Deschutes County
Environmental Health Division

WORK PLAN

La Pine National On-Site Wastewater Treatment and Disposal Demonstration Project

A Cooperative Investigation by Deschutes County Environmental Health Division, U.S. Geological Survey and Oregon Department of Environmental Quality

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USGS
US Geological Survey

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1.0 INTRODUCTION

Groundwater quality in the La Pine region of southern Deschutes County, Oregon is at risk of nitrate contamination from on-site septic system wastewater discharge to groundwater. Nitrate concentrations detected in groundwater indicate that degradation of groundwater quality is in process in the densely developed areas. Most septic systems in the region are traditional conventional type systems. The soils in the region are highly porous and permeable (rapidly draining) with no intervening layer protecting the underlying shallow aquifer. Groundwater temperature is among the lowest in the state, generally 42.5 ^{o}F (6 ^{o}C) to 48.2 ^{o}F (9 ^{o}C) and has a high dissolved oxygen content (3 mg/l to 6 mg/l). These conditions plus a high altitude cold desert climate are not conducive to natural denitrification processes that can occur in soil and groundwater.

A two-dimensional cross-sectional model of groundwater flow and nitrate contaminant fate and transport in the more densely platted areas indicate that nitrate as nitrogen (nitrate) levels could exceed 10 mg/l within 10 to 20 years. The US EPA (EPA) maximum contaminant level (MCL) for nitrate in public water supplies 10 mg/l.

As part of the National Decentralized Wastewater Treatment and Disposal Demonstration Project, the La Pine region was selected to evaluate innovative denitrification technologies. The La Pine region denitrification project includes elements to:

- Install and retrofit up to 200 innovative denitrification systems in the most problematic high-density areas.
- Initiate a systems maintenance infrastructure.
- Establish a 130-well groundwater monitoring network.
- Conduct laboratory testing of representative innovative on-site systems to evaluate performance, on-site system effects on groundwater quality, and the La Pine region groundwater quality.
- Conduct 3-Dimensional groundwater flow and nitrogen contaminant fate and transport modeling, and optimum lot density assessment based on model results.
- Establish a low-interest loan fund for septic system repair.
- Establish a method for development right transfer, lot purchase and other legal obligations associated with properties to decrease overall lot density.

The Deschutes County Environmental Health Division (Deschutes County), Oregon Department of Environmental Quality (DEQ), and the U.S. Geological Survey (USGS), working in cooperation, are addressing the issue of groundwater contamination from on-site systems in the La Pine region. This work plan defines the procedure and quality assurance to accomplish a scientifically sound and defensible study of new and alternative nitrate-reducing on-site system technologies, effects upon groundwater quality, and estimation of optimal density.

1.1 Background

The La Pine region is located approximately 25 miles south of Bend in central Oregon (Figure 1). The region is surrounded by state and federal land. Approximately 12,000 people live in the 20-mile corridor area. The unincorporated community of La Pine is an isolated small rural service center. It lacks public transportation, and the distance from Bend discourages some businesses from establishing there. Where several timber companies existed in the La Pine Region, only one mill now remains. Most residents in the La Pine region are of low or fixed incomes. According to March 1998 economic data for the La Pine region, 49.7% of the population is below the low to moderate income threshold, and 64% of the students in the La Pine area are on the federal lunch program.

Within a corridor of 125 square miles associated with the scenic Deschutes River and the smaller Little Deschutes River are 15,000 lots of one half to one acre platted in the 1960's and 1970's prior to Oregon's land use planning laws in 1974. With no regard for high water table, the aquifer water quality, no promise of infrastructure or facilities, and marketed nationwide to unsuspecting buyers, substantial problems were created. Chief among these problems is that most lots have individual on-site septic systems and domestic wells in an environment of shallow groundwater and rapidly draining soils.

Growth in Deschutes County has increased 35% since the 1990 census. There are currently 4,000 improved lots in the La Pine region study area. At least 6,000 additional existing lots will be improved in the coming years based on the County's growth data. Domestic water needs to support growth comes from groundwater. The La Pine aquifer meets the US EPA criteria as a sole-source aquifer.

Groundwater quality has been a concern for several years. A 1982 study of groundwater identified nitrate concentrations in the vicinity of La Pine as high as 41 mg/l (Century West Engineering corporation, 1982). A step-sewer system was installed in the business district of La Pine as a result of the 1982 study. DEQ sampled groundwater in the La Pine region in 1993 as part of its Statewide Ambient Groundwater Quality Monitoring Program. Again elevated levels of nitrate in groundwater were detected (Peterson, 1994). At the request of Deschutes County Environmental Health Division, the Oregon Department of Environmental Quality (DEQ) began an assessment of the impact of residential development in the La Pine region on groundwater quality. As part of DEQ's assessment, 120 wells were sampled in 1995. The data from this monitoring event shows the presence of nitrate in groundwater above background levels in the more densely populated areas (Figure 2). Nitrate levels outside the more densely platted regions are at background levels, typically less than 0.02 mg/l.

DEQ evaluated groundwater flow and nitrate fate and transport in 1995 using two (2) two-dimensional finite element cross-sectional models constructed along flow path lines through the more densely platted and developed areas. The objective of the model was to assess the future impact of nitrate from septic systems on the groundwater quality. Based on existing 4,000

