Pilot Demonstration of the Passivation Technology for Restoration of Newton Copper Mine

Project Information

1. **Proposal Title:**

   Pilot Demonstration of the Passivation Technology for Restoration of Newton Copper Mine

2. **Proposal applicants:**

   Mark Kravetz, Cherokee Chemical Co., Inc.
   Larry Kamp, COUNSELTECH
   Manoranjan Misra, University of Nevada, Reno
   Raj Mehta, University of Nevada, Reno
   Geraldine Cassinelli, Newton Copper Mine
   Richard Kreth, Kreth, Inc.
   Eric Downs, D & E Construction
   Mark Jolles, NETAFIM USA

3. **Corresponding Contact Person:**

   Mark Kravetz
   Cherokee Chemical Co., Inc.
   3540 East 26th Street Vernon, CA 90023
   800 767-9112
   markkravetz@hotmail.com

4. **Project Keywords:**

   Aquatic Plants
   At-risk species, fish
   Contaminants

5. **Type of project:**

   Implementation_Pilot

6. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

7. **Topic Area**:

   Ecosystem Water and Sediment Quality

8. **Type of applicant:**

   Joint Venture

9. **Location - GIS coordinates:**

   Latitude: 38.001

   Longitude: -120.001

   Datum:

   Describe project location using information such as water bodies, river miles, road intersections, landmarks, and size in acres.

   The Newton Mine is an abandoned copper mine located in amador County, six miles west of the city of Jackson, California adjacent to HWy. 88. The mine is on property identified by Amador County APN 11-160-009 in section 28 T6N, R10, MDB&m. The parcel consists of approx. 64 acres and is co-owned by Donald and douglas Mondani, and Geraldine Cassinelli.The Mine resides in the northeast quadrant of the 1130-acre copper Creek watershed. The mine is an identified source of AMD discharge into the tributary of Copper creek and has adversely impacted the aquatic, riparian, and wetland habitats in the vicinity of the mine.

10. **Location - Ecozone:**

    11.2 Mokelumne River

11. **Location - County:**

    Amador

12. **Location - City:**

    Does your project fall within a city jurisdiction?

    Yes

    If yes, please list the city: Jackson

13. **Location - Tribal Lands:**

    Does your project fall on or adjacent to tribal lands?

    No

14. **Location - Congressional District:**

    Fourth District

15. **Location:**

    California State Senate District Number: 1

    California Assembly District Number: 4

16. **How many years of funding are you requesting?**

17. **Requested Funds:**
    a) Are your overhead rates different depending on whether funds are state or federal?

    No

    If no, list single overhead rate and total requested funds:

    Single Overhead Rate: 44.3

    Total Requested Funds: 1,0,71,742

    b) Do you have cost share partners <u>already identified</u>?

    No

    c) Do you have <u>potential</u> cost share partners?

    No

    d) Are you specifically seeking non-federal cost share funds through this solicitation?

    No

    If the total non-federal cost share funds requested above does not match the total state funds requested in 17a, please explain the difference:

18. **Is this proposal for next-phase funding of an ongoing project funded by CALFED?**

    Yes

    If yes, identify project number(s), title(s) and CALFED program (e.g., ERP, Watershed, WUE, Drinking Water):

CALFED 01-N21	**Laboratory Testing Part of the Passivation Technology**	**CALFED-ERP**

Have you previously received funding from CALFED for other projects not listed above?

No

19. **Is this proposal for next-phase funding of an ongoing project funded by CVPIA?**

    No

Have you previously received funding from CVPIA for other projects not listed above?

No

20. **Is this proposal for next-phase funding of an ongoing project funded by an entity other than CALFED or CVPIA?**

No

Please list suggested reviewers for your proposal. (optional)

Charles Bucknam	**Newmont Mining Corporation**	**303-708-4430**	**Chbucknam@corp.newmont.com**
Arthur D. Chan	**Army Core of Engineers, Sacremento, CA**	**209-726-4477**	**Achan@spk.usace.army.mil**

21. **Comments:**

Environmental Compliance Checklist

<u>Pilot Demonstration of the Passivation Technology for Restoration of Newton Copper Mine</u>

1. **CEQA or NEPA Compliance**
   a) Will this project require compliance with CEQA?

      Yes

   b) Will this project require compliance with NEPA?

      No

   c) If neither CEQA or NEPA compliance is required, please explain why compliance is not required for the actions in this proposal.

2. **If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies).** *If not applicable, put "None".*

   <u>CEQA Lead Agency:</u> RWQCB
   <u>NEPA Lead Agency (or co-lead:)</u>
   <u>NEPA Co-Lead Agency (if applicable):</u>

3. **Please check which type of CEQA/NEPA documentation is anticipated.**

   CEQA
   -Categorical Exemption
   XNegative Declaration or Mitigated Negative Declaration
   -EIR
   -none

   NEPA
   -Categorical Exclusion
   -Environmental Assessment/FONSI
   -EIS
   Xnone

   If you anticipate relying on either the Categorical Exemption or Categorical Exclusion for this project, please specifically identify the exemption and/or exclusion that you believe covers this project.

4. **CEQA/NEPA Process**
   a) Is the CEQA/NEPA process complete?

      No

      If the CEQA/NEPA process is not complete, please describe the dates for completing draft and/or final CEQA/NEPA documents.

      Prior to initiating the work

b) If the CEQA/NEPA document has been completed, please list document name(s):

5. **Environmental Permitting and Approvals** (*If a permit is not required, leave both Required? and Obtained? check boxes blank.*)

LOCAL PERMITS AND APPROVALS

Conditional use permit	
Variance	
Subdivision Map Act	
Grading Permit	Required
General Plan Amendment	
Specific Plan Approval	
Rezone	
Williamson Act Contract Cancellation	
Other	Required

STATE PERMITS AND APPROVALS

Scientific Collecting Permit

CESA Compliance: 2081

CESA Compliance: NCCP

1601/03

CWA 401 certification

Coastal Development Permit

Reclamation Board Approval

Notification of DPC or BCDC

Other

FEDERAL PERMITS AND APPROVALS

ESA Compliance Section 7 Consultation

ESA Compliance Section 10 Permit

Rivers and Harbors Act

CWA 404

Other

PERMISSION TO ACCESS PROPERTY

Permission to access city, county or other local agency land. Agency Name:	
Permission to access state land. Agency Name:	
Permission to access federal land. Agency Name:	
Permission to access private land. Landowner Name: Geraldine Cassinelli	Required

6. **Comments.**

Land Use Checklist

Pilot Demonstration of the Passivation Technology for Restoration of Newton Copper Mine

1. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

2. **Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?**

   Yes

3. **Do the actions in the proposal involve physical changes in the land use?**

   No

   If you answered no to #3, explain what type of actions are involved in the proposal (i.e., research only, planning only).

   Research only.

4. **Comments.**

Conflict of Interest Checklist

<u>Pilot Demonstration of the Passivation Technology for Restoration of Newton Copper Mine</u>

Please list below the full names and organizations of all individuals in the following categories:

- Applicants listed in the proposal who wrote the proposal, will be performing the tasks listed in the proposal or who will benefit financially if the proposal is funded.
- Subcontractors listed in the proposal who will perform some tasks listed in the proposal and will benefit financially if the proposal is funded.
- Individuals not listed in the proposal who helped with proposal development, for example by reviewing drafts, or by providing critical suggestions or ideas contained within the proposal.

The information provided on this form will be used to select appropriate and unbiased reviewers for your proposal.

Applicant(s):

Mark Kravetz, Cherokee Chemical Co., Inc.
Larry Kamp, COUNSELTECH
Manoranjan Misra, University of Nevada, Reno
Raj Mehta, University of Nevada, Reno
Geraldine Cassinelli, Newton Copper Mine
Richard Kreth, Kreth, Inc.
Eric Downs, D & E Construction
Mark Jolles, NETAFIM USA

Subcontractor(s):

Are specific subcontractors identified in this proposal? Yes

If yes, please list the name(s) and organization(s):

Larry kamp	CounselTech
Richard Kreth	Kreth, Inc.
Eric Downs	D & E Construction
Mark Jolles	NetafimUSA

Helped with proposal development:

Are there persons who helped with proposal development?

