SOUTH MAYBE CANYON MINE SITE

Engineering Evaluation/Cost Analysis for an Interim Removal Action for the Cross Valley Fill 2011

February 2011

Prepared By:
U.S. Forest Service, Region 4
Caribou-Targhee National Forest
Soda Springs Ranger District
&
Millennium Science & Engineering, Inc.

MSE

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LIST OF ACRONYMS

AWQC	Ambient Water Quality Criteria
AWRMP	Area Wide Risk Management Plan
ARAR	Applicable or Relevant and Appropriate Requirement
BLM	Bureau of Land Management
CCC	Criteria Continuous Concentration
CCL	Compacted Clay Liner
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	Cubic Feet per second
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CVF	Cross Valley Fill
EC_{10}	Effective Concentration (for 10 percent of the population)
EE/CA	Engineering Evaluation/Cost Analysis
EPA	Environmental Protection Agency
GCL	Geosynthetic Clay Liner
HDPE	High Density Polyethylene
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
MDC	Maximum Detected Concentration
mg/l	Milligrams per liter
MW or MWH	Montgomery Watson Harza Consultants
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effects Level
PEL	Probable Effect Level
PVC	Polyvinyl Chloride
RAL	AWRMP Remedial Action Level
RAO	Removal Action Objective
RMC	Risk Management Criteria
RMP	Risk Management Plan
ROM	Run of Mine
SIR	Site Investigation Report
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TRC	TRC Environmental Inc. (Nu-West's Environmental Contractor)
USFS	USDA, Forest Service
USGS	United States Geological Survey
µg/l	Micrograms per liter

1.0 EXECUTIVE SUMMARY

In 1996, six horses pastured 1.5 miles downstream from the South Maybe Canyon Mine (Site) developed selenosis from chronic exposure to contaminated water in Maybe Creek and pasture plants exposed to creek water. Subsequently, the owner euthanized five of the horses because it was unlikely they would fully recover. Selenium leached into Maybe Creek from waste rock disposed in the South Maybe Cross Valley Fill (CVF) associated with the South Maybe Canyon Mine. Data gathered as part of the South Maybe Canyon Mine Site Investigation and nine supplements (collectively referred to hereinafter as the "SI") demonstrate that the CVF is the primary source of selenium and other hazardous substances at the Site. Selenium and other hazardous substances in waste rock, surface water, and vegetation at the Site continue to pose an unacceptable threat to livestock, wildlife and humans.

The Site is located on Mine Ridge (as referenced in the SI) immediately east of Dry Valley in Caribou County, Idaho, on the Caribou-Targhee National Forest, approximately 26 miles northeast of Soda Springs, Idaho. The Site consists of an open pit phosphate mine and a 30 million-cubic yard (yd^3) waste rock pile, known as the CVF. Waste rock generated during phosphate mining operations was disposed in the CVF with a chert underdrain along the eastern margin extending to a French drain beneath the CVF. Maybe Creek flows through the French drain, then onto private land in Dry Valley. Water discharging from the CVF contains dissolved selenium salts leached from waste rock.

This Engineering Evaluation/Cost Analysis (EE/CA)[1] evaluates alternatives to reduce infiltration and capture runoff, as the means to reduce selenium loading to Maybe Creek and groundwater. As such, the EE/CA scope is limited to an interim Removal Action for

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[1] *In 1998, Nu-West Industries, Nu-West Mining (collectively Nu-West) and the USDA Forest Service entered into an Administrative Order to complete a Site Investigation (SI) and an Engineering Evaluation Cost Analysis (EE/CA) under USDA and Forest Service Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) authority. An Administrative Order on Consent (AOC), under the authorities granted USDA in Executive Order 12580, provided the legal mechanism for work to proceed. Nu-West provided TRC as their environmental contractor to gather data and to author the reports required in the AOC. An initial report was submitted to the Forest Service in 1999 and subsequently 9 annual supplements documented site conditions and the results of several pilot treatment studies. After several attempts to work with Nu-West in the preparation and completion of an EE/CA, the Forest Service undertook completion of the EE/CA. This EE/CA report presents alternatives to curtail water infiltration into the South Maybe Cross Valley Fill. Portions of this document incorporate or use data and information from Nu-West's previous EE/CA draft and the Site Investigation prepared by TRC on behalf of Nu-West.*

source control at the CVF. This EE/CA does not evaluate possible actions to address other impacts at the Site. The Forest Service anticipates that, following implementation of the interim Removal Action contemplated in this EE/CA, the Forest Service will evaluate remedial alternatives in a CERCLA Remedial Investigation and Feasibility Study (RI/FS) to fully address Site contamination.

This EE/CA describes Site conditions, identifies the release mechanisms and environmental risks, evaluates alternatives, and identifies a preferred alternative to address the source of the hazardous substances release.

The streamlined human health risk evaluation contained in this EE/CA concludes that:

- Exposure to selenium in surface water poses a moderate risk to campers.
- Exposure to sediment poses a moderate risk to campers.

Based on the ecological risk screening, selenium antimony, arsenic, cadmium, cobalt, copper, lead nickel, silver, vanadium, and zinc concentrations exceeded one or more criteria for ecological risks.

- Selenium, cadmium, and zinc in surface water downgradient of the CVF exceed Idaho's water quality standards, indicating the presence of ecological risk and potential reduced reproduction in fish downstream into Dry Valley creek.
- Measured concentrations of selenium, cadmium, chromium, nickel, vanadium, and zinc in the two sediment ponds downgradient of the CVF exceeded one or more published ecological risk criteria for sediment.
- The Maximum Detected Concentration (MDCs) of cadmium, chromium, and selenium in vegetation on the CVF exceeded one or more published ecological risk criteria.

Based on the above risks identified in the streamlined risk evaluation, an interim Removal Action at the Site is warranted. Additionally, 40 CFR 300.415 lists removal action factors (factors i, iv, and viii) that justify a Removal Action at the Site.

The following four Removal Action alternatives were developed and compared for effectiveness, implementability, and cost:

Alternative 1 Grading the CVF Top Deck
Alternative 2 Grading and Capping the CVF Top Deck
Alternative 3 Grading and Capping the CVF Top Deck and Downstream Slope
Alternative 4 Grading and Capping the CVF Top Deck and Downstream Slope and Diverting Runoff

The Forest Service identified Alternative 4 as the preferred alternative. Alternative 4 consists of grading and installing a multi-layered engineered cap for the entire CVF, combined with runoff capture and diversion. Alternative 4 provides the best performance and best likelihood of achieving the Removal Action Objective (RAOs). Alternative 4 best isolates waste rock in the CVF from surface water. Alternative 4, while the most expensive alternative, maximizes long-term reduction of infiltration. Alternative 4 utilizes modern implementable and effective actions and technologies to cover the CVF, thus isolating leachable hazardous substances in the waste rock from water.

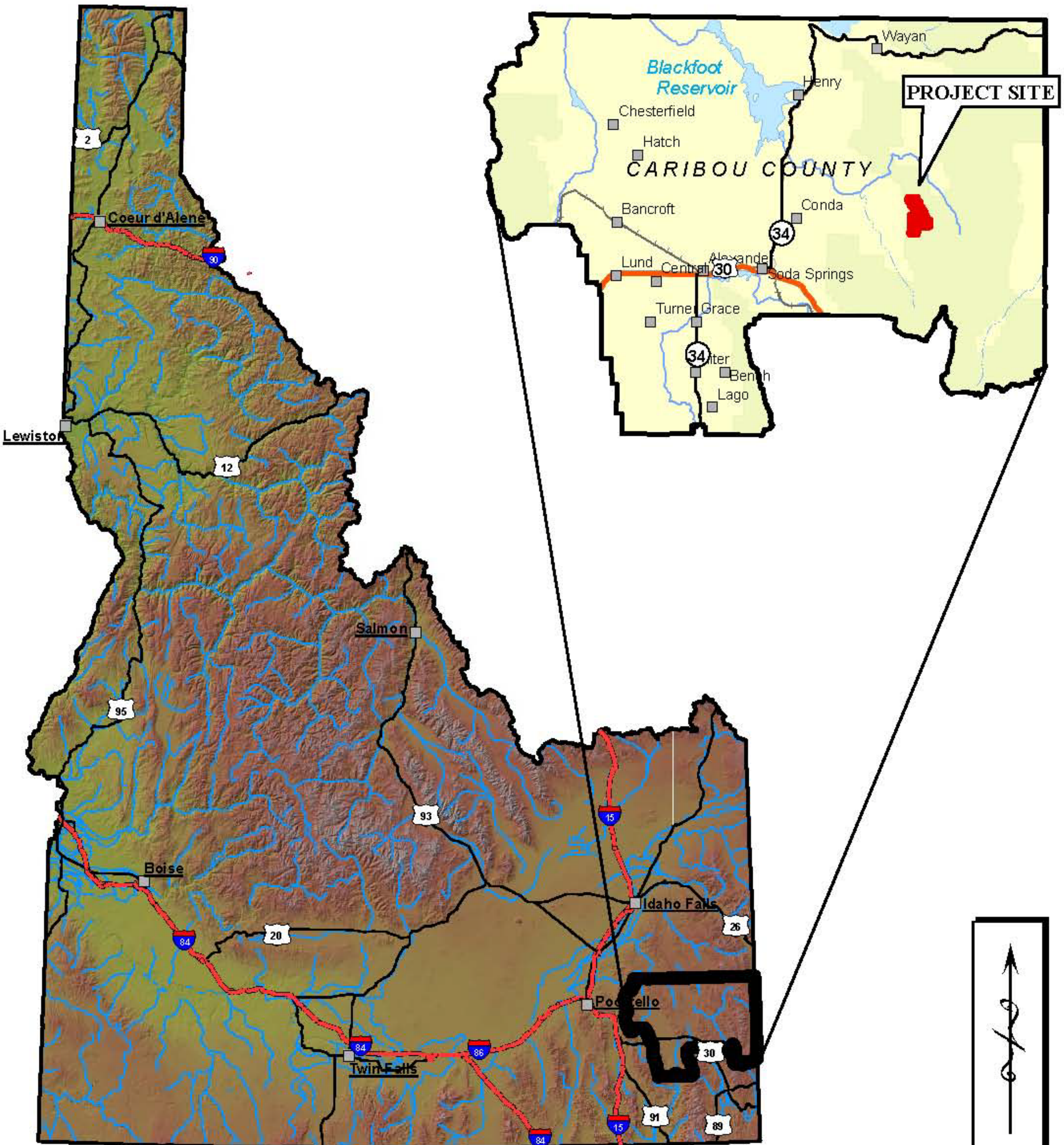
The Forest Service anticipates that additional response actions may be needed to adequately reduce selenium concentrations in Maybe Creek. A RI/FS is planned to develop final response alternatives for the Site. A cap placed on the CVF will reduce infiltration into the fill and reduce leaching of selenium from the CVF. However, water treatment or other actions may be necessary to meet the overall RAOs and Applicable or Relevant and Appropriate Requirements (ARARs) for the Site. Alternative 4, once implemented, will reduce the volume of water infiltrating and subsequently discharging from the toe of the CVF. It is likely that the reduced volume of water discharging from the toe of the CVF may contain higher concentrations of hazardous substances after the cap is installed. However, the application of further remedial alternatives (once monitoring indicates that capping the fill has begun to develop equilibrium conditions for inflow and discharge), may be scaled to treat a smaller volume of contaminated water, than that currently discharged from the CVF. Uncontaminated surface runoff captured by Alternative 4 will be delivered downstream of the discharge point of the CVF, which will also reduce the volume of water flowing through potential water treatment systems.

2.0 SITE CHARACTERIZATION

2.1 Historical Background of the South Maybe Canyon Mine and Waste Rock Dump

The South Maybe Canyon Mine (Site) and related CVF waste rock dump are located on National Forest System lands administered by the Caribou-Targhee National Forest (see Figures 2.1 and 2.2). Phosphate mineral reserves underlying the South Maybe Canyon Mine are covered by Federal Phosphate Mineral Lease I-04 (Lease I-04), administered by the BLM. Beker Industries Corporation (Beker) mined the Site from 1976 to 1978, as the lessee under Lease I-04. The Conda Partnership, consisting of Beker and Nu-West Mining, Inc. (formerly Western Cooperative Fertilizer Company) mined the Site under Lease I-04 from 1979 through 1984. Lease I-04 was issued in 1950, but no extractive mining operations under the lease occurred in Maybe Canyon until 1976. Beker and the Conda Partnership mined phosphate ore using open-pit benching techniques, shipped the ore to Soda Springs, ID for processing, and disposed of waste rock in the CVF. Nu-West Mining, Inc. (Nu-West), a subsidiary of Nu-West Industries, Inc., is the current lessee under Lease I-04.

The CVF waste rock dump is about 1.5 miles long, 0.3 miles wide at its widest point, and 425 feet deep at its maximum depth. A 50-foot deep (approximate) French drain was constructed under the CVF and consists of chert 3 to 4 ft^3 in size. The drain was designed to accommodate a water flow of 200 cubic feet per second (cfs) under the CVF.



MSE Millennium Science & Engineering, Inc.
1555 Shoreline Dr., Ste. 150
Boise, ID 83702 USA
Phone: (208) 345-8292

Site Location

South Maybe Canyon Mine
Caribou County, Idaho

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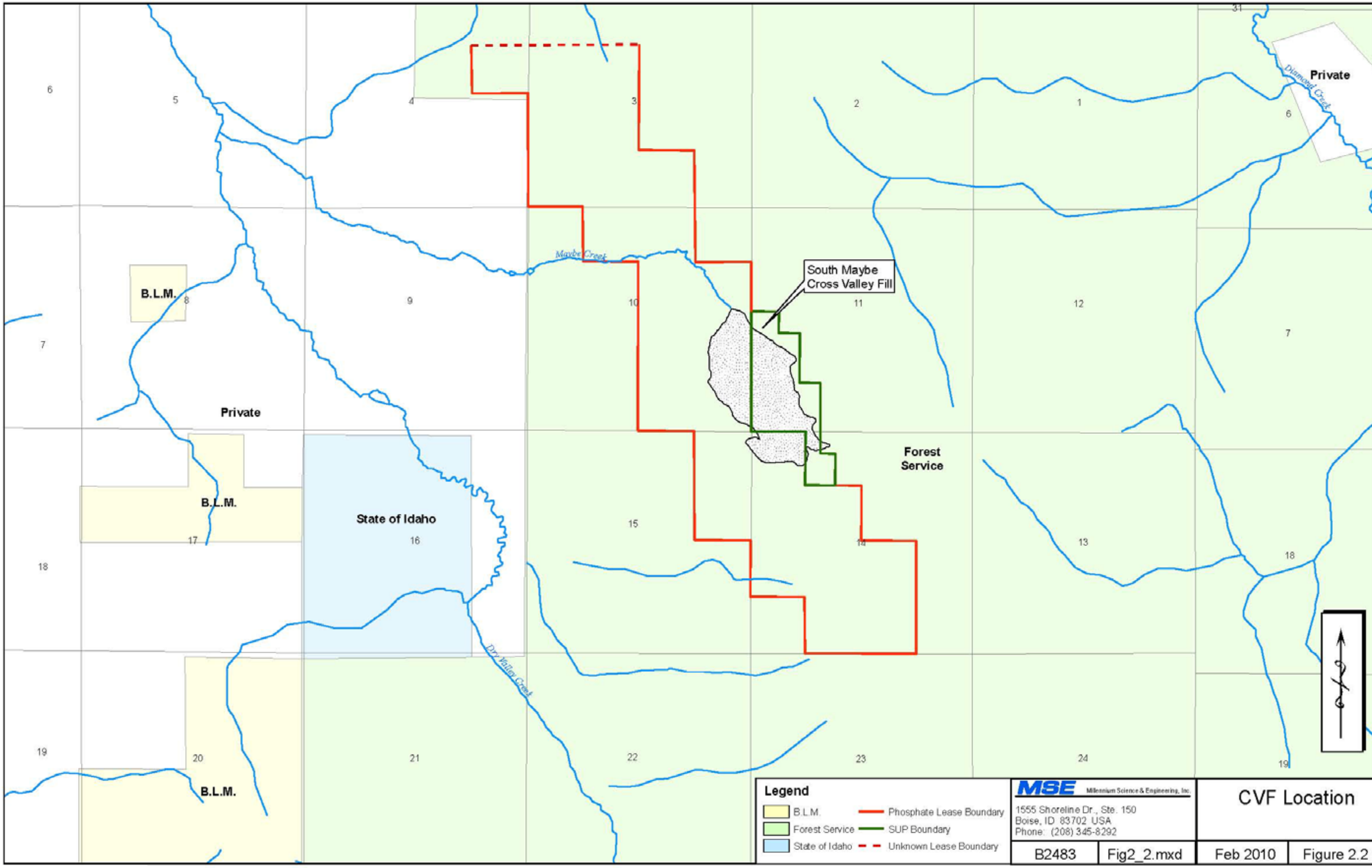

Private
Diamond Creek
Maybe Creek
South Maybe Cross Valley Fill
B.L.M.
Private
B.L.M.
State of Idaho
Forest Service
Dry Valley Creek
B.L.M.
6
5
4
3
2
1
31
6
7
8
9
10
11
12
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18
17
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14
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18
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22
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24
19
Legend
B.L.M.
Forest Service
State of Idaho
Phosphate Lease Boundary
SUP Boundary
Unknown Lease Boundary
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1555 Shoreline Dr., Ste. 150
Boise, ID 83702 USA
Phone: (208) 345-8292
CVF Location
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Figure 2.2

During the 1976 construction season, Beker began the removal of overburden and initial construction of the CVF. In November 1978, Forest Service and U.S. Geological Survey (USGS) personnel were notified by Beker's construction contractor that they had mistakenly placed "from 25,000 to 30,000 yd^3 of waste shales" in the "chert blanket" area of the French drain from the north waste haul road. The agencies were concerned that shales weather rapidly and, if left in place in the chert blanket, "would block the downward movement of water in the blanket."[2] The area of the French drain affected by the misplaced waste shales was long and narrow, parallel to Maybe Creek, and extended for roughly 340 to 400 feet. Subsequent discussions resulted in leaving the material in place as it appeared that drain performance was not affected. However, the placement and precise location of the material is unknown and water infiltrating the CVF may be affected by contacting the waste shale.

2.2 Physiography and Regional Setting

South Maybe Canyon lies within the Southeastern Idaho and Western Wyoming Overthrust belt and is typical of the Middle Rocky Mountain physiographic province in Southeastern Idaho. North/south-trending ranges and valleys, similar to those found in the Appalachian province of the eastern U.S., were created by the eastward compression of sedimentary strata deposited during the late Paleozoic and early Mesozoic times. South Maybe Canyon, located south of the junction with North Fork Maybe Creek, is a steep-sided canyon oriented roughly north/south. From the North Fork Maybe Creek junction, the canyon turns west where it opens into Dry Valley about 0.5 miles from the junction. Vegetation in Maybe Canyon includes riparian vegetation along Maybe Creek and in the wetlands, mixed spruce, fir, and aspen forest, with upland grass species and forbs found with mountain brush species on the arid open slopes. Precipitation in the region generally varies from 17 to 30 inches of precipitation a year, depending on location and elevation.

Mine Ridge is located east of Dry Valley and forms the western side of South Maybe Canyon. The ridge is about 4 miles long. Elevations range from 6,800 feet above sea level (asl) at the north end, to more than 8,800 feet asl at the south end, where Mine Ridge merges with Dry Ridge and forms the headwaters of Maybe Creek. The valley floor in Dry Valley ranges from 6,500 to 6,700 feet asl.

Maybe Creek flows north, parallel to Dry Ridge, until it reaches Maybe Canyon. At the canyon junction with North Maybe Creek, Maybe Creek turns west to flow through Maybe Canyon towards Dry Valley. Maybe Creek forms an alluvial fan at the mouth of the canyon where much of the stream flow is lost to groundwater. The creek discharges from Maybe Canyon onto the alluvial fan and enters Dry Valley as an intermittent stream. Maybe Creek is approximately 4.8 miles long. During normal to above normal

[2] Joseph W. Rasmussen, U.S. Geological Survey Memorandum to Acting District Mining Supervisor, December 11, 1978. Caribou-Targhee National Forest Records.

precipitation years, Maybe Creek forms a confluence with Dry Valley Creek, a tributary to the Blackfoot River. The gradient of Maybe Creek is about 6 percent over most of its course in Maybe Canyon. The gradient increases to 16 percent and greater in the headwaters of the canyon above the CVF. The present channel of Maybe Creek in Dry Valley is broad and poorly defined. The creek traverses a wide area characterized by only a few feet of relief. Several abandoned low-relief surface channels are evident on the fan. The course and channels of Maybe Creek were substantially altered when the adjacent access road and railroad were modified in the early 1990s in connection with development of the Dry Valley Mine located across Dry Valley from Maybe Canyon.

2.3 Geology

Bedrock in Maybe Canyon was deposited during Pennsylvanian, Permian, and Triassic times. Major geologic units at the Site from oldest to youngest are the Pennsylvanian Wells Formation, the Grandeur Tongue of the Permian Park City Formation, the Permian Phosphoria Formation, and the Triassic Dinwoody Formation. A typical cross section illustrating the geologic strata through the CVF waste rock dump is presented in Figure 2.3.

Rocks in the upper Wells Formation west of Mine Ridge are poorly cemented calcareous sandstone with minor limestone interbeds; however, most of the deeper older rocks of the formation are fractured limestone with some interbedded sandstones. These rocks form the folded core of what Nu-West refers to as Mine Ridge. Throughout this region of southeast Idaho, the Wells Formation contains the regional aquifer (Ralston 1980). Rock formations in the upper Wells are easily eroded while the deeper limestone, seen in the road cuts on the west side of the ridge, forms steep slopes, exposed outcrops, and colluvial material.

The Grandeur Tongue of the Park City Formation is a massive, resistant, ridge-forming unit exposed along the crest of the ridge immediately west of the South Maybe Canyon Mine pit. Dolomitic rocks in this geologic unit underlie the footwall ridge west of the South Maybe Mine pit (Armstrong, F. 1969).

At the Site, the geologic strata of the Phosphoria Formation are approximately 370-feet-thick. Economically, the Meade Peak Member is the most important and is approximately 270- feet-thick. Overlying the Meade Peak Member, the Rex Chert Member is 80 to 100 feet thick and forms the hanging wall in the open pits. Siliceous rocks of the Rex Chert Member resist weathering and are useful as coarse and durable material. Phosphate ore was recovered from two ore seams; upper and lower units were mined from within the Meade Peak Member. Between the two ore seams, the "Center Waste" shale (an interbedded black carbonaceous shale, mudstone and siltstone) divides the ore seams and contains most of the hazardous substances discharged from the CVF. The Meade Peak Member weathers to form a swale between the weather resistant ridges formed by the Grandeur tongue and the Rex Chert Member.

Mudstone, sandstone, limestone, and shale of the Triassic Dinwoody Formation are exposed on the east side of Maybe Canyon overlying the older strata of the Phosphoria Formation. Alluvium along Maybe Creek and colluvium along the flanks of the north-south reach of Maybe Canyon developed as the anticlinal structure forming Mine Ridge and Dry Ridge weathered and eroded to become Maybe Canyon. Documents and photos in the Site record show that this material formed most of the surficial deposits in the canyon and led to slumping and slope instability during construction of the CVF as these unconsolidated materials were loaded with waste rock. Ralston describes the upper Dinwoody Formation as limestone with interbedded soft olive-brown calcareous siltstone and the lower Dinwoody Formation as thin limestone interbedded with olive-brown calcareous siltstone and shale (Ralston 1980).

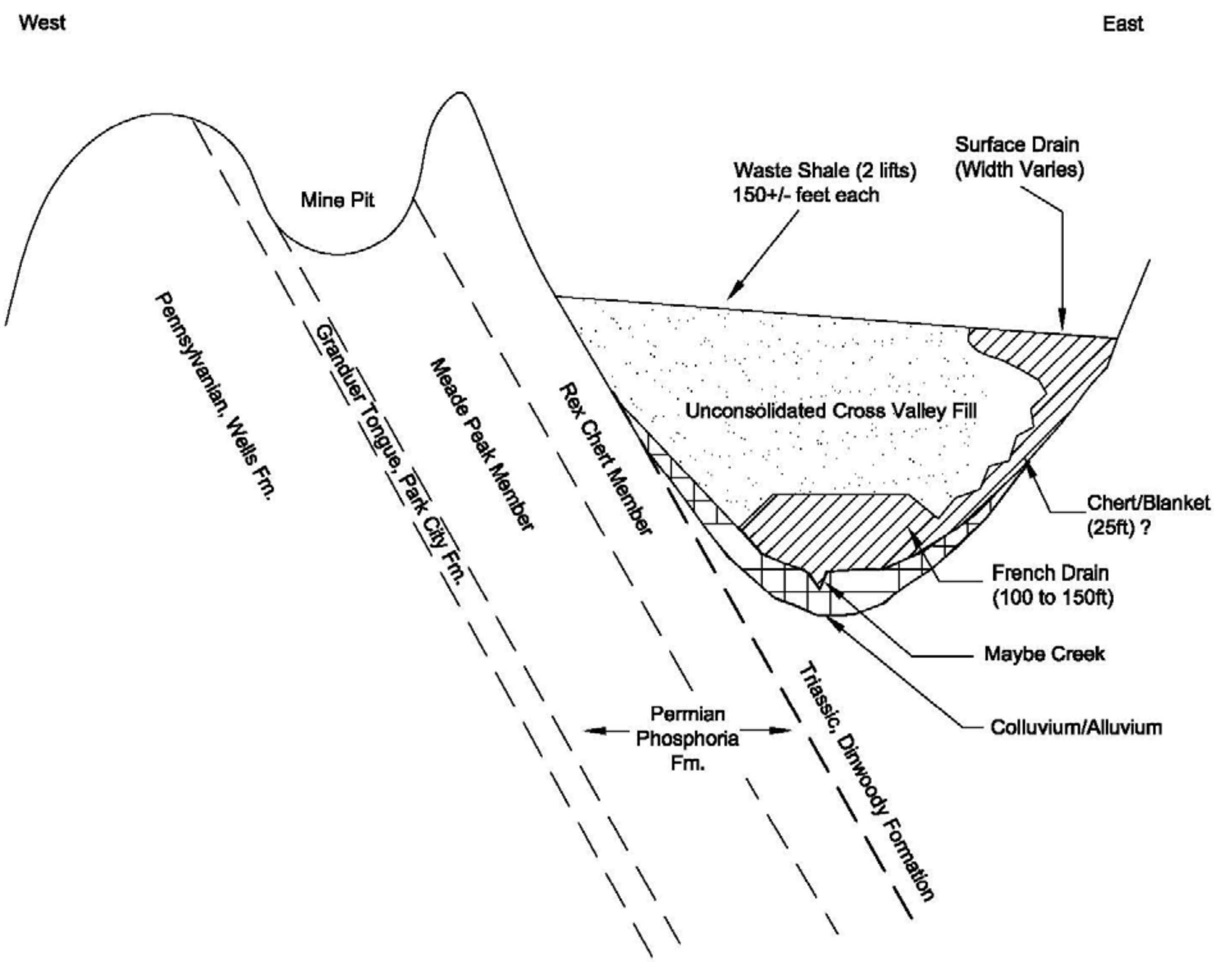
2.4 Local Hydrology and Hydrogeology

Groundwater flows down Maybe Canyon through alluvial and bedrock aquifers beneath the CVF. Bedrock aquifers are present within the Dinwoody and Wells Formations. Shallow alluvial/colluvial aquifers are present within Maybe Canyon and Dry Valley. Surface water features at the Site include Maybe Creek and Dry Valley Creek.

2.4.1 Groundwater in Fractured Bedrock

Rock formations of the Wells Formation serve as an aquifer in the region. Data collected from exploration and monitoring wells completed in the Wells Formation in the area indicate that hydraulic conductivity ranges from 0.08 to 9.94 feet per day (ft/d) and transmissivity ranges from 4 to 3,600 square feet per day (ft^2/d) (Greystone 2003). Ralston concluded that, “Streamflow was always lost to some degree if not entirely when the stream crossed the upper member of the Wells Formation.” Additionally, Ralston concluded, “A major groundwater flow system exists in the lower member of the Wells Formation (Ralston 1980).”

In his general description of the Phosphoria Formation, Ralston states, “The Phosphoria Formation supports very few groundwater flow systems as indicated by both streamflow and spring data.” He goes on to say, “At least two springs were found to discharge from the Rex Chert member of the Phosphoria Formation.” This indicates that in some circumstances the Rex Chert Member may serve as an aquifer, depending on the location and fracturing. Hydraulic conductivity in the Rex Chert Member ranges from 0.1 to 75 ft/d, and transmissivity ranges from 153.7 to 12,000 ft^2/d (Greystone 2003). Ralston found the Meade Peak Member does not support any significant aquifers. Ralston states, “Groundwater flow system exists within the upper and lower members of the Dinwoody Formation at every site measured for their streamflow characteristics. Numerous springs occur in these members especially the lower member.” Limited hydraulic conductivity in the Dinwoody Formation reported by Greystone ranged from 83 to 620 ft/d (Greystone 2003).



MSE Millennium Science and Engineering, Inc.
1555 Shoreline Drive, Suite 150
Boise, Idaho 83702
Phone: (208) 345-8292

Generalized Cross Section of Maybe Canyon Mine and CVF

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2.4.2 Shallow Groundwater in Alluvium and Colluvium

Generally, two shallow groundwater systems are present in the vicinity of the Site, one associated with Maybe Creek and the other in the more complex alluvial sequences of Dry Valley. Unconsolidated sediments associated with Maybe Creek were found to consist primarily of clay and silt derived from shale members of the Dinwoody Formation and chert and limestone fragments from the Rex Chert Member and Dinwoody Formation. Groundwater elevations in Maybe Canyon rise in the spring (April to May) and fall slowly throughout the remainder of the year. Based on information obtained during the installation of the monitoring wells in the canyon, the thickness of colluvial material ranges from 24 to 47 feet. Hydraulic conductivities are low to moderate and range from 3.9 to 28.0 ft/d. No culinary or production wells are developed in the shallow aquifer in Maybe Canyon. Surface water flows generally increase between sample locations SW-2 and SW-4. Increases between stations SW-2 and SW-4 are attributable to groundwater discharges and springs that emerge along the north flowing reach of Maybe Creek immediately downstream of the CVF. Surface water contributions from North Maybe Creek, and perhaps also from alluvial aquifers within this reach of stream account for other flow increases measured at station SW-4. Flows generally decrease downstream of station SW-4 after Maybe Creek turns toward the west crossing the Phosphoria Formation and permeable upper Wells Formation. Figure 2.4 presents an illustration of Site surface water and groundwater interactions.

Unconsolidated alluvial sediments in Dry Valley consist of fine-grained clay and silt. Based on information obtained during the installation of the monitoring wells in the valley, the alluvium is over 100 feet thick. Dry Valley hydrogeology was studied in 2002 as part of the National Environmental Policy Act (NEPA) analysis of predicted impacts of the Dry Valley Mine. Additional studies were conducted by Dale Ralston, PhD, University of Idaho, 1980; and by Kenneth Albert Sylvester in 1975 as part of the Surface, Environment, and Mining (SEAM) program.

A summary of groundwater monitoring well locations and completion depths is presented in Table 2.1. Figure 2.5 presents surface water and groundwater monitoring locations at the Site.

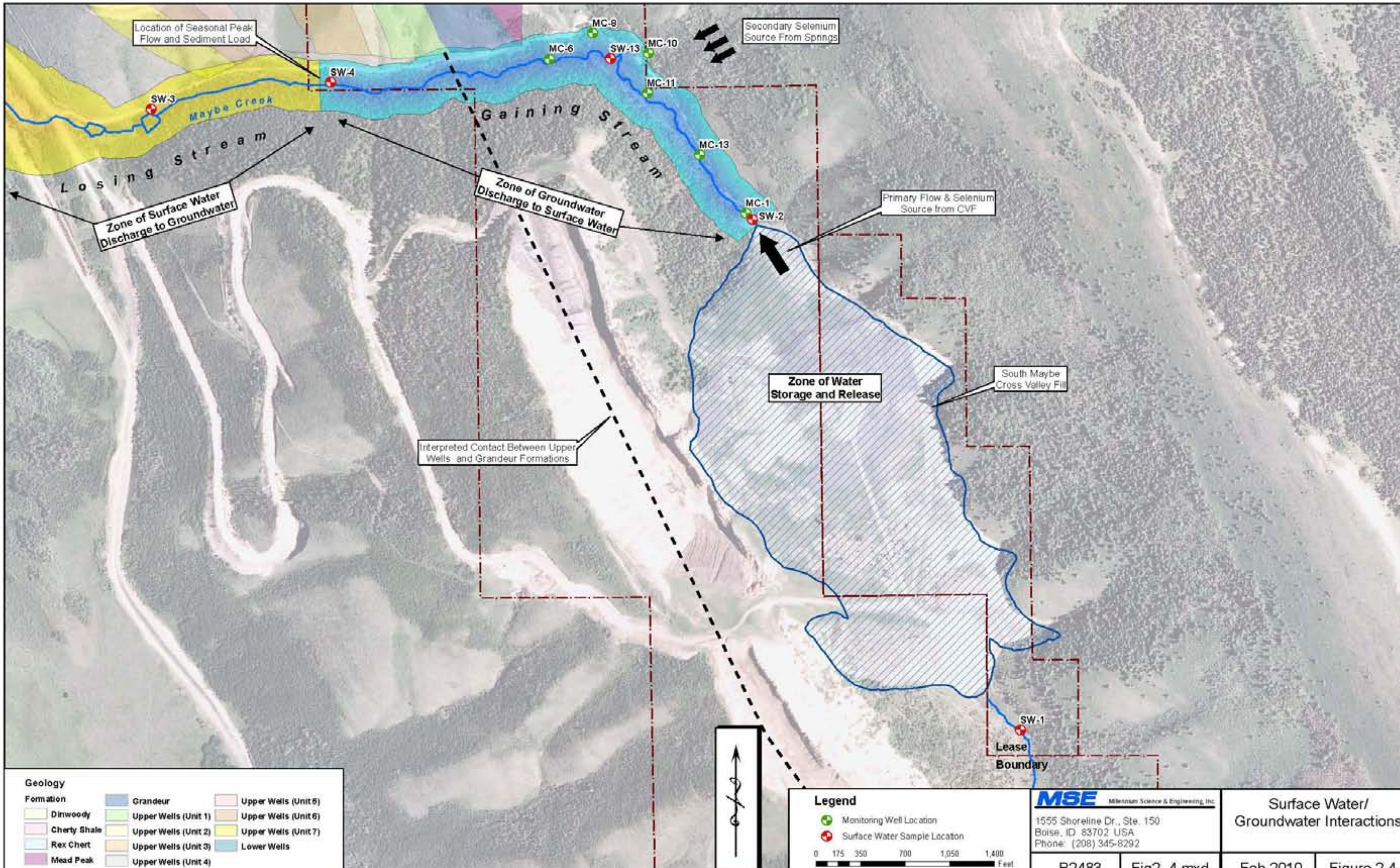
2.4.3 Surface Water

Two streams flow through the Site; Maybe Creek flows north and then west through Maybe Canyon to form a confluence with Dry Valley Creek. Maybe Creek flows approximately 4.8 miles from its headwaters to its confluence with Dry Valley Creek. Dry Valley Creek flows approximately 3.8 miles from its confluence with Maybe Creek to its confluence with the Blackfoot River. The segment of Maybe Creek upstream of the mouth of Maybe Canyon is perennial; downstream of the mouth, the stream becomes intermittent. There are two small ponds within the Maybe Creek channel at the mouth of Maybe Canyon. Overflow from these ponds passes under the mine access road to emerge along the railroad disturbance at the mouth of the canyon. Several small, off-channel stock watering ponds and beaver ponds are present in Dry Valley.

Table 2.1
Groundwater Monitoring Locations, Nu-West Mining Inc.

Sample Location	Description	Ground Elevation (ft asl)	Measuring Point Elevation (ft asl)	Screened Interval (ft below top of casing)	Total Depth (ft)
Maybe Canyon Wells					
MC-1	Below toe of CVF	6915.3	6918.46	6.9-46.9	47
MC-6	Approximately 500 feet below confluence of Maybe Creek and North Fork Maybe Creek	6820.7	6823.6	8-18	30
MC-8	North Fork Maybe Creek	NA	NA	5.4-25.4	25
MC-10	Approximately 400 feet north of MC-11	N/A	NA	7.8-27.8	28
MC-11	Approximately 1,200 feet downstream of MC-1	NA	NA	9.7-19.7	19.9
MC-13	Approximately 500 feet downstream of MC-1	NA	NA	3.7-23.7	23.9
Dry Valley Wells					
DV-2	Near Maybe Creek, approximately 2,500 feet from mouth of Maybe Canyon	6550.9	6553.8	50-60	60
DV-3	North of Maybe Creek, approximately 800 feet east of confluence of Maybe Creek and Dry Valley Creek	6482.0	6484.9	9.5-19.5	20
DV-4	Near confluence of Maybe Creek and Dry Valley Creek	6469.4	6472.4	4.7-14.7	15

Notes:
ft = feet
ft asl = feet above sea level
CVF = Cross valley fill
NA = Not Available



MSE Millennium Science & Engineering, Inc. 1555 Shoreline Dr., Ste. 150 Boise, ID 83702 USA Phone: (208) 345-8292		Surface Water/ Groundwater Interactions	
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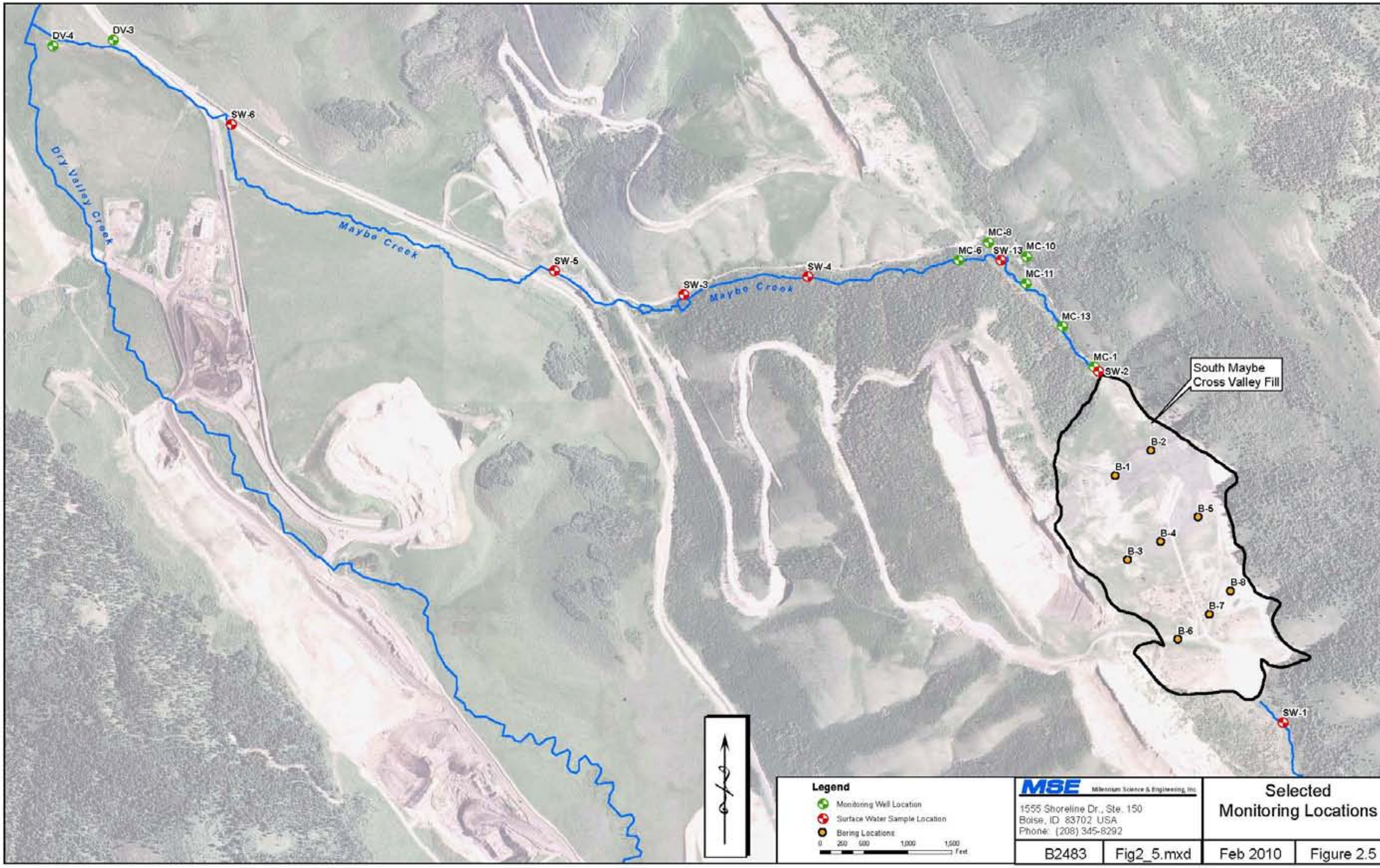

DV-4
DV-3
SW-6
Dry Valley Creek
Maybe Creek
SW-5
SW-3
Maybe Creek
SW-4
MC-8
MC-6
SW-13
MC-10
MC-11
MC-13
MC-1
SW-2
South Maybe
Cross Valley Fill
B-2
B-1
B-5
B-4
B-3
B-8
B-7
B-6
SW-1
Legend
Monitoring Well Location
Surface Water Sample Location
Boring Locations
0 250 500 1,000 1,500 Feet
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1555 Shoreline Dr., Ste. 150
Boise, ID 83702 USA
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Selected
Monitoring Locations
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Figure 2.5

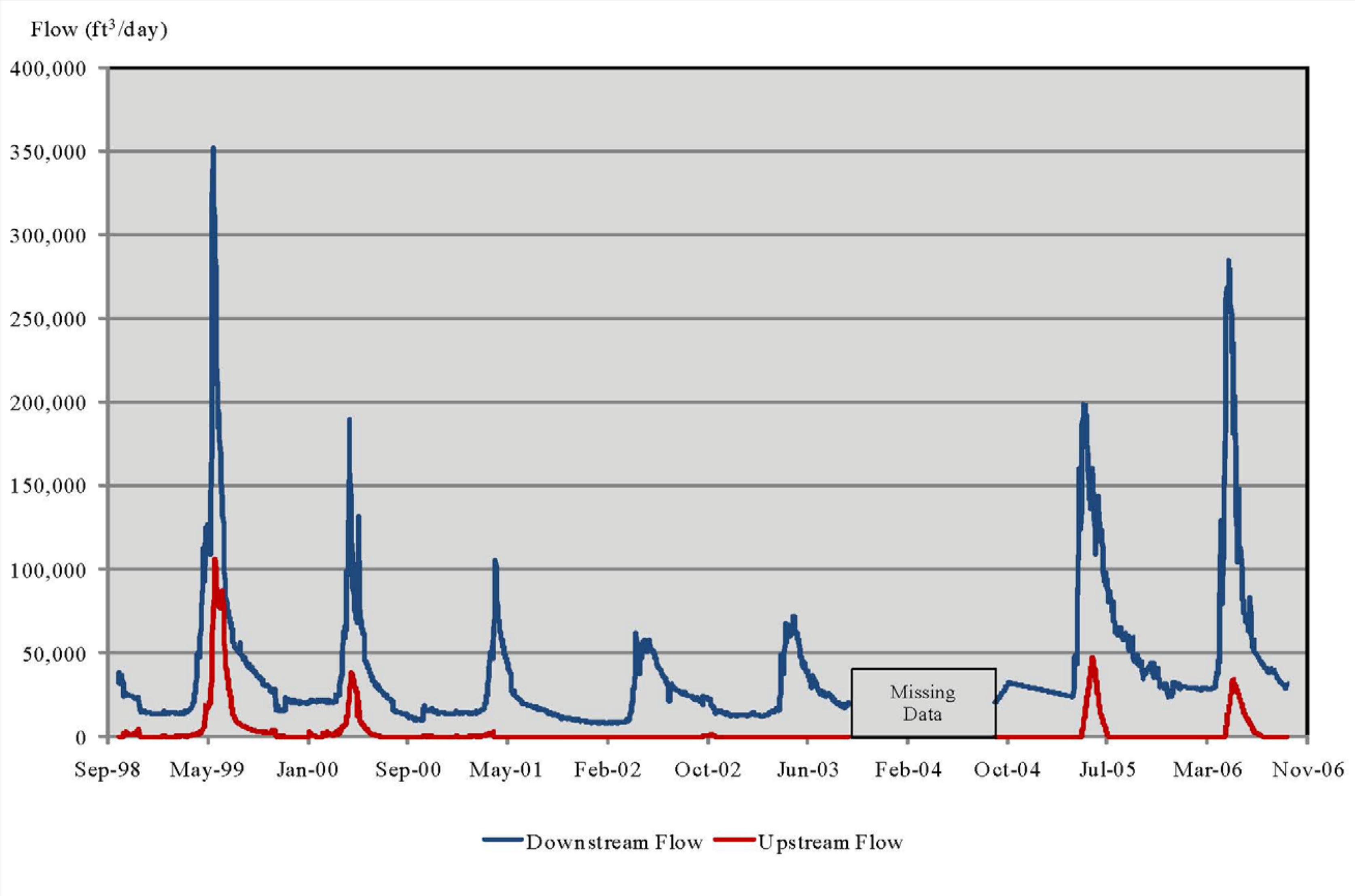
Nu-West installed two flow recorders in Maybe Creek in 1998. SW-1 is located just upstream of the CVF and SW-2 is located just below the downstream toe of the CVF (Figure 2.5). Figure 2.6 presents the hydrographs for these two stations from August 1998 through November 2006. Figure 2.6 shows that SW-1 only flowed in the spring during runoff. In 2002 through 2004, no flow was recorded at SW-1 due to below average precipitation and reduced runoff during those years. The maximum recorded flow rate at SW-1 was 1.3 cfs in May 1999.

During the monitoring program, the highest measured selenium concentrations were at SW-2 located at the downstream toe of the CVF. Typical selenium concentrations ranged from 1.18 to 3.14 milligrams per liter (mg/L) at SW-2. Selenium concentrations at downstream stations are generally lower due to dilution from increased flow. The highest measured selenium concentration at SW-2 was in 2008 at 3.14 mg/L.

Prior to the construction of the CVF, Maybe Creek received water from snowmelt and precipitation, and from several springs that emerged from the Dinwoody Formation in Maybe Canyon. At least one spring, identified on USGS maps, was captured in a spring box and piped to the downstream ponds where it discharged. Initial data collected from this spring in 1997 showed the water to contain selenium at background concentrations; however, in 1998 after 1 year of monitoring, selenium concentrations in this spring were similar to concentrations measured at SW-2. Because spring water concentrations remained above measured background concentrations, Nu-West cut the pipe in 2005 to allow that water to flow into Maybe Creek at SW-2. Additionally, several other springs buried by the CVF were not captured but allowed to flow from beneath the CVF into Maybe Creek.

During drought years, Maybe Creek has been dry at SW-1; however, during those same years Maybe Creek has continued to flow at SW-2. The buried reach of Maybe Creek between SW-1 and SW-2 gains flow, likely a result of infiltrating precipitation, buried springs, upwelling groundwater, and run-off from the surrounding hillsides infiltrating the CVF. Stream flow rapidly increases in the spring during snowmelt and runoff. Stream flows in Maybe Creek upstream and downstream of the CVF slowly decrease after peak snowmelt and return to base flow conditions by late July or August. Flow rates remain at or near base flow unless affected by short duration, high intensity storm events during the summer or until the subsequent spring discharge occurs. During snowmelt, measured peak flows at SW-2 have ranged from 0.7 to 4.1 cfs. Spring runoff is dependent on the volume of water in the snow pack on the CVF. During years with an average snow pack, runoff flows in Maybe Creek have ranged from 2.0 to over 4.0 cfs. In years with below average snow pack, the flow rate has decreased to 1.0 cfs or less. Base flow rate is approximately 0.3 cfs.

Numerous small springs emerge along Maybe Creek immediately downstream of the CVF and upstream of the confluence with North Fork Maybe Creek. Springs emerging along the creek discharge from the lower Dinwoody Formation or alluvial aquifer



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Phone: (208) 345-8292

Flow at Stations SW-1 (Upstream) and SW-2 (Downstream) from 1998 - 2006

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downstream of the CVF. This conclusion is consistent with Ralston's findings that the lower Dinwoody Formation produces springs across southeast Idaho (Ralston 1980).

Additionally, prior to construction of the CVF, springs in Maybe Canyon reportedly discharged from within the Dinwoody Formation (TRC 1999).

Three springs along Maybe Creek were included in the monitoring program: SP-3, SP-7, and SP-9. Spring SP-3 generally exhibits the highest flow rate throughout the year. In 2005, the mean flow rate at SP-3 was 0.181 cfs. The peak flow occurs in the spring then decreases throughout the year. Flow rates at springs SP-7 and SP-9 were lower than at SP-3, but followed a similar pattern. Figure 2.7 presents flows measured at six locations along Maybe Creek in 2006 (TRC 2007). Measured flows in Maybe Creek indicate a gain in stream flows upstream of SW-4 and a loss in stream flows between SW-4 and Dry Valley Creek.

