2007/2008 MONITORING PROGRAM ANNUAL REPORT

USDA FOREST SERVICE

LAKE TAHOE BASIN MANAGEMENT UNIT

Ecosystem Conservation Department
Adaptive Management Monitoring Program

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Chapter I
Introduction

This report contains a summary and analysis of monitoring activities implemented on the Lake Tahoe Basin Management Unit during the field season of 2007 into early 2008.

The Lake Tahoe Basin Management Unit (LTBMU) Monitoring Program provides information to decision makers about the outcome of forest management activities on desired conditions for LTBMU resources. The goal of the Monitoring Program is to provide direction needed for the Forest Plan Revision, the Forest Environmental Management System (EMS), and NEPA Decision documents. The Program has evolved to follow monitoring guidelines established in FSH 1901.12, CH. 19 and 20 (Land Management Plan and Adaptive Planning Process); FSM 1331 (EMS directives); the Adaptive Management Strategy (AMS) as described in Appendix E of the Sierra Nevada Forest Plan Amendment (SNFPA); and from the strategy developed by the National USFS Monitoring and Evaluation Team (MET).

The LTBMU continues to work with our partners in the Basin to ensure a coordinated and prioritized Monitoring Program is developed that meets both the particular needs of the LTBMU as well as the larger Lake Tahoe Basin community.

The LTBMU Monitoring Program addresses four main categories of information needs:

- **Implementation monitoring**: Determines the degree and extent to which application of standards and guidelines met management direction and intent (what, when, where, and how management direction has been followed).

- **Status-and-change monitoring** of ecosystem conditions and management activities: Assesses important biophysical and socio-cultural conditions, to gauge if desired conditions are being achieved and to describe correlative relationship between management activities and conditions to identify potential causal factors for observed changes.

- **Effectiveness monitoring**: Provides a better understanding of how ecosystem components, structures, and processes respond to management activities, and how ecosystem components interrelate.

- **Research**: Designed to support land management by generating new information to address key information gaps related to the fundamental workings of ecosystem processes, interrelationships between processes, development and testing of different management approaches, and development and validation of habitat relationships, ecological indicators, and thresholds.

This report describes the 2007 monitoring accomplishments and key findings from the analysis conducted during the following fall and into early 2008, as it relates to the four above described categories of information. Many of the analysis reports identified can be found at the following website: http://www.fs.fed.us/r5/ltbmu/publications.

This report is organized by key resource issue areas which include some of those identified in the Region 5 AMS, as well as resource issue areas unique to the Lake Tahoe Basin. The issue areas are listed below:

1. Lake Tahoe Clarity
2. Aquatic, Riparian, and Meadow Ecosystems
3. Old Forest Ecosystems /General Forest Ecosystems (includes WUIs)
4. Fire and Fuels
6. Noxious Weeds
7. Recreation/Social Resources.

Chapter II
Lake Tahoe Clarity

In 2007, LTBMU Adaptive Management Monitoring Staff collected data to evaluate the effects of management activities and practices that have the potential to affect Lake Tahoe clarity through impacts to soils and water quality. These include ski resort operations, road obliteration and road best management practices (BMP) retrofit, and temporary construction BMPs. Impacts related to fuels reduction practices are presented separately, in Chapter VI.

II.1 Heavenly Ski Resort

Effectiveness Monitoring Question:

- ***Are watershed conditions at the resort continuing to improve as a result of ski resort management activities?***

The Heavenly Ski Resort Monitoring Plan requires a variety of monitoring elements, including water quality, BMP effectiveness, effective soil cover, and channel condition. Contractors hired by Heavenly Resort implement the monitoring and analysis. BMP monitoring is conducted through Resource Concepts Incorporated (RCI), and the remainder of the monitoring program is conducted through Entrix, Inc. The LTBMU maintains a strong oversight role in the implementation of this program. The contractors have demonstrated a high level of performance in data collection, analysis, and evaluation, particularly in the area of BMP effectiveness monitoring. Key findings from the 2007 Annual Report are presented below.

Key findings from 2007 Annual Monitoring Report for Heavenly Ski Resort (Entrix, 2008)

- Annual stream discharges for 2007 were significantly lower than for 2006 and as a result annual sediment load values are also considerably lower. Peak streamflows were recorded from the last week in April to the second week in May. Annual suspended sediment load, sampled at the property line for Heavenly Valley Creek, decreased from 39 tons/year in 2006 to only1 ton/year in 2007. This amount is far below the TMDL standard for suspended sediment (60 tons/yr, 5 yr rolling average).

- Water Quality parameters were measured at three locations on Heavenly Valley Creek at undisturbed reference stations on Hidden Valley Creek, and at two locations on Edgewood Creek. Values above Lahontan standards for Phosphorous, Chloride and Iron were measured at all stations on Heavenly creek including the reference station. California effluent standards for Bijou Park Creek (California Parking Lot) were exceeded for Total Suspended Sediment, Nitrogen, Phosphorus, Iron and Chloride. Edgewood Creek (below the Boulder Parking Lot) did not exceed the Nevada Department of Environmental Protection effluent “not to exceed” standard for turbidity, suspended solids or total phosphorus as it did in 2006.

- Permanent BMPs were evaluated for implementation and effectiveness at 52 sites in 2007. Implementation was rated fully successful on 42 (81 percent) of the 52 sites evaluated. Four BMP evaluations were scored as not implemented. The percentage

Effectiveness scoring for the 52 BMP evaluations rated 44 (84 percent) as effective. There were 9 sites (16 percent) determined to be "at risk" of effecting water quality and no scores of not effective were received in 2007. Areas of needed improvement are cited as 1) consistently achieving 70 percent effective cover and 2) BMP effectiveness impaired by outside sources of sediment after completion of construction projects needs to be identified promptly to facilitate prompt follow-up stabilization work.

- A total of 79 Temporary BMP evaluations were conducted in 2007.

Temporary BMPs were fully implemented at 49 sites (62 percent). This is a decrease in full implementation from the 2006 evaluation of 78 percent. Minor departures from full implementation were noted at 30 sites (38 percent). Issues related to Temporary BMP implementation monitoring included 1) That plans did not specify clearly that coir logs were to remain after construction, and 2) construction project winterization which includes removal of sediment fences for skier safety should include replacement with coir logs.

Temporary BMP effectiveness scored effective for 74 (94 percent) of the 79 evaluations performed in 2007. A review of the scoring for individual categories indicated periodic concerns with temporary BMP effectiveness related to: 1) Dust control measures associated with management of stockpiles and 2) proper resizing of sediment fences when material stockpiles grow larger than expected.

II.2. Best Management Practices (BMP) Monitoring

The LTBMU has two components to its water quality BMP monitoring program. The first is a regional Best Management Practices Evaluation Program (BMPEP) which has been in place for about 8 years under an agreement with the State Water Quality Control Board and addresses permanent BMPs for forest management activities. The second component was added in 2006, as part of the Lahonton State Water Quality Control Board Stormwater Protection Plan (SWPP) requirement for construction projects. This component addresses monitoring of temporary construction BMPs. Both of these monitoring components use a systematic qualitative assessment of BMP implementation and effectiveness.

II.2.a. Best Management Practice Evaluation Program (BMPEP)

Implementation Monitoring Question:

- ***To what degree are best management practices implemented and effective in protecting soil and water resources?***

The Best Management Practices Evaluation Program (BMPEP) is a qualitative monitoring program implemented throughout US Forest Service (USFS) Region 5 (Pacific Southwest Region). The objectives of this program are to: (i) fulfill USFS monitoring commitments to the State Water Resources Control Board (SWRCB), as described in the SWRCB/USFS Management Agency Agreement and *Water Quality Management for National Forest System Lands in California (USFS, 2000)*, (ii) assess and document the efficacy of the USFS water quality management program, specifically the implementation and effectiveness of BMPs, and (iii) facilitate adaptive management by identifying program successes and shortcomings.

Region 5 has developed standardized protocols and forms for onsite evaluations to assess soil and water protection BMP implementation and effectiveness for various Timber, Engineering, Recreation, Grazing, Prescribed Fire, and Revegetation projects. Implementation evaluations determine the extent to which planned, prescribed and/or required water quality protection measures were actually put in place on project sites. Effectiveness evaluations gauge the extent to which the practices met their water-quality protection objectives.

Evaluations are scored utilizing a rule set developed by regional staff, and are placed into one of four categories: implemented and effective (I-E); implemented, but not effective (I-NE); not implemented, but effective (NI-E); and not implemented and not effective (NI-NE). Not implemented can include BMPs installed, but not implemented correctly according to designs/standards. This type of "hill slope monitoring" uses indirect measures to evaluate BMP effectiveness, so poor scores represent *potential*, rather than *actual*, impairment of beneficial uses by a given activity.

A random number of evaluations to be completed each year are assigned to the National Forests by the Regional Office based on: (i) the relative importance of the BMP in protecting water quality in the Region, and (ii) those management activities most common on the individual Forest.

In 2007, the Lake Tahoe Basin Management Unit (LTBMU) completed 32 Best Management Practices Evaluation Program (BMPEP) evaluations, as part of the Pacific Southwest Region's effort to evaluate the implementation and effectiveness of BMPs created for protecting soil and water resources associated with Timber, Engineering, Recreation, Grazing, and Revegetation activities. This was short of the Regional target of 41 evaluations, due to a lack of projects meeting the Regional target criteria for several categories.

Key Findings from 2007 BMPEP (Brill, Harris, and Norman 2008)

- In 2007, 84.35% of the evaluations were rated as effective, which is above the five year average (82%), and about the same as the 2006 rating.
- Timber project BMPs were 100% implemented and effective. Implementation and effectiveness deficiencies were documented in the engineering and recreation project BMP categories. A number of actions are recommended in the full report to correct documented BMPS deficiencies.

II.2.b. Temporary BMP Monitoring

Temporary Best Management Practices are required during all construction in the Tahoe Basin that involves soil disturbance. Temporary BMPs differ from permanent BMPs as they are designed to remain effective only until construction is complete and permanent BMPs can be applied. Depending on the nature of the activity and site characteristics, a variety of different BMPs may be employed to keep sediment from being mobilized. The LTBMUs Temporary BMP Monitoring program is designed to monitor BMP's applied to forest construction and restoration projects which have the potential for short term adverse impact to soil and water quality. Patterned after the Region 5 BMPEP process, protocols were developed in 2006 to systematically assess and document whether temporary BMPs were implemented, maintained, and effective at preventing adverse impacts to water quality.

2007 was the second year that temporary BMP monitoring was formally conducted on the LTBMU. Ten projects implemented by the Engineering and Ecosystem departments were monitored. The results of this monitoring are summarized below:

Key Findings from 2007 TBMPEP (Brill, Harris and Norman, 2008)

- Only 2 of the 10 projects monitored were rated as fully successful for BMP implementation throughout the entire year (Blackwood Phase II restoration, and Pope Beach Bathrooms??). Five of the 10 projects were rated as successful for implementation when BMPs were initially evaluated, however subsequent evaluations identified BMP ineffectiveness due to lack of maintenance (ie. covering stockpiles).

