F1-116

Request for Funding for Remediation of Inactive Mines in the West Squaw Creek Watershed

Submitted by Mining Remedial Recovery Company

Executive Summary

This proposal requests funding for remedial actions at the Balaklala, Keystone, and Shasta King Mines, which are located approximately 4.5 miles northwest of Shasta Dam in the West Squaw Creek watershed. West Squaw Creek currently discharges approximately 30 lbs/day of copper and 50 lbs/day of zinc into Shasta Lake.

The primary biological and ecological objective of this project is to improve the spawning and rearing habitat for anadromous species in the Bay-Delta ecosystem. This objective will be achieved by reducing the cadmium, copper, and zinc load from West Squaw Creek to Shasta Lake and the upper Sacramento River. This proposal is consistent with the CALFED objectives to fund actions which address non-flow related factors and focus on contaminant source reduction. Improvements to water quality in the upper Sacramento River should also enhance the health of the estuarine habitat downstream. Specifically, this project is expected to restore the instream aquatic habitat for key species such as salmonids, splittail, and striped bass.

The proposed project components include injecting neutralizing and reducing materials into mine workings, and installing passive chemical and biological acid mine drainage (AMD) treatment systems. The project components, anticipated completion dates, and associated costs are shown in Table 1.

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Table 1. West Squaw Creek Inactive Mine Remediation Project Components

Task	Cost	Completion Date
Keystone Mine: Inject neutralizing and reducing materials into mine workings and install a passive limestone treatment system	$700,000	6/1/98
Balaklala Mine: Install a passive limestone treatment system and revegetate waste rock area	500,000	8/1/98
Shasta King Mine: Pipe seeps from waste rock and 890 Level Portal to lower portal and install an anoxic wetland treatments system.	400,000	10/1/98
Total Cost	**$1,600,000**	

The Balaklala, Keystone, and Shasta King Mines are the property of Mining Remedial Recovery Company (MRRC). MRRC was formed specifically to remediate sites impacted by mining activities, and is actively reclaiming several mine, mill, and smelter sites located throughout the United States. Key personnel at MRRC have extensive knowledge of general mine remediation technologies, as well as the site specific conditions at the mines

located in the West Squaw Creek watershed. Michael W. Baum (President and CEO) has over 20 years of management experience related to mining and mine reclamation. Linda M. Mercurio (Environmental Engineer/Project Manager) has coordinated the design, implementation, and monitoring of remedial activities at several MRRC owned mines in the Shasta Lake area.

MRRC has water quality data related to the West Squaw Creek Mines dating back to 1940. In August 1996 and March 1997, MRRC and Adrian Brown, Inc., completed comprehensive sampling of discharges from portals, waste rock dumps, seeps, springs, and receiving streams. MRRC plans to continue collecting monthly portal samples, quarterly receiving stream samples and periodic seep and spring samples before, during, and after the implementation of remedial actions at the West Squaw Creek Mines.

It is not expected that implementation of this project will result in significant third party impacts. The Balaklala, Keystone, and Shasta King Mines are remotely located, and the mine sites and surrounding acreage are the property of MRRC. However, MRRC will submit copies of this proposal to appropriate parties at the CRWQCB, the California Department of Fish and Game, the Forest Service, the Bureau of Land Management, and Bureau of Reclamation. MRRC will also post applicable signs along the access road to the work sites during construction.

To date, MRRC has coordinated and funded water quality studies, the production of detailed base maps, and the completion of a comprehensive feasibility study for several MRRC owned mines located in the Shasta Lake area. In addition, MRRC has expended $2,200,000 to implement control actions at the Mammoth, Balaklala, Stowell, and Keystone Mine sites. MRRC is open to negotiating a cost sharing plan with the CALFED Program to complete the remediation projects described in this proposal. Any CALFED Program resources allocated to remediation of the West Squaw Creek Mines would increase the economic feasibility of several control actions that were evaluated in the feasibility study and included in this proposal, and increase the expected water quality benefits to the upper Sacramento River. MRRC welcomes the opportunity to work together with the CALFED Program to achieve a substantial and rapid reduction in heavy metal loads to the Sacramento River watershed.

Proposal for Funding for Remediation of Inactive Mines Located in the West Squaw Creek Watershed

Submitted by

Mining Remedial Recovery Company

Principal Investigators

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Type of Organization: Private Corporation
Tax Status: For Profit
Tax Identification Number: 25-1612929
RFP Project Group Type: Construction

Project Description

Background Information

West Squaw Creek enters Shasta Lake approximately 2.5 miles northwest of Shasta Dam. The Balaklala, Keystone, and Shasta King Mines all discharge into the south fork of West Squaw Creek. A regional map that includes West Squaw Creek is shown in Figure 1 and detailed base maps of the mine sites are shown in Plates 1-3. The principal sources of metal enriched drainage in West Squaw Creek are pyritic ore remaining in mines, pyritic material in mining waste rock areas and weathering of naturally occurring mineralized rock.

