6.0 DETAILED ANALYSIS OF ALTERNATIVES

This section describes the detailed analysis of removal action alternatives assembled in Section 5.2. EPA guidance (EPA, 1993) outlines the following evaluation criteria for removal action alternatives:

Effectiveness

Overall protection of human health and the environment

Compliance with ARARs

Long-term effectiveness and permanence

Reduction of toxicity, mobility, or volume through treatment

Short-term effectiveness

Implementability

Technical feasibility

Administrative feasibility

Availability of services and materials

State acceptance

Community acceptance

Cost

Approximate relative cost of alternative including capital and operation and maintenance (O&M) costs.

Removal action alternatives for the A Panel external ODA, the Pole Canyon ODA, the D Panel backfilled pits and external ODA, the E Panel external ODA, and Hoopes Spring are described in detail in this section. The No Action Alternative (Alternative 1) is included for each of these source areas to provide a baseline of expected future conditions without any removal actions. Key aspects of the effectiveness, implementability, and cost evaluation criteria presented above are then considered for each alternative involving actions (i.e., Alternatives 2, 3, and 4 for the

source areas and Alternatives 2 and 3 for Hoopes Springs). Only those primary aspects of the implementability and effectiveness criteria that are relevant to the evaluation are discussed.

Many of the alternatives for different portions of the Site (e.g., A Panel and D Panel) contain similar or identical remedial components. Rather than repeating the same detailed analysis for each alternative, the implementability and effectiveness issues are detailed under the first alternative containing that component. For subsequent alternatives, the discussion is summarized with cross-reference to the more detailed evaluation. Supporting information for the detailed analysis is presented in Appendices B through F. These appendices are referenced, where appropriate, in the following discussions. It should be noted that no administrative concerns were identified for any of the removal alternative components that directly address the source areas (i.e., backfilled pits, external ODAs and attendant stormwater detention ponds/seeps). CERCLA actions at these areas would be consistent with the current mining activities, including reclamation requirements, and would meet any substantive requirements for mining/reclamation in the National Forest. Administrative feasibility considerations are discussed for remedy components that extend beyond the ODAs (e.g., creek diversions). State and community acceptance will be addressed during public review of the draft Action Memorandum.

6.1 A Panel External ODA

Baseline conditions (Alternative 1) and implementability, effectiveness, and cost considerations for Alternatives 2, 3, and 4 for the A Panel external ODA are summarized below. Details regarding the A Panel alternatives can be found in Section 5.2.1.

6.1.1 Alternative 1

The A Panel pit is currently being backfilled and closed per BMPs which include a chert blanket, topsoil cover, and planting with native grasses and forbs with low affinity for selenium accumulation. The BMPs, including run-on controls, will also be applied to the small southern portion of the A Panel pit that was backfilled at the time of A Panel mining. The mine plan for closure/reclamation of the A Panel backfilled pit also includes runoff recharge areas to direct low selenium concentration surface waters to areas where they will infiltrate to the Wells Formation. Ongoing sampling of the Culinary, Industrial and Consent Order wells would continue and increases in selenium concentrations in these wells could indicate the need for additional BMPs for the A Panel backfilled pit.

The A Panel external ODA would not be further reclaimed. Infiltration through the ODA is currently estimated at approximately 700,000 cubic feet per year (0.02 cfs). However, with time, the surface vegetation will continue to mature and plant density should continue to increase, potentially reducing infiltration from direct precipitation. This would result in a reduction in

seepage (as expressed at AS-2 and through the base of the ODA) and selenium loading from the ODA, with time. The amount and rate of reduction is not known, however, the estimate for current loading from the external ODA, as measured at AS-2, is already relatively small (28 pounds per year).

6.1.2 Alternative 2

Alternative 2 calls for a 2-foot soil cover and contingent treatment of residual flow, if any, at seep AS-2. After the cover is installed and the vegetation has matured, sediments associated with stormwater detention basins would be capped, except for AP-2, which has collected AS-2 seep water. Sediments from AP-2 will be excavated and disposed of in an existing mine feature.

Implementability

The primary implementability concern is the availability of 295,000 cy of topsoil. This, and other soil volume estimates presented in this section are based on the total area of the source area, a 2-foot thickness, and a 10 percent bulking factor. Topsoil removed in conjunction with mine panel development provides a marginal supply for reclamation. An active topsoil borrow area was not identified locally. Potential local topsoil sources are limited to the larger nearby valley floors. These areas also often have marginal topsoil resources and are private property. Given the increasing value of property in the area, the likelihood of finding a local landowner willing to sell a large volume of topsoil is low. A significant number of haul truck trips (14,750 trips @ 20 cy per trip) would occur on public roads if the source is outside of Sage Valley. If conducted during the period of active mining, coordination with mine traffic would be required. Standard construction practices could be used to implement these actions.

Treatment of Seep AS-2 involves retaining an access road for operation and maintenance of the passive treatment system into the future. Although the access road would be required, the treatment system could be constructed with minimal above-grade structure. Over the last several years, seep AS-2 has flowed only in the spring. During the winter months access will not likely be needed given the ephemeral nature of the seepage. A constant long-term local source of carbon (e.g., whey) would also be required. In addition, spent treatment material would periodically be removed and would be required to be disposed offsite. Information in the literature indicates that the material would be solid rather than hazardous waste, but this would need to be evaluated by testing.

Covering the stormwater detention ponds with chert and removal of AP-2 sediments poses no implementability concerns and can be accomplished using standard engineering practices.

Effectiveness

After implementation of Alternative 2, the total annual infiltration into the A Panel external ODA is estimated to be 350,000 cubic feet (0.011 cfs; Appendix D). This represents a 50 percent reduction relative to pre-removal action conditions. The HELP model does not account for the benefits of a simple soil cover including the increased evapotranspiration that would result from the expected improved surface vegetation. The presence of increased soil/organic matter at the surface will reduce the dissolved oxygen content of infiltrating water and the vegetation will decrease the infiltration rate, thereby limiting leaching potential. Literature describing the effectiveness of vegetated, compacted soil covers in arid areas for reducing infiltration indicates effectiveness as high as a 98 percent reduction for compacted covers in arid areas (Appendix D). Therefore, a 50 percent infiltration reduction is conservatively assumed for the purposes of this evaluation. The exact benefits in terms of reduced oxygen and improved quality of seepage at AS-2 and through the base of the overburden cannot be established, but ongoing monitoring at seep AS-2 would provide an overall indication.

The surface vegetation should also have declining selenium concentrations because of the benefits of the soil barrier and incorporation of a new species seed mix and would eliminate any concerns regarding seasonal livestock grazing exposure. The amended cover and seed mix should be effective over the long-term. Given the setting, there are no physical threats (e.g., erosion) anticipated to adversely affect the soil cover integrity. As vegetation increases, the litter layer will provide a future source of supporting organic matter to the ODA surface and enhance the rate of soil building.

Removal of detention pond AP-2 sediments is expected to be effective. Capping of the other ponds will also be effective at eliminating the potential exposure to large wildlife. Small burrowing wildlife may still be exposed locally, however, the areas are very small, have low selenium concentrations, and therefore would not pose a threat.

Given that the Site is on federal lands, the ability to ensure long-term effectiveness by controlling future disturbances is high. At the time of mine closure, it is also expected that vehicle access to the surface of mined areas will be reduced or eliminated through enforcement of existing National Forest institutional controls. Additional institutional controls can be implemented and enforced, as necessary.

The ultimate effectiveness of the potential passive treatment system at seep AS-2 is unknown. A 75-percent selenium removal level is a reasonable expectation for system performance (Appendix B). A primary consideration for passive bioreactors is performance during the winter when deep frost and low temperatures could limit effectiveness. However, seep AS-2 was not observed to be flowing during the winter months. In addition, the system could be installed well below the ground surface as insulation against severe low winter temperatures.

Although not identified as a concern for the A Panel, all of the actions considered under Alternative 2 should be equally effective for COPCs other than selenium. The primary short-term effectiveness concerns with Alternative 2 are related to the likely volume of truck traffic on public roads required to haul the capping materials, and coordination of that traffic with mine traffic.

