# 3.0 REVIEW OF SITE INVESTIGATION FINDINGS: SITE CONDITIONS TO BE ADDRESSED

As discussed in Section 1.0, the SI (NewFields, 2005) was conducted to describe environmental conditions associated with historical mining activities at the Site. Data were collected to characterize:

- the mine features (source areas) releasing COPCs to the environment;
- the nature and extent of contamination associated with the releases;
- the mechanisms for release and pathways for transport of the COPCs locally and Site-wide; and
- the fate of the COPCs along the transport pathways, including potentially unacceptable human and ecological exposure pathways.

The scope of the SI was outlined in the SI/EECA Work Plan (MFG, 2003a). The Work Plan included a preliminary Site characterization based on the findings of the AWI previously conducted by the IDEQ (TetraTech EMI, 2002) and an abundance of Site-specific data that had been previously collected as part of the requirements for the Smoky Canyon Mine development and operation. The AWI identified seleniferous waste shales in excavated overburden as being the source of elevated COPC levels in the environment. Within the Site, pit backfill and external ODAs for Panels A, D and E, including the Pole Canyon area, and roads constructed of waste shale materials, were specifically identified as source areas. These areas are all indicated on Figure 3-1. Figures 3-2 through 3-4 are 2004 aerial photographs of the A, D and E Panels and external ODAs. These external ODAs contain varying amounts of seleniferous shales that release selenium and other COPCs to the environment.

The physical, hydrologic, and ecological settings for the Site were described in detail in both the Work Plan for the SI (MFG, 2003a) and the SI Report (NewFields, 2005). The descriptions of the Site settings presented in those documents provide a basis for understanding Site conditions, including COPC release and transport. The SI Work Plan and SI Report should be reviewed for additional information about the settings, source areas and environmental conditions at the Site.

## 3.1 Overview of Primary Selenium Fate and Transport Pathways

Selenium, and other COPCs, can be released to the environment from areas where overburden containing waste shales from mining operations is either temporarily stored or permanently disposed (i.e., backfilled pits and external ODAs). The weathered shales are susceptible to

leaching as water from rain and snowmelt infiltrates through these materials. Seepage generated within the ODAs exits as surface seeps or migrates downward to the Wells Formation or the Sage Valley alluvial groundwater where it can be transported to locations of groundwater discharge at springs and along gaining stream reaches.

Groundwater

A valley-fill alluvial groundwater system exists in Sage Valley. The water table in this system is typically less than 30 feet below the ground surface and, at some locations, it is in contact with Sage Creek. The Sage Valley alluvial groundwater flow system is isolated from the Wells Formation by the West Sage Valley Branch Fault that strikes north-south along the western flank of Sage Valley. In essence, the valley-fill alluvial groundwater system has the configuration of a large basin, with flow contributions coming primarily from tributaries along the west side of the valley (Figure 3-5). As the water moves down the valley, outflows from the system are limited to near-surface evapotranspiration and discharge to Sage Creek. The shallow groundwater migrating downgradient from the Pole Canyon ODA contributes water to the alluvial groundwater flow system. This is the only ODA with a shallow groundwater flow path to the Sage Valley alluvial aquifer.

The Wells Formation is continuous throughout the mine panel areas and contains the regional Wells Formation aquifer. Within the mine area, the Wells Formation aquifer lies below several hundred feet, or more, of unsaturated Wells Formation limestone. The Wells Formation outcrops or subcrops within each of the overburden disposal/source areas. Groundwater flow in the upper Wells Formation aquifer, below the Site source areas, is controlled by the combined effects of the West Sage Valley Branch Fault and the large discharge zone created by Hoopes Spring and South Fork Sage Creek springs. Together, these springs discharge in excess of 10 cubic feet per second (cfs), which comprises the majority of flow in lower Sage Creek under all observed SI flow conditions.

A large portion of the annual selenium load is released from the overburden during the spring runoff period, when water flows are highest and selenium oxidized within overburden material over the drier winter period is more susceptible to leaching and transport. The mass of selenium released and transported and the resultant concentrations in surface and groundwater are dependent upon the physical setting of the backfilled pits and ODAs. The ratio of infiltrating water to the mass of seleniferous overburden and the length of the flow path for infiltration through the overburden are the primary factors controlling the selenium transport rate from each source area. In general, the longer the flow path through the overburden, the greater the mass of selenium released per unit of infiltration. The combined influence of these factors can be seen in the established seasonal differences in selenium concentrations and loads associated with seepage from the ODAs.

