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Research Proposal
for
Rehabilitation Studies of
Uranium Mine Spoils and
Disturbed Sites in Southeastern Utah

by

Institute for Land Rehabilitation
Utah State University
Logan, Utah

Approved:

M.K. Jeppesen
Contracts Officer, USU

Cyrus M. McKell
Director, Institute for Land Rehab.

I. Title: Rehabilitation Studies of Uranium Mine Spoils and Disturbed Sites in Southeastern Utah.

II. Personnel: Cyrus M. McKell, Professor of Range Science and Director, Institute for Land Rehabilitation

Gordon Van Epps, Assoc. Prof. of Range Science and Supt. Snow Field Station.

_____ Graduate Research Asst.

III. Period of Study: 5 years, commencing Sept. 1, 1979 to Dec. 30, 1984 1987

IV. Location of Study: Initially 4 mine sites in southeastern Utah, plus studies in greenhouses and laboratories at USU and Snow Field Station.

V. Justification: Increasing public attention to activities which create visible and often dramatic disturbance to the natural environment has resulted in legal requirements for mitigation of such disturbances. Regulations of the Utah Division of Oil, Gas, and Mining require that disturbed areas be revegetated--with an emphasis on native plants of the area because of their obvious adaptation to specific site conditions.

Further, the prudent exercise of corporate responsibility would also seek to mitigate excessive disturbance to land properties in order to create a favorable public image.

Conventional methods of disturbed land rehabilitation involving direct seeding of grasses and other species that may be available commercially hold little promise for effective results under the harsh soil (spoil) and climatic conditions of southeastern Utah. Instead, new and adapted methods for plant establishment must be developed and tested on site.

Native species are generally required for rehabilitation because of their adaptation to site conditions - based on the assumption that plants native to the general area of disturbance would be utilized. A problem exists, however, in attempting to work with many of the species native to the uranium mine sites because little is known about their growth habits and requirements for propagation and growth.

Therefore, to successfully pursue a program of rehabilitation, a mining company should have a proven technology for establishing native plant species under the climatic and soil conditions prevailing at the disturbed sites.

VI. Purpose: The proposed research would be conducted to produce a set of guidelines for rehabilitating disturbed uranium mine sites and spoil piles belonging to or controlled by Energy Fuels Nuclear, Inc. and to demonstrate methods for using native species in difficult site revegetation.

VII. Background Information: There is but a minimum of research applicable to the kinds of problems that would be encountered in the arid region of southeastern Utah where the mines occur. The EMRIA (Energy Mineral Rehabilitation Inventory and Analysis) study of the Henry Mountain coal field (Utah State University 1978) showed that fourwing saltbush (*Atriplex canescens*) mat saltbush (*Atriplex corrugata*) shadscale saltbush (*Atriplex confertifolia*) russian wildrye (*Elymus junceus*) and Indian ricegrass (*Oryzopsis hymenoides*) could be established on simulated mine spoil and soils of low productivity if planted as container-grown transplants. This research drew considerable information

and experience from a four-year rehabilitation study of disturbed sites and processed oil shale disposal areas (Utah State University, 1978). Propagation and planting methods for several important native species of the oil shale region of northeastern Utah were developed. Critical problems of that region are meager rainfall (average of 8 inches annually) and soils or spoil materials containing medium to moderately high levels of salinity. Research on oil shale continues and currently includes a set of field plots on a disposal pile of processed oil shale which has a pH of over 9 and an electrical conductivity (EC_e) ranging upwards from 8 to 25 (agricultural soils greater in EC_e than 3 are poorly suited for conventional crops).

Background information on a number of native plant species was recently published by the Institute for Land Rehabilitation, (Utah State University, 1979). However, few of these species were noted in a survey of the proposed study sites conducted in late June, 1979. Some of the species noted at the mine sites visited were as follows:

Shrubs

Greasewood	*Sarcobatus vermiculatus*
Cuneate saltbush	*Atriplex cuneata*
Mat saltbush	*Atriplex corrugata*
Four-wing saltbush	*Atriplex canescens*
Round leaf atriplex	*Atriplex obovata*
Gray's hop-sage	*Grayia brandegei*
Shadscale saltbush	*Atriplex confertifolia*
Fringe sage	*Artemisia frigida*
Bud sage	*Artemisia spinescens*

Rabbitbrush	Chrysothamnus viscidiflorus
Single leaf ash	Fraxinus anomala
Bigelow's sagebrush	Artemisia bigelovii
Single leaf buffaloberry	Sheperdia argentea
Juniper	Juniperus scopulorum
Forbs	
Evening primrose	Oenothera caespitosa
Suaeda	Suaeda fruticosa
Summer cypress	Kochia americana
Desert mallow	Sphaeralcea coccinea
Annual atriplex	Atriplex patula
Grasses	
Galleta grass	Hillaria jamesii
Indian ricegrass	Oryzopsis hymenoides

Other information of a localized nature on plant species appeared in the Final Environmental Impact Statement on the Kaiparowits energy project (Brigham Young University 1975).

Thus, it appears that rehabilitation studies with plants of the mine sites will have to be conducted in order to use them successfully.

