SOILS RESOURCE TECHNICAL REPORT
Lake Fuels Project

Prepared by:
Robert Davidson
Forest Soil Scientist
Manti-La Sal National Forest
U.S. Forest Service

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INTRODUCTION

The purpose of this report is to provide detailed information and analysis regarding soil resources in order to support the conclusions in an Environmental Assessment. This report will provide a brief description of the project; discuss key assumptions and methodologies used in the analysis; identify existing inventories, monitoring, and research literature review used in the analysis; describe desired conditions and site-specific resource conditions; discuss resource impacts and effects of the proposed action and alternatives; recommend site specific mitigation measures to minimize or avoid these effects; and identify specifically required disclosures for soil resources.

Consideration of Best Available Science – The scientific integrity of the discussions and analyses in this report are based upon the "best science" available at the time the report was prepared. "Best Science" could include a discussion of the methodology used in the analysis. Best science is based on the relevant scientific inventories, monitoring, or research literature that are relied upon and referenced.

Purpose and Need – The District Ranger for the Ferron District of the Manti-La Sal National Forest in conjunction with Sanpete and Emery County has determined a specific need on National Forest land to address the fuel conditions in the Lake Fuels Treatment Project Area. Fuel loadings have increased in recent years as a result of Engelmann spruce mortality from spruce beetle and there is a need to reduce the Condition Class from Moderate to Low at the stand level.

Proposed Action – *Treatments*

1. Remove beetle-killed spruce and other conifer species on approximately 820 acres; regenerate aspen on approximately 145 of these acres and plant spruce on approximately 660 of these acres.
2. Fuels reduction activities will occur on approximately 820 acres using various methods including, but not limited to, piling and burning, broadcast or jackpot burning, or chipping.

Location – The Lake Fuels Project is located on the Ferron Ranger District, Manti-La Sal National Forest in Sanpete County, Utah.

Background – The Lake Fuels Project covers the same area as the Lake Vegetation Project Environmental Impact Statement. As of 2006 the spruce beetle had killed approximately 90 percent of the spruce in the stands proposed for treatment under the Lake Vegetation Project. Because of this changed condition, the Lake Vegetation Project will be scoped as a fuels reduction project under the Healthy

Forest Restoration Act (HFRA). The area has been identified in the Wildfire Protection Plan for both the Sanpete and Emery Counties and the Central Region Wildfire Protection Plan.

ASSUMPTIONS AND METHODOLOGIES OF ANALYSIS

Key Assumptions and Methodologies – The analysis method is to present the desired conditions for soil resources; describe soil types and conditions within the project area; present information on potential effects of the treatments; and then present recommended mitigation measures.

Existing Inventories, Monitoring, and Research Literature Review – Sources of information are used to determine the current quality and condition of soil resources and to analyze the effects of the proposed project and alternatives. Information on the distribution and properties of soil types within the analysis area are included in the Manti-La Sal Soil Survey (USDA Manti-La Sal, 2004). A field visit was made to the project area in October of 2007 to confirm the accuracy of the soil survey data, and to review watershed soil conditions in the proposed project area.

RESULTS OF ANALYSIS

Desired Conditions

Desired Future Conditions (DFC) of the Forest is a description of the land and resource resulting from implementation of the Forest Plan and adherence to Forest goals and objectives. The 1986 Manti-La Sal Forest's LRMP lists DFCs for all management areas.

Soil and Water

Water quality and soil productivity would be maintained or improved. Flood damage repair programs in conjunction with fisheries improvement would result in improved conditions of damaged streams. Other identified watershed improvement needs would be completed at a reasonable rate throughout the planning period, which would reduce soil erosion and stream sedimentation. Future resource uses or activities would be executed so as to minimize impacts to soil and water quality. Reconstructing eroding portions of roads and trails will improve water quality. Protection from damage due to vehicle travel would increase through law enforcement and public education. The soil and water resource inventory and monitoring would be used in activity design and implementation. Water uses and needs including instream flows would be claimed through the State adjudication process. Increases in water yield due to aspen harvest could be less than one percent of current yield, and 95 percent of the increase would b in the Colorado River Basin.

Forest Management Goals

The following goals and objectives from the Manti-La Sal Forest's LRMP are concise statements describing a desired condition to be achieved some time in the future. They are expressed in broad general terms and are timeless in that they have no specific date by which they are to be completed.

