CHAPTER VI

LANDSCAPE SCALE MONITORING WORKPLAN

A. INTRODUCTION:

This workplan is being proposed as a work-tool methodology to determine what landscape scale monitoring will be recommended by a watershed analysis team for inclusion in a specific watershed analysis report. Upon completion, a workplan for a watershed will provide the basic text and data to complete the watershed analysis report chapter that covers landscape scale monitoring.

Background

Federal agencies have a mandate to monitor environmental change, including monitoring to ascertain whether or not State water quality standards are being met. Appropriate monitoring parameters and locations vary according to the type of site, the type of land use, the type of concerns, and the type of impact mechanisms active in the area. To provide useful results, monitoring plans must be tailored for the particular setting in which they are to be carried out.

Watershed Analysis provides the information needed to design appropriate monitoring strategies. In addition, the process of Watershed Analysis will reveal types of data that would be useful for better understanding watershed processes, ecosystems, and impacts in the area.

Monitoring allows us to make decisions based on site specific information. Also, monitoring results will provide information for updates and revisions to both watershed analysis, and project planning and design. With a smaller federal work force, successful monitoring will depend on a cooperative efforts by research stations, universities, other agencies, community groups and volunteers.

Appropriate monitoring variables are those that are likely to change significantly and quickly if the impacts of concern are occurring. Similarly, monitoring location should be chosen that are likely to show significant changes early on. Both the processes driving the change and the response of the resource of concern can be monitored, but the driving processes will exhibit the least lag and so provide the greatest warning of impending impacts. By the time channel morphology changes at a sensitive site, for example, the processes that caused the change are usually too far advanced to do anything about. However, an understanding of process mechanisms is required if appropriate driving processes are to be singled out for monitoring.

Appropriate monitoring parameters and locations are best described for different management related monitoring goals. In addition, the basic data needs for understanding watershed processes and ecosystems are prioritized and their applications described. Research needs may be identified in this section.

B. FOREST LAND MANAGEMENT PLAN MONITORING

To avoid overlap and duplication of effort, and to assure that different monitoring programs are coordinated and compliment each other, it is important that Forest Plan Monitoring is reviewed before Watershed Analysis Teams recommend landscape scale monitoring proposals.

The following table identifies some of the measurements that are already identified for collection in Forest Plan Monitoring Plans in the Blue Mountain area.

Table 6-1: MONITORING MEASUREMENTS ADDRESSED (in one or more of the Forest Plan Monitoring Plans)	
DFC Ecological Elements	***Monitoring Elements***
Air Quality	Air quality in level one air sheds, amount of fuels consumed by prescribed fire, total emissions from prescribed fire, meeting regional S&Gs for smoke emissions, meeting the state smoke management plan.
Water Quality	Are S&Gs and BMPs implemented? Are they effective in meeting water quality objectives, trend in water quality, and cumulative effects of management activities and natural events?
Hydrology	Effects of management on peak flows, low flows and timing of flow if channel forming processes are operating to result in DFC for fish habitat.
Fish/Aquatic Systems	See water quality. If meeting habitat improvement objectives, if fish habitat capability is improving, if fish productivity is improving, are relationships between habitat parameters and fish production as predicted.
Geomorphic Processes	no measurements identified
Fire/Fuels Regime/Risks	Area where fire has been re-introduced, area burned by wildfire, area of high intensity burn, ecological effects of prescribed fire, consideration of use of prescribed fire to meet management objectives.
Corridors	Amount and changes in Wilderness, Wild and Scenic River system, RNAs, Botanical Areas, old-growth allocations, and back country allocations. If Visual Quality Objectives (and associated large tree habitat in Fg) are met.
Travel Linkages	As above for corridors, amount and condition of riparian areas.
TES Viability	Identification and protection of identified and potential habitat for the bald eagle, peregrine falcon and MacFarlanes 4 o-clock. Identification of habitat, habitat protection needs, for sensitive species, adequacy of the protection measures to prevent listing of a species.
Fragmentation	Amount, size and spacing of old-growth, rate of conversion of non-allocated old-growth, harvest unit size and dispersal, maintenance of natural edge during timber management.
Habitat Relations	Habitat use by MIS, population baseline and trends for MIS, biological validity of the elk HEI model, habitat relationships between fish and fish habitat parameters.
Nutrient Cycling Longterm Soil Productivity	Are we meeting soil protection guidelines? Are the guidelines effective in meeting productivity goals? the level of accelerated erosion due to burns, erosion rates.
Grazing Regime	Forage utilization, primary and secondary condition and trend, Riparian condition and trend.
Insect Disease & Noxious Weeds	Effectiveness of Integrated Pest Management, current status of insect and disease, loss due to insect and disease, noxious weed locations, population levels and trends of noxious weeds, level of success for noxious weed eradication projects.

Table 6-1: MONITORING MEASUREMENTS ADDRESSED (Continued)	
DFC Ecological Elements	***Succession Community Structure/Composition***
Forest	old-growth area, quality, size and spacing, replacement old growth location and trend, area affected by timber sales by species group, management area and harvest type, area thinned or otherwise meeting stocking criteria, size and dispersal of harvest units, range and average size of harvest units, area of natural and planted reforestation, area reforested with superior genetic stock, area forested with pine, stocking levels and time frames for reforestation, lands suitable for timber production, area meeting VQOs (and associated habitat for Fg), amount size and spacing of elk cover, level of protection of elk calving areas, and probably some measurement of forest structure for snow melt modeling.
Riparian	Riparian vegetation condition and trend, channel health, shade
Range	Primary and secondary range condition and trend, forage utilization, riparian vegetation condition and trend, forage condition for elk habitat, forage use on elk winter range.
Other	Snag habitat levels, dead down tree habitat levels, mix of deterioration classes for dead tree habitat, snag habitat replacement tree levels, level of protection of unique habitat, location of raptor nest sites, protection and improvement of habitat for raptors.

