DEQ Water Quality Division

2002 / 2003 Progress Report For the Lower Umatilla Basin Groundwater Management Area

November 19, 2004

State of Oregon Department of Environmental Quality

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2002/2003 Progress Report for the Lower Umatilla Basin GWMA

1.0 INTRODUCTION

This report describes the progress made towards implementation of the Lower Umatilla Basin Groundwater Management Area Action Plan during the years 2002 and 2003. This report was prepared by the Oregon Department of Environmental Quality (DEQ) using information provided by the affected and interested parties involved in the Lower Umatilla Basin Groundwater Management Area. It should be noted that many of the parties contributing to this document are also doing other activities that are protective of groundwater both within and outside the GWMA. However, these "other activities" are not mentioned in this document because they are not directly applicable to implementation of the Action Plan.

This section of the report provides information on the establishment of the Lower Umatilla Basin Groundwater Management Area, the purpose of this report, important facts about nitrate, the goals of the Action Plan, and ways to measure success of the Action Plan.

1.1 Establishment of Lower Umatilla Basin Groundwater Management Area

Oregon's Groundwater Protection Act of 1989 requires the DEQ to declare a Groundwater Management Area (GWMA) if area-wide groundwater contamination, caused primarily by nonpoint source pollution, exceeds certain trigger levels.

Nonpoint source pollution of groundwater results from contaminants coming from diffuse land use practices, rather than from discrete sources such as a pipe or ditch. The contaminants of nonpoint source pollution can be the same as from point source pollution, and can include sediment, nutrients, pesticides, metals, and petroleum products. The sources of nonpoint source pollution can include construction sites, agricultural areas, forests, stream banks, roads, and residential areas.

The Groundwater Protection Act also requires the establishment of a local Groundwater Management Area Committee comprised of affected and interested parties. The committee works with and advises the state agencies that are required to develop an action plan that will reduce groundwater contamination in the area.

The Lower Umatilla Basin GWMA was declared in 1990 after nitrate contamination was identified in a 352,000-acre area in the northern portions of Umatilla and Morrow Counties. Groundwater samples from private wells identified nitrate contamination above the federal safe drinking water standard in many samples collected from the area. A four-year comprehensive study of the area was conducted in the early 1990s by the DEQ, the Oregon Water Resources Department, and the Oregon Health Division (now known as the Department of Human Services). The 1995 report titled "Hydrogeology, Groundwater Chemistry, & Land Use in the Lower Umatilla Basin Groundwater Management Area" identified five potential sources of nitrate loading to groundwater:

1. Irrigated Agriculture
2. Land Application of Food Processing Water
3. Septic Systems (rural residential areas)
4. Confined Animal Feeding Operations, and
5. The Umatilla Chemical Depot Washout Lagoons

The Lower Umatilla Basin Groundwater Management Area Action Plan was finalized in December 1997. The Action Plan details the activities to be conducted by the various agencies and organizations involved. The Umatilla and Morrow County Soil and Water Conservation Districts are the local agencies leading implementation of the Action Plan. The ODEQ and ODA have oversight responsibility. Local governments, private industry, and the US Army are also involved in implementation of the Action Plan. The Action Plan recommends general activities and specific tasks to be conducted by involved agencies and groups representing the five sources of nitrate loading. The Action Plan also identifies methods and a schedule for evaluation of the Action Plan progress. It was decided to implement the Action Plan on a voluntary basis recognizing that individuals, businesses, organizations, and governments will, if given adequate information and encouragement, take positive actions and adopt or modify practices and activities to reduce contaminant loading to groundwater.

The ODEQ samples a network of 35 wells[1] every other month for analysis of nitrate. Approximately once a year, these wells are sampled for a larger list of analytes including major ions, metals, and additional pesticides. These data are being used to evaluate changes in groundwater quality over time in response to adoption of BMPs. Progress is being made at land surface, but it may take years or even decades for groundwater quality to return to natural background levels.

1.2 Purpose Of This Report

In accordance with Section VII, Item B.1 of the Action Plan, the purpose of this report is to outline the activities undertaken by the various interested parties related to implementation of the Action Plan during the year 2002 and 2003. In addition, groundwater quality information collected from the bi-monthly monitoring well network is presented.

1.3 Important Facts About Nitrate

The following information is, in large part, from the June 2001 Oregon Health Division's Technical Bulletin - Nitrate Health Effects Information. Edits have been made to the "What is Nitrate and What Are Its Uses" section of the Technical Bulletin and a few comments on blue baby syndrome have been included. This background information is provided to educate the reader and provide a context for the remainder of the report.

Nitrate Synonyms

There are no synonyms for nitrate but there are a number of nitrogen compounds that are important in nitrate effects including nitrites, amines and nitrosamines. All may be present along with nitrates in the environment and in the human body.

What Is Nitrate And What Are Its Uses

Nitrate is a naturally occurring oxide of nitrogen. Nitrogen is always present in the air and it reacts with oxygen and ozone to produce several nitrogen oxides of which nitrate is one. Nitrogen oxidation also occurs in aerobic growing and decomposing biological systems such as soils. Nitrogen is an essential component of living things and is a major component of animal manure, human sewage waste and many commercial fertilizers. Nitrogen in the environment occurs in organic and inorganic forms. There are two dominant inorganic forms: nitrate and ammonia. Most organic and inorganic nitrogen fertilizer sources are ammonia or organic based, not nitrate. Organic nitrogen converts to ammonia which gets oxidized to nitrate by the soil's microbiological system. Most plants take up nitrogen in the nitrate form. Nitrate must be present in the soil for adequate nitrogen uptake by plants. Nitrate has been used for centuries as fertilizers, in explosives and as a food preservative.

How Can I Be Exposed To Nitrates

Everyone is exposed regularly to nitrates because of their presence in foods, in water and because they are formed during digestion and metabolism in our bodies. Nitrates are not harmful unless our exposure to them is excessive. Very young infants, persons taking nitrogen-containing medications, persons who work with nitrates occupationally, and persons with genetic susceptibility to nitrates are harmed at lower exposure levels than others; but high nitrate exposures above the current MCL may be harmful to everyone.

Occurrence And Sources Of Nitrate In Water Supplies

Naturally occurring levels of nitrate in surface and groundwater do not generally exceed 2 milligrams per liter (mg/l). Sources of nitrate in water include fertilizers, septic systems, animal feedlots, industrial wastes, and food processing waste. It can also be naturally occurring in certain geological settings, and can result from decaying organic matter. Elevated levels of nitrate found in well water usually indicate improper well construction or location, overuse of chemical fertilizers or improper disposal of human and animal waste in the vicinity of the well. Water with less than 10 mg/l nitrate as nitrogen (NO_3-N) is generally safe for all household activities including use in foods and beverages.

[1] The well network originally included 38 wells. However, 3 wells were eliminated from the network in 2003 when written permission to continue sampling could not be obtained.

Health Effects Of Drinking Nitrate Contaminated Water

The United States Environmental Protection Agency (USEPA) has set a maximum contaminant level (MCL) of 10 mg/l for nitrate (NO_3-N) in public water supplies. Nitrate levels above 10 mg/l may present a serious health concern for infants and pregnant or nursing women. Adults receive more nitrate exposure from food than from water. Infants, however, receive the greatest exposure from drinking water because most of their food is in liquid form. Nitrate can interfere with the ability of the blood to carry oxygen to vital tissues of the body in infants of six months old or younger. The resulting illness is called methemoglobinemia, or "blue baby syndrome".

Pregnant women may be less able to tolerate nitrate, and nitrate in the milk of nursing mothers may affect infants directly. These persons should not consume water containing more than 10 mg/l nitrate directly, added to food products, or beverages (especially in baby formula). Other domestic uses of affected water such as irrigation, washing and bathing do not result in nitrate absorption. The 10 mg/l standard for NO_3-N in public drinking water supplies has been devised to protect a select group of sensitive persons (infants, and pregnant and nursing women).