Yes

If yes, please list the name(s) and organization(s):

Mano Misra University of Nevada, Reno

Raj Mehta University of Nevada, Reno

Comments:

Budget Summary

<u>Pilot Demonstration of the Passivation Technology for Restoration of Newton Copper Mine</u>

Please provide a detailed budget for each year of requested funds, indicating on the form whether the indirect costs are based on the Federal overhead rate, State overhead rate, or are independent of fund source.

<u>Independent of Fund Source</u>

Year 1												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary** ***(per year)***	**Benefits** ***(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1.1	Planning and Design	200	10,000	2,400	2000	0	0	0	0	14400.0	3,752	18152.00
1.2	Permitting	100	5,000	1,200	1000	0	0	0	0	7200.0	3,190	10390.00
1.3	Mobilization and Installation	960	48,000	11520	2000	22000	120000	0	0	203520.0	90,159	293679.00
2.1	Sample Collection and Monitoring	2000	60,000	14,400	3000	18,000	10,000	0	0	105400.0	46,692	152092.00
2.2	Analytical work	0	0	0	1000	5000	25000	0	0	31000.0	13733	44733.00
3.1	Core Characterization Work at UNR	1000	30,000	600	1000	12,000	0	0	0	43600.0	19315	62915.00
4.1	Project Management	800	40,000	9,600	500	0	0	0	0	50100.0	22194	72294.00
		5060	193000.00	39720.00	10500.00	57000.00	155000.00	0.00	0.00	455220.00	199035.00	654255.00

Year 2												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary** ***(per year)***	**Benefits** ***(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
5.1	Post Restoration	200	23,000	5520	1000	0	50,000	0	0	79520.0	35227	114747.00
5.2	Monitoring	3000	85,000	20,400	2000	5000	0	0	0	112400.0	49793	162193.00
5.3	Analytical	0	0	0	0	1,000	10,000	0	0	11000.0	4873	15873.00
5.4	Decommissioning	200	15,000	300	0	0	21,000	0	0	36300.0	16080	52380.00
6.1	Project Management	800	40,000	9,600	500	0	0	0	0	50100.0	22194	72294.00
		4200	163000.00	35820.00	3500.00	6000.00	81000.00	0.00	0.00	289320.00	128167.00	417487.00

Year 3												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary** ***(per year)***	**Benefits** ***(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Grand Total=<u>1071742.00</u>

Comments.

Budget Justification

Pilot Demonstration of the Passivation Technology for Restoration of Newton Copper Mine

Direct Labor Hours. Provide estimated hours proposed for each individual.

Mr. Mark Kravetz of Cherokee Chemicals and Drs. Misra and Mehta of University of Nevada, Reno will be salaried employees working on the project. In addition, two graduate students will also work on the project doing the core characterization work. Mark Kravetz will work 20 hrs week, Dr. Mehta will work 40 hours week, Dr. Misra will work 10 hours week. Students will work half time during academic year and full time during summer months. A dedicated technician will be working as coordinator.

Salary. Provide estimated rate of compensation proposed for each individual.

Mark Kravetz will be compensated $19,000 during first year and $12,000 during second year. Dr. Mehta will be paid $84,000 each year for two years. He will work as project manager and Quality Assurance Officer. Dr. Misra will be paid $20,000 during first year and $12,000 during second year. Two students will be paid $15,000 each during first year. Only one sutdent will work during second year and paid $15,000.

Benefits. Provide the overall benefit rate applicable to each category of employee proposed in the project.

The benefit rate for employees is 24% and for students is 2%.

Travel. Provide purpose and estimate costs for all non-local travel.

The purpose of non-local travel is to go to the sites and to meet different sub contractors paraticipating in the project. Estimated costs for travel is $10,500 for the first year and $3,500 for second year. This cost includes lodging, meals and other incidentals for employees and students participating in the project for traveling to and fro from the site and to attend and present technical papers during scientific meeetings.

Supplies & Expendables. Indicate separately the amounts proposed for office, laboratory, computing, and field supplies.

Office supplies is estimated to be $1000, computing supplies is estimated to be $2000, laboratory supplies is estimated to be $5,000 and the remaining amount $55,000 will be spent towards field supplies.

Services or Consultants. Identify the specific tasks for which these services would be used. Estimate amount of time required and the hourly or daily rate.

The work will be accomplished by using services provided by 5 companies and 1 university. In addition, an EPA certified laboratory will be contracted to do the analysis of estimated 279 samples (wasterock, influent and effluent). The total amount of contractual funds to be spent during first year will be $155,000 and during second year it is estimated to be $81,000. The breakup is as follows: Cherokee Chemicals $7,510 Kreth, Inc. $140,650 Counseltech $2,800 D&E Construction $12,266 EPABonded Lab $72,774 (wasterock + water analyses) NetafimUSA-No Cost The cost estimates of each subcontractor is appended to the proposal.Cherokee Chemicals estimates are as follows: 5500 lbs lime $935 2200 lbs magnesium oxide $725 100 lbs sodium hydroxide $65 250 lbs potassium permanganate $935 Spray tank rental $2300 Freight $2550 Total: $7510

Equipment. Identify non-expendable personal property having a useful life of more than one (1) year and an acquisition cost of more than $5,000 per unit. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items.

None

Project Management. Describe the specific costs associated with insuring accomplishment of a specific project, such as inspection of work in progress, validation of costs, report preparation, giving presentatons, reponse to project specific questions and necessary costs directly associated with specific project oversight.

We plan to hire a technician dedicated to the project who will coordinate site work, UNR work, coordinate with all contractors plus all the duties associated with the project management. The cost associated with this will be $40,000 per year for two years.

Other Direct Costs. Provide any other direct costs not already covered.

None

Indirect Costs. Explain what is encompassed in the overhead rate (indirect costs). Overhead should include costs associated with general office requirements such as rent, phones, furniture, general office staff, etc., generally distributed by a predetermined percentage (or surcharge) of specific costs.

Indirect Cost used here was 44.3%

Executive Summary

Pilot Demonstration of the Passivation Technology for Restoration of Newton Copper Mine

EXECUTIVE SUMMARY The objective of this proposal is to conduct an on-site pilot demonstration of the passivation for restoration of the Newton Copper Mine. The Newton Copper Mine site is located in an ecologically sensitive area. It is adjacent to Highway 88, which is five miles from the city of Jackson in Amador County, California. The site is easily accessible for pilot operation, data collecting, and monitoring. Cherokee Chemicals Company, in collaboration with the University of Nevada, Reno, will conduct the pilot demonstration project. The passivation technology developed at the University of Nevada, Reno will be used in the demonstration. The University of Nevada, Reno is conducting a laboratory scale research project funded by CALFED (project No. ERP-01-N21). Preliminary results obtained from the project show the strong potential for the passivation technology to be applied to the Newton Copper Mine. Other pilot scale test programs conducted by the EPA at the Gilt Edge Mine in South Dakota and the Golden Sunlight Mine in Montana have confirmed that the proposed technology can be applied to the Newton Copper Mine. However, the Newton Mine is an old abandoned copper mine which is located in a completely different environment. As a result, it is proposed to run a pilot demonstration test for two years at the site to establish the applicability of the technology in California sites. A highly qualified team of experts from different organizations has been assembled to conduct and assist in the investigation. The University of Nevada, Reno, the owner of the passivation process, will work with the prime contractor, Cherokee Chemicals Co., Inc. The research collaborators include: 1) the owners of the Newton Copper Mine; 2) Cherokee Chemical Co., Inc.; 3) COUNSELTECH, Inc.; 4) D & E Construction; 5) KRETH, Inc.; 6) NETAFIMUSA-Irrigation; and 7) Amador County RCD. In addition, the Department of Conservation, the Office of Mine Reclamation, and Amador County will be available as consultants. The demonstration pilot operation will be conducted at the Newton Mine site using three engineered and controlled cells. One pilot cell will be a controlled cell, and the other two will be the passivation demonstration cells. Each cell will be lined with 60 mil HDPE geomembrane and a single-sided geocomposite drainage layer. Each cell will be equipped with 30 spray stations. Only a lime neutralization process will be used in the controlled cell. One of the passivation demonstration cell will be injected with magnesium oxide slurry (UNR-process), and the other with a dilute basic permanganate solution in conjunction with magnesium oxide (Dupont process). The solution will be injected through irrigation channels. Leachate samples will be collected from the three cells at different heights and locations to determine the effectiveness of the process. The controlled and demonstration pilot cells will be monitored for pH and dissolved metals for a period of eighteen months. After that, remediated cells will be restored and monitored for an additional six months. In addition to the above parameters, other variables such as solution migration, channeling, effect of weathering, and any possible role of chemical activity will be established. The outcome of this investigation will develop a proven technology for remediation in other abandoned and inactive mine sites in the state of California. The immediate potential sites will be the Afterthought Mine and the Iron Mountain Mine. Large-scale laboratory tests in other sites have shown that there are no adverse impacts associated with the project.