The following table shows the appropriate scale of analysis for these various monitoring items:

Table 6-2: SCALE OF ANALYSIS						
Ecologically Sustainable Conditions	***Physio. Region***	***Physio. Zone***	***River Basin***	***SWS***	***Stand/ Reach***	***Individ.***
Air Quality	**X**	**X**	**X**	**X**	**X**	
Water Quality	**X**	**X**	**X**	**X**	**X**	
Hydrology	**X**	**X**	**X**	**X**	**X**	
Fish/Aquatic Systems	**X**	**X**	**X**	**X**	**X**	**X**
Geomorphic Processes	**X**	**X**	**X**	**X**	**X**	
Fire/Fuels-Regime/Risks	**X**	**X**	**X**	**X**	**X**	
Corridors	**X**	**X**	**X**	**X**	**X**	
Travel Linkages						
TES Viability	**X**	**X**	**X**	**X**	**X**	**X**
Fragment.	**X**	**X**	**X**	**X**		
Habitat Relations	**X**	**X**	**X**	**X**	**X**	
Nutrient Cycling/ Longterm Soil Product		**X**	**X**	**X**	**X**	**X**
Grazing Regime		**X**	**X**	**X**		
Succession Community Structure/Composition		**X**	**X**	**X**	**X**	

The Wallowa-Whitman Forest Land Management Plan provides overall guidance for implementation and monitoring of the Plan itself and for individual projects designed to accomplish Plan goals. Those goals and the Monitoring Plan are organized around various management areas that are distributed across the Forest.

Forest Plan Monitoring covers a total of 47 monitoring items. Types of monitoring include IMPLEMENTATION, EFFECTIVENESS, AND VALIDATION.

Monitoring items that include only IMPLEMENTATION type monitoring are:
Precommercial Thinning, Suitable Lands Verification, Range Outputs, Allotment Management Planning, Budget,

Monitoring items that include only EFFECTIVENESS type monitoring are:
Insect and Disease Control, Harvest Units, Sensitive Species, Minerals, Wilderness, Wild and Scenic Rivers, ORV Use,

Monitoring items that include only VALIDATION type monitoring are: Costs and Values, Community Effects, Adjacent Lands.

Monitoring items that include both IMPLEMENTATION AND EFFECTIVENESS type monitoring are:
Compliance with NEPA, Timber Offered for Sale, Reforestation, Transportation System, Range Vegetation Conditions, Range Improvements, Noxious Weeds, McFarlane's Four O'Clock, Visual Resource Objectives, Cultural and Historic Site Protection, Rehabilitation, and Interpretation.

Monitoring items that include both IMPLEMENTATION AND VALIDATION monitoring are: Timber Harvest

Monitoring items that include both EFFECTIVENESS AND VALIDATION type monitoring are: Forage Utilization, Watershed Management Standards and Guidelines, Riparian Area Cumulative Effects, Low Flows/Peak Flows, Soil Productivity, Dead and Defective Tree Habitat and Primary Cavity Excavators, Pileated Woodpecker, Goshawk Populations, Pine Marten Populations, Recreation Setting.

Monitoring items that include all three types (IMPLEMENTATION, EFFECTIVENESS AND VALIDATION) are: Old Growth, Elk Habitat, Bald Eagles, Peregrine Falcons, Fisheries,

C. COORDINATED MONITORING FOR ECOSYSTEM SUSTAINABILITY

The Blue Mountain Forest Planners group began efforts in 1992 to initiate a coordinated monitoring approach for ecosystem sustainability in the Blue Mountains. The following table shows the scale of analysis planned for 10 units of ecologically sustainable conditions:

ESC - Ecologically Sustainable Conditions

Table 6-3: SCALE OF ANALYSIS

Ecologically Sustainable Conditions	***Physio. Region***	***Physio. Zone***	***River Basin***	***Watershed***	***SWS***	***Stand/ Reach***	***Individ.***
Air:							
TSP (tons)	**X**	**X**	**X**	**X**			
Class I Violations (days)	**X**	**X**	**X**	**X**			
Water		**X**	**X**	**X**	**X**	**X**	
Hydrology	**X**	**X**	**X**	**X**	**X**	**X**	
Fish/Aquatic		**X**	**X**	**X**	**X**	**X**	
Geomorphic		**X**	**X**	**X**	**X**		
Fire/Fuels:							
Fire Regime		**X**	**X**	**X**	**X**		
Wildfire Risks (acres)		**X**	**X**	**X**	**X**	**X**	
Standing Dead and Down (tons)		**X**	**X**	**X**	**X**	**X**	
Habitat:							
Wildlife (acres)	**X**	**X**	**X**	**X**	**X**	**X**	
Connective (miles)	**X**	**X**	**X**	**X**	**X**		
TES (acres)	**X**	**X**	**X**	**X**	**X**		
Fragmentation (miles)	**X**	**X**	**X**	**X**	**X**		
Soil Productivity:							
Soil Erosion (tons/ac)		**X**	**X**	**X**	**X**	**X**	
Compaction (acres)		**X**	**X**	**X**	**X**	**X**	
Displacement (tons/acre)		**X**	**X**	**X**	**X**	**X**	
Range Condition:							
Trends (acres)		**X**	**X**	**X**	**X**		
Utilization Levels (acres)		**X**	**X**	**X**	**X**	**X**	
Plant Community:							
Forested:							
Late Seral Park (acres)		**X**	**X**	**X**	**X**	**X**	
Structure		**X**	**X**	**X**	**X**	**X**	
Compostion (species)		**X**	**X**	**X**	**X**	**X**	
Succession (acres)		**X**	**X**	**X**	**X**		
Stand size (acres)		**X**	**X**	**X**	**X**	**X**	
Nonforested:							

It is important the note that when monitoring occurs over a broad range of analysis scales the index base line often changes. For example, see the following table to see how an index baseline "natural range of variability" changes at the various analysis scales:

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BROAD-TO-NARROW GEOGRAPHIC SCALE	LIMITING FACTORS AFFECTING CAPABILITY	NATURAL RANGE OF VARIABILITY (acres)
Mixed Physiographic Zone (3,000,000 acres)	1) 70% of acres are within the fir climax forest and can support old growth.	**30%+/-2%**
	2) natural fire frequencies burn and set-back acres.	
	3) 400,000 acres are currently in old growth condition (13%)	
Middle Fk John Day Basin (300,000 acres)	1) 80% of acres are within the fir climax forest and can support old growth.	**20 - 40%**
	2) randomness of fire events becomes more pronounced at this smaller scale.	
	3) 60,000 acres are currently in old growth condition (20%)	
Lower Camp Creek subwatershed (12,862 acres)	1) 90% of acres are within the fir climax forest and can support old growth in this densely-forested area.	**10 - 70%**
	2) fire patterns become more pronounced, as landscape becomes more variable w/in subwatershed, given same event probabilities.	
	3) 2,500 acres are currently in old growth condition (25%)	
Old Growth unit #212 (304 acres)	1) Ponderosa pine is late seral condition on fir climax site.	**0 - 100%**
	2) With fire exclusion, stand will become less open over time, and eventually cease to be park-like in appearance.	
	3) Stand is currently in old growth condition, hence 304 acres meet old growth (100%)	

D. WATERSHED SCALE MONITORING

Hopefully, the above displayed sections on Background Information, Forest Plan Monitoring, and Coordinated Monitoring for Ecosystem Sustainability provide a solid basis upon which to proceed into recommended monitoring at the landscape scale that will be included in the Watershed Analysis Report.

Monitoring in the Meadow Creek watershed should be focused on the main issues brought forth in the watershed analysis. Exact details of monitoring plans need to be tailored to the specific issues affected by a particular project or management direction. It is important that these monitoring plans for individual projects form an integrated group of actions that complement each other to make efficient use of limited monitoring resources (dollars and personnel). As additional projects are implemented and monitored, our collective understanding of processes and key conditions of ecological health should grow. It is also important, as well as as a major challenge, to devise strategies from some of the monitoring that address linkages among physical and biological entities, rather than single disciplines. Therefore, it is imperative that monitoring be an interdisciplinary team effort in development and execution.

Candidate Proposals for Watershed Scale Monitoring:

A review of the watershed analysis results indicates the following factors are relevant in designing a monitoring program for the Meadow Creek watershed:

1. **Resources and impacts of most concern** (draw from Issues, Key Questions, and Relevant Processes listed in Chapter II, also check against Human Uses and Values in Chapter I):

2. **Conditions most susceptible to environmental change** (draw from Chapters III and IV that discuss Past and Current Conditions and Conditions Trends):

3. **Types of changes likely to occur** (draw from Chapters III and IV that discuss Past and Current Conditions and Conditions Trends):

4. **Locations most susceptible to environmental change** (draw from Analysis Maps, Data Tables, and Chapters III and IV that discuss Past and Current Conditions and Conditions Trends):

5. Driving variables or indicators most closely associated with the changes of concern, sorted by costs, time frames for response, and reliability of monitoring each variable or indicator.

6. **Data needs for better understanding processes and ecosystems in the watershed** (draw from Data Gaps summarized in the Appendix):

Prioritization:

Prioritize the above candidate monitoring proposals by a Risk or Cost of Error analysis:

RISK X ENVIRONMENTAL COST OF RISK = RATING VALUE

OR,

LEVEL OF ASSUMPTION X ENVIRONMENTAL COST IF ASSUMPTION IS WRONG = RATING

Cost of error may be biological, economic or political and will be rated 1,2, or 3. Likelihood of error may be related to level of knowledge of the resource, pressure on the resource, or amount of resource available and will be rated 1,2, or 3. The highest possible rating value of 9 would be be given a rating of HIGH.

Tentative Recommendation of Items for Watershed Scale Monitoring:

Based on the above prioritization, recommend what rating values and associated candidate monitoring proposals should tentatively occur in the watershed.

E. SCREENING OF RECOMMENDATIONS BY FOREST PLAN MONITORING COORDINATOR:

Monitoring Questions:

If any of the Tentative Recommendations turn out to be EFFECTIVENESS or VALIDATION type monitoring items, first check with the Forest Plan Monitoring Coordinator to see if the recommendations fit into the overall monitoring plans that are coordinated at the Forest and Regional levels, respectively. After this check is a made, list the monitoring items that are included in the final coordinated recommendation:

For each final recommended monitoring item, answer the following monitoring questions:

1. What is the management objective?

2. What is the Ecological Model? (identify assumptions versus data/facts)

3. What is the Monitoring Objective?

4. What is the Sample Design?

Location:

Frequency:

Project Duration:

5. What is the Variability Threshold?

Limits of Watershed Analysis Monitoring Recommendations:

Since Watershed Analysis is a non-decisional process, the monitoring recommendations will not be fully developed beyond the information provided above. Once a Line Officer decides to follow the recommendations, and move into implementation, there will be a few more monitoring planning items his/her staff will need to develop. The followup should include:

Data Collection Methods:
- Methods
- References
- Limitations and Assumptions (State Hypothesis to be Tested)
- Data Forms Needed
- Personnel Needed
- Collection Time
- Equipment Needed
- Costs

Data Management and Analysis:
- Data Documentation and Reduction
- Data Analysis (Tie to Goals)
- Report Format and Schedule

The following table summarizes the monitoring that would provide information on the condition, maintenance, or recovery of issue topics associated with the watershed. Completed copies of this table will also be set up in a PARADOX database program so the various Wallowa-Whitman watersheds can be sorted and queried to make Forest-wide summaries of proposed monitoring actions.

Issue	***Topic***	***Monitoring Project***	***Monitoring Type***	***Priority Ranking***	***Hi Priority Locations***	***Monitoring Results Utilization Level***

Table with Example Data

Issue	***Topic***	***Monitoring Project***	***Monitoring Type***	***Priority Ranking***	***Hi Priority Locations***	***Monitoring Results Utilization Level***
Vegetation Health	Structural Stage Percentage Compared to HRV	Veg structure stage acres by Plant Association	Implementation	1	Entire Watershed	Project and Provincial
Water Quality	Warm water temperatures	Guaging Station with temperature measurement equipment	Effectiveness	2	Mouth of China Creek	Project and Forest Plan
Wildlife Habitat	Habitat Effectiveness Index	HEI Model Validation	Validation	3	SWS 83B	Forest Plan and Regional

Fire/Fuels – specific monitoring requirements.

LEVEL I **IMPLEMENTATION MONITORING**

Implementation monitoring collects information to determine if plans, projects, prescriptions, and activities are completed as designed. The basic question to be answered is, "Is the plan being implemented as intended?"