Cost

The present value of this alternative (see Appendix E Table E-1) is:

Capital Costs: $4.6 million

O&M: $0.3 million

Total $4.9 million

The vast majority of the cost (approximately $4.7 million) is associated with the soil cover. As discussed above, the availability of the required volume of topsoil is locally is uncertain. If material must be brought from more distant sources then the cost will increase accordingly. The estimated cost for installation of soil covers was based on actual costs for similar actions at other sites in the region (in particular the Butte Priority Soils Operable Unit in Butte, Montana and at the Bunker Hill Superfund Site in Kellogg, Idaho). The cost estimate also includes optional seep treatment (approximately $0.15 million), which would not be required if the existing seep dries up after the cover is installed.

6.1.3 Alternative 3

Alternative 3 calls for amendment of the surface of the external ODA with organic matter (e.g., composted manure or biosolids). Replanting/covering of any residual surface expression of seep AS-2 and AP-2 with coarse chert is also included. Sediments in the remaining detention basins would be excavated and included in pit backfill or placed at the tailings ponds.

Implementability

The primary implementability concern is the local availability of the required 6,640 cy of organic matter for amendment. Local dairies offer an opportunity to obtain manure and some logging/saw mill activities in the region may have log yard wastes that would be suitable. Given the low density of the materials, a number of haul truck trips (over 330 trips at 20 cy per trip) would be required on public roads. If conducted during active mining, coordination with mine traffic will be required.

Because of the coarse rocky surface of some portions of the external ODA surface and the depth of incorporation (i.e., at least twelve inches), special equipment may be required for incorporation (e.g., chisel plow). In addition, any established areas of selenium-accumulator species (e.g., alfalfa) would need to be eliminated with a herbicide (e.g., Roundup) by a licensed contractor prior to amendment and replanting.

Covering of AP-2 and removal of sediments from the remaining A Panel runoff detention ponds can be easily implemented with standard construction equipment.

Effectiveness

Surface amendment and replanting of the external ODA should be effective in reducing the selenium concentration in vegetation by reducing uptake. The development of a mature vegetative cover on the ODA should also decrease infiltration. After implementation of Alternative 3, the total annual infiltration into the A Panel external ODA is estimated to be 350,000 cubic feet (0.011 cfs; Appendix D). This represents a 50 percent reduction relative to pre-removal action conditions. Achievement of this level of infiltration reduction is based on the establishment of a good vegetative cover and therefore will require a relatively longer time period than for a soil cover and may require more intensive O&M activities in the near term such as re-seeding, amendment addition, and fertilization to achieve full coverage. The presence of increased organic matter/vegetation at the surface will also slow the rate of infiltration and reduce the dissolved oxygen content, thereby limiting leaching potential. The exact benefits to reduced and improved quality of seepage at AS-2 and through the base of the overburden cannot be established, but ongoing monitoring at seep AS-2 would provide an overall indication.

As for Alternative 2, selenium concentrations in vegetation should not be a concern for grazing leases. The amended cover and new seed mix should be effective over the long term. As vegetation increases, the litter layer will provide a future supporting source of organic matter to the ODA surface and enhance the rate of soil building.

As described for Alternative 2, sediment removal and capping actions will be effective at eliminating/reducing exposure to wildlife. Minimal reliance on institutional controls is required for Alternative 3 and would be limited to controlling off-road vehicle activity in that portion of the National Forest.

Cost

The present value of this alternative (see Appendix E Table E-2) is:

Capital Costs: $0.4 million

O&M: $0.2 million

Total $0.6 million

The vast majority of the cost (approximately $0.5 million) is associated with the surface amendment and establishment of vegetation. For the purposes of cost estimation, it was assumed that compost would be used for surface amendment. Unit costs for compost were taken from "The Compost Connection for Western Agriculture" published in January 1999 by Cooperative Extension Washington State University Center for Sustaining Agriculture and Natural Resources. This publication included typical compost characteristics and cost for Southern Idaho. Costs for other elements (storm water controls, seep covering, and storm water detention basin sediment removal) are relatively minor.

6.1.4 Alternative 4

Alternative 4 calls for construction of a low-permeability cap over the surface of the A Panel external ODA. Sediments in the detention basins would be removed. The low-permeability cap includes (from the bottom up) a 6-inch cushion layer comprised of native soil (where necessary), a GCL, and a 1-foot thick chert drainage layer with a 1.5-foot vegetated topsoil cover.

Implementability

As for Alternative 2, obtaining a local source of topsoil for covering of the GCL is a primary implementability concern. Approximately 147,000 cy of chert and 221,000 cy of soil would be required for the vegetated cover. Hauling of the soil from an off-site location would require over 11,000 truck trips at 20 cy per trip. Preparation (clearing, grubbing, grading) of the external ODA surface can be accomplished using standard construction equipment. The external ODA poses no particular concerns regarding placement beyond the need to eliminate existing surface vegetation and the presence of coarse material at the surface. However, the area (over 80 acres) is substantial and the construction seasons at the mine are short. Several construction seasons could be required to complete the low-permeability cap.

As discussed for Alternatives 2 and 3, seep and stormwater detention pond sediment removal poses no implementability concerns.

Effectiveness

The low-permeability cap would be effective at controlling infiltration through the A Panel external ODA over the long-term. Analysis of the low-permeability cap using the HELP model indicates that the annual average infiltration rate will decrease by 99 percent (from 700,000 cubic feet per year to 1,000 cubic feet per year; Appendix D). Seep AS-2 is expected to dry up with the reduced infiltration rate.

The low-permeability cap increases the potential for runoff from the A Panel ODA surface. However, it is not expected that the runoff would be substantial and should not threaten to erode the soil cover and underlying cap layers given the moderate slopes of the ODA.

It is anticipated that the GCL cap with soil cover and revised seed mix will reduce selenium concentrations in vegetation and eliminate any future concerns from unrestricted grazing.

It should be noted that pilot studies suggest that low-permeability caps including a GCL may deteriorate over time, resulting in rising infiltration rates. Such deterioration can be attributed to dessication of the GCL which does not completely repair itself after rewetting, ion exchange between the GCL and the soil which increases the GCL's permeability and possible damage to the GCL during installation (Dwyer, 2001). In addition, invasion of the low-permeability cap surface by deep rooted woody species will eventually reduce the integrity of the cap, however, the increasing rate of evapotranspiration should offset any increased potential for infiltration from deep rooting.

The primary short-term effectiveness concerns associated with Alternative 4 are related to the likely volume of truck traffic on public roads required to haul the capping materials. Coordination with mine traffic also raises additional safety concerns.

Cost

The present value of this alternative (see Appendix E Table E-3) is:

Capital Costs: $9.5 million

O&M: $0.2 million

Total $9.7 million

The vast majority of the cost (approximately $9.6 million) is associated with the cap, which includes GCL, geotextile, drainage and soil layers. As discussed above, the availability of the required volume of topsoil is locally is uncertain. If material must be brought from more distant

sources then the cost will increase accordingly. Costs for other elements (storm water controls, and sediment removal) are relatively minor.

6.2 Pole Canyon ODA

Baseline conditions (Alternative 1) and implementability, effectiveness and cost considerations for Alternatives 2, 3, and 4 for the Pole Canyon ODA are summarized below. Details regarding the Pole Canyon ODA alternatives can be found in Section 5.2.2.

6.2.1 Alternative 1

No future actions would occur for the Pole Canyon ODA under Alternative 1. Estimated average inflows to the Pole Canyon ODA of 47.6 million cubic feet per year (1.5 cfs; Appendix D) would continue under Alternative 1. Ninety-three percent of this inflow (44.2 million cubic feet per year) consists of Pole Canyon Creek water. Closure/reclamation of the Pole Canyon ODA has been completed under the mine plan. Ongoing monitoring would continue under the Comprehensive Monitoring Program (MFG, 2002).