Proposal

Cherokee Chemical Co., Inc.

Pilot Demonstration of the Passivation Technology for Restoration of Newton Copper Mine

Mark Kravetz, Cherokee Chemical Co., Inc.
Larry Kamp, COUNSELTECH
Manoranjan Misra, University of Nevada, Reno
Raj Mehta, University of Nevada, Reno
Geraldine Cassinelli, Newton Copper Mine
Richard Kreth, Kreth, Inc.
Eric Downs, D & E Construction
Mark Jolles, NETAFIM USA

PROPOSAL
Pilot Demonstration of the Passivation Technology For Restoration of Newton Copper Mine

Submitted To: CALFED Bay-Delta Program Office
1416 Ninth Street, Suite 1155
Sacramento, CA 95814

Applicant: Mark Kravetz
Managing Director, Mining
Cherokee Chemical Co., Inc.
3540 East 26th Street
Vernon, CA 90023
Tel: 800-767-9112
Fax:323-265-3111

In Collaboration with: Dr. Manoranjan Misra
Director , Center for Mineral Bioprocessing & Remediation
University of Nevada, Reno (MS 388)
Reno, Nevada 89557
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Participants

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Amador County RCD
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Jackson, CA 95642
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Fax: 209-223-3758

TABLE OF CONTENTS

A. PROJECT DESCRIPTION

A1. PROBLEM

Acid Mine Drainage (AMD) is a serious environmental problem facing many inactive, abandoned and active mine sites throughout the United States. The impact of AMD is particularly serious in the Western United States, where mining activities generated huge amounts of mine wastes. Nearly two billion tons of waste rocks, tailings and leach residues are generated each year by mining and processing of ores (Brandon-Pignolet et al., 1990). The mining waste containing sulfide minerals such as pyrite, marcasite, and pyrrhotite oxidize readily in the presence of oxygen, water and microorganisms to produce acid mine drainage (Misra, et al., 1993). The rate of oxidation depends on the sulfide content, morphology, and bacterial activity (Doyle and Mirza, 1990). It is estimated that more than 7,500 miles of rivers and streams are expected to be contaminated by AMD. In the state of California there are approximately 13 acid-generating mine sites. These sites need immediate attention in order to prevent damage to the watersheds, ecosystem, and habitat.

The project objective is to demonstrate the application of passivation technology in the remediation and restoration of the Newton Copper Mine. The Newton Copper Mine operated as an active copper mine through 1946. It is an abandoned copper mine located in Amador County, six miles west of the city of Jackson, California, adjacent to Highway 88. The location of the site is shown in **Figure 1.** The parcel consists of approximately 64 acres. Approximately 15,000 cubic yards of tailings at this site are the source of acid mine drainage.

A tributary to Copper Creek originates about a half-mile northeast of the Newton Mine. The tributary is intruded by a portion of the mine tailings before reaching its confluence with Copper Creek about a half-mile downstream of the mine. Copper Creek travels northwest about 1.5 miles, where it joins Sutter Creek, which flows west to Dry Creek, a tributary to the Mokelumne River.
The Mokelumne River joins the San Joaquin River in the region of the Delta. The Newton Mine resides in the northeast quadrant of the 1130 acre Copper Watershed. The mine is an identified source of acid mine discharge into the tributary of Copper Creek, and has adversely impacted the wetland habitats in the vicinity of the mine. This field demonstration will involve a Treatment Cell which will consist of three side by side cells: 1) Control Cell; 2) Passivation Cell – DuPont process; and 3) Passivation Cell – UNR process.

Figure 1

A2. JUSTIFICATION

It is imperative that preventative measures must be taken to mitigate acid mine drainage. One preventive measure is the coating of sulfides. Over the past few years, DuPont has developed a novel coating method, which is known as a passivation technology. Recently, DuPont Passivation Technology (De Vries, N.H.C., 1996 and Marshall et al., 1998) was donated to the University of Nevada, Reno (UNR) for further development of the process and commercialization. The passivation process can be used in-situ without removing the mining wastes, or it can be used ex-situ. In the meantime, the University of Nevada, Reno has developed another cost-effective technology, which is as promising as the DuPont technology.

A3. FEASIBILITY OF PASSIVATION TECHNOLOGY FOR NEWTON COPPER MINE

Three different Newton Copper Mine tailings were tested over the past year. Passivation and acid-generating potential of the tailings with and without treatment were conducted using the standard protocols, which were developed by the University of Nevada, Reno. Without any passivation (i.e., blank) the final pH of the solution was around 2.0 within the first five minutes, indicating that the tailings are indeed acid producing.

In the DuPont process, 10 grams of tailings were mixed with CaO, MgO and dilute basic $KMNO_4$ at pH 12.0. After mixing for three hours, tailings were filtered and washed. The passivated solid fractions were treated with 30% H_2O_2 to determine the acid-generating potential of the passivated sample. The system pH after H_2O_2 treatment was measured as a function of time. In the UNR process, the same amount of tailings was mixed with MgO and the pH of the suspension was adjusted to 10. For comparison, a series of control tests were conducted. In the control test, tailings were mixed with lime and the pH was adjusted to 12 with caustic. A similar conditioning and H_2O_2 treatment was used. Acid-generating potential of the passivated and controlled sample as determined by hydrogen peroxide treatment is given in **Figures 2-4**. For comparison, pH of the tailings in water (blank) is also given in the same figure.

The control test, which was treated with lime and caustic (without any permanganate and/or magnesium oxide), showed a temporary and short time buffering action when subjected to the acid-generating potential test using hydrogen peroxide. The pH of the solution dropped to 3 after 200 minutes for samples 5-8 and 23-2. Only sample 22-3 took almost 1400 minutes to reach pH 3. On the other hand, both the DuPont Process and the UNR Process were successful in controlling acid generation using the hydrogen peroxide treatment procedures for all three samples (5-8, 22-3 and 23-2).

The above preliminary tests showed that the Newton Copper Mine tailings can successfully be passivated. In addition , pilot plant operations in Gild Edge, South Dakota and Golden Sunlight Mine in Montana has shown that passivation process is effective in controlling AMD.