It has been suggested in human studies that nitrate ingestion may be linked to gastric or bladder cancer. This link, however, has not been firmly established and current exposure levels do not appear to put the population at risk. There is also some evidence that areas having elevated nitrate in drinking water may have increased incidence of spontaneous abortion.

It should be noted that some members of the LUB GWMA Committee believe that blue baby syndrome has not been shown to be a problem in the LUB GWMA. Their belief is based on the lack of reported cases of the illness in the area. Other members of the LUB GWMA Committee counter that argument by noting that blue baby syndrome is often mis-diagnosed, and the medical community is not required to report cases of blue baby syndrome. Regardless of the extent of the blue baby syndrome in the area, the LUB GWMA Committee is committed to reducing the level of nitrate contamination in groundwater.

Removing Nitrate From Drinking Water

Heating or boiling water containing nitrate will not remove the nitrate, the loss of water actually concentrates it. Options to consider if the water supply is contaminated with nitrate above the 10 mg/l level include using bottled water for drinking, and for food and beverage preparation, or installing a home water treatment unit. Mechanical filters or chemical disinfection, such as chlorination, do not remove nitrate from water. Nitrate may successfully be removed from water using treatment processes such as ion exchange, distillation, and reverse osmosis. These treatment techniques require careful maintenance and sampling to achieve and confirm effective operation. If a treatment system is to be used, one with National Sanitation Foundation (NSF) certification should be selected. For additional information on these options, contact the Drinking Water Section of the Department of Human Services at (503) 731-4010.

1.4 Action Plan Goal

The ultimate goal of the Action Plan is to seek solutions to protect the area's groundwater. Recommended solutions should, within a reasonable time, bring the level of nitrate-nitrogen in the groundwater back below the 7 mg/l level triggering the declaration of a GWMA.

1.5 Action Plan Implementation

The Action Plan recommends general activities and specific tasks to be conducted by involved agencies and groups representing the five sources of nitrate loading. The Action Plan identifies methods and a schedule for evaluation of the Action Plan progress. The Action Plan is also voluntary. It was decided to implement the Action Plan on a voluntary basis recognizing that individuals, businesses, organizations, and governments will, if given adequate information and encouragement, take positive actions and adopt or modify practices and activities to reduce contaminant loading to groundwater.

1.6 Measures of Action Plan Success

The Action Plan includes specific ways to gauge success that are focused on each sector. Assessments are primarily conducted on four-year cycles. The specific parties to conduct the assessment are also identified. For each of the five sectors, some benchmark information was to be obtained within 2 years. Other measurable goals for each sector are at 4, 8, 12, etc. years after Action Plan adoption.

2.0 EDUCATION / OUTREACH ASPECTS OF ACTION PLAN IMPLEMENTATION

This section of the report includes information on the educational / outreach activities conducted as part of the Action Plan implementation, general cataloging of information, printed material available, information sources, and future needs in education / outreach.

2.1 Educational / Outreach Activities Conducted

General Information

The Umatilla County SWCD has performed educational and outreach activities focused on the irrigated agriculture and rural residential sectors of the LUB. The Umatilla County SWCD also assists and supports educational meetings held by county extension agents.

The Umatilla County SWCD developed a "Lower Umatilla Basin Groundwater Management Area Education and Outreach Plan" dated December 23, 1997. The plan set forth two goals: 1) Emphasize through education and outreach, the economic importance of groundwater to the citizens of the Lower Umatilla Basin; and 2) Develop steps or measures that increase awareness of groundwater problems and the need for protecting and improving the quality of the resource.

Examples of specific Umatilla County policies to address the educational aspect of the Action Plan implementation include:

1. Umatilla County will maintain a library of materials and contacts regarding BMPs to prevent water contamination.
2. Umatilla County may require video viewing or training regarding septic system maintenance as a condition of development approval.
3. Umatilla County may require video viewing or training regarding proper well placement, construction, and maintenance as a condition of development approval.
4. Umatilla County shall coordinate with other concerned entities to develop an outreach program regarding proper well and septic system maintenance, livestock containment, and lawn fertilization and irrigation.
5. Umatilla County will coordinate with the LUB GWMA committee in establishing an educational program regarding water contamination within the western portion of the County.

Umatilla County Planning Department

Umatilla County Planning has continued to address groundwater quality in the LUBGWMA and groundwater quantity in the Oregon Water Resources Department (OWRD) designated Critical Groundwater Areas (CGWA) through its Department of Land Conservation and Development Periodic Review process. In 2002, Planning Department staff conducted several Planning Commission workshops with Oregon Water Resource Department, Umatilla County Soil and Water Conservation District, Department of Environmental Quality (DEQ), Natural Resource Conservation Service and US Environmental Protection Agency. These workshops were conducted to obtain a clear understanding of the various agency responsibilities regarding groundwater and to assist the County in determining if any County action to limit development in the GWMA and CGWAs would be appropriate to protect groundwater quality and quantity. Each involved agency has some regulatory authority and responsibility. The County's role in the GWMA includes administering a land use code, developing options and alternatives to address the cumulative impact of septic systems, determining where in the basin septic systems could create groundwater degradation, determining how to incorporate groundwater quality concerns in land use review of development proposals, encouraging periodic septic system inspections and maintenance, and developing policies

that encourage guidelines establishing appropriate number of animals allotted per acre to prevent groundwater contamination. The County decided it could not justify amending its Zoning Development Code to restrict development on lands in order to limit nitrate contamination from on-site septic systems. The DEQ has jurisdiction to site and permit septic systems. Responsibilities of other agencies were also identified.

To better understand the impact that a County Ordinance change, or other regulatory action to restrict development, might have on the overall nitrate problem, Planning staff conducted an inventory of lands zoned rural residential, industrial and commercial within the GWMA. Lands with Rural Residential (RR-2 and RR-4) zoning comprise about 5% (7,693 acres) of the 151,680 acres of land in the Umatilla County portion of the GWMA. Lands zoned Industrial, Commercial and Rural Residential within the GWMA comprise about 7% of the total GWMA acreage (10, 609 acres) leaving 93% zoned for agricultural use (EFU). Further analysis of County Assessor records indicates that these lands are approximately 78% built out (lots that have existing development) with approximately 2,076 of 10,609 acres undeveloped at this time.

The majority of the rural residential, industrial and commercial zoned lands within the County's planning jurisdiction in the GWMA have been built out. The cumulative impact of septic systems from those lands that have yet to be developed has not been determined. In light of this, the County Planning Commission asked the opinion of the LUBGWMA Committee as to whether or not to make a recommendation to the Oregon Environmental Quality Commission to consider a "Geographic Rule" as a way to evaluate the cumulative impact of on site septic systems and the impact the systems have on groundwater. The LUB GWMA Committee decided not to recommend pursuing a Geographic Rule at this time. County Planning staff also presented this concept to the Association of Oregon County Planning Directors (AOCPD) who agreed that cumulative impacts of septic systems should be considered as part of the On-site Rules. The AOCPD wrote a letter, dated August 23, 2002, to the DEQ On-Site Program Improvement Advisory Committee encouraging the Committee to consider promulgating rules that are specific to the various regions of the state and to develop a means to evaluate the cumulative effect of on-site septic systems.

The County's primary role in the voluntary Action Plan is to address groundwater quality issues influenced by land use, particularly rural residential. The 1995 Umatilla County Periodic Review Work Program contains several tasks related to the groundwater quality Statewide Planning Goal 6 and is available in the County Planning Department.

1. Umatilla County Planning has participated in the Hermiston Farm Fair each year providing presentations and working in conjunction with other Action Plan natural resource agencies regarding issues involving the LUBGWMA such as water quantity, flood plain, and water quality.

2. The Umatilla County Planning Department continues to have informational written material to present to citizens who inquire about development and natural resources.

