JENNY LAKE DEVELOPED AREA

RESTORATION PLAN

GRAND TETON NATIONAL PARK

September 8, 1990

SOILS AND WATERSHED SECTION
DIVISION OF RESEARCH

YELLOWSTONE NATIONAL PARK

in cooperation with

DIVISION OF MAINTENANCE

GRAND TETON NATIONAL PARK

This project was completed by

Soils and Watershed Section
Division of Research
Yellowstone National Park

in cooperation with

Division of Maintenance
Grand Teton National Park

The report was completed by

John Lane
Dean Neprud
Ann Rodman
Henry Shovic

September 8, 1990

Table of Contents

Introduction and Purpose 1

Methods and Basis for Recommendations 2

Disturbed Areas - Descriptions and Recommendations 4
- General Recommendations 4
  - Assumptions 4
  - Surface Soil and Subsoil 4
  - Soil and Seedbed Preparation 4
  - Seeding 5
  - Erosion Control 5
  - Disposal of Subgrade, Asphalt Concrete, and other Waste Material . . . 5
  - Human Disturbance 6
  - Sequence of Project Completion 6
- Site Specific Recommendations 6
  - A. Paved Road and Parking Are 6
  - B. Building Sites 7
  - C. Foot paths 8
  - D. Closed Campground Road 8
  - E. Disrupted Areas 9
  - F. Gullies near Lakeshore 9
  - G. Old Road with Regrowth 10
  - H. Service Roads 10
  - I. Trampled Areas 11

Project Area Soil Investigation 12
- Introduction 12
- Map Unit Descriptions 12
  - Map Unit 1 12
  - Map Unit 2. 13
  - Map Unit 3. 14
  - Map Unit 4. 15
  - Map Unit 5. 15
  - Map Unit 6 16

Appendix 17
- Glossary of Soils Terms Used in This Report 17
- Area and Quantities Calculations 18
- Compaction Measurement 20
- Soil Descriptions 21

Introduction and Purpose

The Teton Park Road reconstruction project is a multi-year effort that involves the realignment and rebuilding of many road segments, as well as the restoration of some developed areas and roads to pre-disturbance conditions. The Jenny Lake Area Project is one such restoration. A Park management objective is to reconstruct the area, preserving the beauty and integrity of its natural scenery. This makes the Jenny Lake project more than "rehabilitation" or "reclamation", though it includes aspects of both. First, we consider the whole ecosystem and its components: the soils, the landforms, and biota (including plants, animals, and humans). Second, we look to the long run, while respecting immediate needs in visual management and visitor satisfaction. Finally, we are practical, doing enough to help nature return itself to the natural state, without burdening ourselves with unnecessary costs. The Jenny Lake project is built on this architectural theme, an example of practical reconstructive landscape ecology built on the foundation of our basic Park management philosophy.

The Jenny Lake area is in a high use area with high public visibility. Surface soil, the primary plant growth medium, is shallow and water holding capacity is low. These soils have been altered by the long and concentrated use of the area. The new road alignment is designed to remove concentrated vehicle and visitor use from the Jenny Lake shore. Therefore, the existing roads, parking areas, footpaths, and visitor facilities must be removed. Grand Teton National Park objectives are to restore indigenous vegetation, soils, and landforms, especially in high visibility areas. The appearance of old "corridors" should be obliterated. Elimination of a "roaded" appearance is critical. The final product of restoration should not require long term maintenance. Ecological potentials of sites should be considered during restoration.

The overall project goal is as follows (from Project Work Plan-Teton Park Road Rehabilitation and Road Obliteration Soils Project Services, Dec. 12, 1989- Henry Shovic):

> "Define ecological parameters important for site restoration in the Jenny Lake Area (Phase B1, Grand Teton operation). This will take the form of detailed project level specifications and maps, and criteria for topsoil removal. (1990)"

Area covered by this report is about 31 acres. About five acres are disturbed in the form of paved and gravel roads, building foundations, trampled areas, footpaths, and gullies.