Selected water quality data for West Squaw Creek is shown in Figures 2 and 3. The Shasta King Mine, and Windy Creek, which drains the Balaklala and Keystone Mine, are key sources of acid mine drainage (AMD) to West Squaw Creek.

The Keystone Mine lies between 3,380 and 2,976 feet of elevation, and is located upgradient of the Balaklala Mine in the Windy Creek drainage. Windy Creek is a tributary to West Squaw Creek. The Keystone Mine operated between 1900 and 1928. Approximately 122,000 tons of ore were removed from the Keystone Mine. Prior to sealing, the main adit discharged up to 50 gpm of AMD.

In 1993, bulkheads were installed in the main Keystone portal and two higher level portals. After emplacement, the hydraulic head created by the seals caused surface seeps of AMD, with flows up to 50 gpm discharging from the mine. Currently, the pressure head behind the main portal bulkhead averages 50 psi, indicating that the inner workings are at least partially flooded. As a result, zinc concentrations in the water within the mine voids have reduced by an order of magnitude.

In January 1996, a 1,600-ft long, 10-ft wide HDPE-lined diversion channel was installed to collect AMD and other water from the Keystone Mine drainage area. The structure prevents discharges from the Keystone Portal and acidic seeps from flowing into Windy Creek upgradient of the Balaklala Mine site. During April 1997, an additional 300-ft long diversion channel was installed to prevent a seasonal stream from flowing over the Keystone waste rock dump.

The key sources of metals from the Keystone Mine include the main portal and the acidic seep. Metal loads from the Keystone Mine are shown in Figures 4 and 5.

The Balaklala Mine contains two large ore bodies, the Windy Camp and the Weil. The Weil area does not discharge significant quantities of AMD and will not be addressed in this proposal. The Balaklala and Windy Camp Portals are located in the Windy Camp area at elevations of 2,434 and 2,480 ft, respectively. Estimated production from the Windy Camp ore body is 400,000 tons. Operations at the Balaklala Mine ceased in 1928.

In 1984, both the Windy Camp and Balaklala Portal were sealed. A subsequent flood of Windy Creek in 1989 buried the Balaklala Portal. The portal was re-excavated in 1996. Windy Creek flows directly through the Balaklala Mine site. A collapsed stope in the Windy Camp area created a large "glory hole". Prior to 1996, Windy Creek water infiltrated through the waste material in the vicinity of the glory hole and flowed through the mine, resurfacing at a number of locations, including the toe of the Windy Camp waste rock pile. The effluent from the waste rock pile contained significantly higher concentrations of copper and zinc than the influent stream. During 1996 and 1997, a HDPE-lined gabion channel was constructed in the upper Windy Camp area to limit surface water infiltration through waste rock material and the glory hole. In addition, approximately, 40,000 cubic yards of waste rock material were relocated from the lower Windy Camp area to the area surrounding the gabion channel. Constructing the gabion channel and consolidating the waste rock material in a higher and drier location are expected to reduce AMD generation at the Balaklala Mine site.

The principle sources of AMD from the Balaklala Mine include the Balaklala Portal, a subsurface drainpipe, and seeps through waste rock material. The metal loads from the Balaklala Mine are shown in Figures 4 and 5.

The Shasta King Mine lies northwest of the Balaklala Mine, across West Squaw Creek, between 1,605-ft and 1,816-ft of elevation. Approximately 84,000 tons of ore were removed from the mine between 1902 and 1919. The mine has eight adits, one just above West Squaw Creek, and the other seven located within a few hundred feet above the creek. Waste dumps from the adits generally extend from the portals to the creek bottom. Access to the mine is extremely limited. Currently, a 4-wheel drive road ends just across the creek from the lower portal. The waste rock piles located upstream of the lower portal can only be accessed by walking up the creek bed.

A concrete bulkhead is located in the lower Shasta King portal, and the hydrostatic pressure behind the bulkhead ranges from 2 to 5 psi. The bulkhead is currently leaking from its upper edge at approximately 1-5 gpm. The metal loading from the Shasta King Mine is presented in Figures 6 and 7. The principal metal loads from the Shasta King Mine are generated from the waste rock piles which extend into the creek. Copper and zinc concentrations range from 40-70 mg/L in water discharged from the portal and waste rock areas. Feasibility of control actions for the Shasta King Mine will be limited by the lack of access to the site.