3. The Umatilla County Planning Department has also participated, in conjunction with Columbia - Blue Mountain Resource Conservation and Development program, in the development of a natural resource information packet. This project is still in the development phase and will be printed to provide general resource information regarding the Umatilla/Morrow County area.

4. The Umatilla County Planning Department participated in a Umatilla County Soil and Water Conservation District (SWCD) sponsored class by making a presentation on water impacts to water quality and quantity.

Morrow County Planning Department

During 2002 and 2003, the Morrow County Code Enforcement Officer, opened four cases on properties for violations of animal densities. These enforcement activities have been documented and mapped. Morrow County also cooperated with DEQ in septic system violation cases.

Morrow County is also faced with water quantity concerns with three Critical Groundwater Areas and one Classified Groundwater Area identified. At the request of the OWRD in October 2003, Morrow County Planning staff reviewed current and potential lots in the groundwater limited areas for Morrow County. Reviewed was total acreage and its zoning or use, current dwellings in each zone, and the potential dwellings in each zone. The number of potential dwellings at full build out given the current zoning designations is 1,150. This is in addition to the current 813 dwellings. This does assume a fairly aggressive development pattern, but one not unlikely in a 50-year planning horizon.

The Morrow County Planning Department regularly distributes written materials about groundwater quality, OSU Home-A-Syst information, etc. to landowners. The distribution of this groundwater quality information is made a condition of approval of many land use permits, including subdivisions and partitions in residential zones. In addition, a general disclaimer about the impact a proposed development may have on groundwater quality is included in almost every "Finding of Fact" report for land use actions.

Examples of specific Morrow County policies to address the educational aspect of the Action Plan implementation include:

1. Morrow County maintains a library of materials regarding BMPs to prevent water contamination.
2. Morrow County coordinates with the LUB GWMA committee in establishing an educational program regarding water contamination.
3. The Morrow County Planning Department has also participated, in conjunction with Columbia - Blue Mountain Resource Conservation and Development program and others, in the development of a natural resource information packet for Morrow and Umatilla Counties.

Small Acreage Workshop

In 2002, the Umatilla County SWCD and the Oregon Association of Conservation Districts (OACD) hosted a series of three Small Acreage Workshops attended by about 160 people in Umatilla County. The Hermiston workshop had 40 to 50 attendees that learned about conservation planning, conservation regulations, irrigation management, crops and conservation, weed identification and control, and pasture and grazing management. Participants took home a notebook filled with information related to land management and water quality. Participants also suggested topics for future workshops.

Horse Management Workshops

In 2003, the Umatilla County SWCD and OACD hosted a series of Horse Management Workshops addressing horse health, irrigation and fertilizer management, pasture and grazing management, weed management, manure and compost management and conservation planning. The Hermiston session was attended by about 25 local residents.

Rural Residential Workshops

In December 2003, the SWCD hosted two workshops in Hermiston focusing on groundwater issues. Information was presented on wellhead protection, irrigation, and septic system operation and maintenance. Sixty local residents attended the workshops.

LUB GWMA Citizens Advisory Committee Meetings

The LUB GWMA citizens advisory committee held a meeting on March 25, 2002 at OSU Hermiston Research Station. Eighteen members of the committee attended. The group discussed selecting a new committee chair, reviewed 2001 goals, discussed information for next annual report, and ODEQ provided information on nitrate trends in food processing wells.

The LUB GWMA citizens advisory committee held a meeting on September 24, 2002 at the OSU Hermiston Research Station. The committee appointed Ron Rickman, Soil Physicist as the new chair. Ron recently retired from the USDA Agricultural Research Pendleton Station. Several attendees reported on the Technical Meeting

held on July 17, 2002. Dennis Olsen, Umatilla County Planning Director gave the committee an update on the water quality/quantity issues related to the county's Periodic Review.

On October 29, 2002 the LUB citizens committee held a meeting at the OSU Hermiston Research Station. The committee met to approve the 2001 Annual Progress Report developed by DEQ and committee members. Patty Perry, Umatilla County Planner updated the committee on current activities related to the County's Periodic Review.

WRD Groundwater Workshop

A public workshop was held in Pendleton in April 2003 that presented information and facilitated discussion about local groundwater issues. The event was organized by Oregon Water Resources Department and co-sponsored by local natural resource agencies including the SWCD.

E-notes, newsletters and website

The SWCD, through its' website, is maintaining a location for news about events and meetings of interest in Umatilla County and links to other newsletters and websites. Monthly, this information is sent out electronically to a growing number of recipients. Updates to groundwater information and programs will be regularly included. The periodic newsletter sent out both electronically and hard copy gives an accounting of events that the SWCD participates in and provides information about current programs.

LUB Technical Meetings

On January 10, 2002 the technical committee met in Pendleton. The meeting discussed (1) what's needed to finalize the EPA and WRD reports regarding recommended lot sizes to minimize septic system impacts; (2) what are the next high priority items for addressing the above issues; and (3) how should the RGI funds that were allocated in 1998 be used.

On July 17, 2002 the technical committee met to follow-up the technical discussion of January 10, 2002. The intent was to discuss the following: (1) the Rural Lands Database and what additional GIS layers are needed; (2) the EPA and OWRD reports and the upcoming Basin-wide ground water quantity study; (3) the potential range of solutions for addressing the above issues; (4) monitoring needs; and (5) funding needs and how the RGI funds that were allocated in 1998 should be used.

On October 30th, the LUB technical team met to discuss various topics related to the surrounding the Groundwater Management Area and Critical Groundwater Management Area. The group has been focused on assisting Umatilla County Planning Commission with the Periodic Review remand by DLCD.

Public Schools and Civic Groups

The City of Boardman has had an active interest in groundwater education since the early 1990s. The City offers public education in a variety of subjects, including groundwater, to public schools of the area and interested civic groups. Classes have been taught to grades 2 through 12 in the public schools. The City has a groundwater model that is used in several of the classes to show how contamination in groundwater can affect this area. This activity has garnered press coverage in previous years, which further spread the information to the public.

The City of Boardman has developed and distributed flyers and handouts on the Wellhead Protection Area to schools, at civic functions, and other opportunities.

DEQ personnel periodically visit local schools to demonstrate ways to prevent pollution of groundwater and surface water by using a groundwater model and an Enviroscape® model.

OSU Extension staff in Hermiston gave nearly 100 presentations in 2002 and 2003 at national, regional, state, and local venues. Most of these presentations involved soil testing, crop fertilization needs, nutrient management, and practices to reduce nitrogen loading to the groundwater. Local presentations were made at venues such as

growers meetings, Farm Fair, Kiwanis Club meetings, workshops, training seminars, Hermiston High School and local Cub Scout troops

OWEB Small Grant Projects

The Morrow SWCD assisted seven new landowners with small grant projects located in the LUB GWMA. Two projects will improve irrigation efficiency by converting flood irrigation to sprinkler systems in the West Extension Irrigation District and another will improve grazing management by installing a more efficient livestock watering system.

The Umatilla SWCD assisted two new landowners located in the LUB GWMA with applications. One project will help address grazing practices on a small acre operation and the other will improve irrigation efficiency by piping an open irrigation ditch.

Farm Fair

The Umatilla SWCD sponsored a booth at the 2002 event held in the convention center in Hermiston. The three-day event features speakers relating information on pesticide use, cropland production, cattle production and a specific session on regulatory issues. Several hundred visitors composed of primarily full time producers and small acre landowners from Oregon and Washington attend the fair. The booth focused, with significant input from Tom Straughan, on the recent changes in the livestock operation permitting. The booth featured some before and after pictures, AFO/CAFO eligibility chart, copies of the new rules and copies of the three AgWQMAP for Umatilla, Walla Walla and North Fork John Day. The Program manager manned the booth (described in LMA report) for approximately 12 hours, having in-depth conversation regarding water quality issues with several producers.