The following form will be included in each burn plan and is to be completed for every burn. It is intened that the form will be completed on the burn day. The Burn Boss, or other qualified representative, will use the form to record site conditions, effects, and observations that can help in determining if the correct prescription was assigned. It is intended to be be a written record that can be referenced at a later date, and as supplemental information during Level II and III monitoring. This level of monitoring responds to the prescribed fire documentation requirements for post-burn evaluations found in the Wildland and Prescribed Fire Management Policy Reference Guide (pg.70). The level of primary responsibility is the Prescribed Fire Manager/FMO.

Prescribed Burning Monitoring Report Form

Date: ____________________ **Unit Acres:** ____________________________________
Start Time: ____________________ **Unit Name / Number:** ______________________________
End Time: ____________________ **Burn Boss:** ____
Acres Completed: __________________ **Ignition Method:** ______________________________

1. Burn Day Conditions

A. RH min ______________
max ______________

B. Temp min ______________
max ______________

C. Wind Direction ___________
Avg speed ___________

D. Spot Weather Forecast Satisfactory? Y / N
(circle one)

If not, why? ___________________________________

____

____

2. Fire Behavior / Intensity

(Discuss flame length, intensity, torching, areas of interest or concern, objectives)

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3. Smoke Dispersal

A. Direction _________________

B. Height _________________

C. Comments: ______________________________

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4. **Fire Effects; Results**

(Describe burn day objectives and results, may include stand mortality, consumption, anticipated results, unit specific objectives, etc.)

LEVEL II. EFFECTIVENESS MONITORING

Effectiveness monitoring collects the information to determine if plans, projects, prescriptions, and activities are effective in meeting the intent of the management direction. The basic question to be answered is, "Are the onsite results within the range of desired and predicted outcomes. A review of the planning documents (NEPA, and any related documentation), and implementation document (Burn Plan) would be done to review the intended objectives". Did the project accomplish the set goals were the identified parameters satisfactory in meeting the landscape goals.

The monitoring process for the Fire Zones on the Wallowa Whitman National Forest are to:

1. Annually visit a sample of the units from previous years burn projects with the line officer, ID team members, or specialists (minimum level is 2 burn projects - 1 spring, 1 fall). The object of these reviews are to see if the objectives in the EA's, and burn plans were met and to tie together the Level I and Level II monitoring. These burns should be selected by the Ranger and staff and provide the opportunity to review any of the following critical issues - RCA's, improvements, private land coordination/cooperation, habitat, scenic integrity, or other significant issues related to hazard fuel reduction. During these site visits it may be appropriate to look immeditately outside the burn block, if it provides a good preburn surrogate for the treated area, so that a better understanding of the area is possible. .

2. Older burns, three or more years past the implementation year, should be considered for review so that delayed ecological responses can be observed. This should provide a wider range of age classes in which to evaluate the burning program on a temporal scale.

3. Document and compile results of Level I & II monitoring to see what issues are created from burning, if objectives and mitigations were met, if changes need to be made in the program, and to develop out year monitoring locations.

4. The level of primary responsibility is the District Ranger.

LEVEL III. VALIDATION MONITORING

Validation monitoring collects the information to determine whether initial data and assumptions are correct or if there is a better way to meet regulations or objectives. The basic question to be answered is, "Are the results resolving planning issues, concerns, and opportunities?"

Three percent of the prescribed burning acres on the Wallowa Whitman National Forest will be monitored each year. These units will be inventoried prior to burning and again two weeks after burning. Additionally, these same units will be inventoried once again at one, three, and five year intervals. The same individuals that conduct the pre-burn inventories should be used to do the initial post-burn survey which is to be accomplished within two weeks of the burn.

The level of primary responsibility is the Forest Supervisor.

PLOT ESTABLISHMENT AND MEASUREMENT

This monitoring is done on a sample basis. One or more permanent plots are established in each predominant vegetation type within the project area. The plot center is marked by a steel post with a reference tag Attached. One or more trees are tagged with reference tags indicating the direction and distance to the plot center. The plot locations can also be recorded using a Global Position system (GPS) device to aid in relocation. Each monitoring plot has 5 permanent photo plot (PP) points (see item #5 below). The PP's are located at the plot center and radiate in the following cardinal directions (0, 90, 180, 270 degrees) at 37.2 feet from plot center (1/10 acre). Each of the four quadrant PP's are marked with painted rod iron.

The following information is collected from each monitoring plot location: Read entire instructions prior to establishing a plot if unfamilar with the process.

1. Fixed plot information will include: slope, aspect, elevation, fuel loading, duff depth, fuel height, mineral soil, number of seedling to 4.9 inch DBH trees, and photos

2. Two fuel transects are performed at 0 and 90 degrees from plot center. Planar Intercept or photo series may be used for fuel loading, duff depth, and fuel height. Planar Intercept measures fuel loading by size class as well as fuel bed depth, and duff depth. Photo series measurements compare a set of compiled fuels photos and their accompanying fuel profiles with the observed conditions at the site, estimates of fuel loading and depths are generated. Representative fuel profiles may be pulled from different photo sets to assess the Fuel sizes to be measured are 0-.24, .25-.99, 1-2.99, 3-8.99, 9-20, and 20 inch plus.

3. Seedling to 4.9 inch DBH trees: measure the fixed radius plot (37.2 feet) and record the sample trees 5 inches or less. Begin at 0 degrees and proceed with the talley in a clockwise direction. Tree species and size will be recorded for live and dead trees within the plot. Trees may be tagged with metal tags to help identify post burn mortality.

4. A meter square vegetation plot is established at each plot center location. <u>This needs to be done as an initial step in plot establishment to avoid any vegetation disturbance as the complete plot is laid out and information gathered.</u> These meter square plots will photographed before implementation and there after at each monitoring interval.
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5. General area photos are taken of each photo point. Each quadrant photograph (0, 90, 180, 270 degrees) is taken from plot center with a meter stick at the end of the 37.2 transcect as the focal point. Center the meter pole in the image. Another photo is taken of the meter square vegetation plot which will be located along the 270/90 degree plot line with the 0 degree line bisecting the middle of the meter plot (see figure 1 for illustration of the vegetation plot location).