6.2.2 Alternative 2

Alternative 2 calls for a reactive layer of iron filings and organic matter placed on the surface of the Pole Canyon ODA. These amendments would then be covered with a 3-foot chert barrier and a 2-foot vegetated soil cover. Flow in Pole Canyon Creek exiting the Pole Canyon ODA would be treated by introducing a high-organic liquid (e.g., whey) through an infiltration trench at the toe of the Pole Canyon ODA. A run-on control ditch would be placed along the northern flank of the Pole Canyon ODA to intercept and divert run-on from the adjacent slope.

<u>Implementability</u>

The primary implementability concerns are the availability and delivery of materials for the Pole Canyon ODA cover and the ability to treat Pole Canyon Creek spring flows in-situ.

Approximately 639,000 cy of chert and 426,000 cy of soil would be required for the basic cover layers. Nearly 1,000 tons of reactive iron and 9,600 cy of organic matter (e.g., composted manure or biosolids) would also be required. As noted for A Panel alternatives, local availability of large volumes of topsoil and organic amendments are limited and would likely require substantial hauling on public roads (soil alone would require 21,300 truck trips at 20 cy per trip). Management of the truck traffic and coordination with ongoing mining activity would be required. Chert can be accessed within the mine area and a borrow area could be developed.

Grading, contouring, and placement of cover material on the Pole Canyon ODA surface, as well as diversion ditch construction, could be accomplished using standard equipment. Consistent placement of the relatively thin reactive layer (a few inches of iron filings and organic matter) will be difficult over the large, irregular surface of the Pole Canyon ODA. This layer may also be disrupted during the placement of the subsequent layers of material, creating uneven distribution. Some engineering controls would be required to bring the current run-on off the face of the Pole Canyon ODA to reduce erosion potential.

The large spring flows of Pole Canyon Creek would require a substantial treatment system. Pilot-scale testing suggests that organic carbon in the form of whey would need to be added at a rate of approximately 10,000 gallons per day (Appendix B). Discussions with Star Valley Cheese in Thane, Wyoming indicate that their facility produces approximately 15,000 gallons of cheese whey waste per day and that the material would be available at no purchase cost (it would need to be transported to the Site). It is therefore expected that it will be possible to obtain the required quantity of whey. It would be difficult to achieve the appropriate dosage to the creek water to maintain treatment efficiency, as flows and other conditions change. Addition of excess whey could result in problems with the creek water downstream of the ODA. Ongoing supplement of organic matter and O&M requirements would demand better access than currently exists. The current dirt road base and steep slope off the face of the Pole Canyon ODA limits access during periods of snow and wet weather. New access along the western flank of Sage Valley could be required. Although lower Pole Canyon Creek flows currently diminish in late fall, year-round access would be required in the future if annual precipitation at the mine returns to historical levels.

An additional implementability consideration for Alternative 2 is the odor released with the use of whey. The offensive odor may be objectionable to landowners over the long term.

Effectiveness

After implementation of Alternative 2, the estimated water inflow rate to the Pole Canyon ODA would be approximately 45.2 million cubic feet per year (1.43 cfs; Appendix D). This represents an approximate 5 percent reduction relative to current conditions and is associated with reduced infiltration and run-on. Most of the flow that would continue to enter the Pole Canyon ODA is from Pole Canyon Creek (44.2 million cubic feet per year).

The soil and chert cover will reduce the weathering and associated release of selenium from shales currently exposed at the surface of the Pole Canyon ODA. The majority of direct precipitation left to infiltrate the Pole Canyon ODA would contact the iron/carbon amendments which will remove oxygen and reduce the valence state of selenium in the water. This alteration in infiltration chemistry will result in a lowered potential for leaching of selenium. In combination, the chert/soil cover and reactive underlayer should reduce the volume of water and concentration of selenium in the resultant seepage. Based on the pilot study completed in

spring 1999 on the Pole Canyon ODA, it is estimated that the reactive layer will achieve an 80 percent reduction in selenium concentration (Appendix B). However, it may take several years for this reduction to be evident in the seepage emanating from the toe of the Pole Canyon ODA because the pore water within the Pole Canyon ODA currently contains high selenium concentrations. Water infiltrating through the Pole Canyon ODA will continue to join Pole Canyon Creek flows. Some of the water in Pole Canyon Creek is lost directly to the Wells Formation and shallow alluvial groundwater systems under the Pole Canyon ODA. Although the mass of selenium in infiltration will be reduced, Pole Canyon Creek will continue to deliver a substantial portion of the current selenium loading to the underlying groundwater systems.

A limiting factor in the effectiveness of the reactive underlayer will be the likely establishment of preferential pathways for infiltration. This treatment approach has not been applied previously at this scale. Given the large surface area of the Pole Canyon ODA, even with surface grading water may preferentially collect in low spots and infiltrate over time. Larger amounts of infiltration through a small surface area may locally overwhelm the relatively thin layer of reactive material and limit its effectiveness. An additional limiting factor in the effectiveness of the reactive underlayer would be the rapid consumption of the organic carbon from the organic source. The initial store of organic carbon would likely be depleted in five years or less and it would not be feasible to add additional organic carbon due to the presence of the chert and soil over layers.

The effectiveness of the addition of an organic liquid (whey) to the toe of the Pole Canyon backfill would be reflected in Pole Canyon Creek. Although some benefit may occur within the underlying units, a reduction in selenium concentrations within Pole Canyon Creek would be the primary benefit. Based on a recent pilot study, it is expected that a 90 percent reduction in selenium concentrations could be achieved under low flow conditions. Reduction rates that could be achieved under moderate to high flow conditions are unknown (Appendix B).

The effectiveness of this treatment methodology is dependent upon the continual operation of the system. Selenium precipitated through the introduction of organic matter will remain in the solid phase in a reducing environment. If the delivery of organic matter is curtailed or insufficient, the selenium will oxidize, return to solution, and potentially be remobilized. Failure of the system could result in substantial release of precipitated selenium.

The effectiveness of treating Pole Canyon Creek flows exiting the ODA may be limited during the periods of spring runoff. Figure C-3 shows the rapid increase in spring flows and the corresponding rapid subsequent decline. The physical limitations associated with the canyon setting preclude storage of spring flows prior to treatment. An inability to deliver sufficient organic matter with adequate retention time to treat peak spring flows could result in bypass of the system. Bypassed water with elevated selenium concentrations would be similar to current conditions. The bypassed water would flow onto the valley floor, along with the treated portion of flow and captured clean run-on, in the existing channel. Pole Canyon Creek flows within the

valley floor rapidly infiltrate to the underlying alluvial aquifer. Although the effectiveness of reducing the existing selenium load would be limited during peak flows, unacceptable impacts to the alluvial aquifer and/or to cattle drinking from Pole Canyon Creek are not anticipated from the brief period of excess flow.

Under Alternative 2, Pole Canyon Creek would continue to enter the Pole Canyon ODA at its upstream end. Creek water would continue to contact the overburden along the base of the channel and mix with infiltration from direct precipitation. The water flowing along the base of the creek channel would continue to be lost to the Wells Formation and alluvial system. As noted above, these impacted waters would be slightly lower in volume and selenium mass than the current transport.

Overall, it is expected that Alternative 2 would reduce the estimated load of selenium exiting the Pole Canyon ODA, the Wells Formation aquifer, the alluvial groundwater system, and Pole Canyon Creek. If it is assumed that the reduction in selenium loading from the Pole Canyon ODA is equivalent to the estimated reduction in water inflow to the ODA (both infiltration and creek inflow), then a selenium loading reduction of 5 percent may be expected. Treatment of the infiltration water through the reactive barrier, and treatment of Pole Canyon Creek water exiting the ODA, would further reduce selenium loadings associated with infiltration. These actions would have a corresponding benefit to Pole Canyon Creek water quality downstream of the Pole Canyon ODA.

The primary short-term effectiveness concerns associated with Alternative 2 are related to the likely volume of truck traffic on public roads required to haul the cover and treatment materials. Coordination with mine traffic also raises additional safety concerns.

