## Table 1. Special Status Plant and Animal Species Potentially Present at Relief Hill

| Common Name | Scientific Name |
|---|---|
| Threatened Species | |
| Bald eagle | *Haliaeetus leucocephalus* |
| California red-legged frog | *Rana aurora draytonii* |
| Valley elderberry longhorn beetle | *Desmocerus californicus dimorphus* |
| Lahontan cutthroat trout | *Oncorhynchus clarki henshawi* |
| Sensitive Species | |
| American peregrine falcon | *Falco peregrinus anatum* |
| California spotted owl | *Strix occidentalis occidentalis* |
| Great gray owl | *Strix nebulosa* |
| Northern goshawk | *Accipter gentilis* |
| Willow flycatcher | *Empidonax trailii* |
| Greater sandhill crane | *Grus canadensis tabida* |
| Pacific fisher | *Martes pennanti* |
| Marten | *Martes americana* |
| Sierra Nevada red fox | *Vulpes vulpes necator* |
| California wolverine | *Gulo gulo luteus* |
| Pallid bat | *Antrozous pallidus* |
| Townsend's big-eared bat | *Corynorhinus townsendii* |
| Western red bat | *Lasiurus blossevillii* |
| Northwestern pond turtle | *Clemmys marmorata marmorata* |
| **Foothill yellow-legged frog** | ***Rana boylii*** |
| Mountain yellow-legged frog | *Rana muscosa* |
| Northern leopard frog | *Rana pipiens* |
| Great Basin rams-horn snail | *Helisoma newberryi newberryi* |
| Lahontan Lake tui chub | *Gila bicolor pectinifer* |
| Hardhead | *Mylopharodon conocephalus* |
| Candidate Species and Species of Concern | |
| Mount Lyell salamander | *Hydromantes platycephalus* |
| California horned lizard | *Phyronosoma coronatum frontale* |
| Northern sagebrush lizard | *Sceloporus graciosus graciosus* |
| Western spadefoot toad | *Spea hammondii* |
| American dipper | *Cinclus mexicanus* |
| California thrasher | *Toxostoma redivivum* |
| Black swift | *Cypseloides niger* |
| Flammulated owl | *Otus flammeolus* |
| Harlequin duck | *Histrionicus histrionicus* |

## Table 1. Special Status Plant and Animal Species Potentially Present at Relief Hill

| Common Name | Scientific Name |
|---|---|
| Candidate Species and Species of Concern (Continued) | |
| Lewis woodpecker | *Melanerpes lewis* |
| Loggerhead shrike | *Lanius ludovicianus* |
| Long-billed curlew | *Numenius americanus* |
| Oak titmouse | *Baeolophus inornatus* |
| Rufous hummingbird | *Selasphorus rufus* |
| Sage grouse | *Centrocercus urophasianus* |
| White-headed woodpecker | *Picoides albolarvatus* |
| Tricolored blackbird | *Agelaius tricolor* |
| Sierra Nevada showshoe hare | *Lepus americanus tahoensis* |
| Pale Townsend's big-eared bat | *Plecotus townsendii pallescens* |
| Yuma myotis bat | *Myotis yumanensis* |
| Fringed myotis bat | *Myotis thysanodes* |
| Greater western mastiff-bat | *Eumops perotis californicus* |
| Long-eared myotis bat | *Myotis evotis* |
| Long-legged myotis bat | *Myotis volans* |
| Small-footed myotis bat | *Myotis ciliolabrum* |
| Spotted bat | *Euderma maculatum* |
| Amphibious caddisfly | *Desmona bethula* |
| Cold Spring caddisfly | *Lepidostoma ermanae* |
| Lake Tahoe benthic stonefly | *Capnia lacustra* |
| Sagehen Creek goeracean caddisfly | *Goeracea oregona* |
| Shirttail Creek stonefly | *Megaleuctra sierra* |
| Long-tailed caddisfly | *Faula praelonga* |
| Spiny rhyacophilan caddisfly | *Rhyacophila spinata* |
| Green sturgeon | *Acipenser medirostris* |
| Longfin smelt | *Spirinchus thaleichthys* |

Notes:

Source: Forest Service 2004b
Bold text indicates species was reportedly observed at Relief Hill.

**Table 2. Total and Methyl Mercury Concentrations in Samples Collected by the U.S. Geological Survey from 1999 to 2002**

| Station Number/Map ID | Location | Date | Total Mercury Concentration | Methyl Mercury Concentration |
|---|---|---|---|---|
| ***Unfiltered Surface Water*** | | | | |
| 392126120510201/BY93[a] | Relief Hill Deep Blue Tunnel Outflow Near North Bloomfield | 5/20/1999 | 5 ng/L<br>5.5 ng/L | 0.07 ng/L |
| 392111120511301/BY94[b] | Relief Hill Hydraulic Pit Mine Drain Tunnel Outflow Near North Bloomfield | 9/1/1999 | 299 ng/L<br>59 ng/L | <0.025 ng/L |
| 392111120511301/BY94[b] | Relief Hill Hydraulic Pit Mine Drain Tunnel Outflow Near North Bloomfield | 7/30/2002 | 13 ng/L<br>NA | 0.1 ng/L |
| 392119120512201/BY95[c] | Relief Hill Pond Near Relief, California | 7/30/2002 | 0.8 ng/L<br>0.8 ng/L | <0.04 ng/L |
| ***Filtered Surface Water*** | | | | |
| 392126120510201/BY93[a] | Relief Hill Deep Blue Tunnel Outflow Near North Bloomfield | 5/20/1999 | 0.5 ng/L<br>0.7 ng/L | NA |
| 392111120511301/BY94[b] | Relief Hill Hydraulic Pit Mine Drain Tunnel Outflow Near North Bloomfield | 9/1/1999 | 49.2 ng/L<br>68.8 ng/L | NA |
| 392111120511301/BY94[b] | Relief Hill Hydraulic Pit Mine Drain Tunnel Outflow Near North Bloomfield | 7/30/2002 | 2.3 ng/L<br>2.5 ng/L | <0.04 ng/L |
| 392119120512201/BY95[c] | Relief Hill Pond Near Relief, California | 7/30/2002 | <0.1 ng/L<br><0.1 ng/L | <0.04 ng/L |
| ***Sediment*** | | | | |
| 392126120510201/BY93[a] | Relief Hill Deep Blue Tunnel Outflow Near North Bloomfield | 5/20/1999 | NA | 0.0002 mg/kg |
| 392111120511301/BY94[b] | Relief Hill Hydraulic Pit Mine Drain Tunnel Outflow Near North Bloomfield | 9/1/1999 | 0.409 mg/kg | 0.0015 mg/kg |
| 392111120511301/BY94[b] | Relief Hill Hydraulic Pit Mine Drain Tunnel Outflow Near North Bloomfield | 7/30/2002 | 0.02 mg/kg | 0.00031 mg/kg |
| 392119120512201/BY95[c] | Relief Hill Pond Near Relief, California | 7/30/2002 | NA | 0.00031 mg/kg |
| ***Biota*** | | | | |
| Hellgramite | | | | |
| 392111120511301/BY94[b] | Relief Hill Hydraulic Pit Mine Drain Tunnel Outflow Near North Bloomfield | 9/1/1999 | NA | 0.053 mg/kg* |
| Water Strider | | | | |
| 392111120511301/BY94[b] | Relief Hill Hydraulic Pit Mine Drain Tunnel Outflow Near North Bloomfield | 9/1/1999 | NA | 0.094 mg/kg* |
| 392119120512201/BY95[c] | Relief Hill Pond Near Relief, California | 9/1/1999 | 0.048 mg/kg* | 0.047 mg/kg* |

Notes: Sources: Science Applications International Corporation 2004; U.S. Geological Survey unpublished data
Gray shading indicates highest concentration of this constituent for this sample media

a Location is is believed to be the feature referred to as the Waukesha south outlet in Tetra Tech's investigation
b Location is is believed to be the feature referred to as the Cliff tunnel outlet in Tetra Tech's investigation
c Location is is believed to be the feature referred to as the Cliff tunnel inlet No. 5 and No. 6 in Tetra Tech's investigation
* Wet weight
ID Identification
mg/kg Milligram per kilogram
NA Not analyzed
ng/L Nanogram per liter

**Table 3. Total Mercury Concentrations in Historical Samples Collected by Science Applications International Corporation in September 2003**

| Sample ID | Location | Date | Total Mercury Concentration |
|---|---|---|---|
| | ***Surface Water*** | | |
| R-PA/SI-1-SW | Background - Logan Canyon | 9/11/2003 | <0.20 µg/L |
| R-PA/SI-5-SW | Waukesha Drainage Tunnel Outlet | 9/11/2003 | <0.20 µg/L |
| R-PA/SI-8-SW | Large Pit Lake | 9/11/2003 | <0.20 µg/L |
| R-PA/SI-9-SW | Cliff Tunnel Drainage Outlet | 9/11/2003 | <0.20 µg/L |
| R-PA/SI-10-SW | Union Canyon Drainage Tunnel Outlet | 9/11/2003 | <0.20 µg/L |
| R-PA/SI-12-SW | Union Canyon at intersection with South Yuba Trail (near confluence with South Yuba River) | 9/8/2003 | <0.20 µg/L |
| R-PA/SI-14-SW | Logan Canyon at interstction with South Yuba Trail (near confluence with South Yuba River) | 9/8/2003 | <0.20 µg/L |
| | ***Sediment*** | | |
| R-PA/SI-1-SED | Background - Logan Canyon | 9/11/2003 | <0.10 mg/kg |
| R-PA/SI-3-SED | Waukesha Drainage Tunnel Intlet | 9/11/2003 | <0.10 mg/kg |
| R-PA/SI-5-SED | Waukesha Drainage Tunnel Outlet | 9/11/2003 | <0.10 mg/kg |
| R-PA/SI-6-SED | Cliff Tunnel Inlet | 9/11/2003 | <0.10 mg/kg |
| R-PA/SI-8-SED | Large Pit Lake | 9/11/2003 | <0.10 mg/kg |
| R-PA/SI-9-SED | Cliff Tunnel Drainage Outlet | 9/11/2003 | 0.1 mg/kg |
| R-PA/SI-10-SED | Union Canyon Drainage Tunnel Outlet | 9/11/2003 | <0.10 mg/kg |
| R-PA/SI-12-SED | Union Canyon at intersection with South Yuba Trail (near confluence with South Yuba River) | 9/8/2003 | <0.10 mg/kg |
| R-PA/SI-13-SED | Central Drainage at intersection with South Yuba Trail (near confluence with South Yuba River) | 9/8/2003 | <0.10 mg/kg |
| R-PA/SI-14-SED | Logan Canyon at intersection with South Yuba Trail (near confluence with South Yuba River) | 9/8/2003 | <0.10 mg/kg |

Notes: Source: Science Applications International Corporation 2004
Gray shading indicates highest concentration of this constituent for this sample media
µg/L Microgram per liter
ID Identification
mg/kg Milligram per kilogram
PA/SI Preliminary assessment/site inspection

The leader for sample IDs on Figures 2 and 3 was truncated for readability. "120611" was omitted from Tetra Tech sample IDs and "R-PA/" was omitted from Science Applications International Corporation sample IDs.

