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STATE OF ARIZONA

## DEPARTMENT OF MINES AND MINERAL RESOURCES

Mineral Building • State Fairgrounds • Phoenix, Arizona 85007

(602) 255-3791

### MEMORANDUM

FROM: Arizona Dept. of Mines and Mineral Resources

DATE: October 20, 1989

It's a pleasure to distribute some good news for change. All mining interests, especially those with claims on U.S. National Forest lands will be pleased with the attitude expressed in the attached policy statement by Chief Forester F. Dale Robertson.

Additionally, I want to remind you that we have a toll free "1-800" number to our Phoenix office which can be used in calling us from anywhere in Arizona. It is 1-800-446-4259. Our Tucson office is open and staffed by an engineer Monday and Tuesday of each week from 8 A.M. to 5 P.M. Further, on Wednesdays, Thursdays and Fridays our Tucson office phone number, 628-6340, automatically rings in our Phoenix office at no additional charge to the caller.

Enclosures



**AMERICAN  
MINING  
CONGRESS**

FOUNDED 1897  
Suite 300  
1920 N Street N.W.  
Washington, D.C. 20036  
202/861-2800  
TWX 710/822-0126  
Easylink 62756020  
John A. Knebel  
President

MEMORANDUM

September 29, 1989

TO: AMC Public Lands Committee and Associates  
State Mining Associations--Noncoal

FROM: Keith R. Knoblock

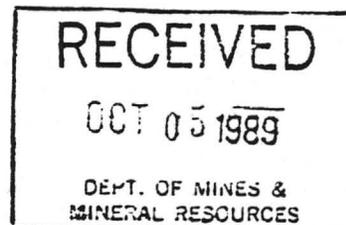
RE: Forest Service Minerals Program Policy

F. Dale Robertson, Chief of the Forest Service, has sent a memorandum (enclosed) to Regional Foresters which stresses the importance of mineral resources on National Forests and directing adherence to the minerals program policy.

He said, "there are indications that this policy is not understood by some of our line and staff officers" and asked that forest supervisors and regional staff be made aware of the responsibility to comply with this policy.

Robertson also stressed the importance of meeting regulation timeframes for approval of mineral operations. He said that "unreasonable delays are unacceptable."

Enclosure



FOREST SERVICE  
MINERALS PROGRAM POLICY

The availability of mineral and energy resources within the National Forests and Grasslands significantly affects the development, economic growth, and defense of the Nation. The mission of the Forest Service in relation to minerals management is to encourage, facilitate, and administer the orderly exploration, development, and production of mineral and energy resources on National Forest System lands to help meet the present and future needs of the Nation.

The Forest Service administers its mineral program to:

1. Encourage and facilitate the orderly exploration, development, and production of mineral and energy resources within the National Forest System in order to maintain a viable, healthy minerals industry and to promote self-sufficiency in those mineral and energy resources necessary for economic growth and the national defense.
2. Ensure that exploration, development, and production of mineral and energy resources are conducted in an environmentally sound manner and that these activities are considered fully in the planning and management of other National Forest resources.
3. Ensure that lands disturbed by mineral and energy activities are reclaimed for other productive uses.

The Forest Service policy is to:

1. Process mineral applications, operating plans, leases, licenses, permits and other use authorizations efficiently and timely.
2. Ensure that mineral resource programs and activities are a part of the planning and management of the National Forest System through the land and resource management planning process (FSM 1922), recognizing that mineral development can occur concurrently or sequentially with other resource uses.
3. Plan and provide for access to and occupancy of National Forest System lands for mineral resource activities, consistent with the overall management objectives and the rights granted through statutes, leases, licenses, and permits. Eliminate or prevent occupancy that is not reasonably incident to and required for mineral operations.
4. Ensure prior to applying for the administrative withdrawal of National Forest System lands from mineral entry, the consideration of (a) the national interest in strategic and critical minerals (b) the value of the mineral resource foregone (c) the value of the resource or improvement being protected (FSM 2760).
5. Ensure that valid existing rights have been established before allowing mineral or energy activities in congressionally-designated or other withdrawn areas.
6. Coordinate and cooperate with other Federal and State agencies having authority and expertise in mineral-related activities.

FOREST SERVICE  
MINERALS PROGRAM POLICY

7. Maintain an effective professional, technical, and managerial work force that is knowledgeable in mineral exploration and development.
8. Ensure the uniform application of exploration, development, and reclamation standards.
9. For all mineral exploration and development proposals that would create environmental disturbance require a reclamation plan to return the land to other productive uses consistent with land and mineral management goals.
10. Showcase mineral development on the National Forest System to demonstrate harmony with other resources and land uses.

United States  
Department of  
Agriculture

Forest  
Service

WO

Reply to: 2800

Date: September 15 1989

Subject: Minerals Program Policy

To: Regional Foresters

*... distributed as another  
membership service by the  
American Mining Congress*

The enclosed Forest Service Minerals Program Policy is summarized from FSM 2800 Zero Code.

I want to personally stress the importance of mineral resources on the National Forests and Grasslands and their development. It is imperative that all of our people understand and follow this policy.

~~There are indications that this~~ policy is not understood by some of our Line and Staff Officers. We must all ensure that this policy is recognized and followed. Therefore, I am asking all Regional Foresters to personally ensure that Forest Supervisors and Regional Staff are aware of their responsibility for compliance with this policy.

~~I also want to stress~~ the importance of meeting regulatory timeframes for approval of mineral operations. Unreasonable delays are unacceptable.

In the review and implementation of this policy, I am further asking that the following be emphasized:

- a. A key objective of the minerals program is to encourage and facilitate the orderly exploration, development, and production of mineral resources.
- b. Demonstrate that minerals can be extracted from National Forests and Grasslands in a way that is sensitive to other resource values and uses of the land.
- c. Managers must develop a good understanding of the minerals industry, its practices, and the mineral laws and regulations.
- d. The Forest Service and industry must develop a strong working relationship so that problems are solved at the ground level and not unduly elevated to the Regional or Washington Offices.

e. Visibility and interaction with the minerals industry must be increased at all levels of the organization by attendance and participation of Line Officers and appropriate staff at industry and professional association activities and meetings.

f. Assure that directories, organization charts, and receptionists direct the mineral industry to personnel who have minerals administration responsibilities.

/s/ George M. Leonard (for)

F. DALE ROBERTSON  
Chief

Enclosure

cc: Forest Supervisors  
District Rangers



**A.F. Budge (Mining) Limited**

4301 North 75th Street  
Suite 101  
Scottsdale, AZ 85251-3504

(602) 945-4630  
FAX (602) 949-1737

March 14, 1990

Mr. Steve R. Plevel  
District Ranger  
USDA Forest Service  
Coronado National Forest  
Santa Catalina Ranger District  
5700 North Sabino Canyon Road  
Tucson, Arizona 85715

Dear Mr. Plevel:

A.F. Budge (Mining) Ltd. appreciates the February 22 telephone call from Bill Lewis, Lands and Mineral Staff, which followed a February 21 visit by Bill and a representative of the Sierra Club to our Korn Kob mineral exploration site in Pima County. This letter addresses your concerns resulting from this trip, which are roads, oil on drill roads, and film on a Buehman Canyon pool. Budge Mining also acknowledges the March 2 letter from your office concerning these issues.

Roads

Concern was expressed about the location of a few drill road segments. The exploration plan map showing proposed roads approved September, 1989 was 1 inch = 200 foot scale, 80 foot contour interval. Budge Mining roads were put in based on this original map and topography. In early 1990, after roads were constructed, Budge Mining completed a more detailed 1 inch = 100 foot scale, 5 foot contour interval topographic map of the area which is attached to this letter. Various road classifications are color coded on this map. Yellow designates roads on Forest land constructed prior to Budge Mining. Orange shows roads on Forest land approved for construction September, 1989, but as yet not constructed. Green indicates roads constructed by Budge Mining on Forest land. Referenced road segments are lettered or numbered.

Page 2

March 14, 1990

Budge Mining letter to

Mr. Steve R. Plevel, USDA Forest Service

Minor changes in the location of a few Budge Mining constructed road segments were made due to actual field considerations. Again, the attached detailed map was not available when roads were constructed. Roads were locally rerouted along contour rather than across steeper terrain routes. This reduced the chances of erosion, made better reclamation easier, and provided safer access. Reroutes are constructed road segment "A" which replaced road segment 1, constructed road segment "B" which replaced road segment 2, constructed road segment "C" which replaced road segment 3, and constructed road segments "D" and "E" which replaced road segments 4 and 5. Constructed roads "F" and "G" were put in to provide geological test information in open data areas which were not previously recognizable on the larger scale map submitted with the exploration plan. Again these two roads are along contour, are not in significantly erodeable situations, and will be relatively easy to reclaim.

The very preliminary best estimate of a possible future mining pit limit on Forest land is outlined on the attached map in order to show that possible future mining would remove all of Budge Mining road construction on Forest land completed to date. By showing this outline it is not indicated that Budge Mining currently has plans to start a mine there.

It is Budge Mining's understanding that orange colored roads numbered 6-14 on the attached map are approved by the Forest Service for construction. We do not have current plans to construct these roads but reserve approval to do so.

#### Oil on Drill Roads

Bill mentioned that during his visit he noticed two larger areas (4 x 8 ft dimensions one area) of diesel or oil spills, and several much smaller oil or fuel spots along drill roads. It is Budge Mining's understanding that the two larger concentrations were caused by an hydraulic line breaking loose from the drill rig in one place and a small diesel overflow during drill rig refueling in the other. The lesser oil spots along the drill roads are a result of small leaks from drill engines or perhaps hydraulic pumps. Oil drippings and contaminated soil cleanup is ongoing and will be completed as soon as possible. In the future, oil or diesel drippings will be contained by appropriate ground cover placed beneath drill equipment.

Page 3  
March 14, 1990  
Budge Mining letter to  
Mr. Steve R. Plevel, USDA Forest Service

Budge Mining Korn Kob project drill holes are being plugged according to Department of Water Resources regulations. Plugging by the drill contractor began March 2 and is intended to be completed by March 20.

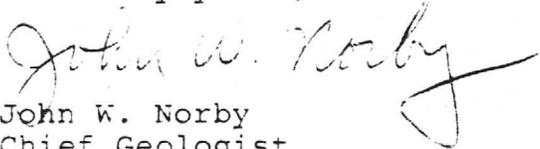
Film on Buehman Canyon Pool

Bill also noted a sheen or film on a Buehman Canyon pool. The site in question was examined by Budge Mining March 1 and an iridescent film was observed. The film may be a naturally occurring organic compound, as local stagnant pools are laden with algae and decaying leaves. Additionally, abundant cattle feces and hoof prints were noted at nearby upstream canyon pools, another possible source of this water surface film.

The only activity Budge Mining has near the pool in question is infrequently traversing the nearby pre-existing access road during the course of exploration activities. This road is also a major local access route for ranchers, hunters, and recreationalists. Our exploration activities, including drilling, are located 1.0 miles west-southwest of the pool in question.

This situation will be further evaluated by an independent consulting firm. Budge Mining understands the importance of protecting the Buehman Canyon riparian ecosystem and would therefore like to resolve this matter.

Sincerely yours,



John W. Norby  
Chief Geologist

INFORMATION RELATIVE TO THE WORK TO BE UNDERTAKEN

1. Location of the work.  
SALMON WELLS ARIZONA
2. Formation to be drilled.
3. Hole size and angle.  
The bore holes shall be drilled a minimum diameter of 5 1/4 inches to a maximum of 5 1/2 inches. The holes shall be drilled at various angles and vertically as desired by client.
4. Hole Depth.  
The bore holes shall be drilled to a maximum depth of (800) feet unless contractor is notified other wise.
5. Scope and Purpose of this undertaking.  
Approximately (10000) to (15000) feet of reverse circulation drilling.

**EQUIPMENT TO BE PROVIDED BY CONTRACTOR FOR UNDERTAKING**DESCRIPTION

1. Model TH-60 INGERSOLL-RAND drill unit.
  - A. Air compressor; 650 C. F. M. at 250 P. S. I.
  - B. Equipped to drill reverse circulation with dual wall pipe.
    - a. Equipped to drill angle holes at 45 and 60 degrees off vertical.
  - C. Water injection system.
2. DRILL SYSTEMS dual wall pipe
  - A. 4 1/2" pipe
3. Crew truck
4. Cyclone assembly
5. Drill bit subs and adapters for tricone and/or down-the-hole hammer drilling.
6. Suitable hammer
7. Appropriate wet or dry sample splitter.
8. Combination pipe and water truck.

SCHEDULE "B"

## SCHEDULE OF PERSONNEL TO BE FURNISHED

1. Driller
2. Sr. Helper
3. Helper

## COMPENSATION SCHEDULE

### MOBILIZATION AND DEMOBILIZATION

The movement of equipment and personnel to the work site will be at a lump sum of (\$500.00) dollars. This amount will cover all wages, subsistence, transportation, and permits however, additional charges may be required to cover the cost of possible permitting problems associated with the rig on certain restricted roads.

### DAILY TRAVEL TIME

The first hour of travel time from the job site to the nearest point of accommodations and fuel supply is included in the payment plan. Travel time in excess of one hour will be charged at a rate of (\$45.00) dollars per hour with no mileage charge.

### SPECIAL EQUIPMENT

If trailers, fuel trucks and tanks, tents, etc. become necessary due to remote locations and long drive times all charges incurred will be at contractors cost plus 15%.

### HOURLY RATE

For all hours consumed at the job site commencing and ending with the shift in the field, drilling, conditioning, reaming, and any and all associated work performed, to exclude only the following list, would be chargeable at the following rate:

(\$185) per hour

#### list of Services not Covered in the Hourly Rate

1. Recovery of stuck pipe or other down-the-hole equipment.
2. Water haulage outside of the daily work shift.

**FOOTAGE RATE**

For all footage drilled, understood to be from the surface to the maximum depth penetrated by the drill bit, to be charged on a per hole basis using the following rate schedule.

<u>DEPTH</u>	<u>VERTICAL</u>	<u>ANGLE</u>
Surface to 500 ft.	\$6.00 Per Foot	\$7.25 Per Foot
ft. to ft.	\$. Per Foot	\$. Per Foot
ft. to ft.	\$. Per Foot	\$. Per Foot
Over ft.	\$. Per Foot	\$. Per Foot

The footage rates quoted above includes, on a per hole basis, the first hour of time (one hour for each circumstance) that may be consumed in setting the surface casing, conditioning & stabilizing hole, reaming back to bottom, waiting on water, rigging for angle, and etc. However time consumed in excess of one hour for any of the above circumstances beyond the control of the contractor would be chargeable at an hourly rate of (\$185.00) dollars per hour.

In the event that down-the-hole and/or job site conditions due to circumstances beyond the control of the Contractor, are such that revenue earned at the footage rate does not equal the revenue that would be earned at the hourly rate for three (3) consecutive days, all drilling after the third day would be conducted at an hourly rate of (185.) dollars per hour plus all bits and materials.

**COMPENSATION for RECOVERY of STUCK or BROKEN DRILL PIPE and/or DOWN-THE-HOLE DRILL TOOLS, and ETC.**

All hours consumed in the recovery and/or attempted recovery of drill pipe and/or associated drill tools, and etc. on any one bore hole would be chargeable at an hourly rate of (\$150.00) dollars per hour for the first (8) hours and at a rate of (\$135.00) dollars per hour thereafter. The maximum chargeable time allowed on any one bore-hole would be (32) hours.

COMPENSATION for ABANDONED and/OR UNRECOVERABLE DRILL PIPE and/or DOWN-THE-HOLE DRILL TOOLS, and ETC.

It is understood that the Contractor's driller is responsible to advise the Client's on-site representative of changes in drilling conditions that may result in lost and/or stuck down-the-hole drilling equipment. In the event that the Contractor would be required to drill through or below surface mine workings or drill in a manner not advised by Contractor's driller which results in stuck or lost drill pipe and tools this would entitle Contractor to receive payment as follows.

Within the first 10,000 feet of drilling at 90% of replacement value, there after, liability would be decreases by 1% for each increment of 1000 feet drilled.

STANDBY TIME

While on standby as requested by the Client the following rates will apply.

- 1. With drill crew \$135.00 dollars per hour
- 2. Without drill crew \$100.00 dollars per hour

The standby rate quoted for without crew is understood to be including an advance notice of one day prior to commencement of the next work shift. The maximum allowable charges would be held to (8) hours per day for standby.

PROVIDING DRILL BITS, DRILLING SUPPLIES, ADDITIONAL EQUIPMENT, and ADDITIONAL PERSONNEL, and ETC.

The Contractor will provide all hammer bits under the footage rate as quoted. However, all tricone bits and wear skirts, specialty sampling equipment, hole abandonment fluid and pumping equipment, casing left in the hole, and etc. will be billed at Contractor's cost plus 15%.

Contractor will provide the first \$100.00 dollars per hole in drill additives, any amount over this will be billed at cost plus 15%.

REPAIR and MAINTENANCE of EQUIPMENT

No charge will be applied for repair and/or maintenance of any Contractor equipment. This is understood to cover any and all above ground equipment.



**A.F. Budge (Mining) Limited**

4301 North 75th Street  
Suite 101  
Scottsdale, AZ 85251-3504

(602) 945-4630  
FAX (602) 949-1737

May 17, 1990

Mr. Pat Harris  
Harris Exploration Drilling & Associates Inc.  
472 South Escondido Boulevard  
Escondido, California 92025

Dear Mr. Harris:

Attached is a compilation of expenses incurred in the cleanup of soils contaminated with various hydrocarbon-based products which occurred during the course of the exploratory drilling at our Korn Kob Project in Pima County, Arizona.

As the contamination resulted directly from your drill rig, we feel a portion of these expenses are your responsibility.

We would appreciate meeting with you at your earliest convenience to resolve this matter and settle on an equitable arrangement for compensation.

Very truly yours,

Ronald R. Short  
General Manager

c: J. Norby

Summary of expenses incurred in the clean-up of soils which had been contaminated with diesel fuel and hydraulic fluids during the course of exploratory drilling by Harris Drilling Co.

March 12 to March 30

Bryant Construction Co.

29 hrs. dozer	\$3,045.00
56 hrs. backhoe	\$3,360.00
69 hrs. 7-yard dump	\$3,105.00
34 hrs. 12-yard dump	\$1,870.00
labor	\$1,250.00

mobilization & travel	\$1,035.00
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Sub-total	\$13,665.00
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Taxes	\$751.58
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Total	\$14,416.58
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Loading material on ATL trucks, April 20	\$503.93
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Transport via ATL to Vulture Mine site	\$2,450.00
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Budge personnel

R. M. Guthrie	\$1,200.00
expenses	\$41.48

J. R. Bosco	\$692.31
expenses	\$518.21

W. Martin & D. Smith	\$720.00
expenses	\$566.83

Total expenses incurred to date:	\$21,109.34
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Western Technologies, Inc. proposal for bioremediation work on contaminated soils	\$8,965.00
--------------------------------------------------------------------------------------	------------

Total expenses for cleanup	\$30,074.34
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United States Forest  
Department of Service  
Agriculture

Coronado NF

Santa Catalina RD  
5700 N. Sabino Canyon Rd.  
Tucson, Arizona 85715

Reply to: 2810

Date: March 2, 1990

John W. Norby  
A.F. Budge Mining  
4301 N. 75th Street  
Scottsdale, AZ 85251

Dear John:

Enclosed is our reply to your letter of 2/28/90 concerning the proposed mining plan myself or Bill Budge. We have discussed the issues and that you are interested in the project.

We have reached agreement on the following items:

1. Unauthorized Road: We will not allow any road but any further road work will be done by the project.
2. Diesel Spill: We will not allow any diesel spill to complete the project.
3. Plugging the Hole: We will not allow any intention the project.
4. Film on the Spill: We will not allow any film on the spill.

We would like to see you at the project site on 2/28/90.

IF it is possible, we would like to see you at the mining operation at the project site.

Thank you for your interest in the project. We will be in your office.

Sincerely,

*William Lewis*

STEVE R. PLEVEL  
District Ranger

Enclosures

cc: Ken Rait, Sierra Club  
Jim DuBois, Dept. of Wildlife  
Dirk Denbarrs



*Handwritten mark*

Mr. Horby also advised that the area was deeply disturbed about 1000 feet from the project and the area will be clear.

If you have any questions please call me at (530) 832-2000.

Sincerely,

*William Lewis*

*For*

STEVE R. PLEVEL  
District Ranger

- cc: John Nacey, District Ranger
- Dirk Berninger, District Ranger
- Jim Habber, District Ranger

Reply to: 2810

Date: March 29, 1990

Ken Rait, Conservation Chair  
Sierra Club - Grand Canyon Chapter  
1321 E. Lee St.  
Tucson, AZ 85719

Dear Ken:

Thankyou for your letter dated March 6 and 14, 1990, regarding the Korn Kob project. I'm sorry our response to your letters have been tardy, but Bill Lewis was not at work the first two weeks in March and I have been busy with other issues. We have continued to work on the problems, though. Lou Leibbrand, Forest Engineer, made a final visit with the Arizona Department of Environmental Quality on March 13, 1990, to assess the problem.

In your March 6, 1990 letter, you raised several concerns that I need to address. The first issue dealt with capping the holes and possible pollution of groundwater. Andrew Rendes, Arizona Department of Environmental Quality (ADEQ) mentioned to Lou Leibbrand that he did not see a problem with this. That oil is a common occurrence in drilling operations and floats to the top if any ground water is encountered. At this time, all the holes have been plugged. The second issue deals with the illegal roads (see the letter from Budge Mining dated March 14, 1990). We feel the appropriate action was taken and the threat of closing down the operation is a very hard slap on the wrist. The third issue dealt with the scum on the spring in Buehman Canyon. We have heard from several sources that this may be a natural phenomenon. Budge Mining has requested Dames & Moore to test the spring and determine if it came from a petroleum product.

The last paragraph requested we halt operations and write an Environmental Impact Statement. We do not believe that this is needed and that Budge Mining has been responsive to investigate or correct problems.

John:

- Our response to Sierra Club's letter of 3/6, 14/90.

- New letter from earth first!!! Will send you response, you are probably finished removing this valuable resource

Bill

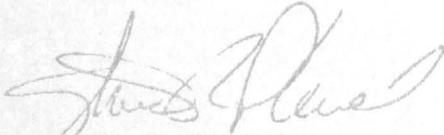
Letter to Ken Rait, continued

Page 2

In your March 14, 1990 letter, the concern was with the decontamination process for the diesel fuel spills. Budge Mining is removing all the contaminated soil from the site and is working with the ADEQ so this can be accomplished according to their standards. At this time, they are about two-thirds completed. The Forest Service feels that this does not need any type of NEPA documentation.

If you have any questions, please contact myself or Bill Lewis, 749-8700.

Sincerely,



STEVE R. PLEVEL  
District Ranger

March 28, 1990

Bill Lewis  
Coronado National Forest  
Santa Catalina Ranger District  
5700 N. Sabino Canyon Road  
Tucson, AZ 85715

Dear Bill:

Thank you for sending me copies of the letters to A.F. Budge Mining and Ken Rait regarding the Korn Kob Mine. The mining company has previously shown disregard for the conditions of their permit and need to be monitored more closely. I'm glad to see that the Forest Service has taken some action on correcting the problems at this project.

Concerning the clean up of the diesel spills, I understand that the intent of the mining company is to remove the contaminated soil from the site as the method of clean up. I am aware that a permit is required for the removal of any resources from Forest Service land, and since soil is in fact a forest resource, we request that a permit be required for this action detailing exactly how the soil is to be removed, contained, transported, disposed of, and where and how it is to be de-contaminated. At the very least an EA should be done to assess the impact.

I would appreciate receiving a copy of the permit (when available) and any future correspondence concerning this project.

Sincerely,



Lainie Levick  
Earth First!  
12120 E. Snyder Rd.  
Tucson, AZ 85749

cc: Department of Environmental Quality

Reply to: 2810

Date: November 13, 1989

Ken Rait, Conservation Chair  
Sierra Club - Rincon Group  
2015 East Ninth Street  
Tucson, Arizona 85719

Dear Ken:

Thank you for your letter dated October 31, 1989 concerning the Korn Kob mine and the road development activities in Buehman Canyon. The letter has three items of concern: 1. a 404 permit, 2. increasing the bond, and 3. completing a environmental assessment.

1. Attached is the Federal Register, Rules and Regulations, concerning 404 permits. On page 41234, section 323.4 Discharges not requiring permits, item 6, that temporary roads for moving mining equipment do not require permits. And on page 41255, section 330.5 Nationwide permits, item 3, that repair or rehabilitation of a previously authorized road is permitted. The road in Buehman Canyon (Forest Service Road #654) has been authorized. William Lewis contacted Robert Dummer, U.S. Army Corps of Engineers, to discuss the matter again and invited him to see the project. However our original position is the same, a permit is not required in this situation.

2. The bond was calculated for approximately 4 acres. It has been revised to include 11 acres of reclamation, which includes the entire area authorized under the operating plan. The new bond total will be \$2,750. This has been discussed with the mining company and they have agreed to the new bond. Based on past experience in this area, the rehabilitation we have prescribed is proper.

3. We feel that the appropriate level of analysis, documentation and public notification was performed. The decision memo, dated September 12, 1989, stated that there was a 45 day appeal period, which expired October 27, 1989. According to our records, you were sent a copy on or about September 13, 1989. The opportunity for relief through the administrative process has expired. As a reminder, this decision permitted only the exploration activity for the purpose of determining the extent of the ore body. Any potential mine development and operation will require additional analysis and documentation resulting in another decision. Therefore there will be opportunity for additional public involvement, assuming the proponent decides there is a feasible operation.

To update you on the progress of this project, the roads have been completed and the drilling started. The mining company did not construct all the roads they were planning. I do not know when the drilling will be finished or when the analysis of the core samples will be completed.

If you have any questions about this letter or the project please feel free to contact myself or William Lewis at 749-8700.

Sincerely,

WFL

STEVE R. PLEVEL  
District Ranger

cc: Budge Mining Company  
Keystone Minerals  
Army Corps of Engineers

minor drainage does not include the construction of any canal, ditch, dike or other waterway or structure which drains or otherwise significantly modifies a stream, lake, swamp, bog or any other wetland or aquatic area constituting waters of the United States. Any discharge of dredged or fill material into the waters of the United States incidental to the construction of any such structure or waterway requires a permit.

(D) Plowing means all forms of primary tillage, including moldboard, chisel, or wide-blade plowing, discing, harrowing and similar physical means utilized on farm, forest or ranch land for the breaking up, cutting, turning over, or stirring of soil to prepare it for the planting of crops. The term does not include the redistribution of soil, rock, sand, or other surficial materials in a manner which changes any area of the waters of the United States to dry land. For example, the redistribution of surface materials by blading, grading, or other means to fill in wetland areas is not plowing. Rock crushing activities which result in the loss of natural drainage characteristics, the reduction of water storage and recharge capabilities, or the overburden of natural water filtration capacities do not constitute plowing. Plowing as described above will never involve a discharge of dredged or fill material.

(E) Seeding means the sowing of seed and placement of seedlings to produce farm, ranch, or forest crops and includes the placement of soil beds for seeds or seedlings on established farm and forest lands.

(2) Maintenance, including emergency reconstruction of recently damaged parts, of currently serviceable structures such as dikes, dams, levees, groins, riprap, breakwaters, causeways, bridge abutments or approaches, and transportation structures. Maintenance does not include any modification that changes the character, scope, or size of the original fill design. Emergency reconstruction must occur within a reasonable period of time after damage occurs in order to qualify for this exemption.

(3) Construction or maintenance of farm or stock ponds or irrigation ditches, or the maintenance (but not construction) of drainage ditches. Discharges associated with siphons, pumps, headgates, wingwalls, weirs, diversion structures, and such other facilities as are appurtenant and functionally related to irrigation ditches are included in this exemption.

(4) Construction of temporary sedimentation basins on a construction site which does not include placement of

fill material into waters of the U.S. The term "construction site" refers to any site involving the erection of buildings, roads, and other discrete structures and the installation of support facilities necessary for construction and utilization of such structures. The term also includes any other land areas which involve land-disturbing excavation activities, including quarrying or other mining activities, where an increase in the runoff of sediment is controlled through the use of temporary sedimentation basins.

(5) Any activity with respect to which a state has an approved program under section 208(b)(4) of the CWA which meets the requirements of sections 208(b)(4) (B) and (C).

(6) Construction or maintenance of farm roads, forest roads, or temporary roads for moving mining equipment, where such roads are constructed and maintained in accordance with best management practices (BMPs) to assure that flow and circulation patterns and chemical and biological characteristics of waters of the United States are not impaired, that the reach of the waters of the United States is not reduced, and that any adverse effect on the aquatic environment will be otherwise minimized. These BMPs which must be applied to satisfy this provision shall include those detailed BMPs described in the state's approved program description pursuant to the requirements of 40 CFR Part 233.22(i), and shall also include the following baseline provisions:

(i) Permanent roads (for farming or forestry activities), temporary access roads (for mining, forestry, or farm purposes) and skid trails (for logging) in waters of the U.S. shall be held to the minimum feasible number, width, and total length consistent with the purpose of specific farming, silvicultural or mining operations, and local topographic and climatic conditions;

(ii) All roads, temporary or permanent, shall be located sufficiently far from streams or other water bodies (except for portions of such roads which must cross water bodies) to minimize discharges of dredged or fill material into waters of the U.S.;

(iii) The road fill shall be bridged, culverted, or otherwise designed to prevent the restriction of expected flood flows;

(iv) The fill shall be properly stabilized and maintained during and following construction to prevent erosion;

(v) Discharges of dredged or fill material into waters of the United States to construct a road fill shall be made in a manner that minimizes the

encroachment of trucks, tractors, bulldozers, or other heavy equipment within waters of the United States (including adjacent wetlands) that lie outside the lateral boundaries of the fill itself;

(vi) In designing, constructing, and maintaining roads, vegetative disturbance in the waters of the U.S. shall be kept to a minimum;

(vii) The design, construction and maintenance of the road crossing shall not disrupt the migration or other movement of those species of aquatic life inhabiting the water body;

(viii) Borrow material shall be taken from upland sources whenever feasible;

(ix) The discharge shall not take, or jeopardize the continued existence of, a threatened or endangered species as defined under the Endangered Species Act, or adversely modify or destroy the critical habitat of such species;

(x) Discharges into breeding and nesting areas for migratory waterfowl, spawning areas, and wetlands shall be avoided if practical alternatives exist;

(xi) The discharge shall not be located in the proximity of a public water supply intake;

(xii) The discharge shall not occur in areas of concentrated shellfish production;

(xiii) The discharge shall not occur in a component of the National Wild and Scenic River System;

(xiv) The discharge of material shall consist of suitable material free from toxic pollutants in toxic amounts; and

(xv) All temporary fills shall be removed in their entirety and the area restored to its original elevation.

(b) If any discharge of dredged or fill material resulting from the activities listed in paragraphs (a) (1)-(6) of this section contains any toxic pollutant listed under section 307 of the CWA such discharge shall be subject to any applicable toxic effluent standard or prohibition, and shall require a Section 404 permit.

(c) Any discharge of dredged or fill material into waters of the United States incidental to any of the activities identified in paragraphs (a) (1)-(6) of this section must have a permit if it is part of an activity whose purpose is to convert an area of the waters of the United States into a use to which it was not previously subject, where the flow or circulation of waters of the United States may be impaired or the reach of such waters reduced. Where the proposed discharge will result in significant discernible alterations to flow or circulation, the presumption is that flow or circulation may be impaired by such alteration. For example, a

States. (These phase-in dates are: After July 25, 1975, discharges into navigable waters of the United States and adjacent wetlands; after September 1, 1976, discharges into navigable waters of the United States and their primary tributaries, including adjacent wetlands, and into natural lakes, greater than 5 acres in surface area; and after July 1, 1977, discharges into all waters of the United States.) (Section 404)

(b) Structures or work completed before December 18, 1968, or in waterbodies over which the district engineer had not asserted jurisdiction at the time the activity occurred provided, in both instances, there is no interference with navigation. (Section 10)

#### § 330.4 Public notice.

(a) *Chief of Engineers.* Upon proposed issuance of new nationwide permits, modification to, or reissuance of, existing nationwide permits, the Chief of Engineers will publish a notice in the *Federal Register* seeking public comments and including the opportunity for a public hearing. This notice will state the availability of information at the Office of the Chief of Engineers and at all district offices which reveals the Corps' provisional determination that the proposed activities comply with the requirements for issuance under general permit authority. The Chief of Engineers will prepare this information which will be supplemented, if appropriate, by division engineers.

(b) *District engineers.* Concurrent with publication in the *Federal Register* of proposed, new, or reissued nationwide permits by the Chief of Engineers, district engineers will so notify the known interested public by an appropriate notice. The notice will include regional conditions, if any, developed by the division engineer.

#### § 330.5 Nationwide permits.

(a) *Authorized activities.* The following activities are hereby permitted provided they meet the conditions listed in paragraph (b) of this section and, where required, comply with the notification procedures of § 330.7.

(1) The placement of aids to navigation and regulatory markers which are approved by and installed in accordance with the requirements of the U.S. Coast Guard (33 CFR Part 86, Subchapter C). (Section 10)

(2) Structures constructed in artificial canals within principally residential developments where the connection of the canal to a navigable water of the United States has been previously authorized (see 33 CFR Part 322.5(g)). (Section 10)

(3) The repair, rehabilitation, or replacement of any previously authorized, currently serviceable, structure or fill, or of any currently serviceable structure or fill constructed prior to the requirement for authorization, provided such repair, rehabilitation, or replacement does not result in a deviation from the plans of the original structure or fill, and further provided that the structure or fill has not been put to uses differing from uses specified for it in any permit authorizing its original construction. Minor deviations due to changes in materials or construction techniques and which are necessary to make repair, rehabilitation, or replacement are permitted. Maintenance dredging and beach restoration are not authorized by this nationwide permit. (Section 10 and 404)

(4) Fish and wildlife harvesting devices and activities such as pound nets, crab traps, eel pots, lobster traps, duck blinds, and clam and oyster digging. (Section 10)

(5) Staff gages, tide gages, water recording devices, water quality testing and improvement devices, and similar scientific structures. (Section 10)

(6) Survey activities including core sampling, seismic exploratory operations, and plugging of seismic shot holes and other exploratory-type bore holes. Drilling of exploration-type bore holes for oil and gas exploration is not authorized by this nationwide permit; the plugging of such holes is authorized. (Sections 10 and 404)

(7) Outfall structures and associated intake structures where the effluent from that outfall has been permitted under the National Pollutant Discharge Elimination System program (Section 402 of the Clean Water Act) (see 40 CFR Part 122) provided that the district or division engineer makes a determination that the individual and cumulative adverse environmental effects of the structure itself are minimal in accordance with § 330.7 (c)(2) and (d). Intake structures per se are not included—only those directly associated with an outfall structure are covered by this nationwide permit. This permit includes minor excavation, filling and other work associated with installation of the intake and outfall structures. (Sections 10 and 404)

(8) Structures for the exploration, production, and transportation of oil, gas, and minerals on the outer continental shelf within areas leased for such purposes by the Department of Interior, Mineral Management Service, provided those structures are not placed within the limits of any designated shipping safety fairway or traffic

separation scheme (where such limits have not been designated or where changes are anticipated, district engineers will consider recommending the discretionary authority provided by 330.8 of this Part, and further subject to the provisions of the fairway regulations in 33 CFR 322.5(1) (Section 10).

(9) Structures placed within anchorage or fleeting areas to facilitate moorage of vessels where such areas have been established for that purpose by the U.S. Coast Guard. (Section 10)

(10) Non-commercial, single-boat, mooring buoys. (Section 10)

(11) Temporary buoys and markers placed for recreational use such as water skiing and boat racing provided that the buoy or marker is removed within 30 days after its use has been discontinued. At Corps of Engineers reservoirs, the reservoir manager must approve each buoy or marker individually. (Section 10)

(12) Discharge of material for backfill or bedding for utility lines, including outfall and intake structures, provided there is no change in preconstruction bottom contours (excess material must be removed to an upland disposal area). A "utility line" is defined as any pipe or pipeline for the transportation of any gaseous, liquid, liquifiable, or slurry substance, for any purpose, and any cable, line, or wire for the transmission for any purpose of electrical energy, telephone and telegraph messages, and radio and television communication. (The utility line and outfall and intake structures will require a Section 10 permit if in navigable waters of the United States. See 33 CFR Part 322. See also paragraph (a)(7) of this section). (Section 404)

(13) Bank stabilization activities provided:

(i) The bank stabilization activity is less than 500 feet in length;

(ii) The activity is necessary for erosion prevention;

(iii) The activity is limited to less than an average of one cubic yard per running foot placed along the bank within waters of the United States;

(iv) No material is placed in excess of the minimum needed for erosion protection;

(v) No material is placed in any wetland area;

(vi) No material is placed in any location or in any manner so as to impair surface water flow into or out of any wetland area;

(vii) Only clean material free of waste metal products, organic materials, unsightly debris, etc. is used; and

(viii) The activity is a single and complete project. (Sections 10 and 404)



# SIERRA CLUB

Grand Canyon Chapter - Arizona

RINCON GROUP

2015 East Ninth St.  
Tucson, AZ 85719

RECEIVED 11/3/89

October 31, 1989

Steve Plevel, District Ranger  
Santa Catalina Ranger District  
5700 N. Sabino Canyon Rd.  
Tucson, AZ 85715

copy to Mike B  
JT  
Bul L

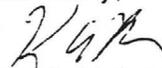
Dear Steve:

The Sierra Club believes that road development activities in Bueham Canyon associated with the Korn Kob mine are in violation of the Clean Water Act. Though communication was made with the Corp of Engineers by district personnel, the Corps, as I understand it, felt that a 404 permit was not necessary. Because some of the road construction activities involving some dredge and fill are in fact taking place through streambeds, a 404 permit is required under the Clean Water Act. We believe your personnel were inadequately advised by Corps personnel and have sent a letter to the Corps reflecting this.

The Sierra Club believes the \$700 bond is completely inadequate for the type of damage being done. I viewed the area last week and am convinced that reclamation would cost well into the thousands. The Sierra Club therefore requests that the bond requirement be raised to \$15,000 to assure adequate reclamation of the area's fragile ecosystem.

Having now seen the area, I believe an environmental assessment should have been completed prior to the issuance of the decision memo. It is unfortunate that these comments come long after the work has begun, but as we discussed, I felt the public comment period was wholly inadequate. This project has to be gotten off the fast track so that public comment as required in NEPA can be incorporated. Therefore, I suggest a stoppage on the work until completion of an environmental assessment, the mining companies agree to the higher bond, and the Corps issues a Section 404 permit. If this can only be done through an appeal of your decision, please notify me as soon as possible so we can take the necessary steps.

Sincerely,

  
Kerr A. Rait  
Conservation Chair

cc: David Baron, Center for Law in the Public Interest  
Keith Bagwell, Arizona Daily Star  
Norma Coile, Tucson Citizen  
Jim Abbott, Forest Supervisor



# SIERRA CLUB

Grand Canyon Chapter - Arizona

R I N C O N   G R O U P  
2015 East Ninth St.  
Tucson, AZ 85719

October 31, 1989

U.S. Army Corps of Engineers  
Charles Holt, Branch Chief  
P.O. Box 2711  
Los Angeles, CA 90053  
CESPL-CO-R

Dear Mr. Holt:

The Sierra Club believes that the Corp of Engineers incorrectly advised Forest Service personnel regarding the necessity of a section 404 permit pursuant to the Clean Water Act. According to Bill Lewis, Santa Catalina District, Coronado National Forest, Corps personnel felt that a 404 permit was unnecessary for road construction being done in Buehman Canyon. Because some dredge and fill is taking place through the streambed, we believe this decision was in error.

Therefore, the Sierra Club requests compliance with the Clean Water Act through the issuance of a 404 permit. Furthermore in accordance with NEPA, we believe an environmental assessment must be completed to assess the impacts of this dredge/fill activity. We view the issuance of the permit as a major federal action which should be open to comment by interested public. I look forward to hearing from you soon regarding your decision.

Sincerely,

A handwritten signature in black ink, appearing to read "Ken A. Rait".

Ken A. Rait  
Conservation Chair

cc: David Baron, Center for Law in the Public Interest  
Keith Bagwell, Arizona Daily Star  
Norma Coile, Tucson Citizen  
Steve Plevel, District Ranger

43  
41255

United States Forest  
Department of Service  
Agriculture

Coronado NF

Santa Catalina RD  
5700 N. Sabino Canyon Rd.  
Tucson, Arizona 85715

Some Responses  
to these letters.

Reply to: 2810

311

Date: October 22, 1990

EXAMPLE:

Susan Stewart  
Box 32011  
Phoenix, AZ 85064

Dear Susan:

Thank you for your letter concerning the potential impacts of the Korn Kob Mine, near Buehman Canyon.

At the present time, the Forest Service does not have a written proposal for a production phase of the mine operation. The company is still reviewing the drill hole data. The scoping process and public notification will begin if and when a plan of operations is submitted. The Forest Service will comply fully with requirements of the National Environmental Protection Act.

The Forest Service is required by law to allow and, in fact, encourage mining activities on public lands open to mineral entry, such as those in the Buehman Canyon area. However, be assured we also recognize our obligation to evaluate possible adverse impacts of such activities and require appropriate mitigation prior to granting authority to begin operations.

Your letter will be kept in the project file and a copy sent to the mining company.

We will keep you informed of any significant developments concerning this project.

Sincerely,

STEVE R. PLEVEL  
District Ranger

cc: Budge Mining

Caring for the Land and Serving People

Carole,  
Please  
circulate to  
Dale & File  
Jarm

Oct 14, 1990

Bill Lewis  
TO: District Ranger  
Santa Catalina Ranger District

I strongly encourage The Forest Service to require a full Environmental Impact Statement be completed for The Korn Kob mine should the deposit be found to be economically recoverable. Based upon what I know of the Berehman Creek riparian area downstream of The deposit, as well as The entire North side of The Catalinas, This is a very unique and beautiful area. Although resource extraction is a vital part of our present society, so is environmental protection, including protection of The habitat as well as protection of aesthetics. I believe that The Korn Kob project will have a significant impact on the environment and, therefore, a full EIS should be required.

Thank you for your time.

Jeanmarie Haney  
Jeanmarie Haney  
2218 E. Copper  
Tucson, AZ 85719

FIFTH AVENUE CARDIOLOGISTS, LTD.

JEROME C. ROBINSON, M.D., F.A.C.C.  
JOHN C. DUGALL, M.D., F.A.C.C.

DIPLOMATES OF AMERICAN BOARD  
OF CARDIOVASCULAR DISEASE

5501 N. 19th AVENUE  
SUITE 111  
PHOENIX, ARIZONA 85015  
TELEPHONE (602) 433-1800

October 11, 1990

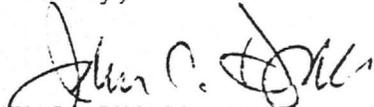
Santa Catalina Ranger District  
5700 North Sabino Canyon Road  
Tucson, Arizona 85715

Attention: Bill Lewis, District Ranger

Dear Ranger Lewis,

We are shocked at the proposal to consider an open copper pit mine in the Santa Catalina Mountains. We support an EIS to assess what would be a detrimental environmental impact of such a proposal.

Sincerely,

  
JOHN C. DUGALL, M.D.

  
JEROME C. ROBINSON, M.D.

  
Karen French, Business Manager

  
Terri Rowe, Nurse

  
Deanne VanAusdal, Secretary

  
Gloria Neely, MA

JCD/gn

OCT 15 1990

October 11, 1990  
26606 S. Cloverland Dr.  
Sun Lakes, AZ 85248

Santa Catalina Ranger District  
5700 N. Sabrino Canyon Rd.  
Tucson, AZ 85715

Attn: Bill Lewis

Dear Bill:

I want to let you know that I and many other citizens of Arizona are outraged at the thought of an open pit mine in the Santa Catalina Mountains, and especially in beautiful Buehman Canyon! I realize that our mining laws encourage mining on public land, but they were written back when we thought land was inexhaustible. Now with our natural lands being desicrated at an alarming rate is no time to allow new mines.

The National Environmental Protection Act was passed in order to stop this desicration. We demand that you comply fully with the intent of this act and that you require a full Environmental Impact Statement, and that you don't issue this permit.

Come on, Man ! The Planet is dying ! Lets save what we still can !

Sincerely,



Alfred S. Fuller

OCT 1

OCTOBER 15, 1990

RICHARD C. CLIFFORD  
Mountain Shadows Apartments  
2430 N. Dodge Blvd. Apt. 109A  
Tucson, AZ 85716

DISTRICT RANGER  
SANTA CATALINA RANGER DISTRICT

DEAR SIR:

I WISH TO INFORM YOU THAT I AM  
STRONGLY OPPOSED TO THE  
POSSIBILITY OF AN OPEN PIT  
COPPER MINE HERE IN THE  
CATALINAS AND THAT I STRONGLY  
UREE FULL COMAIANCE WITH THE  
NATIONAL ENVIRONMENTAL  
PROTECTION ACT (NEPA)  
INCLUDING A FULL EIS, NOT  
JUST AN EA.

MOST SINCERELY  
Richard C. Clifford  
RICHARD C. CLIFFORD

U.S. DEPARTMENT OF AGRICULTURE

Thomas Andersen  
5420 E. El Sendero Rd.  
Cave Creek, AZ 85331

October 15, 1990

Santa Catalina Ranger District  
5700 N. Sabino Canyon Rd.  
Tucson, AZ 85715

Attn: Bill Lewis

Dear Mr. Lewis,

I just wanted to express my feelings regarding the proposed Korn Kob Mine in Buehman Canyon. At a time when our natural environment is under constant attack from all nature of special interests, the idea of opening up more undeveloped land to mining exploration and exploitation is completely repulsive to me.

The very least that should happen is that a full environmental impact study should take place.

In a time when scenic views are becoming an endangered species, I think it's time to make decisions that favor unperturbed, pristine areas.

Thank you,



Tom Andersen

OCT 17 1990

October 8, 1990

Mr. Steve Plevel  
District Ranger  
Coronado National Forest  
5700 N. Sabino Canyon Road  
Tucson, Arizona 85715

Dear Mr. Plevel:

Through word of mouth and news accounts, I have recently become aware of the proposed Korn Kob Mine project in the Buehman Canyon area of the Santa Catalina Mountains.

I am advised that a portion of the planned mine would be on U.S. Forest Service land, meaning that your agency would be directly involved in the permitting and approval process.

I am writing to express my deep concern about the severe environmental effects of such a mine project in this location and to ask that the USFS add my name to any mailing or information lists about it.

As a native Tucsonan to whom the Catalinas are all but sacred, I am nothing short of appalled at the idea of an open pit copper mine in Buehman Canyon. As a businessman, I readily recognize the value of good mining projects and the need for copper in our economy. But not in that place, and not at this time. Once copper prices drop back down to a more realistic long-term level, I'm afraid the Korn Kob Mine would be rendered uneconomical. But the gaping hole and the heap-leaching pits would remain forever.

At a minimum, I believe that a full environmental impact statement should be prepared to determine the impact of the mine and its associated leaching operations on the riparian area along Buehman Creek and on the overall value of that region as a recreational and wildlife resource.

Thank you very much for the opportunity to express my extreme concern about this proposed project. I look forward to being kept informed about its progress through the USFS permitting process.

Sincerely,



Richard C. Hall

Richard C. Hall  
646 N. Elm Street  
Chandler, AZ 85226  
940-0965

Jon S. Horn  
P.O. Box 32373  
Phoenix, AZ 85064

October 11, 1990

Santa Catalina Ranger District  
5700 N. Sabino Canyon Rd.  
Tucson, AZ 85715

Attn: Bill Lewis, District Ranger

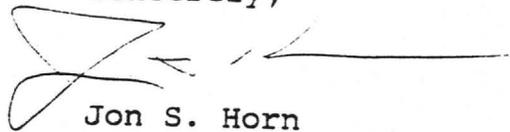
Dear Mr. Lewis:

I have recently read about the Korn Kob open pit copper mine proposed for the Buehman Canyon area. I am very disappointed to discover that such a potentially destructive and polluting use might be allowed in a such a beautiful area of our state.

I would urge your office to require that a full Environmental Impact Statement be researched, prepared, and submitted.

Thank you very much for your time and your continued efforts at protecting the beauty and health of Arizona for all of us.

Sincerely,

A handwritten signature in black ink, appearing to be 'Jon S. Horn', with a long horizontal line extending to the right.

Jon S. Horn



# WalkAmerica<sup>®</sup>

ELSON MILES  
123 S. O'LEARY  
FLAGSTAFF, AZ  
86001

OCT. 16, 1990

DEAR BILL,

PLEASE DENY A USE PERMIT TO  
BUDGE MINING FOR THE KORN KOB  
MINE. THE ECONOMIC VS. ENVIRONMENTAL  
TRADE-OFF ISN'T WORTH IT. YOUR (AND  
MINE) GRANDKIDS WILL THANK YOU FOR  
YOUR FORESIGHT.

THANK YOU,  
ELSON  
MILES

10-10-90

Having been born  
in Tucson the  
Catalina Mts held  
a special place in  
my heart for their  
natural beauty &  
untainted scenery.

The prospect of  
copper mining @  
Buchanan Canyon is  
appalling, and I  
TRUST your dept will  
mount a closely con-  
pliance w/ NEPA  
requirements.

Susan Stewart

Box 32011

Phx AZ 85064

7565 N. Skyline  
Tucson 85718

Dear Mr. Lewis:

I am greatly concerned over the possibility of an open pit mine on the east slope of the Catalina Mountains. Such an undertaking must be prevented, as it would have a significant impact on the environment. A full Environmental Impact Study must be conducted. It is my understanding that the Forest Service must comply with all environmental protection laws. I am greatly opposed to this project.

I appreciate your consideration of my position.

Sincerely,

Carol Mangold

2433 W. Armadillo St.  
Tucson, AZ 85713  
September 27, 1990

Santa Catalina Ranger District  
5700 N. Sabino Canyon Road  
Tucson, AZ 85715

Dear Sir or Madam:

I am appalled by the news that a Scottsdale mining company is planning an open pit copper mine on the Catalina's east slope in the riparian habitat of Buehman Creek. Not only is this creek home to two endangered fish species but runoff from the mine will also threaten the sensitive wild habitat of the San Pedro River. I urge you to fully comply with the National Environmental Policy and I am outraged about this mine which is as large as Bisbee's Lavender Pit. Thank you.

Sincerely,



Alexis Mazón

Reply to: 2810

Date: October 4, 1990

Alexis Mazon  
2433 W. Armadillo Street  
Tucson, Arizona 85713

Dear Alexis:

Thank you for your letter dated September 27, 1990, concerning the potential impacts of the Korn Kob Mine, near Buehman Canyon.

The Forest Service has been in full compliance with the National Environmental Policy Act and will be on future decisions. At the present time, we do not have a written proposal for the production phase of the mine operation. The scoping process and public notification will begin when a plan of operation is submitted.

The size of the mine will probably not be as large as the Lavender Pit in Bisbee.

Thank you for showing your concern about the project and you will be notified if the mining company submits a plan of operation. If you have any further concerns please contact William Lewis at 749-8700.

Sincerely,



STEVE R. PLEVEL  
District Ranger

cc: Budge Mining

Caring for the Land and Serving People

Reply to: 2810

Date: September 4, 1990

Lainie Levick  
Sierra Club, Rincon Group  
12120 E. Snyder Road  
Tucson, Arizona 85749

Dear Lainie:

Thank you for your letter dated August 27, 1990 concerning the potential impacts of the Korn Kob Mine. The Forest Supervisor has asked me to respond to your letter.

I can assure you that you and the public will be included in the scoping process for this project. The amount of interest for this project has been felt by the Forest Service and A.F. Budge Mining.

To date, we do not have a written proposal for the production phase of this mine. The scoping process will start when we receive a plan of operation. The official determination of what level of NEPA documentation will be decided from this process.

The five concerns that you have touched upon in your letter are a good starting point. Riparian habitats are sensitive and critical to the desert southwest.

If there is an economical ore body at the Korn Kob Mine, the mining laws and part of the Forest Service mission is to allow the operation. The un-answered question is HOW. HOW to extract the ore without impacting the other resources?

A.F. Budge Mining, Ltd. has been willing to work with us and that spirit of cooperation will be needed to address the issues if the mine goes into production.

We appreciate your letter and your interest in this project. If you have any questions please contact William Lewis at 749-8700.

Sincerely,



STEVE R. PLEVEL  
District Ranger

Caring for the Land and Serving People

cc: Budge Mining

SEP - 6 1990



# SIERRA CLUB

Grand Canyon Chapter • Arizona

RINCON GROUP

August 27, 1990

Forest Supervisor Jim Abbott  
Coronado National Forest  
300 W. Congress St.  
Tucson, AZ 85701

Re: Korn Kob Mine Scoping Process

Dear Mr. Abbott:

The Sierra Club is deeply concerned with the possibility of the Korn Kob open pit copper mine proposed by A.F. Budge Mining, Ltd. in the Catalina Mountains Reddington Pass area, about 20 miles northeast of Tucson. According to what the Forest Service has told us, and public statements made by the mining company, this would be a heap-leach operation covering about 100 acres adjacent to a sensitive riparian area (Buehman Creek). Our concerns include:

1. Potential contamination of the groundwater and Buehman Creek from mine wastes and overflowing of leaching ponds
2. Impacts to the adjacent riparian area and nearby springs due to the quantity of groundwater pumping
3. Compliance with NEPA and surface water quality standards
4. The adequacy of the reclamation plan to restore wildlife habitat and scenic values
5. Impacts on the natural environment, wildlife and scenic values (the mine site is visible from the Guthrie Mountain trail) while the mine is in production

Surface mining, more than almost any other land use, permanently scars the land. The potential impacts of this type of operation are obviously quite significant. We request to be included in the **scoping process** although we believe that approval of this plan would be a major federal action having a significant effect on the environment, and therefore should go directly to an EIS.

August 27, 1990  
Page 2

Please keep us informed of any further actions regarding this proposed mine. We appreciate the opportunity to work with the Forest Service on this project. Please do not hesitate to call if you have any questions.

Sincerely,

*Lainie Levick*

Lainie Levick  
Rincon Group  
Public Lands Subcommittee  
12120 E. Snyder Road  
Tucson, Arizona 85749  
(602) 749-2960

cc: Steve Plevel, District Ranger  
Rob Smith, Southwestern Rep., Sierra Club  
Phil Hocker, Mineral Policy Center  
Fern Sheppard, Sierra Club Legal Defense Fund  
✓ Congressman Morris Udall  
David A. Mullon, Jr.

Reply to: 2810

Date: September 27, 1990

Kathleen Barclay Mapes  
425 East First Street  
Tucson, Arizona 85705

Dear Kathleen:

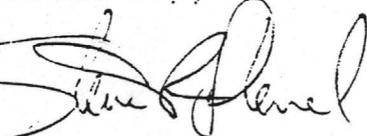
Thank you for the post card that we received on September 11, 1990, concerning the potential impacts of the Korn Kob Mine.

The Forest Service will be in full compliance with the National Environmental Policy Act regarding the future decisions for the mine. Part of our mission, and the mining laws are to allow mining activities. If you really don't want mining activities on National Forests, the way to change it is by changing the mining laws.

At the present time, we do not have a written proposal for the production phase of the mine operation. The scoping process and public notification will begin when a plan of operation is submitted.

Thank you for showing your concern about the project and you will be notified if the mining company submits a plan of operation. If you have any further concerns please contact William Lewis at 749-8700.

Sincerely,



STEVE R. PLEVEL  
District Ranger

*Dear People,  
I am totally  
opposed to the idea  
of opening a  
copper mine on  
the east slope of  
the Catalinas.  
Please let me  
know what  
can be done to help  
prevent the  
mining company  
from moving this  
land.  
Thank you  
Cari*

Cari

Reply to: 2810

Date: September 27, 1990

C. Keller  
3238 E. Lester  
Tucson, Arizona 85716

Dear C. Keller:

Thank you for the post card that we received on September 18, 1990, concerning the potential impacts of the Korn Kob Mine.

I can assure you that we will be in full compliance with the National Environmental Policy Act regarding the future decisions for the mine.

At the present time, we do not have a written proposal for the production phase of the mine operation. The scoping process and public notification will begin when a plan of operation is submitted.

Thank you for showing your concern about the project and you will be notified if the mining company submits a plan of operation. If you have any further concerns please contact William Lewis at 749-8700.

Sincerely,

WR

STEVE R. PLEVEL  
District Ranger

I am writing to demand full  
compliance with the National  
Environmental Policy act regarding  
the planned open pit copper mine  
on the Catalina's east slope.  
The project is very dangerous to  
San Pedro River habitat. Please  
respond.

C. Keller: 3238 E Lester Tucson, 85716

Reply to: 2810

Date: September 27, 1990

Carol Heller  
1503 N. Desmond Ave.  
Tucson, Arizona

Dear Carol:

Thank you for your letter and signatures that we received on September 22, 1990, concerning the potential impacts of the Korn Kob Mine, near Buehman Canyon.

The Forest Service will be in full compliance with the National Environmental Policy Act regarding the future decisions for the mine. Part of our mission, and the mining laws are to allow mining activities. If you really don't want mining activities on National Forests, the way to change it is by changing the mining laws.

At the present time, we do not have a written proposal for the production phase of the mine operation. The scoping process and public notification will begin when a plan of operation is submitted. There is a copper ore deposit at the site.

Thank you for showing your concern about the project and you will be notified if the mining company submits a plan of operation. If you have any further concerns please contact William Lewis at 749-8700.

Sincerely,

*William Lewis*

For

STEVE R. PLEVEL  
District Ranger

1503 N. Desmond Ave.  
Tucson, Az. 85712  
September 25, 1990

Santa Catalina Ranger District  
5700 N. Sabino Canyon Rd.  
Tucson, Az. 85715

Dear Forest Guardians:

We have become quite concerned upon hearing of a proposal for an open-pit copper mine near Buehlman Creek in the eastern Santa Catalinas. We are hoping to be informed that this latest mining enterprise is only somebody's bad dream, but if it is a seriously-advocated project, we urge you to vigorously deny it the use of public land. The resultant toxic release not only into Buehlman Creek, with its endangered fish species, but also into the San Pedro River, must surely constitute a wild flouting in the face of the National Environmental Policy Act. Waivers and exceptions only threaten to make this Act

meaningless.

We have seen the lavender Pit in Bisbee.  
ye gods! Please no move of those!

Sincerely,

Carol Heller

Phoenix Witheler Phoenix W Wheeler 1503 N. Desmond Ave Tucson AZ 85712

Morvenne Yachyan 5656 E. Hampton #104 Tucson, Az 85712

Paula Barbara Williams 401 W. Veterans Blvd Tucson AZ 85713

ALICE O. RITER 2121 S. TIMBERLINE AV. TUCSON, AZ 85710

Mary C. Schanz Mary C. Schanz 301 W. Spring Valley Pl, Tucson, AZ 85737

Karen W. Horton Karen Horton 5830 E. Holickam Tucson, AZ 85712

Cheri Stalman Cheri Stalman 227 E. 1st St. Tucson, AZ 85705

Katherine A. Graham KATHERINE A. GRAHAM 2232 N. FORGERS AVE. TUCSON. AZ 85716

Sally Reynolds Sally Reynolds 1534 E. Silver Tucson AZ 85714

Jackie Peyton Jackie Peyton 1300 E Ft Lowell Tucson AZ 85719

Nancy Steward Nancy Steward 1422 W. PLAZITA LAS PALMAS TUCSON AZ 05104

Cynthia L. Hightower Cynthia L. Hightower 2214 N. 4th Ave #F TUCSON AZ 85705

Tim Schaller Tim Schaller 2214 N. 21st Ave #F TUCSON AZ 85705



**SPRING OVER TO**

**KWIK-KOPY AND...**

**WE'LL HOP TO IT!**

*Received from Bill Lewis*

**RECEIVED APR 26 1990**

**BARTLETT'S KWIK-KOPY**

**7620 E. McKellips, Suite 2**

**Scottsdale, Arizona 85257**

**949-0984**

**949-0985**



SCRD  
BILL LEWIS  
FYI

# SIERRA CLUB

## Grand Canyon Chapter - Arizona

RINCON GROUP

1321 East Lee St.  
Tucson, AZ 85719

Rec'd USDA-r's  
Deputy Regional Forester  
Resources

March 28, 1990

MAR 30 1990

Mr. David Jolly, Regional Forester  
U.S. Forest Service  
Albuquerque, NM

APR 24 1990

Dear Mr. Jolly:

On March 26, I met with Jim Abbott and George Davies of the Walter Dawgie Ski Corp. to discuss the Sierra Club appeal of the Mt. Lemmon Ski Valley expansion. I am very concerned about the manner in which myself and an attorney who accompanied me were treated at the meeting for the following reasons:

\* Mr. Abbott left the decision to Mr. Davies as to whether the attorney could accompany me in the meeting. I see no reason why this was even an issue (as well as why the decision would be left to Mr. Davies), if we are to amicably discuss different aspects of the appeal.

\* There were several times during the meeting when Mr. Abbot spoke in defense of the ski valley expansion. We believe Mr. Abbot's role during these negotiations should be as neutral mediator.

\* Mr. Abbott asserted in the FONSI that summer visitors want increased recreational opportunities made available to them. During the March 26 meeting, Mr. Abbott said that no visitor attitude surveys had been completed to qualify this statement (as pointed out in our appeal) and even if they were, he has said he would place no stock in them. The Sierra Club believes that consistent with NEPA and NFMA, administrative decisions must be made with full consideration of public opinion.

In addition, we are concerned that in at least two issues (communications tower permit fees and mining in the Santa Rita Mountains), we have been left out of the process even though we have requested to be kept informed of Forest Service actions in these areas.

Finally, with regards to the Korn Kob mine site in the Santa Catalina District, the mining company violated the Forest Service decision memo by building unauthorized roads, spilling petroleum products within a foot of several open shafts (potentially contaminating groundwater resources), and by illegally discharging petroleum products into Buehman Creek where there is a recovering population of endangered Gila topminnows. Although we asked the Forest Service to revoke the permit, the Forest responded by saying the relationship between the Forest and

c.c.: Pat Jackson

mining company was stable and no need was seen for revocation. Presently, the Coronado National Forest is allowing un-permitted soil excavation activities of oil-contaminated soil.

In short, the Sierra Club believes that the Coronado National Forest is operating errantly by not following the spirit and intent of NEPA or NFMA. We believe the propriety of the above-mentioned activities should be closely examined by the regional office and urge that, as an interested public, we are given more of an opportunity to have meaningful participation in the decisions affecting the management of our public lands. If you have any questions, please do not hesitate to call. Please contact me to let me know what actions will be taken by the regional office.

Sincerely,

  
Ken A. Rait  
Conservation Chair

cc: Rep. Morris K. Udall  
Senator Dennis DeConcini  
Michael Spear, U.S. Fish and Wildlife Service  
Keith Bagwell, Arizona Daily Star  
Norma Coile, Tucson Citizen

RECEIVED USDA - FS R-3  
Recreation

APR 03 1990

Dir. ROGER DEEVER	— MAYNARD —
Sec. WOODY WORTH	— SALYER —
ESPINOZA	— MONTOYA —
LARSEN	— HARMER —
PROPPER	— BRADSBY —
GILLIO	— COOK —
SANCHEZ	— LONG —



# SIERRA CLUB

Grand Canyon Chapter · Arizona  
RINCON GROUP

2015 East 9th St.  
Tucson, AZ 85719

RECEIVED  
CORONADO NATIONAL FOREST  
TUCSON, ARIZONA

Received 0  
D.O. OCT. 2  
WFL

September 5, 1989

Mr. Jim Abbott, Forest Supervisor  
Coronado National Forest  
300 West Congress  
Tucson, AZ 85701

Dear Mr. Abbott:

It has come to our attention that Keystone Minerals, Inc. and A.F. Budge Mining Corp. are proposing new exploration and development at the Korn Kob Mine on the east slope of the Santa Catalina Mountains. We are deeply concerned about the environmental impacts of the project.

Our concerns are several and we will address them more fully when a Plan of Operations has been completed. In the meantime, there are some road-related issues about which we are requesting information prior to the issuance of the decision memo allowing for the expansion of this infrastructure:

- 1) With regards to the threatened and endangered species, especially the Desert Tortoise, the Gila Topminnow and other fish known to inhabit Buehman Canyon, we would like assurances from Fish and Wildlife Service that the proposed road modifications will not adversely impact their habitat. Which other species could be impacted?
- 2) We request an inventory of the plant community which will be destroyed by these modification.
- 3) Will a Section 404 permit be issued for the project?
- 4) Please keep us informed about specific plans for road improvements, especially to Redington Pass road. What impact will increased human traffic into the area have?

With regards to Steve Plevel's letter of August 28, the following concerns need to be addressed prior to the issuance of the permit:

- 1) Who made the determination that there are no threatened or endangered plants which will be affected by the road construction?
- 2) We assume that a qualified archaeologist determined that there were no cultural resources in the area. Who was this individual?

3) The allegation that the proposed action is not controversial is incorrect. In fact, from the time we received the documents, we were given only 36 hours to determine whether Forest Service personnel could jump ahead of schedule and issue the decision memo. We believe this mine proposal for which these roads will be extended is a highly controversial issue. Arizona Game and Fish was not notified, nor was the Tucson Audubon Society. Was Fish and Wildlife? In fact, we find the rate at which this road project intended to proceed to be quite alarming and sincerely hope that this will not set a precedent for future Forest Service activities which are mandated to incorporate public input. Though the issue now is only the roads, we intend to scrutinize this project at every step due to the adverse impacts we believe will be associated with the proposed mining activities.

4) If this project does not set a precedent for future actions, we hope that in the future we will be given adequate time to respond and be involved in the decision and planning process.

We look forward to an expedient reply to our questions prior to approval being given to extend the road system.

Sincerely,



Ken A. Rait  
Conservation Chair

cc: David Baron, Center for Law in the Public Interest  
Michael Spear, U.S. Fish and Wildlife Service  
Keith Bagwell, Arizona Daily Star  
Tucson Citizen



# SIERRA CLUB

## Grand Canyon Chapter · Arizona

### RINCON GROUP

2015 East Ninth St.  
Tucson, AZ 85719

September 27, 1989

Steve Plevel, District Ranger  
Santa Catalina Ranger District  
5700 North Sabino Canyon Rd.  
Tucson, AZ 85715

Dear Steve:

I am sorry I missed the public forum, but I heard it was useful in providing the public with much valuable information on the proposed ski area expansion.

I am very concerned about the lack of response from the Forest Service regarding my inquiries about the road expansion for the proposed Korn Kobb Mine. The decision to delay the construction for a week allowed us some time to review the proposed decision memo and formulate questions which were submitted within that time frame, but consequently were never answered.

We are deeply concerned about every step of this project and are therefore requesting that an Environmental Assessment be completed to address the impacts of the road construction and exploratory drilling activities. We believe the public input mechanisms associated with the decision memorandum were insufficient, and the concerned public would like to play a greater role in the process. I look forward to an early reply.

Sincerely,

Ken A. Rait  
Conservation Chair

cc: Keith Bagwell, Arizona Daily Star  
David Baron, Center for Law in the Public Interest  
Environmental Reporter, Tucson Citizen

Reply to: 2310

Date: October 11, 1989

Ken A. Rait, Conservation Chair  
Sierra Club, Grand Canyon Chapter, Rincon Group  
2015 East 9th Street  
Tucson, Arizona 85719

Dear Ken:

In response to your letters dated September 5, to the Forest Supervisor and the September 27, 1989, letter we are sincerely sorry for this late reply. The reasons for this late response was discussed at our meeting on October 5, 1989. If you have any concerns or questions on this process please let me know. I felt the meeting was helpful and informative. If you feel that a meeting in the future would be beneficial on this or any project, my door will always be open.

To address your concerns about the exploration work at the Korn Kob Mine we offer the following reply:

1. We had contacted the Forest Hydrologist, Bob Lefevre, to see if the road construction would adversely effect the riparian habitat in Buehman Canyon. He did not believe sediment from the new roads would have a significant effect. Mr. James Tress, Jr., SWCA employee, while checking for plants in the construction area also looked for desert tortoise burrows - none were observed (you have a copy of his letter).
2. We do not have a list of the plants that will be removed by the road construction but have given you a paper entitled, "Perennial Plant List for the Korn Kob Mine Property", by David Laing for Tom L. Heidrick performed around 1975. This paper and the letter from Mr. Tress would give you an idea of what plants might be removed. The most common plant on the north aspect at the mine site is the amole or shin-daggers.
3. The District contacted the Army Corp of Engineers about this project after receiving your letter. The project was discussed over the phone and they felt it would fall under a minor road crossing which has a nation wide permit. They are sending their regulations for our review. At this time I do not see a problem.

4. The Forest Service, Pima County, and Riley West have a working agreement on the maintenance of the Redington Pass Road. This aspect of the project should have very little impact on the road. The production access route has not been decided at this time. Another access for equipment is through San Manuel, south down the San Pedro River and then into Buehman Canyon on road number 654. The other route is over Redington Pass Road and north over the Piety Hill Road. They are improving both access routes which are mostly on private and state lands, except for the Redington Pass Road.