- Out of 32 total BMP effectiveness evaluations performed on the 10 projects, 21 received poor ratings based on what was determined to be minor departures, and 7 poor ratings because of major departures. Brief descriptions of BMP deficiencies are described below:

    - Cookhouse Meadow Restoration experienced a major departure in sediment control and ponding of water. Low spots in the temporary road-bed created water ponding near the newly constructed stream channel at Big Meadow Creek. Coir logs were installed in an effort to keep sediment from flowing into the flowing channel. Silt laden water was seeping between and over the coir logs creating small rills into the channel. The duration of this overland flow is unknown but likely persisted for at least a month during spring runoff.

    - Fallen Leaf Phase I (road construction and pipeline installation) received both minor and major departures. The major departure was caused by the contractor, who purposely released a large amount of water from a new water tank. The release caused erosion and sediment transport which topped over installed coir logs. The area of impact was 3 feet wide by 300 feet long, and the depth of erosion was approximately 2 inches over this area. Fortunately no stream channels are located in close enough proximity for transport of this sediment to reach a waterbody.

      Several tree trunks were damaged by construction equipment because no protective measures were put in place to protect them. The damaged trees were subsequently treated with sealants.

- Fallen Leaf Phase II received a minor departure evaluation due to uncovered soil stockpile spilling over a sediment fence. No SEZ was threatened.

- Lam Watah Trail received both a minor and major departure. The major departure was the result of workers driving on riparian vegetation causing visible compacted tire tracks in an SEZ. The minor departure was for not designating an equipment staging area, and for not using ground protection under heavy equipment while not in use, to protect against accidental leakage of hazardous materials (oil and grease).

- Meeks Bay Campground received minor departure due to failed management of refuse, stockpile materials and ponding of water. A refuse pile which included an old fuel tank was located in the SEZ.

- Pope Beach Parking Area received only a minor departure becauseErosion control fabric was not secured properly on the slope near the restrooms and vehicle turn-around.

- Slaughterhouse Canyon received minor departures related to water diversion from a spring which crossed the surface of the road. Also insufficient TBMPs were utilized related covers and barriers for management of stockpiled material,

- Ward Creek Trail bridge received both minor and major departures. The minor departure was received for not installing a construction fence around the staging area, and replacing this design feature with coir logs. The major departure was the result of TBMPs not being installed properly on the steep bank leading to the creek. As a result a small gully formed which transported sediment into the SEZ, within approximately 5 feet of the channel.

Because monitoring was conducted using a qualitative evaluation process, no quantitative estimate of resource impacts (i.e. area of soil compacted, volume of sediment erosion/transport) was obtained for the TBMP departures described in the previous section. However our analysis of the qualitative data indicates that the amount of sediment transported to a Tahoe Basin water body was likely very limited. This was no doubt due in part to the fact that last year was a very dry year in terms of precipitation.

However to insure the potential for a large release of sediment is minimized in future years, TBMPs should be better maintained throughout project implementation. In 2007, there were quite a few projects where documented TBMP departures were not addressed, even after they were documented in successive evaluations and project managers were notified. Although there were several types of TBMP departures observed, the most persistent was improper management of fine-grained sediment stockpiles. Not only are these types of stockpiles a source of sediment to surface water bodies but they are also significant sources of $PM_{2.5}$ and PM_{10}, from emissions of blowing dust. Lake Tahoe is in attainment for $PM_{2.5}$ but not PM_{10} (CARB, 2006). Other common BMP failures include absence of, or insufficient, designation of construction zones and poor placement of erosion control measures.

The following are recommendations to improve implementation, maintenance, and monitoring of TBMPs during forest construction projects.

- Insure better stockpiles management of fine-grained sediment by: (also recommended in 2006 report):
    - Locating material stockpiles away from surface water bodies (at least 25 feet from ephemeral streams and 50 feet from perennial streams)
    - Properly covering stockpiles when not in use.
    - Surrounding stockpiles with sediment control fence.
    - Specifying these BMPs in contract documents and work orders.

- Correct effectiveness failures within 48 hours after notification, even if the failure is considered a minor departure. (also recommended in 2006 report)

- Ensure better management of refuse and hazardous material.
    - Use proper containers for refuse material.
    - Use protective ground barrier under construction equipment and vehicles, when left in staging area.
    - Keep generators on ground protective barriers and locate at least 25 feet from streams.

- Adequate installation of erosion control measures.
    - Insure adequate erosion control measures are in place before releasing large quantities of water (i.e. water tank removal).
    - Insure erosion control fabric is secured according to specifications to withstand wind and rain, and is maintained throughout project.

Monitoring

- Slaughterhouse Canyon and Pope Beach Phase 3 should be monitored during spring runoff, 2008, to verify winterized BMP effectiveness.

- Monitoring crews should provide better documentation in their effectiveness evaluations about whether observed BMP failures are related to implementation deficiencies (i.e. not implementing BMPs as designed, not adequately including BMPs in design, not adequately maintaining BMPs), or prescribed and implemented BMPs were simply not adequate to protect water quality. The effectiveness monitoring form will be modified to insure this information is clearly documented. Better information should also be provided in the comment field regarding the scale of estimated impact. If soil compaction/disturbance and sediment erosion/transport is observed, the reviewer should provide some information regarding estimated area of impact, and volume of sediment transported.

II.3 Roads and Trails Monitoring

Three separate projects are included in the roads and trails monitoring program. These efforts include monitoring protocols for roads, trails, and Off-Highway Vehicle (OHV) routes. The roads and trails monitoring programs are similar in their implementation; each uses a qualitative assessment of water quality risk, Region 5 BMPEP protocols, and WEPP modeling, to determine BMP effectiveness in protecting water quality. The OHV monitoring uses a qualitative soil loss monitoring assessment to determine the condition of the OHV road or trail.

The primary goals of monitoring roads and trails, as outlined by the 5-Year LTBMU Inventory, Monitoring and Evaluation Plan, are to (i) evaluate the impacts of road decommissioning and BMP upgrades in reducing pollutant loading to Lake Tahoe and (ii) evaluate the effectiveness of road BMP utilization as it relates to proper implementation and water quality protection.

II.3.a Road Decommissioning and BMP Upgrade Program Monitoring

Implementation Monitoring Question:

- ***Has the implementation of Road Decommissioning and BMP Upgrades reduced the potential for water quality impacts, and to what degree were road BMPs successfully implemented and effective?***

Effectiveness Monitoring Question:

- ***What impact do forest roads have on sediment loading to Lake Tahoe, and how successful are BMP retrofits and decommissioning in mitigating those impacts?***

The final Forest Roads BMP Upgrade Monitoring Report was completed in March of 2007 and provides a comprehensive evaluation of all the data collected over the past several years on 150 miles of National Forest System roads. This report was summarized in last year's annual monitoring report.

During 2007, on-site follow-up evaluations were conducted on road segments which were identified through WEPP model analysis in the comprehensive report as having moderate to high erosion potential to determine whether erosion and sediment transport was actually occurring, and if so, identify additional treatment measures. These road segments are as follows:

- Third Creek watershed, Road 17N85
- Burk Creek watershed, Roads 13N78, 13N80, 13N82, 13N82A & 14N32
- Logan House Frontal watershed, Road 14N33
- Skyland-Cave Rock-Lincoln Creek Frontal, Road 13N78
- Tahoe Vista-Griff Creek,16N86, 16N87
- Watson Creek- Carnelian Frontal, 16N73

All of the above road segments were determined through these field evaluations to have low potential for erosion and or sediment delivery to an SEZ. Although the WEPP model can be a valuable tool for identifying areas of concern, and estimating relative magnitude of erosion reductions, the model sometimes just does not accurately reflect on the ground conditions. Field evaluations are always recommended to validate model results, for areas of concern.

II.3.b Trails Decommissioning and BMP Upgrades Monitoring

Implementation Monitoring Question:

- ***Has the implementation of Trail Decommissioning and BMP Upgrades reduced the potential for water-quality impacts?***

Effectiveness Monitoring Question:

- ***What impacts do forest trails have on sediment loading to Lake Tahoe, and how successful are BMP retrofits and decommissioning in mitigating those impacts?***

During the 2007 field season no trails were monitored due to a lack of trail work completed in 2006. Protocols require that trail decommissioning and BMP upgrades undergo at least one winter before evaluations are performed.

II.3.c Off-Highway Vehicle (OHV) Program Monitoring

Status and Trend Monitoring Question:

- ***What are the number and type of users utilizing popular OHV trails in the Basin?***

Implementation Monitoring Question:

- ***What is the potential for soil loss on OHV routes, and what are the current maintenance needs?***

Over the summer of 2007, the OHV Patrol staff evaluated 26 trails and roads (approximately 67 miles) within the Lake Tahoe Basin Management Unit, using an OHV Soil Loss Monitoring Checklist developed through the OHV "greensticker" program. Each road or trail was evaluated and assigned one of the following qualitative ratings: green= acceptable, yellow= needs maintenance, or red= needs major maintenance.

Key Findings, 2007 LTBMU OHV Program Soil Loss Monitoring Report

- The results of these evaluations identified 47 miles of roads and trails as "green", 17 miles as "yellow", and 3 miles as "red."

- Roads/ trails rated red: 1) Kingsbury Stinger, 18E39.3: This is a fall-line motorcycle trail on the Nevada side of the lake, off of the Genoa Peak Road. This trail was rated red due to the steepness of the trail and lack of drainages or grade reversals on the entire length of the trail. The Kingsbury Stinger will most likely need to be re-routed or redesigned to allow for proper drainage. 2) Sand Pit, 12N14: This is a bowl-shaped land feature that contains a motocross track, and is used by motorcycles and ATV's. This trail was rated red due to extensive erosion occurring at the top edge of the pit, and heavy unauthorized use outside of the pit. A complete fence line that would be more difficult to breach would eliminate the out-of-bounds use as well as complaints from neighboring residents who have problems with OHV users entering their property.

- Roads/ trails rated yellow: 1)McKinney Rubicon, 14N04: This road, used by all types of OHV's, was rated yellow because the current drainages leading off the road need reshaping from heavy use. 2) Mt. Watson, 16N73M: Used by all types of OHV's, it was rated yellow due to off-trail use by motorcycles at the top of the mountain, and also drainages on the road need to be addressed. 3) Kings Beach, 18E18: This is a motorcycle

- Roads/ trails rated green: These include Sawmill Pond, Twin Peaks, Saxon Creek, Powerline, High Meadows, Corral, Sidewinder, Noonchester, Buck Lake, 73 Road, Kings Beach, Old County Rd, and Logan House.

II.4 Urban Erosion Control Grant Program Monitoring

Effectiveness Monitoring Question:

- ***What is the effectiveness of specific urban stormwater treatment best management practices (BMPs) in treating particulates, fine sediments, and dissolved nutrients?***

The LTBMU Erosion Control Grants program has awarded $2,412,000 of grant funding from the Southern Nevada Public Land Management Act (SNPLMA) to local governments for Comprehensive Urban Runoff Treatment Effectiveness Monitoring (CURTEM) since 2000. During the time period for this annual report, there were only two active CURTEM projects. The results of previous efforts are presented on the LTBMU website and in previous annual monitoring reports. Thee active projects are described below.