<u>Cost</u>

The present value of this alternative (see Appendix E Table E-4) is:

Capital Costs: $15.0 million

O&M: $9.9 million

Total $24.9 million

The major cost items in this alternative are associated with installation of the soil cover (approximately $15.0 million) and operation of the in-situ creek water treatment system (approximately $9.6 million). As discussed above, the local availability of the required volume of topsoil is uncertain. If material must be brought from more distant sources then the cost will increase accordingly. The costs to effectively operate the in-situ creek water treatment system are conceptual. A local facility (Star Valley Cheese in Thane, Wyoming) produces

approximately 15,000 gallons of whey waste per day and incurs costs to dispose of the waste. Preliminary discussions indicate that the waste would be provided at no charge, with costs associated with transportation. Although some testing has been performed, additional data on creek flows (particularly during spring runoff conditions) and long-term operation of the treatment trench would be required to refine the cost estimate.

6.2.3 Alternative 3

Alternative 3 is focused on water management and is comprised of diversion of most of the upstream Pole Canyon Creek flows around the Pole Canyon ODA and infiltration of the remaining flows to the Wells Formation. Flows at the diversion would be routed through a 30-inch diameter underground pipeline along the canyon wall and brought along either the northern or southern flank of the Pole Canyon ODA. Flows in Pole Canyon Creek below the elevation of creek diversion would be directed to the Wells Formation upstream of the Pole Canyon ODA. The alternative also includes the run-on diversion from Alternative 2. This approach is evaluated in detail in Appendix C. The surface of the Pole Canyon ODA would be amended with organic matter and replanted with a seed mix having a low affinity for selenium uptake.

Implementability

The primary implementability concerns for Alternative 3 are related to the engineering and administrative aspects of diverting Pole Canyon Creek flows (Appendix C). The diversion of Pole Canyon Creek flows along the valley flank, over the crest of the Pole Canyon ODA, and off the face of the valley backfill can be accomplished with standard engineering and construction practices.

Some uncertainties exist regarding the design flows for the collection and diversion system piping. A data logger and flow meter are currently being installed on upper Pole Canyon Creek to better characterize the stream hydrograph.

The design and construction of the infiltration/recharge system for the creek flows downstream of the diversion is not as routine. Simplot has recently constructed Wells Formation recharge areas in conjunction with the Panels B and C development, which may provide information to refine the design. Preliminary analyses indicate that the space available at the upstream end of the Pole Canyon ODA, with reasonable access to the Wells Formation, should conservatively accept the flow from the remaining portion of the Pole Canyon Creek watershed below the diversion (Appendix C). The ability to infiltrate the flow collected by the Pole Creek watershed below the diversion is an important consideration in that, in conjunction with diversion, it would allow for isolation of the Pole Canyon ODA from Pole Canyon Creek flows. As detailed in Appendix C, the current preliminary analyses are based on infiltration analyses from other parts of the Site that likely have limited applicability to the Pole Canyon ODA area.

As noted, a threshold implementability issue is whether Pole Canyon Creek flows originating in the water shed between the Pole Canyon Creek diversion point and the upstream toe of the Pole Canyon ODA can be successfully infiltrated on a year-round basis. Analyses presented in Appendix C indicate a normal spring peak flow of approximately 2 cfs in the remaining portion of the watershed between the diversion point and the Pole Canyon ODA. Based on available information regarding infiltration rates for the Grandeur Member of the Wells Formation, infiltration of a 2 cfs flow would be feasible in an infiltration basin with a floor area of one-half acre located just upstream of the Pole Canyon ODA. The total recharge capacity of the infiltration basin will require ongoing characterization during the design and construction phases. The remainder of Alternative 3, including the surface amendment with 9,600 cy of organic matter, is implementable, but subject to the same concerns identified for amendment of the A Panel external ODA, only at a slightly larger scale.

Operation and maintenance for the diversion structure, recharge basin, and run-on ditch will require year-round access, often with heavy equipment. Correspondingly, an access road along the diversion pipeline will need to be constructed and maintained. As identified for Alternative 2, this will include access along the valley floor to the toe of the Pole Canyon ODA. Other implementability considerations include the short construction season durations for the diversion intake and infiltration basin, which could only be built during low-flow conditions but prior to the onset of winter. In addition, BMPs would need to be implemented to control sediment releases to Pole Canyon Creek.

In order for the diversion and infiltration basin to function as implemented, an O&M program will be required in perpetuity. The program will need to address clearing of debris from the engineered structures and sediment accumulation in the sedimentation and infiltration basins. These materials will be clean and can be incorporated into the Pole Canyon ODA surface.

The potential administrative hurdles to be addressed under Alternative 3 are related to the modification of flows in Pole Canyon Creek. Relative to current conditions, substantially more water could flow in the Pole Canyon Creek channel below the ODA and less water could report to the Wells Formation due to the construction of the diversion under Alternative 3. In addition, less flow will be present in Pole Canyon Creek downstream of the diversion (3/4-mile segment). The degree to which the flow regime will change in these stream segments will depend upon the ability of the Wells Formation infiltration basin to accept flows.

The system could be designed/operated to send as much as 100 percent of the normal Pole Canyon Creek flow to the infiltration basin. However, as the flow directed to the recharge basin increases, the flow in Pole Canyon Creek downstream of the Pole Canyon ODA will decrease. Diminishing the flows in Pole Canyon Creek below the Pole Canyon ODA could trigger issues regarding water rights, which are currently controlled by the Peterson Ranch. Pole Canyon Creek waters are used for irrigation when flows are adequate. The irrigation needs could be replaced through construction of a well in the Sage Valley. Substantially reducing or eliminating

flow in Pole Canyon Creek in Sage Valley would also have to be cleared with the State of Idaho and the Army Corps of Engineers, as would the alteration of the upstream channel to create a recharge basin. The substantive requirements of stream alteration permits (e.g., Clean Water Act Section 404 permit, administered by the Army Corps of Engineers) regarding dredge and fill requirements would also need to be considered and implemented.

Although flow in Pole Canyon Creek has not recently extended far out into the Sage Valley before being lost to irrigation and or the subsurface, historical flows have likely extended across the valley to the North Sage Creek. However, if the proposed infiltration basin above the Pole Canyon ODA were to be used to infiltrate all of the Pole Canyon Creek flow, Pole Canyon Creek would essentially cease to exist downstream of the Pole Canyon ODA, resulting in potentially significant water-rights issues. As discussed above, these administrative matters could be addressed during remedial design and that flexibility in the design, construction and operation sequence is available to incorporate the desired balance between recharge and diversion. For example, the infiltrated basin and diversion could be managed seasonally to provide adequate summer flows to Sage Valley while delivering substantial flows to the Wells Formation year round.

Effectiveness

Alternative 3 will be effective in terms of isolating the Pole Canyon ODA from Pole Canyon Creek and run-on from the northern hillsides. Pole Canyon Creek is the overwhelming source of water to the Pole Canyon ODA. After implementation of Alternative 3, the estimated flow of water entering the Pole Canyon ODA would be approximately 1.04 million cubic feet per year (0.033 cfs; Appendix D). This includes elimination of normal stream inflow; an 80-percent reduction in run-on, and a 50-percent reduction in infiltration, assuming development of a good vegetative cover. Overall, a 98-percent decrease in water inflow to the Pole Canyon ODA would be expected relative to pre-removal action conditions. The reduction in flow through the Pole Canyon ODA is expected to have a corresponding effect on selenium transport. The reduced infiltration and elimination of Pole Canyon Creek flow would greatly decrease the opportunity for leaching of selenium from the overburden.

Although the exact reduction in selenium transport from the Pole Canyon ODA cannot be predicted, the likely effect of the remaining direct infiltration can be characterized for the defined surface water and groundwater pathways. Comparison of the current inflow and outflow rates for Pole Canyon Creek through the Pole Canyon ODA provides a combined rate of flow loss to the alluvial groundwater system and the Wells Formation. This value ranges up to nearly 8 cfs during spring flows (NewFields, 2005). In contrast, the annual average rate of infiltration from direct precipitation through the Pole Canyon ODA is 1.2 million cubic feet per year, or approximately 0.04 cfs (Appendix D). Given that the rate of Pole Canyon Creek loss substantially exceeds the rate of infiltration over the same area, it is expected that the infiltration exiting the bottom of the Pole Canyon ODA will enter the creek channel and be lost to these

underlying groundwater systems. This reduced loss of impacted waters under the Pole Canyon ODA will be further off-set by the introduction of clean water to the Wells Formation in the upstream infiltration basin. The net effect would be a substantial reduction in selenium concentrations in the Wells Formation aquifer and alluvial systems below the Pole Canyon ODA.

