Lower McKenzie River Watershed
Drinking Water Source Protection Monitoring Program
Outline of Major Components
August 2001

Introduction
In August 2000, the Eugene Water & Electric Board (EWEB) completed a plan to protect the McKenzie River as the sole source of drinking water for the community of Eugene. This outline focuses on one piece, source protection monitoring, of the overall drinking water source protection strategy. EWEB is in the process of developing the details associated with implementation of the source protection plan and it appears the following elements may be part of the source protection strategy for the McKenzie River watershed:

- Comprehensive Monitoring Program;
- Disaster Preparedness and Response Program;
- Education and Research Assistance program;
- Point Source Evaluation and Mitigation;
- Nonpoint Source Evaluation and Mitigation;
- Land Acquisition program;
- Public Outreach and Information Sharing; and,
- Watershed Landuse Tracking and Management.

Each of these source protection strategy elements or programs will be further developed and discussed as part of a source protection proposal report. This report will provide details on: program description; objectives and purpose; existing activities or programs; program tasks, activities, and implementation options; partnerships; advantages and disadvantages associated with implementation options; implementation schedule; estimated costs; and, potential funding sources. EWEB anticipates that the draft source protection proposal report will be completed by November 2001. Due to its high priority for implementation, the comprehensive source protection monitoring program is being developed in advance of the other elements listed above.

Background
The *Drinking Water Source Protection Plan (2000)* sets as a priority the need to establish a comprehensive monitoring program to evaluate water quality, biological health, and land use trends within the McKenzie watershed over time. The plan indicated that the focus of a source protection monitoring program should be the assessment of potential impacts from pollution or other degradation sources to the river. A risk assessment was conducted as part of the source protection plan, which identified and prioritized the various sources that threaten the health of the river. The greatest threats to the McKenzie River are from storm sewer discharges and urban runoff. Discharges from commercial and industrial facilities, roadside vegetation management, and agricultural activities were also listed as significant risks for contamination (EWEB, 2000).

This outline presents an overview of the major components that could be included in a comprehensive drinking water source protection monitoring program. The outline includes a proposed time line as to when the various components would be further developed in a monitoring plan and a schedule for implementation.

The stormwater and urban runoff components are highest priorities for further development into a detailed monitoring plan. EWEB hopes to begin implementation of parts of the stormwater and urban runoff monitoring plan in the fall 2001, with full implementation in 2002. This would allow EWEB and others to collect water quality data associated with the first major storm event following an extended period of dry weather. Numerous studies have demonstrated that 70-90% of annual contaminant loading to receiving streams from urban runoff occurs during the flushing action of major storm events following periods of dry weather. Typically, the longer the dry period between storm events, the larger the potential contaminant loading associated with that particular urban stormwater runoff event (Schueler and Holland, 2000; Ferguson, 1998; USGS, 2000; Kerst, 1996).

Purpose and Objectives

The purpose of this outline is to lay out an approach to source protection monitoring in an effort to solicit ideas, comments, and feedback from interested parties prior to development of the more detailed monitoring plans. As indicated above, stormwater and urban runoff will be the first components of the source protection monitoring program to be further developed into a monitoring plan. This outline provides an overview of the entire source protection monitoring program in order to better understand where the stormwater and urban runoff monitoring piece potentially fits into the overall strategy.

This phase of the source protection monitoring program has been designed to: 1) focus on the lower portion of the McKenzie watershed upstream of the Hayden Bridge intake; 2) address the high and medium high risk categories identified in EWEB=s *Drinking Water Source Protection Plan (2000)* (i.e., Storm sewer outfalls, urban runoff, commercial/industrial facilities, road vegetation management, and agricultural activities); 3) rely on partnerships with other stakeholders, educational organizations, and community members for successful implementation; and 4) use of EWEB (Generation, Hayden Bridge, Water Engineering, and Environmental Services) and contracted resources to supplement partnerships.

The objective of a drinking water source protection monitoring program is to provide comprehensive water quality and biological information to allow assessment of the watershed=s health over time. This information will allow EWEB and others to identify potential problems or threats to the drinking water source early on and evaluate the relative success of restoration and other protection strategies to mitigate potential threats. Specific monitoring objectives are presented with the discussion of the monitoring program components.

General Monitoring Concepts

A number of monitoring strategies exist depending on the objectives and goals of a monitoring program

(OWEB, 2000; NRCS 1996; NRC 2000). The source protection monitoring program that is discussed in EWEB=s *Drinking Water Source Protection Plan (2000)* proposes the use of screening-type monitoring for each stormwater outfall and other potential sources until significant hits occur and then focus on more specific analysis. Other monitoring strategies look at doing a more comprehensive monitoring in the early stages of the program to establish baseline levels of pollutants and allow model calibration, followed by screening-type monitoring over the long-term (with periodic comprehensive sampling as a check). The advantages of the latter is that baseline conditions are known and a relationship between screening results and the presence of chemical constituents can be estimated before reliance on screening-type analysis. The best approach may be the combination of these strategies, where the focus of comprehensive analysis is during periods of the year that represent the Aworst-case@ scenario for pollution loading associated with a particular source (e.g., for stormwater and urban runoff it is the first major flushing action after the dry season; for agriculture it is during storm events following chemical applications) followed by screening-type analysis during the remainder of the year.