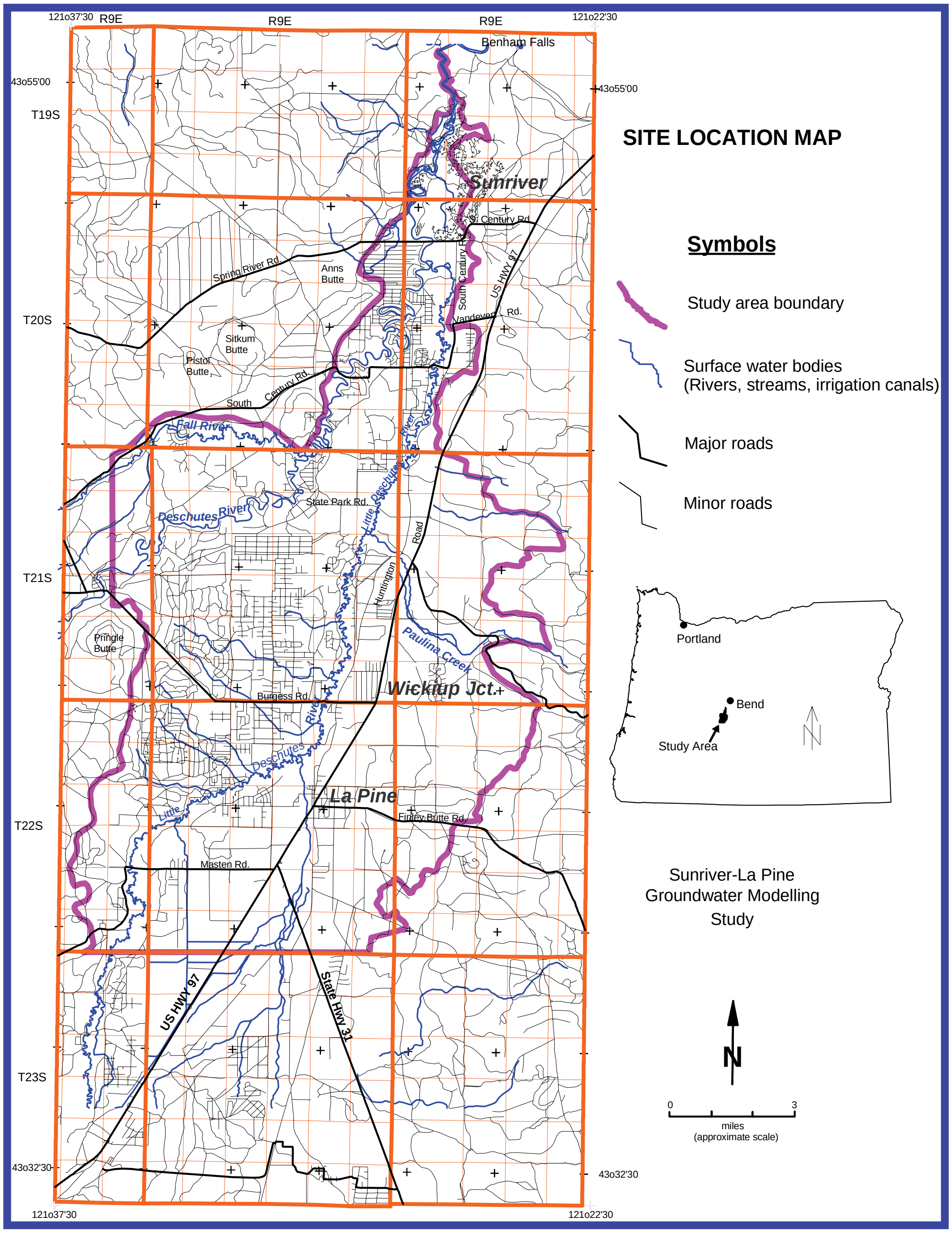

Figure 1. La Pine Decentralized Wastewater Treatment and Disposal National Demonstration Project study area.

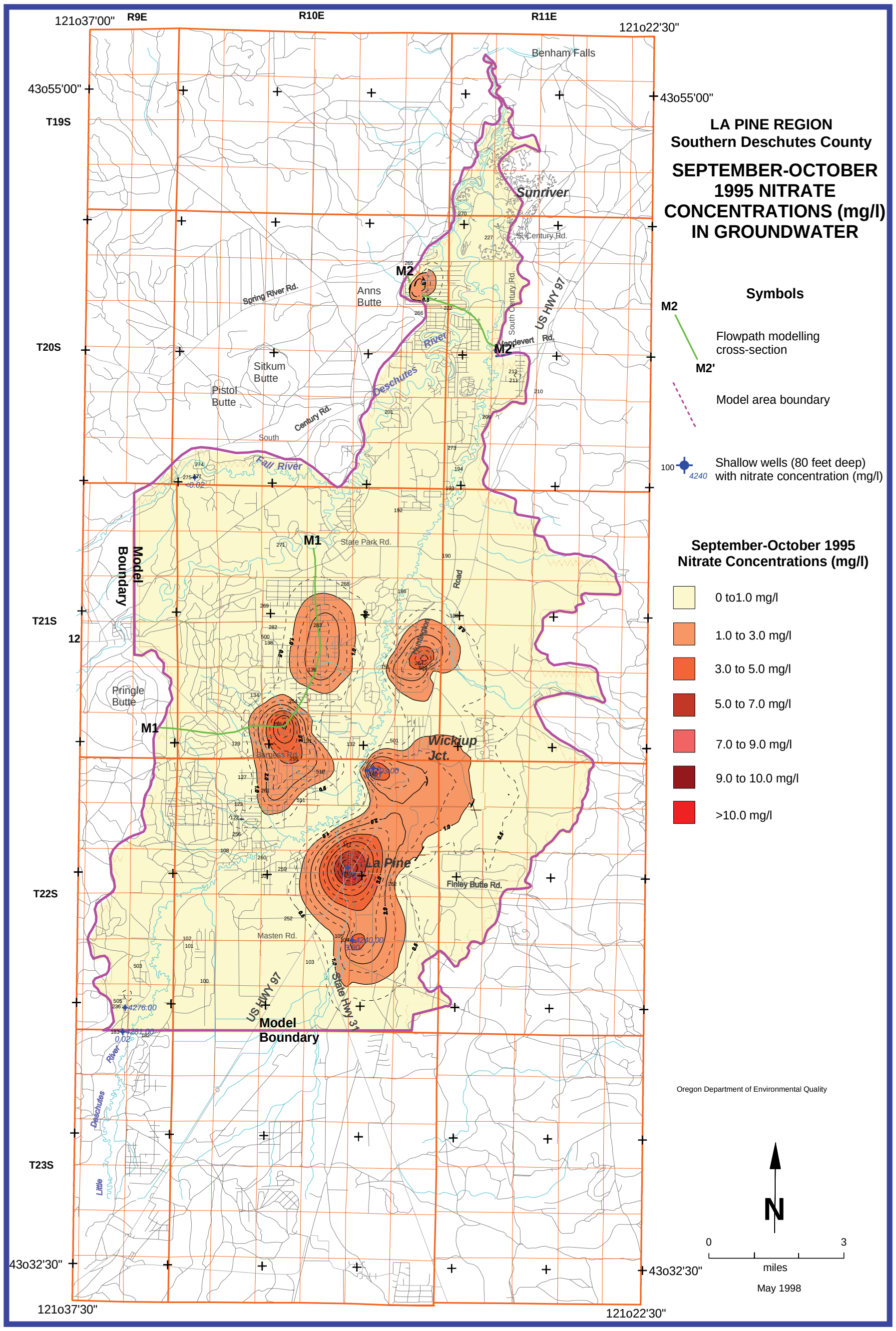

Figure 2. Nitrate in groundwater in the La pine region, October 1995.

improved lots, the model predicts nitrate concentration in groundwater will exceed the federal maximum contaminant level (MCL) of 10 mg/L within 10 to 20 years (Figures 3 and 4). The county and state recognize the need for proactive innovative solutions for the La Pine Region. Through state grants, the residents of the La Pine region and Deschutes County, in cooperation with the state, have undertaken a regional problem solving study. Among key solutions to regional problems recommended by the community-based task force are reduced lot density, development transfer rights, and implement new and innovative nitrate reducing technologies for on-site wastewater treatment and disposal.

1.2 Description of Study Area

The two major unincorporated communities within the study area are Sunriver and La Pine. These communities are approximately 13 and 25 miles south of the city of Bend, respectively.

The study area encompasses approximately 125 square miles and extends from Benham Falls north of Sunriver to the Deschutes County line south of La Pine. The major water bodies in the study area include the Deschutes, Little Deschutes, Fall and Spring rivers.

Most development in the study area occurs in a 20-mile long corridor of US Highway 97. The area is predominantly residential with an urban density in a rural region. Most residential lots are ½ to 1 acre in size. In the northern portion of the study area, most development occurs west of the Deschutes River and between the Deschutes and Little Deschutes rivers west of US Highway 97. In the southern portion, most development occurs predominantly west of the Little Deschutes River, with exceptions in Wickiup Junction (approximately 3 mile north of La Pine) and within La Pine proper.