The Lake Village Monitoring Project funded under SNPLMA Round 6 is being conducted by the Nevada Tahoe Conservation District (NTCD). Water quality data is being collected to determine the effectiveness of the implementation of residential erosion control BMPs in the Lake Village subdivision in Douglas County. Data collection starting in 2003 and ended in April of 2008. The Final Report is expected before the end of 2008.

The Lower and Middle Rosewood Creek Monitoring Projects funded under SNPLMA Round 7 are also being conducted by the NTCD. The lower reach is being monitored to evaluate the effectiveness of SEZ restoration efforts (completed in 2006). The Middle Rosewood Creek reach is being monitored to provide better estimates for hydrology and hydraulics for channel and floodplain design. Monitoring on both reaches is ongoing and expected to continue through the fall of 2008

II.5 Meyers Landfill Monitoring and Maintenance

Implementation Monitoring Question:

- ***Does the administration of the Meyers Landfill hazardous waste clean up site meet mandatory health and safety standards and environmental regulatory standards?***

Effectiveness Monitoring Questions:

- ***Does the Meyers Landfill hazardous waste clean up site pose a significant threat to drinking water sources?***

- ***What is the extent of the plume of ground-water contamination originating from the Meyers Landfill?***

The Meyers Landfill site (MLF) is a closed municipal landfill located on Federal land that is administered by the Forest Service. In the mid-1990s contaminants in groundwater aquifers were identified as originating from the site. The primary Constituent of Potential Concern (COPC) is vinyl chloride.

The site is currently administered under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). Multiple litigations initiated by Potentially Responsible Parties (PRP) remain on-going. An Administrative Record file containing site related information is available for public review at the Forest Supervisor's Office, Lake Tahoe Basin Management Unit.

A Remedial Investigation and Feasibility Study (RI/FS) to characterize the nature and extent of risks posed by hazardous waste on site and to evaluate potential remedial actions was completed in May of 2007 for Operable Unit -1 (OU-1(landfill waste mass)).

A final Record of Decision (ROD), which presents the selected remedial action for OU-1 was finished in November of 2007. The selected remedial action described in the ROD includes a multilayer cap and cover system to isolate and eliminate direct contact with refuse, reduce or eliminate erosion and surface water infiltration through the waste mass and reduce or eliminate potential surface contaminant migration.

With the selection of the remedial action completed, the site specific engineering and design phase is now underway. Various consultants are currently bidding for the design contract. Design contract award and completion of the design plans is expected by September of 2008 with on the ground remedial work starting in the spring of 2009.

Monitoring which occurred in 2007 included on-going ground water investigations focused on delineation of the contaminant plume and better understanding of site specific ground water flow characteristics. This monitoring includes collection and analysis of ground water samples from monitoring wells. These activities provide data used in decision making with regards to the remedial design for both OU-1 and OU-2 (ground water). Currently the contaminant plume extends approximately 1600 feet north of the landfill and is advancing down-gradient very slowly but the velocity has not been fully determined.

Chapter III
Aquatic, Meadow, and Riparian Ecosystems

Monitoring associated with aquatic, meadow, and riparian ecosystems included status and trend biological monitoring, restoration effects monitoring on hydrologic function (floodplain connectivity, sediment transport regimes, and channel stability), biological monitoring (wildlife habitat and species), and finally, range monitoring. Hydrologic function monitoring described under this resource area is also closely linked to the Lake Tahoe clarity resource area. Restoring hydrologic function (reconnecting channels to floodplains) results in multiple ecosystem benefits including reducing stream channel erosion, increasing fine sediment deposition and nutrient uptake within the floodplain, and improving conditions for many riparian dependent plant and animal species.

III.1 Aquatic Associated Plant and Animal TES Status and Trend Monitoring

Status-and-Change Monitoring Questions:

- ***What is the current status of the Sierra Nevada (mountain) yellow legged-frog population(s) in the Lake Tahoe Basin and how are they changing over time?***

- ***What is the current status of special status aquatic plant communities and associated TES plant species (fens, bogs, marshes)?***

Sierra Nevada (Mountain) Yellow -Legged Frog

Sierra Nevada yellow-legged frogs (SNYF), *Rana sierrae*, (formally known as mountain yellow-legged frogs, *Rana muscosa*) are declining throughout the Lake Tahoe Basin (LTB). The only known population in the LTB occurs in the headwaters of Trout Creek. Survey efforts to test for the presence of *Batrachochytrium dendrobatidis (Bd*), a fungus causing massive declines in amphibians worldwide, continued into 2007. Genetic testing of SNYF was also conducted in 2007 in cooperation with UC Berkeley and Eldorado National Forest to provide information for future restoration efforts.

Skin swabs were collected from *R. sierrae* populations in both 2006 and 2007 in order to determine the presence of Bd. Additional swabs were also collected from *R. catesbeiana* (Bullfrog) and *Hyla regilla* (Pacific tree frog). Swabs were collected from adults if possible, but also from subadults and tadpoles. When swabs were not available from a population, extracts from toe clips where analyzed. Results are reported as Bd load (the estimated number of zoospores found on a swab or toe) and percent infected, also referred to as prevalence (the percent of individuals infected with Bd at a given site).

In 2007 swabs were collected from Lake Aloha, Hell Hole, Pyramid Lake, Taylor Creek, and Waca Lake. Toe and tail clips were from the following areas Lake Aloha, Waca Lake, Pyramid Lake, and Hell Hole (with the assistance of the Eldorado National Forest).

For genetic comparison, two other off forest SNYF populations were sampled with assistance from Eldorado National Forest (Ebbett's Pass) and Yosemite National Park (Conness Pond). These populations were chosen because they are among the closest nearby large populations of *Rana sierrae*, and are in the same mitochondrial clade as the Tahoe basin's SNYF based

on the work of Vredenburg et al (2007). Both the Conness and Ebbett's populations are infected with Bd, but appear to be stable (Vredenburg et al 2007).

Bd was detected in *Rana sierrae* adults, juveniles and tadpoles at several sites, and there is a significant increase in both average load and prevalence of Bd in tadpoles at the Hell Hole site (Fisher's Exact Test; $p < 0.001$). One *Hyla regilla* also came up positive at the Hell Hole site. *Rana catesbeiana* were swabbed at one site, Taylor Creek, but no individuals came up positive.

The only site that was sampled in both 2006 and 2007, Hell Hole, showed a marked increase in both prevalence and average load of Bd in *Rana sierrae* larvae (0.21 to .91 and 344 to 1600 zoospores, respectively). Bd has not been shown to negatively affect tadpoles, but does result in death at metamorphosis. Although sample sizes are too small to be definitive, the shift in prevalence and load from 2006 to 2007 may be indicative of Bd invading the Tahoe Basin. No adults or juveniles came up positive in 2006, while in 2007, 75% of subadults were infected, with an average load of 7,287 zoospores. Furthermore, in 2006 Hell Hole was the only site where Bd was found. In 2007, three sites were positive for Bd (Hell Hole, Pyramid Lake, and Waca). Average Bd loads and prevalence at these three sites are consistent with other populations persistent with Bd, although the Hell Hole site falls near the upper end of the range.

Key Findings, Sierra Nevada Yellow Legged Frog Surveys (Sarah Muskopf, LTBMU Biologist, 2007)

- One adult, 4 sub-adults, and 11 *Rana sierrae* larvae were detected in June 2007 in the headwaters of Trout Creek. The population seems to be declining in comparison to the 5 sub-adults found in 2006 and 36 sub-adults found in 2005 (which was the greatest number of sub-adults detected across the past five years of survey data).

- *Rana sierrae* were detected in a small pond near Cagwin Lake in Desolation Wilderness in 2004-2006, however none were found in 2007. The pond contained approximately 10-15 tadpoles and 3 subadults in 2006.

Fen Assessment

In conjunction with the Region 5 fen assessment initiated in 2006, three fen assessments were completed in 2007 on the LTBMU of which two were determined to be fens. As of December 2007, there are now seven known fens on the LTBMU: Grass Lake, Hell Hole, a fen located off Armstrong Pass trail in Meadow, Angora Restoration Project, Bear Glade located in High Meadows, Big Meadow pond area, and Osgood Swamp. Data from fen assessments were entered into the Region 5 fen geo-database which is being utilized for a region wide conservation assessment for fens.

Within the Angora Restoration Project area fen, monitoring of *Meesia triquetra* and *Meesia uliginosa* was initiated in 2006. Since the restoration project caused disturbance to the fen, four 15 meter transects were set up to monitor the cover of *Meesia*. Monitoring of transects occurred in June of 2007 and then again in August of 2007 after the Angora fire. Transects are planned to be monitored in 2008. If the percent cover of *Meesia* does not change more

than 25% then monitoring of the area will be suspended. If at any point there is a 25% change in *Meesia* cover then management actions will be recommended to prevent additional damage to the fen.

Sphagnum species were also identified from known fens. Currently LTBMU known species include: *S. tenellum*, *S. squarrosum*, and *S. lescurii*. Additional species are expected to occur as more sites are assessed in future years.

III.2 Range Allotment Monitoring

Implementation Monitoring Question:

- ***Are USFS range utilization standards and State fecal coliform standards being achieved at the Baldwin Grazing Allotment?***

The grazing permit for the Baldwin grazing allotment expired in December 2006. Because no decisions regarding the new application were made prior to the 2007 "on-date", a temporary permit was administered permitting 30 horses on pasture C for three days or until standards were met. Two additional herbaceous utilization transects were added to Pasture C to ensure standards were met. Measurements were taken using the Region 5 Landscape Appearance Point Method. The horses were removed from the allotment after seven days and all federal standards were met.

Pasture C does not contact Tallac Creek therefore no stream bank trampling data was collected. However, the USFS did collect fecal coliform data and did not exceed State standards during the permitted grazing. Five water samples were collected prior to grazing, throughout the permitted use, and four weeks after the horses were removed from public land. Fecal coliform was measured at three locations: upstream of all grazing pressure (control sample), directly downstream of the private in-holding, and at the downstream end of the allotment, near the mouth of Tallac Creek.

Lastly, to comply with Sierra Nevada Forest Plan Amendment standards to protect current and historic willow flycatcher habitat, grazing was not permitted until after August 15, 2007. Surveys were conducted on the Baldwin Allotment following Regional protocols.

Key Findings, Letter to Permittee (Marceron, 2007)

- All of the herbaceous utilization transects in Pasture C met herbaceous utilization standards according to the guidelines of 40% [maximum] utilization set by the SNFPA Record of Decision.

- Of the 3 locations sampled for fecal coliform during the grazing season, all met the state standards throughout 2007 permitted grazing season on public lands (40 colonies per 100mL).

- Streambank trampling measurements were not taken in 2007 because permitted use was not authorized in pastures containing stream channels.