Surface Water Runoff and Erosion/Sediment Transport

The pathways of surface water runoff and erosion/sediment transport are limited by the coarseness of the overburden materials, surface reclamation measures, and the extensive network of stormwater detention ponds and other BMPs implemented to control surface water and runoff from the disturbed areas. With the exception of several past events, where local failures of overburden fill resulted in overtopping of detention basins or a direct release to lower Pole Canyon Creek, these pathways were not observed to be active. This is true for both stormwater runoff and for seeps that emanate from the base of ODAs. Residual sediments from the historic releases have not been subject to transport from the lower Pole Canyon area into Sage Valley.

Another source of water to the surface of some of the source areas (Pole Canyon ODA and D Panel backfilled pits) is run-on from the adjacent, undisturbed slopes that drain to those areas. For other source areas, most runoff from adjacent slopes cannot run-on to the top of the ODAs due to the height of overburden over the native surface. In these areas, the amount of run on from adjacent slopes that actually infiltrates into the overburden areas is considered negligible.

Soil/Vegetation

Uptake of selenium by vegetation growing directly on overburden or on partially reclaimed overburden presents a localized transport/exposure pathway. Plant uptake of selenium also occurs in riparian and seep soils that are saturated with water originating from overburden seeps. However, plant uptake of selenium is confined to these discrete areas. Also, certain plant species have the ability to accumulate higher selenium concentrations than concentrations observed in the soil/overburden. See Appendix A for further discussion regarding selenium-accumulator species.

## 3.2 Conditions at the Site to be Addressed by Removal Actions

This section describes the major findings of the SI with respect to existing conditions associated with each of the source areas with a focus on issues that will be addressed by removal actions. It includes relevant information concerning nature and extent of contamination, fate and transport and potential human health and ecological risks. As explained in Section 2.1 above, selenium was used during the SI as an indicator for the extent of contamination; therefore, the following summary focuses on the extent of selenium contamination. Table 3-1 summarizes the pathways for transport of selenium by source area.

### 3.2.1 A Panel Pit Backfill and External ODA

A Panel was mined from 1984 through 1995. The panel was divided into four pits (A-1, A-2, A-3 and A-4; see Figure 3-1). At the time of A Panel mining, approximately 280 acres in the A Panel pit area were backfilled with overburden, and 101 of those acres were reclaimed. Until 2003, the north end of A Panel remained open and uncovered, and no overburden materials were disposed or stockpiled in this area until recently when mining began in the C Panel. The north end of the A Panel is now filled with overburden removed from B and C Panels and, along with the previously backfilled area, will be reclaimed per the requirements of the mine plan for those areas.

The A Panel external ODA is located on top of a ridge east of the A Panel pit and is underlain by the Wells Formation (see Figures 3-1 and 3-2). The majority of the A Panel external ODA is located on the eastern side of the ridge that separates the Site from Sage Valley. The disposal area is approximately 3,000 feet long (north to south), between 1,300 and 1,700 feet wide (east to west) and covers approximately 80 acres. Comparing pre-mining and current topography, it is estimated that approximately 7 million cubic yards of material is present within this external ODA. Materials were placed in the external overburden area in 1984 and 1985. Portions of the overburden are covered with topsoil (see Figure 3-6). Most of the area on top of the ODA has no topsoil cover; and the thickness of the soil on covered areas is typically less than 6-inches. The top area was seeded in 1986. Topsoil has been placed on some areas of the east-facing slope, but the thickness in those areas is also typically less than 6-inches. The east slope was originally revegetated in 1989; additional revegetation efforts were implemented in 1996.

<u>Groundwater/Surface Water</u>

Net Infiltration from the surface (i.e., direct precipitation) through the external ODA to the underlying unsaturated Wells Formation bedrock is the primary transport pathway of selenium to groundwater.

There is neither surface water nor groundwater inflow to the ODA. Both the pit backfill and the external ODA are free-draining and the ridge top setting of the external ODA limits the infiltration and corresponding leaching potential.

Infiltration through the overburden migrates vertically downward through more than 900 feet of unsaturated Wells Formation bedrock to the Wells Formation aquifer. The Hydrologic Evaluation of Landfill Performance (HELP) model estimate for annual net infiltration, given existing surface conditions, into the external ODA is 2.4 inches, or 680,000 cubic feet per year over the approximately 80 acres. During the SI, water quality sampling at the nearby Culinary and Industrial Wells indicated that selenium concentrations are lower than the removal action level/drinking water standard (0.05 mg/L). Recent monitoring data indicate that the selenium concentrations at the Culinary and Industrial Wells increased during the summer of 2005.

Although the selenium concentrations remain below the removal action level, the increase was significant and was reported to IDEQ. The change in groundwater quality at these locations took place at the same time as backfilling of the northern portion of the A pit, which is part of the Panels B and C operations and has recently been declining. Simplot is currently evaluating and will ultimately address the conditions that resulted in this change in water quality in accordance with their requirements associated with Panels B and C operations.