Project Approach

The components of the West Squaw Creek Mine Remediation Project focus on the most significant sources of AMD, and will be implemented in a phased approach. Since the Balaklala Mine is located downgradient of the Keystone Mine, remedial actions implemented at the Keystone Mine may reduce the need for further actions at the

Balaklala Mine. By implementing the project components sequentially, the need for each successive control measure can be evaluated before additional capital is invested. The project tasks are outlined below.

1. Keystone Mine: Inject neutralizing and reducing materials into mine workings and install a passive limestone treatment system.

Injection of neutralizing materials into mines has the potential to both reduce the generation of AMD by sealing the mine, and to neutralize AMD at the point where it is generated. Demonstration projects underway at West Virginia University are exploring pneumatic and slurry injection methods for placing fly ash in underground mines. Preliminary results indicate that pneumatic methods can extend borehole spacing to 30 m at costs substantially less than those of slurry methods.

Preventing the interaction of oxygen with pyrite in mine workings can effectively minimize AMD generation. One method to reduce dissolved oxygen concentration in mine water involves placing organic matter in mine workings. Organic materials, such as manure or sludge placed in mine workings are decomposed aerobically by microorganisms that consume oxygen. As the dissolved oxygen concentration in the mine water is reduced, sulfate reducing bacteria convert sulfates to sulfides. Under these reducing conditions, metals are immobilized.

Passive limestone treatment systems can consist of 3/4" to large boulders of limestone placed in a pond, reservoir, channel or mine portal. An example of an alkalinity producing limestone treatment system is shown in Figure 8. Limestone treatment increases the pH of AMD and immobilizes heavy metals by precipitating metal hydroxides and oxides. A pond is required down gradient of a limestone treatment system to accommodate sludge settling.

2. Balaklala Mine: Install a passive limestone treatment system and revegetate consolidated the waste rock area.

Revegetating waste rock areas improves the aesthetic appeal of an inactive mine site. Revegetation projects also reduce erosion of the waste rock, and inhibit air and water flow through waste rock piles. Hence, revegetating a waste rock area can result in significant water quality benefits. Plant selection should be based on compatibility with soil and climate, ecological compatibility, and the ability to form a self-sustaining cover that is resistant to erosion. Before seeding, amendments should be added to the cover soil to facilitate plant growth. Typical amendments include mulch, fertilizer, and liming materials.

3. Shasta King Mine: Pipe seeps from waste rock and 890 Level Portal to lower portal and install an anoxic limestone wetland treatment system.

Constructed wetlands are a relatively inexpensive and low maintenance method of treating AMD. Anaerobic wetland systems are designed to treat water with net acidity. Anaerobic

wetlands improve the water quality of AMD by creating reducing conditions and adding alkalinity. Both processes result in the removal of metals from AMD. A general anaerobic wetland system is illustrated in Figure 9.

Collection of water from the waste rock dump and upper portal areas would be accomplished by use of a concrete wall along the canyon side located beneath the mine portals and just above the creek level. The wall would be backfilled with coarse rock and a pipeline would direct the collected water to the wetland treatment system located outside the main portal.

Expected Benefits

A primary goal of the proposed West Squaw Creek Mine Remediation Project is to improve water quality in the upper Sacramento River for the winter-run and spring-run chinook salmon and the steelhead trout. This project will also achieve an obvious local benefit by reducing AMD discharge rates to West Squaw Creek.

The Basin Plan contains the following quality objectives for copper, zinc, and cadmium for water with hardness = 40 mg/L as $CaCO_3$.

Parameter	Concentration (µg/L) (Dissolved)
Copper	5.6
Zinc	16.0
Cadmium	0.22

Metal concentrations in excess of these limits can be harmful to chinook salmon and steelhead trout. (Water Resources Control Board, 1990). The USBR, and US EPA routinely collect samples from the Sacramento River below Shasta Dam and below Keswick Reservoir. The results of these analyses indicate the that the levels of copper, cadmium and zinc in these water samples regularly exceed detection limits. Hence, the ability of the Sacramento River to accommodate influxes of metals downstream is limited by the water quality in the upper reaches of the river. In order to achieve the Basin Plan objectives in the Sacramento River, major sources of metals upstream of Shasta Dam should be controlled as part of a comprehensive basin-wide contaminant source reduction program.

Background and Biological/Technical Justification

MRRC recently completed a comprehensive feasibility study for several mines located in the West Shasta Mining District. The study evaluated a wide range of potential AMD control and treatment technologies including:

- active chemical treatment,
- wetlands treatment,
- passive limestone treatment,
- surface reclamation of mine waste,
- surface water diversion channels,
- neutralizing or reducing material injection into mine workings, and
- extermination of AMD generating microorganisms.

An active chemical treatment system was not considered to be feasible due to the remote location of the West Squaw Creek Mines, limited space, energy requirements, labor intensiveness, and cost.