Methods and Basis for Recommendations

This project was initiated in May of 1990. We used field investigation, literature review (including the soil survey for Grand Teton National Park), laboratory analysis, project experience in site restoration and reclamation, and ongoing research on revegetation to develop recommendations. We completed a detailed soil investigation for the project area, emphasizing surface soil and subsoil character, vegetation, parent material, and slope. We calculated site restoration needs on a site specific basis by sampling each disturbed site and reviewing data provided by the Division of Maintenance in Grand Teton National Park. This data is in our office in a computer data base and in files.

We based all our site recommendations on the following restoration principles. These principles are well documented in the literature and in numerous projects and experiments.

1. Plant communities present on a site are, in the long run a representation of its ecological parameters. These parameters are the hydrologic, edaphic (soils), climatic, and botanical characteristics. In relatively dry environments (such as the project site), the hydrologic and soils characteristics dominate the system and become as important as the botanical ones.

2. Plant communities represent the most sensitive visual indicator of the status of the local ecosystem, and its parameters.

3. Small disturbances (e.g. fire, grazing, short term drought) can be ameliorated by the existing plant/hydrologic/soil system. Significant disturbance of these parameters (e.g. removal of surface soil, long term drought) causes the system to change.

4. Significant disturbance of any of the parameters (and therefore the ecosystem) makes it probable that the long term plant community will be different than the pre-disturbance state.

5. It is possible to restore a pre-disturbance plant community in the long term by duplicating the pre-disturbance conditions.

6. Once the pre-disturbance conditions have been closely duplicated, small differences in site conditions will be ameliorated by the restored ecosystem. For example, if the soil characteristics closely duplicate the pre-disturbance ones, small fertility differences will be revealed in differences in plant density, and will eventually disappear as vegetation builds organic matter in the soil. In contrast, large differences in organic matter may result in entirely different plant communities, thereby changing the system.

Important system parameters (site conditions) are soil texture (including rock fragments), soil horizons (surface and subsurface), soil organic matter, soil Ph, soil fertility level, soil

compaction level, and soil water holding capacity, seed rain mix and species, genotypes, seed dispersal, competition from other species, slope, microtopography, infiltration capacity, and microclimate. Our approach to Jenny Lake site restoration is to restore these site conditions to an approximation of the pre-disturbed state, recognizing the following constraints.

a. Exotic or introduced species are present in the ecosystem. These are undesirable and are discouraged. Therefore, some modifications may need to be made, such as seeding and spraying.

b. Aesthetics are important in the short term. Some early successional plant communities may not be acceptable for certain high visibility areas. Erosion control measures may be needed in gullied areas or on slopes greater than 15 percent.

c. Human disturbance can be detrimental to ecosystem reconstruction. Some restrictions of visitor access may be necessary to achieve success.

We recommend AGAINST agronomic practices, such as high quality topsoil, irrigation, cover crops, water retaining mulches, or fertilizer unless they ameliorate the conditions described in a. through c. above. General use of these kinds of techniques produce plant communities and ecosystems that do not meet park objectives, and would require long term maintenance.

Disturbed Areas - Descriptions and Recommendations

General Recommendations

Assumptions

On-site inspection during project completion is essential to make on-the-ground modifications and adjustments to these recommendations. Ecosystem reconstruction is based on a different philosophy than is land reclamation or road construction. Project success depends on the knowledge and motivation of the equipment operators and project leaders.

Surface Soil and Subsoil

The term "surface soil" is used throughout this report as opposed to "topsoil" because we want to differentiate between the material used to duplicate the original soil conditions near the surface (surface soil) and soil material selected for its desirable properties for maximum plant growth (topsoil). Surface soil (top 5 inches in depth) from Map Unit 5 was stockpiled in early summer of 1990. This soil is similar to that occurring in the rest of the project area. This soil has a moderate proportion of coarse fragments. They should NOT be screened or otherwise removed. ONLY soils taken from similar ecosystems should be used. Using different soil will probably change the long term plant communities on site and could introduce exotics.