A step-sewer system was installed in the business district of La Pine in the early 1990’s. Sunriver has it’s own sewer system. In addition, portions of the Oregon Water Wonderland subdivision between the Deschutes and Little Deschutes rivers just south of Sunriver and the Meadowbrook subdivision west of the Deschutes River and south of Oregon water Wonderland have small community sewers and wastewater treatment facilities. Wastewater in all remaining areas is disposed by individual on-site septic systems.

1.3 Hydrogeologic Setting

The La Pine subbasin encompasses approximately 640 square miles. The Cascade Range bounds the study area on the west and the Newberry volcano on the east. Volcanic rocks form the northern and southern boundaries of the subbasin. A volcanic north-south trending ridge of small shield volcanoes and lava flows is present through the central portion of the La Pine subbasin.

The La Pine subbasin consists of volcaniclastic deposits. These valley fill deposits are underlain by Miocene-Pliocene volcanic ash a substantial thickness of Quaternary valley fill sediment of

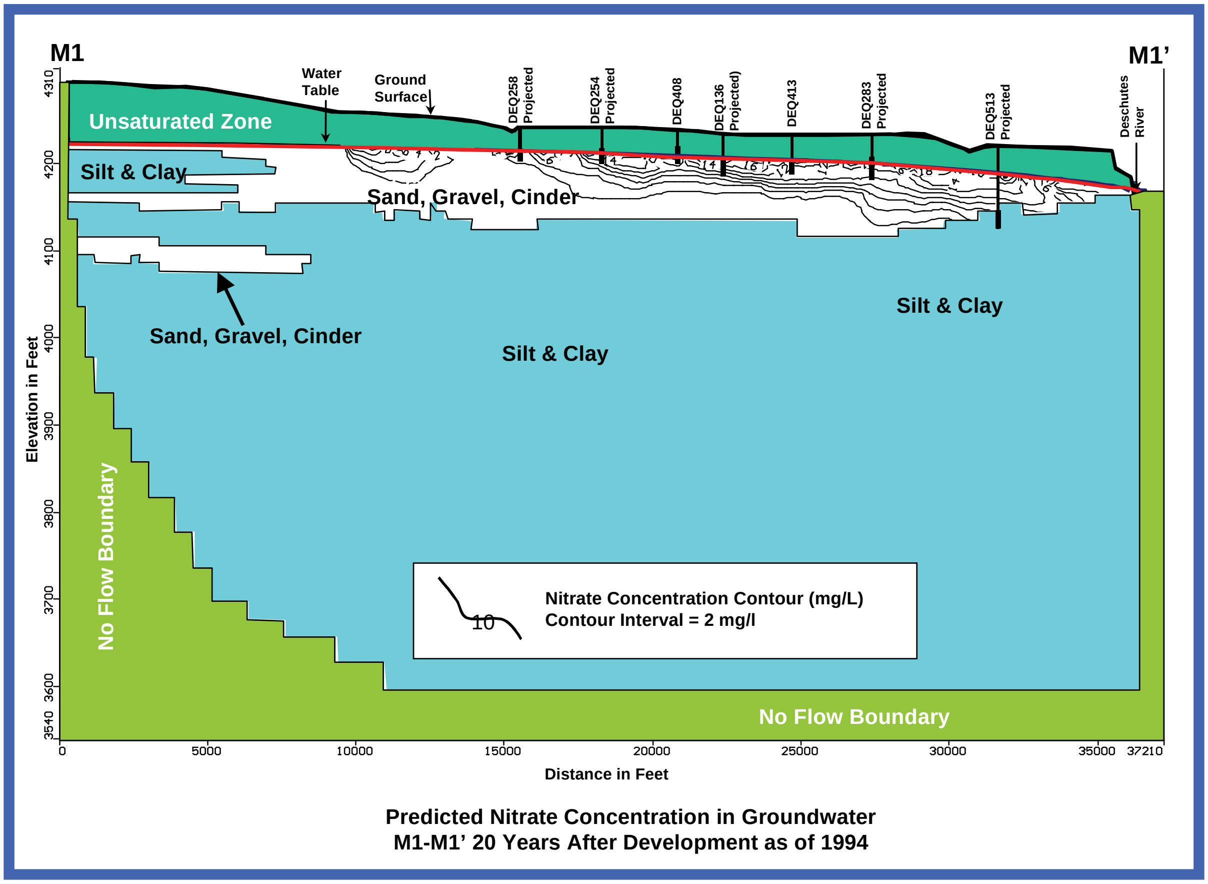

Figure 3. Predicted nitrate concentrations in groundwater in the Day Road area of the la Pine region.

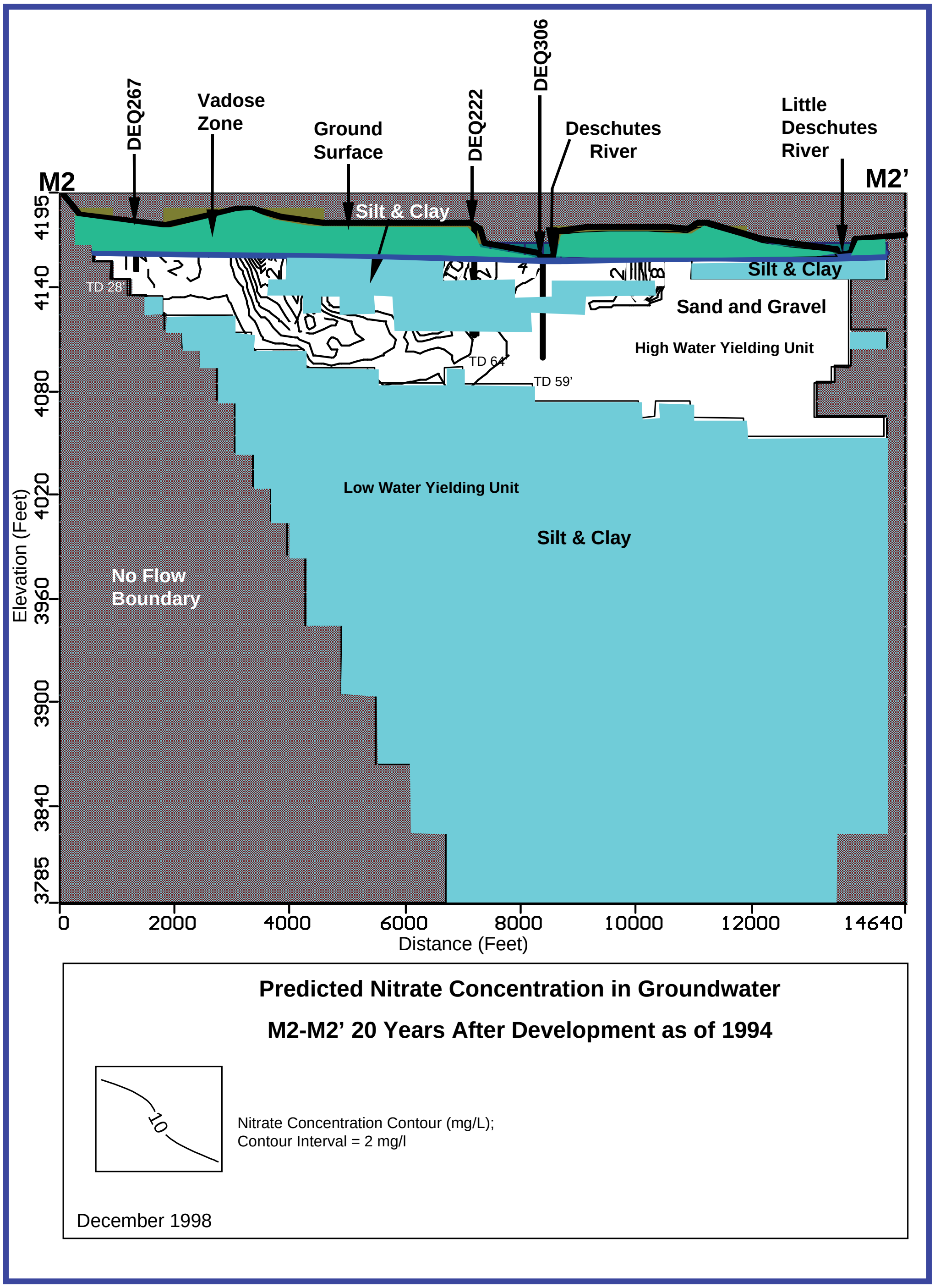

Figure 4. Predicted nitrate concentrations in the Deschutes Recreational Homesite and Oregon Water Wonderland area of the La Pine region.