The waste rock pile at the Balaklala Mine has been reclaimed. Reclaiming the waste rock areas at the Shasta King and Keystone Mines is not feasible due to the steepness of the terrain at these sites and limited anticipated water quality benefits.

Extermination of AMD generation microorganisms was not a preferred solution due to a low expected benefit to cost ratio and considerable maintenance requirements.

The control actions included in this proposal were selected in part, because they focus on the most significant metal loads discharged from the West Squaw Creek mines. The extent of the benefits for aquatic species in the receiving water bodies is expected to be directly related to the achieved reduction in metal loading. Furthermore, the proposed passive treatment systems will require minimal maintenance and accommodate a wide range of flowrates.

If this project proposal is approved, MRRC is prepared to proceed with the proposed control actions in the near future. As stated earlier, a detailed feasibility study has been completed, and a comprehensive monitoring program is in place. To date, MRRC has expended more than $2,000,000 on remedial activities in the West Shasta Mining District.

Proposed Scope of Work

The proposed project is divided into four components:
Design: A detailed design will be completed of the passive limestone and wetland treatment systems. Deliverables: Detailed designs superimposed on base maps of sites and a standard operating procedure for underground injections.
Preconstruction: Preconstruction activities include procurement of required permits and preparing the site and surrounding area for project implementation. Deliverables: Copies of all required permits, and photographs of site preparation.

Construction: The control actions will be implemented in a phased approach in order to evaluate the effects of each successive treatment system prior to proceeding with

additional work. Deliverables: Weekly progress reports detailing technical and financial activities, and copies of all related purchase orders and invoices.

Monitoring: The existing monitoring program will continue throughout all phases of the project implementation. Deliverables: Monthly water quality reports.

Monitoring and Data Evaluation

MRRC periodically collects water samples and measures flow at all portals, seeps, and springs associated with the West Squaw Creek mines. Samples are also collected from West Squaw Creek on a quarterly basis. Samples will be collected on a more frequent basis during and immediately after the implementation of control actions.

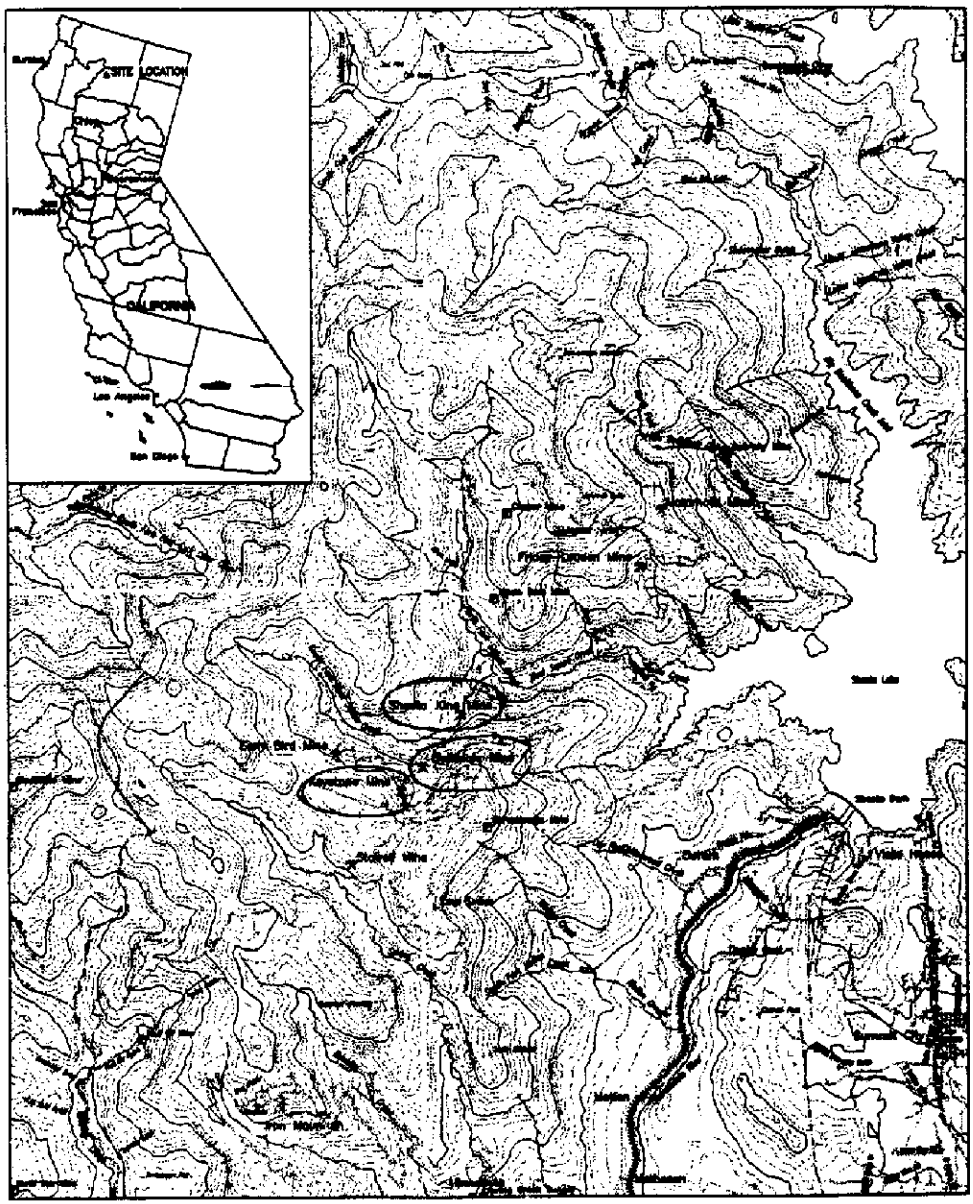
MRRC participates in the Sacramento River Watershed Program (SRWP), an organization that plans to coordinate and supplement several existing water quality monitoring programs operating within the Sacramento River watershed. Results from monitoring activities the West Squaw Creek mines will be contributed to the SRWP, and the West Squaw Creek mines monitoring program will use sampling and analysis methods that are consistent with the SRWP. Cooperation with the SRWP will provide a venue for peer review of the monitoring and data evaluation process.