Surface soil can be stored over winter, but will lose a large part of its viable seed bank, unless stored in piles less than two feet deep. However, this is not critical if seeding is carried out after soils are reconstructed.

Approximating subsoil characteristics is also important, but not as critical as the surface soil. Material having sandy loam texture and 40-70 percent rounded coarse fragments is suitable. This can be taken from material removed for the new parking lot or from a similar area.

Soil and Seedbed Preparation

Disturbed areas should be scarified (ripped) with either a plow or a dozer mounted ripper. Scarifying increases root penetration, and helps to approximate infiltration rates of undisturbed soil. Scarifying depth should be **6 inches**. For roads and large disturbed areas, this implement should have at least three teeth, spaced less than 1 foot apart to obtain proper compaction reduction. One toothed rippers are not recommended because many passes will be needed to achieve an adequate spacing, increasing compaction. On-site inspection will be needed to determine whether to scarify the native soil exposed under paved roads.

Surface soil should not be compacted or scarified after placement. A dozer can be used to back blade the material, but a rake should be used afterwards to reduce any surface compaction and smooth the surface to approximate the "natural" soil contours. Furrows and ridges should be eliminated because they modify the microclimate and create unnatural vegetative patterns. **We recommend returning all areas to about 1 INCH above original contour of the surface. This is to allow for settling. It is important to avoid channeling water and detaining snow melt which would occur in settled depressions and settled troughs. ALL SURFACE SOIL THICKNESS RECOMMENDATIONS HAVE TAKEN THIS ADDITIONAL INCH INTO ACCOUNT.** Surface soil depths given by site are guidelines, and may be modified by the above conditions or others discovered on site as mentioned below.

Large equipment should be used on roads and large disturbed areas to minimize compaction. Smaller areas (trails and gullies) should be reconstructed with a small machine or by hand to minimumize damage done to surrounding undisturbed areas. A smoothing implement (rake) could be used behind a machine, or the area can be raked by hand.

Seeding

Ideally, restoration of the soil and hydrologic system will result in a long term recovery of native vegetation. However, to reduce the effects of exotics and human disturbance, we recommend seeding with native species originating from seed collected near the site. Raking in seed 1/2 inch will improve germination on these droughty sites. Making furrows should be avoided. Any tree or shrub transplants over about 2 feet in height should be irrigated by drip or flood for at least one growing season. Spraying with herbicides could be considered if infestations occur.

Erosion Control

Most of the project area has a low erosion potential. Slopes are generally gentle and soils are highly permeable. Runoff potential is low. However, there are some areas where special measures should be taken to prevent erosion. Where specified, mulch should be sterile wood chips or equivalent, about 1/2 inch deep. Because of wildlife impacts, netting or fabric is NOT recommended, with one exception.

Disposal of Subgrade, Asphalt Concrete, and other Waste Material

All removed material should be transported offsite. None of this material is suitable subsoil or surface soil. Asphaltic materials should be disposed of in an area where no leaching of oils will occur into ground or surface water.

Human Disturbance

Disturbance by visitors could seriously reduce effectiveness of this restoration project. Fencing should be considered to reduce potential for trampling and displacement of soils. A set of low wood fences would discourage visitor use without being visually intrusive. We should fence, at a minimum, the apparent entrances to the reconstructed areas, as they will appear as corridors or trails for some time.

Sequence of Project Completion

This project should be completed in 2-3 years to reduce erosion potential and weed establishment. A general sequence of events could be 1) remove buildings; 2) restore building sites, compacted areas, unused roads, gravel roads, and footpaths; 3) remove asphalt and subgrade; 4) replace subsoil and surface soil on roadway; 5) final grading and smoothing of seedbed on surface soils; and 6) seeding and fence construction.

