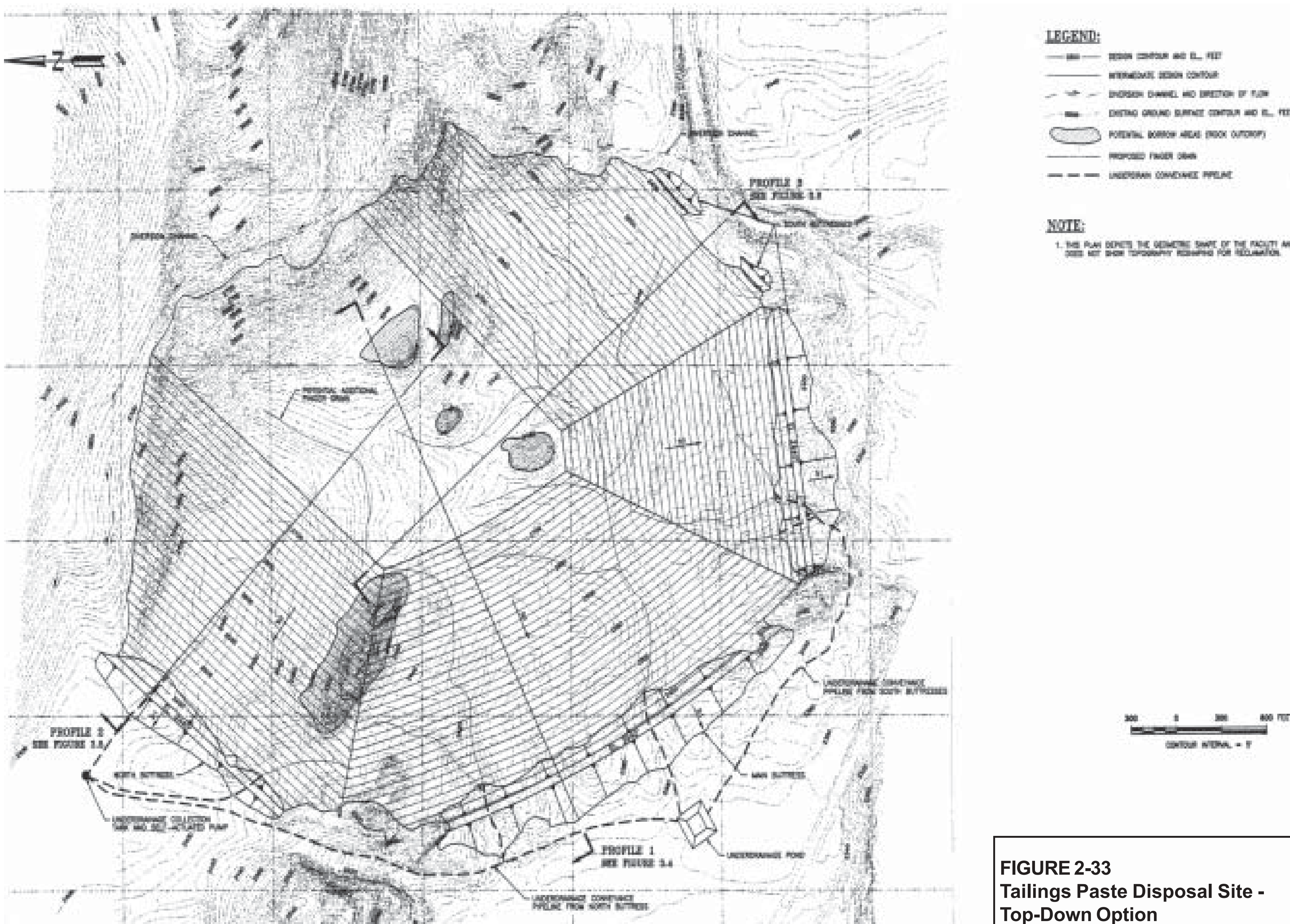


NOTE:
1. THIS PLAN DEPICTS THE GEOMETRIC SHAPE OF THE FACILITY AND DOES NOT SHOW TOPOGRAPHIC RESHAPING FOR RECLAMATION.

2. THE OUTER SLOPES OF THE BOTTOM-UP OPTION COULD BE REDUCED OR FLATTENED TO REDUCE VISUAL IMPACTS (KLOHN-CRIPPEN 1997).

SOURCE: Dames and Moore, Alternate Tailings Impoundment Design, 1992

FIGURE 2-32
Tailings Paste Disposal Site - Bottom-Up Option
Rock Creek Project



SOURCE: Dames and Moore, Alternate Tailings Impoundment Design, 1992

FIGURE 2-33
Tailings Paste Disposal Site -
Top-Down Option
Rock Creek Project

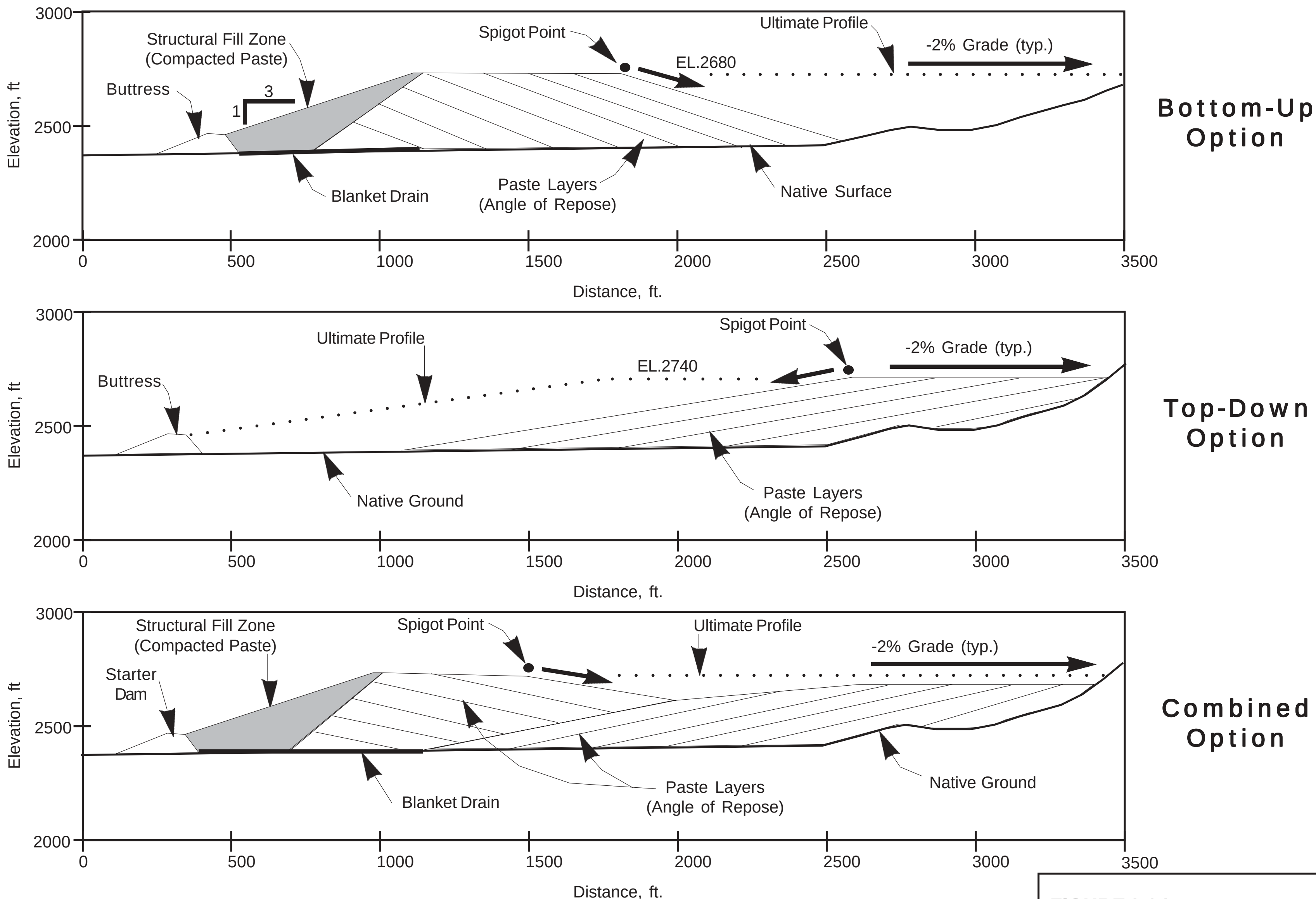


FIGURE 2-34
Paste Deposition Options
Cross Sections
Rock Creek Project

The paste pipeline would be located either on the crest of the toe buttress for the Bottom-Up option or along the upper end of the deposition site for the Top-Down option. The location of the spigot or spigots for the Combined option would depend upon the method(s) being used at the time. Under all options, a low load-bearing crawler crane would be used to position the pipe and spigotting would commence. Once a layer or a lift of paste had been completed, the crane, pipes, and spigot would be relocated further down the row onto the oldest portion of the previous paste layer, or to a new row if the previous one had been completed. A new layer of paste would then be spigotted onto the previous layer(s). There may be some delay in relocating the crane when using the Top-Down option as the paste would need to solidify or compact enough to support the equipment. Although earliest reports (Golder Associates 1996) proposed paste deposit lifts of 3 to 4 feet, a later report recommends that the lifts be reduced to 1 foot until actual field construction experience indicates that a thicker lift can be deposited to ensure paste facility stability (Knight Piesold 1997).

In the Bottom-Up option and the Bottom-Up portion of the Combined option, a structural zone of compacted paste would be constructed upslope of the toe buttresses to permit the construction of a 3:1 slope. The paste would be spigotted behind the structural zone at its angle of repose. The outer slope of the structural zone would crest at an elevation of approximately 2680 feet (320 feet high) (see Figure 2-32). The Top-Down option would be constructed at the angle of repose (approximately 5:1), resulting in longer overall side slopes than the Bottom-Up option. Compaction of slopes would only occur if found to be necessary under the Top-Down option. This would depend on actual field experience. The Top-Down option would have a crest of approximately 2740 feet (380 feet high); although the crest is slightly higher it would be positioned farther away from the highway (see Figure 2-33). The Combined option would have some flatter slopes on the upper portions of the deposit and steeper slopes closest to the highway. The Combined option would have an ultimate elevation somewhere between the first two options, the actual elevation would depend upon when the Bottom-Up component was begun relative to the Top-Down component. It may be possible in final design for either the Bottom-Up or combined option to flatten the outer slopes and deposit the remaining mass of the tailings facility closer to Government Mountain and away from Montana Highway 200 such that the resultant landform would more resemble the Top-Down option. Topographic relief of the upper surface of the paste facility constructed by any of the options could be created by preferential spigotting of the paste and the paste could also be reshaped by dozer to achieve the final grading prior to reclamation. However, this does not mean that the outer slopes of the Bottom-Up option cannot be reduced or flattened to reduce visual effects. Manipulation of the paste to vary the side slopes could be done more easily during construction under the Top-Down option than under the Bottom-Up option. The paste material would be reclaimed on the surface and outer edges when final grade was achieved and timing of reclamation varies somewhat depending upon the option used (see Reclamation).

A system of basin drains would be incorporated into any of the options to maximize recovery of seepage of residual process water in the paste and storm water infiltration through the paste. A blanket drain adjacent to the outer slopes and beneath the compacted structural zone would be constructed to maintain a drainage of the structural zone under the Bottom-Up option and the Bottom-Up portion of the Combined option. For all options an extensive system of finger drains would be constructed beneath the paste facility. Conceptually these drains would consist of 4-inch diameter, slotted pipe surrounded by a zone of crushed rock 10 feet wide and 2 feet thick. The actual location of these finger drains would be determined during the final design. The water collected by the finger drains would be routed to a single collection pond located outside the main buttresses (see figures 2-32 and 2-33), pumped back to the paste plant and, if not needed for paste production, returned to the mill for reuse. Seepage water collected in the paste facility underdrain after mine shutdown would be routed to the water treatment facility for treatment. This procedure would continue until such time that the quality of seepage water would allow direct discharge without treatment.