Our response to your concerns of my letter dated August 28 are as follows:

1. The mining companies hired James A. Tress, Jr, SWCA INC, to review the project for threatened or endangered plants--you have his resume and letter.
2. The cultural resource clearance was conducted by William Lewis, USDA-FS Para-archaeologist.
3. The mining companies did want to start just as soon as possible because they had equipment in the area. We tried to accommodate them with the early start but it was not acceptable to Gayle Hartman and so we stayed with the September 11 date. A letter was not sent to the Tucson Audubon Society but a letter was received from them and their concerns were addressed. A copy of the decision memo was sent to them. They will be advised of further activity in the area. The US Fish and Wildlife were not notified because the project did not require their input. In retrospect we should have notified the Arizona Game and Fish Department.
4. The NEPA process will not be rushed for the production phase of the project. We have notified the mining companies to start the process just as soon as they can and make contact with concerned publics, to meet with them and hear their concerns and see how they can be woven into the project, and to educate the public on the project so they have a clear understanding of the possible impacts.

The Forest Service is conscious of the potential impacts on Buehman Canyon and the reclamation of the mine site.

We look forward to working with you and the mining company on this challenging project.

Sincerely,

*William T. Lewis*

STEVE R. PLEVEL  
District Ranger

FOR

cc: Keystone Minerals  
A. F. Budge Mining Corp.

JOHN:

10/89

COPIES OF SIERRA CLUB  
LETTER AND OUR RESPONSE.

WENT TO THE SITE 10/6 WITH  
FOREST HYDROLOGIST--LOOKS GOOD

ONLY SUGGESTION IS MAKE  
SURE THE WATER BARS GO  
IN ON THE STEEPER SLOPES.

BILL

United States Forest  
Department of Service  
Agriculture

Coronado NF

Santa Catalina RD  
5700 N. Sabino Canyon Rd.  
Tucson, Arizona 85715

---

Reply to: 2810

Date: April 16, 1990

Lainie Levick  
Earth First!!  
12120 E. Snyder Road  
Tucson, AZ 85749

Dear Lainie:

We do not feel a permit or preparation of NEPA documentation is necessary for the removal of contaminated soil from the site. We are working with the Arizona Dept. of Environmental Quality on resolving this issue. The questions you have asked could be best answered by AzDEQ.

Thank you for your letter and your concerns in this project.

Sincerely,



STEVE R. PLEVEL  
District Ranger

cc: Ken Rait, Sierra Club  
AzDEQ, Jim DuBois  
Budge Mining Company

March 28, 1990

Bill Lewis  
Coronado National Forest  
Santa Catalina Ranger District  
5700 N. Sabino Canyon Road  
Tucson, AZ 85715

Dear Bill:

Thank you for sending me copies of the letters to A.F. Budge Mining and Ken Rait regarding the Korn Kob Mine. The mining company has previously shown disregard for the conditions of their permit and need to be monitored more closely. I'm glad to see that the Forest Service has taken some action on correcting the problems at this project.

Concerning the clean up of the diesel spills, I understand that the intent of the mining company is to remove the contaminated soil from the site as the method of clean up. I am aware that a permit is required for the removal of any resources from Forest Service land, and since soil is in fact a forest resource. we request that a permit be required for this action detailing exactly how the soil is to be removed, contained, transported, disposed of, and where and how it is to be de-contaminated. At the very least an EA should be done to assess the impact.

I would appreciate receiving a copy of the permit (when available) and any future correspondence concerning this project.

Sincerely,

*Lainie Levick*

Lainie Levick  
Earth First!  
12120 E. Snyder Rd.  
Tucson, AZ 85749

cc: Department of Environmental Quality

Reply to: 2810

Date: March 29, 1990

Ken Rait, Conservation Chair  
Sierra Club - Grand Canyon Chapter  
1321 E. Lee St.  
Tucson, AZ 85719

Dear Ken:

Thankyou for your letter dated March 6 and 14, 1990, regarding the Korn Kob project. I'm sorry our response to your letters have been tardy, but Bill Lewis was not at work the first two weeks in March and I have been busy with other issues. We have continued to work on the problems, though. Lou Leibbrand, Forest Engineer, made a final visit with the Arizona Department of Environmental Quality on March 13, 1990, to assess the problem.

In your March 6, 1990 letter, you raised several concerns that I need to address. The first issue dealt with capping the holes and possible pollution of groundwater. Andrew Rendes, Arizona Department of Environmental Quality (ADEQ) mentioned to Lou Leibbrand that he did not see a problem with this. That oil is a common occurrence in drilling operations and floats to the top if any ground water is encountered. At this time, all the holes have been plugged. The second issue deals with the illegal roads (see the letter from Budge Mining dated March 14, 1990). We feel the appropriate action was taken and the threat of closing down the operation is a very hard slap on the wrist. The third issue dealt with the scum on the spring in Buehman Canyon. We have heard from several sources that this may be a natural phenomenon. Budge Mining has requested Dames & Moore to test the spring and determine if it came from a petroleum product.

The last paragraph requested we halt operations and write an Environmental Impact Statement. We do not believe that this is needed and that Budge Mining has been responsive to investigate or correct problems.

Caring for the Land and Serving People

JOHN :

- Our response to SIERRA CLUB'S LETTERS  
OF 3/6, 14/90.

- New Letter from earth first!!! Will send  
you response, you are probably finished  
removing this valuable resource.

Bill

In your March 14, 1990 letter, the concern was with the decontamination process for the diesel fuel spills. Budge Mining is removing all the contaminated soil from the site and is working with the ADEQ so this can be accomplished according to their standards. At this time, they are about two-thirds completed. The Forest Service feels that this does not need any type of NEPA documentation.

If you have any questions, please contact myself or Bill Lewis, 749-8700.

Sincerely,

A handwritten signature in cursive script, appearing to read "Steve Plevel".

STEVE R. PLEVEL  
District Ranger

March 28, 1990

Bill Lewis  
Coronado National Forest  
Santa Catalina Ranger District  
5700 N. Sabino Canyon Road  
Tucson, AZ 85715

Dear Bill:

Thank you for sending me copies of the letters to A.F. Budge Mining and Ken Rait regarding the Korn Kob Mine. The mining company has previously shown disregard for the conditions of their permit and need to be monitored more closely. I'm glad to see that the Forest Service has taken some action on correcting the problems at this project.

Concerning the clean up of the diesel spills, I understand that the intent of the mining company is to remove the contaminated soil from the site as the method of clean up. I am aware that a permit is required for the removal of any resources from Forest Service land, and since soil is in fact a forest resource. we request that a permit be required for this action detailing exactly how the soil is to be removed, contained, transported, disposed of, and where and how it is to be de-contaminated. At the very least an EA should be done to assess the impact.

I would appreciate receiving a copy of the permit (when available) and any future correspondence concerning this project.

Sincerely,

*Lainie Levick*

Lainie Levick  
Earth First!  
12120 E. Snyder Rd.  
Tucson, AZ 85749

cc: Department of Environmental Quality

Reply to: 2810

Date: March 2, 1990

RECEIVED MAR 3 1990

John W. Norby  
A.F. Budge Mining  
4301 N. 75th Street Suite 101  
Scottsdale, AZ 85251

Dear John:

Enclosed is our reply to the letter from the Sierra Club dated February 23, 1990 concerning the Korn Kob Mine. If there are any inaccurate statements please contact myself or Bill Lewis. I am aware that you and Bill have been communicating on these issues and that you are working as quickly as you can to correct any problems.

We have reached agreement on the following items:

1. Unauthorized Roads: given the location of the roads, we would have approved them but any further infractions will result in immediate suspension of all operations.
2. Diesel Spill: clean up work will start Saturday (March 3) and it is your intention to complete the project by March 15.
3. Plugging the Drill Holes: work will start Friday (March 2) and it is your intention the project will be completed by March 20, 1990.
4. Film on the Spring: you will investigate this situation and report back to us.

We would like to be notified when these projects are completed.

If it is possible, I would like to meet with you to discuss these problems and your mining operation at the Korn Kob Mine.

Thank you for your prompt action in dealing with these issues and working with our office.

Sincerely,

*William Lewis*

FOR  
STEVE R. PLEVEL  
District Ranger

Enclosures

cc: Ken Rait, Sierra Club  
Jim DuBois, Dept. of Environmental Quality  
Dirk Denbarrs

United States Forest  
Department of Service  
Agriculture

Coronado NF

Santa Catalina RD  
5700 N. Sabino Canyon Rd.  
Tucson, Arizona 85715

Reply to: 131.

Date: March 2, 1990

Ken Rait  
SIERRA CLUB - Grand Canyon Chapter  
1311 East Lee St.  
Tucson, Arizona 85719

Dear Ken:

Thank you for your letter dated February 23, 1990 concerning the Kern Koo project. On February 21, Bill Lewis had called John Norby of Budge Mining to inform him of what you both found on the trip of February 21, 1990. John and Bill also spoke on the phone since then about the problems.

In response to the diesel spills, the areas around drill holes and the two work areas will be cleaned up by the mining company. The work will start Saturday (March 3) and it is their intention to finish by March 15, 1990. In addition, for safety reasons and possible contamination, the holes will be plugged starting Friday (March 2) and it is their intention to finish by March 20, 1990. Mr. Norby has expressed his concern for these spills to the Forest Service and to the driller and the need to resolve this issue as quickly as possible and to prevent future spills.

In response to the unauthorized roads in the area, Mr. Norby is sending us an aerial photo of the roads and outlining the area of the possible mine. Given the location of these roads, the Forest Service would have approved them. We are informing Budge Mining that further infractions will result in immediate suspension of operation.

In response to the spring in Buehman Creek and the evidence of a petroleum product spillage in the spring, Bill did not believe that the petroleum product came via surface runoff from the drilling or diesel spills on National Forest lands because of the long distance between them. Mr. Norby is investigating this situation and will report back to us. The outcome of his investigation will determine if we should be involved.

In response to your request to halt operations and complete an environmental impact statement, we feel the intent of the mining company is to be responsive to these concerns and will take the appropriate action. Our relationship with Budge Mining is stable and see no need to halt operations at this time.

Caring for the Land and Serving People

Mr. Norby also mentioned the problem with litter at the project and was deeply disturbed about it. He has contacted the driller about it and was assured that the area will be clean.

If you have any questions please feel free to contact me. 7-9-8700.

Sincerely,

*William Lewis*

FOL

STEVE R. PLEVEL  
District Ranger

cc: John Norby, Budge Mining  
Dirk Denbarrs, Keystone Minerals  
Jim DuBois, Dept. of Environmental Quality

Reply to: 2810

Date: March 29, 1990

Ken Rait, Conservation Chair  
Sierra Club - Grand Canyon Chapter  
1321 E. Lee St.  
Tucson, AZ 85719

Dear Ken:

Thankyou for your letter dated March 6 and 14, 1990, regarding the Korn Kob project. I'm sorry our response to your letters have been tardy, but Bill Lewis was not at work the first two weeks in March and I have been busy with other issues. We have continued to work on the problems, though. Lou Leibbrand, Forest Engineer, made a final visit with the Arizona Department of Environmental Quality on March 13, 1990, to assess the problem.

In your March 6, 1990 letter, you raised several concerns that I need to address. The first issue dealt with capping the holes and possible pollution of groundwater. Andrew Rendes, Arizona Department of Environmental Quality (ADEQ) mentioned to Lou Leibbrand that he did not see a problem with this. That oil is a common occurrence in drilling operations and floats to the top if any ground water is encountered. At this time, all the holes have been plugged. The second issue deals with the illegal roads (see the letter from Budge Mining dated March 14, 1990). We feel the appropriate action was taken and the threat of closing down the operation is a very hard slap on the wrist. The third issue dealt with the scum on the spring in Buehman Canyon. We have heard from several sources that this may be a natural phenomenon. Budge Mining has requested Dames & Moore to test the spring and determine if it came from a petroleum product.

The last paragraph requested we halt operations and write an Environmental Impact Statement. We do not believe that this is needed and that Budge Mining has been responsive to investigate or correct problems.

Caring for the Land and Serving People

In your March 14, 1990 letter, the concern was with the decontamination process for the diesel fuel spills. Budge Mining is removing all the contaminated soil from the site and is working with the ADEQ so this can be accomplished according to their standards. At this time, they are about two-thirds completed. The Forest Service feels that this does not need any type of NEPA documentation.

If you have any questions, please contact myself or Bill Lewis, 749-8700.

Sincerely,

A handwritten signature in cursive script, appearing to read "Steve Plevel".

STEVE R. PLEVEL  
District Ranger

March 28, 1990

Bill Lewis  
Coronado National Forest  
Santa Catalina Ranger District  
5700 N. Sabino Canyon Road  
Tucson, AZ 85715

Dear Bill:

Thank you for sending me copies of the letters to A.F. Budge Mining and Ken Rait regarding the Korn Kob Mine. The mining company has previously shown disregard for the conditions of their permit and need to be monitored more closely. I'm glad to see that the Forest Service has taken some action on correcting the problems at this project.

Concerning the clean up of the diesel spills, I understand that the intent of the mining company is to remove the contaminated soil from the site as the method of clean up. I am aware that a permit is required for the removal of any resources from Forest Service land, and since soil is in fact a forest resource. we request that a permit be required for this action detailing exactly how the soil is to be removed, contained, transported, disposed of, and where and how it is to be de-contaminated. At the very least an EA should be done to assess the impact.

I would appreciate receiving a copy of the permit (when available) and any future correspondence concerning this project.

Sincerely,

*Lainie Levick*

Lainie Levick  
Earth First!  
12120 E. Snyder Rd.  
Tucson, AZ 85749

cc: Department of Environmental Quality

March 28, 1990

Bill Lewis  
Coronado National Forest  
Santa Catalina Ranger District  
5700 N. Sabino Canyon Road  
Tucson, AZ 85715

Dear Bill:

Thank you for sending me copies of the letters to A.F. Budge Mining and Ken Rait regarding the Korn Kob Mine. The mining company has previously shown disregard for the conditions of their permit and need to be monitored more closely. I'm glad to see that the Forest Service has taken some action on correcting the problems at this project.

Concerning the clean up of the diesel spills, I understand that the intent of the mining company is to remove the contaminated soil from the site as the method of clean up. I am aware that a permit is required for the removal of any resources from Forest Service land, and since soil is in fact a forest resource, we request that a permit be required for this action detailing exactly how the soil is to be removed, contained, transported, disposed of, and where and how it is to be de-contaminated. At the very least an EA should be done to assess the impact.

I would appreciate receiving a copy of the permit (when available) and any future correspondence concerning this project.

Sincerely,

*Lainie Levick*

Lainie Levick  
Earth First!  
12120 E. Snyder Rd.  
Tucson, AZ 85749

cc: Department of Environmental Quality

Reply to: 2810

Date: March 29, 1990

Ken Rait, Conservation Chair  
Sierra Club - Grand Canyon Chapter  
1321 E. Lee St.  
Tucson, AZ 85719

Dear Ken:

Thankyou for your letter dated March 6 and 14, 1990, regarding the Korn Kob project. I'm sorry our response to your letters have been tardy, but Bill Lewis was not at work the first two weeks in March and I have been busy with other issues. We have continued to work on the problems, though. Lou Leibbrand, Forest Engineer, made a final visit with the Arizona Department of Environmental Quality on March 13, 1990, to assess the problem.

In your March 6, 1990 letter, you raised several concerns that I need to address. The first issue dealt with capping the holes and possible pollution of groundwater. Andrew Rendes, Arizona Department of Environmental Quality (ADEQ) mentioned to Lou Leibbrand that he did not see a problem with this. That oil is a common occurrence in drilling operations and floats to the top if any ground water is encountered. At this time, all the holes have been plugged. The second issue deals with the illegal roads (see the letter from Budge Mining dated March 14, 1990). We feel the appropriate action was taken and the threat of closing down the operation is a very hard slap on the wrist. The third issue dealt with the scum on the spring in Buehman Canyon. We have heard from several sources that this may be a natural phenomenon. Budge Mining has requested Dames & Moore to test the spring and determine if it came from a petroleum product.

The last paragraph requested we halt operations and write an Environmental Impact Statement. We do not believe that this is needed and that Budge Mining has been responsive to investigate or correct problems.

Caring for the Land and Serving People

In your March 14, 1990 letter, the concern was with the decontamination process for the diesel fuel spills. Budge Mining is removing all the contaminated soil from the site and is working with the ADEQ so this can be accomplished according to their standards. At this time, they are about two-thirds completed. The Forest Service feels that this does not need any type of NEPA documentation.

If you have any questions, please contact myself or Bill Lewis, 749-8700.

Sincerely,

A handwritten signature in cursive script, appearing to read "Steve Plevel".

STEVE R. PLEVEL  
District Ranger

Reply to: 2810

Date: March 2, 1990

RECEIVED MAR 3 1990

John W. Norby  
A.F. Budge Mining  
4301 N. 75th Street Suite 101  
Scottsdale, AZ 85251

Dear John:

Enclosed is our reply to the letter from the Sierra Club dated February 23, 1990 concerning the Korn Kob Mine. If there are any inaccurate statements please contact myself or Bill Lewis. I am aware that you and Bill have been communicating on these issues and that you are working as quickly as you can to correct any problems.

We have reached agreement on the following items:

1. Unauthorized Roads: given the location of the roads, we would have approved them but any further infractions will result in immediate suspension of all operations.
2. Diesel Spill: clean up work will start Saturday (March 3) and it is your intention to complete the project by March 15.
3. Plugging the Drill Holes: work will start Friday (March 2) and it is your intention the project will be completed by March 20, 1990.
4. Film on the Spring: you will investigate this situation and report back to us.

We would like to be notified when these projects are completed.

If it is possible, I would like to meet with you to discuss these problems and your mining operation at the Korn Kob Mine.

Thank you for your prompt action in dealing with these issues and working with our office.

Sincerely,

*William Lewis*

For  
STEVE R. PLEVEL  
District Ranger

Enclosures

cc: Ken Rait, Sierra Club  
Jim DuBois, Dept. of Environmental Quality  
Dirk Denbarrs

Reply to: 281.

Date: March 2, 1990

Ken Rait  
SIERRA CLUB - Grand Canyon Chapter  
1311 East Lee St.  
Tucson, Arizona 85719

Dear Ken:

Thank you for your letter dated February 23, 1990 concerning the Kern Kob project. On February 21, Bill Lewis had called John Norby of Budge Mining to inform him of what you both found on the trip of February 21, 1990. John and Bill also spoke on the phone since then about the problems.

In response to the diesel spills, the areas around drill holes and the two work areas will be cleaned up by the mining company. The work will start Saturday (March 3) and it is their intention to finish by March 15, 1990. In addition, for safety reasons and possible contamination, the holes will be plugged starting Friday (March 2) and it is their intention to finish by March 20, 1990. Mr. Norby has expressed his concern for these spills to the Forest Service and to the driller and the need to resolve this issue as quickly as possible and to prevent future spills.

In response to the unauthorized roads in the area, Mr. Norby is sending us an aerial photo of the roads and outlining the area of the possible mine. Given the location of these roads, the Forest Service would have approved them. We are informing Budge Mining that further infractions will result in immediate suspension of operation.

In response to the spring in Buehman Creek and the evidence of a petroleum product spillage in the spring, Bill did not believe that the petroleum product came via surface runoff from the drilling or diesel spills on National Forest lands because of the long distance between them. Mr. Norby is investigating this situation and will report back to us. The outcome of his investigation will determine if we should be involved.

In response to your request to halt operations and complete an environmental impact statement, we feel the intent of the mining company is to be responsive to these concerns and will take the appropriate action. Our relationship with Budge Mining is stable and see no need to halt operations at this time.

Mr. Norby also mentioned the problem with litter at the project and was deeply disturbed about it. He has contacted the driller about it and was assured that the area will be clean.

If you have any questions please feel free to contact me. 7-9-8700.

Sincerely,

*William Lewis*

FOL

STEVE R. PLEVEL  
District Ranger

cc: John Norby, Budge Mining  
Dirk Denbarrs, Keystone Minerals  
Jim DuBois, Dept. of Environmental Quality

United States Forest  
Department of Service  
Agriculture

Coronado NF

Santa Catalina RD  
5700 N. Sabino Canyon Rd.  
Tucson, Arizona 85715

Reply to: 2720

Date: December 11, 1989

Carole A. O'Brien  
A.F. Budge (Mining) Limited  
4301 North 75th Street, Suite 101  
Scottsdale, AZ 85251-3504

Dear Carole:

We received your payment for \$2050.00 for the Korn Kob Mine bond. Enclosed is a copy of the Bill for Collection sent in with the payment. Thank you for your attention to the matter.

Sincerely,

*Jerry Austin*

*for*  
STEVE R. PLEVEL  
District Ranger

Enclosures

RECEIVED DEC 14 1989

BILL FOR COLLECTION  
(Reference FSM 6530)

Place of Issue

Tucson, Arizona

Please pay by money order, bank draft, or check payable to Forest Service, USDA.

Date of Issue

December 5, 1989

PAYMENT MUST BE RECEIVED BY THE DUE DATE INDICATED ON THIS BILL. Postmarks are not honored. Payment after the due date is subject to an ADMINISTRATIVE CHARGE and a PENALTY CHARGE in addition to a LATE PAYMENT CHARGE at the rate currently prescribed in Treasury Fiscal Requirements Manual, Chapter 6-8000.

A.F. Budge (Mining) Limited  
4301 N. 75 St., Suite 101  
Scottsdale, AZ 85251-3504

(Please show any change of address below)

-----Fold Here-----

Mail Payment with this statement in the enclosed envelope to:

Unit Collection Officer, Forest Service  
Southwestern Region, File No. 81656  
P.O. Box 60000  
San Francisco, CA 94160-1656

Date or Period	Description	Amount
12/5/89	Bond - Korn Kob Mine 05ta	\$2050.00
	mailed 12/7 k	

Bill No.	Unit No.	Contract No.	Date Payment Due	Amount Due ->
0685	T0-05	*	12/5/89	\$2050.00

Contract Number	Transaction Code	Management Code	PY Code	Object Class	Amount
*	A	863223	*	*	\$ 2050.00
*	*	*	*	*	\$
*	*	*	*	*	\$ *
*	*	*	*	*	\$ *
*	*	*	*	*	\$ *
*	*	*	*	*	\$ *
TOTAL ----->					\$2050.00

Distribution: Original and Receipt Copy to Payor  
Permittee File Numerical File Accounts Receivable File Collection Officer

RECEIVED JAN 31 1990

*For your info - Bin*

# Revisions for mining law proposed in House



David A. Mullan Jr.  
33 N. Stone Ave., Suite 1100  
Tucson, Arizona 85701-1489  
(602) 624-6691

October 31, 1990

Mr. Steve R. Plevel, District Ranger  
Santa Catalina Ranger District, CNF  
5700 N. Sabino Canyon Road  
Tucson, Arizona 85715

Re: Keystone Minerals, Inc., and A.F. Budge Mining Co.  
(collectively referred to hereinafter as "Keystone");  
proposed Korn Kob Mine in Beuhman Canyon, Santa Catalina  
Ranger District, CNF

Dear Mr. Plevel:

Please note my interest in the referenced matter. I request that henceforth you give me notice of any and all developments that occur in connection with the proposed Korn Kob mine, and that you send me copies of all future correspondence or other written materials received and/or prepared by the CNF relating the mine.

A few months ago Bill Lewis informed me that Keystone had completed its exploratory drilling, had run assays on core samples but had not yet indicated whether it intended to develop the claim. Since then I have heard nothing from the Forest Service. If there has been any change in the status of the matter since my discussion with Bill Lewis, please inform me of same.

Although under the District Ranger's Decision Memo of August 1989, Keystone was allowed to proceed with road building and core sample drilling with the use of mechanized equipment but without the benefit of a plan of operations in apparent contravention of 36 CFR 228.4, I assume that any future mining activities pursuant to the Korn Kob proposal will be under a sufficient plan of operations. I request that you send me a copies of Keystone's notice of intent to operate and any proposed plan of operations as soon as practicable after they have been served on the Forest Service.

Bill Lewis also informed me as of the time of our conversation, no decision had been made on the issue of whether and EIS as opposed to an EA will be required for this project. That is understandable,

Mr. Steve R. Plevel, District Ranger  
October 31, 1990  
Page 2

since Keystone had not yet submitted a plan of operations or other written proposal to further develop the claim. I would emphasize, however, that with an operation of this kind--an open pit copper mine and a heap leach extraction system practically in the middle of a stream feeding the San Pedro River--applicable EPA regulations, 40 CFR 1501.3, 1501.4(b), and 1508.9(a)(1), would prohibit ruling out an EIS prior to the preparation of an EA. See, also, Chapter 30 of the Environmental Policy and Procedures Handbook set forth in FSH 1909.15, at paragraph 31, "Documentation of Analysis," requiring the responsible Forest Service officer to document the environmental analysis of a proposed action in a 40 CFR 1508.9 Environmental Assessment to determine whether the proposed action requires preparation of an EIS.

Even without the benefit of an EA, enough is already known about the proposed Korn Kob operations to conclude that an EIS will be necessary. Based on the rough sketches of the mine site, the notes and the correspondence about the mine in your file, and the well known unique characteristics of Beuhman Canyon, I feel that the Forest Service must find that the mine will have a significant impact on the human environment, and must, therefore, inform Keystone, when it submits its proposed plan of operations, that pursuant to 36 CFR 228.5(5), the plan cannot be approved until a final EIS has been prepared. My arguments in support of this conclusion are set forth below.

#### LEGAL CONSIDERATIONS ON THE ISSUE OF WHETHER TO PREPARE AN EIS

An EIS is required for any "major" federal action "significantly affecting the quality of the human environment... ." NEPA § 102(c). Any federal action is "major" per se if it "significantly" affects the quality of the human environment. 40 CFR 1508.18. Thus, the focus is on "significantly."

40 CFR 1508.27 (adopted by the Forest Service in paragraph 05[33] of the Environmental Policy and Procedures Handbook) states that the word "significantly" in NEPA § 102(c) requires a consideration of the context of the proposed action. In a site-specific action such as the Korn Kob Mine, context considerations mean an analysis of impacts on the locale "rather than the world as a whole." 40 CFR 1508.27(a). The importance of this point is that an action significantly affecting the environment of a small locale may be a NEPA § 102(c) "significant" action requiring an EIS even though it may not affect the environment over a large area.

Mr. Steve R. Plevel, District Ranger  
October 31, 1990  
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An inquiry into "significance" also requires an evaluation of the intensity of the impacts of the proposed action. The factors relevant to an evaluation of the intensity of impacts, according to 40 CFR 1508.27(b), include the following:

- (a) the extent to which the action may affect public health or safety;
- (b) the proximity of the site to unique resources such as wild and scenic rivers or ecologically critical areas;
- (c) whether the action will be controversial;
- (d) whether the action will pose unique or unknown risks;
- (e) the degree to which the action will set a precedent for future actions with significant effects; and
- (f) the degree to which the action may affect threatened or endangered species.

#### LEGAL CONSIDERATIONS APPLIED TO THE KORN KOB MINE

Both the context and the intensity of impacts of the Korn Kob Mine will vary depending on which of the many aspects of the human environment is being considered. I will identify and discuss here what I believe are among the more important values that will be seriously impacted by the Korn Kob Mine.

1. Public Health and Safety. The Korn Kob Mine will use a "heap leach" extraction method, processing the ore with enormous quantities of sulfuric acid. It is my understanding that the leaching operations, if approved, will take place in the canyon and close to the stream, which, as noted above, flows directly into the San Pedro River to the east. A sudden overflow after heavy rains, unintended spills or other "releases" of the leaching chemicals into the Beuhman Creek drainage and from there into the San Pedro, could cause tremendous harm over a large area--harm to humans, livestock, wildlife and plants. Residual toxic metals leached from the processed ore, if not properly and permanently contained (if that is even possible), could cause long-term damage to Beuhman Creek, the San Pedro River and the aquifers fed by both of them.

Mr. Steve R. Plevel, District Ranger  
October 31, 1990  
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Minimizing the risks of these kinds of releases into the creek would first require a full understanding of those risks. It would also require an analysis and comparison of the risks and feasibilities associated with other alternatives, such as, for example, locating all heap-leaching operations completely outside the Beuhman Creek drainage. Minimizing the risks requires the development and actual implementation of any and all procedures and systems as may be necessary to protect the public health and safety against the release of toxic substances into the environment, utilizing the best available technology and highest standards for engineering, constructing and installing leaching ponds, liners, leak-detection systems and back-ups to those systems.

The consequences of not adequately addressing the risks of the proposed action--many of which, as other notorious heap-leaching operations in the West have demonstrated, are both "unique and unknown" risks within the meaning of 40 CFR 1508.27(b)--and comparing reasonable alternatives to the action, are so drastic that opting for anything less than the level of scrutiny involved in the preparation of a draft and final EIS would be foolhardy.

2. Scenic Values. Anyone who has hiked Beuhman Canyon knows it is a place of striking beauty. In the immediate vicinity of the proposed mine, the canyon supports an abundant and healthy stand of saguaros reminiscent of the most picturesque areas of Saguaro National Monument. Sycamore, cottonwood, willow and juniper grow along and in the creekbed itself. The creek does not flow continuously at this elevation, but it does surface intermittently to form perennial pools.

At present, there are no substantial man-made intrusions interrupting the natural beauty of the canyon. With the Korn Kob Mine, of course, which will involve, among other things, the blasting and/or bulldozing away of an entire hill on the south side of the creek, that beauty will not only be marred, it will be permanently obliterated.

As noted above, the proximity of the proposed action to a unique resource such as a wild and scenic river is of direct relevance to the "significance" of the action in the context of whether to prepare an EIS. 40 CFR 1508.27(b). Beuhman Creek is currently being considered for recommendation as a wild and scenic river by the Arizona Rivers Coalition. A copy of a preliminary descriptive inventory of Beuhman Creek prepared by this writer for the

Coalition is enclosed herewith.

3. Recreational Use and Access. Beuhman Creek is popular with hikers and hunters, many if not most of whom gain access to the canyon by way of the jeep trail off Redington Road. The mine will be situated up-canyon from where the jeep trail intersects the creek, and from the rough plans and drawings I have seen, it appears that the pit and the leaching ponds will block or interfere with foot traffic along the creek and in the canyon. This will force hikers to detour around the mining compound, and will probably result in increased use of the Brush Corral Hiking Trail higher up in the canyon to avoid the mine. These changes in access and use must be considered in analyzing the significance of the mine's affects on the environment.

4. Wildlife. One of the considerations in determining "significance" is the proximity of the proposed action to ecologically critical areas. 40 CFR 1508.27(b). As you undoubtedly know, Beuhman Creek is the only perennial stream on the eastern slope of the Santa Catalina Mountains. It is, therefore, known to be a major corridor of wildlife migration from the higher elevations of the Catalinas down to the San Pedro River.

This fact--the canyon's critical function as a corridor of migration--is an excellent example of why the context of the proposed action deserves careful consideration. The Korn Kob Mine will displace and/or kill off much of the wildlife in the immediate vicinity of the mine and to a significant extent, due to "edge effect" or similar ecological phenomena, well beyond the mine site itself. However, the Korn Kob will also interpose an enormous, destructive and noisy human presence, breaching the migratory corridor.

Accordingly, it will not do to simply consider impacts on plant and animal species resident in the immediate area of the mine site. The impacts on all wildlife using the canyon as a means of access to and from the San Pedro must be considered. At a very minimum, the Forest Service must determine whether any sensitive, threatened or endangered species use or depend on Beuhman Canyon for this purpose, and whether any essential prey of such species use or depend on it. Measures to avoid or minimize the interference with this migratory pattern should be considered, and alternatives for reclamation designed to fully restore the canyon for this use to wildlife should be evaluated and compared. Frankly, I do not believe these considerations can be given fair and responsible treatment in an EA.

Mr. Steve R. Plevel, District Ranger  
October 31, 1990  
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5. Setting Precedent. I will conclude with another point raised in 40 CFR, 1508.27(b): the degree to which the proposed action will set a precedent for future actions with significant effects. The Santa Catalina Mountains are the most visible and, in my mind, remarkable geological formation in the Tucson area. The Santa Catalina Ranger District supports a variety of multiple uses--and heap-leach mining is completely inconsistent with every one of those uses. The Forest Service should adopt a policy that any action in the Santa Catalina Mountains as destructive and potentially dangerous as open pit, heap-leach mining, will require, as a matter of course, the preparation of an EIS.

Sincerely,



David A. Mullan Jr.

Enclosure

cc: Bill Lewis  
John Gutierrez  
Lainie Levick  
Craig O'Hare  
Gail Peters  
W.S. McGinnis  
Richard Hall  
Morris K. Udall

## ARIZONA RIVERS INVENTORY

Date: 10-10-90

River Name: Beuhman Creek. Mileage: First segment @ 6 miles:  
second segment @ 2 1/4 miles.

Begin & End of Segments: First segment begins at a point in Beuhman Canyon in sec. 1-T12S-R16E and runs in an eastward direction until it intersects the line between secs. 15 & 14-T12S-R17E, all in Pima County, Arizona. Second segment begins where the first ends, and proceeds eastward through secs. 14 & 13 of T12S-R17E and terminates at a point in the NE NE of sec. 19-T12S-R18E, all in Pima County, Arizona.

Acreage: First segment, @ 1920 acres: second segment @ 640 acres.

Percent Private Land: First segment, 0%: second segment, 100%.

Managing Agency: First segment is on the Coronado National Forest, ending on the Forest's eastern boundary. Second segment is on private land.

Access Points: The only access by vehicle is by way of a very rough jeep trail which leads to the end point of the second segment. The Brush Corral Hiking trail intersects Beuhman Creek at a point in sec. 16-T12S-R17E.

Description of River and Terrain: Both segments are in Beuhman Canyon, which descends off the eastern slopes of the Santa Catalina Mountains, not far below what is known as Green Mountain. The canyon is in the midst of extremely rugged terrain, the grade quite steep. It is one of a series of canyons cutting into the eastern end of the Santa Catalinas. At the upper levels of the first segment, at approximately 5500 ft. in elevation, Beuhman Creek runs through a forest of juniper, pine and oak. The second (lower elevation) segment runs through a mixed broadleaf forest of sycamore, cottonwood and willow, perhaps dominated by sycamore. The entire length of the first segment is perennial and free-flowing; near the lower end of the second segment, the creek goes underground but emerges intermittently in small perennial pools. During the spring the entire length of both segments are free-flowing with snowmelt, and both segments run continuously during the summer monsoons.

Detrimental Uses/Threats: The second segment is vulnerable to mining. A deposit of copper was discovered in the canyon in secs. 13 and 24 of T12S-R17E several years ago, and a claimant is considering an open pit mine. The minerals have not been developed to date due to the price of copper, and it is not certain that the economics will justify development in the foreseeable future. In any event, this possible mine would not directly affect the first segment.

Known Conflicts to Designation: See immediately preceding paragraph. Also, the second segment of Beuhman Creek is entirely on private land. This proposal divides Beuhman creek into two segments in the event there is opposition from the individuals who own the lands involved in the second segment

Support/Opposition: See immediately preceding paragraph. However, with respect to the first segment, it is quite possible that the Forest Service will support the nomination of Beuhman Creek.

Other Comments: One of the interesting aspects of Beuhman Creek is its "untouched" character despite being so close to Tucson. This is a consequence of very difficult access. From Tucson, the only practical road leading to the jeep trail accessing the creek is Redington Road, which is unpaved and fairly rough in itself. One cannot travel the jeep trail without a four-wheel drive vehicle with its hubs engaged.

Outstandingly Remarkable Values:

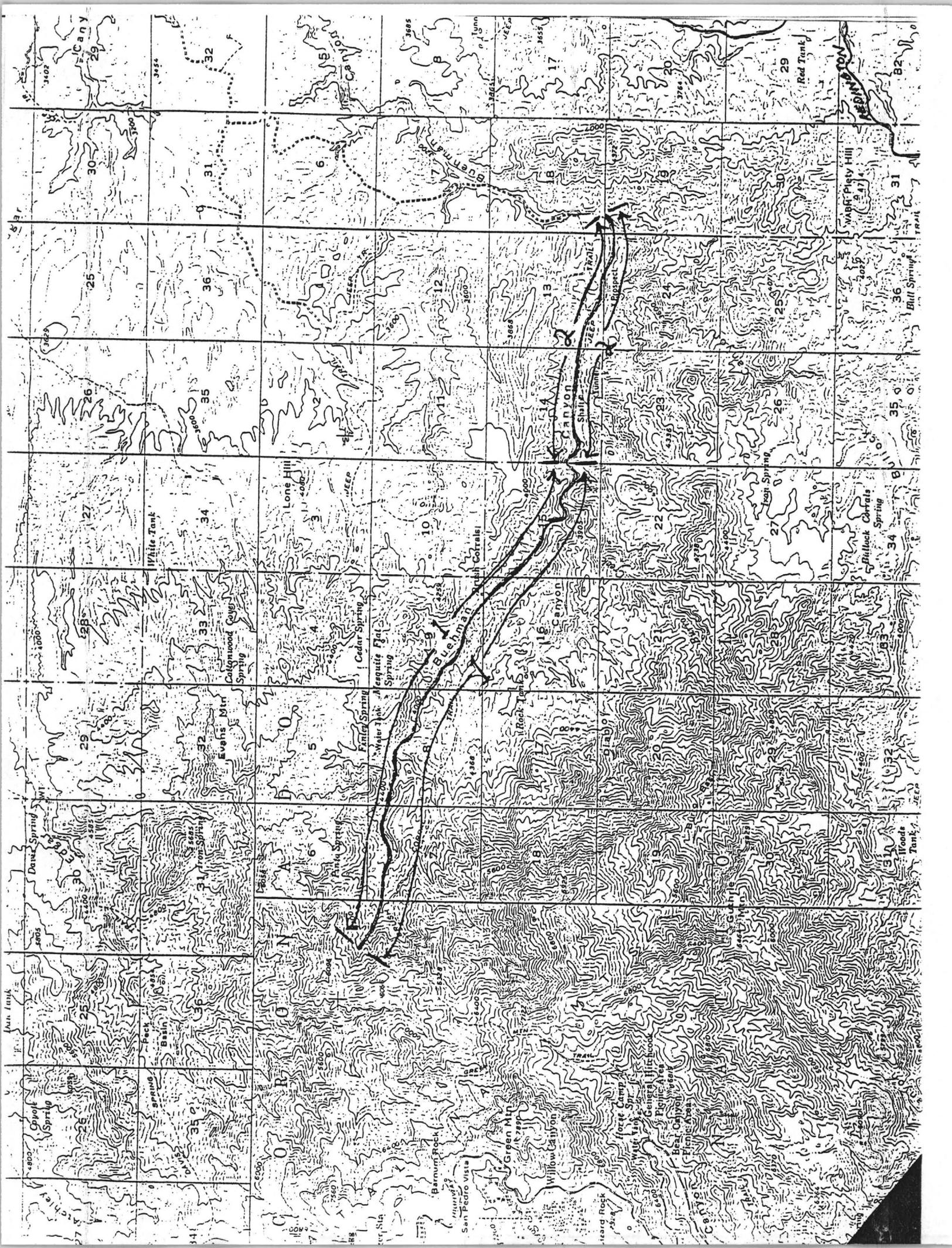
(a) Scenic. Because the creek descends so rapidly, it possesses a high scenic value--within a five- or six-mile stretch, the it moves from a conifer forest into a spectacular stand of saguaros. And due to its inaccessibility, it has wilderness characteristics similar to much more remote areas, while in fact it is only about 15 or 20 miles from Tucson.

(b) Recreational. Both segments of Beuhman Creek provide excellent hiking, whether from the jeep trail or from Brush Corral Trail.

(c) Wildlife. Beuhman Creek is the only perennial stream on the eastern side of the Santa Catalinas, and, as such, it is a major wildlife migration corridor

joining the higher elevations of the mountains with the San Pedro River Valley. The following species generally occur in drainages into the San Pedro, and are likely to occur in Beuhman Canyon:

- (1) Willow flycatcher--listed as endangered in Arizona.
- (2) Gila topminnow--federally listed as an endangered species, was introduced into the upper elevations of Beuhman Canyon in 1982.
- (3) Lowland leopard frog--a candidate species for listing as threatened or endangered.
- (4) Desert tortoise--currently a candidate for listing as threatened or endangered.
- (5) Mexican garter snake--currently a category 2 candidate for listing as threatened or endangered.
- (6) Brown vine snake--a candidate species.
- (7) Ferruginous pygmy owl--listed by state as endangered.
- (8) Gray hawk--listed by state as threatened.
- (9) Mississippi kite--a candidate species for listing as threatened or endangered.
- (10) Black hawk--a candidate for listing as threatened or endangered.
- (11) Tropical kingbird--a candidate for listing as threatened or endangered.
- (12) Speckled dace--populations of these fish have been observed in Beuhman Creek.



Council on Environmental Quality  
Executive Office of the President

LEWIS

**REGULATIONS**  
For Implementing The Procedural Provisions Of The  
**NATIONAL**  
**ENVIRONMENTAL**  
**POLICY ACT**



Reprint  
40 CFR Parts 1500-1508  
(as of July 1, 1986)

WE HAVE THE  
OPTION TO SAY NO  
TO A PROPOSAL

§ 1508.23 Proposal.

"Proposal" exists at that stage in the development of an action when an agency subject to the Act has a goal and is actively preparing to make a decision on one or more alternative means of accomplishing that goal and the effects can be meaningfully evaluated. Preparation of an environmental impact statement on a proposal should be timed (§ 1502.5) so that the final statement may be completed in time for the statement to be included in any recommendation or report on the proposal. A proposal may exist in fact as well as by agency declaration that one exists.

§ 1508.24 Referring agency.

"Referring agency" means the federal agency which has referred any matter to the Council after a determination that the matter is unsatisfactory from the standpoint of public health or welfare or environmental quality.

§ 1508.25 Scope.

Scope consists of the range of actions, alternatives, and impacts to be considered in an environmental impact statement. The scope of an individual statement may depend on its relationships to other statements (§§ 1502.20 and 1508.28). To determine the scope of environmental impact statements, agencies shall consider 3 types of actions, 3 types of alternatives, and 3 types of impacts. They include:

(a) Actions (other than unconnected single actions) which may be:

(1) Connected actions, which means that they are closely related and therefore should be discussed in the same impact statement. Actions are connected if they:

(i) Automatically trigger other actions which may require environmental impact statements.

(ii) Cannot or will not proceed unless other actions are taken previously or simultaneously.

(iii) Are interdependent parts of a larger action and depend on the larger action for their justification.

(2) Cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts

and should therefore be discussed in the same impact statement.

(3) Similar actions, which when viewed with other reasonably foreseeable or proposed agency actions, have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography. An agency may wish to analyze these actions in the same impact statement. It should do so when the best way to assess adequately the combined impacts of similar actions or reasonable alternatives to such actions is to treat them in a single impact statement.

(b) Alternatives, which include: (1) No action alternative.

(2) Other reasonable courses of actions.

(3) Mitigation measures (not in the proposed action).

(c) Impacts, which may be: (1) Direct; (2) indirect; (3) cumulative.

§ 1508.26 Special expertise.

"Special expertise" means statutory responsibility, agency mission, or related program experience.

§ 1508.27 Significantly.

"Significantly" as used in NEPA requires considerations of both context and intensity:

(a) Context. This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.

(b) Intensity. This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:

(1) Impacts that may be both beneficial and adverse. A significant effect may exist even if the Federal agency

believes that on balance the effect will be beneficial.

(2) The degree to which the proposed action affects public health or safety.

(3) Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.

(4) The degree to which the effects on the quality of the human environment are likely to be highly controversial.

(5) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

(6) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

(7) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

(8) The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.

(9) The degree to which the action may adversely affect an endangered or threatened species or its habitat that

has been determined to be critical under the Endangered Species Act of 1973.

(10) Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment.

[43 FR 56003, Nov. 29, 1978; 44 FR 874, Jan. 3, 1979]

#### § 1508.28 Tiering.

"Tiering" refers to the coverage of general matters in broader environmental impact statements (such as national program or policy statements) with subsequent narrower statements or environmental analyses (such as regional or basinwide program statements or ultimately site-specific statements) incorporating by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared. Tiering is appropriate when the sequence of statements or analyses is:

(a) From a program, plan, or policy environmental impact statement to a program, plan, or policy statement or analysis of lesser scope or to a site-specific statement or analysis.

(b) From an environmental impact statement on a specific action at an early stage (such as need and site selection) to a supplement (which is preferred) or a subsequent statement or analysis at a later stage (such as environmental mitigation). Tiering in such cases is appropriate when it helps the lead agency to focus on the issues which are ripe for decision and exclude from consideration issues already decided or not yet ripe.

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Action .....  
Action-forcing .....  
Adoption .....  
Affected Environ  
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Agency Authority  
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ENVIRONMENTAL CONSULTANTS

September 20, 1989

Mr. Steve R. Plevel, District Ranger  
CORONADO NATIONAL FOREST, SANTA CATALINA RD  
5700 N. Sabino Canyon Road  
Tucson, Arizona 85715

Dear Mr. Plevel:

On September 18 and 19, 1989, SWCA, Inc. conducted an endangered plant survey of the proposed drill road locations at the Korn Kob Mine site. The survey consisted of walking the proposed exploratory road alignments and road extensions with a representative of A.F. Budge Ltd. Particular emphasis was placed on the following species suggested by Reggie Fletcher, Botanist R-3 USDA-FS, as having a small possibility of occurring on the project site: *Penstemon discolor*, *Pectis imberbis*, *Streptanthus lemmonii*, and *S. carinatus*. Surveys for other species, such as *Neolloydia erectocentra* var. *erectocentra* were also conducted.

Neither the *Penstemon* nor the *Pectis* were observed during field surveys. Both *Streptanthus* species are probably winter annuals and would not be visible during this time of the year. *Streptanthus lemmonii* is only known from the type specimen collected in 1880 and its occurrence on this property would appear to be very unlikely. *Streptanthus carinatus* is the most likely of the four species to occur on the project site. It is described in Flora of Arizona (Kearney & Peebles 1964) as occurring on limestone slopes at an elevation of 4,500 feet in southern Arizona and western Texas. *Streptanthus carinatus* is listed by the U.S. Fish and Wildlife Service as a Category 3c species. Category 3c species are taxa that have proven to be more abundant and wide spread than was previously believed and or those taxa that are not subject to any identifiable threat.

Neither the *Penstemon* nor the *Pectis* were found during field survey. Review of the available literature concerning the two *Streptanthus* species indicate that it is unlikely that either species would be significantly impacted as a result of exploratory drilling road extensions. On the basis of our survey of the proposed drill road extensions on the project site it is our assessment that special interest plant species pose no impediment to the activity proposed by A.F. Budge on behalf of Keystone Minerals Inc.

During our plant surveys we also kept an eye out for desert tortoise burrows - none were observed.

At Bill Lewis' request I have enclosed a copy of my resume for your review. If you have any questions or if I can be of additional assistance please call me or Mr. Mark Raming at our Tucson address.

Respectfully,

James A. Tress, Jr.  
SWCA, INC.

JAT/dl

Attachments

cc: Mr. John Norby/A.F. BUDGE MINING LTD  
Mr. C. Mark Raming/SWCA, INC.

TUCSON:  
1602 East Ft. Lowell Road  
Tucson, Arizona 85719  
(602) 325-9194

FLAGSTAFF:  
804 North Beaver  
Flagstaff, Arizona 86001  
(602) 774-5500

**JAMES ALBERT TRESS, JR.**

Office Address

SWCA, INC. Environmental Consultants  
1602 East Ft. Lowell Road  
Tucson, Arizona 85719  
(602) 325-9194

Home Address

7063 N. Pomona Rd.  
Tucson, Arizona 85704  
(602) 742-4825

Summary of Work Experience and Qualifications

Mr. Tress is an ecologist and environmental planner with a broad range of experience in resource assessment, land use planning, and project management. He has participated in long-term monitoring programs of plant and soil resources near a nuclear power plant, studied plant community responses to disturbance, conducted endangered species surveys, and participated in the preparation of numerous environmental assessments. Mr. Tress has a broad computer background which includes modeling, statistical analysis, and database management.

Most recently, Mr. Tress has participated in the preparation of an integrated lake and mine spoil reclamation program, managed preparation of an environmental assessment for a potential uranium mine in northern Arizona, and completed resource management and environmental review for a strategic planning program in South Dakota. As project manager, Mr. Tress oversaw the completion of preliminary site planning and architectural concept development for a natural history and cultural center in South Dakota. He has produced a technical manual on native tree relocation techniques and has prepared numerous native plant preservation and revegetation plans.

Mr. Tress has developed SWCA's computer aided mapping capabilities and written programs to automate mapping of archaeological testing and site location data. He has utilized computer aided mapping for various projects including native vegetation preservation plans, riparian and wetland revegetation designs, archaeological artifact density and distribution maps and plant community maps.

Education

- 1986 M.N.S. Arizona State University, Tempe Arizona. Plant Ecology, Department of Botany and Microbiology. Thesis Title: Successional Dynamics of Pinyon-Juniper Woodlands in Arizona.
- 1981 B.S. Northern Arizona University, Flagstaff, Arizona. Biology and Chemistry.

Membership in Professional Societies

Ecological Society of America

Professional Experience

- 1988- Ecologist/Project Manager. SWCA, Inc. Current responsibilities include management of interdisciplinary project teams and ecological consulting services.

James Albert Tress, Jr.

Professional Experience (continued)

- 1986-87 Field Operations Manager. SWCA, Inc. Responsibilities included scheduling of equipment and crews, client interface, quality control, bidding, and billing for the Vegetation Management Division of the Company.
- 1985-86 Project Ecologist. SWCA, Inc. As a subcontractor and as a full-time employee, I provided technical support and consulting services on various contracts including a Bureau of Reclamation contract to study the Terrestrial Ecology of Lower Colorado River Bankline stabilization structures.
- 1985 Environmental Technician. NUS Corp., 910 Clopper Road, Gaithersburg, Maryland. As a subcontractor, I conducted vegetation and soil sampling of natural and agricultural sites in and around Palo Verde Nuclear Generating Station west of Phoenix, Arizona.
- 1983-85 Teaching Assistant. Arizona State University, Department of Botany and Microbiology.
- 1983 Research Assistant. Arizona State University, Department of Botany and Microbiology. Data acquisition and analysis. An index of human comfort was determined based upon ambient environmental conditions - indices were mapped for Arizona.
- 1981-82 Lab Technician. Copper Lake Mining Company., Phoenix Arizona. Wet chemistry and atomic absorption spectrophotometry were used to analyze ore samples and chemical constituents of the extraction process.

Papers Abstracted and Presented

- 1985 Tress, J.A. and J.M. Klopatek. Secondary Succession in Pinyon-Juniper Woodlands in Northern Arizona. Bulletin of the Ecological Society of America 66(2):284. Presented 6/21/85 at the University of Minnesota, Minneapolis, Minnesota.
- 1985 Tress, J.A. and J.M. Klopatek. Secondary Succession of Pinyon-Juniper Woodlands in Northern Arizona. Arizona/Nevada Academy of Science Abstract. Presented 4/27/85 at the University of Nevada Las Vegas, Las Vegas, Nevada.
- 1984 Tress, J.A. and J.M. Klopatek. Thermal comfort and natural energy in Arizona. Arizona/Nevada Academy of Science Abstract. Presented 4/7/84 at the University of Arizona, Tucson, Arizona.

Publications

- 1988 Mills, G.S. and J.A. Tress. Terrestrial Ecology of Lower Colorado River Bankline Modifications. Prepared For: Bureau of Reclamation, Lower Colorado Regional Office, Boulder City, Nevada. Contract Number:6-CS-30-02860.
- 1987 Tress, J.A. and J.M. Klopatek. Successional Changes in Community Structure of Pinyon-Juniper Woodlands in North-Central Arizona. In Pinyon-Juniper Symposium, Intermountain Research Station pp. 80-85.

Publications (cont.)

- 1985 Tress, J.A. and J.M. Klopatek. Disturbance and Succession in Pinyon-Juniper Woodlands Documented (Arizona). Restoration and Management Notes 3(2):80-81.

Professional Reports

- 1989 Coronado Square Native Plant Salvage and Habitat Preservation Plan. Prepared for Bennett Properties, Scottsdale, Arizona.
- 1989 Shiva Residence Significant Native Plant Inventory. Prepared for Stubbs and Schubart, P.C.
- 1989 Homestake Natural History & Cultural Center (Public Distribution Document). Prepared for Homestake Mining Company.
- 1989 Homestake Natural History & Cultural Center (Corporate Distribution Document). Prepared for Homestake Mining Company.
- 1989 Mountain Manor View Preservation Plan. Prepared for Ashir Enterprises, Toronto, Canada.
- 1989 Spearfish Canyon Owners' Association Document Recommendations. Prepared for Homestake Mining Company.
- 1989 Native Plant Salvage Manual. Prepared for the City of Phoenix - Parks, Recreation, & Library Department.
- 1989 Tonto Creek Revegetation/404 Mitigation Plans. Prepared for F&F Construction.
- 1988 Homestake Mining Company Non-Mining Assets - Strategic Plan Technical Supplement.
- 1988 Homestake Mining Company Non-Mining Assets - Strategic Plan Summary Report.
- 1988 Baseline Studies of Soils, Vegetation and Wildlife at Union Pacific Resource Companies Sage Mine Site, Northern Arizona.
- 1988 Recommendations and Alternatives for Reclamation of Pecks Lake and Clarkdale Tailings Pond. Prepared For Phelps Dodge Development Corporation.
- 1988 Preliminary Inventory and Analysis; Environmental and Cultural Resources: Verde Valley Property. Prepared For Phelps Dodge Development Corporation.
- 1988 Preliminary Assessment of Vegetation and Wildlife Values of the Bennett Property at the Corner of Broadway and Houghton Roads in Tucson. Prepared for Bennett Properties, Scottsdale, Arizona.

Professional Reports (continued)

- 1987      Vegetation and Habitat Preservation Plan; Monterra Estates. Prepared for Bellamah Community Development.
- 1987      Vegetation and Habitat Preservation Plan; Copper Creek IV. Prepared for Bellamah Community Development.
- 1987      Assessment of Existing Native Vegetation Along a Reclaimed Water Easement on Property Owned by Mr. and Mrs. Richard Hill. Prepared for Stubbs and Schubart, P.C.
- 1987      Assessment of Damage to Vegetation as a Result of Heavy Equipment Passage. Prepared for Mr. Matts Myhrman.
- 1986      Biological Assessment and Impact Analysis Chapters In Zond Systems Wind Park Environmental Impact Report. Prepared for James M. Montgomery, Consulting Engineers, Inc., Pasadena, California.
- 1986      Mount Lemmon - Ski Valley: Preliminary Environmental Assessment. Prepared for Walter Dawgie Ski Corporation, Mount Lemmon, Arizona.
- 1986      Terrestrial Ecology of Lower Colorado River Bankline Modifications - Interim Report. Prepared for United States Department of the Interior, Bureau of Reclamation, Lower Colorado Region.
- 1985      Phytogeography of Palo Verde Nuclear Generating Station and the Surrounding Region. Prepared for the NUS Corporation, Gaithersburg, Maryland.

JAT8\CV-JAT.1

Reply to: 2810

Date: November 13, 1989

Ken Rait, Conservation Chair  
Sierra Club - Rincon Group  
2015 East Ninth Street  
Tucson, Arizona 85719

Dear Ken:

Thank you for your letter dated October 31, 1989 concerning the Korn Kob mine and the road development activities in Buehman Canyon. The letter has three items of concern: 1. a 404 permit, 2. increasing the bond, and 3. completing a environmental assessment.

1. Attached is the Federal Register, Rules and Regulations, concerning 404 permits. On page 41234, section 323.4 Discharges not requiring permits, item 6, that temporary roads for moving mining equipment do not require permits. And on page 41255, section 330.5 Nationwide permits, item 3, that repair or rehabilitation of a previously authorized road is permitted. The road in Buehman Canyon (Forest Service Road #654) has been authorized. William Lewis contacted Robert Dummer, U.S. Army Corps of Engineers, to discuss the matter again and invited him to see the project. However our original position is the same, a permit is not required in this situation.

2. The bond was calculated for approximately 4 acres. It has been revised to include 11 acres of reclamation, which includes the entire area authorized under the operating plan. The new bond total will be \$2,750. This has been discussed with the mining company and they have agreed to the new bond. Based on past experience in this area, the rehabilitation we have prescribed is proper.

3. We feel that the appropriate level of analysis, documentation and public notification was performed. The decision memo, dated September 12, 1989, stated that there was a 45 day appeal period, which expired October 27, 1989. According to our records, you were sent a copy on or about September 13, 1989. The opportunity for relief through the administrative process has expired. As a reminder, this decision permitted only the exploration activity for the purpose of determining the extent of the ore body. Any potential mine development and operation will require additional analysis and documentation resulting in another decision. Therefore there will be opportunity for additional public involvement, assuming the proponent decides there is a feasible operation.

To update you on the progress of this project, the roads have been completed and the drilling started. The mining company did not construct all the roads they were planning. I do not know when the drilling will be finished or when the analysis of the core samples will be completed.

If you have any questions about this letter or the project please feel free to contact myself or William Lewis at 749-8700.

Sincerely,

WFL

STEVE R. PLEVEL  
District Ranger

cc: Budge Mining Company  
Keystone Minerals  
Army Corps of Engineers

Reply to: 2810

Date: November 8, 1989

RECEIVED NOV 16 1989

John W. Norby, Chief Geologist  
A.F. Budge Mining Limited  
4301 N. 75th Street  
Suite 101  
Scottsdale, AZ 85251

Dear John:

This letter deals with the Korn Kob Mine and the restoration bond that was requested for the operation. The initial cost estimate has been revised.

The breakdown is as follows:

Seed Cost (11 acres) = \$600, Vehicle with rake for 3 days = \$100, Labor-3 people for 3 days for 10 hours at \$15/hr = \$450, Pipe Gates = \$600, Backhoe/cat work (waterbars, repair damage, road closures) = \$1,000. Therefore, we are requesting an additional \$2,050 to make the total bond equal \$2,750.

Our plan for the area, if you do not go into production, is to re-establish the vegetation (grasses) and restrict vehicle use. The roads that have been seeded in the past seem to respond very well. We should seed the area during the time of year for maximum survival and then rake the roads to provide for a good seedbed. Waterbars will stop erosion on roads with a slope. All vehicles will be kept off the site so it may recover. Informational signs should be installed to educate the public on this restriction and help gain compliance.

If you have any questions with the bond or the restoration work please feel free to contact myself or William Lewis at 749-8700.

Sincerely,

*For*   
STEVE R. PLEVEL  
District Ranger

Caring for the Land and Serving People

minor drainage does not include the construction of any canal, ditch, dike or other waterway or structure which drains or otherwise significantly modifies a stream, lake, swamp, bog or any other wetland or aquatic area constituting waters of the United States. Any discharge of dredged or fill material into the waters of the United States incidental to the construction of any such structure or waterway requires a permit.

(D) Plowing means all forms of primary tillage, including moldboard, chisel, or wide-blade plowing, discing, harrowing and similar physical means utilized on farm, forest or ranch land for the breaking up, cutting, turning over, or stirring of soil to prepare it for the planting of crops. The term does not include the redistribution of soil, rock, sand, or other surficial materials in a manner which changes any area of the waters of the United States to dry land. For example, the redistribution of surface materials by blading, grading, or other means to fill in wetland areas is not plowing. Rock crushing activities which result in the loss of natural drainage characteristics, the reduction of water storage and recharge capabilities, or the overburden of natural water filtration capacities do not constitute plowing. Plowing as described above will never involve a discharge of dredged or fill material.

(E) Seeding means the sowing of seed and placement of seedlings to produce farm, ranch, or forest crops and includes the placement of soil beds for seeds or seedlings on established farm and forest lands.

(2) Maintenance, including emergency reconstruction of recently damaged parts, of currently serviceable structures such as dikes, dams, levees, groins, riprap, breakwaters, causeways, bridge abutments or approaches, and transportation structures. Maintenance does not include any modification that changes the character, scope, or size of the original fill design. Emergency reconstruction must occur within a reasonable period of time after damage occurs in order to qualify for this exemption.

(3) Construction or maintenance of farm or stock ponds or irrigation ditches, or the maintenance (but not construction) of drainage ditches. Discharges associated with siphons, pumps, headgates, wingwalls, weirs, diversion structures, and such other facilities as are appurtenant and functionally related to irrigation ditches are included in this exemption.

(4) Construction of temporary sedimentation basins on a construction site which does not include placement of

fill material into waters of the U.S. The term "construction site" refers to any site involving the erection of buildings, roads, and other discrete structures and the installation of support facilities necessary for construction and utilization of such structures. The term also includes any other land areas which involve land-disturbing excavation activities, including quarrying or other mining activities, where an increase in the runoff of sediment is controlled through the use of temporary sedimentation basins.

(5) Any activity with respect to which a state has an approved program under section 208(b)(4) of the CWA which meets the requirements of sections 208(b)(4) (B) and (C).

(6) Construction or maintenance of farm roads, forest roads, or temporary roads for moving mining equipment, where such roads are constructed and maintained in accordance with best management practices (BMPs) to assure that flow and circulation patterns and chemical and biological characteristics of waters of the United States are not impaired, that the reach of the waters of the United States is not reduced, and that any adverse effect on the aquatic environment will be otherwise minimized. These BMPs which must be applied to satisfy this provision shall include those detailed BMPs described in the state's approved program description pursuant to the requirements of 40 CFR Part 233.22(i), and shall also include the following baseline provisions:

(i) Permanent roads (for farming or forestry activities), temporary access roads (for mining, forestry, or farm purposes) and skid trails (for logging) in waters of the U.S. shall be held to the minimum feasible number, width, and total length consistent with the purpose of specific farming, silvicultural or mining operations, and local topographic and climatic conditions;

(ii) All roads, temporary or permanent, shall be located sufficiently far from streams or other water bodies (except for portions of such roads which must cross water bodies) to minimize discharges of dredged or fill material into waters of the U.S.;

(iii) The road fill shall be bridged, culverted, or otherwise designed to prevent the restriction of expected flood flows;

(iv) The fill shall be properly stabilized and maintained during and following construction to prevent erosion;

(v) Discharges of dredged or fill material into waters of the United States to construct a road fill shall be made in a manner that minimizes the

encroachment of trucks, tractors, bulldozers, or other heavy equipment within waters of the United States (including adjacent wetlands) that lie outside the lateral boundaries of the fill itself;

(vi) In designing, constructing, and maintaining roads, vegetative disturbance in the waters of the U.S. shall be kept to a minimum;

(vii) The design, construction and maintenance of the road crossing shall not disrupt the migration or other movement of those species of aquatic life inhabiting the water body;

(viii) Borrow material shall be taken from upland sources whenever feasible;

(ix) The discharge shall not take, or jeopardize the continued existence of, a threatened or endangered species as defined under the Endangered Species Act, or adversely modify or destroy the critical habitat of such species;

(x) Discharges into breeding and nesting areas for migratory waterfowl, spawning areas, and wetlands shall be avoided if practical alternatives exist;

(xi) The discharge shall not be located in the proximity of a public water supply intake;

(xii) The discharge shall not occur in areas of concentrated shellfish production;

(xiii) The discharge shall not occur in a component of the National Wild and Scenic River System;

(xiv) The discharge of material shall consist of suitable material free from toxic pollutants in toxic amounts; and

(xv) All temporary fills shall be removed in their entirety and the area restored to its original elevation.

(b) If any discharge of dredged or fill material resulting from the activities listed in paragraphs (a) (1)-(6) of this section contains any toxic pollutant listed under section 307 of the CWA such discharge shall be subject to any applicable toxic effluent standard or prohibition, and shall require a Section 404 permit.

(c) Any discharge of dredged or fill material into waters of the United States incidental to any of the activities identified in paragraphs (a) (1)-(6) of this section must have a permit if it is part of an activity whose purpose is to convert an area of the waters of the United States into a use to which it was not previously subject, where the flow or circulation of waters of the United States may be impaired or the reach of such waters reduced. Where the proposed discharge will result in significant discernible alterations to flow or circulation, the presumption is that flow or circulation may be impaired by such alteration. For example, a

States. (These phase-in dates are: After July 25, 1975, discharges into navigable waters of the United States and adjacent wetlands; after September 1, 1976, discharges into navigable waters of the United States and their primary tributaries, including adjacent wetlands, and into natural lakes, greater than 5 acres in surface area; and after July 1, 1977, discharges into all waters of the United States.) (Section 404)

(b) Structures or work completed before December 18, 1968, or in waterbodies over which the district engineer had not asserted jurisdiction at the time the activity occurred provided, in both instances, there is no interference with navigation. (Section 10)

#### § 330.4 Public notice.

(a) *Chief of Engineers.* Upon proposed issuance of new nationwide permits, modification to, or reissuance of, existing nationwide permits, the Chief of Engineers will publish a notice in the *Federal Register* seeking public comments and including the opportunity for a public hearing. This notice will state the availability of information at the Office of the Chief of Engineers and at all district offices which reveals the Corps' provisional determination that the proposed activities comply with the requirements for issuance under general permit authority. The Chief of Engineers will prepare this information which will be supplemented, if appropriate, by division engineers.

(b) *District engineers.* Concurrent with publication in the *Federal Register* of proposed, new, or reissued nationwide permits by the Chief of Engineers, district engineers will so notify the known interested public by an appropriate notice. The notice will include regional conditions, if any, developed by the division engineer.

#### § 330.5 Nationwide permits.

(a) *Authorized activities.* The following activities are hereby permitted provided they meet the conditions listed in paragraph (b) of this section and, where required, comply with the notification procedures, of § 330.7.

(1) The placement of aids to navigation and regulatory markers which are approved by and installed in accordance with the requirements of the U.S. Coast Guard (33 CFR Part 66, Subchapter C). (Section 10)

(2) Structures constructed in artificial canals within principally residential developments where the connection of the canal to a navigable water of the United States has been previously authorized (see 33 CFR Part 322.5(g)). (Section 10)

(3) The repair, rehabilitation, or replacement of any previously authorized, currently serviceable, structure or fill, or of any currently serviceable structure or fill constructed prior to the requirement for authorization, provided such repair, rehabilitation, or replacement does not result in a deviation from the plans of the original structure or fill, and further provided that the structure or fill has not been put to uses differing from uses specified for it in any permit authorizing its original construction. Minor deviations due to changes in materials or construction techniques and which are necessary to make repair, rehabilitation, or replacement are permitted. Maintenance dredging and beach restoration are not authorized by this nationwide permit. (Section 10 and 404)

(4) Fish and wildlife harvesting devices and activities such as pound nets, crab traps, eel pots, lobster traps, duck blinds, and clam and oyster digging. (Section 10)

(5) Staff gages, tide gages, water recording devices, water quality testing and improvement devices, and similar scientific structures. (Section 10)

(6) Survey activities including core sampling, seismic exploratory operations, and plugging of seismic shot holes and other exploratory-type bore holes. Drilling of exploration-type bore holes for oil and gas exploration is not authorized by this nationwide permit; the plugging of such holes is authorized. (Sections 10 and 404).

(7) Outfall structures and associated intake structures where the effluent from that outfall has been permitted under the National Pollutant Discharge Elimination System program (Section 402 of the Clean Water Act) (see 40 CFR Part 122) provided that the district or division engineer makes a determination that the individual and cumulative adverse environmental effects of the structure itself are minimal in accordance with § 330.7 (c)(2) and (d). Intake structures per se are not included—only those directly associated with an outfall structure are covered by this nationwide permit. This permit includes minor excavation, filling and other work associated with installation of the intake and outfall structures. (Sections 10 and 404)

(8) Structures for the exploration, production, and transportation of oil, gas, and minerals on the outer continental shelf within areas leased for such purposes by the Department of Interior, Mineral Management Service, provided those structures are not placed within the limits of any designated shipping safety fairway or traffic

separation scheme (where such limits have not been designated or where changes are anticipated, district engineers will consider recommending the discretionary authority provided by 330.8 of this Part, and further subject to the provisions of the fairway regulations in 33 CFR 322.5(1) (Section 10).

(9) Structures placed within anchorage or fleeting areas to facilitate moorage of vessels where such areas have been established for that purpose by the U.S. Coast Guard. (Section 10)

(10) Non-commercial, single-boat, mooring buoys. (Section 10)

(11) Temporary buoys and markers placed for recreational use such as water skiing and boat racing provided that the buoy or marker is removed within 30 days after its use has been discontinued. At Corps of Engineers reservoirs, the reservoir manager must approve each buoy or marker individually. (Section 10)

(12) Discharge of material for backfill or bedding for utility lines, including outfall and intake structures, provided there is no change in preconstruction bottom contours (excess material must be removed to an upland disposal area). A "utility line" is defined as any pipe or pipeline for the transportation of any gaseous, liquid, liquifiable, or slurry substance, for any purpose, and any cable, line, or wire for the transmission for any purpose of electrical energy, telephone and telegraph messages, and radio and television communication. (The utility line and outfall and intake structures will require a Section 10 permit if in navigable waters of the United States. See 33 CFR Part 322. See also paragraph (a)(7) of this section). (Section 404)

(13) Bank stabilization activities provided:

(i) The bank stabilization activity is less than 500 feet in length;

(ii) The activity is necessary for erosion prevention;

(iii) The activity is limited to less than an average of one cubic yard per running foot placed along the bank within waters of the United States;

(iv) No material is placed in excess of the minimum needed for erosion protection;

(v) No material is placed in any wetland area;

(vi) No material is placed in any location or in any manner so as to impair surface water flow into or out of any wetland area;

(vii) Only clean material free of waste metal products, organic materials, unsightly debris, etc. is used; and

(viii) The activity is a single and complete project. (Sections 10 and 404)



# SIERRA CLUB

Grand Canyon Chapter • Arizona

RINCON GROUP

2015 East Ninth St.  
Tucson, AZ 85719

RECEIVED 11/3/89

October 31, 1989

Steve Plevel, District Ranger  
Santa Catalina Ranger District  
5700 N. Sabino Canyon Rd.  
Tucson, AZ 85715

Copy to: MIKE B.  
JT  
Bel L.