The 2003 display was titled "Improving Water Quality Voluntarily" and provided information about rural residential practices (wellhead protection, septic system operation and maintenance), irrigation management practices, and confined animal feeding practices. Fair participants were surveyed for knowledge about local groundwater issues.

Water Wells

Between January 1, 2001 and December 31, 2003, 565 water supply well reports were submitted to the OWRD for Umatilla and Morrow counties. Of the well reports submitted, 475 (84%) were for domestic or community use. Well logs and well construction information are some of the most requested information. On a daily basis, OWRD staff answer questions from the public and well contractors on well construction issues. OWRD publishes a Consumers Guide to well construction. In this publication general well construction questions are answered. These include well set back, household water needs, water right requirements, selecting a contractor, well abandonment, drilling your own well, and other well topics. This pamphlet is handed out to any one inquiring about wells. This is also made available to other agencies for their uses in dealing with the public. Individuals with internet access can obtain a copy online at www.wrd.state.or.us under the publication link.

On a daily basis, OWRD staff deal with well contractors and the public on well construction issues. When a new or recently constructed well is found to be mis-constructed, OWRD requires the well to be repaired or abandoned. When people contact OWRD with water quality problems, well construction and well placement are investigated as the possible cause of the problem. OWRD staff educate the public on how poor well construction can lead to poor water quality.

On the second Monday of every quarter, the OWRD gives its test for new water well drillers. A week prior to this test, the North Central Region Office in Pendleton offers an informal four hour class to individuals wishing to take the drillers test. In this class the State well construction rules and statutes are discussed. Heavy focus is placed on well location, sealing depth, areas of known nitrate contamination, alternative well construction methods, under reamer systems, and telescoping casing methods of construction. In addition to the new driller education, OWRD staff work with SWCD and other agencies on workshops for realtors and other interested

public. Some of the topics covered in these workshops include basic well construction, sand point wells, well location, well abandonment, and water rights.

In 2001, the State legislature passed SB 579, which requires licensed drillers to attend classes in order to obtain Continuing Education Credits (CECs). Each driller is required to have 14 CECs per two-year licensing cycle and must show proof of CECs when licensing in and after 2005. In late 2003, OWRD held a series of workshops across the State to help drillers obtain the necessary CECs required by SB 579. In 2004, classes are planned in the Pendleton/Hermiston area. Topics for this workshop include geology of the Umatilla Basin, septic system location, and nitrate contamination in groundwater.

Confined Animal Feeding Operations (CAFOs)

In cases where non-permitted CAFOs land-apply wastes, ODA offers educational reviews designed to assist operators in identifying potential pollution pathways associated with waste application. The CAFO program requires Agricultural Waste Management Plans for all permitted CAFOs. Through this process, appropriate BMPs are identified that are protective of waters of the state.

Assistance was given by the SWCD and ODA in filling out applications for new Confined Animal Feeding Operations permits and developing Animal Waste Management Plans. Routine inspections were conducted on operations. Upon request, ODA provides individual evaluations of CAFOs to assess the adequacy of groundwater protection measures. These evaluations include a discussion BMPs appropriate for the specific facility.

Irrigation Water Management

The Morrow SWCD co-sponsored an irrigation management workshop in Irrigon. 30 irrigators and customers of the West Extension Irrigation District attended the workshop from the area.

2.2 Residential Survey

Surveys were conducted in 1999 and 2002 of 100 residents in the LUB GWMA to assess the level of awareness of residents to (1) the concerns of the groundwater quality in the GWMA, (2) the causes of the groundwater quality concerns, and (3) the methods which reduce the nitrate loading in the basin. The surveys also were used to help raise the level of awareness of households relative to these three issues.

The results of the May 1999 survey represent a baseline for future studies. The results of the 2002 show public awareness is about the same on some issues, and lower on other issues. Highlights of the survey results include:

- Concerns with Quality of the Groundwater – In 2002, 37% of those surveyed had heard of concerns regarding the quality of groundwater and 13% of those knew of the high nitrate levels specifically. This **percentage is lower** than was reported in 1999 where 57% had heard of concerns regarding groundwater quality (a drop of 20 percentage points) and 24% (a drop of 11 percentage points) knew of the high nitrate levels. The most frequently cited place where these individuals had heard about the groundwater concerns was through friends, neighbors, or relatives (16%) followed by the newspaper (9%).
- Concerns with Elevated Nitrate Levels – In 2002, 29% of the respondents knew that elevated nitrate levels caused health concerns, while only a small portion (2%) of this group knew specifically that blue baby syndrome was of concern. These **percentages have decreased** since 1999 when almost half of the respondents (45%) were aware that elevated nitrate levels caused health concerns and 3% of that grew knew of blue baby syndrome.
- Knowledge of How to Improve the Quality of the Groundwater – In 2002, at least three fourths of the respondents knew that improper fertilizing (79%), septic system location and density (75%) and improper storage of fertilizers and household chemicals (83%) were contributors to the buildup of nitrates in the groundwater. These **percentages are similar** to the 1999 percentages which were 86%, 72%, and 72%, respectively. Additionally, approximately two-thirds of those responding in 2002 knew that concentrated animal manure piles (66%) and concentration of outdoor animals (66%) were also contributors. In 1999, these **percentages are almost the same** : 63% and 68%, respectively.

Approximately half knew that improper well location, well leakage, and age of well were also of concern. These **percentages are similar** to those in 1999 as well.

- Knowledge of Positive Steps or Actions to Reduce the Nitrate Buildup – In 2002, a majority of the individuals responding to the survey knew of most of the positive steps or actions one could take to reduce nitrate buildup in the groundwater. Using correct fertilizing methods (78%), checking the location of septic systems (68%), and properly storing fertilizers and household chemicals (84%) were mentioned by well over two-thirds of the respondents. **In 1999, more people knew** that using correct fertilizing methods (85%) and checking the location of septic systems (82%) were positive steps one could take and **less of the respondents knew** that properly storing fertilizers and household chemicals (77%) was beneficial.
- Knowledge of Possible Sources which Contribute to the Groundwater Concerns – In both 2002 and 1999 **most individuals could not name which sources were contributors to the groundwater concerns** in the area. In 2002, only 15% mentioned agriculture, 11% mentioned the Umatilla Army Depot, 6% mentioned food processing plants, and 4% mentioned animal-feeding operations. In 1999, these numbers were 18%, 5%, 11%, and 15%, respectively.
- Best Way for Individuals to Receive Information – In 2002, the best way for individuals to receive information was as follows: city newsletters (89%), brochures (83%), television (80%), radio (73%), friends, neighbors & family (73%) and local newspapers (over 60%). In 1999, most individuals (over 80%) felt that the media (local newspapers, radio, and television), brochures, and friends, neighbors & family were the best sources for them to receive information about the groundwater quality in the area.
- Where People Would Go If They Had Concerns About the Quality of the Water – In 2002, more than one-third (39%) of the individuals said they would turn to city government offices if they had concerns with the water quality. The second choice was the Oregon Department of Environmental Quality and OSU Extension, which were mentioned by 19% of the respondents. Respondents chose these same places in 1999.
- **Location of Well and Septic System and Acreage** – In 2002, almost half of all the households (41%) were located on a private well, 39% had a private septic system and 31% had homes that were located on more than one acre. Of those who had more than one acre, 13% had more than two animals. In 1999, there were a few more homes on private wells (44%) and private septic systems (42%). Additionally, 40% had homes located on more than one acre with 23% having two or more animals.
- **Free Educational Programs** – In both 1999 and 2002 most people would prefer to attend educational programs regarding water issues at fairs.

2.3 General Cataloging of Information

A bibliography of groundwater information is maintained at the Umatilla County SWCD office. The bibliography includes a wide range of information on topics related to groundwater issues.

The Umatilla County SWCD has a list of information and people knowledgeable in groundwater protection management for different sectors. The list is available at the Umatilla County SWCD office.