## Table 4. Estimated Ground Sluice Dimensions

| Sluice System | Depth (ft) | Width (ft) | Length (ft) | Volume ($ft^3$) | Volume ($yd^3$) |
|---|---|---|---|---|---|
| Cliff | 6 | 12 | 2,963 | 213,336 | 7,901 |
| New | 5 | 12 | 3,675 | 220,500 | 8,167 |
| Middle | 5 | 12 | 4,251 | 255,060 | 9,447 |
| Waukesha | 6 | 12 | 8,160 | 587,520 | 21,760 |
| Union | 2.5 | 12 | 1,688 | 50,640 | 1,876 |
| Total Relief Hill | | | 20,737 | 1,327,056 | 49,150 |
| Total Relief Hill (Cubic Yards) | | | | 49,150 | 1,820 |

Notes: Sluice system locations are shown on Figure 3.

ft Foot

$ft^3$ Cubic foot

$yd^3$ Cubic yard

Sluice depths are estimated based on results of subsurface sample collection and sluice profiling. The original sluice surface was only encountered in one sample location within the Union sluice system; depths in the table reflect the minimum sluice sediment thickness. Actual sediment thickness (and therefore, total sediment volume) may be significantly greater than values listed in the table.

**Table 5. Results of Water Sampling in October 2004 and March 2005**

| | Sample Identification | Location | Date | Time | Total Mercury (ng/L)[a] | Methyl Mercury (ng/L)[b] | Dissolved Mercury (ng/L)[c] | TSS (mg/L) | Temp. (°C) | pH | SC (µS/cm) | Eh (mV) | DO (mg/L) | Flow (gpm) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Undisturbed Sampling Event | 120611W02U | Cliff Tunnel Inlet No.6 (lagoon) | 10/7/2004 | 12:00 | 78.0 | 0.041 | NA | 150 | NR | 3.9 | 5.8 | 242 | 5.03 | 0 | Standing water (groundwater) about 6 inches bgs. |
| | 120611W03U | Waukesha Inlet Pond | 10/6/2004 | 16:50 | 18.9 | 0.704 | NA | 18 | 19.8 | 7.2 | 23 | 128 | 7.5 | 0 | Ponded water. |
| | 120611W05U | Cliff Tunnel Outlet | 10/5/2004 | 17:45 | 21.1 | <0.025 | NA | <10* | 13.3 | 3.2 | 654 | 479 | 8.2 | 0 | Standing water in pools and just below sediment surface. |
| | 120611W06U | Union Tunnel Outlet | 10/6/2004 | 11:30 | 6.80 | 0.031 | NA | <10 | 12 | 6.78 | 326 | 112 | 8.7 | 1.5 gpm | Flowing water. |
| | 120611W20U | (Field Duplicate) | 10/6/2004 | 12:30 | 7.93 | <0.025 | NA | NA | NA | NA | NA | NA | NA | | |
| | 120611W07U | Waukesha South Outlet | 10/5/2004 | 12:20 | 12.3 | <0.025 | NA | <10* | 12.5 | 5.6 | 871 | 124 | 8.6 | 2-4 gpm | Flowing water. |
| | 120611W08U | New Tunnel North Outlet | 10/5/2004 | 14:30 | 4.21 | 0.031 | NA | <10* | 12.4 | 1.86 | 1,609 | 632 | 8.83 | 0 | Standing water in pools and just below sediment surface. |
| | 120611FB | Field Blank | 10/6/2004 | 15:15 | <0.15 | <0.025 | NA | NA | NA | NA | NA | NA | NA | NA | Nanopure water poured into sample container. |
| | 120611ER | Equipment Rinsate | 10/6/2004 | 15:15 | <0.15 | <0.025 | NA | NA | NA | NA | NA | NA | NA | NA | Nanopure water poured over a new sediment sample scoop and into a sample container. |
| Disturbed Sampling Event | 120611W01D | Cliff Tunnel Inlet No.7 (wetland) | 3/24/2005 | 11:50 | 13.9 | 0.081 | 250** | 5 | 7.6 | 6.5 | 56 | 148 | 10.8 | 0 | Plugged inlet, sluice contains vegetation in upper, shallow reaches. CTI- 7 sluices are flooded. Water had risen up to notch in bedrock and is flowing toward CTI-6. |
| | 120611W20D | (Field Duplicate) | 3/24/2005 | 11:50 | 13.8 | 0.070 | 960** | <5 | NA | NA | NA | NA | NA | | |
| | 120611W02D | Cliff Tunnel Inlet No.8 (alternate location) | 3/24/2005 | 14:10 | 7.05 | <0.025 | 680** | <5 | 7.8 | 5.03 | 9 | 279 | 10.3 | 0 | Sample collected due to access concerns at CTI-6 and water at CTI-6U is same as CTI-6. Water sample only collected at end of the sluice near the high wall. No flow measurement. |
| | 120611W05D | Cliff Tunnel Outlet | 3/25/2005 | 12:00 | 9.17 | 0.048 | <200 | <5 | 10.9 | 5.2 | 94 | 223 | 11.1 | 80-100 | Tunnel outlet. |
| | 120611W06D | Union Tunnel Outlet | 3/25/2005 | 13:55 | 7.09 | 0.051 | <200 | 10 | 8.7 | 6.2 | 118 | 217 | 10.9 | 1,484 | Sample collected from 5-inch pool just down stream of tunnel outlet. |
| | 120611W07D | Waukesha South Outlet | 3/24/2005 | 16:45 | 413 | 0.21 | <200 | 510 | 4.3 | 5.95 | 76 | 266 | 12 | 1,123 | Outlet partially blocked by slide. Water discharging from top and bottom of slide. Most discharge is from pool below falls. Water at outlet is turbid, similar to inlet (WTI-3). |
| | 120611W08D | New Tunnel North Outlet | 3/23/2005 | 16:15 | 14.5 | 0.048 | <200 | <5 | 3.5 | 3.17 | 140 | 488 | 10.7 | 449 | none |
| | 120611W09D | Middle Tunnel Inlet No.1 | 3/24/2005 | 15:00 | 63.7 | 0.039 | 430** | <5 | 7.0 | 4.45 | 30 | 311 | 11.1 | 0 | Plugged inlet. Very fine, dry sediment. No vegetation. Inlet is plugged. Water is standing and blue/green. Water has flooded lower portions of sluices. Sample location is vertically above undisturbed sample location. |
| | 120611W10D | New Tunnel North Inlet | 3/23/2005 | 15:30 | 16.7 | 0.076 | <200 | <5 | 3.3 | 3.33 | 93 | 501 | 11.5 | 239 | Open inlet to vertical shaft. Coarse, dry slate sediment. No vegetation. Steady flow of 3-inch depth into inlet. |
| | 120611W17D | New Tunnel South Inlet | 3/24/2005 | 14:45 | 4.70 | <0.025 | <200 | <5 | 7.9 | 3.95 | 131 | 338 | 9.9 | 0 | Plugged inlet. Very fine, dry sediment. No vegetation. Inlet is plugged, water is standing and clear. Water does not extend up sluices so tunnel inlet must have a slow leak. |
| | 120611W19D | Waukesha South Inlet No.4 | 3/24/2005 | 16:50 | 1,880 | 0.288 | 200 | 2,200 | 3.4 | 5.3 | 41 | 288 | 10.8 | 265 | Plugged inlet. Fine to medium, dry sediment. Vegetation. Shallow extremely turbid flow into inlet potentially originating from land slide above drift mine entrance. |
| | 120611W21D | Union Pond Outlet | 3/25/2005 | 14:25 | 3.58 | 0.062 | <200 | <5 | 9.0 | 6.8 | 118 | 221 | 10.3 | 1,926 | Fine to very fine, wet sediment. Sediment is approximately 6 inches deep of white sandy silt with some quartz underlaid by black organic matter mostly decaying leaves. Standing water in large wetland area just upstream of the tunnel inlet. Vegetated. |

**Table 5. Results of Water Sampling in October 2004 and March 2005**

| | Sample Identification | Location | Date | Time | Total Mercury (ng/L)[a] | Methyl Mercury (ng/L)[b] | Dissolved Mercury (ng/L)[c] | TSS (mg/L) | Temp. (°C) | pH | SC (µS/cm) | Eh (mV) | DO (mg/L) | Flow (gpm) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Disturbed Sampling Event (continued) | 120611W22D | Cliff Tunnel Inlet No.6 (upper wetland area) | 3/24/2005 | 12:10 | 5.02 | <0.025 | 1,600** | 10 | 7.6 | 4.6 | 65 | 208 | 10.6 | 0 | Plugged inlet. No vegetation or detritus. Coarse, wet slate sediment. CTI 6U wetland and lower sluices are flooded. Water has risen to notch and spilled into CTI 6. Sample collected at east end of wetland just before notch. |
| | 120611W23D | Middle Tunnel North Inlet No.2 | 3/24/2005 | 16:15 | 3.24 | <0.025 | 4,100** | <5 | 5.2 | 4.1 | 101 | 304 | 9.1 | 15-20 | Inlet is partially blocked. Water is standing in sluices. Flow at other side in collapsed area between MTI-N3 and MTI-N4. Water is clear. |
| | 120611W24D | Middle Tunnel North Inlet No.5 | 3/24/2005 | 15:15 | 269 | 0.318 | 2,400** | <5 | 5.0 | 5.22 | 14 | 246 | 10.7 | 0 | Inlet is plugged and water is pooled. Lower portion of sluices are flooded. Water is green/brown. |
| | 120611W25D | Waukesha Tunnel Inlet No.3 | 3/23/2005 | 15:00 | 32.6 | <0.025 | <200 | 47 | 4.4 | 6.58 | 39 | 198 | 11.4 | 1,397 | Open inlets feeding into a central shaft. Steady stream flowing into inlet 1.4 feet wide and 4 inches deep. |
| | 120611FB01D | Field Blank | 3/25/2005 | 13:15 | <0.15 | <0.025 | NA | NA | NA | NA | NA | NA | NA | NA | Nanopure water poured into sample container. |
| | 120611ER01D | Equipment Rinsate | 3/25/2005 | 13:20 | <0.15 | <0.025 | NA | NA | NA | NA | NA | NA | NA | NA | Nanopure water poured over a new sediment sample scoop and into a sample container. |

Notes:

Gray shading indicates highest concentration (or lowest pH) of this constituent in real samples for this sampling event

a Analyzed by Frontier GeoSciences, Inc. standard operating procedure 069.
b Analyzed by Frontier GeoSciences, Inc. standard operating procedure 070.
c Analyzed by SW-846 Method 7470.
* Sample was analyzed beyond the EPA recommended holding time.
** Results of dissolved mercury analysis are higher than results of total mercury analysis. This issue is discussed in the Disturbed Event under Section 3.3.3 Surface Water Sampling.
*** Calculated flow rates appear to be high due to bias in the velocity meter. Visual flow rate estimates are provided in parentheses.
< Less than
°C Degree Celsius
µS/cm MicroSiemen per centimeter
bgs Below ground surface
DO Dissolved oxygen
EPA U.S. Environmental Protection Agency
gpm Gallon per minute
mg/L Milligram per liter
mV Millivolt
NA Not analyzed
ng/L Nanogram per liter
Eh Oxidation-reduction potential
SC Specific Conductance
Temp. Temperature
TSS Total suspended solids

The leader for sample identifcations (ID) on Figures 2 and 3 was truncated for readability. "120611" was omitted from Tetra Tech EM Inc. sample IDs and "R-PA/" was omitted from Science Applications International Corporation sample IDs.