III.3 Aquatic, Meadow, and Riparian Ecosystem Restoration Monitoring

A variety of variables are monitored as part of the effort to determine the effects and effectiveness of restoration projects in aquatic and riparian ecosystems. These include physical components related to geomorphology and habitat, as well as biotic components including fisheries, macro-invertebrates, and wildlife species monitoring.

III.3.a USFS Hydrologic/Geomorphic Restoration Monitoring

Implementation Monitoring Question:

- ***Are state sediment and turbidity standards being achieved during the first three years post-construction, for channel restoration projects?***

Effectiveness Monitoring Question:

- ***To what degree have restoration efforts been successful in restoring floodplain connectivity, stabilizing stream banks, and re-establishing natural sediment transport regimes?***

Blackwood Creek Channel Restoration

The Blackwood Creek Channel Restoration is a three-phase project designed to enhance and restore stream and floodplain function. Phase I, removal of the fish ladder and construction of a sequence of step pools and riffles, occurred in 2003. Phase II, construction of a new bridge, floodplain, and stream channel where Barker Pass Road crosses the creek, occurred in 2006. Phase III, restoration of channel and floodplain in two channel reaches located below Barker Pass Road, and above the restored fish ladder is scheduled for implementation in 2008 through 2010.

Photo points were established at the Phase I site in 2003 and Phase II site in 2006, and have been repeated annually. Sampling for macro invertebrates was initiated at all restoration sites in 2004, and repeated in 2005, 2006, and 2007 (see section II.3.d for more details). Pre-project wildlife trend surveys in support of Phase III restoration actions were conducted in 2004, 2006, and 2007 (see section III.3.c for more details). In 2007, The LTBMU and LRWQCB developed TMDL compliance parameters based on the geomorphic function. A monitoring plan was prepared for the Phase III project to measure the TMDL compliance parameters of channel sinuosity, floodplain vegetative cover, and stream bank stability.

Installation of permanent cross sections and a survey of the longitudinal profile will also be added to the monitoring parameters at the Phase I and Phase II in 2008, to document post construction channel adjustments. An analysis of project implementation water quality data for the Phase II project was presented in last years annual monitoring report, and analysis of all monitoring results to date for the Phase I and II project data will be conducted in 2008/2009.

Lonely Gulch Project

The purpose of monitoring was to evaluate the effectiveness of a restoration project to restore bank stability along a 350-foot section of Lonely Gulch Creek, located on the west shore of Lake Tahoe. Prior to this restoration implemented in 2003, the site was deemed vulnerable

to large-scale stream bank erosion as stream banks caved-in from excessive tree fall of dead and dying conifer lining the banks of the creek. Restoration included removal of many of the fallen trees, placing several in the bed at grade, and keying them into the banks to provide streambed stability. In addition, sections of streambank were reshaped to a lower angle and planted with native vegetation along the channel's edge.

The Forest Service utilized four metrics to track the performance of the treatments employed during this restoration effort. The four metrics were water quality data, photopoints, cross-sections, and macro invertebrates. Data was collected from 2002 through 2006, and final results were published in a report this spring, which is now available on the LTBMU website. Key findings from this report are presented below.

Key findings, Lonely Gulch Restoration Project Monitoring Report, 2002 through 2006 (Oehrli and Norman, 2008).

- Turbidity and SSC data stayed well within state water quality standards and did not indicate significant differences between above and below project sampling locations.
- Photo documentation indicates that the streambed and banks are recovering and vegetation appears to be on a positive trajectory in terms of developing a riparian corridor.
- Repeat cross-section measurements indicate some isolated lateral erosion of banks, but it is not considered excessive. Vertical adjustments are minor and appear to be a reflection of expected natural flux.
- Macro invertebrate sampling indicates that the site is biologically healthy when compared to other Basin streams.
- There are no visible indications that the streambed, banks, or riparian vegetation at the site responded negatively to a large mid winter flood occurring on December 31, 2005.

Marlette Dam Removal and Restoration Project

In August 2003, the U.S. Forest Service removed an earthen dam on the South Fork of Marlette Creek in an effort to restore channel morphology, hydrologic functions, and riparian vegetation, and to improve fisheries habitat and water quality. The findings reported on this project in last years annual monitoring report has not changed. The final report will be completed in 2008.

Taylor Creek and Tallac Creek

Taylor Creek and Tallac Creek jointly support a large wetland complex adjacent to Lake Tahoe that is both a popular recreation area and an important wildlife and rare plant habitat. Restoration opportunities include stream and swale restoration with the goal of improving lagoon /swale habitat, increasing ground water levels, improving riparian habitat, and potentially improving water quality by restoring wetland function and processes while providing a memorable recreational experience. In 2007, the last year of pre-project groundwater data was collected (initiated in 2002), which will provide information to future restoration efforts. The restoration plan is expected to be completed by April 2009. Future

groundwater measurements as well as other monitoring will not occur at this site until restoration is implemented. This project is not planned for implementation until 2012 and 2013, and NEPA/final design is not scheduled until 2011. The funding for NEPA/final design/ and implementation have not yet secured, and the total cost for NEPA/design is $300K, and implementation $2.5 million, to improve 500 acres of wetland habitat.

Cookhouse Meadow Restoration Project

The Cookhouse Meadow Restoration Project was designed to raise ground-water table levels, reduce seasonal ground-water fluctuations, reestablish over-bank flooding, and reestablish natural sedimentation patterns by abandoning the existing incised channel and constructing a new channel with characteristics of a Rosgen "C" channel type. New channel construction was implemented in 2005. In the summer of 2006, flow was completely diverted from the old channel to the new channel. A series of earth dams capped with native vegetation were constructed to block tributary flow from entering the old channel and to create a series of ponded areas that fill from intercepted groundwater.

In Spring 2006, the *Cookhouse Meadow Restoration Monitoring Plan* was finalized and post implementation monitoring is scheduled through 2010 to include. channel cross sections, three Weixelman plant community plots, sod bank monitoring (second season), macroinvertebrate surveys, groundwater levels (initiated in 2003), wildlife surveys (see section III.3.c), low scale air photo, and photopoints (initiated in 2004). The only one of these parameters that was not monitored in 2007 was macroinvertebrates, due to low stream flows.

An automated water stage recorder was also installed in late 2006, to evaluate channel design capacity through measurements of flood magnitude and timing. These measurement were taken in 2007 along with concurrent turbidity measurements taken above and below the project area to check for excessive release of fine sediment in the project area..

Below are key findings from sampling results, as well as visual observations from WY 2007. A more complete monitoring report for this project will be produced in 2008/2009.

Key Findings (Personal Communication, Craig Oehrli, Restoration Project Leader, June 2008)

- A low snow pack (45% of average) generated below average runoff. Spring runoff discharge peaks occured on May 16th (21 cfs) and May 29th (18.5 cfs). Discharge decreased gradually thereafter and surface flow became intermittent on or around July 31, and was dry by September 1. Observations during the May 16th peak flow show that the channel filled to 60 – 70 percent capacity and appears to be the appropriate water level given the design bank-full discharge of 30 cfs.
- Mean turbidity values (.77 NTU – upstream and 0.76 NTU downstream) suggest that spring runoff flushed no additional suspended sediment and fines from the newly constructed channel.
- Ground water measurements in 2007 show that water levels remained within contact with the root zone throughout most of the meadow thru mid August, in contrast to pre project data which showed that water levels remained in contact with the root zone only until late May in a dry year.

- Repeat cross section measurements combined with visual inspection along the entire channel indicate that the 2007 runoff generated no significant changes in channel cross section shape; several cross sections did show point bar formation and scouring action at several locations along the channel had formed bank undercuts, both of which were expected to occur.
- Weixelman meadow trend measurements in 2007 suggest a shift to wetter meadow conditions. LTBMU Botanists believe more time is needed for conversion of existing plant communities to respond to the new hydrologic conditions.
- Repeat measurements of placed meadow sod along stream banks show that vegetation density is increasing and may have reached capacity. LTBMU Botanists recommend discontinuing annual sod monitoring until further notice.
- Photo points document increased meadow plant vigor overall, most notably along newly constructed stream banks. Conifer die-off occurred, as expected, along the edge of what used to be the terrace bordering the historic channel in the central meadow.

Cold Creek/High Meadows Project

The acquisition of the High Meadows property by the Forest Service was finalized during the winter of 2003. The LTBMU is planning extensive restoration efforts within this property including stream channel/meadow restoration, rehabilitation of roads and trails, and fuels reduction. These efforts are anticipated to begin in the fall of 2008 with the majority of work to occur during 2009.

A pre-project baseline water-quality monitoring effort was initiated during the late spring of 2003. Two water-quality sites were established on Cold Creek, one immediately below the Meadow (43-21) and one at the lower LTBMU property boundary (43-22). Samples obtained at these sites were analyzed for a full complement of sediment and nutrient water-quality parameters. Twenty-four samples were taken at each site in 2007, starting on March 21 and ending on November 8. Since we now have 6 years of pre-project data, containing a variety of water year types, no further water quality monitoring data will be collected until after the project is implemented. Roads within the Cold Creek watershed were assessed in 2004 using the Water Quality Risk Assessment Protocol, and macroinvertebrate samples were collected during the summer of 2005 and 2006. In 2008, the NEPA analysis for this project will be completed which will incorporate an analysis of pre-project data, and a strategy for post project monitoring.

III.3.b Fisheries Restoration Monitoring

Status-and-Change Monitoring Questions:

- ***What is the current status of native and non-native fish and aquatic macro-invertebrates in the following five stream systems with future planned restoration activity: Upper Truckee, Big Meadow, Blackwood, Taylor and Tallac Creeks and Cold Creek?***

- ***What is the current status of native non-game fishes in Lake Tahoe tributaries?***

- ***What is the current status of warm-water invasive fish species (species and extent of invasion) in Lake Tahoe and associated wetlands?***

Effectiveness Monitoring Questions:

- ***Does periodic physical removal of brook trout effectively reduce brook trout long –term abundance in the Meiss Meadow reach of the Upper Truckee drainage?***

- ***What is the most effective hatch box design for producing healthy Lahontan?***

- ***Cutthroat trout fry in Glen Alpine Creek?***

Fisheries monitoring at stream restoration sites in Upper Truckee River, Big Meadow, Tallac and Cold Creeks did not occur in 2007. However, monitoring did occur in Taylor Creek as part of the native non-game fish assessment. Fisheries monitoring will occur in Blackwood Creek (Phase III site) prior to stream restoration activities in 2009 and again in 2011 (post-project implementation).

A macro-invertebrate bio-assessment was conducted as part of the stream restoration monitoring program at Blackwood Creek, Cold Creek, and Upper Truckee River (Sunset Stables reach). All samples will contribute to establishing pre-restoration status of stream macro-invertebrate communities. The Region 5 protocol was used during field collection and all samples were sent to the National Aquatic Monitoring Center (Utah State University; "bug lab") for processing and analysis. Vinson (2008) summarizes the taxonomic data and metrics for assessing the health of aquatic invertebrate assemblages, which include: total taxa richness, EPT taxa richness, Ephemeroptera taxa richness, Plecoptera taxa richness, Trichoptera taxa richness, % EPT abundance, % Ephemeroptera abundance, % Chironomidae abundance, Intolerant taxa richness, % tolerant organisms, Hilsenhoff Biotic Index, % contribution of the dominant taxon, clinger taxa richness, % clinger abundance, % collector-filterer abundance, and the % scraper abundance.