It is anticipated that the source protection monitoring program would be implemented in phases. Stormwater, urban runoff, and McKenzie River monitoring would be implemented first (and in many cases already are being implemented). Subsurface (shallow groundwater), performance (associated with actual conservation, restoration, or source protection projects), and air monitoring would be phased in over time. General tasks associated with implementation of each of the monitoring program components are as follows:

$ Prepare draft monitoring plan;
$ Obtain ownership information on proposed sample locations;
$ Field truth proposed sample locations;
$ Obtain access for sampling;
$ Finalize monitoring plan;
$ Prepare bid documents and bid contractor and analytical work (if necessary);
$ Coordinate with partner organizations and mobilize for sampling effort;
$ Conduct sampling effort;
$ Analyze data and write monitoring results report; and,
$ Adjust monitoring plan based on results and lessons learned during sample collection.

Once monitoring component is implemented for the first time, the ongoing sampling effort will consist of only the last four bullets.

It is also important to understand how the data will be used over the long-term to insure the monitoring program meets those needs from the start. It is anticipated that source protection monitoring data will be used in a Geographic Information System and in conjunction with hydrologic simulation and pollution loading models. The combination of GIS and hydrologic simulation/load modeling would allow EWEB to evaluate the effectiveness of its source protection program and present meaningful data trends that describe the health of the McKenzie watershed over time. One long-term benefit of using the data in a GIS/hydrologic model format is that as monitoring data is collected and the model is calibrated and refined there should be a corresponding reduction in the amount of data necessary to monitor watershed health and identify potential water quality degradation sources.

Stormwater

Storm sewer discharges to the McKenzie River watershed are considered one of the most significant threats to EWEB=s drinking water source. Stormwater runoff contains elevated concentrations of fecal coliform bacteria, petroleum hydrocarbons, sediment, metals, nutrients, pesticides and herbicides, chlorides, polycyclic aromatic hydrocarbons, and other organic compounds. These pollutants tend to become mobilized during flushing actions from major storm events (EWEB, 2000; Schueler and Holland, 2000; Novotny & Olem, 1994; NRC, 2000; Ferguson, 1998). The following is an overview of the key elements of a source protection monitoring program for stormwater runoff.

Existing Data/Monitoring Programs

The 64th, 69th, and 72nd Street storm sewer outfalls in Springfield are monitored by the McKenzie Watershed Council and Thurston High School on a monthly basis for temperature, dissolved oxygen, conductivity, coliform bacteria (e. coli), and turbidity (Figure 1). Results from this monitoring effort indicate the presence of e. coli bacteria above DEQ regulatory limits (406 organisms per 100 ml) for most of the year. The highest levels of e.coli bacteria (2,419 organisms per 100 ml) were found in samples collected from the 69th Street outfall during the month of October. Turbidity levels in all three outfalls start increasing in October and continue to increase through the winter months.

In May 2001, EWEB provided $1,500 in grant funding to Thurston High School (THS) to purchase chemical reagents and laboratory glassware to allow THS to analyze for phosphorous, chromium, cadmium, copper, lead, nickel, nitrates, and zinc. The three outfalls will be evaluated for these analytes beginning in August 2001.

The data collected as part of the McKenzie Watershed Council and Thurston High School Cedar Creek monitoring program is critical to evaluation of the impacts from stormwater runoff and will be integrated with the data collected as part of EWEB=s source protection monitoring program. Since the Cedar Creek monitoring is a fixed interval sampling effort (i.e., monthly), the results tend to provide a base level of contamination from the three storm sewer outfalls and complements EWEB=s storm event sampling program. The data from these two monitoring programs will allow a comprehensive evaluation of annual pollution loading to Cedar Creek and the McKenzie River and the relative contribution from storm events versus base flow. This information will be very useful in developing stormwater mitigation strategies and ultimately designing treatment systems to reduce the amount of pollution entering the watershed.

Stormwater Monitoring Objectives

Several objectives were identified for the stormwater monitoring program:

$ To determine the water quality characteristics of stormwater runoff associated with the seven major outfalls identified upriver of EWEB=s drinking water intake (Figure 1);

- $ To measure the amount of pollution entering the McKenzie River watershed in order to estimate the contribution from this source; and,
- $ To evaluate trends in water quality and pollution loadings from stormwater runoff over time as land use in the area changes and implementation of stormwater management plans occurs.

Monitoring Locations (8)
Seven major storm sewer outfalls (42^{nd}, 48^{th}, 58^{th}, 64^{th}, 69^{th}, 72^{nd}, and High Banks Road)
52^{nd} Street Channel (receives storm runoff from 48^{th}, 58^{th}, and High Banks Road outfalls)

Monitoring Location Prioritization
The following is a prioritization of the outfall locations based on the urban areas that the storm sewer outfalls drain and existing monitoring efforts.

