

# Agua Canyon Gravel Quarry Restoration Project

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### Agua Canyon Gravel Quarry Restoration Project

The Agua Canyon gravel quarry was utilized by the park as a source of road construction materials during the period 1931 to 1943. Several acres were heavily disturbed by the removal of gravel. No attempt was made to reclaim the site, and after 40 years much of the site shows little recovery. Natural revegetation has been limited due to the lack of a soil base, slope instability, nutrient losses and the harsh altitude climate. Erosion has continued at an accelerated rate due to destruction of the normal slope contours and the lack of protective vegetation. The movement of eroded materials from the quarry site have damaged the surrounding forest.

The park proposes to rehabilitate the site by reshaping slope contours and drainages restoring native vegetation, improving soil composition, removing foreign materials, dump piles and roadways, and by realigning and improving an existing trail that runs through the site.

## DEVELOPMENT/STUDY PACKAGE PROPOSAL

|              |     |
|--------------|-----|
| PACKAGE NO.  | 149 |
| REVISION NO. |     |

|                                                                                        |                                                                      |                                     |                                     |                                                 |
|----------------------------------------------------------------------------------------|----------------------------------------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------------------|
| ORG NO<br>1330                                                                         | PARK<br>Bryce Canyon                                                 | DEVELOPED AREA NAME<br>Park General | DA CODE<br>PG                       | REGION<br>RMR                                   |
| STATE<br>Utah                                                                          | STATE CODE (2 ltrs)<br>UT                                            | COUNTY(S)<br>Kane                   | CONGRESSIONAL DISTRICT<br>01        |                                                 |
| Handwrite in<br>PACKAGE TITLE                                                          | REHABILITATE AGUA CANYON                                             | STUDY PACKAGE<br>NEW CONSTRUCTION   | <input type="checkbox"/>            | NEW PACKAGE <input checked="" type="checkbox"/> |
| Block Letters                                                                          | GRAVEL QUARRY                                                        | REHABILITATION                      | <input checked="" type="checkbox"/> | REVISION <input type="checkbox"/>               |
| CRITERIA                                                                               | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 | PARK PRIORITY                       | DATE                                | REG'N PRIORITY                                  |
|                                                                                        | 2 2 0                                                                |                                     |                                     |                                                 |
| PROGRAM THRUST, STATUS AND OTHER INFORMATION                                           |                                                                      |                                     |                                     |                                                 |
| 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 |                                                                      |                                     |                                     |                                                 |

WILL ADDITIONAL OPERATING FUNDS AND POSITIONS BE NEEDED UPON COMPLETION OF THIS PACKAGE?

(IF YES EXPLAIN NEEDS IN SECTION XI OUTLINE OF PLANNING AND MANAGEMENT REQUIREMENTS)

YES ☐ — give details in Sec.  
NO ☒

FULL PACKAGE DESCRIPTION Describe briefly what is needed; estimating details for non-study packages go in Sec. III.F. thru

This project will rehabilitate the Agua Canyon gravel quarry. The project includes recontouring, soil restoration, reseeding, and removal of dump piles from the site. A \$35,000 cost estimate has been prepared.

The Agua Canyon rock quarry was established in 1931 and was used as a source of road building materials until 1943. Some use has occurred periodically since that time. The area has been left to revegetate itself, but because of the degree of disturbance, lack of soil base and harsh, high latitude climate, the natural reestablishment of plant cover has been slow, and much of the site remains devoid of ground cover. Lack of protective vegetation and the destruction of normal ground contours has accelerated erosion.

PACKAGE JUSTIFICATION/CONSEQUENCES 1. Explain why package is needed. 2. Explain consequences if package is not provided.

If no corrective actions are taken, erosion will continue to deteriorate the site. Siltation of surrounding forest land will cause the disturbed area to enlarge. Hikers using the Agua Canyon Trail, which runs directly through the site, will continue to be subjected to an aesthetically deteriorated area and the fact that a Park Service created quarry inside the park has been allowed to exist for 40 years without any attempt to rehabilitate it will continue to be an embarrassment and a liability to park management.

PLANNING AND MANAGEMENT REQUIREMENTS (Follow instructions and outline provided in Program Formulation Guideline and RMR Programs H-2-b) Continue outline on additional pages. Include all outline headings and sub-headings in attachment and discuss those applicable.

Attached

Estimates on Form 10-902 must accompany 10-238's for projects to be accomplished by park staffs.

|                                                                  |                 |                                                                            |                 |
|------------------------------------------------------------------|-----------------|----------------------------------------------------------------------------|-----------------|
| ORIGINATOR (Signature and Title)<br><i>Thomas E. Henry</i>       | DATE<br>2/25/83 | CONCURRENCE (Signature of Superintendent, etc.)<br><i>Robert E. Benton</i> | DATE<br>2/25/83 |
| APPROVAL (Signature of Regional Director or Equivalent Official) |                 |                                                                            | DATE            |

1. Time Constraints

Funds have been legislatively earmarked for this type of project in the 1983 Interior appropriations, making it imperative that this project be implemented this year.

2. Land Acquisition

No land acquisition factors will affect this project.

3. Development Ceiling

No legislative development ceiling will affect this project.

4. Public Interest

Members of the Utah Congressional delegation specifically earmarked funds in the Interior appropriations for this type of project and have indicated their interest and support for the project.

5. Concession Interest

There is no concession interest in this project.

6. Unusual Natural Conditions

The high altitude climate and lack of soil development make natural vegetative regeneration a slow process at the gravel quarry.

7. Operation and Maintenance

The completed project will have no significant impact on park operations or maintenance.

8. Energy Conservation

No energy conservation considerations are involved in this project.

9. Compliance Required

An Environmental Assessment and FONSI have been prepared.

10. Other Factors

None

11. Statement for Management

The Statement for Management was approved March 10, 1982. This project relates to objective #3, the protection and enhancement of scenic values, and objective #4, protection of park resources.

12. Outline of Planning Requirements

Approved April 2, 1982.

13. Related 10-238's

None

14. General Management Plan

The GMP has not been finalized. Nothing in GMP affects this proposal.

15. Related Implementing Plans

None

16. Related Studies

A. Cultural Resource Reports - None applicable to this project.

B. Natural Resource Reports - To be covered in the environmental assessment.

C. Other - None

17. Statutory and Executive Requirements

A. NEPA - An environmental assessment will be prepared to meet NEPA requirements.

B. Section 106 - Any section 106 clearances will be addressed in the environmental assessment.

C. Endangered Species - No known endangered species will be affected by this project. This concern will be reviewed in the environmental assessment.

D. Clean Air - This project will have no known affect on the air quality.

E. Drinking Water - This project will have no known affect on drinking water.

F. Costal Zone Management - Not applicable.

G. DOT Supported Projects - Not applicable.

H. Floodplan Management - Not applicable.

J. Wetlands - Not applicable

K. Agricultural Lands - Not applicable.

L. A-18 - Not applicable.

M. A-25 - Not applicable.

N. Environmental Assessment - An Environmental Assessment and Finding of No Significant Impact have been prepared.

18. Water Resources

No additional water resources will be needed.

19. History and Archeology

There are no known archeological or historical concerns that must be addressed.

20. Historic Architecture

No historic buildings are involved.

21. Museum Exhibits - Not applicable.

22. Design and Construction

Reconstruction of a trail section in the quarry area will be necessary. Cost estimates have been developed.

23. Public Participation

This project does not require public participation.