alluvial (fluvial) and lacustrine (lake) origin, flow tuffs, volcaniclastic sediments, and lava flows (Sherrod and Smith, 1989). Miocene-Pliocene and Quaternary age lavas interfinger with the valley fill deposits along the subbasin margins. The valley fill sediments are covered by 3 to 5 feet of pumice from the Holocene eruption of Mount Mazama.

Groundwater occurs in most of the rocks in the La Pine subbasin. The underlying bedrock of fractured lava, interflow zones, and coarse-grained volcaniclastic sediments, are generally highly productive (Caldwell, 1997). The shallow Quaternary fine to coarse sand, fine to coarse gravel and cinder fluvial deposits are particularly productive. Most wells in the study area are screened in these fluvial deposits. Less permeable silts and clays comprise much of the lacustrine deposits. In some areas of the subbasin, the lacustrine deposits overlie and are intercalated with the fluvial deposits. Lucustrine deposits are exposed in bluffs along portions of the Deschutes River (Cameron and Major, 1987). Because of the intercalated and discontinuous nature of the fluvial and laucstrine deposits, the La Pine aquifer is considered unconfined.

Groundwater table elevation measurements indicate groundwater flow is generally northeastward west of the Deschutes River and Northwestward east of the Little Deschutes River (Figure 5). In the northern portion of the study area, regional groundwater flow becomes northeastward. Stream gauging measurements for the Deschutes and Little Deschutes rivers show the rivers gain in flow (Friday and Miller, 1984;Moffatt, et. all, 1990; Gorman, 1996 unpublished data). The source of the gain is from groundwater discharge. Spring River and Fall River originate from springs in the volcanic rocks indicating the productivity of the fractured volcanic rocks.

1.4 Soils

Soils have been formed on the airfall pumice deposits from the eruption of Mt. Mazama about 6700 years ago. This pumice covers an older soil (paleosol) that developed on alluvium in the basin. The general soil profile is consistent throughout the basin and appears not to have been influenced by erosional activities except in areas adjacent to the existing river channels and within recent flood plains.

The texture of the pumice material varies from that of gravelly coarse sand to a loamy (soils with rapid or very rapid permeability). The buried soil horizon which underlies the pumice deposits range from 10 inches to 3 feet thick and consist of loamy material, texture varying from fine sandy loam to silt loams. The materials, which underlie the buried soil horizons, are typically coarse-grained gravels and sands with discontinuous lenses of silt and clay, associated with the top of the alluvial deposit.

A recent soil survey (NRCS, unpublished report) indicates broad areas that have a distinctive pattern of soils, relief, and drainage. Tutni-Sunriver-Cryaquolls Association occur on pumice-mantled stream terraces and flood plains. Shanahan-Steiger and Lapine Associations occur on pumice-mantled and lava plains and hills (Figure 6).

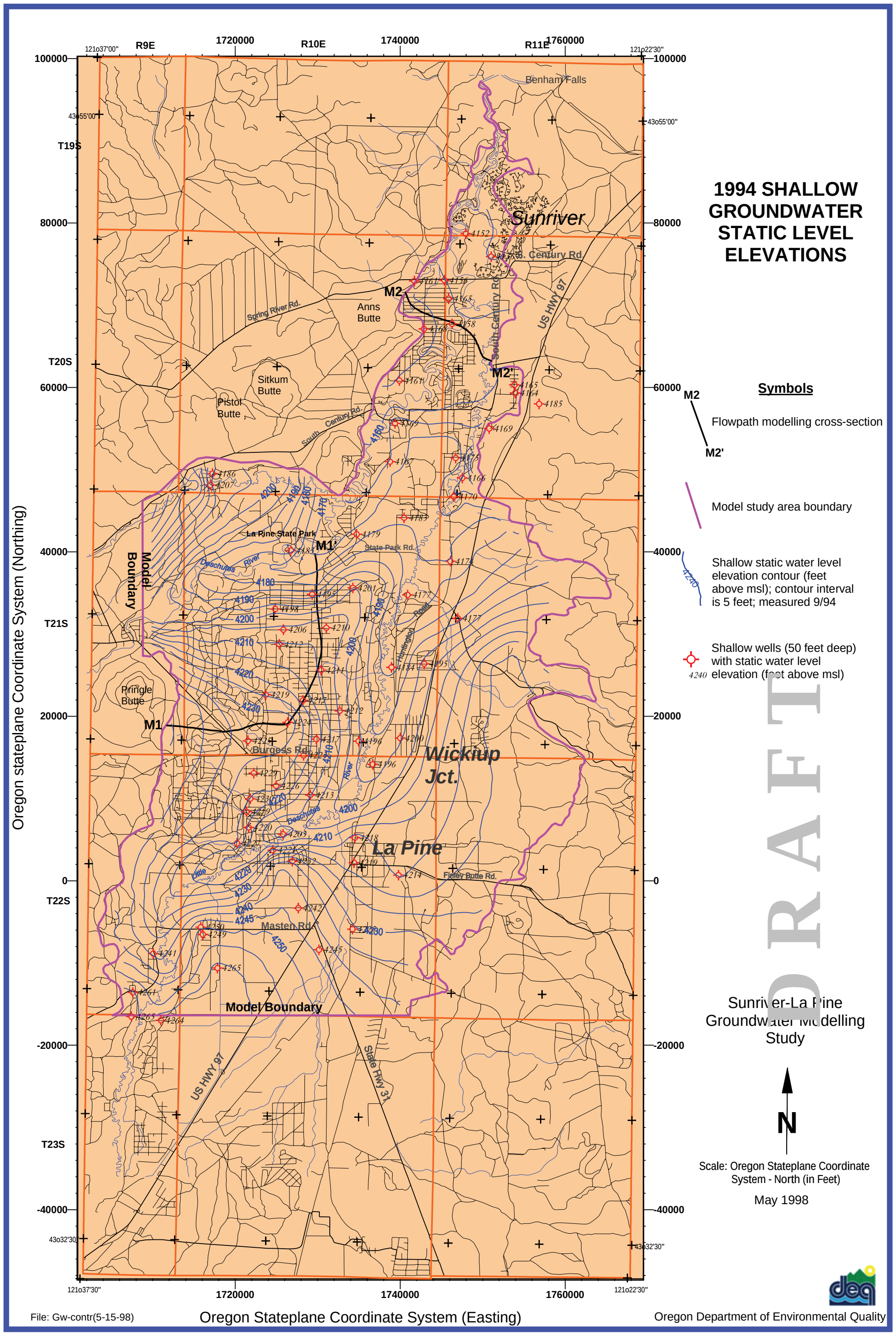

Figure 5. Groundwater table based on 1994 synoptic water level measurements.