6. A few selected monitoring plots may be photographed as the fire is passing. This information can be used to correlate fire behavior with effects as well as environmental conditions.

7. Comments should be made on anything else that may be of interest within the plot.

8. Variable radius plot information will be gathered from the plot center using a 10 BAF prism. Record tree class, species, DBH, live or dead of all 5 inch and greater DBH trees and tag them with metal tags and identification numbers. Start from 0 degrees and move clockwise.

Most of the information collected from these surveys can be entered into Super Stand a PC based software program that is available on most districts. This program can then calculate many different items including trees per acre and statistical summaries as to the accuracy of the samples taken.

The same information and plots would be used for the two week post burn, 1, 3, and 5 year monitoring surveys.

Silviculture – specific monitoring requirements

The following monitoring needs are recommended for the Meadow Creek Watershed specific to the silvicultural and structural DFCs within the watershed.

1. Ongoing stocking surveys to ensure adequate stocking is maintained. Plantation protection measures, if needed, will be determined from these regularly scheduled surveys.
2. Continued updating of stand structure information into the District Vegetation Data base. This likely to be done by ongoing stand diagnosis and stand exams (funding dependent).
3. Monitoring of insect and disease conditions via annual Insect and Disease Condition aerial reconnaissance. Evaluation by District Silviculturist and Zone Entomologist and Zone Pathologist.
4. Continued Post Treatment Monitoring of Harvest units and precommercial thinning to ensure objectives were attained.

Fisheries and Watershed – specific monitoring requirements

This plan addresses monitoring for water quality and listed fish habitat in the Meadow Creek Watershed. In addition to monitoring fish habitat conditions and trends, a number of short-term monitoring items will occur, which will aid monitoring in Meadow Creek Watershed such as site-specific monitoring related to individual projects, Forest Plan monitoring as amended or modified by PACFISH, terms and conditions monitoring in biological opinions, and site-specific monitoring now being conducted on active and ongoing projects.

I. PURPOSE

Monitoring and research are an integral component to successful implementation of a restoration effort for listed fish species. They provide the feedback loop necessary to carry out adaptive management and a means of determining rates of recovery. Monitoring provides the mechanism to evaluate whether activities are meeting objectives. Monitoring provides the basic information needed to adjust future activities if objectives are not being met, or improving trends cannot be shown. Monitoring also provides a mechanism for gaining scientific knowledge of physical processes and biological functions.

The purpose of this monitoring plan is to:

1. Inventory existing conditions of riparian and instream habitat, water quality and salmonid populations in the Meadow Creek Watershed;

2. Compare existing conditions with the set of habitat, water quality and landscape variables described in the Matrix of Pathways and Indicators; and

3. Determine if management activities are resulting in a trend toward pathways and indicators (Desired Future Conditions), meeting Desired Future Conditions (DFC's), or are not successful in moving toward DFC's. In addition, determine the rate of change occurring from implementation of management activities.

II. OBJECTIVES

This monitoring plan has four objectives related to the recovery of freshwater habitat for spring chinook salmon, summer steelhead, and redband trout.

The objectives are to:

1. Document existing conditions for fish habitat and water quality parameters. Existing conditions will determine the baseline conditions for DFC assessment and recovery efforts for the Meadow Creek Watershed.

2. Assess the baseline condition against DFC values to determine needed protection, mitigation and conservation measures. This assessment will also set trend analysis points for monitoring improving trends toward DFC's.

3. Relate water quantity and fish habitat parameters to the future recovery plans for both listed fish species (spring/summer chinook salmon and summer steelhead); and

4. Develop technology transfer opportunities ties for utilization of monitoring results by other Columbia River Basin and Snake River Basin administrative units.

III. METHODS AND DISCUSSION

Methods utilized in this monitoring plan are presented below. Each section describes the methodology and equipment to be used for measurement of each parameter (including references where appropriate), and a discussion presenting the rationale associated with each monitoring effort.

A. <u>Water Quality and Quantity</u>

1. Stream Flow

Streamflow (discharge) is the basic mechanism by which stream channels are formed and maintained. It is also the mechanism used to determine the capacity of a stream to carry sediment, maintain cool temperatures, sort substrate, and form fish and related aquatic habitats. Runoff patterns vary by regional and climatic descriptors such as vegetation, storm events, snow pack, geology, and seasonal climatic conditions (drought). Runoff patterns also influence migration patterns of anadromous salmonid adults and smolts (Bjornn and Reiser 1991).

Many management activities affect the natural streamflow response from a watershed. For example, timber harvests can alter the rate that water, in the form of snowmelt or rainfall, moves from side slopes to channels (Chamberlin et al. 1991). Impacts of this alteration can include changes in the magnitude and timing of streamflow. Activities related to timber harvest (i.e. road building, yarding and burning) can also alter the water balance. The resulting effect varies with the severity of the management action and the ecosystem involved (Chamberlin et al. 1991). Therefore, monitoring streamflow is an important component of a comprehensive monitoring plan.

Gauging stations are established at two sites to provide a continuous record of surface water elevations. These stations were installed in 1992 by the U. S. Forest Service (USFS) in the Meadow Creek Watershed at lower Meadow Creek at the mouth and on Upper Meadow Creek above Bear Creek (see Table 1). The stations are Sutron Accubar Nitrogen Gauge Pressure Sensor gauges housed in a 48 inch corrugated metal pipe on the streambank.

The base data collected at these stations consists of records of stage and measurements of discharge. Observation of factors affecting the stage-discharge relationship, weather records, and other information are used to supplement base data that determine daily discharge. Measurements of discharge are made with a current meter using standard methods (Stednick 1991).

These stations are being monitored and the record developed by the Union County Water Master with cooperation and funding provided by the USFS, Bureau of Reclamation (BOR), and Grande Ronde Model Watershed Program. The record is developed using United States Geological Survey (USGS) specifications based on the period of October 1 to September 30 (Water Year). The gauging stations have low maintenance requirements and have the advantage of continuous recording so individual storm runoff events can be gauged.