In 2007 Aquatic Biologists initiated a basin-wide native non-game fish assessment. The objective of the assessment is to document native non-game fish distribution and habitat indices in tributaries on Forest Service lands in Lake Tahoe. A total of 9 streams (encompassing 22,270 meters) were electro-fished in the south and west shores. All streams were sampled continuously from the mouth to endpoints such as the headwater origins or natural barriers. Surveys found that brook trout (*Salvelinus fontinalis*) was the most common occupying all streams surveyed. Speckled dace (*Rhinichthys osculus*), lahontan redside (*Richardsonius egregius*), and rainbow tout (*Oncorhynchus mykiss*) occupied eight to seven of the streams surveyed. Tahoe sucker (*Catostomus tahoensis*), paiute sculpin **(***Cottus beldingi*), and brown trout (*Salmo trutta*) were the third most common occupying five to six of the streams. The bullhead catfish (*Ameiurus nebulosus*) was found in only two streams and the mountain whitefish (*Prosopium williamsoni*), tui chub (*Gila bicolor*), mountain sucker (*Catostomus platyrhynchus*) and bluegill (*Lepomis macrochirus*) were detected in only one stream. Surveys will be continued in the 2008 field season.

During the Angora Fire fish mortality was observed in Angora Creek at and above Lake Tahoe Blvd. In order to document the effects on aquatic communities 3 fish sampling reaches were established in Angora Creek within the Angora Fire. Each reach was 100 meters in length and utilized a 3-pass depletion methodology. Surveys documented fish species, length and weight. Two species, brook trout and Paiute sculpin, were the only fishes documented in the 3 sampling reaches with brook trout being the most abundant. Sampling will continue in the 2008 field season and include population estimates. An attempt to collect macro-invertebrate data in the Angora Fire as an additional indicator of stream health and recovery was unsuccessful due to inadequate sampling conditions.

Key findings - Effectiveness of brook trout removal in Meiss Meadows (CDFG 2007):

- Brook trout removal appears to be effective at reducing numbers of brook trout in the Upper Meiss meadows area of the Upper Truckee drainage. In 2007, 0 brook trout were captured in Meiss Meadows. Surveys/removals will continue in 2008 to ensure complete removal. Also in 2008, brook trout removal will be initiated downstream of Meiss Meadows in the Upper Truckee River system (termed "LCT expansion area"), which includes 3 unnamed perennial tributaries.

Key findings – Effectiveness of LCT hatch box program:

- An attempt to install and incubate LCT hatch boxes in Glen Alpine Creek was unsuccessful in 2007 due to equipment failure. Starting in 2008 the LCT hatch box program will be coordinated by the US Fish and Wildlife Service and integrated into the Lahontan National Fish Hatchery operations.

Key findings – Warm-water invasive fish assessment (Chandra et al. 2008):

- In 2007, fish sampling occurred at three of the original 15 sites, which included: Tahoe Keys East, Tahoe Keys West, and Taylor Creek. Snorkeling and boat electrofishing occurred on 10 May, 12 June, and 7 August. Total non native fish captured in May, June, and August 2007 ranged from only 20%, 35%, and 38% of 2006 capture rates in Tahoe Keys East respectively. In Tahoe Keys West, capture rates in 2007 were 20.3%, 34.5%, and 93% of 2006 capture rates in May, June, and August.

- Lower capture rates in Tahoe Keys East in 2007 suggest electrofishing during the growing season could effectively reduce non native fish populations. Little reduction of fish caught in the Tahoe Keys West occurred in 2007. This location is located in the homeowner portion of the Tahoe Keys. Recruitment upon removal at Tahoe Keys West is more likely due to greater habitat area and interconnectedness of suitable habitat compared to Tahoe Keys East.

- Phase I of warm-water invasive fish research in the Tahoe Keys and Taylor Marsh is now complete. The results of the 2006 preliminary data collection and analysis were published (Kamerath et al. 2008) with additional publications including the 2007 data expected in 2008/2009. Phase II of warm-water invasive fish research

III.3.c Riparian Terrestrial Wildlife Restoration Monitoring

Status-Trend Monitoring Question:

- ***What are existing conditions for wildlife at restoration project sites and how might they help us identify opportunities for improving ecological conditions at restoration sites?***

Effectiveness Monitoring Question:

- ***How effective will the restoration efforts by LTBMU staff be at restoring ecosystem function within the project areas to achieve the desired historic conditions for wildlife species?***

Four meadow and two creek systems within the Lake Tahoe Basin are in various stages of planning for restoration of ecosystem function; and one additional meadow system (Cookhouse meadow) was restored during summer 2006. Monitoring wildlife before and after restoration is useful for evaluating the success of restoration, and for guiding future restoration projects. In 2007 surveys were conducted for birds, owls, bats, small mammals, and butterflies at the following restoration project sites and accompanying reference sites (reference sites are in parenthesis): 1. Cookhouse Meadow (Grass Lake), 2. Big Meadow (Grass Lake), 3. Meeks (General) 4. Blackwood (McKinney), 5. Taylor/Tallac Marsh (Truckee Marsh), 6. Upper Truckee Marsh (Truckee-Trout Marsh) and 8. High Meadows (Fountain Place). These surveys are conducted to (i) assess relative abundance of wildlife species prior to restoration activities and (ii) establish baseline wildlife data to assist with developing desired conditions and (iii) to use in post-project evaluations.

Surveys have been conducted at each of the restoration project sites and control sites in varying capacities over the past several years based on funding availability and anticipated project implementation. Control sites are used to help identify if changes observed on project sites are due to restoration activities. These ongoing surveys are intended to inform us about this and other recommendations for status and trend monitoring design.

2007 was the first year Ward/Burton Creek was not surveyed. The two year pre-restoration monitoring has been completed. It was the first year of post-restoration at Cookhouse Meadow. Cookhouse Meadow is discussed separately.

Key Findings from Restoration wildlife monitoring reports (Borgmann et al., 2007)

Butterflies:

- Surveys were done at seven sites: Big Meadow, Blackwood Creek, Cookhouse Meadow, Fountain Place, Grass Lake, High Meadow, and McKinney Creek.
- Butterflies were observed using a variety of plant species during our surveys that were conducted across the entire Basin. Important host plant species for focal butterfly species in meadow and creek sites include:

Common name	***Scientific name***	***% Observation***
wandering daisy	Erigeron peregrines	27%
yarrow	Achillea millefolium	24%
western aster	Aster occidentalis	10%
penstemon	Penstemon spp	8%
pennyroyal	Monardella spp	7%
pussypaws	Calyptridium umbellatum	7%
bistort	Polygonum bistortoides	3%
pearly everlasting	Anaphalis margaritacea	2%

- Suggest restoration efforts seek to maintain or enhance flowering species within meadows and along streamsides.

Songbirds:

- Cowbirds were present at most restoration and control sites. Brood parasitism rates by cowbirds were varied ranging from below the 30% threshold to particularly high. Few breeding pairs at some locations made results difficult to trend.
- Predation risk appears to be more influential to the nest success of focal songbird species than vegetation elements (e.g., foliage cover), suggesting that productivity metrics must be monitored if improvements in ecological conditions specific to focal songbirds are to be measured.
- Decreasing stream incision should improve and increase the number of nesting locations for spotted sandpipers, belted kingfishers, common mergansers, and Wilson's snipes.
- Improving meadow wetness and emergent marsh communities should prove beneficial for yellow-headed blackbird, sora, and Wilson's snipe as doing so should improve and increase nesting habitat conditions and reduce predation risk by limiting mammalian predator access to nests.
- Maintaining snags and/or installing nest boxes may be beneficial for mountain bluebird and house wren. Installing nest boxes will provide additional nesting locations for these species.
- Based on low detections of birds associated with riparian areas, restoration efforts should focus on improving the willow component for yellow warblers, calliope hummingbirds, Lincoln's sparrows, and willow flycatchers.
- Low detections of birds associated with riparian areas and montane meadows (yellow warblers, calliope hummingbirds, Lincoln's sparrows, and willow flycatchers).
- All of the desired condition songbird species detected across all meadow sites sampled within the Basin were relatively rare; for example, the most abundant desired condition species, the yellow warbler, was the 12th most abundant species overall, but comprised only 2% of the community.
    - All desired condition species were rare throughout all of the meadows analyzed. Because these desired species were relatively rare throughout the Basin restoration actions directed towards these species should prove extremely beneficial.

Owls:

- Cavity nesting owl species richness and number of detections were fairly low across restoration and control sites, the most commonly detected species at restoration and control sites were the northern saw-whet and great horned owls, both of which do not have highly specialized habitat preferences.
- The ability to detect the presence owls both pre- and post-restoration is necessary to understand how restoration efforts may affect owls; however, detection of owl species is low due to the relatively large home ranges that owls inhabit and the difficulty of observing nocturnal species. Starting surveys in March 2007 increased ability to detect northern saw-whet owls at most sites throughout the Basin.
- Due to low detection frequencies, population estimates for owls were not possible. Limited owl detections may be due to initiating surveys after the peak of the breeding season, therefore, surveys should and will occur earlier in the season in future efforts.
- Surveys were not done at Sunset Reach or Taylor/Tallac Marsh

Bats:

- Little brown bats and silver-haired bats occurred regularly throughout restoration and control sites, similar to historic records.
- Detection frequencies of bats were not sufficient to estimate trends in species abundance or occurrence.
- Little is known about the habitat needs of bat species in the Lake Tahoe basin, and intensive studies to locate and quantify roosting and maternity sites using radio telemetry are needed.
- Desired condition species found were long-eared myotis, fringed myotis, Townsend's big-eared bat, spotted bat, and Yuma myotis. Other species detected were big brown bat, free-tailed bat, hairy-winged myotis, Mexican free-tailed bat and California myotis.

Small Mammals:

- Majority of the voles were found in grass covered areas where willow cover was present and most of the shrews were found in open, grass covered areas without willow cover.
- Two species associated with wet-meadow conditions were noticeably absent or in low abundance at restoration and control sites (broad-footed mole and long-tailed vole) during 2004 and 2006. This suggests a lack of sufficient meadow wetness at restoration sites, a condition targeted for restoration at most restoration sites. Most sites showed an increase in abundance of long-tailed vole in 2007
- Pocket gophers were not detected frequently at meadow restoration or control sites, despite being recorded as the second most frequently occurring species among aquatic-riparian-meadow associated sites in a recent study (Manley and Schlesinger 2001); reasons for this are being explored, including whether the trapping methods employed were appropriate for detection of this fossorial species
- The highest relative abundance of small mammal desired condition species captured in meadow was observed at High Meadows restoration site and its associated control, Fountain Place.
- Maintaining open, wet meadows, increasing willow cover, and retaining adequate downed woody debris and snags, should encourage the persistence of these desired condition small mammal species.