Highest Priority
- $ 52^{nd} Street Channel (drains industrial area & it is a composite of three outfalls)
- $ 42^{nd} Street Outfall (drains industrial area, flows into Irving Slough except during high flow events then discharges into Keizer Slough)

2^{nd} Highest Priority
- $ 69^{th} Street Outfall (drains commercial/residential area and currently monitored)
- $ 64^{th} Street Outfall (drains commercial/residential area and currently monitored)
- $ 72^{nd} Street Outfall (drains commercial/residential area and currently monitored)

3rd Highest Priority
- $ 48^{th} Street Outfall (drains industrial area, discharges into 52^{nd} Street channel)
- $ 58^{th} Street Outfall (drains commercial/residential area, discharges into 52^{nd} Street channel)
- $ High Banks Road (drains residential area, discharges into 52^{nd} Street channel)

Monitoring Frequency (5 times per year)
First Major Flush in October (analyze for all parameters)
Major early winter storm event in Dec./Jan. (selected parameters)
Major late winter storm event in Feb./March (selected parameters)
Spring Storm event in May/June (analyze for all parameters)
Summer storm event in July/August (selected parameters)

Monitoring Parameters
Flow Rate
Temperature
Conductivity
Dissolved Oxygen
pH
Total Organic Carbon

Biochemical Oxygen Demand
Chemical Oxygen Demand
Total Suspended Solids
Turbidity
Nutrients
Metals (total & Dissolved)
Coliform Bacteria (e.coli, fecal coliform, fecal streptococci)
Petroleum Hydrocarbons
Semi-Volatile Organics*
Pesticides/Herbicides*

** = Additional parameters to be collected during first flush and spring runoff sampling.*

Potential Partnerships

City of Springfield
City of Eugene
Lane County
US Geological Survey
Springfield Utility Board
Rainbow Water District
Springfield School District
Lane Community College
McKenzie Watershed Council

Estimated Costs

The costs presented below are conservative estimates and assume no volunteer or partner contributions to the monitoring effort. In addition, costs were calculated for each source protection monitoring program component as a stand alone estimate. This provides an overly conservative estimate if more than one monitoring component is implemented (e.g., stormwater and urban runoff) due to savings from shared equipment and personnel, and reduced analytical costs associated with bidding on larger contracts. The cost estimates below are based on vendor price lists and best professional judgment.

Initial Sampling Event, Fall 2001 (Startup Costs)

These costs assume the purchase or rental of some sampling equipment and field measurement instruments (pH, temperature, conductivity, etc.). It is assumed that samples will be collected from all eight locations and analyzed for all the parameters listed above (except for those parameters measured in the field).

Analytical Costs = $9,000 to $11,000
Equipment Costs = $3,000 to $5,000
Personnel Costs = $500 to $1,000 (approx. 6 to 10 hours level of effort {LOE})
Total Initial Sampling Costs = $12,500 to $17,000

Estimated Annual Costs
These costs assume that all eight locations are sampled five times a year and the samples are analyzed for the parameters indicated under AMonitoring Frequency@.
Analytical Costs = $30,000 to $35,000
Equipment Costs = $500 to $1,000
Personnel Costs = $3,000 to $4,000 (approx. 36 to 40 hours LOE)
Total Annual Sampling Costs = $33,500 to $40,000

Urban Runoff
Urban runoff is similar to stormwater, except instead of looking at outfalls we would be looking at creek basins that drain urban areas or areas with increased development. At this time, two drainage basins (Cedar Creek and Camp Creek) will be evaluated as part of the urban runoff component. Cedar Creek and Camp Creek are the two closest drainage basins upriver of EWEB's intake. Cedar Creek receives stormwater runoff from urban areas. Camp Creek does not contain significant urban development, but due to its close proximity to the Eugene-Springfield area is experiencing increased development within the basin.

Cedar Creek drains an area of approximately 10 square miles in the Cedar Flats and Thurston area (Figure 2). Cedar Creek has two confluences with the McKenzie River, which are approximately 2 and 3 miles upriver of EWEB's intake, respectively. Approximately 55 percent of the Cedar Creek basin consists of forested land with some rural development along hillsides and somewhat steep slopes in the upper portions of the watershed. Approximately 30% of the basin consists of agricultural land use with rural development along the McKenzie River flood plain in the lower portion of Cedar Creek. Approximately 15% of the Cedar Creek basin consists of residential and commercial urban development in the southwest portion of the watershed and along Highway 126 (EWEB, 1993; NRCS, 1987). Cedar Creek receives stormwater runoff from three major outfalls that drain residential and commercial areas of Springfield.

Camp Creek drains an area of approximately 22 square miles in the southern Coburg Hills area (Figure 3). The creek forms a half-mile wide valley with steeper slopes on either side. The confluence with the McKenzie River is approximately six miles upriver of EWEB's intake. Approximately 57 percent of the Camp Creek basin consists of forested land and 28 percent of the basin appears to have been disturbed for timber harvest with exposed soil (EWEB, 1993). Therefore, a total of 85 percent of the watershed is under forest management for timber production along the steeper hillsides and surrounding ridges. Approximately 13.5 percent of the watershed is being used for agriculture and is concentrated along the valley floor. An estimated 1.5 percent of the Camp Creek basin consists of residential development in the lower portion of the watershed (EWEB, 1993; NRCS, 1987).

In addition, the urban runoff monitoring would target highway runoff in the vicinity of the Hayden Bridge intake. Studies have shown that outside of heavy industrial areas, busy highways are the next highest source for petroleum hydrocarbons, poly aromatic hydrocarbons, lead, zinc, and copper (order of magnitude higher than urban runoff from commercial, light industrial, and residential areas) (Novotny & Olem, 1994).