Dear Steve:

The Sierra Club believes that road development activities in Bueham Canyon associated with the Korn Kob mine are in violation of the Clean Water Act. Though communication was made with the Corp of Engineers by district personnel, the Corps, as I understand it, felt that a 404 permit was not necessary. Because some of the road construction activities involveing some dredge and fill are in fact taking place through streambeds, a 404 permit is required under the Clean Water Act. We believe your personnel were inadequately advised by Corps personnel and have sent a letter to the Corps reflecting this.

The Sierra Club believes the \$700 bond is completely inadequate for the type of damage being done. I viewed the area last week and am convinced that reclamation would cost well into the thousands. The Sierra Club therefore requests that the bond requirement be raised to \$15,000 to assure adequate reclamation of the area's fragile ecosystem.

Having now seen the area, I believe an environmental assessment should have been completed prior to the issuance of the decision memo. It is unfortunate that these comments come long after the work has begun, but as we discussed, I felt the public comment period was wholly inadequate. This project has to be gotten off the fast track so that public comment as required in NEPA can be incorporated. Therefore, I suggest a stoppage on the work until completion of an environmental assessment, the mining companies agree to the higher bond, and the Corps issues a Section 404 permit. If this can only be done through an appeal of your decision, please notify me as soon as possible so we can take the necessary steps.

Sincerely,

A handwritten signature in dark ink, appearing to read "Kerr A. Rait".

Kerr A. Rait  
Conservation Chair

cc: David Baron, Center for Law in the Public Interest  
Keith Bagwell, Arizona Daily Star  
Norma Coile, Tucson Citizen  
Jim Abbott, Forest Supervisor



# SIERRA CLUB

## Grand Canyon Chapter - Arizona

RINCON GROUP  
2015 East Ninth St.  
Tucson, AZ 85719

October 31, 1989

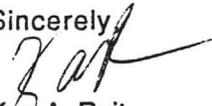
U.S. Army Corps of Engineers  
Charles Holt, Branch Chief  
P.O. Box 2711  
Los Angeles, CA 90053  
CESPL-CO-R

Dear Mr. Holt:

The Sierra Club believes that the Corp of Engineers incorrectly advised Forest Service personnel regarding the necessity of a section 404 permit pursuant to the Clean Water Act. According to Bill Lewis, Santa Catalina District, Coronado National Forest, Corps personnel felt that a 404 permit was unnecessary for road construction being done in Buehman Canyon. Because some dredge and fill is taking place through the streambed, we believe this decision was in error.

Therefore, the Sierra Club requests compliance with the Clean Water Act through the issuance of a 404 permit. Furthermore in accordance with NEPA, we believe an environmental assessment must be completed to assess the impacts of this dredge/fill activity. We view the issuance of the permit as a major federal action which should be open to comment by interested public. I look forward to hearing from you soon regarding your decision.

Sincerely,

  
Ken A. Rait  
Conservation Chair

cc: David Baron, Center for Law in the Public Interest  
Keith Bagwell, Arizona Daily Star  
Norma Coile, Tucson Citizen  
Steve Plevel, District Ranger

43  
41255



ROSE MOFFORD  
GOVERNOR

Arizona  
State Land Department

233 NORTH MAIN AVENUE  
TUCSON, ARIZONA 85701  
(602) 628-5480



OFFICE OF  
STATE LAND COMMISSIONER

September 5, 1989

Riley West, Inc.  
4400 E. Broadway  
Tucson, AZ 85711

Dear Lessee:

This letter is a following-up to my telephone contact made on September 5, 1989. At that time, I explained the stocking of Buehman Canyon in Section 5, T12S, R18E with desert pupfish (Cyprinedor Macularius).

This small fish is currently listed as endangered and any modification of the stream would probably adversely affect the population in Buchman Canyon. If at any time it would become necessary to alter the stream you should contact both the Arizona State Game and Fish Department and the Arizona State Land Department. Thank you for your cooperation, and if I can be of any assistance in the future please give me a call.

Sincerely,

Lyle Rolston  
Range Resource Manager

LR:tm

c: Stephen Williams

# Bellota Ranch

RILEY WEST, INC. • 4400 E. Broadway  
Suite 811 • Tucson, Arizona 85711 • (602) 325-5034

September 15, 1989

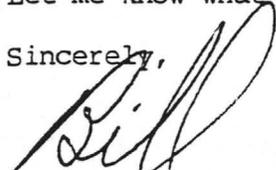
Steve Plevel  
U.S.D.A. Forest Service  
Rt. 15 Box 277F  
Tucson, AZ 85715

Dear Steve:

Enclosed is a copy of a letter we received from the State Land Department regarding the stocking of Buehman Canyon with desert pupfish (an endangered species). I hope you are aware that these fish have been placed in Buehman Canyon now that you have given permission for mining work to be done there. I hope we all don't end up "up the creek" on this deal.

Let me know what your thoughts are on this subject.

Sincerely,



W. S. McGinnis  
President

WSM/vlh

Encl: letter

Reply to: 2310

Date: October 11, 1989

Ken A. Rait, Conservation Chair  
Sierra Club, Grand Canyon Chapter, Rincon Group  
2015 East 9th Street  
Tucson, Arizona 85719

Dear Ken:

In response to your letters dated September 5, to the Forest Supervisor and the September 27, 1989, letter we are sincerely sorry for this late reply. The reasons for this late response was discussed at our meeting on October 5, 1989. If you have any concerns or questions on this process please let me know. I felt the meeting was helpful and informative. If you feel that a meeting in the future would be beneficial on this or any project, my door will always be open.

To address your concerns about the exploration work at the Korn Kob Mine we offer the following reply:

1. We had contacted the Forest Hydrologist, Bob Lefevre, to see if the road construction would adversely effect the riparian habitat in Buehman Canyon. He did not believe sediment from the new roads would have a significant effect. Mr. James Tress, Jr., SWCA employee, while checking for plants in the construction area also looked for desert tortoise burrows - none were observed (you have a copy of his letter).
2. We do not have a list of the plants that will be removed by the road construction but have given you a paper entitled, "Perennial Plant List for the Korn Kob Mine Property", by David Laing for Tom L. Heidrick performed around 1975. This paper and the letter from Mr. Tress would give you an idea of what plants might be removed. The most common plant on the north aspect at the mine site is the amole or shin-daggers.
3. The District contacted the Army Corp of Engineers about this project after receiving your letter. The project was discussed over the phone and they felt it would fall under a minor road crossing which has a nation wide permit. They are sending their regulations for our review. At this time I do not see a problem.

4. The Forest Service, Pima County, and Riley West have a working agreement on the maintenance of the Redington Pass Road. This aspect of the project should have very little impact on the road. The production access route has not been decided at this time. Another access for equipment is through San Manuel, south down the San Pedro River and then into Buehman Canyon on road number 654. The other route is over Redington Pass Road and north over the Piety Hill Road. They are improving both access routes which are mostly on private and state lands, except for the Redington Pass Road.

Our response to your concerns of my letter dated August 28 are as follows:

1. The mining companies hired James A. Tress, Jr, SWCA INC, to review the project for threatened or endangered plants--you have his resume and letter.
2. The cultural resource clearance was conducted by William Lewis, USDA-FS Para-archaeologist.
3. The mining companies did want to start just as soon as possible because they had equipment in the area. We tried to accommodate them with the early start but it was not acceptable to Gayle Hartman and so we stayed with the September 11 date. A letter was not sent to the Tucson Audubon Society but a letter was received from them and their concerns were addressed. A copy of the decision memo was sent to them. They will be advised of further activity in the area. The US Fish and Wildlife were not notified because the project did not require their input. In retrospect we should have notified the Arizona Game and Fish Department.
4. The NEPA process will not be rushed for the production phase of the project. We have notified the mining companies to start the process just as soon as they can and make contact with concerned publics, to meet with them and hear their concerns and see how they can be woven into the project, and to educate the public on the project so they have a clear understanding of the possible impacts.

The Forest Service is conscious of the potential impacts on Buehman Canyon and the reclamation of the mine site.

We look forward to working with you and the mining company on this challenging project.

Sincerely,

*William T. Lewis*

STEVE R. PLEVEL  
District Ranger

cc: Keystone Minerals  
A. F. Budge Mining Corp.

10/89  
JOHN:  
COPIES OF SIERRA CLUB  
LETTER AND OUR RESPONSE.  
WENT TO THE SITE 10/6 WITH  
FOREST HYDROLOGIST--LOOKS GOOD  
ONLY SUGGESTION IS MAKE  
SURE THE WATER BARS GO  
IN ON THE STEEPER SLOPES.  
BILL

FOR

TUCSON  
AUDUBON  
SOCIETY



Audubon Nature  
Shop

300 E. University  
#120  
Tucson, Arizona  
85705

602/629/0510

conservation  
education  
recreation

6 September 1989

Steve Plevel  
District Ranger  
Santa Catalina Ranger District  
5700 N. Sabino Canyon Rd.  
Tucson, AZ 1 85715

Dear Mr. Plevel:

In reference to the proposed Korn Kob Mine exploration, I request that the Forest Service require some kind of bond from Keystone Minerals and A.F. Budge Mining Co. before any exploration is allowed to ensure that all roads (new and existing) are restored if the mine does not achieve a legitimate production level of some kind by 1993.

Please keep Tucson Audubon informed as to what transpires with this exploration proposal and any subsequent plan of operation. Potential impacts to Buehman Canyon water quality and quantity need to be carefully scrutinized. There is an exceptional stand of sycamores along the perennial stretch of Buehman Creek just below the Forest Service boundary that needs to be safeguarded. Zone-tailed hawks nest in this area. This perennial stream offers a potential reintroduction site for Gila topminnow and other native fish.

In summary, mining, with its attendant impacts, is not appropriate for this area. Thank you for considering these comments.

Sincerely yours,

A handwritten signature in cursive script that reads "Ruth Russell".

Ruth Russell  
President

2851.11

In addition to the above, approval of a plan of operations by the Forest Service shall be accompanied by the following statements:

- (1) "Approval of this operating plan does not constitute certification of ownership to any person named as owner herein."
- (2) "Approval of this operating plan does not constitute recognition of the validity of any mining claim named herein, or of any mining claim now or hereafter covered by this plan."

*Notice Delivered  
on Aug 9<sup>th</sup>*

*Second  
Meeting with  
Bill Lewis  
was on  
Aug 17 '55*

2851.11 - Notice of Intention to Operate. A written notice of intention to operate is required from all operators who propose to conduct operations which might cause surface resource disturbance and who have chosen not to file an operating plan. The operation described in the notice must be evaluated and the operator must be informed, within 15 days after the notice is received by the District Ranger, either that his operation is exempt from the requirement for an operating plan or that one is required. The notice of intention must include:

- (1) Name and address of the operator.
- (2) Information sufficient to identify with reasonable certainty the area involved on the ground.
- (3) The route of access to the area of operations.
- (4) The nature of the proposed operations.
- (5) The proposed method of transport to the area of operations.
- (6) Operators should be encouraged to well document and closely tie the information to maps and to describe in some detail any proposed surface disturbing activities such as trenching, drill road and drill site construction or tree cutting.

Where a District Ranger or his duly authorized representative notifies an operator that no operating plan is required for this operation, that notification must be documented with a copy to the operator as promptly and simply as is feasible. The documentation should include the basis for the determination that a plan was not required. The documentation may later be helpful in court or serve as a defense against unwarranted criticisms.

2851.12 - Requirements for Operating Plans. (Reserved)

Property Owner

Den-Baars complained to  
Forest Service Mining Engineer  
about delay in exploration  
permit, citing above statute.

To properly serve its intended purpose, the proposed plan of operations must include the following information. Frequently needed information, but not required by the regulations, is enclosed in brackets.

(1) Name, legal address [and telephone number] of the operators, and their lessees, assigns, or designees [and their duly appointed field representative]

(2) Name, legal mailing address [and telephone number], of all owners other than the operator

(3) [Name of mining district or mineralized area; and name of claim(s) and/or property/ies on which operation(s) will take place or will be based.]

(4) A location map of appropriate scale to show accurately the general area in which mining operations might take place (location of claim(s) and/or property) and proposed route of access. In general, a forest recreation map would be adequate.

(5) A surface disturbance map of the area within which onsite and offsite surface resource disturbing activities will [or could] take place. The scale and accuracy of the map must be adequate to permit identification of the site on the ground. A USGS 7½ minute topographic quadrangle map or its equivalent will suffice in most cases and should be tied to the general area location map.

(6) The type and magnitude of the proposed operations should be well documented and closely tied to the information posted on the maps. Such data will permit an informed evaluation of the impact of the proposed operation(s) on the surface resources with the minimum of delay in approval. As a matter of policy (2852), the Forest Service will require only the minimum of information needed (preferably not to include confidential), but will require information on earth-moving and site clearance operations.

(7) The operator must identify the probable beginning and ending dates within which the proposed operation will be conducted [and, when appropriate, whether the operation will be intermittent or continuing].

(8) The plan of operations shall include sufficient detail to identify the precautions which the operator needs to take to reasonably prevent and/or minimize adverse environmental impacts on National Forest surface resources during and after the proposed operations. Although improvement of surface resource conditions or preparations for future use are desirable goals, they cannot be forced on operators as an added cost.

2851.13 - Approval of Operations. (Reserved)

2851.14 - Bonds. Prior to approval of a plan of operation, including the type and amount of reclamation, the operator must furnish, if required, a guarantee to perform reclamation in an amount equal to the estimated cost of the reclamation work. The guarantee, ordinarily a surety bond, must be filed with the appropriate Regional Fiscal Agent, Forest Service, U.S. Department of Agriculture. If the guarantee is in cash, the check or money order should be drawn payable to the Forest Service, U.S. Department of Agriculture. If a surety bond is submitted, the surety must be among those appearing on the quarterly list of acceptable sureties furnished by the Treasury Department and authorized to do business in the State in which the operation occurs.

Whenever a bond furnished under an approved plan of operations shall be found unsatisfactory, a new bond that is satisfactory will be furnished within 15 days from the date the operator is notified that the original bond or its successor is not satisfactory.

The surety bond or equivalent cash deposit is conditioned upon the Forest Service's acceptance of the operator's reclamation of the disturbed surface resources in accordance with section 252.8 (g) of the regulations.

The authorized Forest Service officer will, in writing, promptly relieve the operator from any further reclamation responsibilities on those areas on which such reclamation requirements agreed upon in the approved plan of operation have been completed and accepted by the Forest Service. This could occur piecemeal, if the reclamation took place in definite stages.

The surety deposit or bond shall be used only to assure compliance with the reclamation requirements agreed upon in the plan of operations by the operator and the Forest Service, and where required must be deposited with the appropriate Forest Service officer before the plan of operations may be approved.

All reasonable effort should be made, through agreements with States which require bonds for reclamation of disturbances in National Forests, to avoid double bonding.

2851.2 - Inspection and Noncompliance. When activities are being conducted under an approved operating plan, regular compliance inspections should be conducted to assure reasonable conformity to the plan and to guard against unforeseen detrimental effects. The frequency, intensity, and complexity of inspection should be commensurate with the potential for irreparable and unreasonable damage to surface resources.

United States  
Department of  
Agriculture

Forest  
Service

Arizona  
Zone  
Office

2324 E. McDowell Road  
Phoenix, AZ 85006  
602 225-5261

Reply To: 2810

Date: September 7, 1989

Subject: Keystone Minerals proposal

To: Steve Plevel, Santa Catalina DR

The Santa Catalina District recently received a proposal, dated August 9, 1989, from Keystone Minerals, Inc. to continue exploration and development of the Korn Kob property in Section 23, T 12 S, R 17 E, Pima County, Arizona. The proposal calls for extension of existing roads to construct new drill sites using caterpillar equipment and auxiliary vehicles. A copy of the proposal was recently forwarded to the AZ Zone Office. The purpose of this memo is to document my concerns about how the exploration proposal is being administered.

The exploration proposal is being reviewed using NEPA standards and procedures as stated in ID No. 2, FSH 1909.15, Chapter 20, Section 26.2. The proper approach for analyzing mining activities on NF lands is the Forest Service mining regulations that have the National Environmental Policy Act integrated as a part of the statutory authority.

The District's procedures for handling this proposal is improper in that a "selected" public is being solicited for input into making a decision. It is questionable whether an unbiased decision can be made if a potentially adverse public is given the opportunity to mold the decision document prior to being finalized. I can appreciate the intent of the District to properly inform the publics that have voiced a concerned interest in any project of this nature. However, I feel that a more proper approach would have been to notify them of the receipt of Keystone Mineral's proposal and invite them to participate in the public comment period as part of the NEPA process.

The standard for administering mining activities, including exploration, on National Forest lands is through the regulations at 36 CFR 228 Subpart A. As you know, surface disturbing activities need to be approved prior to commencing and a bond must be assessed commensurate with the scale of activities and the estimated cost of reasonable and adequate reclamation. Incorrectly, this proposal has been identified as falling within the limits of preliminary exploration and small mineral sample collection. The District's letter dated August 28, 1989 to the Sierra Club, Earth First, etc. is misleading. The letter states that Keystone Mineral's proposal is not a plan of operations, but then talks about exploration of the orebody and the use of mechanized equipment. Similarly, the attached Decision Memo is titled "Korn Kob Mine - Road Building to new drill sites" (emphasis added). The work being proposed is not preliminary exploration project but a continuation of previous exploration work. Regardless of what it is called, 36 CFR 228.4 specifically requires that the exploration work be administered under a Plan of Operations because of the use of mechanized bulldozing equipment.

Gutierrez, Mining Engineer,  
responded to Plevel (but really  
Bill Lewis) about Dirk's  
questions.

While it is obvious that the District has made a concerted effort to work with the proponents and explain the procedures required for mining companies operating on the National Forests, there still appears to be confusion on the part of the operator. Dr. Dirk Den-Baars, Vice President Geology, Keystone Minerals, Inc., has been in contact with this office recently concerning the drilling project. Dr. Den-Baars kept talking about his project as being "less than five acres of disturbance" and not requiring a Plan of Operations. (Den-Baars is applying BLM's 5 acre rules which says that neither a plan of operations nor a mining bond is required if surface disturbance is less than 5 acres). When I explained to him that the 5 acre rule was part of BLM's 3809 mining regulations on public lands, he seemed surprised because he had talked that "language" with the District and they had agreed. By agreeing in the context of the disturbance being less than five acres, the District appears to have led Den-Baars to assume that BLM regulations apply and a Plan of Operations is not required. Not requiring a plan of operations nor a bond from Keystone Minerals, further reinforced his misunderstanding. I explained to Dr. Den-Baars that our regulations require a plan of operations and a bond when "significant" (includes use of mechanized equipment) surface disturbance takes place, but I advised him to contact the District for further clarification.

A major portion of the Arizona Zone Minerals staff duties is to help the Forests and Districts properly interpret and use the Forest Service mining regulations and mining laws in the administration of mineral-related projects. Please do not hesitate to call if you have questions or need further clarification on minerals related projects.

JOHN GUTIERREZ  
Mining Engineer

cc: M. Borens, Coronado NF  
R. Marion, RO  
W. Lewis, Santa Catalina RD

Bill - your copy

TOM,  
I WAS ONLY IN THE AREA OF THE PROPOSED KEYSTONE MINERALS ACTIVITY ONE TIME AND I DON'T REMEMBER ANYTHING UNUSUAL BEING THERE. I DON'T HOLD ANY RECORDS FOR THESE PLANTS ANYWHERE CLOSE TO SEC. 23, BUT I DOUBT THAT ANYBODY HAS LOOKED HARD ENOUGH FOR AN AUTOMATIC CLEARANCE. PENSTEMON DISCOLOR, PECTIS IMBERBIS, STREPTANTHUS LEMMONII, AND STREPTANTHUS CARINATUS HAVE SOME SMALL POSSIBILITY OF BEING THERE BUT SIGHT UNSEEN, I COULD BE SURPRISED BY SOMETHING ELSE TOO. ALL IN ALL YOU HAVE A LOW PROBABILITY OF FINDING ANYTHING WITH THE HIGHEST PROBABILITY BEING STREPTANTHUS CARINATUS. HOPE THIS HELPS.

REGGIE



79



Reply To: 2670 T & E SPECIES

Date: April 20, 1988

Subject: Plant Survey

To: Reggie A. Fletcher

Keystone Minerals, Inc. is proposing to develop an open pit copper mine here on the Santa Catalina Ranger District. The location is in the N 1/2 Sec. 23, T. 12 S., R. 17 E. (map enclosed). An operating plan has not yet been received but I am interested in the possible occurrence of threatened or endangered plants in the area.

Both granitic and limestone based soils occur in the area. Vegetation ranges from creosotebush, sandpaper bush, sahuaro, ocotillo and mesquite up to juniper and oak. Condalia warnockii, according to Becky Devender over at Mason's herbarium at the U of Arizona) also occurs over the area. Dominant grass plants are sideoats grama and three awn.

Do you have any ideas on what T and E plants might occur in an area like this? I would appreciate any information you might have.

Hope all goes well with you.

Sincerely,



Thomas Skinner  
Range/Wildlife Staff



Bill - your copy

TOM,

I WAS ONLY IN THE AREA OF THE PROPOSED KEYSTONE MINERALS ACTIVITY ONE TIME AND I DON'T REMEMBER ANYTHING UNUSUAL BEING THERE. I DON'T HOLD ANY RECORDS FOR TES PLANTS ANYWHERE CLOSE TO SEC. 23, BUT I DOUBT THAT ANYBODY HAS LOOKED HARD ENOUGH FOR AN AUTOMATIC CLEARANCE. PENSTEMON DISCOLOR, PECTIS IMBERBIS, STREPTANTHUS LEMMONII, AND STREPTANTHUS CARINATUS HAVE SOME SMALL POSSIBILITY OF BEING THERE BUT SIGHT UNSEEN, I COULD BE SURPRISED BY SOMETHING ELSE TOO. ALL IN ALL YOU HAVE A LOW PROBABILITY OF FINDING ANYTHING WITH THE HIGHEST PROBABILITY BEING STREPTANTHUS CARINATUS. HOPE THIS HELPS.

REGGIE



78





ENVIRONMENTAL CONSULTANTS

September 14, 1989

John W. Norby  
Chief Geologist  
A.F. Budge (Mining) Limited  
4301 N. 75th Street, Suite 101  
Scottsdale, Arizona 85251

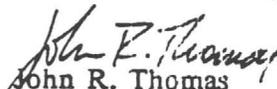
Dear John:

Pursuant to our recent discussions, SWCA proposes to undertake a survey for special interest species on the proposed road corridors for exploratory drilling associated with the Korn Kob Mine. These corridors are on Coronado National Forest Lands. This survey will include appropriate plant species and burrows of desert tortoise. The authorized work includes our staff time to establish the specific species for the survey and contact with the Forest Service. We will provide a letter report which summarizes the results of our survey and the qualifications of the individual who conducted the survey in a form suitable for submission to the Forest Service to fulfill the requirements of the Decision Letter.

The costs for this work will not exceed \$1500 and will be billed on a time and materials basis. SWCA, Inc. will bill for work completed on a semi-monthly basis. Terms for payment are 30 days net. Objections to invoices must be made, in writing, within ten (10) days of the date of invoice; thereafter, the invoice is deemed proper and acceptable.

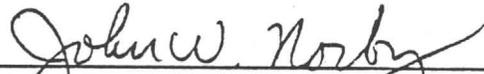
If the scope of work and terms are acceptable, please sign in the space provided below. The signed letter will be considered as authorization to proceed and work will be initiated.

Sincerely,

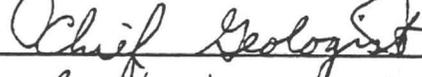
  
John R. Thomas  
SWCA, Inc.

ACCEPTED BY: A.F. Budge Limited

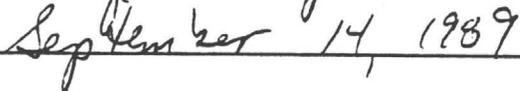
BY:



TITLE:



DATE:



89327-1.p

Reply to: 2810 MINING CLAIMS

Date: September 13, 1989

Ruth Russell - Tucson Audubon Society  
300 E. University #120  
Tucson, Arizona 85705

Dear Ruth:

Attached is the signed decision memo with appendices. There were some changes to the document and two action items: 1. documented evidence that there are no threatened or endangered plants in the project area, and 2. a reclamation bond of \$700.

Please read the decision memo.

This decision is just for the exploration phase-road construction to drill sites. Another environmental document, requiring public input, will be developed if the mine goes into the production phase.

Thank you for your interest in this project and I will keep you inform of any further developments.

Sincerely,

*WFL*

STEVE R. PLEVEL  
District Ranger

Attachments

SENT COPIES OF FINAL DM TO:

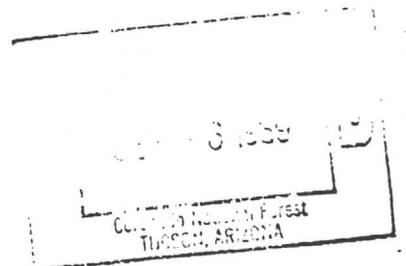
1. Ruth Russell - Tuc Audubon Society
2. Bill McGinnis - Grazing Permittee
3. Ned Powell - Earth First
4. Ken Rait - Sierra Club
5. Gayle Hartman - Concern Citizen
6. ORIGINAL = DIRK DEN-BARS



# SIERRA CLUB

Grand Canyon Chapter · Arizona  
RINCON GROUP

2015 East 9th St.  
Tucson, AZ 85719



Received 0  
D.O. OCT. 2  
WFL

September 5, 1989

Mr. Jim Abbott, Forest Supervisor  
Coronado National Forest  
300 West Congress  
Tucson, AZ 85701

Dear Mr. Abbott:

It has come to our attention that Keystone Minerals, Inc. and A.F. Budge Mining Corp. are proposing new exploration and development at the Korn Kob Mine on the east slope of the Santa Catalina Mountains. We are deeply concerned about the environmental impacts of the project.

Our concerns are several and we will address them more fully when a Plan of Operations has been completed. In the meantime, there are some road-related issues about which we are requesting information prior to the issuance of the decision memo allowing for the expansion of this infrastructure:

- 1) With regards to the threatened and endangered species, especially the Desert Tortoise, the Gila Topminnow and other fish known to inhabit Buehman Canyon, we would like assurances from Fish and Wildlife Service that the proposed road modifications will not adversely impact their habitat. Which other species could be impacted?
- 2) We request an inventory of the plant community which will be destroyed by these modification.
- 3) Will a Section 404 permit be issued for the project?
- 4) Please keep us informed about specific plans for road improvements, especially to Redington Pass road. What impact will increased human traffic into the area have?

With regards to Steve Plevel's letter of August 28, the following concerns need to be addressed prior to the issuance of the permit:

- 1) Who made the determination that there are no threatened or endangered plants which will be affected by the road construction?
- 2) We assume that a qualified archaeologist determined that there were no cultural resources in the area. Who was this individual?

3) The allegation that the proposed action is not controversial is incorrect. In fact, from the time we received the documents, we were given only 36 hours to determine whether Forest Service personnel could jump ahead of schedule and issue the decision memo. We believe this mine proposal for which these roads will be extended is a highly controversial issue. Arizona Game and Fish was not notified, nor was the Tucson Audubon Society. Was Fish and Wildlife? In fact, we find the rate at which this road project intended to proceed to be quite alarming and sincerely hope that this will not set a precedent for future Forest Service activities which are mandated to incorporate public input. Though the issue now is only the roads, we intend to scrutinize this project at every step due to the adverse impacts we believe will be associated with the proposed mining activities.

4) If this project does not set a precedent for future actions, we hope that in the future we will be given adequate time to respond and be involved in the decision and planning process.

We look forward to an expedient reply to our questions prior to approval being given to extend the road system.

Sincerely,



Ken A. Rait  
Conservation Chair

cc: David Baron, Center for Law in the Public Interest  
Michael Spear, U.S. Fish and Wildlife Service  
Keith Bagwell, Arizona Daily Star  
Tucson Citizen



# SIERRA CLUB

## Grand Canyon Chapter · Arizona

RINCON GROUP

2015 East Ninth St.  
Tucson, AZ 85719

September 27, 1989

Steve Plevel, District Ranger  
Santa Catalina Ranger District  
5700 North Sabino Canyon Rd.  
Tucson, AZ 85715

Dear Steve:

I am sorry I missed the public forum, but I heard it was useful in providing the public with much valuable information on the proposed ski area expansion.

I am very concerned about the lack of response from the Forest Service regarding my inquiries about the road expansion for the proposed Korn Kobb Mine. The decision to delay the construction for a week allowed us some time to review the proposed decision memo and formulate questions which were submitted within that time frame, but consequently were never answered.

We are deeply concerned about every step of this project and are therefore requesting that an Environmental Assessment be completed to address the impacts of the road construction and exploratory drilling activities. We believe the public input mechanisms associated with the decision memorandum were insufficient, and the concerned public would like to play a greater role in the process. I look forward to an early reply.

Sincerely,

Ken A. Rait  
Conservation Chair

cc: Keith Bagwell, Arizona Daily Star  
David Baron, Center for Law in the Public Interest  
Environmental Reporter, Tucson Citizen

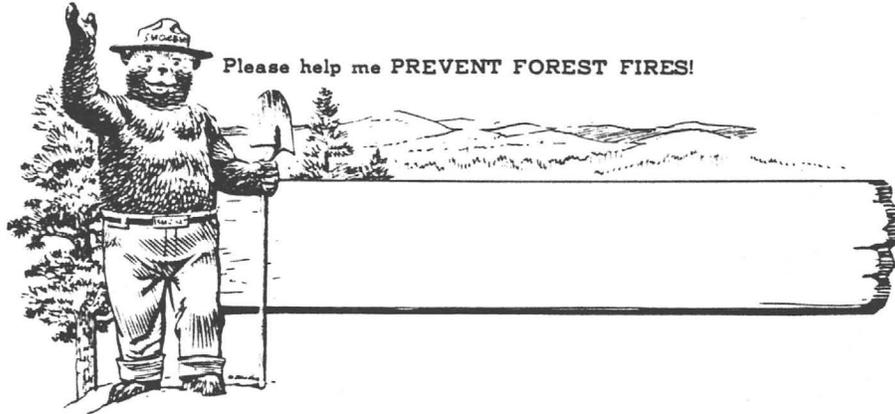
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l Assembly's 90  
overnment.

LETTERS TO THE EDITOR *Star 9/20/89*

Sin brought on fall

The proposed open-pit copper mine  
of the Catalinas may

All innocent



Gayle Hartman

2224 E. 4th St.

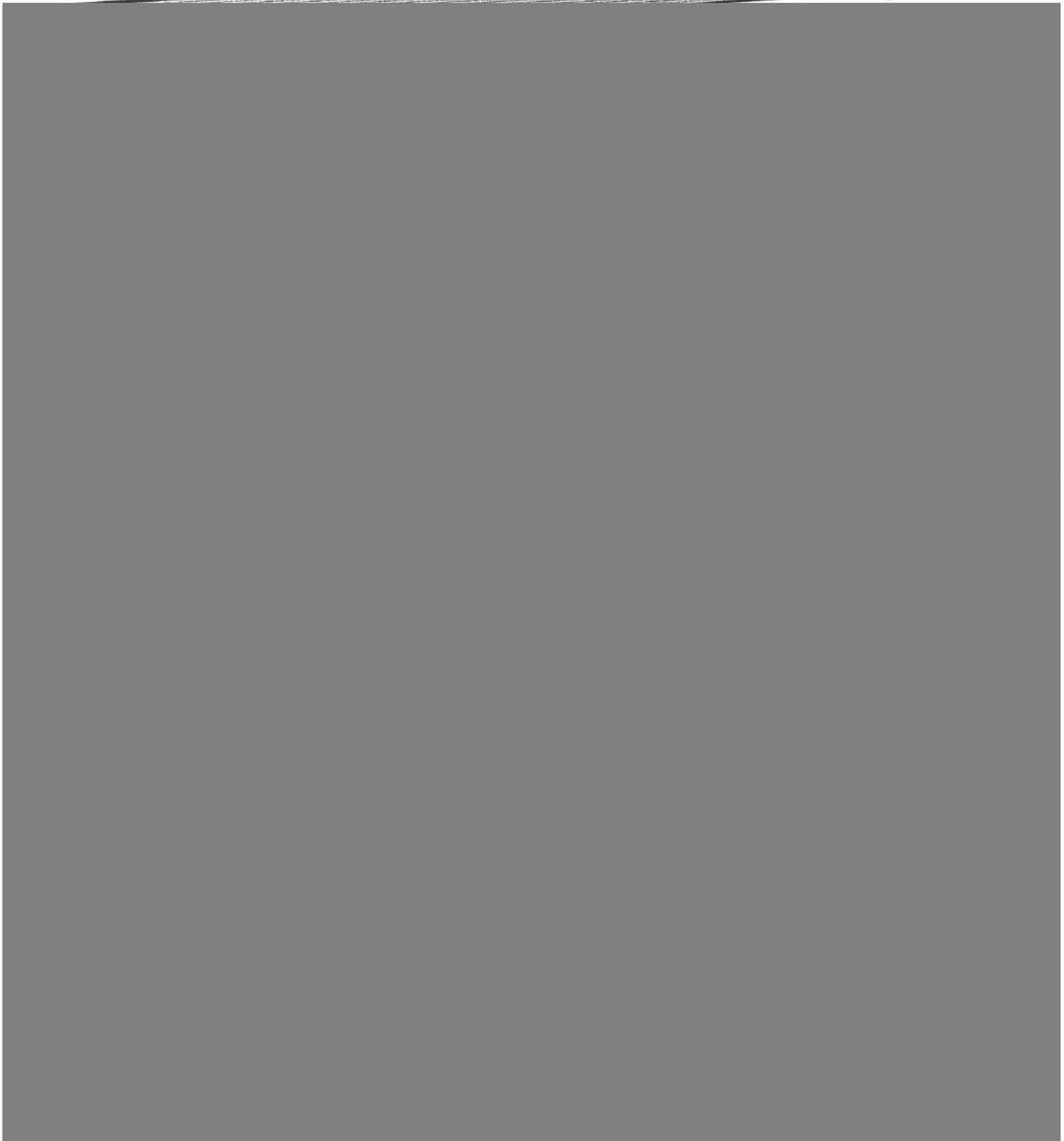
Tucson, AZ 85715

~~32~~ H-325-6974



From t  
the a  
Tombst

10-9-89



Bill Lewis

# R-4

# RECLAMATION

# FIELD GUIDE



REGION 4  
MINERALS MANAGEMENT  
USDA FOREST SERVICE  
OGDEN, UTAH

## **ACKNOWLEDGMENTS**

These guides are a result of many District, Forest, Regional, and Research people sharing their knowledge of reclamation and putting it together in a condensed format for the user. We thank them for their contributions.

A special note of thanks is extended to Raymond W. Brown, Jeanne C. Chambers, Eugene E. Farmer, and Bland Z. Richardson of the Intermountain Forest and Range Experiment Station for their assistance in developing much of the technical information in this document.

Coordinators for this publication were Ben Albrechtsen, Region 4 Reclamation Specialist and Eugene E. Farmer, Intermountain Forest and Range Experiment Station.

Special thanks to Shelley Berrett and Susan McDaniel for their assistance in typing and layout of this material.

Bill Lewis  
S.C.R.D.

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## **R-4 RECLAMATION FIELD GUIDE**

### **1.0 - INTRODUCTION AND PURPOSE**

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Reclamation of disturbed lands in Region 4 is becoming more important as mineral activity increases on National Forest System lands. Exploration and extraction methods involve more land area than in the past and operations are generally larger.

With the increase in activity the mineral administrator needs reclamation information readily available. These Field Guides are intended to bring together an array of existing information into a format that is more usable by field personnel. This intent is to provide the user with:

1. A statement of Forest Service reclamation policy.
2. A background of Forest Service authority.
3. A logical sequence of events for managing the reclamation process.
4. A summary of key reclamation principles.
5. A ready reference and checklist of technical information to be applied on the ground.

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## **2.0 - POLICY**

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1. The Forest Service policy for managing minerals includes:

a. Encourage and facilitate the orderly exploration and development of the mineral resource as one of the multiple uses we manage.

b. Develop a good understanding of the mineral industry's practices and develop a strong working relationship with industry.

2. The Forest Service reclamation activity policy is to:

a. Ensure the uniform application of exploration, development, and reclamation standards.

b. Ensure prompt reclamation of lands to productive uses consistent with land management policies.

c. Integrate appropriate disciplines in the natural sciences, engineering, and design arts in establishing criteria for reclaiming disturbed land, reviewing reclamation plans, and monitoring reclamation activities.

d. Identify information needs that can be provided by research and encourage research projects to provide such information.

e. Utilize the best available information in developing and reviewing reclamation plans.

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### **3.0 - AUTHORITY**

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The following is a brief summary of some of the more important mineral laws that provide authority to the mineral administrator.

#### **3.1 - The 1866 Mining Law**

This was the first general mining law that declared all mineral lands owned by the public to be open to exploration and location.

#### **3.2 - The 1872 Mining Law**

This more comprehensive mining law replaced the 1866 law. It has become known as the General Mining Law. This law provides that all deposits in lands belonging to the United States be free and open to exploration and purchase. The 1872 Mining Law is still in effect and provides a basis for most subsequent acts.

The General Mining Law was amended and certain minerals were excluded from its provisions. Today, the 1872 Mining Law deals primarily with hardrock minerals known as locatables.

#### **3.3 - The Organic Administration Act of 1897**

This law established the "Forest Reserves." It also provided (a) the rights to conduct mining activities and (b) the right of ingress and egress on National Forest System lands to conduct mineral activity.

*This law specifically authorizes the Forest Service to manage the surface resources on National Forest System Lands.*

The Organic Act of 1897 is the one act which provides the authority for the Forest Service to administer reserved and outstanding mineral operations in conjunction with the Secretary of Agriculture Rules and Regulations of 1937, 1947, and 1963.

#### **3.4 - The 1907 Act**

This act provided that "Forest Reserves" become National Forests.

#### **3.5 - The Mineral Leasing Act of 1920**

The 1920 act allows the Department of Interior, Bureau of Land Management to issue leases for disposal of leasable minerals on National Forest System lands, including coal, phosphate, sodium, oil

and gas, oil shale, native asphalt, bitumin and bituminous rock.

### **3.6 - Multiple-Use Mining Act of 1955**

This Act, among other things, provides for multiple use management of land and surface resources on mining claims. *This Act authorizes the United States to manage surface resources so long as these activities are not interfering with the claimants' rights.*

### **3.7 - Federal Land Policy and Management Act - 1976 (FLPMA)**

FLMA requires a claimant to record location notices and assessment work with the Bureau of Land Management. It contains mineral withdrawal provisions and covers siting of pipelines, powerlines, authorization is given for special use right-of-way.

### **3.8 - National Mining and Minerals Policy Act 1970**

This Act reaffirms the policy of the Federal government to foster and encourage private enterprise (a) to develop economically sound and stable domestic mining (and) minerals industries and (b) in the orderly and economic development of domestic mineral resources.

### **3.9 - Statutory Authority - BLM and Forest Service Regulations**

1. The Federal statutes relating to minerals on public lands of the United States are covered in Title 30 of the United States Code.

2. Regulations governing locatable and leasable minerals are found in Title 43, Code of Federal Regulations, and are administered by the BLM. BLM publishes its regulations in circulars.

3. Surface use (locatable minerals) operations conducted on National Forest System lands are administered by regulations found in Title 36 Code of Federal Regulations, Section 228, Subpart A, and are part of the Forest Service manual.

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## **4.0 - DEVELOPING THE RECLAMATION PLAN** \_\_\_\_\_

1. The reclamation plan guides both the operator and the administrator toward a future expected condition of the disturbed area.
2. Reclamation plans are an integral part of the operating plan, either incorporated or as a separate document.
3. The reclamation plan should be developed by the operator with input from the surface administrator. Reclamation plans are approved by the surface managing agency as part of the operating plan.
4. The plan will describe in detail what is expected to happen to the disturbed site, both during and after extraction, to reduce impacts on other resources and return the land to a productive state consistent with the long-term management direction.

### **4.1 - Reclamation and Long-Term Management Direction**

Reclamation plans should reflect the long-term management direction specified in the Forest Plan. For information refer to:

1. Forest Plan, Chapter II, "Analysis of the Management Situation - Minerals."
2. Forest Plan, Chapter containing Forest Management Direction, Forest-wide Standards and Guides - Minerals Management.
3. Forest Plan, Chapter IV, Management Area Direction, Area Standards and Guides.

### **4.2 - Reclamation in Environmental Analysis Reports**

1. Programmatic and project environmental analysis should determine information relative to reclamation requirements for site-disturbing activities.
2. The environmental assessment (EA) and environmental impact statement (EIS) are NEPA documents. Their requirements are not legally binding upon an operator unless they are made part of an operating plan required by the Secretary's regulations.

3. Appropriate constraints and mitigating requirements identified in the Environmental Analysis EA should be incorporated in the operating plan and/or reclamation plan.

4. Planned reclamation activities and their expected effects on other resources should be examined to determine if they satisfy the long-term land use objectives.

#### **4.3 - Determining Reclamation Criteria**

1. Reclamation plans should contain site specific criteria that can be used as performance standards in the bonding process.

2. Reclamation criteria are standards we set to describe the desired end product of reclamation. When the reclamation criteria are met, the bond can be released.

3. In Region 4, Forests will develop reclamation criteria for each project in at least the following areas:

a. Final configuration of the disturbed area.

b. Management of the topsoil and other growing medium.

c. Mass stability requirements.

d. Acceptable plant species for vegetation.

e. Reclamation requirements for seasonal closures, long-term shutdown (more than 1 year), and final reclamation.

f. Air, water, and visual standards.

g. Intervals for review of the operating plan and bond amounts.

h. Conditions for bond release.

4. For environmental protection requirements related to locatable minerals, see Title 36, CFR Mineral Regulations, 228.8 Requirements for Environmental Protection, paragraph (a) through (h).

5. An interdisciplinary (ID) team approach should be used in establishing criteria for mineral land reclamation.

a. ID Teams should identify acceptable resource losses from mineral activities as well as possibilities for enhancement through reclamation

#### 4.4 - Reclamation Plan Content

1. Reclamation plans are part of the operating plans. Authority for review and approval of operating plans is not always the responsibility of the Forest Service.

Mineral Activity	Regulation Reference	Responsibility for Plan - Review & Recommendations	Responsibility for Plan Approval
Oil and Gas	BLM Onshore Oil & Gas Orders No. 1 & 43 CFR 3160	Forest Service	BLM
Phosphate	43 CFR Part 23	Forest Service	BLM
Coal	30 CFR Part 780	Forest Service	FS concurrence, OSM & State approval
Geothermal Resources	43 CFR 3200	Forest Service	FS concurrence, OSM & State approval
Locatable Minerals	36 CFR Part A 228.8	Forest Service	Forest Service
Saleable Minerals	36 CFR Part C	Forest Service	Forest Service
Solid Leasable Minerals on Acquired Lands	43 CFR Part 23	Forest Service	Forest Service & BLM

2. Reclamation plans should contain the following:

- a. Final reclamation requirements consistent with long-term land management objectives.
- b. Mitigating requirements from the NEPA document.
- c. Mandatory information required by regulations.
- d. Reclamation criteria shown in 4.3 above.
- e. Bond calculations.

**NOTES:**

## **5.0 - ADMINISTRATION OF THE RECLAMATION PLAN \_\_\_\_\_**

When approving and administering a reclamation plan, the surface manager should:

1. Review the plan for content.
2. Review the plan on the ground with the operator.
3. Recommend revisions as a result of on-site review.
4. Approve the plan within appropriate timeframes.
5. Set schedule for inspection of operations and reclamation activities.
6. Document inspections and discuss needed changes with the operator.
7. Ensure interim reclamation is current.
8. Take appropriate action in the event of noncompliance.
9. Revise plan as needed.
10. Release bond as reclamation criteria are met.
11. Monitor completed projects as needed.

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## **6.0 - PRINCIPLES OF SCIENTIFIC RECLAMATION** \_\_\_\_\_

There are at least 10 basic steps to reclamation that should always be followed:

1. Ensure that reclamation objectives agree with the long-term land management objectives.
2. Use an interdisciplinary approach to analyze the physical, chemical, and climatic site characteristics and make recommendations for reclamation plan.
3. Conserve all topsoil and material that is suitable for a growing medium on areas to be disturbed. Reapply it during reclamation.
4. Reclaim disturbed areas as soon as practical to minimize exposed surface and soil loss during operations (concurrent reclamation).
5. Control toxic substances that may contaminate water, air, or prohibit plant growth.
6. After mineral extraction, shape the land so it is consistent with sound watershed principles and will accommodate the desired long-term land use.
7. When the final landform is achieved, immediately stabilize the surface to hold the soil in place and guard against soil loss from major storms or spring runoff.
8. Select equipment that is well suited to the site and prepare a good seedbed before attempting revegetation.
9. Plant selected species that will hold the soil in place, provide vegetative diversity and, through succession, contribute to a stable ecosystem.
10. Protect young plants until fully established.

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RECLAMATION FIELD GUIDE you

WANTED.

Bill

## **7.0 - STANDARD RECLAMATION PRACTICES** \_\_\_\_\_

This chapter discusses standard practices for reclamation of disturbed areas. Standard practices apply in most cases.

### **7.1 - Topsoil Management**

Topsoil and selected growing medium often play a key role in the reclamation of lands disturbed by mineral extraction activities. The amount and quality of replaced soils will have a strong effect on the future site productivity of reclaimed lands. Early in the reclamation planning you need to consider these several questions:

1. How much topsoil should be saved?
2. How do we decide what quality of soils to save?
3. Where will salvaged soils be stored?
4. How long will soils be stored?
5. Is direct replacement feasible?
6. How will soils be respread on the spoils?
7. What thickness of respread soil is needed?
8. Is there enough soil to give the desired thickness?
9. What are the alternatives to respraying topsoil?

When good soil materials are in limited supply, consider the relative qualities of the soils that are available. *In general, a thin layer of topsoil over a fair or poor quality subsoil over a spoil material will give greater plant production than using the thin layer of topsoil alone.*

1. Both topsoil and subsoil can be salvaged if they fall within the good or fair categories indicated below. Soils in the poor quality class may also be saved to meet required soil replacement depths.

Table 1. Soil Suitability for Reclamation Use.

SOIL PROPERTY	SOIL QUALITY			
	GOOD	FAIR	POOR	UNSUITABLE
Texture	sandy loam loam silt loam	sandy clay loam silty clay loam clay loam	sandy clay loamy sand silty clay	clay 60%
Rock & gravel (% by volume)	0-10	10-20	20-40	40
pH	6-8	5-6 8-8.5	4.5-5* 8.5-9**	4.5 9
Sodium absorption ratio, (SAR)	4	4-8	8-16	16
Electrical Conductivity (Millimhos/cm)	3	3-7	7-15	15

\*Check for excessive concentrations of heavy metals.

\*\*Check for excessive boron or lime.

2. Salvaged soils may show a variety of properties that fall into different reclamation suitability classes. For example, a salvaged soil material may show texture, pH, SAR, and EC in the *fair* class but rock and gravel content in the *poor* class. In that case, the soil would be classed as *poor* for reclamation. Generally, a soil is judged by its lowest rating.

3. The appropriate depth of replacement soil to use is not clearly defined; judgement is involved. In general, the poorer the chemical and physical properties of the spoil materials, the greater the required depth of replacement soils.

4. In those cases where the spoil materials exhibit no phytotoxic properties, e.g., highly acid or saline, 12 inches of replacement soil is recommended if it is available at reasonable cost and effort. Fine-textured spoils may require less than 12 inches of replacement soil.

5. Coarse-textured or rocky spoils will usually benefit from increased depths of replacement soils—up to about 24 inches.

6. Phytotoxicity is usually associated with either acidity (low pH) or salinity (high pH). Low pH also is associated with an increased concentration of heavy metals. These conditions require from 12 to 48 inches of replacement soil to accomplish successful reclamation.

7. The importance of replacement soils over phytotoxic spoils will usually justify stripping adjacent unmined areas to obtain adequate replacement soils.

8. Soils can be initially classified on surface properties only. For more detailed classification, an incremental system of drill holes or soil pits should be developed.

9. Infrequently, there may be substrata, perhaps at considerable depth, that can be used to advantage as a plant growth medium. Mine operating plans can sometimes be negotiated to take advantage of these substrata as growing mediums.

10. Soil may be temporarily stored in piles or picked up and placed directly on the area to be reclaimed. The latter action is called direct replacement.

11. Stockpiling soil to be used in reclamation is more common than the direct replacement method, especially in mountainous terrain. Some considerations for using soil stockpiles are:

a. Stockpile should be located where it will not be disturbed by future mining.

b. The haul distance and road grade from the stockpile to the areas to be revegetated.

c. The time that the pile will be in place (the shorter the better).

d. The need to revegetate the stockpile to protect the soil from wind and water erosion and to discourage weeds.

## **7.2 - Sediment Control Measures**

Sediment control plans for mining operations are important because the potential for sediment production is high. Erosion losses from unvegetated mine waste embankments can range from 15 tons per acre per year to more than 300 tons per acre per year, depending on weather, spoil, and slope factors.

Sediment control strategies and successful revegetation can cut these losses by a factor of 100 or more. Sediment control on mining operations must consider controlling surface water with engineering structures and vegetal cover.

1. Uncontrolled or misdirected water can cause unacceptable soil losses and large gullies. Water control through sloping, ditching, and berms may be necessary.

2. The most common source of surface water in Region 4 is melting snow; road surfaces are the most common source of runoff.

3. Large outside road berms required by MSHA may need to be breached at selected locations to control water volumes.

4. It generally is better to spread water than to concentrate it. If it is necessary to concentrate water, as in a ditch, size the ditch for the expected volume and spread the water as soon as practical.

5. Ditches often freeze over in the winter and cause significant problems during spring snowmelt.

6. In Region 4, soil erosion problems originating from a melting snowpack usually occur on north or east facing slopes. On south or west slopes, the snowmelt period starts as early as February and daily melt volumes are often too small to generate surface runoff.

7. The most common forms of engineered sediment control are:

- a. Sediment ponds and traps.
- b. Sediment barriers.
- c. Shaping waste embankments.

8. The trapping efficiency of a pond relates to the residence time of the water in the pond; longer residence times increase the efficiency.

9. Ponds should be kept out of permanent stream channels; ponds should not have to handle any more water than necessary.

10. Ponds tend to degrade water quality more than live streams do.

11. Increasing pond size tends to increase pond efficiency but also demands better engineering design.

12. If ponds have to be kept small because of the topography, closely spaced multiple ponds also will increase efficiency.

13. Sediments ponds should be cleaned when they are about two-thirds full of sediment.

14. The integrity of the pond must be ensured through adequate design and construction of the pond dam and the normal and emergency spillway or standpipe.

15. Sediment barriers may be as simple as strategically placed straw bales or as complex as carefully placed geotextile filter cloth.

16. Brush and/or log barriers are commonplace on mines in the Region. They are moderately effective and simple to erect.

17. Timber salvage operations on mines can provide a source of materials for brush and log barriers.

18. Straw bales are only effective on small volumes of sediment.

19. Several features of waste embankments that strongly influence sediment production are:

a. Length and steepness of slopes.

b. Presence or absence of terraces or other slope breaks.

c. Shape of the toe area. Waste embankment toe areas should not be constructed with a concave slope face as this will maximize water velocity and soil erosion on the face. Embankments should not be concave either, as this will concentrate water accumulations. Slopes should be straight.

20. Vegetal cover is the cheapest and most effective method for controlling erosion and sedimentation.

21. During the revegetation process, either wood fiber mulch with tackifier or crimped straw will help control erosion. Recommended mulch application rates for erosion control will vary from 1 to 2 tons per acre.

### **7.3 - Shaping and Grading**

Shaping and grading a site is an important reclamation consideration. The final shape or landform should be hydrologically and visually compatible with the surrounding landforms, if possible. Not only should the site be stable but it should also promote or enhance the post mining land use. Consider the following:

1. Establish a record of conditions existing before disturbance. Use photo points, contour maps, etc.
2. Decide what final landform is desirable and practicable prior to disturbance.
3. Save topsoil to respread after shaping.
4. Determine what landform is most stable; evaluate angle of repose vs 3:1 slopes, etc. Flatter is not always better; length of slope affects water velocity and infiltration.
5. Put the land back to its natural contour where possible and practical.
6. Do not oversteepen slopes in shaping; this causes slope failure or slides.
7. Do not create ponds or depressions that will accumulate surface water unless they are planned.
8. Leave graded surfaces somewhat roughened to trap seed, slow runoff, and provide micro climate.
9. Provide for internal and external drainage of treated areas.
10. Consider long-term mass stability requirements. Where large tailings sites or waste embankments are involved, get review and input from a geotechnical engineer. Waste embankments in Region 4 have to meet a design safety factor criteria.
11. Be aware that large tractor-dozers can efficiently push fill material uphill on a 40 percent slope, beyond that the efficiency is very limited.
12. Consider that contour ripping is safe up to a 2h:1v slope or 50 percent.

13. Site preparation and tractor-drawn planting equipment can be used on slopes up to a 3h:1v (33 percent).

#### **7.4 - Site Preparation and Planting**

A major activity in most reclamation projects is revegetating the disturbed site. Revegetation is likely to be more difficult on sites disturbed by mineral activity than on most Forest revegetation projects. There are several important steps that must be followed to successfully revegetate these disturbed sites. Applying each step will enhance the chances for success; skipping steps will induce failure.

1. Shape the site to make it functionally compatible with the surrounding watershed.

2. Reapply topsoil or any growing medium that has been salvaged.

3. Rip the site after shaping and applying topsoil to eliminate compaction and increase root depth and water infiltration.

a. Rip the mantle when it is relatively dry to permit shattering beneath the surface.

b. Deep ripping should be 2 to 3 feet deep on 2 to 3 foot centers. A "rule of thumb" is the distance between rippers should be equal to the depth ripped.

c. Always rip on the contour of the slope.

d. Cease ripping if it brings a lot of rock to the surface.

4. After ripping a site, disk or harrow to smooth the surface.

5. Fertilize the site as needed.

6. Harrow fertilizer into the soil to increase effectiveness.

7. Plant the harrowed site with a drill or cultipacker-type seeder to assure seeds are planted at the proper depth.

8. Seed should always be covered to provide a hydraulic contact with the soil.

a. Do broadcast seeding immediately after site disturbance so that soil will settle around the seed, providing a seed-soil contact. Use a light chain, log drag or roller, where possible, to cover the seed.

9. Generally schedule planting just prior to the longest precipitation period or when moisture is most favorable for seedling establishment. This means fall planting is preferred in Region 4.

10. Plant species that will establish quickly to prevent erosion and build root biomass.

11. Protect seedlings from grazing until fully established.

## **7.5 - Seed Selection and Handling**

### *Species selection:*

Selection of adapted plant species is essential for successful reclamation. In severe environments, such as the alpine zone, deserts, or steep exposed dry slopes and ridges, the number of adapted species suited for use in revegetation is less than for sites in more moderate climates. Methods of determining what species to select are:

1. Observe plant species found growing naturally on old disturbances near the site to be reclaimed.

2. Consult appropriate research reports and papers regarding revegetation research.

3. Consult with Forest Service scientists, county agents, SCS, or other available experts.

4. Determine if weather patterns favor warm season or cool season plants.

### *Acquisition of seed:*

Seed of adapted plant species may either be collected from plants in the vicinity of the reclamation site or purchased from a seed dealer and distributor.

Seed collection by hand or mechanized equipment may be expensive. Care must be taken to observe plants for seed maturity. Active seed collection must be performed at the proper time. Different species mature seed at different times, hence, seed acquisition of various species may require several different collection trips. Some general guides to seed collection include:

1. Locate appropriate stands of desired species before seed matures.
2. Collect seed only after it matures on the plant.
3. Collect by hand-stripping or using a mechanized device designed for seed collection.
4. Collect seed in either cloth or paper bags or other containers: NEVER seal in plastic bags. This will retain moisture and cause molding.
5. Clean and separate seed from chaff and other undesirable debris as soon as the material is dry.
6. Store the clean seed in a cool dry location in paper or cloth bags.
7. Ensure that local varieties and genetic stock are used.
8. Purchase seed from a reputable seed collector and dealer. It is usually less expensive and less laborious; however, several cautions should be considered:
  - a. Be sure dealer is reputable, does he collect the seed from the location and on the dates specified?
  - b. Be sure germination percent, collection location, species name, pure live seed, and percent weed or other contaminants are specified on bag.

c. Use SCS Plant Material Centers for information about seed and seed dealers. The Centers are an excellent source of information.

9. Establish shrubs and trees on small or critical revegetation sites through transplanting. However, transplanting can be an expensive, labor intensive, and slow method of revegetation. Transplanting requires consideration of the following:

- a. Selection of adapted species.
- b. Sources of plant materials (commercial sources of containerized or bare-root stock, or excavation and collection of rooted plants from the revegetation site).
- c. Care and hardening of the plants prior to planting.
- d. Timing or determining when to plant.
- e. Site conditions and preparation at the time of planting.
- f. Methods of planting, spacing, fertilizing, watering, etc.
- g. Care and assessment following planting.

## 7.6 - Mulching

Mulches are often used in reclamation to protect and stabilize soils until permanent plant cover becomes established. In addition to preventing erosion, a good mulch cover protects seeded areas from the severe effects of heat, cold and drought. The following are suggestions for using mulches:

1. There are many natural and synthetic mulches. Commonly used mulches are:

- |             |                                  |
|-------------|----------------------------------|
| - straw     | - excelsior                      |
| - hay       | - synthetic biodegradable fibers |
| - woodchips | - animal manure                  |
| - jute      | - sewage sludge                  |

2. Dark-colored mulch will raise spring soil surface temperatures.

3. Light-colored mulches will reduce summer soil surface temperatures.

4. Mulching will reduce frost heaving of new seedlings.
5. Mulch reduces rainsplash, surface wind, particle movement and other erosional effects.
6. Mulch should be applied to a roughened surface. Do not grade smooth. Apply asphalt or other suitable tackifiers or crimp mulch into the surface to keep it in place.
7. Common hay and straw mulches for seeding cover and erosion control should be applied at the rate of 2,000 to 3,000 pounds per acre. This amount will provide a 2 to 3 inch deep ground cover.
8. Mulch can be applied by hand on 3:1 or less sloping sites up to 1 or 2 acres in size. Larger steeper sites will require a power blower or mulcher.
9. Fiber mulches can be applied effectively in a slurry of water, seed, and fertilizer with a hydromulcher. Application rate should be at least 2,000 lbs/A.
10. Mulching that is crimped into the soil on dry sites may wick moisture out of the soil in some conditions.

#### **7.7 - Fertilizers and Soil Amendments**

Many disturbed sites are nutrient deficient at the time reclamation is performed. Fertilizers provide nutrients required by seedlings to establish themselves and their own nutrient cycle. The following are considerations when fertilizing reclamation projects:

1. Soils and growing mediums should always be tested for nutrient deficiencies prior to undertaking any kind of revegetation effort.
2. Disturbed lands are usually deficient in nitrogen (N) and phosphorus (P) and often require from 50 to 500 pounds per acre.
3. Plants lacking nitrogen exhibit a yellowish-green color and drying of the lower parts of the plants.
4. Phosphorus deficiencies in plants often cause a purplish color in the leaves and branches, with very little stooing or spreading and poor seed production.

5. Nutrient content of bagged and bulk fertilizers are expressed as a percent of the content by weight.

Example: A 100-pound bag marked 10-10-10 means 10 percent nitrogen (N), 10 percent phosphorous( $P_2O_5$ ), and 10 percent potash ( $K_2O_5$ ) is contained by weight. To apply 20 pounds per acre of the nutrients, it would require 200 pounds of the fertilizer mix.

10 percent per hundred weight = 10 pounds of nutrient  
20 pounds per acre of nutrient = 200 pounds of fertilizer mix

6. Nitrogen fertilizers should be those that will release at the time of germination. Some N fertilizer is highly volatile. Others are coated for slow release.

7. Nitrogen cycling (plants taking up and giving up N) may take several applications. Phosphorus cycling usually begins with one application.

8. Other macro nutrients that plants need in large quantities are potassium, calcium, magnesium, and sulfur.

9. Micro nutrients include boron, copper, manganese, zinc, iron, molybdenum, and chlorine.

10. THE SOIL SHOULD BE TESTED FOR NUTRIENT LEVELS BEFORE ADDING FERTILIZERS.

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## **8.0 - PROCEDURES FOR UNIQUE RECLAMATION SITUATIONS**

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This chapter discusses procedures for dealing with unique reclamation situations.

### **8.1 - Acid Mine Drainage**

Acid soils, acid waste materials, and acid drainage waters are problems on many mine operations. Most acid mine problems on mine locations have the same origin—oxidation of sulphide minerals. In the West, these sulphide minerals are often associated with metallic ores. Most metallic ions are increasingly soluble with decreasing pH. This can become a serious problem; it can usually be assumed that an acid drainage problem is also a heavy metals problem. Acid drainage in the western United States is rarely associated with coal mining but may be a problem in hardrock mines.

#### *Identifying Potential Acid Problems.*

1. It is relatively easy to identify an existing acid drainage problem. A fail-safe indicator is the presence of ferric hydroxide precipitate on the bottom of the streambed. Typically, this precipitate has an orange color, but the color may vary from the yellow-reds through the purples. The precipitate is known as "yellow-boy" in the mining industry.
2. Acid conditions in either the soil/spoils or in surface waters usually indicate acid drainage.
3. Acidic stream water may be crystal clear; don't be fooled by color.
4. Acidic soil/spoils will be bare of vegetation (except for an occasional hardy individual plant) and free of insects and small mammals.
5. You can often smell the sulphurous compounds in spoils.
6. The presence of any metallic-pyrites is a good indicator that acid conditions may develop.

#### *Treating Acid Problems.*

1. Applying lime to acid spoils is the most common treatment for increasing pH.

2. Determine what types of lime are available and their effectiveness in terms of the equivalent amount of calcium carbonate.
3. Know what form the lime has and whether or not a specification for grinding is required.
4. Know the potential acid production from the spoil so that liming rates can be determined.
5. Laboratory test the spoils to be reclaimed for acid potential.
6. Collect samples from the surface 6 inches of the spoil materials. Each sample should weigh about a pound, excluding rock and gravel.
7. Contact the Regional Office for current information concerning spoil analyses procedures, laboratories, and analysis costs.
8. In addition to lime, the successful revegetation of acid spoils requires topdressing with a minimum of 12 inches of topsoil or selected subsoil. If 12 inches of topdressing soils are not available, increase the liming rate and work the lime more deeply into the spoil materials.
9. Treating acid streamflow for the improvement of fisheries or benthic organisms requires sophisticated engineering and environmental analyses. Treatment is very expensive. Obtain help.
10. Consider any mining activity that results in soil or water pH of 4.5 or less to be strongly acid.
11. Revegetate acid sites with some plant species that have demonstrated their ability to survive and grow on such sites.
12. Apply gypsum to treat salt problems caused by migration of chemical salts to the soil surface. These salts can contaminate the replacement soil.
13. Avoid soil/spoil reacidification which results from insufficient application of lime.

## **8.2 - Alkaline Sites**

1. When to expect alkaline soils:

Alkaline soils most often occur in arid to semiarid regions of the western United States where annual precipitation is less than about 15 to 18 inches. Alkalinity usually occurs on the Great Plains in the short-grass prairie regions but may also occur in other flat poorly drained arid areas throughout the West. In these areas, evaporation usually exceeds precipitation.

## 2. What to look for:

Alkaline soils usually support a poor vegetative cover and may be entirely devoid of plants. Often these areas are small, appearing nearly circular in shape, and usually are easy to identify from surrounding vegetated areas. The soil surface usually contains large cracks, and may have a white to dark color with noticeable accumulations of salts. A soil analysis will show high concentrations of NA, Ca, OH, and  $\text{CO}_3$ , indicating a loading of these materials in the surface at concentrations higher than occur in the parent material.

## 3. How to test for:

Alkaline soils have a pH ranging from slightly higher than 7 to 10 or more, depending upon salinity.

Saline-alkaline soils have high concentrations of sodium salts as well as OH and  $\text{CaCO}_3$  with a pH usually from 7 to 8.5. These soils have more than 15 percent of their cation exchange capacity occupied by sodium, but their pH is relatively low (7-8.5) because of the influence of the neutral salts present.

Nonsaline-alkaline soils have a much higher pH, usually close to 10, because they contain relatively small amounts of neutral salts. However, they contain toxic levels of both sodium and OH. These soils are usually in an undesirable physical state. Being high in clay, they tend to clod easily if worked.

## 4. How to treat:

There are three primary methods of treating alkaline soils to improve their condition for plant growth:

*Leaching:* Soils can be flooded with irrigation water to leach out sodium and other undesirable salts. Flooding is primarily useful in soils with high concentrations of calcium and magnesium. However, there is a risk that removal of the neutral salts through flooding may increase alkalinity by increasing the concentration of sodium and OH ions.

*Scarping:* The surface incrustations of accumulated salts physically removed. This method should rarely be used because the basic processes of evaporation accumulates salts and the alkalinity in time.

*Chemical Conversion:* Use of gypsum on alkaline soils is recommended to convert the caustic alkali carbonates into sulfates. Usually, it requires cultivating several tons or more of gypsum into the surface soil and keeping the soil moist to hasten the chemical reaction.

### **8.3 - Borrow Sites**

Borrow sites for sand, gravel and rock are often located and opened without regard to future use or reclamation. It is important that the following considerations be given to each new site.

1. Determine the available volume of material as accurately as possible before opening the site. Identify future borrow needs from the site or, in other words, estimate the life of the pit.
2. Determine the final desired land form and develop a pit design to obtain it while extracting the borrow material.
3. Consider possible future uses for the site such as a pond, wildlife habitat, etc.
4. Consider visuals and surrounding landscapes. Large flat borrow areas may be more acceptable than deep narrow ones. Reclamation efforts should make the site compatible with adjacent areas and uses.
5. Strip and store topsoil for reclamation purposes.
6. Locate waste rock to facilitate easy burial during reclamation. Retain rock suitable for rip-rap or other uses.
7. Address concurrent reclamation measures to reduce sediment and fugative dust.
8. Rip compacted areas and use proper site preparation and revegetation practices in final reclamation.
9. Protect the site from grazing, if necessary.

## **8.4 - Drill Holes**

Drill holes are usually a result of an exploration program. Depending on the scope of the program, there may be hundreds of holes or just one or two drill holes in a given area.

Each state may have requirements for reclamation of drill holes. Minimum Forest Service requirements include the following:

1. Drill holes, other than seismic shot holes, must be identified and located on a map to the quarter section.
2. All completed drill holes 2½ inches or larger in diameter should be filled with subsurface material or like material to prevent migration of water, gas, oil, or other substances from one strata to another.
3. Holes should be plugged at the surface with at least five feet of cement or other approved permanent plugging material.
4. Random checks should be made by the administrator to ensure plugging requirements are being met.

## **8.5 - Facility Removal**

In each mining or drilling operation, some significant incumbrances on the land are the physical facilities. These include office buildings, storage sheds, mills, water tanks, etc. Provisions should be included in each reclamation plan to deal with removal of unnecessary facilities.

Consider the following when dealing with reclamation of operator facilities:

1. Ensure that all structured facilities are included in the operating plan. Make provisions for periodic review and inventory of needed and unneeded facilities.
2. Identify timeframes that facilities will be needed. Bond for removal and reclamation.
3. Describe facilities that will be removed or retained during periods of interim shutdown.

4. Identify facilities that have potential to create environmental liability or problems and ensure they meet State and Federal environmental protection requirements. Examples include:

- Fuel tanks
- Chemical storage areas
- Drilling additives storage
- Explosives storage
- Shop and service areas
- Open shafts
- Unused machinery
- Septic systems

5. Ensure removal or containment of toxic materials or hazardous structures at the completion of the activity.

### 8.6 - Heavy Metals

Heavy metal contamination of soils, spoils, surface waters, and groundwater is invariably associated with acid mine drainage. An acid problem indicates there is probably a heavy metals problem.

#### *Common Heavy Metals*

1. In any specific mining situation, all metals will not be found at dangerous levels. One or more metals will usually be present in concentrations high enough to cause concern in any acid situation.

2. Several concerns need to be recognized.

a. First, the concern for danger to human life. The cations of greatest concern are: arsenic, cadmium, mercury, lead, nickel, manganese, and molybdenum.

b. The presence of copper is the primary concern for fishery and associated benthos.

c. Iron, aluminum, and zinc may be present in the soil/spoil in sufficient concentrations to be toxic to the vegetal cover.

3. Free roaming animals normally will not suffer from grazing revegetated mined lands. Reclaimed uranium mined land may be the exception where vegetation may accumulate radioactive elements.