Land would be cleared and topsoil salvaged in advance of paste deposition (see Reclamation for more detail). While a tailings impoundment would require the entire footprint of the impoundment to be cleared or disturbed prior to construction of the impoundment, the paste deposit alternative restricts disturbance to the active areas. There would be more land disturbed initially under the Bottom-Up option due to construction of the toe buttresses and blanket drain than under the Top-Down option (see Table 2-14).

TABLE 2-14
Summary of Estimated Active Versus Reclaimed Areas Over Time for Alternative Paste Facility Construction Scenarios

Year	Area of Active Disturbance	Area at Final Grade (reclaimable area)	Total Area	Comments
BOTTOM-UP CONSTRUCTION SEQUENCE				
YR 0	0 acres	0 acres	0 acres	
YR 7	78 acres	0 acres	78 acres	Southern face under construction
YR 19	190 acres	0 acres	190 acres	Southern face completed
YR 21	97 acres	115 acres	212 acres	25% of top completed to final elevation
YR 31	74 acres	190 acres	264 acres	50% of top completed to final elevation
YR 33	41 acres	250 acres	291 acres	75% of top completed to final elevation
YR 34	0 acres	305 acres	305 acres	100% of top completed to final elevation
TOP-DOWN CONSTRUCTION SEQUENCE				
YR 0	0 acres	0 acres	0 acres	
YR 7	57 acres	2 acres	59 acres	5:1 depositional surface started across ½ of northern boundary
YR 10	110 acres	4 acres	114 acres	5:1 depositional surface completed across northern boundary
YR 14	105 acres	48 acres	153 acres	25% of top completed to final elevation
YR 20	119 acres	80 acres	199 acres	50% of top completed to final elevation
YR 26	121 acres	135 acres	255 acres	75% of top completed to final elevation
YR 33	93 acres	211 acres	304 acres	
YR 34	0 acres	305 acres	305 acres	100% of top completed to final elevation

Note: Disturbed acreages do not include soil stripping in advance of paste deposition. If soil is removed for a distance of 500 feet in advance of paste deposition, an additional 30 acres of disturbance can be assumed.

Source: Hydrometrics 1997a

Storm Water Control

All storm water detention and retention ponds would be lined with 30-mil HDPE liners for primary seepage containment. The mill pad underdrains would provide secondary collection for the mill site. Underdrains or blanket drains according to final design specifications would provide secondary collection of storm water seepage through the tailings paste facility.

The lined storm water pond at the mill would be enlarged along with all diversions to handle a 100-year/24-hour storm event. Storm water at the adit portal and mill sites would be collected and recycled to the mill for reuse. Water collected from the outer slopes of the mill pad and the mill site underdrains would only be allowed to discharge under conditions specified in the revised MPDES permit (see Appendix D). Otherwise water from the underdrain containment pond would be pumped back to the mill for reuse. Storm water diverted from undisturbed lands above and adjacent to the mill would be discharged through overland flow diffusers or energy dissipating outlets outside the 300-foot streamside-buffer zone (see Figure 2-27).

Since the tailings paste facility and the undisturbed portion of the disposal site would not retain storm water like an impoundment, one or two lined storm water ponds would be constructed at the lower elevations in the tailings disposal site (see Figure 2-26). These ponds would be removed and reclaimed after the tailings facility was completed and reclaimed. These ponds also would be sized to handle the runoff from the active portion of the tailings paste facility site during an 100-year/24-hour storm event. Water collected in the storm water pond could be pumped to the paste plant and then to the mill as process water or used for irrigating reclaimed portions of the tailings paste facility if water quality was acceptable.

Sediment and runoff control of the tailings facility would be handled in two methods. First, limiting unreclaimed areas to the active disposal areas would minimize sediment and runoff. Second, localized sediment retention structures and BMP's would be used in the downslope perimeter of the active panels for control, sampling and recovery of drainage from the tailings paste facility, sediment, and storm water runoff. These structures and collection ditches would act as storm water diversions to channel the water and sediment from the active portion of the tailings paste facility into the tailings facility site storm water ponds. The ditches would also be sized to accommodate a 100-year/24-hour storm event.

Storm water from undisturbed lands above the tailings paste facility would be diverted around the active portions into the north fork of Miller Gulch and to Rock Creek during mine operations. Runoff from reclaimed and fully revegetated, stabilized portions of the tailings paste facility would be diverted to settling basins before mixing with runoff from undisturbed areas. Settling ponds for runoff from newly reclaimed areas along the perimeter of the tailings paste facility would be unlined and would discharge through a constructed drainage network to existing drainages. However, settling ponds on the upper portion of the paste facility would require lining to prevent excess infiltration of water. Storm water from reclaimed areas that were not fully stabilized would be captured along with runoff from the active areas of the tailings paste facility. Undisturbed portions of the paste facility would either drain into existing drainages or be diverted away from active areas, soil stockpiles, and the storm water pond. All these diversions would be sized to handle a 100-year/24-hour storm event. These diversions would be reclaimed and permanent drainage ways established when mine operations ended and the site was fully reclaimed.

The final design for the storm water and sediment control structures at the paste facility must be approved by the Agencies prior to being constructed.

Water Use and Management

A detailed water balance would be refined annually for estimating water use, seepage, and discharges. Actual volumes for a number of water balance variables would be measured to update previously projected calculations. These would include measurements of precipitation; evaporation; mine and adit inflow, outflow, and storage; inflow to the tailings facility; seepage from the tailings facility; seepage collected by the perimeter recovery system; outflow to the treatment system; and discharge to the Clark Fork River.

Baseline data and the similarity of site conditions to the Troy Mine site indicate that acid drainage is not expected. Additional data collected during evaluation adit construction, mine development, and operations would be required to refine predictions of the potential for long-term acid drainage, and to assess the acid drainage potential of waste rock prior to its use as construction material. A representative underground sampling and acid-base testing and monitoring program would be developed and implemented on rock from the adits, ore zones, above and below the ore zones, and in the barren zone as described in Appendix K. The results would help identify materials to be segregated to prevent production of acid leachate or drainage.

The agencies would require a bond for long-term monitoring and maintenance, and possible long term post-closure water treatment in order to ensure ground and surface waters would be protected from unanticipated impacts.

Evaluation Adit Construction Water Requirements. Water requirements for driving the evaluation adit would average 30 gallons per minute (gpm) during the drilling cycle. Additional water may be needed for dust control in the adit. A small amount of potable water would also be needed for the lavatory and lunchroom in the shop.

Water for drilling would initially be hauled to the site from a makeup water well at the confluence of Rock Creek and the Clark Fork River (see Figure 2-26). A lined pond, with a capacity of about 30,000 gallons, would be constructed near the evaluation adit portal to collect site runoff and store the hauled water. A barrier would be erected around the pond to exclude wildlife. A diversion berm would be constructed above the portal and soil stockpile to divert natural runoff around disturbed areas (Figure 2-28).

A pump in this pond would provide water for drilling during the initial evaluation adit construction phase. Excess water encountered in the adit during this phase would be pumped to the pond. After the adit had advanced approximately 350 feet, an 18-foot by 18-foot by 40-foot (97,000-gallon) mine sump would be excavated to function as the evaluation adit water sump. An oil skimmer and pressure filter would be located at this sump to remove oils and grease and suspended solids from the water supply.

Excess water from the adit sump and pond overflow would be pumped through a temporary 6-inch polyethylene pipeline through a biotreatment system and an ion exchange treatment plant for treatment prior to discharge. This pipe would be removed when the mine reached the evaluation adit; then the evaluation adit water would be routed through the mine water drainage and collection system described below. Discharges must comply with the proposed MPDES limits. The evaluation adit is estimated to generate approximately 168 gpm once it was fully constructed.

Potable water would be trucked to the adit site and stored in a tank in the shop until a suitable source was found in the adit. Two wells would be installed to supply the support facility. Sewage from the adit shop and the office and the mine dry at the support facilities would drain to conventional septic tanks and drainfield systems. If, according to DEQ, either or both of the proposed sites or their alternate locations were not suitable for a drainfield, then a holding tank would be installed. This tank would be pumped periodically and hauled to a municipal sewage disposal facility (ASARCO Incorporated 1992).

Mine Operation Requirements. Water use and supply for evaluation and underground mining operations would remain the same as described for Alternatives II through IV. Figure 2-35 provides a schematic diagram of project water handling for mine operation during the end of mine life. Table 2-15 provides additional water balance detail through the mine production period.

Additional water balance detail can be found in the applicant's Alternative V Water Management Plan (Hydrometrics, Inc. 1997). During full production, the mill would require 3,788 gpm of process water. Process water for the mill would come from five sources: reclaimed tailings slurry water, mine discharge water, reclaimed concentrate slurry water, mill site and tailings paste facility site storm water, and if needed, make-up-well water. Process water would remain in an essentially closed loop. Approximately 5 to 10 percent of the flow in the process loop will be diverted to the waste water treatment system and fresh water added to the circuit on an ongoing basis to prevent buildup of excess constituents in the process water. Because the amount of mine water discharge and available reclaim water from the tailings paste plant and the dewatering system at the rail loadout would vary seasonally, a make-up water well has been planned in the Clark Fork River alluvium capable of supplying full make-up water requirements. The location of this proposed well near the confluence of Rock Creek and the Clark Fork River is shown on Figure 2-26. A buried 12-inch steel pipeline would connect with an antisiphon device to the reclaim water line thus carrying water to the mill.

As illustrated in Figure 2-35, mine inflow not used for mill makeup or stored in the mine would be routed to the water treatment facility prior to discharge in the Clark Fork River below Noxon Dam. The rate of mine inflow would vary throughout the mine's life in proportion to the total volume of ore excavated. The rate of mine inflow routed to the water treatment facility would also vary throughout the year in response to climatic conditions, especially precipitation. Figure 2-36 illustrates the estimated average annual flow to the water treatment facility by project year. The table also illustrates the anticipated maximum and minimum flow to the water treatment facility by project year. Discharge flow is estimated at 550 gpm–year 1; 937.7 gpm--year 10; 1,342.7 gpm–year 20; and 2,043.1 gpm--year 30 or end of mine life.

By the end of mine operation, up to 207.7 million gallons of mine and adit water potentially would require storage in an underground reservoir. This reservoir could require a 64-acre pond 10 feet deep. Excess water would be held in or released from storage depending on the ability of the wastewater treatment systems to treat the volume of water to MPDES permit limits. For example, should a problem develop with the mine water treatment system, excess mine water could be stored in the mine for a short time until the problem with the water treatment system was corrected. During the wet season, excess mine water would likely be stored underground. During the dry season, stored water would be released and directed to the water treatment system.

Mine effluent typically would be expected to contain high concentrations of suspended solids at a relatively neutral pH and some dissolved metals similar to the Troy mine. This would contribute a significant portion of the total metals load to mine effluent. Initial removal of suspended solids would be accomplished using two 100,000-gallon mine sumps to settle out the solids, by adding chemicals to flocculate (clump) the particles if necessary, and subsequent filtration. Water would be pumped from the mining face to these sumps for the main mine water supply.