The City of Boardman maintains an information library which includes the Lower Umatilla Basin Study, the LUB Action Plan, the Wellhead Protection Study, inventories of all well logs filed with the Water Resources Department in Township 4N / Range 25E, numerous materials on groundwater protection strategies for construction, storm water management and others. This information is available to the staff, decision-makers in the community, and the general public for review or research.

Umatilla County recognizes groundwater quality and quantity as a concern. Under the State-mandated Periodic Review process, Umatilla County included groundwater quality and quantity in its Periodic Review Work Program. Umatilla County staff has made an inventory of groundwater studies conducted in Umatilla County by various agencies. Specific areas having groundwater quality and quantity problems for the entire County were identified based on the studies inventoried. DEQ, SWCD, EPA, and OWRD are working with the County to address these concerns in response to DLCD's remand of the County's Periodic Review.

2.4 Printed Material

BMP Handbook

The Umatilla County SWCD staff has a Best Management Practices Handbook describing BMPs for air, surface water, and groundwater in one user-friendly document. The handbook was created to make available to the farmer the BMPs for soil erosion and water quality protection (both groundwater and surface water) in the Umatilla Basin in an easy to use and practical format. The document is available at the Umatilla County SWCD office.

Other Educational Printed Material

The following educational materials are available at the Umatilla County SWCD:
Tips on Land & Water Management for Small Acreages in Oregon
Blue Thumb Pamphlet, Water Conservation Tips
Basic Guide for Lawn Maintenance (Pendleton Public Works Pamphlet)
Home*A*Syst pamphlet and worksheets 1-11
Farm*A*Syst overview booklet titled "Twelve simple things you can do to protect well water"
Home*A*Syst pamphlet titled "Why do septic systems fail?"
Groundwater: Pollute or Preserve? It's Your Choice (OSU Extension Circular 1343)
LUB Groundwater Action Plan
Oregon Groundwater Community Involvement Program
"I Love Water" pamphlet

2.5 Information Sources

The following table contains contact information for various topics related to the GWMA.

Topic	Contact	Organization	Telephone #
Irrigated Agriculture BMP Implementation	Bev Kopperud Janet Greenup Don Horneck Loren Unruh	Umatilla County SWCD Morrow County SWCD OSU Extension NRCS	(541) 276-8131 (541) 676-5452 (541) 567-8321 (541) 278-8049
Health effects of nitrate and/or how to remove nitrate from your drinking water	Drinking Water Section	Oregon Health Division	(503) 731-4010
Protecting groundwater quality while developing property	Carla McLane Patty Perry	Morrow Co. Planning Umatilla Co. Planning	(541) 922-4624 (541) 278-6252
Groundwater quality protection guidelines related to lawn and garden maintenance	Bev Kopperud Don Horneck	Umatilla County SWCD OSU Extension	(541) 276-8131 (541) 567-8321
Groundwater quality protection guidelines related to well construction and maintenance	Brian Mayer	Oregon Water Resources Department	(541) 278-5456
Groundwater quality protection guidelines related to animal density	Eric Moeggenberg	Oregon Department of Agriculture	(541) 475-7155
DEQ's bi-monthly monitoring well network	Phil Richerson	Oregon Department of Environmental Quality	(541) 278-4604
Properly siting, installing, and maintaining a septic system	Bernie Duffy or Bob Marshall	Oregon Department of Environmental Quality	(541) 276-4063

2.6 Future Needs in Education / Outreach

The following items have been identified that would assist in the education and outreach aspects of Action Plan implementation:

- Translate additional educational materials into Spanish and make them available to the Spanish-speaking population within the GWMA.
- Conduct more proactive education/outreach activities such as neighborhood meetings, direct mailings, and information at gatherings specifically for the Spanish-speaking populations.

3.0 DETERMINATION AND IMPLEMENTATION OF BMPS

This section of the report includes discussions of various research projects for determining BMPs relevant to the Lower Umatilla Basin. Examples of specific BMPs implemented are also discussed.

3.1 Research into BMP Determination

Research into BMPs has occurred on several levels since declaration of the GWMA. Specific activities related to BMP determination for irrigated agriculture and rural residential development are discussed below.

Irrigated Agriculture

Most agri-chemicals, including nitrogen fertilizers, currently used in the LUB are applied through, or at least under, center pivot irrigation systems. If nutrients and irrigation water are not properly managed, nitrate can leach through the root zone and contaminate groundwater. The primary BMPs to minimize nitrate leaching, cited throughout the scientific literature, are proper irrigation management and the metering of fertilizer throughout the season.

Proper irrigation management involves the careful monitoring of the soil moisture in the root zone and scheduling irrigation to maintain soil moisture near field capacity. The goal of irrigation management is to prevent over-irrigation and under-irrigation.

Proper nutrient management involves knowing the type, amount, and timing of fertilizer application so that no more nutrients are applied than the crop needs so that excess nitrate is not available for leaching. As with soil moisture, knowing the amount of each nutrient in the soil and how much the crop needs allows the application of just the right amount of fertilizer. With the development of chemigation techniques, such metered applications of fertilizer are possible through center pivot and drip irrigation systems.

Some of the past research into determining BMPs for irrigated agriculture in the LUB has revolved around quantifying what constitutes proper irrigation and nutrient management for the local crops, soils, and climate. By quantifying nitrogen present below the root zone, a grower is able to adjust nutrient management practices by adjusting application timing and rates and/or elect to plant an appropriate deep-rooted crop to capture excessive levels of deep nitrogen thus averting nitrate leaching to groundwater. The primary goal of a series of projects partially funded through DEQ's Nonpoint Source Management Program (also known as the 319 program) and involving landowners, IRZ Consulting, and OSU Extension service, was to demonstrate to growers the direct benefits of using deep soil sampling and irrigation water analysis as part of their fertilizer and water management program.

OSU Experiment Station staff in Hermiston continue studying nitrogen uptake in potatoes and onions. The potato data is available in a WSU nutrient management guide and the onion information is available in a PNW onion publication. Kentucky bluegrass is currently being researched for nitrogen utilization and optimum fertilizer practices. The bluegrass work is in initial stages. The data has not yet been linked to the Northwest Irrigation Network.

Rural Residential Development

Umatilla County has incorporated groundwater quality concerns in their Comprehensive Plan Policies. Examples of Umatilla County's policies to address groundwater quality issues in the rural residential setting include:

1. Umatilla County recognizes that the development of performance standards will assist in protecting the quality of groundwater.
2. Umatilla County recognizes the Lower Umatilla Basin Groundwater Management Area and will take the actions requested within the Groundwater Management Area Action Plan.
3. Umatilla County will work in cooperation with DEQ and EPA to determine standards to lower nitrate concentrations in groundwater.

4. Umatilla County will work with DEQ and EPA to develop performance standards for land use development to maintain water quality at a sustainable level both within and outside of designated Critical Groundwater Areas.
5. Umatilla County shall work with DEQ to determine the effectiveness of alternative on-site septic systems in removing nitrates.
6. Umatilla County will consider several factors when creating solutions to the groundwater quality limitations on development. These solutions may include but are not limited to performance standards, alternative septic system technologies, transferable development credits, and sewer systems within cluster development sites.
7. Umatilla County will remain informed about the Source Water Assessments of public water systems and will take necessary steps to limit determined sources of contamination to public water systems.
8. Umatilla County shall encourage and assist managers of all public or community water systems to implement a well head protection program for their wells.

The City of Boardman is in the process of Comprehensive Plan Review and a review of the zoning and development ordinances to assess the need for changes. Incorporation of the Wellhead Protection Area into the Comprehensive Plan is part of the required work items under review. Additionally, groundwater protection in general is being looked at within this review. This process is expected to take until 2003 to complete; however, implementation of some of the concepts already identified is currently taking place. The Planning Commission and Boardman City Council have supported these efforts and expect them to be part of the Comprehensive Plan and the Ordinances when they are completed.