4. There are no mine portal standards for acceptable limits of heavy metals. Every situation is different and must be checked individually. It is much more difficult to control the problem than it is to avoid it; however, on existing mines, control may be the only solution.

5. A 12- to 24-inch application of soil materials followed by successful revegetation will affect long-term control.

6. Revegetation will be helped by applying lime to the spoil surface in sufficient quantity to raise the first 12 inches of spoil material to a pH of 6 or more.

7. The lime should be worked into the spoil surface before topsoiling.

8. Even after soil surfaces have been brought to near neutral condition, the subsurface water bleed-out will continue to be contaminated for years to come.

9. If immediate control is needed, the best solution is to remove all contaminated materials, then topsoil and revegetate the area.

10. When revegetating acid sites, plan to monitor the site for 10 years after the successful establishment of vegetal cover to determine if re-acidification is occurring.

### **8.7 - Highwalls**

State and Federal coal mining regulations normally prohibit an operator from leaving highwalls. This is not true for all mineral commodities. The ultimate disposition of highwalls should be negotiated during the review of the mine operating plan. Highwalls can be part of any mining operation in any terrain.

1. Hazards: The hazards associated with highwalls are the occasional rock fall into the bottom of the pit or perhaps a massive rotational slide of the entire wall.

2. Disposition:

a. The normal procedure is to either leave highwalls in an unreclaimed state or to backfill the pit and bury the wall.

b. Instead of leaving a slick highwall, leave a 3-foot bench every 50 vertical feet. This creates a niche for vegetation and provides nesting areas for raptors and other birds.

c. Highwalls may also be brought down by blasting.

### **8.8 - Land Form and Visual Changes**

Some mineral developments are large enough to actually change the landform and visual characteristics. This is particularly true of large open pit mining operations. Ridges may become valleys, new mountains of waste may be produced, water courses may be changed—all resulting in a varied landform. Managers should be aware of these potential changes and plan for their reclamation in the early stages of development.

The following are ideas for dealing with the landform changes:

1. Visualize probable changes through an artist's conceptual drawing or digital computer modeling.
2. Evaluate the effects that mining methods and type of equipment used will have on final landform, i.e., trucks vs scrapers for moving material will affect the end configuration of dumps, size of roads, steepness of grade, etc.
3. Recognize what the final landform will be. Plan reclamation to conform visually with natural surroundings.
4. Recognize probable changes in soil color, texture, productivity.
5. Determine if final landforms will be stable or unstable.
6. Recognize possible changes in:
  - a. Slope direction, length, or grade.
  - b. Ground water regimes.
  - c. Surface runoff patterns.
  - d. Aspect and vegetative types.
7. Recognize and mitigate, where possible, changes in fish and wildlife habitat.

8. Some activities that change landforms are:

- a. Highwalls.
- b. Open pits.
- c. Haul roads.
- d. Railroads.
- e. Waste embankments.
- f. Tailings ponds.
- g. Stream diversions.

**8.9 - Noxious Weeds and Poisonous Plants**

1. A certain amount of weed invasion is normal following revegetation, especially on arid sites. Weeds will largely disappear after 2 to 3 years, e.g., *Salsola kali* (tumbleweed) and *Sisymbrium* spp. (mustard).

2. Noxious weeds are extremely competitive and can effectively dominate a site. Efforts should be made to recognize and treat noxious weeds as soon as they appear. If noxious weeds exist on a site from which topsoil will be removed, the weeds should be treated prior to topsoil removal (preferably for 2 to 3 consecutive years). Efforts also should be made to control noxious weeds in areas adjacent to sites that will be revegetated.

3. If a site is to be used for grazing, poisonous plants should be treated similar to noxious weeds.

4. Noxious weeds and poisonous plants that occur on National Forest System lands in the Intermountain Region have been identified (see Appendix reference).

5. Detailed methods for the treatment of noxious weeds and poisonous plants are described in USDA Agricultural Handbook No. 565 and USDA, SEA Agriculture Information Bulletin No. 415. Before using any pesticide, review Section 2150 of the Forest Service Handbook and consult the Regional Pesticide Coordinator.

## 8.10 - Open Pit Mines

Open pit operations have major impacts on visuals, land form, and mass stability of an area. It is imperative that these kinds of proposals receive adequate review by specialists in these disciplines.

In Region 4, open pit mines are commonly associated with extracting gold, copper, molybdenum and phosphate. Large open pit mines are more prevalent now than they were a few years ago because of the new ways of extracting gold. The following are ideas to assist in planning reclamation of open pit mines.

1. Recognize that the size and shape of the pit are normally determined by the location (strike and dip) and quality of the ore body.
2. Design to confine roads and other site-disturbing activities to the ultimate pit or dump limits, where possible.
3. Schedule waste location so soil or growing medium material will end up on top of the waste.
4. Plan for backfill of pits, where practical.
5. Consider placement of waste, allowing for a 30-percent average swell factor.
6. Design dumps with the following in mind:
  - a. Long-term sediment production.
  - b. Long-term mass stability.
  - c. Visual impacts.
  - d. Final land use and desired configuration.
7. Plan to control drainage coming onto pits and dumps from surrounding areas.
  - a. Drain water away from dumps and dump face for increased stability.
  - b. Drain water into pits to contain sediment.

8. Get a geotechnical engineering review of the dump design for a large project.

9. Shape dump slopes 3h:1v or flatter if they are to be revegetated; planting on steeper slopes is possible with specialized equipment.

10. Evaluate reshaping and angle of repose dumping against total disturbed acreage and final desired landforms when planning dump locations.

a. Also, consider effects of haul roads, conveyors, etc., in evaluating total disturbance.

11. Consider effects of pit design (depth) on ground water and surface flow patterns.

12. Don't move material twice. It is not economically practical except for topsoil or growing mediums.

13. Evaluate pit design for highwalls. Consider:

a. Public safety.

b. Wildlife migration and other habitat possibilities.

c. Livestock access.

d. Visual impacts.

e. Revegetation possibilities.

### **8.11 - Pipelines**

Pipelines are commonly used in mineral operations. They vary greatly in size. Pipeline installations above and beneath the surface create considerable environmental impacts. Consider the following in reclamation:

1. What the expected use period of the line is. How long it will be needed.

2. What it will carry.

3. Should it be above or below surface?

4. Will it need to be replaced or rotated?
5. How much right-of-way is needed for installation and maintenance? (See page 100, Utilities Visual Handbook.)
6. A contingency plan for leaks and spills.
7. Anticipate settlement of the cover layer on buried lines and compensate to reduce erosion along the line.
  - a. Mound up cover material over the pipe.
  - b. Provide for surface runoff to escape the trench area.
  - c. Construct waterbars at right angles to the slope rather than at right angle to the trench.
8. Save and replace topsoil on all disturbances.
9. Re-establish revegetation as soon as possible to protect soils.
10. Design right-of-way to protect visuals.
11. Determine location of access and maintenance roads and whether they will be part of the transportation system.
12. Precheck trenches for settling 1 year after covering and before releasing the bond.

#### **8.12 - Powerlines**

Reclamation of powerlines often comes after other reclamation has been accomplished.

1. To accomplish reclamation of powerlines:
  - a. Remove all towers and poles.
  - b. Remove cable and guy wires and anchors.
  - c. Obliterate access roads.
  - d. Re-establish vegetation in right-of-ways that complement the surrounding vegetation and terrain.

2. To lessen reclamation problems:

- a. Feather right-of-way cuts in vegetation to provide a natural appearing opening.
- b. Consider that topping vegetation often is all that is necessary to provide clearance during operations.
- c. Consider using helicopters to minimize disturbance during installation and reclamation.
- d. Protect rights-of-way from off-road vehicle travel and wear that may cause additional erosion.
- e. Alter vegetative types on rights-of-way to provide species diversity for wildlife.

### 8.13 - Railroads

Railroads are sometimes used in conjunction with large mining operations. They are like large road prisms in many ways, but also have some unique differences. The following should be considered in planning reclamation of railroads:

1. Ties and rails should be removed. Often, this can be contracted for the salvage value.
2. Design and location of railroads is key to reclamation. Railroads are located on a 2 percent maximum grade.
3. When the railroad is gone, how will the transportation corridor be used?
4. Topsoil should be salvaged and stored for final or interim reclamation.
5. Subgrades or fill are often very large rock or heavily compacted (100 percent) clays. These are often impervious and form a dam-like structure across the natural terrain. Adequate drainage is imperative.
6. If subgrade material is unsuitable, it will need to be removed. This will necessitate locating a waste area.

7. Railroad tracks require ballast for rail and tie stability. Ballast is 1- to 1½-inch diameter rock. It is placed on top of the grade in 6-inch to 3-inch depths. It contains no fines.

8. Ballast should be reclaimed for other uses (2,500 cubic yards per acre). Remove ballast or rip and mix with soil, where possible.

9. Before construction, determine whether railroad prism will be retained or removed during reclamation and bond accordingly.

10. Large cuts and fills should be designed for reclamation and stability.

#### 8.14 - Oil and Gas Wellsites

Oil and gas wellsites are one of the best reclamation opportunities. Most are dry holes or are drilled and capped. This means disturbance lasts a relatively short period of time; all soil material is still on site; and reclamation can begin almost immediately. These conditions favor successful reclamation.

The following are suggested techniques for successful reclamation of wellsites in mountainous terrain:

1. Locate roads on the most reclaimable terrain, flattest slopes, deeper soils, best growing sites.

2. *Do not* disturb road prism or remove topsoil if roads are for short duration (1 to 2 years) in flat terrain.

a. Place adequate gravel layer over topsoil to facilitate traffic.

b. Upon abandonment, use loaders or scrapers to remove gravel down to topsoil layer.

c. Introduce new seed, where necessary, and allow natural seed source in topsoil to regrow.

3. Locate wellsite on best location combining seismic information and surface features. Exact site location is somewhat flexible based on seismic data. Strive for balance between cuts and fills. Avoid:

a. Avalanche paths.

b. Drainage channels.

### *Predisturbance Considerations*

1. Obtain soil and subsoil core samples up to 20- to 30-feet deep on padsite. Determine topsoil makeup.
2. Obtain engineering design on 2-foot contour before disturbance.
3. Establish photo monitoring points.
4. Obtain inventory and site analysis of vegetation.
5. Obtain reference points to enable recontouring.
6. Locate topsoil storage areas—uphill or laterally from pad.
7. Include mitigating requirements from NEPA document into operating plan.
8. Flag clearing limits and stake cuts and fills.
9. Determine if rig is a right- or left-hand setup and design pad accordingly.

### *Site Disturbance and Operations*

1. Balance cut and fill to minimize cut slope.
2. Locate reserve pit in cut portion of pad, if possible.
3. Line pit, if necessary. Use:
  - a. Native clays.
  - b. Bentonite (Use no more than needed. It becomes a problem in reclamation.).
  - c. Membrane liners (allow for sag).
4. Salvage spoil material (leftover fill due to swell).
5. Bury slash in cut portion and bring fill back over it when recontouring.

6. Divert surface runoff away from pad with surface ditches.
7. Construct berm around pad to contain oils and fuel spills.
8. Skim oils off pit and dispose of in proper landfill to prevent ground contamination.
9. Do not allow any solid debris in reserve pit, i.e., pipe, barrels, lumber, etc.

#### *Post Operations and Reclamation*

1. Remove all lumber, iron, wire, and other debris from site after rig is removed. Do not bury these materials on site.
2. Pump water off reserve pit. If water meets state water quality standards, it can go down hole or on surface.
3. Remove heavy fluids and dispose of them in an approved site.
  - a. Mix with pump or grain auger to obtain proper consistency.
  - b. May need to add water to make fluid.
4. "Squeeze" and cover the pit after fluids have been removed.
  - a. Dig deep, narrow lateral trenches radiating out from pit.
  - b. Push dirt from pad into remaining sludge in pit. Working in from edges, force it to flow into the later trenches. *Do not* push any water or drilling fluids into trenches—only heavy sludge.
  - c. Leave space for 2 to 3 feet of dirt to be added on top of sludge in trenches.
5. Cut trenches at sludge line and haul off excess.
6. Cover all sludge, bentonite, etc., with clean material for revegetation.
7. Pump all septic tanks.
8. Plug water wells, unless planned for future use.

9. Reshape cut and fill to preproject contours.

10. Replace topsoil evenly and revegetate the site.

a. Use trees, boulders, and natural debris to enhance visuals and microclimate.

11. Protect trees immediately adjacent to the site from injury to avoid mortality after site is abandoned.

12. Cut well stem 12 inches below ground and mark surface with a steel plate or large rock.

13. A relatively recent method of pit reclamation is called "solidification." The process is to add Portland cement to the pit residue and mix until the sludge solidifies. This "locks up" the residue material permanently so it can be buried on site. The process of pit solidification appears to be cost-effective and environmentally acceptable.

#### **8.15 - Roads**

Roads are one of the most impacting disturbances in mineral operations. The Environmental Protection Agency estimates that roads may produce as much as 300 times more sediment than the same area of undisturbed forest land.

Reclamation of roads is often difficult; partial reclamation is always possible. The following are suggestions for enhancing road reclamation:

1. Locate roads on the flattest and most productive slopes.

2. Determine before construction if the road is to be retained or obliterated in final reclamation.

3. Determine what the road construction method will be; this can affect the amount of disturbance to reclaim. Common road building methods are:

a. Side cast.

b. Cut and fill.

c. End haul.

4. Salvage topsoil in construction. Store uphill if possible.
5. Salvage merchantable timber, burn slash in pits, and bury residual material.
6. Seed and fertilize cut and fill slopes immediately after disturbance to control erosion and establish vegetative cover.

Techniques for use in final reclamation of roads:

1. Suitable gravel should be removed and salvaged where practical.
2. With large bulldozers, road profiles can be pushed to, or near, original contour on cross slopes up to 40 percent.
3. Roads on slopes over 40 percent can be restored to or near original profile with large backhoes or drag lines.
4. The following actions should be considered when reclaiming roads:
  - a. Remove culverts.
  - b. Outslope or restore to original contour. Pull berm into prism.
  - c. Rip on the contour to reduce compaction
  - d. Shape cuts and fills to be seeded.
  - e. Fertilize and seed after shaping. Use a hydroseeder on slopes 2:1 or steeper.
  - f. Introduce rocks, slash, and trees to improve visuals and microclimate.

Reclamation of large 60- to 100-foot-wide roads in steep terrain usually needs the following:

1. Rip to reduce compaction.
2. Pull berm and outside shoulder up the cut slope as far as possible. Use large trackhoe or drag lines.

3. If travelway will be retained, locate it on outside edge of roadway.

4. Reduce height of backslopes where possible.

5. Remove culverts.

6. If broadcast seeding, seed same day as disturbance to get maximum seed covering through sloughing and settling. Use 25 to 30 pounds of seed per acre. Fertilize as appropriate.

### **8.16 - Slime Ponds**

Slime ponds are associated with the phosphate mining and fertilizer industry.

These ponds are phosphatic clay wastes stored above ground behind earthen dams. The waste materials are approximately 50 microns and smaller and result from washing phosphate ore. Phosphate ores are washed, beneficiated, to increase the grade. That is, to increase the content of the  $P_2O_5$ . Beneficiation is to control the grade of the feed into the fertilizer plant. With current technology, it is a necessary part of producing phosphate fertilizers. In Region 4, slime ponds usually will not be located on National Forest land.

#### *Reclamation considerations:*

1. Slime ponds are created by piping the slimes into the pond as 90 to 98 percent water and only 2 to 10 percent solids. A significant fraction of the solids are colloidal and will not settle out.

2. Ponds are typically several acres in size and from 50 to 100 feet deep. Reclamation opportunities are limited.

3. Sometimes, 20 to 30 years are required before the pond will dry and support any type of equipment.

4. In Region 4, probably the only viable option for reclamation is to encourage the early establishment of deep-rooted woody vegetation to maximize the evapotranspiration loss.

5. Farm type equipment usually can operate on these ponds when the solids content exceeds 60 percent in the top 6 feet.

6. Colloidal gel in the bottom of slime ponds probably will not dry for many years.

## 8.17 - Diversions

Stream diversions may be a necessary part of the mining plan. However, other alternatives should always be considered. Diversions of live streams should be discouraged wherever possible. Reasons for diverting streams should be closely examined including the structures or ponds, etc., that might occupy the original area of the stream channel. Check state or Federal laws or regulations controlling stream diversions.

1. Transbasin diversions (where water is diverted from one drainage into another) are complex and should be discouraged. Get help.

2. The longer a stream diversion is in place the greater the chance for environmental damage. Diversions with a short-term life, about 10 years, can be managed more successfully than long-term diversions.

3. Water always seeks the lowest level. Given enough time, the meteorologic and geologic events will put a flowing stream back into the lowest topographic levels. In the long term, all stream diversions are temporary.

4. Construction of a new stream channel should provide for stability of the streambed and streambanks; this might include heavy rip-rap or protective vegetation being established in the channel.

5. With the exception of a brief period during construction the physical quality of the water will likely not be degraded.

6. The headgate, where the stream is originally diverted, should be of adequate size and stoutly constructed.

7. The diversion stream gradient of the new channel should be considered for streambed erosion and bedload implications.

8. The capacity of the proposed new channel should not be less than the capacity of the original channel. This capacity should be determined by a hydrologist.

9. If the proposed new channel is a pipe, then both the pipe capacity and ability of the pipe to remain in place should be considered.

10. For temporary diversions, the reclamation plan should specify how the stream channel will be reclaimed. Normally, pipe or culvert should be removed from the area.

11. Constructed stream channels that are no longer required should be filled with rock and soil.

### **8.18 - Waste Dumps**

With the trend toward larger equipment, large pits, and lower ore grades, there is also a trend toward large waste dumps. With large surface dumps, it is important to consider appropriate performance standards for stability, drainage, and revegetation. Safety requirements can be calculated for each dump or waste embankment. Contact the Regional Geotechnical Engineer for assistance.

1. In Region 4, there are three types of dumps being constructed: (a) head of valley, (b) cross valley, and (c) sidehill.

2. Head of valley fills should be engineered for a long-term factor of safety of not less than 1.25.

3. Cross valley fills have to provide for streamflow through the base of the dump. This is normally accomplished by constructing a rubble drain or french-drain.

4. The long-term factor of safety for cross valley fills should be not less than 1.25.

5. Provisions must also be considered for allowing flood waters or flood waves to enter the upstream end of the french-drain.

6. Flood water must not be permitted to traverse the top of a cross valley fill.

7. If the upstream end of a fill is truncated, a temporary flood water storage area may be created. Such a storage area is a technically acceptable way of dealing with flood waves.

8. Temporary water storage areas may be regulated by state law.

9. The french-drain must have sufficient capacity to transmit flood water safely through the base of the fill. The drain must also be constructed of durable, nonslaking rock.

10. The french-drain and associated temporary storage areas should be able to accommodate the 100-year flood volume from either straight rain or from rain-on-snow.

11. Sidehill waste dumps tend to contain less volume than valley dumps. In this Region, sidehill waste dumps generally have performed satisfactorily.

12. If the natural terrain is steep, the waste dump surface will be steep. Operating revegetation equipment on these dumps may be hazardous if the terrain and waste dump surface are steeper than 3:1.

13. If waste dumps have been engineered with adequate safety factors, it is up to the operating company to construct the dump to design specifications. In order to meet the current on-the-ground conditions, it is almost always necessary to change one or more of the design specifications. This is the normal and expected situation. However, there should be frequent inspections during the construction period to ensure that design specifications are being met or changed in an approved manner.

### **8.19 - Tailings Ponds**

When planning reclamation of a tailings pond, considerations will depend on whether the pond is old, new, or abandoned. In general, stabilization and revegetation of tailings ponds are expensive and difficult. Both the chemical and physical properties of tailings work against stabilization and revegetation.

1. Reclamation cannot be realistically planned unless the chemical properties of the tailings are known. The following information needs to be obtained:

- a. Is the pond acid, caustic, or near neutral in pH?
- b. Is the pH expected to change naturally over time?
- c. Can the pH be adjusted at reasonable expense?
- d. Are there any adverse consequences associated with adjusting pH?

- e. Are heavy metal cations present?
  - f. What about other cations or anions?
  - g. Are there any chemicals left in the pond?
2. If the pond is wet, the pond may be lined on the bottom.
  3. Groundwater contamination may be a problem.
  4. State or other Federal laws and regulations need to be complied with.
  5. Fugitive dust is a major environmental hazard associated with dry tailings ponds.
  6. Sand or earth tailings pond dams must be designed to ensure long-term stability. Emergency spillways are usually needed.
  7. Most tailings dams leak. A seepage return facility should be provided below the main dam.
  8. The seepage return must operate as long as the main pond leaks.
  9. Tailings materials are difficult to revegetate and usually require amendments to adjust to adverse chemistry.
  10. Tailings also need to be stabilized against blowing wind. Young vegetation will not survive severe wind blasting. Topdressing tailings material with 24 to 48 inches of soil may be necessary. If the surface cannot be successfully revegetated, consider covering with 12 inches of rock.
  11. Where translocation of toxic materials by plants or salt migration is a problem, provide a capillary barrier of coarse rock overlain by fine rock (10 to 12 inches) between the tailings surface and the growing medium or topsoil.

## **8.20 - Toxic Chemicals**

There are many toxic chemicals that are used in mining and drilling operations. This chapter is only intended to create an awareness of some of the more common toxic chemicals that may be encountered.

**Cyanide.** This highly toxic chemical is used as a leachate for extracting precious metals from low-grade ores.

1. Little is known about migration of free and complexed cyanides through soils.

2. Sodium Cyanide may remain in dry, alkaline soil for long periods of time, if introduced.

3. Cyanide oxidizes quickly when exposed to air and sunlight. Dilution, oxidation, and chemical alteration are good methods of reclamation.

4. Cyanide is very reactive and short lived.

5. Cyanide solutions must be controlled and contained.

**Salt Spills.** Salt spills are common in oil and gas drilling operations. Spills occur when large deposits of salt water under pressure are encountered in drilling. Dilution and cleanup are effective methods of reclamation.

**Drilling Muds.** These are a variety of chemical additives used in oil and gas drilling operations. Muds contain Chromates and other dangerous chemicals. Reclamation will consist of containment and proper disposal of muds.

Solidification of these residues by adding cement and/or fly ash is becoming an acceptable practice. Hauling muds to an approved disposal site is a common practice in Region 4.

**Other Toxic Materials.** Common contaminants that are particularly harmful to animals, fish, or people are:

Arsenic  
Nickle  
Cadmium  
Mercury  
Copper  
Lead

Common toxic contaminants to plants are:

Aluminum  
Zinc  
Copper

All mineral operations should be examined for all of the aforementioned minerals if they are suspected to be present.

### **8.21 - Reclamation of Mine Adits**

Adits from old mine workings are often left unreclaimed. The following are suggestions for reclamation of adits and mine portal sites:

1. Check adit for acid mine drainage.
2. Remove surface improvements—buildings, track, unused building material, containment ponds, ore stockpiles and ore bins, and other debris.
3. Shape and drain surface area of dumps. Depending on the material, the area may be prepared for seeding.
4. Flatten oversteepened backslopes around portal and ancillary improvements and revegetate them.
5. Assure that roads approaching or leaving the area are properly drained and treated.
6. Realize that attempts to establish vegetation on the face slopes will be dependent on the in-place material. Some weathered material may be treated and stabilized through seeding.
7. Assure public safety around portal area. Refer to Mining Safety and Health Administration (MSHA) direction for closing portals.

NOTES:

**NOTES:**

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## APPENDIX 1

### Planting Matrix — Semiarid

Activity	SPRING		SUMMER		FALL <sup>1</sup>		WINTER	
	Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages
Direct seeding <sup>2</sup> (grasses)	Cool season species only	Winter Moisture variable	Warm season species. More reliable precipitation. Plant prior to July-Aug rains	None	None	Frost heaving. Limited fall growth	None	Unsuitable for germination and growth
Bare root (shrubs)	Not recommended	Not recommended	Plant after initiation of summer rains. Soil moisture must be near saturation	Timing critical. Variable precipitation	If summer rains are late, early fall plantings are possible	Frost heaving	Not recommended	Not recommended
Containerized seedlings	Not recommended	Not recommended	Soil moisture must be near saturation	Variable precipitation	If summer rains are late, early fall plantings are possible	Frost heaving	Not recommended	Not recommended

Climate Summary: Semiarid mesas and valleys of northwestern New Mexico and northeastern Arizona are characterized by low, highly variable rainfall and high summer temperatures. Highest rainfall months are July and August with occasional late summer storms extending into September. Driest months are May and June. Rainfall varies with elevation, but in lower areas averages 7-10 inches annually. Snowfall light most years and seldom remains on ground. Growing season ranges from 140-180 days.

<sup>1</sup> Fall season implies terminal season of the year and that seeds and plants will remain dormant until spring.

<sup>2</sup> Direct seeding involves the use of machinery to place seed in a shallow furrow and cover it with soil. Firming of soil around seeds and placement of fertilizer near to seeds may be accomplished on sites where required. If seeds are broadcast rather than drill seeded, some action to cover them with soil is essential unless it is on freshly graded spoils where natural sloughing will cover the seed.

## APPENDIX 2

### Planting Matrix — Alpine

Activity	SPRING		SUMMER		FALL <sup>1</sup>		WINTER
		Advantages	Disadvantages	Advantages	Disadvantages		
Direct seeding <sup>2</sup> (grasses, sedges, forbs)	Sites not accessible	None	Optimum site conditions have already passed. Site may remain too dry. Seed not yet ready to be collected.	Provides for dormancy requirements. Site conditions are usually optimum in fall (e.g., not too wet). Seed will be in place next spring when conditions are optimum	Seed collection of natives may coincide with optimum planting times. Seeds may have to be collected 1 year ahead or purchased commercially from nurseries. If seeding is too early, frost damage to germinating seedlings may occur		Sites not accessible
Bare-root stock	Not recommended in this life-zone						
Containerized tubelines or native plugs (grass, sedges, forbs, and some shrubs and trees)	Sites not accessible	None	Actively growing plants may not be hardened-off to low temperatures. Conditions not favorable	Plant only after dormancy is induced. Site conditions are usually most favorable	Frost thrusting may lift plants if not firmly packed. High risk of severe storm activity		Sites not accessible

Climate Summary: Short growing season of 45 to 80 days; low summer temperatures averaging about 43°F, high wind speeds, high solar radiation loads, and no frost-free periods (needle ice thrusting can occur at any time). Seasons of summer and fall are compressed into about 2 months, and winter and spring together are about 10 months.

<sup>1</sup> Fall season implies terminal season of the year and the seeds and plants will remain dormant until spring.

<sup>2</sup> Direct seeding involves the use of machinery to place seed in a shallow furrow and cover it with soil. Firming of soil around seeds and placement of fertilizer near to seeds may be accomplished on sites where required. If seeds are broadcast rather than drill seeded, some action to cover them with soil is essential unless it is on freshly graded spoils where natural sloughing will cover the seed.

### APPENDIX 3

## Planting Matrix — Great Basin

Activity	SPRING		SUMMER		FALL <sup>1</sup>		WINTER
	Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages	
Direct seeding <sup>2</sup>	Favorable temperature/precipitation for seedling establishment	Late winter may reduce time available for seeding. Late frost or a short spring may reduce seedling establishment or growth	Not recommended	Not recommended	Seeds may receive needed cold treatment and germinate in late winter	Early winter may prevent completion of seeding operations	Not recommended
Bare-root planting	Plant can establish if planted before summer drought	A short spring season may reduce survival	Not recommended	Not recommended	Plant mid-fall. Avoid late fall planting	Frost heaving in heavy soils. Open winters	Not recommended
Transplanting container grown plants	Best results for establishment are in spring. Hazards of seed germination and establishment are bypassed	Weather may be a problem in scheduling field work	Possible if can be planted in moist soil. Long period of planting if possible	High temperatures and drought can be detrimental	Best results for establishment. Plant early to mid-fall	Frost heaving. Open winters	Not recommended

Climate Summary: An area of isolated mountain ranges and extensive level valleys where a highly variable frost-free growing season may be from 120-180 days in the valleys and less than 100 days in the foothills. Spring and fall temperatures are generally moderated (50°F), but high summer temperatures may reach in excess of about 98°F. Warm season precipitation from erratic thunder-showers is less than half of the total precipitation of about 6-16 inches annually.

<sup>1</sup> Fall season implies terminal season of the year and that seeds and plants will remain dormant until spring.

<sup>2</sup> Direct seeding involves the use of machinery to place seed in a shallow furrow and cover it with soil. Firming of soil around seeds and placement of fertilizer near to seeds may be accomplished on sites where required. If seeds are broadcast rather than drill seeded, some action to cover them with soil is essential unless it is on freshly graded spoils where natural sloughing will cover the seed.

## **APPENDIX 4**

### **Plant Species Suitable for Adverse Conditions**

#### **Moderately Acid Soils**

- Agrostis tenuis* (Common bentgrass)
- Deschampsia caespitosa* (Tufted hairgrass)
- Poa alpina* (Alpine bluegrass)
- Phleum pratense* (Common timothy)
- Carex* spp. (Sedges)
- Achillea millefolium* (Yarrow)
- Sibbaldia procumbens* (Creeping sibbaldia)

#### **Moderately Saline Soils**

- Festuca arundinacea* (Tall fescue)
- Agropyron desertorum* (Crested wheatgrass)
- Agropyron elongatum* (Tall wheatgrass)
- Distichlis stricta* (Desert saltgrass)
- Lotus corniculatus* (Birdsfoot trefoil)
- Eriogonum umbellatum* (Sulfur eriogonum)
- Atriplex* spp. (Saltbush)
- Artemisia* spp. (Sagebrush)

#### **Drought Hardy**

- Agropyron desertorum* (Crested wheatgrass)
- Agropyron sibiricum* (Siberian wheatgrass)
- Agropyron smithii* (Western wheatgrass)
- Agropyron inerme* (Beardless wheatgrass)
- Agropyron spicatum* (Bluebunch wheatgrass)
- Elymus giganteus* (Giant wildrye)
- Elymus junceus* (Russian wildrye)
- Sitanion hystrix* (Squirreltail)
- Hilaria jamesii* (Galleta)
- Oryzopsis hymenoides* (Indian ricegrass)
- Stipa comata* (Needleandthread)
- Sporobolus* spp. (Dropseed)
- Kochia prostrata* (Summercyprus)
- Melilotus officinalis* (Yellow sweetclover)
- Trifolium hirtum* (Rose clover)
- Vicia dasycarpa* (Woolypod vetch)
- Hedysarum boreale* (Utah sweetvetch)
- Camphorosma monspeliaca* (Mediterranean camphorfume)
- Ceratoides lanata* (Winterfat)
- Cercocarpus ledifolius* (Mountain mahogany)
- Atriplex* spp. (Saltbush)
- Artemisia* spp. (Sagebrush)
- Juniperus* spp. (Juniper)

## **APPENDIX 5**

### **Determining Pounds of Seed Per Acre Based on the Number of Seeds Per Square Foot**

NOTE: Normally seeding rates will vary from 20 to 60 seeds per ft<sup>2</sup> depending on site conditions.

#### **Steps for calculating equal seeding rates for each species.**

1. Multiply 1 acre in square ft X number of seeds to be used per ft<sup>2</sup> = total number of seeds required per acre.
2. Divide the total number of seeds per acre by the number of species in the mix = the number of seeds per species.
3. Complete the following calculation for each individual species in the mix:

Divide the number of seeds per species by the number of pure live seeds (PLS) per lb = lbs of seeds required for that particular species.

EXAMPLE: (Using a 1-acre area, 50 seeds/ft<sup>2</sup>, 200,000 PLS/lb and 10 species.)

- a. One acre (43,560 ft<sup>2</sup>) X 50 seeds/ft<sup>2</sup> = 2,178,000 seeds.
- b. 2,178,000 seeds divided by 10 species = 217,800 seeds/species.
- c. 217,800 seeds/species divided by 200,000 PLS/lb = 1.1 pounds/acre of each species.
- d. 1.1 pounds X 10 species = 11 pounds/acre total.

#### **Steps for calculating unequal seeding rates for each species.**

1. Multiply 1 acre in square ft X number of seeds to be used per ft<sup>2</sup> = total number of seeds required per acre.
2. Multiply total number of seeds per acre X the percent composition of the species to be seeded = number of seeds for each individual species.
3. Divide the number of seeds per individual species by the number of PLS per pound = pounds of seed per acre.

**EXAMPLE:** (Using a 1-acre area, 50 seeds/ft<sup>2</sup> and varying numbers of seeds/lb for five species.

a. One acre (43,560 ft<sup>2</sup>) X 50 seeds/ft<sup>2</sup> = 2,178,000 total seeds/acre.

b. Calculations for five species:

Total Seed/A	X % Composition	= No. Seeds/Species	- No. Seeds/ Lb	= Lbs/A
2,178,000	10	217,800	200,000	1.089
2,178,000	10	217,800	260,000	.835
2,178,000	20	435,600	300,000	1.452
2,178,000	30	653,400	140,000	4.667
2,178,000	30	653,400	50,000	13.068
Total lbs/A				21.111

## APPENDIX 6 Seeding Rate Chart

Approximate number of seeds per pound of pure seed and seeds per square foot per pound of pure seed per acre.<sup>1</sup>

Scientific Name	Seeds/ Pound (1000's)	Seeds/ ft <sup>2</sup> /lb /acre
<b>GRASSES</b>		
<i>Agropyron cristatum</i> (crested wheatgrass)	300	6.9
<i>Agropyron dasystachyum</i> (thickspike wheatgrass)	150	3.5
<i>Agropyron desertorum</i> (standard crested wheatgrass)	195	4.5
<i>Agropyron elongatum</i> (tall wheatgrass)	75	1.7
<i>Agropyron inerme</i> (beardless wheatgrass)	125	2.9
<i>Agropyron intermedium</i> (intermediate wheatgrass)	80	1.8
<i>Agropyron riparium</i> (streambank wheatgrass)	160	3.7
<i>Agropyron sibiricum</i> (Siberian wheatgrass)	160	3.7
<i>Agropyron smithii</i> (western wheatgrass)	115	2.6
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	140	3.2
<i>Agropyron trachycaulum</i> (slender wheatgrass)	135	3.1
<i>Agropyron trichophorum</i> (pubescent wheatgrass)	80	1.8
<i>Alopecurus arundinaceus</i> (creeping foxtail)	750	17.2
<i>Alopecurus pratensis</i> (meadow foxtail)	400	9.2
<i>Andropogon barbinodis</i> (cane bluestem)	750	17.2
<i>Andropogon caucasicus</i> (Caucasian bluestem)	860	19.8
<i>Andropogon gerardi</i> (big bluestem)	130	3.0
<i>Andropogon hallii</i> (sand bluestem)	100	2.3
<i>Andropogon ischaemum</i> (yellow bluestem)	830	19.1
<i>Andropogon scoparius</i> (little bluestem)	240	5.5
<i>Bouteloua curtipendula</i> (spike)	140	3.2
(sideoats grama) (grain)	720	16.6
(Avg. mixture)	250	5.8
<i>Bouteloua eriopoda</i> (black grama)	1,300	30.6
<i>Bouteloua gracilis</i> (blue grama)	725	16.7
<i>Bromus biebersteinii</i> (meadow brome)	80	1.8
<i>Bromus carinatus</i> (California brome)	145	3.3
<i>Bromus inermis</i> (smooth brome)	140	3.2
<i>Bromus marginatus</i> (mountain brome)	90	2.1
<i>Bromus mollis</i> (soft chess)	265	6.1

Scientific Name	Seeds/ Pound (1000's)	Seeds/ ft <sup>2</sup> /lb /acre
<b>GRASSES (Continued)</b>		
<i>Bromus rubens</i> (red brome)	260	6.0
<i>Buchloe dactyloides</i> (grain)	275	6.3
(buffalograss) (burs)	40	0.9
<i>Calamovilfa longifolia</i> (prairie sandreed)	275	6.3
<i>Cenchrus ciliaris</i> (grain)	860	19.8
(buffelgrass) (burs)	225	5.2
<i>Cynodon dactylon</i> (Bermudagrass)	1,500	34.5
<i>Dactylis glomerata</i> (orchardgrass)	540	12.4
<i>Distichlis stricta</i> (inland saltgrass)	520	12.0
<i>Elymus cinereus</i> (basin wildrye)	150	3.5
<i>Elymus giganteus</i> (mammoth wildrye)	55	1.3
<i>Elymus junceus</i> (Russian wildrye)	170	3.9
<i>Elymus triticoides</i> (beardless wildrye)	150	3.5
<i>Eragrostis atherstonei</i> (Atherstone lovegrass)	4,000	92.0
<i>Eragrostis chloromelas</i> (Boer lovegrass)	2,800	64.4
<i>Eragrostis curvula</i> (weeping lovegrass)	1,500	34.5
<i>Eragrostis intermedia</i> (plains lovegrass)	3,300	75.9
<i>Eragrostis lehmanniana</i> (Lehmann lovegrass)	6,500	149.0
<i>Eragrostis superba</i> (Wilman lovegrass)	1,100	25.3
<i>Eragrostis trichodes</i> (sand lovegrass)	1,500	34.5
<i>Festuca arizonica</i> (Arizona fescue)	410	9.4
<i>Festuca arundinacea</i> (tall fescue)	210	4.8
<i>Festuca idahoensis</i> (Idaho fescue)	450	10.3
<i>Festuca megalura</i> (foxtail fescue)	800	18.4
<i>Festuca ovina</i> (sheep fescue)	680	15.6
<i>Festuca ovina duriuscula</i> (hard fescue)	560	13.0
<i>Festuca thurberi</i> (Thurber fescue)		
<i>Hilaria belangeri</i> (curlymesquite)	270	6.2
<i>Hilaria jamesii</i> (galleta)	160	3.7
<i>Hilaria mutica</i> (tobosa)	200	4.6
<i>Hilaria rigida</i> (big galleta)	33	0.8
<i>Leptochloa dubia</i> (green sprangletop)	540	12.4
<i>Lolium rigidum</i> (Wimmera ryegrass)	185	4.3
<i>Muhlenbergia montana</i> (mountain muhly)		
<i>Muhlenbergia porteria</i> (bush muhly)	2,400	55.2
<i>Muhlenbergia wrightii</i> (spike muhly)	1,600	37.6
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	160	3.7

Scientific Name	Seeds/ Pound (1000's)	Seeds/ ft <sup>2</sup> /lb /acre
GRASSES (Continued)		
<i>Oryzopsis miliacea</i> (smilgrass)	1,900	43.7
<i>Panicum antidotale</i> (blue panicgrass)	650	14.9
<i>Panicum coloratum</i> (Kleingrass)	490	11.3
<i>Panicum virgatum</i> (switchgrass)	275	6.3
<i>Pennisetum setaceum</i> (fountaingrass)	275	6.3
<i>Phalaris arundinacea</i> (reed canarygrass)	540	7.8
<i>Phalaris tuberosa hirtiglumis</i> (perlagrass)		
<i>Phalaris tuberosa stenoptera</i> (Hardinggrass)	370	8.5
<i>Poa ampla</i> (big bluegrass)	885	20.3
<i>Poa canbyi</i> (Canby bluegrass)	925	21.3
<i>Poa glaucantha</i> (upland bluegrass)	2,500	57.5
<i>Setaria macrostachya</i> (plains bristlegrass)	290	6.7
<i>Sorghastrum nutans</i> (Indiangrass)	175	4.0
<i>Sporobolus airoides</i> (alkali sacaton)	1,600	36.8
<i>Sporobolus contractus</i> (spike dropseed)	2,800	64.4
<i>Sporobolus cryptandrus</i> (sand dropseed)	5,600	128.7
<i>Sporobolus flexuosus</i> (mesa dropseed)	3,300	75.9
<i>Sporobolus giganteus</i> (giant dropseed)	1,400	32.2
<i>Stipa comata</i> (needleandthread)	115	2.6
<i>Stipa viridula</i> (green needlegrass)	165	3.8
<i>Trichachne californica</i> (Arizona cottontop)	1,000	23.0
<i>Trichloris crinita</i> (twoflower trichloris)	1,400	32.2

#### FORBS

<i>Astragalus cicer</i> (cicer milkvetch)	135	3.1
<i>Coronilla varia</i> (crownvetch)	120	2.8
<i>Desmanthus illinoensis</i> (Illinois bundleflower)	85	2.0
<i>Eschscholtzia californica</i> (California-poppy)	300	6.9
<i>Gaillardia pinnatifida</i> (slender gaillardia)		
<i>Helianthus maximiliani</i> (Maximilian sunflower)	150	3.5
<i>Helianthus laetiflorus</i> (stiff sunflower)	85	2.0
<i>Kochia prostrata</i> (prostrate summercypress)	500	11.6
<i>Lotus corniculatus</i> (birdsfoot trefoil)	400	9.2
<i>Medicago sativa</i> (alfalfa)	230	5.3
<i>Melilotus alba</i> (white sweetclover)	260	6.0
<i>Melilotus officinalis</i> (yellow sweetclover)	260	6.0

Scientific Name	Seeds/ Pound (1000's)	Seeds/ ft <sup>2</sup> /lb /acre
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#### FORBS (Continued)

<i>Onobrychis viciaefolia</i> (sainfoin)	20	0.5
<i>Penstemon palmeri</i> (Palmer penstemon)	600	13.8
<i>Penstemon strictus</i> (Rocky Mountain penstemon)		
<i>Petalostemum candidum</i> (white prairieclover)	385	8.9
<i>Petalostemum purpureum</i> (purple prairieclover)	300	6.9
<i>Simsia exaristata</i> (annual bushsunflower)	330	7.6
<i>Trifolium fragiferum</i> (strawberry clover)	300	6.9
<i>Trifolium hirtum</i> (rose clover)	140	3.2
<i>Trifolium incarnatum</i> (crimson clover)	140	3.2
<i>Trifolium pratense</i> (red clover)	275	6.3
<i>Trifolium repens</i> (white clover)	700	16.1
<i>Trifolium subterraneum</i> (subterranean clover)	65	1.5
<i>Vicia americana</i> (American vetch)	41	0.9
<i>Vicia dasycarpa</i> (woolypod vetch)	11	0.3
<i>Vicia villosa</i> (hairy vetch)	20	0.5
<i>Zexmenia hispida</i> (orange zexmenia)	250	5.8

#### WOODY PLANTS

Seed data are furnished for only a few woody plants. These are for species which are most likely to be direct seeded. C. S. Schopmeyer (1974) presents data on the germination and propagation of many species of woody plants.

<i>Acacia greggii</i> (catclaw acacia)	30	0.7
<i>Amorpha canescens</i> (leadplant)	125	2.9
<i>Atriplex canescens</i> (fourwing saltbush)	50	1.2
<i>Atriplex lentiformis</i> (quailbush)	500	11.6
<i>Atriplex nuttallii</i> (Nuttall saltbush)	110	2.5
<i>Atriplex semibaccata</i> (Australian saltbush)	240	5.5

<sup>1</sup> To determine seeds/kg multiply seeds/lb by 2.205. To determine seeds/m<sup>2</sup>/kg/ha multiply seeds/ft<sup>2</sup>/lb/ac by 9.60.

## APPENDIX 7 APPROXIMATE METRIC CONVERSIONS

To convert	Into	Multiply by
<b>LENGTH</b>		
inches	millimeters	25.4
feet	centimeters	30.48
feet	meters	0.328
miles	kilometers	1.609
millimeters	inches	0.0394
centimeters	feet	0.0328
meters	feet	3.048
kilometers	miles	0.624
<b>AREA</b>		
square feet	square meters	0.0929
square miles	square kilometers	2.590
acres	hectares	0.4047
square meters	square feet	10.764
square kilometers	square miles	0.3861
hectares	acres	2.471
<b>WEIGHT</b>		
pounds	kilograms	0.4536
kilograms	pounds	2.205
<b>YIELD OR RATE</b>		
seeds/ft <sup>2</sup> /lb/ac	seeds/m <sup>2</sup> /kg/ha	9.60
lbs seed/ac	kgs seed/ha	1.12
tons/ac	metric tons/ha	2.24
gals/ac	liters/ha	9.34
seeds/m <sup>2</sup> /kg/ha	seeds/ft <sup>2</sup> /lb/ac	0.104
kgs seed/ha	lbs seed/ac	0.89
metric tons/ha	tons/ac	0.446
liters/ha	gals/ac	0.107
<b>TEMPERATURE</b>		
degrees Fahrenheit	degrees Celsius	5/9(°F - 32)
degrees Celsius	degrees Fahrenheit	9/5 °C + 32

## APPENDIX 8

### PRECIPITATION TOLERANCES FOR WILDLAND SEEDING

*Annual Prec.		8"	8-11"	12-18"	19-25"	25"
General Types		Salt Desert Shrub	-Dry-Sage/Juniper	Mid-Sage/Juniper Oak/Mt. Brush	-Moist-Sage/Mt. Brush Aspen-Dry Forest	Mixed Forest
Grasses	Indian rice needle and thread squirrel tail	wheatgrasses Nordan (Standard) Fairway thickspike Russian wildrye	wheatgrasses bluebunch whitmar pubescent intermediate tall, western hycrest Bozoisky wildrye hard fescue basin wildrye big bluegrass Kentucky blue Piute orchard smooth brome	Mt. brome smooth brome timothy orchard blue wildrye tall oat perennial rye slender wheat bearded wheat	cooler ecotypes of 19-25" Zone (i.e., Manchar smooth brome)	
Shrubs and Trees	winter fat 4-wing saltbushes Kochia (drier ecotypes)	Wyoming big sage black sage 4-wing green rabbitbrush	basin big sage Mt. big sage rubber rabbitbrush bitterbrush mahoganies service berry Oregon grape skunkbush hackberry currants, rose	snowberry elderberry ninebark oceanspray maples aspen gooseberries pachistima bearberry huckleberries	same as 19-25" Zone (cooler ecotypes or species, i.e., prickly gooseberry)	
Forbs	Desert globemallo	Munro globemallo astragalus phlox lomatium arabis erigeron (foothill species)	blue flax balsamroot yarrow Indian paint cicer milkvetch birdsfoot trefoil alfalfa sweet clover(s) sweet vetch burnet, sanfoin golden rye Palmer penstemon Mt. lupine silky lupine geranium Aster (glaucodes) strawberry	sweet anise checker mallow strawberry	same as 19-25" Zone (cooler ecotypes)	

\* Most species can be moved up one precipitation level successfully but not downward.

**APPENDIX 9**  
**SPECIES FOR SEEDING RIPARIAN AREAS**  
**Potential Planting Species\***

		4,500' - 5,500' Elev.	5,500' - 6,500' Elev.	6,500' + Elev. (non-alpine)
Fluctuating Waterable (periodic drying in upper profiles)	Graminoides	Kentucky bluegrass timothy basin wildrye meadow foxtail winged sedge	Kentucky bluegrass timothy meadow foxtail basin wildrye blue wildrye baltic rush tufted hairgrass wooly sedge winged sedge	tufted hairgrass Kentucky bluegrass baltic rush
	Shrubs	local willows-(Saex, Sabo, Sadr) currants rose	local willows-(Saex, Sabo, Salu, Sala) Mt. ash twinberry currants rose elderberry serviceberry shrubby cinquefoil	local willows-(Sabo, Salu, Sawo) twinberry elderberry shrubby cinquefoil
	Trees	hybrid poplar cottonwoods lombardy Russian olive Golden and crack willow	aspen cottonwoods golden willow crack willow blue spruce water birch Mt. alder	aspen Engelmann spruce subalpine fur lodgepole Mt. alder
"Permanently Wet" (upper soil profiles)	Graminoides	Nebraska sedge beaked sedge baltic rush reed canary	Nebraska sedge water sedge beaked sedge baltic rush bluejoint reedgrass reed canary	water sedge beaked sedge wooly sedge baltic rush bluejoint reedgrass
	Shrubs	local willows (Saex, Sadr, Sabo, Sala) dogwood	local willows (Saex, Sadr, Sabo, Salu) dogwood twinberry	local willows (Sabo, Sawo, Salu) bog birch dogwood twinberry
	Trees	Hybrid poplar cottonwoods lombardy golden willow crack willow whiplash willow	aspen cottonwoods golden willow whiplash willow crack willow water birch	aspen Engelmann spruce water birch Mt. alder

\* Forb species not included since most will return naturally with proper care.

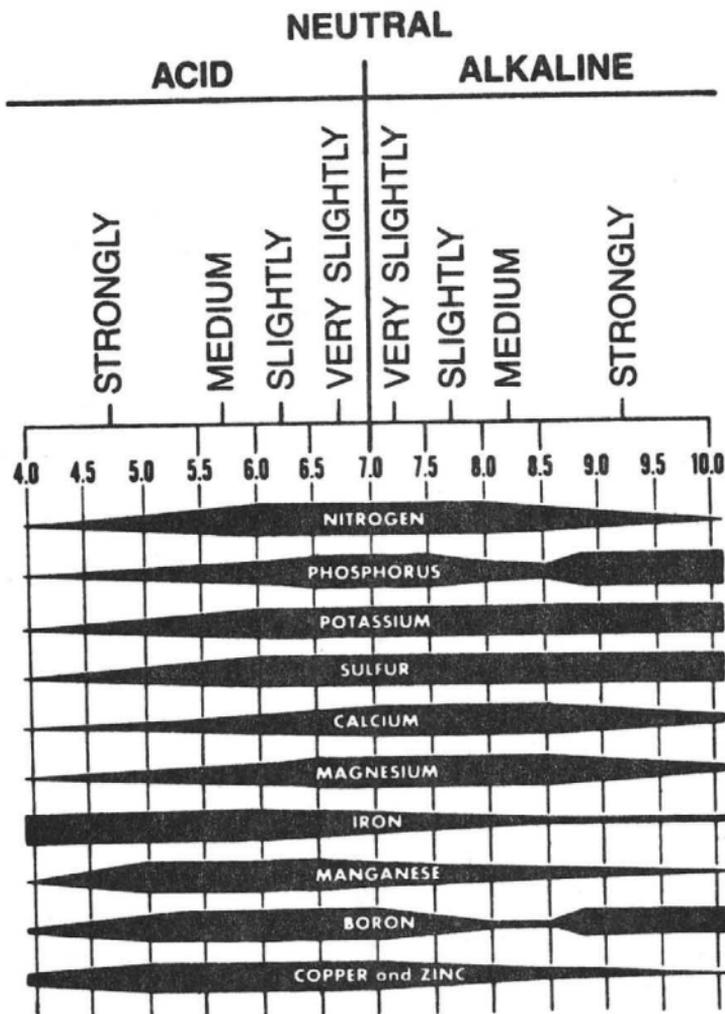
**APPENDIX 10**  
**R-4 - NOXIOUS WEED AND POISONOUS PLANT LIST**

Primary noxious weeds and poisonous plants that occur on National Forest System lands in the Intermountain Region.

Common Name	Scientific Name	Origin
<b>NOXIOUS WEEDS</b>		
Black henbane	<i>Hyoscyanus niger</i>	Europe
Canada thistle	<i>Cirsium arvense</i>	Eurasia
Dalmation toadflax	<i>Linaria dalmatica</i>	Europe
Diffuse knapweed	<i>Centaurea diffusa</i>	Eurasia
Dyers woad	<i>Isatis tinctoria</i>	Europe
Giant (Tall) whitetop	<i>Lepidium latifolium</i>	Europe
Hoary cress (whitetop)	<i>Cardaria draba</i>	Europe
Leafy spurge	<i>Euphorbia spp.</i>	Eurasia
Musk thistle	<i>Carduus theormeri</i>	Eurasia
Plumeless thistle	<i>Carduus acanthoides</i>	Eurasia
Rush skeltonweed	<i>Chondrilla juncea</i>	Eurasia
Russian knapweed	<i>Centaurea repens</i>	Eurasia
Scotch thistle	<i>Onopordum acanthium</i>	Eurasia
Spotted knapweed	<i>Centaurea maculosa</i>	Eurasia
Tansey ragwort *	<i>Senecio jacobaea</i>	Europe
Yellow star thistle	<i>Centaurea solstitialis</i>	Europe
Yellow toadflax (butter and eggs)	<i>Linaria vulgaris</i>	Europe
<b>POISONOUS PLANTS</b>		
Crazy weed	<i>Oxytropis spp.</i>	Native
Death camas	<i>Zigadenus spp.</i>	Native
Locoweed (milkvetch)	<i>Astragalus spp.</i>	Native
Lupine	<i>Lupinus spp.</i>	Native
Larkspur	<i>Delphinium spp.</i>	Native
Poison hemlock	<i>Conium spp.</i>	Eurasia
Water hemlock	<i>Cicuta spp.</i>	Native
Poison-ivy	<i>Toxicodendron spp.</i>	Native

\* New invader to National Forest System lands in the Intermountain Region.

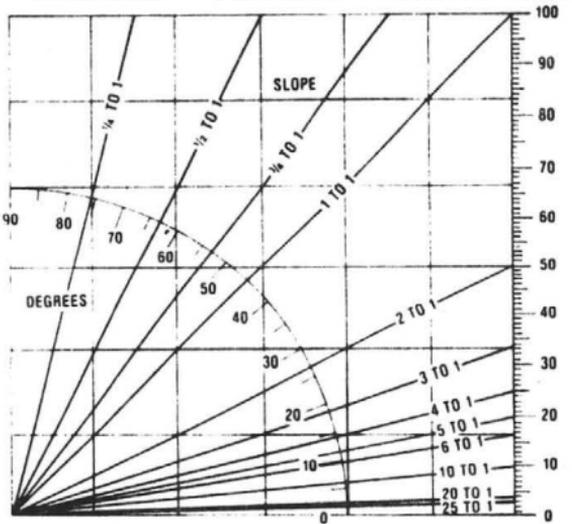
**APPENDIX 11**  
**pH - Nutrient Availability Chart**



How pH affects nutrient availability.

## APPENDIX 12

### GRADE COMPARISON CHART DEGREES — PERCENT — SLOPE



### GRADE IN DEGREES AND PERCENTS

DEGREES	PERCENT
1	1.8
2	3.5
3	5.2
4	7.0
5	8.8
6	10.5
7	12.3
8	14.0
9	15.8
10	17.6
11	19.4
12	21.3
13	23.1
14	24.9
15	26.8
16	28.7
17	30.6
18	32.5
19	34.4
20	36.4
21	38.4
22	40.4
23	42.4
24	44.5
25	46.6
26	48.8
27	51.0
28	53.2
29	55.4
30	57.7
31	60.0
32	62.5
33	64.9
34	67.4
35	70.0
36	72.7
37	75.4
38	78.1
39	81.0
40	83.9
41	86.9
42	90.0
43	93.3
44	96.6
45	100.0

## **APPENDIX 13 SELECTED REFERENCES**

### **Vegetation:**

1. User Guide to Vegetation, USDA Forest Service General Technical Report INT-64.
2. A Guide For the Use of Organic Materials, USDA Forest Service, Northeastern Station General Technical Report NE-98.
3. Plant Materials For Use on Surface Mined Lands in Arid and Semiarid Regions. Ashley A. Thomburg, Plant Materials Specialist, Soil Conservation Specialist, Lincoln, Nebraska.

### **Soils:**

1. User Guide to Soils, USDA Forest Service General Technical Report INT-68.

### **Engineering and Hydrology:**

1. User Guide to Engineering, USDA Forest Service General Technical Report INT-70.
2. User Guide to Hydrology, USDA Forest Service General Technical Report-74.
3. A Guide to Reclaiming Small Tailings Ponds and Dumps, USDA Forest Service General Technical Report INT-57.

### **Landscape Management:**

1. Landscape Architecture Technical Information Series, Vol. 1, No. 3 "Creating Land For Tommorrow." Published by American Society of Landscape Architects and USDA Forest Service - 1978.
2. National Forest Landscape Management Vol. 2, Chapter 2 "Utilities," Forest Service USDA Agric. Handbook 478.



United States Department of Agriculture

Forest Service

FS-441

## For More Information

Persons interested in setting up and implementing a showcasing effort are encouraged to consider the more detailed suggestions and ideas found in "Guide to Showcasing Mineral Activities," FS-440, which can be obtained by writing to the

### Chief, USDA Forest Service

P.O. Box 96090  
Washington, DC 20090-6090

or to the Regional Forester, USDA Forest Service, at any of the following locations:

#### Northern Region

Federal Bldg.  
P.O. Box 7669  
Missoula, MT 59807

#### Pacific Southwest Region

630 Sansome St.  
San Francisco, CA 94111

#### Pacific Northwest Region

319 SW Pine St.  
P.O. Box 3623  
Portland, OR 97208

#### Rocky Mountain Region

11177 West 8th Ave.  
P.O. Box 25127  
Lakewood, CO 80225-2098

#### Southern Region

1720 Peachtree Rd., NW  
Atlanta, GA 30367

#### Southwestern Region

Federal Bldg.  
517 Gold Ave., SW  
Albuquerque, NM 87102

#### Eastern Region

310 West Wisconsin Ave.  
Milwaukee, WI 53203

#### Intermountain Region

Federal Bldg.  
324 25th St.  
Ogden, UT 84401

#### Alaska Region

Federal Office Bldg.  
P.O. Box 21628  
Juneau, AK 99802-1628

In cooperation with:



American Mining Congress



American Petroleum Institute



National Stone Association



August 1989

# Showcasing Mineral Activities

## Partnerships in Action





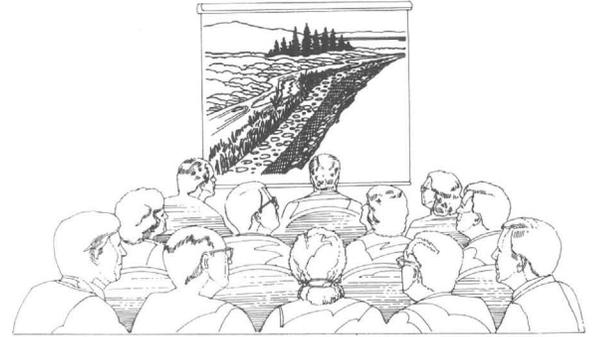
## Introduction

A mineral showcase area is a place to demonstrate that minerals can be extracted from the earth in a way that integrates other resource values and uses of the land. On National Forests and Grasslands, this means that the mineral operation is consistent with the management objectives of the Forest Plan. It also means that as mineral extraction is completed, the land will be reclaimed for other beneficial uses in harmony with the surrounding area.

Society today is highly dependent upon minerals and fossil fuels. Yet, many people feel that the impacts from mining and mineral extraction on public lands are unacceptable. Mineral showcase areas are places to discuss the idea of "caring for the land and serving people." They provide opportunities for people to see and understand mineral operations in an era of environmental awareness.

The purpose of this brochure is to introduce to land managers and industry officials the concept of showcasing mineral activities. In essence, the concept involves establishing one or more showcase areas and interpreting for the public what is going on there so that the idea of responsible natural resource management is conveyed.

To enhance implementation, it would be helpful to establish corporate and agency showcasing objectives and to obtain the mineral showcasing guide.



## Evaluating Success and Making Improvements

- Are the showcase objectives being met? Are the target audience, message focus, and media decisions still valid? Questions like these should be answered in periodic evaluations of the overall mineral showcase effort. Changes should be made as needed to keep the effort viable.
- Also, it is important to determine audience reaction to individual presentations or other specific aspects of the program. How do people feel about the mineral operation? What benefits have they obtained from the visit or presentations?

Remember . . . a good word passed along from satisfied and enlightened members of the audience to friends is the most effective way of letting others know that minerals can be developed in harmony with other natural resources and values.



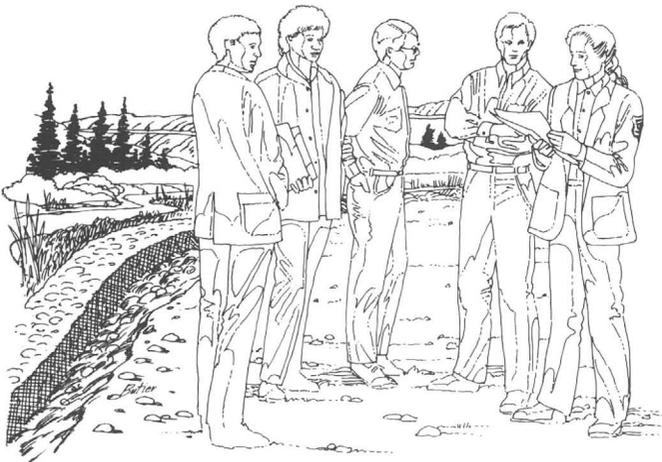


## The Medium—How Shall We Convey the Information?

Once the mineral showcase audience and message have been determined, attention should turn to the job of communicating the message through proper design and presentation.

## Showcasing—Attention to Details

There are key considerations in mineral activity showcasing, some seemingly insignificant, which can contribute greatly to the success of the effort. "Guide to Showcasing Mineral Activities" has checklists for both onsite and offsite presentations for those getting ready to showcase a mineral operation.



## Mineral Showcasing Objectives

### Mineral Activities in a Multiple-Use Setting

The primary objective of showcasing mineral activities is to demonstrate mineral extraction in harmony with other natural resources and values.

### Partnerships in Action

Another objective of mineral showcasing is to demonstrate the partnerships involved—land management agency, mineral industry, local government and others—in natural resource development.

### Selecting the Area

Showcase areas should encompass ongoing mineral operations having a variety of visible surface impacts. They should be areas of interest to the public, where activities are being guided by a land management plan or a set of integrated land use objectives.

Criteria for selecting a showcase area include:

- It is easily accessible.
- It is capable of accommodating visitors safely.
- It demonstrates good management practices and integrated resource management.
- It is supported by industry and cooperating agencies.





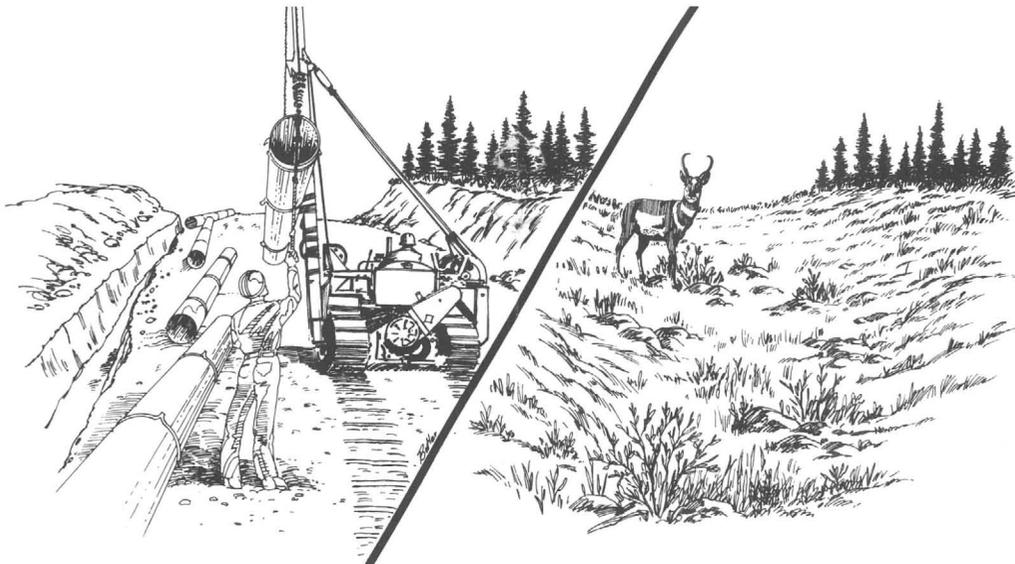
## Gaining Support for the Idea

The best mineral demonstration areas are those where there is a high level of cooperation between industry and the various permitting and regulatory agencies. Therefore, in establishing and interpreting mineral showcase areas, consideration for involvement should be given to a variety of cooperators.



## Planning and Organizing

Once the showcase area has been selected and the concept is supported by the major cooperators, the roles of the various parties need to be defined and documented.



- Consider the need for a Memorandum of Understanding or other formal agreement.
- A mineral showcase action plan showing who is going to do what and when would be helpful.

## Telling the Story

After the administrative arrangements are in place, the cooperators can focus on telling the story. Three key questions need to be answered. Collectively they provide a sound basis for achieving the showcase objectives.

### The Message—What Do We Want To Say?

The overall showcase objectives, previously identified, deal with mineral activities in a multiple-use setting and partnerships in action. As cooperators pursue mineral showcasing, they need to develop the specific message to be conveyed for the particular mineral showcase area.

### The Audience— Whom Do We Want To Get the Message?

Mineral showcase messages directed to specific groups of people stand a better chance of acceptance by their intended audience.



# ARIZONA HIGHWAYS

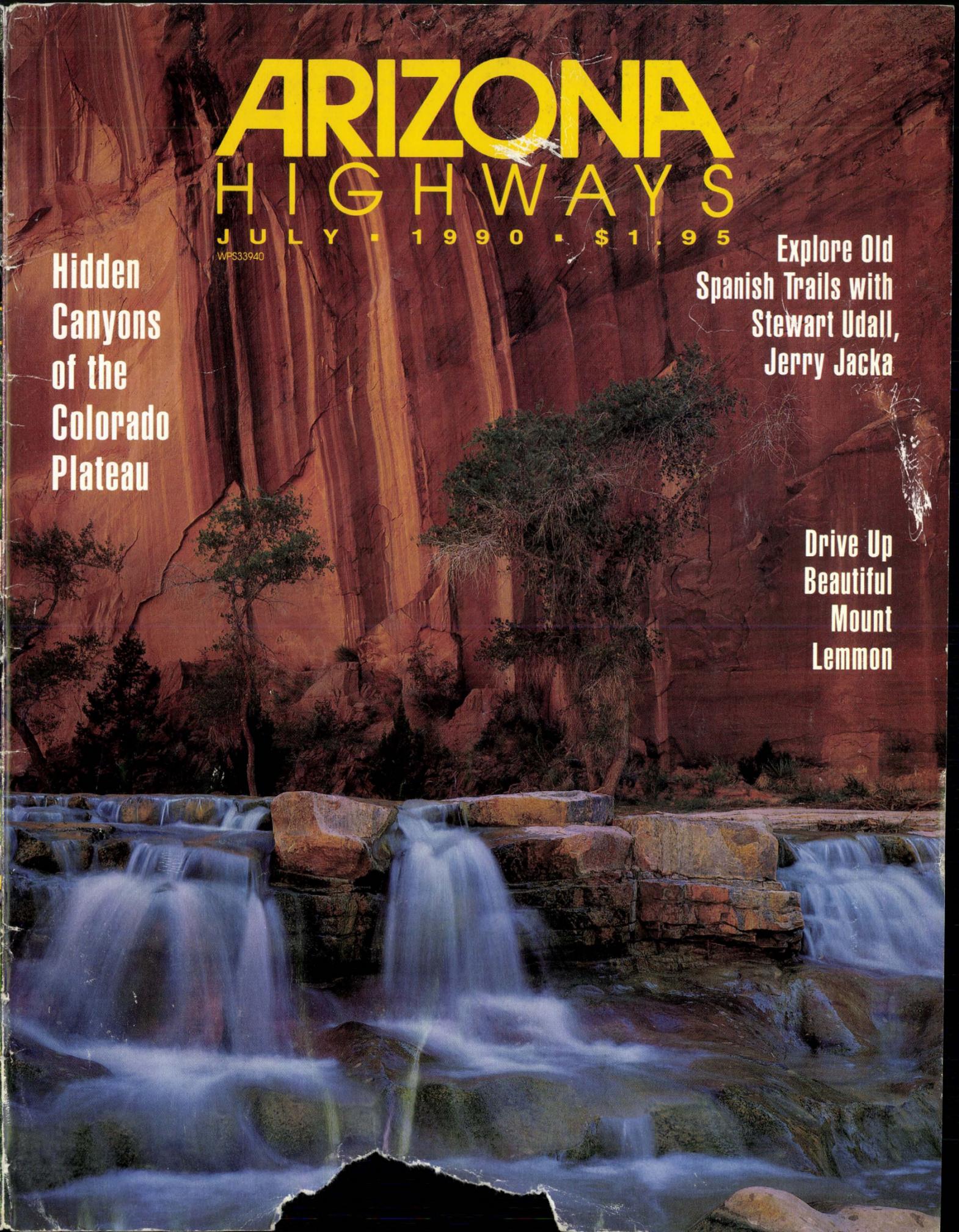
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WPS33940

Hidden  
Canyons  
of the  
Colorado  
Plateau

Explore Old  
Spanish Trails with  
Stewart Udall,  
Jerry Jacka

Drive Up  
Beautiful  
Mount  
Lemmon



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# BOOKSHELF

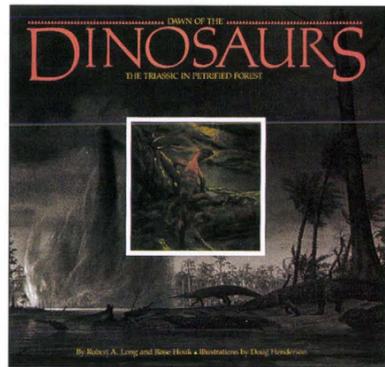
BY BUDGE RUFFNER

**Dawn of the Dinosaurs: The Triassic in Petrified Forest**, by Robert A. Long and Rose Houk. Illustrated by Douglas Henderson. Petrified Forest Museum Association, 1989. 96 pages. Available through Arizona Highways, 2039 W. Lewis Ave., Phoenix, AZ 85009, telephone (602) 258-1000. \$14.95, softcover plus \$2.00 postage.