TABLE 2-15
Water Balance Summary - Average Mine Production Yearly Project Flows - Alternative V

	Line #	1	2	3	4	5	6	7	8	9	10	15	20	25	30
Adit Balance															
Inflow															
Adit Inflow	46	694.3	709.1	765.4	821.8	878.3	934.7	990.9	1047.4	1103.9	1160.2	1442.1	1724.2	2006.0	2288.1
Ore Water	60	19.3	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2
Outflow															
To Biotreatment	119	327.4	173	215.1	266.8	303.4	345.2	383.3	425.5	466.8	541.2	759.4	852.2	1132.9	1392.1
Mill Reservior	120	366.9	536.1	548.2	544.7	556.2	559.1	561.9	561.2	561.1	561.1	496.7	562.8	563.2	549.0
Mine Workings Storage	121	0	0	2.1	10.3	18.6	30.5	45.7	60.7	76.0	57.9	185.9	309.1	310.0	347.0
Ore Water	60	19.3	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2
	SUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mill Balance															
Inflow															
Water in Ore	60	19.3	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2
From Mill Reservoir	63	2485.0	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7
Outflow															
Concentrate Slurry	61	41.6	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9
Tailings	62	2462.8	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0
	SUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Paste Plant Balance															
Inflow															
Tailings	100	2462.8	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0	3726.0
Concentrate Load-Out Facility Return	103	39.8	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2
Outflow															
Paste to Paste Fill Area	102	263.9	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2
Dust Suppression & Irrigation	103	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.1	3.5	3.6	4.7	4.7
Paste Plant Reclaim	104	2238.7	3387.0	3387.0	3387.0	3387.0	3387.0	3387.0	3385.9	3385.9	3385.9	3383.5	3383.5	3382.4	3382.4
	SUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0.0	0
Mill Reservoir Balance															
Inflow															
Paste Fill Area Runoff	107	34.3	42.3	50.0	81.8	81.8	81.8	81.8	83.4	83.6	83.6	120.9	84.0	84.7	84.7
Paste Plant Reclaim	108	2238.7	3387.0	3387.0	3387.0	3387.0	3387.0	3387.0	3385.9	3385.9	3385.9	3383.5	3383.5	3382.4	3382.4
Waste Water	109	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
Plant Runoff	110	53.1	53.1	53.1	53.1	53.1	53.1	53.1	53.1	53.1	53.1	82.3	53.1	53.1	53.1
Makeup From Mine Water	114	366.9	536.1	548.2	544.7	556.2	559.1	561.9	561.2	561.1	561.1	496.7	562.8	563.2	549.2
Makeup From Contingency Well	115	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Outflow															
To Mill	111	2485.0	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7	3759.7
Overflow to Biotreatment System	113	222.6	273.4	293.2	321.5	333.0	335.8	338.7	338.6	338.6	338.6	338.4	338.3	338.2	324.0
	SUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

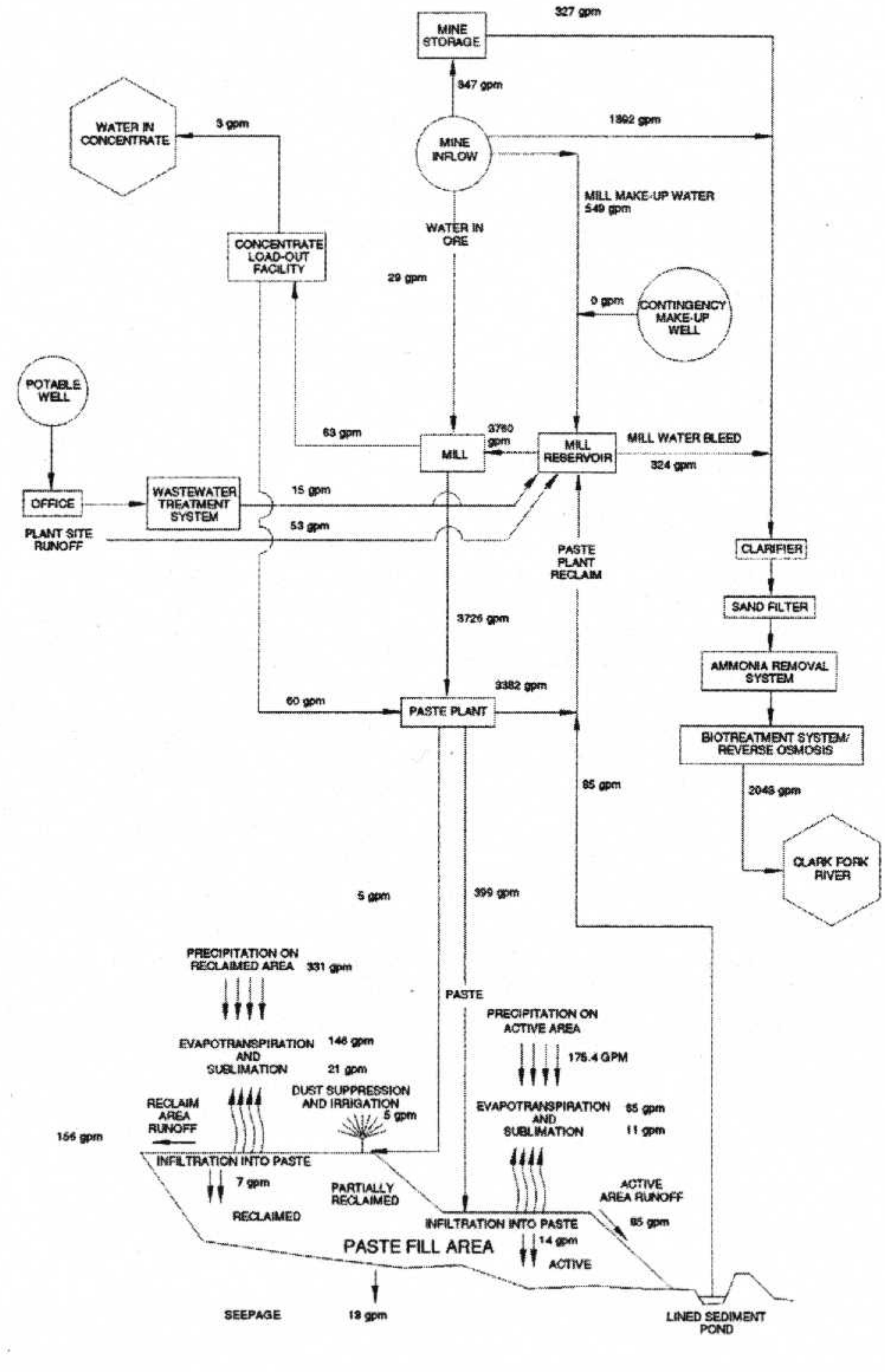
TABLE 2-15
Water Balance Summary - Average Mine Production Yearly Project Flows - Alternative V (Cont'd)

	Line #	1	2	3	4	5	6	7	8	9	10	15	20	25	30
Paste Fill Area Balance															
Paste Fill Active Area Calculations															
Inflow															
Precipitation	86	87.6	87.6	104.0	169.3	169.3	169.3	169.3	172.8	173.1	173.1	257.3	174.1	175.4	175.4
Water in Paste from Paste Plant	102	263.9	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2
Outflow															
Sublimation	90	5.6	5.6	5.6	10.8	10.8	10.8	10.8	11.0	11.0	11.0	10.9	11.1	11.2	11.2
Infiltration of Precip. into Paste	93	7.0	7.0	8.3	13.5	13.5	13.5	13.5	13.5	13.8	13.8	20.6	13.9	14.0	14.0
Evapotranspiration	94	32.7	32.7	40.1	63.3	63.3	63.3	63.3	64.5	64.6	64.6	104.9	65.0	65.5	65.5
Runoff Return to Paste Plant	95	42.3	42.3	50.0	81.8	81.8	81.8	81.8	83.4	83.6	83.6	120.9	84.0	84.7	84.7
Water Retained in Paste	102	263.9	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2	399.2
	SUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Paste Fill Reclaimed Area Calculations															
Inflow															
Precipitation	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.6	79.2	79.2	251.4	252.2	330.6	330.6
Dust Supression & Irrigation	83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.1	3.5	3.6	4.7	4.7
Outflow															
Sublimation	76	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	5.0	10.6	16.1	21.1	21.1
Infiltration of Precip. into Paste	79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.6	1.6	5.0	5.0	6.6	6.6
Evapotranspiration	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.1	35.0	35.0	120.1	111.6	146.3	146.3
Runoff	81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.0	37.5	37.5	115.7	119.5	156.7	156.7
Dust Supression & Irrigation	83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.1	3.5	3.6	4.7	4.7
	SUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mine Workings Storage Balance															
Inflow															
Inflow to Storage	124	0.0	0.0	2.1	10.3	18.6	30.5	45.7	60.7	76.0	57.9	185.9	309.1	310.0	347.0
Outflow															
Outflow from Storage	125	0.0	0.0	2.1	1030	18.6	30.5	45.7	60.7	76.0	57.9	67.7	152.2	328.9	327.0
Change in Storage	s121-f122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	118.2	157.0	-18.9	20.0
	SUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Treatment System															
Inflow															
Direct flow From Mine Workings	130	327.4	173.0	215.1	266.8	303.4	345.2	383.3	425.5	466.8	541.2	759.4	852.2	1132.9	1392.1
Flow from Mine Workings Storage	132	0.0	0.0	2.1	10.3	18.6	30.5	45.7	60.7	76.0	57.9	67.7	152.2	328.9	327.0
Overflow from Mill Reservoir	131	222.6	273.4	293.2	321.5	333.0	335.8	338.7	338.6	338.6	338.6	338.4	338.3	338.2	324.0

TABLE 2-15
Water Balance Summary - Average Mine Production Yearly Project Flows - Alternative V (Cont'd)

	Line #	1	2	3	4	5	6	7	8	9	10	15	20	25	30
Outflow															
To Clark Fork River	133	550.0	446.4	510.4	598.6	655.0	711.5	767.7	824.8	881.4	937.7	1165.5	1342.7	1800.0	2043.1
	SUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Concentrate Load-Out Facility															
Inflow															
Concentrate Slurry	68	41.6	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9
Outflow															
Water in Concentrate	69	1.8	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Concentrate Retum Water	70	39.8	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2
	SUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: All values are in gallons per minute (gpm).
Line # = Line number from water balance model, see Water Management Plan for Alternative V (ASARCO 1997).



SOURCE: Water Management Plan, Hydrometrics, Inc., 1997

FIGURE 2-35
Alternative V Schematic Diagram of Project Water Handling Production Final Year Rock Creek Project

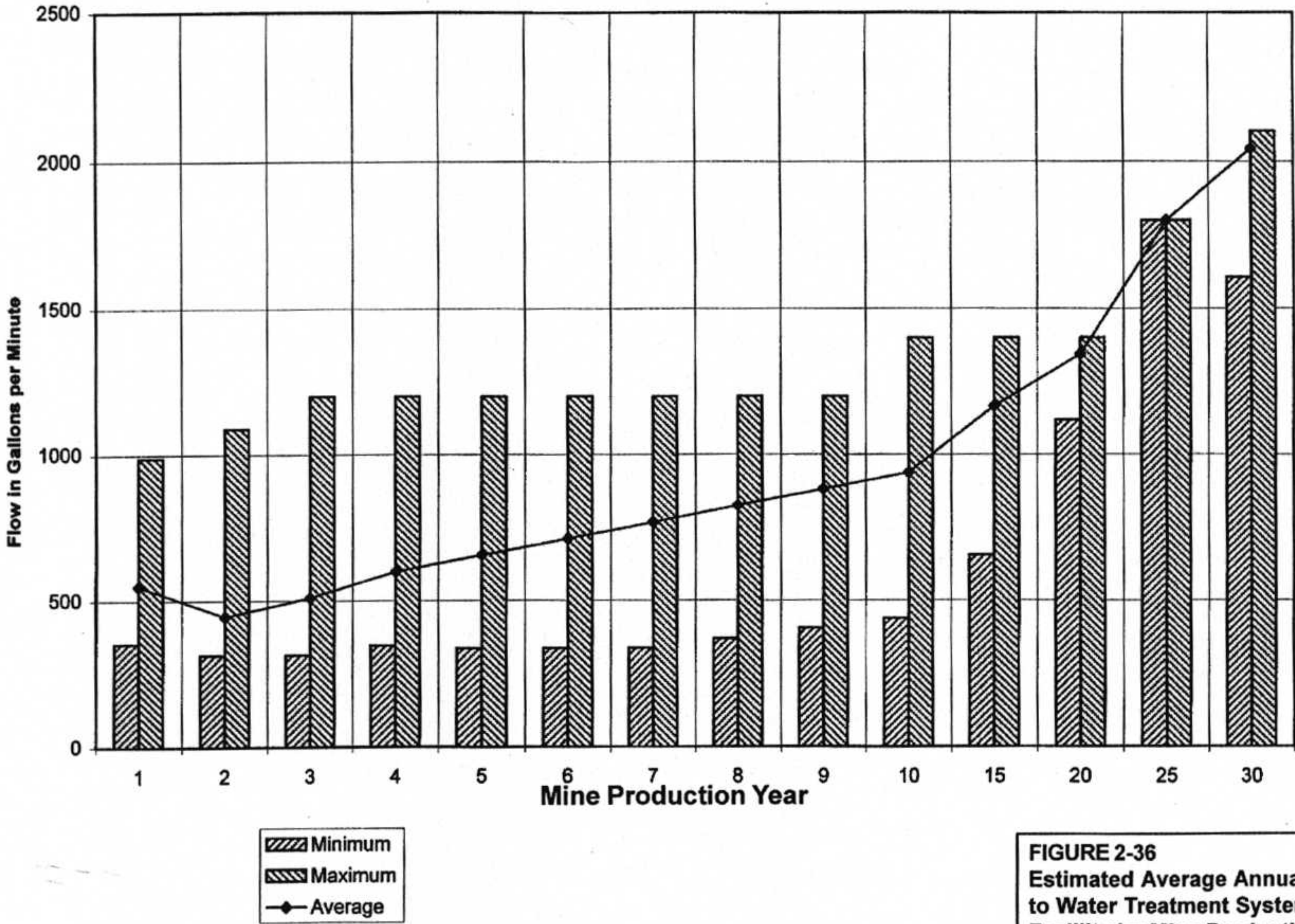


FIGURE 2-36
Estimated Average Annual Flow to Water Treatment System Facillity by Mine Production Year
Rock Creek Project

Segregation of water within the mine and underground workings would be considered in the later stages of active mining. Such segregation could potentially reduce the volume of water requiring treatment prior to discharge. Segregation would be accomplished by separating ground water inflow from non-active mining areas and conveying this water in a separate pipeline to the water treatment facility. This water should be lower in suspended solids, heavy metals, ammonia and nitrate than water from the active mining area. This water may not require treatment prior to discharge or may only require partial treatment to meet discharge permit limits.