Site Specific Recommendations

Site by site recommendations are keyed to Map A. Approximate areas and soil quantities for each type of disturbance are in Table 1 (Appendix). These recommendations are based on park objectives and the principles of site restoration given above. The quantities and project details given are for a COMPLETE restoration of the site. Because peojects are relatively independent, we recommend they be selected and completely finished if funding is limited. Attempting to do a portion of each of them would probably not meet restoration objectives.

Disturbance now under the new parking lot is not cataloged or evaluated. No recommendations are made for the recently installed underground cabling, though some areas are not reclaimed. Compaction is discussed in the Glossary and in the Appendix.

A. Paved Road and Parking Area

The paved road runs from the west end of the new parking area to the intersection with the one-way Jenny Lake Loop road. Included within this section is a road cut area (see Map A), where approximately 326 cubic yards of the original soil was excavated and removed. Interspersed along this road are four paved parking areas. Total paved area disturbance is about 69688 square feet. Test drill holes show that the road has from 4 to 7 inches of asphalt over a 12 to 15 inch gravelly sand base over "native soil". The parking areas have approximately 4 inches of asphalt over 1 inch of leveling sand on top of native soil. This material might be contaminated by leachate from the roadway and also from the asphalt itself. The soil underneath the asphalt is probably compacted. The majority of the soils are formed in glacial till deposited as moraines (Map Unit 1); the soils of the road cut area are in Map Unit 2.

It is difficult to establish vegetation on these areas due to the chemical and physical properties associated with asphalt. The alteration of the landscape caused by removal of soil material has affected the natural hydrology and soil environment of the area, thereby affecting native plant productivity.

Recommendations: The asphalt and sand base should be removed to a depth of 18 inches under the road and 5 inches under the parking areas. Once these two layers are removed the native soil should be scarified to alleviate compaction. Subsoil should be added to within 3 inches of the undisturbed surface and contoured for a natural appearance. On top of this, a 4 inch layer of surface soil should be spread and smoothed to match the natural landscape.

The roadcut area needs further treatment before layering of surface soil. Additional subsoil, up to 48 inches thick should be added to replace subsoil removed during road construction. Contouring this soil to match the existing slope will eliminate 'channeling' and a road cut appearance. Once this subsoil is in place, surface soil can then be spread to a thickness of 4 inches. Since these slopes are greater than 15 percent, a mulch should be added after seeding.

See "General Recommendations" for specifications common to all sites and further description of erosion control, soil preparation, disposal of waste material, and other project recommendations.

B. Building Sites

There are five building sites grouped into four areas. The buildings (Ranger Station, Historic Store, General Store, Comfort Station, and living quarters) and the surrounding areas occupy approximately 20625 square feet. Soils are formed in glacial till deposited as moraines (Map Unit 1). Each building probably has footings extending below the frost line. These footings are assumed to be 1.5 feet deep, 1.5 feet wide and continuous around the building.

The area around the buildings has been heavily compacted by foot traffic. The microclimate of these areas has also been affected by the buildings themselves; shade, precipitation, and sunlight reflection affect vegetation.

Recommendations: After the buildings are moved the areas beneath and around the building sites should be restored. All footings and any other construction material should be excavated and removed. Compacted areas (determined by on-site investigation) should be scarified. The building sites should then be backfilled with subsoil to replace the amount once occupied by construction material. After scarification and backfilling, the area should be spread with 4 inches of surface soil to help promote

plant growth.

See "General Recommendations" for specifications common to all sites and further description of erosion control, soil preparation, disposal of waste material, and other project recommendations.

C. Foot paths

Unrestricted foot travel has created numerous foot paths throughout the study area. Foot travel compacts soil, reducing the amount of pore space available for water and air movement. Compaction concentrated along a trail impedes vegetative growth and reduces water infiltration, thus concentrating water runoff. On slopes greater than 15 percent, the resulting accelerated erosion has led to losses of surface soil and subsoil. Soils are formed in glacial till and are in Map Units 1, 2, 3, and 4. Footpaths are about 10700 square feet within the study area, including 1070 square feet on areas with a slope greater than 15 percent.