Interstate Route 40 crosses a small corner of the Petrified Forest National Park in the high desert country between Holbrook and Chambers, Arizona. It is a dry, brittle land wrinkled with age, its colors running the spectrum from crimson to dun. This book evokes the region as it was 225 million years ago.

The Triassic period (205 to 245 million years ago) was characterized by the advent of dinosaurs and coniferous forests. Then, neither North America nor Arizona were where they are today. Present-day Arizona lay near the equator, and the shoreline of an ancient sea bisected today's Nevada. Huge conifers dotted what is now the Petrified Forest, and freshwater sharks and horseshoe crabs inhabited the ponds and rivers. Thirty-foot-long crocodile-like beasts called phytosaurs roamed across the damp, decaying forest floor. As the ancient land mass broke apart to form the continents we know today, the climate changed drastically. The great trees died and were frozen in stone, the sea life etched in rock.

In 1906 naturalist John Muir arrived in this chromatic desert, which had much of the primordial past locked within its layered floors. He came not to look into the past but to rest, and help one of his daughters recover her health. He was nearly 70. His wife had recently died,



and his daughter, Helen, was suffering from pneumonia, a condition the high, dry desert air might benefit. At Adamana, a water and fuel stop on the Santa Fe Railroad, Muir and his two daughters pitched their tents and waited for the desert to heal lungs and bring peace to troubled minds.

John Muir, a native of Scotland, was educated at the University of Wisconsin. As a naturalist, he had an unquenchable thirst for natural history. Where others saw only a geological curiosity in the Painted Desert, Muir saw a rich laboratory

capable of presenting the ancient history of the Earth to humanity. Disturbed to see casual visitors carry away the treasures of the past, he appealed to President Theodore Roosevelt, and in December, 1906, the Petrified Forest was designated the nation's second national monument.

The Petrified Forest is now a national park containing 94,230 acres. For study purposes, the geology is divided into the lower and upper Chinle formations. The lower is older; the upper was deposited later. Paleontologists, geologists, biologists, and botanists from around the world study the area, constantly unfolding new information.

The authors present a wealth of fact, theory, and speculation in an entertaining, engaging style. A special salute should go to the illustrator, Douglas Henderson, for his extraordinary depictions of Triassic plant and animal life.

*Dawn of the Dinosaurs: The Triassic in Petrified Forest* is the initial effort of the Petrified Forest Museum Association. With this exceptional publication, it has set a standard that will be difficult to surpass.

**Soul Among Lions: The Cougar As Peaceful Adversary**, by Harley G. Shaw. Johnson Books, Boulder, CO. 1989. 140 pages. \$9.95, softcover.

At one time in our history, the tree stump was the symbol of progress. It was evidence that land had been cleared and would soon be plowed and productive, basic ingredients of the American Dream. Today, when a dam brings a river to a halt, a chain saw topples a venerable oak, or the carcass of a cougar is hauled home in the bed of a pickup, we feel something of

value has been lost.

Harley Shaw, a research biologist, has conducted an intensive 10-year study of the cougar in the field. He has separated lion facts from myth. They are, for example, responsible for about one kill each week: deer, colts, calves, whatever is available to sustain them.

But lions are not the constant travelers we once believed. They normally stay within a defined territory that varies in size depending on terrain.

A rare combination of scientist

and storyteller, Shaw gives sound advice to hunters, preservationists, ranchers, and bureaucrats.

(RIGHT) *Youngsters attending Camp Sunrise enjoy the cool waters running through a box canyon of Christopher Creek near Payson. For the whole story, turn to page 16.*

KEN AKERS

(BACK COVER) *Alpine meadows and ponderosa forests on Mount Lemmon belie the arid surroundings of the desert floor below. For more, turn to page 38.*

EDWARD McCAIN

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Text by Stewart Udall  
Photographs by Jerry Jacka  
Udall and Jacka trace the routes of two of the first Europeans to explore Arizona.

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### Camp Sunrise

Text by Trudy Thompson Rice  
Photographs by Ken Akers  
A very special summer camp welcomes kids with cancer to the land beneath the "Tonto Rim."

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### Portfolio: Images and Impressions

Text and photographs by Gary Ladd  
The canyons of the Colorado Plateau resonate with pattern.

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### Whatever Happened to Jojoba?

Text by Jan Barstad  
Photographs by Ron Barstad  
A progress report about a promising desert agribusiness.

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### The Drive up Mount Lemmon

Text by Lawrence W. Cheek  
Photographs by Edward McCain  
The highway up the side of Mount Lemmon near Tucson has a long and colorful history.

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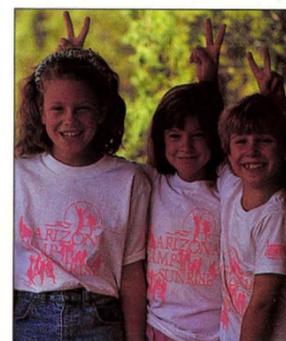
### Arzoniques

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### Bookshelf

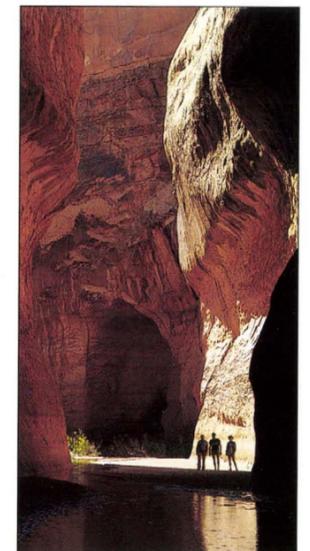


Painted Desert along one of Arizona's oldest trails. JERRY JACKA

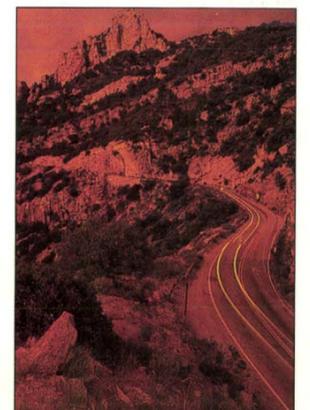


Children of Camp Sunrise, near Payson. KEN AKERS

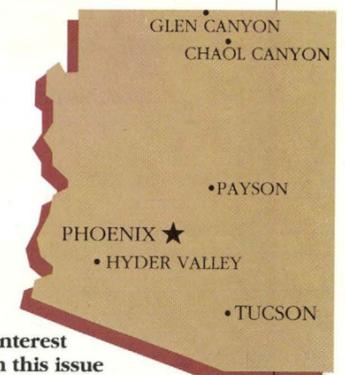
(LEFT) *Secret Pass in the Black Mountains, not far from Oatman. Spanish explorers may have crossed this range here. Stewart Udall's story begins on page 4.* JERRY JACKA  
(FRONT COVER) *Desert varnish streaks the sandstone walls of Chaol Canyon, a tributary of Navajo Canyon near Page. See portfolio beginning on page 22.* GARY LADD



Glen Canyon of the Colorado Plateau. GARY LADD



Mount Lemmon highway near Tucson. EDWARD McCAIN



Points of interest featured in this issue

# EDITOR'S

P A G E

SOME 80 YEARS before the Pilgrims landed at Plymouth Rock in 1620, Spanish trailblazers had pushed through the Southwest, exploring as far east as Kansas. And as the 13 colonies on the East Coast adopted their Declaration of Independence in 1776, Spanish pioneers were settling in along San Francisco Bay. The Indians, of course, were already here, engaging in agriculture and commerce and building their own social orders.

Stewart Udall, former U.S. secretary of the Interior, and Jerry Jacka, among the nation's premier landscape photographers, take us back among those Spanish explorers as they searched for gold and silver among the hills and for religious converts among the Indians. We think you'll be

fascinated discovering the trails those early pathfinders traveled through Arizona and seeing the sights they must have seen. The odyssey, a perfect blend of history and photography, begins on page 4.

History of the Southwest is a periodic feature of *Arizona Highways*, as are stories on wildlife, wilderness areas, and special events. But what you'll find in every issue, beginning this fall, are travel stories — places to go and experiences to absorb — and hiking stories — places to go to walk, to stretch the legs, and to explore close-up the wonders of nature.

Here's a preview of some of the stories coming up:

#### In August:

► Snakes, scorpions, and Gila monsters are the dreaded denizens of the desert — or are they? Writer Larry Cheek will provide us with an enter-

taining, informative look at the monster part of the trio. Also you'll find there's a lot more to those dry washes that seem to be about everywhere in Arizona. They're really the lifelines of the desert.

#### In September:

► There's an avocation that is emerging into a full-blown science. It's called pathfinding, ferreting out the overland trails used by the pioneers and the native peoples. How these trails are discovered after hundreds of years makes engrossing reading.

#### In October:

► Have we got a fall portfolio for you! Photographer Randy



From "Focus on Nature" in October, a spike elk pauses in early morning sunlight in Arizona's high country where herds of the animals have thrived since their reintroduction.

WILLIAM E. BARCUS

Prentice has captured the splendor of the autumn leaves along Cave Creek in southeastern Arizona's Chiricahua Mountains.

► And you'll be surprised at the variety of things to do and places to go as we take you on the best day trips from Phoenix.

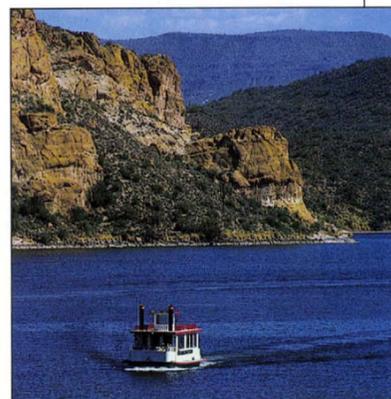
#### In November:

► This month will start from Tucson and set out on the best day trips in the vicinity of the Old Pueblo. The area is rich in Mexican culture and Jesuit missions.

► This month's hike is also in the Tucson area. The location is Esperero Canyon, and we'll head to Bridalveil Falls and beyond. It's a great walking adventure.

That's just a sample of what is ahead in *Arizona Highways*. I hope you'll stay in touch.

— Bob Early



(ABOVE) A Saguaro Lake excursion is yours in the October issue. JAMES TALLON

(BELOW) In September, autumn color fires Crystal Canyon beneath the Mogollon Rim. RICHARD D. FISHER



## In Sedona, a Giraffe of a Different Kind

A serendipitous wrong turn on the way to Boynton Canyon and there we were, looking at a giraffe on a residential street in Sedona. Not a real giraffe, of course, but a life-size one sculptor Mike Medow had constructed in front of his house.

Creating the giraffe was a complicated, delicate, and time-consuming process involving a wire structure and concrete mixed with fiber. After it had cured several weeks, Medow gave his white giraffe a lifelike "coat" of acrylic paint.

Medow worried that his neighbors might be upset about the tree-top high animal, but every neighbor of every age loves it, he says, and some told him they'd be unhappy if he moved it.

Visitors from as far away as Japan have stopped by the animal sculptor's neighborhood to photograph the giraffe and his friends. Yes, his friends. Medow's concrete menagerie has expanded to include a crane that has just snared a fish, an ostrich, several blackbirds, a rabbit, and a rooster.

If you want to be among those who visit these creatures of a different kind, take Coffee Pot Drive to the top of the road and turn left at Maxwell House. Go right on Caswell to the end of the street. Turn right again and you'll be able to spot the lanky quadruped standing majestically at 2010 Buena Vista.

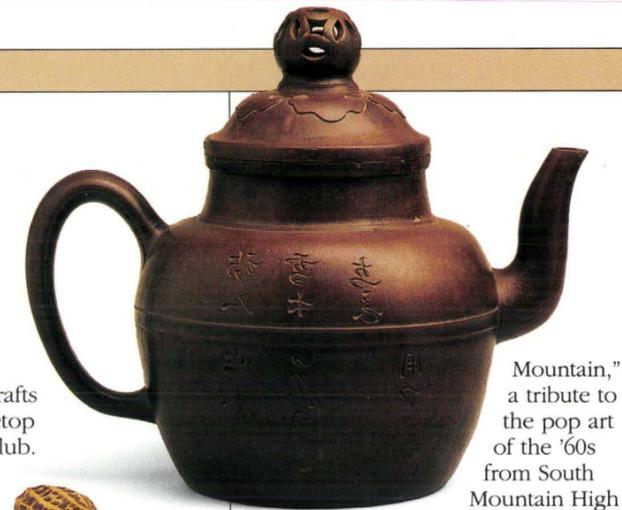
The only request Medow makes is that you "please don't feed the animals."

—Ruth Kwarcianny Huttner

## Calendar

**June 29-July 1, Pinetop.** The Northeastern Arizona Fine Arts Association holds its 15th annual outdoor juried arts and crafts show at the Pinetop Lakes Country Club. Telephone 537-2452.

**July 1-30, Phoenix.** Continuing exhibitions at the Phoenix Art Museum include "The Art of the Yixing Potter," 100 pieces of Chinese stoneware, admired by connoisseurs from the 17th century to the present; "In the Spirit of Yixing: Seven Contemporary Ceramic Artists," work in the purple-brown stoneware characteristic of Yixing pottery; "1920 Summer Fashions," and "Wham! Pow! Pop! Goes South



Mountain," a tribute to the pop art of the '60s from South Mountain High School students.

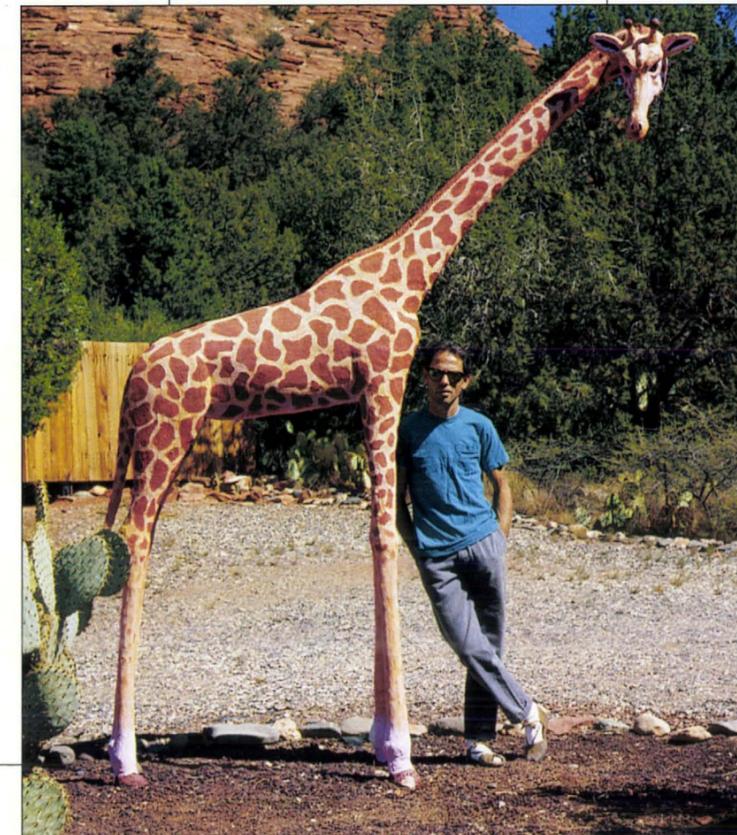
Telephone 257-1880.

**July 4-8, Window Rock.** Fourth of July celebration includes a PRCA rodeo, powwow, carnival, fireworks display, Western concerts, song and dance contests, arts and crafts sales, and more. Telephone 871-6702 or 871-6478.

**July 7-August 12, Flagstaff.** Festival of the Arts at Northern Arizona University. Features pop concerts, symphonies, chamber music, live professional theater, foreign and classic film festivals, art exhibits, dance, and poetry readings. Telephone 774-7750.

**July 27, Scottsdale.** Cool off the kids at Mighty Mud Mania, a footrace through a mud-filled obstacle course. There's also a giant water slide, playgrounds, and free swimming at Chaparral Park. Telephone 994-2771.  
**July 28-29, Pinetop-Lakeside.** Enjoy an Indian market, Native American performances, and food at the third annual White Mountain Native American Art Festival. Telephone 367-4290.

For a free calendar of events, write to Arizona Office of Tourism, 1100 W. Washington St., Phoenix 85007. Unless otherwise noted, all telephone numbers are within area code 602.





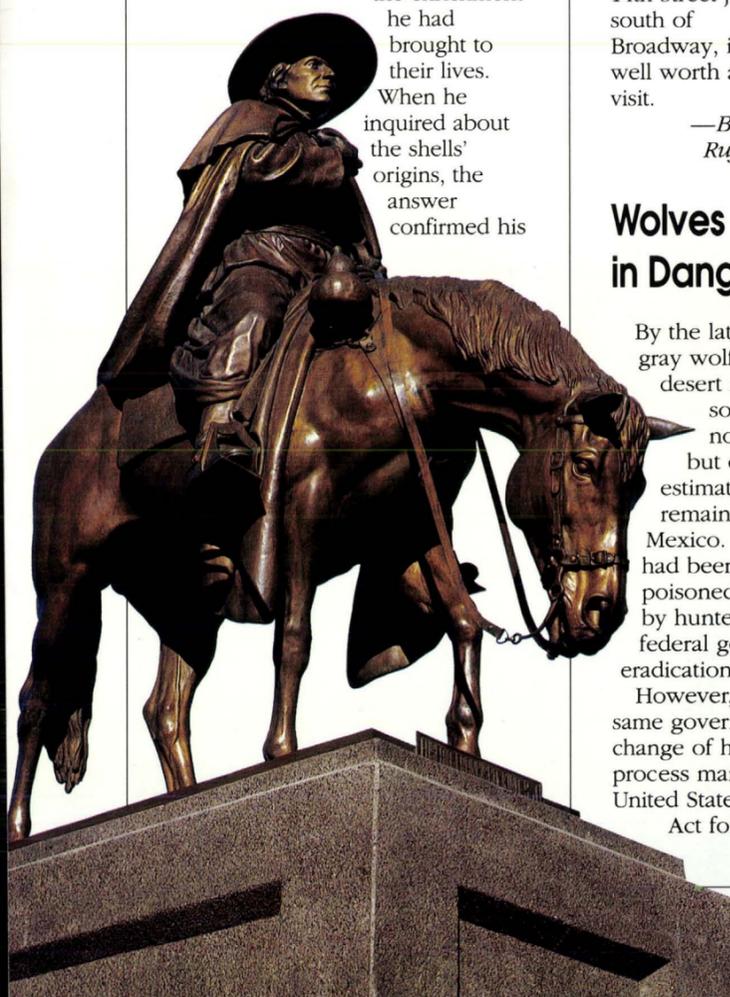
### Three Bronzes of Father Kino

Last year a heroic equestrian statue of Father Eusebio Francisco Kino, the "Padre on Horseback," was dedicated in Tucson. Two other castings of the magnificent bronze were done in Mexico City. One has gone to Magdalena, Sonora, Mexico, where Kino died in 1711 at the age of 66. The other will be dedicated this summer in Trent, Italy, Father Kino's birthplace.

Missionary, peacemaker, farmer, explorer, historian, astronomer, and cartographer: Father Kino was a man of peace, purpose, and dignity. He brought the first beef cattle into Pimería Alta and taught the Indians there to plant and harvest crops they had never before seen.

In 1700 the Pimas gave Kino some abalone shells, a precious gift to express their gratitude for the enrichment he had brought to their lives. When he inquired about the shells' origins, the answer confirmed his

he had brought to their lives. When he inquired about the shells' origins, the answer confirmed his



## ARIZONIQUE

Edited by Vicky Hay

suspicions: there was a land route to California, which was not (as was believed at the time) an island but part of the mainland.

Sculptor Julián Martínez has placed an astrolabe on Kino's saddle and an abalone shell in his hand, icons of the Jesuit explorer's achievements.

The monument, located at Kino Boulevard and 14th Street just south of Broadway, is well worth a visit.

—Budge Ruffner

### Wolves in Danger

By the late 1970s, the Mexican gray wolf, once abundant in the desert mountain ranges of southern Arizona and northern Mexico, was all but extinct. It was estimated that fewer than 50 remained, all of them in Mexico. Most of the population had been trapped, shot, or poisoned early in the century by hunters hired under a federal government-sponsored eradication program.

However, in recent decades that same government has had a change of heart. As part of a process mandated under the United States Endangered Species Act for native endangered

animals, a Mexican Wolf Recovery Plan was started in 1976. The U.S. Fish and Wildlife Service began to develop a program to breed the animals in captivity with an eye to reintroducing them in the American Southwest and Mexico.

Today there are 34 Mexican gray wolves in captivity in six American and three Mexican participating institutions. The Arizona-Sonora Desert Museum in Tucson is one of them. "We hold a pair of wolves in an off-exhibit pen for breeding," says Peter Siminski, curator of

birds and mammals at the museum. "We will permit a breeding this year — we aren't able to do it every year.

"We also have some Mexican gray wolves on exhibit," he adds. In addition to participating in the breeding plan, the museum is involved in education efforts. For example, a museum-produced slide show, *A Call for the Wild*, is available through

the Arizona-Sonora Desert Museum, 2021 North Kinney Road, Tucson AZ 85743 (telephone (602) 883-1380), the U.S. Fish and Wildlife Service, Box 1306, Albuquerque, NM 87103 or the Arizona Game and Fish Department, 2222 W. Greenway Rd., Phoenix 85023 (telephone (602) 942-3000). —Sam Negri

(LEFT) Julián Martínez' sculpture of Father Kimo.

(ABOVE) Gray wolf redux. JAMES TALLON (OPPOSITE PAGE, TOP) Stoneware peanuts and 17th-century Chinese pot, on display this month at Phoenix Art Museum.

(BELOW) Mike Medow and friend. RUTH K. HUTTNER



# LETTERS

YOURS SINCERELY

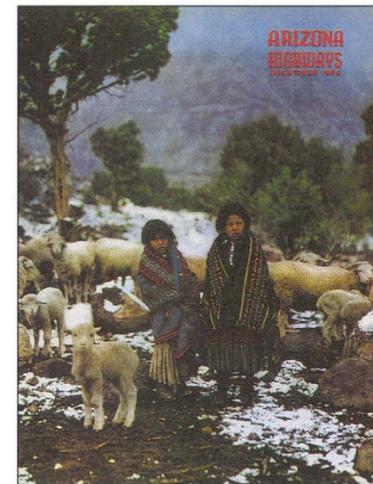
#### FRIENDS' TRAVEL

Telephone the Friends of *Arizona Highways* Travel Desk, (602) 271-5904, for information about our auxiliary's Scenic Tours and Photo Adventures.

**Scenic Tour, October 1-4.** With former *Arizona Highways* Editor Don Dedera, tour the northern part of our state: the Mogollon Rim, Camp Verde, Sedona, Flagstaff, Kingman, Oatman, Laughlin (Nevada), and Wickenburg.

**Photo Adventure, October 19-21.** Gary Ladd escorts photo buffs through Monument Valley.

**Photo Adventure, October 25-28.** Discover the famous Wonderland of Rocks in Chiricahua National Monument with P. K. Weis and Peter Kresan.



"what it was like" in the '40s after World War II as no current historian could ever do. Thank you for the opportunity to enjoy such nostalgia.

Phyllis B. Chisholm  
Laramie, WY

#### BACK ISSUES PAR EXCELLENCE

Each *Arizona Highways* is always a breathtaking treat, but I had to write you about this December (1989) issue. It is so beautiful — I found that inside front cover just awesome. I also appreciate the inset page maps.

Rose Brewer  
Hartland, WI

I indulged myself and ordered your 1925 and 1946 reproductions. [The 1925 reproduction is *Arizona Highways*' first issue; in 1946, we published the country's first all-color magazine. — Editor] I have enjoyed them immensely.

The 1925 issue's reports on how many paved and unpaved miles of road there were reassures me that I didn't imagine traveling on some dirt roads when I first went to Arizona by bus in 1936. The 1946 issue re-creates

#### RESPLENDENT ARIZONA

Some time ago a friend gave some *Arizona Highways* to me. Out of curiosity, I began to read these magazines. Maybe I was thinking about Arizona as only a desert state, but from that moment I had to change my opinion. I was surprised to come to know Arizona as a very colorful state with deep blue lakes and fantastic forests. It's a sensual feast that is not soon forgotten.

Jeorg Jeske  
Minden, West Germany

Last year my wife and I visited Arizona. I was very impressed by the wonderful blue sky of Tucson, the warm weather, the fantastic landscape, and the welcoming people. All this has been held in my mind, and I refresh these memories every month when I get *Arizona Highways*. Looking at the photos, we're happy

to watch the only blue sky we can see here. We dream about going back there one day!

Marco Sartori  
Piacenza, Italy

As a California native who had a friend from Scottsdale, I became very interested in your state. I subscribed after reading your magazine many times in my dentist's office, and now I not only read the entire magazine but find great joy in the absolutely beautiful pictures. I am a sophomore at Sarah Lawrence College in New York. Taping some of your pictures to the walls in my dorm room brings back the happiness and beauty of the West.

Alison Westlund  
Bronxville, NY

## ARIZONA HIGHWAYS

JULY 1990 VOL. 66, NO. 7

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## Arizona's Earliest Highways III

Oñate  
and  
Garcés

Text by Stewart Udall  
Photographs by Jerry Jacka



*In 1983, when Jerry Jacka and I first traveled into Arizona's outback in search of trails traversed by Francisco Vásquez de Coronado and his captains, landscape evidence verified insights we had gleaned from the conquistadores' reports that they had followed trade routes established long before by Indian runners. This conviction was reinforced in subsequent years as we completed our investigation of the pathways trod by the Spaniards who came later to explore the "Tierra Incógnita" of the greater Southwest.*

*As our study of Arizona's geography widened, we became increasingly aware of the explorers' various and innovative approaches: for the entradas of Fray Marcos de Niza, Coronado, and Father Eusebio Kino penetrated the state from the south; the expeditions of Antonio de Espejo and Juan de Oñate entered this region from the east; the long ride of Francisco Garcés from the Colorado River to the Hopi pueblos originated from the west; and the exploring party led by Fray Silvestre Vélez de Escalante in 1776 made a northern passage into Arizona at the end of a wide-ranging excursion from Santa Fe that marked the first entry of Europeans into the Great Basin.*

*With this report, we complete our survey of Arizona's first "highways" by retracing the trails followed by Governor Oñate in 1604 and by Father Garcés in 1776.*

Juan de Oñate was a stellar figure in the history of North America. Don Juan, a founder of the silver city of San Luis Potosi in 1593, contracted a marriage that linked him with the earliest days of Mexico's history: his wife's mother was Doña Leonor Cortés Montezuma, daughter of the great conqueror Hernan Cortés and the Aztec princess Isabel Montezuma. But the younger Oñate's bid for lasting fame rests on his leadership in establishing the first permanent nonmilitary European community in what is now the United States.

Historians have withheld from Juan de Oñate the recognition he deserves as the earliest "founding father" of our country. In the summer of 1598—nine years before the first English settlement in Virginia and 22 years before the Pilgrims came ashore at Plymouth Rock—Don Juan followed what was probably an existing Indian trail to the Río Grande from the south and guided a company of settlers he had organized and financed to a homeland in northern New Mexico. The Oñate party included 10 Franciscan friars; 270 other single men; 129 families; 83 wagons and carts loaded with seeds, tools, and household goods; and 7,000 head of livestock. Unlike the settlers of Virginia and Massachusetts who established coastal colonies that had regular commerce with Europe, Oñate's pioneers made an overland journey of

nearly a thousand miles into a beautiful Shangri-la valley in the heartland of a vast continent before putting down roots in what is now United States soil.

Despite the remoteness of this tiny settlement, however, the entire land mass of the Southwest was accorded status as a new kingdom by the Spanish monarch. Governor Oñate invoked the name of King Felipe II when he proclaimed the official occupation of the province of Nuevo Mexico on the day his expedition crossed the great River of the North at El Paso.

Juan de Oñate was the first experienced mining man to come into the Southwest, and it is clear that he invested his personal fortune in the colonization of his province of Nuevo Mexico on the assumption that he would be able to locate and develop valuable lodes of silver or gold in the new land. Antonio Espejo had described

*Juan de Oñate, Arizona's first governor, may have passed just north of the region called the Painted Desert (RIGHT) on his final expedition in 1604 seeking precious minerals in this new land. The Painted Desert today is home to the Petrified Forest National Park near Holbrook. Motifs above are (TOP) Oñate family crest and (BOTTOM) 17th century Franciscan insignia.*

probably will invite increased traffic: the environmental impact statement projects 1,800 cars a day by 2005.

Steve Plevel, the thoughtful Forest Service district ranger for the Catalinas, spends his furrowed-brow time thinking about how to protect the mountain from an increasing crush of people. As long as there's only one road in, and as long as the Forest Service keeps a watchful eye on how people use it, he says, it can be done.

"There are two kinds of capacity on the mountain," he explains. "The first is its physical capacity. Exceed that, and you're going to have resource damage. Example:

the Bear Canyon campground has been used so heavily that we've now got soil compaction, and there's no reproduction of trees. This isn't an irreversible situation, though. We'll probably go in and close a third of the campground for three to five years, loosen the soil, and it'll regenerate. Then we'll close another third, and so on."

The more difficult problem, Plevel continues, is managing what he calls the "social capacity" of the mountain. For some people — those who go up to escape crowds, noise, and civilization—the mountain's capacity is strained already. What the Forest Service must do, he says, is look at

how the mountain is being used. "A lot of people take the highway up the mountain just to have a barbecue. They're not looking for a wilderness experience; they want to do exactly what they do in their back yards, but in a different setting where it's cooler, and the wind is rustling through the trees. These are the kinds of demands you can concentrate in a small area."

Defenders of the mountain also can take some encouragement from the way the highway is being reconstructed. "Painstaking" doesn't quite describe it; perhaps "revolutionary" does. Says landscape architect Joanne Gallaher, who was in charge of the first three-mile segment, "We were able to change the highway engineers' thinking."

Conventional practice in building a mountain highway, Gallaher explains, is to blast a cleanly beveled cut out of the rock above the highway ledge, then dump the rubble to form an even slope from the road down. The problem with this is its very uniformity. It's all straight lines, and straight lines are not the stuff of nature. The gashes are visible for miles.

Wherever more mountain had to be blasted to accommodate this widened roadway, Gallaher and the design team went out with geologists and actually designed a blasting pattern that would leave a rough, jagged surface. Wherever the rubble had to be dumped downslope, they created irregular ledges so that plants could gain a foothold. Wherever barrel cacti, saguaro, and ocotillo were in the roadway's path, they were transplanted, not bulldozed. Even the guardrails came in for special design attention: they're a flat gray that doesn't reflect sunlight, and the posts are painted a dark green—identical to the mesquite foliage along the lowest several miles of the road.

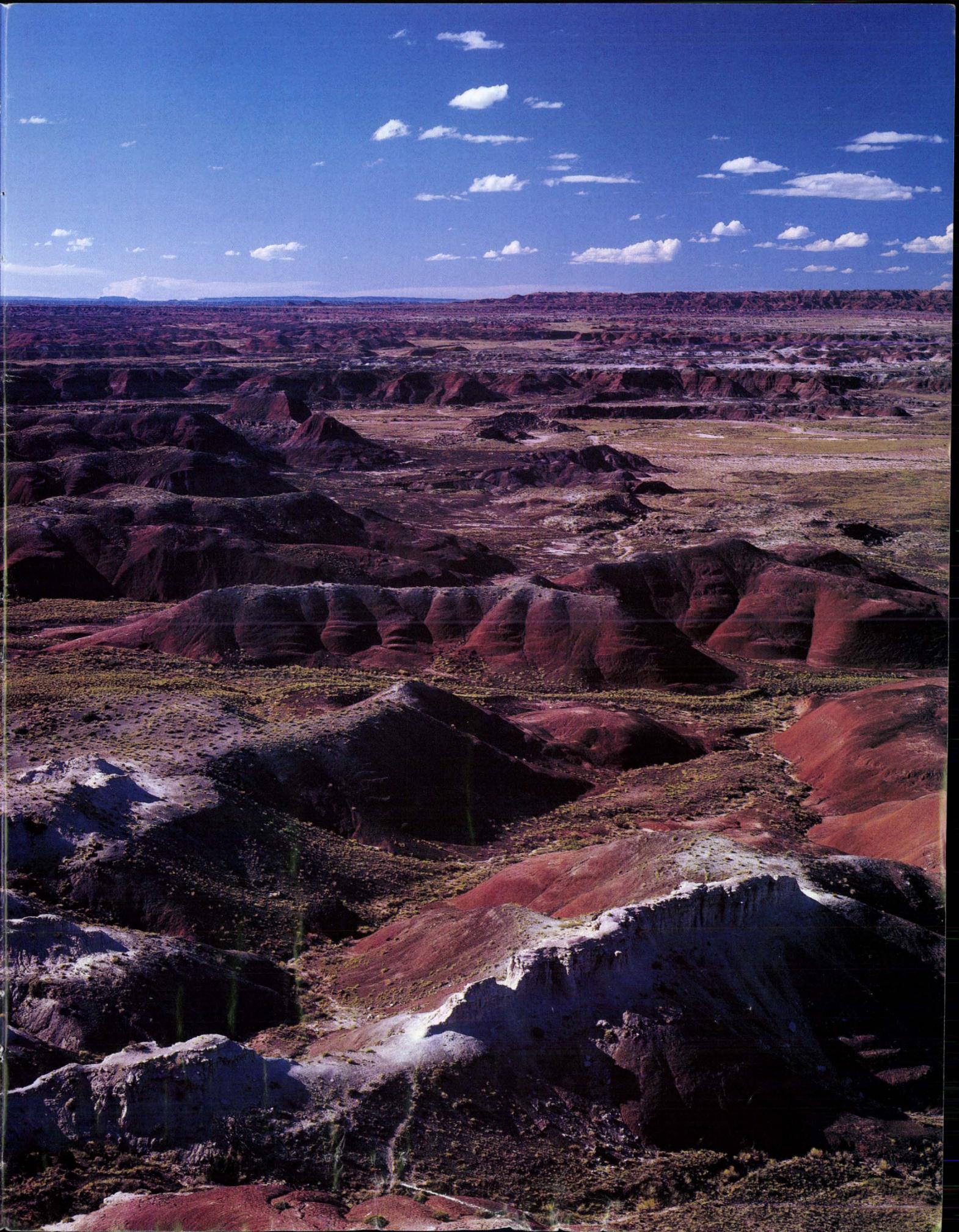
Most people who work with the mountain agree on one point: the road, originally built in an era of minimal environmental consciousness, would not be built at all were it proposed today. (No airport, either.) Only an insignificant fraction of the urban population below would ever get onto the mountain, and its wildness would be preserved. That position makes excellent environmental sense, and yet it's easy to be grateful for Frank Hitchcock and his relentless crusade. All it takes is a warm summer day, a picnic basket, a good friend, and a convertible with the top peeled back. The mountain, maybe, can be asked to forgive that much. ☐

*Free-lance writer Lawrence W. Cheek, an architectural critic and frequent contributor to Arizona Highways, has been a Tucson Citizen journalist and editor of Tucson City Magazine. Award-winning Tucson Photographer Edward McCain also is a frequent contributor to Arizona Highways.*

(LEFT) From a roadside perch in August, rugged canyons measureless to man roll on to the far horizon.

(BELOW) In a fantasyland beneath a canopy of pine, fir, and spruce dressed in winter white, hardy skiers brave the slopes of Mount Lemmon's Ski Valley.





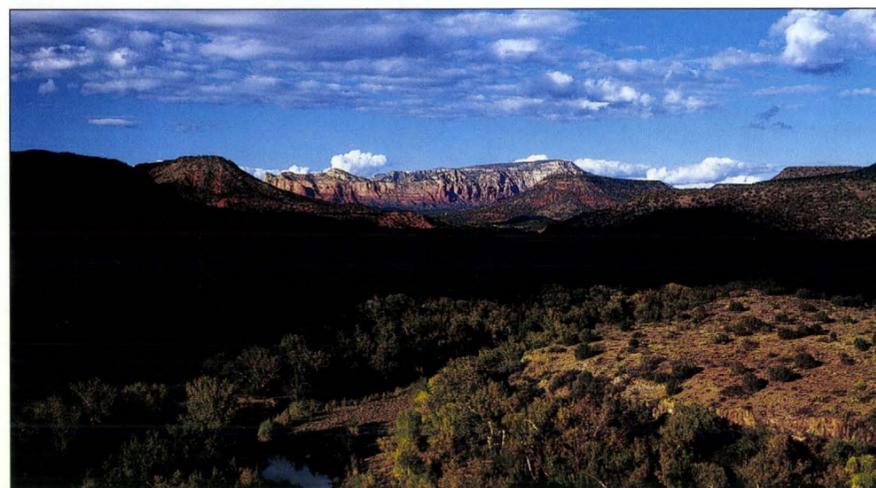


*The Palatkwapi Trail, an ancient Indian pathway, may have been the route chosen by Oñate from the Hopi mesas to the Verde Valley, traversing ponderosa forests to arrive at Stoneman Lake (LEFT), then southwest to Beaverhead Springs on Dry Beaver Creek near Sedona (BELOW). He then followed another trail along the Verde River to its source, passing near Perkinsville. The area between Jerome and Perkinsville (RIGHT) has changed little since Oñate's time.*

promising outcrops of ore to the viceroy's aides in Mexico City after his unauthorized trip into that region in 1583. As a consequence, soon after Oñate established the site of his capital at the confluence of the Chama River and the Río Grande, he sent Capt. Márcos Farfán de los Godos on a winter excursion to Arizona's Verde Valley to search for and evaluate the character of "the mines" located by Espejo.

Although Farfán failed to return with the hoped-for silver samples, his report did not dampen Oñate's expectation that he would find precious minerals to replenish his fortune and enrich his king. The next year, he conducted an upriver foray into a region of southern Colorado never before penetrated by Spanish explorers, but no encouraging ore body was located on this journey. Then, in the fall of 1601, the governor led a 60-day sweep that retraced some of Coronado's eastward steps across the "buffalo plains" to the vicinity of today's Wichita, Kansas.

Having scoured vast regions of his domain without finding silver hills like those in Zacatecas, Governor Oñate was still driven by his dream of a bonanza that would redeem the efforts he and his friends had made to make Nuevo Mexico a shining gem of the Spanish crown. Now, with undertones of desperation, he began contemplating a seaport and possible mines in the western sector of his domain



as the best hope to justify all of the sacrifices that had been made.

One hundred thirty soldiers accompanied Oñate on his final lunge to discover precious minerals in his realm. The caravan began by following paths first taken by Coronado's captains. The riders rode down the Río Grande, then traveled westward to Acoma and present-day Zuni, New Mexico, and northwesterly, perhaps passing just north of the Painted Desert and across Jadito Valley to Awatobi and the other mesa villages of the Hopi Indians in Arizona.

Father Escobar, the scribe of Oñate's last

odyssey in 1604, has provided us with a vivid description of the Hopis. "Very friendly," he tells us, they lodged the Spaniards in their houses and fed them "joyfully and courteously." The natives of this "poor and cold" land, he noted, wore colored blankets and dressed themselves in buckskin and buffalo hides.

In the last century, historians have diverged in their attempts to trace the trail the Oñate party followed to the Verde Valley. One expert even concluded that these travelers approached the area down Sycamore Canyon from the vicinity of



people use the highway itself for recreation; nearly every day, bicyclists are out there matching their muscles against the highway's 5,293-foot vertical gain. Every September there's a United States Cycling Federation-sanctioned race that begins at Tanque Verde Road and proceeds up the highway. Last year's winner made the 34-mile ride in exactly two hours — an average speed of 17 miles an hour.

Traffic-wary Tucsonans think of it as a good road for a Monday drive. Or any other weekday, when traffic tends to be sparse. On warm-weather weekends there isn't any getting-away-from-it-all on Mount Lemmon; on some holidays the Sheriff's Department has to regulate traffic, letting one car start up as another leaves. On the average, 900 cars a day use the highway.

For some people who are concerned about the mountain that is 900 too many.

"I have to admit that the drive up that highway is one of the most beautiful in the country," says Ken Rait, conservation chair for the Sierra Club's Rincon Group. "But our intention, ultimately, is to close the road entirely—although we know that's not politically feasible now."

Why even think of erasing one of Arizona's most spectacular highways? "It just takes the wildness out of the mountain," says Rait. "Mount Lemmon's ecosystem is very fragile, and the more you increase the opportunities for easy access by people, the more impact you have on vegetation and wildlife."

"We lost the grizzly on that mountain around the turn of the century. We lost the wolf in the 1950s. Now we're in danger of losing the black bear. There are only eight to 12 black bears in the Catalinas now, and

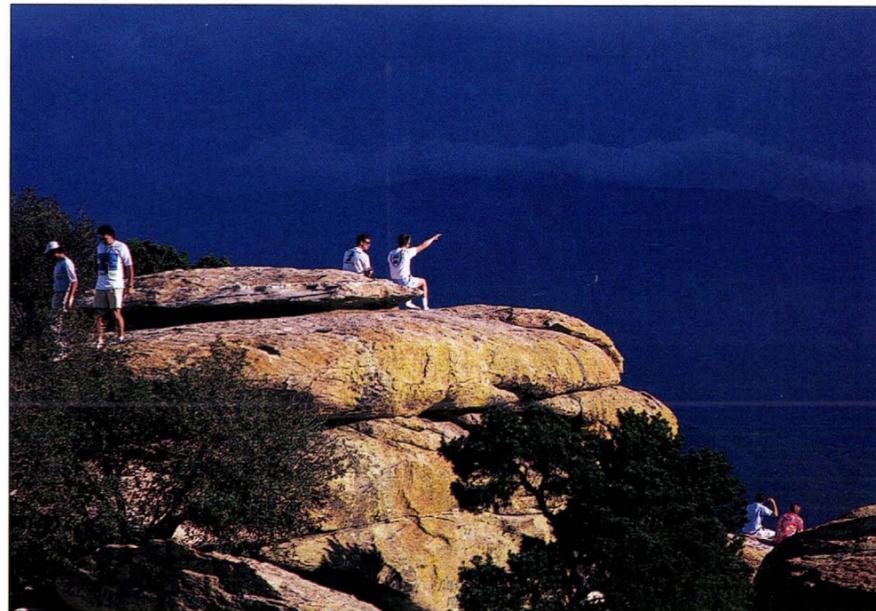
that's way below a viable population."

Eddie Cocking, a wildlife manager for the Arizona Game and Fish Department in Tucson, however, says he thinks the bear population is back up to 12 to 15 because some of the six bears relocated in the summer of 1989 have returned. Cocking also believes that number constitutes a viable population.

Tucson author Charles Bowden's influential 1987 book, *Frog Mountain Blues*, argued from beginning to end for closing the highway. "The mountain I have described will not be something like hot water or cold beer, an indulgence instantly available to everyone," Bowden wrote of

Mount Lemmon. "To go there will call for more than a tank of gas and a machine. Why is that fact so terrible?"

It isn't likely that the highway ever will be closed. The U.S. Forest Service and Federal Highway Administration began a widening project in 1988, which will cost \$15 to \$18 million and stretch through the rest of this decade. The reason is to improve the highway's safety record, which has not been encouraging. (In places, the roadway is just 18 feet wide with one-foot shoulders, and if an inept driver muddles across the centerline, an oncoming car's options are all unpleasant.) Although it will remain a two-lane road, it



(ABOVE) Visitors to popular Windy Point, Milepost 14, find the perfect spot to experience the arrival of a summer storm while enjoying the view.

(LEFT) Autumn on Mount Lemmon means brisk cool air, colorful foliage and, at Ski Valley, an Oktoberfest celebration, complete with costumes, music, dance, and food — all flavored with a German accent.

(RIGHT) Early autumn foliage on Mount Lemmon lures nature lover Caron Nargan to the forested heights along the highway.



Williams. After examining the terrain and studying the words written by Oñate's companions, Jerry and I were persuaded by the logic of a thesis developed by Dr. James W. Byrkit of Northern Arizona University that all of the early Spaniards who visited this region used an ancient but "very precise" Indian pathway—designated by Byrkit as the Palatkwapi Trail—to get from the Hopi mesas to the Verde River. (See "The Palatkwapi Trail," *Plateau*, Vol. 59, No. 4.)

A Hopi tradition, Byrkit says, recites that some Hopi clans once lived in a warm, well-watered area to the south that they referred to as Palatkwapi, the "Place of the Red Rocks." From the Hopi mesas, the Palatkwapi Trail went due south parallel to present-day State Route 87, past the Hopi buttes, and on to Homolovi pueblo (whose ruins just north of Winslow were designated in 1986 as a state park). At this point, the trail crossed the Little Colorado River at the ford known in the 19th century as Sunset Crossing. Archeological evidence indicates that Homolovi and two other pueblos served as way stations that marked the course of the Palatkwapi Trail. These were Nuvakwewtaqa, whose ruins are visible today at Chavez Pass, and the ruin preserved and interpreted in our day by the National Park Service as Montezuma's Well.

From Winslow this old Hopi trail—first

traversed by Espejo in 1583—turns southwest, still aligning with Route 87, through Sunset Pass and on to Chavez Pass. It then turns westward toward Long and Soldier lakes and traverses one of Arizona's beautiful ponderosa pine forests to Pine Springs and Stoneman Lake. From this landmark, signs of an old wagon road in Rattlesnake Canyon support Byrkit's contention that in all likelihood Oñate's party descended that rugged canyon to Dry Beaver Creek and Beaverhead Springs, moved over Beaverhead Flat, crossed Oak Creek near the present community of Cornville, forded the Verde River near Bridgeport, and probably camped at Haskell Springs while investigating the ore outcrops originally staked out by Espejo in the Jerome area.

The supposition that the earliest Spanish explorers used the Palatkwapi Trail is buttressed by maps and other records indicating that this very trail was the road used by many of Arizona's settlers from the East in the 1860s and 1870s after Arizona Territory was split off from the Territory of New Mexico by Congress and President Lincoln in 1863. Territorial records reveal that one of the first American citizens to follow the route was Lt. Col. José Francisco Chaves of the First New Mexico Infantry Volunteers, who was sent to escort Arizona's new governor, John N. Goodwin, from Santa Fe to Fort Whipple, a frontier military post temporarily located 25 miles

north of today's Prescott. Colonel Chaves' report indicates that the route he used on his return trip was the Palatkwapi Trail—and this soon appeared on the military maps of that era as the Chaves (or Chavez) Cutoff. (See "El Coronel," *Arizona Highways*, January 1990.)

Father Escobar relates that from the Jerome area the Spaniards followed the Verde River upstream "to its source." This suggests that the trail Governor Oñate now pioneered across an unknown stretch of his realm passed by Perkinsville and came into Chino Valley near Paulden before climbing westward to the headwaters of the Santa Maria River. This route also was probably a long-used Indian trail that could have followed a natural course into Williamson Valley and then south of the Santa Maria Mountains in Prescott National Forest. It is likely that Oñate proceeded southwest along the Santa Maria River, then west through what is now Alamo State Park, following the Bill Williams River to its confluence with the Colorado River.

One wonders whether Juan de Oñate paused to study the outcrops he passed through, described by Escobar as "mostly mountains with bare rock." The indelible irony that has hovered over his quest for centuries since is that he rode by two areas that later offered up rich yields of gold and silver to placer miners who had



Oñate's unsuccessful midwinter trek passed through the valley of the Bill Williams River (ABOVE). He then followed the river to its junction with the Colorado. From this point, he continued south to the Gulf of California, before returning home empty-handed to his capital on the Rio Grande.

primitive equipment. Within a 40-mile arc to the south of Oñate's path in Yavapai County lay, near the surface, silver and gold deposits that sparked a boom in placer mining and helped make Prescott the new territory's first capital.

On their pleasant December ride to the big river in the west, Father Escobar informs us, the Spaniards stayed close to the "bed of the [Bill Williams] river." During their uneventful journey along the plain formed by the Colorado, the Spaniards encountered several large settlements of peaceful Indian farmers, but they were unable to obtain much information about possible mines. There were other disappointments. Where the river entered the Gulf of California, there were no Indians fishing for pearls and no promising site for a seaport.

Governor Oñate was surely downcast on his long midwinter ride back to his capital on the Rio Grande. He had personally inspected more of the Southwest's expanse than any Spaniard before him, but the sil-

ver hills that tantalized him eluded his grasp. He did, however, leave a mark on the land that enjoys the distinction of being this nation's oldest non-Indian signature artifact, and the source of the term "Pasó por aquí" ("Here passed by") frequently found in New Mexico literature. East of Zuni on one of the sandstone walls at the

dramatic castle rock that is preserved now as El Morro National Monument, Don Juan carved this synopsis of his last exploring expedition:

Here passed by the Governor-General Don Juan de Oñate, from the discovery of the South Sea, the 16th of April, 1605.

**Spanish Exploration Milestones in Arizona, 1536-1776**

- 1536 Cabeza de Vaca and Estéban traverse southeastern Arizona on their Long Walk from Texas to the Pacific Ocean.
- 1539 Estéban and Marcos de Niza reconnoiter the route from Sonora to Zuni, later called the Coronado Trail.
- 1540 Coronado treks to Zuni; Tovar travels to Hopi villages; Cárdenas is the first European to see the Grand Canyon; Diaz travels Devil's Highway.
- 1583 Espejo follows the Palatkwapi Trail from Hopi villages to Verde Valley.
- 1604-05 Oñate crosses Arizona searching for a route to the Pacific Ocean.
- 1691-98 Kino blazes trails for Arizona's first missions.
- 1774-75 De Anza and Garcés cross Arizona to California.
- 1776 Garcés pioneers an eastern route to Grand Canyon from the Colorado River.
- 1776 Escalante and Dominguez, returning from the Great Basin to Santa Fe, map parts of northern Arizona.

*Continued from page 38*

and became very capable operators. On completion of their sentences they were deported to Mexico and they sent word to the Prison Bureau that they had been able to secure employment as jackhammer operators in the mine [at Cananea, Sonora] at a much higher rate of pay than their former pay as muckers."

Elsewhere in the report, though, the Mexicans appear less contented. "Mexican Immigration Law violators made the best common laborers at the pick and shovel work...but there was a period when none were sent to this camp because of their tendency to escape and because budgeted funds were insufficient to pay guards for the overtime required to recapture them."

An assortment of tax evaders, bank robbers, opium runners, and conscientious objectors also did time on the road crew. For them, it probably was preferable to prison. They lived in an unfenced camp on the mountain at about 5,000 feet elevation, raised fresh vegetables, congregated around evening campfires, and played baseball with teams from nearby Civilian Conservation Corps projects. They even made pets of the mountain's wildlife: Sally, a captured javelina, "was very appreciative of table scraps and back scratching by

inmates," the report noted.

"A small percentage" of malcontents loafed or sabotaged equipment—a favored technique was to remove the spark plugs from engines and drop steel nuts into the cylinders. Most, the report concluded, underwent body- and character-building and completed their sentences "much better qualified to take their places as normal members of society."

The road they built was, and still is, astounding.

Viewed from living room windows on Tucson's south edge, 20 miles away, the Santa Catalina Mountains look benignly two-dimensional, a great blue-gray construction paper cutout propped up on the horizon. Viewed from above—or on a highway engineer's topo map—the range is an outrageous jumble of canyons, gulches, ridges, escarpments, peaks, and spires. There are few gentle slopes and no highland meadows. This mountain did not invite the building of a highway; it had to be convinced with dynamite.

The road leaves suburban Tucson behind at an elevation of 2,880 feet. Almost immediately it slices through a spectacular saguaro forest in Soldier Canyon. Five miles later, the desert gives way to chaparral, the second of six life

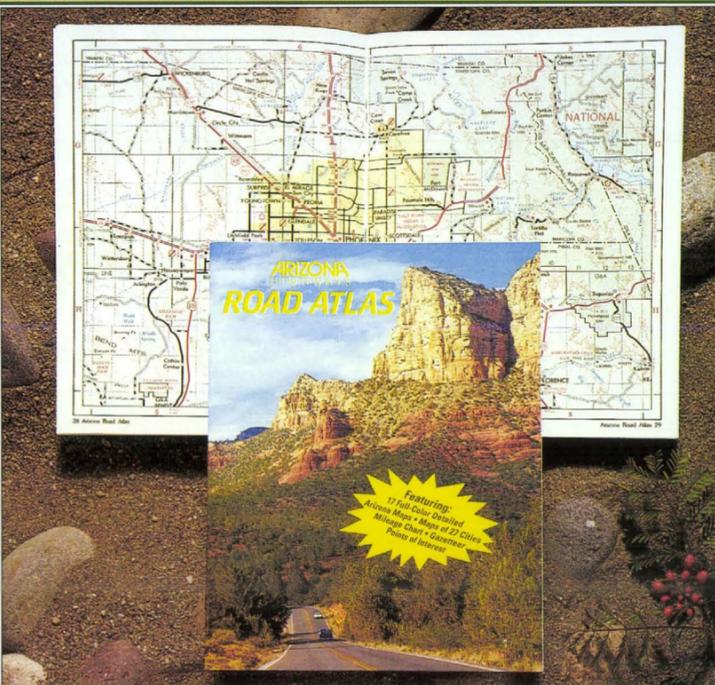
zones on the mountain. At about 10 miles, geologic spectacles parade by: wind-sculpted rocks resembling, for example, a duck wearing a combat helmet. Juniper and oak, then piñon pine, and finally Engelmann spruce and ponderosa pine forests squeeze away the horizons.

Periodically the road smashes through forest into open sky. From Windy Point Vista, you can see Mexico 70 miles to the south; if you ride the lift at Ski Valley, you may see the San Francisco Mountains 200 miles to the north.

At Ski Valley or Summerhaven, where the road ends, it's a reliable 25 to 30 degrees cooler than in the Tucson basin. An average winter dumps 120 to 150 inches of snow on the slopes at Ski Valley. Tucson collects barely an inch of snow once every four years. No matter what the season, the mountain has the power to turn the city into a distant memory.

"This highway offers the equivalent of driving from Mexico to Canada in an hour," says Sarah Davis, a landscape architect with the U.S. Forest Service. It also connects the city with several forms of recreation: picnic grounds, campgrounds, fishing at Rose Canyon Lake, an 85-day ski season usually beginning in late December, and a network of hiking trails. Some

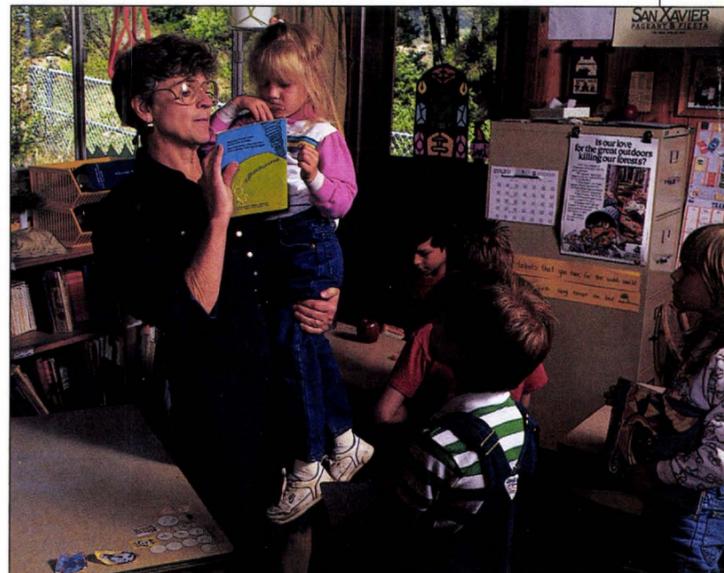
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# Life at the Top



(LEFT) On bright summer weekends, entertainment draws crowds from the hot lowlands to the Alpine Inn in the village of Summerhaven atop Mount Lemmon. (ABOVE) Summerhaven has its own one-room schoolhouse, where teacher Florence Koch instructs students in kindergarten through sixth grade.

There must be something in the thin, cool air of Summerhaven, the village at the end of the Mount Lemmon Highway, that induces a mystical high. One current resident calls it "Camelot." Last year a bewitched reporter described it as "a Brigadoon you can reach by car."

For many of the residents, though, Summerhaven's allure is simple and practical. "My kids walk two minutes to school, and my business is attached to our house, so I don't have latchkey kids," says gift shop owner Debbie Voight. "For a single mom, what could be more ideal?"

Summerhaven is home to about 50 year-round residents. In summer their numbers swell to maybe 400. It doesn't look like Camelot. Strewn along the road are about 200 motley cabins, four small shops, two inns, two restaurants, a post office, and a one-room school. That's it. Although Summerhaven is developing, it will never compete with Aspen. There are only 240 acres of private land in the village, which is surrounded by the Coronado National Forest.

This suits most of the residents just fine. None of them moved here to get rich. They came because they wanted to simplify their lives, or because they were attracted by the mountain.

"It's a different kind of stress," explains Chris Coppock, her smile radiating cheer. She and husband Steve moved up from Tucson in 1988. Now she's one of Summerhaven's cottage industrialists, running a diminutive retail bakery, shipping her roasted pecans down to stores in the flatlands, and renting cabins to overnight guests. She manages the work load like a juggler. Five minutes left on the oven timer? Enough to dash off to make a bed in one of the cabins. Yet it's not the kind of pressure she used to feel in Tucson. It has something to do

with being a guest herself, in a sense, of the mountain.

"Living here helps put things in perspective," she says. "I feel that what I do is important, but in the grand scheme of things? These trees, these rocks — they'll all be here after I'm gone."

Living on the mountain also seems conducive to developing independence, says Florence Koch. She teaches 15 students, kindergarten through sixth grade, in Zimmerman School's single room. "These kids seem exceptionally creative and free to express themselves," she says. "I've taught classes in other places where, if I gave them an art assignment, they'd be saying, 'I don't know what you want me to do.' That's not the case here. I don't have to draw them a map."

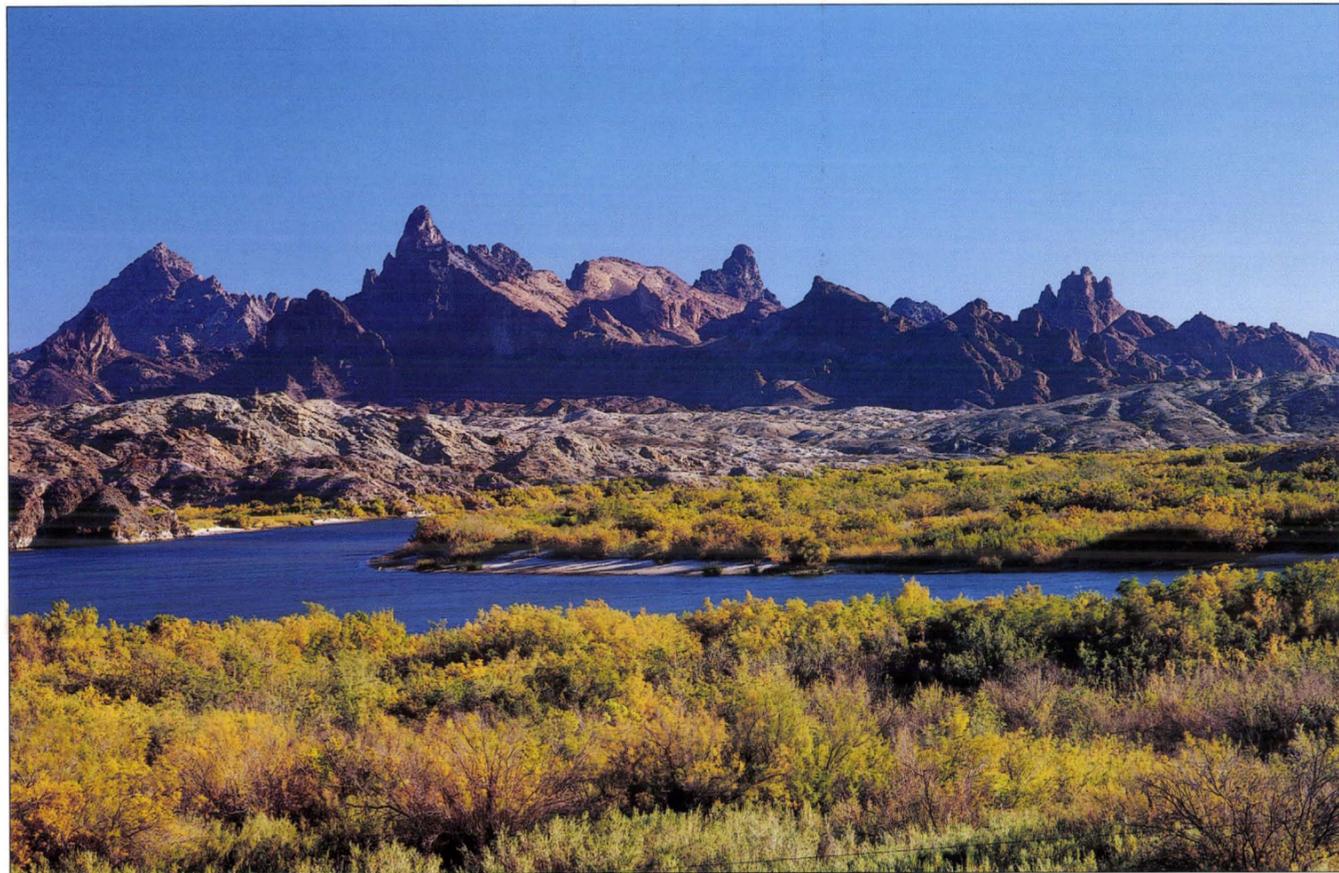
Jerry and Jackie Groch, who bought the Alpine Inn in 1988, add that Summerhaven is a community of fierce individualists. There's some feuding, they say, and newcomers are welcomed slowly. Still, the village's isolation means that its people help each other. "One of our neighbors stopped in on a busy night, saw that we were overloaded, and just started waiting tables," says Jerry Groch. "It's that kind of place."

—L.W.C.

**Author's note:** Accommodations: Alpine Inn, P.O. Box 789, Mount Lemmon, AZ 85619, telephone (602) 576-1500; and Pine Cone Suites, P.O. Box 716, Mount Lemmon, AZ 85619; telephone (602) 576-1542.

Ski information: Mount Lemmon Ski Valley, P.O. Box 612, Mount Lemmon, AZ 85619; ski and road conditions, telephone (602) 576-1400.





*Father Garcés is so well fitted to get along with the Indians...that he appears to be but an Indian himself.... God has created him, as I see it, solely for the purpose of seeking out these unhappy, ignorant and rustic people.*

—Fray Pedro Font (1775)



What distinguishes the Spartan odysseys of Fray Francisco Garcés is that, unlike Spain's other trailblazers in the Southwest, he typically traveled alone on his journeys of discovery. The first assignment of this native of Aragon when he arrived in Sonora in 1768 was to serve at Mission San Xavier del Bac on the Santa Cruz River as the padre of the Pima Indians. Bac, the northernmost of the missions established by Jesuit priests before they were expelled from the New World, would be the starting point of his far-flung excursions into the Sonoran and Mojave deserts.

Two personal attributes enabled Father Garcés to carve out a special niche in the history of the American West. He was a magnificent missionary because he was able to win the trust of the Indians he encountered by attuning himself to their modes of thought and action. He was an exceptional explorer because his fearless

approach to his work enabled him to disdain the usual escort of soldiers and plunge into undiscovered country armed only with "charity and zeal."

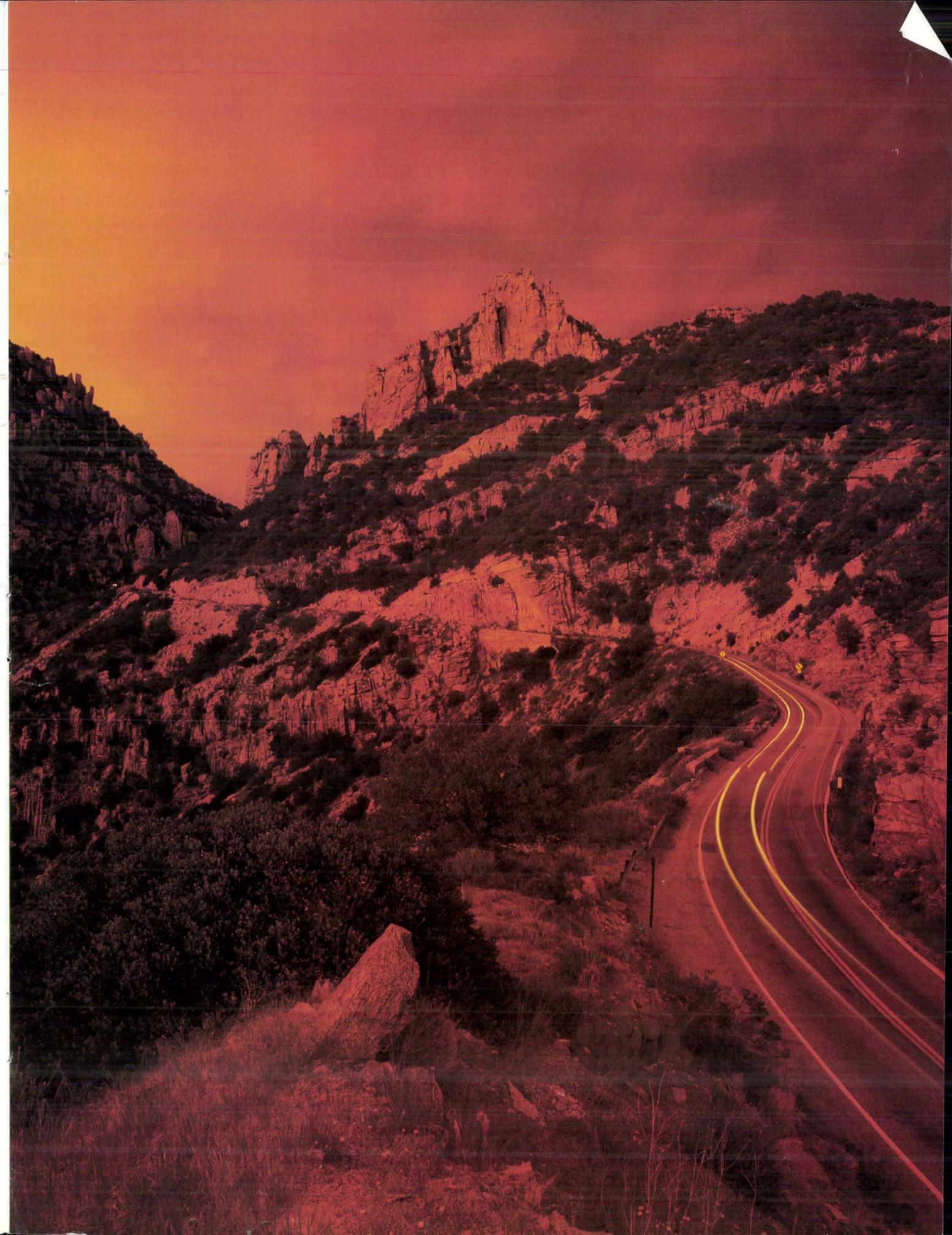
It was very fortunate for Spain that Fray Francisco's ministry coincided with the rule of New Spain's last dynamic viceroy, Antonio Maria de Bucareli. In the 1770s, Bucareli began developing a two-pronged plan to strengthen Spain's presence in California in order to thwart Russian and English intrusions into the northern sector of that province. The viceroy's first priority was to ascertain whether there was a passable overland "road" from Sonora to the California coast. If such a pathway could be found, it would allow him to assemble settlers with livestock on the west coast of Mexico. Soldiers would then escort them across the deserts west of Tucson to the Pacific, then northward up California's inland valleys, where they would establish a community and a fort on the south side of San Francisco Bay.

Bucareli's second strategy involved the discovery of a trail that would link New Mexico with Father Junipero Serra's new mission at Monterey, California, and enable these two provinces to profit from interchange of commerce.

Father Garcés' initial contribution to

Western history was the result of a one-man reconnaissance trip he made in 1771 into the region west of present-day Calexico. This bit of adventure convinced Fray Francisco that travelers could cross the wastelands west of Yuma to the California coast. Thus, when Bucareli ordered Sonora's boldest frontier soldier, Capt. Juan Bautista de Anza, to study the feasibility of such an overland route in the winter of 1774, Anza asked Father Garcés to guide his company into this unmapped region. The location of a path across the desert to the green hills of southern California enabled Anza to march forward to "upper California" and prepare a report for the viceroy recommending that Spain establish a military outpost on the south side of San Francisco Bay. This report set the stage for Spain's last great surge of exploration in the West in 1776.