Water originating within the mill site also would be collected and routed to a drainage sump at the mill site for use as process water. Water filters and an oil skimmer would be located in the mill area to remove suspended solids and oil and grease from the water supply. Filter backwash would be sent with tailings to the tailings paste plant. Filtered water from mine and mill sumps in excess of the requirements for mine development and mill make-up water would flow through a buried pipeline to the water treatment facility before discharging to the Clark Fork River.

Reclaim water from the paste plant and the concentrate dewaterer at the rail loadout would either be returned to the mill for reuse as process water or to the waste water treatment facility for treatment prior to discharge to the Clark Fork River. This excess water would be discharged through a clarifier and sand filtration unit or other similar unit to remove suspended solids before being routed to the water treatment system for nitrate removal.

General Waste Water Treatment. Two waste water treatment systems designed primarily for nitrate removal would be installed: an anoxic (low oxygen content) semi-passive biotreatment system and a reverse osmosis treatment system. Neither system would be designated as the primary or back-up system. A portable version of the reverse osmosis system would be built to handle mine discharge water from the evaluation adit and placed at the support facilities site. This unit would be moved to the water treatment facility site if a decision was made to continue with the mining operation and expanded to accommodate greater flows that would occur during mine construction and operation. It may take some time for the biological treatment system to become fully operational during mine start-up when variable flows and conditions would be expected; the reverse osmosis system would have the primary water treatment role during evaluation and mine start-up compared to the passive biotreatment system under Alternative II. Sterling expects that the biotreatment system would become the main treatment system; however, the reverse osmosis system would still be available to operate during bioreactor upsets or if higher treatment efficiencies were required. Also as noted, the quantity (flow rate) of excess mine water directed to the water treatment facility could be reduced during such situations by diverting excess mine water to the in-mine storage area.

A schematic diagram of the biotreatment waste water process is found in Figure 2-37. Figure 2-37 displays the proposed layout of the water treatment facilities. At the final design stage, modifications to the treatment system may be made depending on a number of factors, including the actual discharge water characteristics, the final MPDES permit limits, and the technology available at the time. All modifications would still have to result in compliance with MPDES permit limits and not result in impacts significantly different from or greater than those identified in the final EIS. If any did occur, then the modifications would be subject to the appropriate level of additional MEPA/NEPA analysis.

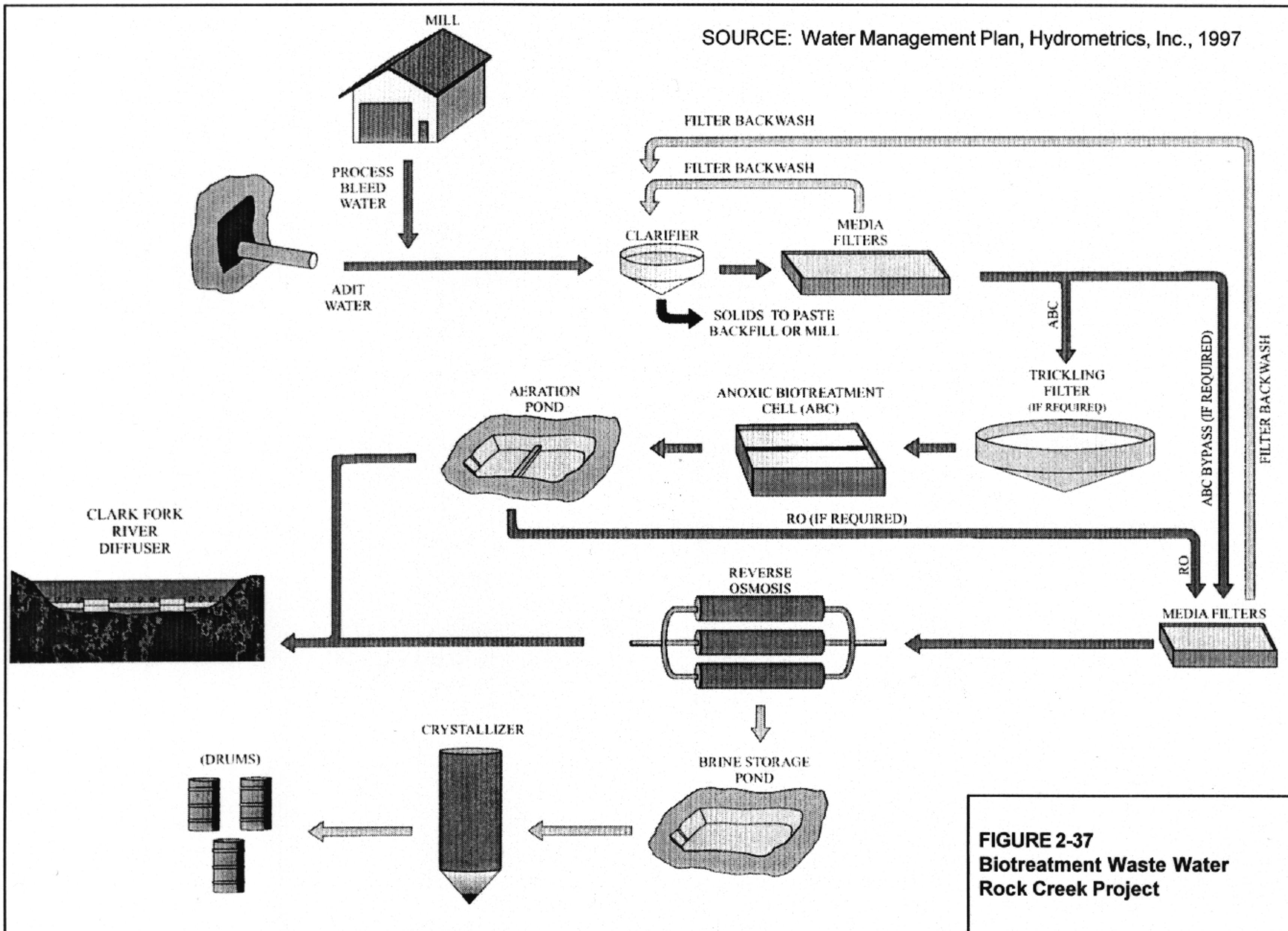
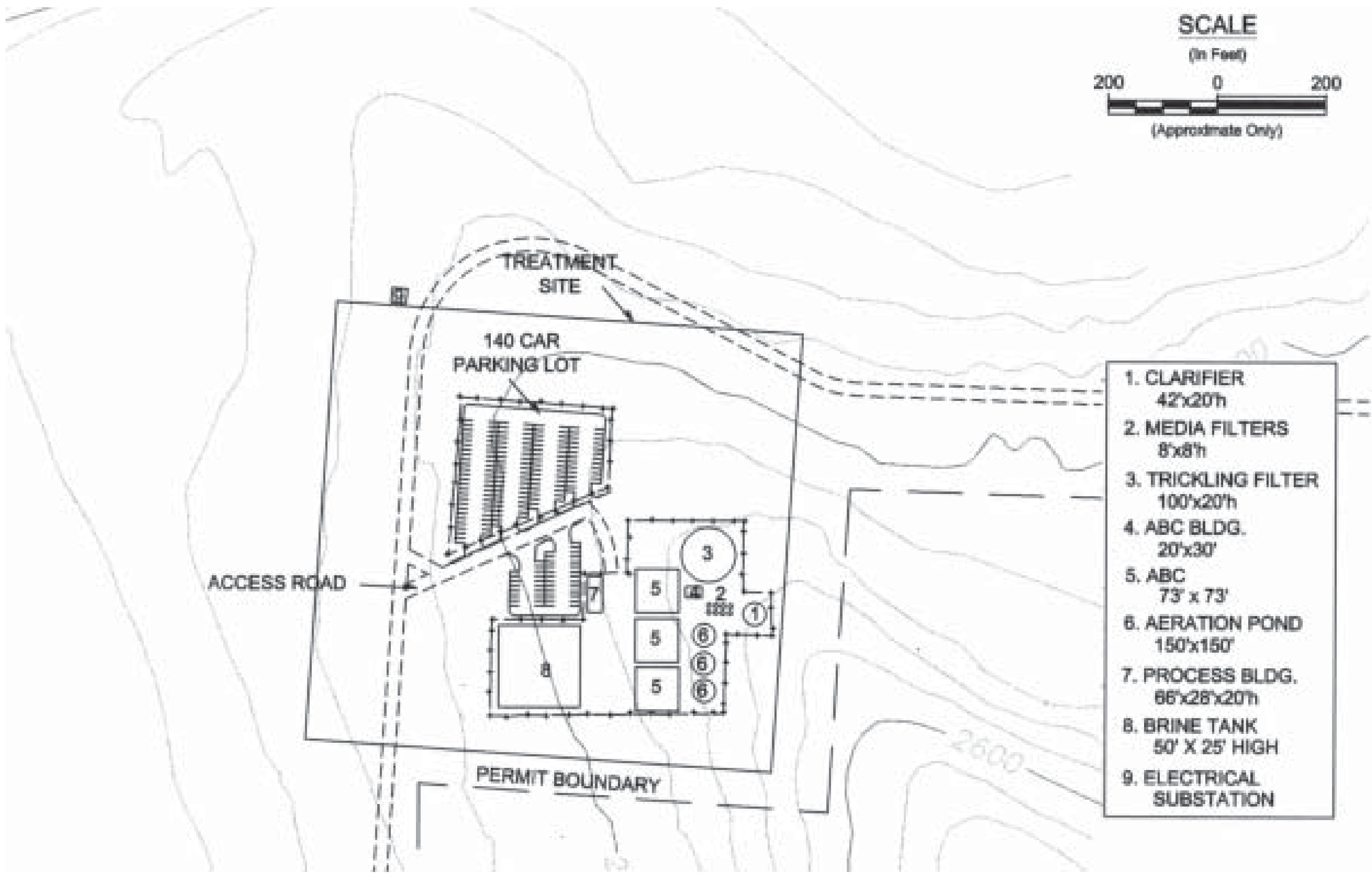


FIGURE 2-37
Biotreatment Waste Water
Rock Creek Project



NOTE:
As illustrated, the aeration pond is sized for 2,300 gpm operation.
All other facilities are sized for 650 gpm operation.

SOURCE: Water Management Plan, Hydrometrics, Inc., 1997

FIGURE 2-38
Water Treatment Facility Plan
Rock Creek Project

Mine water would flow through a buried pipeline to the water treatment facility. Sedimentation tanks (clarifiers) would remove a high percentage of suspended solids in the discharge water (at least 95 percent). The sludge from the clarifiers would be taken to the paste plant and incorporated into the tailings paste for deposition. Water leaving the clarifiers would also flow through sand filters for final suspended solids removal (80 percent of the remaining fraction). The partially treated water would then be directed to one or both of the water treatment systems depending on system capacity, amount of flow, and other variable conditions.