**Table 6. Results of Solid Matrix Sampling in October 2004 and March 2005**

| | Sample ID | Location | Date | Time | Low-level Total Mercury (mg/kg)[a] | Low-level Methyl Mercury (mg/kg)[b] | Total Mercury (mg/kg)[c] | Sample Depth (inches) | Comments |
|---|---|---|---|---|---|---|---|---|---|
| Undisturbed Sampling Event | 120611S01U | Cliff Tunnel Inlet No.7 (western sluice) | 10/7/2004 | 10:45 | 0.0692 | <0.00002 | 0.066 | 36 | Plugged inlet, sluice contains vegetation in upper, shallow reaches. Fine, dry sediment. |
| | 120611S02U | Cliff Tunnel Inlet No.6 (lagoon) | 10/7/2004 | 12:00 | 0.0631 | <0.00002 | 0.060 | 36 | Plugged inlet. No vegetation or detritus. Coarse, wet slate sediment. |
| | 120611S03U | Waukesha Inlet Pond | 10/6/2004 | 17:00 | 0.179 | 0.000779 | NA | Surface | Plugged inlet. Ponded water. Very fine sediments. No vegetation in pond. Vegetation in upstream sluice. Some detritus in sediment. |
| | 120611S04U | Waukesha Inlet No. 1, 2, 3 (composite) | 10/7/2004 | 16:45 | 0.0191 | <0.00002 | 0.024 | 66 | Open inlets feeding into a central shaft. No standing water. Fine to medium, dry sediment over coarse slate. |
| | 120611S05U | Cliff Tunnel Outlet | 10/5/2004 | 18:00 | 0.0243 | <0.00002 | 0.089 | 6 | Open outlet. Fine to medium, wet sediment. No flow. |
| | 120611S06U | Union Tunnel Outlet | 10/6/2004 | 11:45 | 0.221 | 0.000232 | 0.063 | Surface | Open outlet. Tunnel filled about 2/3 full of sediment. Roof collapse just upstream from portal. Sediments are fine to coarse. |
| | 120611S20U | (Field Duplicate) | 10/6/2004 | 11:45 | 0.263 | 0.000674 | NA | | |
| | 120611S07U | Waukesha South Outlet | 10/5/2004 | 12:20 | 0.0169 | 0.000024 | 0.029 | 6 | Collapsed outlet. Flowing water. Fine sediment. No vegetation. Some detritus. |
| | 120611S08U | New Tunnel North Outlet | 10/5/2004 | 14:45 | 0.0471 | <0.00002 | 0.081 | 24 | Open outlet. No flow. Wet sediments. Fine to medium sediments over coarse slate. |
| | 120611S09U | Middle Tunnel Inlet No.1 | 10/7/2004 | 16:55 | 1.92 | 0.000108 | 5.9 | 60 | Plugged inlet. Very fine, dry sediment. No vegetation. |
| | 120611S10U | New Tunnel North Inlet | 10/7/2004 | 17:10 | 0.132 | <0.00002 | 0.11 | 36 | Open inlet to vertical shaft. Coarse, dry slate sediment. No vegetation. |
| | 120611S17U | New Tunnel South Inlet | 10/7/2004 | 18:00 | 0.0738 | <0.00002 | 0.079 | 36 | Plugged inlet. Very fine, dry sediment. No vegetation. |
| | 120611S18U | Union Sluice | 10/6/2004 | 14:00 | NA | NA | 0.011 J | 24 | Medium to coarse, wet sand. Gleying in overlying fines. |
| | 120611S19U | Waukesha South Inlet No.4 | 10/8/2004 | 10:20 | 0.0697 | <0.00002 | 0.078 | 36 | Plugged inlet. Fine to medium, dry sediment. Vegetation. |
| | 120611S21U | Union Pond Outlet | 10/6/2004 | 14:30 | NA | NA | 0.012 J | Surface | Fine to very fine, wet sediment. Black with lots of detritus. Standing water in large wetland area just upstream of the tunnel inlet. Vegetated. |
| | 120611S23U | Middle Tunnel North Inlet No.2 | 10/8/2004 | 12:00 | 0.0449 | <0.00002 | 0.031 | 36 | Partially plugged inlet. Fine to very fine, dry sediments. No vegetation. |
| Disturbed Sampling Event | 120611S01D | Cliff Tunnel Inlet No.7 (western sluice) | 3/24/2005 | 11:50 | 0.107 | 0.000836 | NA | Surface | Plugged inlet, sluice contains vegetation in upper, shallow reaches. Cliff Tunnel Inlet No.7 sluices are flooded. Water had risen up to notch in bedrock and is flowing toward Cliff Tunnel Inlet No.6. |
| | 120611S20D | (Field Duplicate) | 3/24/2005 | 11:50 | 0.0827 | 0.00041 | NA | | |
| | 120611S09D | Middle Tunnel Inlet No.1 | 3/24/2005 | 15:00 | 0.579 | 0.000122 | NA | Surface | Plugged inlet. Very fine, dry sediment. No vegetation. Inlet is plugged. Water is standing and blue/green. Water has flooded lower portions of sluices. Sample location is vertically above undisturbed sample location. |
| | 120611S10D | New Tunnel North Inlet | 3/23/2005 | 15:30 | 0.0185 | <0.00002 | NA | 3 | Open inlet to vertical shaft. Coarse, dry slate sediment. No vegetation. Steady flow of 3-inch depth into inlet. |
| | 120611S17D | New Tunnel South Inlet | 3/24/2005 | 14:45 | 0.00779 | <0.000028 | NA | Surface | Plugged inlet. Very fine, dry sediment. No vegetation. Inlet is plugged, water is standing and clear. Water does not extend up sluices so tunnel inlet must have a slow leak. |
| | 120611S19D | Waukesha South Inlet No.4 | 3/23/2005 | 16:50 | 0.102 | 0.000538 | NA | 3 | Plugged inlet. Fine to medium, dry sediment. Vegetation. Shallow extremely turbid flow into inlet potentially originating from land slide above drift mine entrance. |
| | 120611S21D | Union Pond Outlet | 3/25/2005 | 14:25 | 0.00605 | <0.000025 | NA | 4 | Fine to very fine, wet sediment. Sediment is approxiamtely 6 inches deep of white sandy silt with some quartz underlaid by black organic matter mostly decaying leaves. Standing water in large wetland area just upstream of the tunnel inlet. Vegetated. |
| | 120611S22D | Cliff Tunnel Inlet No.6 (upper wetland area) | 3/24/2005 | 12:10 | 0.00259 | <0.000028 | NA | Surface | Plugged inlet. No vegetation or detritus. Coarse, wet slate sediment. Cliff Tunnel Inlet No.6U wetland and lower sluices are flooded. Water has risen to notch and spilled into Cliff Tunnel Inlet No.6. Sample collected at east end of wetland just before notch. |
| | 120611S25D | Waukesha Tunnel Inlet No.3 | 3/23/2005 | 15:00 | 0.0181 | 0.000041 | NA | 4 | Open inlets feeding into a central shaft. Steady stream flowing into inlet 1.4 feet wide and 4 inches deep. |

Notes: All sample results are by dry weight.
*Italics* font indicates sample was analyzed by Method 7471 (not low-level).
Gray shading indicates highest concentration (or lowest pH) of this constituent in real samples for this sampling event.

a Analyzed by Frontier GeoSciences, Inc. standard operating procedure 069.
b Analyzed by Frontier GeoSciences, Inc. standard operating procedure 070.
c Analyzed by SW-846 Method 7471.

ID Identification
< Less than
J Value is less than the reporting limit.
mg/kg Milligram per kilogram
NA Not analyzed

**Table 6. Results of Solid Matrix Sampling in October 2004 and March 2005**

The leader for sample IDs on Figures 2 and 3 was truncated for readability. "120611" was omitted from Tetra Tech EM Inc. sample IDs and "R-PA/" was omitted from Science Applications International Corporation sample IDs.

**Table 7. Total and Methyl Mercury Concentrations in Water Samples Collected from 1999 to 2005**

| Sample ID | Location | Total Mercury Concentration (ng/L) | Methyl Mercury Concentration (ng/L) |
|---|---|---|---|
| ***Tetra Tech EM Inc. "Undisturbed" EE/CA Sampling Event*** | | | |
| **120611W02U** | **Cliff Tunnel Inlet No.6 (lagoon)** | **78** | 0.041 |
| 120611W03U | Waukesha Inlet Pond | 18.9 | 0.704 |
| 120611W05U | Cliff Tunnel Outlet | 21.1 | <0.025 |
| 120611W06U | Union Tunnel Outlet | 6.80 | 0.031 |
| 120611W07U | Waukesha South Outlet | 12.3 | <0.025 |
| 120611W08U | New Tunnel North Outlet | 4.21 | 0.031 |
| ***Tetra Tech EM Inc. "Disturbed" EE/CA Sampling Event*** | | | |
| 120611W01D | Cliff Tunnel Inlet No.7 (wetland) | 13.9 | 0.081 |
| 120611W02D | Cliff Tunnel Inlet No.8 (alternate location) | 7.05 | <0.025 |
| 120611W05D | Cliff Tunnel Outlet | 9.17 | 0.048 |
| 120611W06D | Union Tunnel Outlet | 7.09 | 0.051 |
| **120611W07D** | **Waukesha South Outlet** | **413** | 0.21 |
| 120611W08D | New Tunnel North Outlet | 14.5 | 0.048 |
| **120611W09D** | **Middle Tunnel Inlet No.1** | **63.7** | 0.039 |
| 120611W10D | New Tunnel North Inlet | 16.7 | 0.076 |
| 120611W17D | New Tunnel South Inlet | 4.7 | <0.025 |
| **120611W19D** | **Waukesha South Inlet No.4** | **1,880** | 0.288 |
| 120611W21D | Union Tunnel Inlet (aka Union Pond Outlet) | 3.58 | 0.062 |
| 120611W22D | Cliff Tunnel Inlet No.6 (upper wetland area) | 5.02 | <0.025 |
| 120611W23D | Middle Tunnel North Inlet No.2 | 3.24 | <0.025 |
| **120611W24D** | **Middle Tunnel North Inlet No.5** | **269** | 0.318 |
| 120611W25D | Waukesha Tunnel Inlet No.3 | 32.6 | <0.025 |
| ***U.S. Geological Survey Data*** | | | |
| 392126120510201 (BY93) | Waukesha South Outlet | 5.5 | 0.07 |
| **392111120511301 (BY94)** | **Cliff Tunnel Outlet (September 1, 1999)** | **299** | <0.025 |
| 392111120511301 (BY94) | Cliff Tunnel Outlet (July 30, 2002) | 13 | 0.1 |
| 392119120512201 (BY95) | Pit Pond at the Cliff Tunnel Inlet | 0.80 | <0.04 |
| Mine tunnels in the Greenhorn Creek Watershed (16 total mercury samples; 14 methyl mercury samples) | 90 percent concentration | 50,000 | 5 |
| | 75 percent concentration | 2,000 | 0.8 |
| | 50 percent concentration | 80 | 0.13 |
| | 25 percent concentration | 7 | 0.02 |
| | 10 percent concentration | 4 | NR |
| Ground sluices in the Greenhorn Creek Watershed (7 samples) | 90 percent concentration | 180,000 | NR |
| | 75 percent concentration | 30 | 0.3 |
| | 50 percent concentration | 9 | 0.1 |
| | 25 percent concentration | 5 | 0.02 |
| | 10 percent concentration | 0.8 | NR |
| Pit lakes, ponds, or wetlands in the Greenhorn Creek Watershed (6 total mercury samples; 5 methyl mercury samples) | 90 percent concentration | 200 | NR |
| | 75 percent concentration | 30 | 0.37 |
| | 50 percent concentration | 6 | 0.05 |
| | 25 percent concentration | 4 | 0.03 |
| | 10 percent concentration | 2 | NR |

**Table 7. Total and Methyl Mercury Concentrations in Water Samples Collected from 1999 to 2005**

| Sample ID | Location | Total Mercury Concentration (ng/L) | Methyl Mercury Concentration (ng/L) |
|---|---|---|---|
| ***U.S. Geological Survey Data (Continued)*** | | | |
| Streams in the Greenhorn Creek Watershed (16 total mercury samples; 14 methyl mercury samples) | 90 percent concentration | 250 | 0.14 |
| | 75 percent concentration | 30 | 0.08 |
| | 50 percent concentration | 5 | 0.05 |
| | 25 percent concentration | 4 | 0.02 |
| | 10 percent concentration | 2 | NR |
| Median concentration in Greenhorn Creek Watershed (44 total mercury samples; 40 | | 9.6 | 0.07 |
| ***Screening Levels*** | | | |
| EPA Maximum Contaminant Level | | 2,000 | NP |
| California Public Health Goal in Drinking Water | | 1,200 | NP |
| **EPA National Recommended Ambient Water Quality Criteria for Freshwater Aquatic Life Protection, Continuous Concentration (4-day average)** | | **770*** | NP |
| **California Toxics Rule Criteria for Inland Surface Waters, Human Health** | | **50**** | NP |
| EPA Preliminary Rediation Goal for tap water | | 11,000 | 3,600 |

Notes: Sources: Science Applications International Corporation 2004; Alpers and others 2005; U.S. Geological Survey (USGS) unpublished data

**Bold** font indicates analyte in real sample exceeds one or more criteria (criteria exceeded also noted in bold).
Gray shading indicates highest concentration of this constituent measured at Relief Hill

| | |
|---|---|
| * | Expressed as dissolved mercury |
| ** | Primary screening criteria used for this document. |
| < | Less than |
| aka | = Also known as |
| EE/CA | Engineering evaluation/cost analysis |
| EPA | U.S. Environmental Protection Agency |
| ID | Identification |
| ng/L | Nanogram per liter |
| NP | Not promulgated |
| NR | Not reported |

The leader for sample IDs on Figures 2 and 3 was truncated for readability. "120611" was omitted from Tetra Tech sample IDs and "R-PA/" was omitted from Science Applications International Corporation sample IDs.