No research regarding BMP determination for septic systems in rural residential development, CAFOs or the land application of food processing process water was conducted in the LUB GWMA in 2002 or 2003.

CAFOs

ODA has developed an inventory of potential CAFOs and AFOs. Evaluations are ongoing to determine the status of these operations. All permitted CAFOs are required to follow an approved Animal Waste Management Plan. Each Plan incorporates the applicable BMPs as described in NRCS standards.

ODA has begun to develop a prioritized list of information, research and demonstration needs related to CAFO/AFO management and groundwater protection. Pasture management and manure storage are issues that have been identified as important for small acreage farms. It is believed that feed store operators could be instrumental in distributing this information. DEQ, ODA, and SWCD are discussing possible funding opportunities to implement various educational and outreach tasks.

3.2 BMP Implementation

BMP implementation has occurred on several levels since declaration of the LUB GWMA. Specific examples of BMP implementation are discussed below.

Irrigated Agriculture

The Umatilla County SWCD Water Quality Coordinator created a "Nutrient Management Worksheet" for use by NRCS planning staff working in the Lower Umatilla Basin.

Irrigation Management – Companies like IRZ Consulting and Simplot Soilbuilders play an important role in implementing irrigation management in the LUB.

IRZ's irrigation management service includes soil moisture monitoring, an on-line source of daily crop water use and evapotranspiration reports, the use of aerial infrared photography, the development of comprehensive water conservation plans, and irrigation scheduling software.

Simplot Soilbuilder's irrigation scheduling and crop water management services utilize crop ET rates, plant water uptake within the root zone and moisture movement through the soil profile.

Morrow SWCD conducted a project in the LUB GWMA that accomplished irrigation efficiency improvements. OWEB Small Grant Program funds were used in cooperation with the West Extension Irrigation District and 5 landowners. Flood irrigation had caused excessive drainage water and tail water. Most of the cooperating landowners converted to sprinkler irrigation. It is estimated that 180 acre-feet of water will be saved per year. Morrow County Road Department will also benefit since tail water will no longer be flowing across its right-of-way, causing damage to the roadway.

Implementation Funding
The SWCD directors held two special meetings to develop resource concern priorities and develop ranking criteria for the 2003 EQIP season. EQIP Ground and Surface Water funds are available for funding irrigation efficiency projects. The directors convened the Local Working Group, which serves as an advisory committee at the county level. At the county level approximately $800,000 was available to growers implementing conservation practices in 2003. The annual amount increases every year until 2007. The Local Working Group meets annually to review the resource priorities and ranking criteria.

Currently, USDA EQIP funding is providing cost share to participating growers to conduct vadose zone sampling. One grower is conducting vadose zone sampling on 500 irrigated acres.

Giddings Probe - OSU Extension Service provides maintenance and one-on-one training for a Giddings Probe used for deep soil sampling. It was checked out for 225 days in 2002 and 2003 for sampling in Umatilla and Morrow Counties.

The Giddings Probe is used for deep soil sampling. This is of particular value following high nitrogen use, shallow rooted crops. Sampling after crops such as potatoes and onions to depths beyond two feet is difficult with hand probes. The Giddings probe was acquired to allow deeper sampling: to four feet, six feet, or even deeper (samples have been collected from nine feet where soil depth allows). The concept is to measure the amount of residual nitrogen, particularly in the three to five feet zone that might still be pulled back up and utilized by a "sponge crop" such as cereal, grass seed, or sudan grass. Although alfalfa leaves some residual nitrogen itself, this is generally deposited in the surface two feet and its deeper rooting habit (even to depths of six to seven feet) can be an effective way to move nitrogen back to the surface where it can then be removed with the harvested crop.

CAFOs
Educational reviews were (and still are) offered by ODA to assist operators in identifying potential pollution pathways associated with waste application. The CAFO operator identifies and adopts BMPs through the Animal Waste Management Planning process. ODA reviews Animal Waste Management Plans (AWMPs) that are submitted as part of a CAFO's National Pollutant Discharge Elimination System (NPDES) permit. ODA offers courtesy reviews of AWMPs written for non-permitted operations.

As of October 2003, all permitted large CAFOs are required to take annual manure samples and analyze them for N, P, & K. ODA evaluates these results and crop needs to determine if manure is being applied at agronomic rates.

Rural Residential

The City of Boardman includes groundwater protection and wellhead protection as integral parts of staff reports developed for land use decisions within the jurisdictional boundaries of the City, the Urban Growth Boundary, and the delineated Wellhead Protection Area. Although there is not a Wellhead Protection Ordinance, review of potential impacts of any development is accomplished through a process of staff review, Site Team review (bringing in other utilities and agencies for review), and Planning Commission approval (when use is not outright). These reviews allow for the assessment of groundwater and other environmental impacts to be addressed or mitigated prior to development. The City of Boardman does not allow new septic systems within the City limits.

The City of Boardman has developed a Municipal Sewer System Plan that includes a requirement for developers to extend sewers to new developments within City limits, and that prohibits new septic systems within 300 feet of the municipal sewer system.

Morrow County was actively involved in Periodic Review until 1997 when the Oregon Legislature exempted counties with a population less than 15,000 (which included Morrow County) from the process. The one unresolved work program item was to study and develop policies with regard to development inside the critical groundwater and groundwater contaminated areas. Despite being exempt from the Periodic Review process, Morrow County continued working on the issue and concluded that rural residential development was the topic where the County may want to consider regulatory measures for development. The main concern related to groundwater contamination was septic tank density. A study conducted by EPA for the GWMA (including both Morrow and Umatilla Counties) concluded a large minimum lot size would be required to ensure attainment of the 7 mg/l goal for the GWMA. The Planning Commission and County Court reviewed the study and concluded the recommendations were much too onerous and the County did not change the minimum lot size. The Oregon Land Conservation & Development Commission (LCDC), however, revised Oregon Administrative Rules for Goal 14 and, effective October 3, 2000, essentially imposed a 2-acre minimum lot size for existing residentially zoned lands outside of urban growth boundaries. This eliminated Morrow County's one-acre residential zone, and effectively reduced the potential future impact of nitrate contamination from on-site septic systems in rural areas. Another effect of the LCDC rule change was to limit the minimum lot size for newly zoned residential lands to ten acres. So, any zone changes to allow farm or other ground to be taken out of exclusive farm use and put into a residential zone would not allow two acre or four acre parcels; the minimum lot size would be ten acres. This change greatly limits the potential for widespread groundwater contamination from rural septic systems.

Food Processor Process Water

Each of the food processors that land-apply water have a permit and an Operation, Monitoring, & Maintenance Plan (OM&M Plan) on file with DEQ. These documents detail various BMPs regarding nutrient management and water management, specific to their facility. An example of nutrient management that some facilities perform is post-harvest soil sampling (to help compare the amount of nitrogen applied to the amount of nitrogen removed). An example of water management that some facilities perform is soil moisture monitoring (to allow the control of deep percolation of process water).

Hermiston Foods has worked on water conservation at their plant site during 2002 and 2003. They have reduced the amount of process wastewater to about 45% of the total water applied to the crops. They have also worked on improving the removal of solids from the waste stream before it is sent to the land application site. Both of these changes reduce the amount of nutrients applied. They have also nearly eliminated the use of commercial fertilizer. Occasionally a small amount of starter fertilizer is required when rotating into wheat. They have eliminated the use of less desirable crops and use only those crops that show good nutrient removal. Over the last several years, this rotation has been alfalfa hay, and then every three to four years that is rotated with wheat. They are also working toward expanding the acres irrigated with process water to reduce the amount of process water applied per acre.

Simplot reduced the amount of nitrogen applied per acre by adding 3,200 acres of property to their land application system. They added continuous soil moisture monitoring equipment to assist in water management and reduce leaching of nitrate to groundwater. They constructed an additional lagoon (115 million gallon capacity) allowing for longer storage and eliminating winter application of process wastewater.