Recommendations: The affected areas should be scarified to reduce compaction. The exact amount of surface soil needed to restore the area to a predisturbed condition is determined on a site by site basis. In general, areas with slopes less than 15 percent will need 4 inches of surface soil. In areas with slopes greater than 15 percent, subsoil should be added to within 4 inches of the desired surface level, and then 5 inches of surface soil should be added. A mulch should be added on these slopes after seeding.

See "General Recommendations" for specifications common to all sites and further description of erosion control, soil preparation, disposal of waste material, and other project recommendations.

D. Closed Campground Road

The closed campground road is still obvious eight years after closure. The original road was paved. Approximately 30 percent of the original asphalt is still in place. In most places vegetative regrowth does not mask the road. Gravel and pieces of asphalt are concentrated along the surface of the roadbed. Pipe and other relics from the old campground are common along both roadsides. Soils are formed in glacial till deposited as moraines (Map Unit 1). This road occupies approximately 15000 square feet.

Recommendations: The portions of this road nearly bare of vegetation should be scarified and the asphalt removed. Any subgrade sand beneath the asphalt should be removed. The remaining soil should be scarified to reduce compaction. On-site inspection should determine whether subsoil additions are needed. If required, subsoil should be added and contoured to within 3 inches of the undisturbed surface level. A 4

inch thick layer of surface soil should be spread over the area. Care should be taken to minimize damage to existing patches of vegetation. All pipe and other materials should be removed from the area.

See "General Recommendations" for specifications common to all sites and further description of erosion control, soil preparation, disposal of waste material, and other project recommendations.

E. Disrupted Areas

The comfort station leachfield and a small area southwest of the closed campground road are included in this section. These areas have been dug up and haphazardly filled resulting in the loss of surface soil. The area is characterized by more surface rocks and a lighter colored surface than the adjacent non-disturbed areas. Removing surface soil and replacing it with subsoil changes the ecological parameters of a site. Soils are formed in glacial till deposited as moraines (Map Unit 1). The area affected is about 13125 square feet.

Recommendations: Scarification is probably not needed on these sites. The area should be contoured to match existing natural areas around it. A 4 inch layer of surface soil should then be spread and smoothed.

See "General Recommendations" for specifications common to all sites and further description of erosion control, soil preparation, disposal of waste material, and other project recommendations.

F. Gullies near Lakeshore

The lakeshore in the project area has about 24 gullies created by a combination of heavy visitor use, soils having low bearing strength, and concentration of runoff from trails and trampled areas. Soils are formed in sandy lakeshore sediments over glacial till (see Map Unit 4). The sandy soil has been washed away in most gullies, exposing the coarse textured till. The gullies occupy approximately 2624 square feet.

Recommendations: The restoration of the trampled areas (see I.) and construction of a new lakeside trail will help reduce continued gully formation. The new paved lakeside trail should be designed to drain only into areas that are vegetated and restricted from visitor use.

Reconstruction of the original contours where gullies now occur is difficult because soil has been lost into the lake. Therefore, artificial restructuring of the eleven large gullies (located on Map A) is recommended. Recommendations for the smaller gullies are the

same as for foot paths (see C.).

Restructuring consists of 1) construction of log cribbing, keyed 2 feet into gully bottom and sides, then staked with steel rebar or fence posts in non-visible positions; 2) backfill with subsoil material to 2 inches below natural contour; 3) add 3 inches of surface soil. Cribbing should be about 2 inches higher than final surface contour to allow for sediment trapping. Logs should be greater than 6 inches in diameter and treated to prevent deterioration. Planks should be placed upgradient from the logs to prevent piping of soil through cracks in logs. Cribbing should be constructed as close to lake shore as practical without being visually intrusive. A mulch should be used after seeding to minimize erosion. Of course, if access points or trails are planned in any of these areas, we recommend no restructuring.

One of the large gullies is on a very steep slope and requires special treatment. This gully is marked on Map A. The methods listed above will probably be ineffective here. We should use some secured erosion control fabric, possibly overlain by high quality topsoil, and a netted mulch. On-site design is needed for reconstruction.