Anoxic Biotreatment System. The semi-passive biological system for treating mine water would consist of one or more anoxic biotreatment cells, containing gravel-packed, attached-growth denitrification reactors. An in-ground concrete biotreatment cell designed to treat 650 gpm would be 6 feet deep and 73 x 73 feet in area (5,330 ft^2). Four of these wells would be constructed to treat 2,300 gpm (maximum design flow). These cell dimensions are based on preliminary design data for 80 percent nitrate-nitrogen removal at 6°C.

The pretreated (clarified and filtered) water would flow through a trickling filter to convert the ammonia to nitrate (nitrification). The trickling filter may need to be enclosed or insulated to allow for proper functioning during colder seasons.

The biotreatment process would rely on methanol as the carbon source for the denitrification process instead of the manure and straw included in the passive biotreatment system proposed and discussed for Alternatives II through IV. Methanol at a concentration of approximately 60 mg/L would be continually added to the influent water. Methanol concentrations would be monitored and adjusted as necessary to achieve optimal nitrogen removal. A 300-gallon tank (approximate volume) would be located adjacent to the biotreatment system building for initial use of the biotreatment process. A larger tank would be installed if biotreatment proves to be successful. Daily methanol consumption, if the biotreatment system was the primary waste water treatment system, would range from several gallons during initial startup to approximately 250 gallons during maximum discharge of 2,300 gpm. Phosphorus may also need to be added for microbial growth. It is estimated that approximately 1 milligram of phosphate (as phosphorus) would have to be added for every 30 milligrams of nitrate (as nitrogen) removed.

Mine water and methanol would enter the bottom of the biotreatment cell(s), and upwards flow through the cells would be controlled by a pump. The cell(s) would be filled with gravel and inoculated with several hundred gallons of sludge taken from the nitrogen-removal recycle loop at the Kalispell wastewater treatment plant. The cell(s) should not require reinoculation. The biotreatment cell(s) would not generate sludge or reject material requiring disposal. Nitrate would be converted to nitrogen gas (denitrification) and methanol to carbon dioxide; these nontoxic gaseous by-products would be vented to the atmosphere. Relatively small amounts of biomass may be generated which would discharge to the aeration pond where it would be broken down.

After biological treatment for nitrate removal, the effluent would flow to an aeration pond with a 12-hour minimum residence time prior to reaching the final monitoring point before discharging to the Clark Fork River. The aeration pond would be lined with 30 mil HDPE. The aeration pond would include a calm pre-discharge zone and a multi-level discharge structure to minimize suspended solids in the effluent. Excess methanol and biomass from the biological nitrate removal system would be reduced through aerobic biological action. Dissolved hydrogen sulfide, if present, would also be reduced through aeration. However, sludge containing small quantities of heavy metals may build up in the aeration pond over time. Sampling of this sludge will be required to determine the most appropriate method of site reclamation after the mine is shut down and mine wastewater treatment is no longer required (see Revegetation). At the full flow rate of 2,300 gpm near the end of mine life, the required ten-foot-deep pond would encompass approximately one-half acre. If the effluent did not meet discharge limits, it would be returned to the treatment facility for further treatment.

Reverse Osmosis Water Treatment. Reverse osmosis (RO) was selected for several reasons as the second water treatment system instead of ion exchange, which was proposed in the draft EIS. The reverse osmosis system is less complex, requires less operator attention, generates a smaller waste stream, and has no added chemicals. In addition, reverse osmosis technology has been proven to be capable of removing dissolved pollutants, such as nitrate, from water in many large capacity waste water treatment facilities throughout the world. Because the reject water or waste stream cannot be easily disposed of at the project site, the reverse osmosis system would operate at a high recovery rate to minimize the waste volume.

The reverse osmosis would most likely be the primary waste water treatment system used during evaluation and early stages of mine operation. When the biotreatment system became fully operational, the reverse osmosis systems would primarily be used during biotreatment system upsets or maintenance. It may also be used as a polishing step when the effluent did not meet standards. During such an event a portion of the biotreatment system effluent would be treated with reverse osmosis such that the recombined effluent from both systems met the limits of the MPDES permit.

The reverse osmosis system would be housed in a building approximately 66 feet long, 28 feet wide, and 20 feet high. It would contain reverse osmosis units sufficient to treat flows up to 650 gpm, the maximum flow expected in year 5 of production and year 10 of project life. The modular nature of reverse osmosis would allow simple installation of additional reverse osmosis units if reverse osmosis were still required for the treatment of 100 percent of the mine discharge in later years of mine operation. These units are complete with high-pressure pumps, cartridge filters, membrane modules and all other necessary equipment. This operation would probably require one operator around-the clock initially and after operations had been finalized, only a day-shift operator. The clarifier and media filters would probably be located outside the reverse osmosis building.

Once the influent water had undergone pretreatment for removal of suspended solids, the reverse osmosis could run continuously and reduce dissolved ion concentrations, including nitrate, nitrite, ammonia, and metals, by more than 90 percent. As flows increased during the life of the project, additional modules could be incorporated easily into the existing facility. Routine maintenance would include instrument calibration, chemical cleaning, and periodic membrane replacement. Membranes would require replacement every three to five years.

Only minimal quantities of brine (liquid waste from the reverse osmosis process containing elevated levels of nitrate, nitrite, ammonia, metals, and other ions) would be generated if the biotreatment becomes the primary treatment system with occasional use of the reverse osmosis. The waste brine that is generated, approximately 10 percent of system inflow when reverse osmosis treatment is required, would either be stored and gradually blended back into the biotreatment treatment system or crystallized/evaporated. The waste would not be classified as a hazardous waste as defined in 40 CFR 261.21-261.25. The brine or crystallized solid would not be ignitable, corrosive, or reactive and it would be non-toxic based on EPA's Toxicity Characteristic Leaching Procedure (TCLP) criteria (Hydrometrics

1997a). Estimated concentrations of waste brine presume no nitrogen removal by biotreatment. Waste brine concentrations would decrease in direct proportion to nitrogen removal efficiencies in biotreatment.

The brine would be stored in 500,000 gallon, epoxy-coated, covered, vertical, bolted steel tanks (60 feet in diameter and 25 feet high). A single tank would provide 5 days of brine storage for the initial 650 gpm reverse osmosis facility. Three tanks would be required to hold approximately 5 days of brine storage for estimated maximum mine operation waste water flow of 2,300 gpm.

A crystallizer/evaporator would be installed on site to treat any reverse osmosis brine generated. The brine would be reduced to one 55-gallon drum of waste per day for every 250 gpm of water treated (one drum of crystallized solid waste per 360,000 gallons of water treated). This waste would either be stored in drums or in a tanker trailer based on the actual waste volume being produced. It is anticipated that over 99 percent of the heavy metals originally present in the mine wastewater would be removed by pretreatment through clarification and filtration prior to treatment in the reverse osmosis system so only one percent of the metals would remain in the crystallized brine. The end product would be a solid which could be disposed as a regulated waste in an approved landfill such as those in Missoula, Kalispell, and Spokane or used by fertilizer companies in western Montana, Idaho, eastern Washington, and Canada.

After excess water from the proposed project was treated by settling, filtration, and the waste water treatment systems, treated effluent would be discharged to the Clark Fork River from a proposed outfall and engineered in-stream diffuser downstream from Noxon Reservoir. The purpose of the diffuser would be to distribute treated water though a perforated steel pipe to allow more mixing with river water. The in-stream diffuser also would reduce discharge velocities.[14] The diffuser would be located approximately 750 feet above the confluence of the river and Rock Creek and would run the entire width of the river. The diffuser would need to be in place prior to construction of the evaluation adit for discharge of water generated during that phase of the project. Prior to installation, a design study would be performed to reevaluate streamflow conditions and streambed characteristics at the selected outfall location. The diffuser design would be finalized after the study was complete, and an appropriate method of anchoring would be selected. If the diffuser was relocated from the proposed location, the agencies would need to determine how or if that affected the impact of the discharge to the river and if the MPDES permit limits needed to be adjusted. If the changes were significant, then additional MEPA/NEPA analysis would probably be required.

A sewage treatment facility would be incorporated into the mill complex design. This facility would contain the standard aeration tank with activated sludge, a settling tank with a sludge return to the aeration tank, and a chlorine contact chamber. Effluent from the contact chamber would be directed to the tailings disposal system, and sludge would be disposed of at an approved off-site facility.

Transportation

Access to the evaluation adit and the minor improvements to FDR No. 2741 would remain the same as for Alternatives III and IV. During construction of the evaluation adit, access to the evaluation adit site would be via existing FDR No. 150 and Chicago Peak Road, FDR No. 2741, and a short spur

[14] The diffuser would be fixed at the bank on concrete thrust blocks and surrounded by cobble riprap to provide shoreline protection. It would lie in the river channel, perpendicular to the flow of the river. The perforations of the diffuser system would be designed to reduce the discharge velocity to less than 2 feet per second, and allow mixing to occur across a broad cross-sectional profile of the river.

road. Improvements to existing FDR No. 2741 would include a minimum road width of 14 feet, improved or added road turnouts about every 1,000 to 1,500 feet, and a reconditioning of the road surface for year-round use and maintenance. Minor amounts of clearing may be necessary for turnouts and for snowplowing. The short spur road would need a 14-foot wide surface to accommodate equipment. This work would be done in consultation with the Forest Service.

Employees would use the parking lot at the alternate support facility site along the existing FDR No. 150 (figures 2-26 and 2-28) and would be transported in four-wheel-drive vans to the adit along FDR Nos. 150 and 2741. This would limit mine-related traffic to the minimum number of vehicles needed to transport work crews and supplies to the adit.

Because of the year-long schedule for adit construction, it would be necessary to plow snow on FDR No. 2741 for one winter. Snowplowing for a portion of FDR No. 150 would occur over mine life. Snow removal and disposal would follow Forest Service guidelines.

FDR No. 150 would be realigned with Montana Highway 200 as described for Alternatives III and IV to meet applicable MDT siting requirements. This alternate route for FDR No. 150 would intersect Montana Highway 200, 0.23 miles west of FDR No. 1022 (McKay Creek Road). This route would then proceed westerly and northerly over NFS lands and Sterling land as for Alternatives III and IV. However, FDR No. 150 would connect to an old existing road in the vicinity of the waste water treatment plant if final siting proved the old road to be suitable. This modified alignment would take advantage of an existing road farther away from Rock Creek and reduces the amount of new construction. This existing road would be upgraded and paved and a new segment constructed to connect to existing FDR No. 150 approximately 0.25 miles above the confluence with Engle Creek as described for Alternative III. This alternate road would need to be constructed prior to closure of existing FDR No. 150 at the tailings facility site. FDR No. 150 below the mill would have minimum width shoulders to provide structural support to the driving lane. The shoulders would not be conducive to parking along road and no turnouts would be provided to minimize stopping along the road. Sterling would time its road closure schedule for FDR No. 150 to accommodate essential local access needs.

The relocated portions of FDR No. 150 and the parking lot at the proposed waste-water treatment facility site would be constructed during the first part of the development phase (year 2) to keep construction related-traffic away from Rock Creek, to provide a road capable of handling the expected mine construction-related and public levels of traffic, and to allow for busing of mine adit construction workers to the mill site and mine portal. Access to the evaluation adit support facilities, paste plant, and the tailings paste facility site from the mill would require mine vehicles to travel down FDR No. 150 to Montana Highway 200 and then northwest on the highway to Government Mountain Road and then southeast on FDR No. 150B.

All roads used during mine operation between the mill, the mine, the paste plant, the water treatment facility, the highway, and the rail loadout facility would be paved or graveled (see Table 2-16 and Figure 2-26). FDR No. 150 above the mine and the Chicago Peak Road, FDR No. 2741, would not be paved. The service road, FDR No. 150B, around the outer edge of the tailings disposal site from the paste plant to Government Mountain Road would be paved; a short stretch of maintenance road along the west side of the disposal site would be graveled. FDR No. 150B from the paste plant to the junction with FDR No. 150 would be reconstructed as a gravel road and used only for pipeline maintenance after mine production begins. FDR No.150B would be gated at both ends and access would be restricted to mine-related traffic. A 10-foot wide gravel maintenance road would be constructed along the cross-country portion of the discharge water pipeline between the Clark Fork River and FDR No. 150. A small parking lot for 6-8 vehicles would be required at the paste plant for operators and mine management vehicles and supply deliveries. Additional gravel roads or maintenance trails would be required to provide access to the utility corridor where it does not follow FDR No. 150. Sterling would be responsible for maintaining these mining-related roads and trails. Maintenance of FDR No. 150 would be Sterling's responsibility, unless additional use by the Forest Service or other interests warranted a cost-share agreement.