3.3 Future Needs Regarding BMP Determination and Implementation

From July 30, 2001 to August 2, 2001, a field visit of the Lower Umatilla Basin Ground Water Management Area (LUB GWMA) was conducted to identify research needs related to nitrate pollution of the GWMA.

The field visit was conducted by Tom Straughan (ODA water quality planner), Ray Denny (program manager for Umatilla SWCD), Phil Richerson (DEQ nonpoint source hydrogeologist), and Erick Burns (ODA hydrogeologist). Sites visited include many of the monitoring well locations, permitted confined animal feeding operation (CAFOs), and the Hermiston Agricultural Research and Extension Center. Don Horneck and George Clough represented OSU Extension for a half-day meeting designed to identify research needs.

Those research needs identified fell into two broad categories: 1) hydrogeologic character of the GWMA, and 2) BMP implementation. The first category encompasses those research topics that will allow interpretation of nitrate trend data. This is critical since there currently are severe limitations to the ability to predict when and how observed nitrate data relate to improvement of water quality within the GWMA. The hydrogeologic research needs are discussed in Section 6.0. The second category is an important aspect of action plan implementation and will allow spatial analysis of management factors as they relate to water quality. The BMP research needs are discussed below.

In accordance with the Action Plan, implementation of BMPs will be tracked to ensure that BMP implementation occurs. Currently this is not occurring in an organized fashion that will allow spatial analysis of BMP implementation relative to monitoring well nitrate concentrations. Tracking of BMP implementation in both time and space will allow evaluation of BMP effectiveness, and it will also allow success stories to be documented in a scientifically defensible manner.

Continued BMP development and implementation is also an important part of GWMA management. Since groundwater quality will change very slowly, performance of new and already existing BMPs should continue to be evaluated. Most BMPs have not been rigorously tested in a manner that ensures the target nitrate levels for groundwater will be achieved.

1. *BMP Implementation*

    a. *Document BMP implementation on the GWMA scale in a system that allows spatial analysis (e.g., GIS).*

        It would be beneficial to track BMP implementation both temporally and spatially. This will allow quantification and documentation that action plan goals are being achieved and will also allow analysis of monitoring well water quality relative to BMP implementation. This provides the positive link between landowner activities and resultant water quality. It is anticipated that this is likely a very controversial and time-consuming task. Since privacy issues and perception of government priorities will be large drivers, those entities with higher credibility with the landowners will need to accomplish the work, and great pains will need to be taken to preserve landowner anonymity while still preserving scientific value. A very detailed work plan would be required for this item, but the results would be very valuable. [Primary candidates for work are OSU Ext, Umatilla SWCD, and OSU Geography (or other department with interest and GIS skill).]

b. Field scale BMP performance evaluations.

In some cases, it would be beneficial to perform evaluations of BMPs (both existing and experimental) at the field scale. Since the GWMA is highly variable, this process will provide case studies that show the viability of practices for production as well as environmental protection. Effectively, these studies will be demonstration projects and should have a strong outreach component. Proposed projects should have very well developed monitoring plans capable of documenting BMP performance. [Primary candidates for work are OSU Ext, Umatilla SWCD, OSU Bioresource Engineering, and OSU Soil Sciences.]

c. Revise some of the fertilizer guides and recommended BMPs.

Deficiencies were noted with various fertilizer guides. Several guides are approximately 20 years old, and they recommend rates and practices that are not consistent with present practices. On a case-by-case basis, fertilizer guides and BMP guidance documents should be revised. Plans to revise fertilizer guides should provide basic information that describes the deficiencies of the current document and the number of acres that will be affected by the revisions. Review and revision should also evaluate the environmental aspects of the document. Consideration should be given to adding a section giving environmental pointers (e.g., "To account for mineralization of nitrogen from organic sources, a mineralization N test can be used.", "Over-irrigation may result in leaching of nitrate.", etc.). [Primary candidates for work are OSU Ext and OSU Soil Sciences.]

d. Mineralization N test.

One particular BMP that should be evaluated is a mineralization N test. This test requires a digestion period (therefore, more lead time by the operator), but it provides information to the operator about how much nitrogen will become available to the plant during the growing season. A comparison of this test with other commonly used tests may encourage operators to use this test when applicable. This test may allow more accurate budgeting of nitrogen. [Primary candidates for work are OSU Ext and OSU Soil Sciences.]

e. Groundwater workshop for growers and certified crop advisors.

Reportedly, it is relatively difficult for certified crop advisors to satisfy their groundwater points requirement due to a general low number of workshops that qualify. For this reason, groundwater workshops in both GWMAs should be well attended. Sponsoring these workshops allows DEQ and ODA to ensure that the content is consistent with the intent of the action plans and with groundwater protection in general. [Primary candidates for work are OSU Ext, ODA, DEQ and the SWCDs.]

f. Develop outreach material/strategy for small acreage growers and/or lawn and garden care.

Small acreage growers and homeowners occupy a relatively small percentage of the GWMA. In those areas with higher density of residences, the effect of their practices on groundwater may be appreciable. Historically, these people have been very difficult to communicate with in an effective and efficient manner. Grants designed to effectively communicate environmentally protective practices to this demographic should be encouraged. Innovative approaches may be necessary to draw in these portions of the LUB Community. [Primary candidates for work are OSU Ext and the Umatilla SWCD.]

4.0 GROUNDWATER QUALITY MONITORING

Following is a discussion of the results of DEQ's ongoing bi-monthly sampling, the water quality evaluation at food processor process water land application sites, and the ongoing groundwater cleanup at the US Army Umatilla Chemical Depot Washout Lagoons.

4.1 Results of DEQ's Bi-Monthly Monitoring

As indicated in Section 1.1, the ODEQ samples a network of 35 wells every other month for analysis of nitrate. The results of this monitoring are presented in Table 1. In addition to the 24 sampling events conducted since adoption of the Action Plan, results from two additional events are included in Table 1. These additional events include the first bimonthly event (October 1991) and the synoptic event (July 1992) conducted during the investigation phase of the project. It is important to note that the water quality discussion in this report is an informal evaluation of the four years of data collected since adoption of the Action Plan. The first formal trend analysis of the bi-monthly monitoring well network data is scheduled for 2009, and will include 12 years of data.

The maximum nitrate value observed between January 1998 and November 2001 at each well is identified in Table 1 with shading. The scattered distribution of the shaded cells indicates maximum nitrate values over the past four years occurred at different times at different locations. This suggests some wells may have increasing nitrate trends while other wells may have decreasing nitrate trends.

The maximum nitrate value observed at each sampling event is identified in Table 1 with large bold numbers. The large bold numbers indicate the maximum nitrate values during the past four years. The maximum values in alluvial aquifer wells have most often been at well UMA085 (19 of 24 events) but have also occurred at well UMA096 (3 of 24 events), UMA156 (1 of 24 events), and UMA198 (1 of 24 events). The average nitrate concentration at well UMA085 is 32.9 ppm.

The large bold numbers also indicate the maximum nitrate value during the past four years in the basalt aquifer wells has always been at well UMA029, if this well was sampled. Well UMA028 exhibited the highest nitrate concentration during the two events well UMA029 was not sampled. The average nitrate concentration at well UMA029 is 44 mg/l. The average nitrate concentration at well UMA028 is 9.4 mg/l.

It was noted in the 2000 Annual Progress Report that concentrations at well UMA029 seemed anomalously high. Testing of irrigation water by landowners and irrigation consultants from numerous basalt wells throughout the LUB suggests nitrate concentrations in the basalt aquifer are generally less than 10 ppm. A preliminary evaluation of wells exhibiting high nitrate concentrations was conducted in 2001. This evaluation is discussed in Section 4.4.