Although no drinking water standards are currently exceeded in the Wells Formation groundwater at the A Panel, groundwater quality must be maintained to avoid potential human health risks.

Seeps

Some of the water that infiltrates into the A Panel external ODA flows laterally along the contact with the natural ground surface at the base of the pile. Water discharges from the downslope toe of the pile at the overburden-seep location AS-2. Seep flow may be lost between the discharge point and the nearest basin (AP-2) due to evapotranspiration. The seep water that is collected in detention basin AP-2 then either evaporates from the basin or migrates downward into the subsurface (in this case the Wells Formation).

The AS-2 seep flow is relatively small. Assuming 1 gallon per minute (gpm) for a period of 3 months, the amount of water discharged would be less than 20,000 cubic feet per year, or less than 3 percent of the water potentially entering the overburden as surface infiltration. The seep water has selenium concentrations above the removal action level for non-regulated surface water. The estimate of the selenium load discharged at AS-2 in May 2003 was less than 7 pounds per year assuming 3 months of seep flow. Approximately half the amount of seep water estimated to discharge into the basin annually is estimated to evaporate from the basin.

Stormwater Detention Basins

Surface runoff from the A Panel backfilled pit area has transported solids with elevated COPC concentrations to the nearby stormwater detention basins. Sediments in detention basins AP-3, AP-4 and AP-9A contain COPC concentrations (except copper) above the removal action levels specified by IDEQ for non-regulated sediment (Figure 3-1 shows the basin locations). Detention basins AP-1, AP-5, AP-6, AP-7 and AP-8 (Figure 3-1) are located in the northern portion of the A Panel and currently collect water from the unfilled pit area. These basins may have received surface runoff from disturbed areas, overburden stockpiles or backfilled pit areas in the past. The sediments collected from these basins also contain elevated COPC concentrations relative to the removal action levels. Therefore, erosion and surface transport of overburden solids from the A Panel area to the detention basins has taken place.

Sediment collected in the detention basins has not been released for transport outside of the mining-disturbed areas. The only stormwater detention basins containing water with COCs present at concentrations warranting action are the basins that receive flow from overburden seeps. Therefore, the detention basins that contain water warranting action will be addressed by the actions taken at the seep areas.

ODA Surface Conditions

External near-surface and root-zone soil and overburden materials present on the A Panel ODA have selenium concentrations higher than recommended by the USFS for soil used in reclamation of mining-disturbed areas. However, the pit is being backfilled and covered under the requirements of the mine plan and the surface conditions of this ODA are continuously changing as a result of the ongoing backfilling activities.

The forage vegetation currently growing on the A Panel ODA has an average selenium concentration of 11.6 mg/Kg, which is higher than IDEQ's removal action level of 5 mg/Kg, and does not meet USFS and BLM guidelines for unrestricted grazing uses (see Table 2-1). Selenium-accumulator species, such as alfalfa and sweet clover, were included in the forage vegetation and have elevated selenium concentrations. These species contribute to the elevated selenium content of forage in the mine-disturbed areas.

In addition, haul road materials utilized in the A Panel area have elevated selenium concentrations and may have originated, at least in part, from waste shales. Although there is no evidence for transport of selenium from the road materials to surface waters or to nearby soils as airborne dust, the road materials do have the potential to release selenium to infiltrating water and surface runoff.

### 3.2.2 Pole Canyon ODA

The Pole Canyon ODA is located to the south of A Panel and north of the D Panel (see Figure 3-1). The western (upstream) portion of the disposal area currently extends approximately 150 feet above the Pole Canyon Creek bed while the eastern (downstream) portion rises about 500 feet above the creek bed. The disposal area extends approximately 4,600 feet from the western toe to the eastern toe. The disposal area width (north to south direction) ranges from approximately 1,000 feet up to 1,700 feet. The footprint of the disposal area covers approximately 100 acres and, based on a comparison of pre-mining to current topography, it is estimated that approximately 26 million cubic yards of material are present in the ODA. Most overburden in the Pole Canyon ODA originated from A Panel mining during the period from 1985 to 1990. A much smaller portion of the overburden originated from the D Panel (D-2 pit) and was placed on the west side of the Pole Canyon ODA in 1997.

The Pole Canyon ODA fills a large lower portion of lower Pole Canyon, and Pole Canyon Creek flows along its original channel directly beneath and through the overburden materials. The overburden was placed directly on top of the existing surficial deposits and bedrock, which include alluvial deposits adjacent to Pole Canyon Creek, thin colluvial deposits on the canyon slopes, and Wells Formation bedrock. Pole Canyon was filled from above by dumping overburden materials from end dump trucks into the canyon. Initially, only chert material was placed in the disposal area to limit the amount of fine material that entered the Pole Canyon Creek flow. Natural sorting of those materials by gravity due to end-dumping resulted in predominantly coarse materials filling the narrow canyon bottom first and creation of a “French drain" or zone of higher hydraulic conductivity through which Pole Canyon Creek continues to flow.