24. Additional Operating Needs

No additional operating needs will result from completion of this project.

## BRYCE CANYON NATIONAL PARK

### ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT FOR RESTORATION OF THE AGUA CANYON QUARRY TO ITS NATURAL STATE

#### I. Purpose and Need

This environmental assessment discusses the alternatives and their environmental impacts for restoration of the Agua Canyon quarry to its natural state.

The rock quarry, located near the main road, about 15 miles south of park headquarters, was established in 1931 and used as a supply for road construction materials until 1943. The area was left to revegetate itself, but because of the degree of disturbance and the lack of nutrients in the barren soil, little ground cover has reestablished itself.

The quarry area is highly visible to hikers using the Agua Canyon connector trail. The quarry creates a significant negative impact to the aesthetic values of the park.

The park plans to restore the area during FY 83 if funds supplied for reclamation work, through an Office of Surface Mining grant program, become available.

#### II. Alternatives

A. No Action – Under this alternative the negative visual impact of the area would continue. Vegetative and ground cover will remain sparse. Deterioration of the habitat by erosion will continue, and the continued loss of nutrients will cause the impacted area to remain and to enlarge. The steep dirt road leading to the quarry from the main road will remain, encouraging continued vehicle traffic into the area.

B. Restore to Natural State – Totally eliminating the evidence of the rock quarry will be consistent with Park Service management philosophy. The area would be recontoured where appropriate, and reseeded and transplanted where needed. Existing roads and foreign materials, such as piled blacktop, will be removed. The needed work will require the efforts of a crew using hand tools along with an assortment of heavy equipment.

#### III. Impacts

A. No Action – Significant aesthetic impacts would continue. The threat of erosion will also remain as long as the quarry exists.

B. Restore to Natural State – Restoration of the site will require construction activities that will cause impact to the area during the project. Some vegetation will probably be destroyed when unnatural mounds are leveled, foreign material removed, and the roads are obliterated.

No endangered species or archeological sites will be disturbed by this project.

IV. Mitigating Measures

A. No Action - If the quarry is left to restore itself naturally the park will probably have to take measures to control erosion and, if the scar begins to enlarge, reduce the impact.

B. Restore to Natural State - Restoration work would cause temporary disturbance of the area. Measures would be taken to hold any disturbance to a minimum. Mitigating measures would also be taken to leave all disturbed areas in as natural a state as possible.

Once recontoured, the area would be seeded with native plants, sensitive native plants would be transplanted, and then the whole area would be Hydro-mulched to help restore nutrients and the ground cover. The existing roads would be removed and the Agua Canyon connector trail would be relocated and improved.

If any endangered species or archeological sites are disturbed or noted during construction work will be halted and not continued until the appropriate agencies have been consulted and mitigating measures taken.

V. Preparer - Tom Biller, Resource Manager, Bryce Canyon National Park, Utah.

VI. Consultation With Others - Mary Ann Wright, Utah Division of Natural Resources, Surface Mining Office, Salt Lake City, Utah; Tom Henry, Chief I&RM, Bryce Canyon National Park, Utah.

Approved: Robert E. Benton  
Superintendent

Date: 2-25-83

VII. Finding of No Significant Impact - Since the restoration will improve the natural state and the aesthetics of the quarry area, and since construction affects can be satisfactorily mitigated to the extend possible, Alternative B is selected as the proposal. The above discussion indicated that this is not a federal action that would have significant impact on the environment, thus an environmental impact statement will not be prepared.

Approved: \_\_\_\_\_  
Regional Director

Date: \_\_\_\_\_

Estimated Costs to Rehabilitate Agua Gravel Pit

|                                                                                                                                                                                                                          |              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Recontour and scarify $\frac{1}{2}$ acre plus $\frac{1}{4}$ mile old access road, rework and restore to natural soil composition and drainage pattern 11,900 squard yards.                                               | \$7,140      |
| Remove material consisting of old asphalt and miscelaneous stone materials using front end loader and truck. Haul to dump area outside park. Twenty-five round trips of 60 miles @ \$1/mile, \$10 per load landfill fee. | 3,450        |
| Restore topsoil on $\frac{3}{4}$ acre, 605 cubic yards.                                                                                                                                                                  | 6,100        |
| Reseed 11,000 squard yards with native seed; mulch over seed.                                                                                                                                                            | 5,060        |
| Resurface backcountry trail that runs through gravel pit; 586 square yards of crushed shale.                                                                                                                             | 2,340        |
| Remove existing entrance to access road, relocate gate and level area for parking space for backcountry hiker's cars.                                                                                                    | <u>5,000</u> |
|                                                                                                                                                                                                                          | \$29,090     |
| Add 10% for remote area fee                                                                                                                                                                                              | \$2,910      |
| Add 8% design and travel fee                                                                                                                                                                                             | <u>2,560</u> |
| Total estimate                                                                                                                                                                                                           | \$34,560     |



Photo #1 - View of southeast corner of quarry. Very limited vegetative recovery has taken place.