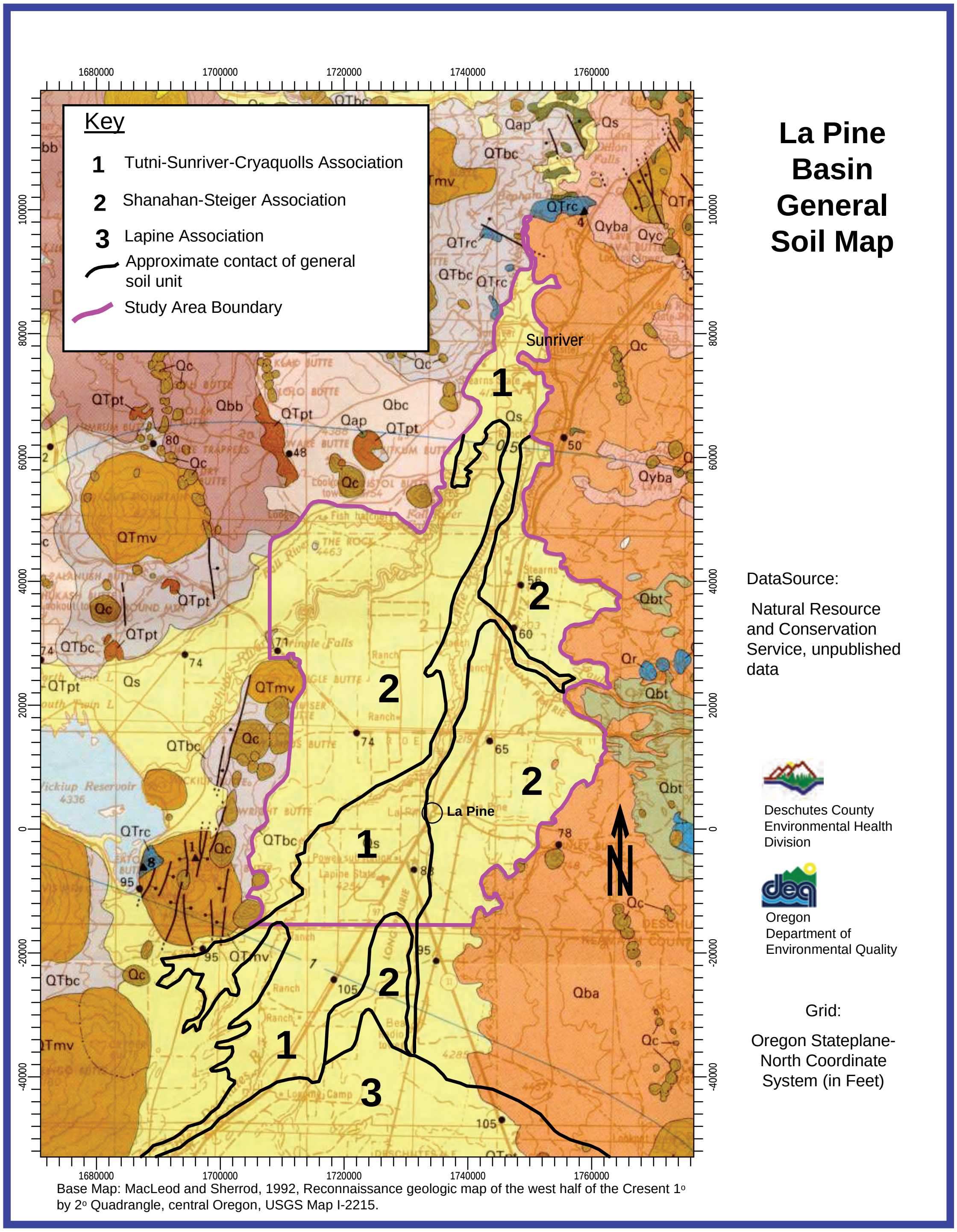

Figure 6. General soil associations in the La Pine Basin.

Tutni soils are on stream terraces. These soils are more than 60 inches deep to bedrock and are somewhat poorly drained. They have a very dark grayish brown loamy coarse sand surface layer; a mottled, dark grayish brown very gravelly coarse sand substratum; and a very dark grayish brown sandy loam buried layer. Depth to a seasonal high water table is 18 to 48 inches.

Sunriver soils are on stream terraces. These soils are more than 60 inches deep to bedrock and are somewhat poorly drained. They have a very dark gray sandy loam surface layer; a mottled, light brownish gray coarse sand subsoil; and a mottled, very dark gray sandy loam buried layer. Depth to a seasonal high water table is 24 to 48 inches.

Cryaquolls are on flood plains. These soils are more than 60 inches deep to bedrock and are poorly drained and very poorly drained. They have a dark brown silt, silt loam, or gravelly loamy sand surface layer; a very dark gray, mottled sandy loam, loam, silt loam, or loamy sand subsoil; and a very dark gray sand substratum. A seasonal high water table is at the surface to a depth of 24 inches below the surface. These soils are subject to rare flooding. Of minor extent in this unit are Wickiup soils on stream terraces,

Shanahan soils are more than 60 inches deep to bedrock and are somewhat excessively drained. These soils have a dark brown loamy coarse sand surface layer, a yellowish brown and brown loamy coarse sand and coarse sand substratum, and a dark brown loam and gravelly sandy loam buried layer. Depth to the buried layer is 20 to 40 inches.

Steiger soils are more than 60 inches deep to bedrock and are somewhat excessively drained. These soils have a dark grayish brown loamy coarse sand surface layer, a pale yellow gravelly coarse sand substratum, and a dark yellowish brown loam buried layer. Depth to buried layer is 40 to 60 inches or more.

Lapine are more than 60 inches deep to bedrock and are excessively drained soils formed in pumice and ash. These soils have a very dark grayish brown and dark brown gravelly loamy coarse sand surface layer and a very pale brown and light gray gravelly to extremely gravelly coarse sand substratum.

1.5 Climate

According to the Oregon Climate Service, the La Pine region, which is in the rain shadow of the Cascade range, has a high desert climate. The average elevation of the La Pine region is about 4,200 feet above mean sea level. The Wickiup Dam NOAA weather station is at an elevation of 4,360 feet above mean sea level and most closely represents the La Pine region temperature and rainfall conditions. Summer (June-August) mean monthly maximum and minimum temperatures for the period of 1961 to 1990 at the Wickiup Dam weather station range from 80 to 42 ^{o}F, respectively (27 to 6 °C). Winter (December – March) monthly maximum and minimum temperatures range from 46 to 17 ^{o}F (8 to –8 °C). Extreme temperatures are not unusual for the region, ranging from >100 to –30 ^{o}F (>38 to –34 °C).

Monthly maximum and minimum precipitation for summer and winter ranges from <0.7 inches to >3.68 inches. The mean annual precipitation ranges between 14 and 21 inches. Snowfall during winter months is common with monthly means of 19 to 22 inches. The frost free period can vary from 10 to 50 days.