The net effectiveness of the combined actions could be monitored at wells GW-15, GW-16, and GW-22. Monitoring at these locations will also allow for evaluation of the ongoing effects of residual vertical infiltration through the overburden, including exceedances of the groundwater quality standards. At a minimum, it is expected that 2 cfs during spring flows, and lesser amounts during drier times of the year, will be the rate of recharge to the Wells Formation through the constructed infiltration basin (see Appendix C). Clean creek water re-introduced to the creek bed upstream of the West Sage Valley Branch Fault can be lost to the alluvial system and the underlying Wells Formation. On the valley side of the fault, water would be lost solely to the valley fill system. This alternative would result in unimpacted waters replacing some or all of the impacted water currently transported through these pathways. As noted under the implementability discussions, the ratio of water directed to the infiltration basin versus diverted over the Pole Canyon ODA could be adjusted based on the ability of the recharge basin to rapidly accept infiltration. If more than the residual flow in Pole Canyon Creek below the diversion is directed to the Wells Formation, the dilution effect on any residual infiltration through the Pole Canyon ODA would be greater. Considering the ratio of the range of Pole Canyon Creek flow to infiltration, diverting all of the Pole Canyon Creek flow to the Wells Formation would result in concentrations substantially lower than currently measured. Over time, this beneficial reduction would translate to corresponding reductions at the downgradient surface expression of Hoopes Spring. Dilution of selenium concentrations in the Wells Formation groundwater would provide additional benefit.

During periods of peak runoff or extreme storm events there is a possibility that the flows in Pole Canyon Creek upstream of the Pole Canyon ODA could overwhelm both the diversion and the infiltration basin. Such events could result in Pole Canyon Creek overflows briefly entering the Pole Canyon ODA. There are no structural concerns regarding the Pole Canyon ODA as it has and is currently passing all ranges of Pole Canyon Creek flows. The overflow waters would enter and likely leach selenium from the overburden. As is the current condition, the overflow waters would report first to the Wells Formation and alluvial groundwater systems at the current losing reaches of Pole Canyon Creek under the Pole Canyon ODA. Remaining flows would emanate from the Pole Canyon ODA toe in the existing Pole Canyon Creek channel and mix with diverted clean waters. No significant impact on water quality beyond the brief transient event is expected and the annual selenium loading to all pathways would still be substantially less than is currently observed.

Under Alternative 3, the combination of amendment with organic matter, elimination of selenium-accumulator species (e.g., alfalfa), and replanting with species having a low affinity for

selenium accumulation would effectively reduce the current limited concerns regarding exposure to grazing livestock. The Pole Canyon ODA only occupies a small portion of the Pole Canyon grazing allotment (approximately 10 percent) and the expected improvements in decreased selenium concentrations under Alternative 3 would remove any concerns regarding unrestricted grazing.

Overall, Alternative 3 is expected to successfully address the environmental concerns identified during the SI. Benefits from the infiltration and diversion of Pole Canyon Creek will be relatively rapid, as will the benefits of run-on control. The benefits of surface amendment and a new cover seed mix for vegetation will be observed within the first grazing season. Additional time will be required for the vegetation to mature and direct precipitation infiltration chemistry and volume to improve.

Cost

The present value of this alternative (see Appendix E Table E-5) is:

Capital Costs: $3.4 million

O&M: $1.2 million

Total $4.6 million

The principal costs for this alternative are associated with diversion of creek flow around the ODA (approximately $2.2 million), infiltration of creek flow above the ODA (approximately $1.2 million) and surface amendment (approximately $1.1 million). Operation of creek flow diversion and infiltration systems would be required over the long term.

6.2.4 Alternative 4

Alternative 4 includes all of the surface water management components of Alternative 3 but replacement of the Pole Canyon ODA surface amendment with a low-permeability cap. The low-permeability cap design includes a GCL, as described in Section 6.1.4 for the A Panel external ODA.

Implementability

All of the implementability issues identified for the water management components of Alternative 3 are relevant to Alternative 4. Additional implementability concerns for Alternative 4 are related to acquisition and transport of the cap materials. Although chert may be mined locally (213,000 cy), as discussed for A Panel ODA Alternative 2, large volume topsoil borrow availability (nearly

320,000 cy) is expected to be locally limited (Sage Valley) and also limited within the Star Valley. Transport of this large volume of topsoil (nearly 16,000 haul truck trips at 20 cy per trip) would result in risks to the public if the source is outside Sage Valley. Effective placement of a GCL cap over a large area of irregular surface poses some implementability concerns. Given the short construction seasons and availability of cover materials, seeding and covering the large area may take several seasons.

Effectiveness

The Alternative 4 components that are also included in Alternative 3 were evaluated for effectiveness in Section 6.2.3. However, the inclusion of the low-permeability cap under Alternative 4 changes the overall effectiveness by increasing short-term risks due to truck traffic and by significantly reducing the near-term potential for infiltration of direct precipitation. HELP model evaluations (Appendix D) indicate that the low-permeability cap could reduce infiltration to 0.003 in/yr. Although achieving this low infiltration rate over such a large area may be difficult due to the potential for construction breaches and/or settlement tears that result in preferential flow paths, a substantial reduction in infiltration is expected. Correspondingly, the selenium load leaving the base of the ODA would also be reduced by a similar factor.

After implementation of Alternative 4, the estimated annual flow of water entering the Pole Canyon ODA would be 0.44 million cubic feet per year (0.014 cfs; Appendix D). This reflects a 99-percent decrease relative to pre-removal action conditions. The time to achieve full effectiveness of the low-permeability cap would be dependent upon the construction period. Once the cap is fully installed there would be a period where any water stored above the field capacity would slowly migrate vertically through the Pole Canyon ODA over time. However, the amount released would be small relative to current seasonal infiltration and would diminish rapidly.

Overall, Alternative 4 would provide substantial hydraulic isolation of the Pole Canyon backfill and would result in greatly diminished selenium loading potential.

Cost

The present value of this alternative (see Appendix E Table E-6) is:

Capital Costs: $16.5 million

O&M: $1.1 million

Total $17.6 million

The vast majority of the cost (approximately $14.0 million) is associated with the cap, which includes GCL, geotextile, drainage and soil layers. As discussed for the A Panel above, the availability of the required volume of topsoil is locally is uncertain. If material must be brought from more distant sources then the cost will increase accordingly. In addition, costs are significant for diversion of creek flow around the ODA (approximately $2.2 million) and infiltration of creek flow above the ODA (approximately $1.2 million).

6.3 D Panel Backfilled Pits and External ODA

Baseline conditions (Alternative 1) and implementability, effectiveness, and cost considerations for Alternatives 2, 3, and 4 for the D Panel backfilled pits and external ODA are summarized below. Details regarding the D Panel alternatives can be found in Section 5.2.3.

6.3.1 Alternative 1 – No Action

The northern 230 acres of the D Panel backfilled pits and all of the D Panel external ODA were reclaimed prior to the recent establishment of the BMPs that are now used at the Site. Those BMPs include placement of a chert barrier between the seleniferous shales and the topsoil cover. The southern 100 acres of the backfilled pits have been reclaimed using these BMPs and therefore do not require additional actions under this EECA.

As described in detail in Section 5.2.3, several seeps are present in the D Panel area that contain elevated selenium concentrations. These seeps, associated sediment in detention basins below the seeps, and the presence of selenium-accumulator plant species in the northern portion of the backfilled pits and all of the external ODA result in the potential for livestock exposure to unacceptable selenium concentrations. The potential for run-on exists for the western of the backfilled pits as well as from areas of undisturbed ground within the backfilled pits area.