Implementability

The CRWQCB-Central Valley Region issued two orders related to the West Squaw Creek mines site on June 20, 1996. Order No. 96-154 includes waste discharge requirements for the West Squaw Creek mines adits, and Cease and Desist Order No. 96-155 requires that MRRC comply with an extensive task schedule. To date, MRRC has met each of the compliance deadlines contained in the cease and desist order

The West Squaw Creek mines are located on parcels that are owned by MRRC, and there are no existing easements for the proposed work sites. Hence, third party impacts are expected to be minimal.

If required to do so, MRRC will coordinate an environmental assessment prior to implementation of the proposed control actions. Further, MRRC will assure that all applicable OSHA and MSHA requirements are met.



Mining Remedial Recovery Company

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LOCATION MAP OF MRRC MINES

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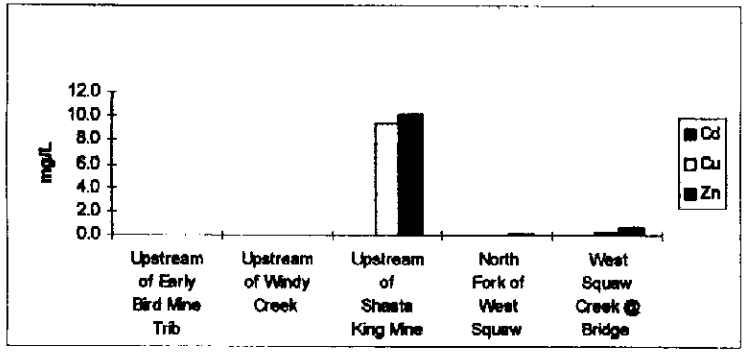

Figure 2. Metal Concentrations in West Squaw Creek - August 1996

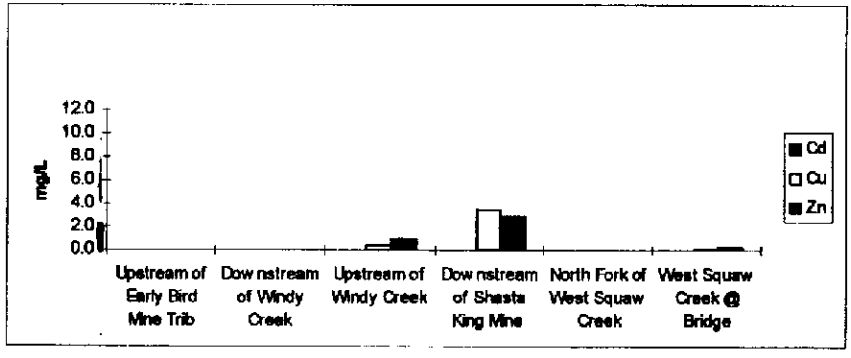

Figure 3. Metal Concentrations in West Squaw Creek - March 1997

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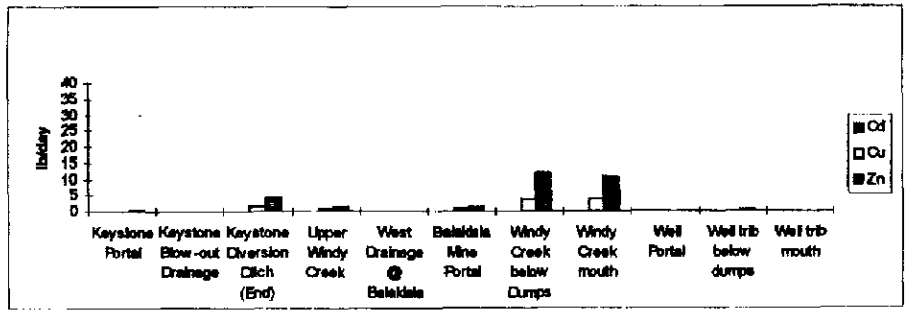