Recommendations for Restoration Design

- Restoration efforts could focus on improving the structural diversity of the understory plant community, focusing in areas where natural regeneration is limited. Increasing structural diversity increases the number of available nest sites and increases the amount of foliage concealing the nest site, which may reduce predation risk.
- Increase proportion of wet meadow to improve conditions for willow regeneration and to reduce the ability of mammalian predators to access songbird nests.
- Create conditions that will result in an increase flowering herbaceous ground cover focusing on plant families associated with focal butterfly species.
- Plant vegetation in a clumped arrangement rather than in a uniform design.
- Retain old trees with existing cavities, and provide for recruitment of trees that can be managed as snags.
- Decreasing stream incision and improving meadow wetness will likely benefit species by increasing foraging and nesting opportunities.
- Maintain wet conditions across 75% of meadow until at least 1 August in selected meadow areas.
- Where possible, preserve riparian habitat corridors, cottonwood, willow and alder woodlands, and areas with open water to provide foraging opportunities for bats.
    - Snags are a potential source of roost sites for bats, efforts should be made to determine if the number of snags with cavities is sufficient to meet the needs of bats in the Basin (or specifically at Big Meadow).

Cookhouse Meadow (Post Restoration)

- During the first year post-restoration, the percentage of Cookhouse Meadow that contained saturated surface soil conditions remained above 50% of the meadow area until 20 June, at which point the percentage of the meadow that contained saturated soil continued to decline throughout the summer months.
    - Recommend that meadow wetness be monitored for at least 2 years to assess if the objective is being met in more normal precipitation years.
- Data collected in 2007 were used to assess pre-restoration conditions because the willows planted did not exceed 0.5 m in height.
- Some objectives were not met the first year post-restoration. This may be caused to 2007 being a relatively dry year as snow pack in the proceeding winter was below normal (30% of average annual snow pack).

<u>Butterflies</u>:

- Both the restoration site and the control sites showed similar patterns in butterfly richness and abundance over time.
    - Recommend additional post-restoration monitoring to determine if the objective has been met.

<u>Songbirds</u>:

- Songbird species richness increased by 38% at Cookhouse Meadow. The control sites did not increase with the same magnitude.
- Based on one year of post-restoration monitoring the species richness objective is proceeding in the desired direction.
- Abundance of desired condition songbirds did not increase and did not meet the objective.

- 1st year post-restoration indicate that for 2 of 6 focal bird species, (dusky flycatcher and warbling vireo); nesting success did not change after restoration relative to control sites.
    - Wilson's warbler nesting success decreased slightly after restoration relative to controls. This may be caused by parasitism increasing to 40% in 2007.
    - 3 focal bird species had an insufficient number of nests monitored (<2) to draw conclusions.
- Recommend monitoring continue in 2008 and 2009 to determine if the low nesting success observed is symptomatic of a problem, which would then require additional analyses to determine the cause of reduced nesting success.
- Parasitism levels observed for dusky flycatchers and warbling vireo nests are not of concern.

Owls:

- Three owl species were detected, the northern pygmy-owl, northern saw-whet owl, and long-eared owl.
- Due to the low numbers of species detected across years, including owl richness may be of limited benefit when attempting to quantify restoration success.

Bats:

- Two desired condition bat species were detected in 2007.
- Bat species richness did not increase relative to control sites in the first year following restoration.
- The relatively frequency of use by bats decreased slightly relative to the control sites.

Small Mammals:

- The vagrant shrew was detected for the first time postrestoration, other desired condition species detected pre-restoration were not detected postrestoration.
- Richness and abundance of desired condition small mammal species did not increase one year post-restoration.
- Results indicate that restoration activities in the first year post-restoration were not the primary influence on the decline of chipmunk relative abundance in the meadows.
- Objective of increasing weasel and western jumping mice abundance was not met
- Relative abundance of shrews decreased at Cookhouse and increased/stabilized at the Control sites.
- Vole relative abundance increased at all sites and was more pronounced at Cookhouse.

III.4 Water Rights Program Monitoring

Status and Change Monitoring Question:

- ***What is the current status of Forest Service water rights in the Lake Tahoe Basin in terms of compliance with state laws and regulations?***

The Forest Service is required to protect water rights owned by the United States on National Forest System (NFS) lands. Our goals are to ensure 1) the water rights are maintained in accordance with State forfeiture or abandonment laws and regulations. 2) water is applied to the purpose of use and in the manner specified in the water right permit, license, or decree,

and 3) water use is monitored under special use authorization. The Forest Service began its water rights field verification program during the summer of 2004 to ensure that all water rights are being put to the stated beneficial use and all documents are updated and recorded in NRIS (Natural Resource Information System). During the summer of 2007, 14 initial and 2 follow-up field verifications were performed on Forest Service water rights. To date, 67 water rights have been field verified out of the total 158 active water rights. Verification is focused on FS facilities such as day use areas, campgrounds, resorts operating under special permits, and visitor centers. Heavenly Ski Area water rights are not included in our field verification.

Key Findings, Water Rights Status Reports March, June, & December, 2007 (Brill & Harris, 2007)

- Of the 16 domestic water rights in California that were field verified during the summer of 2007, 6 (3 appropriative water rights and 3 riparian water rights) are no longer being put to the beneficial use indicated in the permit or license. Changes of beneficial use to fish and wildlife enhancement will be submitted to state agencies in 2008 for these water rights.

- Future work includes field verification of 36 Appropriative water rights and 42 Riparian water rights in California and 4 water rights in Nevada. Field verification of all existing LTBMU water rights is expected to be completed by the end of 2008.

Chapter IV
Old Forest Ecosystems and General Forest Ecosystems (includes WUIs)

In order to engage in a more comprehensive monitoring strategy for the Lake Tahoe Basin Management Unit, the Ecosystem Conservation Department has continued to broaden its scope of monitoring biological resources. Efforts have focused on providing better information on the overall health of the Basin's biological resources, the impact of various restoration activities in restoring habitats and populations, and the effects of ecosystem fragmentation and other anthropogenic disturbances.

IV.1 TES and Threshold Wildlife Species Monitoring

Status-and-Trend Monitoring Questions:

- ***What is the status and trend of presence and what is the reproductive status of identified TES species in the Sierra Nevada?***

- ***What are the status and trend of species composition and richness for wetland birds, and is the TRPA standard for 18 sites with occupancy being met?***

LTBMU Wildlife Staff has in cooperation with other federal, state, academic and private organizations, continued to conduct an ongoing status and trend monitoring program for the following TES species: California spotted owl (*Strix occidentalis occidentalis*), northern goshawk (*Accipiter gentilis*), osprey (*Pandion haliaetus*), willow flycatcher (*Empidonax traillii*), and bald eagle (*Haliaetus leucocephalus*). In 2007, LTBMU personnel and cooperators monitored a total of 20,494 acres of California spotted owl habitat; 24,650 acres of northern goshawk habitat, 271 acres of willow flycatcher habitat, 15,807 acres of suitable osprey habitat including 139 nest sites, and 26 locations for bald eagle including one nest site.

Key Findings, 2007 Annual Wildlife Monitoring Report (Lyon 2007)

California spotted owl - The LTBMU and its partners detected a total of 17 individual spotted owls in the Lake Tahoe Basin in 2007: up from 14 detected in 2006. Nine territories were active in 2007: up from five in 2006. More spotted owl pairs were detected in 2007 than in 2006 (4 versus 3). The number of territories where reproductive activity was detected and where juveniles fledged remained static from 2006 to 2007 (1). The number of young fledged decreased from three in 2006 to two in 2007.

Northern goshawk - The number of individual northern goshawks detected in 2007 was less than in 2006 (24 versus 40 total) and the number of active territories in 2007 decreased compared to 2006 (12 versus 26). The number of territories where reproductive activity was detected declined compared to 2006 (2 versus 5). Similarly, the number of territories that successfully fledged young declined from 3 to 2 over the same period. Finally the number of juveniles fledged in 2007 is less than in 2006 (3 versus7).

Osprey - The 2007 survey effort was similar to that in 2006. In 2007, LTBMU and its partners detected 36 osprey nests (versus 40 in 2006), 24 active nests (versus 25 in 2006).

Bald eagle - The number of wintering bald eagles detected during the 2007 count was more than in 2006 (9 versus 7). Adult bald eagles were detected on the northern and eastern shores of Lake Tahoe. The nest in Emerald Bay was the only active nest observed in the Lake Tahoe Basin, and fledged two juveniles. This nest has been active in seven of ten years between 1997 and 2007 and successfully fledged an average of 1.5 juveniles in those seven years.

Wetland Birds - Surveys for wetland birds were conducted from 1999 through 2004. However, in 2005 and 2006 and 2007 no wetland bird surveys were conducted due to a lack of funding and the need to revise the protocol for future seasons.

Willow flycatcher – As part of this Central Sierra study, 15 sites were surveyed throughout the Lake Tahoe Basin. Willow flycatchers were detected at four of these sites (in Tallac Creek, Blackwood Canyon, South Lake Tahoe Airport, and Uppermost Upper Truckee). The number of detections in 2007 relative to 2006 changed as follows: territories increased from 5 to 6, adults decreased from 7 to 6, nests remained static with 1, successful nests increased from 0 to 1, and the number of juveniles fledged increased from 0 to 4.

IV.2 Threatened Endangered and Sensitive (TES) Plant Species Monitoring

Status-and-Trend Monitoring Question:

- ***What is the status and trend of TRPA rare plant community richness at threshold sites?***

Cause-and-Effectiveness Monitoring Questions:

- ***How effective is the LTBMU Tahoe yellow cress outplanting project at increasing the population of Tahoe yellow cress in the Lake Tahoe Basin?***

- ***How effective is the transplanting of Tahoe draba to protect individuals and maintain population size?***

Status-and-Trend Monitoring Question:

- ***What is the status and trend of TRPA rare plant community richness at threshold sites?***

LTBMU botany staff, in cooperation with other federal, state and county agencies and non-governmental organizations, monitor TES plant species and six rare plant community threshold sites on a regular basis. In 2007, monitoring occurred for TRPA special interest plant species Tahoe yellow cress (*Rorippa subumbellata*), Tahoe draba (*Draba asterophora* var. *asterophora)* and Cup Lake draba (*Draba asterophora* var. *macrocarpa)*. No other TRPA special interest plant

Six Tahoe Regional Planning Agency rare plant community threshold sites originally set up in 2004 were monitored in 2005 for status and trend of species richness and have not yet been analyzed. No monitoring occurred in 2007. These six sites were distributed among three fens (Grass Lake, Hell Hole, Osgood Swamp), a marsh (Pope Marsh), a meadow (Taylor Creek) and a cushion plant community (Freel Peek).

In August 2006, the Global Observation Research Initiatives in Alpine Environments (GLORIA), with the help of the Forest Service, established three monitoring plots on Freel

Peak and surrounding ridges. The monitoring plots extend from the summit down to a ten meter elevation contour line. The plots will be read every five years to monitor the trend of the Freel Peak cushion plant communities through time and changing conditions.