Figure 2. Solution pH Values in Peroxide Test for Newton Copper Mine Sample-2 (22-3)

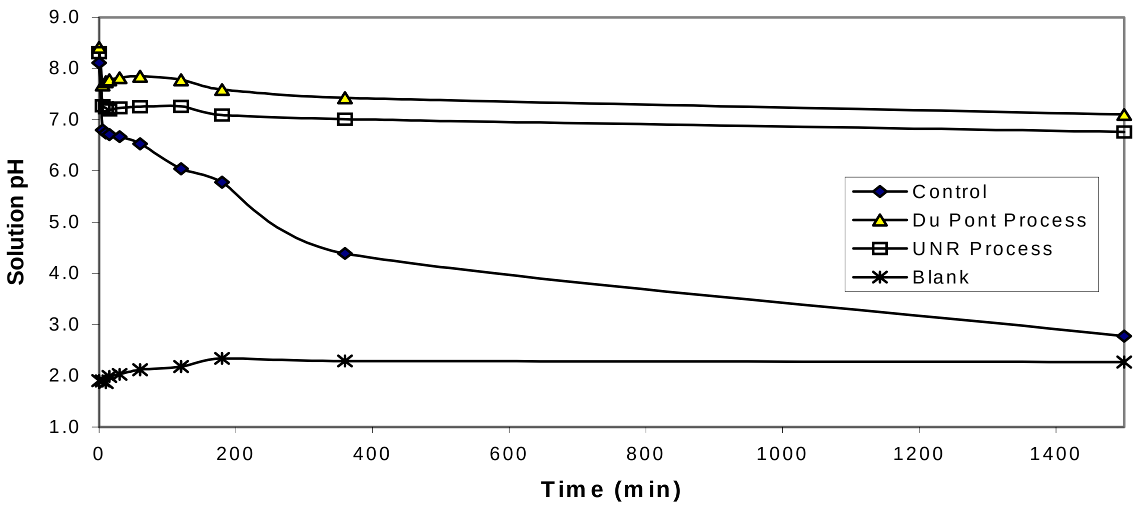


Figure 3. Solution pH Values in Peroxide Test for Newton Copper Mine Sample-1 (5-8)

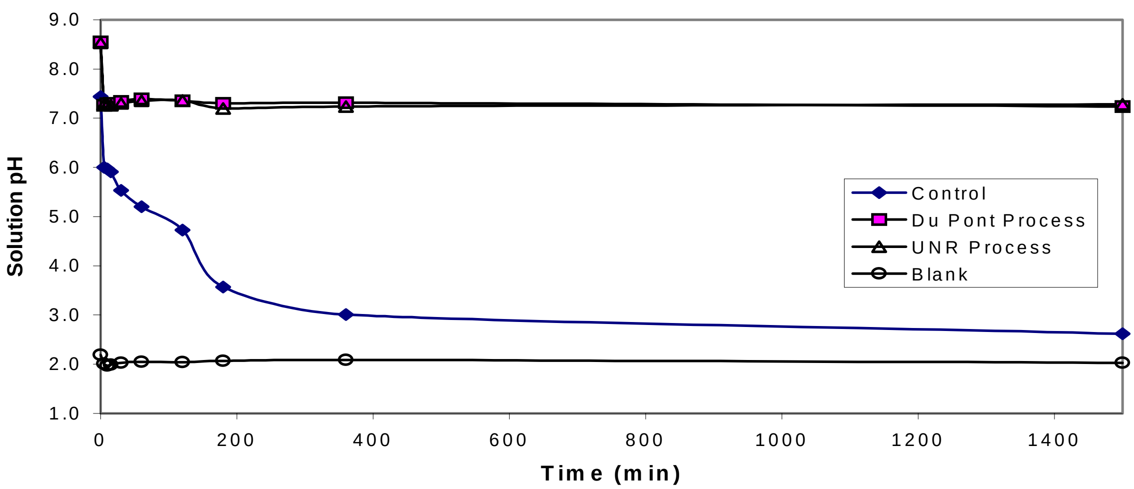
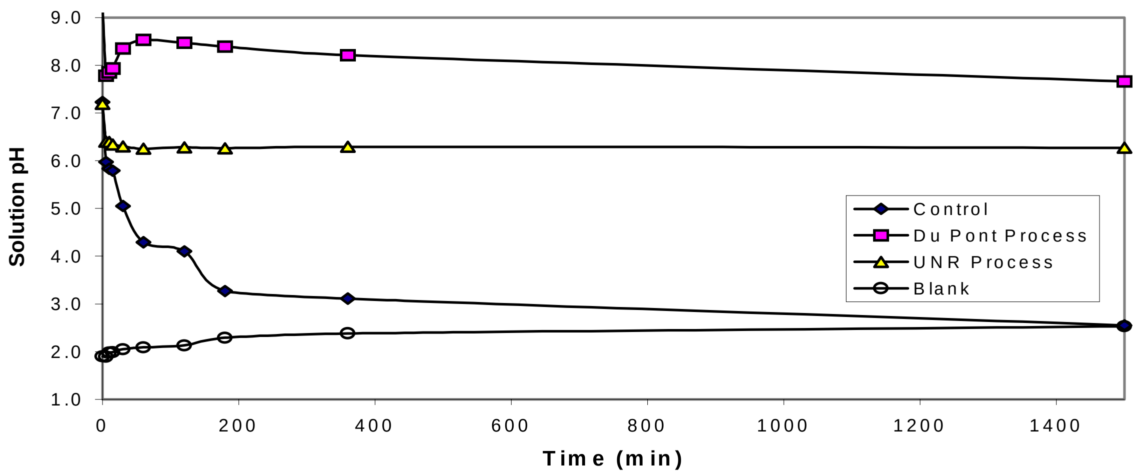


Figure 4. Solution pH Values in Peroxide Test for Newton Copper Mine Sample-3 (23-2)



A4. APPROACH

The passivation process essentially creates an inert layer on the sulfide phase by contacting the sulfide with a basic permanganate solution to produce an inert manganese-iron oxide layer. This layer prevents contact with atmospheric oxygen during weathering of the sulfide rock, thus preventing sulfuric acid generation as shown in **Figure 5**. Another critical element of the process is the addition of trace amounts of magnesium oxide during pH adjustment (Mehta, Chen, and Misra, 2000). Magnesium oxide addition enhances the coating strength. Recently, the University of Nevada, Reno has developed a magnesium oxide process, which is referred to as the UNR process. An Atomic Force Microscope (AFM) picture of a typical reactive pyrite (FeS_2) after passivation using the process is given in **Figure 6**. For comparison, the same pyrite particle before passivation is also presented in **Figure 6**. The massive nature of passivation coating can be seen clearly from **Figure 6**. The approach will be to conduct side by side testing at the Newton Mine site and at the University of Nevada, Reno so that the information may be complimentary. This section describes experimental design and procedures, equipment and materials, cell loading, treatment cell operation and monitoring, sampling and analysis, data analysis and interpretation, residual management and the parallel UNR tests such as long-term weathering tests and film stability tests.