Sometime prior to 1996, a slope failure occurred on the face at the toe of the external ODA. A chert filter was required in the initial mine plan; however, most of the filter was removed and used to fill the void created by the failure. During the spring of 1996 (several years after active disposal had ended), the eastern toe became saturated and a slope failure occurred on the face above the Pole Canyon Creek outflow. Material was released to the creek channel, with some material reaching private lands downstream. The SI reported that the sediments in Pole Canyon Creek immediately below the ODA contain elevated concentrations of COCs. Additional sediment/soil sampling in Sage Valley, along the typically dry Pole Canyon Creek drainage, indicated minimal transport of COCs to private lands with selenium concentrations less than 5 mg/Kg in all but two of the soil samples collected from Sage Valley. The chert filter was reconstructed, and limestone was brought in to fill and buttress the failure area. The toe of the disposal area has since remained stable.

Reclamation of the east side of the disposal area began in 1992 when the slope was reshaped and seeded. Revegetation efforts continued on the east side during 1995 when topsoil was placed on the slope and the area was reseeded. In most areas, 3 to 12 inches of topsoil are present on the overburden, but on the steeper east-facing slope, there are areas where the shale overburden is currently exposed. The western portion of the disposal area was revegetated in 1997. Some areas along the haul road have not yet been reclaimed. Any sediment containing COCs above removal action levels, whether on private or federal land, will be addressed.

<u>Groundwater/Surface Water</u>

The Pole Canyon ODA is distinct from the other Smoky Canyon Mine ODAs because of its canyon backfill setting and the presence of an underlying shallow alluvial groundwater system associated with Pole Canyon Creek. The creek enters the west end of the ODA, flows east at the base of the overburden through the previously described high permeability zone along the original creek channel at the base of the fill, and discharges from the east end, or downstream toe, of the ODA. Pole Canyon Creek leaves the toe of the ODA channel, and from there it flows

downstream into Sage Valley. During the course of the SI, Pole Canyon Creek only flowed a short distance into the valley before the flows dissipated due to infiltration and diversion for irrigation.

As a result of its unique setting, the Pole Canyon ODA is the largest contributor of selenium to both the Site surface water and groundwater flow systems. Selenium released to infiltrating water is transported vertically downward to the base of the ODA where the infiltration water can mix with Pole Canyon Creek flowing through the base of overburden materials filling the former creek channel. The large volume of Pole Canyon Creek flow contacting the overburden is expected to have a lower selenium concentration than the much smaller volume of vertical infiltration. The higher concentration in infiltration is diluted by the much larger Pole Canyon Creek flows, especially during spring runoff events. As Pole Canyon Creek flows through the ODA, it loses flow to both the alluvial groundwater flow system and the Wells Formation. The Pole Canyon Creek water that remains for discharge from the lower toe of the overburden is itself a pathway for transport of overburden constituents into northern Sage Valley, with loss to alluvial deposits in lower Pole Canyon and eventually to the Sage Valley alluvial aquifer.

Pole Canyon Creek water lost to the Wells Formation migrates vertically downward through more than 250 to 400 feet of unsaturated bedrock and then enters the aquifer. Wells Formation groundwater below Pole Canyon flows a short distance east from the ODA to the West Sage Valley Branch Fault, which acts as a boundary to further eastward flow. Wells Formation groundwater then flows south parallel to the fault surface. A component of the groundwater in the Wells Formation that contains selenium from the Pole Canyon ODA follows the fault for eventual discharge at Hoopes Spring. It is expected that some of the Wells Formation groundwater impacted by the Pole Canyon ODA may flow north along the fault. However, there is no local discharge of Wells Formation groundwater to the north.

The estimated range for annual average infiltration into the Pole Canyon ODA from incident precipitation, based on long-term average precipitation conditions, was 1.2 million cubic feet per year. The annual inflow from two other sources (surface run-on from adjacent slopes and Pole Canyon Creek) was also estimated. The surface run-on was estimated conservatively based on an average of 12 inches of runoff annually (based on long-term average precipitation conditions) from 50 acres of hillside north of Pole Canyon for an annual total of approximately 2.2 million cubic feet per year. When combined with the precipitation infiltration, the estimate of net infiltration at the surface totals approximately 3.4 million cubic feet per year. The greatest contributor of water to the ODA is Pole Canyon Creek inflow with approximately 10 times greater water influx to the ODA than the net infiltration from the surface and 50 times greater that the upgradient alluvial inflow.