In addition, one permanent flow transect has been installed on Meadow Creek to provide streamflow data for the summer (June - September) (site 95, see Table 1). This station utilizes a UNIDATA 64K data logger (planned to be updated to 128K as funding becomes available) linked to a capacitive water depth probe (model 6621) that provides a continuous record of surface water elevation. Measurements of discharge are made with a current meter (Marsh-McBirney Model 201 D) using standard methods (Stednick 1991).

Permanent flow transects provide additional data during the summer months. The summer period include both low flows and summer rainstorm events. This data will be indexed to the gauging stations and will provide further information for streamflow analyses.

The gauging stations are permanent sites that are designed to continuously measure streamflow. The data will characterize the hydrograph for long-term monitoring of the potential effects of management activities on streamflow and the effectiveness of restoration activities directed at meeting DFC's. Streamflow data will be used to correlate monitoring parameters such as suspended sediment, temperature, smolt migration, and evaluate yearly variation in instream habitat parameters.

These data, in conjunction with historical records (period 1903-1959) of streamflow for the Grande Ronde River located at La Grande, Oregon (USGS gauge 13319000), and Catherine Creek will provide for long term, comprehensive characterization of streamflow for the Meadow Creek Watershed.

The following table displays the water quality and quantity monitoring sites for the Meadow Creek Watershed Monitoring Plan and the parameter(s) measured at each site. There are fourteen sites in all.

Meadow Creek Watershed Water Quality and Quantity Monitoring Sites

Site #	SWS	Location	Type of Site	Parameter(s)
12	86A	Meadow Creek near McIntyre Rd	Temperature Site	Stream Temperature (S)
89	86A	Lower Meadow Creek	Gauging Station Temperature Site Weather Station	Flow & Stage (Y) Stream Temperature (Y) Air Temperature, Relative Humidity & Solar Radiation (S)
10	86B	Dark Canyon Creek	Temperature Site	Stream Temperature (S)
11	86C	McCoy Creek	Temperature Site	Stream Temperature (S)
81	86D	McCoy Creek	Temperature Site	Stream Temperature (S)
13	86F	Burnt Corral Creek	Temperature Site	Stream Temperature (S)
46	86F	Burnt Corral Cr. @ 2444040 Rd	Temperature Site	Stream Temperature (S)
14	86G	Bear Creek	Temperature Site	Stream Temperature (S)
15	86H	Upper Meadow Creek	Gauging Station Temperature Site Weather Station	Flow & Stage (Y) Stream Temperature (Y) Air Temperature, Relative Humidity & Solar Radiation (S)
16	86H	Meadow Creek above smolt trap	Temperature Site	Stream Temperature (S)
85	86H	Meadow Creek	Rain Gauge Weather Station	Precipitation (S) Air Temperature, Relative Humidity& Solar Radiation (S)
51	86I	Waucup Creek @ 21 Rd	Temperature Site	Stream Temperature (S)
95	86I	Meadow Creek above 21 Rd	Flow Transect Temperature Site Weather Station	Flow & Stage (S) Stream Temperature (S) Air Temperature, Relative Humidity & Solar Radiation (S)
60	86J	Meadow Creek @ Waucup Creek	Temperature Site	Stream Temperature (S)

SWS = Subwatershed
(S) = Summer, June through October, measurements
(Y) = Year-round measurements

2. Stream Temperature

The primary effect of management activities on stream temperature is through removal or manipulation of streamside vegetation. Vegetation within the streamside zone provides a thermal insulating layer during extreme temperature periods in the summer and winter months. Instantaneous maximum stream temperatures and their duration are the main concern.

Deviations from natural stream temperature ranges can negatively affect salmonid survival (Meehen 1991). Stream temperatures regulate the behavior, metabolism, and mortality of fish. Temperatures above optimum can cause altered timing of migration, accelerated or retarded maturation, and disease outbreak in migrating and spawning fish. In addition, juvenile fish growth rates are reduced in stream temperature that exceed optimal, but are lower than lethal limits (Bjornn and Reiser 1991).

Stream temperature measuring equipment is designed to identify reaches where stream temperatures may be adversely affecting fish and other aquatic organisms. The current problem of elevated stream temperatures is documented from existing monitoring stations.

Stream temperature monitoring stations are established at thirteen locations within the Meadow Creek Watershed. These stations utilize a UNIDATA 64K data logger (planned for update to 128K when funding becomes available) or Hobo Tempmeter linked to a thermistor (Model 6607A). Hourly maximum, minimum and average stream temperatures are continuously recorded for the summer period (June to October). Two temperature stations (located at the gauging stations) are recording year-round. However, icing conditions and equipment failure due to extreme cold make winter sampling difficult.

The effectiveness of management practices to reduce temperatures will be evaluated with these data stations.

3. Climatic Variables

Climatic conditions have a direct influence on hydrologic processes through influences on temperate regimes as well as peak flow and runoff timing and magnitude. Climate data such as ambient air temperature, relative humidity, global radiation, and precipitation are necessary to evaluate annual stream temperature and flow characteristics.

Precipitation monitoring provides rainfall and snow pack data to correlate with streamflow. There are several natural factors that influence the amount of rainfall that will reach a stream channel as runoff. These factors include the type, extent and condition of vegetation, and soil type (Brooks *et al*. 1991). Interception, transpiration, evaporation and infiltration affect rainfall runoff patterns. Management activities can change the natural relationship between rainfall and streamflow through the manipulation of vegetation, road building, and/or livestock grazing. The amount of rainfall that reaches the stream channel as runoff can be can estimated through correlation of streamflow and precipitation measurements.

Monitoring stations for ambient air temperature, relative humidity, and solar radiation are established at four Iocations: the two gauging stations (sites 89 & 15), one precipitation site (site 85), and one flow transect site (site 95). These stations utilize a UNIDATA 64K (planned for update to 128K) data logger linked to a weather instrument (Model 6501 DU). This data is recorded for the summer period (June to September), except for the gauging station sites, which record year-around.

A monitoring station for precipitation (rain) is established at one location (site 85) based on methods described by Corbett (1955) (site 85). This station utilizes a UNIDATA 64K data logger (scheduled to be updated to 128K) linked to a tipping bucket rainfall gauge (Model 6506A). This data will be recorded hourly for those periods not influenced by the accumulation of snow. Tipping bucket gauges are not functional during periods of snow accumulation.