Soil and Water

- Maintain satisfactory watershed conditions.
- Provide favorable conditions of water flow (quality, quantity, and timing).
- Protect National Forest System lands or resources from unacceptable damage caused by the development of water uses.
- Improve deteriorated watershed conditions where feasible.

- Provide sufficient water for multiple-use management by securing favorable flows of water, which is interpreted to include those flows necessary to maintain stable and efficient steam channels as required by the Organic Act of 1897, and provide for fish and wildlife habitat, recreation, and livestock use as required by the Multiple Use Act of 1960.
- Protect soil and water productivity so that neither will be significantly or permanently impaired.
- Protect and enhance riparian areas including dependent resources.

SOIL RESOURCE FEATURES AND CONDITIONS

The Lake Fuels project lies within four different Forest Management Areas: Wood Fiber Production and Utilization (TBR), Range Forage Production (RNG), Undeveloped Motorized Recreation sites (UDM), and Watershed Protection and Improvement (WPE). The Management Areas are described in Chapter 3, of the Manti-La Sal NF 1986 Land and Resource Management Plan (USDA Manti-La Sal NF, 1986). Table 1 shows the acres by management area within the project area (also see Figure 2):

TABLE 1

Land Management Area	Acres
RNG	3495
TBR	2002
UDM	95
WPE	56

The project treatment areas are primarily located in the Wood Fiber Production and Utilization (TBR) and Range Forage Production (RNG) management areas; therefore, the LRMP Soil Resource Management general direction relative to these management areas states:

- F001 – Maintain or improve soil productivity and watershed qualities within the ecological site capabilities.
- F002 – Minimize adverse, man-caused impacts to the soil resource including accelerated erosion, compaction, contamination, and displacement.
- F002, a and b – The specific soil standards and guidelines associated with these general directions state that soil erosion losses need to be maintained at or below soil loss tolerance “T” Factor values as defined by the Soil Conservation Service (see Table 2).

The project area is delineated by the Manti-La Sal Soil Survey (UT645) which is a third order soil survey. The soil survey went through correlation to meet USDA Natural Resources Conservation Service (NRCS) standards in 2004. The soil map units affected by the treatments are shown in Figure 1, Soils Map. Affected soil map units include 45, 45A, 413, 570, 628, 628A, 701, and 701A. The map units primarily affected by the project area include 628, 701 and 701A. Information about soil type can be found in the Manti-La Sal Soil Survey (USDA Manti-La Sal, 2004). Table 2 contains a summary of pertinent soil characteristics.

Soil Map Unit 628 occurs on glacial moraines and outwash derived from North Horn and Flagstaff formations. Vegetation consists of aspen dominant, with spruce-fir, mountain big sage, and high mountain brush. The Becks’ component vegetation consists of perennial forbs and wetland vegetation.

Soil Map Unit 701 occurs on steep north slopes in the North Horn formation. Vegetation consists of spruce-fir.

Soil Map Unit 701A occurs on moderate slopes on North Horn formation. Vegetation consists of Spruce-fir.

TABLE 2: Soil Types and Properties

Soil Map Unit	Soil Map Unit Name Percent Slope Component % of Map Unit	Acres	Runoff Rating	Soil Erodibility Rating	Erosion Hazard (bare soil)	Surface Soil Texture	Surface Rock (%)	Rooting Depth (in.)	T Factor (tons/acre)
628	Hobacker-Baird Hollow-Becks families 5 to 30% slopes								
	Hobacker 40%	31	Medium	Moderate	Moderate	sl, VGR, VCB, VST	35-60	40-60	3
	Baird Hollow 25%	19	Medium	Low	Moderate	l, cl, CB, VCB	15-60	60	3
	Becks 20%	15	Slow	Low	Low	l, GR	15-35	<20	1
701	Croydon-Elwood families 30 to 60% slopes								
	Croydon 50%	325	Medium	Moderate	High	l, GR, CB	15-35	40-60	3
	Elwood 35%	228	Rapid	Moderate	High	l, sl, VGR, VCB	35-60	30-50	2-3
701A	Croydon families 10 to 40% slopes								
	Croydon 80%	50	Rapid	Moderate	High	l, sl, VGR, VCB	35-60	30-50	2-3

T Factor – Soil loss tolerance (ton/acre). The classes of T factors are 1, 2, 3, 4, and 5.
Erosion Hazard (bare soil) – susceptibility of soil to erosion, or the potential inherent in the soil itself to erode if the forces that cause erosion are applied to an area that is not adequately protected.
Low – problems of soil erosion control are unimportant
Moderate – some attention must be given to prevent unnecessary soil erosion.
High – methods of operation and disturbance must be planned to minimize soil erosion.