Urban runoff to the McKenzie River watershed is considered one of the most significant threats to EWEB=s drinking water source. Urban runoff contains elevated concentrations of fecal coliform bacteria, petroleum hydrocarbons, sediment, metals, nutrients, pesticides and herbicides, chlorides, poly aromatic hydrocarbons, and other organic compounds. These pollutants tend to become mobilized during flushing actions from major storm events. The following is an overview of the key elements of a source protection monitoring program for urban runoff.

Existing Data/Monitoring Programs

Cedar Creek

Ten locations (including three major storm sewer outfalls) along Cedar Creek are monitored by the McKenzie Watershed Council and Thurston High School on a monthly basis for temperature, dissolved oxygen, conductivity, coliform bacteria (e. coli), and turbidity. Results from this monitoring effort indicate the presence of e. coli bacteria above DEQ regulatory limits (406 organisms per 100 ml) for most of the year. The highest levels of e.coli bacteria in the creek were found in samples collected downstream from the storm sewer outfalls. Turbidity levels in the creek start increasing in October and continue to increase through the winter months and tend to be more turbid downstream of the storm sewer outfalls.

In addition to water quality monitoring, the McKenzie Watershed Council and Thurston High School conduct macroinvertebrate sampling at two Cedar Creek locations (using the standard riffle/pool protocol and sending samples to Corvallis lab for evaluation). Thurston Biology students also conduct macroinvertebrate sampling and identification at three additional locations along Cedar Creek.

Camp Creek

The McKenzie Watershed Council and Thurston High School plan to initiate a monitoring program in the Camp Creek basin and have submitted a proposal to the Oregon Watershed Enhancement Board (OWEB) to request grant funding to support the effort. The Camp Creek monitoring program will be patterned after the Cedar Creek program. It is anticipated that the scope of the sampling will start with a few locations and increase as more property owners grant access to the creek for monitoring.

Keizer Slough

One location (well field access road bridge) is monitored by EWEB=s Hayden Bridge staff on a monthly basis for temperature, pH, conductivity, turbidity, metals, semi-volatile organic compounds, volatile organic compounds, fecal coliform bacteria, and dissolved oxygen. Cursory review of the data did not highlight significant concentrations of metals or other organic contaminants, but a more thorough evaluation of the data is needed.

Surface water and sediment sampling has been conducted in the Keizer Slough by Weyerhaeuser as part of an audit by the U.S. EPA to evaluate the reasons behind the redish color in two small ponds located near the cooling ponds. These investigations were conducted in 2001 and the final report has not been completed to date.

Existing Data Usage
The data collected as part of the Cedar Creek, Camp Creek, and Keizer Slough monitoring programs is critical to evaluation of the impacts from urban runoff and will be integrated with the data collected as part of EWEB=s source protection monitoring program. Since the existing monitoring programs are fixed interval sampling efforts (i.e., monthly), the results tend to provide a base level of contamination in the stream basins and complements EWEB=s storm event sampling program. The data from these monitoring programs will allow a comprehensive evaluation of annual pollution loading to the McKenzie River and the relative contribution from storm events versus base flow. This information will be very useful in developing urban runoff mitigation strategies and ultimately designing treatment systems to reduce the amount of pollution entering the river.

Urban Runoff Monitoring Objectives
Several objectives were identified for the urban runoff monitoring program:

- $ To determine the water quality characteristics of urban drainage basins with confluences upriver of EWEB=s drinking water intake;
- $ To measure the amount of pollution entering the McKenzie River watershed in order to estimate the contribution from this source;
- $ To evaluate trends in water quality and pollution loadings from urban drainage basins over time as land use in the area changes and implementation of watershed protection and conservation strategies take place; and,
- $ To evaluate and measure the relative health of these urban drainage basins over time to determine the effectiveness of watershed protection and conservation programs.

Monitoring Locations (16)
Cedar Creek drainage (six locations)
Camp Creek drainage (five locations)
Highway Drainage (two locations)
Keizer Slough (three locations)

Monitoring Location Prioritization
The following is a prioritization of the urban runoff monitoring locations based on the minimum data needs to assess drainage from urban areas and existing monitoring efforts.

Highest Priority (7)

- $ Cedar Creek (three locations: upstream, downstream of outfalls and urban drainage, and prior to confluence with the McKenzie River);
- $ Camp Creek (two locations: upstream of urban development areas and prior to confluence with the McKenzie River);

$ Highway Drainage (one location as a representative sample of highway runoff);
$ Keizer Slough (one location at current sample location).