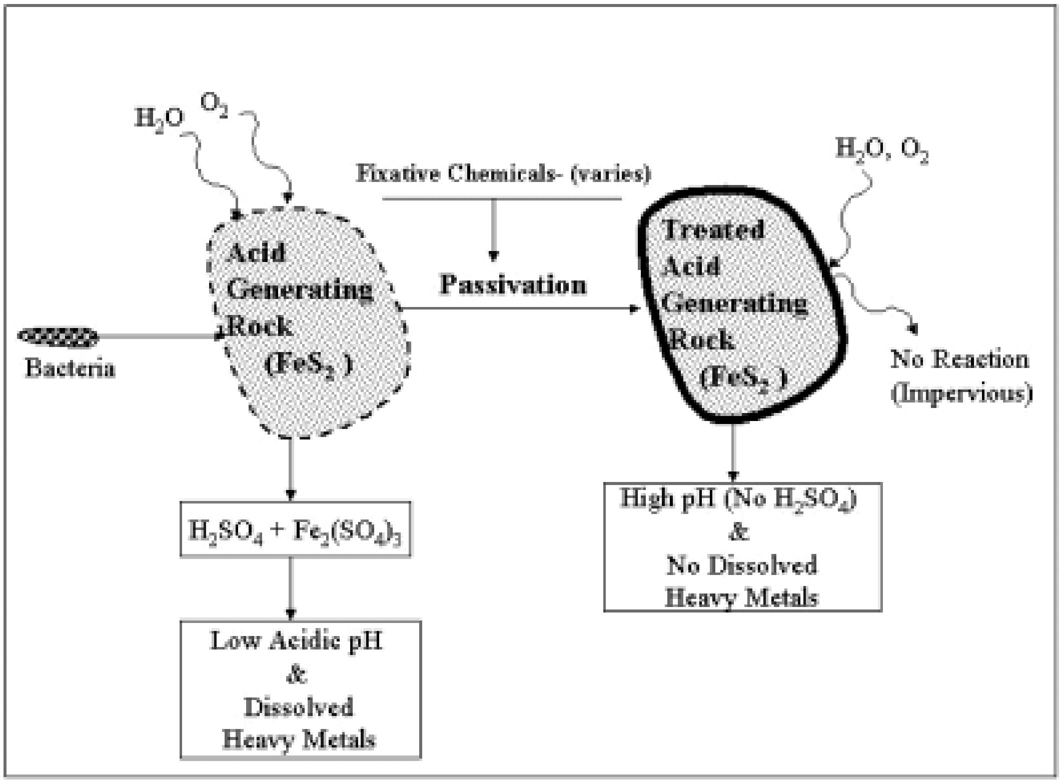


Figure 5. Acid Rock Passivation Process

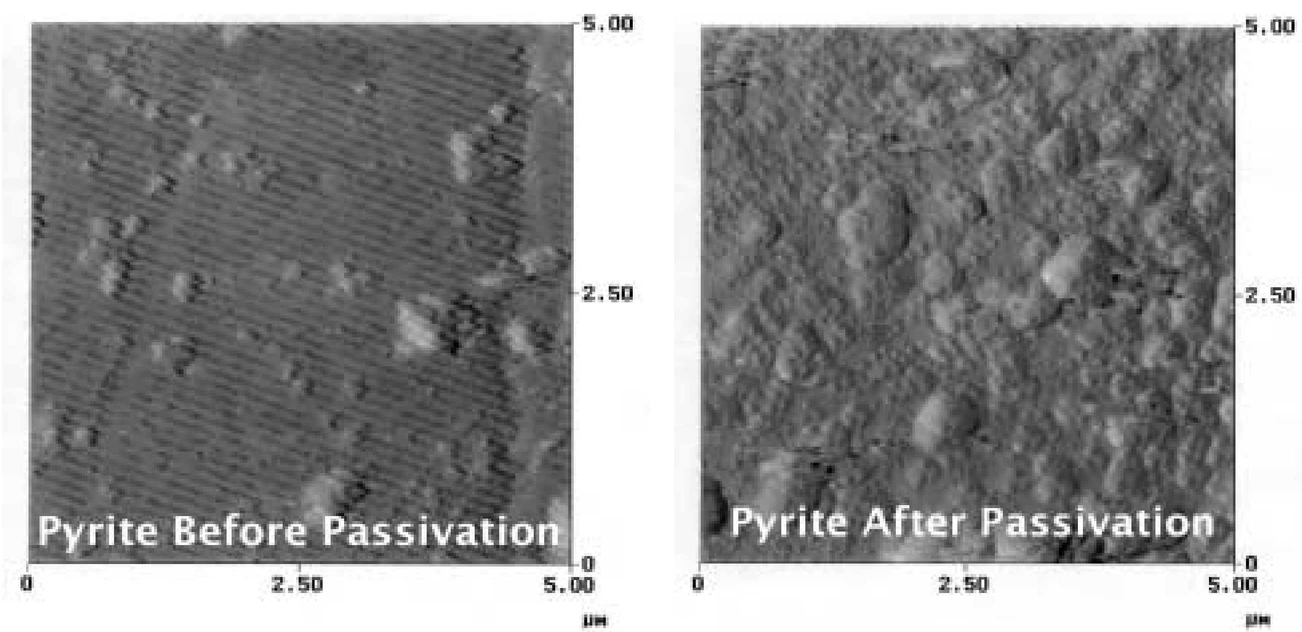


Figure 6. Atomic Force Microscope (AFM) picture of pyrite particle before and after passivation (5 micron scale)

A4-1. Experimental Design and Procedures

The experimental design identifies the tier and scale of testing, the volume of wasterock to be tested, the critical parameters, and the type and amount of replication. As previously stated, the study will provide site-specific information as treatability studies to aid in the development of remedial planning options for cleanup of the Newton Mine and provide valuable research findings that foster the development of potentially viable mine waste remediation technology. On the basis of the on-going R & D study currently performed by the UNR and funded by the CALFED (contract # 4600001469), the operational and performance information will be used estimate pilot scale treatment costs and schedules. Performance monitoring of the technology under site conditions will be conducted for two years. Approximately 185 cubic yards per cell will be tested. Critical parameters for the study include:

- Influent volume
- Residence time
- Reagent concentration

The total number of samples and QC samples will depend upon flow duration. Samples shown in **Table 3** are projected for a 2-year study.

Table 3
SAMPLE SUMMARY

Activity	Sample Source	Analysis								Total Samples (Rock and Water)
		Acid-Base Accounting (ABA)		Neutralization Potential (NP)		Target Analyte List (TAL) Metals		Water Quality Parameters		
		Sample	QC	Sample	QC	Sample	QC	Sample	QC	
Setup	Stockpiled Wasterock	6	1	6	1	6	1			21
	Treatment Cell Wasterock	6	3	6	3	6	3			27
	Treatment Cell Influent					2	1	2	1	6
Operation										
1st Month	Treatment Cell Influent					1		1		2
	Treatment Cell Effluent					27	3	27	3	60
Year 1	Treatment Cell Effluent					3	1	3	1	8
11 months	Treatment Cell Effluent					27	3	27	3	60
Year 2	Treatment Cell Influent					3	1	3	1	8
12 months	Treatment Cell Effluent					27	3	27	3	60
	Treatment Cell Residuals	6	3	6	3	6	3			27
	Total	18	7	18	7	108	19	90	12	**279**

A4-2. Sampling and Analysis

This section describes the types of samples that will be collected and specifies the level of quality control (QC) required.

A4-2.1 Sample Collection

Cherokee Chemicals and UNR personnel will be collecting the samples during the study. Sample personnel will be trained on proper sample collection, storage, shipment, and custody procedures in consultation with the CALFED officials.

A4-2.2 Testing Analysis

During the course of the study, various media will be tested and/or analyzed. Media will be defined as follows:

Stockpiled Wasterock- Wasterock removed from the wasterock source areas and stockpiled near the treatment cell area

Treatment Cell Wasterock- Wasterock-Wasterock loaded from the stockpile into the treatment cells.

Treatment Cell Influent- Water applied to the treatment cell through the irrigation system.

Treatment Cell Effluent- Leachate/effluent exiting the treatment cell through the PVC pipe and into the sample containers.

Treatment Cell Residuals-Wasterock present in the cell at the conclusion of the study.

Wasterock and water samples will be analyzed for the following parameters by an EPA CLP laboratory.

Wasterock Samples

- Acid-Base Accounting (ABA)
- Neutralization Potential (NP)
- Target Analyte List Metals (TAL)

Water Samples

- TAL metals
- Water quality parameters
- Field measurements (by portable field equipment)

Stockpiled Wasterock

After the wasterock has been transported to the stockpile area and reworked, six grab samples will be collected. Samples will be analyzed for the following parameters:

- Acid-Base Accounting (ABA)

- Neutralization Potential (NP)
- Leachate TAL metals

A statistical evaluation of the results will be performed to determine sample mean, median, and standard deviation.

Treatment Cell Wasterock

Two grab samples will be collected from each treatment cell during loading of the cell. These samples will be collected randomly, and collected prior to reagent application. Samples will be analyzed for:

- Acid-base Accounting (ABA)
- Neutralization Potential (NP)
- Leachate TAL metals

A statistical evaluation similar to the performed on the stockpile wasterock will be performed.

