WATERSHED ANALYSIS PLAN FOR EVALUATION OF THE 1983 LANDSLIDE EVENT ON THE MANTI-LASAL NATIONAL FOREST

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January 20, 1984

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INTRODUCTION

During the spring and summer of 1983, the Manti-LaSal National Forest experienced major landslide* and flooding events which caused substantial damage. Most of this activity was on the San Pitch and Manti Divisions of the Forest, with some additional damage on the Moab District. A damage assessment team was formed and it reported 131 significant landslide areas which accounted for more than 2,700 acres of land moved by landslides. The assessment did not include detailed study or evaluation of all of the landslides and the circumstances that were involved in the events. In preparation for further analysis, aerial photographs at a scale of 1:40,000 were taken of the Manti and San Pitch Divisions in September 1983. Color aerial photographs at a scale of 1:12,000 were also taken on part of the Manti Division in areas of significant damage.

OBJECTIVES

The objective of this plan is to determine the magnitude and spacial relationships of 1983 landslide occurrences and to describe the land characteristics and climatic events that contributed to the instability and flooding. This is to be done by a systematic documentation and analysis approach that will effectively store, analyze, and display the data. The data will yield information that clearly describes current conditions and will be useful in better understanding and predicting landslide and flooding events and their potential effects on the natural environment and Forest management. The following questions should be answered by the study:

1. How many landslides were active on the Manti-LaSal National Forest in 1983 and where are they located?

2. How many acres and what percent of each subwatershed was disturbed by land movement in 1983?

3. What factors were significant in causing the landslides and floods?

4. What is the probability of future slope failures and floods under various climatic events?

5. How do the present landslides affect resource management?

6. What is the anticipated future impact from slope failure and flooding?

7. What type of monitoring should be maintained?

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*Landslides as used here refer to a broad category of mass movement events.

8. What type of management systems could we implement to reduce landslides and flooding incidents and damage?

9. Where is special monitoring needed?

PROCEDURES

A. Landslide Documentation

Black and white aerial photographs at a scale of 1:40,000 taken in September 1983 will be used as an inventory base for this evaluation. The landslides will be identified by photograph interpretation supplemented by some ground varification. Other resource data will be obtained from appropriate sources and correlated with the landslide events. The following steps will be followed:

1. On the 1983 1:40,000 aerial photographs, delineate an effective mapping area on alternative photographs, then identify each landslide or mass movement occurrence that was active in 1983.

2. Plot the landslides (mass movement) on 1:24,000 scale topographic orthophoto quads.

3. Assign an identification number to each land movement. This would be done by giving the subwatershed number plus the number each landslide consecutively from one to the total number within the subwatershed.

4. Based on the aerial photographs, topographic maps, and other data sources, record the following for each landslide. Code on an appropriate data input form by subwatershed and landslide number.

   a. Location to the nearest quarter section.

   b. District

   c. Type of mass movement.

      (1) Landslide

      (2) Slump

      (3) Mudslide

      (4) Debris Avalanche

      (5) Earth Flow

      (6) Etc.

   d. Did the movement occur on an old slide?

      (1) Yes

      (2) No

e. Size Category

(1) Less than 5 acres.
(2) Five to ten acres.
(3) 10-50 acres.
(4) 50-100 acres.
(5) Over 100 acres.

f. Length of mass movement (slide).

g. Elevation at top of slide.

h. Elevation at bottom of slide.

i. Slope aspect (N, NE, E, SE, S, SW, W, NW).

j. Slope gradient in percent (use 10% intervals).

k. Shape of slope.

(1) Concave
(2) Convex
(3) Straight

l. Position on the slope.

(1) Top of slide.

(a) Upper Third
(b) Middle Third
(c) Lower Third

(2) Bottom (Termination)

(a) Upper Third
(b) Middle Third
(c) Lower Third

m. Did the slide terminate in a stream?

(1) Yes
(2) No

n. Broad vegetative type (cover type).

(1) Aspen
(2) Conifer
(3) Brush
(4) Grass
(5) Forb
(6) Pinyon-Juniper
(7) Rock

o. Bedrock Formation

p. Direction of bedrock dip.

q. Does it appear that faulting contributed to movement?