See "General Recommendations" for specifications common to all sites and further description of erosion control, soil preparation, disposal of waste material, and other project recommendations.

G. Old Road with Regrowth

Areas of old road with active regrowth are located at the west, south, and east sides of the old campground section. Compaction and changes in the microtopography of these sites have altered conditions for vegetative growth. Soils are formed in glacial till deposited as moraines (Map Units 1 and 2). Approximately 13750 square feet are affected in some way by these old road corridors.

Recommendations: The vegetative regrowth on the western road is probably adequate. Areas with less active regrowth should be treated. Barren areas should be scarified, contoured, spread with 4 inches of surface soil, and smoothed.

See "General Recommendations" for specifications common to all sites and further description of erosion control, soil preparation, disposal of waste material, and other project recommendations.

H. Service Roads

Gravel roads are used to access building sites and the comfort station. These areas are severely compacted, support little to no vegetation, and have poor water infiltration.

Soils formed in glacial till deposited as moraines (Map Unit 1). The total area disturbed by these roads is approximately 14063 square feet.

Recommendations: After the gravel surface is removed, the remaining native soil should be scarified. After scarifying, the areas should be contoured to grade and a 4 inch layer of surface soil spread and smoothed.

See "General Recommendations" for specifications common to all sites and further description of erosion control, soil preparation, disposal of waste material, and other project recommendations.

I. Trampled Areas

These are areas that have been compacted by foot traffic for many years. They are located near parking lots, buildings, and on the lake shore. Trampling leads to increased soil compaction, decreased infiltration, decreased plant vigor, and increased runoff and erosion. In most areas some compacted surface soil remains on site. The steeper slopes near the boat dock have caused more erosion, resulting in surface soil and subsoil loss. Soils are formed in glacial till (Map Unit 1), with a small amount formed in lake sediments (Map Unit 4). Trampled areas occupy approximately 36719 square feet.

Recommendations: Scarification will reduce the compaction in these areas. After scarification a 2 inch layer of surface soil should be spread and smoothed. Addition of subsoil may be needed in a small area near the boat dock. Because erosion has been greater in this area, 4 inches of surface soil should be added (see Erosion Control).

See "General Recommendations" for specifications common to all sites and further description of erosion control, soil preparation, disposal of waste material, and other project recommendations.

Project Area Soil Investigation

Introduction

This soil investigation has been made to support this project. It can also be used for other planned projects in the Jenny Lake area. See Map B for legend and delineations. Map Unit areas follow in Table 2.

Table 2. Soil Map Unit summary

Map Unit	Sq. Feet	Acres	% of Total Area
1	656100	15.1	49
2	128100	2.9	9
3	87700	2.0	6
4	70600	1.6	5
5	414400	9.5	31
Total	1356900	31.1	100

Map Unit Descriptions

Map Unit 1

These very deep, well drained soils are formed in glacial till deposited as moraines. The topography is gently undulating. Most slopes are 3 percent, but range from 0 to 8 percent. The ground surface averages 30 percent coarse fragments (ranging from 25 to 35 percent), composed of 1 percent boulders, 4 percent stones, 3 percent cobbles, and 22 percent gravel. This map unit makes up 49 percent of the study area, or 15.1 acres.

The surface soil has a loam or sandy loam texture. The average thickness is 8.5 cm (3.3 in.), ranging from 5 to 15 cm (2.0 to 5.9 in.). This layer averages 24 percent coarse fragments (ranging from 10 to 65 percent), mainly cobbles and gravel. The average surface soil pH is 5.7, ranging from 5 to 6.5.

The sandy loam subsoil is thicker than 75 cm (29.3 in.). It averages 40 percent coarse fragments (ranging from 15 to 70 percent), mainly gravel, cobbles, and some stones. The pH is 5.7 (ranging from 5.5 to 6). Soil description 5 is typical of this map unit (see Appendix).