Figure 4. Metal Load from the Keystone and Balaklala Mine - August 1996

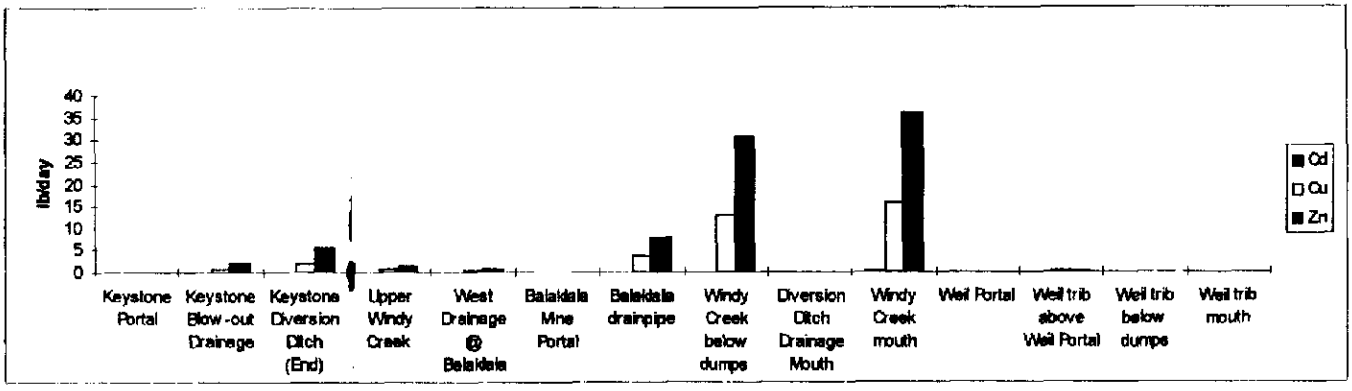

Figure 5. Metal Load from the Keystone and Balaklala Mine - March 1997

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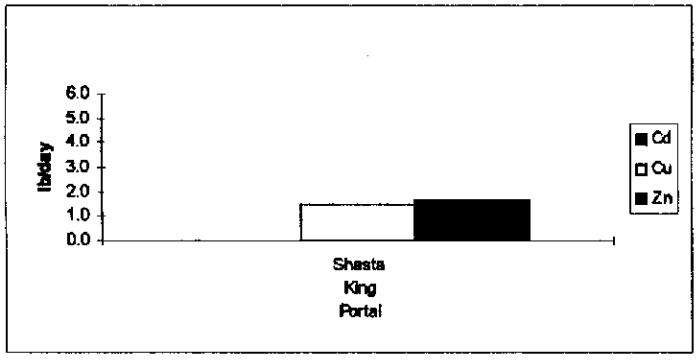