An annual water/mass balance was developed for transport from the Pole Canyon ODA, utilizing paired groundwater and surface water information collected during the SI. On an annual basis, approximately half of the selenium load leaving the ODA was estimated to report

to the underlying Wells Formation (304 pounds per year). The remainder is split between loss to the alluvial groundwater flow system (136 pounds per year) and Pole Canyon Creek outflow (92 pounds per year). However, farther downstream, Pole Canyon Creek loses water to the alluvial groundwater system. The total amount of water leaving the ODA via Pole Canyon Creek on an annual basis is similar to the total amount of water that migrates from the base of the ODA to the Wells Formation aquifer.

A large portion of the annual selenium load is released during the spring runoff period. In the spring, the proportion of water and selenium mass load entering Pole Canyon Creek and the alluvial system is much greater than the proportion reporting to the Wells Formation. This shift reflects the fixed capacity of the unsaturated Wells Formation to accept recharge along the canyon floor. Selenium leaving the Pole Canyon ODA in the alluvial system joins the larger Sage Valley alluvial aquifer. Dilution and attenuation have limited the effects on the Sage Valley alluvial aquifer to valley floor areas adjacent to the losing reach of Pole Canyon Creek. This is supported by lower selenium concentrations in the alluvial groundwater at GW-22 relative to the selenium concentrations in alluvial groundwater within lower Pole Canyon (GW-15).

The selenium mass balance is further supported by the relatively consistent water level and selenium concentration in the Wells Formation monitoring well immediately downstream of the Pole Canyon ODA (GW-16). This condition reflects seasonal water storage in the unsaturated portion of the Wells Formation. Water from different time periods mixes within the unsaturated zone and continues to drain from the unsaturated zone to the underlying aquifer over the fall and winter as flows in Pole Canyon Creek and the alluvial system diminish. The moderation of flow within the unsaturated portion of the Wells Formation results in a relatively uniform flow and concentration of selenium being delivered to the Wells Formation aquifer. As discussed previously, the downstream end of the Pole Canyon ODA is adjacent to the West Sage Valley Branch Fault. Selenium leaving the Pole Canyon ODA in the Wells Formation is expected to move predominantly to the south along the West Sage Valley Branch Fault. The damage zone along the western side of the West Sage Valley Branch Fault provides a conduit to Hoopes Spring. The West Sage Valley Branch Fault also provides a barrier to selenium transport between the valley fill alluvial system and the Wells Formation aquifer.

Surface Water/Sediments

Lower Pole Canyon Creek water and stream sediments contain selenium above removal action levels for surface waters that support aquatic life. Selenium concentrations are also elevated in the riparian and aquatic vegetation and benthic macroinvertebrates from lower Pole Canyon Creek below the ODA. The presence of high COPC concentrations in lower Pole Canyon Creek sediment samples is due to the deposition of overburden slope materials into the creek during past slope failures at the toe of the ODA. The slope has since been stabilized, but residual sediments remain in the creek bed immediately below the ODA. The concentrations of COPCs

in sediments may also be elevated due to sorption of aqueous COPCs from creek water to the sediment surfaces.

ODA Surface Conditions

The average selenium concentration in forage vegetation collected from the surface of the Pole Canyon ODA (10.4 mg/Kg) exceeds the IDEQ's 5 mg/Kg removal action level and the vegetation does not meet interim USFS/BLM guidelines for vegetation on reclaimed mine areas. Selenium-accumulator species, such as alfalfa and sweet clover, were included in the forage vegetation and contain elevated selenium concentrations. These species contribute to the elevated selenium content of forage on the mine-disturbed area.

In addition, the haul road materials on/crossing the Pole Canyon ODA have elevated selenium concentrations and may have originated, at least in part, from waste shales. Although there is no evidence of past transport of selenium from the road materials to surface waters or to nearby soils as airborne dust, the road materials do have the potential to release selenium to infiltrating water and surface runoff.

Stormwater Detention Basins

One detention basin associated with the Pole Canyon ODA (DP-14) contains sediments with selenium concentrations above the relevant removal action level for non-regulated surface water. The only stormwater detention basins containing water with COCs present at concentrations warranting action are the basins that receive flow from overburden seeps. Therefore, the detention basins that contain water warranting action will be addressed by the actions taken at the seep areas.

### 3.2.3 D Panel Backfilled Pit and External ODA

D Panel is located south of the Pole Canyon external ODA and north of Sage Creek, as shown on Figure 3-1. D Panel was segmented into three pits (D-1, D-2 and D-3 pit; see Figure 3-1). D Panel is approximately 6,000 feet long (north to south) with a width varying from approximately 2,300 to 3,000 feet (east to west). The D Panel backfilled pits cover an area of approximately 330 acres.