1.6 Project Objectives

The primary objective of the La Pine National Decentralized Wastewater Treatment and Disposal project is to protect the La Pine subbasin aquifer's water quality. The intent of this study is to accomplish the objective while allowing development to occur through a holistic approach of innovative denitrification technologies, in combination with understanding groundwater flow and nitrate fate and transport assessment, and to determine the appropriate development density through lot size optimization modeling based on the results of the denitrification systems study and assessment of the fate and transport of nitrate in the groundwater.

1.7 Project Approach

Eight major tasks are identified to achieve the project objectives. The project approach is to accomplish these tasks, listed below, over the five-year duration of the project.

- Task 1 - Install new and retrofit existing systems with 200 or more innovative on-site systems by a grant and/or low-interest loan program.
- Task 2 - Establish a regional monitoring well network of up to 130 wells.
- Task 3 - Set up an on-site septic systems maintenance structure.
- Task 4 - Develop a funding program to assist in low-interest loans for septic system repair and/or replacement using new denitrification technology.
- Task 5 - Collect and analyze field data on new and retrofitted septic systems and from the groundwater monitoring network.
- Task 6 - Conduct laboratory analytical testing of system effluent and groundwater samples.
- Task 7 - Conduct 3-Dimensional groundwater flow and nitrate fate and transport modeling, lot size optimization modeling for nitrate loading reduction, and identify areas and/or neighborhoods of concern for development of a comprehensive groundwater protection strategy.
- Task 8 - Prepare quarterly progress reports and a final project report.

1.7.1 Task 1 - Install new and retrofit existing systems with 200 or more innovative denitrification technology on-site systems

The primary objective of this project is installing and evaluating the performance of new and innovative denitrification technologies to reduce nitrate loading to groundwater from on-site septic systems. The goal is to develop and promote on-site system technologies that protects groundwater quality from nitrate contamination. To accomplish this task, solicitation of new and innovative technologies, selection of systems, evaluation of system performance, and developing a comprehensive incentive program for final adoption needs to be done. Implementation of Task 1 will be accomplished through the following task components:

1.7.1.1 Select new and innovative technologies

This task will entail establishing a technical review committee consisting of three members qualified in the design, performance and/or site evaluation and system installation. The committee should consist of one representative from Deschutes County, one representative from DEQ and one representative from the US EPA familiar with on-site system technologies.

New and innovative technologies will be solicited through advertisement in journals and publications of the on-site industry.

New and innovative technologies should be designed and selected with the goal to achieve specific performance standards in discharge effluent as indicated in Table 1 of the workplan.

Under an existing EPA 319 Project, two innovative denitrification systems have been installed in La Pine and are operational. On-going monitoring results are being collected. Once a technical review committee has been formed, the results will be submitted to the committee as a part of technology selection process.

1.7.1.2 Select appropriate new and retrofit sites

New sites and sites selected for retrofitting must meet or exceed minimum site selection criteria for conventional sand filters under Oregon Administrative Rules (OAR) 340-71-290. Existing sites that are to receive retrofit systems will need a new site evaluation. In addition, the proposed retrofit technology should be matched to the existing system to the extent possible. In some cases, the retrofit would require removal of the existing septic tank.

1.7.1.3 Select control sites

Up to five existing sites will be selected as control sites for this study. These control sites will include conventional and sand filter on-site systems. The control sites will have monitoring wells installed upgradient and downgradient of the existing drainfields. Where possible, lysimeters will be installed beneath the drainfields. The purpose of these control sites is to evaluate the performance of existing systems and measure the level of improvements of the new and retrofit systems over existing systems.

1.7.1.4 Install new and retrofit on-site systems

The goal of this subtask is to install and retrofit 200 or more, if possible, on-site wastewater systems in the La Pine region with the new and innovative technologies selected through Subtask 1.7.1.1. Of these on-site systems, up to 40 representative systems will be selected for detailed performance analyses, including groundwater monitoring. The sampling protocol for these representative system evaluations will include monthly sampling of the nitrogen analyte species and chloride for the first year of system operation, then bi-monthly sampling after the first year. All other analytes will be sampled on a bi-monthly to quarterly basis. The remaining systems will be monitored on an as-needed basis, either individually or by system type, depending on the performance data obtained and the system maintenance required from the representative systems.

Each of the 200 new and retrofit system will need a permit as required in Oregon Administrative Rules. The permit will require that the system be operated and maintained in accordance with the manufacturer's operation and maintenance guidelines, recommendations, and performance specifications.

The installation of all new and retrofit systems will be in accordance with the manufacturer's installation guidance, recommendations and oversight. A representative from Deschutes County Environmental Health Division, DEQ, and the manufacturer's representative may be present at the site during system installation to assure proper installation.

A comprehensive incentive program will be developed to promote those innovative systems that have met the overall performance standards within a reasonable evaluation period not to exceed a period of three years. The incentive will consist of a flexible grant and/or low-interest loan program to homeowners to install the innovative systems for new developments or existing systems.

Each component of the 200 systems and existing structures, domestic well, monitoring wells and domestic wells on adjacent properties will be located to a common reference point (e.g. a property corner point). The reference point will be surveyed for location and elevation in UTM or Oregon Stateplane-North Coordinate System. An As-Built map (in hard copy and electronic format such as *.DXF files for layers compatible for import into ArcView or ArcInfo GIS programs) will be submitted to DEQ within 3 weeks after installation of the on-site system. The map will be prepared at a scale no smaller than 1 inch equals 30 feet and include, but not be limited to, the following elements:

- All structures on the property.
- All system components, including existing components for a retrofit system.
- Measurements of all components.
- Distances between all components of the on-site system.
- Distances of all structures from the property corners.
- Distances of all components from any structure on the property and from the property corners and property lines.
- All monitoring wells
- Domestic well on the property and the domestic wells on the adjacent properties, provided that adjacent property owners provide permission to have their wells surveyed.

1.7.1.5 Evaluate system performance.

The intent of this subtask is to achieve a level of on-site wastewater system performance where nitrate and other pollutants will have a minimal impact on groundwater quality. New and retrofit on-site system performance will be evaluated as to how well the system meets the manufacturer's specifications and the projects end-of-pipe performance standards specified in Table 1. Other innovative technology selection criteria will s include initial system cost, and the system's operation and maintenance costs. The system performance will be evaluated through an assessment of on-site system performance indicators (Table 2) of the effluent from each system component and groundwater impacts at the downgradient compliance groundwater monitoring well. The effluent samples will be collected at specified system components in accordance with the sampling protocol under Task 5. In addition, samples will be collected from the vadose zone beneath the drainfield to evaluate the drainfield treatment performance with respect to nitrate concentration.

Table 1
Minimum On-site System Performance Standards at Discharge to Drainfield

- Total nitrogen concentration $\leq$ 10 mg/l.
- Fecal coliform and E. Coli levels $\leq$ two orders of magnitude MPN/100 ml.
- Five-day Biological Oxygen Demand (BOD_5) $\leq$10 mg/l .
- Total suspended solids (TSS) $\leq$10 mg/l.