Figure 6. Metal Load from the Shasta King Mine - August 1996

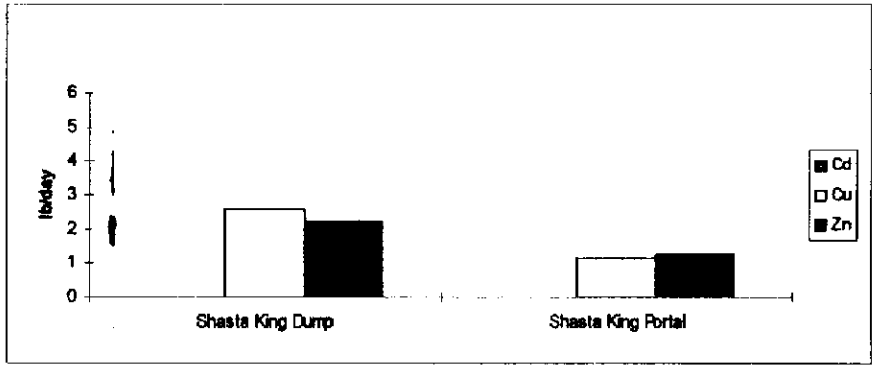

Figure 7. Metal Load from the Shasta King Mine - March 1997

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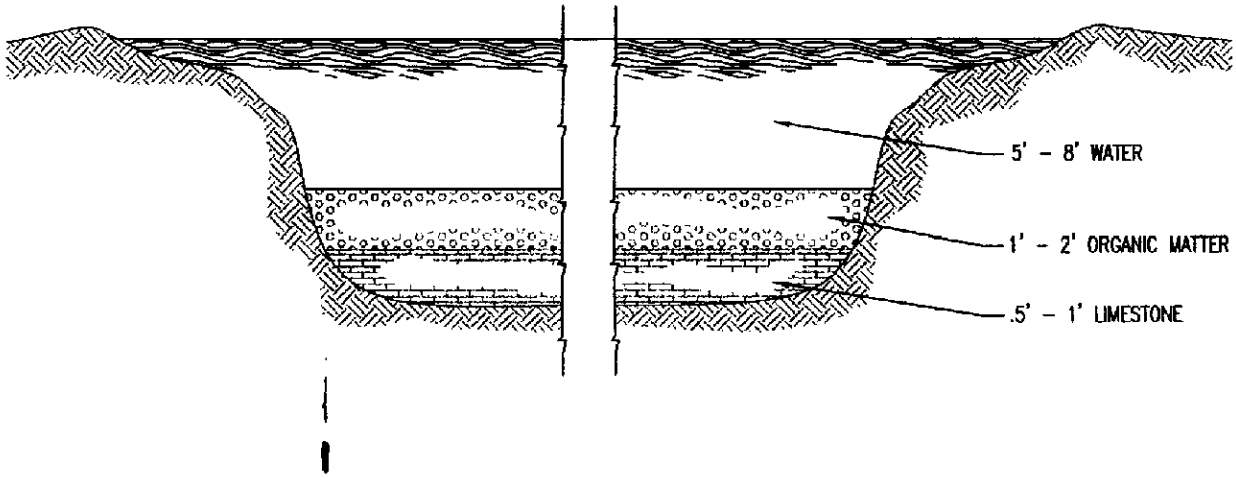

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Mining Remedial Recovery Company

MRRC

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Shasta County, CA

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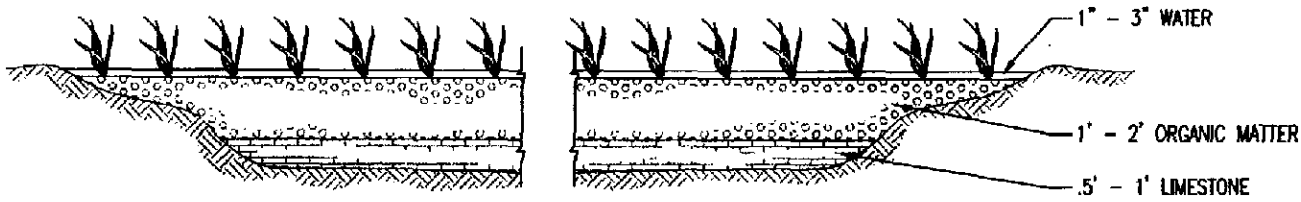

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Mining Remedial Recovery Company

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ANAEROBIC WETLANDS

AdrianBrown

Shasta County, CA

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Costs and Schedule to Implement West Squaw Creek Mine Remediation Project

Budget Costs

The budgeted cost for each proposed task is outlined in Table 2.

Table 2. Cost breakdown for project tasks.

Project Task	*Direct Salary and Benefits*	*Overhead Labor*	*Service Contracts*	*Material Costs*	*Maintenance Costs for 10 years*	*Total Costs*
1	23,000	7,000	250,000	400,000	20,000/yr	880,000
2	10,000	5,000	175,000	300,000	10,000/yr	590,000
3	8,000	4,000	228,000	150,000	10,000/yr	490,000
					Total Cost	1,960,000

MRRC is open to negotiating a cost sharing plan with the CALFED Program to complete the remediation projects described in this proposal. CALFED Program resources allocated to any of the outlined tasks would increase the economical feasibility of that task, and increase the expected benefits to aquatic species in the upper Sacramento River.

MRRC plans to hire subcontractors to complete the construction components of the proposed tasks. In selecting subcontractors, MRRC will solicit bids and evaluate potential subcontractors based upon the following factors:

- related project experience,
- appropriate licenses and credentials,
- OSHA certification,
- MSHA certification, and
- cost.

Schedule Milestones

A schedule for the proposed project tasks is shown in Table 3. MRRC would appreciate receiving CALFED funding prior to each completion date, but is open to other payment schedules.