Snow pack and additional climatic data will be retrieved from a USFS Remote Automated Weather Station (RAWS), a long-term monitoring site located at the Starkey Experimented Forest and Range Headquarters.

4. Sediment/Substrate

The relationship between increases in fine sediments and salmonid production is not conclusive. Most studies on salmonids have been concerned with the effects of sedimentation on egg and fry survival; however, Everest *et al*. (1967) emphasizes that little effort has been made to relate sediment as a limiting factor to salmonid populations. Laboratory studies have investigated the effects of fine sediments out of context with natural aquatic ecosystems (Chapman 1956, Everest *et al*. 1967). None of these studies can assist managers in determining if sediment is limiting natural populations of salmonids (Everest *et al*.1967). What can be inferred about controlled laboratory studies is that at some specific life stages salmonids are vulnerable to deposited and suspended inorganic sediment (Chapman 1966).

The favored approach is one that relies on quantifiable and repeatable measurements of elements such as large woody debris, stream bank stability, stream bank angle, width to depth ratio, and pool frequency. These elements, when described in terms of DFC's, will act as surrogates for sediment. It is speculated that if all of these elements are within the threshold for the established DFC's, then fine sediment is estimated to not be an impact to egg survival or winter habitat. Therefore, we will not intensely sample fine sediments for developing relationships for egg to emergence survival. This contention is supported by scientists that developed the PACFISH, SAT and FEMAT reports (Dr. Fred Everest, Fisheries Research Scientist, PNW Research Station, Juneau, Alaska and Dr. James Sedell, Aquatic Research Scientist, PNW Research Station, Corvallis, Oregon, Personal Communication).

Meadow Creek and major tributaries are proposed to be monitored visually and potentially through water column grab samples, twice, during the spring runoff period, during periods of unseasonal warming, and/or following large storm events by foot and/or by helicopter to assess water color/clarity and isolate point sources of sedimentation.

Substrate conditions will be monitored throughout the Meadow Creek Watershed through the utilization of Wolman (1954) pebble counts conducted during stream habitat surveys. All fishbearing streams in the Watershed have been surveyed, although pebble counts are a relatively new part of the survey and have not been a part of most past surveys. All fishbearing streams are scheduled to be re-surveyed in the Meadow Creek Watershed over the next 5 years. Streams are typically re-surveyed every 5-10 years to monitor trends in fish habitat condition, including substrate. These surveys, including Wolman pebble counts, will provide baseline data and eventually trend data and an index of substrate conditions. Monitoring requires revisiting the same transects and plots as previously established. At each transect, the exact location of the previously sampled plots must be relocated.

In addition, surface fines will be measured visually as a percent of wetted channel surface area. This will be collected simultaneously with the stream habitat survey on all fish bearing streams every five to 10 years.

B. Instream and Riparian Habitat

Physical habitat characteristics have been documented with stream and riparian surveys. Use of repeated surveys of streams approximately every five to 10 years will provide documentation of trends in habitat.

Key elements that will be monitored include large woody debris, pool frequency and depth, bank stability, width to depth ratio, and bank angle for meadow reaches. All watersheds will be monitored for physical elements and will be correlated to direct or indirect fish habitat and water quality impacts and the other monitoring parameters. Research projects in the Meadow Creek Watershed conducted by Pacific Northwest Research Station (PNW), Oregon Department of Fish and Wildlife (ODFW), and Oregon State University (OSU) will be correlated to these elements in order to validate findings.

The Hankin and Reeves (1988) methodology as modified by the Pacific Northwest Region of the USFS (R6 Stream Inventory) has been used to conduct surveys on approximately 80 miles of streams containing existing or potential fish habitat. The R6 Stream Inventory and the ODFW Aquatic Inventory are compatible, and both have been and would continue to be utilized. Resurvey and reevaluation of the stream reaches containing existing or potential fish habitat would be conducted on every five to 10 years.

Riparian canopy closure measurements taken will be site specific and more detailed than those with the R6 Stream Inventory. The objectives of canopy closure monitoring are to 1) determine level and occurrence of destructive forest pests and their corresponding threat to attainment of canopy closure DFC's, and 2) determine if species composition and stocking are sufficient to meet canopy closure DFC's.

Riparian canopy monitoring would be accomplished through 1) annual aerial observations of insect and disease conditions, 2) analysis of acres of tree thinning used to reduce insect epidemics, 3) track and model forest pest occurrences using Geographic information System (GIS) or other appropriate methods, and 4) measure crown density at year 3, 5, 10, and 20 in thinned stands.

If more detailed data is needed on specific reaches, the same parameters as mentioned above can be collected within a defined primary riparian zone using measured line transects. These transects are site-specific, project driven, and time consuming and would be used only where the data from the riparian/aquatic inventory indicates a need for more detailed information to aid in the site-specific decision process.

Reference reaches for quantifying and qualitatively describing DFC's for forested reaches have been established at Limber Jim Creek and Lookout Creek, and at one location on Beaver Creek (Cove Creek) (Case and Kaufmann 1993). These represent the best quality stream segments for forested reaches at higher elevations thereby ensuring that data is collected, which allow reasonable approximation of DFC values. Although these reaches are located in the Upper Grande Ronde Watershed (85), they are representative of forested reaches in the Meadow Creek Watershed. A study of habitat elements in reference reaches in the Upper Grande area is integral to refining and revising DFC's and monitoring strategies for instream and riparian habitats.

Reference reaches for quantifying and qualitatively describing DFC's for meadow and transition reaches have been established on Meadow Creek and McCoy Creek in the Meadow Creek Watershed and on Limber Jim Creek in the Upper Grande Ronde Watershed (85). These reaches are designed to exclude one or more users of riparian area resources (such as livestock, big game, recreationalists, roads, etc.). These exclosures provide information regarding rate of recovery, successional progression toward site potential, effectiveness of restoration measures, and ultimately information for the refinement and revision of DFC's and monitoring strategies.