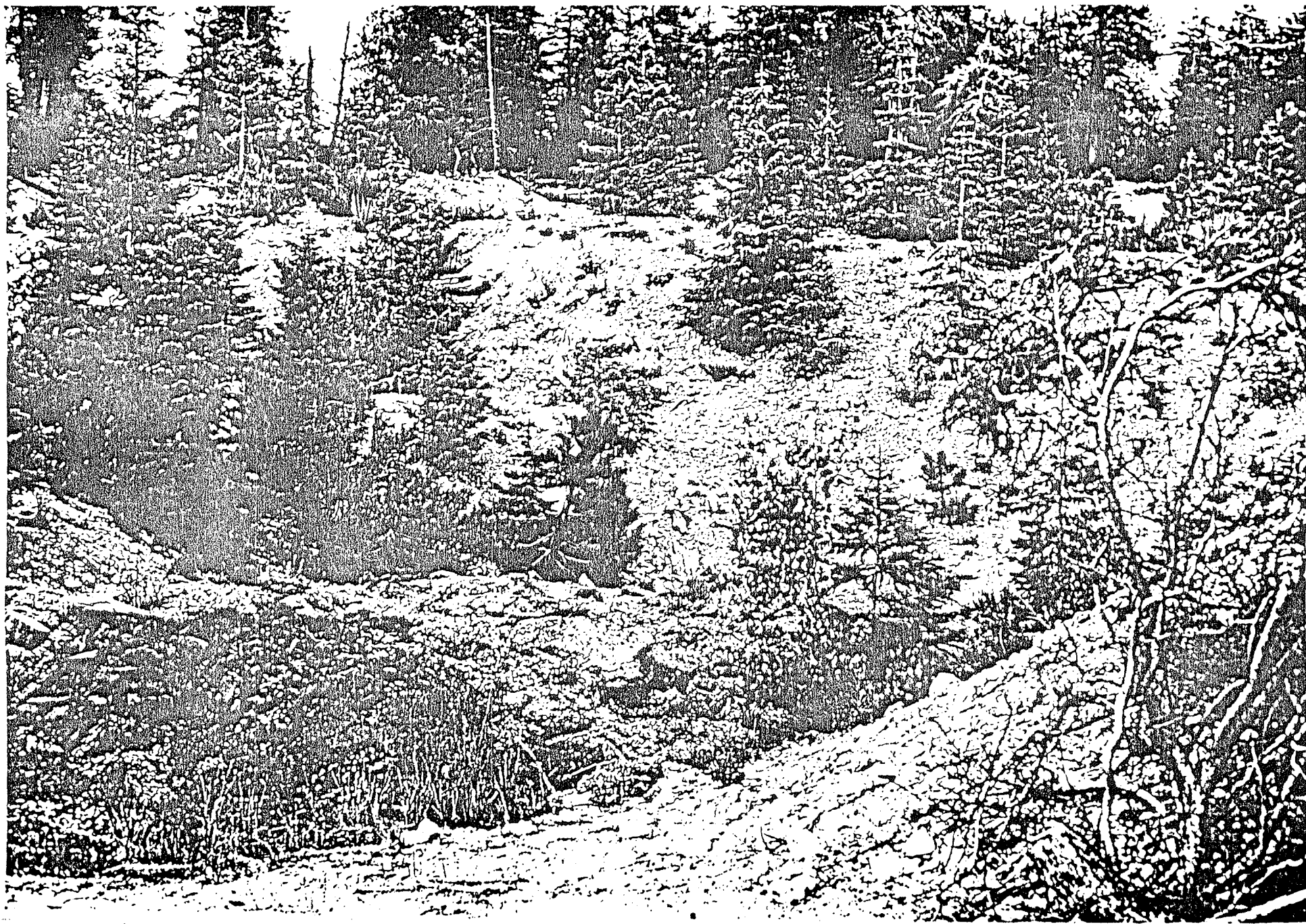


Photo #2 - View of typical section of quarry on east side. Some regeneration of tree cover, but little ground cover apparent. No soil formation is occurring due to continued erosion. Piles of broken asphalt in left foreground.

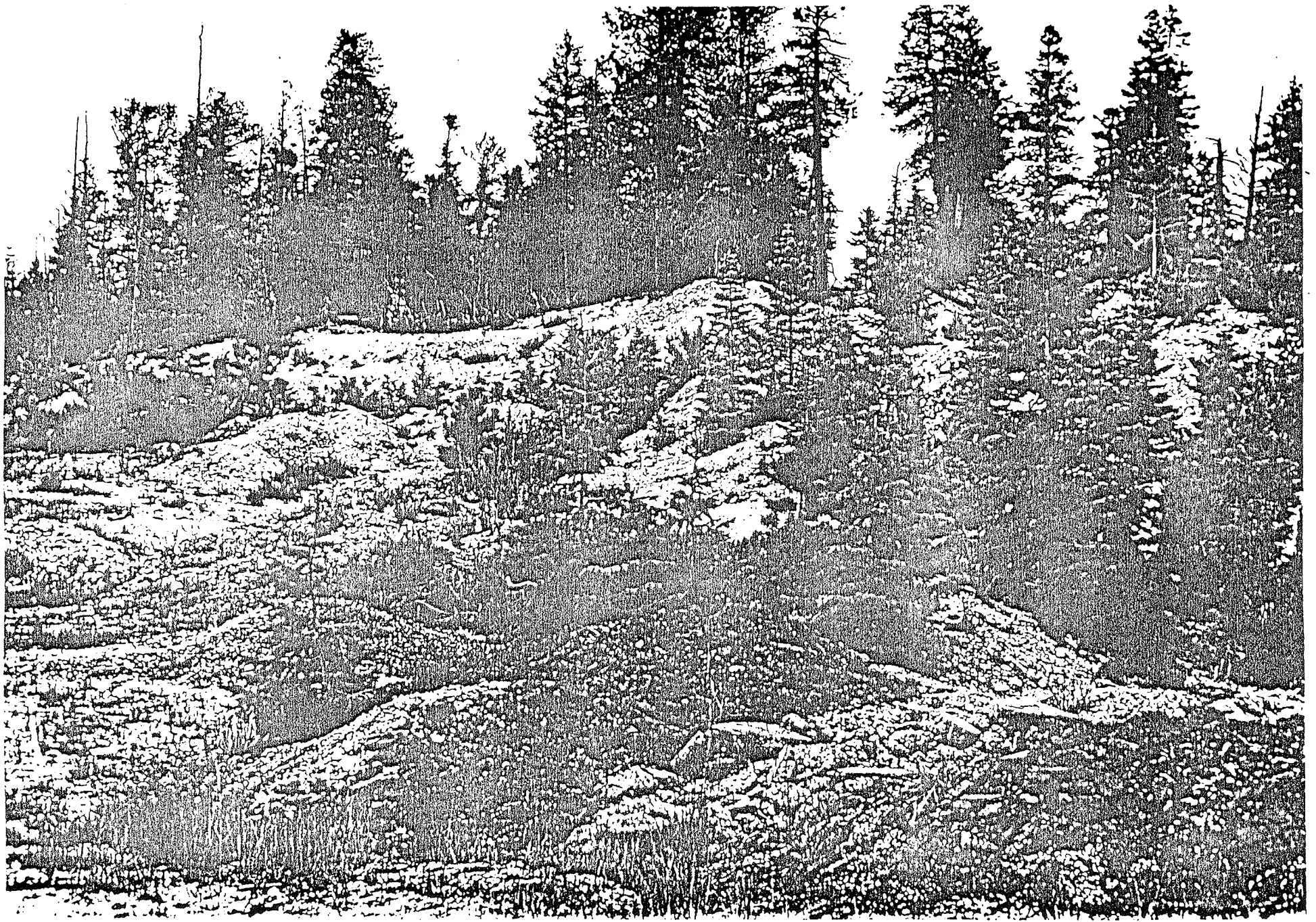


Photo #3 - View of area to the north of photo #2. Slope profile has been heavily altered. Dump piles of gravel and asphalt.



Photo #4 - View of northeast section of quarry. Dump piles, unstable slopes, and lack of vegetation.



Photo #5 - View looking northeast across north end of quarry.

JAN 31 1994



JANUARY 27, 1994

MINERAL'S OUTREACH MEMO

3000 (UT910)

TO: ALL MINERAL'S DSD'S, WO DIVISION CHIEFS & DISTRICT STAFF

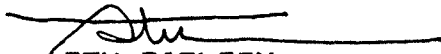
FROM: BLM MINERAL'S OUTREACH COORDINATOR

SUBJ: USE OF MUNICIPAL SLUDGE BIOSOLIDS IN MINED LAND RECLAMATION

THE ATTACHED DECEMBER 1993 ARTICLE FROM THE MINING ENGINEERING MAGAZINE DOCUMENTS AN EXCITING PUBLIC LAND'S STUDY WHICH IS UNDERWAY ON THE BUTCHER BOY MINE OUT OF CARSON CITY, NEVADA.

MONUMENTAL COOPERATION AND FORESIGHT BY A LOT OF PARTICIPANTS MADE THIS PROJECT POSSIBLE. WHILE THE CONCEPT ISN'T NEW, REAL-LIFE APPLICATION MOST CERTAINLY IS. INDUSTRY, THE STATE OF NEVADA, THE BUREAU, EPA AND OTHERS DESERVE GREAT CREDIT JUST FOR HAVING THE STAMINA TO PUSH THROUGH ALL OF THE INSTITUTIONAL BARRIERS AND BIASES WHICH, AT FIRST, SEEMED TO THWART SUCH A PROJECT.

THE ATTACHED, FOUR AUTHOR TALE RELATES A HISTORY OF THE UNIQUE, ONGOING EFFORT. THIS IS A CLASSIC CASE OF RISK MANAGEMENT FOR THE COMMON GOOD. IT CAN ALSO BE ARGUED THAT THIS IS PUBLIC LAND MANAGEMENT IN ITS MOST INTENSE FORM.