Monitoring Frequency (5 times per year)
First Major Flush in October (analyze for all parameters)
Major early winter storm event in Dec./Jan. (selected parameters)
Major late winter storm event in Feb./March (selected parameters)
Spring Storm event in May (analyze for all parameters)
Summer storm event in July (selected parameters)

Monitoring Parameters
Temperature
Conductivity
Dissolved Oxygen
pH
Total Organic Carbon
Biochemical Oxygen Demand
Chemical Oxygen Demand
Total Suspended Solids
Turbidity
Nutrients
Metals (total & Dissolved)
Coliform Bacteria (e.coli, fecal, fecal streptococci)
Petroleum Hydrocarbons
Semi-Volatile Organics*
Pesticides/Herbicides*

** = Additional parameters to be collected during first flush and spring runoff sampling.*

Biological Monitoring
In addition to water quality monitoring, bioassessment surveys and macroinvertebrate sampling would be conducted two times a year in the Cedar Creek and Camp Creek drainage, and Keizer Slough. Bioassessment surveys are intended to provide a visual and qualitative record at various stations along a stream of its biological health. The bioassessment is a cost effective way of recording channel condition, riparian health, bank stability, water appearance, pool/riffle presence, bed materials, canopy cover, and hydrologic alterations over time. A number of bioassessment techniques are available from simple (Rapid Stream Assessment Technique, Metropolitan Washington COG, 1992) to the more complex (Rapid Bioassessment Protocol, US EPA, 1999) and everything in between (Stream Visual Assessment Protocol, USDA NRCS, 1999 and Volunteer Streamside Biosurvey Technique, US EPA 1997). Macroinvertebrate sampling would augment the visual stream surveys to provide quantitative data of biological health. The following is a summary of the tasks associated with the biological monitoring part

of the urban runoff monitoring program.

Stream Visual Bioassessment Survey
Macroinvertebrate Sampling
Stream Flow Measurements

Potential Partnerships
Weyerhaeuser
City of Springfield
Lane County
McKenzie River Trust
Oregon Department of Transportation
Oregon Department of Environmental Quality
East Lane County Soil and Water Conservation District
Natural Resource Conservation Service
US Geological Survey
US Department of Agriculture
Oregon Department of Fish & Wildlife
McKenzie Watershed Council
Large Land Owners in Basins
Community Members
Springfield School District
Lane Community College
University of Oregon
Oregon State University

Estimated Annual Costs
The costs presented below are conservative estimates and assume no volunteer or partner contributions to the monitoring effort. In addition, costs were calculated for each source protection monitoring program component as a stand alone estimate. This provides an overly conservative estimate if more than one monitoring component is implemented (e.g., stormwater and urban runoff) due to savings from shared equipment and personnel, and reduced analytical costs associated with bidding on larger contracts. The cost estimates below are based on vendor price lists and best professional judgment.

Initial Sampling Event, Fall 2001 (Startup Costs)
These costs assume the purchase or rental of some sampling equipment and field measurement instruments (pH, temperature, conductivity, etc.). It is assumed that samples will be collected from all sixteen locations and analyzed for all the parameters listed above (except for those parameters measured in the field).
Analytical Costs = $20,000 to $25,000
Equipment Costs = $3,000 to $5,000

Personnel Costs = $1,500 to $2,000 (approx. 14 to 20 hours LOE)
Total Initial Sampling Costs = $24,500 to $32,000

Estimated Annual Costs
These costs assume that all sixteen locations are sampled five times a year and the samples are analyzed for the parameters indicated under AMonitoring Frequency@. It is also assumed that stream bioassessment surveys with macroinvertebrate sampling will be conducted twice a year.
Analytical Costs = $55,000 to $65,000
Equipment Costs = $1,500 to $2,000
Personnel Costs = $9,000 to $12,000 (approx. 115 hours: 45-sampling/70-bioassessment)
Total Annual Sampling Costs = $65,500 to $79,000

<u>McKenzie River Monitoring</u>
The McKenzie River is the sole drinking water source for the City of Eugene. As part of the source protection program, storm event monitoring would be conducted at four locations to evaluate impacts from and correlate river data with the urban and stormwater runoff monitoring efforts discussed above.

Existing Data/Monitoring Programs
Willamette Basin Studies
The McKenzie River has been monitored by the USGS and DEQ as part of the broader Willamette River Basin study (DEQ, 1995; DEQ, 2000; USGS, 1998). The majority of the monitoring was associated with the Coburg monitoring location in the lower McKenzie River. The upper McKenzie River was not monitored as part of these studies. Results indicate that the lower McKenzie River has the highest water quality in the Willamette Basin and was rated between good and excellent health overall. Although water quality in the lower McKenzie River is considered good, it still occasionally violates water quality standards. Logging, urban development, road building, and agricultural uses are considered the major nonpoint pollution sources within the watershed.

Ambient Monitoring Program
Ambient monitoring is currently being conducted by DEQ at seven locations on the McKenzie River to assess general water quality conditions of the river (Figure 4). The monitoring program is being supported by the McKenzie Watershed Council members. The ambient monitoring program is conducted eight times a year for temperature, pH, conductivity, bacteria (e. Coli and fecal coliform), nutrients, metals (Al, Ca, Fe, La, Li, Mg, Mn, K), BOD, TOC, chlorophyll, color, total organic halogens, total solids, total suspended solids, turbidity, and dissolved oxygen. Results indicate that in general water quality in the McKenzie is good and tends to decreases as one moves down river. Water quality was found to be temperature-limited during various times of the year (DEQ, 2000).

EWEB Intake Monitoring
EWEB=s Hayden Bridge Filtration Plant conducts numerous analysis on the raw water pumped from the McKenzie River. Depending on the parameters the raw water is monitored continuously (e.g., pH,

turbidity, and total organic carbon), hourly, daily or monthly.