Permanent photo points would be established within selected reference reaches as well as within other key areas. These camera points would be designed to record changes within riparian areas occurring to the vegetative composition, cover, etc. A minimum of one camera point is established for each reference reach. Key area camera points would also be established outside these reference reaches, as appropriate, to monitor changes induced by management activities.

C. Salmonid Habitat Utilization

Historical and current distribution on spring chinook salmon, summer steelhead, and bull trout, for all freshwater life history stages, has been documented. Data on file with ODFW, PNW, Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and USFS has been reviewed and discussed in Chapter III of this Watershed Analysis. Data used to determine distribution includes historical information and over 10 years of extensive data collection throughout the watershed. This effort helped to determine baseline conditions and describe fish community structure throughout the year with observational relationships determined where possible.

Fish habitat utilization monitoring will continue, as potential habitat is made accessible to fish through replacement of existing culverts acting as barriers to upstream habitat. Streams within the Meadow Creek Watershed with culverts identified as fish passage barriers and planned for repair in the next two years are Dark Canyon Creek, East Burnt Corral Creek and Waucup Creek. Approximately 13 miles of potential habitat would be made accessible upon replacement of these culverts. The effectiveness of culvert replacements to remove fish passage barriers and make habitat accessible will be evaluated on these streams.

The documentation of distribution has been used to correlate use and abundance to habitat parameters. Water quality and fish habitat parameters have been used in conjunction with life history data to refine the DFC and assess recovery. This information has been used to develop high priority protection and/or restoration projects that benefit both adults and juveniles. The correlation of fish use, habitat condition, and water quality will all guide future project proposals.

D. Research

Research is an integral part of any monitoring effort. Research provides scientifically credible linkages between monitoring data and restoration activities. Research can also assist in identification and refinement of DFC's and monitoring strategies. The following list of research activities are provided to show that monitoring activities described here and in conjunction with each section of Chapter III are being validated

Meadow Creek Riparian Recovery Study -This study is designed to assess the long-term effects of grazing strategies on riparian vegetation. The study tests 1) the long-term management of riparian vegetation and 2) riparian vegetation recovery and acceleration of recovery. OSU Department of Rangeland Resources, PNW Research Station and Wallowa-Whitman National Forest are conducting the study, which was begun in 1987 by PNW Research Station. The Meadow Creek Study will aid in the development of riparian vegetation restoration plans and projects. The study would facilitate refinement and revision of DFC's, RMO's, and matrix elements. PNW Research Station will conduct further research through aerial photo analysis. This rate of recovery is essential to determine if and when DFC's for riparian plant communities are achieved.

Meadow Creek Instream Restoration Study - This project was conducted by PNW in Corvallis with cooperation from Wallowa-Whitman National Forest (WWNF). It began in 1987and continued for ten years. The purpose of the study was to evaluate the effectiveness of instream structures for increasing steelhead smolt production and determination of steelhead life history strategies in tributary ecosystems. The study was initiated to examine large woody debris placements. Analysis of the data will be conducted as funds become available.

Syrup Creek Sediment Delivery Study - This project was conducted by the Department of Forest Engineering at OSU in cooperation with PNW in Corvallis and the WWNF. This project began in 1990 and continued for eight years. The purpose of the study was to validate a sediment delivery model for ash soils related to road construction and timber harvest. This study will assist in understanding sediment contribution to stream channels from management activities. Analysis of the data is scheduled for 2002.

Meadow Hydrology Study - This project is being conducted by the Department of Forest Engineering, Fisheries, and Wildlife at OSU in cooperation with PNW in Corvallis and the WWNF. This project began in 1992 and is continuing. The purpose of the study is to assess the hydrologic nature of two meadow ecosystems, Squaw Creek and West Chicken Creek. This study will assist in the understanding of meadow ecosystems and help refine DFC's for those systems.

Meadow Vegetation Study - This project is being conducted by the Department of Fisheries and Wildlife at OSU in cooperation with PNW in Corvallis and the WWNF. This project began in 1993 and is continuing. The purpose of the study is to characterize the vegetative component in relation to the hydrologic regime and soils characterized in the Meadow Hydrology Study (above).

Juvenile Life History Study - This project is a cooperative effort between PNW, ODFW and WWNF. This project partially began in 1993 and concluded in 2000. The purpose of the study was to characterize the life history characteristics of spring chinook salmon and summer steelhead in relationship to their habitat in the Upper Grande Ronde and Catherine Creek.

Stream Temperature Characterization Study - This project was conducted by the Department of Forest Engineering at OSU in cooperation with PNW in Corvallis and WWNF. This project began in 1990 and completed in 1993. The purpose was to describe the summer stream temperature regime in the Upper Grande Ronde River and validate a temperature prediction model, TEMP86. The La Grande Ranger District is now using the initial temperature stations as long-term temperature data stations.

Additional research needs are being developed as current research and monitoring efforts continue. Research is an ongoing effort, necessary to evaluate the effectiveness of restoration activities and refine DFC's and monitoring strategies.

E. Technology Transfer

The La Grande Ranger District will prepare annual reports by April 1 of each year. Reports will clearly present baseline data and evaluate each additional year's collection to the baseline condition.

Review of the annual report may indicate the need to refine or revise data collection procedures. This would incorporate elements related to the following: the monitoring strategy, monitoring locations, new techniques to better address data needs, trend data, changes in standards for habitat elements, restoration plans, and management guidelines.

Production of General Technical Notes on the monitoring results will be completed in cooperation with PNW and Fish Habitat Relations programs. Research results will be presented in thesis or dissertation documents and in journal articles. This documentation will be available for use on other Snake and Columbia River Basin administrative units.

IV. CONCLUSION

The monitoring plan relies on correlation of water quality, instream and riparian habitat and fish population monitoring to determine whether the objectives are being met for the Meadow Creek Watershed. Each section of the monitoring plan is directly or indirectly related to parameters that will, in the short or long term, verify whether an improving trend in water quality and fish habitat is being achieved.

Data will be synthesized and reported in an annual monitoring report. When the annual report is reviewed, a refinement or revision of the data collection may ensue. This would incorporate elements relating to the following: the monitoring strategy, monitoring locations, new techniques incorporated to better address data needs, trend data, changes in standards for habitat elements, restoration plans, and management guidelines.