TABLE 2-16
Summary of Roads To Be Used
Under Alternative V

Road	Section	Type	Length	Width	Access
FDR No.150	Hwy 200 to mill site	Paved	5.04 mi	24 ft	Open
FDR No.150	Mill site to FDR No.2741	Gravel	2.8 mi	14 ft	Open
FDR No.2741	FDR No.150 to evaluation adit portal spur road	Gravel	4.6 mi	14 ft	Open only when there is no snow, plowed during year 1, but no public parking/turnarounds available during winter
FDR No.150B	FDR No.150B to paste plant road	Gravel	1.07 mi	14 ft	Locked gates/Sterling pipeline maintenance access only
FDR No.150B	Paste plant road to Government Mtn. Rd.	Paved	1.52 mi	14 ft	Sterling and supply traffic only
FDR No.150	Government Mtn. Rd. From FDR No.150B to rail loadout facility	Gravel	0.25 mi	24 ft	Open, county road
Access Rd.	FDR No.150 to parking area/waste water treatment plant	Paved	0.15 mi	24 ft	Sterling visitor, and supply traffic only
Access Rd.	North from 150B along west side of disposal site	Gravel	0.57 mi	10 ft	Sterling maintenance only
Access Rd.	From Hwy 200 to Clark Fork River	Gravel	0.75 mi	10 ft	Sterling pipeline maintenance only
Access Rd.	FDR No.150B to paste plant	Paved	0.98 mi	14 ft	Sterling and supply traffic only

One existing bridge on FDR No. 150 over Rock Creek near the mill site would be replaced. Bridges to be constructed or reconstructed over Engle and Rock creeks would be realigned nearly perpendicular to the stream. An extension to the culvert on the West Fork of Rock Creek above the last bridge on FDR No. 150 is proposed. The existing bridge over Rock Creek near the junction of FDR Nos. 150B and 150 would not be reconstructed because there would be no concentrate hauled from the mill to the rail loadout facility; however some repairs may be necessary to provide safe crossings for trucks hauling waste rock to the paste facility site during mine development. If this bridge deteriorated during mine operation and the Forest Service determined it was unsafe, it would be removed by Sterling. Road construction activities include: FDR No. 150 reconstruction in close proximity to Rock Creek, associated bridge construction, reconstruction below the proposed mill site would most likely be conducted during the last half of the year of evaluation adit construction between August 1 and March 31. Construction activities would take place only during periods of low flow and dry weather to minimize impacts to the stream and harlequin ducks.

Truck hauling of concentrate from the mill to the rail loadout facility would be replaced by pipeline transport of the concentrate. This would eliminate eight trucks per day making the round trip between the mill and the loadout facility.

Prior to mine construction, Sterling must submit a traffic management plan to reduce total average daily traffic (ADT) to the mill site and to mitigate impacts on harlequin duck as well as grizzly bears. This plan would address evaluation, construction,[15] and operation mine-related traffic (excluding public recreation, Forest Service, logging traffic and other private and public traffic). A travel lane would need to be maintained for traffic on FDR No. 150 during road construction and reconstruction. The traffic plan would also need to allow private landowners reasonable access to their property, and public access to NFS lands. In addition, emergency medical access to the mill and mine sites would need to be considered in the plan. The plan must include provisions for busing employees during mine construction and operation between the waste water treatment facility area and the mill and mine. Mine construction workers would be bused from the support facilities site until FDR No. 150 had been relocated and a parking lot at the waste water treatment plant had been constructed. A parking lot capable of handling the parking needs of the largest shift plus visitors to the mine, estimated at 150 to 175 vehicles, would be necessary (see Figure 2-38). Busing employees would then continue from this location and would reduce the mine construction- and operation-related traffic to primarily supply vehicles, mine management vehicles, and two or three buses twice per shift including the administrative workers shift.

A portion of FDR No. 150B may be removed and reclaimed after the tailings paste facility has been reclaimed and the paste treatment plant decommissioned, removed, and reclaimed. The need for closure, reclamation, or modification of Forest System roads used by Sterling during mine operation to gravel or dirt roads would be determined by the KNF at mine closure. The post-mining treatment of roads would depend on forest land uses, needed road densities, and KNF's ability to maintain paved roads versus gravel or dirt roads. Road closures are described in the Threatened and Endangered Species Mitigation plan for this alternative.

[15] Mine related construction traffic would be limited to 30 roundtrips per month on FDR No. 150B between April 1 and July 31 and unlimited traffic from August 1 to March 31.

Utilities

Evaluation Adit Electrical Supplies. Alternative V replaces the diesel generators with two propane-fired generators (545 kW and 735 kW). The support facilities would be supplied with power from a local distribution line along Government Mountain Road as described for Alternatives II through IV.

Pipelines. A single utility corridor would be developed along FDR No. 150 and would include the transmission powerline, a tailings slurry pipeline, ore concentrate pipeline, mine discharge pipeline, and return water pipeline (see Figure 2-29). The pipelines would split into two corridors at the junction of FDR Nos. 150 and 150B. The tailings slurry pipeline and concentrate pipeline and a return water line would follow or parallel the FDR No.150B road alignment to the paste plant. The concentrate pipeline and return water line would continue along FDR No. 150B and a short stretch of the Government Mountain Road to the rail loadout facility. The mine water discharge line and a return reclaim water line would follow the new FDR No. 150 alignment to the waste water treatment plant and the discharge line would continue to the discharge outfall in the Clark Fork River and connect with the make-up water well located adjacent to the river. See Table 2-17 for information on the size and types of pipe proposed for use. All pipelines would be buried at least 24 inches deep. Burying the pipelines would provide better protection from vandalism, eliminate the visible presence of the pipelines, and facilitate concurrent reclamation in the pipeline corridor along most of the route between the mill and the paste plant. The pipelines would be visible at the four above ground crossings of Rock Creek, West Fork of Rock Creek, and Engle Creek. All lines would be encased in a larger steel pipe at creek crossings adjacent to or near bridge crossings to guard against the unlikely event of a leak or rupture.

Powerlines. Sterling would construct 5.3 miles of 230 kV transmission line with 61-foot-high wooden utility poles, dark porcelain or polymer insulators, and nonspecular conductors to reduce contrast within a 100-foot right-of-way. The transmission line would parallel the new FDR No. 150 until it intersected existing FDR No. 150 and then continue to parallel the existing FDR No. 150 from a new switchyard on an existing 230 kV line near Montana Highway 200 to the mill as described for Alternatives III and IV. Sterling would construct the new switchyard adjacent to the existing Noxon/Libby 230 kV line near Montana Highway 200 in a dedicated power line right-of-way. Two new substations at the mill and in the tailings storage facility area would be constructed as for Alternatives II through IV:

- one substation would be constructed at the mill site to distribute electricity through lower voltage lines to equipment within the mill site, adit, and mine; and
- a second substation would be constructed near FDR No. 150 in the vicinity of the tailings paste facility for electrical distribution to that area. This would involve clearing a 100 by 100 foot area and fencing it.

The rail loadout facility would be supplied power from a local distribution line along Government Mountain Road. Sterling would be responsible for paying all construction costs for the substations and transmission line. Annual power consumption is estimated at 95,000,000 kW-hours, with a peak demand of 13,300 kW. No power provider has been selected for supplying the mine's estimated annual consumption of 95,000,000 kW-hours.

TABLE 2-17
Summary of Pipeline Information for Alternative V

Pipeline	Location	Size	Type
Tailings Slurry Pipeline	Mill to paste plant	16 to 24 inches(1)	Steel/polyethylene dual-wall pipe w/leak detection
Reclaim water return pipeline	Paste plant to mill	16 inches	Dual-wall pipe w/leak detection(2)
Mine water discharge pipeline/make-up water pipeline(3)	Mine to waste water treatment plant to Clark Fork river diffuser	12 to 14 inches	Single-walled pipe w/leak detection
Mine segregation water pipeline (option for later development)	Mine to waste water treatment plant	10 inches	Type undetermined at this time
Concentrate pipeline	Mill to rail loadout facility	3 inches	Dual-wall pipe w/leak detection(2)
Concentrate return water line	Rail siding to paste plant	2 inches	Dual-wall pipe w/leak detection(2)
Storm water return pipeline	Paste facility site storm water retention pond to paste plant	6 inches	Single-walled pipe w/leak detection

Source: Hydrometrics 1997a

Notes: (1) The final pipeline diameter will need to be determined based on tailings viscosity and topographic analysis of final pipeline corridor.
(2) The type of dual wall pipe has not been determined at this time.
(3) Mine water is estimated to meet mill make-up water requirements; however, a contingency make-up water well site has been identified near the Clark Fork River in the event that insufficient mine water is available. In this event, make-up water would utilize the discharge pipeline.

Utility corridor right-of-way clearing. Sterling would use the following measures to reduce right-of way clearing and help produce a feathered, more natural-appearing edge of timber along the utility and road corridor. These measures would be applied to appropriate segments of the corridor during the design phase:

- retaining non-hazardous trees and brush on the right-of-way;
- cutting trees at ground level to reduce visibility of stumps;
- disposing of felled material with the least possible impact on remaining vegetation; and
- selective clearing of timber adjacent to the corridor to soften the edge between cleared and uncleared areas.

Erosion and Sediment Control

Wind and water erosion control measures are described in detail throughout Sterling's permit application in operation and reclamation plans. These measures involve 1) mechanical practices to minimize fugitive dust, 2) grading to reduce erosion potential, 3) soil-handling techniques to enhance stability, 4) hydrologic systems to control runoff and sedimentation, and 5) revegetation practices to provide a stabilizing cover. Sterling would follow Forest Service soil and water conservation practices. A storm water discharge permit may be required from DEQ. As part of this permit or the MPDES permit, Sterling would be required to submit a storm water management plan for DEQ approval. This plan would describe the methods to minimize and control runoff contamination.

Sterling would be required to implement all BMPs detailed in its permit application and described under Alternative II. In addition, a vegetation management plan would be developed by Sterling and approved by the Agencies to minimize disturbance during clearing and construction and to maximize revegetation success on all cut-and-fill slopes and reclaimed road segments. A field review would be required by agency hydrologists/soil scientists after facilities and roads have been staked in the field but before construction begins to identify any additional BMPs needed on a site-specific basis.

Sterling would mitigate for unavoidable fine sediment impacts to Rock Creek resulting from the construction of facilities and changes in the road system. Sediment mitigation measures would consist of stabilization, armoring and revegetation of existing sediment sources in the Rock Creek floodplain, and maintenance of these measures for the term of the project. Concurrent with project start-up, Sterling would mitigate an eroding cutbank where Engle Creek joins Rock Creek (site P1). Also beginning in year 1, Sterling would inventory the Orr Creek and Snort Creek basins to identify potential sediment mitigation opportunities and estimate the annual fine sediment production in tons/year for all identified floodplain sediment sources in the watershed. Sterling would submit a fine sediment mitigation plan to the Agencies for approval, and cumulatively reduce the annual fine sediment loading to Rock Creek by at least 400 tons by mitigating two or more sediment sources in the west fork basin and in the mainstem floodplain of Rock Creek prior to the end of the project construction period. Treated mitigation sites would be monitored in average to above-average snowpack years (as of April 15), or in the event of greater than bankfull discharge events. This monitoring would be needed to measure erosion of the treated sites and to quantify any need for further mitigation that would maintain the 400 ton fine sediment reduction and ensure effectiveness of the mitigation program for the life of the project.

Employment

The development schedule and employment levels during all phases of the project would be the same as described for Alternative IV. Development of the evaluation adit would take about a year. Work would start with 23 employees in the first quarter and increase to a maximum of 73 workers in the fourth quarter. Mine construction might immediately follow the adit work, or there could be a period of inactivity lasting months or even years between the two phases.