No removal actions would be implemented under Alternative 1. Instead, reclamation actions performed under the mine plan would be allowed to mature. These reclamation actions are expected to reduce direct infiltration, and infiltration of runoff, into the southern 100 acres of the D Panel backfilled pits by approximately 50 percent due to the eventual development of a good vegetative cover. The total estimated infiltration into the backfilled pits 330-acre area under the no action alternative is 8.16 million cubic feet per year (0.259 cfs). This represents a 15 percent reduction relative to current conditions. Infiltration into the D Panel external ODA would also be reduced by the maturation of the existing stand of vegetation. The amount of infiltration reduction is reasonably expected to be approximately 50 percent. Thus, direct infiltration into the D Panel external ODA would be on the order of 150,000 cubic feet per year (0.005 cfs). This would result in a reduction in seepage at DS-7 and DS-10 and selenium loading from the ODA, with time. The amount and rate of reduction is not known. Achievement of these levels of

infiltration reduction in the D Panel backfilled pits and ODA will require longer periods of time than alternatives involving soil covers or amendments.

6.3.2 Alternative 2

Alternative 2 calls for a 2-foot soil cover on the northern portion of the D Panel backfilled pits (approximately 230 acres) and the external ODA (approximately 25 acres). The approximate volume of soil required to construct this cover is approximately 905,000 cubic yards. The soil cover would be revegetated with a seed mix that has a low potential for selenium uptake. In addition, surface water run-on controls would be installed along a portion of the backfilled pits. Sediment in detention basins would be covered with chert to eliminate direct contact by livestock and wildlife. Seeps that do not dry or up or exhibit improving water quality as a result of capping would be treated, and sediment in seep collection ponds would be excavated and disposed on-Site.

Implementability

Implementability issues for a soil cover in the D Panel area are the same as those identified for Alternative 2 at the A Panel and primarily focus on the availability of 905,000 cy of topsoil to cover the northern 230 acres of the D Panel backfilled pits as well as the D Panel external ODA. Safety concerns associated with the transport of the topsoil (over 45,000 haul truck trips at 20 cy per trip). Coordination of the haul trucks with mine traffic would comprise an additional implementability concern. Potential treatment of seeps using passive iron/organic reduction will increase O&M requirements but is considered implementable (see Section 6.1.2).

Effectiveness

The combination of soil cover and improved seed mix would address any concerns related to unrestricted grazing. After implementation of Alternative 2 and the establishment of a mature stand of vegetation, the estimated average annual infiltration rate through the D Panel backfilled pits area would be reduced to 2.55 million cubic feet per year and that run-on to the backfilled pits area would be reduced to 1.8 million cubic feet per year, for a total water input to the backfilled pits area of 4.35 million cubic feet per year (0.138 cfs; Appendix D). This represents an approximate 55 percent reduction in total inflow to the backfilled pits under Alternative 2 relative to current conditions. Infiltration to the D Panel external ODA would be reduced to 150,000 cubic feet per year (0.005 cfs; Appendix D) and run-on would be eliminated. This represents more than a 50 percent reduction in annual inflow to the external ODA under Alternative 2 when compared to current conditions. As noted for the A Panel, the soil cover is expected to provide additional benefits in terms of improved water quality in seepage emerging from the D Panel backfilled pits and ODA. If necessary, treatment of the remaining seep flows is expected to be effective at removing approximately 75 percent of the selenium loading. Other

effectiveness evaluations for Alternative 2 in the A Panel area are applicable to Alternative 2 in the D Panel backfilled pits and ODA (see Section 6.1.2).

Short-term effectiveness issues for Alternative 2 are safety related concerns associated with heavy haul truck traffic, as identified for the A Panel (Section 6.1.2) and coordination with mine traffic.

Cost

The present value of this alternative (see Appendix E Table E-7) is:

Capital Costs: $14.0 million

O&M: $0.7 million

Total $14.7 million

The vast majority of cost for this alternative is associated with installation of the soil cover (approximately $14.3 million). As discussed above for the A Panel, the availability of the required volume of topsoil is locally is uncertain and costs would increase if material had to be transported from more-distant sources. The cost estimate also includes optional seep treatment (approximately $0.4 million), which would not be required if the existing seeps dry up after the soil cover is installed.

6.3.3 Alternative 3

Alternative 3 calls for amending the existing surface materials in the northern portion of D Panel backfilled pits and ODA with composted manure or other organic amendments and revegetating the amended surfaces with plants that accumulate only low levels of selenium. Sediment excavation from the D Panel storm water detention basins and covering of seeps and seep collection ponds with chert is also included.

Implementability

Implementability issues associated with amending the D Panel backfilled pits and ODA are similar to those described for Alternative 3 at the A Panel, consisting primarily of the local availability of the required 20,400 cy of organic matter at 80 tons/acre and the number of haul truck trips (over 1,000 trips at 20 cy) that would be required on public roads. If conducted during active mining, coordination with mine traffic would be needed (see Section 6.1.3).

Effectiveness

Surface amendment and replanting of the northern 230 acres of the D Panel backfilled pits and external ODA should be effective in reducing the selenium concentration in vegetation by reducing uptake and through planting. The development of a mature vegetative cover in these areas should also decrease infiltration. Maturation of existing vegetation in the southern 100 acres of the backfilled pits area should result in a similar reduction in infiltration (approximately 50 percent). After implementation of Alternative 3, the total annual infiltration into the backfilled pits is estimated to be on the order of 2.55 million cubic feet per year and runon is estimated to be reduced to 1.8 million cubic feet per year through the installation of a run-on control channel. Therefore, total water entering the backfilled pits area after implementation of Alternative 3 is approximately 4.35 million cubic feet per year (0.138 cfs). This represents an approximate 55 percent reduction relative to current conditions. After implementation of Alternative 3, infiltration through the D Panel external ODA is estimated to be reduced to 150,000 cubic feet per year and run-on should be eliminated. This represents a 50 percent reduction relative to pre-removal action conditions. Achievement of these levels of infiltration reduction will depend on the establishment of a good vegetative cover which will require several growing seasons and may require operations and maintenance activities such as periodic re-seeding and fertilization on a spot basis. The presence of increased organic matter/vegetation at the surface will also slow the rate of infiltration and reduce the dissolved oxygen content, thereby limiting leaching potential. Other effectiveness issues related to Alternative 3 in the D Panel area are the same as those described for the A Panel area (see Section 6.1.3).

Short-term effectiveness issues for Alternative 3 are safety related concerns associated with heavy haul truck traffic, as identified for the A Panel (Section 6.1.3).

Cost

The present value of this alternative (see Appendix E Table E-8) is:

Capital Costs: $1.0 million

O&M: $0.7 million

Total $1.7 million

The vast majority of the cost (approximately $1.6 million) is associated with the surface amendment and establishment of vegetation. Costs for other elements (storm water controls, seep covering, and storm water detention basin sediment removal) are relatively minor.

6.3.4 Alternative 4

Alternative 4 includes the installation of a low-permeability cap on the northern 230 acres of the D Panel backfilled pits and the D Panel external ODA. Surface water run-on controls would be implemented, as for Alternatives 2 and 3. Sediment in storm water detention basins would be excavated and disposed on-Site, as for Alternative 3. Seeps DS-7 and DS-10 would be expected to dry up after emplacement of the low-permeability cap and sediment in the seep collection ponds would be excavated and disposed on-Site.

Implementability

Implementability issues associated with the installation of a low-permeability cap on a portion of the D Panel backfilled pits and the D Panel external ODA are the same as those described for the A Panel (see Section 6.1.4) and are primarily associated with acquisition of the large quantity of soil needed to complete the cap and transportation of that soil on public roads as well as within the mine site. Difficulties associated with the placement of the GCL within the cap also comprise an implementability concern.

Effectiveness

The low-permeability cap would be effective in addressing any existing concerns regarding unrestricted grazing in the future. The cap would also be effective at controlling infiltration through the external ODA over the long-term. After implementation of Alternative 4, infiltration and run-on to the D Panel backfilled pits is estimated to be reduced to 765,000 cubic feet per year and 675,000 cubic feet per year, respectively, for a total of 1.44 million cubic feet per year (0.046 cfs). This represents a total reduction in inflow of 85 percent relative to current conditions. The estimated infiltration through the D Panel external ODA after implementation of Alternative 4 is 300 cubic feet per year. This represents a reduction in inflow of greater than 99 percent for the D Panel external ODA when compared to current conditions. Other effectiveness issues associated with the implementation of Alternative 4 in the D Panel area are the same as those identified for the A Panel (see Section 6.1.4).