Treatment Cell Influent

Water used to irrigate the treatment cells will be periodically tested. The samples will be collected from a sample port located at the terminus of the main line. Two samples will be collected prior to the start of the study. Samples will be collected at a rate of one per month, if irrigation is occurring. However, if significant deviation in the water chemistry is observed the collection rate frequency will be increased. Samples will be analyzed for:

- TAL metals
- Water-quality parameters
- Field Measurements

Treatment Cell Effluent

Treatment cell effluent will be collected on a semiweekly basis during the first month of the study. Samples will be collected on weekly basis for the next 6 months and on a monthly basis thereafter. During winter months, treatment cells will be inspected for effluent flow. The following flow events/conditions and resulting sampling strategy will be implemented.

Short-Duration Flow Event- A short-Duration flow event is defined as a discharge from the treatment cell (effluent) lasting less than 24 hours. If a sufficient volume of effluent is flowing from the pipe, the sample will be collected from the pipe prior to entering the 1st sample container. These samples will most likely be collected following the application of irrigation water to the cell.

Long-Duration Flow Event- A long duration flow event is defined as a discharge from the treatment cell (effluent) lasting longer than 24 hours. The sample will be collected from the pipe prior to entering the 1st sample container. These samples will most likely be collected following intense, long duration storm event.

Samples will be analyzed for:

- TAL metals
- Water-quality parameters

- Field Measurements

<u>Treatment Cell Residuals (at completion of study)</u>

Following completion of the study, the cells may be profiled (reagent reactions variation with depth). During this profiling, at least two samples from each cell will be analyzed for:

- Acid-Base Accounting (ABA)
- Neutralization Potential (NP)
- Leachate TAL metals
- Leachate pH
- Scanning Electron Microscopic Characterization

A4-3. Equipment and Materials

This section describes the equipment, materials, and reagents that will be used in the performance.

A4-3-1. <u>Treatment Cell Installation</u>

The treatment cell area will be selected in such a way that the study could be conducted over several years without impacting site operations if any or effect potential future remedial activities. Three treatment cells will be constructed The dimension of each treatability cell will be 10-ft wide by 40-ft long. The back of the cell will be 20-ft high and the front of the cell will be 5-ft high resulting in a slope of 40% on the top of the cell . Each cell will contain 185 cubic yard (approximately 250 tons) of waste rock. A total of 750 tons will, therefore, be treated in three cells. To facilitate structural strength synergy, the cells will share a common wall as shown in **Figure 7-8.** Heavy equipment (such as front-end loader and excavator) and labor will be used to facilitate the loading of the cells. The following procedure will be used for each of the three cells:

Figure 7. View of a Cell filled with Wasterock

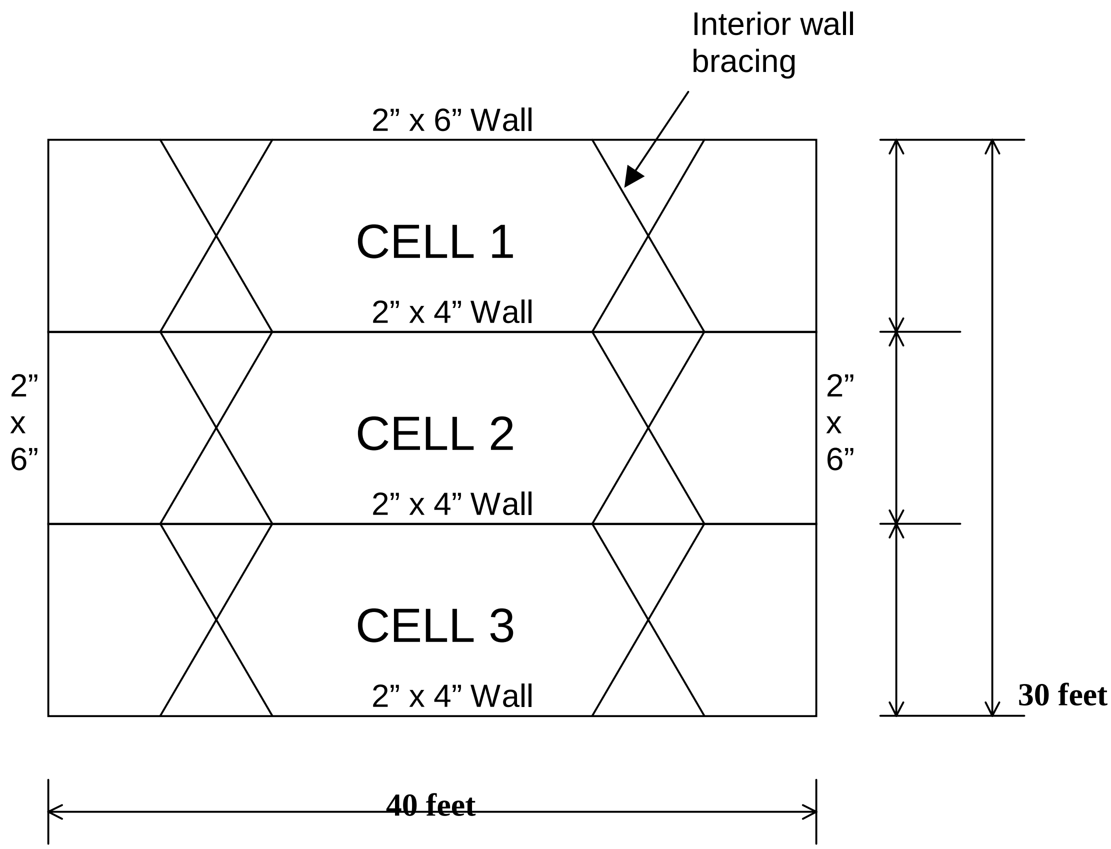


Figure 8. Design of the Treatment Cell Consisting of the Three Side-by-Side Cells

A4-3-1.1 **Bed Preparation:** The treatment cell footprint will be carefully surveyed. The area will be sacrified to a depth of 1 foot within the footprint. The material will be reworked to remove large rocks that can not be removed by hand. Compaction of the footprint foundation will be achieved by repeated passes by heavy equipment. The foundation will be prepared in accordance with the PVC liner's manufacturer's recommendation.

A4-3-1.2 **Wall Construction:** The walls of the treatment cell will be constructed of a common stud lumber frame and CDX exterior plywood sheathing. The 2-inch by 4-inch studs will be secured to a 2-inch by 4-inch header/sole plate using 16d (penny) nails on 12-inch centers. Studs will be cut to appropriate length and angle. Each frame section will be adequately braced during assembly of cell.

The CDX plywood sheathing will be placed on the frame. Galvanized nails (8d) will secure the sheathing to the frame. Nails will be placed on 6-inch on center at edge and 8-inch on center in field.

A4-3-1.3 **PVC Liner:** Prior to placing the PVC liner, the bed of the cell will be prepared. Using fill material, a 3% slope will be established in each cell. Grade stakes will be used to ensure slope. Additional imported material will be used along the back and sidewalls to create a basin in the middle of the channel where the PVC pipe will be placed. A 30-mil PVC liner will be placed in each treatment cell. The material will be selected based on contability of the liner with the acid generating wasterock and the reagents to be used in the study, compatibility, durability, and longevity.

The liner will be cut so folds and ripples are not present in the cell. All nails used to secure the liner will be within the freeboard of the loaded cell. To prevent damage to the PVC liner, an 8-oz non-woven geotextile lining will be placed over the PVC liner. In addition, geotextile will be placed over support fill material along sidewalls to minimize erosion. A pipe boot will be field welded on the front wall liner.

A4-3-1.4 **Effluent Pipe and Sample Collection Basins:** A perforated 3/4-inch diameter PVC pipe will be placed on the floor of the liner and along the longitudinal axis of the cell. To prevent clogging of the 0.10-inch slot perforation, a 5-ounce filter fabric will be wrapped around the pipe along its entire length. An end cap will be placed on each pipe. Pipe joints will be welded using a PVC premier and glue. Fine grained crushed rock or sand will be used to support the bottom and sides of the pipe.