Erosive Soil in Project Area.

As seen in Table 2, the major portion of the project area primarily affects soil map units 628, 701 and 701A. Soil map unit 628 contains soils with moderate soil erosion hazard; however, both soil map units 701 and 701A contain soils with a high soil erosion hazard. These erosive soil types include Croydon and Elwood components and account for 603 acres of the 820 treatment acres, or 74% of the treatment area. As noted in the table, surface soil types within these three soil map units have either sandy loam, loam, or clay loam textures.

All three map units have soil components containing significant rock within the surface soil, primarily gravels, cobbles and stones. The presence of surface rock (cobble size or greater) makes these soils comparatively more resistant to erosion by intercepting raindrop impact. Surface rock helps harvest water; the water drains off the rock and soaks into the soil surrounding the rock, thus increasing the water content of the soil. With a greater percentage of subsurface rock, the wetting front actually extends deeper into the soil profile, thus increasing soil moisture deeper into the root zone. During the hot dry months, plant roots have access to this deep soil moisture thus maintaining plant growth and productivity. Soils high in cobble and greater include Hobacker, Baird Hollow, Hobacker, Clayey-skeletal Pachic Haplocryolls, Croydon, and Elwood.

Soils high in gravel sized rock have less water holding capacity because they may tend to be excessively drained. These soils include Becks; however, portions of the other soil components also contain appreciable amounts of gravels. Soils containing high gravel content are comparatively less productive and are more sensitive to soil loss from erosion.

Existing Soil Quality Condition

The USFS Region IV soil condition evaluation and qualitative soil management monitoring form was used to assess existing conditions. The soil health rating and soil health trend are based on the hydrologic and physical soil condition ratings. Soil health indicators are rated as satisfactory, impaired or unsatisfactory based on observed condition ratings. Assessment evaluations are based on ocular

documentation, by data collection for effective ground cover, and by describing the soil profile. Two soil condition evaluations were made for the Lake Fuels project area. These sample locations are found on Figure 1, Soils Map. Effective ground cover was measured using a 100-ft transect every 1 foot at each location in addition to measuring soil compaction along the 100-ft transect every 10 feet. Soil profile description was made for Soil Pit 628-1. Both these sites had a satisfactory soil health rating with an aggrading soil health trend. Data collected are shown in the table below:

Soil Condition Assessment

Sample Number	Soil Health Rating	Soil Health Trend
Sample 701A-1	Satisfactory	Aggrading
Sample 628-1	Satisfactory	Aggrading

The soil description for sample 628-1 matches the Hobacker component for soil map unit 628. As described for the Hobacker component, it has a mollic surface to a depth of 20 to 30 inches. It is very gravelly, very cobbly, or very stony loam or sandy loam, mildly acid to neutral. Below the mollic surface is a cambic horizon with a thickness of approximately 18 inches. It is very gravely, very cobbly, or very stony loam or sandy loam, mildly acid to neutral.

The Croydon soil component makes up 80 percent of the soil map unit 701A. As described for the Croydon component, it has a mollic diagnostic surface to a depth of 16 to 25 inches. It is a gravelly or cobbly loam, and is slightly acid. An albic horizon (zone of significant leaching) is present below the mollic surface and above the argillic horizon. The argillic horizon occurs at a depth of 14 to 20 inches and extends to a depth of 40 to 50 inches. It is a clay loam or gravelly clay loam, and is slightly acid.

ENVIRONMENTAL EFFECTS

This section will describe the potential direct, indirect, and cumulative effects that could occur to soil resources as a result of the proposed action. The area of analysis for all effects will be the project activity area.

Effects to the soil resources will be disclosed in terms of the kind and amount of detrimental disturbance predicted or anticipated from project activity. Detrimental disturbances are those which cause an unacceptable loss in soil productivity. For mechanical treatments, detrimental disturbances may consist of accelerated soil erosion and soil compaction.

Potential soil erosion and sedimentation will be quantitatively analyzed using the FS WEPP model.

Potential soil compaction hazard is quantitatively assessed based upon soil site properties with assessments made in the field.