2.5 Source Characterization

2.5.1 Description of the CVF

The CVF was constructed to store waste rock generated during mining operations at the Site. As designed, the CVF would overlie, at its core, a chert drain constructed using 3 to 4 ft^3 blocks of chert. The 50-foot deep drain would lie at the deepest part of the drainage paralleling the natural channel. The drain at its deepest point was designed to be covered with 425 feet of fill. The design flow rate for the drain was 200 ft^3/s. During construction, miners at the Site segregated waste rock into two general categories. Coarse and durable chert mined from the Rex Chert Member as overburden was placed along the stream channel to form the core of the drain underlying this mile-long structure. As the core grew, chert was dumped from the top of the drain. Larger boulders rolled to the bottom while smaller pieces stayed higher up the slope.

Once the core structure became large enough to support haul truck traffic on the surface, miners began dumping chert along the western aspect of South Maybe Canyon creating a blanket of durable rock designed to serve as a drain for runoff from the western aspect of South Maybe Canyon and from the final dump surface once the fill was completed. While the blanket feature was designed to be shale-free, an incident, documented in the project files, provides evidence that approximately 30,000 yd^3 of waste shale was deposited in the blanket over several work shifts. After consultation with the oversight agencies, construction continued leaving this material in place.

On completion of a substantial portion of the drain, miners began placing waste shale in the fill. This material dumped from mine trucks along the slope between the pit and the drain built eastward until the drain was covered. As the CVF grew, miners selectively dumped chert or "Run of Mine" (ROM) shale and waste rock in the appropriately designated areas to complete construction of the core drain and blanket and to dispose of waste shale in the fill. Heterogeneous conditions described by TRC in the Second

[3] The raw mined waste as it is delivered by trucks prior to placement in waste disposal areas.

Supplement to the Site Investigation in 2002 likely resulted from placing ROM in the fill (TRC 2002). Volume estimates in the SIR indicate that the CVF contains approximately 29 million yd^3 of chert and shale (TRC 1999) or approximately 52 million tons.

2.5.2 Waste Rock Characterization

Waste shale can be brown, grading to black, carbonaceous shale, mudstone, and siltstone. When mined, it forms poorly-sorted boulder, gravel, and sand-sized angular clasts in a fine-grained matrix of brown to black silt and plastic black clay. As the shale weathers on the CVF surface, it can crumble, or it can initially expand into thin wafers resembling the pages in books, as individually deposited beds delaminate. When mined, chert fractures into angular pieces, widely ranging in size from boulders to sand, and can have interbeds of silt and clay.

In the *"Life Cycle of the Phosphoria Formation,"* Hein (2004) presents interpretations developed by McKelvey and others who, "…surmised that the large amounts of fluorine, chromium, vanadium rare-earth elements, selenium, and other elements in the Phosphoria were derived from seawater, either directly through precipitation or sorption, or indirectly through alteration of biogenic material, and the conclusions are supported by the recent work of Piper (2001)." Table 1-7 of the *Final Environmental Impact Statement on the Development of Phosphate Resources in Southeastern Idaho*, completed in 1977, shows the estimated abundance of rare elements of the Meade Peak Phosphatic Shale Member. The ideas of McKelvey, Piper and others are accepted today as an explanation of the development of phosphatic deposits in the Permian Phosphoria Sea (Hein 2004).

Black shale of the Meade Peak Member is particularly carbon rich. Herring and Grauch (2004) state, "The Meade Peak [Formation] is a phosphatic black shale that is notably enriched in several trace elements compared to most other black shales and even to many other phosphatic black shales. Compared to the average world-shale composition, the Meade Peak waste-rock is exceptionally enriched in Ag [Silver], Cd [Cadmium], Cr [Chromium], Se [Selenium], U [Uranium], and Zn [Zinc]."

Average concentrations of selenium in samples collected from the Meade Peak Member in southeast Idaho were reported in the *Draft Environmental Impact Statement, Development of Phosphate Resources in Southeastern Idaho* (U.S. Department of the Interior [USDI] and U.S. Department of Agriculture [USDA] 1976). The reported selenium concentrations averaged 30 milligrams per kilogram (mg/kg) in phosphate rock, 40 mg/kg in carbonate rocks, and 14 mg/kg in mudstone. For comparison, the average selenium concentration in the earth's continental crust is 0.05 mg/kg. Samples collected by the USGS from the Site reported that selenium concentrations in samples from the lower phosphate zone ranged from 15 to 165 mg/kg (Desborough 1977). These samples also contained up to 2.3 percent pyrite. The highest concentrations of selenium correlated with the highest concentrations of organic carbon, leading the USGS to conclude, at that time, that selenium is concentrated in organic matter. The sample with a selenium concentration of 165 mg/kg contained 32 percent organic carbon by weight, whereas the lowest concentration of selenium (15 mg/kg) was in a sample with 1.9 percent organic carbon by weight. Herring, et al. (2004), concluded that during deposition, "The Se [selenium] was carried by water into zones where conditions of sufficient organic matter and lack of oxygen reduced the Se to elemental form." In deep subsurface outcrops, selenium was insoluble in its reduced state; mined and disposed waste shales began to oxidize and weather and precipitation leached selenium from large waste rock embankments.

Samples of waste shale, chert, and limestone were collected by TRC from the Site in 1997. The samples were collected from the center waste, upper waste, Rex Chert Member, and Dinwoody Formation. Analytical results from the waste shale contained selenium concentrations of 10.6 to 14.9 mg/kg and indicate that waste shale is the primary source of the selenium in Maybe Creek. Selenium in the waste shale is susceptible to leaching, when exposed to weathering conditions, and releases into the environment.

Samples from the Rex Chert Member analyzed for selenium had an average concentration of 0.9 mg/kg and samples from the Dinwoody Formation contained an average concentration of less than 0.5 mg/kg. Selenium in the siliceous matrix of the Rex Chert Member and the Dinwoody Formation does not easily oxidize and does not leach into the environment at elevated concentrations.

Based on the various lithologies within the CVF that were sampled during drill investigations, a comparison of chert and waste shale indicates that shale could be characterized as having greater density, greater moisture content, and lower hydraulic conductivity.

Surface water samples collected in 1998 and reported in the *Maybe Canyon Site Investigation Report (SIR)* (March 1999), lists 26 anions and 27 other parameters in the initial investigation (TRC 1999). TRC reported that aluminum, iron, and zinc were frequently detected along with selenium in affected waters downstream of the CVF (SIR and supplements). The following fourteen elements were not detected or were detected infrequently: antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, silver, thallium, and vanadium. Analytical results presented by TRC in the initial SIR and supplements, indicate that waste shale is the primary source of the selenium in Maybe Creek.

2.5.3 Construction of the CVF

Available construction records, aerial photographs and inspections of the CVF waste rock dump were examined to determine its construction specifications and history. Based on available information, the Meade Peak Member was mined using shovel and truck techniques. Mined sections were typically 270 feet thick, including the phosphate ore bed and waste rock.

As the first step to construction of the CVF, a French drain consisting of chert from the Rex Chert Member was constructed in and parallel to the channel of Maybe Creek to transport the stream flow beneath the CVF. A 25-foot-thick chert blanket was placed under the entire east side of the CVF to transport surface water drainage from the top of the CVF and the adjacent hillside (Dry Ridge) through the chert blanket to the French drain and into Maybe Creek. Waste rock was placed on top of the French drain using the shovel and truck technique to form the CVF. A schematic of the French drain and the waste rock of the CVF is shown on Figure 2.3. Presently, the top of the CVF is unevenly graded with mounds of dumped soil near the southern end of the CVF. Several large depressions, where shale is the primary material exposed on the surface, collect precipitation. Water that collects in the depressions either infiltrates or evaporates. Minor rill development indicates limited overland flow from the top of the CVF. Coarse chert exposed at the northern and southern ends of the CVF rapidly infiltrates precipitation. The long graded slope on the downstream (northern) toe of the CVF shows minor rill development from surface runoff.

The CVF was constructed in horizontal lifts from the upstream (south end) to the downstream (north end) using haul trucks and bulldozers and by end-dumping waste rock and pushing the waste rock over angle of repose embankments. This process resulted in gravity sorting of the waste rock, with larger boulder-sized clasts collecting at the bottom of the embankment.

The CVF contains approximately 29 million yd^3 of waste rock or about 52 million tons, using the standard conversion of 1.8 tons/yd^3. The total surface area of the CVF waste rock dump is approximately 128 acres (not corrected for slopes). The dump surface can be divided into the following sub-areas: the upstream slope, crest to toe (about 13 acres); the downstream slope, crest to toe (about 40 acres (24 acres of shale, 16 acres of chert)); and the top deck of the CVF (about 75 acres). This area does not include other disturbed ancillary areas such as the mine and haul roads. The downstream toe of the CVF in Maybe Canyon is at an elevation of 6,880 feet asl. The downstream slope of the CVF is graded to a slope of approximately 3 horizontal:1 vertical (3H:1V). The southern slope portion of the CVF, which had been left at angle of repose when mining was completed in 1984, was regraded to a slope of approximately 3H:1V in the fall of 2004. Additional regrading was performed on the southern slope in 2009 to stabilize erosion.

2.5.4 Hydraulic Characteristics of the CVF

The CVF is predominantly unsaturated; however, thin fully-saturated perched zones do exist in several areas. The percent saturation in all borehole samples ranged from 44 percent to 98 percent. During core drilling for monitoring well installation in 2001, saturated zones were observed in boring BH-4 from 114 to 115 feet below ground surface (bgs) and from 124 to 125 feet bgs. The total depth of BH-4 is 220 feet. Saturated conditions were also observed at the waste rock/alluvium contact in borings along the western side of the CVF (Figure 2.5).

The CVF is heterogeneous with respect to hydraulic conductivity. However, hydraulic conductivity generally decreases with depth. Unsaturated waste rock within the CVF has low hydraulic conductivity regardless of material type and ranges from 4×10^{-5} to 6×10^{-11} centimeters per second (cm/sec) until the drain is encountered.

Infiltration into the ROM materials on the CVF surface occurs along preferential flow paths (macropores) that are believed to decrease in number and permeability with depth. Infiltration rates measured on the surface of the CVF ranged from 2.15 to 11.2 inches per hour (in/hr). At increasing depths, infiltration of water is impeded by increasing compaction. Vertical infiltration is also impeded by interlayering of different size fractions, which causes capillary breaks where coarser layers underlie finer grained layers. It appears water flows laterally along preferential flow paths under unsaturated conditions (interflow) along the finer grained layers until it reaches a point where vertical movement can again occur. Based on surface gradient and construction details, water within the ROM material in the CVF is inferred to flow to the east where it enters the chert blanket. Once internal and surface flow reach the chert blanket and core drain, porosity and unsaturated preferential flow occurs, allowing increased flow velocities through the chert blanket to the bottom of the CVF.

The moisture content deep within the stored ROM material in the CVF is assumed to be essentially constant. Water held in these finer textured materials under saturated conditions is released from the CVF at a steady rate. This assumption is based on the age of the CVF (over 25 years) and the consistent baseflow measurements.

Approximately 18 to 30 inches of precipitation fall on the surface of CVF annually, and half of the precipitation is in the form of snow. This amount is based on records from the Dry Valley Mine and indicates that the CVF receives less precipitation than the Slug Creek Divide National Water and Climate Center (SNOTEL) Station. Peak flow rates in Maybe Creek, as measured at SW-2, are coincident with snowmelt from the surface of the CVF, as discussed further in Section 4.0. This could be interpreted to mean that snowmelt is rapidly conveyed as surface flow and along preferential flow paths within the waste rock material, chert blanket, and French drain to the toe of the CVF. In general, the CVF top deck slopes to the east. This slope promotes surface water flow towards the chert blanket. Once water enters the blanket, it moves quickly through the porous material and emerges from the toe of the CVF at SW-2.

2.6 Nature and Extent of Selenium Contamination

Selenium is the most widespread and concentrated contaminant of potential concern (COPC) at the Site. This section describes the nature and extent of selenium concentrations in surface water, groundwater and vegetation at the Site. Section 2.4, above, discusses the characterization and selenium concentrations of contaminant source materials in the CVF. Section 2.6.1 discusses the concentrations of selenium in surface water. Section 2.6.2 presents selenium concentrations in groundwater. Section 2.6.3 discusses selenium concentrations in vegetation on the surface of the CVF. The streamlined risk evaluation discussed in Section 3.0 evaluates concentrations of other constituents present at the Site.

2.6.1 Surface Water

While surface water measurements taken upstream of the CVF indicate hazardous substance concentrations at or below laboratory detection limits, selenium is present above detectable concentrations in surface water downstream of the CVF, including Maybe Creek and Dry Valley Creek, and in springs along the reach immediately downstream of the CVF in Maybe Canyon. The CVF is the only known source of selenium and other contaminants of concern in the upper Maybe Creek drainage. However, lower in the canyon, contaminants are present in waste rock from the Dump 6 failure, from shale piled near the historic portal to the underground workings, and in the sediment ponds at the Forest boundary.

Precipitation that falls on the top deck of the CVF infiltrates the surface and percolates through waste shale dissolving selenium salts. Groundwater also emerges from the Dinwoody Formation beneath the CVF and from the associated alluvium beneath Maybe Creek. Selenium concentrations in surface water consistently increase in late April or early May, peak in late May, then decrease throughout summer and fall. Spring and early summer flow in Maybe Creek often reaches Dry Valley creek. It is during this period that most of the annual contaminant load reaches the Blackfoot River and presents an exposure to fish in lower Dry Valley Creek and the Blackfoot River.

The surface water at SW-2 is classified as calcium-sulfate and very hard (TRC 1999). Hardness values range from 753 to 875 mg/L. As a result of the waste placement, total dissolved solids (TDS) and sulfate concentrations are also elevated. Sulfate concentrations, hardness and TDS decrease downstream of SW-2 and bicarbonate concentrations increase. The water type downstream of SW-2 remains calcium-sulfate.

Maximum selenium concentrations in surface water measured at SW-2 have increased during the 10 years of monitoring from 0.71 mg/L total selenium in 1997 to 3.14 mg/L total selenium in 2008. Selenium concentrations decrease downstream from the CVF discharge point at SW-2. Water sampled from the ponds at the mouth of Maybe Creek ranged between 0.653 and 1.350 mg/L in 2006. Upstream of the ponds at SW-4, concentrations were 1.5 mg/L in 2007 and 2.44 mg/L in 2008.

Selenium concentrations in Maybe Creek upstream of the CVF at surface water monitoring station SW-1 have typically been below or at the detection limit (0.001 mg/L). Table 2.2 and Figure 2.8 present the selenium concentrations measured in 2006 at four stations on Maybe Creek downstream of the CVF. For comparison, the chronic exposure cold water biota standard in surface water for selenium promulgated by the U.S. Environmental Protection Agency (EPA) and adopted by the State of Idaho is 0.005 mg/L total dissolved selenium. The acute exposure cold water standard is 0.020 mg/L total dissolved selenium.

Similar to Maybe Creek, selenium concentration in the springs peak in late spring, and then decrease throughout the remainder of the year. In 2005, selenium concentrations ranged from 0.234 to 1.340 mg/L in spring SP-3, from 0.078 to 1.530 mg/L in SP-7, and from 0.026 to 0.270 mg/L in spring SP-9. Most springs were removed from the water

Table 2.2
Concentration of Total Selenium at Four Surface Water Monitoring Stations, 1997-2008

Date	Total Selenium Concentration from 1997-2008 (mg/L)			
	SW-2	SW-13	SW-4	SW-5
06/10/1997	0.71	NS	NS	NS
05/22/1998	1.43	NS	NS	NS
05/26/1998	NS	NS	0.86	0.73
05/25/1999	2.2	NS	1.7	1.7
05/09/2000	1.5	1.2	1.02	0.96
05/15/2001	2.01	1.6	1.410	1.050
05/02/2002	2.3	1.34	1.06	1.13
04/27/2003	2.6	1.87	1.33	NS
05/04/2004	1.99	NS	NS	NS
05/05/2004	NS	1.65	1.46	1.26
05/24/2005	1.47	1.23	1.08	1.00
05/15/2006	2.15	NS	NS	NS
05/16/2006	NS	1.42	1.22	1.35
05/14/2007	2.11	1.67	1.50	1.47
05/19/2008	3.14	2.56	2.44	2.45

Notes:
mg/L = milligram per liter
NS = Not sampled

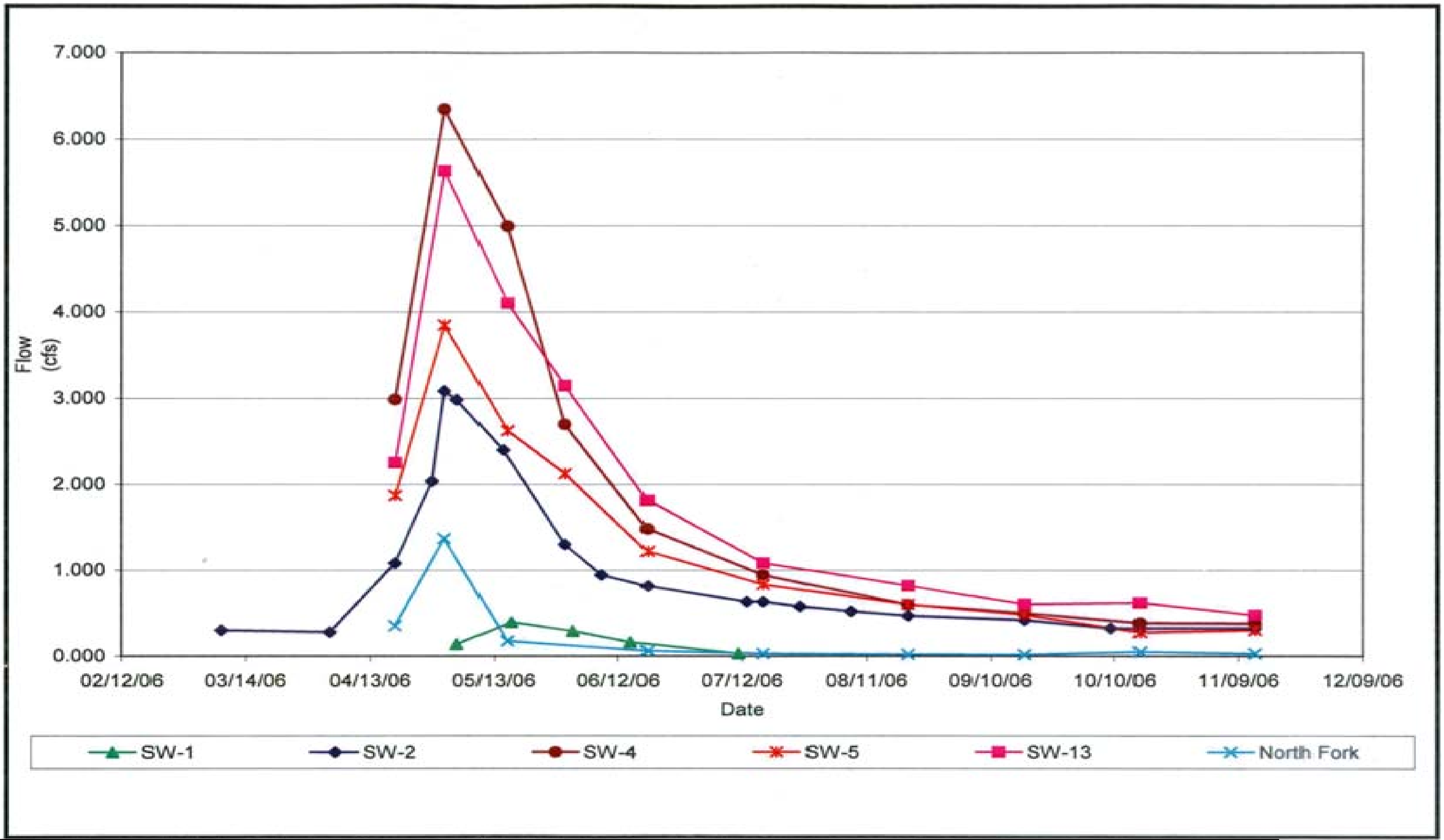


Figure 2.7 Surface Water Flow Rates along Maybe Creek, 2006

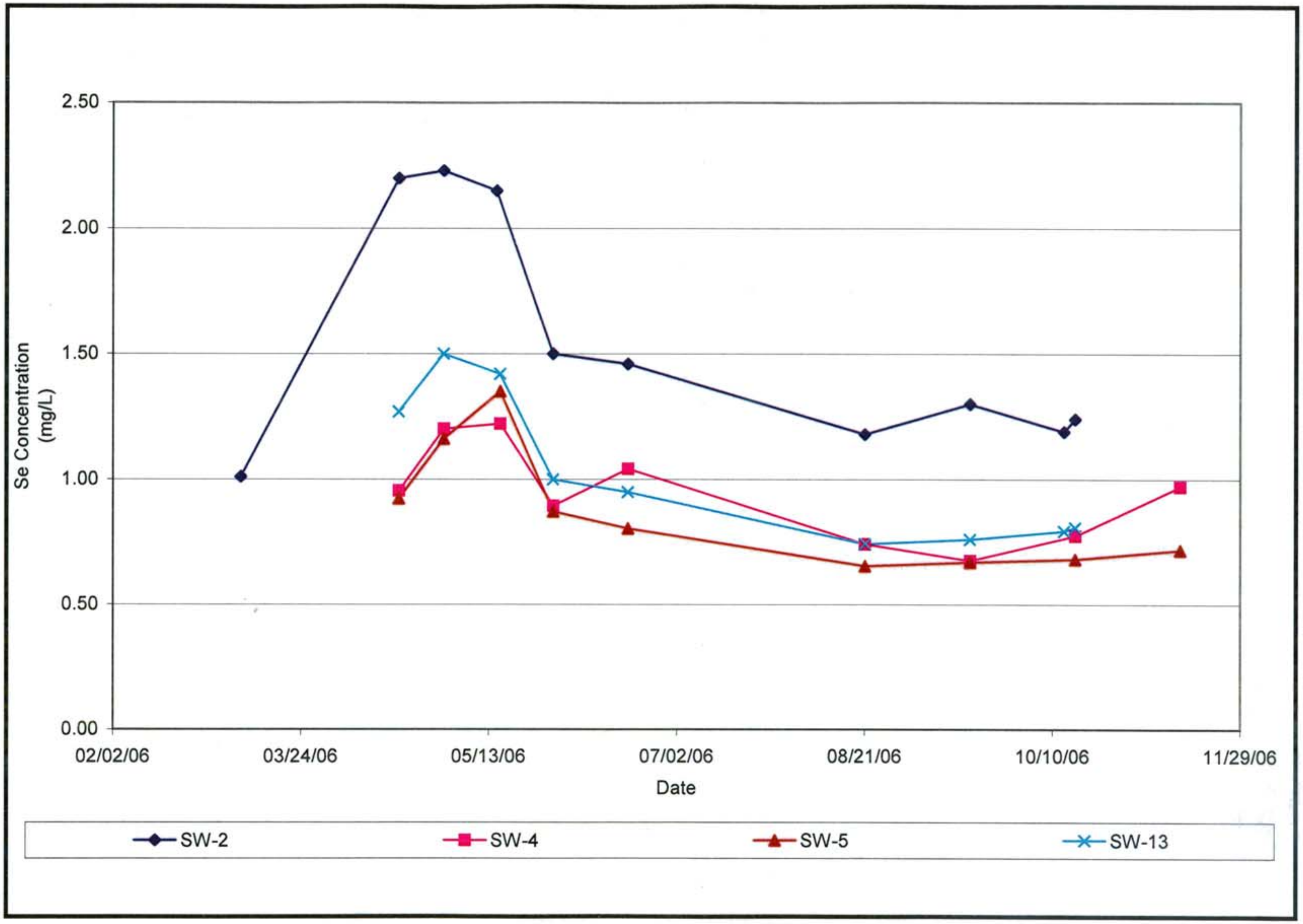


Figure 2.8 Selenium Concentrations at Four Monitoring Stations on Maybe Creek, 2006.

quality monitoring program in 2006. However, some springs were re-sampled by MSE in 2009. Data from this sampling event are included in Appendix A.

Selenium load is the total mass of selenium released from the fill measured in lbs/day. Load is calculated by multiplying flow rate by concentration. Load, calculated at each sampling station, increases during spring runoff, then decreases in summer and fall as flow rates decrease along with contaminant concentrations. Table 2.3 presents the selenium loads at the downstream stations in 2006. Figure 2.9 illustrates the temporal changes in selenium loads in 2006 (TRC 2007). The selenium load at SW-2 was 1.62 pounds per day (lb/day) on March 8, 2006. The load increased to 37.1 lb/day on May 1, 2006. Selenium loads decreased as flows and concentrations decreased in late May and June. The selenium load was 2.97 lb/day on August 21, 2006. Selenium loads followed a similar trend at the other downstream stations.

Peak selenium loads increased in 2008 and 2009 from less than 5 lb/ day at base flow to selenium loads over 70 lb/day in May of 2008 and over 50 lb/day in May of 2009 at SW-2. Figure 2.10 presents a summary of flows, selenium concentrations and loads at SW-2 over the 1999 through 2009 period of record. The highest selenium concentrations, flows and loads occurred at SW-2 in 2008 and 2009. The highest selenium loads at the Site occurred in May of 2008 at SW-13 (79 lb/day) and at SW-4 (87 lb/day) (TRC Ninth Supplement Table 3.3, 2009).

Figures 2.11, 2.12 and 2.13 present stream flows and selenium concentrations and loads at four stations along Maybe Creek during three sampling events in May, June, and October of 2009. Surface water quality and flow data collected in 2009 are included in Appendix A. Stream flows generally increased between SW-2 and SW-4 indicating a gaining reach along Maybe Creek. Stream flows generally decreased between SW-4 and SW-5 indicating a losing reach where Maybe Creek discharges to the underlying alluvium and Wells Formation. Selenium loads are sustained up to SW-4 then decline as surface water discharges into the underlying alluvium at SW-5.

2.6.2 Groundwater

Selenium is detectable in shallow alluvial groundwater monitoring wells in Maybe Canyon and Dry Valley. In general, selenium concentrations are highest in the spring and decrease during the summer. Selenium concentrations generally increase as groundwater elevations increase and decrease as groundwater elevations decrease.

Groundwater from six wells in Maybe Canyon was sampled monthly and analyzed for dissolved selenium to evaluate seasonal changes in selenium concentrations (Table 2.4). Concentrations were highest at well MC-1, located just downstream of the CVF. Selenium concentrations in well MC-1 are similar to concentrations in surface water at monitoring station SW-2. In 2006, selenium concentrations ranged from 1.14 to 2.56 mg/L at well MC-1, and from 0.28 to 0.714 mg/L in well MC-6 further downgradient. Concentrations of selenium measured in groundwater in 2009 follow similar trends. Groundwater quality data collected in 2009 are presented in Appendix A.

Table 2.3
Total Selenium Loads at Six Surface Water Monitoring Stations on Maybe Creek, 2006

	Selenium Load by Station (lb/day)					
Date	**SW-1**	**SW-2**	**SW-13**	**SW-4**	**SW-5**	**North Fork**
03/08/2006	NA	1.62	NA	NA	NA	NA
04/19/2006	NA	12.84	7.41	5.56	5.38	0.01
05/01/2006	NA	37.10	24.95	19.96	19.30	0.02
05/15/2006	NA	27.82	NA	NA	NA	NA
05/16/2006	NA	NA	31.44	32.88	19.10	0.00
05/30/2006	NA	10.52	7.01	6.25	6.10	0.00
06/19/2006	NA	6.41	4.17	4.57	3.52	0.00
07/17/2006	NA	NA	NA	NA	NA	0.00
08/21/2006	NA	2.97	1.87	1.86	1.64	0.00
09/18/2006	NA	2.92	1.71	1.51	1.50	0.00
10/13/2006	NA	NA	NA	NA	NA	NA
10/16/2006	NA	2.14	1.40	1.34	1.18	NA
Average	NA	11.59	9.99	9.24	7.21	0.00
Minimum	NA	1.62	1.40	1.34	1.18	0.00
Maximum	NA	37.10	31.44	32.88	19.30	0.02
Standard Deviation	NA	12.66	11.60	11.31	7.61	0.01

Notes:
lb/day = pound per day
NA = Not available

Table 2.4
Dissolved Selenium Concentrations in Groundwater, 2006

Date	Dissolved Selenium Concentration (mg/L)					
	MC-1	**MC-6**	**MC-8**	**MC-10**	**MC-11**	**MC-13**
4/19/2006	1.7	0.662	0.0085	0.0053	NS	NS
5/2/2006	2.03	0.412	0.0029	0.002	0.859	0.983
5/15/2006	2.56	0.28	NS	0.0039	0.962	1.44
5/16/2006	NS	NS	0.0019	NS	NS	NS
5/30/2006	1.87	0.554	0.0025	0.0014	0.889	1.56
6/19/2006	1.68	0.633	0.0039	0.0014	0.834	1.4
8/21/2006	1.14	0.548	0.0273	0.0039	0.766	0.925
9/18/2006	1.27	0.676	0.0367	0.0149	0.714	0.975
10/13/2006	1.3	NS	0.0536	0.0642	0.784	0.861
10/16/2006	NS	0.714	0.0435	0.0379	0.779	0.932
11/13/2006	NS	0.705	NS	NS	NS	NS

Notes:
mg/L = milligram per liter
NS = Not sampled

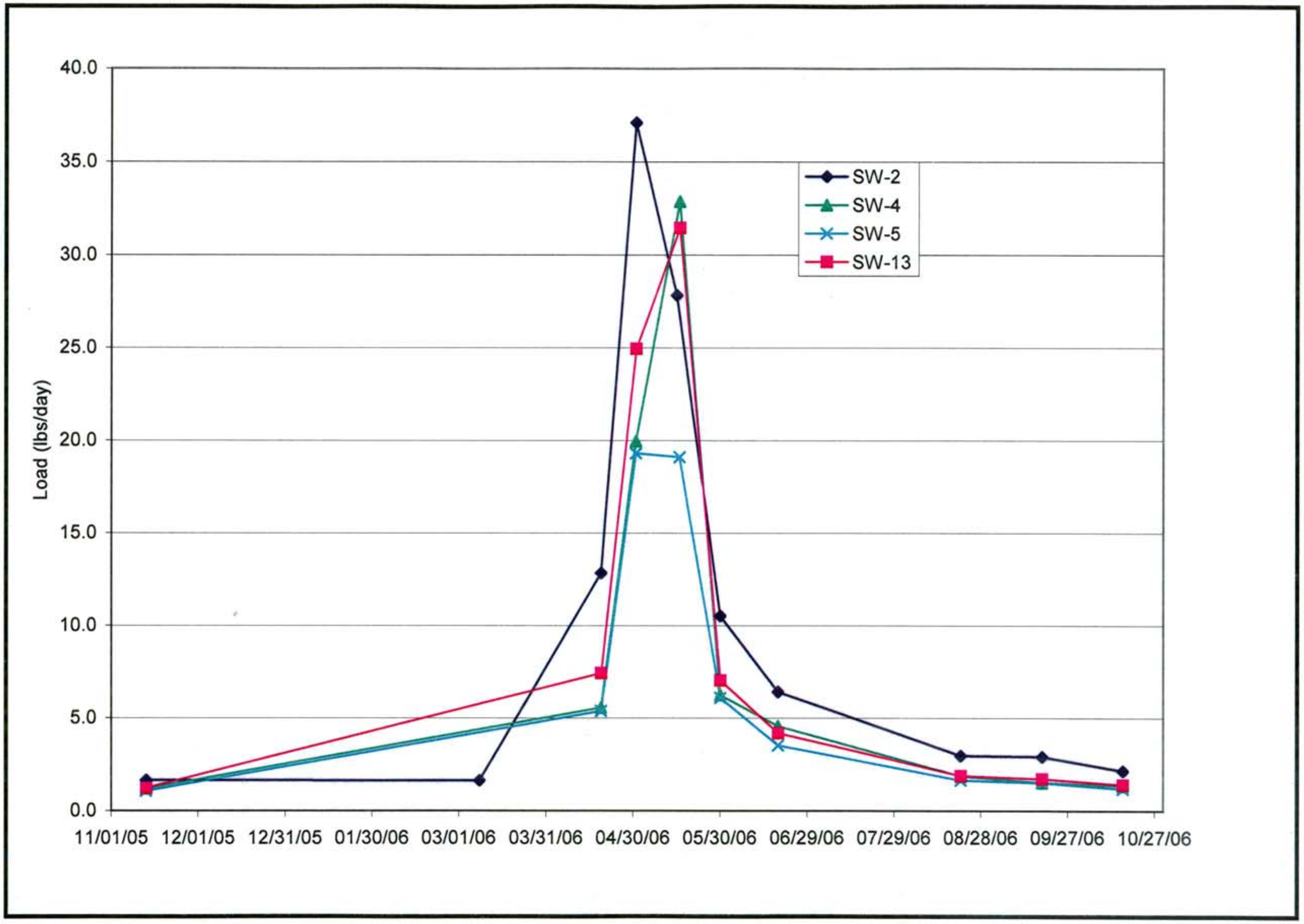
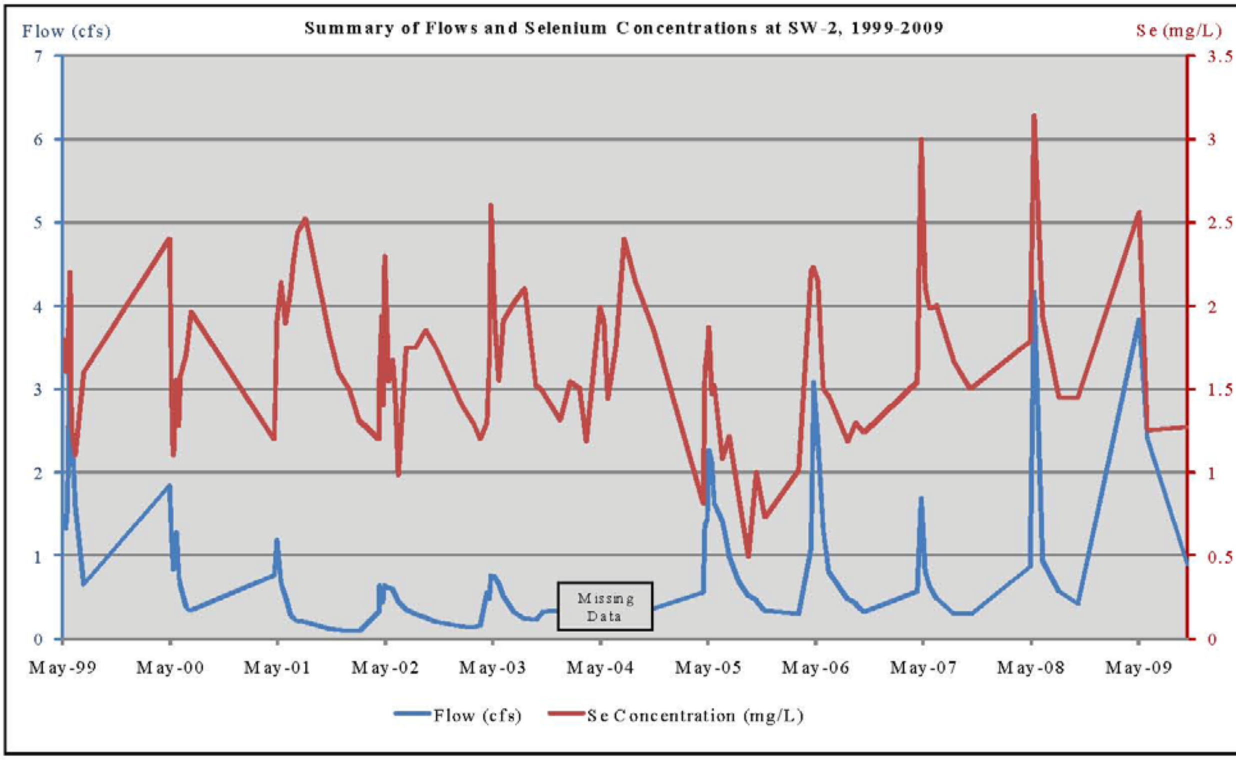
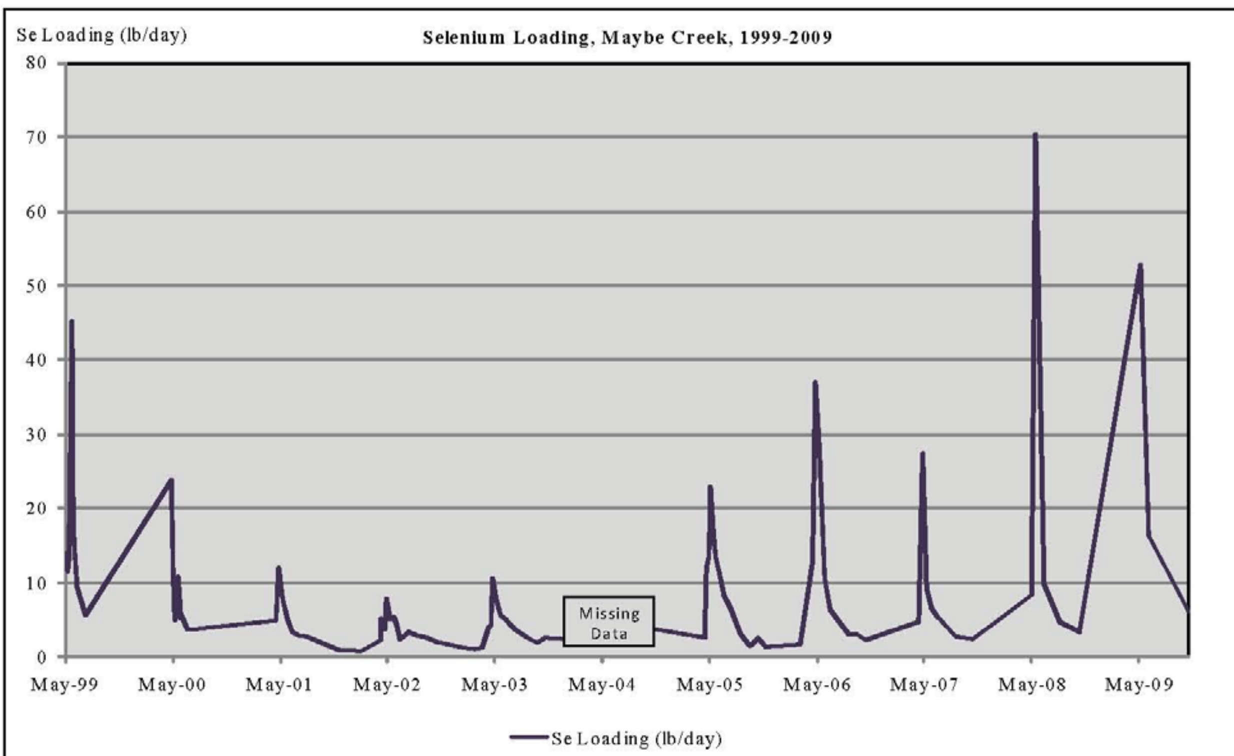


Figure 2.9 Mean Selenium Loads at Four Stations on Maybe Creek, 2006.





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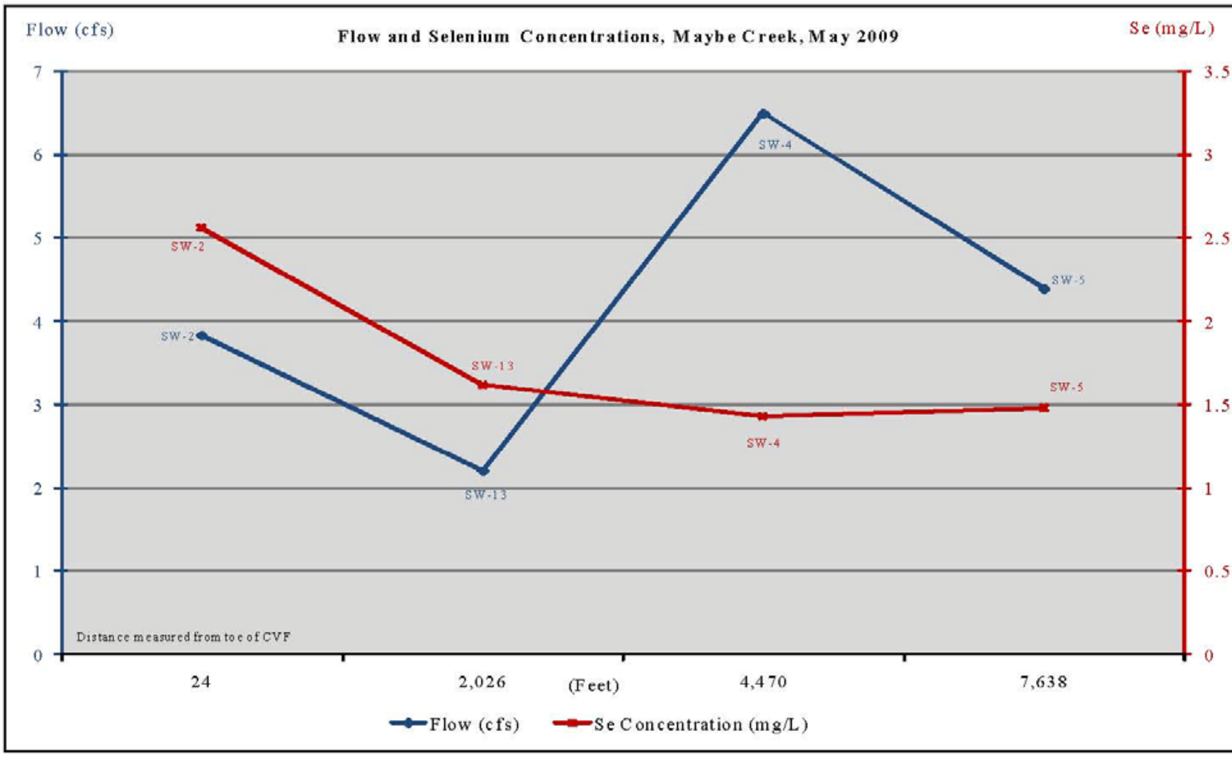
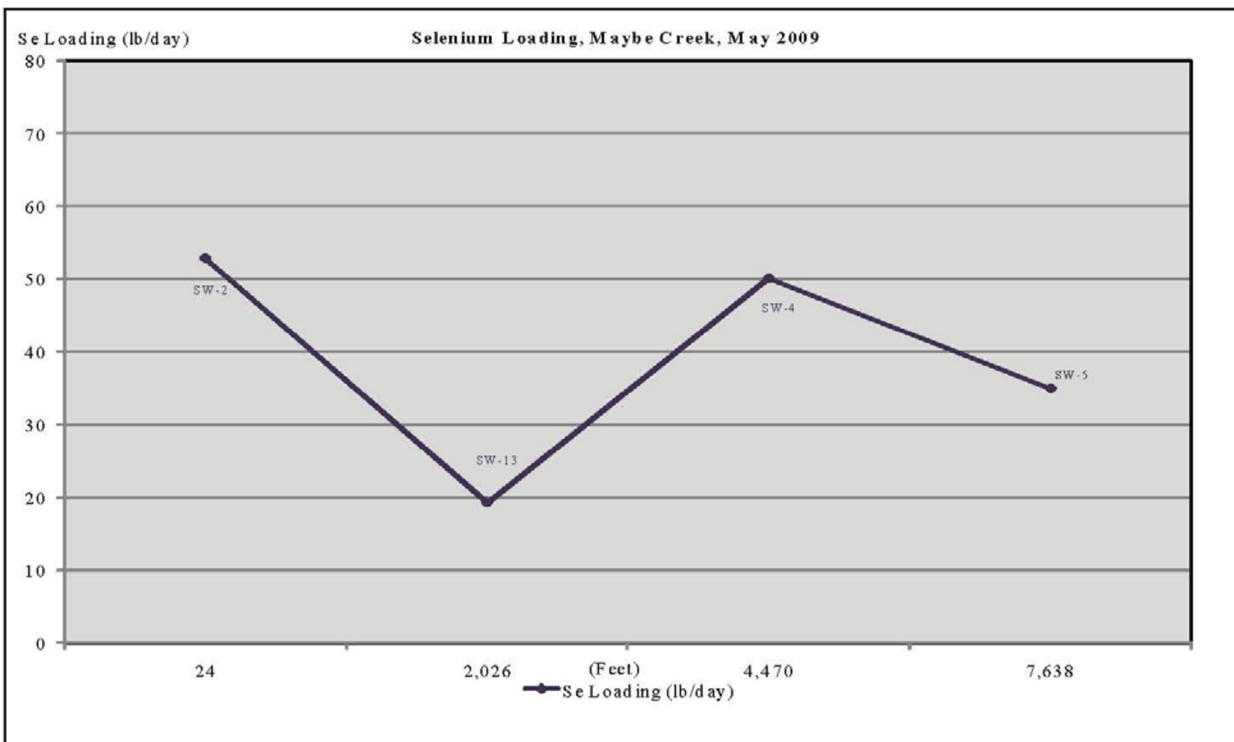
1555 Shoreline Dr., Ste. 150
Boise, ID 83702 USA
Phone: (208) 345-8292

Summary of Flows and Selenium Concentrations and Loading, Maybe Creek, 1999 - 2009

B2483	Fig2_10.mxd	Feb 2010	Figure 2.10





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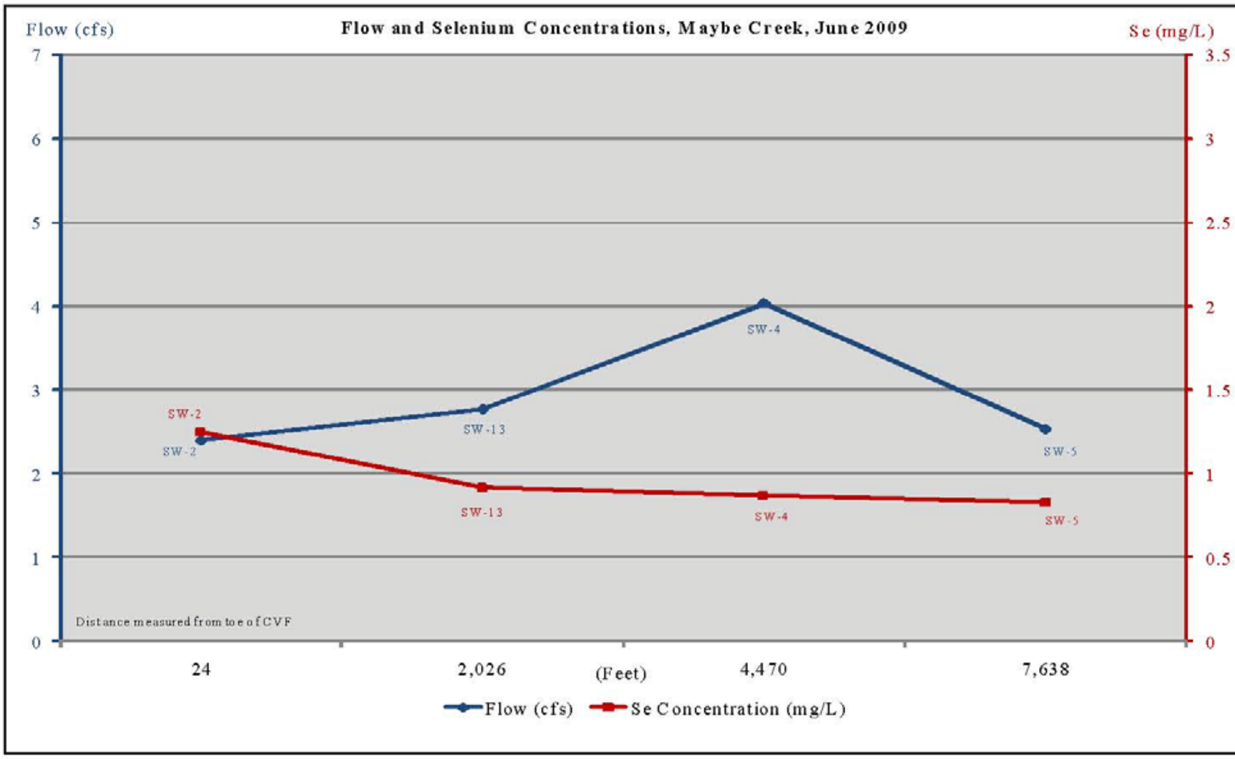
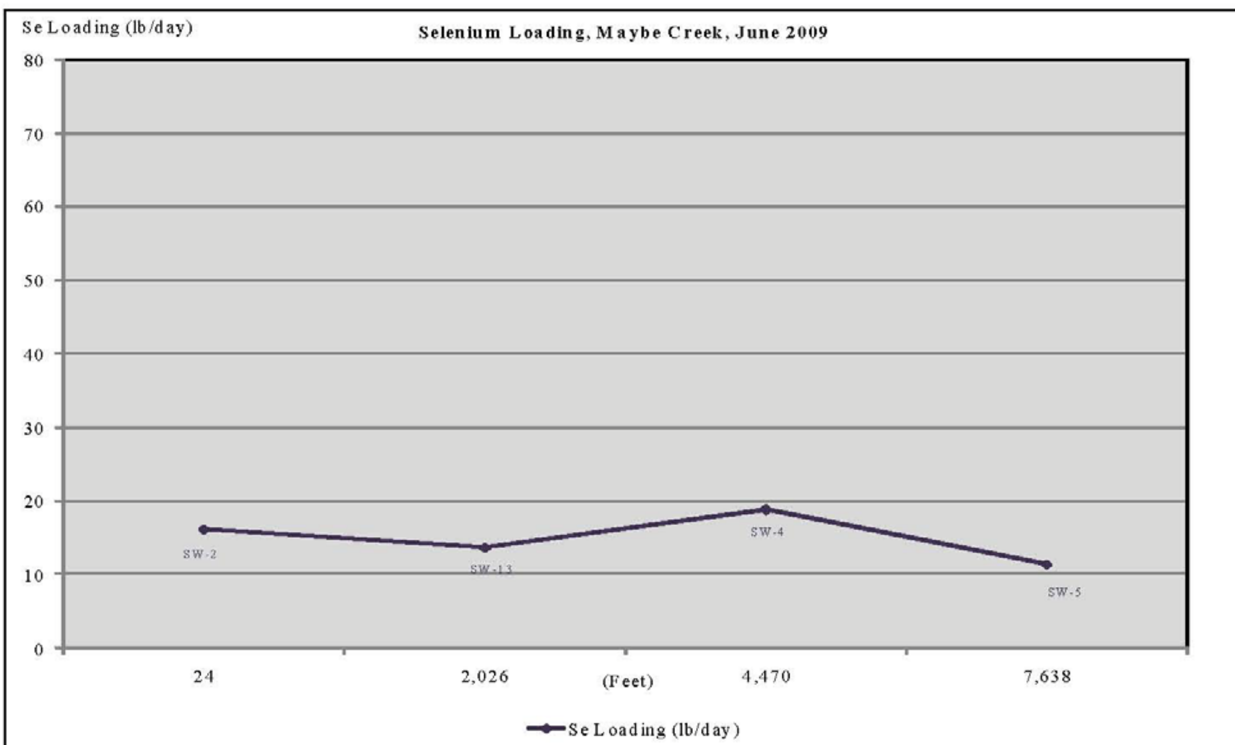
Boise, ID 83702 USA
Phone: (208) 345-8292