A temporary end cap will be attached to the pipe during waste rock loading. Flexible couplers will be used to attach the perforated pipe to the pipe extending from the pipe boot. The pipe will be covered with sand to prevent damage to pipe and liner.

A series of collection basins will be placed at the exterior base of each cell. The basins will consist of "p" trap to prevent air from entering the cell from the pipe and three 5-gallon plastic containers. The basins will be configured to allow treatment cell effluent to cascade from one container to the next. The containers will be sealed to prevent non-cell effluent from entering the container. Each container will be equipped with a cap to facilitate sampling. A flexible rubber hose will attach the pipe extending from the pipe boot to the first container.

A4-3-1.5 **Irrigation System:** To simulate precipitation events, an irrigation system will be constructed for each cell. The system will consist of meters, valves, a main feed line, secondary lines and risers, and sprinkler heads. The system will be constructed after all wasterock has been loaded into the cell. The water will be pushed under pressure through a 2-inch plastic pipe to the cell area. A reducer will be used to size the pipe from 2 inch to 3/4 inch. A totalizer will measure the volume of water applied to each cell for each simulated event. A drain plug will be used to drain the system.

A4-3-1.6 **Time Domain Reflectometry (TDR) Moisture Measuring Equipment:** Two TDR probes will be placed in each cell to measure moisture content in the cell. The probes will be permanently buried within the wasterock material. Probes will be connected to the Trase System to measure the volumetric water content of the wasterock. Wasterock will be placed around the probes to prevent damage to the probes.

A4-3-1.7 **Wasterock Temperature Probe:** Temperature probes (HOBO's) will be placed in each cell during loading of wasterock into the cell. These probes are placed in the sells to measure temperature increase/decreases associated with sulfide oxidation/acid generation.

A4-3-1.8 **Tubing:** Medical grade tubing will be inserted in each treatment cell so that oxygen generation can be monitored. It will be sealed to eliminate the possibility of oxygen entering the pile via the tubing. During visits, the tubing will be connected to a peristaltic pump and connected to an oxygen sensor.

A4-4. Cell Loading

- A front-end loader will remove sufficient waste rock from the homogenized stockpile to construct a one-foot thick layer in one test cell. It is estimated that 20 tons of rock will be required for this. The rock will be placed in the "mixing coral".

- Lime and magnesium oxide will be added to the rock in the mixing coral. Application of the technology requires that 11 lb. lime/ton and 4.4 lb. magnesium oxide/ton be used. Based on the estimated waste rock tonnage for a one-foot thick layer in the test cell of 20 tons; 220 lb. lime and 88 lb. magnesium oxide must be added to the waste rock in the mixing coral.

- The waste-rock and the reagents will then be thoroughly mixed using a front-end loader in the mixing coral.

- After mixing, the loader will load the mixed waste-rock into the assigned cell. Treatment will consist of adding a dozen 20-tonbatches per cell. Each batch will provide for a one-foot lift in the treatment cell. Waste rock will be added to treatment cells one cell at a time to maintain integrity of the structure.

- We will insure that each 20-ton batch contains the proper amount of lime (220 lbs.) and MgO (88 lbs.). A scale will be used to insure accuracy. Once the bed is placed and leveled, a liquid reagent of dilute potassium permanganate will be sprayed on top of each bed. This will be accomplished using a 150-gallon feed tank that will contain 150-gallons of water, 1 gallon of 50% liquid sodium hydroxide, and 25 lbs. of potassium permanganate to make 2% solution. Mixing will take place with a self-contained recirculation pump. A low-pressure spray nozzle with 200 feet of extension hose will be used to feed the permanganate solution. We will produce just enough permanganate solution in the 150-gallon feed tank so that no solution is left over at the end of the day. Application of 50 to 55 gallons of the permanganate solution per batch will take approximately 10 minutes. On -site water will be supplied by a 500-gallon mobile water truck. Water supply for the truck will be within 1000 ft of treatment cells. Due to the low volume of permanganate solution added to the treatment cell, effluent from the cell is not anticipated. Therefore no measuring of the permanganate concentration or the pH of the effluent will be performed.

A4-5. Treatment Cell Operation and Monitoring

- Once the three cells have been loaded, the cells will receive meteoric precipitation, which will be augmented by applied moisture by the use of sprinklers. Multiple rain gauges will be placed in each cell to measure the amount of moisture received. Influent water will be taken from the site and be analyzed periodically for metals, sulfate, pH, etc. A perforated pipe placed in the bottom of each cell will collect leachate and deliver it to a sample collection basin. Effluent water will be analyzed regularly for metals, anions, pH, etc. Calculated cell porosity and a gamma probe will be used to determine the wetting front in each cell. This information will be evaluated to determine frequency and quantity of simulate precipitation events. It is anticipated that approximately 0.2 inches of water will be applied to each cell every third day of the study. Irrigation of the cells will be suspended if windy conditions occur.

- The following observations will be made on a daily basis: Structural integrity of cells; integrity of irrigation system; physical appearance of waste rock, drainage patterns; effluent flow rate; effluent field parameters and characteristics; rain gauge measurements; and weather. Treatment cell effluent samples are anticipated to be collected on a semiweekly basis during the first month of the study. Samples are anticipated to be collected on weekly basis for the next 6 months and on a monthly basis thereafter.

- A personnel team consisting of members from Cherokee Chemicals and UNR will oversee treatability cell loading and the passivation process application.

A4-6. Residual Management (Dismantling of Test Cells and Post-Remediation Activity)

As discussed earlier, two of the passivated cells will be monitored for a period of twelve months. It is proposed to revegetate the passivated tailings using native perennial plants and seeding. Following the revegetation, the growth characteristics of the plants and flow-through the restored pilot pads will be monitored for an additional nine months. During that period, pH and concentration of dissolved metals will be monitored. This phase of the study will establish the aesthetic and ecological suitability of the process.

In addition, the cells, which were prepared to give baseline information, will be treated with the passivated chemicals for final remediation and restoration. The controlled cell passivation will be initiated simultaneously with the restoration activity. Demo residuals will include:

- Treated wasterock;
- Treatment cell (frame, liner, and sample container); and
- Laboratory samples and containers.

Wasterock will be remediated in accordance with the Record of Decision. The treatment cell frame, liner, and sample containers will be cleaned (hot water) and disposed in an approved landfill or disposed of on site. Laboratory samples will be consumed in the analysis and/or disposed of by the laboratory.

A4-7. Core Characterization Tests

In addition to conventional chemical analysis, samples of core materials from three different cells will be removed in a timely manner and examined by Scanning Electron Microscope (SEM), Energy Dispersive X-ray Analysis (EDXA), and Atomic Force Microscopy (AFM). This task will be conducted in parallel with the monitoring task. This work will be conducted at UNR.

A5. PERFORMANCE MEASURES

Performance measures of the demonstration will include achieving quantitative performance goals based on the anticipated cleanup criteria to be established in the Record of Decision (ROD). Since cleanup criteria have not been established for the site, therefore a 90% reduction in the contaminant concentrations will generally be an appropriate performance goal. This level of performance is in agreement with EPA's guideline established in the 1990 revised NCP, which states that treatment as part of CERCLA remedies should generally achieve reductions of 90 to 99 percent in the concentration or mobility of individual contaminants of concern, although there will be situations where reductions outside the 90 to 99 percent range that achieve health based or other site specific remediation goals will be appropriate (55 FR 8721). In addition to contaminant reduction percent discussed above, the national ambient water quality criteria (AWQC) and California AWQC (i.e., State AWQC) will be adopted as performance goals of the study. For both national and State AWQC, several contaminants of potential concern have criteria that vary depending on water hardness, therefore, this parameter will also be measured.

A6. DATA HANDLING (ANALYSIS & INTERPRETATION)

This section describes the procedures for recording observations and raw data in the field or laboratory, including the use of bound notebooks, data collection sheets, and photographs. All data will be reviewed and validated/evaluated in accordance with QAPP.