  
STU CARLSON

ATTACHMENT:  
BIOSOLID ARTICLE

# Municipal sludge biosolids in mined land reclamation: Great Basin pilot study

David Loomis, James DeLaureal, Craig McCaa and Dennis Trexler

Unlike previous gold mining booms in Nevada's Great Basin, the current boom includes a serious commitment to mine reclamation. Many of the smaller mines began reclaiming in the late 1980s but met with limited success due in part to poor soil characteristics. Public land managers and the mining industry began looking for ways to improve reclamation success. One promising technique is suggested by an ongoing research project using sludge biosolids, the solid residue of municipal waste water treatment.

During the 1980s, limited space in landfills led municipal governments to search for alternate ways to dispose of their biosolids. The cities of Reno and Sparks, NV and the US Bureau of Land Management (BLM) searched for ways to combine these needs to everyone's mutual benefit. Yet barriers remained. The federal government had major concerns about potential bioaccumulation of metals and contamination of drinking water from the land application of municipal biosolids.

The barriers were lifted late in 1991 when an interagency task force led by the Environmental Protection Agency

(EPA) issued a new federal policy on the use of biosolids on federal land. The policy encouraged biosolids as a soil amendment to reclaim degraded minelands and invited federal agencies to develop biosolid pilot projects. In response, BLM enlisted the help of American Resources Corp. (ARC) and the University of Nevada, Las Vegas for a pilot study at ARC's Butcher Boy Mine near Wadsworth, NV.

Although biosolids have been used in mine land reclamation in the eastern United States for 20 years, before this pilot study, none had been used on public lands in the arid Great Basin. Land application of biosolids improves soil conditions by improving nutrient uptake, increasing water retention, permitting easier root penetration and enhancing soil fertility. Biosolids increase ecosystem productivity and can lead to significant improvements in the structure and diversity of plant and animal communities. Thus, land application of biosolids promotes biodiversity.

## Permitting requirements

Biosolids for land application must be anaerobically processed, composted

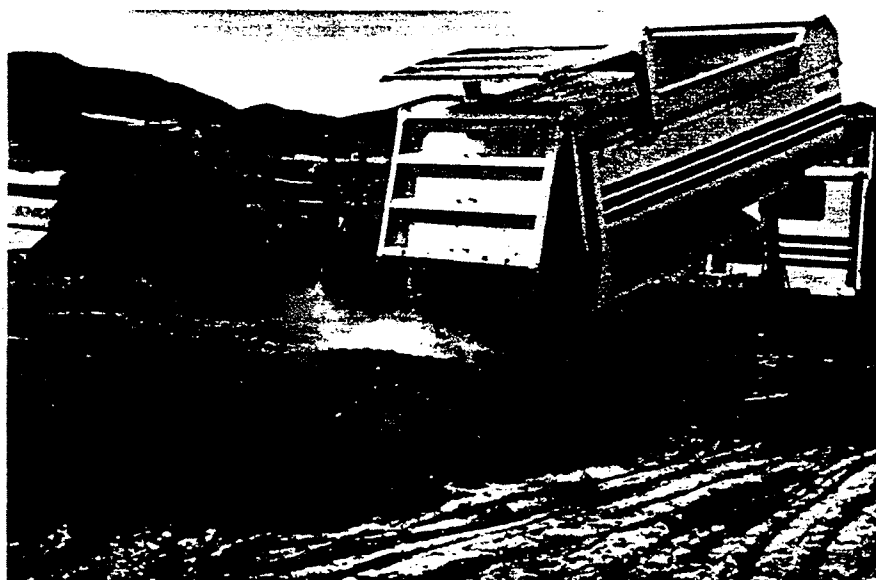
or lime treated to reduce pathogens and must contain low levels of trace metals. Baseline data on growth medium chemical composition, cation exchange capacity and pH should be evaluated. Physical characteristics of proposed sites for biosolids application should include an understanding of the surface drainage, depth to ground water, proximity to surface water, topography and the species considered in the revegetation program.

After these criteria have been evaluated and the site and reclamation needs have been established, a meeting with federal or state reclamation specialists should be initiated. The EPA recently loosened its biosolid regulations, increasing the potential for beneficial land applications in the future.

Monitoring requirements generally will not exceed those required for a permit to mine. Recently, the Nevada Division of Environmental Protection agreed to allow reclamation using biosolids to be an amendment to the existing mine reclamation permit, thereby streamlining the permitting and monitoring procedures.

## Site description

The biosolid study site is 65 km (40 miles) northeast of Reno on a long, gently sloping alluvial fan. It consists of five, 4046-m<sup>2</sup> (1-acre) plots arranged from west to east on a relatively level area of regraded placer tailings. These deposits are, by nature, extremely cobbly and are deficient in soil materials. Organic matter and soil microflora are also deficient or completely lacking since



Delivery of sludge biosolids and loading the spreader.

David Loomis, James DeLaureal and Craig McCaa are environmental planner, soil scientist and reclamation specialist, respectively, with the US Bureau of Land Management, Carson City District, 1535 Hot Springs Road, Suite 300, Carson City, NV 89706. Dennis Trexler is director, Division of Earth Sciences, Harry Reid Center for Environmental Studies, University of Nevada-Las Vegas, 100 Washington St., Suite 201, Reno, NV 89503.

the deposits were mined at depths of 3 to 24 m (10 to 80 ft).

The climate is typical of the western Great Basin, with cold winters and warm, dry summers. Most precipitation falls as snow from November through March. A few isolated convection storms provide rainfall during the summer, but there is very limited soil moisture during the growing season. Average annual precipitation is 150 to 200 mm (6 to 8 in.).

### Biosolid characteristics

Though not classified as a hazardous waste, biosolids are regulated because they contain potentially harmful trace metals and disease pathogens. Biosolids are municipal sewage sludges that meet EPA criteria for beneficial use. The biosolids for this pilot study were obtained from the Truckee Meadows Water Reclamation Facility (TMWRF).

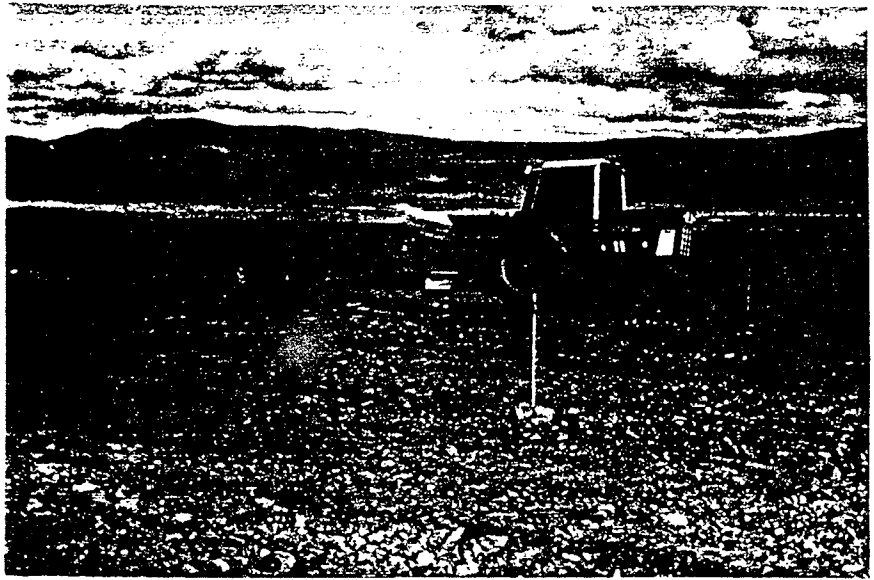
About 80% of the weight of the biosolids is water. Of the solid content, about 60% is organic matter. Nitrogen accounts for about 5%, of which 1% is ammonia. Inorganic forms of nitrogen, such as ammonia and nitrate, are directly available for uptake by plants and serve as quick release fertilizers. Organic nitrogen must be converted to a plant usable form by the activity of soil micro-organisms. It serves as a long-term, slow-release fertilizer. Phosphate content of the TMWRF product is 4%. Potassium content is minimal, amounting to only 0.3%.