**Table 8. Total and Methyl Mercury Concentrations in Solid Matrix Samples Collected from 1999 to 2005**

| Sample ID | Description | Total Mercury Concentration (mg/kg) | Methyl Mercury Concentration (mg/kg) |
|---|---|---|---|
| ***Tetra Tech EM Inc. "Undisturbed" EE/CA Sampling Event*** | | | |
| 120611S01U | Cliff Tunnel Inlet No.7 (western sluice) | 0.0692 / *0.066* | <0.00002 |
| 120611S02U | Cliff Tunnel Inlet No.6 (lagoon) | 0.0631 / *0.06* | <0.00002 |
| **120611S03U** | **Waukesha Inlet Pond** | **0.179** | 0.000779 |
| 120611S04U | Waukesha Inlet No. 1, 2, 3 (composite) | 0.0191 / *0.024* | <0.00002 |
| 120611S05U | Cliff Tunnel Outlet | 0.0243 / *0.089* | <0.00002 |
| **120611S06U** | **Union Tunnel Outlet** | **0.221 / 0.063** | 0.000232 |
| 120611S07U | Waukesha South Outlet | 0.0169 / *0.029* | 0.000024 |
| 120611S08U | New Tunnel North Outlet | 0.0471 / *0.081* | <0.00002 |
| **120611S09U** | **Middle Tunnel Inlet No.1** | **1.92 / *5.9*** | 0.000108 |
| 120611S10U | New Tunnel North Inlet | 0.132 / *0.11* | <0.00002 |
| 120611S17U | New Tunnel South Inlet | 0.0738 / *0.079* | <0.00002 |
| 120611S18U | Union Sluice | 0.011 J | NA |
| 120611S19U | Waukesha South Inlet No.4 | 0.0697 / *0.078* | <0.00002 |
| 120611S21U | Union Pond Outlet | 0.012 J | NA |
| 120611S23U | Middle Tunnel North Inlet No.2 | 0.0449 / *0.031* | <0.00002 |
| ***Tetra Tech EM Inc. "Disturbed" EE/CA Sampling Event*** | | | |
| 120611S01D | Cliff Tunnel Inlet No.7 (western sluice) | 0.107 | 0.000836 |
| **120611S09D** | **Middle Tunnel Inlet No.1** | **0.579** | 0.000122 |
| 120611S10D | New Tunnel North Inlet | 0.0185 | <0.00002 |
| 120611S17D | New Tunnel South Inlet | 0.00779 | <0.000028 |
| 120611S19D | Waukesha South Inlet No.4 | 0.102 | 0.000538 |
| 120611S21D | Union Pond Outlet | 0.00605 | <0.000025 |
| 120611S22D | Cliff Tunnel Inlet No.6 (upper wetland area) | 0.00259 | <0.000028 |
| 120611S25D | Waukesha Tunnel Inlet No.3 | 0.0181 | 0.000041 |
| ***Science Applications International Corporation PA/SI Sampling (Detected results only)*** | | | |
| R-PA/SI-9-SED | Cliff Drainage Tunnel Outlet | 0.10 | NA |
| ***U.S. Geological Survey Data*** | | | |
| 392126120510201 (BY93) | Waukesha South Outlet | NA | 0.0002 |
| **392111120511301 (BY94)** | **Cliff Tunnel Outlet (September 1, 1999)** | **0.409** | 0.0015 |
| 392111120511301 (BY94) | Cliff Tunnel Outlet (July 30, 2002) | 0.02 | 0.00031 |
| 392119120512201 (BY95) | Pit Pond at the Cliff Tunnel Inlet | NA | 0.00031 |
| Sediment from the Greenhorn Creek Watershed by field panning method (14 samples) | 90 percent concentration | 20,000 | NA |
| | 75 percent concentration | 15,000 | NA |
| | 50 percent concentration | 1,500 | NA |
| | 25 percent concentration | 1,000 | NA |
| | 10 percent concentration | 400 | NA |
| Sediment from the Greenhorn Creek Watershed by lab methods (10 total mercury samples; 9 methyl mercury samples) | 90 percent concentration | 10,000 | 0.009 |
| | 75 percent concentration | 11 | 0.005 |
| | 50 percent concentration | 0.18 | 0.0007 |
| | 25 percent concentration | 0.007 | 0.00004 |
| | 10 percent concentration | 0.005 | 0.00001 |

**Table 8. Total and Methyl Mercury Concentrations in Solid Matrix Samples Collected from 1999 to 2005**

| Sample ID | | Description | Total Mercury Concentration (mg/kg) | Methyl Mercury Concentration (mg/kg) |
|---|---|---|---|---|
| ***Screening Levels*** | | | | |
| Concentrations in California background soils[a] | | Minimum | 0.10 | NR |
| | | Maximum | 0.90 | NR |
| | | Average | 0.26 | NR |
| Human Health Screening Benchmarks | EPA Preliminary Remediation Goal (Industrial)[b] | | 310 | NP |
| | BLM Risk Management Criteria[c] | Camper | 40 | NP |
| | | Human Worker | 60 | NP |
| | | Surveyor | 480 | NP |
| | | ATV Driver | 550 | NP |
| Ecological Screening Benchmarks | **EPA Ecotox Threshold[d]** | | **0.15** | NP |
| | **BLM Risk Management Criteria[c]** | **Robin** | **1** | NP |
| | | Cotton Tail | 15 | NP |
| | | Mule Deer | 9 | NP |
| | | **Mallard** | **4** | NP |

Notes: Sources: Science Applications International Corporation 2004; Alpers and others 2005; U.S. Geological Survey (USGS) unpublished data

**Bold** font indicates analyte in real sample exceeds one or more criteria (criteria exceeded also noted in bold).
*Italics* font indicates sample was analyzed by method 7471 (not low-level)
Gray shading indicates highest concentration of this constituent measured at Relief Hill

[a] Source: Bradford and others 1996
[b] Source: Smucker 2004
[c] Source: Ford 1996
[d] Source: EPA 1996

ATV All terrain vehicle
BLM U.S. Department of the Interior, Bureau of Land Management
EE/CA Engineering evaluation/cost analysis
EPA U.S. Environmental Protection Agency
ID Identification
mg/kg Milligram per kilogram
NA Not analyzed
NP Not promulgated
NR Not reported
PA/SI Preliminary assessment/site inspection

The leader for sample IDs on Figures 2 and 3 was truncated for readability. "120611" was omitted from Tetra Tech sample IDs and "R-PA/" was omitted from Science Applications International Corporation sample IDs.

## Table 9. Total and Methyl Mercury Concentrations in Invertebrate Samples Collected from 1999 to 2002

| Common Name | Sample Location | Date | Live Weight (gram) | Moisture (Percent) | Total Mercury (mg/kg) | Methyl Mercury (mg/kg) |
|---|---|---|---|---|---|---|
| Hellgrammite | **Cliff Tunnel Outlet (BY94)** | **9/1/1999** | **0.86** | **80.3** | **NA** | **0.053** |
| | Background South Yuba River (BY117)[a] | 9/30/1999 | 0.99 | 78.4 | NA | 0.031 |
| | Background Bear River (BY199)[b] | 9/12/2000 | 1.52 | 74.9 | 0.035 | 0.038 |
| | Background Bear River (BY199)[b] | 9/15/2001 | 0.61 | 79.6 | 0.041 | 0.040 |
| | Background Bear River (BY199)[b] | 9/15/2001 | 3.48 | 75.7 | 0.040 | 0.029 |
| Water Strider | **Cliff Tunnel Outlet (BY94)** | **9/1/1999** | **0.6** | **58.3** | **NA** | **0.094** |
| | **Pit Pond at the Cliff Tunnel Inlet (BY95)** | **9/1/1999** | **1.85** | **55.3** | **0.048** | **0.047** |
| | Background South Yuba River (BY117)[a] | 9/30/1999 | 1.42 | 55.2 | NA | 0.050 |
| | Background Bear River (BY199)[b] | 10/1/1999 | 1.07 | 57.2 | NA | 0.027 |
| | Background Bear River (BY199)[b] | 9/21/2000 | 1.3 | 76.1 | 0.028 | 0.027 |
| | Background Bear River (BY199)[b] | 9/15/2001 | 1.3 | 64.7 | 0.070 | 0.050 |
| | Background Bear River (BY199)[b] | 8/23/2002 | 1.4 | 63.0 | 0.045 | 0.041 |
| | South Yuba and Bear River Watersheds[c] (35 samples): 90 percent concentration | | | | | 0.16 |
| | South Yuba and Bear River Watersheds[c] (35 samples): 75 percent concentration | | | | | 0.10 |
| | South Yuba and Bear River Watersheds[c] (35 samples): median concentration | | | | | 0.084 |
| | South Yuba and Bear River Watersheds[c] (35 samples): 25 percent concentration | | | | | 0.07 |
| | South Yuba and Bear River Watersheds[c] (35 samples): 10 percent concentration | | | | | 0.05 |
| | Greenhorn Creek Watershed[d] (56 samples): 90 percent concentration | | | | | 0.027 |
| | Greenhorn Creek Watershed[d] (56 samples): 75 percent concentration | | | | | 0.018 |
| | Greenhorn Creek Watershed[d] (56 samples): 50 percent concentration | | | | | 0.011 |
| | Greenhorn Creek Watershed[d] (56 samples): 25 percent concentration | | | | | 0.009 |
| | Greenhorn Creek Watershed[d] (56 samples): 10 percent concentration | | | | | 0.007 |

Notes:

Sources: Science Applications International Corporation 2004; Alpers and others 2005; U.S. Geological Survey (USGS) unpublished data

**BOLD** **Bold** font indicates sample was collected at Relief Hill

Gray shading indicates highest concentration of this constituent for this sample media at Relief Hill

[a] Sample was collected from a background location at the South Yuba River at Eagle Lakes near Emigrant Gap.

[b] Sample was collected from a background location at the Bear River at Highway 20 near Emigrant Gap.