Tahoe yellow cress (*Rorippa subumbellata*) monitoring consisted of monthly effectiveness monitoring of the 7,500 container-grown plants outplanted at 11 sites planted from 2003 through 2006 that were still present in 2007. In addition, 100 plants were translocated and monitored on non-USFS land. The annual September lake wide survey identified 11,847 stems of Tahoe yellow cress stems at 30 sites around the lake.

In 2006 a Memorandum of Understanding (MOU) was established to provide guidance for the implementation of conservation measures for Tahoe draba (*Draba asterophora* var. *asterophora)* and Cup Lake draba (*Draba asterophora* var. *macrocarpa)*. Efforts are currently being undertaken to understand the variation between and within populations by researchers at Brigham Young University. Preliminary genetic results demonstrate that these plants are indeed very rare and that there is a need to protect individuals and populations through the development of conservation measures. No monitoring was conducted on Tahoe draba or Cup Lake draba in 2007 by LTBMU staff. However, LTBMU staff worked with researchers to assist in the identification of long term monitoring sites. Researchers established long term monitoring plots at four locations, two of which are on LTBMU land at Freel Peak and Heavenly Ski Resort. To date, transplant efforts have not been successful.

IV.3 Aspen Restoration Wildlife Monitoring

Status-and-Change Monitoring Question:

- ***What is the current status or condition of aspen stands in Lake Tahoe Basin, with particular attention to avian and small mammal community composition?***

- ***What is the current distribution and condition of aspen stands within the Lake Tahoe basin, and which of these stands should be a priority for restoration?***

Effectiveness Monitoring Question:

- ***Is aspen restoration effective at restoring expected avian and small mammal communities within aspen stands in Lake Tahoe Basin?***

The Aspen Community Mapping and Condition Assessment Project (2002-2007) addressed Lake Tahoe Watershed Assessment "Biological Integrity Issue 6: The Need to Understand the Integrity and Condition of Ecologically Significant Areas in the Basin" and identified that approximately 1,600 acres (64%) out of a total 2,500 acres of aspen on the forest are currently at moderate, high, or highest risk of loss from the landscape and should be a priority for restoration. Risk of loss is an assessment of the probability that an aspen stand may not persist on the landscape based on stand conditions such as conifer encroachment and aspen regeneration. An estimated 1,115 acres (70%) of the moderate, high, or highest risk aspen stands on the LTBMU are located outside other planned, proposed, and current vegetation treatment project areas (that may treat aspen) and/or outside Wilderness Areas (where treatments are largely prohibited). These 1,115 acres of aspen will likely be treated,

as funding permits, by the Aspen Community Restoration Project. Moderate, high, and highest risk aspen stands located on Forest System lands are fairly evenly distributed across the Basin where suitable site conditions exist.

From 2004 through 2006, the LTBMU conducted a study to: (i) review the status of wildlife associated aspen stands in Lake Tahoe Basin, (ii) quantify the species richness and abundance of birds and rodents in aspen stands scheduled for restoration through the removal of conifer, (iii) make recommendations on the specific restoration treatments to be applied to the stands, (iv) monitor the response of birds and rodents to aspen restoration, and (v) make recommendations for large-scale application of aspen restoration in the Basin. The result of this work was presented in the 2006 LTBMU annual monitoring report. No monitoring was conducted in 2007. Monitoring will resume in 2008, to gather data to address monitoring objectives iv and v.

Chapter V
Noxious Weed Monitoring

Status-and-Trend Monitoring Question:

- ***What are the status and trend of the number of acres of noxious weeds located adjacent to roads, trails, and along the wildland/urban interface within the Lake Tahoe Basin?***

Effectiveness Monitoring Question:

- ***How effective are the efforts by LTBMU staff at reducing the number of acres of noxious weed infestation in Lake Tahoe Basin?***

The LTBMU noxious weed program, in coordination with other federal, state and county agencies and non-governmental organizations, conducts both effectiveness monitoring of treated infestations and status and trend monitoring of noxious weed primarily around roads, trails, and along the wildland/urban interface within the Lake Tahoe Basin

Results from 2007 monitoring are presented in the 2007 Botany Year End Accomplishment Report. Key findings are presented below.

Key Findings, 2007 Botany Year End Accomplishment Report (Reed, 2007)

- There were a total of **72.7** gross acres and **5.55** infested acres of invasive weeds documented in 2007. Gross area decreased by 9.91 acres and infested area increased by .91 acres.

- Basin wide status and trend monitoring discovered 57 new infestation sites, increasing the total number of weed sites from 334 to 362. Many of the sites are infested with multiple species, totaling 407 different species occurrences treated by LTBMU staff. Bull thistle (*Cirsium vulgare*) continues to be the most prevalent weed.

Chapter VI
Fire and Fuels Monitoring

A variety of monitoring efforts were implemented to evaluate the impacts of fuels reduction activities on ecosystem components such as soil quality, water quality, fuel loading, vegetation structure and diversity, and wildlife habitat.

VI.1 Programmatic Fuels Reduction Project Soil Monitoring

Effectiveness Monitoring Question:

- ***What effects are fuels reduction projects having on soil characteristics that can affect runoff, erosion, and water quality?***

To quantify the impacts of fuels reduction projects on soils, the LTBMU began monitoring these projects in more detail in 2005. A Soil Quality Monitoring Plan (Norman and Christensen, 2006) was developed to measure pre- and post-project soil characteristics that include saturated hydraulic conductivity, bulk density, soil cover, and soil disturbance. Primary soil characteristics such as saturated hydraulic conductivity and bulk density are measured to estimate the amount of compaction and the associated reduction in soil porosity as a result of fuels reduction projects. Measured soils characteristics are used in the Watershed Erosion Prediction Project (WEPP) Model to predict potential runoff and erosion impacts from changes in soil parameters. The only project monitored in 2007 was the Heavenly SEZ Fuels Reduction Demonstration project, described below.

Heavenly Creek SEZ Demonstration Project Soils Monitoring

Cause and Effect Monitoring Question

- ***What are the impacts of low impact mechanical equipment used to reduce fuels, on soil quality characteristics of land classified as SEZ?***

The 21-acre Heavenly Creek SEZ Fuels Reduction Project, completed in late summer of 2007, represented the first use of low-ground-pressure CTL forwarder/harvester technology to treat overstocked fuels within lands classified in the Tahoe Basin as stream environment zone (SEZ). (SEZs are defined as biological communities that owe their characteristics to the presence of surface water or a seasonally high ground-water table).

Project impacts were evaluated through a monitoring program designed to measure changes in soil quality (hydraulic conductivity, bulk density/soil porosity, and soil cover) that affect the capacity of the land to maintain healthy vegetation communities and resistance to erosion. The parameters and protocols were similar to that utilized on other LTBMU fuels reduction projects in upland areas (Ward, 2007). Measured soil parameters were compared to Regional soil quality monitoring standards. Soil Quality monitoring results were presented in a final report in March of 2008, and is available on the LTBMU website. Monitoring of vegetation parameters will be conducted in 2008, with a report of those finding produced in 2008/2009. Key findings from the soil quality monitoring report are presented below.

- Erosion and runoff model simulations, utilizing the measured changes in soil quality parameters, predict no real erosion or sediment delivery response as a result of project activities (<.03 ton/acre). Also, no changes in soil quality occurred that would affect vegetation response negatively. Rather successional growth of riparian vegetation is expected to be enhanced as a result of the removal of dense overstocked lodgepole stands.

- The post-project hydraulic conductivity (Ksat, a measure of the rate water flows through the soil) was 2.4 in/hr, well above the WEPP model predicted erosion response trigger level of 1.0 in/hr. Although Ksat was reduced by over 50%, the overall post-project conditions proved sufficiently favorable to prevent an erosive runoff response. This resiliency is due to a combination of low gradient slopes (≤15%), high level of post-project soil cover (89%), robust vegetation cover, dry soil moistures (≤11%), and the relatively high baseline Ksat values represented by the soils at the site (which are typical of Tahoe Basin SEZs).

- The results of this monitoring effort indicate that treatment of many areas of the Tahoe Basin which are classified as SEZ, with CTL forwarder/harvester technology, can be safely implemented under dry soil conditions. Post-project Ksat measurements also detected no significant difference between areas where equipment operated over a slash mat, versus visible equipment tracks with out a slash mat. These results indicate that the high cost associated with creating and removing slash mats may be avoidable in SEZs with low soil moisture and other appropriate settings.

- Future projects should be implemented and monitored to determine the full range of soil conditions in which this technology can be used without causing adverse impacts to soils and water quality.

VI.2 Fire History and Fire Effects Study

Research Question:

- ***What have been the impacts of historic wildfire and long-term fire suppression on discharge water quality, soil fertility, and forest health?***

In January of 2005 a study was initiated with the University of Nevada, Reno to continue investigating some of the findings obtained through the Biomass Treatment Effects Study. Simulation modeling will be used to synthesize existing information concerning the ecosystem effects of wildland fire, prescribed fire, fuel treatments, and fire suppression. The primary objective of the project is to develop a landscape-level, simulation model for analyzing the effects of varying fire regimes (including fire suppression) on nutrient cycling for forests throughout the Tahoe Basin, and to conduct a basinwide analysis utilizing this model. This first phase of the project is complete in that a model has been developed and was applied on two scenarios (fire suppression, and historic fire) over the entire Tahoe Basin. The findings from this first phase have and will be documented in several research papers. The results have also been summarized in a final report submitted by the principal investigators to the LTBMU. Key findings are presented below. In late 2007, funding was obtained for a second phase of the project, to conduct the necessary field data collection to

validate and calibrate the model. The authors warned that their confidence in the outputs from the model at this point is not robust, and model results should not be applied too literally to guide management actions until the second validation phase is completed. The following are key findings from the mid-year progress report for the second phase of this project.

Key findings from April 30, 2008 Mid-Year Progress Report for the Fire History and Fire Effects Study (Weisberg, 2008)

- Over the past six months, project work has focused on two main tasks: field sampling of nutrient runoff and soil nutrients, and modeling landscape-level effects of fire regime and forest management on fluxes of carbon, nitrogen and phosphorus. Progress is described below for these two project components:

- Eight runoff collectors were installed under chaparral and Jeffrey pine trees at each of two sites during the weeks of Oct. 29th and Dec. 10th, 2008. Samples have been collected from these sites and are being prepared for nutrient analyses.

- For field validation of model outputs, litter and mineral soils have been collected from 73 chaparral and Jeffrey pine stands throughout the Lake Tahoe Basin. Samples are being prepared for analysis of total nitrogen and phosphorus concentrations, and will provide data for evaluation of the soil nitrogen and phosphorus contents simulated by the model. Field data on organic soil depth, bulk density, stand age, and vegetation cover have also been collected from these same sites.

- A nutrient cycling model has been coupled to the widely used landscape dynamics model, LANDIS-II. Over the past six months project investigators have identified logical flaws in how the LANDIS model represents biomass allocation and forest mortality. These flaws call into question our earlier, preliminary results in that the model incorrectly produced very low levels of litter accumulation, which is a key input to the nutrient cycling model. Investigators have redeveloped the NuCycling-Succession model so that these problems are nearly corrected.