Table 3. Task Schedule

Task	Completion Date
1. Keystone Mine: Inject neutralizing and reducing materials into mine workings and install a passive limestone treatment system	6/1/98
2. Balaklala Mine: Install a passive limestone treatment system and revegetate waste rock area	8/1/98
3. Shasta King Mine: Pipe seeps from waste rock and 890 Level Portal to lower portal and install an anaerobic wetland treatment system.	10/1/98

Third Party Impacts

It is not expected that implementation of this project will result in any significant third party impacts. The West Squaw Creek mines are remotely located, and the mine sites and the surrounding acreage are the property of MRRC. However, MRRC will submit a description of selected remedial actions to appropriate parties at the CRWQCB, the California Department of Fish and Game, the Forest Service, the Bureau of Land Management, and Bureau of Reclamation. MRRC will also post applicable signs along the access road to the work site during construction.

Applicant Qualifications

MRRC was formed specifically to remediate sites impacted by mining activities, and is actively reclaiming several mine, mill, and smelter sites located throughout the United States. Key personnel at MRRC have extensive knowledge of general mine remediation technologies, as well as the site specific conditions at the West Squaw Creek mines.

In 1995, MRRC completed a remediation project at the Sunbank Mine site located near Silverton, Colorado. Sixty percent of the funding for this project was provided by the US EPA. The mine openings and adits were backfilled, regraded and capped. The mine dump was removed from the stream, consolidated into one area, regraded, and capped. Currently, AMD from the mine is collected and passed through a limestone treatment system which then feeds into a series of settling ponds. This project has resulted in substantial improvements to water quality, and demonstrates MRRC ability to work with a government agency to achieve a common goal.

MRRC personnel who are involved in the West Squaw Creek remediation project are profiled below.

Michael W. Baum, President
Michael Baum will manage the financial aspects of the proposed West Squaw Creek remediation project. Mr. Baum has over 20 years of management experience in the areas of construction, mine operation and mine reclamation. He has been directly in charge of operations and reclamation at more than twenty mine, mill, and smelter sites located throughout the United States. Mr. Baum has been involved in numerous negotiations involving Consent Decrees for remedial activities in both the CERCLA and RCRA programs, and has been responsible for the attainment of several permits required to perform remedial and mining activities.

Ken Henderson, Construction Manager/Administration
Ken Henderson will manage the construction of the proposed West Squaw Creek remediation project. Mr. Henderson has over 30 years of management and technical experience in the areas of mine operations, project design, and construction management. He holds a degree in Mining Engineering for the University of Colorado and an Environmental Law Degree from the University of Arizona. Mr. Henderson has been involved in the management of several mining operations and mine remediation projects throughout the western United States.

Linda Mercurio, Environmental Engineer/Project Manager
Linda Mercurio will coordinate the design, implementation, and monitoring components of the proposed project. Ms. Mercurio holds an M.S. in Environmental Engineering from Utah State University and a B.S. in Mathematics Education from Northeastern University. She has extensive knowledge of the water quality issues related to the West Squaw Creek mines and has been instrumental in evaluating potential control actions.

Don Simpson, Project Designer
Don Simpson will assist with remedial actions related to underground mine workings. Mr. Simpson has been involved with the management of metal mining and milling for over 40 years. He holds a degree in Mining Engineering from the University of Arizona. During his career, Mr. Simpson has held senior management positions in mine exploration, production, and reclamation.

Compliance with Standard Terms and Conditions

Attached please find the required forms for a successful proposal. MRRC has elected not to submit a bidder's bond at this time because subcontractors will perform the majority of the public works construction efforts. As stated on the CALFED Category III RFP internet site, under these circumstances, bid and payment bonds can be deferred until such time as subcontracts are sought and awarded, and before work is performed. It is understood that obligations from CALFED to MRRC will be contingent upon receiving the bid/payment bonds.

Ken Henderson is a licenced general contractor in the State of California.
(Licence No. 728820)

NONDISCRIMINATION COMPLIANCE STATEMENT

Mining Remedial Recovery Company (MRRC) hereby certifies, unless specifically exempted, compliance with Government Code Section 12990 (a-f) and California Code of Regulations, Title 2, Division 4, Chapter 5 in matters relating to reporting requirements and the development, implementation and maintenance of a Nondiscrimination Program. MRRC agrees not to unlawfully discriminate, harass or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, disability (including HIV and AIDS), medical condition (cancer), age, marital status, denial of family and medical care leave and denial of pregnancy disability leave.

CERTIFICATION

I, Linda Mercurio, hereby swear that I am duly authorized to legally bind MRRC to the above described certification. I am fully aware that this certification, executed on the date and in the county below, is made under penalty of perjury under the laws of the State of California.

Linda M. Mercurio July 25, 1997, Shasta County, California
Linda M. Mercurio
Environmental Engineer and Project Manager
Mining Remedial Recovery Company