## Table 9. Total and Methyl Mercury Concentrations in Invertebrate Samples Collected from 1999 to 2002

| | |
|---|---|
| [c] | All samples collected from the South Yuba and Bear river watersheds between May and October 1999. Data include samples collected at background locations, on mine sites, and at downstream locations. |
| [d] | All samples collected from the Greenhorn Creek watershed during 1999 through 2001. Data include samples collected at background locations, on mine sites, and at downstream locations. |
| mg/kg | Milligram per kilogram |
| NA | Not analyzed |

## Table 10. Long-Term Risk Reduction Goals for Surface Water

| Chemical of Potential Concern | Human Health Protection | Unit | Source | Ecological Protection | Unit | Source |
|---|---|---|---|---|---|---|
| Mercury | 0.050 | µg/L | [a] | 0.77 | µg/L | [b] |
| Suspended Sediment | * | * | [c] | * | * | [c] |

Notes:

a U.S. Environmental Protection Agency California Toxics Rule water quality criteria based on total recoverable mercury
b U.S. Environmental Protection Agency ambient water quality criteria based on dissolved mercury
c California Regional Water Quality Control Board, Central Valley Region, Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and the San Joaquin River Basin
* No numeric concentration; solids in surface water should not cause nuisance or adversely affect beneficial uses.
µg/L Microgram per liter

## Table 11. Long-Term Risk Reduction Goals for Sediment

| Chemical of Potential Concern | Human Health Screening Concentration | Unit | Source | Ecological Screening Concentration | Unit | Source |
|---|---|---|---|---|---|---|
| Mercury | 40[a] | mg/kg | [b] | 1[c] | mg/kg | [b] |

Notes:

a Camper exposure scenario
b U.S. Department of the Interior, Bureau of Land Management (BLM) risk management criteria for metals at BLM mining sites (Ford 1996)
c Robin receptor
mg/kg Milligram per kilogram

**Table 12. General Response Actions, Technology Types, and Process Options**

| General Response Action | Technology Type | Process Options |
|---|---|---|
| No Action | None | None |
| Institutional Controls | Access Restrictions | Fencing/Barrier |
| | | Land Use Control |
| | | Water Use Control |
| Engineering Controls | Surface Water Controls | Sediment Detention Structure |
| | | Surface Diversion |
| | Sediment Controls | Grading |
| | | Revegetation |
| | | Road Obliteration |
| | | Erosion and Flood Control |
| | Sediment Containment | Consolidation |
| | | Earthen Cover |
| | | Sediment Sealing and Earthen Cover |
| Treatment | Physical/Chemical Treatment of Surface Water | Settling or Filtration |

**Table 13. Technology Screening Comments Summary**

| General Response Actions | Technology | Process Options | Description | Screening Comment |
|---|---|---|---|---|
| No Action | None | Not applicable | No action. | Not applicable. |
| Institutional Controls | Access Restrictions | Fencing/ Barrier | Install fence around site access points and areas susceptible to erosion. | Partially effective. Vandalism and penetration of the barriers is likely. May facilitate natural revegetation in the long term, but short-term improvements in sediment stability are minimal. Potentially effective in conjunction with other technologies. Readily implementable. |
| | | Land Use Control | Implement restrictions to control current and future land use. | Partially effective. Use of the site could be limited through policy measures such as zoning or special land allocation. Physical restriction measures may not be feasible due to access rights of existing private property and mining interests. Establishment and implementation of policy measures might require increased on-site enforcement. Potentially effective in conjunction with other technologies. Policy measures are readily implementable. |
| | | Water Use Control | Implement restrictions to control current and future water use. | Partially effective for on-site waters; however, beneficial uses of off-site water cannot be readily changed. Not readily implementable. |
| Engineering Controls | On-Site Surface Water Controls | Sediment Detention Structure | Install sediment detention basins or check dams to capture mobile sediment discharged from ponds, ground sluices, and drain tunnels. | Very effective for capturing mobile sediment and reducing downstream entrainment of sediment (reduces velocity). Readily implementable. |
| | | Surface Diversion | Install surface drains or ditches to capture and divert run-on and run-off around areas susceptible to erosion. | Very effective for bypassing surface flows around areas susceptible to erosion. Readily implementable. |
| | | Tunnel Plugging | Install plugs at drain tunnel inlets and/or outlets to minimize surface water flow through the tunnels. | Very effective for minimizing the release of sediment from tunnel networks. Creates dramatic and unknown effects on site hydrology. May create large ponds that methylate mercury and negatively affect private property and existing mining interests. Readily implementable but more challenging to construct than other engineering controls. |
| | On-Site Sediment Controls | Selective Grading | Grade selected areas to reduce gradients in drainages (reducing surface run off energy) and eliminate steep surfaces susceptible to erosion (such as sluice walls). | Very effective for reducing sediment mobility. Grading would leave bare ground that would require stabilization measures. Would also require soil stabilization measures. Readily implementable. |

**Table 13. Technology Screening Comments Summary**

| General Response Actions | Technology | Process Options | Description | Screening Comment |
|---|---|---|---|---|
| Engineering Controls (Continued) | On-Site Sediment Controls (Continued) | Site-wide Grading | Grade the entire area disturbed by hydraulic mining to reduce surface runoff energy and eliminate steep surfaces susceptible to erosion. | Very effective for reducing sediment mobility. Grading would leave bare ground that would require stabilization measures. Would also require soil stabilization measures. Would provide similar protection as selective grading at a higher construction, revegetation, and maintenance costs. Readily implementable. |
| | | Revegetation | Add amendments to disturbed areas and seed with appropriate vegetative species to establish an erosion-resistant ground surface. | Very effective for stabilizing bare soil in many areas on site that are currently susceptible to erosion. Would also require measures to minimize sediment transport in areas where revegetation is not practical, such as existing sluice and drainage systems where vegetation may be washed away or buried. Readily implementable. |
| | | Road Obliteration | Obliterate existing dirt roads on site by ripping the surfaces and placing obstructions (such as boulders) to prevent future road use. | Very effective for minimizing large vehicle traffic on site, which compacts soil, inhibits growth of soil-stabilizing vegetation, and generates dust that may be mobilized in storm water runoff. Only applies to a small portion of the site and would require additional process options that address other portions of the site. The roads that provide vehicular access to the site are on private property or support current mining on site; access for private interests cannot be compromised. Readily implementable. |
| | | Erosion and Flood Control | Install drainage ditches and sediment detention basins to manage surface water run on, infiltration, run off, erosion, and off-site sediment transport. (Equivalent to surface water controls described above.) | Very effective for capturing mobile sediment, reducing downstream entrainment of sediment (reduces velocity), and bypassing surface flows around areas susceptible to erosion. Readily implementable. |
| | Sediment Containment | Consolidation | Excavate geologic materials susceptible to erosion place them in an on-site repository. Sediment in drain tunnels may be classified as a hazardous or designated waste, and require special handling and disposal. | Partially effective. Excavation of sediment in ground sluices, pit lakes, wetlands, and drain tunnels may expose mercury that has accumulated at the base of the sediment, potentially leading to a release of mercury from the site. Excavation of sluice walls and pit high walls susceptible to erosion would leave bare ground that would require stabilization measures. Readily implementable. |
| | | Earthen Cover | Fill ground sluices with soil and establish vegetative cover to stabilize the surface. Similar to, but less encompassing than the grading process options discussed above. | Partially effective. Sediment erosion would be reduced. Not applicable for features that retain water for much of the year (pit lakes, wetlands, and drain tunnels). Would also require soil stabilization measures in covered areas. Readily implementable. |

**Table 13. Technology Screening Comments Summary**

| General Response Actions | Technology | Process Options | Description | Screening Comment |
|---|---|---|---|---|
| Engineering Controls (Continued) | Sediment Containment (Continued) | Sediment Sealing and Earthen Cover | Seal sediment in ground sluices in place, then fill ground sluices with soil and establish vegetative cover to stabilize the surface. | Partially effective. Sediment erosion would be reduced. Not applicable for features that retain water for much of the year (pit lakes, wetlands, and drain tunnels). Would also require soil stabilization measures in covered areas. Anticipated to provide equal protectiveness to the earthen cover process option but at a higher cost. Readily implementable. |
| Treatment | Physical/ Chemical Treatment of Surface Water | Settling or Filtration | Construct an on-site treatment facility that separates suspended solids from storm water flows with a settling basin or fine sand filter. | Moderately effective at fine sediment removal. Effectiveness is also questionable given variability in dosage required to address changing influent flow rates during storm events. Greater long-term operation and maintenance commitment than engineering controls discussed above. Process is not readily implementable because of the lack of electrical infrastructure. |

Note: Eliminated alternatives are shaded.

## Table 14. Removal Action Alternatives Summary

| Alternative Number | Alternative Description |
|---|---|
| Alternative 1 | No Action |
| Alternative 2 | Land Use Controls and Access Restrictions<br><br>*Identify land use consistent with allocation of the area as a riparian conservation area. Prevent land use that could lead to mobilization of sediment through access restriction after termination of the existing mine's plan of operations. Access for private property and existing mining interests must not be compromised.* |
| Alternative 3 | Selective Engineering Controls, Land Use Controls, and Access Restrictions<br><br>*Divide site into watershed units roughly corresponding to sluice systems. Within each watershed unit, implement surface water runon/runoff controls, sediment detention structures, erosion controls, and revegetation to minimize migration of sediment off site. Identify land use consistent with allocation of the area as a riparian conservation area. Prevent land use that could lead to mobilization of sediment through access restriction after termination of the existing mine's plan of operations. Access for private property and existing mining interests must not be compromised.* |
| Alternative 3a | Selective Engineering Controls including Check Dams in Open Sluice Tunnels, Land Use Controls, and Access Restrictions<br><br>*In addition to Alternative 3 engineering controls, check dams will be constructed within open and accessible sluice tunnel inlets to provide additional sediment retention capacity.* |

**Table 15. Cost Estimate for Alternative 2: Land Use Controls and Access Restrictions**

| Cost Item | Quantity | Unit | Unit Cost | Unit MH Cost | Unit Equipment Cost | Unit Material Cost | Cost |
|---|---|---|---|---|---|---|---|
| **Item 1: Designation as a Riparian Conservation Area** | | | | | | | * |
| **Item 2: Assume Control of the Access Gate** | | | | | | | * |
| **Item 3: Equipment Mobilization/Demobilization** | | | | | | | **$ 590** |
| Job Trucks | 2 | EA | $95 | $0 | $95 | $0.00 | $ 190 |
| Bobcat | 1 | EA | $400 | $0 | $750 | $0.00 | $ 400 |
| **Item 4: Sign Placement for Access Restriction** | | | | | | | **$ 5,100** |
| Sign, Wooden 4x4 pole | 30 | EA | $70 | $0 | $0 | $ 71 | $ 2,100 |
| Sign Placement | 30 | MH | $100 | $65 | $35 | $ - | $ 3,000 |
| **Subtotal Construction Costs** | | | | | | | **$ 6,000** |
| Construction Contingencies | Percent of Construction Costs | | 25% | *(15% bid + 10% scope contingencies)* | | | **$ 1,500** |
| **Project Management** | | | | | | | **$ 2,100** |
| Construction Contractor Project Management | 20 | MH | $105 | $105 | $0 | $0.00 | $ 2,100 |
| **Construction Management** | | | | | | | **$ 2,000** |
| Health and Safety Oversight - CIH | 3 | MH | $120 | $120 | $0 | $0.00 | $ 360 |
| Engineering Oversight | 16 | MH | $75 | $75 | $0 | $0.00 | $ 1,200 |
| Per Diem and Vehicle for Oversight Personnnel | 2 | Day | $214 | $214 | $0 | $0.00 | $ 428 |
| **Bonding and Insurance** | **4% of Construction Cost** | | | | | | **$ 200** |
| **TOTAL CAPITAL COSTS** | | | | | | | **$ 11,800** |
| **Site Maintenance** | | | | | | | **$ 64,400** |
| *Present Worth of O&M Costs Based on 30 Year Life and 3.0% Discount Rate* | | | | | | | |
| Replace 7 Signs Every 5 Years | 35 | EA | $170 | | | | $ 4,100 |
| Repair Gate Every 5 Years (beginning Year 5) | 6 | EA | $1,000 | | | | $ 3,400 |
| Annual Site Inspections | 30 | EA | $1,000 | | | | $ 18,400 |
| Post-Removal Sampling (During Inspections) | 30 | EA | $1,000 | | | | $ 9,200 |
| Forest Service Project Management | 328 | MH | $80 | | | | $ 16,400 |
| O&M Contingencies | Percent of O&M Costs | | 25% | *(15% bid + 10% scope contingencies)* | | | $ 12,900 |
| **TOTAL PRESENT WORTH** | | | | | | | **$ 76,000** |