Continuation of Current Management Action

The Manti-La Sal National Forest 1986 Land and Resource Management Plan, Soil Resource Management F001, general direction 01 and 02 state: (01) maintain or improve soil productivity and watershed qualities within the ecological site capabilities; and (02) minimize adverse, man-caused impacts to the soil resource including accelerated erosion, compaction, contamination, and displacement.

Soil map unit 628 primarily contains aspen mixed-conifer vegetation, while map units 701 and 701A primarily contain spruce-fir vegetation types. The spruce-fir makes up 83 percent of the area and the aspen-conifer accounts for 13 percent of the area. Ground cover was determined for soil map units 628 and 701A by ocular estimate. The following table shows the results of each transect:

Effective Ground Cover [/1]

	Gravel rock (> ¾ inch)	Litter wood debris	Living Vegetation	Biotic Crust	Bare soil	Total Effective Ground Cover
Percent Value						
Sample 701A-1		35	50		15	85
Sample 628-1		40	60			100

[/1] Ocular estimate.

For the two samples collected within these community types, the average cover average for spruce-fir is 85 percent cover and 100 percent cover for the aspen-conifer, which meets or exceeds the PNC value for percent cover. Therefore, current ecological soil conditions meet the Forest Plan general directives.

Soil Erosion Effects

Soil productivity is impacted from loss of topsoil associated hillslope erosion.

- The USFS WEPP model (http://forest.moscowfsl.wsu.edu/fswepp/) was used to predict hillslope soil erosion and sedimentation estimates for the project area. Modeled values are estimates only for predicted soil erosion with a ±50% error. Using the WEPP Fuel Management Erosion Analysis (FuME) model and based on a 30-year climate cycle, results showed that there was no significant erosion or sedimentation predicted for the project area under current management. Inputs include soil texture, percent slope, slope length, percent rock, and climate.

The following table shows the predicted erosion rates for each soil map unit area:

Table – Erosion Modeling Summary.

Soil Map Unit	Soil Map Unit Component	Soil Texture	Average Erosion (tons/acre/yr)	30-yr Event Erosion (tons/acre)
701	Croydon	Loam	< 0.1	< 0.1
	Elwood	Sandy Loam	< 0.1	< 0.1
701A	Croydon	Sandy Loam	< 0.1	< 0.1
628	Hobacker	Sandy Loam	< 0.1	< 0.1
	Baird Hollow	Clay Loam	< 0.1	< 0.1
	Becks	Loam	< 0.1	< 0.1

Results of erosion modeling using the FS WEPP methodology:

- The average annual erosion rate for all sample sites is below the allowable soil loss ("T" Factor value) for the soil type. Long-term soil quality and productivity would therefore not be impaired by the continuation of current management.

Soil Compaction

Soil compaction can occur in any soil type. Compaction can directly affect soil productivity. Typically, after years of traffic and grazing pressure, surface soil compaction can develop. Foot traffic cause soil

particles of different sizes to become clustered together, filling up all available air spaces, compacting into a hard layer that can't easily be penetrated by moisture or roots. Some soil types are more susceptible to compaction than others, but once a compaction problem has become established, it cannot be alleviated and can only get worse with time. As moisture penetrates the compacted layer, and traffic continues, the compaction layer becomes denser and thicker. Soil compaction was measured at each sample site using a shovel and a large soil knife. There was no evidence of detrimental soil compaction at either of the two sample sites. Where depth penetration was limited, shallow subsurface rock inhibited the shovel from being driven into the soil. However, soil compaction was found on historic skid trails and haul routes.

Recommended Mitigation
Avoid potential soil erosion effects by limiting ground based mechanical treatment to slopes less than 40 percent as prescribed in the Manti-La Sal Land Management and Resource Plan. For all treatment areas, ground based mechanical equipment should be restricted to occur during the normal dry operating season, or over snow, to mitigate the potential for detrimental compaction when soils are moist or wet.

For slopes greater than 40%, helicopter use will be utilized and therefore minimal disturbance will occur to surface soils in these upper elevation areas.

Use any historic skid trails and haul routes to minimize new soil disturbance and soil compaction.

For all temporary roads, staging areas, landings, and skid trails restore soil productivity. Obliterate temporary roads, staging areas, and landings first by alleviated prism and subsoil compaction by using ripping, tilling, or deep surface roughening, then restore to approximate original contour by pushing and/or lifting road fill back into place and put the road prism back to slope, and finally, seed with an appropriate mix to re-vegetate with native forbs, grasses and shrubbery.