Environmentally safe biosolid loading limits outlined in the EPA regulations are based on trace metals content. Compared to the national average for metal content, the TMWRF biosolids are very low in metals. They have only 16% of the average lead content and 13% of the average cadmium content found in biosolids analyzed in 180 facilities studied by the EPA.

One of the most commonly asked questions about biosolids is the potential for bioaccumulation of trace metals in the food chain. Of the total trace metals content in the TMWRF biosolids, only 37% of the boron, 0.6% of the copper and 0.2% of the zinc were detected in a weak acid dissociable analysis. Therefore, only a small percentage of the trace metals content is available for plant uptake. When the EPA's recommended application rates are not exceeded, there is little or no risk involved in land application of biosolids.

### Methodology

Before the biosolids were applied to



Spreading biosolids on plot four.



Vegetation growth on plots one, two, three and four in June 1993, six months after biosolid application. The control plot in the center left was only seeded. The other plots were all treated with biosolids and seeded.

the test site, Butcher Boy Mine staff recontoured the area to approximate natural landforms, resulting in gently sloping, rolling terrain. The nearest down slope well was then sampled for trace metals, a precipitation measuring device was installed and the recontoured soils were sampled with these results:

- The pH of the soil was 8 or medium alkaline — well above the EPA minimum of 6.5 for land application of biosolids.

- Organic matter was almost nonexistent. Therefore, nitrogen release was only 38 kg/hm<sup>2</sup> (34 lbs/acre).

- Cation exchange capacity was moderate at about 15. This is within EPA standards and was used to determine application rates.

Land application began on Nov. 18, 1992. The biosolids were transported from the treatment plant by truck to the test site. On site, the biosolids were loaded into a Ford/New Holland Model 308 organic spreader. The spreader has a capacity of 8706 L (2300 gal) or 8.4 m<sup>3</sup> (11 cu yd) per load. It was towed behind a conventional farm tractor while spreading the biosolids over four 4046-m<sup>2</sup> (1-acre) test plots.

Two test plots were treated with 27 t (30 st) of biosolids per acre on a dry weight basis. Two other plots were treated with 13 t (15 st) of biosolids per acre. One plot was supplemented with zeolite at the request of the Butcher Boy Mine staff to test the affect of zeolite on the uptake of trace metals from the

biosolids into vegetation. The remaining plot served as the control for the study with no biosolids applied.

The two primary constituents of concern were copper and cadmium. Under the 40 CFR 257 regulations in effect during 1992, only 4% of the maximum allowable copper was applied to the test plots at the 27-t (30-st) per acre rate. The loading rate for copper at 27-t (30 st) per acre was 10 kg (22 lbs) per acre, well below the allowable 228 kg (504 lb) per acre under the 257 regulations. At 27 t (30 st) per acre, a total of 0.02 kg (0.06 lbs) per acre of cadmium were applied. The allowable loading rate was 0.2 kg (0.45 lbs) per acre.

Due to the rocky soil, conventional tilling equipment could not be used to incorporate the biosolids into the soil. Instead, a five-blade ripper mounted on a D4 Caterpillar was used for the mixing process.

After the ripping treatment, four of the one-acre plots, including the control plot, were seeded with 3.6 kg (8 lbs) of four-wing saltbush, 2.2 kg (5 lbs) of siberian wheatgrass and 2.2 kg (5 lbs) of Hycrest crested wheatgrass. The seeding was done with a broadcast seeder mounted to the rear of a Polaris all-terrain-vehicle. After seed application, the plots were dragged with a chain harrow to cover the seed. The remaining plot was seeded the following spring to test the relationship between biosolid application and the timing of seeding.

To protect the site from livestock, a solar-powered electric fence was installed around the perimeter. In addition, small wire cages were placed on each plot. The cages prevent rodents

from eating the vegetation and ensure the accuracy of future vegetation monitoring. The final step was to post the study site with warning signs. Although the area is not readily accessible to the public, this extra precaution was taken to further ensure safety.

### Monitoring

The pilot study includes an extensive monitoring program focused on climate, ground water quality, soil constituents, vegetation density and cover, and trace metal bioaccumulation.

A precipitation gauge was installed on site to monitor climatic conditions. About 100 mm (4 in.) of precipitation were measured during the winter of 1992-1993, 50% above average. This has contributed greatly to the preliminary success of the revegetation.

Quarterly water quality monitoring reports from the nearest downslope well have revealed virtually no changes in the trace metal content of the ground water.

Vegetation monitoring will include annual estimates of plant density and vegetative cover as well as vegetative uptake of trace metals. Plant density will be determined by the number of plants per square meter, while vegetative cover will be assessed using a line-intercept method for both basal and canopy cover. Plant tissue analysis for trace metals will be by laboratory analysis. Monitoring-sampling will be yearly, in June.

First year results are encouraging. Substantial establishment of seeded shrubs and perennial grasses has occurred, along with the establishment of

nonseeded volunteer annual grass species and other weeds. The most promising response has occurred on both plots treated with 13 t (15 st) of biosolids per acre. While the control plot had a high density of seeded species, their size and vigor was minimal compared to the treated plots.

### Preliminary conclusions and recommendations

Early results from Butcher Boy Mine pilot study are promising. No degradation of ground water or any other adverse environmental impacts have occurred. Municipal sludge biosolids have clearly had a significant positive impact on reclaiming the mine. The establishment and substantial growth of seeded and volunteer species have already increased biodiversity and initiated the establishment of a viable, functioning ecosystem.

The economic viability of biosolid land applications is greatest for mines located near treatment plants. For this pilot project, the biosolids were delivered at no cost since the mine was located closer to the treatment plant than the current agricultural re-use site. Hauling costs are a critical factor in determining project feasibility. Waste water reclamation facilities are encouraged to dewater biosolids to facilitate their use in mine reclamation.

This pilot study indicated the need for specialized equipment to apply the biosolids. The Ford/New Holland spreader worked well for applying biosolids to a relatively level terrain, but had difficulty negotiating side slopes. Future projects should consider alternative equipment on steeper slopes. Hydromulching equipment has been used successfully for biosolids application in other areas and may be applicable in the Great Basin.

Definitive results from this pilot project will not be available for another five years. Short-term results, however, are positive enough to encourage others to experiment with biosolids. These projects are not only a way of enhancing mineland reclamation efforts, but also a way of recycling a material that can become an environmental and economic burden to local communities. ♦

### Acknowledgments

The authors thank American Resources Corp., Empire Farms, Schuster Trucking, Truckee Meadows Water Reclamation Facility and the Nevada Division of Environmental Protection for their assistance.



Close up of vegetation growth on plot three in June 1993. This plot had the best response to treatment. It received 13 t (15 st) of biosolids and was seeded with grasses and forbs.