The epic year of U.S. history is 1776. As every American knows, that watershed date saw the 13 colonies on the Atlantic coast launch a campaign for political independence that led to the creation of the United States of America. But relatively few Americans realize that, because of Viceroy Bucareli's initiatives, 1776 was also a vintage year for Spanish exploration and settlement in an area that would ultimately



For an  
extraordinary  
scenic adventure

# TRY A DRIVE UP MOUNT LEMMON

Text by Lawrence W. Cheek  
Photographs by Edward McCain

Forget the Mount Lemmon Highway. It's a waste of taxpayers' money. Within two decades, highways and automobiles will be as obsolete as horses and mules. Instead of a road, let's build an airport on the highest of Tucson's surrounding mountains. Then we'll buy a fleet of municipal planes. *An air line would bring the cooling breezes and tall pines to within 30 minutes of Congress Street. Summer vacationers could breakfast on top of the range, fly to Tucson for a shopping trip, and be back in the mountains in time for lunch. The poor tired businessman could live at home beneath the pines and be at his office or store for the full eight- or ten-hour shift.*

This was *The Arizona Daily Star's* editorial brainstorm of July 13, 1927, the middle of a long summer in which editors of the rival *Star* and *Tucson Citizen* sat in their sweltering offices dreaming of pine trees and feuding over the proposed road into the forests of 9,157-foot Mount Lemmon. The *Citizen*, which supported the highway, heckled the *Star* and its "air line" while trotting out a daily parade of experts predicting economic disaster without the highway. On July 20, the headline in the *Citizen* warned:

TUCSON DOOMED TO BE 8 MONTH TOWN  
UNLESS MOUNTAIN ROAD BUILT

Voters were unconvinced; they rebuffed \$500,000 bond proposals to build the highway in 1928 and 1930. But the *Citizen's* publisher, Gen. Frank H. Hitchcock, wouldn't give up. In 1933 he heard that the director of the Federal Bureau of Prisons wanted to experiment with employing inmates on highway construction to help "rehabilitate" them. A flurry of meetings ensued, and work began on the highway within three months.

It turned out to be more daunting than anyone had imagined. By the time the 25-mile-

long road reached the ponderosa pines, it had taken 18 years, 8,003 federal prisoners, and nearly \$1 million — even with all that free labor. But the result was a road that, mile for mile, is arguably Arizona's most spectacular — and one that remains controversial even today.

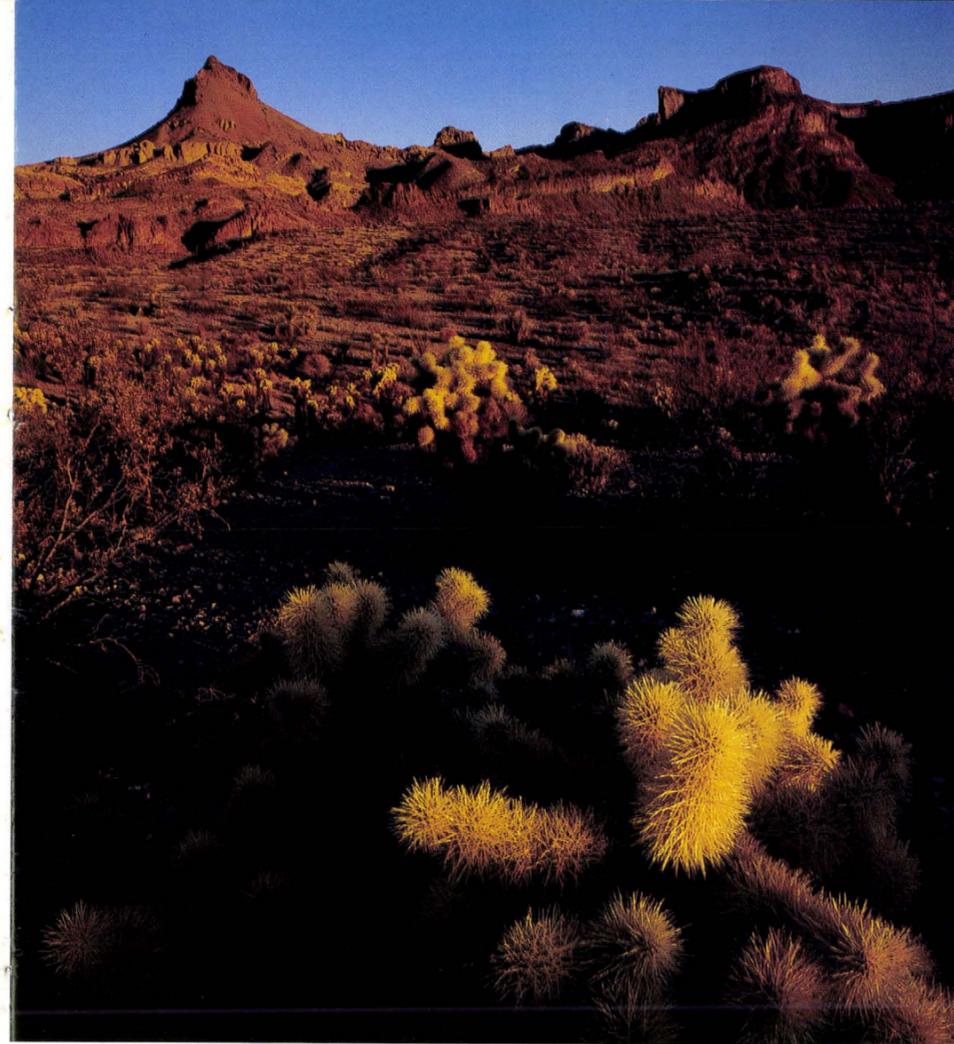
It seems odd, at least judging by today's sensitivities, that no dispute erupted over *how* the highway was being built.

A large number of the inmates were Mexican citizens whose only crime had been crossing the border in search of work. Frequently they were malnourished and had to be fed for a week or two before they were strong enough for construction work. Their usual sentence was 30 days.

The gringo's-eye view, contained in a 1951 U.S. Department of Commerce report, was that the U.S. government did the illegal immigrants a favor. "These Mexicans were very proud of their assignment as skilled operators of equipment," the report said. "They worked hard

*Text continued on page 41*

(RIGHT)  
*Interrupted  
in the midst of  
noonday  
chores, an  
Aberts squirrel  
scrutinizes a  
curious visitor  
to its woodland  
home along the  
Mount Lemmon  
highway  
(OPPOSITE PAGE).*



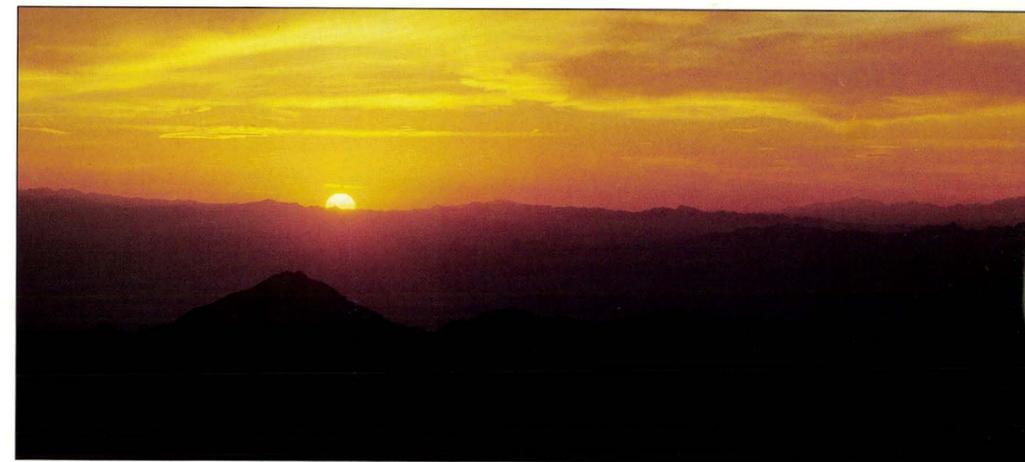
**T**he Needles, near Topock (OPPOSITE PAGE), are a prominent landmark for travelers on the Colorado River. In an effort to find a shorter route to the missions of Junipero Serra in California, Father Garcés, in 1776, rode north along the Colorado to this area. On a later trek to seek out a trail from the Colorado River to the Hopi villages, he passed through the Black Mountains (LEFT). From there he had a spectacular view (BELOW) looking over the valley of the Colorado River west into California.

(FOLLOWING PANEL, PAGES 12 AND 13) *Supai Village*, home of the Havasupai Indians in the Grand Canyon, seems only slightly less remote today, with helicopters and horses to reach it, than when it was visited by Father Garcés in 1776.

become part of the new nation.

The year 1776 saw Captain Anza lay the foundation for the city of San Francisco by leading a company of 240 settlers on a thousand-mile trek from Culiacán to northern California. That same year, pursuant to an order issued by the viceroy, an expedition led by Father Silvestre Escalante left Santa Fe on a history-making search for an overland route to Monterey. Escalante's party ranged northward almost to Wyoming and mapped so many areas in the intermountain region and the Great Basin that Herbert Bolton, the distinguished authority on the history of the Spanish borderlands, proclaimed that Escalante and his men explored "more unknown territory than Daniel Boone, George Rogers Clark, or Lewis and Clark." This was also the year Francisco Garcés brought his work as a discoverer to a climax by locating a "northern trail" that offered a land link, via the Hopi country, to interconnect the missions of northern California with the settlements in Nuevo Mexico.

Father Garcés was the great friend of the Yuma Indians, and when the caravan of the founding families of San Francisco arrived at Tubac in December, 1775, Captain Anza asked him to guide his company down the Santa Cruz and Gila rivers,



and help them safely pass through the Indian country along the Colorado River. With this accomplished, the padre undertook missionary work among the tribes along the river. But Garcés, a free spirit who rarely waited for orders from his superiors, apparently soon decided that if he went upriver he could find a shorter route across the desert to the new missions Father Serra was establishing along the California coast.

Accompanied only by his Indian friend

Sebastian, Garcés mounted his mule on February 14, 1776, and set out on a lonely seven-month trek. He first rode north along the big river to the area of "The Needles," where he persuaded two Mojave Indians to join his tiny expedition. The padre then turned westward, discovered the Mojave River, traversed the Mojave Desert, and penetrated the San Bernardino Mountains to the San Gabriel Mission. The next leg of his journey took him north, and by the end of April he had crossed





was anyone else who started the jojoba industry," she says with some amusement. "If we had been, we'd never have planted jojoba at all."

Farmers have known the basics of growing corn, wheat, and cotton for thousands of years. But Whittaker and other jojoba growers were attempting nothing less than the domestication of a wild plant in fewer than 10 years, instead of 10 to 100 centuries.

"We didn't even know jojoba's water requirements," says Whittaker. "We started on the assumption that it needed less than an acre-foot of water, but now we know it must have three acre-feet per year for optimal growth."

Plantation owners had to experiment with distance between rows and distance between plants. Initially they underestimated the extent to which the shrub would grow when irrigated and had to remove

plants as they grew much larger than their wild relatives.

Harvesting was the growers' biggest headache. Jojoba, a perennial, matures slowly. When plantation harvesting began in 1982, plants were small and Hyder Jojoba used a modified raspberry picking machine, which rode over each row like an inverted letter U, beating the shrubs with metal or plastic wands to loosen the ripe seed.

Soon the plants grew too large for this method, and the company switched to vacuum-like machines combined with blowers. Other growers, such as John Tryon of Desert Farm Management and Dale Van Boening of Western Jojoba, are working on new harvester designs.

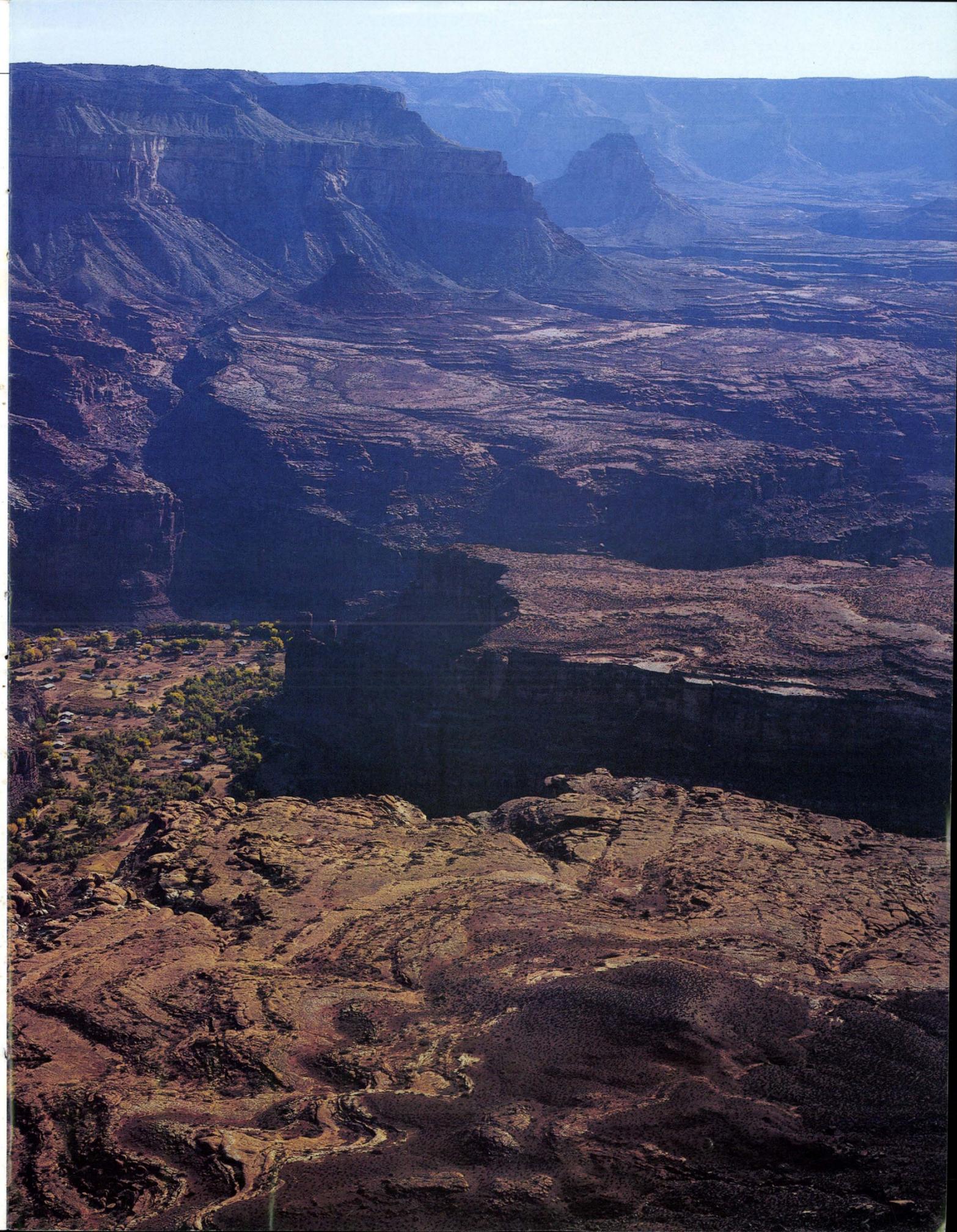
The plantations were more labor- and capital-intensive than anyone ever dreamed. Investors, seeing no return for more years than they cared to contem-

plate, began to drop away. But the "jojoba nuts" hung on despite the problems and new challenges, such as frost and pests.

Because the flower on the female plant is located on the outside edge of the shrub for pollen pick-up, it is susceptible to even mild frost. Growers have been hit hard by frost damage, even in Hyder Valley where frosts are few.

Worse, bugs discovered the concentration of jojoba shrubs on the plantations. Grasshoppers have descended in huge numbers on Hyder Jojoba; Say's stinkbug infiltrated the fields around Tacna; and cutworms, thrips, and loopers have plagued all growers.

Vicki Hubbard, president of Associated Jojoba group and the Jojoba Growers Association, says that insects and cold weather reduced by almost half the 1988-89 crop and further damaged the 1989-90 crop. "We applied for pest registration in



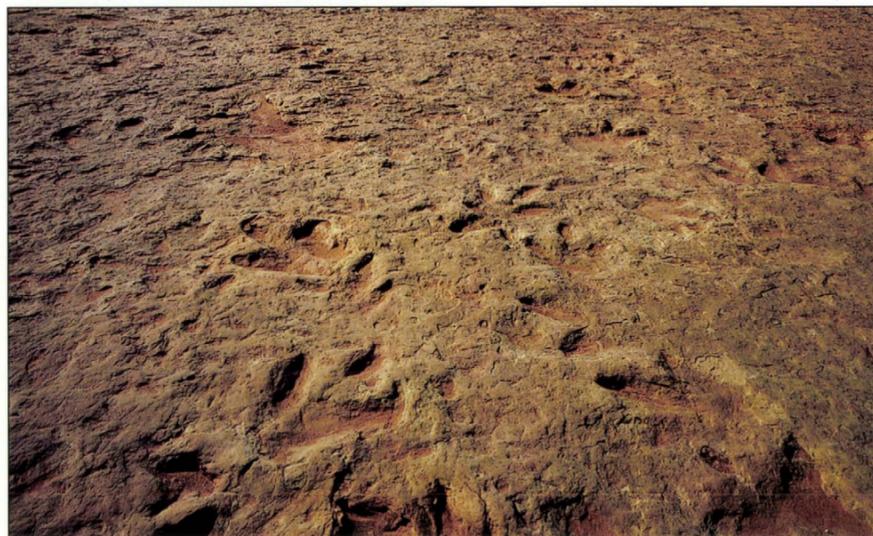


*Padre Garcés' exploratory journey from the Colorado River to Hopi passed near Peach Springs, then struck north to the home of the Havasupai. From there he doubtless rode in a southeasterly direction, avoiding Cataract Creek (LEFT). His trail to Hopi also may have passed the region where dinosaur tracks (BELOW) were later discovered near Tuba City. From this point, the Hopi Mesas lay in an easterly direction, beyond the Moenkopi Plateau, seen in the distance (RIGHT).*

Antelope Valley and the Tehachapi Mountains and had entered the San Joaquin Valley through Tejon Canyon.

When his Indian companions were intimidated by reports that natives to the north might kill them, Father Garcés left them at Tejon and traveled alone for two weeks, exploring the southern reaches of the San Joaquin Valley. Garcés' journal substantiates that he was the first European to discover the Kern and White rivers, the first to explore the foothills of the Sierra Nevada, the first to survey the resources of Kern and Tulare counties—and that he was the European discoverer of the site of the present city of Bakersfield. Armed with insights about the relationship of the Sierra and the Central Valley to the coastlands on the western horizon—insights that confirmed his hunch that a trail linking Santa Fe and Monterey was feasible—Father Garcés rejoined his Indian companions and took a shortcut route back to his Mojave River path to The Needles.

With only a short pause to rest, Francisco Garcés in early June struck out alone into a vast region never seen before by European eyes to seek out a trail from the Colorado River to Oraibi. His first task was to locate a path through the desert spirals and monoliths of the Black



Mountains. Jerry Jacka and I have concluded that the padre and his mule either traveled through Secret Pass Canyon east of Bullhead City or, more likely, wound through Sitgreaves Pass, a route that would later accommodate the Beale Wagon Road in the 1850s and this century's transcontinental automobile road that gained widespread fame as Route 66.

Geographical landmarks and Fray Francisco's journal entries offer additional evidence that after the priest reached the vicinity of Kingman, he probably traveled on the same alignment toward Peach Springs that Arizona's highway engineers staked out 150 years later for Route 66. As he followed this path, Garcés would have studied the forested Hualapai Mountains



United States, Mexico, and a dozen foreign countries, although total acreage is down from 40,000 in 1985-86 to about 15,000 that were managed actively in 1989.

It's safe to say that the promise of jojoba is still that — a promise, and pioneer growers are determined to see the promise through to its fulfillment. To understand where jojoba production is going, one needs to know where it has been.

Although its botanical name is *Simmondsia chinensis*, jojoba (pronounced ho-HO-bah) is not from China but the Sonoran Desert in Arizona, northern Mexico, and Baja California as well as the Colorado Desert in California. A cousin of boxwood, it grows on dry slopes and along washes, from sea level to 4,000 feet. Its leathery gray-green leaves are browsed by deer and livestock; hence its nicknames, deemut and goatnut. Indians of the Southwest occasionally ate the nuts or

ground them to make a coffee-like drink. They used the oil for cooking, dressing leather, and conditioning hair and skin.

Jojoba's male and female flowers grow on separate plants, its pollen is carried by the wind, and it is very sensitive to frost. Its fruit is a capsule with a husk that turns brown as it ripens, giving it the look of an elongated acorn; when the husk shatters, one and sometimes two brown fruits drop to the ground.

In 1925 Boyce Thompson Arboretum Director F. J. Crider began to investigate the use of jojoba to control soil erosion because its taproot can grow to 35 feet. Chemists at the University of Arizona in Tucson looked into the composition of jojoba oil.

They turned up the surprising fact that jojoba "oil," which constitutes 49 to 56 percent of the weight of the nut, is actually a liquid wax. It is unique among vegetable oils because it is very stable and doesn't become rancid even when subjected to high temperatures and pressures.

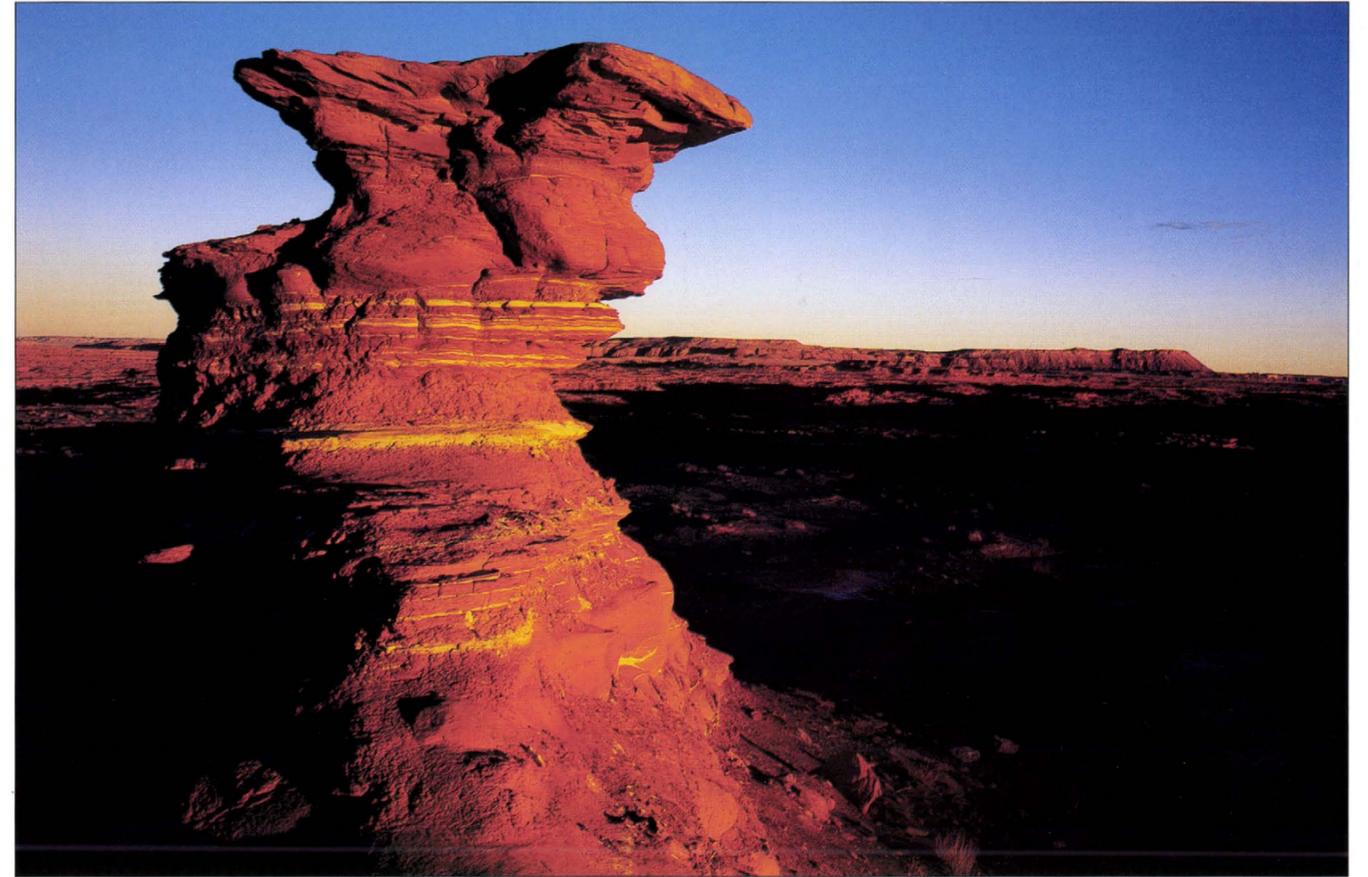
Early in the 1970s, conservationists became interested in the oil because its structure is remarkably like that of sperm whale oil. Jojoba oil might serve as a renewable substitute for sperm whale oil, thus reducing pressure on the endangered species.

In the middle '70s, the Arab oil embargo brought jojoba oil to the attention of industrial chemists, who regarded it as a potential petroleum substitute, or additive. Finally, advocates of alternative agriculture saw jojoba, which survives in the wild with little rainfall and no cultivation, as a crop for arid lands.

With these factors in its favor, jojoba was a prime candidate for investment, and the scramble was on to harvest as much wild jojoba as possible in Mexico and on the bajadas of central Arizona and southern California. Collection wasn't easy because the seed ripens in July and August when desert temperatures often rise above 115° F. Inevitably someone must have thought that "there's an easier way to do this," and the first commercial jojoba plantations were born.

By 1979 commercial plantings of 40 acres or more were in the ground in Arizona and southern California. One such plantation was Hyder Jojoba, Inc., in Hyder, Arizona, which planted its first acres in early 1980 and increased to 1,200 acres by 1987.

Hyder's owner, Carole Ann Whittaker, was a continuing education specialist at the University of California, Los Angeles, until she caught jojoba fever from friends and associates. Remembering those days at the beginning of the decade, Whittaker shakes her head. "I wasn't a farmer, and neither



on his right and the gold-rich Cerbat Hills on his left (a range he named "the Swarthy Mountains") before he passed by the Peacock Mountains and onward up Truxton Wash.

Terrain logic next suggests that Father Garcés and his three Indian companions (Hopis or Hualapais who said they lived in the direction he wanted to go) set a northeasterly course by Fraziers Well that probably paralleled today's Indian Route 18 to the rim of Havasu Canyon—and a panoramic view of the scenic canyon that is the home of the Havasupai Indians. Here, since he had an opportunity to "see yet other peoples and discover new regions," the fray tarried for several days during which, with considerable astonishment, he rode to the rim to view the chasm of the Grand Canyon and perhaps descended into the deep valley to visit the Indians in the village of Supai.

From there he doubtless rode in a southeasterly direction on an existing trade trail used by the Hualapais, the Supais, and the Hopis. Avoiding the abyss created by Cataract Creek, this trail angled across the Coconino Plateau toward Red Butte, which is near U.S. Route 180 south of Tusayan. Here, a few miles from the edge of the South Rim of the Grand Canyon, the

European trailblazing of Father Garcés probably ended. It was in this area that one of Coronado's captains, Garcia Lopez de Cardenas, had ridden with his men in 1540 when he became the first European to view the splendid gorge cut by a great river into the Colorado Plateau.

If we assume that Father Garcés stayed on this prehistoric trail into Hopi country, it is reasonable to surmise that he rode west to the Cameron area, crossed the Little Colorado River, turned north to Moenkopi Springs, then rode his mule southeast across the Moenkopi Plateau, skirting Coal Mine Canyon, and to old Oraibi. An entry in Fray Francisco's diary reveals he was at Oraibi on the then-meaningless date of July 4, 1776, but the Hopis were inhospitable and ushered him on his way with the admonition, "Get thee gone without delay . . . back to thy land."

On his return trip, Fray Francisco ministered to his Indian brothers as he retraced his steps to The Needles, to Yuma, and back to his home base at San Xavier del Bac. And he surely wondered whether the new road he had pioneered would, in time, open new fields for harvesting Indian converts and help his country strengthen its California colonies.

The story of Father Garcés has a tragic

ending, for he was a Franciscan marked for martyrdom. In 1781, blunders by Spanish officials inflamed the Yuma Indians and provoked a rebellion that led to the killing of Garcés and the other priests in that area. We have an eyewitness account of this massacre that informs us about the last hours in the life of Father Garcés. The report tells us that Fray Francisco's faith in his Indian brothers never wavered, and that just before his death he delivered a rebuke to a fellow Spaniard who wanted to assign blame for the uprising.

"Let us forget now whose fault it is," the good man said, "and simply consider it God's punishment for our sins." ❧

*Stewart Udall, served as Secretary of the Interior from 1961 to 1969. He is author of The Quiet Crisis, Agenda for Tomorrow, and, with photographer Jerry Jacka, of To the Inland Empire: Coronado and Our Spanish Legacy. Jacka, a frequent contributor to Arizona Highways and expert in contemporary native American art, collaborated with writer Lois Jacka to produce Beyond Tradition: Contemporary Indian Art, and Its Evolution and an accompanying videocassette. Udall and Jacka have written about the Spanish exploration of the Southwest in April 1984, January 1988, and October 1988 issues of Arizona Highways.*



(PREVIOUS PANEL, PAGES 32 AND 33) *Jojoba seed close-up. When the husk turns brown, it shatters, dropping one or two brown fruits. The oil derived from the fruit is used by cosmetic and lubricant manufacturers.*

(ABOVE) *Jojoba bushes flourish at a 3,000-foot elevation near Four Peaks northeast of Phoenix. The future of jojoba grown on plantations depends on breeding in frost and pest resistance, plus improving the plant's shape and oil content.*

(RIGHT) *Modern-day jojoba plantation at Hyder, Arizona. In early 1980, farmers knew very little about growing this native of the Sonoran and Colorado deserts, or what its water needs were. Harvesting, too, proved to be a headache. But die-hard growers continued to meet the challenges.*



Kids with special needs enjoy a week at

# CAMP

# SUNRISE

Camp Sunrise at the R-C Scout Ranch east of Payson is, to the casual observer, just one more summer camp where kids have fun in the rugged mountains of Arizona. It has the requisite swimming hole, archery range, slightly frazzled but still good-humored counselors, and more than its share of rowdy campers.

Muddy shoes line the porch of the dining hall, and the July day is a hot one, even in Payson. It's mid-week, and the campers look like they've been away from civilization (read "home") for at least a month. Their clothes don't match (they did on Sunday when they arrived), and they're embellished with odd trinkets they've made in camp classes.

Camp Sunrise, it seems, is indeed a typical summer camp.

But listen closely to the dining hall chatter:

"I brought a pink dress to wear to the dance Friday night. Mom said I should wear my wig, too, but it's hot. I wonder if I'm the first bald-headed person to wear a pink dress to a dance?"

"Who cares?"

"Are we going rappelling again? Good. I was puking the first time and missed it."

"Go ahead. Bite me, you stupid mosquito. You'll get a mouthful of chemo, and that'll make you sorry you picked on me."

"Javier gave us a scare last night. He danced too hard and hyperventilated a bit. He's just been diagnosed, and he doesn't realize cancer slows you down."

"It didn't slow *me* down."

"Did too."

"Did not."

"I hate this macaroni junk. I want another cookie."

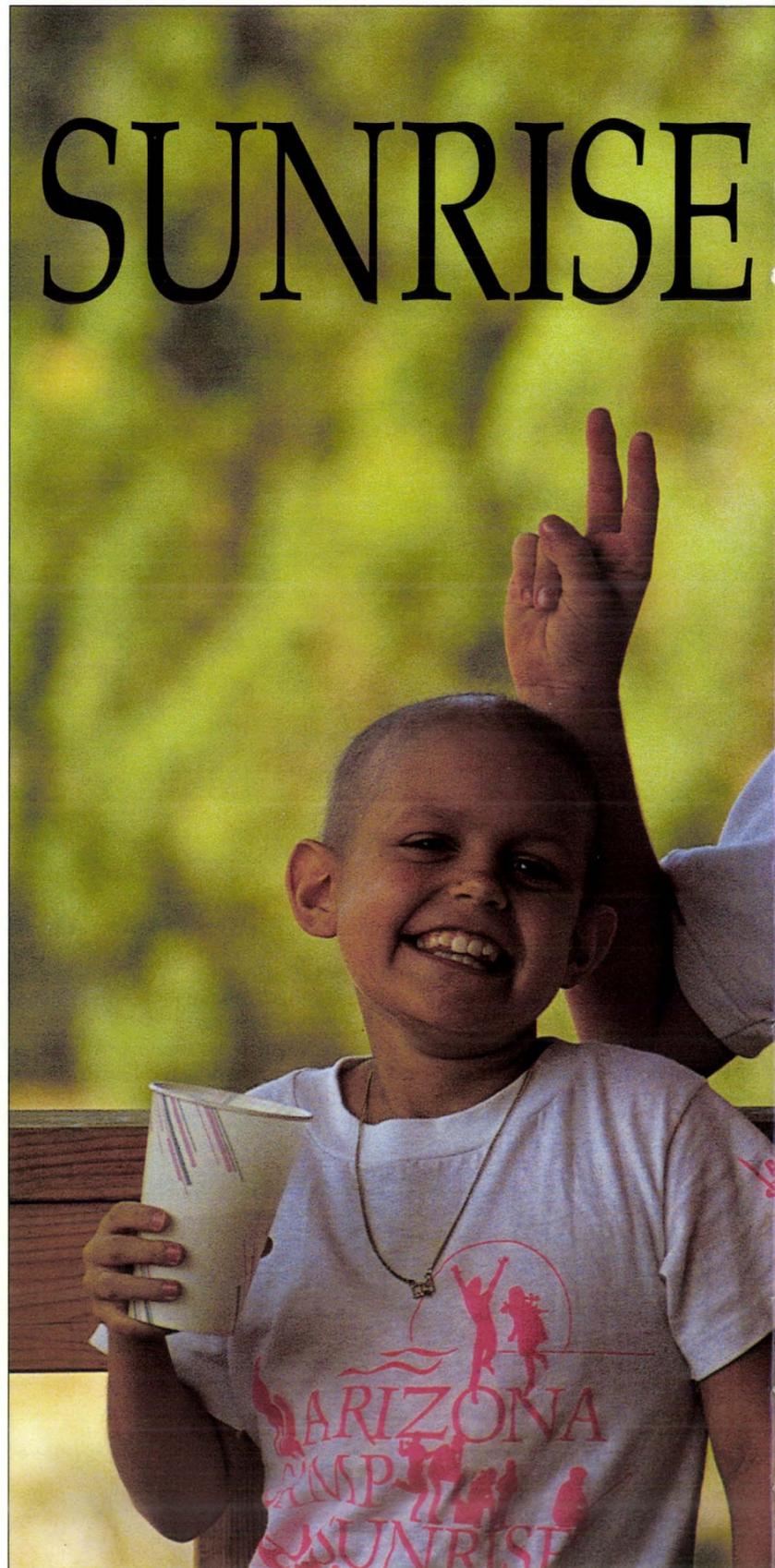
"I miss my mama. She makes good macaroni."

"What do you know? You were only four when you were diagnosed."

Five minutes of lunchtime conversation shows these aren't ordinary campers and Camp Sunrise is no ordinary summer camp. The campers have cancer, and Camp Sunrise offers them a week of being a regular kid—not "The Kid with Cancer."

"I don't like being the only kid at school who gets chemo [therapy] because that means I'm the only fifth-grader without hair," says a 10-year-old,

*The "Boy Busters," as they are known affectionately, inhabit one cabin at Camp Sunrise. From left, Jill Busby, Brandi Balwinski, Stacey Orendorff, and Christel Eiber wear devilish smiles with their "borns."*



TEXT BY TRUDY THOMPS

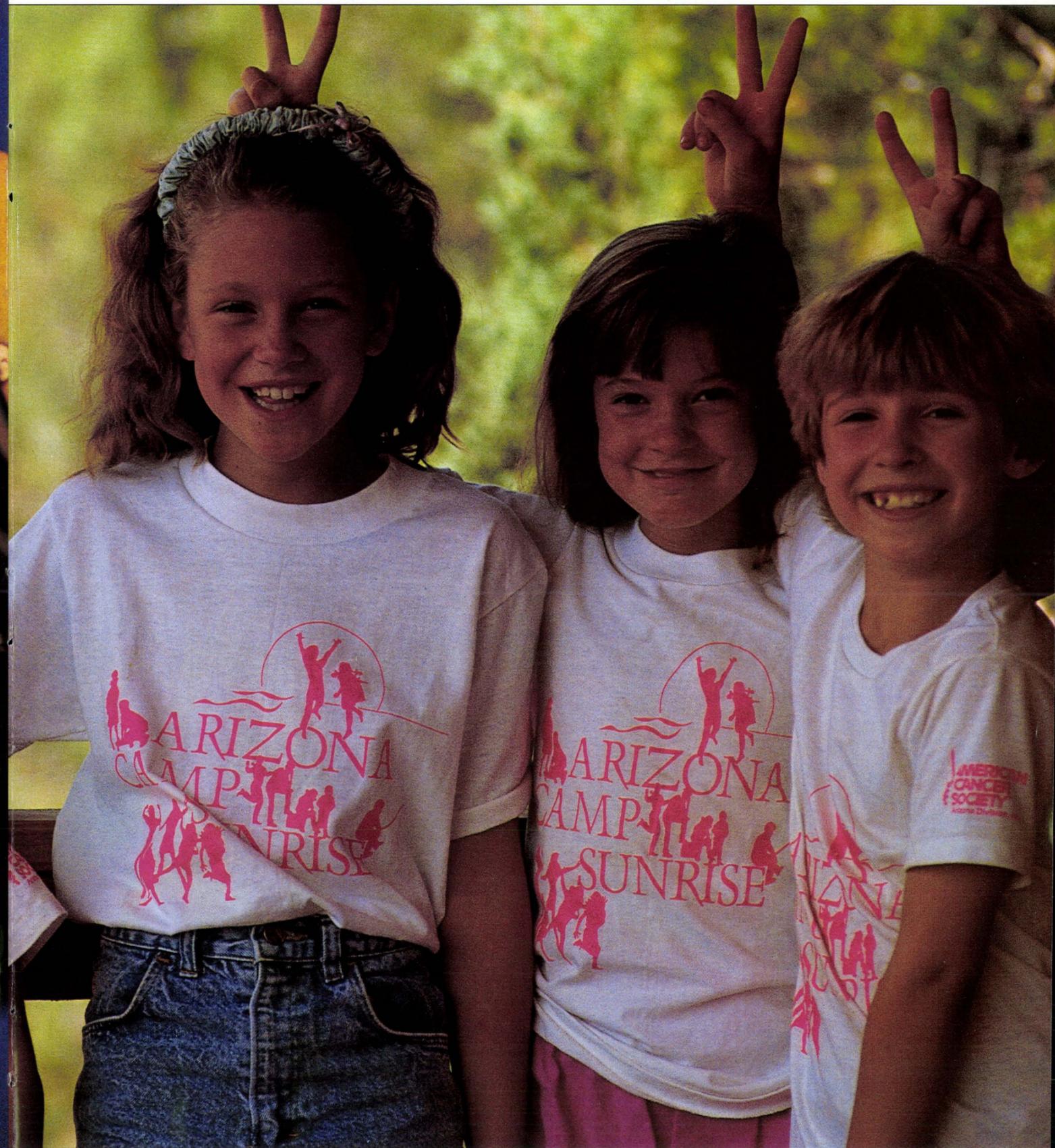
# WHATEVER HAPPENED TO JOJOBA?

It was 1980, and jojoba was the darling of the venture capital crowd. Enthusiasts were succumbing to jojoba fever as if to a new virus. Professional people were leaving lucrative jobs to become jojoba farmers. Jojoba crusaders were trumpeting a grand scheme to save the sperm whale, render desert lands productive, conserve water and oil, revolutionize the cosmetics and lubricants industries, and (perhaps incidentally) make a whopping profit in the bargain. "Jojoba" was engraved in large letters across shampoo bottles, signaling the importance of this new ingredient, and The Bean was King.

Ten years later, farmers, investors, and shampoo users are catching their collective breath, looking around, and asking, "Whatever happened to jojoba?"

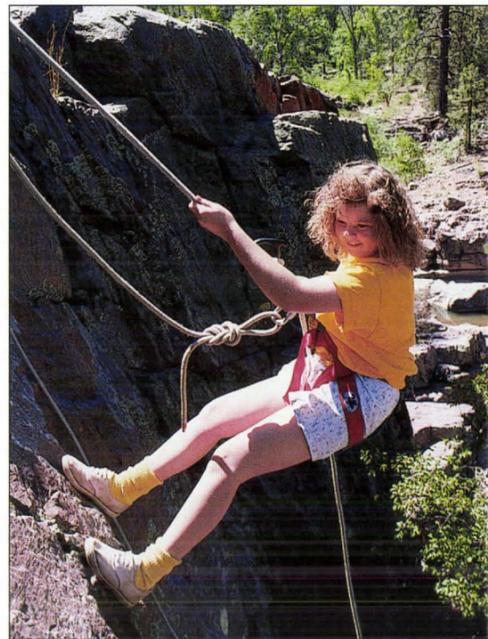
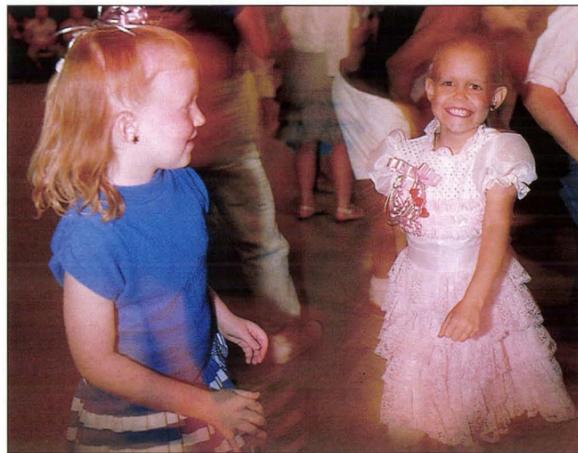
The jojoba shrub and its oily brown nut are still being grown on plantations in the southwestern

TEXT BY JAN BARSTAD  
PHOTOGRAPHS BY RON BARSTAD



ON RICE ☼ PHOTOGRAPHS BY KEN AKERS

(RIGHT) Michelle Rogers and Jill Busby enjoy an opportunity to socialize at the Camp Sunrise dance. Monica Reed (FAR RIGHT) shows no fear as she rappels the rock walls of a box canyon above Christopher Creek. Under a full moon (OPPOSITE PAGE), storytelling and sing-alongs provide memorable moments around a campfire.



sculpturing a huge sandwich. "Other kids make fun, and my teachers get real nervous. Then my brother gets mad and gets in fights. It makes my dad sad. Here at camp, everybody understands. We can talk about cancer or we can forget about it.

"Cancer is no big deal here because everybody has it. Even most of the counselors have it. So they don't get real nervous about it."

He's right. Nobody gets nervous about cancer at Camp Sunrise. The campers, ages seven to eighteen, all have the disease, and many of their counselors, all of them volunteers, have had it too.

Camp Sunrise was started in June, 1983, with 23 young cancer survivors. They didn't know it, but they were pioneering one of the first oncology camps in the country, recalls Ann Wheat, manager of Childhood Cancer Services for the Arizona Division of the American Cancer Society. "Children with cancer need a place where they can be regular kids, where their cancer is incidental to what's going on. That's why we started Camp Sunrise."

Wheat and her campers, counselors, nurses, and doctors have been pioneering ever since. They helped launch an unlikely project—a book about the humor of kids with cancer—when they shared their experiences with Phoenix humorist Erma Bombeck. The book, *I Want to Grow Hair, I Want to Grow Up, I Want to Go to Boise: Children Surviving Cancer*, was released in October, 1989, by Harper and Row. The title came from a letter written by a child in Seattle who was asked to make three wishes, says Bombeck. She adds, "Clearly there's something going on in Boise that I don't know about."

The book got its start when Wheat called Bombeck and invited her to lunch to discuss writing about the humor expressed by children who have cancer. What made her call Bombeck, a nationally syndicated columnist whom she had never

met? "I just thought she'd be interested in the kids and their humor," Wheat says. "Being around the kids had convinced me that they have a special humor all their own . . . one that the rest of the world would enjoy and appreciate."

Bombeck, though reluctant at first, agreed to meet the Camp Sunrise kids and possibly write a brochure. But the children at Camp Sunrise convinced her that, indeed, their humor and insight were something special. The brochure quickly grew into a book—one that is based on interviews and correspondence with children from across the nation who have cancer. Bombeck says, "This is not my book—it's theirs."

Bombeck and her husband, Bill, have donated the book's royalties to help fund research programs of the American Cancer Society, and they have sponsored one of the new cabins at Camp Sunrise.

The cabins aren't fancy, but Wheat calls them "pure luxury." In those early years of Camp Sunrise, she and her band of campers, counselors, and nurses were housed in tents. For the first five summers, they "roughed it" without benefit of a permanent camp home. Even the ebullient Wheat admits, "That was a challenge." But she adds: "We had our share of fun and found out that camp was a much-needed break for kids and for their families."

In 1985 the camp was held for the first time at the R-C Scout Ranch. The ranch has hosted thousands of scouts and leaders since 1944, when it was first leased from the U.S. Forest Service (it was part of Tonto National Forest). The property, which has since been acquired through a negotiated land swap, sits on 75 acres of meadows and forests. Christopher Creek meanders through the property, and a little box canyon creates a swimming hole.

After two summers at R-C, cancer society leaders approached the Boy Scouts about the possibility of a long-term use

agreement as well as about making some improvements. Facilities at the ranch were primitive and, although campers don't need or want "sissified" quarters, experienced cancer society workers knew that campers with cancer sometimes need more than a tent and a pit toilet.

On Christmas Eve, 1987, the cancer society and the Boy Scouts of America signed an agreement that called for the improvements and provided a home for Camp Sunrise for at least 15 years.

Fund-raising began, and the American Cancer Society collected \$60,000 for two sleeping cabins and an upgraded water system that campers began using in June, 1988. The Theodore Roosevelt Council of the Boy Scouts of America obtained a grant of \$350,000 from the Anne N. Forsman Foundation for construction of a 130-seat dining hall and a new shower and rest room facility. Then the cancer society raised another \$50,000 to construct two additional cabins. The dining hall, additional cabins, and other new facilities were dedicated in July, 1989.

That summer, the Bombeck Cabin was among the new structures dedicated in ceremonies on Parents' Day. The cabin had been home all week to the "Boy Busters," a lively gang of little girls whose squeals alerted all of Payson when a male of any age came within 100 feet of the cabin. The Boy Busters, however, did make an exception (only after a whispered conference with their counselor) and allowed Bill Bombeck to stand on the porch long enough to have his picture taken with themselves and Erma.

The new buildings, says Wheat, will

(BELOW) Sunrise near Glen Canyon silhouettes Tower Butte and Navajo Mountain. (LEFT) In the vicinity of Glen Canyon, a stream flowing toward Lake Powell forms a waterfall beneath a tapestry of desert varnish on red sandstone cliffs.



Continued from page 22  
in deep twilight even at noon in midsummer.

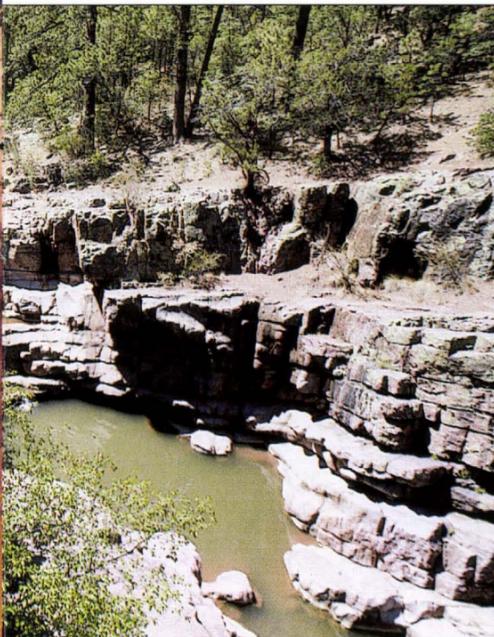
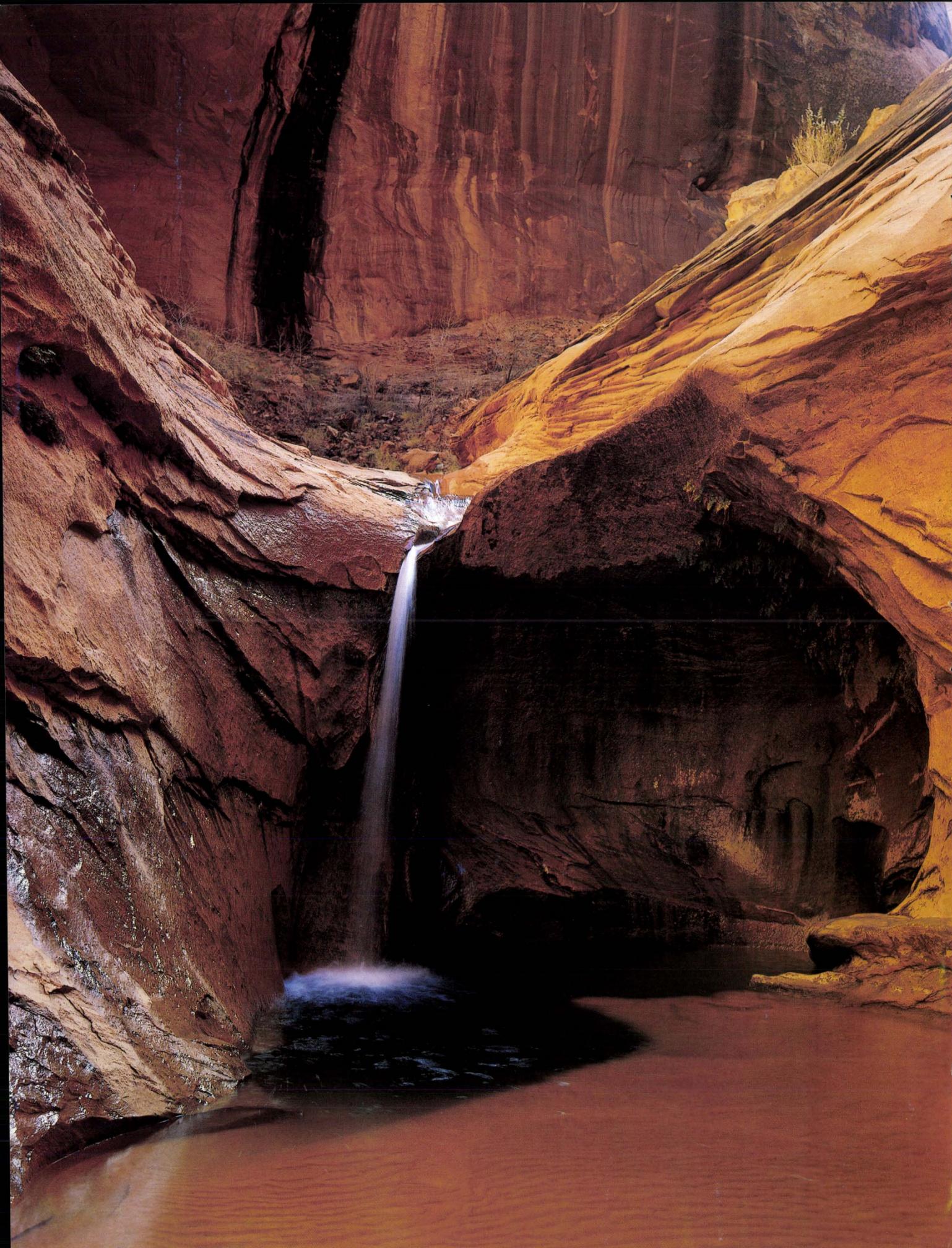
The canyons resonate with pattern. Cracks and curls are born and grow old in a mud-bottomed pothole. An undulating sculptured wall suggests the fluid form of rushing water. Maidenhair ferns and scarlet monkey flowers follow seep lines, and boulders with green and orange skins of lichen doze in ranks. Canyon

time pulses to the rhythms of flood and drought, windstorm and hush, withering heat and stark cold.

To those who explore them, the shadowy canyons, the darkened corridors, and twisting passages offer seclusion, refreshment, and delight.

—Gary Ladd

Gary Ladd will lead a limited group of photo enthusiasts on a tour of Monument Valley October 19 to 21. For more information, telephone 271-5904.



make Camp Sunrise available to more children and their families. The summer camping program is one of several free programs available through the cancer society to children with malignancies. Campers' siblings, often affected by the stress of cancer in the family, convene for their own "Sidekicks" camp every summer after Camp Sunrise. Campers and their families hold a reunion every January prior to a hot-air balloon race that is conducted in their honor. Families and campers stay in touch throughout the year through the "grapevine," says Wheat.

Camp Sunrise, like other activities the cancer society offers children and their families, is an all-volunteer operation that depends on donated materials and services. Many of the volunteers spend their vacations at Sunrise, riding herd on campers and sharing such skills as how to catch a fish, how to bake a treat in a solar oven or hit a bullseye with an arrow.

Melissa Tang, a Phoenix computer programmer, is a veteran of Camp Sunrise and is Wheat's "right hand" in planning—and running—the camp. Tang, known as "M" by her charges, says she can't imagine a summer without Camp Sunrise. "It's just part of what I do. I couldn't spend my vacation anywhere else."

Sending any child away for the first time to summer camp can be traumatic, but parents of Camp Sunrise kids say it's a special challenge to them. Monica Reed of Springerville was only seven years old when she attended her first Camp Sunrise several years ago. Her dad, Marshall, says, "Turning her loose that first time was almost more than I could do. She's my lit-



tle buddy, and we'd just learned she had cancer. It was so hard to leave her . . . but now it's a little easier because we know how much Camp Sunrise means to her."

So what do kids with cancer do at summer camp? The same things every other child does. They ride horses, fish, cook, swim, hike, scare each other with after-dark stories, sing songs, and make new friends. They eat food they wouldn't touch

at home, plot against their counselors, and brag about their big brothers. They do some occasional whining (who doesn't), develop what they're sure are lifetime crushes on their counselors, get mad at their buddies, and laugh after lights-out at even the dumbest jokes. (If April showers bring May flowers, what do May flowers bring? Pilgrims.)

They're homesick one minute and



they're having a grand time the next. They write poignant poems about friends who aren't at Camp Sunrise this year because they've lost their battle with cancer, and they tell funny stories about how they entertain classmates by ripping off their wigs at opportune moments.

While hiking, the littlest girls make a list of "things to do to get kids to like you" for their counselor, who will someday be a doctor. "Don't wear a lab coat. Wear little stuffed animals on your stethoscope and keep your stethoscope inside your clothes to keep it warm. It doesn't matter where you keep the animal because he'll be warm anyway. Give your patients candy, and ask them about school, not about how they feel."

A pretty 15-year-old gets all dressed up for the Friday night dance and develops a

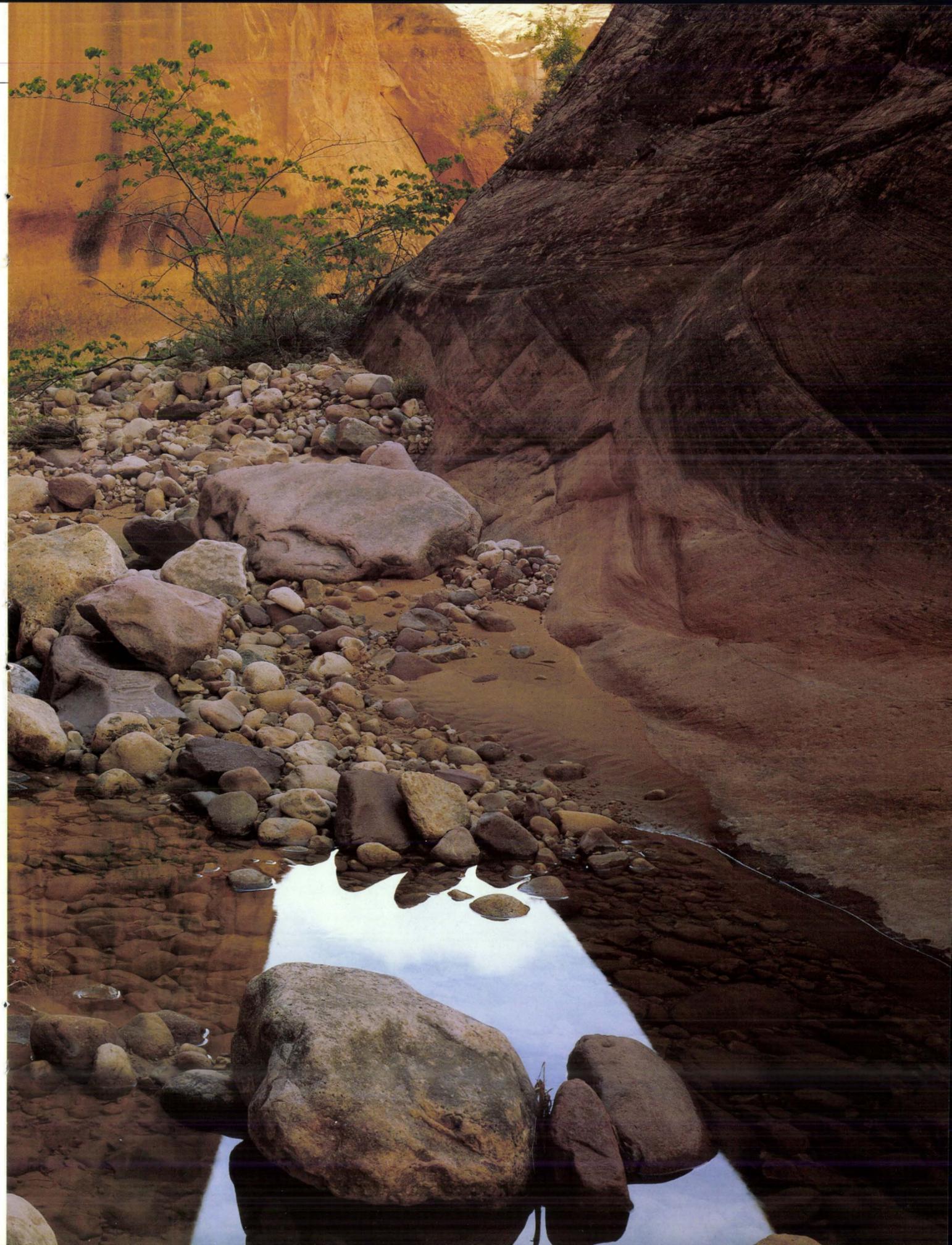
nosebleed. It's her fourth one today and she says, with a trembling lip, that she feels like crying. But she doesn't. She's resting under the watchful eye of the volunteer nurses and physician in the Med Shed. Her friends are sympathetic but matter-of-fact. "Lie down and rest. We'll stay with you until it stops." They do.

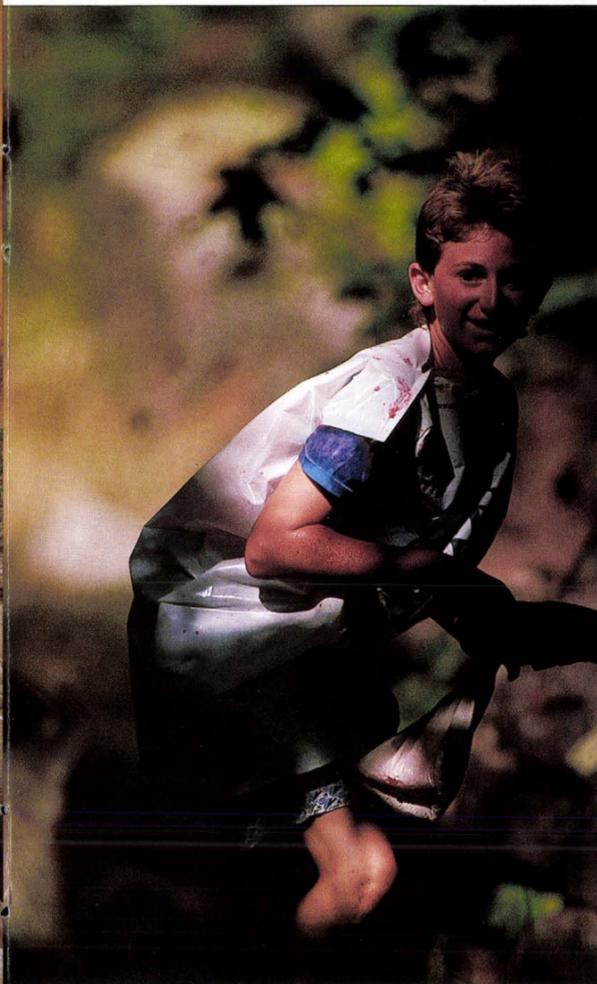
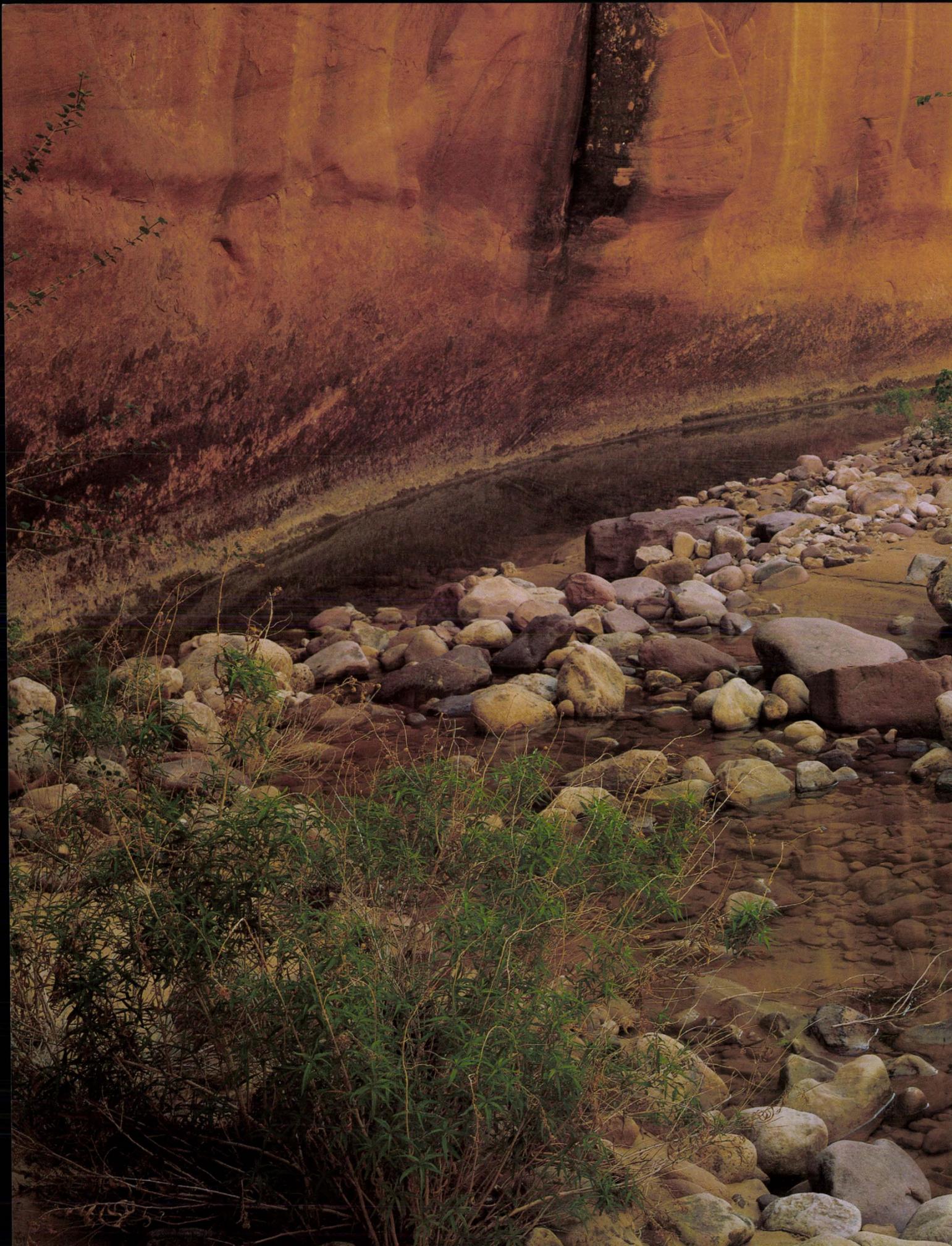
All the campers know where the Med Shed is and know when they're supposed to be there. A trip to the Shed is as much a part of camp routine as a trip to the dining hall, camp counselors say. Nurses and a physician, all skilled in caring for children with cancer, donate their time to the camp. Sue Tomlinson, R.N., has been a Camp Sunrise nurse for "years." She explains how she keeps up with busy campers who have complicated medical histories: "Every camper has a medical

chart so we know his or her condition and treatment. The kids are very knowledgeable about their own situations, and they know what needs to be done."

Besides caring for campers' cancer-related problems, Med Shed nurses treat the usual summer camp ailments—tummy aches, blisters, and sunburn. "They have their share of garden-variety bumps and scrapes," Tomlinson says. "We treat it all."

Every camper's medications are kept in the Med Shed and dispensed by nurses. Painkillers, antibiotics, and chemotherapeutic agents are part of these campers' gear. Many of the children have "lines," lingo for tubing that has been surgically tunneled under the skin of the chest and threaded into the vein that leads to the heart. These lines provide the path for chemotherapy.





(OPPOSITE PAGE) Sporting armor of plastic garbage bags, counselors and campers engage in the Great Jell-O War.

(LEFT) Sol Meltzer waits for his chance to plaster the "enemy" with a fistful of Jell-O.

(ABOVE) The war over, John Bush displays the remnants of doing battle with the slippery ammunition.

As the 10-year-old said, nobody gets nervous about this kind of thing at Camp Sunrise. In fact, it's routine. For example, little Jesus danced too hard on Friday night, and his line had to be retaped by his dancing partner—one of the nurses.

Progress in helping children like Jesus overcome cancer has been steady, and today substantially more than half those children afflicted can look forward to recovery. According to the National Cancer Institute, the percentage of children living at least five years after a diagnosis of cancer is now 63 percent—up from 24 percent in 1950. Where once the major focus of attention was on terminal care, it now is shifting to "survivor issues," such as family and peer support.

One of the highlights of the week at Camp Sunrise is the Great Jell-O War. Ammunition is gallons of Jell-O that has been sliced into cubes. Campers and counselors are divided into teams, and soon each team captain begins howling about the other guy getting an unfair advantage due to assorted underhanded tactics. The charges are unsubstantiated (but rumors

are flying about extra Jell-O being smuggled in). The team captains assemble their teams—crews of big kids and little kids, some wearing garbage bag ponchos as armor—for a strategy session. Lookouts are posted lest any spies sneak in and hear the strategy.

The biggest kids eagerly accept the "special forces" assignment: they'll be the offensive wedge that will probably get plastered with Jell-O. The little kids will be right behind them as they try to overpower the other team and steal their "pot of gold," which is really orange Jell-O. It sounds simple. The big kids in the wedge will get creamed, but the little kids will press on under their cover, and the Great Jell-O War will be nothing but a skirmish. And, as one overconfident team captain predicts, "It'll be over before the other guys know what hit 'em."

While it's clear that the team tastes victory, some of the younger infantry are beginning to taste their ammunition. The team captain knows he's in trouble and elects to launch the first attack while his team still has ammunition.

A half hour later, both teams are covered in Jell-O. Innocent bystanders are covered in Jell-O. There's confusion about who actually won. Accusations are still flying, and so is an occasional cube of Jell-O.

Ev Griffin, the R-C Scout Ranch's resident caretaker, has promised the warriors that he'll hose them down with a fire hose. Some of the stickier kids say that's the best part of the deal. Griffin, who's a well-known figure around the camp (he camped there as a Scout, brought campers there as a counselor, and now lives on the property year-round), wields the fire hose with the experienced touch of a man who knows these kids. He knows who can stand the extra blast that they're all begging for—and he knows who can't.

"Camp Sunrise is the highlight of my summer," he says. "A lot of these campers come back year after year, and they ask me the first day if I'll wash 'em down with my fire hose again after the Jell-O War. I don't think they know I look forward to it as much as they do."

How could anybody possibly look forward to spending a week with children who have cancer? "If you don't know, you ought to do it, and find out for yourself," says Griffin. "It's not something I can explain."