Flow and Selenium Concentrations and Loading, Maybe Creek May 2009

B2483	Fig2_11.mxd	Feb 2010	Figure 2.11





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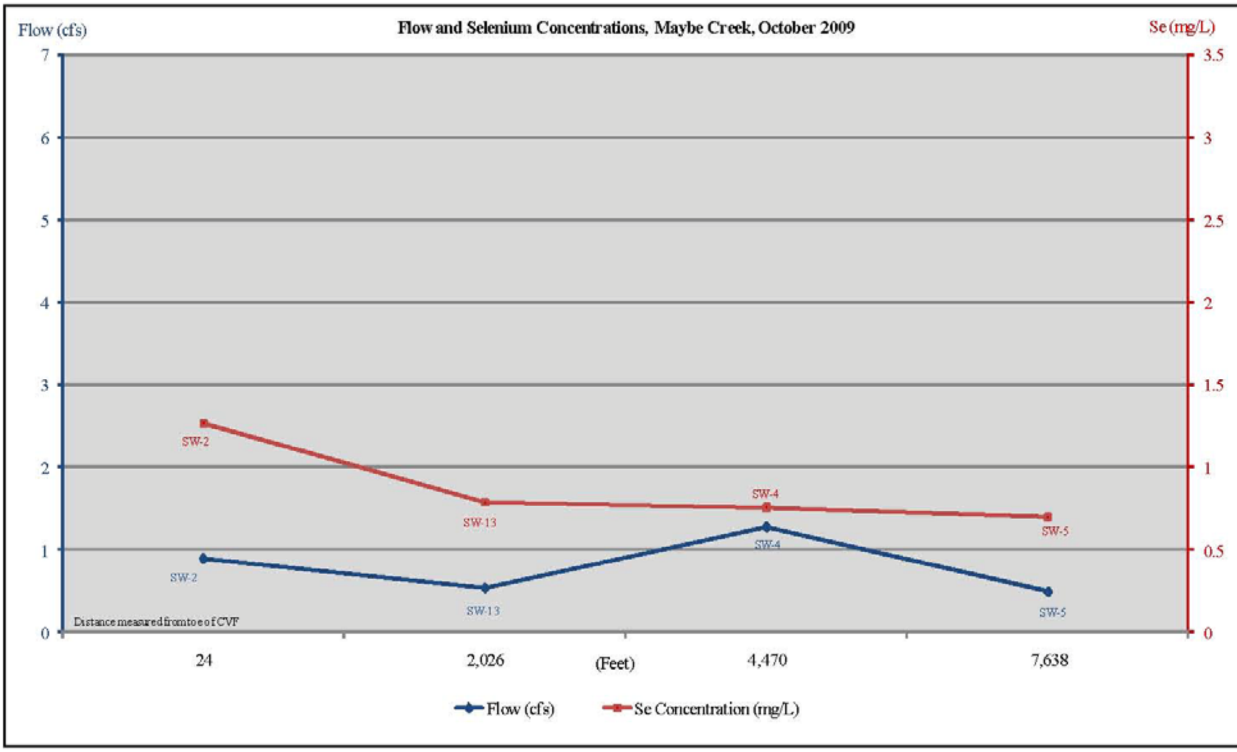
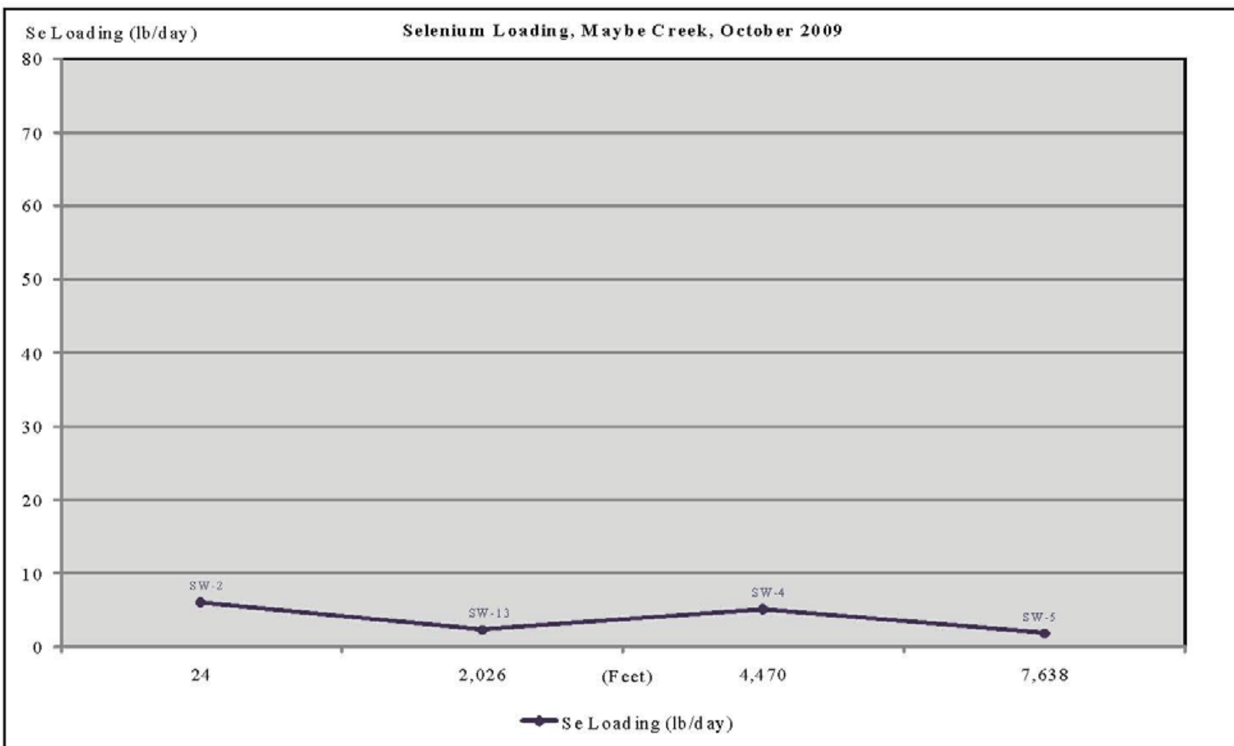
Boise, ID 83702 USA
Phone: (208) 345-8292

Flow and Selenium Concentrations and Loading, Maybe Creek June 2009

B2483	Fig2_12.mxd	Feb 2010	Figure 2.12





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1555 Shoreline Dr., Ste. 150
Boise, ID 83702 USA
Phone: (208) 345-8292

Flow and Selenium Concentrations and Loading, Maybe Creek October 2009

B2483	Fig2_13.mxd	Feb 2010	Figure 2.13

Groundwater in monitoring wells near the toe of the CVF is classified as calcium-sulfate. Calcium and sulfate concentrations in groundwater from these wells were similar to those in the surface water at monitoring station SW-2. The water is classified as very hard.

Groundwater in monitoring wells located downgradient of the CVF is classified as calcium-bicarbonate. The sulfate concentrations, conductivity, and TDS values in groundwater from these wells are lower than in the wells near the toe of the CVF.

2.6.3 Vegetation

Vegetation on the top deck of the CVF was sampled by TRC in 1998 and analyzed for: antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc.

The impact to vegetation at the Site is documented in the first supplement to the Maybe Canyon SIR (TRC 2000). Ten vegetation samples collected from four locations on top of the CVF in 1998 contained selenium at concentrations above background. Vegetation samples consisted of various grass, forb and/or shrub species. Selenium concentrations ranged from 2.46 to 13.5 mg/kg in the grass samples, from 2.95 to 76.1 mg/kg in samples of forbs, and from 6.14 to 11.0 mg/kg in samples of shrubs (TRC 1999).

3.0 STREAMLINED RISK EVALUATION

This section presents a limited-scope, screening-level evaluation of the potential human health and ecological risks associated with exposure to waste materials in the CVF in its current condition. This evaluation involved selecting maximum detection concentrations (MDCs) from available data sets for Contaminants of Potential Concern (COPCs) in various media at, or in close proximity to, the CVF and comparing them to existing criteria. While many of these criteria are risk based, no detailed risk calculations or toxicological evaluations were conducted for this streamlined risk evaluation.

The primary contaminant source at the Site is waste rock in the CVF. Waste rock resulting from phosphate mining is composed of overburden and interburden materials removed during mining to access the phosphate ore bodies. Waste rock includes alluvium, shale from the overlying Dinwoody Formation, center waste shale of the Meade Peak Member, and the overlying chert from the Rex Chert and cherty shale members of the Phosphoria Formation, and the underlying Wells Formation Limestone. Analysis of waste rock samples collected from the CVF in 1997 indicate that center waste shale contained selenium concentrations of 10.6 and 14.9 mg/kg, which is representative of the primary source of selenium in Maybe Creek (TRC 1997). While selenium is the primary COPC, other COPCs exist in the waste rock that may also pose a potential risk to human health and the environment. As waste rock weathers and degrades, contaminants are more readily released into the environment.

The primary release mechanisms of COPCs from the waste rock are erosion, dissolution of oxidation salts, leaching by infiltration and percolation, and surface water runoff. Each of these primary release mechanisms transports hazardous substances along multiple exposure pathways from contaminant sources to receptors.

The South Maybe Canyon area, including the CVF, is open to recreational hikers, hunters, campers, and livestock herders. Native Americans also use the area for hunting game and gathering native plants for personal consumption and ceremonial use. All of these users are potential human receptors. The area supports or contains habitat for up to 75 species of mammals, 272 species of birds, 16 species of reptiles, 16 species of fish, and 7 species of amphibians (USGS and Forest Service 1977; Forest Service 1985, 1997; Idaho Conservation Center Data Base 1999; all as cited in Montgomery Watson [MW] 1999). Vegetation in the vicinity of the Site includes riparian, forest, and upland habitats. Plant species include spruce, fir, pine, aspen, willow, dogwood, sedge, sagebrush, and assorted native and exotic grasses and forbs found naturally or introduced to stabilize the Site.

This streamlined risk evaluation identifies those COPCs (measured in samples of vegetation, surface water, sediment, and riparian soil collected at or downstream of the CVF) that exceed the human health and ecological risk screening criteria presented in Section 3.2.

3.1 Analytical Data

Analytical data evaluated for this streamlined risk evaluation include data from samples of vegetation, small mammals, terrestrial invertebrates, surface water, sediment, and soil collected as part of Site investigation activities conducted between 1998 and 2009. These data are presented in the Maybe Canyon SIR, dated March 1999 (TRC 1999), in separate supplements to the SIR (TRC 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009), and in Site investigation data collected in 2009 by Millennium Science & Engineering, Inc. (MSE). The Site investigation data collected by MSE is summarized in Appendix A. The MDCs of each analyte were used in this streamlined risk evaluation. The analytical data from each environmental medium are described below.

3.1.1 Surface Water

Surface water monitoring was initiated under CERCLA in 1998 and initially consisted of periodically collecting samples from nine stations located on Maybe Creek and Dry Valley Creek. The monitoring program has been modified over time to collect data for supplemental investigations. Surface water samples have generally been collected during spring runoff from April through July. The current monitoring program consists of collecting surface water samples from four stations on Maybe Creek and several springs in Maybe Canyon. Both filtered and unfiltered samples were analyzed for dissolved and total metals and other inorganic parameters. Parameters monitored in the SI Report (TRC 1998) were modified in May 1999. Some initial parameters for analysis were not detected or were detected infrequently during later sampling events and were subsequently dropped from the sampling program.

Monitoring station SW-2 is located on Maybe Creek at the toe of the CVF, and is the downstream surface water sampling station closest to the CVF. Contaminant concentrations at SW-2 have generally been greater than those at sampling stations farther downstream. Table 3.1 provides a summary of MDCs measured in surface water samples.

3.1.2 Sediment

During site investigation activities in September and November 1998, sediment samples were collected from Maybe Creek and from the upper and lower sediment ponds located near the mouth of Maybe Canyon. The samples were analyzed for 18 inorganic constituents and total organic carbon (TOC) (TRC 1999). In June 2007, nine additional sediment samples were collected from the sediment ponds consisting of seven samples from the upper pond and two samples from the lower pond. The samples were analyzed for total selenium, TOC, and percent solids (TRC 2008). This streamlined risk evaluation considered sediment samples collected in both 1998 and 2007 from all locations downstream of the CVF. Data from these samples were compiled from the original analytical lab reports (TRC 1999 and 2008). The MDCs of COPCs in the sediment samples are presented in Table 3.2.

3.1.3 Riparian Soils

In September and November 1998, 37 samples of surface soil were collected and analyzed for 18 inorganic constituents and TOC (TRC 1999). The sample locations were along seven transects oriented across Maybe Creek, and consisted of 13 floodplain stations, 8 in-stream stations, and 16 upland stations.

This streamlined risk evaluation used data from the two floodplain samples collected along Transect 2, which is the sampling transect closest to the downstream toe of the CVF. Data from these samples were compiled from the original analytical lab reports (TRC 1999). The MDCs of COPCs in the two riparian soil samples are presented in Table 3.3.

3.1.4 Vegetation

In September and November 1998, 80 samples of various grass, forb and shrub species were collected and analyzed for 18 inorganic constituents (TRC 1999). Ten of those samples were collected from four locations on the top surface of the CVF, and the remaining samples were collected primarily from transects downstream of the CVF (9 samples from the immediate vicinity of the settling ponds, 11 samples from in-stream

Table 3.1
Maximum Detected Concentrations of COPCs in Surface Water Samples

Analyte	MDC (μg/L)	Analyte	MDC (μg/L)
Aluminum	1,140	Manganese	96
Antimony	120	Mercury	ND
Arsenic	ND	Molybdenum	20
Barium	35	Nickel	66
Beryllium	ND	Selenium	3140
Cadmium	24	Silver	ND
Chromium	ND	Uranium	7.4
Copper	ND	Vanadium	11
Iron	1,200	Zinc	400
Lead	ND		

Notes:
μg/L = microgram per liter
COPC = Contaminant of potential concern
MDC = Maximum detected concentration
ND = Not detected

Table 3.2
Maximum Detected Concentrations of COPCs in Sediment Samples

Analyte	MDC (mg/kg)	Analyte	MDC (mg/kg)
Antimony	ND	Manganese	2,410
Arsenic	4.02	Mercury	0.17
Beryllium	1.20	Molybdenum	5.20
Cadmium	20.2	Nickel	192
Chromium	81.0	Selenium	829
Cobalt	9.00	Silver	3.40
Copper	26.0	Vanadium	91.0
Iron	19,700	Zinc	943
Lead	16.0		

Notes:
mg/kg = milligram per kilogram
COPC = Contaminant of potential concern
MDC = Maximum detected concentration
ND = Not detected

locations on Maybe Creek, 26 samples from the Maybe Creek floodplain, and 24 upland locations). The MDCs of COPCs in these vegetation samples are presented in Table 3.4.

3.2 Screening Criteria

This streamlined risk evaluation used previously-derived criteria to provide a screening-level evaluation of the potential human health and ecological risk associated with exposure to COPCs at the Site if no action were to be taken. The screening criteria used are described below.

3.2.1 U.S. Bureau of Land Management Risk Management Criteria

The BLM developed Risk Management Criteria (RMCs) for Metals at BLM Mining Sites[4] as a screening tool for assessing risks to humans and wildlife from metals at abandoned mine sites on BLM lands. The RMCs were derived based on previous work at mining sites, available toxicity data, and standard EPA exposure assumptions. While not a true metal, selenium was included in BLM's selection of Contaminants of Concern (COC).

RMCs are intended to be used by land managers as a cautionary signal that potential health hazards are present and that natural resource management or remedial actions may be required. Furthermore, RMCs may be used as target cleanup levels if remedial action is undertaken. BLM suggests that exceedances of the RMCs be interpreted as follows (Ford 2004):

- Less than RMC = low risk
- 1 to10 times the RMC = moderate risk
- 10 to 100 times the RMC = high risk
- Greater than 100 times the RMC = extremely high risk

BLM provides human health RMCs for various media and exposure scenarios for antimony, arsenic, cadmium, copper, lead, manganese, mercury, nickel, selenium, silver, and zinc. For this risk evaluation, MDCs from the surface water, sediment, and riparian soil data sets were compared to the corresponding RMCs based on a camper scenario. A Native American subsistence scenario may be possible at the Site; however, no specific RMCs for this scenario are available.

BLM provides ecological RMCs for COCs in soil for various wildlife and livestock species. Currently, BLM RMCs are available for arsenic, cadmium, copper, lead, mercury, and zinc. No soil RMCs are available for selenium. For this risk evaluation, MDCs from the soil data were compared to ecological RMCs for six potential receptors: deer mouse, mule deer, elk, cattle, sheep, and robin. Additionally, the MDCs were
Table 3.3

[4] Ford, Karl. "Risk Management Criteria for Metals at BLM Mining Sites", Technical Note 390 rev., October 2004. U.S. Department of the Interior, Bureau of Land Management.

Table 3.3
Maximum Detected Concentrations of COPCs in Riparian Soil Samples

Analyte	MDC (mg/kg)	Analyte	MDC (mg/kg)
Antimony	3.00	Manganese	885
Arsenic	7.76	Mercury	0.22
Beryllium	1.00	Molybdenum	6.40
Cadmium	20.8	Nickel	98.0
Chromium	181	Selenium	15.0
Cobalt	5.00	Silver	2.40
Copper	36.0	Vanadium	170
Iron	12,600	Zinc	536
Lead	11.0		

Notes:
mg/kg = milligram per kilogram
COPC = Contaminant of potential concern
MDC = Maximum detected concentration

Table 3.4
Maximum Detected Concentrations of COPCs in Vegetation Samples

Analyte	MDC (mg/kg)	Analyte	MDC (mg/kg)
Antimony	ND	Manganese	168
Arsenic	2.42	Mercury	0.09
Beryllium	ND	Molybdenum	31.7
Cadmium	30.0	Nickel	6.65
Chromium	40.0	Selenium	76.1
Cobalt	ND	Silver	ND
Copper	11.0	Thallium	ND
Iron	1,400	Vanadium	13.7
Lead	ND	Zinc	192

Notes:
mg/kg = milligram per kilogram
COPC = Contaminant of potential concern
MDC = Maximum detected concentration
ND = Not detected

compared to the median RMCs, which are suggested for use as criteria suitable for protecting groups of species, communities, or ecosystems (Ford 2004).

3.2.2 Action Levels from the Area Wide Risk Management Plan for the Southeast Idaho Phosphate Mine Sites

In 2004, the IDEQ published the Final Area Wide Risk Management Plan (AWRMP): Removal Action Goals and Objectives, and Action Levels for Addressing Releases and Impacts from Historic Phosphate Mining Operations in Southeast Idaho (IDEQ 2004). The purpose of the AWRMP was to provide discretionary guidance to assist with mine-specific risk management decisions regarding impacts from selenium and related trace metals in the Southeast Idaho Phosphate Mining Resource Area.

The AWRMP presents monitoring action levels and Remedial Action Levels (RAL) for various media for the seven most probable COPCs associated with mining activities in southeast Idaho: cadmium, chromium, copper, nickel, selenium, vanadium, and zinc. The basis for the RALs in each media is discussed below.

3.2.2.1 Surface Water

The RALs for surface water bodies regulated by the State of Idaho are based on Idaho's Water Quality Standards, Criteria Continuous Concentration (CCC or chronic criterion), found in Idaho Administrative Procedures Act (IDAPA) 58.01.02, except for the RAL for vanadium, which is based on Tier II Secondary Chronic Benchmarks. The RALs used in this streamlined risk evaluation are based on IDAPA 58.01.02. The criteria for hardness dependent metals, which are based on a standard hardness value of 100 mg/L, were calculated using IDEQ's Metals Criteria Calculator (IDEQ 2008), and were rounded to two significant figures. The average hardness of samples collected from SW-2 in 2007 was 629.7 mg/L (TRC 2008). Idaho's Water Quality Standards are among the potential Applicable or Relevant and Appropriate Requirements (ARARs) for the Site.

3.2.2.2 Sediment

The RALs for sediment supporting aquatic life are based on the National Oceanic and Atmospheric Administration (NOAA) probable effects levels (PEL) for aquatic species, where available. In the absence of PELs, the literature-referenced effective concentration (EC10) for reproductive effects in freshwater birds and fish was used for selenium, and Area Wide background levels, which exceeded the non-regulated sediment risk levels, were used for vanadium. Where the MDC for Area Wide background levels exceeded the benchmarks for any constituent, the background MDC was used as the criterion instead of the selected risk threshold value.

3.2.2.3 Riparian/Fluvial Soils

The RALs for riparian/fluvial soils are based on incidental ingestion by sensitive species residing in riparian zones and wetland areas and consist of one half of the no observed adverse effects level (NOAEL) single media acceptable concentration. Where the MDC for Area Wide background levels exceeded the benchmarks for any constituent, the background MDC was used as the criterion instead of the calculated risk threshold value.

3.2.2.4 Vegetation

The vegetation RALs for all constituents were derived from risk-based calculations for potential effects on herbivorous birds and mammals.

3.3 Human Health Risk Evaluation

A comparison of the MDCs, for the surface water, sediment, and riparian soil samples from the Site to the available BLM RMCs for the camper scenario, is presented in Table 3.5. As BLM RMCs are only available for antimony, arsenic, cadmium, copper, lead, manganese, mercury, nickel, selenium, silver, and zinc, no other constituents were considered for this evaluation. The screening shows that there are exceedances of human health RMCs as listed below, indicating that there is potentially unacceptable risk to human health at the Site.

- Selenium in surface water exceeds the RMC for campers at a level indicating moderate risk.
- Selenium in sediment exceeds the RMC for campers at a level indicating moderate risk.

Table 3.5
Human Health Risk Screening

Media and Receptor	Units	COPC Concentration																			
		Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Uranium	Vanadium	Zinc
Surface Water (SW-2) MDC	µg/L	**1,140**	**120**	**ND**	**35**	**ND**	**24**	**ND**	**NA**	**ND**	**1,200**	**ND**	**96**	**ND**	**20**	**66**	**3,140**	**ND**	**7.4**	**11**	**400**
BLM RMC - Camper	µg/L	NC	124	93	NC	NC	155	NC	NC	11,490	NC	50	1,548	93	NC	6,194	1,548	1,548	NC	NC	92,909
Sediment MDC	mg/kg	**NA**	**ND**	**4.02**	**NA**	**1.20**	**20.2**	**81.0**	**9.00**	**26.0**	**19,700**	**16.0**	**2,410**	**0.17**	**5.20**	**192**	**829**	**3.40**	**NA**	**91.0**	**943**
BLM RMC - Camper	mg/kg	NC	62	46	NC	NC	155	NC	NC	5,745	NC	1,000	21,679	46	NC	3,094	774	774	NC	NC	46,455
Riparian Soils (Transect 2) MDC	mg/kg	**NA**	**3.00**	**7.76**	**NA**	**1.00**	**20.8**	**181**	**5.00**	**36.0**	**12,600**	**11.0**	**885**	**0.22**	**6.40**	**98.0**	**15.0**	**2.40**	**NA**	**170**	**536**
BLM RMC - Camper	mg/kg	NC	50	20	NC	NC	70	NC	NC	5,000	NC	1,000	19,000	40	NC	2,700	700	700	NC	NC	40,000

Notes:
µg/L = microgram per liter
mg/kg = milligram per kilogram
Exceedances of BLM RMCs (Ford 2004) are shaded and interpreted as follows:
< RMC = low risk
1 to 10X RMC = Moderate risk
BLM = U.S. Bureau of Land Management
COPC = Contaminant of potential concern
MDC = Maximum detected concentration
NA = Not available
NC = No BLM RMC
ND = Not detected
RMC = Risk Management Criteria

3.4 Ecological Risk Evaluation

A comparison of the MDCs for vegetation, surface water, sediment, and soil samples collected from the Site, along with the available AWRMP RALs and BLM RMCs is presented in Table 3.6. The BLM and AWRMP combined provide criteria for arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, vanadium, and zinc. Due to the lack of additional criteria, no other constituents were considered in this risk evaluation. The screening shows that there are exceedances of the RALs and/or RMCs as listed below, indicating that there is unacceptable risk to ecological receptors at the Site.

- Cadmium, chromium, and selenium in vegetation exceed the RALs.
- Cadmium, selenium, and zinc in surface water exceed the RALs (i.e., Idaho Water Quality Standards which are among the Site's potential ARARs).
- Cadmium, nickel, selenium, vanadium, and zinc in sediment exceed the RALs.
- Cadmium, chromium, nickel, selenium, and vanadium in riparian soil exceed the RALs. Additionally, arsenic, cadmium, copper, lead, and zinc in riparian soils exceed the RMCs for one or more species.
- Cadmium and zinc in riparian soils exceed the median RMCs as well as RMCs for individual species. As discussed above, Ford suggests using median RMCs as criteria suitable for protecting groups of species, communities, or ecosystems (Ford 2004).

Table 3.6
Ecological Risk Screening

Media and Receptor	Units	COPC Concentration																				
		Aluminum	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Cobalt**	**Copper**	**Iron**	**Lead**	**Manganese**	**Mercury**	**Molybdenum**	**Nickel**	**Selenium**	**Silver**	**Thallium**	**Uranium**	**Vanadium**	**Zinc**
CVF Vegetation MDC	mg/kg	**NA**	**ND**	**2.42**	**NA**	**ND**	**30.0**	**40.0**	**ND**	**11.0**	**1,400**	**ND**	**168**	**0.09**	**31.7**	**6.65**	**76.1**	**ND**	**ND**	**NA**	**13.7**	**192**
AWRMP Removal Action Levels	mg/kg	NC	NC	NC	NC	NC	4.2	30.6	NC	88.0	NC	NC	NC	NC	NC	35.5	8.3	NC	NC	NC	55.9	615
Surface Water (SW-2) MDC	µg/L	**1,140**	**120**	**ND**	**35**	**ND**	**24**	**ND**	**NA**	**ND**	**1,200**	**ND**	**96**	**ND**	**20**	**66**	**3,140**	**ND**	**NA**	**7.4**	**11**	**400**
AWRMP Removal Action Levels for regulated surface water	µg/L	NC	NC	NC	NC	NC	1.3	230	NC	37	NC	NC	NC	NC	NC	170	5.0	NC	NC	NC	20.0 (dissolved)	380
Sediment MDC	mg/kg	**NA**	**ND**	**4.02**	**NA**	**1.20**	**20.2**	**81.0**	**9.00**	**26.0**	**19,700**	**16.0**	**2,410**	**0.17**	**5.20**	**192**	**829**	**3.40**	**NA**	**NA**	**91.0**	**943**
AWRMP Removal Action Levels for sediments supporting aquatic life	mg/kg	NC	NC	NC	NC	NC	5.1	100.0	NC	197	NC	NC	NC	NC	NC	44	2.6	NC	NC	NC	72	210
Riparian Soils (Transect 2) MDC	mg/kg	**NA**	**3.00**	**7.76**	**NA**	**1.00**	**20.8**	**181**	**5.00**	**36.0**	**12,600**	**11.0**	**885**	**0.22**	**6.40**	**98.0**	**15.0**	**2.40**	**NA**	**NA**	**170**	**536**
AWRMP Removal Action Levels for riparian/fluvial soils	mg/kg	NC	NC	NC	NC	NC	5.6	110	NC	117	NC	NC	NC	NC	NC	37	5.2	NC	NC	NC	83	738
BLM RMC - Deer Mouse	mg/kg	NC	NC	230	NC	NC	7	NC	NC	640	NC	142	NC	2	NC	NC	NC	NC	NC	NC	NC	419
BLM RMC - Mule Deer	mg/kg	NC	NC	200	NC	NC	3	NC	NC	102	NC	106	NC	9	NC	NC	NC	NC	NC	NC	NC	222
BLM RMC - Elk	mg/kg	NC	NC	328	NC	NC	3	NC	NC	131	NC	127	NC	11	NC	NC	NC	NC	NC	NC	NC	275
BLM RMC - Cattle	mg/kg	NC	NC	419	NC	NC	15	NC	NC	413	NC	244	NC	45	NC	NC	NC	NC	NC	NC	NC	1082
BLM RMC - Sheep	mg/kg	NC	NC	352	NC	NC	12	NC	NC	86	NC	203	NC	38	NC	NC	NC	NC	NC	NC	NC	545
BLM RMC - Robin	mg/kg	NC	NC	4	NC	NC	0.3	NC	NC	7	NC	6	NC	1	NC	NC	NC	NC	NC	NC	NC	43
BLM RMC - Median	mg/kg	NC	NC	275	NC	NC	3	NC	NC	136	NC	125	NC	8	NC	NC	NC	NC	NC	NC	NC	307

Notes:
Screening criteria for hardness dependent metals are based on a hardness value of 400 mg/L. The average hardness of samples collected from SW-2 in 2007 was 629.7 mg/L (TRC 2008).
Removal Action Levels (RAL) are based on Idaho's current (2008) Water Quality Standards, found in Idaho Administrative Procedures Act (IDAPA) 58.01.02, except for vanadium, which is based on Tier II Secondary Chronic Benchmarks.
Exceedances of AWRMP RALs are denoted by gray shading.
µg/L = microgram per liter
mg/kg = milligram per kilogram
Exceedances of BLM RMCs (Ford 2004) are shaded and interpreted as follows:
< RMC = low risk
1 to 10X RMC = Moderate risk
10 to 100X RMC = High risk
AWRMP = Area Wide Risk Management Plan
BLM = U.S. Bureau of Land Management
COPC = Contaminant of potential concern
CVF = Cross valley fill
MDC = Maximum detected concentration
NA = Not available
NC = No BLM RMC
ND = Not detected
RMC = Risk Management Criteria

4.0 WATER BALANCE ANALYSIS

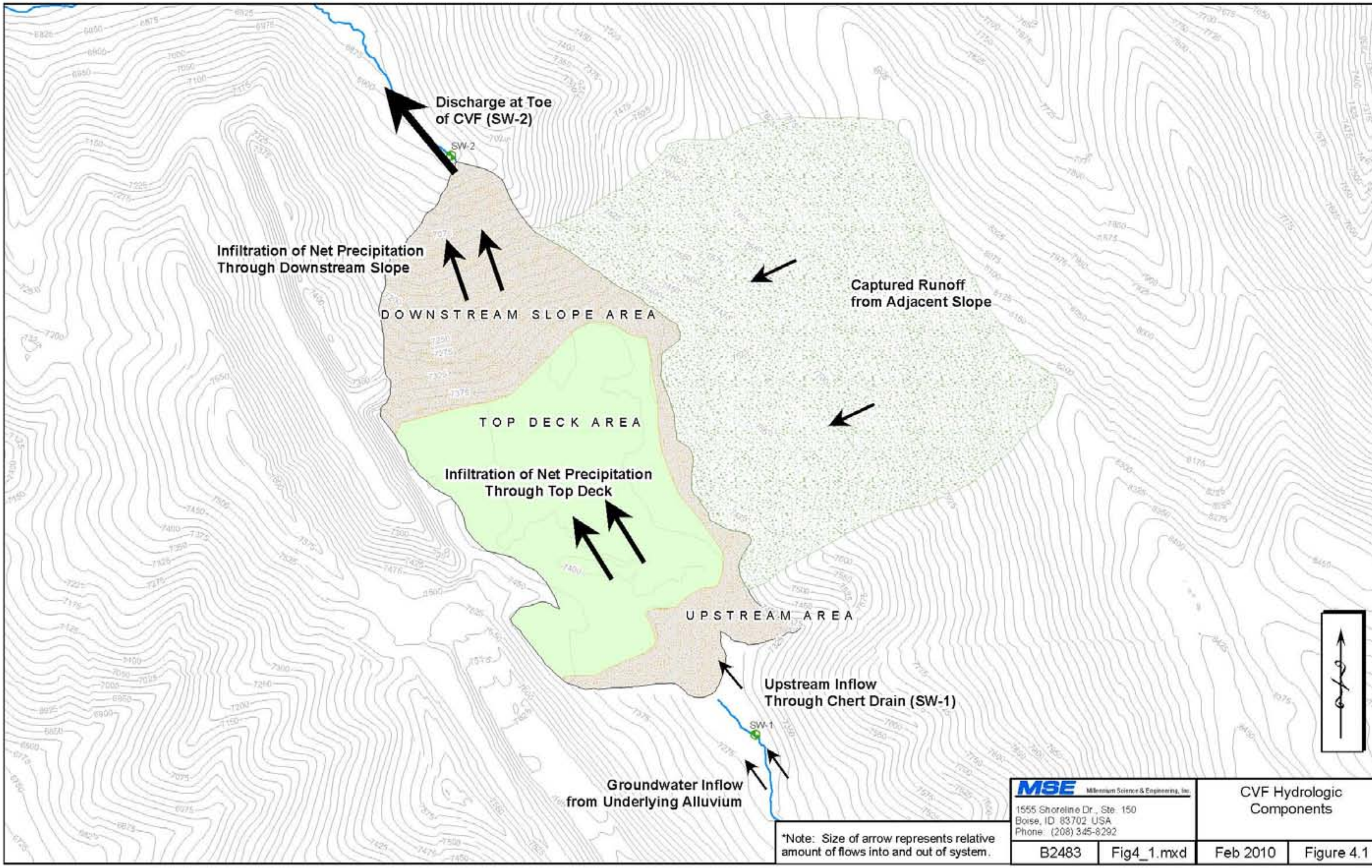
Water sources provide the transport mechanism to leach and release contaminants from phosphate mine generated waste rock disposed in the South Maybe CVF. Alternatives proposed in this EE/CA were developed to manage water that would infiltrate the surface of the fill, migrate downgradient, and discharge as a portion of the Maybe Creek flow. To better understand the different surface and groundwater contributions to Maybe Creek, a water balance was prepared to estimate and separate surface and groundwater contributions.

This section describes the prevailing hydrologic components controlling water flow and associated selenium loading mechanisms within the CVF. The water balance describes the relative contribution of the major components of flow that comprise stream flows in Maybe Creek at the toe of the CVF. Inflows to the CVF include surface water flows above the CVF in Maybe Creek (SW-1) and recharge into the surface of the CVF from net precipitation from snow and rain (less evaporation) on the top deck and slopes of the CVF. Primary outflows include discharge at SW-2 into Maybe Creek, and evapotranspiration from the CVF surface. Groundwater also discharges from alluvial materials below the CVF as seeps and springs during high flows, which also contribute to discharge into Maybe Creek.

The CVF can be divided into areas based on position within the CVF and the estimated volume of seleniferous waste rock within each area. Figure 4.1 illustrates the primary hydrologic components affecting flows in and out of the CVF. The areas include the downstream slope of the CVF comprised of 15 acres of chert materials at the toe of the slope and 25 acres of shale at approximately 3H:1V grade seen in the upper slope. The top deck consists of approximately 68 acres of ROM material that includes a substantial shale component, and approximately 7 acres of chert blanket along the eastern margin of the CVF. The upstream toe of the CVF is mostly chert graded at 3H:1V but some seleniferous waste rock occurs in the upper portions of the CVF on the western side. Runoff from 176 acres of Dry Ridge east of the CVF can contribute water to Maybe Creek during peak flows. Undisturbed rocks of the Dinwoody Formation form the ridge lying above the CVF. Sampling elsewhere has shown the Dinwoody Formation to be devoid of seleniferous waste rock.

4.1 Surface Water Flows

Measured stream flows in and out of the CVF in Maybe Creek were used to quantify the major components of the water balance. The water balance analysis utilizes daily flow measurements in Maybe Creek at monitoring stations SW-1 and SW-2 during the 1999 through 2006 water years. Figure 2.6 illustrates the relationship between flows at SW-1 upstream of the CVF and flows at SW-2 downstream of the CVF.



Discharge at Toe of CVF (SW-2)
SW-2
Infiltration of Net Precipitation Through Downstream Slope
DOWNSTREAM SLOPE AREA
Captured Runoff from Adjacent Slope
TOP DECK AREA
Infiltration of Net Precipitation Through Top Deck
UPSTREAM AREA
Upstream Inflow Through Chert Drain (SW-1)
SW-1
Groundwater Inflow from Underlying Alluvium
*Note: Size of arrow represents relative amount of flows into and out of system.
MSE Millennium Science & Engineering, Inc.
1555 Shoreline Dr., Ste. 150
Boise, ID 83702 USA
Phone: (208) 345-8292
CVF Hydrologic Components
B2483
Fig4_1.mxd
Feb 2010
Figure 4.1

Flows measured downstream of the CVF are much greater than those measured upstream of the CVF. During the drought years from 2001 to 2004, Nu-West's contractor was not able to measure surface water flow at SW-1 (immediately upstream from the CVF) while flows at SW-2 (immediately downstream for the CVF) ranged from 0.5 cfs to slightly over 1.0 cfs. All discharge flowing at SW-2, during these years, is attributed to recharge through the CVF and from minor groundwater discharge flows, as springs, beneath the fill. Baseflow in Maybe Creek is estimated to be between 0.10 and 0.25 cfs during late summer through late fall. During dry years, when seasonal infiltration into and through the fill is lowest, in late summer, emergent flow at the toe of the fill is indicative of discharges from the springs beneath the fill. During wetter years, the proportion of flows at SW-2 attributable to upstream discharges at SW-1 is greater; however, surface water flow from the basin above SW-1 would still constitute only a minor portion of flows in Maybe Creek at the toe of the CVF. Over the period of record, upstream flows constitute an average of 8.5 percent of flows downstream of the CVF.

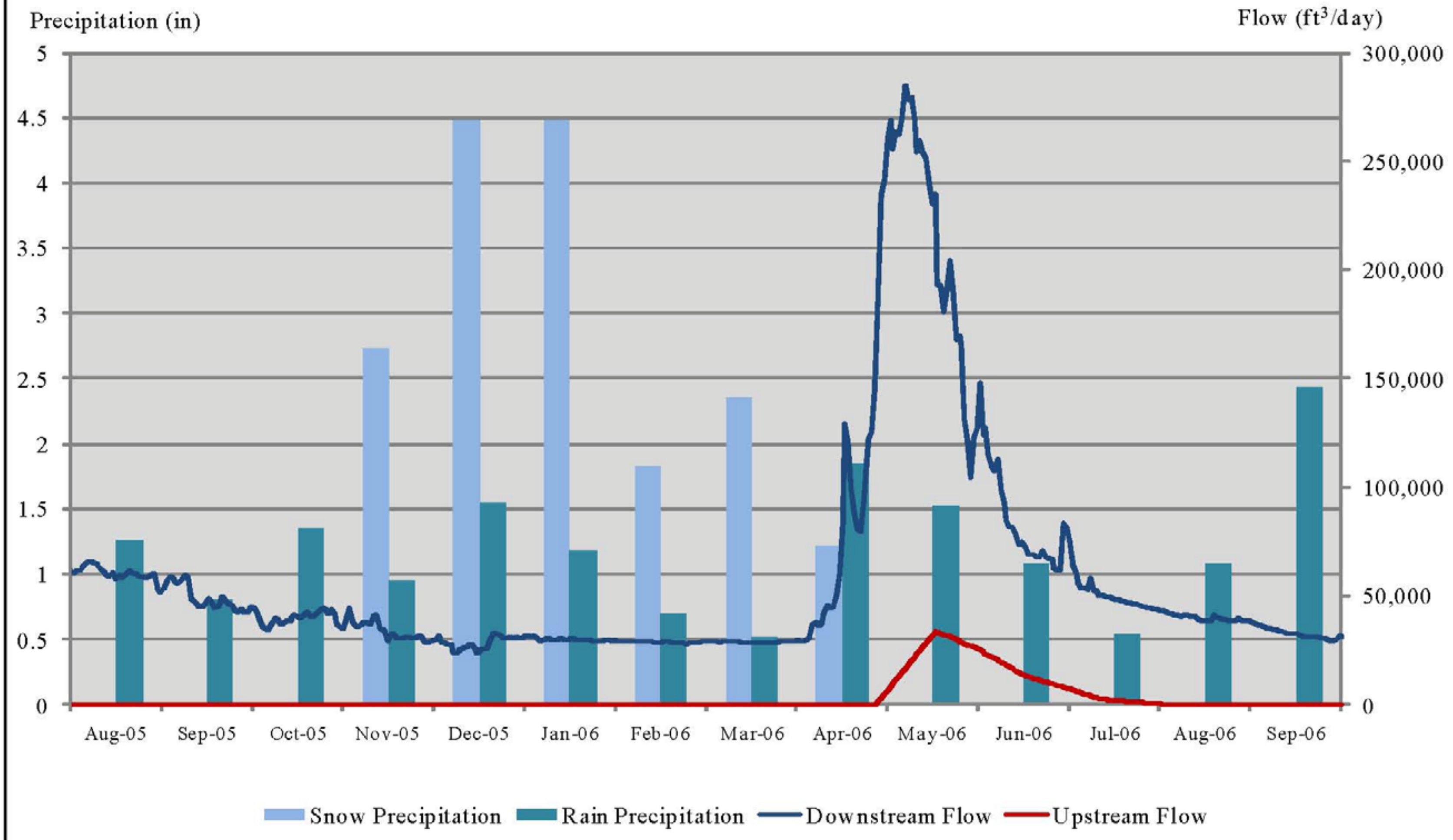
4.2 Precipitation

Precipitation records were obtained from the Slug Creek SNOTEL station, the Dry Valley Mine, and the weather station on top of the CVF. The SNOTEL station provides the most complete data set of daily precipitation records available for the area. Precipitation data from weather stations at the Dry Valley Mine and the CVF indicate the CVF receives less water than the Slug Creek Station. The Slug Creek SNOTEL station is located approximately 11 miles southeast of the Site at approximately the same elevation as the CVF. The annual average precipitation at the Slug Creek SNOTEL station is 32.0 inches based on a 30-year period of record. The precipitation measured at the Slug Creek SNOTEL station between 1999 and 2006 ranged from 20.1 to 35.4 inches per year. The range of precipitation measured between 1999 and 2006 includes 2 years of below average rainfall and snowpack (i.e., 2000 = 24.1 inches, and 2001 = 20.1 inches), and 2 years of above average precipitation (1999 = 33.3 inches, and 2006 = 35.4 inches).

Correction factors were developed to relate the amount of precipitation measured at the CVF to the Slug Creek SNOTEL station. Correction factors were based on snow moisture content surveys conducted for three survey dates at the CVF using ratios of snow water content and rainfall comparing the two sites. Snow water equivalent correction factors were calculated by dividing the daily average snow water content measured at the CVF for three survey dates by the snow water content measured at the Slug Creek station during the same period. The average correction factors that relate rainfall and snow water equivalent at Slug Creek to the CVF are 0.90 and 0.76, respectively. Annual volumes of precipitation falling on the CVF were calculated from the corrected daily measurements for each water year. The estimates of precipitation provide a reliable evaluation of contribution by rainfall and snow on the CVF. Most of the annual precipitation occurs between October and June.

During the winter months, snow accumulates on the surface of the CVF. As temperatures increase with the onset of spring, the snowpack begins to melt and springtime rains increase infiltration. Melt water flows through the snowpack and along the upper surface of the CVF until it infiltrates into the CVF or reaches Maybe Creek. Most of the snowmelt infiltrates the surface of the CVF, as minimal runoff is observed entering Maybe Creek from the CVF surface. During summer months, runoff from short duration high intensity storm events may flow over the surface of the CVF for a short distance before it infiltrates the CVF. During hotter months, infiltration volumes are smaller because a higher percentage of precipitation evaporates. Precipitation that does infiltrate the CVF mixes with the underflow within the fill before discharging at SW-2 as Maybe Creek.

While some of the precipitation accumulated during the winter as snow sublimates, most of the melt each spring, as the weather warms, enters the CVF as infiltration. Water from snowmelt is responsible for peak discharges in Maybe Creek at the toe of the CVF. Figure 4.2 illustrates the relationship between flows downstream of the CVF at SW-2 and estimated total monthly precipitation during the 2005-2006 water years. In the water balance, increased flow at SW-2 is determined by subtracting baseflow from the flow volume emerging at SW-2. Baseflow is calculated by subtracting all known sources of water from the discharge at SW-2. The remaining flow is the baseflow. Due to the timing and type of precipitation, a large portion of the annual precipitation is released during a relatively short time (i.e., 3 to 5 weeks) in the spring and early summer. The peak discharge at SW-2 in the spring is a function of the amount and type of precipitation during a particular water year.



MSE Millennium Science & Engineering, Inc
1555 Shoreline Dr., Ste. 150
Boise, ID 83702 USA
Phone: (208) 345-8292

Precipitation and Discharge Correlation for Water Year 2006

B2483	Fig4.2.mxd	Feb 2010	Figure 4.2

4.3 Groundwater Base Flow

Base flow, attributable to groundwater, comes from springs and seeps that emerge from aquifers in alluvium, colluvium, and the Dinwoody Formation beneath the CVF. Selenium leaches from the CVF as water flows in and over the seleniferous waste rock in the fill. Groundwater flow in the alluvium, colluvium, and Dinwoody Formation beneath the CVF is a minor component of the total discharge at SW-2, as represented by baseflow during hotter months (Figure 2.6). Groundwater flow in the alluvium and colluvium beneath the CVF is estimated by a simplified application of Darcy's Law as a function of aquifer hydraulic conductivity, hydraulic gradient, and saturated cross-sectional area. The hydraulic conductivity of the aquifer used for the calculation is 3.0 x 10^{-3} cm/sec (8.5 ft/d) and was derived from the geometric mean of hydraulic conductivity measurements at PZ-1, MC-1, MC-6, MC-8, MC-11, MC-12, and MC-13. The hydraulic gradient beneath the CVF was estimated from water level measurements at PZ-1 and MC-1, upgradient and downgradient of the CVF, respectively. The calculated gradient is approximately 0.070 feet/feet. The geometry of the aquifer in cross section is assumed to be triangular where the ridges on either side of the CVF form two sides of a rhombus. The water table (assumed to be horizontal in cross section) forms the third side. The slopes of the aquifer bottom on either side of the rhombus, are assumed to follow the slope of each ridge, and are estimated from topography. The saturated alluvial/colluvial cross-sectional area under the fill is estimated to be 17,980 square feet (ft^2), which yields an estimated groundwater flow rate of approximately 10,700 cubic feet per day (ft^3/day) (0.12 cfs or 80,000 gallons per day [gpd]) under these conditions. This value corresponds well with baseflows observed during dryer months (Figure 2.6).

This analysis suggests that groundwater flow from the alluvium is a small component of flows beneath the CVF and that the greatest percentage of flow at SW-2 originates from infiltration into the CVF.

4.4 Water Balance Summary

Table 4.1 presents a general summary of the primary hydrologic components of flow measured upstream and downstream of the CVF. Annual volumes of water measured between SW-1 and SW-2 from 1998 to 2006 were calculated along with the annual precipitation estimated to fall on approximately 115 acres of the top deck and downstream slope of the CVF. The gross calculations of total volume of annual precipitation were compared to the total increase in flow across the CVF between SW-1 and SW-2. The analysis does not balance to zero because it does not incorporate water lost due to evapotranspiration, which would reduce calculated net precipitation, nor does the analysis consider baseflow. The analysis indicates a large percentage of flow emerging from the toe of the dump originates from precipitation falling on and infiltrating through the CVF.