Existing Data Usage

Additional evaluation of existing data is needed to provide a more complete picture of the McKenzie River water quality and assist in shaping future water quality monitoring programs. The data collected as part of the ambient monitoring program is critical to evaluation of overall water quality trends in the McKenzie and will be integrated with the data collected as part of EWEB=s source protection monitoring program. Since the existing ambient monitoring program is a fixed interval sampling effort (i.e., monthly), the results tend to provide a base level of contamination in the river and compliments EWEB=s storm event sampling program. The data from ambient and storm event monitoring can be used to assess the effects of pollution loads on the water quality in the McKenzie River.

The existing data collected by EWEB at Hayden Bridge would be incorporated with the storm event monitoring data. The continuous and hourly raw water data will be useful in determining optimal storm event sampling times.

McKenzie River Monitoring Objectives

Several objectives were identified for the McKenzie River monitoring program:

- To determine the water quality effects from pollution sources and correlate pollution loading estimates with measured effects in the river;
- To evaluate trends in water quality and correlate with trends in pollution loadings from urban drainage basins over time as land use in the area changes and implementation of watershed protection and conservation strategies take place; and,
- To evaluate and measure the relative health of the lower McKenzie River over time to determine the effectiveness of watershed protection and conservation programs.

Monitoring Locations (4)

Hendricks Bridge
Downstream of confluence w/Camp Creek
Downstream of confluence w/Cedar Creek
Hayden Bridge

Monitoring Frequency (5 times per year)

First Major Flush in October
Major early winter storm event in Dec./Jan.
Major late winter storm event in Feb./March
Spring Storm event in May
Summer storm event in July

Monitoring Parameters

Flow Rate

Temperature
Conductivity
Dissolved Oxygen
pH
Total Organic Carbon
Chemical Oxygen Demand
Biochemical Oxygen Demand
Total Suspended Solids
Turbidity
Nutrients
Metals (total & Dissolved)
Coliform Bacteria (fecal, e.coli, fecal streptococci)
Color
Petroleum Hydrocarbons*
Semi-Volatile Organic Compounds*
Pesticides/Herbicides*

* = Parameters that could be collected during first flush and spring runoff sampling if contaminants are detected at significant concentrations in stormwater and/or urban runoff sampling.

Biological Monitoring

In addition to water quality monitoring, photographic assessment and Macroinvertebrate sampling would be conducted on a periodic basis. The photographic assessment would include photo documentation on the river as well as detailed aerial photo flights possibly once every 3-5 years. Macroinvertebrate sampling would be conducted 1-2 times a year. The photographic assessment is intended to provide a visual record of the river and surrounding areas over time to allow assessment of overall river health and changes in land use patterns. The following is a summary of the tasks associated with the biological monitoring part of the ambient monitoring program.

Satellite Imagery
Photographic River Assessments
Aerial Photo Flights
Macroinvertebrate Sampling
River Flow Measurements

Potential Partnerships

McKenzie River Trust
Lane County
US Forest Service
US Army Corps of Engineers
US Geological Survey

US Department of Agriculture
Oregon Department of Transportation
US Bureau of Land Management
Oregon Department of Environmental Quality
Oregon Department of Fish & Wildlife
McKenzie Watershed Council
McKenzie River Guides
Community Members
University of Oregon
Oregon State University

Estimated Annual Costs

The costs presented below are conservative estimates and assume no volunteer or partner contributions to the monitoring effort.
Analytical Costs = $10,000 to $13,000
Equipment Costs = $1,000 to $2,000
Personnel Costs = $2,000 to $4,000 (approx. 45 hours (15-sampling/30-macroinvertebrate)
Total Annual Costs = $13,000 to $19,000

<u>Subsurface or Shallow Groundwater Monitoring</u>

Focused monitoring of shallow groundwater in areas of the watershed provides important information to better understand groundwater-surface water interaction and the contribution of groundwater pollution to the river (NRC, 2000). The shallow wells would be targeted in areas of specific land uses or potential problem areas (i.e., agricultural, high density rural development, stream confluences, and known groundwater contamination). The idea would be to target specific locations to allow extrapolation to other areas within the watershed that have similar land uses or problems. This information would be very useful for hydrologic modeling and providing a good understanding of nonpoint source contributions and groundwater-surface water interaction. It is anticipated that once these relationships are better understood the scope and frequency of shallow groundwater monitoring would be significantly reduced.

Existing Data/Monitoring Programs

Some shallow wells exist in the Weyerhaeuser area, but do not appear to be located to monitor the surface water-groundwater interaction. Additional evaluation of these shallow wells is needed to determine if some of them could be used for shallow groundwater monitoring associated with surface water interaction.

Subsurface Monitoring Objectives

Several specific objectives were identified for the shallow groundwater monitoring program:

- To provide a better understanding of the interaction between groundwater and the McKenzie River;

$ To evaluate the significance of groundwater pollution loading to the river from various source types;

$ To evaluate trends in water quality and pollution loadings from shallow groundwater over time as land use in the area changes and implementation of watershed protection and conservation strategies take place; and,

$ To evaluate and measure the relative health of shallow groundwater discharging to the river downgradient of pollution source areas over time to determine the effectiveness of watershed protection and conservation programs.