During the initial phase of mine construction, the entire workforce would consist of 73 Sterling employees, then 275 contract construction personnel would be brought onto the project for 18 months. Employment of Sterling and contract workers would peak at a total of 348 during mine construction, with the minimum employment of 180 mine workers following this peak at about year four of construction. Sterling would have no direct control over contract labor schedules. It is expected that the contractor would use a 7-day work week with more than one shift per day.

As contract construction ended, the Sterling workforce would be expanded to 180 workers, from where it would continue to increase to 340 permanent full time workers nearly 2 years later as the mine reached full production. The project would operate 24 hours per day, 7 days a week, 354 days a year. It would have an expected operating life of up to 30 years. At the end of production there would be a two-year shutdown and reclamation period employing 35 workers. Because the available labor force initially would not have all the skills needed to develop and operate the mine, Sterling proposes to conduct an intensive training program.

Adit Closure

The adit closure plans for the air-intake ventilation and evaluation adits would be the same as described in Alternatives III and IV.

The evaluation adit would be plugged with reinforced concrete at mine closure. Since this adit would be a decline and the portal is above the water table, the purpose of the plug would be primarily to close off access and eliminate any potential for surface water inflow.

Closure of the main access adits would depend upon what impacts if any occur to the wilderness lakes above the mine and the potential for creation of springs and seeps down gradient of the mine workings. If the mine had an impact on the groundwater recharge of the wilderness lakes and the buffer zones at the ore outcrops was sufficient to prevent springs and seeps then the mine would be sealed and flooded. If despite the ore outcrop buffer zones, the potential for the creation of springs and seeps existed as determined by data collected during mine operation, then the mine adits would not be sealed but only closed to prevent access. In this case, the discharge would continue to be pumped in perpetuity down to the waste water treatment plant until it met the MPDES discharge limits without treatment and then would be discharged without treatment into the Clark Fork River.

If there were no impacts either to the lakes or the potential for creation of new springs and seeps was negligible, or if there were impacts to the wilderness lakes that needed to be reduced, then the main access adits would be sealed once mine water met ground water standards without treatment. Under these scenarios the service and conveyor adits would be plugged with reinforced concrete near the elevation of the orebody within the mine. This would prevent 1,150 feet of water pressure that would develop if adit seals or plugs were only placed at lower elevations in the adits. The adits would be closed at the portal with non-mineralized waste rock to prevent access. Drainage from the portal (inflow to the adits below the elevation of the plugs) would be treated and discharged to the Clark Fork River until it met applicable surface water quality standards without treatment at which time it would be allowed to infiltrate into the reclaimed mill pad and underlying alluvium. Monitoring data would be used to establish discharge requirements prior to the time of adit closure.

The wilderness air intake ventilation adit would be reclaimed. Sterling would develop a plan to restore the air intake ventilation adit within the CMW to its premining appearance and configuration following mine closure. The grate and fan would be removed internally and the adit would be sealed with a 12-inch-thick bulkhead. The bulkhead would be constructed from within the adit using reinforced concrete. Equipment removal and plugging would be conducted primarily from inside the adit. Rock from adjacent areas and/or waste rock treated with oxidating compounds would be used for the surface closure to replicate natural conditions and appearances. Sterling would investigate the potential for creating bat habitat at both the evaluation and air-intake ventilation adits. Depending upon the results of the study, agencies may require modification to adit closure plans to accommodate bats.

The adit closure plan would need to be finalized and submitted to the agencies for review and approval prior to mine closure.

Reclamation

Reclamation of the evaluation disturbances, adits, mill site and utility corridors would remain the same as described for Alternatives III and/or IV, depending upon the facility in question. The revegetation plan is summarized and seed mixes are described in Appendix J. An updated, detailed reclamation plan[16] that covered revegetation of all mine facilities would need to be submitted for Agency review and approval before mine construction. The plan would provide the means to ensure adequate reclamation and minimize visual impacts of the project. Plans for reclaiming any Forest System roads, if required, would be submitted to the Forest Service for review and approval.

Reclamation objectives remain the same as described under Alternative II. Short-term reclamation objectives are to stabilize disturbed areas and to prevent air and water pollution. The long-term reclamation objective is to establish a postoperational environment compatible with existing land uses and consistent with the Forest Plan. Specific reclamation objectives include the following:

- permanent protection for air, surface water, and ground water resources;
- protection of public health and safety by removing potential hazards;
- maintenance of public access through the project area;
- restoration of wildlife habitat;
- design of a land configuration compatible with the watershed;
- re-establishment of an aesthetic environment allowing for visual quality and recreational opportunity; and
- re-establishment of postoperational biological potential suitable for supporting vegetative cover appropriate to the area.

To accomplish these objectives, Sterling proposes to provide interim revegetation and stabilization of most disturbed areas, to follow measures described under Sediment and Erosion Control, and, after mining, to reclaim all disturbed areas by recontouring and redistributing soil, and revegetating.

Postmining Topography. All buildings and other structures at the evaluation adit support facilities site would be removed once the mill site was operational. It is estimated that the support facilities would be used through exploration and the first 3 to 4 years of mine construction and operation. This site would be either recontoured to approximate original contours or otherwise developed for facilities associated with the operation of the tailings paste facility.

Sterling would regrade the evaluation adit waste rock dump to approximate existing contours at the end of operations, eliminating any bench at the adit portal. Waste rock from the lower Revett Formation,[17] a rock formation with similar characteristics to surface rock, would be used for the surface layer of the dump, especially for the portion that would be left unvegetated. If necessary to meet visual quality objectives, waste rock surfaces that remained exposed after reclamation would be treated with oxidizing compounds to blend them with adjacent talus (Reynolds 1995). Where possible, existing trees

[16] This primarily entails incorporating the additional agency requirements into the revegetation plans for all mine facilities that are contained in Sterling's permit applications and submitting them to the Agencies to verify that all requirements have been added and to approve the plans if acceptable.

[17] This rock type would be the last waste rock removed from the evaluation adit. Due to variations in rock types within the formation, it may be necessary to stockpile quartzite material that closely resembles surface talus to blend the new rock dump with the existing talus as much as possible. This material would be stockpiled on the bench or stored in the adit until ready for deposition as the final layer on the rock dump.

at the outer edge of this talus slope and existing pockets of trees and shrubs within this talus slope would be retained and would not be damaged during dumping. Reclamation of the evaluation adit portal would be the same as described for Alternative II. If stockpiled ore at the evaluation adit proved uneconomical to process, Sterling would develop a plan, subject to review and approval by the Agencies, to dispose of the ore in conjunction with reclamation of the evaluation adit.

A channel would be constructed across the evaluation adit waste rock dump from the area of the backfilled lined pond to the access road cut to connect natural drainage areas above and below the evaluation adit dump. This channel would be lined with coarse rock to prevent erosion. Disturbances other than the evaluation adit waste rock dump (i.e., facilities area, diversion ditches, fuel storage area) would be graded to blend with adjacent undisturbed topography.

Sterling would be required to submit more detailed design and regrading plans for all mine facilities for Agencies' approval in conjunction with the final design of the paste facility. Landform design for the tailings paste facility would incorporate topographic templates from the surrounding area to help meet reclamation goals and Forest Service visual standards. These plans would result in reclaimed sites that decrease landform and vegetation differences between mine facilities and surrounding natural landscapes.

The diversion structures above the reclaimed tailings facility would remain as permanent stream channels to route runoff around the reclaimed tailings mass. All mechanical facilities associated with the tailings facility would be removed. The remaining surface disturbances (e.g., runoff control ditches, seepage capture and storm water ponds, facility pads, soil stockpile sites, emergency dump ponds, and internal and perimeter access roads) would be returned to approximate original contours.

After mining and ore processing were completed, all mill buildings and related equipment and infrastructure, the conveyor, and the power line would be dismantled and removed. Paving material would be buried on site or removed to a disposal facility. Inert waste such as steel, concrete, plastic, or wood would be buried in on-site waste disposal areas or sold to scrap dealers for recycling; some waste may be transported to an approved waste transfer station as authorized by the county solid waste district. Buried pipelines would remain in place except at stream crossings.

Once ground water quality beneath the tailings facility met ground water quality standards and MPDES limits without treatment, and Sterling was given permission to shut down the seepage collection system, all remaining tailings facility-related surface components would be removed, and the sites regraded according to approved plans. Wells would be decommissioned once monitoring was no longer required or the well was no longer required (i.e., a contingency pumpback well used to control seepage when control was no longer a need). When the waste water treatment facility would not be needed for treating tailings seepage and/or mine adit discharge, the buildings, related equipment, and surface discharge pipelines would be removed and the sites regraded to approximate original contours.

Final reclamation of portions of mine facilities, such as outer slopes of the mill site pad and completed portions of the tailings paste facility would be done as early as possible to assist in decreasing the visual impact of the project. Toe buttresses and paste layers creating the deposit surfaces for all options, and the compacted paste zone of the Bottom-Up option, would be designed to minimize straight horizontal crests, long linear contours and uniformly sloping surfaces; however, stability requirements would have precedence. Contours of reclaimed surfaces, including those on the top surface of the deposit, would mimic those of surrounding topography. Both regrading and selective placement of the paste during deposition would be used to create topographic pockets, swales, ridges and surface water drainages. Rocky soils and possibly cement additive would be used in steepened drainageways to create naturalized swales and help break up the massiveness of the deposit.

Vegetation Removal and Disposition. The mining company must prepare a Vegetation Removal and Disposition Plan that deals with the potential uses of vegetation removed from areas to be disturbed. The plan must detail disposition and storage plans during mine life. The vegetation debris piles and surface lift soil piles containing large quantities of organic debris should be stored in carefully selected storage sites to prevent off-site impacts from the production of low quality organic acids as the materials begin to decay.

Where possible, slash from timber-clearing operations would be salvaged for soil protection. Large or whole pieces could be used as physical barriers and catchments and ground-up slash would be used as mulch or as an additive to stored topsoil. Large or whole pieces could also be used to enhance or create desirable fisheries habitat in Rock Creek according to aquatic/fisheries mitigation plans. All mulching materials would be certified weed-seed free.

Soil Salvage and Handling Plan. Direct haul soil salvage and replacement would be required as much as possible to enhance revegetation success of native unseeded species. Most soil would have to be stockpiled. Areas such as road cut-and-fill slopes, power line pole locations and access roads, and other disturbances that would remain postmine should be reclaimed as soon as final grades are achieved with direct haul soil or soil that has been stockpiled for less than one year. This would increase the chances of direct transplantation and propagation of many of the local ecotypes on the reclaimed surface.

Soil stockpiles would be constructed with a 2.5:1 side slope and 3:1 ramps. Soil stockpiles would be incrementally stabilized (rather than waiting until the design capacity was reached) to reduce erosion and maintain soil biological activity in the surface. Soil stockpiles would have organic matter added to help retain soil quality. Seeding would be done as soon after disturbance as possible rather than waiting until the next appropriate season. Fertilizer and mulch would be applied to the piles as necessary. Sediment traps would be used downslope where necessary to minimize soil movement.

In forested soils, it is advantageous to stockpile the surface organic and mineral horizons and store them separately from subsoil mineral horizons. Ideally, this would mean that the surface 6-12 inches of organic materials and soil would be separated from the subsurface 12-18 inches of soil in a 24 inch soil replacement profile. To pick up a uniform 6-12 inch organic and mineral layer in a forested setting is not practicable. Soil would be salvaged in a two-lift process with the first lift being the more suitable topsoil and the second lift being subsoils excavated up to 36 inches; average total salvage depth equaling 24 inches. Replaced soil depths would average 24 inches over the tailings paste facility, the mill site, and the waste water treatment facility site. If extra soil is available at the mill site, it should be stockpiled for use at the paste facility or other locations. DEQ requires salvage of rocky soil (less than 50 percent rock fragments) if it is characteristic of the area. Shallow and rocky soils would be salvaged at the evaluation adit and at the mine portal if present. Sterling would be required to submit a revised soil salvage and handling program that deals with two lift salvage and storage practices and concerns over water quality, and direct haul soil replacement on acreages reclaimed during mine life.

Soils salvaged from 7.7 acres at the evaluation adit site would be removed in two lifts where soil was available and where slopes were less than 2:1. The soil would be stockpiled northwest of the evaluation adit (see Figure 2-26). All of the first lift soil and half of the second lift soil would be redistributed over 5.0 acres at the adit, waste rock dump top, and facilities to an average total depth of 12 inches. The remaining second lift soils would be redistributed over a portion of the slope face of the dump designated for revegetation at an average depth of 13 inches over 1.9 acres. Approximately 1.4 acres on the waste rock dump would be left as talus to achieve a mosaic appearance.