The primary short-term effectiveness concerns associated with Alternative 4 are related to the likely volume of truck traffic on public roads required to haul the cap materials. Coordination with mine traffic also raises additional safety concerns.

Cost

The present value of this alternative (see Appendix E Table E-9) is:

Capital Costs: $29.2 million

O&M: $0.4 million

Total $29.6 million

The vast majority of the cost (approximately $29.5 million) is associated with the cap, which includes GCL, geotextile, drainage and soil layers. As discussed above, the availability of the required volume of topsoil is locally is uncertain. If material must be brought from more distant sources then the cost will increase accordingly. Costs for other elements (storm water controls, and sediment removal) are relatively minor.

6.4 E Panel External ODA

Baseline conditions (Alternative 1) and implementability, effectiveness, and cost considerations for Alternatives 2, 3, and 4 for the E Panel external ODA are summarized below. Details regarding E Panel alternatives can be found in Section 5.2.4. The E Panel external ODA alternatives address only the southern 50 acres of the ODA where seleniferous shales are present. The northern portion of the ODA contains only chert and does not require additional actions.

6.4.1 Alternative 1

As described in Section 5.2.4, the primary environmental issues at the E Panel ODA are related to seepage. Pit backfill is currently being implemented consistent with BMPs and is expected to reduce the potential for plant uptake, leaching, and transport of selenium. Surface water management (e.g., diversion ditches and cutoffs) to control run-on and runoff will be part of the final reclamation plan. Final reclamation would address any run-on from the E Panel backfilled pits area to the E Panel external ODA.

No further reclamation actions, other than those associated with the current mine plan, would be implemented at the southern portion of the E Panel external ODA under Alternative 1. Over the long term, infiltration through the ODA would be reduced by the maturation of the existing vegetation. Once a healthy stand of vegetation is established, it is reasonable to expect an approximate 50 percent reduction in direct infiltration, resulting in an infiltration rate of 325,000 cubic feet per year (0.010 cfs) through the southern portion of the ODA (Appendix D). Maturation of vegetation would result in a reduction in seepage (as expressed at ES-4 and ES-5

and through the base of the ODA) and selenium loading from the ODA with time. The amount and rate of reduction is not known. Seep ES-3, which drains an area comprised of chert and is of low selenium concentration, would decrease in flow under this alternative and may eventually dry up.

6.4.2 Alternative 2

Under Alternative 2, sediments in storm water detention basins EP-1, EP-2, EP-6, EP-7, and EP-9 would be covered with chert to limit direct contact. Seeps ES-4 and ES-5 would be treated if they do not dry up as a result of the currently planned reclamation. Sediments from the EP-4 and EP-5 seep collection ponds would be excavated and disposed on-Site.

Implementability

The implementability issues associated with seep treatment and sediment excavation/disposal in the E Panel area are the same as those identified for the A Panel area (see Section 6.1.2). However, seeps in the E Panel external ODA area appear to maintain flow longer into the fall and winter and there is additional concern for winter access.

Effectiveness

The effectiveness in terms of infiltration reduction under Alternative 2 would be the same as described above for Alternative 1 and would primarily rely on the maturation of existing vegetation.

The effectiveness issues associated with seep treatment and sediment excavation/disposal in the E Panel area are the same as those identified for the A Panel external ODA under Alternative 2 (see Section 6.1.2). It is expected that the seep treatment system could achieve approximately 75 percent reduction in selenium loading. However, flows at the E Panel seeps appear to extend longer into the winter. The treatment system for these seeps would have to be installed well below the surface to prevent a reduction in efficiency due to low winter temperatures.

Cost

The present value of this alternative (see Appendix E Table E-10) is:

Capital Costs: $0.3 million

O&M: $1.2 million

Total $1.5 million

The vast majority of cost for this alternative is related to optional treatment of seeps, if they do not dry up after the cover becomes effective (approximately $0.3 million capital and $1.2 million O&M, for long-term treatment).

6.4.3 Alternative 3

Alternative 3 calls for amending the existing surface materials in the southern 50 acres of the E Panel ODA with organic matter and revegetating the amended surfaces. Sediment excavation from the E Panel storm water detention basins would also be implemented with on-Site disposal of the sediment. Seeps ES-4 and ES-5 would be covered with chert, if they do not dry up as a result of the surface cover. Sediments in seep collection ponds EP-4 and EP-5 would be covered with chert to eliminate direct contact.

Implementability

Implementability issues associated with amending the southern portion of the E Panel ODA are the same as those described for A Panel, consisting primarily of the local availability of the required 4,000 cy of organic matter at 40 tons/acre and the number of haul truck trips (200 truck trips at 20 cy per trip) that would be required on public roads. If conducted during active mining, coordination with mine traffic will be required (see Section 6.1.3).

Effectiveness

After implementation of Alternative 3, the total infiltration into the southern 50 acres of the E Panel external ODA is estimated to be 325,000 cubic feet per year (0.010 cfs; Appendix D). This represents a 50 percent reduction relative to pre-removal action conditions. Achievement of this level of infiltration reduction will require a shorter time period and may require less intensive O&M activities such as periodic re-seeding and fertilization relative to alternatives that do not include amendment. The presence of increased soil at the surface will slow the rate of infiltration and reduce the dissolved oxygen content, thereby limiting leaching potential. Other effectiveness issues related to Alternative 3 in the E Panel area are the same as those described for the A Panel external ODA (see Section 6.1.3).

Short-term effectiveness issues for Alternative 3 are safety related concerns associated with heavy haul truck traffic, as identified for the A Panel (Section 6.1.3).

Cost

The present value of this alternative (see Appendix E Table E-11) is:

Capital Costs: $0.2 million

O&M: $0.2 million

Total $0.4 million

The principal cost is associated with acquiring the surface amendment material and amending the surface (approximately $0.4 million).

6.4.4 Alternative 4

Alternative 4 includes the installation of a low-permeability cap on the E Panel external ODA. Sediment in storm water detention basins would be excavated and disposed on-Site, as for Alternative 3. Seeps ES-4 and ES-5 would be expected to dry up after emplacement of the low-permeability cap and sediment in the seep collection ponds would be excavated and disposed on-Site.

Implementability

Implementability issues associated with the installation of a low-permeability cap on the E Panel external ODA are the same as those described for the A Panel external ODA under Alternative 4 (see Section 6.1.4) and primarily focus on the availability of soil for the vegetated cover (over 133,000 cy required), the transportation of such soil on public roads (6,650 truck trips at 20 cy per trip), and potential difficulties associated with installing the GCL.

Effectiveness

The primary short-term effectiveness concerns associated with Alternative 4 are related to the likely volume of truck traffic on public roads required to haul the cap materials. Coordination with mine traffic also raises additional safety concerns.

The low-permeability cap would be effective at controlling infiltration through the external ODA over the long-term. After implementation of Alternative 4, the estimated average annual infiltration rate through the ODA would be 550 cubic feet per year (<0.001 cfs; Appendix D). This represents a reduction of greater than 99 percent for the ODA under Alternative 4 when compared to current conditions. Other effectiveness issues associated with the implementation

of Alternative 4 in the E Panel external ODA are the same as those identified for the A Panel external ODA (see Section 6.1.4).

Cost

The present value of this alternative (see Appendix E Table E-12) is:

Capital Costs: $7.0 million

O&M: $0.1 million

Total $7.2 million

The vast majority of the cost (approximately $7.1 million) is associated with the cap, which includes GCL, geotextile, drainage and soil layers. As discussed above, the availability of the required volume of topsoil is locally is uncertain. If material must be brought from more distant sources then the cost will increase accordingly. Costs for other elements (sediment removal) are relatively minor.

6.5 Hoopes Spring

Details regarding Hoopes Spring alternatives can be found in Section 5.2.5. It is noted that since selenium is transported to Hoopes Spring from Site source areas, monitoring at the source areas would also be performed to assess the effectiveness of control actions. The results of this monitoring may provide an early indication of the likely effect on selenium concentrations in Hoopes Spring discharge.