Mining operations were conducted over various intervals from 1993 through 1997. The D-1 pit was mined during 1993 and 1994 with some overburden used to backfill the pit and some placed in the D Panel external ODA. Overburden from the D-2 pit (mined from 1993 through 1997) was used as backfill in the D-1 and D-2 pits and some was placed on the Pole Canyon Creek external ODA. The D-3 pit was mined in 1995 and 1996 and overburden was used as backfill in pits D-1, D-2 and D-3. Overburden material handling did not segregate chert from

Meade Peak Member shales. The volume of overburden present in the D Panel pit backfill area is estimated at approximately 64 million cubic yards.

Reclamation activities have been completed at the backfilled mine pits. Reclamation of the D Panel pit reflects the evolving BMPs for management of overburden. Reclamation approaches for the different D Panel areas are mapped on Figure 3-6. The backfilled areas of D-1 pit were reshaped, covered with topsoil from E Panel mining activities in 1998 and 1999 and seeded. On the southern end of the D Panel backfill (see Figure 3-6), a 10-foot-thick layer of chert overburden was placed on the waste-shale overburden before the backfill was covered with 12-inches of topsoil. All of the topsoiled area has been seeded/planted for revegetation. The most recent revegetation effort was completed on the south end of the D Panel pit backfill in 2002.

The D Panel external ODA is located east of D Panel, between the Pole Canyon Creek external ODA and Sage Creek on a hillside that leads down into Sage Valley (see Figure 3-1). The external ODA is approximately 1,000 feet long (north to south) and 1,700 feet wide (east to west) in its center, and covers approximately 25 acres. Comparing pre-mining and current topography, it is estimated that there is approximately 1.6 million cubic yards of overburden in the external ODA.

The external ODA received overburden from D panel mining operations in 1993 and 1994. Material segregation was not practiced during the handling and external disposal of the overburden materials. A slope failure occurred in the external ODA during the spring of 1997. Overburden taken from the D-3 pit was placed in the external ODA to stabilize the lower slope and prevent future failures. A new detention basin (DP-7, see Figure 3-1 for location) was constructed below the original basin that had been built below the D Panel external ODA because the first basin had filled almost completely with sediment from the slope failure. More than 12-inches of topsoil was placed over the ODA in 1998 and 1999 and seeded.

Groundwater

Analogous to the A Panel, there is no groundwater inflow and no surface water inflow into the backfilled pit, and therefore the water supply to the pit backfill is limited. The footprint of the D Panel pit-backfill area is 366 acres. The only source of water to the D Panel pit backfill area is the net infiltration from incident precipitation. Annual surface infiltration from incident precipitation estimated for the D Panel backfill area at the time of the SI was approximately 3.94 million cubic feet per year. Additional water is also supplied by runoff from undisturbed surfaces surrounding the backfill area, such that the total net infiltration is estimated at 5.09 million cubic feet per year. The depth to water in the Wells Formation is estimated at 250 to 300 feet below the lowest pit-floor level.

Water that infiltrates into the pit backfill materials is free-draining and migrates vertically to the bottom of the backfill and then drains into the underlying Phosphoria Formation or unsaturated

Wells Formation. Overburden constituents released by in-situ weathering of the backfill materials can be transported vertically downward into the Wells Formation by drainage from the pit floor. Where the pit is floored by the lower permeability Phosphoria Formation (lower Meade Peak Member shale), infiltration would be slower than in areas where the pit is floored by the Wells Formation. As such, it is possible that localized saturated zones could be established along the base of backfill that overlies the Phosphoria Formation bedrock.

Net infiltration from the surface is also the only source of water to the D Panel external ODA. The HELP model estimate for annual net infiltration across this area, given existing surface conditions, is 300,000 cubic feet per year. Water that infiltrates into the external ODA migrates downward to the natural land surface and then migrates either laterally along that contact in the downslope direction to eventually discharge at the bottom of the pile or continues vertically downward into underlying geologic units. Additional water is also supplied by runoff from the D Panel pits that infiltrates above the haul road and flows under the haul road and into the external ODA.

Analogous to the A Panel external ODA, the D Panel overburden materials are placed directly on the subcrop/outcrop area for the Wells Formation. The Wells Formation water level measured at GW-16, approximately ½ mile to the north, is 150 to 200 feet below the base of the overburden disposed in this area. The external ODA is observed to be free-draining. Any saturated flow conditions would be limited to those along drainage channels in the pre-existing topographic surface under the disposal area. These drainages collect water infiltrating through the overburden and along the underlying side slopes.