## Agua Rock Quarry Rehabilitation Project

### Purpose of Project

To rehabilitate the Agua rock quarry and to return the five acre pit to it's natural state. The area is highly visible from the air and creates a significant negative impact to the aesthetic values to backcountry hikers.

### Location

The Agua rock quarry is located at the south end of Bryce Canyon National Park (see figure 1), about fifteen miles south of the visitor center. There is a fire control access road along with a hiking trail head connecting with the under-the-rim trail. Note aerial photograph, figure 2.

### History

The rock quarry was established and utilized from 1931-43, supplying road materials for the main park road. This area has been left to reestablish by itself on the bare Wasatch limestone formation.

### Agua Environment

The area surrounding the quarry is located in a natural environment subzone. This zone consists of those lands not included in the wilderness zone, yet are not developed. This area is above the rim and is managed on preservation, that is the land is used, but protected against development.

The Agua ecosystem consists of a natural plant community that represents the lower Canadian life zone about 8500 feet. The area surrounding the rock quarry is a dense forest of douglas fir, white fir, blue spruce and aspen. Shrubs and wildflowers occupy niche on the forest floor. Many varieties of wildlife use the connecting trail from below the rim. Principal species include mule deer, gray fox, bobcat cougar, and black bear.

Attached are pictures showing are area. Figures 3-6.

### Soils

The soils found around the rock quarry are shallow. Precipitation is low. These soils are unleached and contain a variety of minerals including calcium, iron, potash, phosphate and magnesium.

Generally, the soils are poorly developed, containing very little topsoil, and they are not bound by vegetation.

### Backcountry Use

Last year the backcountry use has increased use on the connecting trail through the rock quarry area to connect with the under-the-rim trail.

Today, the Agua rock quarry area is not being used. The following alternatives should be considered:

Alternative A: Continuation of current no action. Should we follow this course, deterioration from erosion will continue to accelerate do to the absence of vegetative cover, and continued loss of a variety of minerals and loss of vegetation in the immediate area unless mitigating measures are implemented. There would be an increase in visual impact on the site. This course of action is not consistent with the natural management zone.

Alternative B: Totally eliminate the evidence of the Agua rock quarry and rehabilitate the area to as near a natural condition as possible. The elimination of the old rock quarry will require a major investment of funds, materials, equipment and manpower. With the banishment of the rock quarry and restoring the area to it's natural condition will in the long term be consistent with the natural management zone.

The equipment needed would be a small dozer and hand tools to finish contouring and planting small trees, shrubs, and grasses.

NATURAL RESOURCES PROJECT STATEMENT

Area Priority No.  
Reference No. 1

Park and Region

Bryce Canyon National Park, Rocky Mountain Region

Project Name

Revegetation Visitor Use Area

Statement of Problem:

To rehabilitate the Agua rock quarry and to return the five acre site to it's natural state. The area is highly visible from the air and creates a significant negative impact to the aesthetic values to backcountry hikers. Also the vegetation has been destroyed and erosion has occurred as a result.

What has been done:

Nothing

Description of Work to be done:

Totally eliminate the evidence of the Agua rock quarry and rehabilitate the area to as near a natural condition as possible. The contouring reseeding, and replanting of native species and stabilizing the ground cover with mating.

Also the area around the store picnic area and old roadway needs the same type of rehabilitation.

Length of Time Needed:

30 man/days

What are the Alternatives:

Alternative A: Continuation of current no action. Should we follow this course, deterioration from erosion will continue to accelerate do to the absence of vegetative cover, and continued loss of a variety of minerals and loss of vegetation in the immediate area unless mitigating measures are

RECOMMENDATIONS FOR REHABILITATION IN THE AGUA ROCK QUARRY AREA  
4-80 Jim Hannah

1. Remove road storage materials from area.
2. Limit contouring to produce surfaces with short slopes to increase rainfall and snow melt retention (using handtools and small equipment).
3. Soil type should be analyzed in area. Refer to Soil Survey BRCA by Soil Conservation as a guide to soil type in Agua area.
4. Haul in soil to cover bare rocks.
5. Mulching with saw dust, bark, wood chips, straw or use "Soil saver" or a combination of two, this will insulate the soil against solar radiation and reduces evaporation. Mulch will break down after ground cover is established. Also this mulch will supply valuable organic matter to the soil.
6. Hydro-seed with native shrubs and grasses or hand plant native species. If native seeds are expensive or hard to find, seeds could be gathered in the fall and contract to a local nursery. Transplanting provides a higher survival rate.
7. To insure survival and establishment particularly for shrubs and grasses that demand large amounts of water, the area should be watered every two weeks with water pumper.
8. Suggested plant species: ~~White Fir, Manzanita, Gambel's Oak,~~  
~~Curl-leaf Mt. Mahogany, Ponderosa Pine, Douglas Fir, Currant,~~  
~~Elderberry, Oregon Grape, and Antelope Bitterbrush,~~ Aspen, ~~Agaveleaf~~  
~~Rabennod~~  
native grasses

## Store Area and Old Roadway Rehabilitation Project

### Purpose of Project

To rehabilitate the store, cabin area (3 acres) and old roadway leading up to the Bryce Lodge (3 acres). This area is highly visible and creates a negative impact.

### Location

The store, cabin area and old roadway is located in the main park area, see figure 1 and aerial photograph, figure 7. On site photographs are being taken.

### History

The store, cabins, and roadway were built in the 1930's. In 1976 the store and cabins were removed leaving the foundations, plumbing, and electrical wires in the area. In the 1950's the old roadway use was terminated.

### Action Alternatives

Alternative A: Continuation of no action, should we follow this course deterioration from erosion will continue do to the absence of vegetative cover. There will be an increase in visual impact on the site. This course of action is not consistent with the General Management Plan.

Alternative B: Totally eliminate the evidence of the stone foundations, plumbing and electric wires and rehabilitate the area to as near a natural condition as possible.

Equipment needed would be front-end loader and hand tools to finish contouring and planting native trees, shrubs, and grasses.

implemented. There would be an increase in visual impact on the site. This course of action is not consistent with the natural management zone.

Alternative B: Totally eliminate the evidence of the Agua rock quarry and rehabilitate the area to as near a natural condition as possible. The elimination of the old rock quarry will require a major investment of funds, materials, equipment and manpower. With the banishment of the rock quarry and restoring the area to it's natural condition will in the long term be consistent with the natural management zone.

The equipment needed would be a small dozer and hand tools to finish contouring and planting small trees, shrubs, and grasses.

Personnel Needed:

Day labor

Administration and Logistics:

Transportation of work crew and equipment.

Funds available in Park base:

NO

Funds requested from Region:

Through Office of Surface Mining

Date of Submission

9-79

References:

Agua Rock Quarry Rehabilitation Project Report 9-79

Bob:

I hope this helps, even though I don't think it's exactly what you wanted. There was nothing specific in part one (the only part available yet) of the appropriation record for mine site clean-up. However, the following addresses OSM regulatory and reclamation efforts, and projected budget increases for those areas. Call if you want me to try any other avenues.