Notes:

Costs were prepared in accordance with U.S. Enviromental Protection Agency (2000) guidelines and are based on engineers estimates, historical costs for similar projects, and vendor quotes. In accordance with EPA guidance (EPA 1993, 2000), these engineering costs are estimates that are expected to be within plus 50 to minus 30 percent of the actual project cost (based on year 2006 dollars). ***As a result, cost range for Alternative 2 is approximately $53,000 to $114,000.***

Construction costs include environmental prime contractor markup of 18% and environmetal prime contractor oversight and project management.

| | |
|---|---|
| * | Internal or administrative costs to the Forest Service were not included in the calculation. |
| % | Percent |
| EA | Each |
| LS | Lump sum |
| MH | Man hour |
| O&M | Operation and maintenance |
| OHV | Off-highway vehicle |

**Table 16. Cost Estimate for Alternative 3: Selective Engineering Controls, Land Use Controls, and Access Restrictions**

| Cost Item | Quantity | Unit | Unit Cost | Unit MH Cost | Unit Equipment Cost | Unit Material Cost | Cost |
|---|---|---|---|---|---|---|---|
| **Item 1: Designation as a Riparian Conservation Area** | | | | | | | ***** |
| **Item 2: Assume Control of the Access Gate** | | | | | | | ***** |
| **Item 3: Equipment Mobilization/Demobilization** | | | | | | | **$ 4,480.00** |
| Job Trucks | 4 | EA | $95 | $0.00 | $95 | $0.00 | $ 380 |
| Excavator | 1 | EA | $750 | $0.00 | $750 | $0.00 | $ 750 |
| Shed | 1 | EA | $500 | $0.00 | $500 | $0.00 | $ 500 |
| ATV | 2 | EA | $500 | $0.00 | $500 | $0.00 | $ 1,000 |
| Generator | 1 | EA | $200 | $0.00 | $200 | $0.00 | $ 200 |
| Fire Suppression Equipment | 1 | EA | $500 | $0.00 | $500 | $0.00 | $ 500 |
| Office Trailer | 1 | EA | $200 | $0.00 | $200 | $0.00 | $ 200 |
| Water Truck | 1 | EA | $200 | $0.00 | $200 | $0.00 | $ 200 |
| Backhoe | 1 | EA | $750 | $0.00 | $750 | $0.00 | $ 750 |
| **Item 4: Sign Placement for Access Restriction** | | | | | **$** | | **5,100** |
| Sign, Wooden 4x4 pole | 30 | EA | $70 | $0.00 | $0.00 | $ 71 | $ 2,100 |
| Sign Placement | 30 | MH | $100 | $64.90 | $35.40 | $ - | $ 3,000 |
| **Item 5: Build 7-foot Dam to Create WTI-1 Sediment Detention Basin** | | | | | **$** | | **6,500** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 6: Vegetate WTI-1 Sediment Detention Basin** | | | | | **$** | | **10,450** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 7: Build 7-foot Dam to Create WTI-2 Sediment Detention Basin** | | | | | **$** | | **6,500** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 8: Vegetate WTI-2 Sediment Detention Basin** | | | | | **$** | | **10,450** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 9: Build 7-foot Dam to Create WTI-3 West Fork Sediment Detention Basin** | | | | | **$** | | **6,500** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 10: Vegetate WTI-3 West Fork Sediment Detention Basin** | | | | | **$** | | **10,450** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 11: Build 7-foot Dam to Create WTI-3 Sediment Detention Basin** | | | | | **$** | | **6,500** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 12: Vegetate WTI-3 Sediment Detention Basin** | | | | | **$** | | **10,450** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 13: Build 7-foot Dam to Create S-WTI-1 West Fork Sediment Detention Basin** | | | | | **$** | | **6,500** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 14: Vegetate S-WTI-1 West Fork Sediment Detention Basin** | | | | | **$** | | **10,450** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 15: Build 7-foot Dam to Create S-WTI-3 West Fork Sediment Detention Basin** | | | | | **$** | | **6,500** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 16: Vegetate S-WTI-3 West Fork Sediment Detention Basin** | | | | | **$** | | **10,450** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 17: Construct a Rock Armored Spillway at the South Fork of S-NTI-1** | | | | | **$** | | **5,000** |
| Rock Armor Spillway | 1 | EA | $5,000 | | $0.00 | $ 5,000 | $ 5,000 |
| **Item 18: Construct a Rock Armored Spillway at S-NTI-2** | | | | | **$** | | **5,000** |
| Rock Armor Spillway | 1 | EA | $5,000 | | $0.00 | $ 5,000 | $ 5,000 |
| **Item 19: Improve 900 Feet of Existing OHV Trail for New Sluice System** | | | | | **$** | | **7,009** |
| Improve Existing OHV Trail | 900 | LF | $8 | $0.00 | $7.79 | $ - | $ 7,009 |

**Table 16. Cost Estimate for Alternative 3: Selective Engineering Controls, Land Use Controls, and Access Restrictions**

| Cost Item | Quantity | Unit | Unit Cost | Unit MH Cost | Unit Equipment Cost | Unit Material Cost | Cost |
|---|---|---|---|---|---|---|---|
| **Item 20: Reclaim 900 Feet of OHV Trail for New Sluice System** | | | | | | **$** | **7,009** |
| Improve Existing OHV Trail | 900 | LF | $8 | $0.00 | $7.79 | $ - | $ 7,009 |
| **Item 21: Build 7-foot Dam to Create CTI-1 Sediment Detention Basin** | | | | | | **$** | **6,500** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 22: Vegetate CTI-1 Sediment Detention Basin** | | | | | | **$** | **10,450** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 23: Improve 500 Feet of Existing OHV Trail for Cliff Sluice System** | | | | | | **$** | **3,900** |
| Improve Existing OHV Trail | 500 | LF | $8 | $0.00 | $7.79 | $ - | $ 3,900 |
| **Item 24: Reclaim 500 Feet of OHV Trail** | | | | | | **$** | **3,600** |
| Reclaim Improved Road after 3rd year reseeding at 3.0% discount rate | 500 | LF | $8 | $0.00 | $7.79 | $ - | $ 3,600 |
| **Subtotal Construction Costs** | | | | | | | **$ 160,000** |
| Construction Contingencies | Percent of Construction Costs | | 25% | *(15% bid + 10% scope contingencies)* | | | **$ 40,000** |
| **Project Management** | | | | | | **$** | **6,300** |
| Construction Contractor Project Management | 60 | MH | $105 | $105.00 | $0.00 | $0.00 | $ 6,300 |
| **Construction Management** | | | | | | **$** | **34,300** |
| Health and Safety Oversight - CIH | 27 | MH | $120 | $120.00 | $0.00 | $0.00 | $ 3,300 |
| Health and Safety Oversight - General | 99 | MH | $75 | $75.00 | $0.00 | $0.00 | $ 7,400 |
| Engineering Oversight | 99 | MH | $75 | $75.00 | $0.00 | $0.00 | $ 7,400 |
| Site Security Officer | 73 | Day | $150 | $150.00 | $0.00 | $0.00 | $ 11,000 |
| Per Diem and Vehicle for Oversight Personnnel | 24 | Day | $214 | $214.00 | $0.00 | $0.00 | $ 5,200 |
| **Design** | | | | | | | **$ 21,500** |
| Contingency | 1 | LS | $3,000 | $0.00 | $0.00 | $3,000.00 | $ 3,000 |
| Project Work Plan | 1 | LS | $7,500 | $0.00 | $0.00 | $7,500.00 | $ 7,500 |
| Completion Report | 1 | LS | $11,000 | $0.00 | $0.00 | $11,000.00 | $ 11,000 |
| **Bonding and Insurance** | **4% of Construction Cost** | | | | | | **$ 6,400** |
| **TOTAL CAPITAL COSTS** | | | | | | | **$ 268,500** |
| **Item 25: Site Maintenance** | | | | | | **$** | **121,400** |
| *Present Worth of O&M Costs Based on 30 Year Life and 3.0% Discount Rate* | | | | | | | |
| Replace 7 Signs Every 5 Years | 35 | EA | $170 | | | | $ 4,400 |
| Repair Gate Every 5 Years (beginning Year 5) | 6 | EA | $1,000 | | | | $ 3,700 |
| Cleanout Sedimentation Basins First 3 Years and Every 5 Years beginning Year 5 | 8 | EA | $8,500 | | | | $ 42,400 |
| Annual Site Inspections | 30 | EA | $1,000 | | | | $ 19,600 |
| Post-Removal Sampling (During Inspections) | 30 | EA | $1,000 | | | | $ 9,600 |
| Forest Service Project Management | 328 | MH | $80 | | | | $ 17,400 |
| O&M Contingencies | Percent of O&M Costs | | 25% | *(15% bid + 10% scope contingencies)* | | | $ 24,300 |
| **TOTAL PRESENT WORTH** | | | | | | | **$ 390,000** |

Notes:

Costs were prepared in accordance with U.S. Enviromental Protection Agency (2000) guidelines and are based on engineers estimates, historical costs for similar projects, and vendor quotes. In accordance with EPA guidance (EPA 1993, 2000), these engineering costs are estimates that are expected to be within plus 50 to minus 30 percent of the actual project cost (based on year 2006 dollars). ***As a result, cost range for Alternative 3 is approximately $273,000 to $585,000.***

Construction costs include environmental prime contractor markup of 18% and environmetal prime contractor oversight and project management.

* Internal or administrative costs to the Forest Service were not included in the calculation.