As noted for the adjacent Pole Canyon ODA, selenium transported to the Wells Formation aquifer in this area has the potential for further downgradient transport to Hoopes Spring, where groundwater discharges to the Hoopes Spring/lower Sage Valley drainage.

Surface Water

Surface runoff of incident precipitation, including snowmelt, from the D Panel external ODA is collected by the DP-7 storm water detention basin.

The DP-7 basin also collects DS-7 seep water. The DS-7 seep is present throughout the year, and flow varies from year to year depending on annual precipitation amounts, though during a recent relatively dry year, there was little seasonal variability observed in seep flow. The water in DP-7 contains elevated concentrations of selenium that are the highest observed in any of the D Panel basin waters sampled during the SI. These concentrations exceed the removal action level for non-regulated surface water (0.201 mg/L for transient use).

Surface and shallow subsurface transport of COPCs, including selenium, is locally attenuated by interaction with soils in the immediate vicinity of the DS-7 seep. Soil in the seep area (DT-

38) contains higher COPC concentrations (11.1 mg/Kg surface and 24.4 root zone) than soil outside of the seep area (DT-36, 8.4 mg/Kg surface and 2.9 root zone). This distinction indicates that transport of COPCs to soil by the seep flow has taken place. COPCs retained in soil are not as available for transport to either the basin water at DP-7 or subsurface flow paths to the Wells Formation. The presence of water, sediment, soil, and terrestrial vegetation with selenium above removal action levels represents a potential risk for terrestrial ecological receptors and grazing livestock using the area around this seep.

Stormwater detention basins DP-1, DP-2, DP-3, DP-4, DP-5, DP-6, DP-8, DP-9, DP-11, DP-13 and DP-15 contain sediment with selenium above the removal action level for sediments that do not support aquatic life. Water collected in detention basins is not released outside of the mining disturbed areas and does not represent a Site-wide surface water transport pathway. No other surface water contacts overburden materials in the D Panel external ODA, and there are no other surface water transport pathways.

ODA Surface Conditions

The average selenium concentration of near surface soil and overburden present on the D Panel ODA area is less than the USFS selenium guideline for soil that is used to reclaim mine-disturbed areas. The forage vegetation currently growing on the D Panel backfilled pit and external ODA has an average selenium concentration less than the removal action level, with average concentrations of 4 mg/Kg and 1.6 mg/Kg along the north and south transects, respectively. However, there are some sample locations on the north and east portions of the D Panel area where forage vegetation, which includes selenium-accumulator species, has higher selenium concentrations.

### 3.2.4 E Panel External ODA

Source Area Description/History

E Panel is located on the hillside above Sage Valley south of Sage Creek and north of South Fork Sage Creek (see Figure 3-4). The panel is approximately 6,500 feet long (north to south) and between 2,000 and 2,700 feet wide (east to west) in the center and has a footprint area of approximately 370 acres. Roads within E Panel have been constructed of chert. E Panel was segmented into three pits (E-1, E-2 and E-3 pit). The E Panel source area is comprised of pit backfill and an external ODA. Minor mining activities are on-going at the E-0 pit, which is expected to be filled with overburden from future mining activities at the F and G panels. The external ODA overlies moderately steep slopes and covers several minor drainages. The pit backfill and external ODA footprints are roughly the same size.

Mining began in E-1 pit in 1998 and was completed in 2001. The pit was backfilled with overburden from E Panel mining operations beginning in 2000. Material-segregation BMPs were performed in this area, and there is a chert cap covered by topsoil. At the time of the SI, approximately 17 million cubic yards of overburden have been placed as backfill in the E Panel pits, and the final backfill volume planned is 55 million cubic yards.

The E Panel external ODA is located east of the E Panel mined area between the Sage Creek and South Fork Sage Creek on a hillside that leads down into Sage Valley (see Figure 3-4). The ODA is approximately 5,000 feet long (north to south) and between 700 and 1,700 feet wide (east to west). The E Panel external ODA covers approximately 100 acres. It is estimated to contain approximately 13 million cubic yards of material (based on pre-mining and current topography). Overburden was placed in the disposal area in 1998 and 1999 as mining first occurred in E Panel. Material management has been performed consistent with recent BMPs. Chert was disposed in the northern portion of this area (approximately 50 acres), and seleniferous waste shale in the southern portion (approximately 50 acres). A chert cap is present and covered with topsoil over the entire ODA (refer to Figure 3-6 for map of reclamation cover types).

Groundwater

Net infiltration from the surface is the primary source of water to the E Panel external ODA. There is a small amount of run-on from the backfilled pits along the haul road that divides the backfilled E Panel pits and the external ODA. The Wells Formation water level measured at GW-18, approximately 1/4 mile to the east, is approximately 200 feet below the base of the overburden disposed in this area, and there is no groundwater flow into the overburden from the Wells Formation.