Data will be summarized in tabular and/or graphic form. Data presented graphically, independent variable will be plotted on the abscissa and the dependent variable will be plotted on the ordinate. Preliminary identified variables are as follows:

Independent Variables
Water
Time
Wasterock metal concentration
Channelization/residence time

Dependent Variables
pH
Metals concentration

A statistical evaluation will be performed to identify statistically significant difference in treatment effectiveness between dependent variables and treatment cells. Statistic evaluation may include use of analysis of variance (ANOVA) and covariance (ANCOVA) and other methods to provide some additional information about the direction in which the mean is trending and its stability.

The study will provide data to address the following criteria:

1. Overall protection of human health and the environment;
2. Compliance with applicable or relevant and appropriate requirements;
3. Long-term effectiveness and permanence;
4. Reduction of toxicity, mobility, and volume through treatment;
5. Short-term effectiveness;
6. Implementability;
7. Cost;
8. State acceptance; and
9. Community acceptance.

A7. EXPECTED PRODUCTS/OUTCOMES

It is expected that the study will result in the following outcomes:

1. Documentation and performance evaluation of the passivation technology under site conditions;
2. Develop preliminary design for full scale implementation of the passivation technology;

A8. WORK SCHEDULE

The work schedule is presented in **Table 4**.

Table 4. Quarterly Project Schedule for Project Duration of Two Years

Activities	Year1-1Q			Year1-2Q			Year1-3Q			Year1-4Q			Year2-1Q			Year2-2Q			Year2-3Q			Year2-4Q		
Planning & Submittal	x																							
Agency Review & modification		x																						
Permitting			x																					
Mobilization Project				x																				
Installation					x																			
Monitoring & Sample Collection						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Analytical						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			
Core Characterization							x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Post Restoration																			x	x	x	x	x	
Decommissioning																				x	x	x	x	
Final Report																								x

B. APPLICABILITY TO CALFED ERP

B1. CALFED ERP

This project specifically addresses the ERP's strategic objective, targets, and programmatic actions associated with the loading of toxic pollutants and contaminants in all aquatic environments in the CALFED region. The common goal is the reduction of concentrations and loading of metal contaminants to eliminate the adverse impact to the aquatic environment. The project is also in direct accordance with the CALFED Ecosystem Restoration Program Goal No. 6, which includes the maintenance of water quality to eliminate toxic impacts on ecosystem organisms. These common goals will assist the overall CALFED objectives to improve the quality of the Bay-Delta ecosystem via ERP. Additionally, the restoration of the Newton Mine can be used to further demonstrate appropriate long-term preventative solutions to abandoned mine remediation in California. The Water Quality Program will need such studies as they progress into the enormous issue of restoration of abandoned mine lands. The Newton Mine exists under Cleanup and Abatement Order No. 98-178 issued by CVRWQCB on May 20, 1998. The proposed funding is requested to initiate the pilot operation, which will lead to the complete prevention of AMD and restoration of the site.

B2. RELATIONSHIP TO OTHER ECOSYSTEM RESTORATION PROJECTS

This project will provide direct benefits for CALFED objectives addressing water quality. CALFED programs associated with watershed management are also benefited by this project. Benefits to third parties will include improved water quality for downstream users and aesthetic improvements to the mine site and surrounding environment.

B3. REQUEST FOR NEXT PHASE FUNDING

At this time, Cherokee Chemicals has plans to submit proposals for next phase of funding in this area related to the full scale implementation of the Passivation Technology at Newton Mine.

B4. PREVIOUS CALFED FUNDING

Cherokee Chemicals has not received prior CALFED funding, however we have worked closely with the UNR on this technology at other mine sites. UNR has received previous CALFED funding and currently has an active laboratory R & D project.

B5. SYSTEM-WIDE ECOSYSTEM BENEFITS

The system-wide benefits of this project will be largely related to water quality and the demonstration of appropriate ecosystem restoration methods for abandoned mine remediation. The improved health of the environment that was adversely impacted by the mine will benefit the overall ecosystem of the region by enhancing the natural processes vital to the balance of the system. The positive benefits of this project in the form of an improved aquatic environment will compliment other ecosystem restoration projects in the state of California.

Compatibility with Non-Ecosystem Objectives

This project will provide direct benefits for CALFED objectives addressing water quality. CALFED programs associated with watershed management are also benefited by this project. Benefits to third parties will include improved water quality for downstream users and aesthetic improvements to the mine site and surrounding environment.

B6. LAND ACQUISITION

The project does not involve land acquisition.

C. QUALIFICATIONS

Cherokee Chemical Company, COUNSELTECH, Kreth, Inc, D & E Construction and NETAFIM USA will conduct the actual on-site testing and engineering work. **Mark Kravetz** of Cherokee Chemical, Inc. is the Managing Director of Mining Applications. He has been involved in acid mine drainage and wastewater treatment for over 15 years. **Mr. Kravetz** has worked directly with Newmont Mining, Barrick, Placerdome, and Hecla Mining Company. Cherokee Chemical Company will be the prime subcontractor to run the passivation demonstration on-site along with COUNSELTECH. Larry Kamp is the President of COUNSELTECH. Mr. Kamp has designed many heap operations with appropriate instrumentation. Mr. Kamp will be involved in the construction of the passivated pads. D & E construction of VISALIA, California, Kreth, Inc. of IONE, California and NetaFim, USA will work with COUNSEL-TECH.

The University of Nevada, Reno (UNR) will act as subcontractor to the Cherokee Chemicals. **Dr. M. Misra**, Director of the Center for Mineral Bioprocessing and Remediation has been involved in AMD and other mines related problems since 1988. They will be in-charge of analytical protocol, QA, and monitoring aspects of the project. **Dr. M. Misra** has over 19 years experience in the research and development of process remediation and control of acid mine drainage. **Dr. Misra** is Professor and Chairman of the Metallurgical and Materials Engineering department of the University of Nevada, Reno. He is also the Director for the Center for Mineral Bioprocessing and Remediation. He has six patents in the areas of heavy metals and the removal and treatment of acid mine drainage. He has improved the original DuPont passivation technology as applied to AMD. **Dr. Misra** has worked on several acid mine drainage projects including Iron Mountain Mines, Newton Copper Mine, and the Afterthought Mine, all in California. He has worked on other AMD projects involving Hecla Mining Company in Idaho, Brohm's operation in South Dakota and the Newmont Mining operation in Nevada. **Dr. Raj Mehta**, Research Professor, University Center for Environmental Sciences and Engineering will work as QA officer and will oversee day to day monitoring and analytical operations.

Ms. Geraldine Cassinelli, one of the owners of the Newton Mine, will be responsible for permitting and on-site engineering coordination work.

D. COST

Please see the attached Forms VI and VII.
Cost Sharing- None.

E. LOCAL INVOLVEMENT

The proposed project involves coordination with county and local government to maintain understanding of the proposed remediation/restoration project. Local environmental groups, conservancies, and local landowners are being notified to ensure awareness of the project and its associated impacts. Copies of Letters of Support from Congressman John T. Doolittle, Senator Tim Leslie, Assembly man Thomas Rico Oller and Director of General Services Administration Trevor Mottishaw of Amador County are included as an attachment. Organizations and groups that have been notified include:

- Amador County Board of Supervisors
- Mokulemne River Watershed Group
- Amador County RCD
- Office of Congressman J.T. Doolittle

The plan for public outreach will include the posting of public notices to concerned parties and public meetings conducted by the Amador County Board of Supervisors and the Amador County RCD. Potential third party impacts will be positive and realized as improvements to the health and aesthetic values of the ecosystem and water quality of the Copper Creek watershed.

F. COMPLIANCE WITH STANDARD TERMS AND CONDITIONS

We will comply with the Standard State and Federal contract terms described in Attachments D and E.

G. LITERATURE CITED

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