Table 2
On-site System Performance Indicators

On-site Systems	Groundwater
Laboratory Analyte	**Laboratory Analyte**
Chloride	Chloride
Total Alkalinity	Total Kjeldahl Nitrogen (TKN)
Total Sulfate	Ammonia as Nitrogen
Total Phosphorous	Nitrate + Nitrite as Nitrogen
Total Kjeldahl Nitrogen (TKN)	Fecal Coliform
Ammonia as Nitrogen	E. Coli
Nitrate + Nitrite as Nitrogen	**Field Analyte**
Biological Oxygen Demand (BOD_5)	pH
Total Suspended Solids	Temperature (^oC)
Fecal Coliform	Conductivity
E. Coli	Dissolved Oxygen
Field Analyte	
pH	
Temperature (^oC)	
Conductivity	
Dissolved Oxygen	

1.7.1.6 Establish a groundwater monitoring system for each site

The groundwater gradient on each site will be established before the installation of the on-site septic system. The gradient will be determined by installing monitoring wells and measuring the depth to groundwater. All monitoring wells will be surveyed to establish location and elevation of the wellhead. Once the gradient is determined, at least one downgradient monitoring well will be installed, developed and sampled to establish a groundwater quality baseline before the septic system is activated. Groundwater samples will be collected from a designated upgradient well and the downgradient well.

Groundwater will be tested for the same analytes as the septic systems. Samples will be collected in accordance with the sampling protocol under Task 5.

1.7.2 Task 2 - Establish a regional monitoring well network of up to 130 wells.

A regional monitoring well network of 120 wells was established as part of the earlier groundwater quality investigations in the study area. This well network consists mostly of domestic wells with some public water supply wells. This network will be expanded to at least 130 wells. New wells will be added based on the results of the Spring 1999 groundwater sampling event of the 120-well network, identification of data gap areas and needs for understanding of the hydrologic flow regime model requirements under Task 7. The additional wells will be selected from exiting domestic wells and drilling new wells.

Basic requirements for selecting additional exiting domestic wells includes the following:

- An Oregon Water Resources Department (OWRD) well record
- Suitable lithologic description on the well record
- Suitable screen interval
- Well construction design
- Well owner permission to sample the well

All monitoring well installations are required to comply with OWRD monitoring well construction rules (OAR 690-240). In addition, all monitoring wells require an OWRD Start Card prior to well installation. An OWRD well Identification Tag is required for each installed well. The Start card number and Well Identification Tag number are required on the well log.

Specific well installation procedures are provided in the Field Sampling Plan (Appendix A).

In order to make a more complete evaluation of the system performance and the fate of nitrate in the vadose zone, a simple monitoring scheme will be undertaken. The scheme can be as simple as obtaining soil cores by probing the drainfields and measuring nitrate concentration. A more elaborate but a more involved system will entail installing suction cup or pan lysimeters. A literature search or consultation with people with hand-on experience in these fields will be undertaken before a given scheme is adopted.

1.7.3 Task 3 - Set up an on-site sewage systems maintenance structure.

The new and innovative denitrification technology systems will require periodic maintenance to assure proper performance. In addition, performance maintenance is required under Oregon Administrative Rules permit that will be issued for each system utilizing an innovative technology until DEQ's rules are amended based on the results of this study. However to ensure proper long-term maintenance for these new technologies, and to expand needed maintenance to other on-site systems, a systems maintenance program needs to be established. To further ensure an adequate base of on-site systems if maintenance is "phased" in, beginning with new systems and then later adding other (existing) systems upgrades, DEQ is considering adding conditions in the permit to require those systems to be included within the maintenance entity when one is established.

Two general directions available for area-wide maintenance of on-site systems in the La Pine region are:

1. Formation of a maintenance district.
2. Formation of a government/private partnership with government providing the mandate and private business providing the service.

Each general direction has legal and political issues to resolve before implementation. The principle issues include:

- Education of on-site system owners for the need of system maintenance.
- Exploration of case histories of differing maintenance schemes to try to avoid repeating past mistakes and selecting what works best.
- Exploration of expanding the current La Pine sanitary district to include on-site system maintenance.
- Amending state rule(s) and/or enacting county ordinance(s) that:
    - Require upgrading existing on-site systems with new nitrate-reducing technology based on the results of this study.
    - Require periodic on-site system maintenance to assure proper system performance.
    - Establishing educational/certification qualifications for license holders that may perform maintenance on these new technology and existing systems
    - Provide incentives through the permitting process such as issuing construction permits once a maintenance entity is in place.

- Achieving voter approval for forming a fee-based on-site systems maintenance entity.

In order to accomplish Task 3, determine the appropriate maintenance system and resolve the legal and political issues, the following subtask will be undertaken with the objective of establishing an area-wide on-site maintenance system:

- Conduct a literature search of maintenance system case histories with follow-up interviews.
- Consult with known entity representatives for guidance in developing a maintenance entity.
- Identify what works and does not work with on-site maintenance systems.
- Develop and implement a public education program on the needs for proper and periodic on-site system maintenance, including, but not limited to:

    - Maintenance guidelines.
    - Impacts of no maintenance.
    - Education forums.
    - Mass mailings.

- Select/design the appropriate on-site maintenance system mechanism.
- Develop a fee-based funding mechanism and achieve voter approval where required.
- Identify where state rule(s) and/or county ordinances are required to implement the maintenance system.
- Develop an on-site system maintenance education and certification program to assure qualified personnel maintain these new technology on-site systems.

The research and interviewing of maintenance entities would be accomplished within 6 months of the project conception. At that time, it will be known as to whether there is legislative authority for certification of maintenance personnel. Whether there is authority at the state level, or a need at the local level, state rulemaking or drafting of a local ordinance for certification would begin immediately after the research aspects are completed with implementation projected at 12 months from the project conception. Concurrently during the certification process, public meetings would be held to gather input as to the type of entity to best fit the needs of the area. The options include, but are not exclusive of, a county ordinance, a district formation, contracting to an existing sewer district, or combination of the above. It is expected that an entity would be in place within 36 months of the project conception.

1.7.4 Task 4 - Develop a funding program to assist in low-interest loans for new on-site sewage system, repair, and/or replacement of existing on-site system using new denitrification technology.

The objective of Task 4 is to establish a permanent funding program to assist homeowners with installing new technology on-site systems, and repairing and retrofitting existing systems with new and innovative technologies during and after the duration of this study. As such, DEQ and Deschutes County will establish a low-interest, self-funding loan program. The initial funding of the low-interest loan program will be provided through this project. Deschutes County will manage the program for the project duration.

Initially, this task will require research of various lending programs that are comparative in nature to the goal of this proposal; new and upgrading of systems or system components that are failing to the surface and/or may be contributing to groundwater contamination.

The existing lending programs that will be contacted include local governments in Oregon that currently offer low interest loans for utility assessments. These programs are believed to be comparable in that:

- Public health risk and pollution control is emphasized.
- The local entity has in place procedures in compliance with Oregon laws for lending.
- The local entity has developed a process for checking the credit worthiness of the applicant.
- The local entity has a process for collection of the payments and protection of the loan in case of default.
- The program is designed and operated for an indefinite life.

A lending program developed to fit the South Deschutes needs will then be drafted with the assistance of financial officers within both DEQ and the County.

The priority consideration will be given to applicants who fall into the categories listed below. Low-income property owners that are in one of the categories listed below will be given higher priority.