*I have another call in to OSM - if anything Mary Ann  
good comes of it, we'll call + leave a  
message w/ Tom Henry.*

Excerpts From: Senate Hearings before the Committee on Appropriations  
DOI and Related Agencies Appropriations  
FY 1983, 97th Congress, 2nd Session, Part 1

"Surface Mining Reclamation and Enforcement:

"The 1983 budget for the Office of Surface Mining projects that all but three coal producing states will have assumed primacy for regulating coal mining operations within their boundaries by the beginning of FY 1983. It is also anticipated that two additional states will assume this responsibility in FY 1983, leaving Georgia as the only state that will have a direct federal program, reflecting that state's decision not to have a state program. We consider this to be one of the Department's most significant accomplishments as we expect greater local control, increased environmental safeguards and increased production through less burdensome regulations. This policy, mandated by the Congress in SMCRA will have a major impact on federal-state relations.

"For OSM's regulatory programs, the 1983 budget includes a significant increase of more than 1/3 over 1982 levels in the amount of grant money provided to states to assist them with their efforts in assuming primacy for coal mining operations within their borders. This change is consistent with the Administration's overall effort to reduce the level of federal involvement in matters which can be better handled by State and local governments. The budget includes nearly \$20 million in increased funds to be made directly available to the States to carry out their reclamation work, together with an off-setting reduction in funds requested for direct federal reclamation work. I expect favorable consideration will be given to a supplemental request, should states demonstrate a need for, and capability to administer, additional grant funds for both reclamation and regulations in 1983."

# Mine spoil reclamation in the Southwest

by Rick Fletcher  
Rocky Mountain Station

In a recent energy message, President Carter called for a dramatic increase in the nation's coal production - from 650 million tons mined in 1975 to 1.2 billion by 1985. The federal government estimates that over 50 percent of U.S. coal production for the rest of this century will be mined by surface methods. However, mining, particularly surface or strip mining, requires disturbing the land.

Although reclamation methods for mine spoils began soon after the turn of the century, economic and technical limitations left most spoils abandoned without any attempt at reclamation.

As technology improved and surface mining became more prominent and widespread, the public began to take notice and demand action to prevent unnecessary damage to mined lands and adjacent areas. This resulted in enactment of strip mine legislation, with the first state laws going into effect in 1939. Today, the majority of states have surface mining and reclamation laws.

The Four Corners area in the Southwest contains some of the richest coal deposits in the West. In 1973, scientists at the Rocky Mountain Station began to look for efficient and effective ways to successfully reclaim spoils left after mining.

Earl Aidon, Project Leader for the Station's Mine Spoil Reclamation unit in Albuquerque, which began under the Forest Service's SEAM (Surface Environment and Mining) Program, explains, "Coal resources in the Southwest are extensive, particularly in northwest New Mexico and northeast Arizona. Reclamation of these strip-mined lands can be a problem due to the climatic conditions. Problems of revegetating strip mine areas in this region differ drastically from those in more humid areas, particularly the East."

Ask Earl what results have come out of these years of research and he'll tell you that plant establishment on Southwestern mine spoils is both practical and feasible. "When we started these studies, people thought that you couldn't grow anything on mine spoils around here. Well, through close cooperative efforts with mining companies, we've helped show that you can," he said.

Proper reclamation involves a multitude of steps and details - far too many to mention in this report, but, there are some basic requirements that need attention to ensure any hope of success. These include site preparation, mulching, and temporary irrigation on low rainfall sites.

## Site stabilization

Site stabilization should be one of the first steps in reclaiming mine spoils. This is probably the most expensive, yet necessary step. Failure to stabilize spoil surfaces against raindrop and runoff impacts prior to establishment of vegetation will result in a high degree of rehabilitation failure.

Prevention or reduction of surface runoff and soil erosion can be achieved by a combination of measures that include land shaping, seeding and mulching. Spoils should be shaped to produce as many flat surfaces with short slopes as possible, and, at the same time, leaving the soil surface in a rough or furrowed condition. The resulting topography should, ultimately, increase rainfall retention, infiltration and percolation, increase leaching of spoil salts, and reduce runoff and erosion.



## Mulching

Mulches, such as hay, straw, bark, wood chips, etc. are an effective and often times necessary tool for establishing vegetation on Southwestern mine spoils. Mulching insulates the soil against intense solar radiation, reduces evaporation, raises ground temperatures during winter, and lowers them during summer.

Mulches can also break down after ground cover establishment, supplying valuable organic matter to the soil.

Mulching can also reduce the impact of raindrops, help control erosion, and hold seed and seedlings in place.

Scientists at Albuquerque have found that straw is the most stable and long-lasting mulch for the Southwest.

## Irrigation

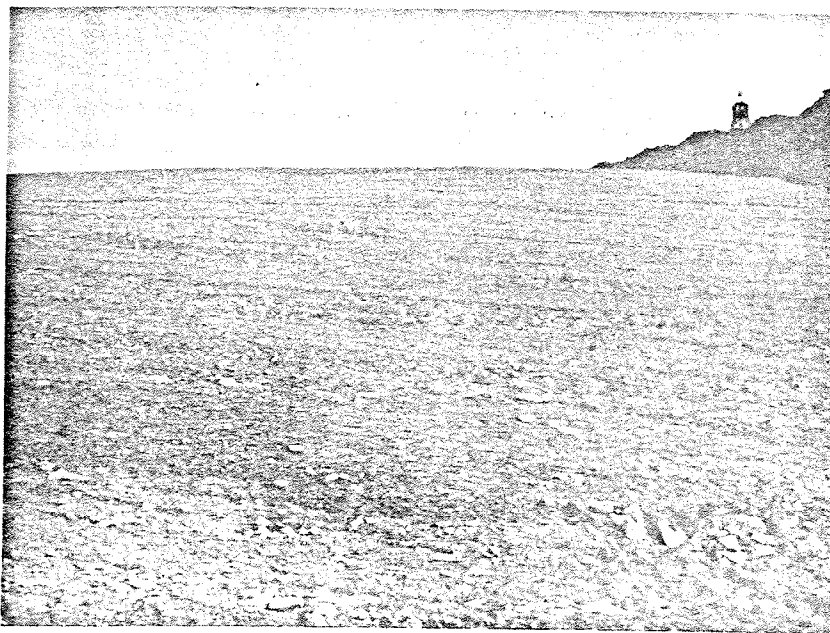
Water is a vital factor to any reclamation effort, especially in the arid Southwest. Moisture is critical for revegetation success during the planting and early establishment phases.

In the Southwest where precipitation is so erratic, irrigation is almost a necessity during the first year to ensure survival and establishment, particularly for shrubs that demand larger amounts of water.

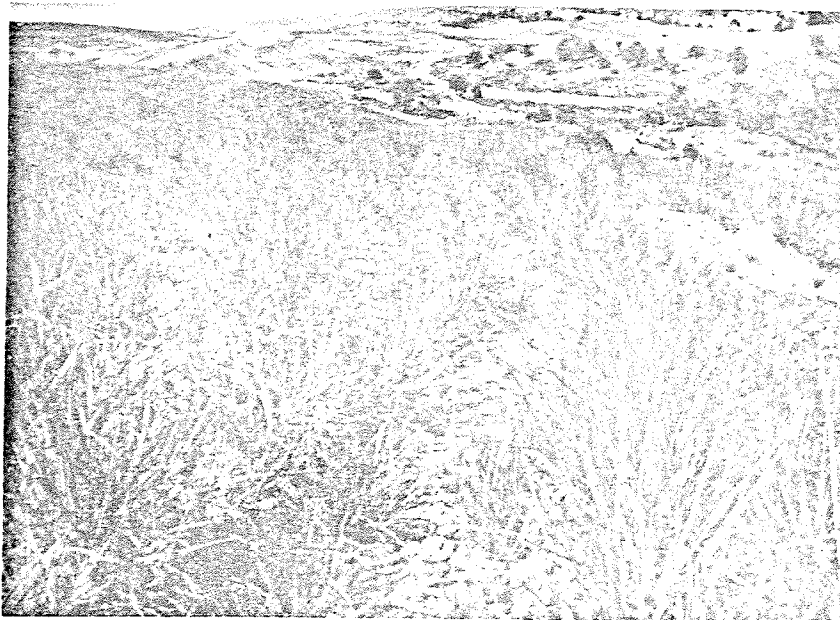
Station scientists have found that when plenty of water is available, such as from wells, reservoirs, etc., the overhead sprinkler system will produce the highest plant density. If available water is in short supply and high plant density is not critical, drip irrigation should be used.