Table 4.1
Summary of Hydrologic Components

Date	Upstream Flow (SW-1) (ft^3/yr)	Downstream Flow (SW-2) (ft^3/yr)	Flow Gained Between SW-1 & SW-2[a] (ft^3/yr)	Precipitation (in/yr)	Potential Precipitation Contribution to CVF Area[b] (ft^3/yr)
Oct-98 to Sept-99	4,204,960	18,765,575	14,560,615	29.97	12,510,977
Oct-99 to Sept-00	1,324,765	11,916,114	10,591,349	21.69	9,054,491
Oct-00 to Sept-01	81,389	7,984,926	7,903,538	18.09	7,551,671
Oct-01 to Sept-02	0	7,859,641	7,859,641	23.94	9,993,753
Oct-02 to Sept-03	21,490	9,670,088	9,648,598	24.75	10,331,888
Oct-03 to Sept-04	ND	ND	ND	28.44	11,872,278
Oct-04 to Sept-05	1,394,778	21,161,201	19,766,423	29.97	12,510,977
Oct-05 to Sept-06	1,303,087	21,144,639	19,841,552	31.86	13,299,957

Notes:
ft^3/yr = cubic feet per year
in/yr = inch per year
[a]Flow gained between SW-1 & SW-2 = SW-1 – SW-2
[b]Potential precipitation contribution to CVF area = Precipitation X CVF area X unit conversions
CVF area = 115 acres
CVF = Cross valley fill

5.0 REMOVAL ACTION OBJECTIVES

This EE/CA focuses on a limited, targeted interim Removal Action for the CVF and includes targeted objectives for the CVF. Sediment and riparian soils will be addressed in a future Remedial Investigation and Feasibility Study. Based on the results of the streamlined risk evaluation, RAOs were developed to mitigate the identified risks associated with the CVF. The RAOs for this focused EE/CA are to:

- Minimize infiltration on the surface of the CVF to reduce the load (concentration times volume) of selenium and other hazardous substances into Maybe Creek;
- Prevent exposure of human and ecological receptors to hazardous substances in vegetation on the surface of the CVF; and
- Capture and isolate precipitation runoff from the CVF surface and to consequently reduce flow from within the fill. Smaller emergent flows will be easier to manage if further treatment is determined to be necessary.

6.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section provides a description and screening of the management and treatment technologies identified as potential options for meeting the RAOs. Removal Action technologies were analyzed for their effectiveness, implementability, and cost to meet RAOs. The criteria used to screen the technologies, as provided in the EPA Office of Solid Waste and Emergency Response (OSWER) guidance (USEPA 1993), are:

- Effectiveness,
- Implementability, and
- Cost.

Effectiveness criteria include the ability to meet the RAOs, compliance with ARARs, and overall protection of human health and the environment. Implementability is a measure of the technical and administrative feasibility of constructing the Removal Action and the availability of services and materials. Technical feasibility includes the ability to construct, operate, maintain and monitor the Removal Action. Administrative feasibility includes the ability to obtain approvals to install, operate, and monitor the response actions from the appropriate agencies.

Estimated costs include relative estimates of capital equipment and installation, as well as operation, maintenance and monitoring (OM&M) expenses.

6.1 Description and Screening of Technologies

A limited number of technologies appropriate for addressing the RAOs were identified for providing source control for the CVF. Guidance documents, technical journals, pilot studies, results from similar projects, and other sources were used to identify technologies appropriate for source control for the CVF. The screening includes proven technologies

Table 6.1
Technologies Analyzed for the Cross Valley Fill

Technology	Effectiveness-Overall Protection of Human Health and the Environment	Technical Feasibility for Removal Contaminants and Media of Concern	Availability of Materials and Services and Administrative Feasibility	Costs	Technology Retained
Capping	Capping to limit infiltrating water from contacting seleniferous rock.	Capping is a proven technology implemented at other similar mining sites.	Cap materials may not be available locally. Cap materials can be purchased and brought on Site.	High	**Yes**
Grading and Diversions	Grading and diversions to improve runoff control, erosion, to reduce contact time between surface water and waste rock, and to reduce Se loading.	Technically feasible and can be implemented on the surface and downstream face of the CVF.	Local expertise and equipment is available for grading and diversion options; administratively feasible.	Medium	**Yes**
Chemical and/or Biological Fixation	Chemical and biological additives have been shown to reduce the mobility of Se from the waste rock which would lower Se loadings.	This alternative only treats near surface waste rock; it is not feasible to treat or amend all the seleniferous rock in the CVF; the great depth (250+ feet) limits the implementability.	Treatment Materials would have to be imported from treatment producers.	High	No
Removal	Waste rock removal and relocation from Maybe Canyon to reduce Se loadings in Maybe Creek would transfer contaminants to a new location while it may be necessary to leave some waste rock in place because of swell. Removal would effectively remediate current waste location.	Large volume of material to move; limited number of acceptable disposal places to take the waste. May need additional controls installed at the new location. Extensive manpower, oversight, and equipment necessary for several years to complete.	Off-Site permitted disposal facility or repository not readily available; administrative feasibility uncertain.	High	No
Institutional Controls	Institutional controls are administrative actions and provide limited protection to human health or the environment; Se loadings would remain the same.	Implementable	Implementable.	Low	**Yes**

Notes:
CVF = Cross valley fill

that have been successfully implemented at similar sites. Technologies evaluated during screening include:

- Institutional Controls,
- Excavation and On-Site/Off-Site Disposal,
- Chemical and/or Biological Fixation,
- Grading and Diversions, and
- Capping.

6.1.1 Institutional Controls

Institutional controls (IC), such as administrative and/or legal controls, minimize the potential for exposure of humans to contamination by limiting land or resource use. ICs may be used at different points in the investigation and response process in conjunction with other actions to promote the short-term and long-term protection of human health and the environment. ICs should be considered at properties where hazardous substances prevent unlimited use and unrestricted exposure (USEPA 2000). Common examples of ICs include zoning restrictions, building or excavation permits, well drilling prohibitions, and easements and restrictive covenants. When response actions cannot restore National Forest System lands to their unrestricted beneficial uses, the Forest Service may implement ICs through Forest Plan amendments and/or notations on Forest Service land status records.

Institutional controls alone will not be effective in preventing or reducing infiltration into the CVF, or in preventing exposure to ecological receptors. However, institutional controls may be effective in conjunction with other technologies such as capping to prevent uses by humans that would damage such technologies.

Institutional controls were retained for further evaluation in combination with other acceptable technologies. Overall, short-term costs for implementing ICs are low.

6.1.2 Excavation and On-Site/Off-Site Disposal

Waste rock could potentially be excavated from the CVF and transported to the original mine pit and/or another location for disposal. A portion of the original mine pit has already been filled to create the land bridge; the remaining portion of the pit could accommodate approximately one-half of the CVF waste rock. As a consequence of mining, excavation increases waste rock volume by approximately 30 percent. Excess material that cannot be backfilled would be either left in place or transported and disposed of at a separate facility.

Environmental protection measures employed to reduce sedimentation, unmanaged runoff, and Site reclamation would be necessary. Excavation and transport to an off-site facility is likely to be implementable and effective with minimal need for post removal

Site controls. However, costs associated with this alternative are substantial when considering equipment, staff, transportation, and disposal costs. Excavation and backfill of the material on-site, as a response action, would be required to meet RAOs, contemporary repository construction standards, and any required post-removal Site controls for the repository. In addition to the waste rock in the CVF, the underlying alluvial material and colluvial material underlying the fill would also require removal. Water infiltrating these materials will have transported contaminants from the fill into these materials. These actions may require placement of a low-permeable cap over the removed material as well as capping any material that is not removed from the existing location.

Removal and relocating the CVF from Maybe Canyon would be costly to implement. However, it may reduce long-term exposure to waste materials in direct contact with Maybe Creek. Effectiveness may be limited if all of the materials underlying the fill are not adequately removed and an adequate disposal site is not available. Waste rock removal using 150-ton capacity haul trucks was calculated to require approximately 350,000 trips to move the estimated 29,000,000 yd^3 of waste rock. A substantial equipment fleet would be required to load, transport, haul, distribute, and reclaim such a large volume of material in a reasonable time. The cost estimate (Appendix B1, TRC) shows the anticipated cost to remove the CVF would exceed $1,800,000,000. Due to the high cost of implementation and likelihood of this option creating additional environmental impacts to the region with the 350,000 haul truck trips, removing the CVF from Maybe Canyon was not retained for further evaluation.

6.1.3 Chemical and/or Biological Fixation

Fixation technologies employ chemical or biological additives to immobilize soluble selenium in waste rock. This treatment process involves the addition of materials to the CVF that combine physically and/or chemically with the waste rock to decrease the selenium mobility. The fixation process includes mechanically mixing a binding agent with waste material. The fixation can be completed by mixing waste near the surface in place or by excavating the waste, mixing with a binding agent, and placing the stabilized material in a repository. In-situ fixation is only effective for shallow waste deposits. Fixation of deep waste deposits requires extensive material handling and processing.

Chemical and biological fixation as a technology is implementable; however, it may not have the long-term effectiveness required to meet RAOs at the Site. Chemical and biological fixation technologies are effective under the appropriate circumstances. At this Site, it would be extremely difficult to apply a binding agent through the entire thickness of the CVF (425 ft in depth) using mechanical mixing. The surface of the CVF could be treated, but the deeper seleniferous rock would remain untreated and selenium loading from this deeper seleniferous rock would continue to Maybe Creek. The cost for implementing a fixation technology was calculated to be greater than $10 million. Chemical and biological fixation was not retained for further evaluation because it is not technically feasible to apply binding material to the large volume of material within the entire CVF.

6.1.4 Grading and Diversions

Grading and surface water diversions are potential technologies to reduce infiltration and control surface water runoff and erosion of the CVF. Specific grading options include increasing slope gradients, decreasing slope gradients, smoothing surfaces, and installing terraces. Specific surface water diversion options include diverting water to (1) the chert blanket located along the eastern side of the CVF, or (2) diversions off the margins of the CVF. Surface water flow directed to the chert blanket would infiltrate and flow beneath the CVF to Maybe Creek. Surface water directed to diversions off the CVF would be isolated from waste rock in the CVF and diverted around the CVF to Maybe Creek. Grading and surface water runoff diversion options for the top deck and downstream slope of the CVF are discussed below.

The CVF top deck would be graded at a constant slope toward the chert blanket to (1) eliminate surface depressions where water collects, and (2) increase the surface gradient from the west to the east side of the CVF to direct surface water runoff to either the chert blanket or to a diversion channel along the eastern margin of the CVF. The diversion channel would also intersect runoff from 176 acres of undisturbed forest upslope from the CVF.

Grading alternatives for the downstream CVF slope include reducing the overall slope angle to 3.5H:1V and installing graded terraces to capture and isolate runoff, and to reduce slope lengths and surface water velocities. Surface flow from the lowest elevations of the slope (i.e. the toe) would flow directly into Maybe Creek. The bottom 15 acres of the slope are chert and will not be included in the Removal Action.

The existing CVF top deck has a high infiltration rate allowing precipitation to percolate through the waste rock and leach selenium to Maybe Creek. Grading the CVF top deck would minimize water collection in ponds during snowmelt and after storms, and reduce infiltration through the waste material. Grading alone would have limited effect on controlling infiltration and runoff from the CVF. Services and materials are available and it is administratively feasible to grade the CVF. Grading, in combination with other technologies, may contribute to effective water control and the achievement of RAOs.

Surface water diversion on the CVF top deck into the chert blanket is an implementable technology. The effectiveness of diverting water into the chert blanket may be limited by the infiltration capacity of the chert blanket depending on the size and duration of a specific storm and permeability of the chert blanket. Diverted water would pass through the blanket to the French drain beneath the CVF where it would eventually flow into Maybe Creek. The French drain is reported to have a capacity of 200 cfs. However, water infiltrating the chert blanket and French drain may interact with seleniferous waste rock inappropriately placed in the blanket.

Diverting and capturing runoff in a diversion channel and transporting the water off the CVF is implementable, but challenging because of the steepness and length of the slope.

The materials and services necessary to implement this technology are available. This technology would effectively reduce the volume of water infiltrating the waste rock, and reduce selenium loading to Maybe Creek.

Costs associated with grading and diversion options would be less than $5 million. Grading and diversion options were retained for further evaluation in combination with other technologies.

6.1.5 Capping

Capping involves placing natural and/or synthetic materials over waste materials to control infiltration, surface water runoff, and erosion; and to prevent direct contact with mine waste. Common cap designs include:

- Evaporative caps designed to limit infiltration through evapotranspiration,
- Low permeability caps designed to promote runoff, and
- A combination of the above technologies.

Various naturally occurring and geosynthetic materials are commonly used in caps for landfills and other impoundments such as the CVF. Common types of cap materials include: vegetated covers consisting of natural growth media, compacted clay liners (CCL), geosynthetic clay liners (GCL), and relatively impermeable geomembrane liners (e.g., high-density polyethylene (HDPE) or polyvinyl chloride [PVC]). Drainage layers are often incorporated above the low permeability layer to control saturation; bedding layers are added beneath the liner to minimize damage to the geo-membrane materials during installation. Growth media (soil or a soil substitute) is added to promote soil moisture storage in the overlying layers, improve the reclamation plant community and subsequently erosion control.

Vegetative caps alone require substantial thickness of growth media and would not effectively control infiltration or exposure to seleniferous waste shales at the surface of the CVF. CCL and GCL options are roughly equivalent in reducing infiltration and increasing evapotranspiration. Drainage and runoff control would also need to be provided. Degradation of CCL caps over time reduces long-term performance and effectiveness because the clay dehydrates and cracks during wetting and drying cycles. A CCL-only cap was therefore determined not to meet the effectiveness and performance criteria. Similarly, a cap design using only a GCL for the low permeability layer was determined not to meet the performance and effectiveness criteria because of the potential for increases in permeability over time during wet/dry cycling. Therefore, CCL and GCL options alone were not advanced because of long-term performance limitations. Vegetative covers, CCLs and GCLs were therefore dropped from further consideration as a primary capping technology but were retained for further consideration in a multi-layer hybrid cap configuration. Vegetative cover was retained as a potential upper layer of a multi-layer hybrid cap to provide protection of the lower layers, minimize erosion, and promote evapotranspiration. GCL was retained as a potential layer of a multi-layer hybrid cap because it can provide backup leakage protection in the event that an overlying low permeability layer becomes damaged.

Different cap design requirements for the top deck and the downstream slope apply because of differences in gradient and slope length. Low gradient slopes can accommodate a greater variety of cap designs, including layered cover systems. Slopes with steeper gradients limit the application of layered cover systems because of constructability and stability issues.

Capping the top deck of the CVF with a low permeability geomembrane would isolate the waste rock from direct contact with Site receptors, increase runoff, and minimize infiltration of precipitation and snowmelt. The addition of growth media over the geomembrane would provide protection for the low permeability liner and store water to support reclamation plant growth, which would, in turn, promote evapotranspiration. The top deck of the CVF would require grading prior to cap installation.

Based on the existing gradient (approximately 3H:1V) and long slope lengths, layered cap designs that do not include slope breaks are not appropriate for the downstream slope of the CVF. Grading options for the downstream slope include reducing the slope gradient to 3.5H:1V overall and maximum of 3.2H:1V, and installing terraces to provide slope breaks. If the downstream slope were reduced, a hybrid layered cap could be installed. The terraces and slope could be capped with a low permeability cover and surface water runoff diverted off the CVF.

Services and materials are available for capping the top deck and downstream slope of the CVF and it is administratively feasible. Sources of growth media, fine-grained materials, and coarse durable rock need to be identified. The cost to grade and cap the CVF is greater than $10 million. Capping was retained for further evaluation because it is a proven effective and implementable technology.

The following multi-layered cap configurations were retained for further evaluation.

<u>Top Deck of CVF</u>

The multi-layer cap configuration retained for further evaluation for the top deck of the CVF includes the following elements:

- Surface grading,
- Bedding layer,
- GCL,
- Low permeability geomembrane,
- Synthetic drainage material, and
- Vegetated soil layer.

<u>Downstream Slope of CVF</u>

The multi-layer cap configuration retained for further evaluation for downstream slope of the CVF includes the following elements:

- Grading downstream slope (including terracing),
- Bedding layer,
- Low permeability geomembrane,
- Synthetic drainage material, and
- Vegetated soil layer.

6.2 Summary of Technologies Retained

Table 6.1 presents a summary of the effectiveness, implementability, and cost of the six technologies screened in the analysis discussed above. The technologies retained for further analysis include:

- Capping,
- Grading and diversions, and
- ICs.

These technologies were then combined to create Removal Action alternatives for further evaluation.

Further analysis of the Site will be conducted as a RI/FS. The need for additional response alternatives to achieve long-term remedial goals will be evaluated in the future.

7.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Based on the analysis presented in Section 6.0, alternatives incorporating the technologies that passed the screening criteria were developed. In developing the Removal Action alternatives[5], technologies were grouped into Removal Action alternatives that (1) attain substantial cleanup, (2) control potential releases or future releases, and (3) assure present and future protection of public health and the environment. Factors and evaluation criteria considered during development and analysis of the alternatives include Site conditions and factors listed in the Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA (USEPA 1993).

A range of alternatives developed to meet RAOs for the South Maybe CVF include, as their principal element, reduction of the toxicity, mobility, or volume of the mine waste. The streamlined risk evaluation, summarized in Section 3.0, was used to identify media at the Site that require response. The streamlined risk evaluation indicates there are potential human health and ecological risks associated with exposure to vegetation on the

[5] "Removal actions or alternatives" are the regulatory label given to response actions identified through the EE/CA process. Removal actions include a range of source control, treatment and ICs.

CVF and water leaching through the CVF to Maybe Creek. Consequently, alternatives evaluated for this interim Removal Action address the source (i.e., the CVF).

7.1 Analysis Criteria

Described below are the criteria used to analyze the removal alternatives.

7.1.1 Effectiveness

The effectiveness of an alternative refers to its ability to meet the objective within the scope of the Removal Action. Each alternative was evaluated against the scope of the Removal Action.

7.1.1.1 Overall Protection of Public Health and the Environment

Each alternative was evaluated on the degree to which it would protect public health and the environment. This included assessments of other evaluation criteria, including long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

The discussion focuses on how each alternative achieves adequate protection and describes how the alternative reduces, controls, or eliminates risks at the Site through the use of treatment, engineering, or ICs. This evaluation addresses any unacceptable short-term impacts.

7.1.1.2 Compliance with ARARs and Other Criteria, Advisories, and Guidance

The criterion summarizes which requirements are "applicable or relevant and appropriate" to an alternative and describe how the alternative addresses those requirements. A list of potential ARARs for the Site is included as Appendix C.

7.1.1.3 Long-Term Effectiveness and Permanence

This criterion assesses the extent and effectiveness of the controls that are required to manage risk posed by treatment residuals and/or untreated wastes at the Site. The following factors are considered for each alternative:

Magnitude of Risk
Since this Removal Action is an interim step to be followed by remedial action, this factor was not evaluated.

Adequacy and Reliability of Controls
The completed removal action may require [Post Removal Site Control] PRSC. PRSCs are those response activities necessary to sustain the integrity of a … removal action following its conclusion.

This criterion assesses the degree of post-removal Site control (PRSC) activities that may be required to monitor the Site after the removal alternative has been implemented and to sustain the integrity of the removal action.

7.1.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Where an action is planned, treatment technologies were evaluated on their ability to reduce the principal threats posed by the release, including the extent to which the toxicity, mobility, or volume of the contaminants are reduced (either alone or in combination).

7.1.1.5 Short-Term Effectiveness

The short-term effectiveness criterion addresses effects of the alternative during implementation before the RAOs have been met. Alternatives were also evaluated with respect to their effects on human health and the environment following implementation. The following factors were addressed as appropriate for each alternative: [6]

Protection of the Community
This factor addresses any risk to the affected community that results from implementation of the proposed action, whether from air quality impacts, fugitive dusts, transportation of hazardous materials, or other sources.

Protection of the Workers
This factor addresses any threats to site workers and the effectiveness and reliability of protective measures that would be taken.

Environmental Impacts
This factor evaluates the potential adverse environmental impacts from the implementation of each alternative. The factor also addresses the reliability of mitigation measures in preventing or reducing the potential impacts.

Time Until Response Objectives Are Achieved
This factor estimates the time needed to achieve protection for the Site itself or for individual elements or threats associated with the Site.

7.1.2 Implementability

The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The following factors were considered under this criterion:

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[6] Guidance on Conducting Non-Time Critical Removal Actions under CERCLA, EPA540-R-93-057, August 1993. Section 2.6

7.1.2.1 Technical Feasibility

Each alternative was evaluated for factors such as assembling, staffing, and operating the alternative within the time frames in the removal schedule.

Each alternative was evaluated for technology maturity, prior use under similar conditions for similar wastes, and difficulty in operation after construction. Operational difficulties could include the frequency or complexity of equipment maintenance or controls, the need for raw materials, or the need for a large technical staff.

The evaluation considered environmental conditions with respect to the operation, set-up, and construction phases of the alternative. Certain technologies are difficult to construct or operate in remote locations. Climate or terrain may severely impact or eliminate specific alternatives from consideration.

7.1.2.2 Administrative Feasibility

The administrative feasibility factor evaluates activities needed to coordinate with other offices and agencies. The administrative feasibility of each alternative was evaluated, including the need for off-site permits, adherence to applicable non-environmental laws, and concerns of other regulatory agencies.

7.1.2.3 Availability of Services and Materials

This factor considers if equipment, personnel, services and materials, and other resources necessary to implement an alternative are available in time to maintain the removal schedule. This factor also involves considering such services as laboratory testing capacity and turnaround for chemical analyses, adequate supplies and equipment for on-site activities, or installation of extra utilities (e.g., power lines, sewer connections).

Prospective Technologies

This factor considers whether specific technologies are generally available for the Site. Promising technologies sometimes require further development before they can be applied at full-scale. This is of particular use in developing innovative technologies.

7.1.2.4 State and other Agency Acceptance

The Forest Service will consult with the State and other agencies during the public comment period.

7.1.2.5 Community Acceptance

Community acceptance of an alternative will be considered in the final selection of the alternative in the Action Memorandum.

7.1.3 Cost

Each Removal Action alternative was evaluated to determine its projected cost. The evaluation compared each alternative's capital and operating costs, PRSC, and monitoring costs.

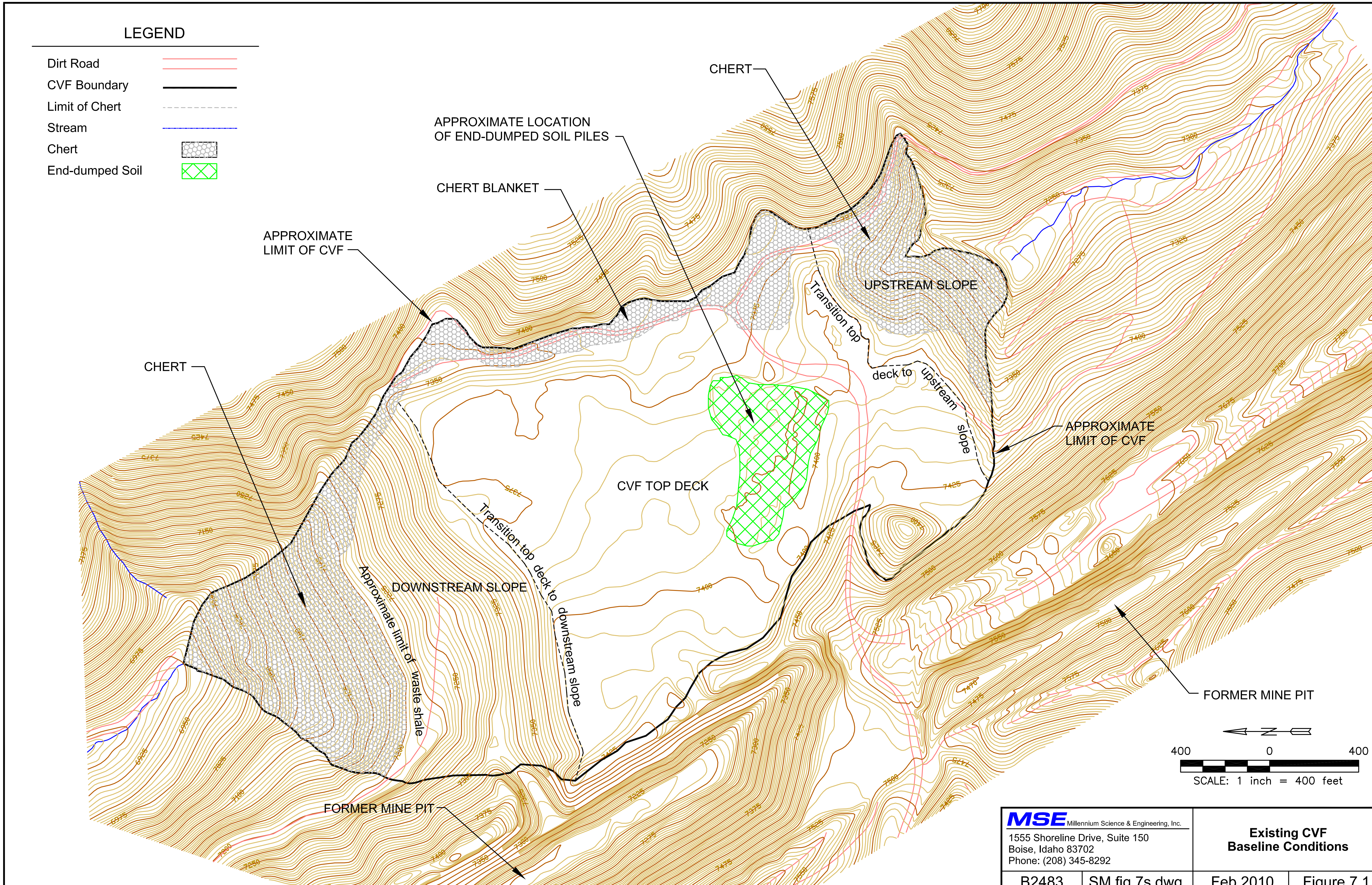
The following items are considered capital costs:

- Direct Capital Costs
  - Construction costs
  - Equipment and material costs
  - Contingency allowances
  - Transportation Costs
  - Analytical Costs
- Indirect Capital Costs
  - Engineering and design expenses
  - License or permit costs
  - Start-up and shakedown costs
- Annual Operating and Maintenance Costs
  - Operation (labor and material) costs
  - Maintenance costs
  - Auxiliary materials and energy
  - Transportation and disposal of residuals
  - Monitoring and analytical costs

7.2 Development and Description of Alternatives

The technologies retained for further consideration include combinations of capping, grading, diversion of surface water, and ICs. Section 7.2 describes how these technologies will be applied or combined to create Removal Action alternatives for source control of the CVF. The current configuration of the CVF is presented in Figure 7.1. Key issues that affect Removal Action options include:

- capturing precipitation and reducing infiltration on the CVF top deck and downstream slope; and
- managing and controlling runoff and run-on.



MSE Millennium Science & Engineering, Inc.
1555 Shoreline Drive, Suite 150
Boise, Idaho 83702
Phone: (208) 345-8292

Existing CVF Baseline Conditions

B2483	SM fig 7s.dwg	Feb 2010	Figure 7.1

Four Removal Action alternatives were developed and evaluated for the CVF. The first three alternatives consider grading and capping portions of the CVF and directing runoff into the chert blanket along the east side of the CVF. Alternative 4 considers:

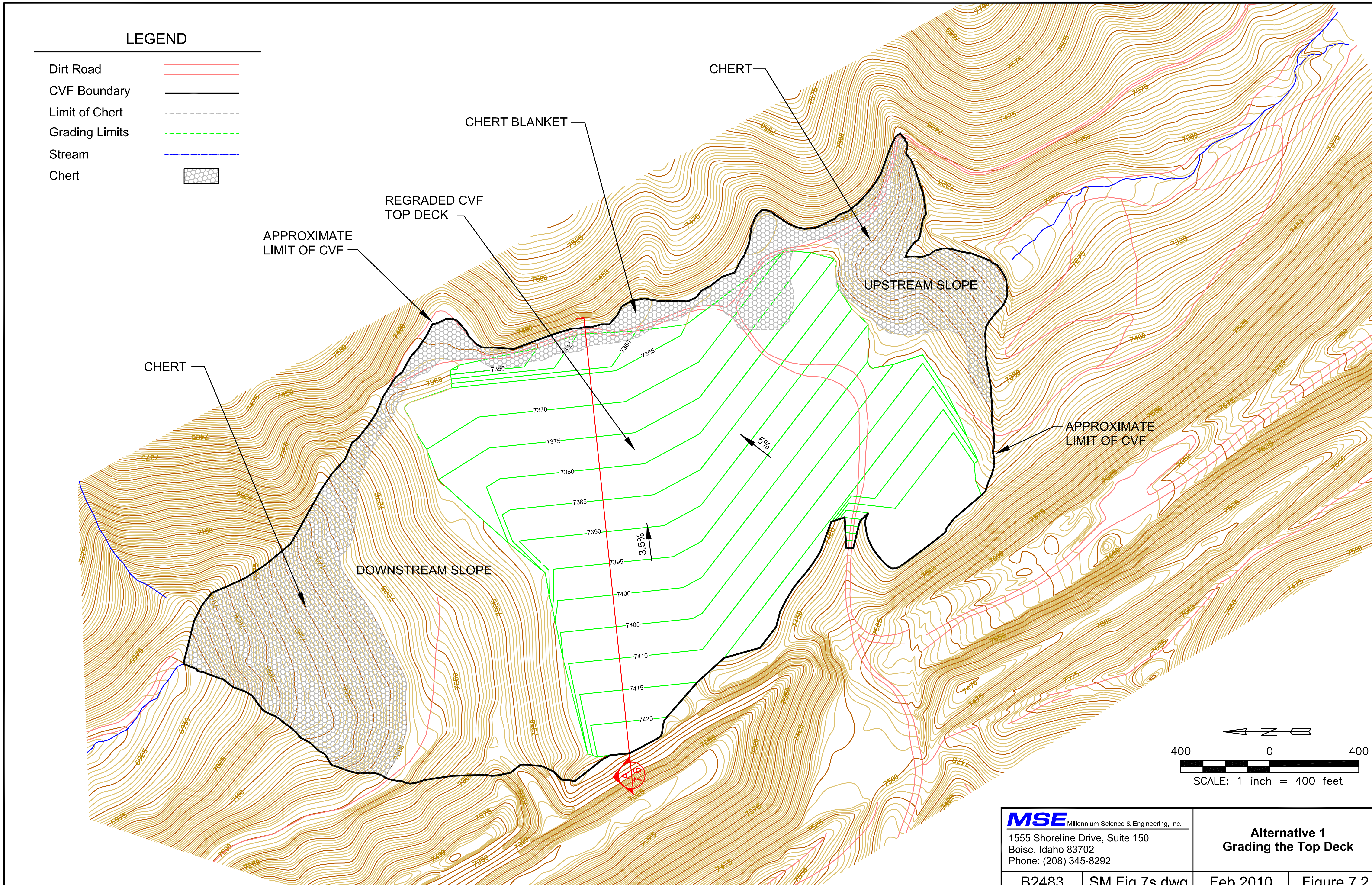
- capping all of the exposed seleniferous shale on the CVF and the chert blanket; and
- diverting runoff from the CVF.

The specific Removal Actions evaluated for the CVF top deck and downstream slope are:

Alt.	CVF Top Deck	CVF Downstream Slope	Infiltration Control	Institutional Controls
1	Grading to approximately 3.5% -5% slope to the east	No Action	Increases runoff from the top deck and diverts runoff into chert blanket	Grazing Restrictions/ Vegetation Control
2	Grading and capping approximately 68 acres	No Action	Minimizes infiltration on the top deck and diverts runoff into chert blanket	Grazing Restrictions
3	Grading and capping approximately 68 acres	Grading, terracing, and capping approximately 24 acres	Minimizes infiltration on the top deck and slope and diverts runoff into chert blanket	Grazing Restrictions
4	Grading and capping approximately 75 acres	Grading, terracing, and capping approximately 25 acres	Minimizes infiltration on the top deck and slope and diverts runoff around the CVF	Grazing Restrictions

7.2.1 Alternative 1 - Grading the Top Deck

Alternative 1 consists of grading 68 acres of the CVF top deck, in conjunction with ICs, to reduce infiltration of snowmelt and storm water into the CVF. The top deck would be graded from west to east at approximately 3.5 to 5 percent. Grading would promote runoff, produce slight reductions in infiltration, and slightly reduce contact times with seleniferous waste rock on the surface of the CVF. Approximately 273,000 yd^3 of material on the slope of the CVF would need to be cut from the upper slope of the dump and then filled elsewhere on the CVF to achieve the proposed grading plan shown in Figures 7.2 and 7.6. Runoff that does not infiltrate the waste rock on the top deck of the CVF would flow across the surface and into the chert blanket on the east side to percolate through the chert and eventually into Maybe Creek at SW-2. Grading would fill or eliminate low spots where water currently collects increasing infiltration. Barriers (e.g., fences or other obstructions) could be installed to limit access to the CVF. Grading the surface would remove most vegetation. ICs applied to grazing permits restricting sheep



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Boise, Idaho 83702
Phone: (208) 345-8292

Alternative 1
Grading the Top Deck

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and cattle access would limit uncontrolled exposure to volunteer plants that eventually will invade the CVF surface. Selective re-vegetation would be required to minimize selenium uptake and control erosion.

7.2.2 Alternative 2 - Grading and Capping the Top Deck

Alternative 2 includes the grading components described for Alternative 1 and adds capping the top deck (68 acres) of the CVF to minimize infiltration, to cover exposed waste rock and to prevent vegetative uptake of contaminants from waste rock. Top deck grading specifications, as described in Alternative 1 to promote runoff and collect drainage, are the same. A low permeability infiltration reducing cap would be installed over the regraded surface to reduce infiltration and direct runoff to the chert blanket along the east side of the CVF. Precipitation on the surface could flow along surface, or along drainage layers in the cap, and discharge into the chert blanket. From there it would percolate through the chert fill along the eastern margin of the CVF and eventually discharge to Maybe Creek at SW-2.

This multi-layer cap design includes a 1-foot-thick cushion layer of fine-grained material placed on the graded fill overlain with:

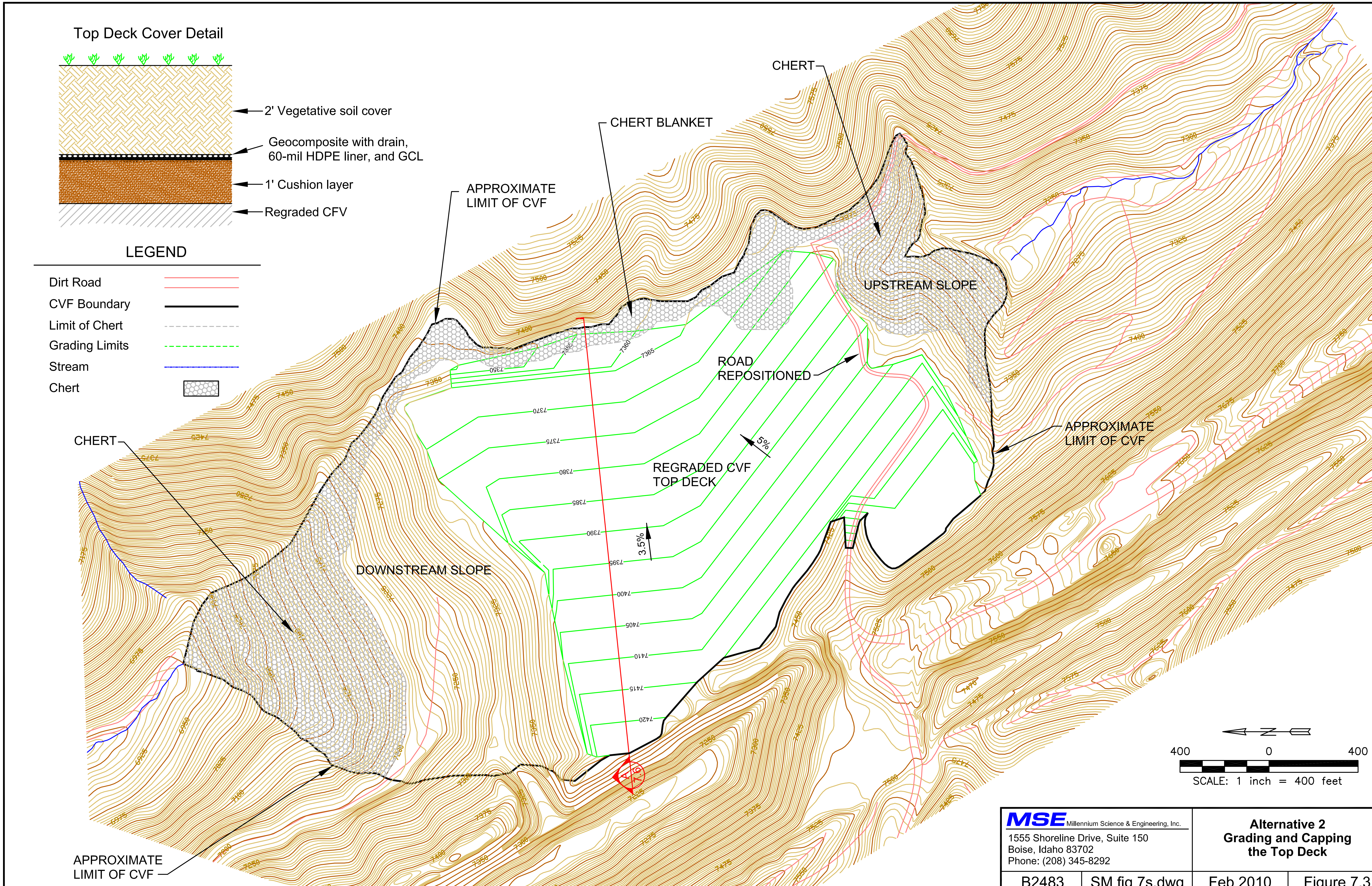
- a low-permeability geomembrane,
- a drainage layer, and
- a 2-foot, or thicker, layer of growth media to store water. The growth media would also be selectively planted with species known to transpire moisture.

The drainage layer utilizing geocomposite drainage net (GDN) would provide drainage control and minimize saturation. Geosynthetic drainage materials are proposed over natural drainage materials because of availability, ease of construction, installation quality, superior performance, and lower cost. Two low-permeability geomembrane options were considered:

- a welded 60-mil HDPE low-permeability layer, and
- a welded 60-mil HDPE layer over a separate overlapped GCL layer.

With proper installation, either option would reduce infiltration by more than 95 percent and promote positive drainage control from the cap. Geomembranes are a preferred material in cap construction because of their predictability, reliability, and performance characteristics. Additional protection would be provided by the added GCL layer in the event of a geomembrane failure. While material and installation costs are estimated to be $1.5 million higher, the layered geomembrane (welded HDPE over a separate overlapped GCL) is recommended because of superior overall performance (most leak-proof). Figures 7.3 and 7.6 illustrate the grading plan and cap design for Alternative 2.

ICs applied to grazing permits would restrict sheep and cattle access. Forest Service Special Orders, as ICs, would be issued to prevent damage from off road vehicles.


Top Deck Cover Detail
2' Vegetative soil cover
Geocomposite with drain,
60-mil HDPE liner, and GCL
1' Cushion layer
Regraded CFV
LEGEND
Dirt Road
CVF Boundary
Limit of Chert
Grading Limits
Stream
Chert
CHERT
CHERT BLANKET
APPROXIMATE LIMIT OF CVF
UPSTREAM SLOPE
ROAD REPOSITIONED
5%
REGRADED CVF TOP DECK
3.5%
DOWNSTREAM SLOPE
CHERT
APPROXIMATE LIMIT OF CVF
APPROXIMATE LIMIT OF CVF
400 0 400
SCALE: 1 inch = 400 feet
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Boise, Idaho 83702
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Alternative 2
Grading and Capping
the Top Deck
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Figure 7.3

7.2.3 Alternative 3 – Grading and Capping the Top Deck and Downstream Slope

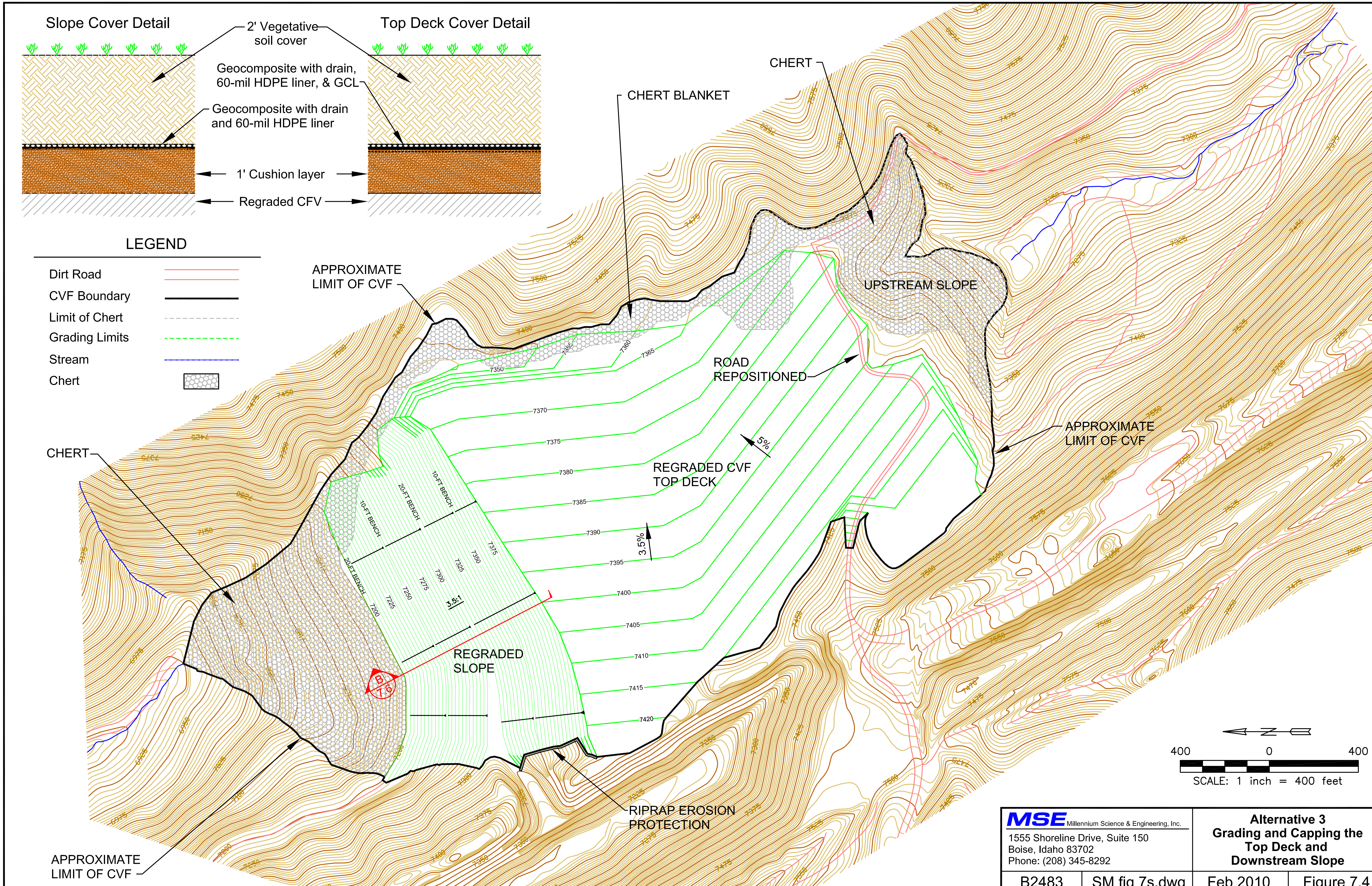
Alternative 3 includes the same grading and capping components described for Alternative 2 and adds grading, terracing and capping 24 acres on the downstream slope of the CVF to reduce infiltration and cover exposed waste rock and to prevent vegetative uptake of hazardous substances from waste rock. Alternative 3 builds on Alternative 2 by flattening the downstream slope of the CVF to 3.5H:1V, the creation of in-sloped terraces, and the installation of a hybrid low-permeability cap over the dump face and each terrace.

The existing downstream slope of the CVF is currently sloped to approximately 3H:1V and consists of exposed waste shale and chert waste rock. Waste shale fill extends to the midpoint of the downstream slope to an approximate elevation of 7,200 feet asl. The total area of the downstream slope on the CVF is approximately 40 acres, of which approximately 25 acres of the upper slope contains waste shale. The downstream slope length is approximately 1,000 feet with an elevation drop of approximately 175 feet. Because of its length and steepness and the materials exposed on the surface, the downstream CVF slope is susceptible to surface erosion. However, the high permeability of slope materials allows snowmelt and rain to infiltrate. Primary design considerations for the downstream CVF slope are reduced infiltration, runoff management from surrounding slopes, erosion management, and slope stability. Infiltration is less on the downstream slope than it is on the top deck because the current grade produces higher runoff velocities. However, infiltration does occur because of the permeability of the surface

The cap design for the CVF downstream slope includes a 1-foot-thick cushion layer of fine grained material placed on the graded fill overlain with 1) a low-permeability geomembrane, 2) a drainage layer, and 3) a 2-foot-thick layer of growth media planted with native and possibly non-native vegetation selected to store and transpire moisture. The highly-permeable drainage layer also serves as a capillary break that will promote water storage in the finer textured growth media for plant use. The coarse rock drainage layer and geomembrane would inhibit root penetration into the underlying shale. Geosynthetic drainage materials were proposed over natural drainage materials because of availability, ease of construction and installation quality, and superior long-term performance and lower cost.

The steep slope increases the complexity of constructing a layered cap on the CVF downstream slope. With proper installation, the single layer 60-mil geomembrane alone will by design reduce infiltration by more than 95 percent over its footprint and promote positive drainage control off the cap. Geomembranes are a preferred material in cap construction because of their predictability, reliability and performance characteristics. The added GCL layer is not warranted due to the risk of cap failure / sliding / instability associated with construction on a relatively steep slope.

Capping the downstream CVF slope with geosynthetic materials requires reducing the overall slope to approximately 3.5H:1V to achieve the required cap stability and to



Slope Cover Detail
Top Deck Cover Detail
2' Vegetative soil cover
Geocomposite with drain, 60-mil HDPE liner, & GCL
Geocomposite with drain and 60-mil HDPE liner
1' Cushion layer
Regraded CFV
LEGEND
Dirt Road
CVF Boundary
Limit of Chert
Grading Limits
Stream
Chert
CHERT
CHERT BLANKET
APPROXIMATE LIMIT OF CVF
UPSTREAM SLOPE
ROAD REPOSITIONED
5%
REGRADED CVF TOP DECK
3.5%
10-FT BENCH
20-FT BENCH
10-FT BENCH
20-FT BENCH
3.5:1
REGRADED SLOPE
B 7.6
APPROXIMATE LIMIT OF CVF
RIPRAP EROSION PROTECTION
APPROXIMATE LIMIT OF CVF
CHERT
400 0 400
SCALE: 1 inch = 400 feet
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Boise, Idaho 83702
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Alternative 3
Grading and Capping the Top Deck and Downstream Slope
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Figure 7.4

improve implementability, constructability and performance. Regrading the slope would require moving approximately 180,000 yd^3 of mine waste.

Grading on the terraced slope will direct surface flow to the margins of the CVF and the chert blanket along the eastern side of the CVF. Terraces will segment the slope. Shorter slope segments enhance slope stability and reduce runoff velocities. Terraces would be in-sloped to capture and direct runoff to the margins of the CVF. The terraces and channels would be lined with low permeability geosynthetic material, and covered with coarse rock or selected growth media and vegetation, to control erosion and surface water runoff. The groins of the slope would also be lined and armored. A typical grading plan and cap section are illustrated in Figures 7.4 and 7.6. Water flowing through the chert blanket may contact seleniferous waste rock contained in the CVF. Flow rates at the downstream toe of the CVF are not expected to substantially change as a result of implementation of this alternative.

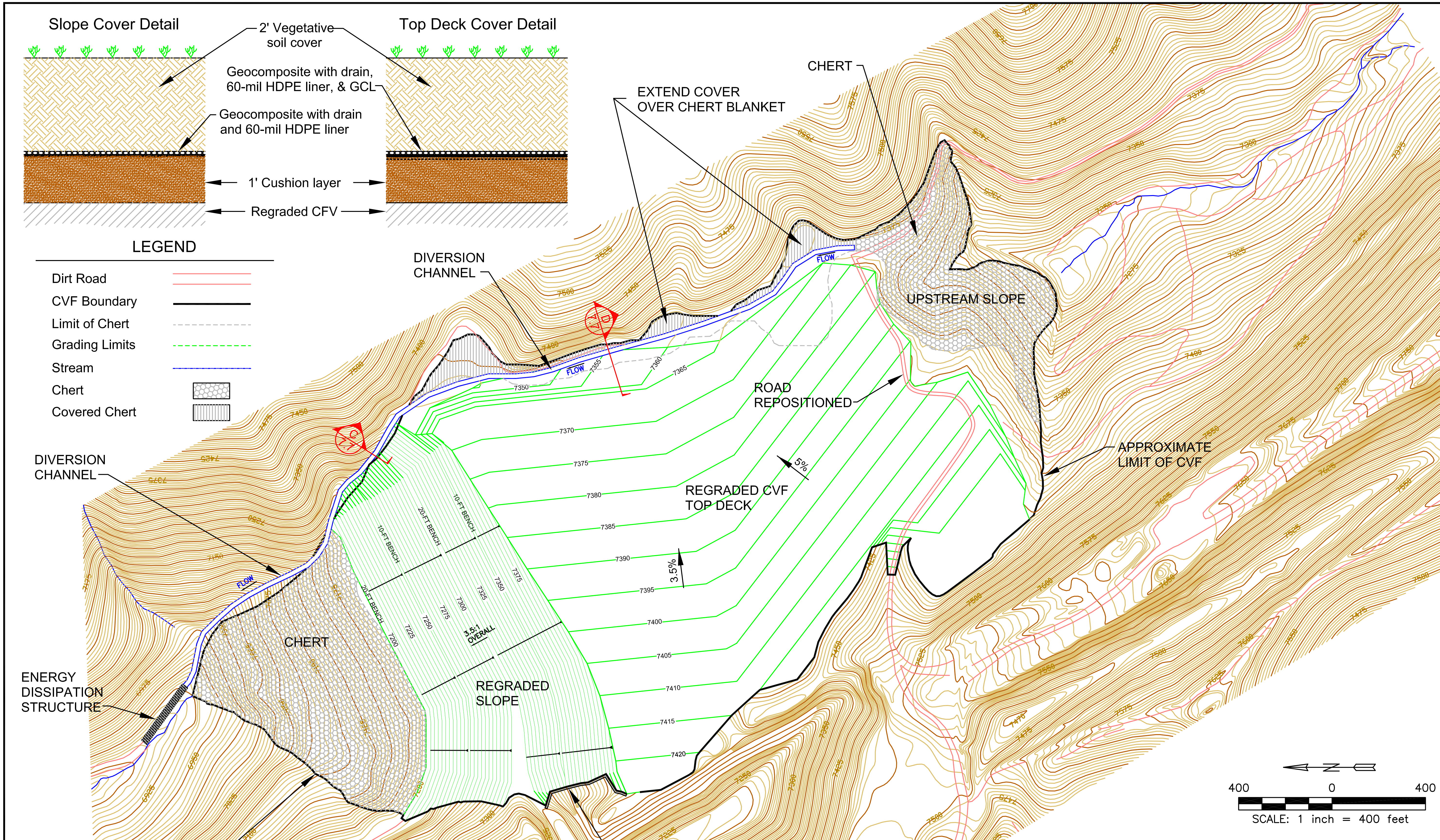
ICs applied to grazing permits would restrict sheep and cattle access. Forest Service Special Orders, as ICs, would be issued to prevent damage from off road vehicles.