Cumulative Effects

The Affected Environment and Environmental Effects sections cover current resource conditions and include effects of past management and past projects in evaluating present conditions. This section briefly describes ongoing, planned and foreseeable future activities that may contribute to cumulative effects in considering effects of the proposed action on the existing environment.

Because soils are sedentary, effects in a particular area only loosely influence soil conditions in adjacent areas. Consequently, the area of consideration for cumulative effects on soil resources consists of the project area. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. Past, ongoing, planned and foreseeable future activities are considered for each of the actions on the existing environment.

Past and/or historic activities include:

- Livestock grazing
- Logging and timber management
- Construction and maintenance of roads and trails
- Development and maintenance of recreation facilities
- Habitat restoration projects
- Vegetation management projects
- Dam construction, maintenance and water storage projects

Ongoing activities include:

- Dam construction, maintenance and water storage projects
- Timber salvage
- Livestock grazing
- Dispersed recreation use
- Maintenance/improvement of recreation facilities
- Maintenance/improvement of roads and trails
- Use of unclassified roads
- Continued weed treatment

Planned Activities:

- Widening of Millers Flat Road
- Construction of motorized connecting trail with South Skyline Drive

Foreseeable Future Activities:

- Dam safety repairs, maintenance
- Continued livestock grazing
- Road maintenance/improvements
- Continued maintenance /improvements of recreation facilities
- Bug spraying in spruce
- Hazard tree removal

The cumulative effects for soils are summarized in the following table. The total acreage for the project area is 5648 acres. There are 820 acres of actual treatment areas within the project area. The estimated amount of land with long-term soil commitments is anticipated to be around 220 acres. The short-term impacts are projected to range from 4,140 acres for the no-action alternative to 5,010 acres under the proposed action. The total acres from long-term plus short-term impacts range from 4,360 acres for the no-action alternative to 5,230 acres for the proposed action.

Indicator	**Acres by Alternative***	
	Proposed Action	**No Action**
LONG-TERM SOIL COMMITMENT		
NF System Roads	10	10
Unclassified Roads	< 1	< 1
Motorized Trails	10	10
Non-motorized Trails	10	10
Administrative Site	< 10	< 10
Huntington Reservoir	190	190
Total Estimated Soil Commitment	220	220
% of Allotments' Project Area	4 %	4 %
MAXIMUM SHORT-TERM EFFECTS		
Hazardous Fuel Treatment - Tractor	400	< 1
Hazardous Fuel Treatment - Helicopter	420	< 1
Grazing[1]	4,130	4,130
Dispersed Recreation	10	10
Temporary Roads	10	< 1

Indicator	Acres by Alternative*	
	Proposed Action	No Action
Landings	10	< 1
Skid Trails	30	< 1
Cable Skidding	<1	< 1
Total Short-Term Impacts	5,010	4,140
% of Allotments' Project Area	89 %	73 %
TOTALS		
Total Long-Term Soil Commitment	220	220
Total Short-Term Impacts	5,010	4,140
Total Estimated Impacted Soils	5,230	4,360
% of Project Area	92 %	77 %

* Estimated acres rounded to nearest 10 acres
[1] 85% use on Spring Lake; 50% use on South Skyline; 65% use on remainder allotment areas

Through analysis of the proposed alternative, it is determined that there will be 16 % increase of temporary, short-term disturbance to soil resources beyond existing conditions under this alternative. Construction and use of temporary roads, skid trails and landings would create an additional 50 acres of displaced soil disturbance and compacted soils that will affect soil quality and soil productivity. However, with implementation of recommended mitigation measures and project design features, these effects would not permanently impair soil productivity and quality. Following restoration activities, full recovery of soil quality would not likely occur within ten years.

Several existing system roads will be used to access the proposed treatment areas. These roads are native surface and are currently experiencing accelerated erosion. Upon completion of project activities, these native surface roads will undergo maintenance to help reduce erosion and minimize sedimentation from the road prisms. Implementation of mitigation measures will therefore result in a net cumulative reduction in erosion on these roads. The lower elevation areas with slopes less than 40 % will incur surface soil disturbance since these areas will subject to tractor use for tree removal and skidding; upper elevation areas with slopes greater than 40% will have very little if any surface soil disturbance since these areas will have helicopter access and use for tree removal.