For more information about the American Cancer Society's services for children with cancer, call 1-800-227-2345. ■

*Trudy Thompson Rice is a registered nurse and free-lance writer specializing in health topics. Award-winning photojournalist Ken Akers, who lives in Phoenix, is a frequent contributor to Arizona Highways.*

CANYON  
COUNTRY

# Images and Impressions

Portfolio by Gary Ladd

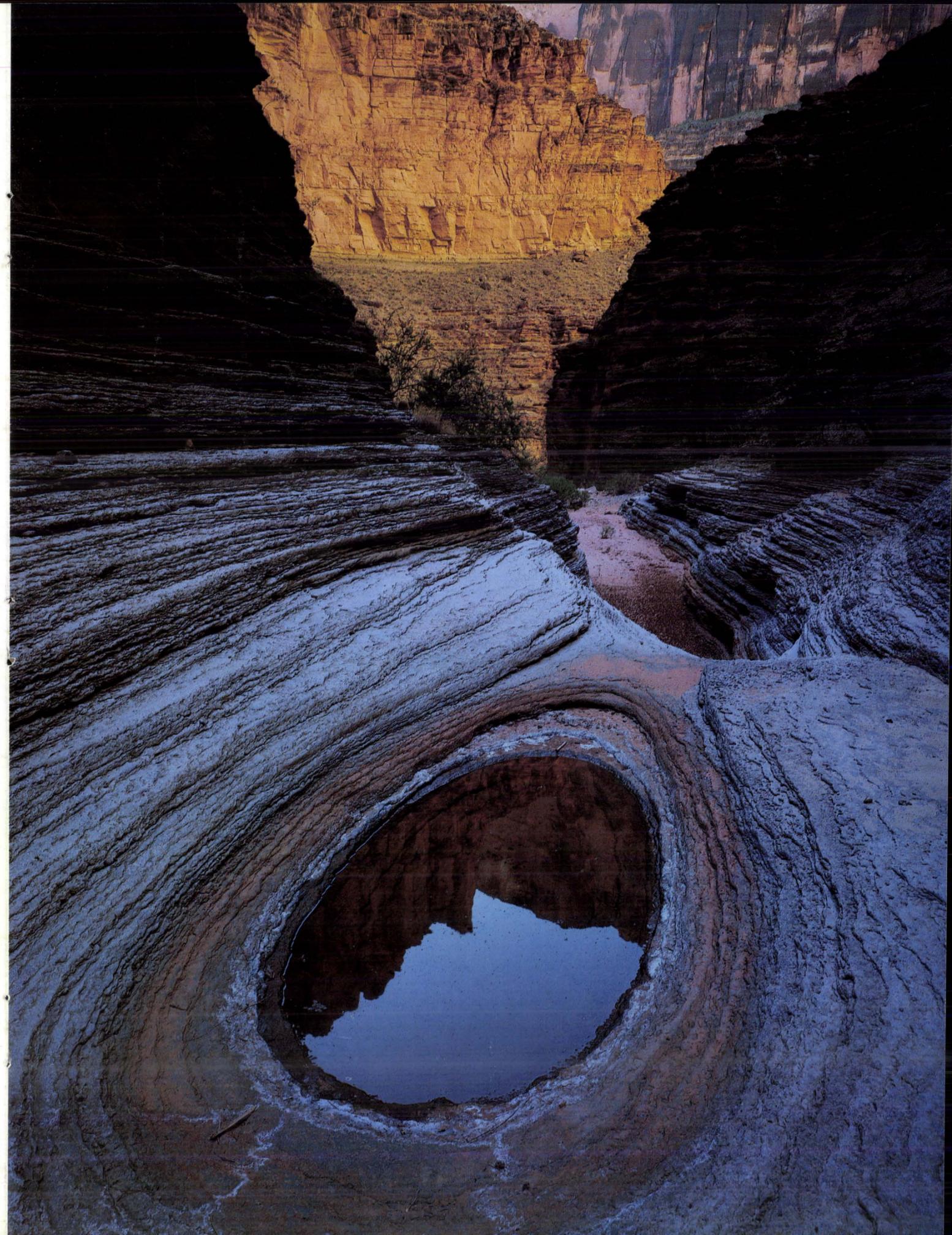
**T**he landscape of the Colorado Plateau is secretive. The intense emptiness of the desert stretches to sharp-edged horizons, and plateaus rise in grand stratigraphic steps. But concealed among the mesas is a maze of intriguing hidden canyons.

The most inconspicuous features of the plateau, yet perhaps its greatest treasures, these canyons—slots, cracks, joints, chutes, and rockbound corridors—are tranquil havens. Tiny streams meander from cliff to cliff, and quiet pools mirror sky and rock. Amphitheaters echo the voices of the water. Here, slender fingers of desert varnish reach down sheer walls from the parched world above to touch the soothing waters of the inner realms.

Some canyons are so deep and narrow, their walls so convoluted, that they are skyless. Sunlight never penetrates, and the bottom stays

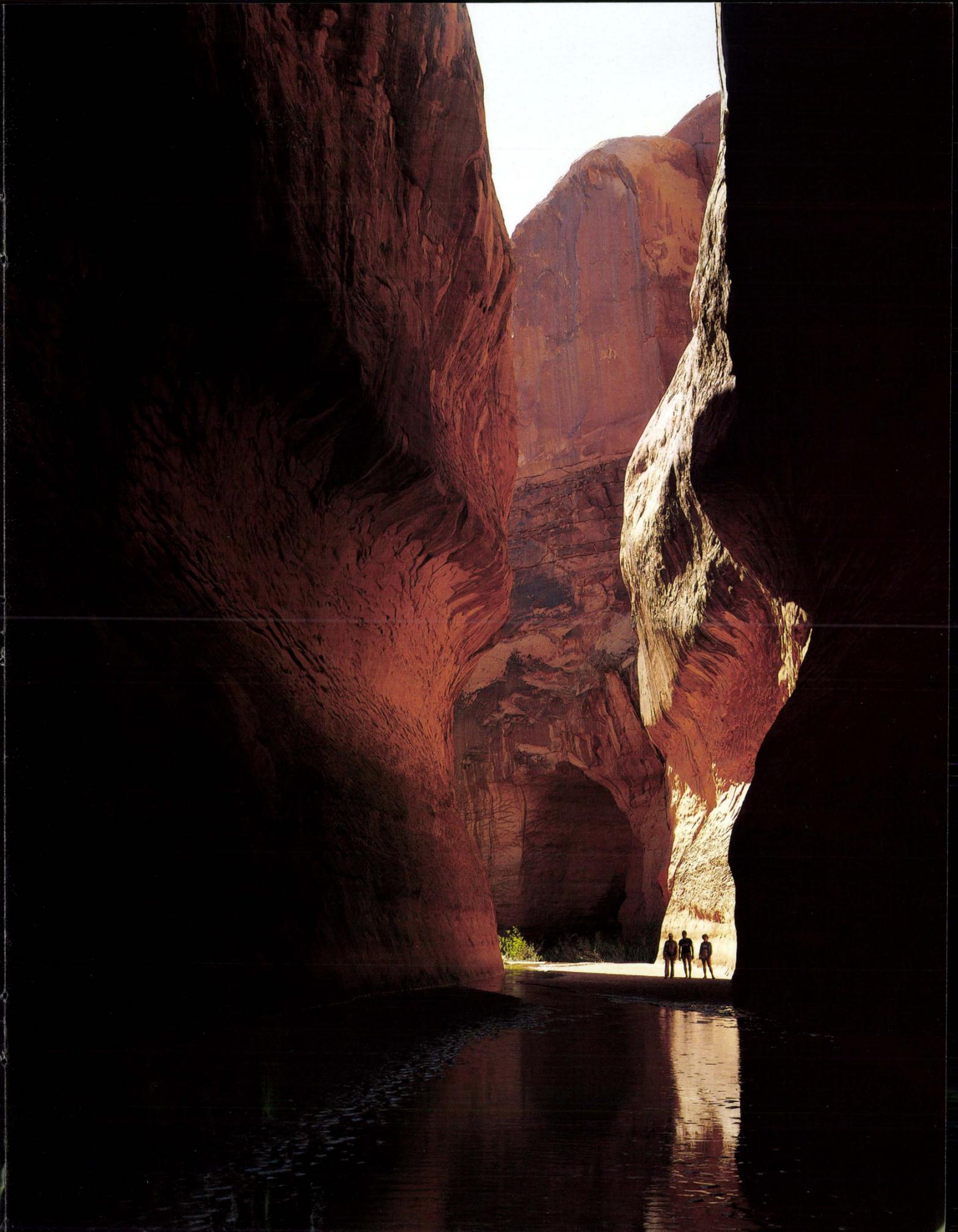
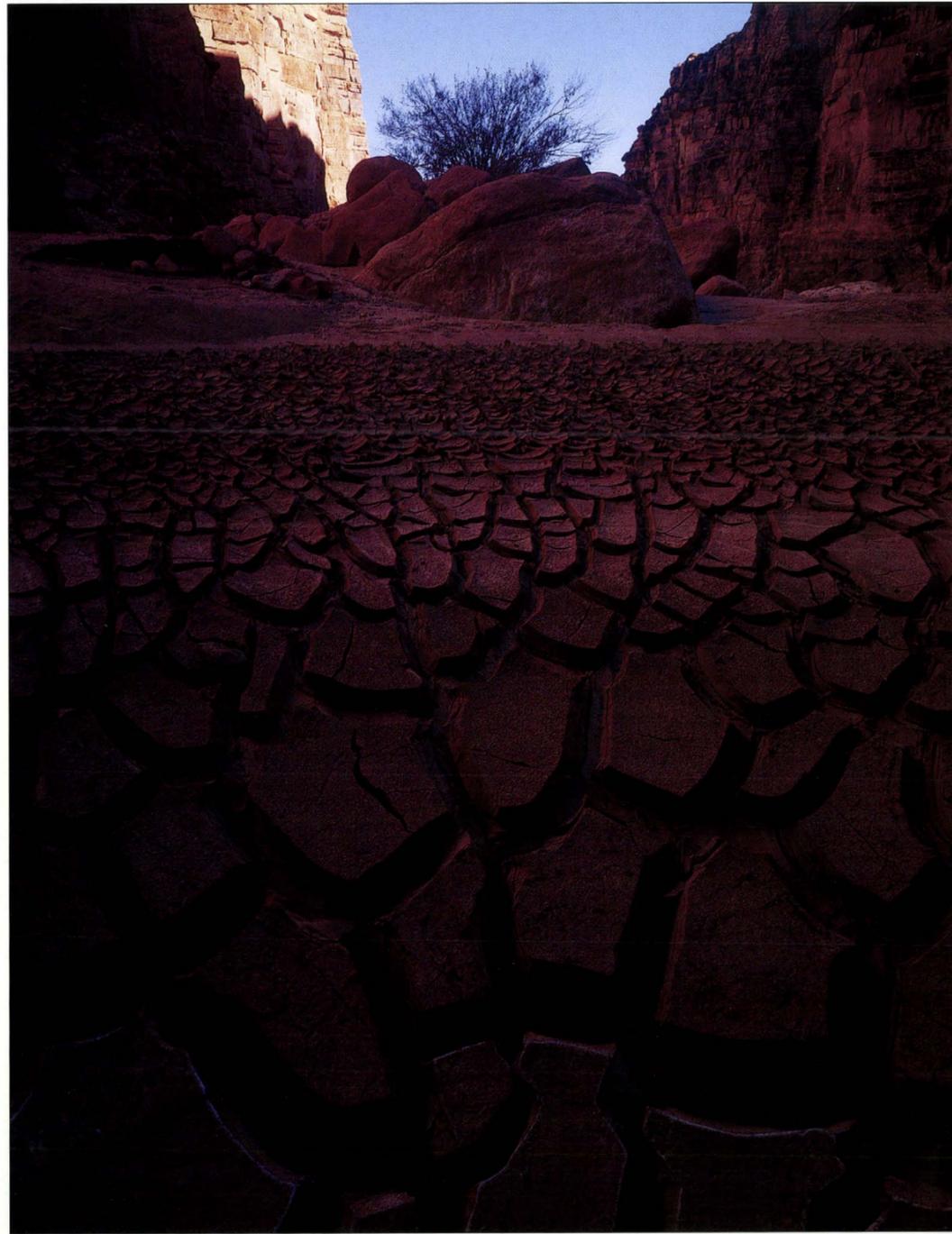
*Text continued on page 31*

(RIGHT)  
*Afternoon light illuminates a deep canyon near Navajo Mountain on the Navajo reservation south of the Glen Canyon National Recreation Area.*



(PRECEDING PANEL) *A stormy sunset near Page, Arizona, in early July. Tower Butte looms in the distance.*  
(BELOW) *Dried mud forms a pattern like crazed ceramic in a basin deep inside Six Mile Wash. This picture and the one at right were taken at Grand Canyon National Park.*

(OPPOSITE PAGE) *Rainwater pools on a limestone ledge in Cork Spring Canyon.*  
(FOLLOWING PANEL) *A shallow stream flowing between narrow sandstone walls waters redbud trees in Oak Canyon, a tributary of Lake Powell near Navajo Mountain.*







### Washington Report . . .

a statement that has lasted a decade. The Bush administration accepted the early promise, reliability, and expressed hope for quick progress on energy conservation. Waxman's surcomit' is

producers of Eastern high-sulphur coal. He also recognizes it is unlikely legislators from the West will support legislation detrimental to high-sulphur producers. If such a bill were adopted, it would be a boon for Western low sulphur coal producers, a potential disaster for the Eastern coal industry.

than coal and eventually move toward nuclear energy as the nation's primary energy source.

"The energy policy must not ignore coal," Ranall said.

### Nevada wilderness bill is subject of House hearing

Several congressmen and several mining industry representatives expressed opposition to Nevada wilderness legislation (S 974) during a hearing held before the House Subcommittee on Energy and Conservation.

Representative Bill Malmgren (R-Mont) expressed his disapproval for denying the Nevada State National Guard an opportunity to use the land. He also charged that the bill would prevent the land from being completed and returned to the Senate.

Representative Joe Casburn, Chairman of the Subcommittee of Energy and Conservation, expressed his support for the bill during the hearing.

Representative Malmgren said, "We are concerned about the impact of the bill on the State's energy resources. There are several exemptions in the bill that could result in a loss of energy resources. He pointed out that the bill would quadruple

### Foundation challenges desert tortoise in the

In a brief filed in court, the foundation challenges the State's decision to never have been listed as a species.

The foundation claims the tortoise was illegally sold to the government. The tortoise is a threat to the survival of the tortoise. The tortoise is a threat to the survival of the tortoise.

MSLF and the foundation are concerned about the environment. The tortoise is a threat to the survival of the tortoise. The tortoise is a threat to the survival of the tortoise.

Instead of protecting the tortoise, the government is threatening the tortoise. The tortoise is a threat to the survival of the tortoise. The tortoise is a threat to the survival of the tortoise.

If order is to be maintained, the government must protect the tortoise. The tortoise is a threat to the survival of the tortoise. The tortoise is a threat to the survival of the tortoise.

### Ranall says House will protect interests of low-sulphur coal

Ranall said the House will protect the interests of low-sulphur coal. The tortoise is a threat to the survival of the tortoise. The tortoise is a threat to the survival of the tortoise.

Ranall said the House will work to the advantage of Western producers of low-sulphur coal and to the disadvantage of

## WHAT ARE YOUR PROSPECTS?

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To: A.F. BUDGE MINING LTD. John Norby

Page 1

# Mining firm to seek gold near Y camp in Catalinas

By Richard Ducote  
The Arizona Daily Star

12/21/90

Newmont Exploration Ltd. plans to drill test holes in search of gold near the Triangle Y Ranch Camp in the Santa Catalina Mountains and has staked new mining claims on surrounding Coronado National Forest land.

The Newmont Mining Corp. subsidiary has signed a 10-year lease with YMCA of Tucson officials, owners of land and old mining claims near the camp south of Oracle.

Newmont's lease agreement with the YMCA includes 15 patented mining claims on 245 acres. Some of the mining claims date back to the late 1800s.

Gold, silver and tungsten have been mined in the area since Territorial days.

In addition to the leased claims, Newmont has staked 38 new claims on about 600 acres of nearby national forest land in the area of Apache Peak, the company confirmed.

A spokesman for Newmont in Denver said

exploratory drilling could begin next year on the claims leased from the YMCA.

"Obviously, our intention is to conduct exploratory drilling to see if there is significant gold mineralization potential," said James F. Hill, Newmont, vice president for corporate relations.

Hill would not reveal Newmont's plans for the new claims on the public land in the area. He pointed out that permits to drill on forest land can take up to a year to obtain and require a 30-day notice for appeals by the public.

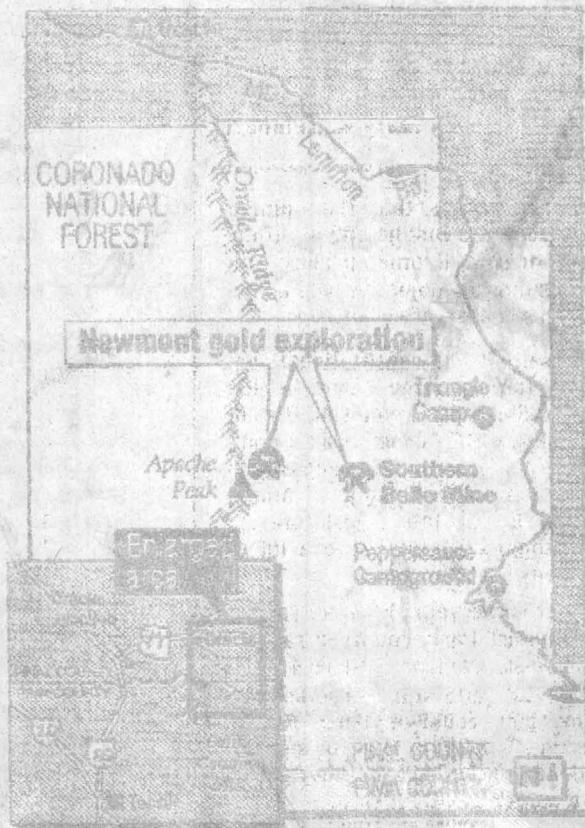
The company has not applied for such permits yet, a Forest Service spokesman said.

Newmont recently stirred up fierce opposition among some residents of the town of Portal, near the Chiricahua Mountains in southeastern Arizona, with similar plans to explore for gold.

Newmont's plan of operation in Portal is being challenged by environmental groups.

Tucson environmentalists are just now learn-

SEE MINING, Page 4A



From: Disc  
2 Pages

# Mining

Continued from Page One

ing of the Newmont activity in the Catalinas.

Newmont spokesman Hill said the company is currently working to "make the area safe" on the 245 acres of YMCA-owned land containing the leased claims.

Fewer than 1 percent of Newmont's "exploration targets" ever become working mines, Hill said. "Finding gold doesn't always lead to a gold mine."

The company's 90 percent-owned subsidiary, Newmont Gold Ltd., is North America's largest producer of gold, with 1990 production estimated at 1.7 million ounces, Hill said.

The only gold mine currently operated by the company is in the Carlin, Nev., area, where Newmont employs 2,300 people.

Don Deal, president and chief executive officer of the YMCA of Tucson, said yesterday that the Newmont lease was unanimously approved by the organization's board about two months ago after several meetings with Newmont officials.

## Payments to YMCA

The Denver-based mining company will pay \$15,000 to the Tucson YMCA this year and next year, Deal said. The company has also pledged to do some road grading and to improve the safety of existing mine tunnels and shafts, he added.

Newmont has the right to cancel the lease "if they don't find any worthwhile deposits" of gold ore, Deal said.

Newmont has told YMCA officials that it plans to drill about four test holes on the property, he said.

The Triangle-Y Camp land was donated in 1947 by Oracle pioneer Elizabeth Lambert Wood and contains a prohibition against the sale of the land by the YMCA, but leasing of mineral rights is allowed, Deal confirmed.

## "Buffalo Bill"

Dean Prichard, news editor of the San Manuel Miner, lives near the Southern Belle mining claims, an area rich in mining history.

Prichard said William F. "Buffalo Bill" Cody wintered in Oracle with his Wild West Show troupe in the early 1890s and staked some of the modern mining claims in the area.

Prichard, who wrote a recent story for his newspaper about the Newmont plans to explore on the YMCA property, said the mining company would probably find a lot of supporters in the Oracle area if the company approached the community in an open fashion.

"People here are used to mining, because Magma Copper Co. is right here" in nearby San Manuel, he said. "Newmont would have no problems if they would let us know what they are doing. But people fear they will 'open-pit' the mountain. That's the fear."

## Federal requirements

Santa Catalina District Ranger Steve Plevel said Newmont's only contact with his office has been in regard to minor work on an access road through forest property to the Y camp land.

Only if the company begins to disturb the land surface does Newmont need to file for permits from the Forest Service, Plevel said.

Mineral extraction is "one of the legitimate uses of national forest land under the Mining Law of 1872 and other laws," he said.

"There are some limits on that, of course, and the process we go through to decide what's okay and what's not is the environmental analysis process."

So far, Plevel said, he has heard from no Newmont representative about "what they propose to do or how they propose to do it."

Newmont's activities on the private Y camp land are beyond the jurisdiction of the Forest Service.

Bill Lewis, a lands and minerals staff member in the Catalina Ranger District, said mining companies frequently stake claims in a large area around the primary exploration target to protect against infringement by others.

## Environmentalists

Tucson environmentalists were cautious in their reaction to the Newmont activity.

Craig O'Hare, acting conservation chairperson for the Sierra Club in Tucson, had not heard of the company's actions until yesterday.

But he expressed worry that the exploration could lead to open-pit mining for gold ore and cyanide-solution leaching of the ore in the area.

Cyanide leaching is a process in wide use in gold mining. It has led to an explosion of exploration for gold because it lowers the cost of producing the metal.

## Environmentalists distort the facts about mining

by DIRK DEN-BAARS

Environmental groups like to portray mining as a destroyer of nature even though mines occupy less than 1 percent of our nation's land surface — much less than cities, highways or farms.

The big destroyers of natural habitat are people and natural disasters, such as volcanic eruptions, earthquakes and flash floods. Most uses of land by people are a necessary tradeoff. We must clear land to grow food and build towns. We need some acreage to build mines to produce needed metals.

Earth First! and the Sierra Club, with their extreme environmental views and actions, do more harm than they realize. They tell half-truths and show a narrow-minded bias against mining or any other interaction between people and nature.

Emotional outbreaks and pointing fingers are not ways to improve our environment. Only the proper application of science and innovative engineering can do that. People are part of the ecological cycle. Environmental interaction between mines, people and nature can be harmonious if done right.

It was appalling to see a recent letter to the editor calling a mine a disastrous venture. There is a concerted, dictatorial effort on the way to destroy the Mining Law of 1872. This law and the Multiple Use Act, among others, made it possible to make this a great country, independent of foreign sources of metals. It sustains our high standard of living. Indeed, mining is one of the main pillars of our way of life and our Western civilization.

I am disturbed by people who may have some education in biology or botany, but lack understanding of nature and its interaction with people.

### Guest opinion

#### Environmental interaction between mines, people and nature can be harmonious if done right.

Some environmentalists are suspected of planting desert tortoises and other rare species in areas where they think development should be prevented. There seems to be no concern about the species itself. The public isn't fooled by this vocal minority, which is abusing environmental laws. These are probably the same people who think copper, iron and other metals come from hardware stores.

Most building materials and metals in our homes come from mines. Driving a car, radio and TV programs, telephones and other conveniences would not be possible without mines. Mines meet our demands for a high standard of living, and they do it by highly skilled work by thousands of people.

Ores have to be mined where they are found. They can't be moved to a more convenient location. A case in point is the Buehman Canyon copper mine located on the northeast side of the Catalina Mountains near Redington.

The mine will be located south of the canyon and will not destroy riparian vegetation, as some had thought. The big destroyer of Buehman Canyon

riparian habitat is severe flash floods, which over the years have wiped out large sections of canyon all the way to the San Pedro river, eight miles away.

Notwithstanding these severe conditions, the state has spent public funds to introduce the Gila Top Minnow, the Leopard Frog and other rare species into a stretch of lower Buehman Canyon, where they surely will be wiped out by these violent floods. With a more knowledgeable study of the area, the state could have found a suitable stream where these species could survive.

Arizona now has about 2.7 million acres of wilderness, including nearly 1.1 million acres of the state's top scenic areas. It has special riparian conservation areas: the Gila Box and the San Pedro Riparian National Conservation Area. Legislation also protects Arizona's riparian habitat at Burro Creek, the Santa Maria River, Big Sandy River, People's Canyon, the Bill Williams River and others. Enough is enough.

Leaching copper from oxide ore heaps, as has been done in Arizona for many years, requires many safeguards, which are inspected and enforced by a number of state and federal agencies. The ore heaps are carefully built on top of at least two impermeable membranes of high-density polyvinyl, which protect the environment by containing the mining chemicals in a closed-loop system.

The membranes are covered with fine ore and sand to prevent accidental punctures. Ore is spread on top and diluted sulphuric acid solutions (1 percent to 2 percent) are applied to dissolve the copper. These solutions of predominantly copper sulfate are pumped to a plant where pure copper is recovered from the solutions. The barren solutions are returned to the heaps after restoring their acidity.

Holes are drilled below and downstream to monitor groundwater and check for accidental leaks. They recover solutions from a leak until it is repaired, preventing any possible contamination.

Many copper minerals found in natural ore deposits are toxic and sometimes contain arsenic compounds. At Buehman Canyon, vegetation is sparse because of these toxic minerals on the surface. Mining would remove these toxic minerals, conceivably improving the riparian habitat adjacent to the mine.

During a recent TV program on the San Pedro riparian habitat, a reporter accused the future Buehman Canyon mine of pollution or otherwise destroying the riparian habitat at Cascabel on the San Pedro river, about 10 miles upstream from Buehman Canyon. She did not explain how this impossible feat would be accomplished. A little knowledge might have prevented the reporter from making such a misleading statement.

Mining companies should pay more attention to public relations by publishing informative articles or through informative ads or programs. This would improve mining's image and set straight some misconceptions about the industry. They should promote careers in mining, metallurgy and geology.

Arizona is a great mining state. We can all work together to keep it that way. Tremendous progress is being made in environmental studies. Environmental groups, which have done little to find solutions, should do more work rather than waste time and money in court battles.

Dirk Den-Baars is a consulting geologist in Tucson who has worked in Europe, Africa, the far East and Mexico.

Opinions of others  
Analyses  
Background reports

# Perspective

Tucson Citizen

9A

Wednesday, January 9, 1991

## Environmentalists distort the facts about mining

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# Perspective

Tucson Citizen

9A

Opinions of others  
Analyses  
Background reports

Wednesday, January 9, 1991

## Environmentalists distort the facts about mining

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# NATURE

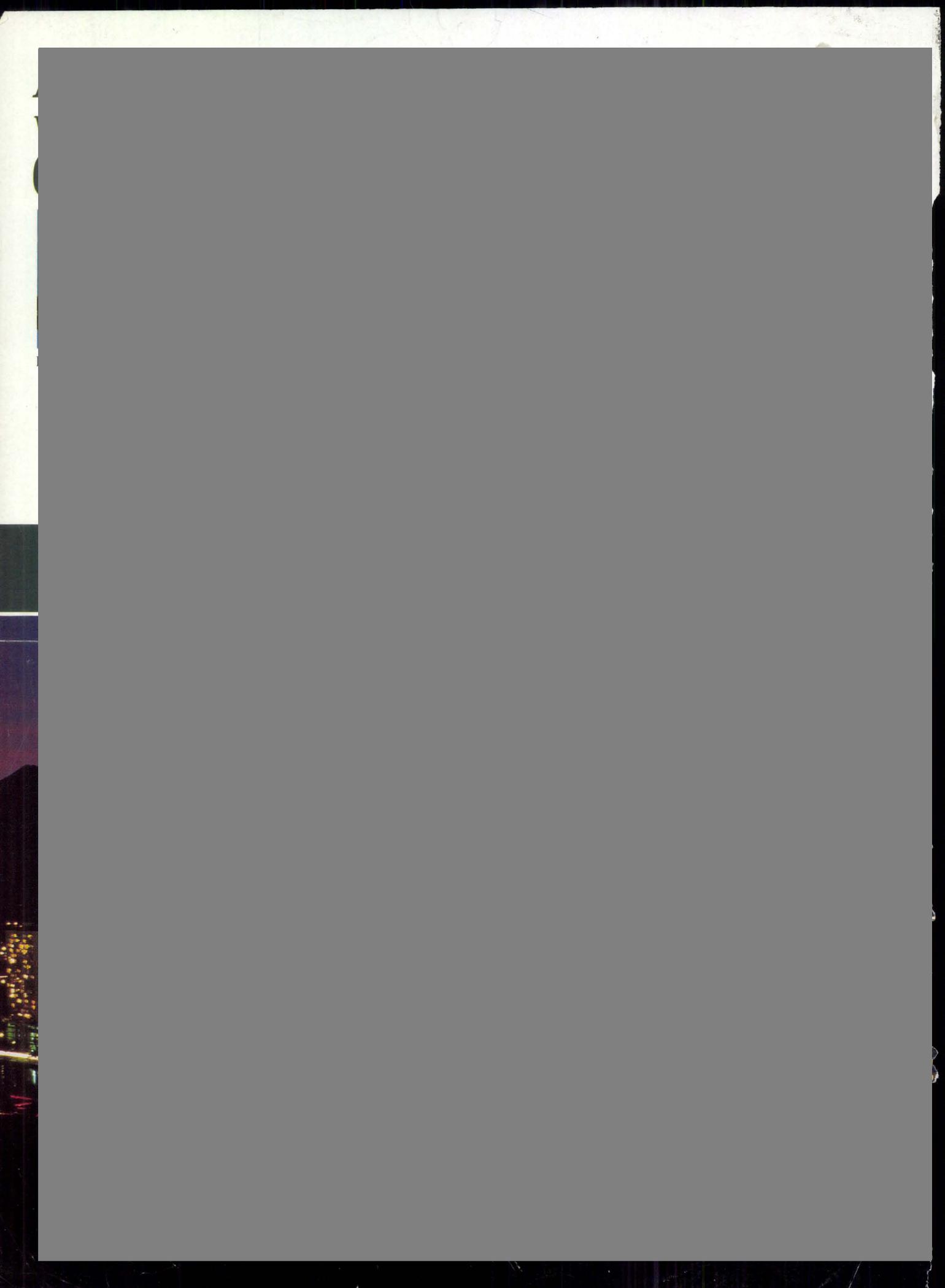
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*In a race for survival, the desert tortoise  
makes slow, unsteady progress*

BY ELLEN ALPERSTEIN









**WESTERN  
TECHNOLOGIES  
INC.**

303 East 17th Avenue, No. 910  
Denver, Colorado 80203  
(303) 894-8327

September 29, 1989

Mr. John Norby  
A.F. Budge (Mining) Ltd.  
4301 N. 75th Street  
Suite 101  
Scottsdale, Arizona 85251-3504

Proposal Number: 295-9A-111

Dear Mr. Norby:

Western Technologies Inc. (WTI) is pleased to submit the following scope of work to conduct an Environmental Fatal Flaw Analysis (FFA) for A.F. Budge (Mining) Ltd.'s Korn Kob project area. This proposal consists of a narrative describing the Scope of Work, Costs and Schedule, General Conditions and Indemnity Agreement.

The purpose of the FFA is to catalog an array of environmental permits required by federal, state and local governments for mining and milling operations; to inventory and assess critical environmental issues; and to identify issues which may delay or prevent operational startup. For example, required permits cover air quality, water quality, underground storage tanks, water supply systems, solid and hazardous wastes, biological assessments, activities impacting archaeological resources or historic sites, and mining and reclamation reports for exploration and mine development on Federal patented and unpatented lands.

The development of the FFA report will help define the permitting methods and philosophies Budge may wish to adopt. For example, some companies and government officials have preferred early and open public and government involvement in their planning and permitting. Others have addressed permitting primarily in the government and public relations context. Still others have addressed permitting from an internal staffing, scheduling and organizational point of view. Finally, the study will define the methods for expediting the mineral resource permitting process and to define sequential and simultaneous permitting processes.

The key elements of the fatal flaw study are as follows:

1. Identification of required environmental permits.
2. Identification of the information and analyses required for submission of complete permit applications; this in turn often determines important priorities when limited air, water or habitat resources are available.
3. To assess and inventory critical environmental issues.

4. Procedural compliance. For instance, a permit requirement may involve mandatory consultation with other agencies. Legal requirements for public involvement or hearings, consultation with other agencies for their approval of various aspects of the permit are of particular concern to those for regulatory compliance.
5. Determination of whether a project/permit may require the preparation of an EA or EIS. Based on discussions with Budge personnel, WTI has been requested to attempt to avoid the costs and time necessary to complete this approval process.

Environmental permitting of mining projects, if an environmental impact statement is required, can take as little as 15 to 18 months or as much as three to five years. With millions of dollars often already spent for exploration and potential profits in the balance, delay for these periods of time is very costly. For that reason, environmental permitting is usually begun several years in advance of the date on which construction is expected to commence. Typically, this is during the exploration phase when the feasibility of mining is not clear. In order to avoid delays in mine development, the environmental evaluation and permitting must get under way prior to engineering and siting studies.

Along with Budge's managers, governmental relations personnel, mining engineers, and attorneys, our environmental technical personnel can play an important role in defining and implementing a program which complies with environmental laws. As part of Budge's permitting team, WTI can plan a constructive role in cutting through the permitting maze.

The difficulty presented by the early stage at which environmental permitting must begin is that the size and location of mining operations have usually not been determined. Several scales of operation are usually under consideration in feasibility studies, as are alternative locations for major elements of the projects such as mill sites, tailings' disposal sites, roads, and power and water sources. Whether mining will be conducted underground or on the surface is sometimes not determined, nor are specific milling or metallurgical processes. What Budge thinks the project will look like three years before construction can and will change in response to technical, economical and environmental considerations.

Despite the dynamic state of mine project design and engineering, environmental evaluation and permitting must begin early to avoid delay, additional expense and lost profits. A preliminary or conceptual project description must be developed describing the size or range of sizes of proposed mining and milling facilities and the reasonable or feasible alternative locations for them. Air emissions, water effluents, and waste streams must be described and estimated in order for the permitting process to begin.



As the basis for the permit and related environmental analyses, it is advisable to describe and use the full range of production levels which may be conducted from the smallest to the largest. The upper end of the scale is the more important end to analyze and to permit. If a smaller operation is considered more probable in early planning, and a decision is later made for economic reasons to increase production, amended permits and supplemental environmental analysis may be necessary.

In light of the potential regulatory permitting delays and the potential impacts related to Federal, state, and local regulatory entities intervention in the mine planning, construction and operation process, WTI is proposing to conduct an Environmental Fatal Flaw Analysis.

### **DELIVERABLES**

WTI will prepare a permitting checklist, outlining the major Federal, state and local permits and approvals applicable to Budge's proposed exploration and mining operations. The checklist will identify:

- Environmental permits that are required for exploration, mining and milling;
- Inventory and rank of critical issues and concerns;
- Governmental agency, regulatory personnel, telephone numbers and mailing addresses; and
- Time required to obtain the permit.

After the regulatory structure and permitting requirements are defined, WTI will provide a technical synopsis which outlines the technical data required to obtain a permit within specified timeframes. The technical synopsis will outline potential technical issues and studies, and potential program costs. Following the definition of the technical requirements, WTI will prepare and submit a general Critical Path graph which defines technical issues which may adversely affect the permitting and approval process.

### **COST AND SCHEDULES**

WTI will conduct the study within 30 days after the contract is awarded for a lump sum fee of \$10,000.00. The project will be under the direction of Mr. Chris Cull and supported by Mr. George M.L. Robinson (Resumes Attached). A general overview of the project components are graphically displayed on Figure 1.



**CONFIDENTIALITY**

The relationship between WTI and A.F. Budge (Mining) Ltd. shall be regarded as strictly confidential. All work performed and any reports produced under the proposed Scope of Work will be treated as confidential property. None of the information generated during this project (including technical information, experience or data) may be disclosed to others without the prior written consent of A.F. Budge (Mining) Ltd. or their assigned parties unless such disclosure is required by law or subpoena.

We certainly appreciate the opportunity to propose on this interesting project and will be ready to begin the initial tasks within one week of award data. Upon acceptance, please sign the acceptance block to acknowledge that this proposal and attachments have been read and accepted, and return one copy to WTI.

Yours truly,

**WESTERN TECHNOLOGIES INC.**



Chris Cull  
Director Environmental Division - Tucson



George M.L. Robinson  
Vice President - Mining Services

Accepted for:

**A.F. BUDGE (MINING) LTD.**

By: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

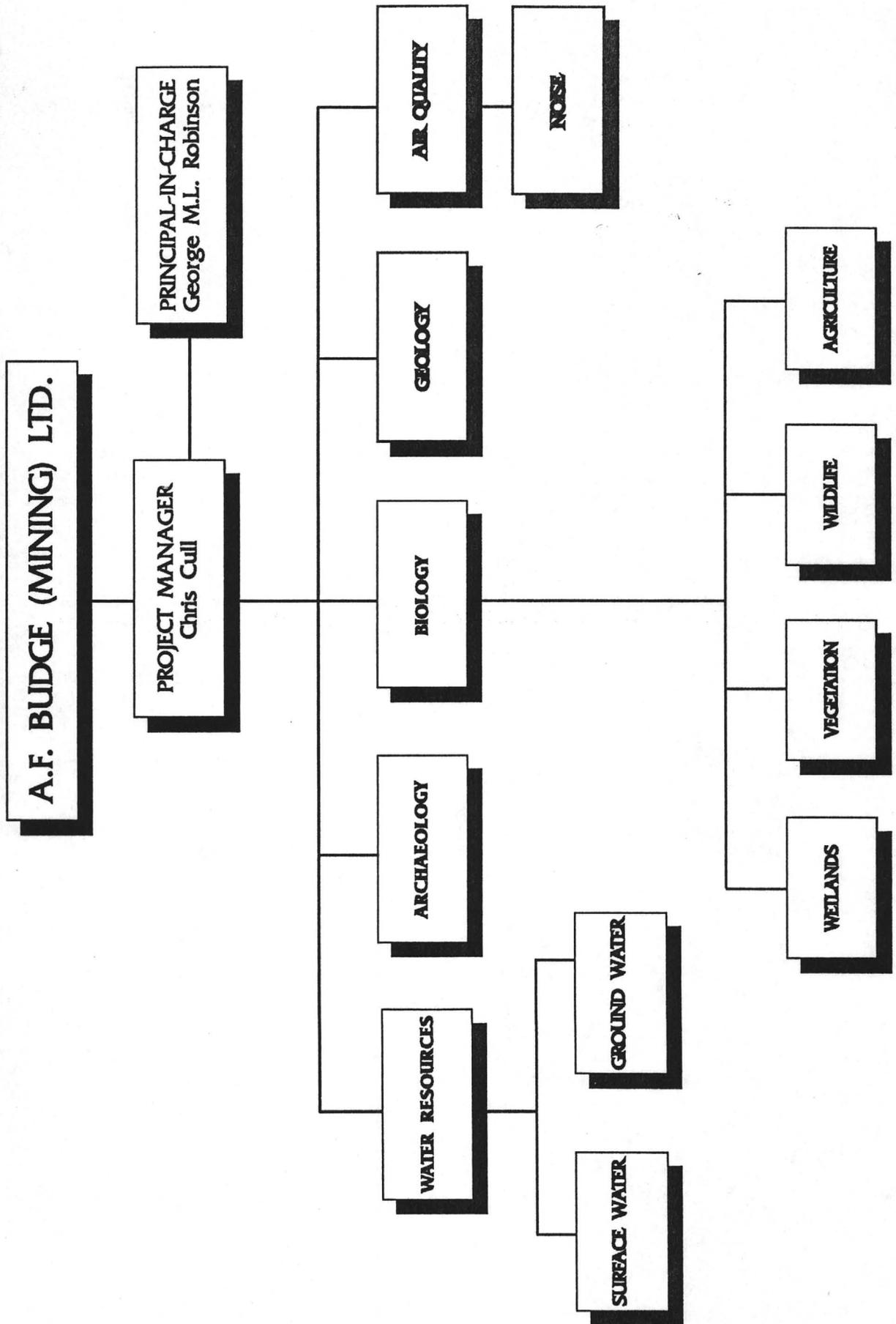
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**FIGURE 1**  
**PROJECT ORGANIZATION**  
**A.F. BUDGE (MINING) LTD. PROJECT**  
**TECHNICAL & REGULATORY FATAL FLAW ASSESSMENT**





RECEIVED JUL 13 1990

**A.F. Budge (Mining) Limited**

(602) 945-4630

4301 North 75th Street  
Suite 105  
Scottsdale, AZ 85251-3504

FAX (602) 949-1737

*This letter faxed but not mailed  
7/10/90.*

July 10, 1990

Mr. Steve R. Plevel  
District Ranger  
USDA Forest Service  
Coronado National Forest  
Santa Catalina Ranger District  
5700 North Sabino Canyon Road  
Tucson, Arizona 85715

Dear Mr. Plevel:

Budge Mining agrees in principle with the provisions outlined in the May 25 Draft Revised Korn Kob Rehabilitation Plan. The time frame and flexibility of road rehabilitation are discussed separately. Proposed Draft Revised Rehabilitation plan items are specifically addressed below:

1. Outsloping and installation of waterbars on new drill roads on Forest Service land can be accomplished as soon as possible.
2. White control crosses for aerial survey can be removed as soon as possible.
3. Existing roads will be left in place and they will not be recontoured.
4. If the three permitted additional roads in the southeast corner of the drill area are constructed, they will be recontoured.
5. Slopes at some of the road intersections will be reduced when roads are rehabilitated so vegetation will have a better opportunity to establish itself.



**A.F. Budge (Mining) Limited**

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4301 North 75th Street  
Suite 105  
Scottsdale, AZ 85251-3504

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Page 2  
July 10, 1990  
Budge Mining letter to  
Mr. Steve R. Plevel, USDA Forest Service

It is suggested that proposed drill road rehabilitation not be performed until there are no additional or future plans for use of the roads for exploration, development or access purposes. Budge Mining definitely plans to rehabilitate the drill roads and gain release of the bond, but would prefer not to do this until the roads have completed serving the exploration, development, and/or access purposes for which they were constructed.

Vegetation cover on drill roads which is 60 percent of surrounding cover within 3 years is a realistically attainable cover. This vegetation cover will be the Forest Service approved species mix (probably fast growing grasses), and not the surrounding natural species (which will later replace the grasses). Once this planted vegetation cover is attained, the bond will be released. If after 3 years, only part of the rehabilitated roads are sufficiently covered with vegetation, then a percentage of the bond will be released based on percentage of roads sufficiently covered. The roads not sufficiently covered will be reseeded.

Flexibility in method of revegetation is recommended so that the desired cover can be achieved. The roads will be ripped and seeded, and the seed will be hand raked in. During new road revegetation, access to these roads will be blocked. It is suggested that the specifics of the road preparation and seed planting be left flexible so that whatever reasonable methods work can be done. Seed species, mix, and amount applied should also be left flexible, again so the desired cover can be achieved. In order to achieve the desired product, Budge Mining reserves the right to contract an independant specialist to recommend different road preparation, planting, seed species, seed mixes, or seed application amounts. The Forest Service would then approve these recommended new revegetation methods prior to their implimentation.

Sincerely yours,

John W. Norby  
Chief Geologist,  
for A.F. Budge (Mining) Ltd.

# HUMBOLDT MINING SERVICES

3605 Gull Street • Reno, Nevada 89506 • Telephone 702 / 972-8811

July 4, 1990

John:

Comments on Korn Kob "Interim Rehabilitation Plan" draft from USFS.

Item:

1. Standard practice is to outslope all roads, because this allows continuous drainage from the road surfaces. However, if you anticipate having wet drill holes, or injecting water into drill holes, it is very hard to keep drill water and cuttings onto a road surface with outsloped roads. It is preferable in this case, although it causes more reclamation work, to inslope the roads to keep the material on the road surface. Then the water will just follow the road down, to end in a sump. After drilling, though, you will probably have to outslope the roads to satisfy the FS.

2. Installing water bars is standard practice. However, this has to be done after drilling, if you want to keep water/cuttings on the road surfaces.

3. Rip/scarify -- OK.

4. Seed the roads. Seeding the roads is easy. Scarify, broadcast, run over the broadcast seed with dozer to bury the seed.

However, if the fill slope is compacted, we have found it difficult to get seed to grow, because the seed just sits on top of the hardpan and the birds get it or it washes away. We scarified the fill slope by dragging an anchor chain along the slope, then broadcasting. Sometimes we would then leave it, or drag a board or the chain back along to bury the seed.

It is very difficult to get seed to grow on the cut slope, if the slope will be sloughing at all. We ended up doing it by scarifying by hand rake, if soft enough, or by touching the slope with a cat blade, if harder, broadcasting, then applying double amounts of seed. Then hand rake the seed in to 1/4" depth. Even then, it will be hard to guarantee even 70% cover in just two years.

As to the amount of seed, the FS is not even close as to what you will need to try to achieve 70 or 100% cover. a mile of road at say, 30 feet width of total

disturbance (road surface, cut and fill slopes; and maybe 40 feet in some places) is 160,000 sq. ft. of disturbance per mile, or about 3.7 acres. Usually, one needs at least 4 or 5 lbs of seed per acre: this is 18.5 lbs per mile or more. We often doubled that, on the premise that it was cheaper to buy seed than to reseed at a future date.

Cover. If the grasses grow well for two years, maybe you can achieve 100% ("same as natural cover") in time. I guess it depends on how much soil is mixed in in the road surface, cut and fill slopes, etc., rainfall, etc., etc. I would guess the road surface will do very well, but the cut and fill slopes won't, unless conditions are good for growth. I suggest you negotiate for 70% of natural, surrounding cover in ~~two~~<sup>3 or 4</sup> years as the criteria. Then, the premise is that natural flora will slowly take over the grasses, and will achieve whatever cover conditions will allow.

100%!

I haven't seen the site, but the grasses will probably do reasonably well since they grow fast. However, your grassy roads may be the best forage around, and cattle may wipe out much of your crop, if they are allowed free rein. In this case, you need the support of the FS to deny grazing privileges for the affected rancher for a couple of years, or, you fence the area off.

by ~~erosion~~ eating, and worse, by trampling.

after all, ~~the~~ unless the seed mix is the same as natural vegetation, the purpose of seeding at all is to stabilize soil against erosion. 100% cover may not be as important as the stabilized the new plants afford.

Rehabilitation Plan (page 2 of FS draft)

1. putting three new roads back to natural grade within three years. We have always said that recontouring would be completed when there is no future use by the mining company, or the company that may take over from the present mining company. However, the FS has been pushing for deadlines recently. Maybe the way to word it is "if there are no additional or future plans for use of the roads, for exploration drilling or access to exploration areas, the roads will be returned to natural contour within one year of a decision to not use the roads" or some such.

2. Hydrologically. It seems to me that it is up to the Ranger to determine, for any given plan of operations generating surface disturbance, if the carrying out of the plan, including such items as water-barring, and other interim stabilization methods, will cause overall detriment to the watershed, or when the amount of the

work ("cumulative impact") (includes other types of disturbance -- cows, for instance) will result in significant, or irreparable degradation. If he believes a significant impact will occur, despite interim, or final reclamation, he should demand an EIS, or similar, to measure that impact.

Otherwise, I don't know what they mean. The watershed will act similarly, unless you plan to completely alter a drainage (such as placing a waste dump in one). This entire sentence by the FS looks like a cover-your-ass sentence to me.

3. change "establish the same cover" to "achieve 70% of surrounding natural cover within two years", or better yet, within three or four years. Remember, everyone thinks of the revegetation they have seen on road surfaces at other locations, but they forget that revegetation doesn't always work well on cut and fill slopes. Your note of 60% is even better than the 70%.

You should reserve the right to change the seed mix (varieties of plants.) After all, they are recommending the mix, but what if it doesn't work? You should be allowed to commission a study by a botanist or range specialist, and recommend an additional, or different mix geared for the specific area. Of course the Ranger would have final approval of what seed mix you apply. I found that the FS sometimes required some species just to see if they would do well on the Austin site. It's mostly trial and error anyway, unless the seed mix matches existing flora.

Your note that existing vegetation in one area is "naturally sparse" will be covered by getting Plevel's approval for "x"% of surrounding cover.

Steve

May 25, 1990

On April 23, 1990 a field visit was conducted by the Forest Service to review the rehabilitation plan for the Korn Kob Mine. The following people attended: Steve Plevel-District Ranger, Mike Borens-SO Minerals Staff, Tim Conner-DO Range Staff, Bob Lefevre-Forest Hydrologist, Lou Leibbrand-Forest Engineer, and Bill Lewis-DO Minerals.

The objective for the meeting was to review the rehab plan for the exploration phase and discuss any interim measures that needed to be taken while we are waiting to hear if the mine will go into production. Another objective was to take a look at the long term management for the area.

#### INTERIM REHABILITATION PLAN

Some of these items should be accomplished before the summer rainy season or at a time that would insure maximum revegetation potential.

1. All the new roads will be outsloped.
2. Install waterbars identified by a forest engineer.
3. Rip/scarify the roads to a depth of approx. 3 inches.
4. Seed the roads, and the cut & fill slopes with:

MIX: 16:1 ratio of grama grass to lovegrass

SPECIES: Vaughn's sideoats grama, Lehman's lovegrass

AMOUNT: 1/2 pound per mile of road (don't forget cut & fills)

PER CENT COVER: same as natural cover in 2 years

5. Every March the Forest Service and the mining company will review the site for any possible problems.

The Forest Service will advise/help the mining company on these items but we should emphasized what the end product will be and not on how to do it.

REHABILITATION PLAN: if the mine does not go into production

1. ROADS: leave the existing roads in place. The reasoning behind this was that we could possible damage the area if we tried to bring it back to natural grade and the benefit would not be that great (vegetation will soften the visual impact).

If the mine plans on constructing the three roads in the southeast corner (see map), they would have to put them back to the natural grade within three years. These roads are located in a new area without any previous disturbance.

2. HYDROLOGICALLY: the watershed should act similiar to the natural condition, such as erosion, water quality, etc.

3. VEGETATION: establish the same cover as the natural condition with the same mix as in number 4 above.

4. ROAD ACCESS: \*\*\*\*\*

NEGOTIATE THE TIME FRAME:

1. Reduce the slopes at some of the road intersections(see map) so vegetation will have a better opportunity to get established.

2. Block the access into the area.

Two additional items came to light during the visit:

1. Cover the sand on the fill slopes by the drill holes.

2. Remove the "X" markings for the photo flights when you are finished with them.

\_\_\_\_\_  
STEVE R. PLEVEL  
District Ranger

\_\_\_\_\_  
BUDGE MINING

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

### **ACKNOWLEDGMENTS**

These guides are a result of many District, Forest, Regional, and Research people sharing their knowledge of reclamation and putting it together in a condensed format for the user. We thank them for their contributions.

A special note of thanks is extended to Raymond W. Brown, Jeanne C. Chambers, Eugene E. Farmer, and Bland Z. Richardson of the Intermountain Forest and Range Experiment Station for their assistance in developing much of the technical information in this document.

Coordinators for this publication were Ben Albrechtsen, Region 4 Reclamation Specialist and Eugene E. Farmer, Intermountain Forest and Range Experiment Station.

Special thanks to Shelley Berrett and Susan McDaniel for their assistance in typing and layout of this material.

Bill Lewis  
S.C.R.D.

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## **R-4 RECLAMATION FIELD GUIDE**

### **1.0 - INTRODUCTION AND PURPOSE**

---

Reclamation of disturbed lands in Region 4 is becoming more important as mineral activity increases on National Forest System lands. Exploration and extraction methods involve more land area than in the past and operations are generally larger.

With the increase in activity the mineral administrator needs reclamation information readily available. These Field Guides are intended to bring together an array of existing information into a format that is more usable by field personnel. This intent is to provide the user with:

1. A statement of Forest Service reclamation policy.
2. A background of Forest Service authority.
3. A logical sequence of events for managing the reclamation process.
4. A summary of key reclamation principles.
5. A ready reference and checklist of technical information to be applied on the ground.

NOTES:

NOTES:

## **2.0 - POLICY**

---

1. The Forest Service policy for managing minerals includes:
  - a. Encourage and facilitate the orderly exploration and development of the mineral resource as one of the multiple uses we manage.
  - b. Develop a good understanding of the mineral industry's practices and develop a strong working relationship with industry.
2. The Forest Service reclamation activity policy is to:
  - a. Ensure the uniform application of exploration, development, and reclamation standards.
  - b. Ensure prompt reclamation of lands to productive uses consistent with land management policies.
  - c. Integrate appropriate disciplines in the natural sciences, engineering, and design arts in establishing criteria for reclaiming disturbed land, reviewing reclamation plans, and monitoring reclamation activities.
  - d. Identify information needs that can be provided by research and encourage research projects to provide such information.
  - e. Utilize the best available information in developing and reviewing reclamation plans.

NOTES:

NOTES:

### **3.0 - AUTHORITY**

---

The following is a brief summary of some of the more important mineral laws that provide authority to the mineral administrator.

#### **3.1 - The 1866 Mining Law**

This was the first general mining law that declared all mineral lands owned by the public to be open to exploration and location.

#### **3.2 - The 1872 Mining Law**

This more comprehensive mining law replaced the 1866 law. It has become known as the General Mining Law. This law provides that all deposits in lands belonging to the United States be free and open to exploration and purchase. The 1872 Mining Law is still in effect and provides a basis for most subsequent acts.

The General Mining Law was amended and certain minerals were excluded from its provisions. Today, the 1872 Mining Law deals primarily with hardrock minerals known as locatables.

#### **3.3 - The Organic Administration Act of 1897**

This law established the "Forest Reserves." It also provided (a) the rights to conduct mining activities and (b) the right of ingress and egress on National Forest System lands to conduct mineral activity.

*This law specifically authorizes the Forest Service to manage the surface resources on National Forest System Lands.*

The Organic Act of 1897 is the one act which provides the authority for the Forest Service to administer reserved and outstanding mineral operations in conjunction with the Secretary of Agriculture Rules and Regulations of 1937, 1947, and 1963.

#### **3.4 - The 1907 Act**

This act provided that "Forest Reserves" become National Forests.

#### **3.5 - The Mineral Leasing Act of 1920**

The 1920 act allows the Department of Interior, Bureau of Land Management to issue leases for disposal of leasable minerals on National Forest System lands, including coal, phosphate, sodium, oil

and gas, oil shale, native asphalt, bitumin and bituminous rock.

### **3.6 - Multiple-Use Mining Act of 1955**

This Act, among other things, provides for multiple use management of land and surface resources on mining claims. *This Act authorizes the United States to manage surface resources so long as these activities are not interfering with the claimants' rights.*

### **3.7 - Federal Land Policy and Management Act - 1976 (FLPMA)**

FLMA requires a claimant to record location notices and assessment work with the Bureau of Land Management. It contains mineral withdrawal provisions and covers siting of pipelines, powerlines, authorization is given for special use right-of-way.

### **3.8 - National Mining and Minerals Policy Act 1970**

This Act reaffirms the policy of the Federal government to foster and encourage private enterprise (a) to develop economically sound and stable domestic mining (and) minerals industries and (b) in the orderly and economic development of domestic mineral resources.

### **3.9 - Statutory Authority - BLM and Forest Service Regulations**

1. The Federal statutes relating to minerals on public lands of the United States are covered in Title 30 of the United States Code.
2. Regulations governing locatable and leasable minerals are found in Title 43, Code of Federal Regulations, and are administered by the BLM. BLM publishes its regulations in circulars.
3. Surface use (locatable minerals) operations conducted on National Forest System lands are administered by regulations found in Title 36 Code of Federal Regulations, Section 228, Subpart A, and are part of the Forest Service manual.

NOTES:

#### **4.0 - DEVELOPING THE RECLAMATION PLAN**

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1. The reclamation plan guides both the operator and the administrator toward a future expected condition of the disturbed area.
2. Reclamation plans are an integral part of the operating plan, either incorporated or as a separate document.
3. The reclamation plan should be developed by the operator with input from the surface administrator. Reclamation plans are approved by the surface managing agency as part of the operating plan.
4. The plan will describe in detail what is expected to happen to the disturbed site, both during and after extraction, to reduce impacts on other resources and return the land to a productive state consistent with the long-term management direction.

#### **4.1 - Reclamation and Long-Term Management Direction**

Reclamation plans should reflect the long-term management direction specified in the Forest Plan. For information refer to:

1. Forest Plan, Chapter II, "Analysis of the Management Situation - Minerals."
2. Forest Plan, Chapter containing Forest Management Direction, Forest-wide Standards and Guides - Minerals Management.
3. Forest Plan, Chapter IV, Management Area Direction, Area Standards and Guides.

#### **4.2 - Reclamation in Environmental Analysis Reports**

1. Programmatic and project environmental analysis should determine information relative to reclamation requirements for site-disturbing activities.
2. The environmental assessment (EA) and environmental impact statement (EIS) are NEPA documents. Their requirements are not legally binding upon an operator unless they are made part of an operating plan required by the Secretary's regulations.

3. Appropriate constraints and mitigating requirements identified in the Environmental Analysis EA should be incorporated in the operating plan and/or reclamation plan.

4. Planned reclamation activities and their expected effects on other resources should be examined to determine if they satisfy the long-term land use objectives.

#### **4.3 - Determining Reclamation Criteria**

1. Reclamation plans should contain site specific criteria that can be used as performance standards in the bonding process.

2. Reclamation criteria are standards we set to describe the desired end product of reclamation. When the reclamation criteria are met, the bond can be released.

3. In Region 4, Forests will develop reclamation criteria for each project in at least the following areas:

- a. Final configuration of the disturbed area.
- b. Management of the topsoil and other growing medium.
- c. Mass stability requirements.
- d. Acceptable plant species for vegetation.
- e. Reclamation requirements for seasonal closures, long-term shutdown (more than 1 year), and final reclamation.
- f. Air, water, and visual standards.
- g. Intervals for review of the operating plan and bond amounts.
- h. Conditions for bond release.

4. For environmental protection requirements related to locatable minerals, see Title 36, CFR Mineral Regulations, 228.8 Requirements for Environmental Protection, paragraph (a) through (h).

5. An interdisciplinary (ID) team approach should be used in establishing criteria for mineral land reclamation.

a. ID Teams should identify acceptable resource losses from mineral activities as well as possibilities for enhancement through reclamation

#### 4.4 - Reclamation Plan Content

1. Reclamation plans are part of the operating plans. Authority for review and approval of operating plans is not always the responsibility of the Forest Service.

Mineral Activity	Regulation Reference	Responsibility for Plan - Review & Recommendations	Responsibility for Plan Approval
Oil and Gas	BLM Onshore Oil & Gas Orders No. 1 & 43 CFR 3160	Forest Service	BLM
Phosphate	43 CFR Part 23	Forest Service	BLM
Coal	30 CFR Part 780	Forest Service	FS concurrence, OSM & State approval
Geothermal Resources	43 CFR 3200	Forest Service	FS concurrence, OSM & State approval
Locatable Minerals	36 CFR Part A 228.3	Forest Service	Forest Service
Saleable Minerals	36 CFR Part C	Forest Service	Forest Service
Solid Leasable Minerals on Acquired Lands	43 CFR Part 23	Forest Service	Forest Service & BLM

2. Reclamation plans should contain the following:

- a. Final reclamation requirements consistent with long-term land management objectives.
- b. Mitigating requirements from the NEPA document.
- c. Mandatory information required by regulations.
- d. Reclamation criteria shown in 4.3 above.
- e. Bond calculations.

NOTES:

## **5.0 - ADMINISTRATION OF THE RECLAMATION PLAN \_\_\_\_\_**

When approving and administering a reclamation plan, the surface manager should:

1. Review the plan for content.
2. Review the plan on the ground with the operator.
3. Recommend revisions as a result of on-site review.
4. Approve the plan within appropriate timeframes.
5. Set schedule for inspection of operations and reclamation activities.
6. Document inspections and discuss needed changes with the operator.
7. Ensure interim reclamation is current.
8. Take appropriate action in the event of noncompliance.
9. Revise plan as needed.
10. Release bond as reclamation criteria are met.
11. Monitor completed projects as needed.

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NOTES:

## **6.0 - PRINCIPLES OF SCIENTIFIC RECLAMATION \_\_\_\_\_**

There are at least 10 basic steps to reclamation that should always be followed:

1. Ensure that reclamation objectives agree with the long-term land management objectives.
2. Use an interdisciplinary approach to analyze the physical, chemical, and climatic site characteristics and make recommendations for reclamation plan.
3. Conserve all topsoil and material that is suitable for a growing medium on areas to be disturbed. Reapply it during reclamation.
4. Reclaim disturbed areas as soon as practical to minimize exposed surface and soil loss during operations (concurrent reclamation).
5. Control toxic substances that may contaminate water, air, or prohibit plant growth.
6. After mineral extraction, shape the land so it is consistent with sound watershed principles and will accommodate the desired long-term land use.
7. When the final landform is achieved, immediately stabilize the surface to hold the soil in place and guard against soil loss from major storms or spring runoff.
8. Select equipment that is well suited to the site and prepare a good seedbed before attempting revegetation.
9. Plant selected species that will hold the soil in place, provide vegetative diversity and, through succession, contribute to a stable ecosystem.
10. Protect young plants until fully established.

NOTES:

## **7.0 - STANDARD RECLAMATION PRACTICES \_\_\_\_\_**

This chapter discusses standard practices for reclamation of disturbed areas. Standard practices apply in most cases.

### **7.1 - Topsoil Management**

Topsoil and selected growing medium often play a key role in the reclamation of lands disturbed by mineral extraction activities. The amount and quality of replaced soils will have a strong effect on the future site productivity of reclaimed lands. Early in the reclamation planning you need to consider these several questions:

1. How much topsoil should be saved?
2. How do we decide what quality of soils to save?
3. Where will salvaged soils be stored?
4. How long will soils be stored?
5. Is direct replacement feasible?
6. How will soils be respread on the spoils?
7. What thickness of respread soil is needed?
8. Is there enough soil to give the desired thickness?
9. What are the alternatives to respraying topsoil?

When good soil materials are in limited supply, consider the relative qualities of the soils that are available. *In general, a thin layer of topsoil over a fair or poor quality subsoil over a spoil material will give greater plant production than using the thin layer of topsoil alone.*

1. Both topsoil and subsoil can be salvaged if they fall within the good or fair categories indicated below. Soils in the poor quality class may also be saved to meet required soil replacement depths.

Table 1. Soil Suitability for Reclamation Use.

SOIL PROPERTY	SOIL QUALITY			
	GOOD	FAIR	POOR	UNSUIT- ABLE
Texture	sandy loam loam silt loam	sandy clay loam silty clay loam clay loam	sandy clay loamy sand silty clay	clay 60%
Rock & gravel (% by volume)	0-10	10-20	20-40	40
pH	6-8	5-6 8-8.5	4.5-5* 8.5-9**	4.5 9
Sodium absorption ratio, (SAR)	4	4-8	8-16	16
Electrical Conduc- tivity (Millimhos/cm)	3	3-7	7-15	15

\*Check for excessive concentrations of heavy metals.

\*\*Check for excessive boron or lime.

2. Salvaged soils may show a variety of properties that fall into different reclamation suitability classes. For example, a salvaged soil material may show texture, pH, SAR, and EC in the *fair* class but rock and gravel content in the *poor* class. In that case, the soil would be classed as *poor* for reclamation. Generally, a soil is judged by its lowest rating.

3. The appropriate depth of replacement soil to use is not clearly defined; judgement is involved. In general, the poorer the chemical and physical properties of the spoil materials, the greater the required depth of replacement soils.

4. In those cases where the spoil materials exhibit no phytotoxic properties, e.g., highly acid or saline, 12 inches of replacement soil is recommended if it is available at reasonable cost and effort. Fine-textured spoils may require less than 12 inches of replacement soil.

5. Coarse-textured or rocky spoils will usually benefit from increased depths of replacement soils—up to about 24 inches.

6. Phytotoxicity is usually associated with either acidity (low pH) or salinity (high pH). Low pH also is associated with an increased concentration of heavy metals. These conditions require from 12 to 48 inches of replacement soil to accomplish successful reclamation.

7. The importance of replacement soils over phytotoxic spoils will usually justify stripping adjacent unmined areas to obtain adequate replacement soils.

8. Soils can be initially classified on surface properties only. For more detailed classification, an incremental system of drill holes or soil pits should be developed.

9. Infrequently, there may be substrata, perhaps at considerable depth, that can be used to advantage as a plant growth medium. Mine operating plans can sometimes be negotiated to take advantage of these substrata as growing mediums.

10. Soil may be temporarily stored in piles or picked up and placed directly on the area to be reclaimed. The latter action is called direct replacement.

11. Stockpiling soil to be used in reclamation is more common than the direct replacement method, especially in mountainous terrain. Some considerations for using soil stockpiles are:

a. Stockpile should be located where it will not be disturbed by future mining.

b. The haul distance and road grade from the stockpile to the areas to be revegetated.

c. The time that the pile will be in place (the shorter the better).

d. The need to revegetate the stockpile to protect the soil from wind and water erosion and to discourage weeds.

## **7.2 - Sediment Control Measures**

Sediment control plans for mining operations are important because the potential for sediment production is high. Erosion losses from unvegetated mine waste embankments can range from 15 tons per acre per year to more than 300 tons per acre per year, depending on weather, spoil, and slope factors.

Sediment control strategies and successful revegetation can cut these losses by a factor of 100 or more. Sediment control on mining operations must consider controlling surface water with engineering structures and vegetal cover.

1. Uncontrolled or misdirected water can cause unacceptable soil losses and large gullies. Water control through sloping, ditching, and berms may be necessary.
2. The most common source of surface water in Region 4 is melting snow; road surfaces are the most common source of runoff.
3. Large outside road berms required by MSHA may need to be breached at selected locations to control water volumes.
4. It generally is better to spread water than to concentrate it. If it is necessary to concentrate water, as in a ditch, size the ditch for the expected volume and spread the water as soon as practical.
5. Ditches often freeze over in the winter and cause significant problems during spring snowmelt.
6. In Region 4, soil erosion problems originating from a melting snowpack usually occur on north or east facing slopes. On south or west slopes, the snowmelt period starts as early as February and daily melt volumes are often too small to generate surface runoff.
7. The most common forms of engineered sediment control are:
  - a. Sediment ponds and traps.
  - b. Sediment barriers.
  - c. Shaping waste embankments.
8. The trapping efficiency of a pond relates to the residence time of the water in the pond; longer residence times increase the efficiency.
9. Ponds should be kept out of permanent stream channels; ponds should not have to handle any more water than necessary.
10. Ponds tend to degrade water quality more than live streams do.

11. Increasing pond size tends to increase pond efficiency but also demands better engineering design.

12. If ponds have to be kept small because of the topography, closely spaced multiple ponds also will increase efficiency.

13. Sediments ponds should be cleaned when they are about two-thirds full of sediment.

14. The integrity of the pond must be ensured through adequate design and construction of the pond dam and the normal and emergency spillway or standpipe.

15. Sediment barriers may be as simple as strategically placed straw bales or as complex as carefully placed geotextile filter cloth.

16. Brush and/or log barriers are commonplace on mines in the Region. They are moderately effective and simple to erect.

17. Timber salvage operations on mines can provide a source of materials for brush and log barriers.

18. Straw bales are only effective on small volumes of sediment.

19. Several features of waste embankments that strongly influence sediment production are:

a. Length and steepness of slopes.

b. Presence or absence of terraces or other slope breaks.

c. Shape of the toe area. Waste embankment toe areas should not be constructed with a concave slope face as this will maximize water velocity and soil erosion on the face. Embankments should not be concave either, as this will concentrate water accumulations. Slopes should be straight.

20. Vegetal cover is the cheapest and most effective method for controlling erosion and sedimentation.

21. During the revegetation process, either wood fiber mulch with tackifier or crimped straw will help control erosion. Recommended mulch application rates for erosion control will vary from 1 to 2 tons per acre.

### 7.3 - Shaping and Grading

Shaping and grading a site is an important reclamation consideration. The final shape or landform should be hydrologically and visually compatible with the surrounding landforms, if possible. Not only should the site be stable but it should also promote or enhance the post mining land use. Consider the following:

1. Establish a record of conditions existing before disturbance. Use photo points, contour maps, etc.
2. Decide what final landform is desirable and practicable prior to disturbance.
3. Save topsoil to respread after shaping.
4. Determine what landform is most stable; evaluate angle of repose vs 3:1 slopes, etc. Flatter is not always better; length of slope affects water velocity and infiltration.
5. Put the land back to its natural contour where possible and practical.
6. Do not oversteepen slopes in shaping; this causes slope failure or slides.
7. Do not create ponds or depressions that will accumulate surface water unless they are planned.
8. Leave graded surfaces somewhat roughened to trap seed, slow runoff, and provide micro climate.
9. Provide for internal and external drainage of treated areas.
10. Consider long-term mass stability requirements. Where large tailings sites or waste embankments are involved, get review and input from a geotechnical engineer. Waste embankments in Region 4 have to meet a design safety factor criteria.
11. Be aware that large tractor-dozers can efficiently push fill material uphill on a 40 percent slope, beyond that the efficiency is very limited.
12. Consider that contour ripping is safe up to a 2h:1v slope or 50 percent.

13. Site preparation and tractor-drawn planting equipment can be used on slopes up to a 3h:1v (33 percent).

#### **7.4 - Site Preparation and Planting**

A major activity in most reclamation projects is revegetating the disturbed site. Revegetation is likely to be more difficult on sites disturbed by mineral activity than on most Forest revegetation projects. There are several important steps that must be followed to successfully revegetate these disturbed sites. Applying each step will enhance the chances for success; skipping steps will induce failure.

1. Shape the site to make it functionally compatible with the surrounding watershed.
2. Reapply topsoil or any growing medium that has been salvaged.
3. Rip the site after shaping and applying topsoil to eliminate compaction and increase root depth and water infiltration.
  - a. Rip the mantle when it is relatively dry to permit shattering beneath the surface.
  - b. Deep ripping should be 2 to 3 feet deep on 2 to 3 foot centers. A "rule of thumb" is the distance between rippers should be equal to the depth ripped.
  - c. Always rip on the contour of the slope.
  - d. Cease ripping if it brings a lot of rock to the surface.
4. After ripping a site, disk or harrow to smooth the surface.
5. Fertilize the site as needed.
6. Harrow fertilizer into the soil to increase effectiveness.
7. Plant the harrowed site with a drill or cultipacker-type seeder to assure seeds are planted at the proper depth.

8. Seed should always be covered to provide a hydraulic contact with the soil.

a. Do broadcast seeding immediately after site disturbance so that soil will settle around the seed, providing a seed-soil contact. Use a light chain, log drag or roller, where possible, to cover the seed.

9. Generally schedule planting just prior to the longest precipitation period or when moisture is most favorable for seedling establishment. This means fall planting is preferred in Region 4.