<u>Loan Application Categories:</u>

1. Property owners with systems failing to the surface. An average of 40 repairs are requested per year in the area.

2. Property owners with systems where the drainfield is, at some time of the year, in contact with the groundwater. Estimates place this number at approximate 200. They are considered failures but are difficult to prove other than by water table measurements.

3. Property owners with leaking tanks. These tanks can contribute sewage effluent directly to the groundwater in the many areas of shallow water tables. An average of 30 tanks are replaced each year.

4. Property owners installing new systems. As development occurs in the La Pine region, new on-site systems will be installed. Growth in the La Pine region will continue. County records indicate an average of 150 new building permits per year were issued over the past few years. This trend is expected to continue which results in a net increase in nitrate loading to the aquifer. The fund may provide financial assistance in installing the nitrate-reducing technologies.

The first year will consist of establishing the fund and developing fund management and operation protocols. Simultaneously, the County will identify properties during the first two years that require repair and/or upgrades and recruit these properties to be involved in Task 1. As information becomes available from tasks 1, 2, and 7 the final implantation plan will be formed after the first two years.

1.7.5 Task 5 - Collect and analyze field data on new and retrofitted septic systems and from the groundwater monitoring network.

In order to evaluate the new and retrofitted septic systems as well as monitor groundwater quality, it is necessary to collect and analyze data, utilizing sound and scientific methods. In addition, up to five existing non-retrofitted sites as control to compare of performance new and retrofitted sites. Task 5 includes the following elements:

- Groundwater monitoring well selection, location and installation
- Groundwater sample collection
- On-site sewage system sample collection
- Existing on-site system control site sample collection
- Recording field data
- Calibrating field instruments
- Chain-of-Custody documentation
- Sample handling and transport
- Health and safety

DEQ and/or Deschutes County Environmental Health Division staff will collect samples and other pertinent field data for the on-site system performance evaluation. In addition, samples collected for groundwater modeling and on-site system groundwater monitoring wells will be collected by DEQ, US Geological Survey (USGS) and Deschutes County Health Division. The details and protocols for implementing Task 5 are provided in the Field Sampling Plan (Appendix A).

1.7.6 Task 6 - Conduct laboratory analytical testing of system effluent and groundwater samples.

All analytical testing of the on-site system effluent and groundwater samples will be in accordance with the protocols established in the Sample Analysis Plan (Appendix B). The samples will be analyzed by DEQ's laboratory in Portland, Oregon, except bacteria samples. The Oregon Health Division will analyze bacteria samples at it's laboratory in Portland.

The analytical results will under go quality assurance (QA) and quality control (QC) as specified in the Sample Analysis Plan. Subsequent to the QA/QC process, the results will be entered into the Laboratory Information Management System (LIMS) database at DEQ and uploaded into the U.S. EPA STORET database. The results will then be made available to the project manager for analysis of on-site system performance as identified in Tables 1and 2 (Section 1.7.1.5) and groundwater quality.

1.7.7 Task 7 - Conduct 3-Dimensional groundwater flow and nitrate fate and transport modeling, and lot size optimization modeling for nitrate loading reduction

The goal of task 7 is to develop an understanding of the three-dimensional groundwater flow regime and the fate and transport of nitrate in groundwater within the study area. In addition, one of the principle objectives from the modeling effort is an estimation of development/lot densities based on the nitrogen handling capability of the aquifer while restoring, maintaining, and/or improving the high water quality of the aquifer. The principle objectives of Task 7 are:

- Determine the fate and transport of nitrate in groundwater within the study area.
- Determine the effects of on-site systems on the groundwater quality.
- Estimate the nitrogen loading capacity of the aquifer to determine optimal lot size (density) while protecting and/or improving the existing water quality to be utilized as a planning tool for growth in the La Pine region.

The groundwater model will be a three-dimensional finite element model developed in a cooperative effort of the U.S. geological Survey and DEQ. The groundwater and nitrate fate and transport modeling work plan is presented in Appendix C.

1.7.8 Task 8 - Prepare quarterly progress reports and a final project report

Project progress reports will be submitted to the US EPA quarterly. The progress reports will summarizes the activities and goals accomplished during the quarter, project and/or on-site system challenges encountered during the quarter and actions taken to resolve these challenges, status of the project schedule with respect to project milestones, and identification of the objectives and goals for the next quarter. Program adjustments will be reviewed and made as appropriate based on EPA's review comments of the quarterly reports. In addition, DEQ, Deschutes County and the USGS will hold quarterly public information meeting on the project's progress and preliminary findings, as well as to answer questions from the public.

A final report will be submitted upon completion of the project. The final report will include the following elements:

- Summary of the project objectives.
- Summary of the technical approach.
- Summary of geologic and hydrologic conditions of the La Pine region.
- Summary of specific site conditions, including soils and groundwater, where the new and innovative technologies have been installed.
- A technical summary of each new and innovative on-site system type.
- Presentation of the on-site systems performance data, analysis of the data, and discussion of on-site system types with respect to the minimum performance goals and criteria presented in this work plan.
- Presentation of the hydrologic model and the nitrogen fate and transport model methodology, model assumptions, conceptual model, and model results (a summary of the model results which will be publishes separately as a USGS Water-Resources Investigations Report.
- A summary of the development/lot density modeling approach and results.
- A discussion of conclusions reached based on the project data, on-site systems performance, and hydrogeologic/fate and transport model results.
- A summary of recommendations based on the overall project results.

All project reports, except USGS quarterly progress reports and data will be posted on DEQ's On-Site Program's web site. A link to the USGS project web site will be created in the DEQ web sites. In addition, a link will be created in the Deschutes County web site to DEQ's web site.

2.0 BUDGET AND TIME SCHEDULE

2.1 Budget

La Pine, Oregon has been selected to be a recipient of federal funding as a part of the National Community Decentralized Wastewater Demonstration Project. The U.S. Congress has selected three geographically and geologically diverse sites for these projects which includes Warren, Vermont ($1.5 million), Block Island/Green Hill Pond, Rhode Island ($3.0 million), and La Pine, Deschutes County , Oregon ($5.5 million).

In addition to the federal grant, the U.S. Geological Survey will be providing a match of approximately $471,500 for U.S. Geological Survey work under Task 7.

The budget will be administered by the U.S. EPA as a construction grant. The $5.5 million awarded to DEQ will be distributed by task as indicated in Table 3.

Table 3
Budget by Task

Task	Budget ($)
Task 1: Install new and retrofit existing on-site systems	2,300,000*
Task 2: Establish regional monitoring well network	200,000
Task 3: Establish on-site system maintenance entity	450,000
Task 4: Develop low-interest loan funding program	1,000,000*
Task 5: Collect and analyze field data	300,000
Task 6: Perform laboratory tests on field samples	600,000
Task 7: Conduct hydrologic and nitrogen fate/transport model	500,000
Task 8: Prepare quarterly and a final report	150,000
Total	5,500,000

* The funding base to implement these various tasks may be adjusted as the grant and low-interest loan program is developed.

2.2 Project Schedule

The project duration will be five (5) years. The anticipated schedule is provided in Table 4.

Table 4
Anticipated Project Schedule

	Start Date		Completion Date	
Task	**Month**	**Year**	**Month**	**Year**
1	May	1999	August	2001
2	May	1999	August	2000
3	October	1999	October	2004
4	October	1999	October	2004
5	May	1999	April	2004
6	May	1999	April	2004
7	May	1999	October	2002
8	August	1999	October	2004

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