VI.3 Fuels and Vegetation Fuels Reduction Project Monitoring

Cause and Effect Monitoring Question:

- ***What are the effects and effectiveness of fuels reduction practices on vegetation, fuel loads, and wildlife?***

The Lake Tahoe Basin Management Unit did not fund post project effectiveness monitoring or analysis in 2007/2008, to follow-up on pre-project monitoring funded by the USFS and described in last years annual monitoring report. However funding was provided for post project monitoring by the Nevada Division of State Lands through the Neveda State License Plate grant funds. Information about the post project monitoring effort should be obtained from Nevada Division of State Lands, CTC, or the principle investigators at BMP Ecosciences or the USFS Pacific Southwest Research Station.

VI.4 Angora Wildfire Effects and Restoration Monitoring

The Angora Wildfire that began in July 2007 burned approximately 2736 acres of National Forest land. The majority of the burned area (~2500 acres) is in the Angora Creek drainage which drains into the Upper Truckee River. Following the Angora wildfire of 2007 the LTBMU established a post fire monitoring strategy to assess post fire conditions for an assessment of restoration needs, as well as establish a baseline for monitoring long term recovery of the burn area. This monitoring strategy will be updated as part of the NEPA process for the Angora Long Term Restoration Project, currently underway. The following describes the components of the current draft monitoring strategy.

Vegetation and Fuels

Cause and Effect Monitoring Question:

- ***What was the effect(s) of the Angora wildfire on vegetation, fuel loads, and wildlife and how do these ecological components change over time in areas that are actively managed as well as those areas left to recover on their own?***

The purpose of this monitoring component is to establish repeatable monitoring transects to quantify the current condition of the Angora fire area as it relates to vegetation condition and regeneration, fuels, tree mortality, snag retention, and effects of hydromulch treatment on understory vegetation. This project will also serve as a data source for wildlife habitat on the the fire perimeter and as a data source for future modeling efforts to better understand the role and impacts of wildfire on LTBMU ecosystems.

The specific monitoring parameters include:

1. vegetation succession
2. fuels accumulation
3. snag retention
4. postfire conifer regeneration
5. effects of hydromulch treatments on understory vegetation
6. long-term mortality of trees still alive after fire
7. aspen regeneration

Monitoring will be based on a spatial sampling grid across the fire, and stratified by fire severity. Some plots will be sampled outside of the fire area as controls. Standard Forest Service protocols were employed where available, and data entered into corporate databases. Although funding agreements were established with the Regional Ecologist and the University of Montana, to conduct this study, the first year of data collection is scheduled for 2008.

Soil and Water

Cause and Effect Monitoring Question:

- ***What was the effect of the Angora wildfire on soil stability and hydrophobicity and when will soil hydrophobicity recover to back ground levels?***

The purpose of this component is to assess the watershed impacts of the fire as it relates to soil and water quality. In August of 2007, 1:8,000 resolution aerial photographs were flown over the entire burn area. The purpose of this measure is to provide a baseline for a visual assessment of burn area conditions as it relates to erosion and mass wasting.

One of the potential results of the fire was an increase in the hydrophobicity (water repellency) of the soil, which may increase the potential for runoff and erosion. A monitoring effort was initiated to provide repeatable measurements of hydrophobicity changes, using the Mini Disk Infiltrometer (MDI) method. Hydrophobicity measurements are categorized as either high, low, or none. Slopes represented by sites rated as none or low are expected to result in minimal increases in runoff. Slopes represented by sites rated as high, have the potential for significant increases in runoff from those sites, if high intensity precipitation events occur. A total of six different sites were selected for monitoring in the project area. The sites were selected based on characteristics that have been correlated to hydrophobicity in soils. These characteristics are 1) burn severity, 2) aspect (north or south facing), and 3) position on the slope (upper or lower). The soil burn severity ranged from low to high, with 24% of the area experiencing low severity burn, 42% moderate severity, and 34% high severity (Weaver, Biddinger and Rust, 2007). All transects were located on slopes experiencing high to moderate severity burn.

The first year of monitoring data was collected in the summer of 2007, and published in a report available on the LTBMU website. Key findings from the report are presented below.

Key findings from the Angora Hydrophobicity Report (Tolley, 2008):

- Surprisingly, the characteristic that most closely correlated to the soil hydrophobicity in the Angora Fire is the slope aspect and not the burn severity or slope elevation. The soils on all three northeast facing slopes (Tahoe Mountain and High School sites) have minimal or no water repellency, while the soils on all three southeast facing slopes (Angora Ridge and Boulder Mountain sites) have relatively high water repellency, regardless of differences in burn severity or slope elevation.
- When applying the results of these measurements over the entire burn area, it is estimated that 1,819 acres of high to moderately burned slopes in the Angora Burn located on south east facing slopes, exhibit some degree of hydrophobicity.
- It is also estimated that 530 acres of the high to moderately burned slopes in the Angora Burn located on north east facing slopes, exhibit no hydrophobicity (the remaining 751 acres of low severity burn are also assumed to exhibit no hydrophobicity).
- Approximately 20% of the hydrophobic area of the burn (or 475 acres) is located on lands rated as high erosion hazard.
- Monitoring for the 2008 season will focus on re-sampling the 3 sites located on the southeast facing slopes as these are the sites that experienced some degree of hydrophobicity. In addition visual monitoring within the high erosion hazards area will be performed to determine whether erosion features are developing (including use of low elevation aerial photography). Additional hydrophobicity monitoring sites may be established if substantial recovery is not observed. In addition, hydrophobicity will be measured on an adjacent unburned southeast facing slope.

Channel Condition Monitoring (Angora Meadow above Lake Tahoe Blvd)

Cause and Effect Monitoring Question:

- ***What was the effect of the Angora wildfire on Angora Creek channel condition, and how will channel condition improve as a result of restoration actions?***

The purpose of this component is to assess the impacts of the Angora wildfire fire as it relates to stream channel and floodplain condition. In October 2007, we established a 300-meter long monitoring reach just above Lake Tahoe Boulevard. This area was judged to best reflect cross sectional response and channel adjustments to fire-related sediment loading. Within this reach, we documented baseline conditions for bank-full cross sectional area, locations of existing woody debris complexes, and the position of the longitudinal profile. We also installed three cross sections with bank erosion pins to quantify bank erosion rates. Additionally, the Tahoe Regional Planning Agency (TRPA) installed six sediment traps on the floodplain to evaluate post fire floodplain sedimentation characteristics. We will analyze the baseline data in 2008 to evaluate departure from desired condition and the data be used as part of the NEPA analysis and design for restoration of the creek through the meadow. We will resurvey cross sections, longitudinal profile, and sediment traps following the occurrence of significant flood (bank-full level or greater) events prior to implementation of restoration activities. Post project evaluations will occur following restoration activities, currently scheduled for 2011.

Stream temperature in Angora Creek was also monitored in 2007 with the objective of looking at effects from increased solar input resulting from the Angora Fire, specifically loss of stream-side vegetation. Long-term continuous stream temperature data loggers (Onset Stowaways) were installed in a location in the fire and a location outside of the fire. Data loggers were installed in August and removed in October. Stowaways were completely submerged and put in an area of the stream that was shaded at least 80% of the time during sunlight hours (i.e. undercut bank). Stream temperature monitoring will continue in the field season in 2008.

Chapter VII
Recreation and Social Resources

Recreation monitoring continues to be an ongoing effort in the LTBMU recreation programs. These are performed by wilderness rangers and OHV patrollers who are primarily assigned the duty of providing education to the public and enforcing USFS regulations regarding recreation use. For the past decade, wilderness rangers and volunteers have actively been monitoring encounters and campsite conditions within the Desolation Wilderness. In 2006 and 2007 the LTBMU had 1400 hours of monitoring time generated by 35 Wilderness Volunteers. Social and resource modeling is being collected and summarized for a statistically valid trend analysis and evaluation, scheduled to be conducted in the winter of 2009. Informal observations are the same as presented in last years report.

On the OHV/OSV side of the recreation program, the summer and winter of 2007/2008, OHV patrollers have completed hundreds of daily OHV monitoring logs each year detailing such monitoring data as:

Patrol Areas
Visitor Counts broken down into types of OHV & OSV vehicles
Vehicles in Compliance with Green Sticker Regulations
Citations Issued
Resource Damage
Any needed additional information

All data has entered into an electronic database and will be analyzed in a comprehensive analysis scheduled for 2009. Key findings from the OHV patrol staff 2007 annual report are presented below.

Key Findings from 2007 OHV Monitoring Report (OHV Program,, 2007)

Trail counters were placed from July 4, 2007 to November 4, 2007 on the Corral and Sidewinder trails to count the number of users. An OHV visitor survey was also taken from users on the Corral and Sidewinder trails and at the staging area for the McKinney Rubicon trail to determine the quality of experience for OHV visitors.

- From patrol observations, it was determined that the vast majority of users on the Corral and Sidewinder OHV trails were mountain bikers, and OHV users made up only a small percentage of the total number of users on these trails. The daily average number of users on the Corral trail was: 42 in August, 25 in September, and 26.5 in October. On the Sidewinder trail, the average daily count was: 40 in July, 34 in August, 45 in September, and 32 in October. Weekend use was higher on average than weekday use.

- OHV visitor experience survey results show a wide variety of OHV experience levels, from one to forty-two years. The majority of users had been on the trails before, and many were local residents. The main concerns expressed in the “suggestions” section of the survey were from motorcycle users on the Corral or Sidewinder trails. They would

Chapter VIII
Discussion

Biological resources monitoring will continue to be a significant component of the LTBMU monitoring program and refinements and adjustments to the biological monitoring program will occur over the next several years as changes in budgets, needs, and species lists occur. A major new unexpected project was added to the Forest Monitoring program in 2007 as a result of the Angora wildfire. Data collection was initiated on a variety of ecological parameters including soils, vegetation, fuels, and geomorphology. Data collection will continue in the Angora wildfire for several years to evaluate the recovery of the burned area in areas that are actively managed as well as areas without active management.

Continued focus was also implemented in the evaluation the effects of fuels reduction practices on soil quality, this year focusing on the effects of mechanical treatments within an SEZ. Measured soils data was used to predict project impacts to water quality utilizing the Watershed Erosion Prediction Project Model for simulating hydrologic and erosion response (WEPP). This approach has continued to be successful in providing a cost effective, quantitative evaluation of the specific impact of fuels reduction treatment practices on soils and water quality. This monitoring approach will be repeated in future years, when different soil types or project conditions exists, and or different/treatment practices are utilized.

Desired conditions, management strategies, management approaches, and objectives will be identified in the LTBMU Forest Plan revision, due to be completed in 2009. Monitoring strategies will evolve to track and evaluate trends and the attainment of the desired conditions established through this process. The Forest Plan Revision will also present a comprehensive monitoring and evaluation program . This Plan is still being developed, and is anticipated to meet the agency requirements for monitoring as described in Forest Service Handbooks and Manuals for Land Management Planning, Adaptive Management, and Environmental Management Systems.

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