Through analysis of the no-action alternative, it is determined that this alternative would not result in negative impact to soil resources. Therefore, it is determined that there will be no direct or indirect cumulative effects to soil resources within the analysis area under the no-action alternative.

Summary – Environmental Consequences

Following review of the proposed action and potential effects of implementation, it was determined that for the areas sampled, conditions meet the Forest Plan objectives, standards and guidelines. For the project area, soils are stable with overall soil conditions aggrading based on the USFS Region IV soil condition evaluation and qualitative soil management monitoring survey. The average annual erosion rate for all sample sites is below the soil loss ("T" value) for the soil type. There is no evidence of detrimental soil compaction. Long-term soil quality and productivity are therefore not currently impaired. There will be a 16% overall cumulative increase in temporary, short-term disturbance; however, based on project treatment descriptions, soils will not be detrimentally disturbed. Therefore, it is anticipated that the overall impact of this action will not result in any long-term effects to existing soil resources beyond current conditions.

CITATIONS

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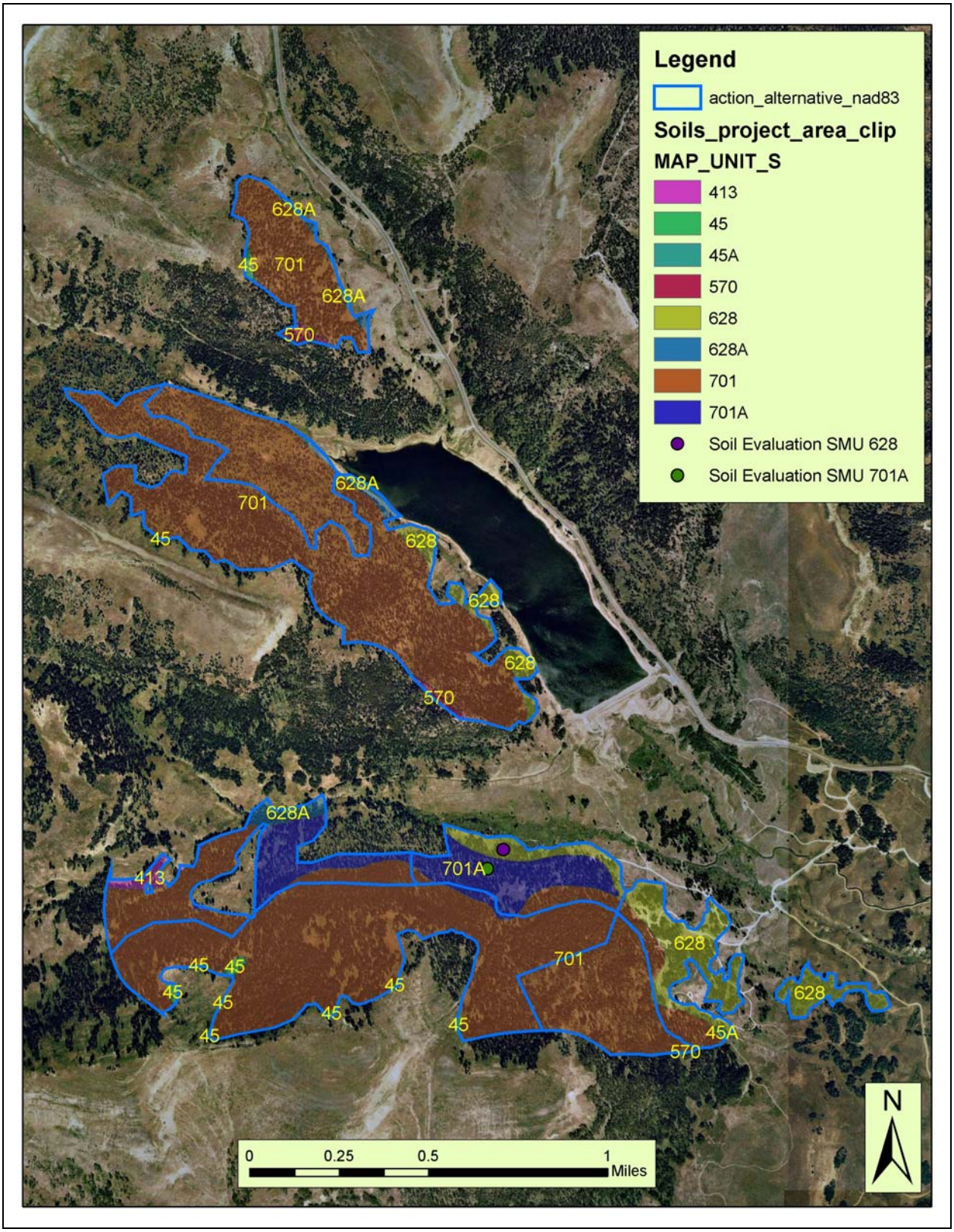