(1) Yes
(2) No

r. Drainage density of landform where slide occurred.

s. Possible affect of man's activities in activating mass movement.

(1) None
(2) Road
(3) Pipeline
(4) Irrigation Ditch
(5) Timber Harvest
(6) Other

t. Landtype association.

u. Soil Type

v. Range allotment number.

w. Forest Management Planning Analysis Unit number.

5. Obtain ground photographs of representative landslides and flooding damage.

B. Meteorologic and hydrologic data documentation. From U.S.G.S., Weather Bureau, SCS, and Irrigation Company records determine the following:

1. Precipitation quantities and patterns. Enter data for selected areas.

a. Average annual precipitation (in inches).

b. Average monthly precipitation (in inches).

(1) January
(2) February
(3) March
(4) April
(5) May
(6) June
(7) July
(8) August
(9) September
(10) October
(11) November
(12) December

c. Actual monthly precipitation (measured or estimated).

(1) October 1981
(2) November 1981
(3) December 1981
(4) January 1982
(5) February 1982
(6) March 1982
(7) April 1982
(8) May 1982
(9) June 1982
(10) July 1982
(11) August 1982
(12) September 1982
(13) October 1982
(14) November 1982
(15) December 1982
(16) January 1983
(17) February 1983
(18) March 1983
(19) April 1983
(20) May 1983

(21) June 1983

(22) July 1983

(23) August 1983

d. Precipitation type (average annual).

(1) Percent Rain

(2) Percent Snow

e. Precipitation type (October 1981 through September 1982 water year).

(1) Percent Rain

(2) Percent Snow

f. Precipitation type (October 1982 through August 1983).

(1) Percent Rain

(2) Percent Snow

2. Snow packs and snowmelt data.

3. Air temperature data as related to the form of precipitation and snowmelt.

4. Streamflow data.

C. Data Storage and Analysis

1. Establish a computer data base for landslides.

2. Determine computer data file format.

3. Determine statistical procedures for prediction and correlation.

4. Enter data into data base.

5. Run log Pearson III Flood Frequency Analysis for each precipitation and stream flow station having adequate data.

6. Run stratification models.

7. Run statistical models.

D. Complete analysis of findings.

E. Reporting

A report including maps, photographs, and diagrams will be produced which summarizes the data and addresses the objectives of this study by May 1, 1984.

F. Estimated cost ($8,000 - $10,000).

1. Geologist, soil scientist, and hydrologist (6 pay periods in combination).

2. Computer tech. assistance.

3. Data processing ($300.00)

4. Travel and supplies.

DISCUSSION

Much knowledge currently exists on landslide and flooding processes. A problem was anticipated before the 1983 landslide and flooding event actually occurred on the Manti-LaSal National Forest. Some currently known facts are:

1. Most of the failures and flooding occurred in areas already mapped and described as unstable lands (Godfrey's instability mapping and Steinfeld's Land System Inventory).

2. Most of the slope failures were on the generally west facing slopes of the Manti Division on the North Horn Formation with a westward dip of the bedrock.

3. The area received two consecutive abnormally high precipitation years.

4. The spring of 1983 was cool for an extended period which delayed runoff, then warm weather came which caused rapid, high volume runoff.

5. The "landslide and flood damage assessment" of 1983 contains some analysis of the situation.

REFERENCES

The following references are available:

1. Godfrey, Dr. Andrew E. 1972. "Report on a Field Reconnaissance of Mantle Instability on the Manti Division of the Manti-LaSal National Forest and an Adjacent Portion of the Fishlake National Forest".

2. Steinfeld, David E. 1979. "Land Systems Inventory for the Sanpete Planning Unit, Manti-LaSal National Forest".

3. Rapin, Dale L. 1977. "Soil Resource Inventory, Ferron-Price Planning Unit, Manti-LaSal National Forest".

4. National Research Council. Transportation Research Board. 1978. Landslides, Analysis and Control. Special Report 176. National Academy of Sciences, Washington D.C.

5. Bureau of Land Management, Oregon State Office, 1976. "Slope Stability in Road Construction".

6. Forest Service. 1983. "Emergency Watershed Protection Report, Spring and Summer 1983, Manti-LaSal National Forest".