7.2.4 Alternative 4 – Grading and Capping the Top Deck and Downstream Slope, and Diverting Runoff

In addition to the Alternative 3 components described above, Alternative 4 provides for the capture of surface water runoff from the cap and diversion away from the CVF. The cap design for Alternative 4 is essentially the same as Alternative 3 except the chert blanket at the surface of the CVF would be covered with a low-permeable cap to limit infiltration. Water captured in the system would be delivered downgradient of the fill in Maybe Canyon, thus maximizing isolation of water from precipitation from the CVF waste rock. Isolating this water from the waste rock reduces probability and if necessary the quantity of future water treatment.

Figures 7.5 and 7.7 present grading and capping plans for Alternative 4. Runoff from the cap would be directed to a concrete-lined diversion channel along the east side of the CVF. The steep slope and armoring in the channel would essentially eliminate infiltration along the flow path during spring snowmelt and storm events. Armored channels installed along the margin of the CVF slope would be designed to prevent erosion. Water flow in the diversion channels is estimated to occur for 4 to 6 weeks during spring runoff and after typical late summer high intensity rain events.

ICs applied to grazing permits would restrict sheep and cattle access. Forest Service Special Orders, as ICs, would be issued to prevent damage from off road vehicles.



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Alternative 4
Grading and Capping Top Deck and Downstream Slope and Diverting Runoff

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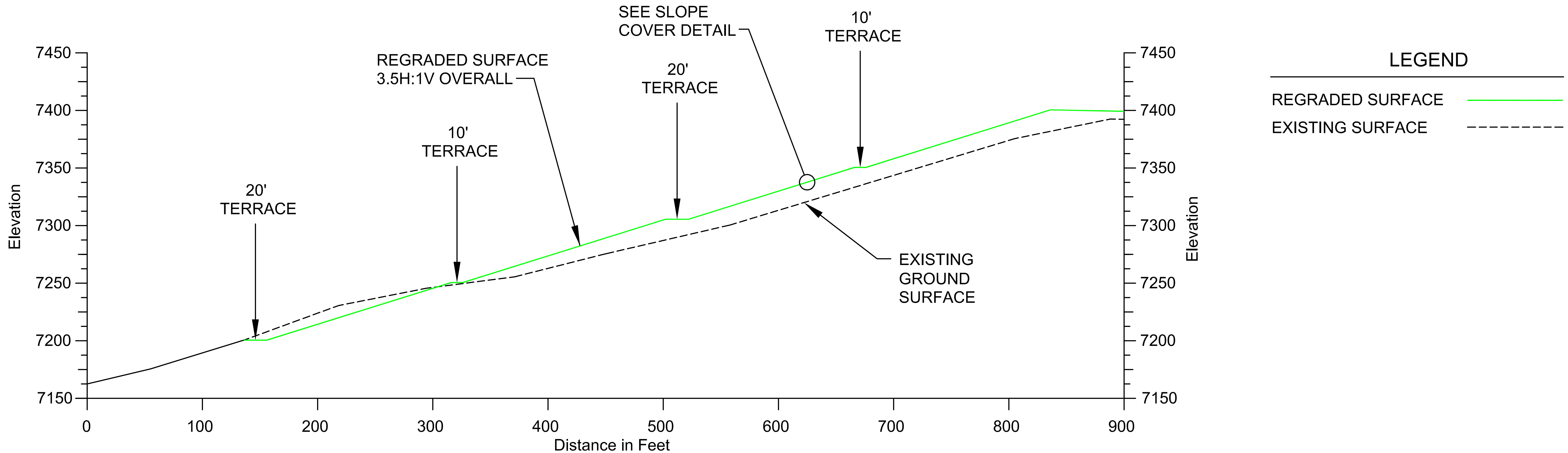
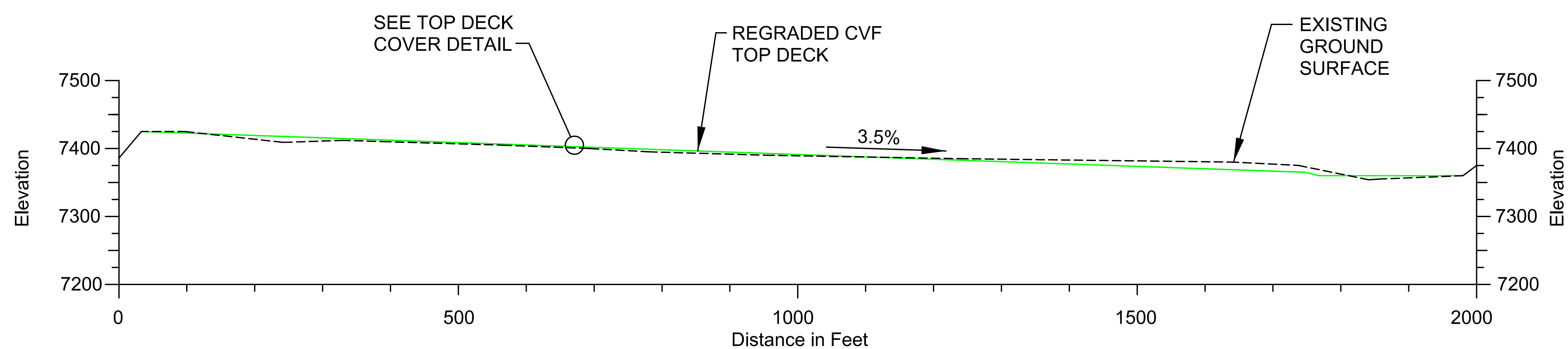


B
7.4
REGRADED AND TERRACED DOWNSTREAM SLOPE CROSS SECTION

Not to Scale



A
7.2
REGRADED CVF TOP DECK CROSS SECTION

Not to Scale

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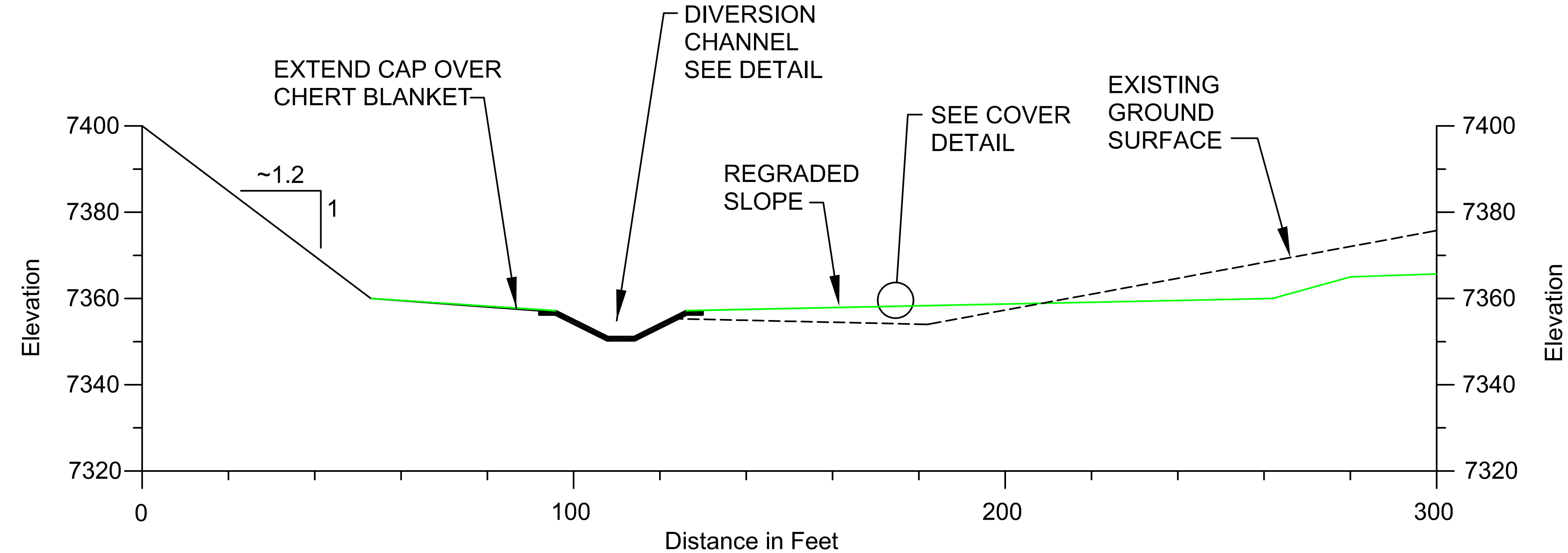
Regraded CVF Cross Sections

B2483	SM fig 7s.dwg	Feb 2010	Figure 7.6

LEGEND

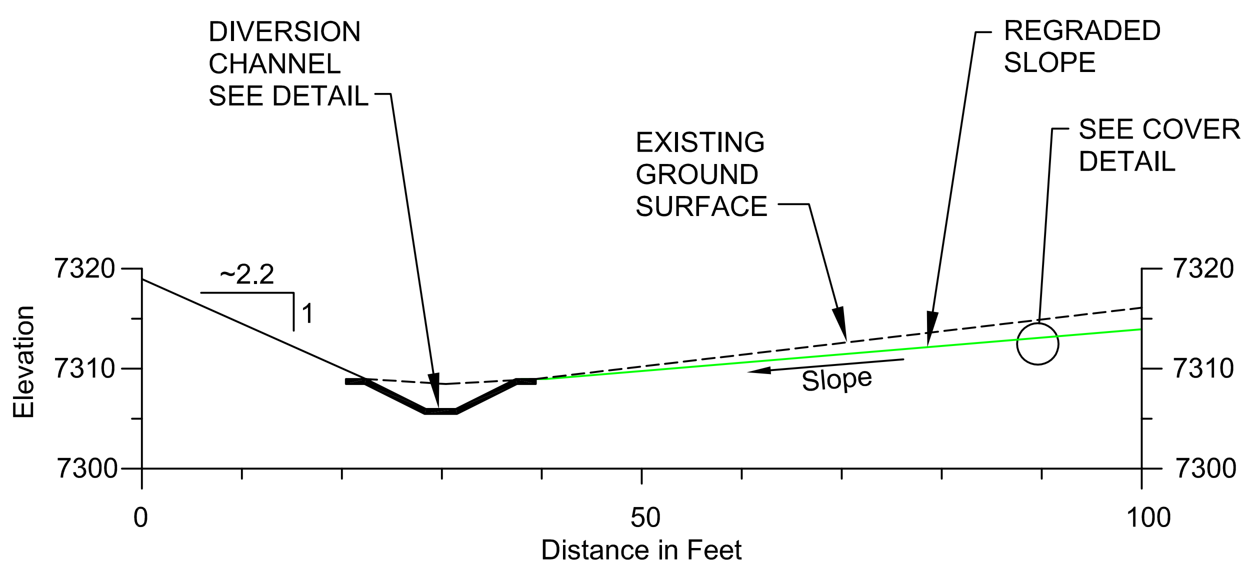
REGRADED SURFACE

EXISTING SURFACE



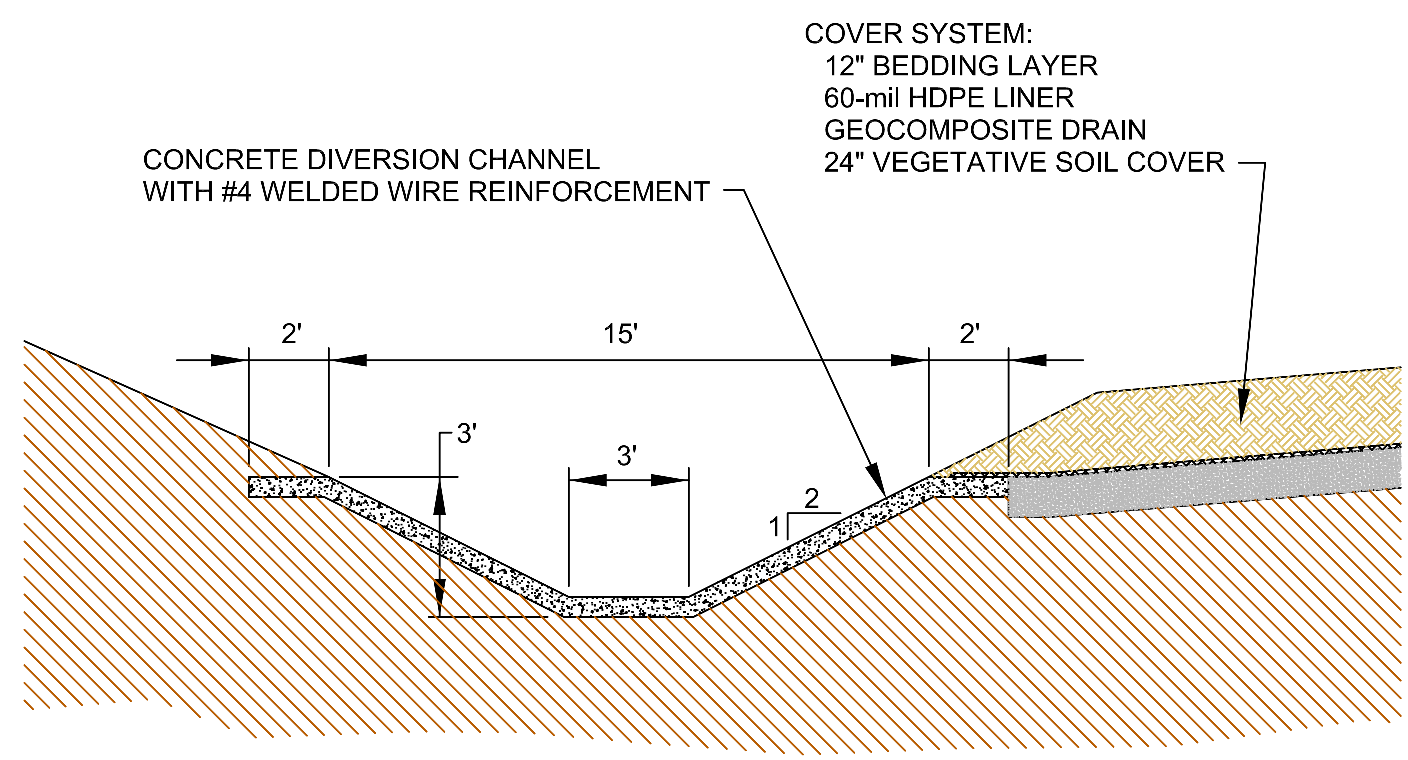
D 7.5 DIVERSION CHANNEL CROSS SECTION ON CVF TOP DECK

Not to Scale



C 7.5 DIVERSION CHANNEL CROSS SECTION ON DOWNSTREAM SLOPE

Not to Scale



DIVERSION CHANNEL DETAIL

Not to Scale

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B2483	SM fig 7s.dwg	Feb 2010	Figure 7.7

7.3 CVF Alternative Analysis Results

Alternatives described in section 7.2 are evaluated based on effectiveness, implementability, and costs in this section.

7.3.1 Effectiveness

The effectiveness of each alternative is evaluated based on the individual criteria described in Section 7.1.1.1.

7.3.1.1 Overall Protection of Public Health and the Environment

Alternative 1 - Grading the Top Deck
Alternative 1 would provide similar protection of public health and the environment as the existing situation. Grading the CVF top deck may temporarily increase infiltration until vegetation re-establishes on the graded surface. As vegetation returns, infiltration would decrease but remain similar to the existing condition. Selenium loading to Maybe Creek would likely remain the same and possibly increase, in the short-term, as shale in the CVF surface is exposed to weathering conditions. Institutional and engineering controls to limit access to the CVF surface may reduce risk to wildlife and livestock from direct ingestion of dust and contaminated vegetation. Regrading the top deck of the CVF alone would not substantially change current conditions and would not provide greater protection to public health and the environment. Infiltration of precipitation and snowmelt into the CVF, and the consequent release of selenium and other hazardous substances, would continue.

Alternative 2 - Grading and Capping the Top Deck
Alternative 2 would improve protection of public health and the environment over the current situation. Placing a low permeability cap on the fill would limit selenium loads to Maybe Creek by reducing the volume of infiltrating precipitation through seleniferous rock top deck of the CVF. Additionally, this cap would be designed to prevent vegetative uptake of selenium from CVF shales.

Directing runoff from the top deck of the CVF and upslope forested areas to the chert blanket would continue to allow leaching of selenium from any shales placed within the chert blanket along the eastern margin of the CVF. Based on historic information, approximately 30,000 yd^3 of waste shale was placed in the chert blanket. Water diverted into the chert blanket would contact that seleniferous waste rock. This alternative will not reduce water flow rates discharging from the toe of CVF since the precipitation would merely be re-directed to the chert blanket which conveys water to the toe of the CVF. Therefore, a similar volume of water would continue to discharge from the toe of the CVF at SW-2 as it does now. Post-removal water quality monitoring at SW-2 would measure changes in water quality and the effectiveness of this alternative to reduce the release of selenium and other hazardous substances.

Alternative 3 – Grading and Capping the Top Deck and Downstream Slope
Alternative 3 employs additional measures to improve protection to human health and the environment over both Alternatives 1 and 2. Cap installation further reduces selenium loading to Maybe Creek by limiting infiltration through the top deck and the downstream slope of the CVF. Surface water runoff would be diverted from the downstream slope of the CVF along terraces to the perimeter of the fill. Based on historic information, approximately 30,000 yd^3 of waste shale was placed within the chert blanket during construction. Water diverted into the chert blanket may still contact seleniferous waste rock contained in the CVF under this alternative. This alternative would not reduce discharge flow rates at the toe of CVF since precipitation is merely re-directed to the chert blanket, which directs water to the toe of the CVF. Post-removal water quality monitoring at SW-2 would be utilized to evaluate the effectiveness of this alternative, and in future investigations, to determine the need for further actions. The volume of water discharging from the toe of the dump would remain near that observed currently. Future actions to further reduce releases in discharge from the CVF would have to be designed to manage this entire volume of water currently discharging from SW-2.

Alternative 4 – Grading and Capping the Top Deck and Downstream Slope and Diverting Runoff
Alternative 4 employs additional measures not included in the previous alternatives to provide more protection of human health and the environment. Cap designs constructed like those in Alternative 3 would similarly minimize selenium loads to Maybe Creek through the top deck and the downstream slope of the CVF by limiting water infiltration. In addition to the cap, runoff would be captured and diverted from the CVF in lined channels. The chert blanket would be capped along the eastern margin of the CVF to further limit infiltrating water from contacting seleniferous waste rock in the blanket. Runoff water from the surface of the CVF and dump face would be isolated from waste rock in the fill and diverted for delivery downstream. Captured water would remain clean because it would not contact waste rock to dissolve contaminants. Successful implementation of this alternative would substantially reduce the volume of contaminated water discharging from SW-2.

Alternative 4 would be designed to capture run-on from upslope areas adjacent to the fill. Alternative 4 maximizes the volume of water isolated from contact with the CVF seleniferous waste. Capping, combined with diversion, limits the selenium mass discharging from the CVF to only the load dissolved by water emerging from springs buried by the CVF. However, removing this volume of clean water from the water balance equation would result in less dilution of the residual contaminated water. Dissolved contaminant concentrations may increase at SW-2 even though the total load of selenium discharging the CVF decreases. Smaller quantities of water discharging from the fill would be easier to manage. Discharge from SW-2 will be evaluated in a RI and FS planned for the Site. Additional treatments may be needed.

7.3.1.2 Compliance with ARARs and Other Criteria, Advisories, and Guidance

Section 300.415(j) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) indicates that removal actions under CERCLA section 104 should attain ARARs under Federal or State environmental laws or facility siting laws, to the extent practicable considering the urgency of the situation and the scope of the removal.[7]

ARARs are presented in Appendix C. Key ARARs include: the Federal Ambient Water Quality Criteria (AWQC) (40 CFR 131), the Idaho Water Quality Standards (IDAPA §58.01.02), and Rule for Control of Fugitive Dust (IDAPA §58.01.01.650 - .651). The federal AWQC and the Idaho Water Quality Standard for total dissolved selenium are both 5.0 µg/l for protection of aquatic organisms for chronic effects. In May 2009, the selenium concentration at the toe of the CVF (SW-2) was 2.56 mg/l or 2560 µg/l and 1.6 mg/l or 1600 µg/l approximately 500 feet downstream at SW-13.

The federal AWQC for cadmium is 0.00025 mg/l or 0.25 µg/l for protection of aquatic organisms for chronic effects. The Idaho Water Quality Standard for cadmium is 0.0006 mg/l or 0.6 µg/l. In May 2009, the cadmium concentration at the toe of the CVF (SW-2) was 0.0045 mg/l or 4.5 µg/l and decreased downstream at SW-13 to 0.0024 mg/l or 2.4 µg/l.

The federal AWQC and the Idaho Water Quality Standard for zinc is 0.120 mg/l or 120 µg/l for protection of aquatic organisms for chronic effects. In May 2009, the zinc concentration at the toe of the CVF (SW-2) was 0.208 mg/l or 208 µg/l and decreased downstream at SW-13 to 0.115 mg/l or 115 µg/l.

The Idaho Rule for Control of Fugitive Dust is an ARAR since all of the alternatives contain movement of significant amounts of soil.

While none of the alternatives are anticipated to achieve complete compliance with all ARARs, they would contribute to meeting the water quality ARARs at the Site. All of the alternatives developed were anticipated to address the RAOs for the site. Minimizing infiltration, bioaccumulation, and isolating precipitation will likely not eliminate all the water from discharging from the CVF thus not fully comply with ARARs. Residual sources of water identified in the water balance, as springs and up drainage runoff, may continue to transport contaminants from the CVF after removal action implementation. No alternative considered as part of this EE/CA would capture or isolate water flowing down the Maybe Creek channel from the watershed above the CVF. Most of the surface water flow from the upper drainage is seasonal and begins to subside shortly after seasonal snow melt concludes each year. Springs known to exist prior to construction of the CVF will continue to flow post construction of any alternative presented in the EE/CA. These two sources of flow in the Maybe Creek watershed are identified in the water balance presented by Nu-West in the Site Investigation reports for this Site. Post

[7] See, Guidance on Conducting Non-time Critical Removal Actions Under CERCLA, EPA 540-R-93-057. Page 37.

removal action monitoring, further remedial investigations, and a feasibility study leading to further response actions may be necessary to satisfy CERCLA ARAR requirements.

Alternative 1 - Grading the Top Deck

Alternative 1 would not substantially reduce releases of hazardous substances, would not achieve RAOs, and would not contribute to eventually meeting key water quality ARARs. Grading the top deck alone does not limit water infiltration into the CVF. Regrading the dump surface would eliminate basins or areas that seasonally pond water and would create an evenly graded surface that would improve surface runoff more than the existing condition. Alternative 1 would not alter the characteristics of the material found on the surface of the CVF. Because there is no physical barrier to block the infiltration, precipitation would continue to infiltrate the dump surface at close to current levels. For the short-term, infiltration and runoff may increase until the vegetation, destroyed by the grading, can be re-established. Since this Alternative does not include a physical barrier to isolate the seleniferous soils from vegetation rooting in the fill, vegetation re-established on the CVF would bioaccumulate or take up selenium from the waste shale. This represents no change from the current condition.

Implementation of Alternative 1 would not achieve compliance with water quality ARARs.

Fugitive dust control ARARs would be met by suppressing the dust generated during construction with mitigation measures such as water sprayed on the CVF. Dust control mitigations would apply to all alternatives.

Alternative 1 does not conform to the Caribou-Targhee Land and Resource Management plan goal of restoring pre-mine beneficial uses.

Alternative 2 - Grading and Capping the Top Deck

Alternative 2 minimally addresses RAOs. Applying a cap, as described in the alternative, would limit infiltration through the highly permeable materials on the top deck of the CVF. Because it only restricts infiltration for a portion of the CVF and continues to allow infiltration over much of the CVF, it minimally addresses the RAOs and key water quality ARARs. With sufficient mitigation, this alternative would meet fugitive dust ARARs.

Alternative 2 is expected to reduce selenium loading to Maybe Creek. The Forest Service expects selenium loads at the discharge point SW-2 to eventually decrease as infiltration is redirected away from a large portion of the waste rock contained in the fill. A substantial portion of annual precipitation would be captured and stored in the cap materials to support plant growth. Moisture stored in the cover would be subject to evaporation and transpiration from reclamation plantings. Redirected precipitation draining from the cap or as surface water flow would evaporate as water flows to the blanket drain. Because it is uncertain whether water entering the drain would become contaminated by improperly placed materials in the drain, or remain isolated from shale stored in the CVF, post implementation monitoring would be necessary to determine compliance with water quality ARARs. Because other portions of the dump will not receive treatment, hazardous substance concentrations at SW-2 are expected to continue to exceed AWQC. Discharge flows from the CVF at SW-2 would remain similar to current conditions.

Grading and capping the top deck, with a design to limit root access to waste shale, would be a first step to prevent exposure of human and ecological receptors to hazardous substances in vegetation on the surface of the CVF. Capping the top deck will limit the vegetation's ability to root in seleniferous soils and take up selenium. Since this alternative does not propose to cap the downstream slope of the CVF, vegetation re-established on the downstream slope may still accumulate selenium from the seleniferous waste shale.

Implementation of Alternative 2 would not achieve compliance with water quality ARARs nor conform to the beneficial use restoration goals in the Caribou-Targhee National Forest Land and Resource Management plan would not occur.

Fugitive dust control ARARs would be mitigated using dust control measures during construction. (e.g., water sprayed on the CVF).

Alternative 3 - Grading and Capping the Top Deck and Downstream Slope
Alternative 3 adds measures that moves this alternative further towards compliance with ARARs by further limiting infiltration into the CVF and subsequently contact with waste shale containing selenium. Alternative 3 is expected to result in greater selenium load reduction to Maybe Creek than Alternatives 1 and 2. Clean water that would otherwise dissolve and transport hazardous substances is redirected off of the CVF to adjacent land and to drain through the blanket and SW-2. Alternative 3 adds a cover to the downstream face of the CVF. Fifteen acres of chert material at the toe of the CVF would not be capped. Capping the downstream face further limits precipitation exposure to contaminant bearing waste shales. Alternative 3 also provides slope stabilizing features. Selenium loads discharging from the CVF at SW-2 would gradually decrease as infiltration is isolated from waste rock. With flows reduced, dissolved contaminant concentrations may increase at SW-2 even though the total load of selenium discharging the CVF decreases. Capping the downstream slope of the CVF along with regrading and capping the top deck will result in substantially less infiltration than Alternative 2.

Alternative 3 moves further toward compliance with ARARs than Alternatives 1 and 2. However, reintroducing runoff to the fill through the chert blanket, where it may contact seleniferous waste shale limits the potential of Alternative 3 to contribute toward achievement of water quality ARARs. Post removal action monitoring will measure the effectiveness of the removal action on improving water quality discharging from SW-2.

Grading and capping the top deck will contribute to preventing exposure of human and ecological receptors to hazardous substances in vegetation on the surface of the CVF. A cap design for the top deck and downstream slope will limit reclamation plants from rooting in seleniferous soils and take up selenium.

Implementation of Alternative 3 would change water quality at SW-2. Precipitation moisture captured in the top deck and slope caps would not discharge from SW-2. Consequently, contaminant loads at SW-2 would decrease while concentrations may increase. Alternative 3 would not achieve compliance with water quality ARARs but would generally improve water quality at SW-2.

Cap design features included in the design to limit or eliminate contaminant bioaccumulation in reclamation plan would improve conformance with the Caribou-Targhee National Forest Land and Resource Management plan. Conformance with some of the Caribou-Targhee Land and Resource Management plan goal of restoring pre-mine beneficial uses would result from implementation of this alternative.

Fugitive dust control ARARs would be met by suppressing the dust that is generated (e.g., water sprayed on the CVF).

Alternative 4 - Grading and Capping the Top Deck and Downstream Slope and Diverting Runoff

Alternative 4 would contribute the most toward meeting water quality ARARs by minimizing the infiltration into the CVF and water contact with waste shale. Of the alternatives presented, Alternative 4 provides greatest reduction in the Maybe Creek selenium load, as a result of the most extensive CVF capping. As with Alternative 3, dissolved selenium and other hazardous substance loads would decrease at discharge point SW-2 and eventually stabilize as site conditions and removal actions mature. Evaporation and transpiration would increase as reclamation plants covering the CVF mature.

Alternative 4 is more robust than Alternative 3 due to the addition of a system to capture clean water on the top deck surface of the fill and face and divert runoff from the fill surface into lined channels that would discharge downgradient of the CVF toe.

Alternative 4 caps the CVF chert blanket. Water that would otherwise enter the blanket would be captured in a ditch on the eastern side of the regraded CVF and flow from the top deck along a system of channels. Captured water would be delivered downstream of the CVF and thereby substantially reduce the discharge volume from SW-2. Water volume at SW-2 would drop to base flow conditions as little water from slopes surrounding the CVF or precipitation that has fallen on the fill would enter the top deck, chert blanket drain, or dump face. As a consequence, less clean water infiltrates resulting in a reduction in the total load of selenium discharging from the CVF. This benefit outweighs the possibility that contaminant concentrations will increase at SW-2 due to the remaining undiluted, but much smaller, CVF water volume. Water discharged from the surface water runoff collection and diversion channels would meet ARARs. This water would represent baseline water quality for snow and rainfall, and surface water runoff from undisturbed land adjacent to the CVF. Monitoring the post implementation discharge at SW-2 will show the effects of the action on discharge water at both SW-2 and on captured water. Clean water captured from the top deck would be discharged down gradient of SW-2.

Grading and capping the entire CVF (except for the 15 acres of chert material at the toe) will prevent exposure of human and ecological receptors to hazardous substances in vegetation on the surface of the CVF. The cap design on the top deck and downstream slope will include features to limit vegetation from rooting into seleniferous soils and prevent bioaccumulation.

Implementation of Alternative 4, would reduce the quantity of contaminated water discharged at SW-2, but likely would not sufficiently improve water quality at SW-2 to meet water quality ARARs. Discharge water from the runoff capture system would comply with water quality ARARs at the discharge point. Alternative 4 is expected to reduce peak selenium loads at SW-2 from the current average of more than 11 lbs/day to less than 5 lbs/day.

Cap features to limit or eliminate contaminant bioaccumulation would improve conformance with the Caribou-Targhee National Forest Land and Resource Management plan. Conformance with the Caribou-Targhee Land and Resource Management plan goal of restoring pre-mine beneficial uses would result from implementation of this alternative.

Fugitive dust control ARARs would be met by suppressing the dust that is generated (e.g., water sprayed on the CVF).

7.3.1.3 Long-Term Effectiveness and Permanence

Alternative 1 - Grading the Top Deck

Alternative 1 does not provide long-term effectiveness and does not represent a substantial change from the current situation. Grading the top deck alone does not minimize infiltration of runoff into the CVF because there is no physical barrier to block infiltration. Additionally, in the short-term, infiltration and runoff may increase until the vegetation destroyed by grading can be re-established. Since this Alternative does not include the placement of a physical barrier to isolate seleniferous soils, vegetation re-established on the CVF would take up selenium from waste shale, which is the current condition. Vegetation selected to plant after grading would be screened to establish quickly and to limit bioaccumulation. However, it is difficult to establish plant communities on waste shale. This Alternative would only require monitoring, to assure that no erosion develops, and maintenance, to repair erosion. Plant communities would be self sustaining.

Alternative 2 - Grading and Capping the Top Deck

Alternative 2 provides some long-term effectiveness by limiting the amount of precipitation entering the CVF, but like all of the action alternatives, Alternative 2 could require maintenance. Estimates presented to the Forest Service show that the cap on the top deck will reduce infiltration in this area by at least 95%. Monitoring effectiveness would be required to ensure the cap is limiting infiltration into the CVF. Diverting runoff water into the chert blanket would limit the long-term effectiveness by allowing water to re-enter the CVF where it may contact waste rock and release selenium and other hazardous substances from the waste material.

Water quality and flow monitoring at SW-2 would verify if Alternative 2 is performing effectively. Grading and capping are low maintenance actions. Revegetation success is critical to cap performance. Monitoring revegetation on the cap and erosion of capping materials are important elements post construction. Mitigation measures will be employed to manage erosion and to improve plant success. Long-term operation and maintenance of monitoring and flow measurement equipment would occur.

Alternative 3 - Grading and Capping the Top Deck and Downstream Slope
Alternative 3 would provide long-term effectiveness by reducing infiltration of precipitation on the CVF but would require long-term maintenance and monitoring to sustain performance. Vegetation, slope stability, and water volume and quality would be monitored. It is estimated that the cap on the top deck and downstream slopes will reduce infiltration in these two areas by at least 95%.

Alternative 4 - Grading and Capping the Top Deck and the Downstream Slope and Diverting Runoff
Alternative 4 would provide long-term effectiveness by minimizing infiltration of precipitation on the entire CVF, but would require long-term maintenance and monitoring to sustain performance. In addition to the monitoring and maintenance required for Alternatives 2 and 3, debris removal from the diversion channel will be necessary to maintain long-term function. It is estimated that the cap on the top deck and downstream slopes will reduce infiltration in these three areas by at least 95%. Alternative 4 is expected to reduce peak selenium loads at SW-2 to less than 5 lb/day.

This is the only alternative that fully meets the third RAO to capture and isolate precipitation runoff from the CVF surface in order to minimize the amount of contaminated water exiting the toe of the CVF, in case additional water treatment is necessary. Channels and liners will require periodic monitoring for tears or leaks that must be repaired.

7.3.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 1 - Grading the Top Deck
Alternative 1 would not reduce toxicity, mobility, or volume of the waste material. Selenium would continue to leach from the CVF.

Alternative 2 - Grading and Capping the Top Deck
It is estimated that Alternative 2 would reduce infiltration on the top deck by at least 95%. Alternative 2 thereby reduces mobility of hazardous substances in the waste rock. The toxicity and volume of the waste rock shale in the CVF would remain the same. Allowing runoff to enter the CVF via the chert blanket may allow continued mobility of hazardous substances remaining in the CVF.

Alternative 3 - Grading and Capping the Top Deck and the Downstream Slope
Alternative 3 further reduces infiltration into the CVF thereby reducing the mobility of hazardous substances in the waste rock. Water would be allowed into the chert blanket and therefore the possibility the contaminants would continue to mobilize exists. The toxicity and volume of the waste rock shale in the CVF would remain the same.

Alternative 4 - Grading and Capping the Top Deck and Downstream Slope and Diverting Runoff
Alternative 4 minimizes infiltration into the CVF and isolates runoff and run-on from the CVF thereby reducing the mobility of hazardous substances from the waste rock. Alternative 4 would significantly reduce the load of hazardous substances entering Maybe Creek at SW-2 by diverting clean run-on and runoff around the CVF rather than through the chert blanket. Alternative 4 is expected to reduce peak selenium loads at SW-2 to less than 5 lb/day. The toxicity and volume of the hazardous substances in the CVF would not be reduced.

7.3.1.5 Short-Term Effectiveness

Alternative 1 - Grading the Top Deck
Grading the CVF may create fugitive dust. A mitigation program would be implemented to protect the community and workers. Elements of the program may include watering the surface to reduce dust and other measures, including an air monitoring program. Environmental impacts may include increased sedimentation for a short time. Sediment control mitigation would be employed and impacts would be minimal. This Alternative would not meet any of the RAOs.

Alternative 2 - Grading and Capping the Top Deck
Grading the CVF may create fugitive dust. A mitigation program would be implemented to protect the community and workers. Elements of the program may include watering the surface to reduce dust and other measures, including an air monitoring program. Environmental impacts may include increased sedimentation for a short time, but impacts would be minimal. This alternative would meet the RAOs for vegetation on the top deck within two years after completion of the cap (approximate length of time to re-establish

vegetation). While some precipitation would be captured in the cap material, runoff from the cap, and surrounding land would continue to infiltrate the CVF through the downstream slope and chert blanket, thus potentially exposing water to seleniferous shale. Thus, it is unlikely that this Alternative would substantially contribute to meeting water quality ARARs in the short-term.

Alternative 3 - Grading and Capping the Top Deck and Downstream Slope
Grading the CVF may create fugitive dust. A mitigation program would be implemented to protect the community and workers. Elements of the program may include watering the surface to reduce dust and other measures, including an air monitoring program. Environmental impacts may include increased sedimentation for a short time. While sediment production can be mitigated, impacts would be minimal. This alternative would meet the response action objectives for vegetation on the top deck and downstream slope within two years after completion of the cap (approximate length of time to re-establish vegetation). Because precipitation would continue to infiltrate the CVF through the chert blanket, thus potentially exposing water to seleniferous shale, this Alternative may not contribute to meeting water quality ARARs in the short-term.

Alternative 4 - Grading and Capping the Top Deck and Downstream Slope and Diverting Runoff
Grading the CVF may create fugitive dust. A mitigation program would be implemented to protect the community and workers. Elements of the program may include watering the surface to reduce dust and other measures, including an air monitoring program. Environmental impacts may include increased sedimentation for a short time, but impacts would be minimal. This alternative would meet the response action objectives for vegetation on the top deck and downstream slope within two years after completion of the cap (approximate length of time to re-establish vegetation). Because precipitation infiltrating the CVF through the top deck, downstream slope, and chert blanket would be substantially minimized, this Alternative has the greatest potential to meet water quality ARARs downstream in the shortest time frame. Upon completion water captured in the collection and diversion system would discharge at ARAR-compliant background concentrations.

7.3.2 Implementability

7.3.2.1 Technical Feasibility

Alternative 1- Grading the Top Deck
Grading the surface of the CVF can be implemented using conventional earth-moving equipment. Winter conditions may limit the construction season to 5 to 6 months.

Alternative 2 - Grading and Capping the Top Deck
Grading the CVF and constructing the cap can be implemented using conventional earth-moving equipment. Winter conditions may limit the construction season to 5 to 6 months. Geologic materials needed to construct a cap can be acquired locally;

manufactured materials would be either acquired locally or from regional commercial sources.

Alternative 3 - Grading and Capping the Top Deck and the Downstream Slope
Grading the CVF and constructing terraces on the downstream slope can be implemented using conventional earth-moving equipment. Winter conditions may limit the construction season to 5 to 6 months. Geologic materials needed to construct a cap can be acquired locally; manufactured materials would be either acquired locally or from regional commercial sources.

Alternative 4 - Grading and Capping the Top Deck and the Downstream Slope and Diverting Runoff
Grading the CVF and constructing the cap can be implemented using conventional earth-moving equipment. Winter conditions may limit the construction season to 5 to 6 months. Geologic materials needed to construct a cap can be acquired locally; manufactured materials would be either acquired locally or from regional commercial sources.

Diverting storm water runoff around the CVF will be challenging because of the significant elevation change and steep slope. Materials used to construct the diversion channel must perform under winter and spring runoff conditions. Cold temperatures could cause ice damming and damage to the channel liner. Greater ground disturbing activity would be required to implement Alternative 4.

7.3.2.2 Administrative Feasibility

All alternatives are administratively feasible; there are no known permitting limitations. The Forest Service will be able to implement the necessary ICs.

7.3.2.3 State and other Agency Acceptance

The Forest Service will consult with the state and other federal agencies during public comment on this EE/CA.

7.3.2.4 Community Acceptance

Community acceptance of this action will be determined after receiving public comments on the EE/CA.

7.3.3 Costs

Each alternative was evaluated based on the estimated project costs. The estimated cost for each alternative included direct capital costs, indirect capital costs, and annual operating and maintenance costs. The total capital cost for each alternative is:

- Alternative 1: $1,900,000
- Alternative 2; $11,600, 000
- Alternative 3: $15,800,000
- Alternative 4: $17,200,000 (channel costs)

Detailed cost estimates are provided in Appendix B.

8.0 COMPARATIVE ANALYSIS AND RECOMMENDED REMOVAL ACTION ALTERNATIVE

8.1 Alternatives Comparison

This section presents a comparison of each alternative's performance to that of the other alternatives with respect to the RAOs and the criteria described in Section 7.

The first RAO is to minimize infiltration on the surface of the CVF thereby reducing leaching of selenium and other hazardous substances into the CVF and Maybe Creek. The water balance analysis described in Section 4.0 indicates a large (i.e., 70 to 80 percent) percentage of flows at the toe of the CVF originates from precipitation on and recharge through the CVF. Since the majority of flows downstream of the CVF in Maybe Creek originate from precipitation falling on the CVF surface, source controls that minimize surface infiltration and runoff are essential to meet this RAO.

Alternative 1 would not substantially reduce infiltration on the surface of the CVF and selenium loads to Maybe Creek because it does not substantially change the current condition. There is no physical barrier to prevent precipitation from infiltrating into the CVF. Grading the CVF top deck may temporarily increase infiltration until vegetation re-establishes on the graded surface. Selenium loading to Maybe Creek would likely remain the same and possibly increase in the short-term as shale in the CVF surface is exposed to weathering conditions. Therefore, this alternative does not meet the effectiveness criteria, which include the ability to meet the RAOs, compliance with ARARs, and overall protection of human health and the environment.

Alternative 2 reduces infiltration into the fill by capping the 68 acre top deck. Runoff to the blanket is promoted from the top deck, but all of the water diverted from the top deck would still discharge at SW-2 and contact waste rock materials along the flow path. Selenium loads to Maybe Creek would be reduced because of the top deck cover; however, materials in the toe of the fill would remain exposed to the weather and leaching. Therefore, this alternative does not meet the effectiveness criteria, which include the ability to meet the RAOs, compliance with ARARs, and overall protection of human health and the environment.

Alternative 3 would minimize surface infiltration with caps on the top deck and downstream slope of the fill by approximately 95%. Alternative 3 better controls surface infiltration because of the downstream slope cap; however, re-introduction of runoff into the chert blanket could substantially reduce overall net effectiveness of this option.

Alternative 4 would provide the greatest reduction in overall surface infiltration into the CVF. Approximately 95% of the precipitation and runoff that currently contacts contaminant bearing waste rock in the fill would be diverted and isolated from the CVF, thereby providing the greatest net reduction in selenium loading to Maybe Creek. Alternative 4 is expected to reduce the overall hydraulic loading (e.g. input of water) to and from the CVF by approximately 70 to 80 percent (there is still the introduction of water into the CVF from the buried springs). Water balance information presented in chapter 4, demonstrates that by diverting and isolating precipitation and run-on by implementing Alternative 4, peak hydraulic loads at SW-2 would stabilize after construction near 0.5 cfs at the toe of the CVF. Alternative 4 is expected to reduce peak selenium loads at SW-2 to less than 5 lb/day. Springtime peak flows would be reduced to base flow levels with implementation of Alternative 4.

The second RAO is to minimize exposure of human and ecological receptors to hazardous substances in vegetation on the CVF surface.

Alternative 1 would not meet this RAO because there is no physical barrier to prevent future vegetation from taking up the selenium from the waste shale. Vegetation established on the downstream slope will continue to take up selenium from the seleniferous waste shale. Alternative 1 is not substantially different than the current site condition.

Alternative 2 would partially meet this RAO by capping the surface of the top deck of the CVF with a design to prevent root contact with the underlying shale, but the downstream slope would not be capped. Vegetation established on the downstream slope will continue to take up selenium from the seleniferous waste shale.

Alternatives 3 and 4 would meet this RAO by capping the surface and downstream slope of the CVF, and thus breaking the connection between seleniferous material and plants which can absorb selenium and make it available to grazing animals. Alternatives 3 and 4 would effectively meet the second RAO.

Idaho Water Quality Standards are key ARARs for the Site. However, all alternatives associated with this interim Removal Action will not achieve complete compliance with this ARAR.

Alternative 1 would not result in improved water quality or compliance with water quality standards because it does not change the current infiltration conditions.

Alternatives 2 and 3 would reduce loading of hazardous substances to surface water, which would result in some reduction of contaminant concentrations downstream, but would not result in compliance with all water quality standards.

Alternative 4 would provide the greatest reduction in loading of hazardous substances to the CVF and Maybe Creek, resulting in the greatest contribution toward compliance with ARARs. Alternative 4 separates and isolates surface water that falls as precipitation on the fill and upslope areas from upwelling water beneath the fill and water sources in the Maybe Creek drainage upgradient of the fill. Capture and diversion, of the 70-80% of all the water that contacts the CVF, would provide downstream flow at the discharge point that complies with water quality standards.

Substantial flow reductions in discharge from the toe of the fill at SW-2 would carry a smaller dissolved load of contaminants from the fill. While resulting contaminant concentrations in this discharge may increase, the smaller water volume and contaminant stream would be more effectively managed if further improvement in water quality are determined to be necessary.

The consequential decrease in the total load of selenium discharging from the CVF should eventually result in downstream locations of Maybe Creek coming into compliance with federal AWQC and Idaho Water Quality Standards sooner than Alternatives 2 and 3. Alternative 4 would also provide the greatest reduction in the volume of water that may require treatment in the future.

Alternatives 1, 2, 3, and 4 require different levels of effort but all are implementable. Grading the CVF and, for Alternatives 2, 3, and 4, constructing the cap can be implemented using conventional earth-moving equipment and proven engineering technologies. Winter conditions may limit the construction season to 5 to 6 months. The required materials are available either locally or from commercial sources.

Alternative 4, offers the additional engineering challenge of capturing runoff, diverting it into channels, and controlling flow velocities and energy developed as the diverted runoff water drops several hundred feet in elevation along steep terrain. However, it is still implementable.

Alternative 4 would provide the greatest level of source control at the Site and be consistent with any potential future remedial action at the Site.

The costs for the four alternatives range from $1,900,000 to $17,200,000. Alternative 4 is the most expensive and Alternative 1 is the least expensive.

Alternative 1, while implementable and the least expensive, would not effectively improve water quality or meet any of the RAOs.

Alternative 2 is implementable, but still lacks the effectiveness to substantially improve water quality or achieve the RAOs. Some improvements in water quality and isolation of vegetation on the top deck would be achieved at a cost of approximately $11,600,000.

Alternative 3, like 2, is implementable and its effectiveness improves with the cap extension over the downstream slope of the CVF. However, this effectiveness is compromised by re-introducing run-off from the top deck and run-on from the slopes above the CVF into the chert blanket to discharge at SW-2. Alternative 3 costs approximately $15,800,000.

Alternative 4 would be the most reliable and effective source control option relative to cost. Alternative 4 is approximately $1,400,000 more costly than Alternative 3 at $17,200,000. However, Alternative 4 isolates water from the seleniferous waste shale, delivers clean surface water downstream of the toe of the CVF, and provides the greatest reduction in the volume of water that may require treatment in the future.

8.2 Recommended Removal Action Alternative

Alternative 4, grading and capping the top deck and downstream slope and diverting runoff around the CVF is the recommended Removal Action alternative. Alternative 4 addresses:

- Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants;
- High levels of hazardous substances or pollutants or contaminants in soils largely or nearly at the surface, that may migrate; and
- Other situations or factors that may pose threats to human health, welfare, or the environment.[8]

As described above, Alternative 4 represents the best balance among the criteria of effectiveness, implementability, and cost.

Additionally, this alternative has the best chance to meet water quality standards of all of the alternatives without water treatment. If water treatment is determined to be necessary, Alternative 4 will substantially reduce the cost and the feasibility because of the much reduced quantity of contaminated water at SW-2.

- The cap design for the CVF top deck includes a 1-foot-thick cushion layer that will be placed on the graded fill, overlain with a GCL and a 60-mil HDPE low-permeability geomembrane, a drain layer, and covered with a 2-foot-thick layer of soil cover and vegetation.
- The cap design for the CVF slope includes a flattened slope with in-slope terraces and intermediate slopes covered with a 1-foot-thick cushion layer that would be placed on the graded fill, overlain with a 60-mil HDPE low-permeability geomembrane, a drain layer, and then covered with a 2-foot-thick vegetated soil

[8] See NCP Section 300.415(b)(2)

cover. The recommended alternative would re-grade the downstream CVF slope to an overall 3.5H:1V slope.