Because the paste would be deposited layer upon layer, soil would be stripped just ahead of the extent of the proposed disturbance for each layer. The first soil stripped for the first two or three layers would need to be stockpiled for reclaiming the final segment and outer slope. At times soil being salvaged may not be suitable for the portions of the facility that need to be reclaimed; this soil would also be stockpiled until needed for other purposes. The soils would be segregated according to rocky or non-rocky soils and first lift versus second lift and, if necessary, stockpiled adjacent to the deposit site (see Figure 2-26). Sufficient volumes of the colluvial and alluvial soils, including their rocky subsoils, within the tailings paste facility footprint would need to be salvaged and stored for use in reclaiming slopes 8 percent or greater and along reconstructed drainage ways to minimize erosion. Based on experience and preliminary research to control erosion at Golden Sunlight Mines, the lacustrine soils could be mixed with the rocky subsoils or crushed bedrock to produce a soil with 20% rocks greater than 1 inch in diameter. The mixed soil must also have less than 20% very fine sand in the fine soil matrix (Golden Sunlight Mines 1995). The lacustrine soils could be placed on all slopes less than 8 percent (approximately 12.5:1) without the addition of rock materials as long as the slope length is limited by armored drainageways or other erosion control features. Soil would be salvaged in a two-lift process with the first lift being the more suitable topsoil and the second lift being subsoils excavated up to 36 inches; average total salvage depth equaling 24 inches. Replaced soil depths would average 24 inches over the tailings paste facility. The final design of the paste facility would need to include a volume determination of soil types needed based on the slope breakdown of the paste facility.

Sterling would need to conduct a more detailed soil survey to more accurately determine the amounts and types of soils available for reclamation prior to construction of the paste facility and associated facilities. Since rocky materials are also needed for constructing the toe buttresses, the survey is especially important to ensure there is enough material available for both requirements or to identify the need to obtain more rocky material from other sources than has been estimated in Table 2-13.

The tailings paste could, if needed, have organic amendments or fertilizer added to the uppermost lift. This material, which would have no cement added, may need to be ripped prior to topsoil replacement to minimize the development of a root-barrier zone. Both regrading this material and selective placement of the paste during deposition would be used to create diverse topographic pockets, swales, ridges and surface water drainages constructed to a predetermined surveyed gradient in the final design. Overall outer slopes would range between 2H:1V and 5H:1V. These slopes would be protected against erosion using BMPs described in detail for Alternative II and in the Erosion and Sediment Control section above. The compacted slopes of the Bottom-Up or Combined option would have less potential for slope variability due to the method of construction and would have a general appearance similar to that of a conventional tailings impoundment. The flatter slopes of the Top-Down option appear to offer greater flexibility to develop a more natural appearing landform.

Disturbed areas, especially parking lots, roads, and building sites, would be ripped prior to soil replacement to reduce any root zone barriers due to compaction and to facilitate storm water infiltration after reclamation. Any disturbed area to be seeded would be scarified to a depth of 6 to 12 inches prior to seeding for best seed establishment. Where soil fertility may be low and tilth poor, organic matter (weed-free aged manure, compost) would be incorporated into respread soils before planting.

Revegetation. Sterling would develop a detailed final planting design[18] for all disturbed areas including the area between the impoundment footprint and the highway. Final designs would avoid uniform distributions of plants, with planting densities, species selection, and their distributions repeating natural patterns in the surrounding landscape. A combination of planting designs, natural mortality, and possible thinning of thick tree stands would achieve a natural-appearing mosaic of vegetation on reclaimed areas. Forest Service standards for revegetation would be required on NFS lands.

Sterling proposes to meet short- and long-term objectives stated in its revegetation plan. The plan specifically addresses species selection for final and interim seed mixtures and planting schemes, seeding and planting rates, seedbed preparation, seeding and planting methods, cultural treatments, and interim revegetation. The proposed seeding and planting mixes are presented in Appendix J of the final EIS and the applicant's proposed reclamation plan (ASARCO Incorporated 1987-1997). Weed seed-free seed mixes would be modified to include grass and forb species suited for quick stabilization as well as those needed for long-term wildlife habitat needs. Locally collected seeds and plants would be used whenever possible.

The proposed species selection and seeding/planting rates are based on preoperation vegetation types, environmental tolerance, species that exhibit hardiness on postoperational sites, and a variety of other factors. An understory seed mix consisting of grasses and forbs would be used on all disturbance areas. Shrubs would be seeded on most sites, but not on the evaluation adit site or the transportation and utility corridors.

Grass species proposed, including both native (preferred) and non-natives (where other options are not feasible), are typical of those used for reclaiming sites in similar settings. Forbs and shrubs proposed are native species that typically occur in one or more of the communities identified within the project area. No clovers would be planted on any disturbed areas during mine operation, as clover is a bear attractant. No cereal grains are to be added to the seed mixes. Seed mixtures may be modified due to limited species availability, poor initial performance, advances in reclamation technology, or a variety of other factors.

Seeding rates would average about 120 pure live seeds per square foot (13 to 16 pounds per acre) for drill seeding and roughly twice that for broadcast seeding. Drill seeding would occur on slopes of less than 3:1 (horizontal to vertical) that are not rocky as determined by the Agencies. Steeper slopes and rocky areas would be broadcast or hydroseeded (a technique where seed is mixed into a slurry and sprayed onto a slope). Seeding would occur in the first appropriate season following site preparation.

Sterling proposes a number of cultural treatments for seedbed preparation. Sites would be prepared for seeding by grading; ripping to prepare the surface for soil placement; respreading salvaged soil; and tilling soils on gentle slopes (3:1 or less) to break up clods and relieve compaction, as needed. Phosphorus fertilizer, important for seedling establishment, would be applied prior to seeding. Once seeding occurred, straw mulch would be applied and anchored according to slope steepness and seeding method. Nitrogen fertilizer would be applied early in the subsequent growing season to enhance growth.

[18] This primarily entails incorporating the additional agency requirements into the revegetation and reclamation plans for all mine facilities that are contained in Sterling's permit applications and submitting them to the Agencies to verify that all requirements have been added and to approve the plans if acceptable.

Successful establishment and growth of trees are necessary to obtain the greatest visual mitigating effects on and adjacent to mine facilities. Given the importance of mycorrizhal fungi for tree growth and establishment, Sterling would obtain locally grown tree seedlings from an appropriately inoculated soil medium. Legume species would be inoculated with appropriate nitrogen-fixing bacteria. Other methods such as transplanting native shrubs and/or very small trees could be proposed. Fertilizer requirements and planned fertilizer applications would be carefully calculated to minimize nutrient losses due to deep leaching.

Shade cards or other methods would be used to protect tree and shrub seedlings, especially on south- and west-facing slopes of the impoundment and mill site. New tree and shrub plantings would be protected from wildlife browsing by netting. Drip-irrigation would be used during April through early June for up to three years after planting trees and shrubs on the tailings paste facility face to help with plant establishment.

Trees would be planted on slopes that do not exceed 3:1 in the tailings impoundment area, the facilities area, the waste rock dump top, and the access road to the waste rock dump. Trees would be planted in 2-to-4-foot-wide strips alternating with 8-foot-wide strips that were drill seeded. Trees would be planted 6 feet apart to achieve an initial stocking rate of 663 trees/acre. Planting patterns would be modified as needed to better mimic natural vegetation patterns on adjacent undisturbed lands. Reforestation of the transportation corridor and the evaluation adit area would rely on natural regeneration. Shrubs would also be planted on the tailings facility face. Shrubs would be planted on the access road cuts, only if herbaceous vegetation was not providing adequate erosion control.

During mine life, Sterling would also reclaim all cut-and-fill slopes along the access roads, and the adit portal slopes to maximize native plant establishment and minimize erosion, weed invasion and visual impacts during mine life. Interim reclamation plans would be developed with agency reclamation specialists to reduce slopes if practicable to approximate postmine contours wherever possible. Slopes reclaimed during operations would be revegetated with the permanent seed mix and planted as per the approved plan. This aggressive reclamation program is designed to increase native plant establishment, increase sediment and erosion control, limit noxious weed invasion, and reduce visual impacts during mine life.

Throughout mine life, disturbances would be seeded as they occurred with the permanent seed mix. Final revegetation (seeding) would occur in some areas during the preoperational phase; others would be revegetated incrementally when possible, such as the tailings paste facility. Final revegetation of all other disturbances not previously reclaimed would be completed within 2 years after mining.

Sterling would finalize a detailed planting plan for the mill site. Final revegetation of pad faces would occur as soon as the pad was completed. It would be seeded with grasses and forbs and planted with containerized shrubs and trees. Plantings would mimic natural patterns of vegetation.

Reclamation of the tailings paste facility would be somewhat different from that of a traditional tailings impoundment. Concurrent topsoiling and reclamation would allow the portion of the top and outer slopes of the paste facility that had achieved final grade to be reclaimed while the next segment was constructed. However, the timing of final reclamation would vary somewhat depending upon which option is selected. Final reclamation of the Bottom-Up option would occur on an annual basis unless specified otherwise by the Agencies. Reclamation of a small portion of the Top-Down option could begin in year 7 of mine operation (see Table 2-14) and could only be done when the layers had reached their maximum height as each succeeding paste layer would cover the preceding layer. The sides and top of the Top-Down option could still be reclaimed concurrently with the stripping of soil from the next area proposed for disturbance rather than waiting until the facility was completely constructed. Reclamation of the Combined option would depend upon which method was being used at the time.

Interim revegetation would occur on an on-going basis for all paste options. An interim seed mix would be added to the paste before its deposition to limit erosion off paste slopes during operations and to reduce aesthetic impacts. A color tackifier or hydroseeding would also be applied to deposit lifts as needed for interim reclamation and stabilization prior to initiation of final reclamation activities. Both toe buttresses and paste deposit slopes for any of the deposition options would be seeded annually with final revegetation mix on any portion that reaches final grade.

Trees would be planted on each segment as it was reclaimed and seeded with approved planting mixes of grasses, forbs, and shrubs. The applicant has planted trees for screening between the main powerline and Montana Highway 200; however, the planting would be inspected during evaluation activities and any dead, dying or missing trees would be replaced to achieve the required density.

Sludge would be removed from the aeration pond after the water treatment system was decommissioned and dismantled, dried, and enclosed in a geomembrane lined cell in the impoundment. The substrate would be buried in the impoundment under a graded compacted layer of at least 6 feet of tailings near the embankment face. Topography in the area of the sludge would be mounded to prevent excess water from potentially moving through the substrate.

Reclamation of the mounded tailings over the aeration pond slurry cell substrate would be completed by applying a minimum of 24 inches of soil, followed by revegetation. The pond would be backfilled with clean subsoils to a mounded configuration to produce an area which would limit infiltration through the old pond area. Then the mounded subsoil area would be covered with a surface lift of soil and revegetated. Bond would be calculated to cover this reclamation modification and would include the salvage and storage of the materials needed to complete the reclamation at mine closure.

At the end of mine life agency reclamation personnel would review the reclamation success on the slopes and decide if the successful portions with up to 20-30 years of vegetation growth could be left in the final reclamation plan. Portions with unsuccessful reclamation would be recontoured as per the reclamation plan and soiled or rocked accordingly.

Pipeline Corridor Reclamation. The pipeline would be built and installed and covered with at least 24 inches of soil that had been salvaged prior to construction. No trees or shrubs would be seeded along the pipeline corridor, but any trees or shrubs that volunteered would be left. Trees that encroached on powerline conductors or were in the way of maintenance vehicles would be removed. Maintenance or replacement of a pipeline liner would require some redisturbance of a small area that would be immediately reclaimed after the work was done. When the pipelines were no longer needed they would be removed for a distance of 15 to 20 feet from stream crossings and where the pipes surfaced at the mill, the paste plant, the waste water treatment facility, and the Clark Fork River. The pipes would be completely drained, capped, sealed, the ends reburied, and the redisturbed section regraded, stabilized if necessary, and revegetated. The remaining buried segments of the pipeline would remain in place.