10. Plant species that will establish quickly to prevent erosion and build root biomass.

11. Protect seedlings from grazing until fully established.

#### **7.5 - Seed Selection and Handling**

##### *Species selection:*

Selection of adapted plant species is essential for successful reclamation. In severe environments, such as the alpine zone, deserts, or steep exposed dry slopes and ridges, the number of adapted species suited for use in revegetation is less than for sites in more moderate climates. Methods of determining what species to select are:

1. Observe plant species found growing naturally on old disturbances near the site to be reclaimed.

2. Consult appropriate research reports and papers regarding revegetation research.

3. Consult with Forest Service scientists, county agents, SCS, or other available experts.

4. Determine if weather patterns favor warm season or cool season plants.

*Acquisition of seed:*

Seed of adapted plant species may either be collected from plants in the vicinity of the reclamation site or purchased from a seed dealer and distributor.

Seed collection by hand or mechanized equipment may be expensive. Care must be taken to observe plants for seed maturity. Active seed collection must be performed at the proper time. Different species mature seed at different times, hence, seed acquisition of various species may require several different collection trips. Some general guides to seed collection include:

1. Locate appropriate stands of desired species before seed matures.
2. Collect seed only after it matures on the plant.
3. Collect by hand-stripping or using a mechanized device designed for seed collection.
4. Collect seed in either cloth or paper bags or other containers: NEVER seal in plastic bags. This will retain moisture and cause molding.
5. Clean and separate seed from chaff and other undesirable debris as soon as the material is dry.
6. Store the clean seed in a cool dry location in paper or cloth bags.
7. Ensure that local varieties and genetic stock are used.
8. Purchase seed from a reputable seed collector and dealer. It is usually less expensive and less laborious; however, several cautions should be considered:
  - a. Be sure dealer is reputable, does he collect the seed from the location and on the dates specified?
  - b. Be sure germination percent, collection location, species name, pure live seed, and percent weed or other contaminants are specified on bag.

c. Use SCS Plant Material Centers for information about seed and seed dealers. The Centers are an excellent source of information.

9. Establish shrubs and trees on small or critical revegetation sites through transplanting. However, transplanting can be an expensive, labor intensive, and slow method of revegetation. Transplanting requires consideration of the following:

a. Selection of adapted species.

b. Sources of plant materials (commercial sources of containerized or bare-root stock, or excavation and collection of rooted plants from the revegetation site).

c. Care and hardening of the plants prior to planting.

d. Timing or determining when to plant.

e. Site conditions and preparation at the time of planting.

f. Methods of planting, spacing, fertilizing, watering, etc.

g. Care and assessment following planting.

#### **7.6 - Mulching**

Mulches are often used in reclamation to protect and stabilize soils until permanent plant cover becomes established. In addition to preventing erosion, a good mulch cover protects seeded areas from the severe effects of heat, cold and drought. The following are suggestions for using mulches:

1. There are many natural and synthetic mulches. Commonly used mulches are:

- |             |                                  |
|-------------|----------------------------------|
| - straw     | - excelsior                      |
| - hay       | - synthetic biodegradable fibers |
| - woodchips | - animal manure                  |
| - jute      | - sewage sludge                  |

2. Dark-colored mulch will raise spring soil surface temperatures.

3. Light-colored mulches will reduce summer soil surface temperatures.

4. Mulching will reduce frost heaving of new seedlings.
5. Mulch reduces rainsplash, surface wind, particle movement and other erosional effects.
6. Mulch should be applied to a roughened surface. Do not grade smooth. Apply asphalt or other suitable tackifiers or crimp mulch into the surface to keep it in place.
7. Common hay and straw mulches for seeding cover and erosion control should be applied at the rate of 2,000 to 3,000 pounds per acre. This amount will provide a 2 to 3 inch deep ground cover.
8. Mulch can be applied by hand on 3:1 or less sloping sites up to 1 or 2 acres in size. Larger steeper sites will require a power blower or mulcher.
9. Fiber mulches can be applied effectively in a slurry of water, seed, and fertilizer with a hydromulcher. Application rate should be at least 2,000 lbs/A.
10. Mulching that is crimped into the soil on dry sites may wick moisture out of the soil in some conditions.

#### **7.7 - Fertilizers and Soil Amendments**

Many disturbed sites are nutrient deficient at the time reclamation is performed. Fertilizers provide nutrients required by seedlings to establish themselves and their own nutrient cycle. The following are considerations when fertilizing reclamation projects:

1. Soils and growing mediums should always be tested for nutrient deficiencies prior to undertaking any kind of revegetation effort.
2. Disturbed lands are usually deficient in nitrogen (N) and phosphorus (P) and often require from 50 to 500 pounds per acre.
3. Plants lacking nitrogen exhibit a yellowish-green color and drying of the lower parts of the plants.
4. Phosphorus deficiencies in plants often cause a purplish color in the leaves and branches, with very little stooling or spreading and poor seed production.

5. Nutrient content of bagged and bulk fertilizers are expressed as a percent of the content by weight.

Example: A 100-pound bag marked 10-10-10 means 10 percent nitrogen (N), 10 percent phosphorous ( $P_2O_5$ ), and 10 percent potash ( $K_2O_5$ ) is contained by weight. To apply 20 pounds per acre of the nutrients, it would require 200 pounds of the fertilizer mix.

10 percent per hundred weight = 10 pounds of nutrient  
20 pounds per acre of nutrient = 200 pounds of fertilizer mix

6. Nitrogen fertilizers should be those that will release at the time of germination. Some N fertilizer is highly volatile. Others are coated for slow release.

7. Nitrogen cycling (plants taking up and giving up N) may take several applications. Phosphorus cycling usually begins with one application.

8. Other macro nutrients that plants need in large quantities are potassium, calcium, magnesium, and sulfur.

9. Micro nutrients include boron, copper, manganese, zinc, iron, molybdenum, and chlorine.

10. THE SOIL SHOULD BE TESTED FOR NUTRIENT LEVELS BEFORE ADDING FERTILIZERS.

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## **8.0 - PROCEDURES FOR UNIQUE RECLAMATION SITUATIONS**

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This chapter discusses procedures for dealing with unique reclamation situations.

### **8.1 - Acid Mine Drainage**

Acid soils, acid waste materials, and acid drainage waters are problems on many mine operations. Most acid mine problems on mine locations have the same origin—oxidation of sulphide minerals. In the West, these sulphide minerals are often associated with metallic ores. Most metallic ions are increasingly soluble with decreasing pH. This can become a serious problem; it can usually be assumed that an acid drainage problem is also a heavy metals problem. Acid drainage in the western United States is rarely associated with coal mining but may be a problem in hardrock mines.

#### *Identifying Potential Acid Problems.*

1. It is relatively easy to identify an existing acid drainage problem. A fail-safe indicator is the presence of ferric hydroxide precipitate on the bottom of the streambed. Typically, this precipitate has an orange color, but the color may vary from the yellow-reds through the purples. The precipitate is known as "yellow-boy" in the mining industry.
2. Acid conditions in either the soil/spoils or in surface waters usually indicate acid drainage.
3. Acidic stream water may be crystal clear; don't be fooled by color.
4. Acidic soil/spoils will be bare of vegetation (except for an occasional hardy individual plant) and free of insects and small mammals.
5. You can often smell the sulphurous compounds in spoils.
6. The presence of any metallic-pyrites is a good indicator that acid conditions may develop.

#### *Treating Acid Problems.*

1. Applying lime to acid spoils is the most common treatment for increasing pH.

2. Determine what types of lime are available and their effectiveness in terms of the equivalent amount of calcium carbonate.
3. Know what form the lime has and whether or not a specification for grinding is required.
4. Know the potential acid production from the spoil so that liming rates can be determined.
5. Laboratory test the spoils to be reclaimed for acid potential.
6. Collect samples from the surface 6 inches of the spoil materials. Each sample should weigh about a pound, excluding rock and gravel.
7. Contact the Regional Office for current information concerning spoil analyses procedures, laboratories, and analysis costs.
8. In addition to lime, the successful revegetation of acid spoils requires topdressing with a minimum of 12 inches of topsoil or selected subsoil. If 12 inches of topdressing soils are not available, increase the liming rate and work the lime more deeply into the spoil materials.
9. Treating acid streamflow for the improvement of fisheries or benthic organisms requires sophisticated engineering and environmental analyses. Treatment is very expensive. Obtain help.
10. Consider any mining activity that results in soil or water pH of 4.5 or less to be strongly acid.
11. Revegetate acid sites with some plant species that have demonstrated their ability to survive and grow on such sites.
12. Apply gypsum to treat salt problems caused by migration of chemical salts to the soil surface. These salts can contaminate the replacement soil.
13. Avoid soil/spoil reacidification which results from insufficient application of lime.

## **8.2 - Alkaline Sites**

1. When to expect alkaline soils:

Alkaline soils most often occur in arid to semiarid regions of the western United States where annual precipitation is less than about 15 to 18 inches. Alkalinity usually occurs on the Great Plains in the short-grass prairie regions but may also occur in other flat poorly drained arid areas throughout the West. In these areas, evaporation usually exceeds precipitation.

#### 2. What to look for:

Alkaline soils usually support a poor vegetative cover and may be entirely devoid of plants. Often these areas are small, appearing nearly circular in shape, and usually are easy to identify from surrounding vegetated areas. The soil surface usually contains large cracks, and may have a white to dark color with noticeable accumulations of salts. A soil analysis will show high concentrations of  $\text{Na}$ ,  $\text{Ca}$ ,  $\text{OH}$ , and  $\text{CO}_3$ , indicating a loading of these materials in the surface at concentrations higher than occur in the parent material.

#### 3. How to test for:

Alkaline soils have a pH ranging from slightly higher than 7 to 10 or more, depending upon salinity.

Saline-alkaline soils have high concentrations of sodium salts as well as  $\text{OH}$  and  $\text{CaCO}_3$  with a pH usually from 7 to 8.5. These soils have more than 15 percent of their cation exchange capacity occupied by sodium, but their pH is relatively low (7-8.5) because of the influence of the neutral salts present.

Nonsaline-alkaline soils have a much higher pH, usually close to 10, because they contain relatively small amounts of neutral salts. However, they contain toxic levels of both sodium and  $\text{OH}$ . These soils are usually in an undesirable physical state. Being high in clay, they tend to clod easily if worked.

#### 4. How to treat:

There are three primary methods of treating alkaline soils to improve their condition for plant growth:

*Leaching:* Soils can be flooded with irrigation water to leach out sodium and other undesirable salts. Flooding is primarily useful in soils with high concentrations of calcium and magnesium. However, there is a risk that removal of the neutral salts through flooding may increase alkalinity by increasing the concentration of sodium and  $\text{OH}$  ions.

*Scarping:* The surface incrustations of accumulated salts physically removed. This method should rarely be used because the basic processes of evaporation accumulates salts and the alkalinity in time.

*Chemical Conversion:* Use of gypsum on alkaline soils is recommended to convert the caustic alkali carbonates into sulfates. Usually, it requires cultivating several tons or more of gypsum into the surface soil and keeping the soil moist to hasten the chemical reaction.

### **8.3 - Borrow Sites**

Borrow sites for sand, gravel and rock are often located and opened without regard to future use or reclamation. It is important that the following considerations be given to each new site.

1. Determine the available volume of material as accurately as possible before opening the site. Identify future borrow needs from the site or, in other words, estimate the life of the pit.
2. Determine the final desired land form and develop a pit design to obtain it while extracting the borrow material.
3. Consider possible future uses for the site such as a pond, wildlife habitat, etc.
4. Consider visuals and surrounding landscapes. Large flat borrow areas may be more acceptable than deep narrow ones. Reclamation efforts should make the site compatible with adjacent areas and uses.
5. Strip and store topsoil for reclamation purposes.
6. Locate waste rock to facilitate easy burial during reclamation. Retain rock suitable for rip-rap or other uses.
7. Address concurrent reclamation measures to reduce sediment and fugative dust.
8. Rip compacted areas and use proper site preparation and revegetation practices in final reclamation.
9. Protect the site from grazing, if necessary.

#### **8.4 - Drill Holes**

Drill holes are usually a result of an exploration program. Depending on the scope of the program, there may be hundreds of holes or just one or two drill holes in a given area.

Each state may have requirements for reclamation of drill holes. Minimum Forest Service requirements include the following:

1. Drill holes, other than seismic shot holes, must be identified and located on a map to the quarter section.
2. All completed drill holes 2½ inches or larger in diameter should be filled with subsurface material or like material to prevent migration of water, gas, oil, or other substances from one strata to another.
3. Holes should be plugged at the surface with at least five feet of cement or other approved permanent plugging material.
4. Random checks should be made by the administrator to ensure plugging requirements are being met.

#### **8.5 - Facility Removal**

In each mining or drilling operation, some significant incumbrances on the land are the physical facilities. These include office buildings, storage sheds, mills, water tanks, etc. Provisions should be included in each reclamation plan to deal with removal of unnecessary facilities.

Consider the following when dealing with reclamation of operator facilities:

1. Ensure that all structured facilities are included in the operating plan. Make provisions for periodic review and inventory of needed and unneeded facilities.
2. Identify timeframes that facilities will be needed. Bond for removal and reclamation.
3. Describe facilities that will be removed or retained during periods of interim shutdown.

4. Identify facilities that have potential to create environmental liability or problems and ensure they meet State and Federal environmental protection requirements. Examples include:

- Fuel tanks
- Chemical storage areas
- Drilling additives storage
- Explosives storage
- Shop and service areas
- Open shafts
- Unused machinery
- Septic systems

5. Ensure removal or containment of toxic materials or hazardous structures at the completion of the activity.

### **8.6 - Heavy Metals**

Heavy metal contamination of soils, spoils, surface waters, and groundwater is invariably associated with acid mine drainage. An acid problem indicates there is probably a heavy metals problem.

#### *Common Heavy Metals*

1. In any specific mining situation, all metals will not be found at dangerous levels. One or more metals will usually be present in concentrations high enough to cause concern in any acid situation.

2. Several concerns need to be recognized.

a. First, the concern for danger to human life. The cations of greatest concern are: arsenic, cadmium, mercury, lead, nickel, manganese, and molybdenum.

b. The presence of copper is the primary concern for fishery and associated benthos.

c. Iron, aluminum, and zinc may be present in the soil/spoil in sufficient concentrations to be toxic to the vegetal cover.

3. Free roaming animals normally will not suffer from grazing revegetated mined lands. Reclaimed uranium mined land may be the exception where vegetation may accumulate radioactive elements.

4. There are no mine portal standards for acceptable limits of heavy metals. Every situation is different and must be checked individually. It is much more difficult to control the problem than it is to avoid it; however, on existing mines, control may be the only solution.

5. A 12- to 24-inch application of soil materials followed by successful revegetation will affect long-term control.

6. Revegetation will be helped by applying lime to the spoil surface in sufficient quantity to raise the first 12 inches of spoil material to a pH of 6 or more.

7. The lime should be worked into the spoil surface before topsoiling.

8. Even after soil surfaces have been brought to near neutral condition, the subsurface water bleed-out will continue to be contaminated for years to come.

9. If immediate control is needed, the best solution is to remove all contaminated materials, then topsoil and revegetate the area.

10. When revegetating acid sites, plan to monitor the site for 10 years after the successful establishment of vegetal cover to determine if re-acidification is occurring.

### **8.7 - Highwalls**

State and Federal coal mining regulations normally prohibit an operator from leaving highwalls. This is not true for all mineral commodities. The ultimate disposition of highwalls should be negotiated during the review of the mine operating plan. Highwalls can be part of any mining operation in any terrain.

1. Hazards: The hazards associated with highwalls are the occasional rock fall into the bottom of the pit or perhaps a massive rotational slide of the entire wall.

2. Disposition:

a. The normal procedure is to either leave highwalls in an unreclaimed state or to backfill the pit and bury the wall.

b. Instead of leaving a slick highwall, leave a 3-foot bench every 50 vertical feet. This creates a nich for vegetation and provides nesting areas for raptors and other birds.

c. Highwalls may also be brought down by blasting.

### **8.8 - Land Form and Visual Changes**

Some mineral developments are large enough to actually change the landform and visual characteristics. This is particularly true of large open pit mining operations. Ridges may become valleys, new mountains of waste may be produced, water courses may be changed—all resulting in a varied landform. Managers should be aware of these potential changes and plan for their reclamation in the early stages of development.

The following are ideas for dealing with the landform changes:

1. Visualize probable changes through an artist's conceptual drawing or digital computer modeling.
2. Evaluate the effects that mining methods and type of equipment used will have on final landform, i.e., trucks vs scrapers for moving material will affect the end configuration of dumps, size of roads, steepness of grade, etc.
3. Recognize what the final landform will be. Plan reclamation to conform visually with natural surroundings.
4. Recognize probable changes in soil color, texture, productivity.
5. Determine if final landforms will be stable or unstable.
6. Recognize possible changes in:
  - a. Slope direction, length, or grade.
  - b. Ground water regimes.
  - c. Surface runoff patterns.
  - d. Aspect and vegetative types.
7. Recognize and mitigate, where possible, changes in fish and wildlife habitat.

8. Some activities that change landforms are:

- a. Highwalls.
- b. Open pits.
- c. Haul roads.
- d. Railroads.
- e. Waste embankments.
- f. Tailings ponds.
- g. Stream diversions.

#### **8.9 - Noxious Weeds and Poisonous Plants**

1. A certain amount of weed invasion is normal following revegetation, especially on arid sites. Weeds will largely disappear after 2 to 3 years, e.g., *Salsola kali* (tumbleweed) and *Sisymbrium spp.* (mustard).

2. Noxious weeds are extremely competitive and can effectively dominate a site. Efforts should be made to recognize and treat noxious weeds as soon as they appear. If noxious weeds exist on a site from which topsoil will be removed, the weeds should be treated prior to topsoil removal (preferably for 2 to 3 consecutive years). Efforts also should be made to control noxious weeds in areas adjacent to sites that will be revegetated.

3. If a site is to be used for grazing, poisonous plants should be treated similar to noxious weeds.

4. Noxious weeds and poisonous plants that occur on National Forest System lands in the Intermountain Region have been identified (see Appendix reference).

5. Detailed methods for the treatment of noxious weeds and poisonous plants are described in USDA Agricultural Handbook No. 565 and USDA, SEA Agriculture Information Bulletin No. 415. Before using any pesticide, review Section 2150 of the Forest Service Handbook and consult the Regional Pesticide Coordinator.

### **8.10 - Open Pit Mines**

Open pit operations have major impacts on visuals, land form, and mass stability of an area. It is imperative that these kinds of proposals receive adequate review by specialists in these disciplines.

In Region 4, open pit mines are commonly associated with extracting gold, copper, molybdenum and phosphate. Large open pit mines are more prevalent now than they were a few years ago because of the new ways of extracting gold. The following are ideas to assist in planning reclamation of open pit mines.

1. Recognize that the size and shape of the pit are normally determined by the location (strike and dip) and quality of the ore body.
2. Design to confine roads and other site-disturbing activities to the ultimate pit or dump limits, where possible.
3. Schedule waste location so soil or growing medium material will end up on top of the waste.
4. Plan for backfill of pits, where practical.
5. Consider placement of waste, allowing for a 30-percent average swell factor.
6. Design dumps with the following in mind:
  - a. Long-term sediment production.
  - b. Long-term mass stability.
  - c. Visual impacts.
  - d. Final land use and desired configuration.
7. Plan to control drainage coming onto pits and dumps from surrounding areas.
  - a. Drain water away from dumps and dump face for increased stability.
  - b. Drain water into pits to contain sediment.

8. Get a geotechnical engineering review of the dump design for a large project.

9. Shape dump slopes 3h:1v or flatter if they are to be revegetated; planting on steeper slopes is possible with specialized equipment.

10. Evaluate reshaping and angle of repose dumping against total disturbed acreage and final desired landforms when planning dump locations.

a. Also, consider effects of haul roads, conveyors, etc., in evaluating total disturbance.

11. Consider effects of pit design (depth) on ground water and surface flow patterns.

12. Don't move material twice. It is not economically practical except for topsoil or growing mediums.

13. Evaluate pit design for highwalls. Consider:

- a. Public safety.
- b. Wildlife migration and other habitat possibilities.
- c. Livestock access.
- d. Visual impacts.
- e. Revegetation possibilities.

#### **8.11 - Pipelines**

Pipelines are commonly used in mineral operations. They vary greatly in size. Pipelines installations above and beneath the surface create considerable environmental impacts. Consider the following in reclamation:

1. What the expected use period of the line is. How long it will be needed.
2. What it will carry.
3. Should it be above or below surface?

4. Will it need to be replaced or rotated?
5. How much right-of-way is needed for installation and maintenance? (See page 100, Utilities Visual Handbook.)
6. A contingency plan for leaks and spills.
7. Anticipate settlement of the cover layer on buried lines and compensate to reduce erosion along the line.
  - a. Mound up cover material over the pipe.
  - b. Provide for surface runoff to escape the trench area.
  - c. Construct waterbars at right angles to the slope rather than at right angle to the trench.
8. Save and replace topsoil on all disturbances.
9. Re-establish revegetation as soon as possible to protect soils.
10. Design right-of-way to protect visuals.
11. Determine location of access and maintenance roads and whether they will be part of the transportation system.
12. Precheck trenches for settling 1 year after covering and before releasing the bond.

#### **8.12 - Powerlines**

Reclamation of powerlines often comes after other reclamation has been accomplished.

1. To accomplish reclamation of powerlines:
  - a. Remove all towers and poles.
  - b. Remove cable and guy wires and anchors.
  - c. Obliterate access roads.
  - d. Re-establish vegetation in right-of-ways that complement the surrounding vegetation and terrain.

2. To lessen reclamation problems:

- a. Feather right-of-way cuts in vegetation to provide a natural appearing opening.
- b. Consider that topping vegetation often is all that is necessary to provide clearance during operations.
- c. Consider using helicopters to minimize disturbance during installation and reclamation.
- d. Protect rights-of-way from off-road vehicle travel and wear that may cause additional erosion.
- e. Alter vegetative types on rights-of-way to provide species diversity for wildlife.

**8.13 - Railroads**

Railroads are sometimes used in conjunction with large mining operations. They are like large road prisms in many ways, but also have some unique differences. The following should be considered in planning reclamation of railroads:

1. Ties and rails should be removed. Often, this can be contracted for the salvage value.
2. Design and location of railroads is key to reclamation. Railroads are located on a 2 percent maximum grade.
3. When the railroad is gone, how will the transportation corridor be used?
4. Topsoil should be salvaged and stored for final or interim reclamation.
5. Subgrades or fill are often very large rock or heavily compacted (100 percent) clays. These are often impervious and form a dam-like structure across the natural terrain. Adequate drainage is imperative.
6. If subgrade material is unsuitable, it will need to be removed. This will necessitate locating a waste area.

7. Railroad tracks require ballast for rail and tie stability. Ballast is 1- to 1½-inch diameter rock. It is placed on top of the grade in 6-inch to 3-inch depths. It contains no fines.

8. Ballast should be reclaimed for other uses (2,500 cubic yards per acre). Remove ballast or rip and mix with soil, where possible.

9. Before construction, determine whether railroad prism will be retained or removed during reclamation and bond accordingly.

10. Large cuts and fills should be designed for reclamation and stability.

#### **8.14 - Oil and Gas Wellsites**

Oil and gas wellsites are one of the best reclamation opportunities. Most are dry holes or are drilled and capped. This means disturbance lasts a relatively short period of time; all soil material is still on site; and reclamation can begin almost immediately. These conditions favor successful reclamation.

The following are suggested techniques for successful reclamation of wellsites in mountainous terrain:

1. Locate roads on the most reclaimable terrain, flattest slopes, deeper soils, best growing sites.

2. *Do not* disturb road prism or remove topsoil if roads are for short duration (1 to 2 years) in flat terrain.

- a. Place adequate gravel layer over topsoil to facilitate traffic.
- b. Upon abandonment, use loaders or scrapers to remove gravel down to topsoil layer.
- c. Introduce new seed, where necessary, and allow natural seed source in topsoil to regrow.

3. Locate wellsite on best location combining seismic information and surface features. Exact site location is some what flexible based on seismic data. Strive for balance between cuts and fills. Avoid:

- a. Avalanche paths.
- b. Drainage channels.

### *Predisturbance Considerations*

1. Obtain soil and subsoil core samples up to 20- to 30-feet deep on padsite. Determine topsoil makeup.
2. Obtain engineering design on 2-foot contour before disturbance.
3. Establish photo monitoring points.
4. Obtain inventory and site analysis of vegetation.
5. Obtain reference points to enable recontouring.
6. Locate topsoil storage areas—uphill or laterally from pad.
7. Include mitigating requirements from NEPA document into operating plan.
8. Flag clearing limits and stake cuts and fills.
9. Determine if rig is a right- or left-hand setup and design pad accordingly.

### *Site Disturbance and Operations*

1. Balance cut and fill to minimize cut slope.
2. Locate reserve pit in cut portion of pad, if possible.
3. Line pit, if necessary. Use:
  - a. Native clays.
  - b. Bentonite (Use no more than needed. It becomes a problem in reclamation.).
  - c. Membrane liners (allow for sag).
4. Salvage spoil material (leftover fill due to swell).
5. Bury slash in cut portion and bring fill back over it when recontouring.

6. Divert surface runoff away from pad with surface ditches.
7. Construct berm around pad to contain oils and fuel spills.
8. Skim oils off pit and dispose of in proper landfill to prevent ground contamination.
9. Do not allow any solid debris in reserve pit, i.e., pipe, barrels, lumber, etc.

*Post Operations and Reclamation*

1. Remove all lumber, iron, wire, and other debris from site after rig is removed. Do not bury these materials on site.
2. Pump water off reserve pit. If water meets state water quality standards, it can go down hole or on surface.
3. Remove heavy fluids and dispose of them in an approved site.
  - a. Mix with pump or grain auger to obtain proper consistency.
  - b. May need to add water to make fluid.
4. "Squeeze" and cover the pit after fluids have been removed.
  - a. Dig deep, narrow lateral trenches radiating out from pit.
  - b. Push dirt from pad into remaining sludge in pit. Working in from edges, force it to flow into the later trenches. *Do not* push any water or drilling fluids into trenches—only heavy sludge.
  - c. Leave space for 2 to 3 feet of dirt to be added on top of sludge in trenches.
5. Cut trenches at sludge line and haul off excess.
6. Cover all sludge, bentonite, etc., with clean material for revegetation.
7. Pump all septic tanks.
8. Plug water wells, unless planned for future use.

9. Reshape cut and fill to preproject contours.
10. Replace topsoil evenly and revegetate the site.
  - a. Use trees, boulders, and natural debris to enhance visuals and microclimate.
11. Protect trees immediately adjacent to the site from injury to avoid mortality after site is abandoned.
12. Cut well stem 12 inches below ground and mark surface with a steel plate or large rock.
13. A relatively recent method of pit reclamation is called "solidification." The process is to add Portland cement to the pit residue and mix until the sludge solidifies. This "locks up" the residue material permanently so it can be buried on site. The process of pit solidification appears to be cost-effective and environmentally acceptable.

#### **8.15 - Roads**

Roads are one of the most impacting disturbances in mineral operations. The Environmental Protection Agency estimates that roads may produce as much as 300 times more sediment than the same area of undisturbed forest land.

Reclamation of roads is often difficult; partial reclamation is always possible. The following are suggestions for enhancing road reclamation:

1. Locate roads on the flattest and most productive slopes.
2. Determine before construction if the road is to be retained or obliterated in final reclamation.
3. Determine what the road construction method will be; this can affect the amount of disturbance to reclaim. Common road building methods are:
  - a. Side cast.
  - b. Cut and fill.
  - c. End haul.

4. Salvage topsoil in construction. Store uphill if possible.
5. Salvage merchantable timber, burn slash in pits, and bury residual material.
6. Seed and fertilize cut and fill slopes immediately after disturbance to control erosion and establish vegetative cover.

Techniques for use in final reclamation of roads:

1. Suitable gravel should be removed and salvaged where practical.
2. With large bulldozers, road profiles can be pushed to, or near, original contour on cross slopes up to 40 percent.
3. Roads on slopes over 40 percent can be restored to or near original profile with large backhoes or drag lines.
4. The following actions should be considered when reclaiming roads:
  - a. Remove culverts.
  - b. Outslope or restore to original contour. Pull berm into prism.
  - c. Rip on the contour to reduce compaction
  - d. Shape cuts and fills to be seeded.
  - e. Fertilize and seed after shaping. Use a hydroseeder on slopes 2:1 or steeper.
  - f. Introduce rocks, slash, and trees to improve visuals and microclimate.

Reclamation of large 60- to 100-foot-wide roads in steep terrain usually needs the following:

1. Rip to reduce compaction.
2. Pull berm and outside shoulder up the cut slope as far as possible. Use large trackhoe or drag lines.

3. If travelway will be retained, locate it on outside edge of roadway.
4. Reduce height of backslopes where possible.
5. Remove culverts.
6. If broadcast seeding, seed same day as disturbance to get maximum seed covering through sloughing and settling. Use 25 to 30 pounds of seed per acre. Fertilize as appropriate.

#### **8.16 - Slime Ponds**

Slime ponds are associated with the phosphate mining and fertilizer industry.

These ponds are phosphatic clay wastes stored above ground behind earthen dams. The waste materials are approximately 50 microns and smaller and result from washing phosphate ore. Phosphate ores are washed, beneficiated, to increase the grade. That is, to increase the content of the  $P_2O_5$ . Beneficiation is to control the grade of the feed into the fertilizer plant. With current technology, it is a necessary part of producing phosphate fertilizers. In Region 4, slime ponds usually will not be located on National Forest land.

#### *Reclamation considerations:*

1. Slime ponds are created by piping the slimes into the pond as 90 to 98 percent water and only 2 to 10 percent solids. A significant fraction of the solids are colloidal and will not settle out.
2. Ponds are typically several acres in size and from 50 to 100 feet deep. Reclamation opportunities are limited.
3. Sometimes, 20 to 30 years are required before the pond will dry and support any type of equipment.
4. In Region 4, probably the only viable option for reclamation is to encourage the early establishment of deep-rooted woody vegetation to maximize the evapotranspiration loss.
5. Farm type equipment usually can operate on these ponds when the solids content exceeds 60 percent in the top 6 feet.
6. Colloidal gel in the bottom of slime ponds probably will not dry for many years.

## **8.17 - Diversions**

Stream diversions may be a necessary part of the mining plan. However, other alternatives should always be considered. Diversions of live streams should be discouraged wherever possible. Reasons for diverting streams should be closely examined including the structures or ponds, etc., that might occupy the original area of the stream channel. Check state or Federal laws or regulations controlling stream diversions.

1. Transbasin diversions (where water is diverted from one drainage into another) are complex and should be discouraged. Get help.
2. The longer a stream diversion is in place the greater the chance for environmental damage. Diversions with a short-term life, about 10 years, can be managed more successfully than long-term diversions.
3. Water always seeks the lowest level. Given enough time, the meteorologic and geologic events will put a flowing stream back into the lowest topographic levels. In the long term, all stream diversions are temporary.
4. Construction of a new stream channel should provide for stability of the streambed and streambanks; this might include heavy rip-rap or protective vegetation being established in the channel.
5. With the exception of a brief period during construction the physical quality of the water will likely not be degraded.
6. The headgate, where the stream is originally diverted, should be of adequate size and stoutly constructed.
7. The diversion stream gradient of the new channel should be considered for streambed erosion and bedload implications.
8. The capacity of the proposed new channel should not be less than the capacity of the original channel. This capacity should be determined by a hydrologist.
9. If the proposed new channel is a pipe, then both the pipe capacity and ability of the pipe to remain in place should be considered.

10. For temporary diversions, the reclamation plan should specify how the stream channel will be reclaimed. Normally, pipe or culvert should be removed from the area.

11. Constructed stream channels that are no longer required should be filled with rock and soil.

### **8.18 - Waste Dumps**

With the trend toward larger equipment, large pits, and lower ore grades, there is also a trend toward large waste dumps. With large surface dumps, it is important to consider appropriate performance standards for stability, drainage, and revegetation. Safety requirements can be calculated for each dump or waste embankment. Contact the Regional Geotechnical Engineer for assistance.

1. In Region 4, there are three types of dumps being constructed: (a) head of valley, (b) cross valley, and (c) sidehill.

2. Head of valley fills should be engineered for a long-term factor of safety of not less than 1.25.

3. Cross valley fills have to provide for streamflow through the base of the dump. This is normally accomplished by constructing a rubble drain or french-drain.

4. The long-term factor of safety for cross valley fills should be not less than 1.25.

5. Provisions must also be considered for allowing flood waters or flood waves to enter the upstream end of the french-drain.

6. Flood water must not be permitted to traverse the top of a cross valley fill.

7. If the upstream end of a fill is truncated, a temporary flood water storage area may be created. Such a storage area is a technically acceptable way of dealing with flood waves.

8. Temporary water storage areas may be regulated by state law.

9. The french-drain must have sufficient capacity to transmit flood water safely through the base of the fill. The drain must also be constructed of durable, nonslaking rock.

10. The french-drain and associated temporary storage areas should be able to accommodate the 100-year flood volume from either straight rain or from rain-on-snow.

11. Sidehill waste dumps tend to contain less volume than valley dumps. In this Region, sidehill waste dumps generally have performed satisfactorily.

12. If the natural terrain is steep, the waste dump surface will be steep. Operating revegetation equipment on these dumps may be hazardous if the terrain and waste dump surface are steeper than 3:1.

13. If waste dumps have been engineered with adequate safety factors, it is up to the operating company to construct the dump to design specifications. In order to meet the current on-the-ground conditions, it is almost always necessary to change one or more of the design specifications. This is the normal and expected situation. However, there should be frequent inspections during the construction period to ensure that design specifications are being met or changed in an approved manner.

#### **8.19 - Tailings Ponds**

When planning reclamation of a tailings pond, considerations will depend on whether the pond is old, new, or abandoned. In general, stabilization and revegetation of tailings ponds are expensive and difficult. Both the chemical and physical properties of tailings work against stabilization and revegetation.

1. Reclamation cannot be realistically planned unless the chemical properties of the tailings are known. The following information needs to be obtained:

- a. Is the pond acid, caustic, or near neutral in pH?
- b. Is the pH expected to change naturally over time?
- c. Can the pH be adjusted at reasonable expense?
- d. Are there any adverse consequences associated with adjusting pH?

- e. Are heavy metal cations present?
  - f. What about other cations or anions?
  - g. Are there any chemicals left in the pond?
2. If the pond is wet, the pond may be lined on the bottom.
  3. Groundwater contamination may be a problem.
  4. State or other Federal laws and regulations need to be complied with.
  5. Fugitive dust is a major environmental hazard associated with dry tailings ponds.
  6. Sand or earth tailings pond dams must be designed to ensure long-term stability. Emergency spillways are usually needed.
  7. Most tailings dams leak. A seepage return facility should be provided below the main dam.
  8. The seepage return must operate as long as the main pond leaks.
  9. Tailings materials are difficult to revegetate and usually require amendments to adjust to adverse chemistry.
  10. Tailings also need to be stabilized against blowing wind. Young vegetation will not survive severe wind blasting. Topdressing tailings material with 24 to 48 inches of soil may be necessary. If the surface cannot be successfully revegetated, consider covering with 12 inches of rock.
  11. Where translocation of toxic materials by plants or salt migration is a problem, provide a capillary barrier of coarse rock overlain by fine rock (10 to 12 inches) between the tailings surface and the growing medium or topsoil.

#### **8.20 - Toxic Chemicals**

There are many toxic chemicals that are used in mining and drilling operations. This chapter is only intended to create an awareness of some of the more common toxic chemicals that may be encountered.

*Cyanide.* This highly toxic chemical is used as a leachate for extracting precious metals from low-grade ores.

1. Little is known about migration of free and complexed cyanides through soils.
2. Sodium Cyanide may remain in dry, alkaline soil for long periods of time, if introduced.
3. Cyanide oxidizes quickly when exposed to air and sunlight. Dilution, oxidation, and chemical alteration are good methods of reclamation.
4. Cyanide is very reactive and short lived.
5. Cyanide solutions must be controlled and contained.

*Salt Spills.* Salt spills are common in oil and gas drilling operations. Spills occur when large deposits of salt water under pressure are encountered in drilling. Dilution and cleanup are effective methods of reclamation.

*Drilling Muds.* These are a variety of chemical additives used in oil and gas drilling operations. Muds contain Chromates and other dangerous chemicals. Reclamation will consist of containment and proper disposal of muds.

Solidification of these residues by adding cement and/or fly ash is becoming an acceptable practice. Hauling muds to an approved disposal site is a common practice in Region 4.

*Other Toxic Materials.* Common contaminants that are particularly harmful to animals, fish, or people are:

- Arsenic
- Nickle
- Cadmium
- Mercury
- Copper
- Lead

Common toxic contaminants to plants are:

Aluminum  
Zinc  
Copper

All mineral operations should be examined for all of the aforementioned minerals if they are suspected to be present.

#### **8.21 - Reclamation of Mine Adits**

Adits from old mine workings are often left unreclaimed. The following are suggestions for reclamation of adits and mine portal sites:

1. Check adit for acid mine drainage.
2. Remove surface improvements—buildings, track, unused building material, containment ponds, ore stockpiles and ore bins, and other debris.
3. Shape and drain surface area of dumps. Depending on the material, the area may be prepared for seeding.
4. Flatten oversteepened backslopes around portal and ancillary improvements and revegetate them.
5. Assure that roads approaching or leaving the area are properly drained and treated.
6. Realize that attempts to establish vegetation on the face slopes will be dependent on the in-place material. Some weathered material may be treated and stabilized through seeding.
7. Assure public safety around portal area. Refer to Mining Safety and Health Administration (MSHA) direction for closing portals.

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**APPENDIX 1**  
**Planting Matrix — Semiarid**

Activity	SPRING		SUMMER		FALL <sup>1</sup>		WINTER	
	Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages
Direct seeding <sup>2</sup> (grasses)	Cool season species only	Winter Moisture variable	Warm season species. More reliable precipitation. Plant prior to July-Aug rains	None	None	Frost heaving. Limited fall growth	None	Unsuitable for germination and growth
Bare root (shrubs)	Not recommended	Not recommended	Plant after initiation of summer rains. Soil moisture must be near saturation	Timing critical. Variable precipitation	If summer rains are late, early fall plantings are possible	Frost heaving	Not recommended	Not recommended
Containerized seedlings	Not recommended	Not recommended	Soil moisture must be near saturation	Variable precipitation	If summer rains are late, early fall plantings are possible	Frost heaving	Not recommended	Not recommended

Climate Summary: Semiarid mesas and valleys of northwestern New Mexico and northeastern Arizona are characterized by low, highly variable rainfall and high summer temperatures. Highest rainfall months are July and August with occasional late summer storms extending into September. Driest months are May and June. Rainfall varies with elevation, but in lower areas averages 7-10 inches annually. Snowfall light most years and seldom remains on ground. Growing season ranges from 140-180 days.

<sup>1</sup> Fall season implies terminal season of the year and that seeds and plants will remain dormant until spring.

<sup>2</sup> Direct seeding involves the use of machinery to place seed in a shallow furrow and cover it with soil. Firming of soil around seeds and placement of fertilizer near to seeds may be accomplished on sites where required. If seeds are broadcast rather than drill seeded, some action to cover them with soil is essential unless it is on freshly graded spoils where natural sloughing will cover the seed.

## APPENDIX 2 Planting Matrix — Alpine

Activity	SPRING	SUMMER		FALL <sup>1</sup>		WINTER
		Advantages	Disadvantages	Advantages	Disadvantages	
Direct seeding <sup>2</sup> (grasses, sedges, forbs)	Sites not accessible	None	Optimum site conditions have already passed. Site may remain too dry. Seed not yet ready to be collected.	Provides for dormancy requirements. Site conditions are usually optimum in fall (e.g., not too wet). Seed will be in place next spring when conditions are optimum	Seed collection of natives may coincide with optimum planting times. Seeds may have to be collected 1 year ahead or purchased commercially from nurseries. If seeding is too early, frost damage to germinating seedlings may occur	Sites not accessible
Bare-root stock	Not recommended in this life zone					
Containerized tubelines or native plugs (grass, sedges, forbs, and some shrubs and trees)	Sites not accessible	None	Actively growing plants may not be hardened off to low temperatures. Conditions not favorable	Plant only after dormancy is induced. Site conditions are usually most favorable	Frost thrusting may lift plants if not firmly packed. High risk of severe storm activity	Sites not accessible

Climate Summary Short growing season of 45 to 80 days; low summer temperatures averaging about 43°F, high wind speeds, high solar radiation loads, and no frost free periods (needle ice thrusting can occur at any time). Seasons of summer and fall are compressed into about 2 months, and winter and spring together are about 10 months

<sup>1</sup> Fall season implies terminal season of the year and the seeds and plants will remain dormant until spring

<sup>2</sup> Direct seeding involves the use of machinery to place seed in a shallow furrow and cover it with soil. Firming of soil around seeds and placement of fertilizer near to seeds may be accomplished on sites where required. If seeds are broadcast rather than drill seeded, some action to cover them with soil is essential unless it is on freshly graded spoils where natural sloughing will cover the seed

### APPENDIX 3 Planting Matrix — Great Basin

Activity	SPRING		SUMMER		FALL <sup>1</sup>		WINTER
	Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages	
Direct seeding <sup>2</sup>	Favorable temperature/precipitation for seedling establishment	Late winter may reduce time available for seeding Late frost or a short spring may reduce seedling establishment or growth	Not recommended	Not recommended	Seeds may receive needed cold treatment and germinate in late winter	Early winter may prevent completion of seeding operations	Not recommended
Rare root planting	Plant can establish if planted before summer drought	A short spring season may reduce survival	Not recommended	Not recommended	Plant mid fall Avoid late fall planting	Frost heaving in heavy soils. Open winters	Not recommended
Transplanting container grown plants	Best results for establishment are in spring Hazards of seed germination and establishment are bypassed	Weather may be a problem in scheduling field work	Possible if can be planted in moist soil Long period of planting if possible	High temperatures and drought can be detrimental	Best results for establishment. Plant early to mid fall	Frost heaving Open winters	Not recommended

Climate Summary: An area of isolated mountain ranges and extensive level valleys where a highly variable frost-free growing season may be from 120-180 days in the valleys and less than 100 days in the foothills. Spring and fall temperatures are generally moderated (50°F), but high summer temperatures may reach in excess of about 98°F. Warm season precipitation from erratic thunder-showers is less than half of the total precipitation of about 6-16 inches annually.

<sup>1</sup> Fall season implies terminal season of the year and that seeds and plants will remain dormant until spring.

<sup>2</sup> Direct seeding involves the use of machinery to place seed in a shallow furrow and cover it with soil. Firming of soil around seeds and placement of fertilizer near to seeds may be accomplished on sites where required. If seeds are broadcast rather than drill seeded, some action to cover them with soil is essential unless it is on freshly graded spoils where natural sloughing will cover the seed.

## APPENDIX 4

### Plant Species Suitable for Adverse Conditions

#### Moderately Acid Soils

*Agrostis tenuis* (Common bentgrass)  
*Deschampsia caespitosa* (Tufted hairgrass)  
*Poa alpina* (Alpine bluegrass)  
*Phleum pratense* (Common timothy)  
*Carex* spp. (Sedges)  
*Achillea millefolium* (Yarrow)  
*Sibbaldia procumbens* (Creeping sibbaldia)

#### Moderately Saline Soils

*Festuca arundinacea* (Tall fescue)  
*Agropyron desertorum* (Crested wheatgrass)  
*Agropyron elongatum* (Tall wheatgrass)  
*Distichlis stricta* (Desert saltgrass)  
*Lotus corniculatus* (Birdsfoot trefoil)  
*Eriogonum umbellatum* (Sulfur eriogonum)  
*Atriplex* spp. (Saltbush)  
*Artemisia* spp. (Sagebrush)

#### Drought Hardy

*Agropyron desertorum* (Crested wheatgrass)  
*Agropyron sibiricum* (Siberian wheatgrass)  
*Agropyron smithii* (Western wheatgrass)  
*Agropyron inerme* (Beardless wheatgrass)  
*Agropyron spicatum* (Bluebunch wheatgrass)  
*Elymus giganteus* (Giant wildrye)  
*Elymus junceus* (Russian wildrye)  
*Sitanion hystrix* (Squirreltail)  
*Hilaria jamesii* (Galleta)  
*Oryzopsis hymenoides* (Indian ricegrass)  
*Stipa comata* (Needleandthread)  
*Sporobolus* spp. (Dropseed)  
*Kochia prostrata* (Summercyprus)  
*Melilotus officinalis* (Yellow sweetclover)  
*Trifolium hirtum* (Rose clover)  
*Vicia dasycarpa* (Woolypod vetch)  
*Hedysarum boreale* (Utah sweetvetch)  
*Camphorosma monspeliaca* (Mediterranean camphorfume)  
*Ceratoides lanata* (Winterfat)  
*Cercocarpus ledifolius* (Mountain mahogany)  
*Atriplex* spp. (Saltbush)  
*Artemisia* spp. (Sagebrush)  
*Juniperus* spp. (Juniper)

**APPENDIX 5**  
**Determining Pounds of Seed Per Acre Based**  
**on the Number of Seeds Per Square Foot**

NOTE: Normally seeding rates will vary from 20 to 60 seeds per ft<sup>2</sup> depending on site conditions.

**Steps for calculating equal seeding rates for each species.**

1. Multiply 1 acre in square ft X number of seeds to be used per ft<sup>2</sup> = total number of seeds required per acre.
2. Divide the total number of seeds per acre by the number of species in the mix = the number of seeds per species.
3. Complete the following calculation for each individual species in the mix:

Divide the number of seeds per species by the number of pure live seeds (PLS) per lb = lbs of seeds required for that particular species.

EXAMPLE: (Using a 1-acre area, 50 seeds/ft<sup>2</sup>, 200,000 PLS/lb and 10 species.)

- a. One acre (43,560 ft<sup>2</sup>) X 50 seeds/ft<sup>2</sup> = 2,178,000 seeds.
- b. 2,178,000 seeds divided by 10 species = 217,800 seeds/species.
- c. 217,800 seeds/species divided by 200,000 PLS/lb = 1.1 pounds/acre of each species.
- d. 1.1 pounds X 10 species = 11 pounds/acre total.

**Steps for calculating unequal seeding rates for each species.**

1. Multiply 1 acre in square ft X number of seeds to be used per ft<sup>2</sup> = total number of seeds required per acre.
2. Multiply total number of seeds per acre X the percent composition of the species to be seeded = number of seeds for each individual species.
3. Divide the number of seeds per individual species by the number of PLS per pound = pounds of seed per acre.

EXAMPLE: (Using a 1-acre area, 50 seeds/ft<sup>2</sup> and varying numbers of seeds/lb for five species.

a. One acre (43,560 ft<sup>2</sup>) X 50 seeds/ft<sup>2</sup> = 2,178,000 total seeds/acre.

b. Calculations for five species:

Total Seed/A	X % Compo- sition	= No. Seeds/ Species	- No. Seeds/ /Lb	= Lbs/A
2,178,000	10	217,800	200,000	1.089
2,178,000	10	217,800	260,000	.835
2,178,000	20	435,600	300,000	1.452
2,178,000	30	653,400	140,000	4.667
2,178,000	30	653,400	50,000	13.068
			Total lbs/A	21.111

**APPENDIX 6**  
**Seeding Rate Chart**

Approximate number of seeds per pound of pure seed and seeds per square foot per pound of pure seed per acre.<sup>1</sup>

Scientific Name	Seeds/ Pound (1000's)	Seeds/ ft <sup>2</sup> /lb /acre
<b>GRASSES</b>		
<i>Agropyron cristatum</i> (crested wheatgrass)	300	6.9
<i>Agropyron dasystachyum</i> (thickspike wheatgrass)	150	3.5
<i>Agropyron desertorum</i> (standard crested wheatgrass)	195	4.5
<i>Agropyron elongatum</i> (tall wheatgrass)	75	1.7
<i>Agropyron inerme</i> (beardless wheatgrass)	125	2.9
<i>Agropyron intermedium</i> (intermediate wheatgrass)	80	1.8
<i>Agropyron riparium</i> (streambank wheatgrass)	160	3.7
<i>Agropyron sibiricum</i> (Siberian wheatgrass)	160	3.7
<i>Agropyron smithii</i> (western wheatgrass)	115	2.6
<i>Agropyron spicatum</i> (bluebunch wheatgrass)	140	3.2
<i>Agropyron trachycaulum</i> (slender wheatgrass)	135	3.1
<i>Agropyron trichophorum</i> (pubescent wheatgrass)	80	1.8
<i>Alopecurus arundinaceus</i> (creeping foxtail)	750	17.2
<i>Alopecurus pratensis</i> (meadow foxtail)	400	9.2
<i>Andropogon barbinodis</i> (cane bluestem)	750	17.2
<i>Andropogon caucasicus</i> (Caucasian bluestem)	860	19.8
<i>Andropogon gerardi</i> (big bluestem)	130	3.0
<i>Andropogon hallii</i> (sand bluestem)	100	2.3
<i>Andropogon ischaemum</i> (yellow bluestem)	830	19.1
<i>Andropogon scoparius</i> (little bluestem)	240	5.5
<i>Bouteloua curtipendula</i> (spike)	140	3.2
(sideoats grama) (grain)	720	16.6
(Avg. mixture)	250	5.8
<i>Bouteloua eriopoda</i> (black grama)	1,300	30.6
<i>Bouteloua gracilis</i> (blue grama)	725	16.7
<i>Bromus biebersteinii</i> (meadow brome)	80	1.8
<i>Bromus carinatus</i> (California brome)	145	3.3
<i>Bromus inermis</i> (smooth brome)	140	3.2
<i>Bromus marginatus</i> (mountain brome)	90	2.1
<i>Bromus mollis</i> (soft chess)	265	6.1

Scientific Name	Seeds/ Pound (1000's)	Seeds/ ft <sup>2</sup> /lb /acre
GRASSES (Continued)		
<i>Bromus rubens</i> (red brome)	260	6.0
<i>Buchloe dactyloides</i> (grain) (buffalograss) (burs)	275 40	6.3 0.9
<i>Calamovilfa longifolia</i> (prairie sandreed)	275	6.3
<i>Cenchrus ciliaris</i> (grain) (buffelgrass) (burs)	860 225	19.8 5.2
<i>Cynodon dactylon</i> (Bermudagrass)	1,500	34.5
<i>Dactylis glomerata</i> (orchardgrass)	540	12.4
<i>Distichlis stricta</i> (inland saltgrass)	520	12.0
<i>Elymus cinereus</i> (basin wildrye)	150	3.5
<i>Elymus giganteus</i> (mammoth wildrye)	55	1.3
<i>Elymus junceus</i> (Russian wildrye)	170	3.9
<i>Elymus triticoides</i> (beardless wildrye)	150	3.5
<i>Eragrostis atherstonei</i> (Atherstone lovegrass)	4,000	92.0
<i>Eragrostis chloromelas</i> (Boer lovegrass)	2,800	64.4
<i>Eragrostis curvula</i> (weeping lovegrass)	1,500	34.5
<i>Eragrostis intermedia</i> (plains lovegrass)	3,300	75.9
<i>Eragrostis lehmanniana</i> (Lehmann lovegrass)	6,500	149.0
<i>Eragrostis superba</i> (Wilman lovegrass)	1,100	25.3
<i>Eragrostis trichodes</i> (sand lovegrass)	1,500	34.5
<i>Festuca arizonica</i> (Arizona fescue)	410	9.4
<i>Festuca arundinacea</i> (tall fescue)	210	4.8
<i>Festuca idahoensis</i> (Idaho fescue)	450	10.3
<i>Festuca megalura</i> (foxtail fescue)	800	18.4
<i>Festuca ovina</i> (sheep fescue)	680	15.6
<i>Festuca ovina duriuscula</i> (hard fescue)	560	13.0
<i>Festuca thurberi</i> (Thurber fescue)		
<i>Hilaria belangeri</i> (curlymesquite)	270	6.2
<i>Hilaria jamesii</i> (galleta)	160	3.7
<i>Hilaria mutica</i> (tobosa)	200	4.6
<i>Hilaria rigida</i> (big galleta)	33	0.8
<i>Leptochloa dubia</i> (green sprangletop)	540	12.4
<i>Lolium rigidum</i> (Wimmera ryegrass)	185	4.3
<i>Muhlenbergia montana</i> (mountain muhly)		
<i>Muhlenbergia porteria</i> (bush muhly)	2,400	55.2
<i>Muhlenbergia wrightii</i> (spike muhly)	1,600	37.6
<i>Oryzopsis hymenoides</i> (Indian ricegrass)	160	3.7

Scientific Name	Seeds/ Pound (1000's)	Seeds/ ft <sup>2</sup> /lb /acre
GRASSES (Continued)		
<i>Oryzopsis miliacea</i> (smilgrass)	1,900	43.7
<i>Panicum antidotale</i> (blue panicgrass)	650	14.9
<i>Panicum coloratum</i> (Kleingrass)	490	11.3
<i>Panicum virgatum</i> (switchgrass)	275	6.3
<i>Pennisetum setaceum</i> (fountaingrass)	275	6.3
<i>Phalaris arundinacea</i> (reed canarygrass)	540	7.8
<i>Phalaris tuberosa hirtiglumis</i> (perlagrass)		
<i>Phalaris tuberosa stenoptera</i> (Hardinggrass)	370	8.5
<i>Poa ampla</i> (big bluegrass)	885	20.3
<i>Poa canbyi</i> (Canby bluegrass)	925	21.3
<i>Poa glaucantha</i> (upland bluegrass)	2,500	57.5
<i>Setaria macrostachya</i> (plains bristlegrass)	290	6.7
<i>Sorghastrum nutans</i> (Indiangrass)	175	4.0
<i>Sporobolus airoides</i> (alkali sacaton)	1,600	36.8
<i>Sporobolus contractus</i> (spike dropseed)	2,800	64.4
<i>Sporobolus cryptandrus</i> (sand dropseed)	5,600	128.7
<i>Sporobolus flexuosus</i> (mesa dropseed)	3,300	75.9
<i>Sporobolus giganteus</i> (giant dropseed)	1,400	32.2
<i>Stipa comata</i> (needleandthread)	115	2.6
<i>Stipa viridula</i> (green needlegrass)	165	3.8
<i>Trichachne californica</i> (Arizona cottontop)	1,000	23.0
<i>Trichloris crinita</i> (twoflower trichloris)	1,400	32.2

#### FORBS

<i>Astragalus cicer</i> (cicer milkvetch)	135	3.1
<i>Coronilla varia</i> (crownvetch)	120	2.8
<i>Desmanthus illinoensis</i> (Illinois bundleflower)	85	2.0
<i>Eschscholtzia californica</i> (California-poppy)	300	6.9
<i>Gaillardia pinnatifida</i> (slender gaillardia)		
<i>Helianthus maximiliani</i> (Maximilian sunflower)	150	3.5
<i>Helianthus laetiflorus</i> (stiff sunflower)	85	2.0
<i>Kochia prostrata</i> (prostrate summercypress)	500	11.6
<i>Lotus corniculatus</i> (birdsfoot trefoil)	400	9.2
<i>Medicago sativa</i> (alfalfa)	230	5.3
<i>Melilotus alba</i> (white sweetclover)	260	6.0
<i>Melilotus officinalis</i> (yellow sweetclover)	260	6.0

Scientific Name	Seeds/ Pound (1000's)	Seeds/ ft <sup>2</sup> /lb /acre
FORBS (Continued)		
<i>Onobrychis viciaefolia</i> (sainfoin)	20	0.5
<i>Penstemon palmeri</i> (Palmer penstemon)	600	13.8
<i>Penstemon strictus</i> (Rocky Mountain penstemon)		
<i>Petalostemum candidum</i> (white prairieclover)	385	8.9
<i>Petalostemum purpureum</i> (purple prairieclover)	300	6.9
<i>Simsia exaristata</i> (annual bushsunflower)	330	7.6
<i>Trifolium fragiferum</i> (strawberry clover)	300	6.9
<i>Trifolium hirtum</i> (rose clover)	140	3.2
<i>Trifolium incarnatum</i> (crimson clover)	140	3.2
<i>Trifolium pratense</i> (red clover)	275	6.3
<i>Trifolium repens</i> (white clover)	700	16.1
<i>Trifolium subterraneum</i> (subterranean clover)	65	1.5
<i>Vicia americana</i> (American vetch)	41	0.9
<i>Vicia dasycarpa</i> (woolypod vetch)	11	0.3
<i>Vicia villosa</i> (hairy vetch)	20	0.5
<i>Zexmenia hispida</i> (orange zexmenia)	250	5.8

#### WOODY PLANTS

Seed data are furnished for only a few woody plants. These are for species which are most likely to be direct seeded. C. S. Schopmeyer (1974) presents data on the germination and propagation of many species of woody plants.

<i>Acacia greggii</i> (catclaw acacia)	30	0.7
<i>Amorpha canescens</i> (leadplant)	125	2.9
<i>Atriplex canescens</i> (fourwing saltbush)	50	1.2
<i>Atriplex lentiformis</i> (quailbush)	500	11.6
<i>Atriplex nuttallii</i> (Nuttall saltbush)	110	2.5
<i>Atriplex semibaccata</i> (Australian saltbush)	240	5.5

<sup>1</sup> To determine seeds/kg multiply seeds/lb by 2.205. To determine seeds/m<sup>2</sup>/kg/ha multiply seeds/ft<sup>2</sup>/lb/ac by 9.60.

**APPENDIX 7**  
**APPROXIMATE METRIC CONVERSIONS**

To convert	Into	Multiply by
<b>LENGTH</b>		
inches	millimeters	25.4
feet	centimeters	30.48
feet	meters	0.328
miles	kilometers	1.609
millimeters	inches	0.0394
centimeters	feet	0.0328
meters	feet	3.048
kilometers	miles	0.624
<b>AREA</b>		
square feet	square meters	0.0929
square miles	square kilometers	2.590
acres	hectares	0.4047
square meters	square feet	10.764
square kilometers	square miles	0.3861
hectares	acres	2.471
<b>WEIGHT</b>		
pounds	kilograms	0.4536
kilograms	pounds	2.205
<b>YIELD OR RATE</b>		
seeds/ft <sup>2</sup> /lb/ac	seeds/m <sup>2</sup> /kg/ha	9.60
lbs seed/ac	kgs seed/ha	1.12
tons/ac	metric tons/ha	2.24
gals/ac	liters/ha	9.34
seeds/m <sup>2</sup> /kg/ha	seeds/ft <sup>2</sup> /lb/ac	0.104
kgs seed/ha	lbs seed/ac	0.89
metric tons/ha	tons/ac	0.446
liters/ha	gals/ac	0.107
<b>TEMPERATURE</b>		
degrees Fahrenheit	degrees Celsius	$5/9(^{\circ}\text{F} - 32)$
degrees Celsius	degrees Fahrenheit	$9/5^{\circ}\text{C} + 32$

**APPENDIX B  
PRECIPITATION TOLERANCES FOR WILDLAND SEEDING**

Annual Prec.	3"	8-11"	12-18"	19-25"	25"
General Types	Salt Desert Shrub	-Dry-Sage/Juniper	Mid-Sage/Juniper Oak/Mt. Brush	-Moist-Sage/Mt. Brush Aspen-Dry Forest	Mixed Forest
Grasses	Indian rice needle and thread squirrel tail	wheatgrasses Nordan (Standard) Fairway thickspike Russian wildrye	wheatgrasses bluebunch whitmar pubescent intermediate tail, western hycrest Bozoisky wildrye hard fescue basin wildrye big bluegrass Kentucky blue Prute orchard smooth brome	Mt. brome smooth brome timothy orchard blue wildrye tail oat perennial rye slender wheat bearded wheat	cooler ecotypes of 19-25" Zone (i.e., Manchac smooth brome)
Shrubs and Trees	winter hat 4-wing saltbushes Kochia (drier ecotypes)	Wyoming big sage black sage 4-wing green rabbitbrush	basin big sage Mt. big sage rubber rabbitbrush bitterbrush mahoganies service berry Oregon grape skunkoush hackberry currants, rose	snowberry elderberry ninebark oceanspray maples aspen gooseberries pachistima pearberry huckleberries	same as 19-25" Zone (cooler ecotypes or species, i.e., prickly gooseberry)
Forbs	Desert globemailo	Munro globemailo astragalus phlox lomatium arabis engeron (foothill species)	blue flax baisamroot yarrow Indian paint cicer milkvetch birdsfoot trefoil alfalfa sweet clover(s) sweet vetch burnet, santoin golden rye Palmer penstemon Mt. lupine silky lupine geranium Aster glaucodes strawberry	sweet anise checker mallow strawberry	same as 19-25" Zone (cooler ecotypes)

\* Most species can be moved up one precipitation level successfully but not downward.

**APPENDIX 9**  
**SPECIES FOR SEEDING RIPARIAN AREAS**  
**Potential Planting Species\***

		4,500' - 5,500' Elev.	5,500' - 6,500' Elev.	6,500' + Elev. (non-alpine)
Fluctuating Waterable (periodic drying in upper profiles)	Graminoides	Kentucky bluegrass timothy basin wildrye meadow foxtail winged sedge	Kentucky bluegrass timothy meadow foxtail basin wildrye blue wildrye baltic rush tufted hairgrass wooly sedge winged sedge	tufted hairgrass Kentucky bluegrass baltic rush
	Shrubs	local willows-Saex, Sabo, Sadr) currants rose	local willows-Saex, Sabo, Saju, Sala) Mt. ash twinberry currants rose elderberry serviceberry shrubby cinquefoil	local willows-Sabo, Saju, Sawo) twinberry elderberry shrubby cinquefoil
	Trees	hybrid poplar cottonwoods lombardy Russian olive Golden and crack willow	aspen cottonwoods golden willow crack willow blue spruce water birch Mt. alder	aspen Engelmann spruce subalpine fir lodgepole Mt. alder
"Permanently Wet" (upper soil profiles)	Graminoides	Nebraska sedge beaked sedge baltic rush reed canary	Nebraska sedge water sedge beaked sedge baltic rush bluejoint reedgrass reed canary	water sedge beaked sedge wooly sedge baltic rush bluejoint reedgrass
	Shrubs	local willows (Saex, Sadr, Sabo, Sala) dogwood	local willows (Saex, Sadr, Sabo, Saju) dogwood twinberry	local willows (Sabo, Sawo, Saju) bog birch dogwood twinberry
	Trees	Hybrid poplar cottonwoods lombardy golden willow crack willow whiplash willow	aspen cottonwoods golden willow whiplash willow crack willow water birch	aspen Engelmann spruce water birch Mt. alder

\* Forb species not included since most will return naturally with proper care.

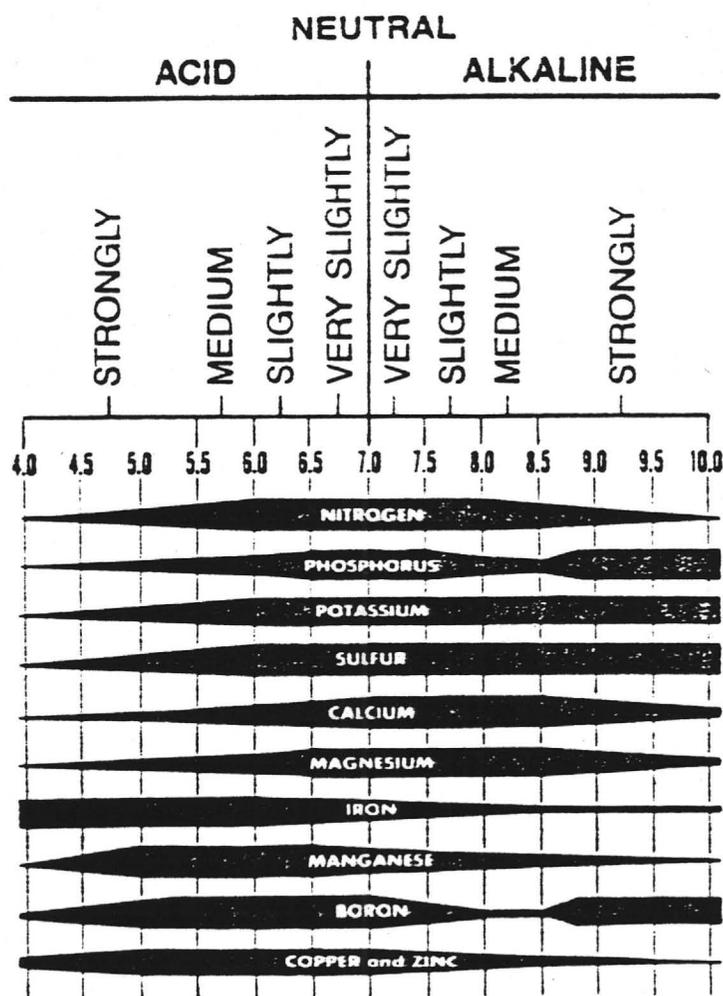
**APPENDIX 10**  
**R-4 - NOXIOUS WEED AND POISONOUS PLANT LIST**

Primary noxious weeds and poisonous plants that occur on National Forest System lands in the Intermountain Region.

Common Name	Scientific Name	Origin
<b>NOXIOUS WEEDS</b>		
Black henbane	<i>Hyoscyamus niger</i>	Europe
Canada thistle	<i>Cirsium arvense</i>	Eurasia
Dalmation toadflax	<i>Linaria dalmatica</i>	Europe
Diffuse knapweed	<i>Centaurea diffusa</i>	Eurasia
Dyers woad	<i>Isatis tinctoria</i>	Europe
Giant (Tall) whitetop	<i>Lepidium latifolium</i>	Europe
Hoary cress (whitetop)	<i>Cardaria draba</i>	Europe
Leafy spurge	<i>Euphorbia spp.</i>	Eurasia
Musk thistle	<i>Carduus theormeri</i>	Eurasia
Plumeless thistle	<i>Carduus acanthoides</i>	Eurasia
Rush skeltonweed	<i>Chondrilla juncea</i>	Eurasia
Russian knapweed	<i>Centaurea repens</i>	Eurasia
Scotch thistle	<i>Onopordum acanthium</i>	Eurasia
Spotted knapweed	<i>Centaurea maculosa</i>	Eurasia
Tansey ragwort *	<i>Senecio jacobaea</i>	Europe
Yellow star thistle	<i>Centaurea solstitialis</i>	Europe
Yellow toadflax (butter and eggs)	<i>Linaria vulgaris</i>	Europe
<b>POISONOUS PLANTS</b>		
Crazy weed	<i>Oxytropis spp.</i>	Native
Death camas	<i>Zigadenus spp.</i>	Native
Locoweed (milkvetch)	<i>Astragalus spp.</i>	Native
Lupine	<i>Lupinus spp.</i>	Native
Larkspur	<i>Delphinium spp.</i>	Native
Poison hemlock	<i>Conium spp.</i>	Eurasia
Water hemlock	<i>Cicuta spp.</i>	Native
Poison-ivy	<i>Toxicodendron spp.</i>	Native

\* New invader to National Forest System lands in the Intermountain Region.

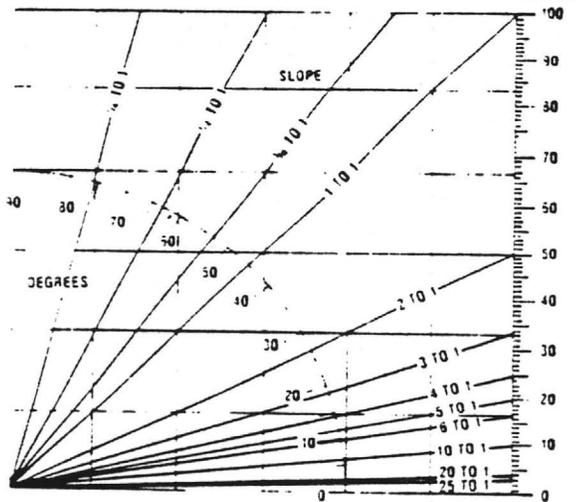
**APPENDIX 11**  
**pH - Nutrient Availability Chart**



How pH affects nutrient availability.

APPENDIX 12

GRADE COMPARISON CHART  
DEGREES — PERCENT — SLOPE



GRADE IN DEGREES  
AND PERCENTS

DEGREES	PERCENT
1	1.8
2	3.5
3	5.2
4	7.0
5	8.8
6	10.5
7	12.3
8	14.0
9	15.8
10	17.5
11	19.4
12	21.3
13	23.1
14	24.9
15	26.8
16	28.7
17	30.6
18	32.5
19	34.4
20	36.4
21	38.4
22	40.4
23	42.4
24	44.5
25	46.5
26	48.8
27	51.0
28	53.2
29	55.4
30	57.7
31	60.0
32	62.5
33	64.9
34	67.4
35	70.0
36	72.7
37	75.4
38	78.1
39	81.0
40	83.9
41	86.9
42	90.0
43	93.3
44	96.6
45	100.0

**APPENDIX 13  
SELECTED REFERENCES**

**Vegetation:**

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2. A Guide For the Use of Organic Materials, USDA Forest Service, Northeastern Station General Technical Report NE-98.
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2. User Guide to Hydrology, USDA Forest Service General Technical Report-74.
3. A Guide to Reclaiming Small Tailings Ponds and Dumps. USDA Forest Service General Technical Report INT-57.

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