- Within the length of the slope, terraces would be added to reduce slope length and erosion potential. Between the terraces a low permeability geomembrane would control infiltration while a soil cover would support vegetation.
- In-slope terraces constructed into the CVF slope would have a geomembrane-lined channel along the inner slope with the geomembrane liner extended onto the terrace surface. Riprap would be placed over the geomembrane to protect the liner on the surface.
- Vegetation planted on the fill would be native plants adapted to the elevation and aspect, and protective of cap layers.
- Captured runoff would be routed down the slope of the CVF along the margins of the slope in a concrete channel with energy dissipation provided at the bottom of the CVF. Clean runoff will be routed into Maybe Creek well past the discharge at SW-2.

This alternative can be implemented using available technologies, materials, and services. This alternative will effectively meet the RAOs and reduce loading of hazardous substances to surface water. This Removal Action for source control at the Site would be consistent with any potential future remedial action, such as water treatment, at the site.

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APPENDICES

APPENDIX A-1

LABORATORY ANALYTICAL RESULTS FOR SURFACE WATER SAMPLES FROM 2009 MONITORING EVENTS

Appendix A-1 - Laboratory Analytical Results for Surface Water Samples from 2009 Monitoring Events

Inorganic Laboratory Sampling Results for Sampling Event # 1 - Week of May 11, 2009																				
		Constituent of Concern Concentrations (mg/L)																		
Site	Sample ID	Calcium		Magnesium		Potassium		Sodium		Cadmium		Chromium		Nickel		Selenium		Zinc		Total Hardness (as CaCO3)
SW-5	SW-5-051309	131		36.8		1.32		5.04		0.00108		0.00367	D	0.0230		1.48	D	0.0490		479
SW-4	SW-4-051309	132		37.0		1.3		5.02		0.00185		0.00622	D	0.0295		1.43	D	0.0799		481
N-FORK	N-FORK-051309	44.3		12.4		0.79		3.47		0.000200	U	0.00125	U	0.00100	U	0.00300	U	0.00500	U	162
SW-13	SW-13-051309	139		41.0		1.40		5.32		0.00244		0.00313	D	0.0385		1.62	D	0.115		515
SP-9	SP-9-051409	59.9		10.0		0.75		3.82		0.000200	U	0.00125	U	0.00100	U	0.0103	D	0.00500	U	191
SP-3	SP-3-051409	184		55.2		1.64		5.99		0.00444		0.00318	D	0.0667		2.54	D	0.203		688
SW-2	SW-2-051409	118		27.6		0.89		4.87		0.000200	U	0.00147	D	0.00167		1.10	D	0.00500	U	408
SW-2	B3-051409	186		53.9		1.64		5.56		0.00451		0.00315	D	0.0664		2.56	D	0.208		687
SW-1	SW-1-051409	43.5		13.7		0.80		2.67		0.000200	U	0.00125	U	0.00101		0.00300	U	0.00500	U	165
N/A	FB2-051409	0.040	U	0.060	U	0.5	U	0.5	U	0.00200	U	0.00125	U	0.00100	U	0.00300	U	0.00500	U	0.347

Notes:
Results are preliminary and non-validated.
mg/L = milligrams per liter

Lab Qualifiers:

D Result is from a diluted sample.
J Result below the reporting limit (MRL).
U Results below the method detection limit (MDL). Non-detects are reported at the MDL with a U.

Appendix A-1 - Laboratory Analytical Results for Surface Water Samples from 2009 Monitoring Events

Inorganic Laboratory Sampling Results for Sampling Event # 2 - Week of June 8, 2009																					
		Constituent of Concern Concentrations (mg/L)																			
Site	Sample ID	Calcium		Magnesium		Potassium		Sodium		Cadmium		Chromium		Nickel		Selenium		Zinc		Total Hardness (as CaCO3)	
SW-5	SW-5-060809	100		26.7		1.00		4.60		0.000442		0.00150	U	0.0151		0.829	D	0.0344		360	
SW-4	SW-4-060809	102		26.2		0.95		4.56		0.00122		0.00159	D	0.0171		0.869	D	0.0526		362	
N-FORK	N-FORK-060809	59.8		13.1		0.50	U	4.32		0.000200	U	0.00150	U	0.00121		0.00300	U	0.00500	U	203	
SW-13	SW-13-060809	106		27.4		0.97		4.71		0.00128		0.00150	U	0.0198		0.916	D	0.0619		378	
SP-9	SP-9	Site not sampled during this event																			
SP-3	SP-3	Site not sampled during this event																			
SW-2	SW-2060809	119		33.4		1.16		4.93		0.00252		0.00150	U	0.0364		1.30	D	0.120		435	
SW-2	B1-060809	123		34.3		1.19		4.94		0.00254		0.00150	U	0.0396		1.25	D	0.120		449	
SW-1	SW-1-061009	48.9		13.9		0.76		2.63		0.000200	U	0.00150	U	0.00113		0.00300	U	0.00500	U	179	
N/A	FB2-060909	0.040	U	0.060	U	0.50	U	0.50	U	0.000200	U	0.00150	U	0.00100	U	0.00300	U	0.00500	U	0.347	

Notes:
Results are preliminary and non-validated.
mg/L = milligrams per liter

Lab Qualifiers:

- D Result is from a diluted sample.
- J Result below the reporting limit (MRL).
- U Results below the method detection limit (MDL). Non-detects are reported at the MDL with a U.

Appendix A-1 - Laboratory Analytical Results for Surface Water Samples from 2009 Monitoring Events

Inorganic Laboratory Sampling Results for Sampling Event # 3 - Week of October 19, 2009											
		Constituent of Concern Concentrations (mg/L)									
Site	**Sample ID**	**Calcium**	**Magnesium**	**Potassium**	**Sodium**	**Cadmium**	**Chromium**	**Nickel**	**Selenium**	**Zinc**	**Total Hardness (as CaCO3)**
SW-5	SW-5-102009	102	25.8	1.09	4.57	0.000129 J	0.00110 JD	0.0101	0.702 D	0.0144	361
SW-4	SW-4-102009	101	25.7	0.96	4.63	0.000695	0.00043 JD	0.0121	0.759 D	0.0293	357
N-FORK	N-FORK-102009	55.2	11.7	0.62	3.89	0.000024 U	0.00112 JD	0.00104	0.00030 U	0.00106 J	186
SW-13	SW-13-102009	105	26.5	0.93	4.63	0.000751	0.00129 JD	0.0136	0.792 D	0.0341	370
SP-9	NA	Site not sampled during this event									
SP-3	NA	Site not sampled during this event									
SW-2	SW-2-102009	127	33.9	1.05	5.16	0.00185	0.00116 JD	0.0299	1.29 D	0.0888	457
SW-2	B1-102209	127	33.8	1.03	5.08	0.00195	0.00090 JD	0.0134	1.27 D	0.0893	455
SW-1	NA	Site was dry, no samples collected									
NA	FB1-102409-SW	0.076	0.043 J	0.09 U	0.13 J	0.000024 U	0.00067 JD	0.000141 J	0.00030 U	0.00048 U	0.366

Notes:
Results are preliminary and non-validated.
mg/L = milligrams per liter
Lab Qualifiers:
D Result is from a diluted sample.
J Result below the reporting limit (MRL).
U Results below the method detection limit (MDL). Non-detects are reported at the MDL with a U.

APPENDIX A-2

LABORATORY ANALYTICAL RESULTS FOR GROUNDWATER SAMPLES FROM 2009 MONITORING EVENTS

Appendix A-2 - Laboratory Analytical Results for Groundwater Samples from 2009 Monitoring Event

Inorganic Results for Groundwater Samples from Sampling Event # 3 - Week of October 19, 2009											
		Constituent of Concern Concentrations (mg/L)									
Site	**Sample ID**	**Calcium**	**Magnesium**	**Potassium**	**Sodium**	**Cadmium**	**Nickel**	**Selenium**	**Zinc**	**Chromium**	**Total Hardness (as CaCO3)**
MC-1	MC-1-102309	139	38.3	1.45	5.85	0.000024 U	0.00281	1.17 D	0.00166 J	0.00039 JD	506
MC-13	MC-13-102409	123	31.3	1.27	5.40	0.000042 J	0.00228	0.85 D	0.00235 J	0.00060 JD	435
MC-10	MC-10-102309	60.7	9.61	0.49 J	3.95	0.000024 U	0.00118	0.00603 D	0.00081 J	0.00029 U	191
MC-6	MC-6-102309	126	28.1	0.85	5.52	0.000024 U	0.00229	0.791 D	0.00236 J	0.00279 D	429
MC-11	MC-11-102409	143	33.0	1.09	5.85	0.000024 U	0.00286	0.775 D	0.00104 J	0.00197 U	494
MC-8	MC-8-102409	75.6	21.5	1.12	4.49	0.000024 U	0.00156	0.0234 D	0.00057 J	0.00062 JD	277
MC-1B	MC-1B-102309	137	38.4	1.51	5.92	0.000024 U	0.00288	1.14 D	0.00057 J	0.00045 JD	501
FB2	FB2-102409-GW	0.041	0.018 U	0.09 U	0.02 U	0.000024 U	0.000114 J	0.00030 U	0.000048 U	0.00029 U	0.347

Notes:

Results are preliminary and non-validated.

mg/L = milligrams per liter

Lab Qualifiers:

D Result is from a diluted sample.

J Result below the reporting limit (MRL).

U Results below the method detection limit (MDL). Non-detects are reported at the MDL with a U.

APPENDIX A-3

HISTORICAL FLOW, SELENIUM CONCENTRATIONS, AND SELENIUM LOADING CALCULATIONS

Appendix A-3 - Historical Flow, Selenium Concentrations, and Selenium Loading Calculations

Date	Flow (cfs)	Se (mg/L)	Se Loading (lb/day)	Date	Flow (cfs)	Se (mg/L)	Se Loading (lb/day)	Date	Flow (cfs)	Se (mg/L)	Se Loading (lb/day)
5/5/99	1.44	1.80	14.00	10/24/02	0.21	1.74	1.93	5/30/06	1.30	1.50	10.51
5/12/99	1.31	1.60	11.33	1/20/03	0.14	1.40	1.09	6/19/06	0.81	1.46	6.41
5/19/99	1.55	1.60	13.42	2/27/03	0.13	1.30	0.94	8/21/06	0.47	1.18	2.97
5/26/99	3.81	2.20	45.25	3/20/03	0.16	1.20	1.07	9/18/06	0.42	1.30	2.92
6/2/99	2.66	1.30	18.64	4/16/03	0.56	1.30	3.90	10/16/06	0.32	1.24	2.14
6/7/99	2.27	1.20	14.66	4/21/03	0.48	1.70	4.37	4/18/07	0.57	1.54	4.73
6/16/99	1.59	1.10	9.40	4/27/03	0.76	2.60	10.66	4/30/07	1.69	3	27.35
7/15/99	0.65	1.60	5.62	5/13/03	0.74	1.89	7.54	5/14/07	0.81	2.11	9.22
5/1/00	1.83	2.40	23.74	5/28/03	0.67	1.55	5.56	5/29/07	0.63	1.98	6.73
5/9/00	1.03	1.20	6.63	6/9/03	0.51	1.90	5.19	6/19/07	0.49	2	5.29
5/16/00	0.82	1.10	4.87	7/14/03	0.33	2.01	3.56	8/20/07	0.30	1.66	2.69
5/22/00	1.28	1.56	10.74	8/22/03	0.24	2.10	2.69	10/16/07	0.30	1.5	2.43
5/31/00	0.75	1.28	5.19	9/29/03	0.23	1.52	1.85	5/5/08	0.88	1.79	8.50
6/6/00	0.64	1.58	5.43	10/22/03	0.32	1.49	2.56	5/19/08	4.16	3.14	70.45
6/26/00	0.39	1.70	3.61	12/18/03	0.34	1.31	2.42	6/16/08	0.94	1.93	9.78
7/13/00	0.33	1.96	3.54	1/21/04	--	1.54	--	8/12/08	0.57	1.45	4.46
4/24/01	0.75	1.20	4.87	2/25/04	--	1.50	--	10/14/08	0.42	1.45	3.28
4/30/01	1.17	1.90	12.02	3/15/04	--	1.18	--	5/11/09	3.83	2.56	52.88
5/15/01	0.66	2.14	7.62	5/4/04	--	1.99	--	6/8/09	2.40	1.25	16.18
5/29/01	0.51	1.89	5.24	5/17/04	--	1.90	--	10/19/09	0.89	1.27	6.10
6/14/01	0.29	2.08	3.29	5/29/04	--	1.44	--				
6/25/01	0.26	2.26	3.15	6/29/04	--	1.77	--				
7/10/01	0.22	2.43	2.87	7/26/04	--	2.40	--				
8/7/01	0.20	2.52	2.70	9/2/04	--	2.14	--				
10/30/01	0.12	1.80	1.19	11/3/04	0.37	1.84	3.67				
11/27/01	0.10	1.60	0.85	4/19/05	0.56	0.81	2.44				
1/1/02	0.10	1.50	0.77	4/26/05	1.37	1.61	11.93				
2/1/02	0.09	1.31	0.65	5/3/05	1.44	1.75	13.58				
4/11/02	0.34	1.20	2.19	5/10/05	2.27	1.87	22.90				
4/15/02	0.64	1.50	5.16	5/17/05	2.12	1.47	16.78				
4/23/02	0.43	1.94	4.46	5/24/05	1.64	1.52	13.41				
4/26/02	0.48	1.40	3.62	6/22/05	1.41	1.08	8.21				
4/28/02	0.54	1.68	4.88	7/14/05	0.99	1.22	6.50				
5/2/02	0.63	2.30	7.87	8/17/05	0.69	0.85	3.15				
5/15/02	0.60	1.54	5.01	9/19/05	0.52	0.49	1.37				
5/28/02	0.59	1.67	5.31	10/17/05	0.46	1.00	2.47				
6/7/02	0.53	1.44	4.08	11/15/05	0.33	0.73	1.31				
6/17/02	0.45	0.98	2.38	3/8/06	0.30	1.01	1.62				
7/15/02	0.35	1.75	3.32	4/19/06	1.08	2.20	12.83				
8/16/02	0.30	1.75	2.80	5/1/06	3.08	2.23	37.07				
9/19/02	0.25	1.85	2.48	5/15/06	2.40	2.15	27.80				

APPENDIX A-4

FLOW MEASUREMENTS FROM 2009 MONITORING EVENTS

Appendix A-4 - Flow Measurements from 2009 Monitoring Events

Date	Site ID	Total Flow (cfs)
May-09	SW-5	4.388
	SW-4	6.4917
	N-Fork	0.6738
	SW-13	2.206
	SP-9	NM
	SP-3	0.5662
	SW-2	3.83
	SW-13	0.15
June-09	SW-5	2.5339
	SW-4	4.0279
	N-Fork	0.1554
	SW-13	2.7674
	SP-9	NM
	SP-3	NM
	SW-2	1.33
	SW-13	0.39
October-09	SW-5	0.4904
	SW-4	1.275
	N-Fork	NM
	SW-13	0.5356
	SP-9	NM
	SP-3	NM
	SW-2	0.5
	SW-13	NM

Notes:
NM = Flow was to low or not measured during this event.
cfs = cubic feet per second

APPENDIX A-5

DAILY UPSTREAM AND DOWNSTREAM FLOWS
(1998 THROUGH 2006)

Appendix A-5 - Daily Upstream and Downstream Flows (1998 through 2006)

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
10/1/1998	1	38,204	0	11/28/1998	59	14,556	0	1/25/1999	117	14,160	389
10/2/1998	2	31,325	0	11/29/1998	60	14,954	0	1/26/1999	118	14,194	319
10/3/1998	3	31,606	0	11/30/1998	61	14,945	0	1/27/1999	119	13,978	255
10/4/1998	4	34,098	0	12/1/1998	62	14,918	0	1/28/1999	120	13,990	226
10/5/1998	5	33,346	0	12/2/1998	63	14,552	0	1/29/1999	121	13,725	203
10/6/1998	6	33,640	0	12/3/1998	64	14,636	0	1/30/1999	122	13,677	176
10/7/1998	7	36,048	0	12/4/1998	65	13,954	0	1/31/1999	123	14,134	165
10/8/1998	8	36,707	0	12/5/1998	66	14,189	0	2/1/1999	124	14,359	160
10/9/1998	9	31,954	0	12/6/1998	67	14,297	0	2/2/1999	125	14,463	139
10/10/1998	10	33,881	0	12/7/1998	68	14,108	0	2/3/1999	126	14,014	116
10/11/1998	11	31,768	0	12/8/1998	69	13,540	0	2/4/1999	127	14,068	104
10/12/1998	12	23,332	1,020	12/9/1998	70	13,810	0	2/5/1999	128	13,967	91
10/13/1998	13	25,950	2,264	12/10/1998	71	14,204	0	2/6/1999	129	13,828	80
10/14/1998	14	25,758	2,151	12/11/1998	72	14,231	0	2/7/1999	130	13,614	87
10/15/1998	15	25,628	2,094	12/12/1998	73	14,140	0	2/8/1999	131	13,769	98
10/16/1998	16	25,596	2,044	12/13/1998	74	14,143	0	2/9/1999	132	13,756	102
10/17/1998	17	24,933	1,980	12/14/1998	75	13,950	0	2/10/1999	133	13,884	98
10/18/1998	18	24,374	1,908	12/15/1998	76	13,952	0	2/11/1999	134	13,784	98
10/19/1998	19	24,563	2,529	12/16/1998	77	13,902	0	2/12/1999	135	13,767	92
10/20/1998	20	24,563	2,271	12/17/1998	78	14,162	0	2/13/1999	136	13,872	89
10/21/1998	21	24,783	2,899	12/18/1998	79	14,203	0	2/14/1999	137	14,114	85
10/22/1998	22	24,839	1,943	12/19/1998	80	13,744	0	2/15/1999	138	13,875	86
10/23/1998	23	24,967	2,240	12/20/1998	81	13,847	0	2/16/1999	139	13,901	85
10/24/1998	24	25,284	1,969	12/21/1998	82	13,714	0	2/17/1999	140	14,001	83
10/25/1998	25	25,407	2,044	12/22/1998	83	13,584	0	2/18/1999	141	13,877	81
10/26/1998	26	25,031	1,980	12/23/1998	84	13,146	0	2/19/1999	142	13,664	83
10/27/1998	27	24,745	1,980	12/24/1998	85	12,987	0	2/20/1999	143	13,787	81
10/28/1998	28	24,431	1,998	12/25/1998	86	12,993	0	2/21/1999	144	13,690	84
10/29/1998	29	24,119	1,958	12/26/1998	87	13,236	0	2/22/1999	145	13,600	848
10/30/1998	30	24,242	1,959	12/27/1998	88	13,336	0	2/23/1999	146	13,832	674
10/31/1998	31	24,182	1,874	12/28/1998	89	13,477	0	2/24/1999	147	13,779	579
11/1/1998	32	23,994	1,754	12/29/1998	90	13,502	0	2/25/1999	148	14,472	400
11/2/1998	33	24,117	1,834	12/30/1998	91	13,466	0	2/26/1999	149	13,474	481
11/3/1998	34	23,591	1,778	12/31/1998	92	13,702	0	2/27/1999	150	13,415	432
11/4/1998	35	23,254	1,830	1/1/1999	93	13,626	0	2/28/1999	151	13,716	399
11/5/1998	36	23,561	1,680	1/2/1999	94	13,618	0	3/1/1999	152	13,699	340
11/6/1998	37	23,009	1,756	1/3/1999	95	13,731	0	3/2/1999	153	13,379	318
11/7/1998	38	22,886	2,608	1/4/1999	96	13,572	0	3/3/1999	154	13,368	297
11/8/1998	39	22,732	1,566	1/5/1999	97	13,634	0	3/4/1999	155	13,668	535
11/9/1998	40	22,459	1,501	1/6/1999	98	13,519	0	3/5/1999	156	13,935	1,040
11/10/1998	41	22,523	1,517	1/7/1999	99	13,487	0	3/6/1999	157	14,050	844
11/11/1998	42	22,551	1,697	1/8/1999	100	13,537	0	3/7/1999	158	14,059	813
11/12/1998	43	22,308	1,427	1/9/1999	101	13,557	0	3/8/1999	159	13,811	733
11/13/1998	44	22,643	1,703	1/10/1999	102	13,591	0	3/9/1999	160	13,786	663
11/14/1998	45	23,037	1,561	1/11/1999	103	13,633	0	3/10/1999	161	13,675	613
11/15/1998	46	23,313	1,482	1/12/1999	104	13,374	0	3/11/1999	162	13,655	581
11/16/1998	47	22,884	3,613	1/13/1999	105	13,277	0	3/12/1999	163	13,575	543
11/17/1998	48	23,222	1,425	1/14/1999	106	13,251	0	3/13/1999	164	13,605	511
11/18/1998	49	22,701	3,645	1/15/1999	107	13,306	0	3/14/1999	165	14,059	497
11/19/1998	50	22,580	1,338	1/16/1999	108	13,233	0	3/15/1999	166	14,982	353
11/20/1998	51	21,315	4,489	1/17/1999	109	13,101	0	3/16/1999	167	14,274	437
11/21/1998	52	15,599	0	1/18/1999	110	13,374	0	3/17/1999	168	14,332	414
11/22/1998	53	15,680	0	1/19/1999	111	13,209	1,012	3/18/1999	169	14,251	402
11/23/1998	54	14,945	0	1/20/1999	112	13,648	946	3/19/1999	170	14,067	386
11/24/1998	55	14,932	0	1/21/1999	113	14,567	624	3/20/1999	171	14,235	372
11/25/1998	56	14,707	0	1/22/1999	114	14,229	700	3/21/1999	172	14,096	360
11/26/1998	57	14,924	0	1/23/1999	115	13,765	573	3/22/1999	173	14,241	339
11/27/1998	58	14,937	0	1/24/1999	116	13,990	483	3/23/1999	174	14,633	337
3/24/1999	175	14,849	329	5/21/1999	233	204,612	40,757	7/18/1999	291	54,005	10,802
3/25/1999	176	14,704	576	5/22/1999	234	239,930	47,441	7/19/1999	292	53,297	10,418
3/26/1999	177	14,809	1,143	5/23/1999	235	314,315	57,567	7/20/1999	293	53,175	9,976
3/27/1999	178	15,398	1,150	5/24/1999	236	352,189	70,825	7/21/1999	294	53,298	9,663
3/28/1999	179	15,973	1,002	5/25/1999	237	350,863	75,608	7/22/1999	295	52,685	9,175
3/29/1999	180	15,821	824	5/26/1999	238	329,472	77,289	7/23/1999	296	52,146	8,808
3/30/1999	181	15,870	785	5/27/1999	239	291,308	84,686	7/24/1999	297	52,392	8,454

Notes:
Flow measurement in cubic feet per day

Appendix A-5 - Daily Upstream and Downstream Flows (1998 through 2006)

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
3/31/1999	182	16,371	741	5/28/1999	240	311,002	103,022	7/25/1999	298	50,883	8,245
4/1/1999	183	17,750	702	5/29/1999	241	305,461	105,611	7/26/1999	299	50,435	8,132
4/2/1999	184	18,638	652	5/30/1999	242	286,178	106,047	7/27/1999	300	50,678	7,997
4/3/1999	185	18,674	796	5/31/1999	243	279,304	98,202	7/28/1999	301	49,704	7,861
4/4/1999	186	19,000	1,368	6/1/1999	244	246,259	91,433	7/29/1999	302	50,394	9,100
4/5/1999	187	21,086	1,450	6/2/1999	245	229,650	89,012	7/30/1999	303	55,735	8,004
4/6/1999	188	23,167	1,025	6/3/1999	246	221,460	89,438	7/31/1999	304	53,790	7,862
4/7/1999	189	24,225	1,052	6/4/1999	247	206,484	81,311	8/1/1999	305	50,676	7,603
4/8/1999	190	24,762	1,521	6/5/1999	248	199,329	77,271	8/2/1999	306	49,747	7,354
4/9/1999	191	26,157	1,509	6/6/1999	249	183,761	77,349	8/3/1999	307	48,936	7,513
4/10/1999	192	28,015	1,739	6/7/1999	250	195,744	79,728	8/4/1999	308	48,334	7,223
4/11/1999	193	30,798	1,863	6/8/1999	251	191,875	81,011	8/5/1999	309	48,417	6,993
4/12/1999	194	34,751	2,069	6/9/1999	252	183,769	78,523	8/6/1999	310	47,307	6,808
4/13/1999	195	40,236	2,078	6/10/1999	253	177,619	77,769	8/7/1999	311	46,357	6,612
4/14/1999	196	41,609	1,490	6/11/1999	254	168,477	77,566	8/8/1999	312	45,654	6,424
4/15/1999	197	48,468	1,593	6/12/1999	255	164,068	79,277	8/9/1999	313	45,930	6,258
4/16/1999	198	50,434	1,672	6/13/1999	256	159,388	77,074	8/10/1999	314	46,596	6,176
4/17/1999	199	48,033	1,830	6/14/1999	257	153,925	76,585	8/11/1999	315	44,636	6,136
4/18/1999	200	48,927	1,851	6/15/1999	258	141,531	77,958	8/12/1999	316	45,102	5,885
4/19/1999	201	48,263	1,788	6/16/1999	259	136,962	87,270	8/13/1999	317	44,563	5,785
4/20/1999	202	46,773	1,927	6/17/1999	260	140,296	86,363	8/14/1999	318	44,564	5,758
4/21/1999	203	46,897	2,198	6/18/1999	261	132,351	82,420	8/15/1999	319	44,291	5,719
4/22/1999	204	50,306	2,687	6/19/1999	262	127,013	78,189	8/16/1999	320	43,947	5,679
4/23/1999	205	59,012	3,002	6/20/1999	263	117,437	72,057	8/17/1999	321	43,097	5,554
4/24/1999	206	65,016	2,977	6/21/1999	264	108,132	64,020	8/18/1999	322	42,529	5,365
4/25/1999	207	64,381	2,593	6/22/1999	265	99,203	57,240	8/19/1999	323	42,215	5,416
4/26/1999	208	76,424	3,122	6/23/1999	266	92,670	50,903	8/20/1999	324	42,295	5,320
4/27/1999	209	91,374	3,894	6/24/1999	267	87,779	45,444	8/21/1999	325	42,600	5,248
4/28/1999	210	103,733	4,555	6/25/1999	268	84,146	42,357	8/22/1999	326	42,483	5,171
4/29/1999	211	112,223	4,824	6/26/1999	269	79,669	39,618	8/23/1999	327	41,274	5,146
4/30/1999	212	106,446	5,148	6/27/1999	270	78,945	38,078	8/24/1999	328	40,856	5,082
5/1/1999	213	99,883	5,821	6/28/1999	271	78,050	36,231	8/25/1999	329	40,707	5,019
5/2/1999	214	94,390	6,536	6/29/1999	272	75,684	35,866	8/26/1999	330	41,199	5,000
5/3/1999	215	92,775	7,154	6/30/1999	273	74,843	34,304	8/27/1999	331	40,591	4,615
5/4/1999	216	91,920	7,780	7/1/1999	274	74,195	32,329	8/28/1999	332	40,445	4,045
5/5/1999	217	124,636	14,777	7/2/1999	275	72,341	30,641	8/29/1999	333	39,994	3,929
5/6/1999	218	115,791	15,042	7/3/1999	276	71,654	29,144	8/30/1999	334	39,844	4,368
5/7/1999	219	112,857	16,941	7/4/1999	277	70,595	27,593	8/31/1999	335	41,130	4,187
5/8/1999	220	120,007	18,444	7/5/1999	278	68,145	26,152	9/1/1999	336	40,105	3,935
5/9/1999	221	126,153	18,148	7/6/1999	279	67,340	25,071	9/2/1999	337	38,398	4,063
5/10/1999	222	121,844	17,765	7/7/1999	280	67,100	23,586	9/3/1999	338	37,557	4,201
5/11/1999	223	117,314	17,335	7/8/1999	281	66,214	21,197	9/4/1999	339	38,660	4,133
5/12/1999	224	113,443	18,479	7/9/1999	282	65,104	19,537	9/5/1999	340	38,880	3,889
5/13/1999	225	115,731	19,995	7/10/1999	283	64,975	18,281	9/6/1999	341	38,221	3,825
5/14/1999	226	115,401	19,914	7/11/1999	284	64,567	17,048	9/7/1999	342	37,341	3,774
5/15/1999	227	114,364	19,942	7/12/1999	285	63,995	15,763	9/8/1999	343	37,419	3,714
5/16/1999	228	110,101	19,745	7/13/1999	286	60,542	14,461	9/9/1999	344	37,376	3,662
5/17/1999	229	108,500	20,084	7/14/1999	287	57,193	13,656	9/10/1999	345	36,942	3,599
5/18/1999	230	112,488	22,891	7/15/1999	288	56,266	12,776	9/11/1999	346	36,655	3,494
5/19/1999	231	134,317	26,688	7/16/1999	289	53,792	11,789	9/12/1999	347	35,398	3,495
5/20/1999	232	167,412	32,280	7/17/1999	290	53,048	11,462	9/13/1999	348	35,436	3,433
9/14/1999	349	35,795	3,379	11/11/1999	42	15,266	424	1/8/2000	100	19,730	0
9/15/1999	350	35,610	3,324	11/12/1999	43	15,009	357	1/9/2000	101	19,730	0
9/16/1999	351	35,790	3,335	11/13/1999	44	15,352	426	1/10/2000	102	20,198	0
9/17/1999	352	35,610	3,280	11/14/1999	45	15,450	390	1/11/2000	103	19,847	0
9/18/1999	353	35,112	3,226	11/15/1999	46	15,222	370	1/12/2000	104	19,269	0
9/19/1999	354	34,644	3,237	11/16/1999	47	15,140	903	1/13/2000	105	19,154	0
9/20/1999	355	34,119	3,089	11/17/1999	48	15,321	356	1/14/2000	106	19,155	0
9/21/1999	356	33,451	3,036	11/18/1999	49	14,951	911	1/15/2000	107	19,097	0
9/22/1999	357	33,208	3,052	11/19/1999	50	14,734	335	1/16/2000	108	19,557	0
9/23/1999	358	33,560	3,074	11/20/1999	51	23,252	0	1/17/2000	109	19,211	0
9/24/1999	359	33,627	3,188	11/21/1999	52	22,582	0	1/18/2000	110	19,966	0
9/25/1999	360	33,344	3,104	11/22/1999	53	22,399	0	1/19/2000	111	19,499	3,036
9/26/1999	361	32,230	2,978	11/23/1999	54	20,641	0	1/20/2000	112	20,313	2,837
9/27/1999	362	31,577	2,901	11/24/1999	55	21,527	0	1/21/2000	113	20,348	2,497

Notes:

Flow measurement in cubic feet per day

Appendix A-5 - Daily Upstream and Downstream Flows (1998 through 2006)

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
9/28/1999	363	30,290	2,779	11/25/1999	56	21,885	0	1/22/2000	114	21,227	2,099
9/29/1999	364	30,768	2,828	11/26/1999	57	22,762	0	1/23/2000	115	20,197	1,718
9/30/1999	365	31,346	2,609	11/27/1999	58	22,609	0	1/24/2000	116	21,228	1,449
10/1/1999	1	31,442	2,858	11/28/1999	59	21,704	0	1/25/2000	117	21,584	1,167
10/2/1999	2	30,188	2,777	11/29/1999	60	21,945	0	1/26/2000	118	21,346	956
10/3/1999	3	29,649	2,873	11/30/1999	61	22,005	0	1/27/2000	119	20,549	764
10/4/1999	4	30,296	2,817	12/1/1999	62	21,885	0	1/28/2000	120	20,461	678
10/5/1999	5	30,703	2,772	12/2/1999	63	21,168	0	1/29/2000	121	20,607	609
10/6/1999	6	30,392	2,784	12/3/1999	64	20,963	0	1/30/2000	122	20,432	529
10/7/1999	7	29,748	2,666	12/4/1999	65	19,616	0	1/31/2000	123	21,110	494
10/8/1999	8	29,484	2,680	12/5/1999	66	20,698	0	2/1/2000	124	21,112	480
10/9/1999	9	29,350	2,800	12/6/1999	67	20,933	0	2/2/2000	125	21,078	418
10/10/1999	10	29,251	2,748	12/7/1999	68	21,139	0	2/3/2000	126	20,931	349
10/11/1999	11	29,282	2,717	12/8/1999	69	20,257	0	2/4/2000	127	20,637	312
10/12/1999	12	29,116	2,652	12/9/1999	70	20,756	0	2/5/2000	128	20,842	274
10/13/1999	13	29,052	2,534	12/10/1999	71	21,554	0	2/6/2000	129	20,432	240
10/14/1999	14	28,781	2,567	12/11/1999	72	21,614	0	2/7/2000	130	19,992	261
10/15/1999	15	27,760	2,489	12/12/1999	73	21,764	0	2/8/2000	131	20,403	294
10/16/1999	16	26,721	2,353	12/13/1999	74	21,286	0	2/9/2000	132	20,547	307
10/17/1999	17	26,535	3,723	12/14/1999	75	20,025	0	2/10/2000	133	21,020	294
10/18/1999	18	26,983	2,859	12/15/1999	76	20,314	0	2/11/2000	134	21,138	294
10/19/1999	19	26,795	3,006	12/16/1999	77	20,842	0	2/12/2000	135	21,197	277
10/20/1999	20	26,853	3,297	12/17/1999	78	20,842	0	2/13/2000	136	20,815	268
10/21/1999	21	27,146	3,440	12/18/1999	79	20,314	0	2/14/2000	137	21,286	255
10/22/1999	22	27,175	3,137	12/19/1999	80	20,196	0	2/15/2000	138	21,375	259
10/23/1999	23	27,214	2,764	12/20/1999	81	20,547	0	2/16/2000	139	21,315	255
10/24/1999	24	27,765	4,334	12/21/1999	82	20,196	0	2/17/2000	140	21,138	250
10/25/1999	25	27,438	3,279	12/22/1999	83	19,963	0	2/18/2000	141	20,901	244
10/26/1999	26	27,275	2,988	12/23/1999	84	19,615	0	2/19/2000	142	20,547	250
10/27/1999	27	27,160	2,459	12/24/1999	85	19,499	0	2/20/2000	143	20,782	244
10/28/1999	28	15,459	500	12/25/1999	86	19,500	0	2/21/2000	144	21,256	253
10/29/1999	29	15,450	490	12/26/1999	87	19,558	0	2/22/2000	145	21,256	2,545
10/30/1999	30	14,901	490	12/27/1999	88	19,442	0	2/23/2000	146	20,960	2,022
10/31/1999	31	16,113	625	12/28/1999	89	19,559	0	2/24/2000	147	21,138	1,738
11/1/1999	32	15,480	438	12/29/1999	90	19,559	0	2/25/2000	148	21,138	1,599
11/2/1999	33	15,285	458	12/30/1999	91	19,616	0	2/26/2000	149	20,961	1,444
11/3/1999	34	18,545	356	12/31/1999	92	20,142	0	2/27/2000	150	20,723	1,295
11/4/1999	35	15,107	458	1/1/2000	93	20,255	0	2/28/2000	151	21,138	1,196
11/5/1999	36	15,237	420	1/2/2000	94	20,371	0	2/29/2000	152	21,019	1,101
11/6/1999	37	15,355	439	1/3/2000	95	19,963	0	3/1/2000	153	20,842	1,019
11/7/1999	38	15,275	652	1/4/2000	96	19,846	0	3/2/2000	154	20,313	953
11/8/1999	39	15,313	392	1/5/2000	97	19,962	0	3/3/2000	155	20,108	891
11/9/1999	40	15,243	375	1/6/2000	98	19,501	0	3/4/2000	156	20,608	1,604
11/10/1999	41	15,331	379	1/7/2000	99	19,705	0	3/5/2000	157	21,079	3,121
3/6/2000	158	21,227	2,533	5/3/2000	216	137,554	35,771	6/30/2000	274	32,973	1,371
3/7/2000	159	21,197	2,438	5/4/2000	217	128,026	38,141	7/1/2000	275	31,884	1,284
3/8/2000	160	20,724	2,200	5/5/2000	218	118,254	37,958	7/2/2000	276	31,886	1,223
3/9/2000	161	20,902	1,989	5/6/2000	219	107,600	36,703	7/3/2000	277	31,366	1,037
3/10/2000	162	20,488	1,838	5/7/2000	220	99,204	36,825	7/4/2000	278	30,137	1,002
3/11/2000	163	20,430	1,743	5/8/2000	221	95,051	35,606	7/5/2000	279	30,048	873
3/12/2000	164	20,079	1,628	5/9/2000	222	88,567	34,895	7/6/2000	280	30,958	786
3/13/2000	165	20,138	1,533	5/10/2000	223	84,584	33,819	7/7/2000	281	30,626	722
3/14/2000	166	20,430	1,492	5/11/2000	224	80,136	31,643	7/8/2000	282	30,231	709
3/15/2000	167	20,196	1,412	5/12/2000	225	76,576	30,092	7/9/2000	283	29,431	682
3/16/2000	168	20,050	1,310	5/13/2000	226	74,424	29,111	7/10/2000	284	28,236	712
3/17/2000	169	20,196	1,242	5/14/2000	227	73,496	28,352	7/11/2000	285	29,062	616
3/18/2000	170	20,079	1,207	5/15/2000	228	72,108	27,852	7/12/2000	286	29,032	553
3/19/2000	171	19,962	1,159	5/16/2000	229	70,962	27,533	7/13/2000	287	28,897	464
3/20/2000	172	20,225	1,115	5/17/2000	230	69,906	26,699	7/14/2000	288	28,463	411
3/21/2000	173	20,138	1,079	5/18/2000	231	68,227	26,082	7/15/2000	289	27,728	373
3/22/2000	174	20,167	1,018	5/19/2000	232	67,526	25,331	7/16/2000	290	27,397	364
3/23/2000	175	20,079	1,011	5/20/2000	233	100,390	11,878	7/17/2000	291	27,121	392
3/24/2000	176	20,051	987	5/21/2000	234	105,263	13,903	7/18/2000	292	26,488	264
3/25/2000	177	20,255	1,728	5/22/2000	235	110,257	15,569	7/19/2000	293	26,209	234
3/26/2000	178	20,874	3,428	5/23/2000	236	124,110	17,924	7/20/2000	294	26,194	215

Notes:
Flow measurement in cubic feet per day

Appendix A-5 - Daily Upstream and Downstream Flows (1998 through 2006)

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
3/27/2000	179	22,560	3,449	5/24/2000	237	131,186	20,905	7/21/2000	295	25,883	216
3/28/2000	180	24,588	3,006	5/25/2000	238	72,425	9,165	7/22/2000	296	25,706	214
3/29/2000	181	24,148	2,472	5/26/2000	239	74,544	8,713	7/23/2000	297	25,479	214
3/30/2000	182	23,807	2,356	5/27/2000	240	70,701	8,614	7/24/2000	298	25,024	176
3/31/2000	183	23,560	2,223	5/28/2000	241	68,274	8,674	7/25/2000	299	24,936	164
4/1/2000	184	23,962	2,107	5/29/2000	242	67,146	8,574	7/26/2000	300	24,617	166
4/2/2000	185	24,210	1,957	5/30/2000	243	66,290	8,171	7/27/2000	301	24,334	182
4/3/2000	186	23,931	2,389	5/31/2000	244	64,894	7,676	7/28/2000	302	24,204	128
4/4/2000	187	24,847	4,103	6/1/2000	245	63,607	7,275	7/29/2000	303	24,163	113
4/5/2000	188	29,936	4,349	6/2/2000	246	63,458	6,980	7/30/2000	304	24,915	128
4/6/2000	189	33,633	3,075	6/3/2000	247	62,707	6,724	7/31/2000	305	24,798	136
4/7/2000	190	33,797	3,157	6/4/2000	248	61,831	6,417	8/1/2000	306	24,782	108
4/8/2000	191	33,274	4,564	6/5/2000	249	61,003	6,170	8/2/2000	307	24,086	122
4/9/2000	192	34,910	4,526	6/6/2000	250	55,056	5,933	8/3/2000	308	22,807	121
4/10/2000	193	36,941	5,218	6/7/2000	251	46,124	5,521	8/4/2000	309	22,351	193
4/11/2000	194	41,328	5,588	6/8/2000	252	45,600	5,346	8/5/2000	310	22,322	97
4/12/2000	195	50,038	6,206	6/9/2000	253	44,257	5,225	8/6/2000	311	22,192	72
4/13/2000	196	58,879	6,233	6/10/2000	254	44,097	4,856	8/7/2000	312	22,128	55
4/14/2000	197	62,270	5,959	6/11/2000	255	43,998	4,578	8/8/2000	313	22,047	44
4/15/2000	198	60,360	6,372	6/12/2000	256	42,619	4,553	8/9/2000	314	21,993	49
4/16/2000	199	58,421	6,688	6/13/2000	257	42,373	4,163	8/10/2000	315	21,988	42
4/17/2000	200	59,195	7,320	6/14/2000	258	41,867	3,952	8/11/2000	316	21,353	26
4/18/2000	201	62,803	7,405	6/15/2000	259	41,135	3,820	8/12/2000	317	20,677	11
4/19/2000	202	65,444	7,150	6/16/2000	260	40,319	3,478	8/13/2000	318	20,646	20
4/20/2000	203	63,941	7,709	6/17/2000	261	39,577	3,329	8/14/2000	319	20,312	15
4/21/2000	204	63,423	8,794	6/18/2000	262	39,523	3,135	8/15/2000	320	20,248	17
4/22/2000	205	72,541	10,747	6/19/2000	263	38,789	3,255	8/16/2000	321	20,673	50
4/23/2000	206	92,708	12,010	6/20/2000	264	38,068	2,742	8/17/2000	322	15,366	0
4/24/2000	207	98,478	11,907	6/21/2000	265	37,516	2,551	8/18/2000	323	15,125	0
4/25/2000	208	95,913	12,964	6/22/2000	266	37,555	2,376	8/19/2000	324	15,283	0
4/26/2000	209	97,107	15,608	6/23/2000	267	36,701	2,290	8/20/2000	325	15,069	0
4/27/2000	210	117,954	19,472	6/24/2000	268	35,849	2,013	8/21/2000	326	14,833	0
4/28/2000	211	166,827	22,775	6/25/2000	269	34,929	1,870	8/22/2000	327	14,814	0
4/29/2000	212	189,816	24,118	6/26/2000	270	33,973	1,792	8/23/2000	328	14,810	0
4/30/2000	213	173,821	25,739	6/27/2000	271	33,372	1,659	8/24/2000	329	14,720	0
5/1/2000	214	158,449	29,105	6/28/2000	272	33,344	1,600	8/25/2000	330	14,542	0
5/2/2000	215	142,510	32,681	6/29/2000	273	33,111	1,470	8/26/2000	331	14,616	0
8/27/2000	332	14,895	0	10/24/2000	24	10,072	0	12/21/2000	82	13,714	0
8/28/2000	333	14,853	0	10/25/2000	25	10,001	0	12/22/2000	83	13,584	0
8/29/2000	334	14,584	0	10/26/2000	26	10,321	0	12/23/2000	84	13,146	0
8/30/2000	335	14,439	0	10/27/2000	27	9,699	0	12/24/2000	85	12,987	0
8/31/2000	336	14,174	0	10/28/2000	28	9,544	0	12/25/2000	86	12,993	0
9/1/2000	337	14,048	0	10/29/2000	29	10,063	0	12/26/2000	87	13,236	0
9/2/2000	338	14,078	0	10/30/2000	30	9,946	0	12/27/2000	88	13,336	0
9/3/2000	339	13,972	0	10/31/2000	31	16,113	625	12/28/2000	89	13,477	0
9/4/2000	340	14,005	0	11/1/2000	32	15,480	438	12/29/2000	90	13,502	0
9/5/2000	341	13,904	0	11/2/2000	33	15,285	458	12/30/2000	91	13,466	0
9/6/2000	342	13,133	0	11/3/2000	34	18,545	356	12/31/2000	92	13,702	0
9/7/2000	343	13,069	0	11/4/2000	35	15,107	458	1/1/2001	93	13,626	0
9/8/2000	344	13,528	0	11/5/2000	36	15,237	420	1/2/2001	94	13,618	0
9/9/2000	345	13,263	0	11/6/2000	37	15,355	439	1/3/2001	95	13,731	0
9/10/2000	346	13,393	0	11/7/2000	38	15,275	652	1/4/2001	96	13,572	0
9/11/2000	347	13,500	0	11/8/2000	39	15,313	392	1/5/2001	97	13,634	0
9/12/2000	348	13,310	0	11/9/2000	40	15,243	375	1/6/2001	98	13,519	0
9/13/2000	349	13,631	0	11/10/2000	41	15,331	379	1/7/2001	99	13,487	0
9/14/2000	350	13,442	0	11/11/2000	42	15,266	424	1/8/2001	100	13,537	0
9/15/2000	351	13,358	0	11/12/2000	43	15,009	357	1/9/2001	101	13,557	0
9/16/2000	352	13,130	0	11/13/2000	44	15,352	426	1/10/2001	102	13,591	0
9/17/2000	353	13,124	0	11/14/2000	45	15,450	390	1/11/2001	103	13,633	0
9/18/2000	354	12,843	0	11/15/2000	46	15,222	370	1/12/2001	104	13,374	0
9/19/2000	355	12,954	0	11/16/2000	47	15,140	903	1/13/2001	105	13,277	0
9/20/2000	356	12,271	0	11/17/2000	48	15,321	356	1/14/2001	106	13,251	0
9/21/2000	357	12,562	0	11/18/2000	49	14,951	911	1/15/2001	107	13,306	0
9/22/2000	358	11,479	0	11/19/2000	50	14,734	335	1/16/2001	108	13,233	0
9/23/2000	359	11,032	0	11/20/2000	51	16,428	898	1/17/2001	109	13,101	0

Notes:
Flow measurement in cubic feet per day

Appendix A-5 - Daily Upstream and Downstream Flows (1998 through 2006)

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
9/24/2000	360	10,849	0	11/21/2000	52	15,599	0	1/18/2001	110	13,374	0
9/25/2000	361	11,008	0	11/22/2000	53	15,680	0	1/19/2001	111	13,209	1,012
9/26/2000	362	11,181	0	11/23/2000	54	14,945	0	1/20/2001	112	13,648	946
9/27/2000	363	11,270	0	11/24/2000	55	14,932	0	1/21/2001	113	14,567	624
9/28/2000	364	11,684	0	11/25/2000	56	14,707	0	1/22/2001	114	14,229	700
9/29/2000	365	11,781	0	11/26/2000	57	14,924	0	1/23/2001	115	13,765	573
9/30/2000	366	11,687	0	11/27/2000	58	14,937	0	1/24/2001	116	13,990	483
10/1/2000	1	11,383	0	11/28/2000	59	14,556	0	1/25/2001	117	14,160	389
10/2/2000	2	10,667	0	11/29/2000	60	14,954	0	1/26/2001	118	14,194	319
10/3/2000	3	10,591	0	11/30/2000	61	14,945	0	1/27/2001	119	13,978	255
10/4/2000	4	10,348	0	12/1/2000	62	14,918	0	1/28/2001	120	13,990	226
10/5/2000	5	9,931	0	12/2/2000	63	14,552	0	1/29/2001	121	13,725	203
10/6/2000	6	9,786	0	12/3/2000	64	14,636	0	1/30/2001	122	13,677	176
10/7/2000	7	9,794	0	12/4/2000	65	13,954	0	1/31/2001	123	14,134	165
10/8/2000	8	9,626	0	12/5/2000	66	14,189	0	2/1/2001	124	14,359	160
10/9/2000	9	10,197	0	12/6/2000	67	14,297	0	2/2/2001	125	14,463	139
10/10/2000	10	10,459	0	12/7/2000	68	14,108	0	2/3/2001	126	14,014	116
10/11/2000	11	9,953	0	12/8/2000	69	13,540	0	2/4/2001	127	14,068	104
10/12/2000	12	9,237	0	12/9/2000	70	13,810	0	2/5/2001	128	13,967	91
10/13/2000	13	9,399	0	12/10/2000	71	14,204	0	2/6/2001	129	13,828	80
10/14/2000	14	9,434	0	12/11/2000	72	14,231	0	2/7/2001	130	13,614	87
10/15/2000	15	9,493	0	12/12/2000	73	14,140	0	2/8/2001	131	13,769	98
10/16/2000	16	9,628	0	12/13/2000	74	14,143	0	2/9/2001	132	13,756	102
10/17/2000	17	9,735	0	12/14/2000	75	13,950	0	2/10/2001	133	13,884	98
10/18/2000	18	9,950	0	12/15/2000	76	13,952	0	2/11/2001	134	13,784	98
10/19/2000	19	9,842	0	12/16/2000	77	13,902	0	2/12/2001	135	13,767	92
10/20/2000	20	9,949	0	12/17/2000	78	14,162	0	2/13/2001	136	13,872	89
10/21/2000	21	10,145	0	12/18/2000	79	14,203	0	2/14/2001	137	14,114	85
10/22/2000	22	10,281	0	12/19/2000	80	13,744	0	2/15/2001	138	13,875	86
10/23/2000	23	10,199	0	12/20/2000	81	13,847	0	2/16/2001	139	13,901	85
2/17/2001	140	14,001	83	4/16/2001	198	50,434	1,672	6/13/2001	256	25,076	0
2/18/2001	141	13,877	81	4/17/2001	199	48,033	1,830	6/14/2001	257	25,359	0
2/19/2001	142	13,664	83	4/18/2001	200	48,927	1,851	6/15/2001	258	26,896	0
2/20/2001	143	13,787	81	4/19/2001	201	48,263	1,788	6/16/2001	259	26,054	0
2/21/2001	144	13,690	84	4/20/2001	202	46,773	1,927	6/17/2001	260	25,195	0
2/22/2001	145	13,600	848	4/21/2001	203	46,897	2,198	6/18/2001	261	23,847	0
2/23/2001	146	13,832	674	4/22/2001	204	50,306	2,687	6/19/2001	262	23,391	0
2/24/2001	147	13,779	579	4/23/2001	205	59,012	3,002	6/20/2001	263	23,229	0
2/25/2001	148	14,472	400	4/24/2001	206	65,016	2,977	6/21/2001	264	22,965	0
2/26/2001	149	13,474	481	4/25/2001	207	46,035	0	6/22/2001	265	23,194	0
2/27/2001	150	13,415	432	4/26/2001	208	57,301	0	6/23/2001	266	22,637	0
2/28/2001	151	13,716	399	4/27/2001	209	73,647	0	6/24/2001	267	22,897	0
3/1/2001	152	13,699	340	4/28/2001	210	92,512	0	6/25/2001	268	22,352	0
3/2/2001	153	13,379	318	4/29/2001	211	105,072	0	6/26/2001	269	22,009	0
3/3/2001	154	13,368	297	4/30/2001	212	101,383	0	6/27/2001	270	21,823	0
3/4/2001	155	13,668	535	5/1/2001	213	95,223	0	6/28/2001	271	21,707	0
3/5/2001	156	13,935	1,040	5/2/2001	214	87,330	0	6/29/2001	272	21,453	0
3/6/2001	157	14,050	844	5/3/2001	215	81,395	0	6/30/2001	273	21,408	0
3/7/2001	158	14,059	813	5/4/2001	216	77,192	0	7/1/2001	274	21,230	0
3/8/2001	159	13,811	733	5/5/2001	217	74,417	0	7/2/2001	275	20,874	0
3/9/2001	160	13,786	663	5/6/2001	218	71,257	0	7/3/2001	276	20,709	0
3/10/2001	161	13,675	613	5/7/2001	219	69,252	0	7/4/2001	277	20,724	0
3/11/2001	162	13,655	581	5/8/2001	220	68,273	0	7/5/2001	278	20,364	0
3/12/2001	163	13,575	543	5/9/2001	221	67,391	0	7/6/2001	279	19,834	0
3/13/2001	164	13,605	511	5/10/2001	222	65,305	0	7/7/2001	280	19,428	0
3/14/2001	165	14,059	497	5/11/2001	223	63,092	0	7/8/2001	281	19,374	0
3/15/2001	166	14,982	353	5/12/2001	224	62,065	0	7/9/2001	282	19,014	0
3/16/2001	167	14,274	437	5/13/2001	225	60,669	0	7/10/2001	283	18,888	0
3/17/2001	168	14,332	414	5/14/2001	226	59,258	0	7/11/2001	284	19,048	0
3/18/2001	169	14,251	402	5/15/2001	227	57,060	0	7/12/2001	285	18,837	0
3/19/2001	170	14,067	386	5/16/2001	228	57,766	0	7/13/2001	286	18,797	0
3/20/2001	171	14,235	372	5/17/2001	229	57,012	0	7/14/2001	287	18,891	0
3/21/2001	172	14,096	360	5/18/2001	230	54,493	0	7/15/2001	288	18,564	0
3/22/2001	173	14,241	339	5/19/2001	231	53,563	0	7/16/2001	289	18,611	0
3/23/2001	174	14,633	337	5/20/2001	232	51,044	0	7/17/2001	290	18,325	0