Regional information is available from hydrologic and ecological studies conducted by USU scientists in the mancos shale area of southeastern Utah several years ago (Wein and West 1973, ~~Iradj~~ Hassary and Gifford 1979). These studies indicate a high erosion pattern is a consistent occurrence but can be temporarily stopped by surface manipulation (gully plugs) and vegetation although vegetation establishment under natural conditions occurred infrequently and inconsistently.

VII. Objectives: The general objective of the proposed research is to provide guidelines for the propagation establishment and survival of preponderantly native plant species on disturbed sites and uranium mine spoils in southeastern Utah. Field plots established in the process of the research would serve as a demonstration of the methods and species studied. Specific objectives are to:

A. Collect seeds and planting materials (cuttings, clonal divisions, roots, and seedlings) as available of dominant native species in the vicinity of four mine sites.

B. Study means for propagating plant species collected in objective A. These studies would include seed germination requirements, greenhouse propagation of container-grown plants, and growth requirements such as water and fertility needs sufficient to produce materials for outplanting.

C. Set out field plantings utilizing plant materials produced in B. Field plantings to include methods for establishment, surface treatments to optimize use of runoff water (water harvesting) and methods to reduce water loss.

D. Prepare annual reports and a set of guidelines for use in rehabilitating difficult sites in the Uranium Mining areas of southeastern Utah. The guidelines would be a special addendum to the final report.

VIII. Methods for Research: In general the research would follow the pattern of investigation used in our studies for the White River Shale project at Bonanza, Utah. (Institute for Land Rehabilitation 1978). A coordinated program of field and laboratory studies would be undertaken

that would include attention to current research needs of Energy Fuels, Nuclear Inc. A graduate research assistant would be employed to do detailed research on the native species and thus provide technical information to support the results obtained in field plots at four sites tentatively identified as:

1. Sahara Mine area, south of Greenriver in the San Rafael Swell.
2. WeeHope Mine in the Winget Mesa area.
3. Glade Mine on the west side of the Blue Mountains
4. Repeat Mine, near Hovenweep N. Monument.

The research work would be accomplished under tasks as follows which would implement the objectives stated previously.

Task #1. Visit field sites and vicinity areas to collect seeds and planting materials at appropriate times of the season. Take notes on plant characteristics, suitability for rehabilitation work, and general relationship to wildlife and livestock use. A set of criteria for use in rehabilitation work would be developed similar to the one reported by Plummer et al. (1968).

Task #2. A series of studies in the greenhouse and seed laboratory would be undertaken to determine the best ways to clean and prepare seeds collected in Task 1, to develop germination requirements, to induce rooting of cuttings where seed germination results are too low, and requirements for obtaining healthy vigorous container-grown plants (from seeds or cuttings). This work would require various pieces of USU equipment and techniques, depending on the plant species. A graduate student would make this research the central theme of his/her thesis research.

Task #3. A series of field plots would be set out in four locations to test methods for plant establishment and growth. Plant materials produced in task 1 and 2 would be used in the field plantings.

Field research sites would be located on suitable spoil disposal piles and disturbed areas of the following mines:

Sahara mine. Approximately 10 miles south of highway I-70 on highway 24. Average precip. about 6 inches.

Wee Hope Mine south side of Winget Mesa. Average precip. 8 inches.

Glade Mine. Northwest slopes of Abajo Mountains 7500 ft. elevation. Average precip. 25 inches.

Repeat Mine. N. of Hovenweep, Nat. Monument. Average precip. 8 inches.

In each location where possible an area of at least 100 x 200 ft. would be graded and fenced with rabbitproof fencing. Land preparation to be accomplished to meet the needs of the field research by Energy Fuels Nuclear Inc. Additional plots of a smaller size may be fenced to study specific problems such as planting and surface treatments on slopes.

Plantings would be in conjunction with treatments of spoils to increase water retention (creating basins, furrows, ridges, etc.), to ameliorate spoil chemical composition (mulch, fertilize, leach, add ammendments, etc.) or to harvest water from slopes for support of plant growth. Specific plans for planting would be developed as each problem is better identified from chemical and physical analysis of spoils from the areas. A preliminary group

of spoil samples were submitted to the USU soils laboratory for analysis on July 5. Results from analysis of other soil/spoil samples from the general area are on file at USU and are available for study.

Because of the widely fluctuating weather conditions from year to year in southeastern Utah some plantings would have to be repeated and all plots observed for several years to determine survival. The time proposed for establishing field plots would be the spring of 1981. Prior to that time field plots would be located, graded, fenced and prepared for planting. Monitoring of results would be for a minimum of 3 years. During this time other studies -- of a short term nature would be set out.

Task 4. This task is a reporting task that would communicate results of the studies to Energy Fuels Nuclear and to technical rehabilitation specialists. A six-month reporting schedule is proposed; 30 June and 31 December each year of the project. The December report would be the annual report while the June report would be more of the nature of any interim report.

In addition short reports prepared for presentation at technical-professional meetings may be prepared and presented as appropriate 1/.

A set of guidelines for rehabilitation measures to be followed in locations typical of the four study sites would be prepared.

1/ The policy of the University, as a public institution, is to publish results as determined to be scientifically sound. Rights of review would be afforded to the company but final publication is the duty of the University. The company should not disclose any proprietary information it wishes to keep confidential. Research workers would respect any such information designated as confidential.

Specific issues peculiar to the uranium mine sites such as loose material, sterile spoils, and heretofore commercially unknown native plants would be explained in the guidelines.