Areas Targeted for Monitoring (6)
Area at Hayden Bridge Intake
Keizer Slough/Weyerhaeuser/SUB Well field Area
Confluence area w/Camp Creek
Confluence area w/Cedar Creek
Agricultural Land upriver of EWEB Intake
Rural Urban Development area (septic systems)

Monitoring Frequency (Various)
Monthly (static water levels)
Quarterly for Water Quality (agricultural monitoring tied to pesticide/herbicide/fertilizer application schedule)

Monitoring Parameters
Static Water Level
Temperature
Conductivity
Dissolved Oxygen
pH
Total Organic Carbon
Nutrients
Metals (Dissolved)
Coliform Bacteria (fecal, e.coli)
Pesticides/Herbicides*
Petroleum Hydrocarbons*
Semi-Volatile Organic Compounds*
Volatile Organic Compounds*
* Depends on land use that is being monitored.

Potential Partnerships
Lane County
Oregon Department of Agriculture

City of Springfield
Springfield Utility Board
Rainbow Water District
Weyerhaeuser
East Lane County Soil and Water Conservation District
Natural Resource Conservation Service
Oregon Health Department
Oregon Department of Water Resources
Oregon Department of Environmental Quality
US Geological Survey
McKenzie Watershed Council
Agricultural Community
Pesticide and Herbicide Manufactures
Lane County Community College
Oregon State University
University of Oregon

Estimated Annual Costs

The costs presented below are conservative estimates and assume no volunteer or partner contributions to the monitoring effort. In addition, costs were calculated for each source protection monitoring program component as a stand alone estimate. This provides an overly conservative estimate if more than one monitoring component is implemented (e.g., stormwater and urban runoff) due to savings from shared equipment and personnel, and reduced analytical costs associated with bidding on larger contracts. The cost estimates below are based on vendor price lists and best professional judgment.

Initial Sampling Event (Startup Costs)

These costs assume that 30 shallow monitoring wells will be installed by a licensed well driller and the location and top-of-casing height for each well properly surveyed. Startup costs also assume the purchase or rental of some sampling equipment and field measurement instruments (pH, temperature, conductivity, water level indicator, etc.). It is assumed that samples will be collected from all thirty well locations and analyzed for all the parameters listed above (except for those parameters measured in the field).

Well Installation (assume 30 wells) = $15,000 to $20,000
Surveyor Costs = $3,000 to $5,000
Analytical Costs = $15,000 to $20,000
Equipment Costs = $10,000 to $12,000
Personnel Costs = $13,000 to $15,000 (approx. 180 hours LOE)
Total Initial Sampling Costs = $56,000 to $72,000

Estimated Annual Costs

These costs assume that all thirty well locations are sampled four times a year and the samples are

analyzed for the parameters indicated under AMonitoring Frequency@. It is also assumed that water level measurements will be collected on a monthly basis.
Analytical Costs = $45,000 to $65,000
Equipment Costs = $1,000 to $2,000
Personnel Costs = $7,000 to $10,000 (approx. 110 hours: 70-sampling/40-water level)
Total Annual Sampling Costs = $53,000 to $77,000

Air Quality Monitoring

Atmospheric deposition of As, Cd, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Se, Ti, V, and Zn is estimated be approximately 10% when compared to amount of pollutants contained in domestic and industrial effluents (i.e., 10% of total liquid discharges). In addition to the deposition of metals, other pollutants such as acidity (nitrogen and sulfur oxides from fossil fuel burning) and pesticides/herbicides are commonly transported in the atmosphere (NRC, 2000; Novotny & Olem, 1994). The purpose of air sampling is to determine the atmospheric contribution of pollutants to the watershed. This would include dry deposition and wet deposition (rain water samples). This is an important component to understanding the health of the watershed and how land use changes impact deposition of pollutants over time. This information would also be very useful in modeling contaminant loading to the McKenzie River.

Existing Data/Monitoring Programs

Lane Regional Air Pollution Authority (LRAPA) performs continuous air quality monitoring throughout Lane County and administers and enforces air quality permits issued to industry in the area. LRAPA, through AirMetrics, manufactures, markets, and rents portable air pollution samplers. In Lane County, three pollutants are regularly measured: particulate matter (PM_{10}), carbon monoxide (CO) and ozone (O_3). LRAPA measures pollutants at five locations in Eugene, one location in Springfield, one location in Oakridge (southeast of Eugene/Springfield), one location in Saginaw (south of Eugene/Springfield) and one location in Cottage Grove (south of Saginaw).

Air Monitoring Objectives

Several specific objectives were identified for the air quality monitoring program:

- $ To evaluate the significance of air deposition pollution loading to the river and watershed; and,
- $ To evaluate trends in air quality and pollution loadings from air deposition over time as land use in the area changes and implementation of watershed protection and conservation strategies take place.