Notes:
Flow measurement in cubic feet per day

Appendix A-5 - Daily Upstream and Downstream Flows (1998 through 2006)

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
3/24/2001	175	14,849	329	5/21/2001	233	49,264	0	7/18/2001	291	18,181	0
3/25/2001	176	14,704	576	5/22/2001	234	49,168	0	7/19/2001	292	18,241	0
3/26/2001	177	14,809	1,143	5/23/2001	235	48,911	0	7/20/2001	293	18,360	0
3/27/2001	178	15,398	1,150	5/24/2001	236	48,638	0	7/21/2001	294	18,204	0
3/28/2001	179	15,973	1,002	5/25/2001	237	47,740	0	7/22/2001	295	18,081	0
3/29/2001	180	15,821	824	5/26/2001	238	46,986	0	7/23/2001	296	18,208	0
3/30/2001	181	15,870	785	5/27/2001	239	46,505	0	7/24/2001	297	18,050	0
3/31/2001	182	16,371	741	5/28/2001	240	45,045	0	7/25/2001	298	18,090	0
4/1/2001	183	17,750	702	5/29/2001	241	44,371	0	7/26/2001	299	17,866	0
4/2/2001	184	18,638	652	5/30/2001	242	42,767	0	7/27/2001	300	17,602	0
4/3/2001	185	18,674	796	5/31/2001	243	41,804	0	7/28/2001	301	17,864	0
4/4/2001	186	19,000	1,368	6/1/2001	244	41,644	0	7/29/2001	302	17,591	0
4/5/2001	187	21,086	1,450	6/2/2001	245	40,216	0	7/30/2001	303	17,646	0
4/6/2001	188	23,167	1,025	6/3/2001	246	38,388	0	7/31/2001	304	17,077	0
4/7/2001	189	24,225	1,052	6/4/2001	247	36,896	0	8/1/2001	305	17,082	0
4/8/2001	190	24,762	1,521	6/5/2001	248	37,409	0	8/2/2001	306	17,202	0
4/9/2001	191	26,157	1,509	6/6/2001	249	37,409	0	8/3/2001	307	17,195	0
4/10/2001	192	28,015	1,739	6/7/2001	250	37,361	0	8/4/2001	308	17,238	0
4/11/2001	193	30,798	1,863	6/8/2001	251	31,994	0	8/5/2001	309	17,012	0
4/12/2001	194	34,751	2,069	6/9/2001	252	28,182	0	8/6/2001	310	17,106	0
4/13/2001	195	40,236	2,078	6/10/2001	253	27,660	0	8/7/2001	311	17,150	0
4/14/2001	196	41,609	1,490	6/11/2001	254	26,859	0	8/8/2001	312	17,268	0
4/15/2001	197	48,468	1,593	6/12/2001	255	25,376	0	8/9/2001	313	17,041	0
8/10/2001	314	16,762	0	10/7/2001	7	11,957	0	12/4/2001	65	8,984	0
8/11/2001	315	16,609	0	10/8/2001	8	11,774	0	12/5/2001	66	8,907	0
8/12/2001	316	16,748	0	10/9/2001	9	11,153	0	12/6/2001	67	9,247	0
8/13/2001	317	16,166	0	10/10/2001	10	10,764	0	12/7/2001	68	9,026	0
8/14/2001	318	16,323	0	10/11/2001	11	11,107	0	12/8/2001	69	8,539	0
8/15/2001	319	16,141	0	10/12/2001	12	10,447	0	12/9/2001	70	8,863	0
8/16/2001	320	16,163	0	10/13/2001	13	11,249	0	12/10/2001	71	8,626	0
8/17/2001	321	16,176	0	10/14/2001	14	11,379	0	12/11/2001	72	8,636	0
8/18/2001	322	16,269	0	10/15/2001	15	10,736	0	12/12/2001	73	8,178	0
8/19/2001	323	16,092	0	10/16/2001	16	10,833	0	12/13/2001	74	8,614	0
8/20/2001	324	15,725	0	10/17/2001	17	11,167	0	12/14/2001	75	9,126	0
8/21/2001	325	15,457	0	10/18/2001	18	10,517	0	12/15/2001	76	8,755	0
8/22/2001	326	15,464	0	10/19/2001	19	10,725	0	12/16/2001	77	8,411	0
8/23/2001	327	15,504	0	10/20/2001	20	10,807	0	12/17/2001	78	8,733	0
8/24/2001	328	15,546	0	10/21/2001	21	10,879	0	12/18/2001	79	8,689	0
8/25/2001	329	15,412	0	10/22/2001	22	10,860	0	12/19/2001	80	8,754	0
8/26/2001	330	15,572	0	10/23/2001	23	10,665	0	12/20/2001	81	8,689	0
8/27/2001	331	15,609	0	10/24/2001	24	9,851	0	12/21/2001	82	8,690	0
8/28/2001	332	15,505	0	10/25/2001	25	9,902	0	12/22/2001	83	8,581	0
8/29/2001	333	15,503	0	10/26/2001	26	10,093	0	12/23/2001	84	8,230	0
8/30/2001	334	15,329	0	10/27/2001	27	10,359	0	12/24/2001	85	7,893	0
8/31/2001	335	15,287	0	10/28/2001	28	10,595	0	12/25/2001	86	7,862	0
9/1/2001	336	14,959	0	10/29/2001	29	10,513	0	12/26/2001	87	8,147	0
9/2/2001	337	15,185	0	10/30/2001	30	10,606	0	12/27/2001	88	8,273	0
9/3/2001	338	15,078	0	10/31/2001	31	10,525	0	12/28/2001	89	8,528	0
9/4/2001	339	15,091	0	11/1/2001	32	10,304	0	12/29/2001	90	8,507	0
9/5/2001	340	15,053	0	11/2/2001	33	10,262	0	12/30/2001	91	8,463	0
9/6/2001	341	13,569	0	11/3/2001	34	9,820	0	12/31/2001	92	8,646	0
9/7/2001	342	13,239	0	11/4/2001	35	9,809	0	1/1/2002	93	8,231	0
9/8/2001	343	12,943	0	11/5/2001	36	10,217	0	1/2/2002	94	8,116	0
9/9/2001	344	13,388	0	11/6/2001	37	10,444	0	1/3/2002	95	8,765	0
9/10/2001	345	13,613	0	11/7/2001	38	10,195	0	1/4/2002	96	8,454	0
9/11/2001	346	13,929	0	11/8/2001	39	9,359	0	1/5/2002	97	8,474	0
9/12/2001	347	14,099	0	11/9/2001	40	9,460	0	1/6/2002	98	8,787	0
9/13/2001	348	13,760	0	11/10/2001	41	9,675	0	1/7/2002	99	8,570	0
9/14/2001	349	13,366	0	11/11/2001	42	9,737	0	1/8/2002	100	8,625	0
9/15/2001	350	13,406	0	11/12/2001	43	9,853	0	1/9/2002	101	8,744	0
9/16/2001	351	13,329	0	11/13/2001	44	9,988	0	1/10/2002	102	7,936	0
9/17/2001	352	13,313	0	11/14/2001	45	9,705	0	1/11/2002	103	8,252	0
9/18/2001	353	13,078	0	11/15/2001	46	9,592	0	1/12/2002	104	8,178	0
9/19/2001	354	13,154	0	11/16/2001	47	9,514	0	1/13/2002	105	8,199	0
9/20/2001	355	12,908	0	11/17/2001	48	9,582	0	1/14/2002	106	7,947	0

Notes:
Flow measurement in cubic feet per day

Appendix A-5 - Daily Upstream and Downstream Flows (1998 through 2006)

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
9/21/2001	356	13,070	0	11/18/2001	49	9,490	0	1/15/2002	107	8,304	0
9/22/2001	357	12,906	0	11/19/2001	50	8,996	0	1/16/2002	108	7,946	0
9/23/2001	358	12,833	0	11/20/2001	51	9,232	0	1/17/2002	109	7,957	0
9/24/2001	359	12,880	0	11/21/2001	52	9,987	0	1/18/2002	110	7,936	0
9/25/2001	360	13,092	0	11/22/2001	53	10,167	0	1/19/2002	111	8,041	0
9/26/2001	361	12,718	0	11/23/2001	54	9,670	0	1/20/2002	112	8,188	0
9/27/2001	362	12,758	0	11/24/2001	55	8,976	0	1/21/2002	113	8,432	0
9/28/2001	363	12,893	0	11/25/2001	56	9,558	0	1/22/2002	114	8,549	0
9/29/2001	364	12,643	0	11/26/2001	57	9,270	0	1/23/2002	115	8,399	0
9/30/2001	365	12,463	0	11/27/2001	58	8,541	0	1/24/2002	116	8,314	0
10/1/2001	1	12,486	0	11/28/2001	59	8,524	0	1/25/2002	117	8,283	0
10/2/2001	2	12,229	0	11/29/2001	60	9,402	0	1/26/2002	118	8,560	0
10/3/2001	3	12,081	0	11/30/2001	61	9,314	0	1/27/2002	119	8,411	0
10/4/2001	4	11,898	0	12/1/2001	62	9,063	0	1/28/2002	120	8,273	0
10/5/2001	5	11,383	0	12/2/2001	63	9,512	0	1/29/2002	121	7,769	0
10/6/2001	6	11,806	0	12/3/2001	64	9,380	0	1/30/2002	122	7,614	0
1/31/2002	123	7,904	0	3/30/2002	181	9,357	0	5/27/2002	239	51,271	0
2/1/2002	124	7,914	0	3/31/2002	182	10,357	0	5/28/2002	240	50,945	0
2/2/2002	125	7,863	0	4/1/2002	183	12,498	0	5/29/2002	241	51,047	0
2/3/2002	126	7,624	0	4/2/2002	184	14,696	0	5/30/2002	242	50,835	0
2/4/2002	127	7,696	0	4/3/2002	185	15,180	0	5/31/2002	243	50,388	0
2/5/2002	128	7,821	0	4/4/2002	186	15,704	0	6/1/2002	244	48,696	0
2/6/2002	129	8,041	0	4/5/2002	187	17,386	0	6/2/2002	245	47,517	0
2/7/2002	130	8,518	0	4/6/2002	188	20,333	0	6/3/2002	246	47,286	0
2/8/2002	131	8,474	0	4/7/2002	189	23,607	0	6/4/2002	247	46,183	0
2/9/2002	132	8,094	0	4/8/2002	190	26,371	0	6/5/2002	248	46,106	0
2/10/2002	133	7,821	0	4/9/2002	191	28,022	0	6/6/2002	249	45,977	0
2/11/2002	134	8,040	0	4/10/2002	192	28,482	0	6/7/2002	250	45,411	0
2/12/2002	135	7,894	0	4/11/2002	193	29,245	0	6/8/2002	251	43,617	0
2/13/2002	136	7,927	0	4/12/2002	194	28,828	0	6/9/2002	252	41,304	0
2/14/2002	137	8,146	0	4/13/2002	195	29,675	0	6/10/2002	253	41,117	0
2/15/2002	138	7,586	0	4/14/2002	196	39,222	0	6/11/2002	254	41,088	0
2/16/2002	139	7,959	0	4/15/2002	197	55,064	0	6/12/2002	255	40,982	0
2/17/2002	140	8,400	0	4/16/2002	198	62,034	0	6/13/2002	256	40,784	0
2/18/2002	141	8,399	0	4/17/2002	199	54,342	0	6/14/2002	257	40,523	0
2/19/2002	142	8,442	0	4/18/2002	200	47,072	0	6/15/2002	258	40,705	0
2/20/2002	143	8,453	0	4/19/2002	201	42,064	0	6/16/2002	259	39,753	0
2/21/2002	144	7,894	0	4/20/2002	202	39,229	0	6/17/2002	260	38,968	0
2/22/2002	145	8,094	0	4/21/2002	203	38,032	0	6/18/2002	261	37,466	0
2/23/2002	146	8,570	0	4/22/2002	204	36,723	0	6/19/2002	262	37,483	0
2/24/2002	147	8,476	0	4/23/2002	205	36,802	0	6/20/2002	263	36,750	0
2/25/2002	148	8,263	0	4/24/2002	206	37,007	0	6/21/2002	264	37,320	0
2/26/2002	149	7,905	0	4/25/2002	207	38,193	0	6/22/2002	265	36,241	0
2/27/2002	150	7,989	0	4/26/2002	208	41,440	0	6/23/2002	266	35,950	0
2/28/2002	151	8,273	0	4/27/2002	209	46,153	0	6/24/2002	267	35,878	0
3/1/2002	152	8,326	0	4/28/2002	210	46,490	0	6/25/2002	268	35,457	0
3/2/2002	153	7,979	0	4/29/2002	211	46,297	0	6/26/2002	269	35,091	0
3/3/2002	154	7,884	0	4/30/2002	212	50,940	0	6/27/2002	270	34,683	0
3/4/2002	155	8,115	0	5/1/2002	213	54,878	0	6/28/2002	271	34,295	0
3/5/2002	156	8,421	0	5/2/2002	214	54,816	0	6/29/2002	272	33,568	0
3/6/2002	157	8,678	0	5/3/2002	215	53,609	0	6/30/2002	273	33,204	0
3/7/2002	158	8,809	0	5/4/2002	216	54,865	0	7/1/2002	274	32,455	0
3/8/2002	159	8,539	0	5/5/2002	217	56,705	0	7/2/2002	275	32,078	0
3/9/2002	160	8,358	0	5/6/2002	218	57,487	0	7/3/2002	276	30,913	0
3/10/2002	161	8,389	0	5/7/2002	219	57,527	0	7/4/2002	277	31,426	0
3/11/2002	162	8,389	0	5/8/2002	220	55,777	0	7/5/2002	278	31,425	0
3/12/2002	163	8,389	0	5/9/2002	221	53,338	0	7/6/2002	279	27,312	0
3/13/2002	164	8,442	0	5/10/2002	222	51,873	0	7/7/2002	280	21,344	0
3/14/2002	165	8,463	0	5/11/2002	223	50,834	0	7/8/2002	281	21,519	0
3/15/2002	166	8,347	0	5/12/2002	224	50,293	0	7/9/2002	282	20,945	0
3/16/2002	167	8,506	0	5/13/2002	225	49,907	0	7/10/2002	283	20,899	0
3/17/2002	168	8,549	0	5/14/2002	226	50,230	0	7/11/2002	284	27,137	0
3/18/2002	169	8,421	0	5/15/2002	227	52,071	0	7/12/2002	285	31,227	0
3/19/2002	170	8,346	0	5/16/2002	228	56,963	0	7/13/2002	286	31,034	0
3/20/2002	171	8,241	0	5/17/2002	229	57,156	0	7/14/2002	287	30,605	0

Notes:
Flow measurement in cubic feet per day

Appendix A-5 - Daily Upstream and Downstream Flows (1998 through 2006)

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
3/21/2002	172	8,062	0	5/18/2002	230	57,364	0	7/15/2002	288	30,368	0
3/22/2002	173	8,263	0	5/19/2002	231	56,691	0	7/16/2002	289	29,350	0
3/23/2002	174	9,244	0	5/20/2002	232	55,992	0	7/17/2002	290	29,606	0
3/24/2002	175	9,985	0	5/21/2002	233	52,448	0	7/18/2002	291	29,336	0
3/25/2002	176	9,424	0	5/22/2002	234	51,852	0	7/19/2002	292	29,004	0
3/26/2002	177	8,961	0	5/23/2002	235	51,373	0	7/20/2002	293	28,156	0
3/27/2002	178	8,798	0	5/24/2002	236	52,169	0	7/21/2002	294	28,511	0
3/28/2002	179	8,743	0	5/25/2002	237	51,574	0	7/22/2002	295	28,377	0
3/29/2002	180	9,113	0	5/26/2002	238	51,289	0	7/23/2002	296	27,765	0
7/24/2002	297	28,108	0	9/20/2002	355	22,037	0	11/17/2002	48	14,229	0
7/25/2002	298	27,190	0	9/21/2002	356	21,115	0	11/18/2002	49	13,655	0
7/26/2002	299	26,901	0	9/22/2002	357	21,182	0	11/19/2002	50	13,607	0
7/27/2002	300	27,362	0	9/23/2002	358	21,529	0	11/20/2002	51	13,847	0
7/28/2002	301	26,974	0	9/24/2002	359	21,964	0	11/21/2002	52	14,228	0
7/29/2002	302	27,223	0	9/25/2002	360	21,898	0	11/22/2002	53	14,474	0
7/30/2002	303	27,323	0	9/26/2002	361	21,406	0	11/23/2002	54	14,525	0
7/31/2002	304	27,219	0	9/27/2002	362	20,537	0	11/24/2002	55	14,294	0
8/1/2002	305	26,823	0	9/28/2002	363	20,028	0	11/25/2002	56	12,678	0
8/2/2002	306	26,188	0	9/29/2002	364	19,820	0	11/26/2002	57	12,740	0
8/3/2002	307	26,244	0	9/30/2002	365	19,157	0	11/27/2002	58	13,660	0
8/4/2002	308	26,418	0	10/1/2002	1	18,008	0	11/28/2002	59	13,439	0
8/5/2002	309	26,235	0	10/2/2002	2	24,311	463	11/29/2002	60	13,513	0
8/6/2002	310	26,286	0	10/3/2002	3	23,553	479	11/30/2002	61	13,517	0
8/7/2002	311	26,306	0	10/4/2002	4	23,402	469	12/1/2002	62	13,806	0
8/8/2002	312	25,250	0	10/5/2002	5	23,070	462	12/2/2002	63	12,974	0
8/9/2002	313	24,849	0	10/6/2002	6	23,036	464	12/3/2002	64	13,566	0
8/10/2002	314	25,455	0	10/7/2002	7	23,891	444	12/4/2002	65	13,261	0
8/11/2002	315	26,216	0	10/8/2002	8	24,347	447	12/5/2002	66	12,961	0
8/12/2002	316	25,601	0	10/9/2002	9	23,680	467	12/6/2002	67	12,713	0
8/13/2002	317	25,180	0	10/10/2002	10	23,144	458	12/7/2002	68	12,160	0
8/14/2002	318	25,800	0	10/11/2002	11	22,618	453	12/8/2002	69	11,823	0
8/15/2002	319	26,260	0	10/12/2002	12	21,180	612	12/9/2002	70	11,810	0
8/16/2002	320	25,590	0	10/13/2002	13	21,166	800	12/10/2002	71	12,432	0
8/17/2002	321	25,307	0	10/14/2002	14	21,381	786	12/11/2002	72	12,441	0
8/18/2002	322	24,843	0	10/15/2002	15	21,326	764	12/12/2002	73	12,477	0
8/19/2002	323	24,937	0	10/16/2002	16	21,324	733	12/13/2002	74	12,530	0
8/20/2002	324	24,994	0	10/17/2002	17	21,574	951	12/14/2002	75	12,700	0
8/21/2002	325	24,607	0	10/18/2002	18	21,737	794	12/15/2002	76	12,787	0
8/22/2002	326	24,016	0	10/19/2002	19	22,030	922	12/16/2002	77	12,455	0
8/23/2002	327	24,126	0	10/20/2002	20	18,417	928	12/17/2002	78	12,911	0
8/24/2002	328	24,124	0	10/21/2002	21	18,234	1,268	12/18/2002	79	12,601	0
8/25/2002	329	24,080	0	10/22/2002	22	18,374	1,016	12/19/2002	80	12,282	0
8/26/2002	330	24,335	0	10/23/2002	23	18,174	1,001	12/20/2002	81	12,306	0
8/27/2002	331	23,905	0	10/24/2002	24	17,747	1,261	12/21/2002	82	12,257	0
8/28/2002	332	23,757	0	10/25/2002	25	17,540	1,065	12/22/2002	83	12,209	0
8/29/2002	333	24,326	0	10/26/2002	26	17,571	994	12/23/2002	84	11,592	0
8/30/2002	334	23,972	0	10/27/2002	27	17,594	888	12/24/2002	85	11,568	0
8/31/2002	335	23,553	0	10/28/2002	28	15,459	500	12/25/2002	86	11,616	0
9/1/2002	336	23,654	0	10/29/2002	29	15,450	490	12/26/2002	87	12,003	0
9/2/2002	337	23,681	0	10/30/2002	30	14,901	490	12/27/2002	88	12,293	0
9/3/2002	338	24,294	0	10/31/2002	31	16,113	625	12/28/2002	89	12,343	0
9/4/2002	339	24,140	0	11/1/2002	32	13,662	0	12/29/2002	90	12,440	0
9/5/2002	340	23,392	0	11/2/2002	33	13,359	0	12/30/2002	91	12,318	0
9/6/2002	341	22,795	0	11/3/2002	34	13,499	0	12/31/2002	92	12,319	0
9/7/2002	342	22,708	0	11/4/2002	35	13,839	0	1/1/2003	93	12,391	0
9/8/2002	343	22,385	0	11/5/2002	36	13,992	0	1/2/2003	94	12,367	0
9/9/2002	344	21,802	0	11/6/2002	37	14,531	0	1/3/2003	95	12,465	0
9/10/2002	345	21,768	0	11/7/2002	38	14,584	0	1/4/2003	96	12,416	0
9/11/2002	346	22,614	0	11/8/2002	39	14,773	0	1/5/2003	97	12,465	0
9/12/2002	347	22,545	0	11/9/2002	40	14,629	0	1/6/2003	98	12,270	0
9/13/2002	348	22,094	0	11/10/2002	41	14,407	0	1/7/2003	99	12,184	0
9/14/2002	349	21,859	0	11/11/2002	42	14,318	0	1/8/2003	100	12,257	0
9/15/2002	350	22,526	0	11/12/2002	43	14,218	0	1/9/2003	101	12,197	0
9/16/2002	351	23,365	0	11/13/2002	44	14,774	0	1/10/2003	102	12,639	0
9/17/2002	352	22,096	0	11/14/2002	45	14,627	0	1/11/2003	103	12,800	0

Notes:
Flow measurement in cubic feet per day

Appendix A-5 - Daily Upstream and Downstream Flows (1998 through 2006)

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
9/18/2002	353	21,797	0	11/15/2002	46	13,897	0	1/12/2003	104	12,675	0
9/19/2002	354	21,507	0	11/16/2002	47	13,768	0	1/13/2003	105	12,477	0
1/14/2003	106	12,651	0	3/13/2003	164	12,234	0	5/10/2003	222	60,519	0
1/15/2003	107	12,515	0	3/14/2003	165	13,285	0	5/11/2003	223	61,196	0
1/16/2003	108	12,197	0	3/15/2003	166	14,536	0	5/12/2003	224	63,418	0
1/17/2003	109	12,136	0	3/16/2003	167	14,265	0	5/13/2003	225	63,887	0
1/18/2003	110	12,221	0	3/17/2003	168	14,252	0	5/14/2003	226	69,128	0
1/19/2003	111	12,087	0	3/18/2003	169	14,252	0	5/15/2003	227	71,613	0
1/20/2003	112	12,442	0	3/19/2003	170	13,894	0	5/16/2003	228	71,375	0
1/21/2003	113	12,639	0	3/20/2003	171	14,240	0	5/17/2003	229	69,949	0
1/22/2003	114	12,911	0	3/21/2003	172	14,087	0	5/18/2003	230	64,445	0
1/23/2003	115	12,700	0	3/22/2003	173	14,291	0	5/19/2003	231	61,354	0
1/24/2003	116	12,428	0	3/23/2003	174	14,575	0	5/20/2003	232	61,527	0
1/25/2003	117	12,613	0	3/24/2003	175	14,512	0	5/21/2003	233	61,594	0
1/26/2003	118	12,675	0	3/25/2003	176	14,433	0	5/22/2003	234	61,487	0
1/27/2003	119	12,976	0	3/26/2003	177	14,591	0	5/23/2003	235	61,462	0
1/28/2003	120	13,236	0	3/27/2003	178	14,837	0	5/24/2003	236	61,657	0
1/29/2003	121	12,800	0	3/28/2003	179	14,589	0	5/25/2003	237	60,333	0
1/30/2003	122	12,985	0	3/29/2003	180	14,202	0	5/26/2003	238	58,833	0
1/31/2003	123	13,387	0	3/30/2003	181	14,447	0	5/27/2003	239	58,030	0
2/1/2003	124	14,050	0	3/31/2003	182	15,196	0	5/28/2003	240	57,478	0
2/2/2003	125	14,447	0	4/1/2003	183	16,790	0	5/29/2003	241	56,503	0
2/3/2003	126	13,487	0	4/2/2003	184	17,008	0	5/30/2003	242	55,070	0
2/4/2003	127	13,869	0	4/3/2003	185	16,912	0	5/31/2003	243	51,115	0
2/5/2003	128	13,237	0	4/4/2003	186	16,449	0	6/1/2003	244	49,972	0
2/6/2003	129	13,012	0	4/5/2003	187	15,935	0	6/2/2003	245	46,871	0
2/7/2003	130	12,332	0	4/6/2003	188	15,536	0	6/3/2003	246	46,612	0
2/8/2003	131	12,431	0	4/7/2003	189	15,271	0	6/4/2003	247	45,495	0
2/9/2003	132	12,626	0	4/8/2003	190	14,641	0	6/5/2003	248	44,084	0
2/10/2003	133	12,812	0	4/9/2003	191	15,538	0	6/6/2003	249	43,503	0
2/11/2003	134	12,172	0	4/10/2003	192	18,623	0	6/7/2003	250	41,471	0
2/12/2003	135	12,211	0	4/11/2003	193	21,822	0	6/8/2003	251	42,303	0
2/13/2003	136	12,874	0	4/12/2003	194	25,388	0	6/9/2003	252	43,778	0
2/14/2003	137	12,911	0	4/13/2003	195	32,152	0	6/10/2003	253	44,168	0
2/15/2003	138	12,663	0	4/14/2003	196	41,588	0	6/11/2003	254	43,210	0
2/16/2003	139	12,429	0	4/15/2003	197	48,868	0	6/12/2003	255	43,316	0
2/17/2003	140	12,465	0	4/16/2003	198	48,089	0	6/13/2003	256	41,043	0
2/18/2003	141	12,330	0	4/17/2003	199	41,442	0	6/14/2003	257	40,211	0
2/19/2003	142	12,003	0	4/18/2003	200	38,564	0	6/15/2003	258	39,730	0
2/20/2003	143	12,124	0	4/19/2003	201	37,211	0	6/16/2003	259	39,173	0
2/21/2003	144	11,919	0	4/20/2003	202	37,745	0	6/17/2003	260	38,247	0
2/22/2003	145	11,449	0	4/21/2003	203	41,190	0	6/18/2003	261	38,974	0
2/23/2003	146	11,966	0	4/22/2003	204	49,410	0	6/19/2003	262	37,924	0
2/24/2003	147	11,725	0	4/23/2003	205	55,501	0	6/20/2003	263	36,693	0
2/25/2003	148	11,640	0	4/24/2003	206	56,193	0	6/21/2003	264	36,513	0
2/26/2003	149	11,557	0	4/25/2003	207	58,975	0	6/22/2003	265	35,119	0
2/27/2003	150	11,533	0	4/26/2003	208	67,588	0	6/23/2003	266	33,712	0
2/28/2003	151	11,737	0	4/27/2003	209	65,684	0	6/24/2003	267	32,889	0
3/1/2003	152	11,930	0	4/28/2003	210	55,988	0	6/25/2003	268	33,986	0
3/2/2003	153	11,846	0	4/29/2003	211	59,887	0	6/26/2003	269	34,581	0
3/3/2003	154	12,111	0	4/30/2003	212	63,462	0	6/27/2003	270	35,876	0
3/4/2003	155	12,282	0	5/1/2003	213	62,445	0	6/28/2003	271	31,235	0
3/5/2003	156	12,306	0	5/2/2003	214	64,019	0	6/29/2003	272	28,553	0
3/6/2003	157	12,245	0	5/3/2003	215	67,016	0	6/30/2003	273	28,641	0
3/7/2003	158	12,172	0	5/4/2003	216	64,983	0	7/1/2003	274	36,217	0
3/8/2003	159	12,172	0	5/5/2003	217	62,783	0	7/2/2003	275	35,225	0
3/9/2003	160	12,099	0	5/6/2003	218	60,186	0	7/3/2003	276	34,579	0
3/10/2003	161	12,148	0	5/7/2003	219	59,348	0	7/4/2003	277	34,073	0
3/11/2003	162	12,147	0	5/8/2003	220	62,816	0	7/5/2003	278	33,331	0
3/12/2003	163	12,257	0	5/9/2003	221	61,946	0	7/6/2003	279	33,274	0
7/7/2003	280	33,143	0	9/3/2003	338	19,178	0	10/31/2004	31	30,850	0
7/8/2003	281	31,974	0	9/4/2003	339	19,562	0	11/1/2004	32	31,223	0
7/9/2003	282	31,860	0	9/5/2003	340	19,624	0	11/2/2004	33	31,595	0
7/10/2003	283	30,029	0	9/6/2003	341	19,834	0	11/3/2004	34	31,968	0
7/11/2003	284	31,150	0	9/7/2003	342	19,444	0	11/4/2004	35	31,915	0

Notes:
Flow measurement in cubic feet per day

Appendix A-5 - Daily Upstream and Downstream Flows (1998 through 2006)

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
7/12/2003	285	31,561	0	9/8/2003	343	19,030	0	11/5/2004	36	31,862	0
7/13/2003	286	29,763	0	9/9/2003	344	18,271	0	11/6/2004	37	31,809	0
7/14/2003	287	28,379	0	9/10/2003	345	17,339	0	11/7/2004	38	31,755	0
7/15/2003	288	28,175	0	9/11/2003	346	17,608	0	11/8/2004	39	31,702	0
7/16/2003	289	26,778	0	9/12/2003	347	18,689	0	11/9/2004	40	31,649	0
7/17/2003	290	27,931	0	9/13/2003	348	17,197	0	11/10/2004	41	31,596	0
7/18/2003	291	26,401	0	9/14/2003	349	17,386	0	11/11/2004	42	31,543	0
7/19/2003	292	24,567	0	9/15/2003	350	18,547	0	11/12/2004	43	31,490	0
7/20/2003	293	27,190	0	9/16/2003	351	18,796	0	11/13/2004	44	31,436	0
7/21/2003	294	27,568	0	9/17/2003	352	16,640	0	11/14/2004	45	31,383	0
7/22/2003	295	27,569	0	9/18/2003	353	16,248	0	11/15/2004	46	31,330	0
7/23/2003	296	25,777	0	9/19/2003	354	16,898	0	11/16/2004	47	31,277	0
7/24/2003	297	26,931	0	9/20/2003	355	17,455	0	11/17/2004	48	31,224	0
7/25/2003	298	25,106	0	9/21/2003	356	17,496	0	11/18/2004	49	31,171	0
7/26/2003	299	25,130	0	9/22/2003	357	17,960	0	11/19/2004	50	31,118	0
7/27/2003	300	24,315	0	9/23/2003	358	18,348	0	11/20/2004	51	31,064	0
7/28/2003	301	24,327	0	9/24/2003	359	18,220	0	11/21/2004	52	31,011	0
7/29/2003	302	25,396	0	9/25/2003	360	18,505	0	11/22/2004	53	30,958	0
7/30/2003	303	25,900	0	9/26/2003	361	18,516	0	11/23/2004	54	30,905	0
7/31/2003	304	26,194	0	9/27/2003	362	18,733	0	11/24/2004	55	30,852	0
8/1/2003	305	25,829	0	9/28/2003	363	18,957	0	11/25/2004	56	30,799	0
8/2/2003	306	24,088	0	9/29/2003	364	19,521	0	11/26/2004	57	30,745	0
8/3/2003	307	23,331	0	9/30/2003	365	19,297	0	11/27/2004	58	30,692	0
8/4/2003	308	23,183	0	10/1/2004	1	19,669	0	11/28/2004	59	30,639	0
8/5/2003	309	23,906	0	10/2/2004	2	20,042	0	11/29/2004	60	30,586	0
8/6/2003	310	23,660	0	10/3/2004	3	20,415	0	11/30/2004	61	30,533	0
8/7/2003	311	24,541	0	10/4/2004	4	20,787	0	12/1/2004	62	30,480	0
8/8/2003	312	24,064	0	10/5/2004	5	21,160	0	12/2/2004	63	30,426	0
8/9/2003	313	24,291	0	10/6/2004	6	21,533	0	12/3/2004	64	30,373	0
8/10/2003	314	25,110	0	10/7/2004	7	21,905	0	12/4/2004	65	30,320	0
8/11/2003	315	25,448	0	10/8/2004	8	22,278	0	12/5/2004	66	30,267	0
8/12/2003	316	24,302	0	10/9/2004	9	22,651	0	12/6/2004	67	30,214	0
8/13/2003	317	24,074	0	10/10/2004	10	23,024	0	12/7/2004	68	30,161	0
8/14/2003	318	24,776	0	10/11/2004	11	23,396	0	12/8/2004	69	30,108	0
8/15/2003	319	24,451	0	10/12/2004	12	23,769	0	12/9/2004	70	30,054	0
8/16/2003	320	23,499	0	10/13/2004	13	24,142	0	12/10/2004	71	30,001	0
8/17/2003	321	22,852	0	10/14/2004	14	24,514	0	12/11/2004	72	29,948	0
8/18/2003	322	22,269	0	10/15/2004	15	24,887	0	12/12/2004	73	29,895	0
8/19/2003	323	22,981	0	10/16/2004	16	25,260	0	12/13/2004	74	29,842	0
8/20/2003	324	23,758	0	10/17/2004	17	25,632	0	12/14/2004	75	29,789	0
8/21/2003	325	22,631	0	10/18/2004	18	26,005	0	12/15/2004	76	29,735	0
8/22/2003	326	20,557	0	10/19/2004	19	26,378	0	12/16/2004	77	29,682	0
8/23/2003	327	20,784	0	10/20/2004	20	26,750	0	12/17/2004	78	29,629	0
8/24/2003	328	20,476	0	10/21/2004	21	27,123	0	12/18/2004	79	29,576	0
8/25/2003	329	20,655	0	10/22/2004	22	27,496	0	12/19/2004	80	29,523	0
8/26/2003	330	21,293	0	10/23/2004	23	27,868	0	12/20/2004	81	29,470	0
8/27/2003	331	21,068	0	10/24/2004	24	28,241	0	12/21/2004	82	29,417	0
8/28/2003	332	19,974	0	10/25/2004	25	28,614	0	12/22/2004	83	29,363	0
8/29/2003	333	18,829	0	10/26/2004	26	28,987	0	12/23/2004	84	29,310	0
8/30/2003	334	18,816	0	10/27/2004	27	29,359	0	12/24/2004	85	29,257	0
8/31/2003	335	18,944	0	10/28/2004	28	29,732	0	12/25/2004	86	29,204	0
9/1/2003	336	19,406	0	10/29/2004	29	30,105	0	12/26/2004	87	29,151	0
9/2/2003	337	19,065	0	10/30/2004	30	30,477	0	12/27/2004	88	29,098	0
12/28/2004	89	29,044	0	2/24/2005	147	25,961	0	4/23/2005	205	51,037	0
12/29/2004	90	28,991	0	2/25/2005	148	25,908	0	4/24/2005	206	68,386	0
12/30/2004	91	28,938	0	2/26/2005	149	25,855	0	4/25/2005	207	82,791	0
12/31/2004	92	28,885	0	2/27/2005	150	25,802	0	4/26/2005	208	118,685	0
1/1/2005	93	28,832	0	2/28/2005	151	25,749	0	4/27/2005	209	153,431	0
1/2/2005	94	28,779	0	3/1/2005	152	25,696	0	4/28/2005	210	156,848	0
1/3/2005	95	28,725	0	3/2/2005	153	25,642	0	4/29/2005	211	160,040	0
1/4/2005	96	28,672	0	3/3/2005	154	25,589	0	4/30/2005	212	142,627	0
1/5/2005	97	28,619	0	3/4/2005	155	25,536	0	5/1/2005	213	128,422	0
1/6/2005	98	28,566	0	3/5/2005	156	25,483	0	5/2/2005	214	123,273	0
1/7/2005	99	28,513	0	3/6/2005	157	25,430	0	5/3/2005	215	124,299	0
1/8/2005	100	28,460	0	3/7/2005	158	25,377	0	5/4/2005	216	134,534	757

Notes:
Flow measurement in cubic feet per day

Appendix A-5 - Daily Upstream and Downstream Flows (1998 through 2006)

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
1/9/2005	101	28,407	0	3/8/2005	159	25,323	0	5/5/2005	217	155,452	2,404
1/10/2005	102	28,353	0	3/9/2005	160	25,270	0	5/6/2005	218	185,386	4,051
1/11/2005	103	28,300	0	3/10/2005	161	25,217	0	5/7/2005	219	190,824	5,698
1/12/2005	104	28,247	0	3/11/2005	162	25,164	0	5/8/2005	220	192,741	7,345
1/13/2005	105	28,194	0	3/12/2005	163	25,111	0	5/9/2005	221	198,492	8,992
1/14/2005	106	28,141	0	3/13/2005	164	25,058	0	5/10/2005	222	196,214	10,640
1/15/2005	107	28,088	0	3/14/2005	165	25,005	0	5/11/2005	223	198,051	12,287
1/16/2005	108	28,034	0	3/15/2005	166	24,951	0	5/12/2005	224	192,853	13,934
1/17/2005	109	27,981	0	3/16/2005	167	24,898	0	5/13/2005	225	188,875	15,581
1/18/2005	110	27,928	0	3/17/2005	168	24,845	0	5/14/2005	226	193,720	17,228
1/19/2005	111	27,875	0	3/18/2005	169	24,792	0	5/15/2005	227	173,539	18,876
1/20/2005	112	27,822	0	3/19/2005	170	24,739	0	5/16/2005	228	192,501	20,523
1/21/2005	113	27,769	0	3/20/2005	171	24,686	0	5/17/2005	229	182,883	22,170
1/22/2005	114	27,716	0	3/21/2005	172	24,632	0	5/18/2005	230	177,373	23,817
1/23/2005	115	27,662	0	3/22/2005	173	24,579	0	5/19/2005	231	169,392	25,464
1/24/2005	116	27,609	0	3/23/2005	174	24,526	0	5/20/2005	232	165,976	27,112
1/25/2005	117	27,556	0	3/24/2005	175	24,473	0	5/21/2005	233	158,396	28,759
1/26/2005	118	27,503	0	3/25/2005	176	24,420	0	5/22/2005	234	148,851	30,406
1/27/2005	119	27,450	0	3/26/2005	177	24,367	0	5/23/2005	235	144,488	32,053
1/28/2005	120	27,397	0	3/27/2005	178	24,314	0	5/24/2005	236	141,279	33,700
1/29/2005	121	27,343	0	3/28/2005	179	24,260	0	5/25/2005	237	150,134	35,348
1/30/2005	122	27,290	0	3/29/2005	180	24,207	0	5/26/2005	238	153,487	36,995
1/31/2005	123	27,237	0	3/30/2005	181	24,154	0	5/27/2005	239	141,191	38,411
2/1/2005	124	27,184	0	3/31/2005	182	24,101	0	5/28/2005	240	135,913	39,828
2/2/2005	125	27,131	0	4/1/2005	183	24,048	0	5/29/2005	241	139,884	41,244
2/3/2005	126	27,078	0	4/2/2005	184	23,995	0	5/30/2005	242	140,758	42,660
2/4/2005	127	27,024	0	4/3/2005	185	23,941	0	5/31/2005	243	144,736	44,077
2/5/2005	128	26,971	0	4/4/2005	186	23,888	0	6/1/2005	244	147,736	45,493
2/6/2005	129	26,918	0	4/5/2005	187	23,835	0	6/2/2005	245	159,816	46,910
2/7/2005	130	26,865	0	4/6/2005	188	23,782	0	6/3/2005	246	137,389	45,081
2/8/2005	131	26,812	0	4/7/2005	189	23,729	0	6/4/2005	247	136,659	43,252
2/9/2005	132	26,759	0	4/8/2005	190	23,676	0	6/5/2005	248	130,531	41,424
2/10/2005	133	26,706	0	4/9/2005	191	23,623	0	6/6/2005	249	123,240	39,595
2/11/2005	134	26,652	0	4/10/2005	192	23,569	0	6/7/2005	250	114,931	37,767
2/12/2005	135	26,599	0	4/11/2005	193	23,516	0	6/8/2005	251	108,691	35,938
2/13/2005	136	26,546	0	4/12/2005	194	23,463	0	6/9/2005	252	116,062	34,110
2/14/2005	137	26,493	0	4/13/2005	195	23,410	0	6/10/2005	253	116,583	32,281
2/15/2005	138	26,440	0	4/14/2005	196	23,357	0	6/11/2005	254	119,150	30,453
2/16/2005	139	26,387	0	4/15/2005	197	29,581	0	6/12/2005	255	121,989	28,624
2/17/2005	140	26,333	0	4/16/2005	198	33,190	0	6/13/2005	256	130,828	26,796
2/18/2005	141	26,280	0	4/17/2005	199	37,153	0	6/14/2005	257	131,117	24,967
2/19/2005	142	26,227	0	4/18/2005	200	47,267	0	6/15/2005	258	143,886	23,139
2/20/2005	143	26,174	0	4/19/2005	201	48,334	0	6/16/2005	259	140,357	21,310
2/21/2005	144	26,121	0	4/20/2005	202	46,176	0	6/17/2005	260	136,956	19,482
2/22/2005	145	26,068	0	4/21/2005	203	44,941	0	6/18/2005	261	125,984	17,653
2/23/2005	146	26,015	0	4/22/2005	204	42,551	0	6/19/2005	262	121,869	15,825
6/20/2005	263	124,002	13,996	8/17/2005	321	59,402	0	10/14/2005	14	39380	0
6/21/2005	264	122,286	13,282	8/18/2005	322	57,750	0	10/15/2005	15	40815	0
6/22/2005	265	121,708	12,569	8/19/2005	323	58,953	0	10/16/2005	16	39773	0
6/23/2005	266	123,369	11,855	8/20/2005	324	60,902	0	10/17/2005	17	39556	0
6/24/2005	267	116,727	11,141	8/21/2005	325	61,432	0	10/18/2005	18	40471	0
6/25/2005	268	113,351	10,428	8/22/2005	326	59,755	0	10/19/2005	19	42059	0
6/26/2005	269	110,784	9,714	8/23/2005	327	59,595	0	10/20/2005	20	39829	0
6/27/2005	270	103,188	9,000	8/24/2005	328	58,657	0	10/21/2005	21	40134	0
6/28/2005	271	98,440	8,286	8/25/2005	329	58,793	0	10/22/2005	22	40807	0
6/29/2005	272	93,988	7,573	8/26/2005	330	57,943	0	10/23/2005	23	41826	0
6/30/2005	273	91,710	6,859	8/27/2005	331	58,897	0	10/24/2005	24	43374	0
7/1/2005	274	93,154	6,145	8/28/2005	332	59,338	0	10/25/2005	25	43783	0
7/2/2005	275	97,534	5,432	8/29/2005	333	60,108	0	10/26/2005	26	41216	0
7/3/2005	276	89,425	4,718	8/30/2005	334	53,571	0	10/27/2005	27	43133	0
7/4/2005	277	89,264	4,004	8/31/2005	335	51,325	0	10/28/2005	28	41321	0
7/5/2005	278	90,523	3,291	9/1/2005	336	53,058	0	10/29/2005	29	36845	0
7/6/2005	279	92,144	2,577	9/2/2005	337	56,563	0	10/30/2005	30	36099	0
7/7/2005	280	93,595	1,863	9/3/2005	338	58,841	0	10/31/2005	31	34576	0
7/8/2005	281	90,908	1,149	9/4/2005	339	57,895	0	11/1/2005	32	38586	0