Figure 1. Whispering Pines Hazardous Fuels Project – Soil Map

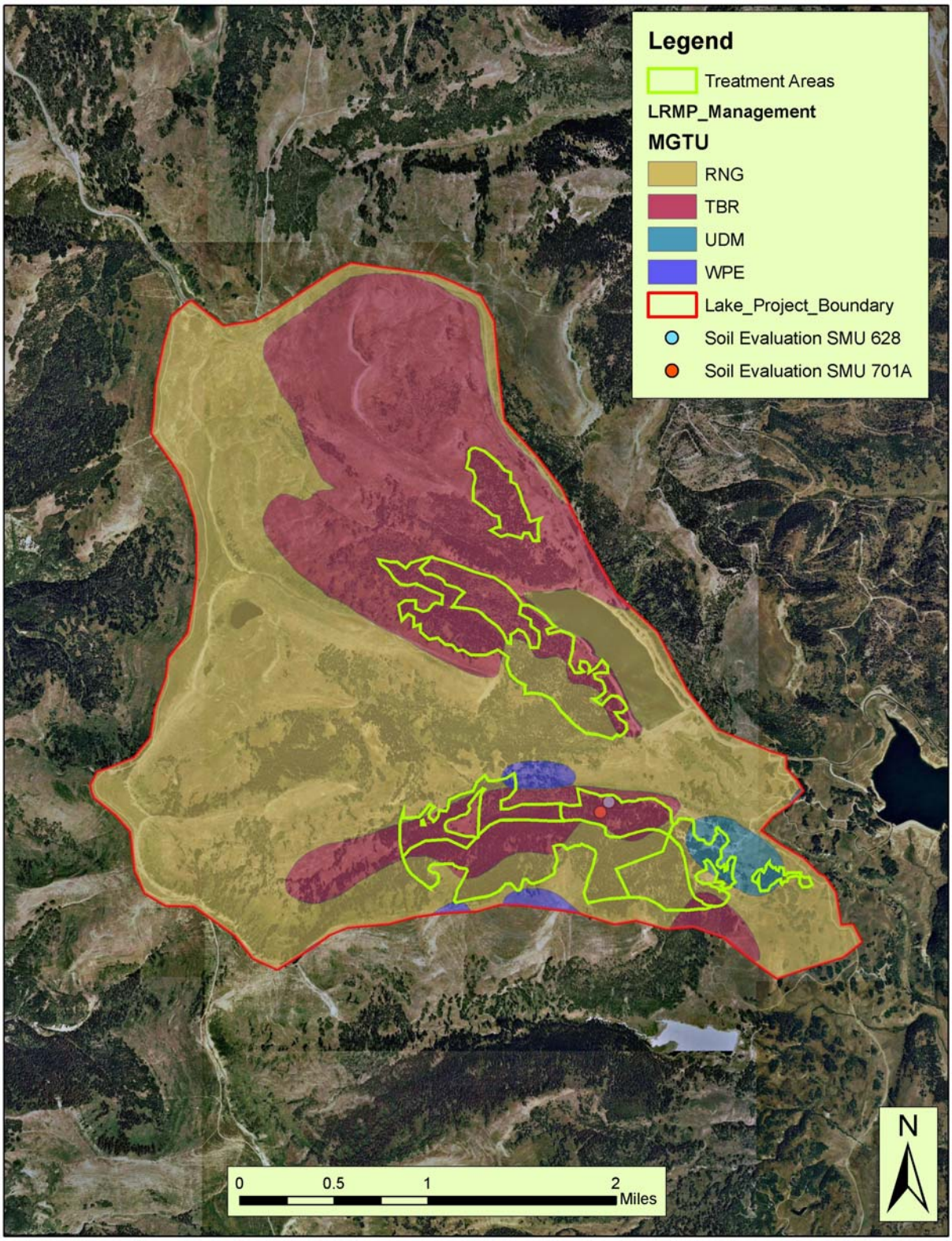

Figure 2. Manti-La Sal LRMP Management Areas