Analogous to the A and D Panel external ODAs, the E Panel is unsaturated (free-draining). The HELP model estimate for annual net infiltration across this area, given existing surface conditions, is 1.33 million cubic feet per year on average over the 100-acre area. Water that infiltrates into the external ODA migrates downward to the underlying natural ground surface and then migrates either laterally along that contact in the downslope direction to discharge at the toe of the external ODA, at the location of the pre-existing drainages, or continues vertically downward into underlying geologic units.

Surface Water

Three seeps are present along the base of the E Panel external ODA. These seeps are coincident with the underlying drainages, and their combined annual flows represent roughly half of the estimated annual infiltration to the external ODA. Flow and selenium concentrations vary substantially between E Panel seeps. Seasonal variation can also be observed for individual E Panel seeps. Selenium concentrations in E Panel seeps ranged from less than

detection (less than 0.001 mg/L) to over 13 mg/L. The seeps are collected in detention basins, which prevent surface discharge. Sediments in those detention basins also exhibit selenium concentrations above the removal action level for basins that do not support aquatic life. The soil and vegetation in the immediate vicinity of these seeps and also along the flow path from the seeps to the stormwater detention basins have high selenium concentrations. The presence of water, sediment, soil, and terrestrial vegetation with selenium above removal action levels represents a potential risk for terrestrial ecological receptors and grazing livestock using the area around these seeps. Data collected along the seepage flow path indicates that attenuation of selenium transport is occurring.

### 3.2.5 Hoopes Spring and Lower Sage Creek Drainage

As discussed previously, groundwater in the Wells Formation aquifer transports selenium originating from source areas to Hoopes Spring. The Wells Formation aquifer is confined by the overlying Phosphoria Formation north of Smoky Canyon and flows generally north at greater depths with increasing distance from the Site. No surface discharges from the Wells Formation have been identified north of the mine.

In the Pole Canyon area, the depth to groundwater in the Wells Formation ranges from approximately 500 feet on the west side of the ODA to approximately 250 feet on the east side. Groundwater flows east under the ODA to the West Sage Valley Branch Fault. Groundwater from the Pole Canyon source area then flows south along the fault, most likely within the fault's damage zone, and eventually discharges approximately 2 miles south at Hoopes Spring.

In the D Panel and E Panel areas, the groundwater flow directions are also east toward the West Sage Valley Branch Fault and then to Hoopes Spring (Figure 3-7). All of the upper Wells Formation groundwater that passes under the D Panel, including the local recharge to the Wells Formation flows either to Hoopes Spring or southeast to South Fork Sage Creek springs (Figure 3-7). Surface discharge of Wells Formation water at Hoopes Spring is the primary transport pathway for selenium leaving the Site. Water discharged at Hoopes Spring contains selenium at concentrations two to three times higher than the 0.005 mg/L selenium stream standard. The spring flow and selenium concentrations at Hoopes Spring remain relatively constant throughout the year.

Selenium discharged with groundwater at Hoopes Spring is transported by surface flow within the Hoopes Spring drainage to lower Sage Creek. Lower Sage Creek receives most of its flow from the Hoopes Spring drainage. The selenium concentrations in lower Sage Creek vary seasonally. During relatively low-flow conditions, lower Sage Creek has exhibited selenium concentrations above the water quality standard at location LSV-4. Given that Hoopes Spring provides the majority of flow in lower Sage Creek under all flow conditions, exceedances of the standard persist downstream until further dilution from South Fork Sage Creek reduces

selenium concentrations in lower Sage Creek to less than the standard. Some portion of the Hoopes Spring selenium load appears to be attenuated in lower Sage Creek during low-flow conditions. However, on an annual basis, the majority of the selenium load is discharged to Crow Creek. The Sage Creek selenium load has little effect on selenium concentrations in Crow Creek.

Aquatic tissues collected from the Hoopes Spring drainage have elevated selenium concentrations. Selenium concentrations in aquatic biota (macroinvertebrates, periphyton and macrophytes) exceed the area-wide EPCs. The selenium concentrations in fish tissue are also higher than the area-wide EPCs and the draft toxicity threshold level, indicating that there may be some risk to fish due to selenium in Hoopes Spring water.

Elevated selenium concentrations are also observed in aquatic tissue in lower Sage Creek, below the confluence with Hoopes Spring. Selenium concentrations in aquatic invertebrates and fish tissue were elevated in lower Sage Creek, indicating potential risk to aquatic receptors due to selenium transport by Hoopes Spring water to lower Sage Creek.