Sprinkler systems are very effective - they give full area coverage, are durable and easily portable. On some steep slopes, however, they may cause an erosion problem. Sprinklers have been successful in a number of applications in reclamation of disturbed lands, but only when the systems were properly designed and operated.

Drip irrigation provides water slowly to a fixed location. It is designed to optimize soil moisture at a specific



Soon after coal is removed from the mine, the topography is reshaped to smooth



After the first growing season small grass plants germinate in the roughened surface material. Research has shown the roughened topography, treated with mulches, to be necessary for germination and survival.

site. With drip irrigation, less water is used than with any other system - often resulting in a water savings of 30 percent over sprinkler irrigation. Also, a drip irrigation system will generally cause less erosion problems.

## Plant species

The Southwest hosts a variety of vegetation. Earl explains that when revegetating mine spoils, chances of success can be improved by using

native plants that are best adapted to the local environment.

Although plant species vary according to geographic location, results of studies show that the most promising species to plant in the Southwest are the grasses al sacaton, western wheatgrass, Indian ricegrass, and the shrub fourwing saltbush.

Two popular forms of revegetating are direct seeding and transplanting seedlings. Drilling is by far the most common method of direct seeding - mechanically placing the seed at a proper depth and controlling the seeding rate while distributing the seed uniformly.

Transplanting provides a higher survival rate, but is considerably more expensive than seeding. On one study plot in northwestern New Mexico, 24 percent of seeded plants emerged and were surviving one year after seeding, compared to a 100 percent survival rate for transplanted plugs one year after planting. Scientists are now working on ways to reduce the costs of transplanting.

## Soil communities

Scientists with the Albuquerque project have recently been scrutinizing soil organisms that influence physical and chemical characteristics of mine spoil material. Undisturbed or natural soils contain a balanced assemblage of bacteria, fungi, and insects which make up the soil community. These organisms process dead plant material and convert it into mineral soil, fix nitrogen, redistribute soil particles, improve aeration, and generally have an enhancing effect on the soil structure. Mine spoils, however, usually lack this biological soil community. As a result, research scientists began to look at ways to establish a soil biota, as well as a

supportive organic substrate for the soil organisms.

Knowing that termites occur naturally on unmined areas in the Southwest, researchers wanted to know what affect termites could have on revegetating mine spoils. Results of these studies show that under lab conditions, marked differences occurred between spoils untreated and termite-worked spoils. Termite activity made the soil more friable and uniform. The insects also helped to break up large chunks and mixed the soil, producing a desirable sand-clay-loam texture. Overall, their activity enhanced porosity, percolation and aeration of the substrate. Scientists are now working to find ways of establishing termite colonies on mine spoils in the Southwest.



*After five years, these shrubs are reseeding themselves and spreading to adjacent areas. Note the spread of grass plants in the foreground.*



*After several growing seasons, the wheatgrasses planted here show good density and vigor. Research is now underway to determine the best management practices needed to use and perpetuate these revegetated sites.*

Reclamation techniques have changed dramatically in the last decade, primarily due to the intense interest and concern of the public. Approaches previously considered impractical and unrealistic are now being proven. Results from years of research on mine spoil reclamation are now being used at several mining sites in the Four Corners area.

Research has, by no means, answered all the questions associated with mine spoil reclamation in the Southwest, but, with additional studies and cooperative efforts between universities, mining companies, government agencies, and others, the development of practical solutions to the most pressing problems can be found.

There are many details that need attention when dealing with mine spoil reclamation. This article has touched only on a few. For additional information, contact Earl Aldon, Rocky Mountain Forest and Range Experiment Station, Forestry and Range Sciences Laboratory, 5423 Federal Building, 517 Gold Ave. S.W., Albuquerque, New Mexico 87101. Phone (505) 766-2384, FTS - 474-2384.

Publications suggested for further reading are: *The Use of Termites and Other Soil Fauna to Develop Soils on Strip Mine Spoils*, Research Note RM-361-FR21; "Reclamation of Coal-mined Land in the Southwest", a reprint from the *Journal of Soil and Water Conservation*, March-April 1978 issue, Volume 33, Number 2; "Demonstration Test of Two Irrigation systems for Plant Establishment on Coal Mine Spoils", a reprint from the proceedings of the *Fourth Symposium on Surface Mining and Reclamation*, NCA/BCR Coal Conference and Expo III in Louisville, Kentucky, October 1976. These publications are all available upon request from the Rocky Mountain Station.

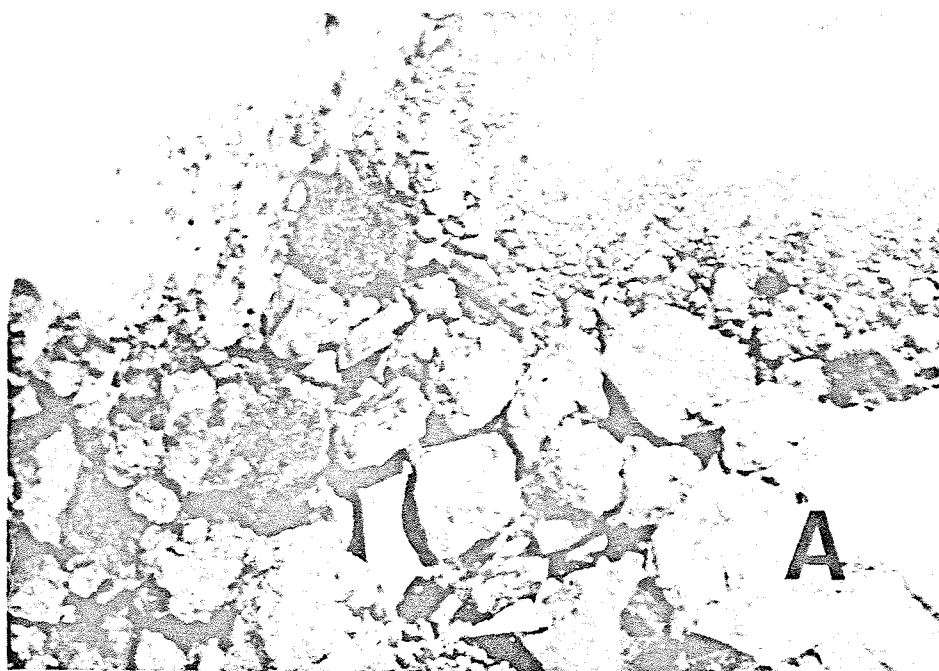


Figure (A) shows raw spoils. Figure (B) shows soil that has been subjected to termite activity. The insects helped to break up large chunks, mix the soil, and give it a more friable and uniform texture - desirable for planting seeds or seedlings.