6.5.1 Alternative 1

As described in Section 5.2.5, the primary issue with Hoopes Spring discharge is elevated selenium concentrations. Hoopes Spring currently has selenium concentrations in the range of 10 to 15 µg/l which exceed the aquatic life criteria of 5 µg/l. The contribution of selenium from Hoopes Spring also results in concentrations slightly above the aquatic life criteria in Sage Creek to its confluence with Crow Creek.

Without response actions at the various source areas that contribute selenium to the Wells Formation (e.g., the Pole Canyon ODA), or treatment of Hoopes Spring discharge, concentrations will continue to exceed the aquatic life criteria into the future. There is also the potential that selenium concentrations could increase with time with additional contributions from source areas.

With regard to biological conditions in Hoopes Spring, selenium concentrations in fish tissues are also elevated. These concentrations are only slightly below EPA's screening level for recreational fish consumption. It is not known what effects, if any, elevated selenium may be having on the fishery productivity (i.e., population density, diversity, and biomass).

6.5.2 Alternative 2

Alternative 2 for Hoopes Spring consists of water quality and biological monitoring and testing to track trends in Hoopes Spring selenium concentrations and to better understand the likely biological impacts. This information could be used to establish a site-specific selenium criterion for Hoopes Spring and Sage Creek. Active treatment of Hoopes Spring would be implemented if the results of this monitoring indicate an increasing selenium concentration trend and/or unacceptable biological impacts. Alternative 2 would only be suitable for inclusion with active measures for the Pole Canyon external ODA, the D Panel backfilled pits and external ODA, and the E Panel external ODA that would control the ongoing release of selenium from these sources.

Implementability

The water quality and biological monitoring/testing called for under Alternative 2 are readily implementable. The monitoring and biological testing would be consistent with the Clean Water Act and State of Idaho requirements for evaluation of site-specific stream standards.

Implementability issues for treatment of Hoopes Spring pose a greater challenge and are discussed under Alternative 3, below.

Effectiveness

This effectiveness of this action would be related to the source control activities. Identification of a Site-specific standard and the associated greater understanding of the biological effect of selenium would provide additional certainty as to the effectiveness of those actions. The expected effectiveness of contingent treatment is presented below under Alternative 3.

Cost

The present value of this alternative (see Appendix E Table E-13) is:

Capital Costs: $0.47 million

O&M: $0.03 million

Total $0.5 million

Costs are associated with the initial study (assumed to be 3 years) and subsequent long-term water quality monitoring.

6.5.3 Alternative 3

Alternative 3 calls for the active treatment of the entirety of Hoopes Spring flow (potentially up to 7 cfs) to achieve the goal of 5 ug/L for selenium within Hoopes Spring and downstream. For the purposes of the EECA, it is assumed that a biologically-based active treatment technology would be used to reduce the oxidized states of selenium in Hoopes Spring waters to the elemental form. The elemental selenium would be precipitated as a sludge and disposed of off-Site. The effluent from the biological system would be further treated to remove biological material and ammonia and the entire treated flow would then be re-introduced to the Hoopes Spring channel immediately below the point of capture.

This alternative would be conducted in addition to, or in lieu of, the source control alternatives analyzed in the proceeding sections. A conceptual design of the treatment scheme is presented in Appendix B. It is anticipated that substantial treatability testing at both bench and field levels would be required in advance of design.

<u>Implementability</u>

Although the biological treatment technology has been demonstrated at a pilot level, there are currently no facilities operating at the scale that would be required for Hoopes Spring. Other treatment technologies may ultimately be more effective, depending on subtleties in the water chemistry. Substantial effort would be required to develop a treatment design that would be efficient and appropriately effective for the flow, water chemistry and setting of Hoopes Spring. The required treatability testing design, construction, and implementation period would be several years. Implementation of a 6 to 7 cfs active treatment plant at Hoopes Spring could be accomplished utilizing standard construction techniques. However, the setting and environmental conditions pose a myriad of complex fundamental implementation considerations and details. The primary considerations are presented below.

Hoopes Spring flow originates as a diffuse groundwater discharge over a 400-yard reach of a poorly defined stream channel. This represents approximately 1/3 of the stream length above the confluence with North Fork Sage Creek. Collection of Hoopes Spring flow for treatment would involve this portion of the stream. Capture of the flows for treatment would involve construction activities within the stream/riparian areas and would be required to meet the substantive portions of a 404 permit.

This area currently has limited access via an unpaved road on private property. Access and, at a minimum, a lease or easement would be required from the landowner. Winter access is

currently not available nor is a power supply. A roadway suitable for year-round access for construction equipment and a power line from the mine area would have to be established. The roadway and power source would need to be maintained until concentrations in Hoopes Spring diminished to acceptable levels, rendering the treatment facility unnecessary. The roadway would provide daily access for operators and provide access for supplies and sludge disposal. A 30-year project duration was utilized for the purpose of this evaluation. However, if source control actions were not effective, or sole reliance was placed on treatment, treatment could continue well beyond 30 years. This would exceed the life of the mine and mill and, correspondingly, provisions for power and access would have to be incorporated into a revised mine closure plan. If access were to be established from the south, off public roadways, rather than through the mine area, construction and operation traffic could affect local landowners. It is envisioned that operation would require one to two workers per shift, year-round. Sludge removal requirements are currently unknown, but could be needed as often as twice per month. Based on literature sources, it is anticipated that the sludge will not be a characteristic hazardous waste, however, this would need to be verified during treatability testing.

Overall, the installation and operation of a large-scale, year-round treatment facility at Hoopes Spring would substantially change the current setting. It is anticipated that the public perception of this facility coupled with private landownership of Hoopes Spring and access to Hoopes Spring will raise substantial administrative implementability considerations. Additional administrative feasibility considerations are also raised under related effectiveness discussions.

Effectiveness

Although significant treatability testing will be required and an extensive operational optimization period is anticipated, it is probable that an effective treatment facility ultimately could be designed, constructed, and operated for the 6 to 7 cfs flow range observed in Hoopes Spring. In contrast to Pole Canyon ODA, the relatively constant flow rate and water quality improve the ability to effectively remove selenium from such large surface flows with low initial concentrations. The primary effectiveness considerations are related to re-establishing the current Hoopes Spring conditions with treated water. As noted in Appendix B, although lower in selenium, the treated water will have different chemical characteristics, in particular for a biological treatment plant; high biological oxygen demand, and elevated ammonia. Add-on unit processes would be required to remove oxygen demanding material and ammonia. These processes would also modify the water chemistry such that it would not be feasible to recreate the original chemistry minus selenium.

As noted in the above implementability discussions, a substantial portion of the stream course (approximately 1/3) may be committed to collection of the flows for treatment. The pretreated water characteristics may not be immediately established at the discharge point and therefore, there is some uncertainty as to how effective treatment would be for establishing the desired biological conditions within the short length of Hoopes Spring drainage. Considering the areas

required for capture of flows, the modification of nearby areas, and questions regarding the post-treatment condition of flows, the current levels of biological production (fishery) within the Hoopes Spring water course could be compromised. Although selenium concentrations would be reduced in the stream downstream of the capture point, the characteristics of the treated water could be different enough that the biological condition of the stream would change accordingly. Because Hoopes Spring is the predominant flow in Sage Creek (greater than 75 percent) above the South Fork Sage Creek confluence, these changes in the characteristics of the water may also influence conditions in Sage Creek. The corresponding biological consequences of treating the entirety of Hoopes Spring flow cannot reasonably be predicted beyond the elimination of risks posed by elevated selenium concentrations.

Cost

The present value of this alternative (see Appendix E Table E-14) is:

Capital Costs: $29.9 million

O&M: $11.3 million

Total $41.2 million

The cost estimate includes a selenium treatment system and subsequent organic removal and de-nitrification unit processes to improve water discharge quality. Other processes may be needed to more closely replicate Hoopes Spring water, which will result in additional costs. In addition, it has been assumed that waste sludge could be disposed as a solid waste. If treatability testing finds that the sludge is characteristic hazardous waste, then addition costs would be entailed.