% Percent

AC Acre

EA Each

LS Lump sum

MH Man hour

O&M Operation and maintenance

OHV Off-highway vehicle

**Table 17. Cost Estimate for Alternative 3a: Selective Engineering Controls Including Check Dams in Open Sluice Tunnels, Land Use Controls, and Access Restrictions**

| Cost Item | Quantity | Unit | Unit Cost | Unit MH Cost | Unit Equipment Cost | Unit Material Cost | Cost |
|---|---|---|---|---|---|---|---|
| **Item 1: Designation as a Riparian Conservation Area** | | | | | | | ***** |
| **Item 2: Assume Control of the Access Gate** | | | | | | | ***** |
| **Item 3: Equipment Mobilization/Demobilization** | | | | | | | **$ 4,480.00** |
| Job Trucks | 4 | EA | $95 | $0.00 | $95 | $0.00 | $ 380 |
| Excavator | 1 | EA | $750 | $0.00 | $750 | $0.00 | $ 750 |
| Shed | 1 | EA | $500 | $0.00 | $500 | $0.00 | $ 500 |
| ATV | 2 | EA | $500 | $0.00 | $500 | $0.00 | $ 1,000 |
| Generator | 1 | EA | $200 | $0.00 | $200 | $0.00 | $ 200 |
| Fire Suppression Equipment | 1 | EA | $500 | $0.00 | $500 | $0.00 | $ 500 |
| Office Trailer | 1 | EA | $200 | $0.00 | $200 | $0.00 | $ 200 |
| Water Truck | 1 | EA | $200 | $0.00 | $200 | $0.00 | $ 200 |
| Backhoe | 1 | EA | $750 | $0.00 | $750 | $0.00 | $ 750 |
| **Item 4: Sign Placement for Access Restriction** | | | | | | **$** | **5,100** |
| Sign, Wooden 4x4 pole | 30 | EA | $70 | $0.00 | $0.00 | $ 71 | $ 2,100 |
| Sign Placement | 30 | MH | $100 | $64.90 | $35.40 | $ - | $ 3,000 |
| **Item 5: Build 7-foot Dam to Create WTI-1 Sediment Detention Basin** | | | | | | **$** | **6,000** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 6: Vegetate WTI-1 Sediment Detention Basin** | | | | | | **$** | **11,850** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 7: Build 7-foot Dam to Create WTI-2 Sediment Detention Basin** | | | | | | **$** | **6,000** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 8: Vegetate WTI-2 Sediment Detention Basin** | | | | | | **$** | **11,850** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 9: Build 7-foot Dam to Create WTI-3 West Fork Sediment Detention Basin** | | | | | | **$** | **6,000** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 10: Vegetate WTI-3 West Fork Sediment Detention Basin** | | | | | | **$** | **11,850** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 11: Build 7-foot Dam to Create WTI-3 Sediment Detention Basin** | | | | | | **$** | **6,000** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 12: Vegetate WTI-3 Sediment Detention Basin** | | | | | | **$** | **11,850** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 13: Build 7-foot Dam to Create S-WTI-1 West Fork Sediment Detention Basin** | | | | | | **$** | **6,000** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 14: Vegetate S-WTI-1 West Fork Sediment Detention Basin** | | | | | | **$** | **11,850** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 15: Build 7-foot Dam to Create S-WTI-3 West Fork Sediment Detention Basin** | | | | | | **$** | **6,000** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 16: Vegetate S-WTI-3 West Fork Sediment Detention Basin** | | | | | | **$** | **11,850** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 17: Construct 3 Check Dams Above N-MTI-4** | | | | | | **$** | **7,500** |
| Construct 3 Check Dams | 3 | LS | $3,000 | $0.00 | $0.00 | $ 3,000 | $ 9,000 |

**Table 17. Cost Estimate for Alternative 3a: Selective Engineering Controls Including Check Dams in Open Sluice Tunnels, Land Use Controls, and Access Restrictions**

| Cost Item | Quantity | Unit | Unit Cost | Unit MH Cost | Unit Equipment Cost | Unit Material Cost | Cost |
|---|---|---|---|---|---|---|---|
| **Item 18: Vegetate above N-MTI-4 Check Dams** | | | | | | **$** | **11,850** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 19: Construct 3 Check Dams Above N-NTI-1** | | | | | | **$** | **7,500** |
| Construct 3 Check Dams | 3 | EA | $3,000 | $0.00 | $0.00 | $ 3,000 | $ 9,000 |
| **Item 20: Vegetate Area Above N-NTI-1 Check Dams** | | | | | | **$** | **11,850** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 21: Construct a Rock Armored Spillway at the South Fork of S-NTI-1** | | | | | | **$** | **4,950** |
| Rock Armor Spillway | 1 | EA | $5,000 | | $0.00 | $ 5,000 | $ 5,000 |
| **Item 22: Construct a Rock Armored Spillway at S-NTI-2** | | | | | | **$** | **4,950** |
| Rock Armor Spillway | 1 | EA | $5,000 | | $0.00 | $ 5,000 | $ 5,000 |
| **Item 23: Improve 900 Feet of Existing OHV Trail for New Sluice System** | | | | | | **$** | **7,009** |
| Improve Existing OHV Trail | 900 | LF | $8 | $0.00 | $7.79 | $ - | $ 7,009 |
| **Item 24: Reclaim 900 Feet of OHV Trail for New Sluice System** | | | | | | **$** | **7,009** |
| Improve Existing OHV Trail | 900 | LF | $8 | $0.00 | $7.79 | $ - | $ 7,009 |
| **Item 25: Construct 3 Check Dams Above CTI-4** | | | | | | **$** | **7,500** |
| Construct 3 Check Dams | 3 | EA | $3,000 | $0.00 | $0.00 | $ 3,000 | $ 9,000 |
| **Item 26: Vegetate above CTI-4 Check Dams** | | | | | | **$** | **11,850** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 27: Construct 3 Check Dams Above CTI-5** | | | | | | **$** | **7,500** |
| Construct 3 Check Dams | 3 | EA | $3,000 | $0.00 | $0.00 | $ 3,000 | $ 9,000 |
| **Item 28: Vegetate above CTI-5 Check Dams** | | | | | | **$** | **11,850** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 29: Build 7-foot Dam to Create CTI-1 Sediment Detention Basin** | | | | | | **$** | **6,000** |
| Construct Dam | 1 | EA | $6,500 | $0.00 | $0.00 | $ 6,500 | $ 6,500 |
| **Item 30: Vegetate CTI-1 Sediment Detention Basin** | | | | | | **$** | **11,850** |
| Hydroseed Sediment Detention Basin and Berm | 0.5 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 5,000 |
| Wattles | 300 | LF | $2.50 | $1.25 | $0 | $ 1.25 | $ 750 |
| Year 2 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,400 |
| Year 2 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| Year 3 Reseed at 3.0 % Discount Rate | 0.25 | AC | $10,000 | $0.00 | $10,000 | $ - | $ 2,300 |
| Year 3 Sedimentation Basin Cleanout at 3.0 % Discount | 1.00 | LS | $750 | $0.00 | $750 | $ - | $ 700 |
| **Item 31: Improve 500 Feet of Existing OHV Trail for Cliff Sluice System** | | | | | | **$** | **3,900** |
| Improve Existing OHV Trail | 500 | LF | $8 | $0.00 | $7.79 | $ - | $ 3,900 |
| **Item 32: Reclaim 500 Feet of OHV Trail** | | | | | | **$** | **3,600** |
| Reclaim Improved Road after 3rd year reseeding at 3.0% discount rate | 500 | LF | $8 | $0.00 | $7.79 | $ - | $ 3,600 |
| **Subtotal Construction Costs** | | | | | | | **$ 243,000** |
| Construction Contingencies | Percent of Construction Costs | | 25% | *(15% bid + 10% scope contingencies)* | | | **$ 60,800** |
| **Project Management** | | | | | | **$** | **8,400** |
| Construction Contractor Project Management | 80 | MH | $105 | $105.00 | $0.00 | $0.00 | $ 8,400 |
| **Construction Management** | | | | | | **$** | **48,100** |
| Health and Safety Oversight - CIH | 38 | MH | $120 | $120.00 | $0.00 | $0.00 | $ 4,600 |
| Health and Safety Oversight - General | 138 | MH | $75 | $75.00 | $0.00 | $0.00 | $ 10,300 |
| Engineering Oversight | 138 | MH | $75 | $75.00 | $0.00 | $0.00 | $ 10,300 |
| Site Security Officer | 104 | Day | $150 | $150.00 | $0.00 | $0.00 | $ 15,600 |
| Per Diem and Vehicle for Oversight Personnel | 34 | Day | $214 | $214.00 | $0.00 | $0.00 | $ 7,300 |
| **Design** | | | | | | | **$ 21,500** |
| Contingency | 1 | LS | $3,000 | $0.00 | $0.00 | $3,000.00 | $ 3,000 |
| Project Work Plan | 1 | LS | $7,500 | $0.00 | $0.00 | $7,500.00 | $ 7,500 |
| Completion Report | 1 | LS | $11,000 | $0.00 | $0.00 | $11,000.00 | $ 11,000 |
| **Bonding and Insurance** | **4% of Construction Cost** | | | | | | **$ 9,700** |
| **TOTAL CAPITAL COSTS** | | | | | | | **$ 391,500** |
| **Item 33: Site Maintenance** | | | | | | **$** | **137,600** |
| *Present Worth of O&M Costs Based on 30 Year Life and 3.0% Discount Rate* | | | | | | | |
| Replace 7 Signs Every 5 Years | 35 | EA | $170 | | | | $ 4,400 |
| Repair Gate Every 5 Years (beginning Year 5) | 6 | EA | $1,000 | | | | $ 3,700 |
| Cleanout Sedimentation Basins First 3 Years and Every 5 Years beginning Year 5 | 9 | EA | $8,500 | | | | $ 55,400 |
| Annual Site Inspections | 30 | EA | $1,000 | | | | $ 19,600 |
| Post-Removal Sampling (During Inspections) | 30 | EA | $1,000 | | | | $ 9,600 |
| Forest Service Project Management | 328 | MH | $80 | | | | $ 17,400 |
| O&M Contingencies | Percent of O&M Costs | | 25% | *(15% bid + 10% scope contingencies)* | | | $ 27,500 |
| **TOTAL PRESENT WORTH** | | | | | | | **$ 529,000** |

**Table 17. Cost Estimate for Alternative 3a: Selective Engineering Controls Including Check Dams in Open Sluice Tunnels, Land Use Controls, and Access Restrictions**

| Cost Item | Quantity | Unit | Unit Cost | Unit MH Cost | Unit Equipment Cost | Unit Material Cost | Cost |
|---|---|---|---|---|---|---|---|

Notes:

Costs were prepared in accordance with U.S. Enviromental Protection Agency (2000) guidelines and are based on engineers estimates, historical costs for similar projects, and vendor quotes. In accordance with EPA guidance (EPA 1993, 2000), these engineering costs are estimates that are expected to be within plus 50 to minus 30 percent of the actual project cost (based on year 2006 dollars). **As a result, cost range for Alternative 3a is approximately $370,000 to $794,000.**

Construction costs include environmental prime contractor markup of 18% and environmetal prime contractor oversight and project management.

| | |
|---|---|
| * | Internal or administrative costs to the Forest Service were not included in the calculation. |
| % | Percent |
| AC | Acre |
| EA | Each |
| LS | Lump sum |
| MH | Man hour |
| O&M | Operation and maintenance |
| OHV | Off-highway vehicle |