Areas Targeted for Monitoring (3)

Area at Hayden Bridge Intake
Keizer Slough/Weyerhaeuser/SUB Weyerhaeuser Well field Area
Upper Watershed (Background)

Dry Deposition Monitoring Frequency (3)
Summer Months (three sample events)

Wet Deposition Monitoring Frequency (3)
Initial Storms Events After Dry Season (2 sampling events)
Winter Storm Event (1 sampling event)

Monitoring Parameters
pH
Particulate
Nutrients
Metals
Pesticides/Herbicides
Petroleum Hydrocarbons
Semi-Volatile Organic Compounds
Volatile Organic Compounds
Meteorological Measurement Stations

Potential Partnerships
Lane Regional Air Pollution Authority
City of Springfield
Springfield Utility Board
Rainbow Water District
Lane County
Oregon Department of Environmental Quality
McKenzie Watershed Council
Agricultural Community
Industrial Business Community
Lane County Community College
Oregon State University

Estimated Annual Costs
Cost estimates for air monitoring were not developed at this time. It was felt that additional discussions and coordination with LRAPA would be necessary to provide an accurate cost estimate.

Performance Monitoring
Performance monitoring is conducted on a limited basis to determine the effectiveness of a practice or technology. For example, if a retention pond and wetland system were constructed to treat stormwater or urban runoff, performance monitoring would be conducted as part of the project to evaluate the effectiveness of the treatment. This type of monitoring would then be used to explore ways the treatment system could be enhanced and optimized. Data collected as part of the other components of

the source protection monitoring program would be used in conjunction with the more project specific type monitoring to provide a broader perspective on a projects overall success within the watershed.

Commercial/Industrial Facility Monitoring

The majority of discharges from industrial and commercial facilities are regulated by various agencies (DEQ, LRAPA, EPA, City of Springfield, ect.). This piece of the source protection monitoring program would involve identification of all water and air discharge permits and obtaining and reviewing monitoring reports required under the permits. It would also involve active participation during issuance of new permits or renewal of existing permits to make sure the discharge requirements and monitoring parameters are appropriate. Opportunities may arise where EWEB could work cooperatively with a facility to go beyond what is required under a permit to reduce pollution and conduct additional monitoring.

Monitoring Data Management and Reporting

As indicated at the beginning of this document, a critical piece to a successful monitoring program is data management, analysis, and reporting. Due to the long-term nature of a source protection monitoring program there is potential for management of large data sets and being able to clearly identify trends associated with water quality and watershed health. The use of a Geographic Information System (GIS) and hydrologic simulation and pollution loading models would allow effective data management, analysis, and reporting. Recent developments in GIS and hydro modeling have produced a GIS hydro data model that supports mapping of water features, can trace water movement from one feature to the next, and models the time patterns of water flow and the water quality (or other attributes) associated with these features (Maidment and Djokic, 2000; Maidment, 2001).

The South Florida Water Management District integrated GIS and a watershed model (Stormwater Runoff and Pollutant Model or SRPM) for use as a powerful data analysis and decision making tool (Xue and Bechtel, 1996). GIS provides the power to analyze special watershed data such as land use types, slope, drainage systems, land use acreages, percent of impervious surfaces, and soils. This information can be used as inputs for a watershed model. A
watershed model simulates stormwater runoff and its associated pollutant loads for present conditions and also can predict loadings as a result of changes in land use and other human activities. Linkage of GIS and the watershed model reduces the problem of data formatting for model users. The integrated GIS tool also provides capabilities for watershed decision makers and planners to estimate runoff and pollution loads in various catchment areas within a watershed or over a large-scale region to quickly evaluate and compare alternative actions using graphic results (Xue and Bechtel, 1996).

The use of GIS as a data management tool would also provide a means to disseminate data results and trends over the internet (via EWEB=s web page) to the McKenzie River community and other stakeholders. The majority of existing information and data associated the McKenzie watershed from other stakeholders (MWC, USFS, BLM, LCOG, LRAPA, City of Springfield, SUB, etc.) is currently managed in a GIS environment.

Potential Partnerships

McKenzie Watershed Council
Oregon Department of Environmental Quality
Oregon Health Division
Oregon State University
US Geological Survey
City of Springfield
Lane Council of Governments
University of Oregon InterGraphics
Springfield Utility Board
Lane County

Reporting

It is anticipated that upon completion of a sampling event, a brief monitoring results report would be prepared that summarizes the data and highlights some of the more significant field observations and analytical results. Biological monitoring information would be summarized in a bioassessment summary report.

A comprehensive annual report would be prepared that discusses analytical results, biological health of urban creeks, trends, proposed changes to monitoring components, land use changes, watershed restoration/conservation/protection projects, partnerships, drinking water use trends, and other related topics associated with source protection and monitoring.

Estimated GIS and Modeling Costs

The costs presented below are conservative estimates and assume no volunteer or partner contributions to the monitoring data management effort.

GIS Software and License = $15,000 to $20,000
    Annual Maintenance = $2,000 to $3,000
GIS IMF for Web Page = $35,000 to $40,000
    Annual Maintenance = $5,000 to $10,000
Modeling/Data Base Software = $15,000 to $20,000
    Annual Maintenance = $5,000 to $10,000
Total Startup Costs = $65,000 to $80,000
Total Annual Maintenance Costs = $12,000 to $23,000

Proposed Monitoring Program Implementation Schedule

Table 1 summarizes the target dates for implementation of the various components of the source protection monitoring program. The general tasks associated with implementation of each component were discussed earlier in this outline in the *General Monitoring Concepts* section.

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