Notes:
Flow measurement in cubic feet per day

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
7/9/2005	282	88,422	436	9/5/2005	340	55,729	0	11/2/2005	33	44048	0
7/10/2005	283	86,521	0	9/6/2005	341	55,400	0	11/3/2005	34	37720	0
7/11/2005	284	79,735	0	9/7/2005	342	57,461	0	11/4/2005	35	35899	0
7/12/2005	285	81,957	0	9/8/2005	343	59,250	0	11/5/2005	36	35450	0
7/13/2005	286	86,024	0	9/9/2005	344	58,552	0	11/6/2005	37	36228	0
7/14/2005	287	85,326	0	9/10/2005	345	48,855	0	11/7/2005	38	37166	0
7/15/2005	288	84,235	0	9/11/2005	346	47,427	0	11/8/2005	39	37575	0
7/16/2005	289	83,329	0	9/12/2005	347	45,687	0	11/9/2005	40	36645	0
7/17/2005	290	79,647	0	9/13/2005	348	44,829	0	11/10/2005	41	40037	0
7/18/2005	291	74,049	0	9/14/2005	349	44,877	0	11/11/2005	42	40527	0
7/19/2005	292	74,538	0	9/15/2005	350	46,513	0	11/12/2005	43	35626	0
7/20/2005	293	75,998	0	9/16/2005	351	48,302	0	11/13/2005	44	33982	0
7/21/2005	294	80,465	0	9/17/2005	352	46,810	0	11/14/2005	45	33709	0
7/22/2005	295	79,727	0	9/18/2005	353	43,986	0	11/15/2005	46	28649	0
7/23/2005	296	71,017	0	9/19/2005	354	44,909	0	11/16/2005	47	31664	0
7/24/2005	297	68,161	0	9/20/2005	355	48,398	0	11/17/2005	48	31817	0
7/25/2005	298	67,303	0	9/21/2005	356	49,007	0	11/18/2005	49	30124	0
7/26/2005	299	63,405	0	9/22/2005	357	47,211	0	11/19/2005	50	30261	0
7/27/2005	300	61,857	0	9/23/2005	358	46,088	0	11/20/2005	51	30044	0
7/28/2005	301	63,613	0	9/24/2005	359	45,350	0	11/21/2005	52	30638	0
7/29/2005	302	64,688	0	9/25/2005	360	42,936	0	11/22/2005	53	31143	0
7/30/2005	303	64,800	0	9/26/2005	361	41,885	0	11/23/2005	54	30172	0
7/31/2005	304	64,247	0	9/27/2005	362	43,449	0	11/24/2005	55	29715	0
8/1/2005	305	62,009	0	9/28/2005	363	41,933	0	11/25/2005	56	30766	0
8/2/2005	306	59,836	0	9/29/2005	364	41,997	0	11/26/2005	57	31496	0
8/3/2005	307	61,352	0	9/30/2005	365	43,850	0	11/27/2005	58	28488	0
8/4/2005	308	61,263	0	10/1/2005	1	44577	0	11/28/2005	59	28215	0
8/5/2005	309	62,434	0	10/2/2005	2	42411	0	11/29/2005	60	28360	0
8/6/2005	310	63,581	0	10/3/2005	3	38498	0	11/30/2005	61	28833	0
8/7/2005	311	65,161	0	10/4/2005	4	35354	0	12/1/2005	62	29475	0
8/8/2005	312	64,977	0	10/5/2005	5	34544	0	12/2/2005	63	31127	0
8/9/2005	313	64,696	0	10/6/2005	6	33822	0	12/3/2005	64	28296	0
8/10/2005	314	63,974	0	10/7/2005	7	36733	0	12/4/2005	65	27790	0
8/11/2005	315	61,937	0	10/8/2005	8	38891	0	12/5/2005	66	27269	0
8/12/2005	316	60,702	0	10/9/2005	9	39300	0	12/6/2005	67	27502	0
8/13/2005	317	59,218	0	10/10/2005	10	36589	0	12/7/2005	68	23419	0
8/14/2005	318	58,352	0	10/11/2005	11	36910	0	12/8/2005	69	23339	0
8/15/2005	319	60,285	0	10/12/2005	12	38273	0	12/9/2005	70	24815	0
8/16/2005	320	57,229	0	10/13/2005	13	38080	0	12/10/2005	71	25280	0
12/11/2005	72	26130	0	2/7/2006	130	28921	0	4/6/2006	188	36701	0
12/12/2005	73	27213	0	2/8/2006	131	28737	0	4/7/2006	189	37559	0
12/13/2005	74	27149	0	2/9/2006	132	28592	0	4/8/2006	190	36156	0
12/14/2005	75	25537	0	2/10/2006	133	28825	0	4/9/2006	191	37607	0
12/15/2005	76	23339	0	2/11/2006	134	28512	0	4/10/2006	192	41866	0
12/16/2005	77	24510	0	2/12/2006	135	28015	0	4/11/2006	193	45475	0
12/17/2005	78	25352	0	2/13/2006	136	27999	0	4/12/2006	194	44064	0
12/18/2005	79	25497	0	2/14/2006	137	28280	0	4/13/2006	195	44858	0
12/19/2005	80	29226	0	2/15/2006	138	28568	0	4/14/2006	196	49822	0
12/20/2005	81	31664	0	2/16/2006	139	28769	0	4/15/2006	197	59607	0
12/21/2005	82	32450	0	2/17/2006	140	28440	0	4/16/2006	198	83139	0
12/22/2005	83	32314	0	2/18/2006	141	27999	0	4/17/2006	199	129336	0
12/23/2005	84	31496	0	2/19/2006	142	27750	0	4/18/2006	200	120088	0
12/24/2005	85	29988	0	2/20/2006	143	27806	0	4/19/2006	201	99251	0
12/25/2005	86	30116	0	2/21/2006	144	27718	0	4/20/2006	202	87518	0
12/26/2005	87	30662	0	2/22/2006	145	27718	0	4/21/2006	203	80051	0
12/27/2005	88	30164	0	2/23/2006	146	27526	0	4/22/2006	204	79169	0
12/28/2005	89	30838	0	2/24/2006	147	27742	0	4/23/2006	205	93429	0
12/29/2005	90	30293	0	2/25/2006	148	27839	0	4/24/2006	206	112437	0
12/30/2005	91	29876	0	2/26/2006	149	27847	0	4/25/2006	207	121973	0
12/31/2005	92	31648	0	2/27/2006	150	27999	0	4/26/2006	208	125093	0
1/1/2006	93	31167	0	2/28/2006	151	28616	0	4/27/2006	209	145858	0
1/2/2006	94	30750	0	3/1/2006	152	28584	0	4/28/2006	210	187884	1,680
1/3/2006	95	31183	0	3/2/2006	153	28745	0	4/29/2006	211	234073	3,375
1/4/2006	96	30221	0	3/3/2006	154	28817	0	4/30/2006	212	241556	5,070
1/5/2006	97	28472	0	3/4/2006	155	28665	0	5/1/2006	213	260572	6,765

Notes:

Flow measurement in cubic feet per day

Appendix A-5 - Daily Upstream and Downstream Flows (1998 through 2006)

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
1/6/2006	98	29154	0	3/5/2006	156	28568	0	5/2/2006	214	268608	8,460
1/7/2006	99	29820	0	3/6/2006	157	28288	0	5/3/2006	215	255463	10,155
1/8/2006	100	29779	0	3/7/2006	158	28464	0	5/4/2006	216	263058	11,850
1/9/2006	101	29467	0	3/8/2006	159	28544	0	5/5/2006	217	262280	13,545
1/10/2006	102	29370	0	3/9/2006	160	28633	0	5/6/2006	218	269868	15,240
1/11/2006	103	29547	0	3/10/2006	161	28865	0	5/7/2006	219	284641	16,935
1/12/2006	104	29804	0	3/11/2006	162	28913	0	5/8/2006	220	277856	18,630
1/13/2006	105	29499	0	3/12/2006	163	28673	0	5/9/2006	221	279396	20,325
1/14/2006	106	29579	0	3/13/2006	164	28272	0	5/10/2006	222	268745	22,020
1/15/2006	107	29771	0	3/14/2006	165	28199	0	5/11/2006	223	254001	23,715
1/16/2006	108	29747	0	3/15/2006	166	27774	0	5/12/2006	224	259184	25,410
1/17/2006	109	29587	0	3/16/2006	167	27814	0	5/13/2006	225	253137	27,105
1/18/2006	110	29579	0	3/17/2006	168	27879	0	5/14/2006	226	250545	28,800
1/19/2006	111	29579	0	3/18/2006	169	28047	0	5/15/2006	227	239314	30,495
1/20/2006	112	29370	0	3/19/2006	170	28007	0	5/16/2006	228	229810	32,190
1/21/2006	113	29266	0	3/20/2006	171	28215	0	5/17/2006	229	234994	33,885
1/22/2006	114	29322	0	3/21/2006	172	28071	0	5/18/2006	230	192660	33,304
1/23/2006	115	28929	0	3/22/2006	173	27911	0	5/19/2006	231	192660	32,724
1/24/2006	116	28841	0	3/23/2006	174	27871	0	5/20/2006	232	180565	32,143
1/25/2006	117	28961	0	3/24/2006	175	27710	0	5/21/2006	233	190933	31,562
1/26/2006	118	28777	0	3/25/2006	176	28095	0	5/22/2006	234	203892	30,982
1/27/2006	119	29042	0	3/26/2006	177	28344	0	5/23/2006	235	189205	30,401
1/28/2006	120	29202	0	3/27/2006	178	28576	0	5/24/2006	236	167606	29,820
1/29/2006	121	28985	0	3/28/2006	179	28705	0	5/25/2006	237	169334	29,240
1/30/2006	122	29018	0	3/29/2006	180	28913	0	5/26/2006	238	165878	28,659
1/31/2006	123	28833	0	3/30/2006	181	28977	0	5/27/2006	239	131320	28,078
2/1/2006	124	28881	0	3/31/2006	182	28889	0	5/28/2006	240	120953	27,498
2/2/2006	125	28881	0	4/1/2006	183	29026	0	5/29/2006	241	103674	26,917
2/3/2006	126	28584	0	4/2/2006	184	28937	0	5/30/2006	242	122681	26,336
2/4/2006	127	28560	0	4/3/2006	185	28857	0	5/31/2006	243	126136	25,756
2/5/2006	128	28625	0	4/4/2006	186	29419	0	6/1/2006	244	147735	25,175
2/6/2006	129	28777	0	4/5/2006	187	30437	0	6/2/2006	245	123545	24,377
6/3/2006	246	127000	23,578	7/31/2006	304	42,722	348	9/27/2006	362	28,396	0
6/4/2006	247	114041	22,780	8/1/2006	305	42,353	232	9/28/2006	363	29506	0
6/5/2006	248	109721	21,981	8/2/2006	306	41,984	116	9/29/2006	364	31149	0
6/6/2006	249	107130	21,183	8/3/2006	307	41,614	0	9/30/2006	365	30622	0
6/7/2006	250	112313	20,384	8/4/2006	308	41,245	0	**Totals/year**		28,104,243	1,682,950
6/8/2006	251	98490	19,586	8/5/2006	309	40,876	0	Percent (upstream/downstream)			5.99%
6/9/2006	252	92442	18,787	8/6/2006	310	40,507	0				
6/10/2006	253	84667	17,989	8/7/2006	311	40,137	0				
6/11/2006	254	81211	17,190	8/8/2006	312	40,343	0				
6/12/2006	255	81211	16,392	8/9/2006	313	40,380	0				
6/13/2006	256	77755	15,593	8/10/2006	314	40,230	0				
6/14/2006	257	73436	14,795	8/11/2006	315	40,100	0				
6/15/2006	258	74300	13,996	8/12/2006	316	39,783	0				
6/16/2006	259	72572	13,560	8/13/2006	317	38,931	0				
6/17/2006	260	68252	13,124	8/14/2006	318	38,286	0				
6/18/2006	261	68252	12,689	8/15/2006	319	38,029	0				
6/19/2006	262	68252	12,253	8/16/2006	320	37,772	0				
6/20/2006	263	67388	11,817	8/17/2006	321	38,157	0				
6/21/2006	264	67388	11,381	8/18/2006	322	40,343	0				
6/22/2006	265	70844	10,945	8/19/2006	323	40,119	0				
6/23/2006	266	67388	10,510	8/20/2006	324	39,450	0				
6/24/2006	267	66524	10,074	8/21/2006	325	38,470	0				
6/25/2006	268	66524	9,638	8/22/2006	326	38,305	0				
6/26/2006	269	62204	9,202	8/23/2006	327	38,213	0				
6/27/2006	270	61340	8,766	8/24/2006	328	38,231	0				
6/28/2006	271	61340	8,330	8/25/2006	329	38,141	0				
6/29/2006	272	82939	7,895	8/26/2006	330	39,319	0				
6/30/2006	273	81211	7,459	8/27/2006	331	38,469	0				
7/1/2006	274	74300	7,023	8/28/2006	332	38,065	0				
7/2/2006	275	63932	6,587	8/29/2006	333	38,249	0				
7/3/2006	276	60476	6,151	8/30/2006	334	37,772	0				
7/4/2006	277	56157	5,715	8/31/2006	335	37,154	0				
7/5/2006	278	53565	5,280	9/1/2006	336	36,719	0				

Notes:

Flow measurement in cubic feet per day

Appendix A-5 - Daily Upstream and Downstream Flows (1998 through 2006)

Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1	Date	Day	SW-2	SW-1
7/6/2006	279	53565	4,844	9/2/2006	337	36,286	0				
7/7/2006	280	52701	4,408	9/3/2006	338	35,835	0				
7/8/2006	281	57885	3,972	9/4/2006	339	35,407	0				
7/9/2006	282	51837	3,536	9/5/2006	340	34,783	0				
7/10/2006	283	51837	3,100	9/6/2006	341	34,571	0				
7/11/2006	284	50109	2,665	9/7/2006	342	34,253	0				
7/12/2006	285	49,740	2,549	9/8/2006	343	33,900	0				
7/13/2006	286	49,370	2,433	9/9/2006	344	33,514	0				
7/14/2006	287	49,001	2,317	9/10/2006	345	33,392	0				
7/15/2006	288	48,632	2,201	9/11/2006	346	32,643	0				
7/16/2006	289	48,262	2,085	9/12/2006	347	32,056	0				
7/17/2006	290	47,893	1,970	9/13/2006	348	31,815	0				
7/18/2006	291	47,524	1,854	9/14/2006	349	31,918	0				
7/19/2006	292	47,154	1,738	9/15/2006	350	32,040	0				
7/20/2006	293	46,785	1,622	9/16/2006	351	31,029	0				
7/21/2006	294	46,416	1,506	9/17/2006	352	30,841	0				
7/22/2006	295	46,046	1,390	9/18/2006	353	30,603	0				
7/23/2006	296	45,677	1,274	9/19/2006	354	30,552	0				
7/24/2006	297	45,308	1,159	9/20/2006	355	30,349	0				
7/25/2006	298	44,938	1,043	9/21/2006	356	30,570	0				
7/26/2006	299	44,569	927	9/22/2006	357	30,383	0				
7/27/2006	300	44,200	811	9/23/2006	358	30,130	0				
7/28/2006	301	43,830	695	9/24/2006	359	29,963	0				
7/29/2006	302	43,461	579	9/25/2006	360	29,342	0				
7/30/2006	303	43,092	463	9/26/2006	361	28,926	0				

Notes:
Flow measurement in cubic feet per day

APPENDIX B-1

TRC DETAILED COST ESTIMATES

Maybe Canyon
Relocate Cross Valley Fill to Mine Pit

NPV
Date

	ELEMENTS	ACTIVITIES	US Quantity	US Units	US UNIT RATE	ITEM TOTAL	ITEM NPV	ELEMENT SUBTOTALS
1	**Project Management**							
	Project Management and Supervision		5.5	yr	$479,950	$2,876,700	$2,675,393	
	Project Reporting		5.5	yr	$7,200	$42,840	$39,863	
		Subtotal:				$2,919,540		$2,715,256
	Regulatory Agency Oversight (USFS)		5.5	yr	$24,000	$144,000	$133,913	
	Regulatory Agency Reporting (USFS)		5.5	yr	$6,000	$36,000	$33,478	
		Subtotal:				$180,000		$167,391
	Project Management Subtotal:					$3,099,540		$2,882,647
	Treatment Alternative Implementation							
	Engineering Design and Construction							
2	**Engineering & Design**							
	Prelim. Engineering/Vendor Evaluations		1	ea	$10,000	$10,000		
	Detailed Engineering and Design (Includes Drawings)		1	ea	$40,000	$40,000		
	System/Equipment Specifications		1	ea	$5,000	$5,000		
	Design Report (30, 60, 90, 100%)		1	ea	$15,000	$15,000		
	Contingency (10% of Engineering and Design)			10%		$7,000		
		Subtotal:				$77,000		$77,000
3	**Permitting**							
	Construction Permits (City Building & Safety, Grading, Fire, Etc.)		1	ea	$10,000	$10,000		
	NPDES or Sewer Discharge Permit		-	ea	$10,000	$0		
	AQMD Permit		-	ea	$5,467	$0		
	Engineering Support		1	ls	$10,000	$10,000		
	Contingency (10% of Permitting)			10%		$2,000		
		Subtotal:				$22,000		$22,000
4	**Construction and Startup**							
	Construction Management		5.5	year	$906,850	$4,987,675	$4,606,532	
	Engineering Oversight/Support/QA/QC		5.5	year	$302,283	$1,662,558	$1,535,511	
	Equipment Procurement and Subcontracting		1	ea	$15,000	$15,000		
	Site Preparation and Support Facilities:							
	Clear and Grub Cut Area and Place Area		80	acre	$1,318	$105,413		
	Construct Decontamination Area		3	ls	$9,274	$27,823		
	Excavate CVF Waste, Transport and Place and Compact into Mine Pit 5000' Haul, 2 Passes		14,500,000	cy	$7.21	$104,554,929	$96,565,168	
	Install Liner on Cap		-	sf	$1	$0		
	Excavate, Transport and Place and CompactClay Cover from On-Site Location 5000' Haul, 2 Passes		-	cy	$7	$0		
	Excavate, Transport and Place and Compact Vegetative Cover from On-Site Location onto Clay Cap		-	cy	$7	$0		
	Survey and QA/QC Cap		1,450	day	$3,379	$4,899,962	$4,525,522	
	Reseed After Construction Slope Mix Hydroseed		100	acre	$2,373	$237,340	$219,204	
	Install Settlement Markers		-	ea	$500	$0	$0	
	Load, Transport and Dispose of Excess Waste from Pit to Landfill 50 Miles Away		26,100,000	ton	$63	$1,649,667,169	$1,523,604,759	
	Install Stormwater Control and Silt Fence/Remove Later		15,000	lf	$5	$69,556		
	Contingency		1	5%		$88,311,371		
		Subtotal:				$1,854,538,796		$1,631,099,518
	Operation and Maintenance							
5	**Labor and Supervision**							
	Engineering Oversite/Support		30	yr	$3,000	$90,000	$60,565	
	Labor (Daily for first 2 weeks then weekly)		-	yr	$34,320	$0	$0	
	Contingency (5% of Labor and Supervision)			5%		$4,500	$3,028	
		Subtotal:				$94,500		$63,594
6	**Material, Supplies and Repairs**							
	Miscellaneous Materials and Supplies		30	yr	$20,000	$600,000	$403,769	
	Subcontractor Services		30	yr	$14,640	$439,200	$295,559	
	Contingency (5% of Materials, Supplies and Repairs)			0%		$0	$0	
		Subtotal:				$1,039,200		$699,328
7	**Performance Evaluation and Reporting**							
	Construction Completion Report		1	ea	$80,000	$80,000		
		Subtotal:				$80,000		$80,000
	Treatment Alternative Implementation Subtotal:					$1,855,851,496		$1,632,041,440
	Relocate Cross Valley Fill To Mine Pit Grand Total:					$1,858,951,036		$1,634,924,087

APPENDIX B-2

MSE DETAILED COST ESTIMATES

Appendix B
Cost Estimate - Alternative 1 Grade Top Deck

Item No.	Description	Est Qty	Unit	Unit Price	Total	Comments	Source
1	Site Preparation-Site Access	1	Ls	$50,000.00		Lump due to unknown conditions	
1	Grade Topdeck	273,125	CY				
	Equipment Necessary						
	D-9 Cat		Cy	8.56		Assume average use of all equip.	Dynamac
	Large Excavator		Cy	4.74			Dynamac
	Scraper		Cy	4.92			Dynamac
	Articulated Dump		Cy	3.32			Dynamac
	Average Cost Per Yard Subtotal =		**Cy**	**5.39**	**$ 1,471,162**		
	Subtotal Construction Cost =				**$ 1,521,162**		
	Mobilization Cost =		3%		**$ 45,635**		
	Final Design Cost =		3%		**$ 45,635**		
	Construction Oversight Cost =		3%		**$ 45,635**		
	Contingency =		15%		**$ 228,174**		
	TOTAL PROJECT COST				**$ 1,886,240**		

Appendix B
Cost Estimate - Alternative 2 - Grading and Capping Top Deck

Item No.	Description	Est Qty	Unit	Unit Price	Total	Comments	Source
1	Site Preparation-Site Access	1	Ls	$50,000.00	$50,000	Due to unknown conditions	
2	Top Deck- Regrade	273,125	Cy	$5.39	$1,471,162	Price from Alt. 1	Dynamac
3	Excavate and Load Bedding Layer	112,295	Cy	$4.74	$532,351	Assumes on site or adjacent borrow source	RS0276
4	Haul Bedding Layer	112,295	Cy	$3.05	$342,388	Assumes 5 mile RT haul	RS0705
5	Install Bedding Layer	112,295	Cy	$2.71	$304,850	1' thick bedding sand over Topdeck	Dynamac
6	Purchase and Ship GCL	329,120	Sy	$3.38	$1,113,505		RS0520
7	Install GCL	329,120	Sy	$1.37	$450,069		Dynamac
8	Purchase and Ship HDPE	329,120	Sy	$3.19	$1,050,162		CO Linings
9	Install HDPE	329,120	Sy	$1.37	$450,069		CO Linings
10	Purchase and Ship Geo-Drain	329,120	Sy	$2.73	$900,139		CO Linings
11	Install Geo-Drain	329,120	Sy	$1.37	$450,069		CO Linings
12	Excavate Cover Media	224,590	Cy	$4.74	$1,064,701	Assumes on site or adjacent borrow source	RS0276
13	Haul Cover Media	224,590	Cy	$3.05	$684,776	Assumes 5 mile RT haul	RS0705
14	Install and Grade Cover Media	224,590	Cy	$2.25	$505,050	2' thick cover media	RS0205
	Subtotal Construction Cost =				**$9,369,291**		
	Mobilization Cost =			3%	**$281,079**		
	Final Design Cost =			3%	**$281,079**		
	Construction Oversight Cost =			3%	**$281,079**		
	Contingency =			15%	**$1,405,394**		
	TOTAL PROJECT COST				**$11,617,921**		

Appendix B

Cost Estimate - Alternative 3 - Grading and Capping Top Deck and Slope

Item No.	Description	Est Qty	Unit	Unit Price	Total	Comments	Source
1	Site Preparation-Site Access	1	Ls	$50,000.00	$ 50,000	Due to unknown conditions	
2	Grade and Cap Topdeck	1	Ls	$9,369,290.98	$ 9,369,291	Price from Alt. 2	Dynamac
3	Slope- Regrade 3.5:1 w/ terraces	177,403	Cy	$6.46	$ 1,146,677	Price from Alt. 1 with 20% increase	Dynamac
4	Excavate Bedding Layer	38,908	Cy	$4.74	$ 184,449	Assumes on site or adjacent borrow source	RS0276
5	Haul Bedding Layer	38,908	Cy	$3.05	$ 118,631	Assumes 5 mile RT haul	RS0705
6	Install Bedding Layer	38,908	Cy	$2.71	$ 105,625	1' thick bedding sand over slope	Dynamac
7	Purchase and Ship HDPE	116,724	Sy	$3.19	$ 372,445		CO Linings
8	Install HDPE	116,724	Sy	$1.37	$ 159,619		CO Linings
9	Purchase and Ship Geo-drain	116,724	Sy	$2.73	$ 319,239		CO Linings
10	Install Geo-Drain	116,724	Sy	$1.37	$ 159,619		CO Linings
11	Excavate Cover Media	77,816	Cy	$4.74	$ 368,898	Assumes on site or adjacent borrow source	RS0276
12	Haul Cover Media	77,816	Cy	$3.05	$ 237,261	Assumes 5 mile RT haul	RS0705
13	Install Cover Media	77,816	Cy	$2.25	$ 174,990	2' thick topsoil layer	RS0205
14	Riprap West Groin on Upper Slope	280	Cy	$34.44	$ 9,643	Assumes 3'x5'x500'	Dynamac
	Subtotal Construction Cost =				**$ 12,776,387**		
	Mobilization Cost =			3%	**$ 383,292**		
	Final Design Cost =			3%	**$ 383,292**		
	Construction Oversight Cost =			3%	**$ 383,292**		
	Contingency =			15%	**$ 1,916,458**		
	TOTAL PROJECT COST				**$ 15,842,720**		

Appendix B

Cost Estimate - Alternative 4A - Grading and Capping Top Deck and Slope with Diversion of Runoff Water

Item No.	Description	Est Qty	Unit	Unit Price	Total	Comments	Source
1	Site Preparation-Site Access	1	Ls		$ 50,000	Due to unknown conditions	
2	Grade and Cap Topdeck and Slope	1	Ls		$ 12,776,387	Price from Alt. 3	Dynamac
3	Purchase and Ship GCL	35545	Sy	$3.38	$ 120,259	Additional area on Topdeck	RS0520
4	Install GCL	35545	Sy	$1.37	$ 48,608	Additional area on Topdeck	RS0511
5	Purchase and Ship HDPE	35545	Sy	$3.19	$ 113,418	Additional area on Topdeck	CO Linings
6	Install HDPE	35545	Sy	$1.37	$ 48,608	Additional area on Topdeck	CO Linings
7	Purchase and Ship Geo-drain	35545	Sy	$2.73	$ 97,215	Additional area on Topdeck	CO Linings
8	Install Geo-drain	35545	Sy	$1.37	$ 48,608	Additional area on Topdeck	CO Linings
9	Excavate Bedding Material	10041	Cy	$4.74	$ 47,601	Assumes on site or adjacent borrow source	RS0276
10	Haul Bedding Material	10041	Cy	$3.05	$ 30,615	Assumes 5 mile RT haul	RS0705
11	Install Bedding Material	10041	Cy	$6.75	$ 67,740	1' thick bedding sand 3x due to slopes	RS0205
12	Excavate Bypass Channel	4,000	Cy	$4.74	$ 18,963	Assumes 3' bottom width, 2:1 side slopes, 1500' length	RS0276
13	Shape Bypass Channel	2,000	Sy	$3.45	$ 6,908	Assumes 3' bottom width, 2:1 side slopes, 1500' length	RS3305
14	Pour Concrete Bypass Channel	1,500	Lf	$57.57	$ 86,354	15% additional for open wing walls	RS3305
15	Excavate Energy Dissipation Pool	1,120	Cy	$4.74	$ 5,310	Assumes 300' x 40' x 4', 3:1 side slopes	RS0276
16	Pour Concrete Energy Dissipation Pool	460	Cy	$529.45	$ 243,547	Assumes 300' x 40' x 4', 3:1 side slopes	RS3308
17	Large Gabions	50	Cy	$106.36	$ 5,318		USFS
	Subtotal Construction Cost =				**$ 13,815,456**		
	Mobilization Cost =			3%	**$ 414,464**		
	Final Design Cost =			3%	**$ 414,464**		
	Construction Oversight Cost =			3%	**$ 414,464**		
	Contingency =			15%	**$ 2,072,318**		
	TOTAL PROJECT COST				**$ 17,131,165**		

APPENDIX C

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Standard, Limitation, or Requirement Criteria	Citation	Description	Action, Contaminant or Location	Applicable / Relevant and Appropriate or To Be Considered
Action Specific Requirements				
Clean Water Act (CWA): Water Quality Standards	33 USC 1342 - 1344 40 CFR 122	Water pollution prevention and control for point source discharges.	Action: On-site discharges of point-source water	Substantive requirements (as implemented by the State of Idaho since Idaho is an authorized state) may be applicable to on-site discharges of point-source water (e.g., dump toe and run-off diversion discharges.) However, this action alone will not likely result in compliance with water quality standards.
CWA: Section 404	33 CFR 323	Dredge or fill requirements. This regulation prohibits discharge of dredged or fill material into waters of the United States without a permit.	Action: Dredging or filling wetlands	Substantive requirements are applicable for any on-site action that involves dredging or filling in a wetland.
CWA: Storm Water Discharges	40 CFR 122.26	Water pollution prevention and control of storm water discharges.	Action: On-site discharges of storm water during construction	Substantive requirements may be applicable to on-site discharges of construction-related storm water.

Standard, Limitation, or Requirement Criteria	Citation	Description	Action, Contaminant or Location	Applicable / Relevant and Appropriate or To Be Considered
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	7 USC 136(q)	Requirements for control of pesticides.	Action: Storage, use, disposal, and transportation of pesticides	Not an ARAR unless pesticides are used during cleanup, e.g., for control of invasive weeds.
Hazardous Materials Regulations	49 CFR 171 - 173 & 177 49 USC 1801 - 1813	The movement of hazardous materials on public roadways must be in accordance with placarding, packaging, documentation and other requirements of this regulation.	Action: Transportation	Not an ARAR. Transport of hazardous materials on public highways is not anticipated for this removal action.
Migratory Bird Treaty Act	16 USC 703 et seq.	Taking, killing, possessing migratory game unlawful.	Action	Substantive requirements are applicable. However, the taking of game is not anticipated for this removal action.
Resource Conservation and Recovery Act (RCRA): Criteria for Municipal Solid Waste (MSW) Landfills	40 CFR 258.50-56	Groundwater monitoring requirements for engineered disposal facilities to ensure appropriate assessment, monitoring, and protection of groundwater.	Action: Post-removal ground-water monitoring	Not applicable since the removal action does not involve a municipal solid waste landfill. However, substantive requirements may be relevant and appropriate to the ground monitoring program to be developed for this site.

Standard, Limitation, or Requirement Criteria	Citation	Description	Action, Contaminant or Location	Applicable / Relevant and Appropriate or To Be Considered
RCRA: Hazardous Waste Facilties	40 CFR 264.97-99	Groundwater monitoring requirements for hazardous waste disposal facilities to ensure appropriate assessment, monitoring, and protection of groundwater.	Action: Post-removal ground-water monitoring	Not applicable since the removal action does not involve a hazardous waste disposal facility. However, substantive requirements (as implemented by the State of Idaho since Idaho is an authorized state) may be relevant and appropriate to the ground monitoring program to be developed for this site.
RCRA: Criteria for Municipal Solid Waste (MSW) Landfills	40 CFR 258.60(a)(1-3)	Closure criteria for capping MSW facilities.	Action: Capping	Not applicable since the removal action does not involve a municipal solid waste landfill. However, substantive requirements may be relevant and appropriate to the design of a cap and run-on/run-off control systems.

Standard, Limitation, or Requirement Criteria	Citation	Description	Action, Contaminant or Location	Applicable / Relevant and Appropriate or To Be Considered
RCRA: Criteria for Hazardous Waste TSD facilities	40 CFR 264.117 and 264.228(b)	Closure and post-closure care (maintenance and monitoring) criteria for hazardous waste disposal facilities.	Action: Capping	Not applicable since the removal action does not involve a hazardous waste disposal facility. However, substantive requirements (as implemented by the State of Idaho since Idaho is an authorized state) may be relevant and appropriate to the design of the cap and run-on/run-off control systems.
RCRA: Land Disposal Restrictions	40 CFR 268	Establishes restrictions for land disposal of hazardous wastes.	Action: Land Disposal	Not an ARAR because the material to be cleaned up is exempt from hazardous waste regulations.
Safe Drinking Water Act (SDWA): Underground Injection Control Program	40 CFR 144	Regulates underground injection into certain classes of wells. Its purpose is to prevent contamination of ground water that may be a source of drinking water.	Action: Underground injection	Not an ARAR. No underground injection is anticipated for this removal action.

Standard, Limitation, or Requirement Criteria	Citation	Description	Action, Contaminant or Location	Applicable / Relevant and Appropriate or To Be Considered
Surface Mining Control and Reclamation Act (SMCRA)	30 USC 1201 - 1326 30 CFR 816.43, 45-47, and 111 30 CFR 784	Governs activities associated with coal exploration and mining.	Action: Capping, run-on and run-off control, revegetation, and control of sediment	Not applicable since the site is not a coal mine. However certain requirements may be relevant and appropriate to the design of the cap and run-on/run-off control systems.
Contaminant Specific Requirements				
Clean Air Act: National Primary and Secondary Ambient Air Quality Standards (NAAQS)	42 USC 7409 40 CFR 50	Establishes Air Quality Levels that protect public health.	Contaminant: Fugitive Dust	Defer to the State of Idaho requirements for the control of fugitive dust.
Clean Air Act: NESHAP's	40 CFR 61	The Environmental Protection Agency has promulgated standards for certain hazardous air pollutants from specific sources.	Contaminant: Hazardous Air Pollutants.	Not an ARAR because hazardous air pollutants not likely generated as a result of this removal action.

Standard, Limitation, or Requirement Criteria	Citation	Description	Action, Contaminant or Location	Applicable / Relevant and Appropriate or To Be Considered
CWA: Water Quality Standards	40 CFR 131	Sets criteria for water quality based on toxicity to aquatic organisms and human health. Requires states to develop standards based on the criteria.	Contaminant: Various	Federal Ambient Water Quality Criteria are not applicable and would only be relevant and appropriate if there is no state standard for any of the Contaminants of Potential Concern (COPCs) identified by the IDEQ's Area Wide Investigation, or if there is a state standard but it is less stringent than the criteria and the Forest Service chooses to add an extra measure of protection.
RCRA: List of Hazardous Wastes	40 CFR 261, Subpart C and D	Defines those solids wastes which are subject to regulation as hazardous wastes under 40 CFR Parts 262-265 and Parts 124, 270, and 271. The Bevill Exclusion at 40 CFR 261.4(b)(7) excludes solid waste from the extraction, beneficiation and processing of ores and minerals including phosphate rock from the definition of hazardous waste.	Contaminant: Various	RCRA hazardous waste regulations are not applicable to this removal act. However, certain RCRA regulations may be relevant and appropriate and are discussed under action and location specific requirements.

Standard, Limitation, or Requirement Criteria	Citation	Description	Action, Contaminant or Location	Applicable / Relevant and Appropriate or To Be Considered
Safe Drinking Water Act (SDWA): National Primary Drinking Water Regulations	40 CFR 141	Establishes health-based standards (MCLs) for public water systems.	Contaminant: Various	MCLs are not applicable to this removal action because it does not involve a public water system. However, MCLs may be relevant and appropriate for any groundwater cleanup at the site. This removal action alone will not likely result in compliance with MCLs.
SDWA: National Secondary Drinking Water Regulations	40 CFR 143	Establishes welfare-based standards (secondary MCLs) for public water systems.	Contaminant: Various	Federal secondary MCLs are not ARARs because they are not enforceable requirements. They are TBC if alternative involves groundwater cleanup. This removal action alone will not likely result in compliance with secondary MCLs.
Toxic Substances Control Act	15 USC 2601 et seq.	Enacted by Congress to give EPA the ability to track the 75,000 industrial chemicals currently produced or imported into the United States.	Contaminant: Listed Toxic Substances	Not an ARAR for phosphate mines since toxic substances not likely to be encountered.

Standard, Limitation, or Requirement Criteria	**Citation**	**Description**	**Action, Contaminant or Location**	**Applicable / Relevant and Appropriate or To Be Considered**
		Location Specific Requirements		
American Indian Religious Freedom Act	42 USC 1996 et seq.	To protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites.	Location: Ceremonial sites and areas where sacred objects are located	Substantive requirements are applicable to on-site actions.
Archaeological and Historic Preservation Act	40 CFR 6.301(c) 16 USC 469 et seq.	Data recovery and preservation activities.	Location: Sites with significant scientific, prehistoric, historic, and archeological	Substantive requirements are applicable to on-site actions.
Archaeological Resources Protection Act	16 USC 470(aa-ii) 43 CFR 7	Steps must be taken to protect archaeological resources and sites that are on public and Indian lands and to preserve data.	Location: Archeological resource sites	Substantive requirements are applicable to on-site actions.
Bald and Golden Eagle Protection Act	16 USC 668 et seq. 50 CFR 22	Prohibits any person from knowingly possessing or harming a bald or golden eagle, part of or complete nest, egg or part of Bald Eagle without being permitted to do so.	Location: Eagle nesting sites	Substantive requirements are applicable to on-site actions.

Standard, Limitation, or Requirement Criteria	Citation	Description	Action, Contaminant or Location	Applicable / Relevant and Appropriate or To Be Considered
Caribou-Targhee Land Use Management Plan (National Forest Management Act)	16 USC 1601 - 1614 36 CFR 219	Establishes multiple use goals and objectives, forest-wide management requirements, and monitoring and evaluation requirements. Establishes direction so that future decisions affecting the Forest will include an interdisciplinary approach to achieve integrated consideration of physical, biological, economic and other sciences.	Location: Caribou-Targhee National Forest	Substantive requirements, e.g., for the protection of wildlife and certain plant species, establishment of roads, and success of vegetative cover, may be applicable to on-site actions.
Endangered Species Act	7 USC 136 16 USC 460 16 USC 1531 et seq. 40 CFR 6.302 50 CFR 402	Federal Agencies are prohibited from jeopardizing threatened and endangered species or adversely modifying habitats essential to their survival. Requires consultation with the Service charged with protecting listed species.	Location: Critical habitat of an endangered or threatened species.	Substantive requirements are applicable to on-site actions.
Federal Land Policy and Management Act (FLPMA)	43 USC 1701 - 1785	Public lands and their resources are periodically and systematically inventoried and their present and future use is projected through a land use planning process, and that the land be managed for the use and protection of the land and its natural resources.	Location: Federal lands administered by BLM and lands with BLM mineral leases	Not likely to be an ARAR for most land administered by the Forest Service.
Fish and Wildlife Coordination Act	16 USC 661 et seq. 16 USC 1531 - 1566 40 CFR 6.302(g)	Requires Federal agencies involved in actions that will result in the control or structural modification of any natural stream or body of water for any purpose, to take action to protect the fish and wildlife resources that may be affected by the action.	Location: Streams and waterways	Substantive requirements are applicable to on-site actions.

Standard, Limitation, or Requirement Criteria	Citation	Description	Action, Contaminant or Location	Applicable / Relevant and Appropriate or To Be Considered
Hazardous and Solid Waste Regulations: Treatment, Storage and Disposal (TSD) facilities	40 CFR 264.18	Location standards and restrictions for hazardous waste TSD facilities.	Location: Fault zones, floodplains, salt domes, undergound mines, caves	Not applicable because a new TSD facility will not sited and the material addressed is exempt from hazardous waste regulations. Location restrictions could be relevant and appropriate to any alternative that involves siting a new disposal facility.
Hazardous and Solid Waste Regulations: Solid Waste Facilities	40 CFR 257.3(1-4)	Location standards and restrictions for solid waste disposal facilities and for determining the probability of adverse effects on human health and the environment.	Location: Near surface water, groundwater, endangered species, or floodplains	Not applicable. However, the location restrictions could be relevant and appropriate to any alternative that involves siting a new disposal facility.

Standard, Limitation, or Requirement Criteria	Citation	Description	Action, Contaminant or Location	Applicable / Relevant and Appropriate or To Be Considered
Hazardous and Solid Waste Regulations: Municipal Solid Waste Facilities	40 CFR 258.10-15	Location standards and restrictions for municipal solid waste disposal facilities.	Location: Wetlands, fault areas, seismic zones, unstable areas, or near airports	Not applicable because the removal action does not involve municipal solid waste. However, location restrictions could be relevant and appropriate to any alternative that involves siting a new disposal facility.
Historic Sites Act	16 USC 461 - 467 40 CFR 6.301(a) 36 CFR 62	Requires Federal agencies to consider the existence and location of potential and existing National Natural Landmarks to avoid undesirable impacts on them.	Location: National Natural Landmarks	Not an ARAR because there are no National Natural Landmarks at the site.
National Historic Preservation Act National Historic Landmarks Act	16 USC 470 et seq., 36 CFR 60, 63, 65 & 800 40 CFR 6.301(b & c)	Section 106 of the NHPA process, balances needs of Federal undertaking with the effects the undertaking may have on historic properties. If historic properties or landmarks eligible for, or included in, the National Register of Historic Places exists within remediation areas, remediation activities must be designed to minimize the effect on such properties.	Location: Historic Properties	Substantive requirements are applicable to on-site actions. A cultural resources survey has been performed and no historic features were identified.

Standard, Limitation, or Requirement Criteria	Citation	Description	Action, Contaminant or Location	Applicable / Relevant and Appropriate or To Be Considered
Native American Graves Protection and Repatriation Act	25 USC 3001 et seq. 43 CFR 10	This pertains to the identification and appropriate disposition of human remains, funerary objects, sacred objects, or objects of cultural patrimony found on Federally controlled lands.	Location: Native American Grave sites	Substantive requirements are applicable to on-site actions.
Protection of Floodplains	40 CFR 6.302(b) 40 CFR 6 Appendix A, implementing Executive Order 11988	Requires federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the adverse impacts associated with direct and indirect development of a floodplain.	Location: Floodplains	Substantive requirements are applicable to on-site actions.
Protection of Wetlands	40 CFR 6.302(a) 40 CFR 6 Appendix A, implementing Executive Order 11990	Wetlands protection: Agencies conducting certain activities are required to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to not support construction in wetlands if a practical alternative exists.	Location: Wetlands	Substantive requirements are applicable to on-site actions.

Standard, Limitation, or Requirement Criteria	Citation	Description	Action, Contaminant or Location	Applicable / Relevant and Appropriate or To Be Considered
Action Specific Requirements				
Endangered Species	Idaho Code §36-201	Authorizes the Idaho Department of Fish and Game authority to classify threatened or endangered wildlife and protected non-game species.	Action	Applicable. Any state-identified threatened or endangered species not already Federally identified will be protected to the extent practicable.
Protection of Animals and Birds	Idaho Code §36-1101 to 1103	Prohibits taking of wildlife, birds (including destruction of eggs or nests), and fur-bearing animals except as provided by Idaho Department of Fish and Game hunting regulations.	Action	Substantive requirements are applicable.
Surface Mining	Idaho Code §47-1501 to 1519 and IDAPA 20.03.02.140	Establishes standards and authorizes rules implemented by the Idaho Department of Lands for reclaiming lands affected by surface exploration and mining, including recontouring, erosion control and revegetation. Requires implementation of best management practices that prevent the release of hazardous or deleterious constituents, and protect surface water quality.	Action: Capping, erosion control, regrading, revegetation	Substantive requirements may be relevant and appropriate.
Water Quality Standards: Violation of Water Quality Standards	IDAPA §58.01.02.080	Prohibits discharges that violate water quality standards or injure beneficial uses. Allows the agency to authorize short-term exemptions.	Action	Substantive requirements are applicable.

General Surface Water Quality Criteria	IDAPA §58.01.02.200.04	Establishes water quality criteria for radioactive materials.	Action	Not applicable as radioactive materials are not contaminants of concern for the removal action.
Action and Contaminant Specific Requirements				
Hazardous Substance Emergency Response Act (SERC)	Idaho Code §§39-7101 to 7115	Requires notification of a hazardous substance release. Requires development and implementation of the Hazardous Materials Incident Command Response Plan. Establishes liability for costs arising from a hazardous substance incident.	Action and Contaminant	Relevant and appropriate if any spills occur during the removal action.
Hazardous Waste Management Act of 1983	1993 Session Law Ch. 291, Sections 1-8	Revises the definition of restricted hazardous waste. Deletes exemptions for certain mining wastes. Changes the process for the Board to identify hazardous wastes. Allows release of confidential information to safe guard public health and safety. Changes disposal fees.	Action and Contaminant	Sections pertaining to closure and post-closure care may be relevant and appropriate. (See discussion of RCRA under Federal requirements).
Hazardous Waste Disposal	IDAPA 58.01.05.011	Land disposal requirements.	Action and Contaminant	Not applicable. (See discussion of land disposal restrictions under Federal requirements.).

Hazardous Waste Generation	IDAPA 58.01.05.006	Rules for generators of hazardous waste. Purge water from any ground water sampling should be containerized and labeled as purge water until sampling results are received. Then appropriate disposal pathway can be determined.	Action and Contaminant	No hazardous waste is expected to be generated for this removal action. The requirements will be considered during the development of the ground water monitoring program for the site.
Hazardous Waste Management Act of 1983	Idaho Code §36-4401	Authorizes rules for generation, collection, treatment, storage, disposal, and transport of hazardous waste consistent with RCRA. Requires a permit for treatment, storage, discharge, incineration, release, spilling, placement, or disposal of hazardous wastes. Establishes treatment requirements for certain wastes prior to disposal into or on land. Requires that manifested waste be treated, stored, or disposed of in a permitted facility.	Action and Contaminant	Not applicable. Certain requirements pertaining to closure and post-closure care may be relevant and appropriate for this removal action. (See discussion of TSDs under Federal requirements.)
Idaho Department of Water Resources (IDWR)	Idaho Code §§42-3801-3813 and IDAPA 37.03.07	Requires a permit or compliance with “minimum stand” for alteration of stream channel to protect fish and wildlife habitat, aquatic life, recreation, aesthetic beauty, or water quality. Authorizes the Board to adopt rules to set standards.	Action and Contaminant	Substantive requirements are applicable.

Water Quality Standards	IDAPA §58.01.02	Safeguards the quality of state waters and designates uses, which are to be protected.	Action and Contaminant	Water quality standards, as promulgated by the state, are applicable to the site. This removal action alone is not likely to result in achieving these standards.
Idaho Risk-Based Decision-Making for Remedial Action Guidance	Idaho Department of Environmental Quality, December	Guidance document for risk-based decision-making using human health and transport models.	Action and Contaminant	TBC.
Rules for the Control of Air Pollution in Idaho: Ambient Air Quality	IDAPA §58.01.01.577	Provides regulatory standards for PM 10 and several other air pollutants.	Action and Contaminant	Relevant and Appropriate.
Rules for the Control of Air Pollution in Idaho: Rules for Control of Fugitive Dust	IDAPA §58.01.01.650 -.651	Requires that all reasonable precaution be taken to prevent the generation of fugitive dust.	Action and Contaminant	Applicable. Any state-identified threatened or endangered species not already Federally identified will be protected to the extent practicable.
Action and Location Specific Requirements				
Dredge and Placer Mining (IDL)	Idaho Code §§47-1301 to 1324 and IDAPA 20.03.01.040	Requires reclamation after mining and establishes narrative standards. Prohibits dredge mining on National Wild and Scenic Rivers. Includes specific requirements for restoration of disturbed lands. Authorizes rules.	Action and Location	Not an ARAR - the removal action does not involve the reclamation of dredge or placer mines.
Contaminant Specific Requirements				

Water Pollution Abatement (DEQ)	Idaho Code §§39-3617 to 3621	Provides for designation of Outstanding Resource Waters (ORWs). Prohibits new or modified non-point source activities that lower water quality in ORWs without use of approved ORW BMPs. Allows temporary activities that do not alter uses or character of a stream segment.	Contaminant	Not an ARAR because the removal action will not affect an Outstanding Resource Water.
Water Quality Standards (WQS): Administrative Policy, Protection of Waters of the State	IDAPA §58.01.02.050.02	Protects surface water for beneficial uses.	Contaminant	Water quality standards, as promulgated by the state to protect the beneficial uses, are applicable to the site. This removal action alone is not likely to result in achieving these standards.
WQS: Antidegradation Policy	IDAPA §58.01.02.051	Requires that existing water uses and water quality, high quality water and ORWs be maintained and protected.	Contaminant	Antidegradation requirements are applicable.
WQS: Analytical Procedures	IDAPA §58.01.02.090	Establishes analytical procedures that must be used to determine compliance with water quality standards.	Contaminant	Substantive requirements are applicable for water quality sampling.

WQS: Surface Water Use Classifications	IDAPA §58.01.02.100	Defines specific beneficial use designations for surface water, which in turn determine applicable standards.	Contaminant	Water quality standards, as promulgated by the state to protect the beneficial uses, are applicable to the site. This removal action alone is not likely to result in achieving these standards.
WQS: General Surface Water Use Designations	IDAPA §58.01.02.101	Establishes general surface water use designations for waters not otherwise classified. Cold water aquatic and secondary contact recreational are designated beneficial uses for Maybe and Dry creeks.	Contaminant	Water quality standards, as promulgated by the state to protect the beneficial uses, are applicable to the site. This removal action alone is not likely to result in achieving these standards.
WQS: General Surface Water Quality Criteria	IDAPA §58.01.02.200	Establishes narrative water quality criteria for hazardous, deleterious and radioactive materials; floating, suspended or submerged matter; excess nutrients; oxygen-demanding materials-and sediment.	Contaminant	Substantive requirements are applicable to on-site discharges of point source water (i.e., discharge from dump toe and cap run-off diversion.) The removal action alone will not likely result in compliance with these requirements.

WQS: Surface Water Quality Criteria for Use Classifications	IDAPA §58.01.02.250 to .253	Establishes numerical surface water quality criteria for beneficial use classifications.	Contaminant	Water quality standards, as promulgated by the state to protect the beneficial uses, are applicable to the site. This removal action alone is not likely to result in achieving these standards.
WQS: Variances from Water Quality Standards	IDAPA 58.01.02.260	Establishes procedures and requirements for water quality variance.	Contaminant	Not applicable as no variance is associated with the removal action.
WQS: Site Specific Surface Water Quality Criteria	IDAPA §58.01.02.275	Establishes procedures for developing site specific surface water quality criteria.	Contaminant	Not an ARAR as there are no site specific criteria for Maybe Creek or receiving waters.
Ground Water Quality Rule: Ground Water Quality Standards	IDAPA §58.01.11.200	Protects groundwater for beneficial uses including potable water supplies, establishes use classifications and establishes water quality criteria for ground water.	Contaminant	Substantive requirements are applicable but the removal action alone will not likely result in compliance with these requirements.

Hazardous Waste Identification	IDAPA 58.01.05.005	Identifies characteristic and listed hazardous waste.	Contaminant	RCRA hazardous waste regulations are not applicable - parts of the RCRA regulations may be relevant and appropriate. (See discussion of RCRA action and location-specific requirements under Federal ARARs.).
Hazardous Waste Permits	IDAPA 58.01.05.006 and .012	Rules for hazardous waste permits.	Contaminant	RCRA hazardous waste regulations are not applicable - parts of the RCRA regulations may be relevant and appropriate. (See discussion of RCRA action and location-specific requirements under Federal ARARs.).
Water Pollution Abatement	1995 Session Law Ch. 352, Section 1 §§39-3601 to 39-3639	Repeals I.C § 38-1314 and I.C. §§39-3614 through 39-3621. Creates a new Chapter 36 regarding water quality, which protects surface water quality and establishes an environmental remediation fund.	Contaminant	Relevant and Appropriate.
IDEQ Area Wide Risk Management Plan	Idaho Department of Environmental Quality, February	Guidance document for regional removal action goals and objectives, and action levels.	Contaminant	TBC.

Guidelines for Interpretation of Biological Effects of Selected Constituents in Biota, Water and Sediment	National Irrigation Water Quality Program Information Report No. 3, Nov 1998, DOI	Provides information on selenium effects and thresholds from other historical sites.	Contaminant	TBC .
Public Health Assessment for Southeast Idaho Phosphate Mining Resource Area	Agency for Toxic Substances and Disease Registry (ATSDR), February 24, 2006	Provides information on the effects of phosphate mining releases on human health.	Contaminant	TBC.
Location Specific Requirements				
Designated Uses	IDAPA §58.01.02.150 to 160	Designates uses for specific water bodies by hydrologic basin.	Location	Water quality standards, as promulgated by the state to protect the beneficial uses, are applicable to the site. This removal action alone is not likely to result in achieving these standards.