**Table 18. Comparative Analysis of Alternatives**

| Assessment Criteria | Alternative 1<br>No Action | Alternative 2<br>Land Use Controls and Access Restrictions | Alternative 3<br>Selective Engineering Controls, Land Use Controls, and Access Restrictions | Alternative 3a<br>Selective Engineering Controls Including Check Dams in Open Sluice Tunnels, Land Use Controls, and Access Restrictions |
|---|---|---|---|---|
| **Overall Protectiveness** | | | | |
| *Public Health, Safety, and Welfare* | No reduction in risk. | Reduces sediment and mercury concentrations in on-site surface water and in the heavily used South Yuba River downstream from the site. The release of sediment and particulate-bound mercury would be addressed by limiting human activity in areas susceptible to erosion. Limits site uses (such as OHV use), which reduces potential exposure of site visitors to residual mercury.<br><br>Provides a lower level of protection than Alternatives 3 and 3a because this alternative does not address sediment once it has become mobile in surface runoff. | Reduces sediment and mercury concentrations in on-site surface water and in the heavily used South Yuba River downstream from the site. The release of sediment and particulate-bound mercury would be addressed by stabilizing material susceptible to erosion, capturing sediment that has been mobilized in storm water runoff, and limiting human activity in areas susceptible to erosion. Limits site uses (such as OHV use), which reduces potential exposure of site visitors to residual mercury.<br><br>Provides overall protection greater than Alternative 2. Overall protection is slightly lower than Alternative 3a because Alternative 3a includes additional sediment capture measures. | Reduces sediment and mercury concentrations in on-site surface water and in the heavily used South Yuba River downstream from the site. The release of sediment and particulate-bound mercury would be addressed by stabilizing material susceptible to erosion, capturing sediment that has been mobilized in storm water runoff, and limiting human activity in areas susceptible to erosion. Limits site uses (such as OHV use), which reduces potential exposure of site visitors to residual mercury.<br><br>Provides overall protection greater than Alternatives 2 and 3. |
| *Environmental Protectiveness* | No protection offered. | Reduces off-site transport of sediment and particulate-bound mercury by limiting human activity in areas susceptible to erosion. Site uses would be managed in order to maintain desirable riparian conditions.<br><br>Provides a lower level of protection than Alternatives 3 and 3a because this alternative does not address sediment once it has become mobile in surface runoff. | Reduces off-site transport of sediment and particulate-bound mercury by stabilizing material susceptible to erosion, capturing sediment that has been mobilized in storm water runoff, and limiting human activity in areas susceptible to erosion.<br><br>Provides overall protection greater than Alternative 2. Overall protection is slightly lower than Alternative 3a because Alternative 3a includes additional sediment capture measures. | Reduces off-site transport of sediment and particulate-bound mercury by stabilizing material susceptible to erosion, capturing sediment that has been mobilized in storm water runoff, and limiting human activity in areas susceptible to erosion.<br><br>Provides overall protection greater than Alternatives 2 and 3. |
| *Overall Protectiveness Rating* | Unacceptable | Acceptable | Good | Very Good |
| **Compliance with ARARs** | | | | |
| *Chemical-Specific* | None apply. | Chemical-specific ARARs may be met. Meeting chemical-specific ARARs is less certain than with Alternatives 3 and 3a because this alternative does not address sediment once it has become mobile in surface runoff. | Chemical-specific ARARs would be met. | Chemical-specific ARARs would be met. |
| *Location-Specific* | None apply. | Location-specific ARARs may not be met because stream banks and beds may continue to be eroded due topographic and drainage features created by historical hydraulic mining. | Location-specific ARARs would be met. | Location-specific ARARs would be met. |
| *Action-Specific* | None apply. | Action-specific ARARs would be met. | Action-specific ARARs would be met. | Action-specific ARARs would be met. |
| *Compliance with ARARs Rating* | Not applicable | Acceptable | Very Good | Very Good |
| **Long-Term Effectiveness and Permanence** | | | | |
| *Magnitude of Residual Risk* | No reduction in erosion and off-site transport of sediment and particulate-bound mercury. | Reduction in mobilization of sediment and particulate-bound mercury. Limited reduction in off-site transport of contaminants; impact of release to watershed might be reduced but would not be eliminated. | Reduction in mobilization and off-site transport of sediment and particulate-bound mercury. Mercury potentially remaining at the base of ground sluices, pit lakes, and wetlands would be further entombed beneath mobilized sediment that settles on site. | Reduction in mobilization and off-site transport of sediment and particulate-bound mercury. Mercury potentially remaining at the base of ground sluices, pit lakes, wetlands, and sluice tunnels would be further entombed beneath mobilized sediment that settles on site. |
| *Adequacy and Reliability of Controls* | No controls implemented; no reliability. | Access restrictions could effectively reduce vehicle traffic in areas susceptible to erosion. Would require a presence on site by enforcement staff to prevent unauthorized uses. On-site maintenance is expected to be minimal. | Would continue to minimize the off-site transport of sediment and particulate-bound mercury indefinitely as long as the engineering controls are adequately maintained. Rock-lined channels and sediment detention basins would require periodic inspection; debris removal may also occasionally be necessary to ensure proper flow. Periodic inspections would be needed to prevent recreational users from developing trails again. Would require a presence on site by enforcement staff to prevent unauthorized uses. | Would continue to minimize the off-site transport of sediment and particulate-bound mercury indefinitely as long as the engineering controls are adequately maintained. Rock-lined channels, sediment detention basins, and check dams would require periodic inspection; debris removal may also occasionally be necessary to ensure proper flow. Periodic inspections would be needed to prevent recreational users from developing trails again. Would require a presence on site by enforcement staff to prevent unauthorized uses. |
| *Long Term Effectiveness and Permanence Rating* | Acceptable | Acceptable | Good | Very Good |

**Table 18. Comparative Analysis of Alternatives**

| Assessment Criteria | Alternative 1<br>No Action | Alternative 2<br>Land Use Controls and Access Restrictions | Alternative 3<br>Selective Engineering Controls, Land Use Controls, and Access Restrictions | Alternative 3a<br>Selective Engineering Controls Including Check Dams in Open Sluice Tunnels, Land Use Controls, and Access Restrictions |
|---|---|---|---|---|
| **Reduction of Toxicity, Mobility, and Volume through Treatment** | | | | |
| *Treatment Process Used and Materials Treated* | None. | None. | None. | None. |
| *Volume of Contaminated Materials Treated* | None. | None. | None. | None. |
| *Expected Degree of Reduction* | None. | Mobility of sediment and particulate-bound mercury would be reduced, but to a lesser degree than Alternatives 3 and 3a. No change in the toxicity or volume of contaminants. | Mobility of sediment and particulate-bound mercury would be reduced. No change in the toxicity or volume of contaminants. | Mobility of sediment and particulate-bound mercury would be reduced to a greater degree than Alternative 3. No change in the toxicity or volume of contaminants. |
| *Reduction of Toxicity, Mobility and Volume through Treatment Rating* | Unacceptable | Unacceptable | Acceptable | Good |
| **Short-Term Effectiveness** | | | | |
| *Protection of Community During Remediation* | Not applicable. | Fugitive dust emissions control may be required during construction. Increased truck traffic may be a concern during transport of construction material to treatment areas. | Fugitive dust emissions control may be required during construction. Increased truck traffic may be a concern during transport of construction material to treatment areas. | Fugitive dust emissions control may be required during construction. Increased truck traffic may be a concern during transport of construction material to treatment areas. |
| *Protection of On-Site Workers During Remediation* | Not applicable. | Expected to be sufficient. On-site workers must be adequately protected by using appropriate personal protective equipment and by following proper operating and safety procedures. | Expected to be sufficient. On-site workers must be adequately protected by using appropriate personal protective equipment and by following proper operating and safety procedures. | Expected to be sufficient. On-site workers must be adequately protected by using appropriate personal protective equipment and by following proper operating and safety procedures. |
| *Time Until Preliminary Remediation Measure Objectives are Achieved* | Not applicable. | Meets surface water PRMOs after implementation of physical measures (such as road obliteration) and establishment and effective enforcement of land use policies. Growth of soil-stabilizing vegetation would take years in areas that are not revegetated as part of the removal action. | Meets surface water PRMOs after construction of erosion and sediment controls, revegetation, and establishment and effective enforcement of land use policies. Would achieve goals in a shorter timeframe than Alternative 2 because the majority of areas susceptible to erosion would be revegetated during construction. | Meets surface water PRMOs after construction of erosion and sediment controls, revegetation, and establishment and effective enforcement of land use policies. Would achieve goals in a shorter timeframe than Alternative 2 because the majority of areas susceptible to erosion would be revegetated during construction. |
| *Short Term Effectiveness Rating* | Unacceptable | Unacceptable | Good | Good |
| **Implementability** | | | | |
| *Ability to Construct and Operate* | No construction or operation involved. | The "Framework" (Forest Service 2004) authorizes the Forest Service to establish RCAs on public lands it administers. RCA establishment is considered an administrative task to be completed by the Forest Service. | The "Framework" (Forest Service 2004) authorizes the Forest Service to establish RCAs on public lands it administers. RCA establishment is considered an administrative task to be completed by the Forest Service. Constructing erosion and sediment controls, obliterating dirt roads, and revegetating bare areas on site would require the services of a contractor experienced in the proper construction procedures. Existing roads to the site may limit access by large construction and transport vehicles. | The "Framework" (Forest Service 2004) authorizes the Forest Service to establish RCAs on public lands it administers. RCA establishment is considered an administrative task to be completed by the Forest Service. Constructing erosion and sediment controls, obliterating dirt roads, and revegetating bare areas on site would require the services of a contractor experienced in the proper construction procedures. Existing roads to the site may limit access by large construction and transport vehicles. |
| *Ease of Implementing More Action if Necessary* | This measure does not inhibit implementation of other actions. | Implementation of future measures would be controlled by policy rather than physical conditions at the site. Future actions would have to meet goals and objectives for RCAs as defined by the "Framework" (Forest Service 2004). | Implementation of future measures would be controlled more by policy than by physical conditions at the site. Future actions would have to meet goals and objectives for RCAs as defined by the "Framework" (Forest Service 2004). Physical conditions on site after the removal action would not significantly change the ease of implementing future measures from current conditions. | Implementation of future measures would be controlled more by policy than by physical conditions at the site. Future actions would have to meet goals and objectives for RCAs as defined by the "Framework" (Forest Service 2004). Physical conditions on site after the removal action would not significantly change the ease of implementing future measures from current conditions. |
| *Availability of Services and Capacities* | Not applicable. | Establishment of RCAs requires designation by a Forest Service hydrologist and would depend entirely on staff availability. Construction services are available locally and within the state. Enforcement of land allocation policies would depend entirely on Forest Service enforcement staff availability. | Establishment of RCAs requires designation by a Forest Service hydrologist and would depend entirely on staff availability. Construction services are available locally and within the state. Enforcement of land allocation policies would depend entirely on Forest Service enforcement staff availability. | Establishment of RCAs requires designation by a Forest Service hydrologist and would depend entirely on staff availability. Construction services are available locally and within the state. Enforcement of land allocation policies would depend entirely on Forest Service enforcement staff availability. |
| *Availability of Equipment and Materials* | Not applicable. | Available locally and within the state. | Available locally and within the state. | Available locally and within the state. |

**Table 18. Comparative Analysis of Alternatives**

| Assessment Criteria | Alternative 1<br>No Action | Alternative 2<br>Land Use Controls and Access Restrictions | Alternative 3<br>Selective Engineering Controls, Land Use Controls, and Access Restrictions | Alternative 3a<br>Selective Engineering Controls Including Check Dams in Open Sluice Tunnels, Land Use Controls, and Access Restrictions |
|---|---|---|---|---|
| **Implementability (Continued)** | | | | |
| *Estimated Present Worth Cost with 30 Years of Operation and Maintenance*[a] | **$0** | **$76,000 ($53,000-$114,000)**[b] | **$390,000 ($273,000-$585,000)**[b] | **$529,000 ($370,000-$794,000)**[b] |
| *Implementability Rating* | **Good** | **Good** | **Good** | **Good** |
| **Overall Rating** | **Unacceptable** | **Acceptable** | **Good** | **Very Good** |

Notes: Source: Forest Service 2004. "Sierra Nevada Forest Plan Amendment, Final Supplemental Environmental Impact Statement, Record of Decision." January.

a Does not include internal Forest Service costs for RCA establishment and land use control enforcement

b Costs were prepared in accordance with U.S. Environmental Protection Agency (2000) guidelines and are based on engineers estimates, historical costs for similar projects, and vendor quotes. In accordance with EPA guidance (EPA 1993, 2000), these engineering costs are estimates that are expected to be within plus 50 to minus 30 percent of the actual project cost, shown in parentheses below the cost estimate (based on year 2006 dollars).

ARAR Applicable or relevant and appropriate requirement
Forest Service U.S. Department of Agriculture Forest Service
OHV Off-highway vehicle
PRMO Preliminary remediation measure objective
RCA Riparian conservation area

Rating Scale:

Unacceptable…Acceptable…Good…Very Good…Excellent