Figure 1 is a graph of average and median nitrate concentrations in the Alluvial Aquifer and Basalt Aquifer during the three years since the Action Plan was adopted (1998 through 2000). Each data point represents either the average or median nitrate concentration of the wells sampled during that particular sampling event. The purpose of graphing the average and median nitrate concentrations is to provide an indication of area-wide nitrate concentrations. It is important to note that these values represent the "middle" portion of the data set. Individual wells exhibit significantly higher and lower concentrations. The LOWESS lines[2] in Figure 1 suggest:

- the average concentration in the Alluvial Aquifer wells fluctuated slightly but remained fairly constant at about 10 ppm,
- the median concentration in the Alluvial Aquifer wells started at about 7 ppm and may be slightly declining,
- the average concentration in the Basalt Aquifer wells decreased slightly during 1998, then increased through 1999, then flattened back out at about 12.5 ppm in 2000, and
- the median concentration in the Basalt Aquifer wells started at about 3.5 ppm and increased about 1 ppm.

[2] LOWESS stands for LOcally WEighted Scatterplot Smoothing and is a data smoothing technique used to illustrate the underlying structure of a data set. LOWESS is similar to a moving average.

The larger difference between average and median values in Basalt Aquifer wells than in the Alluvial Aquifer wells reflects the high values observed in the Basalt Aquifer well UMA029. Average values are influenced by every data point while median values reflect only the "middle" value. This difference is evident in the dip in average values of January and March 2001, when well UMA029 was not sampled. The LOWESS lines in Figure 1 provide an indication of how the average water quality data is changing through time but does not constitute a trend analysis. The first formal trend analysis of the well network data is scheduled for 2009.

The cyclic nature of the average nitrate values in the Alluvial Aquifer wells (e.g., the spikes at March of each year) suggests seasonality may be an important factor in water quality changes. The cyclic nature of the average nitrate values in the Basalt Aquifer wells is less obvious.

4.2 2003 Synoptic Sampling Event

One of the research needs identified in 2001 was the resampling of the 200+ wells used during the 1992 synoptic sampling event (which characterized the regional groundwater chemistry). With EPA's support (i.e., they analyzed the samples), DEQ conducted the 2003 Synoptic Sampling Event in September and October 2003. For a variety of reasons, only 135 of the 200+ wells could be sampled. Groundwater samples collected from the 135 wells were analyzed for nitrate, ammonia, bromide, calcium, chloride, fluoride, iron, magnesium, manganese, potassium, phosphorus, sodium, sulfate, and perchlorate.

Nitrate

When 1992 nitrate concentrations are compared to 2003 nitrate concentrations throughout the GWMA, most wells exhibited higher concentrations in 2003. However, due to the inherent variability of groundwater nitrate concentrations (including seasonal fluctuations), it would be inappropriate to draw conclusions regarding long term nitrate trends from two data points. For example, the fact that a September 2003 nitrate concentration is a few parts per million (ppm) higher than a June 1992 concentration does not necessarily mean that nitrate concentrations are increasing over time. It is possible that both concentrations are within the range of natural fluctuation and analytical precision. However, significant differences in the two nitrate concentrations (i.e., tens of ppm) are more likely to represent a significant change in water quality (e.g., a long term trend or response to a localized spill or discharge).

Of the 135 wells tested in 2003, 118 wells were also tested in 1992 and had detectable nitrate concentrations during both sampling events. Of these 118 wells, 78 wells showed an increase in nitrate concentrations. Nitrate increases ranged from 0.03 to 32.4 ppm, and typically increased between 3 and 7 ppm. The other 40 wells showed a decrease in nitrate concentrations. Nitrate decreases ranged from 0.01 to 43.4 ppm, and typically decreased between 1 and 6 ppm.

Although far from conclusive, the comparison described above does hint at increasing nitrate trends in the GWMA. A more detailed discussion of the 1992 and 2003 nitrate concentrations will be provided in the next progress report.

Perchlorate

Perchlorate was added to the 2003 sampling event because it had previously been detected at several locations in the region. Including perchlorate in such a regional sampling event was planned to help determine if the perchlorate is confined to specific locations or if it is a more regional problem. Sample results indicate that perchlorate was detected at over half of the wells sampled, which was unexpected. Due to the widespread nature of the perchlorate detections, and the health concerns associated with low levels of perchlorate, DEQ, Oregon Department of Human Services, and the United States Environmental Protection Agency (EPA) are working together to develop options for further study and potential necessary actions to address perchlorate in the area. A more detailed discussion of the 2003 Synoptic Sampling Event perchlorate concentrations will be provided in the next progress report.

Table 1
Comparison of Nitrate Values (in ppm) from Selected Sampling Events
Lower Umatilla Basin Groundwater Management Area

Alluvial Aquifer

Well ID	Oct-91 (1st bimonthly event)	Jul-92 (synoptic event)	Jan-98 (1st event after Action Plan adoption)	Jan-01	Mar-01	May-01	Jul-01	Sep-01	Nov-01	Jan-02	Mar-02	May-02	Jul-02	Sep-02	Nov-02	Jan-03	Mar-03	May-03	Jul-03	Sep-03	Nov-03	Minimum value per well; 1998 thru 2003	Maximum value per well; 1998 thru 2003	Median value per well; 1998 thru 2003	Average per well; 1998 thru 2003
UMA033	10	7.6	6.6	6.8	6.82	6.73	6.84	6.88	6.98	7.22	7.26	7.28	7.01	7.28	7.2	7.57	7.08	7.39	7.18	6.97	6.98	6.47	7.57	6.99	7.00
UMA034	2.5	2	5	3.76	5.04	3.47	3.39	2.95	2.82	3.73	4.49	4.22	2.26	2.55	2.35	2.65	3.63	3.97	2.77	2.03	1.43	1.43	7.37	4.02	4.00
UMA038	1.6	3	3.9	2.38	3.51	1.69	0.983	2.96	4.23	2.88	2.76	ns	3.16	2.82	1.99	ns	3.37	9.68	3.14	2.20	2.08	0.983	9.68	3.00	3.11
UMA039	2.1	1.3	3.5	4.14	3.31	3.34	4.12	4.15	4.38	4.71	4.41	4.56	4.57	5.04	5.67	ns	ns	ns	ns	ns	ns	2.06	5.67	4.11	4.01
UMA046	1.4	0.47	0.56	0.485	0.512	0.473	0.429	0.61	0.512	0.479	0.461	1.08	3.5	3.24	1.96	0.665	0.576	0.531	1.09	1.98	0.575	0.406	3.5	0.51	0.85
UMA048	1.8	1.2	1.8	2.03	1.69	1.9	1.72	2.09	2.13	2.17	1.99	1.71	1.69	1.64	2.02	1.88	2.02	1.83	1.73	1.65	2.18	1.64	2.18	1.87	1.89
UMA056	6.4	6.6	6.8	6.31	6.22	5.74	3.87	5.18	6.55	6.64	6.13	6.13	6.2	5.15	6.55	6.63	6.48	6.60	6.23	6.27	6.14	3.87	7.32	6.53	6.33
UMA058	13	23	16	8.03	7.38	7.76	9.01	9.43	7.24	7.2	8.4	14.4	12.9	9.96	8.31	7.2	8.28	8.4	9.22	9.55	8.30	7.2	21	11.1	11.3
UMA066	4.8	6.5	8.5	8.55	8.63	9.21	8.82	8.01	8.48	9.12	9.18	9.24	6.24	5.58	ns	ns	ns	ns	ns	ns	ns	5.58	9.38	8.53	8.29
UMA084	14	10	14	8.32	5.23	6.19	10.8	12.5	9.16	6.75	4.36	3.94	3.35	5.68	7.61	4.23	3.68	7.66	9.06	11.8	10.0	3.35	16	10.5	8.96
UMA085	20	22	**29**	**34.4**	**34**	**35.1**	**36.6**	**36.3**	**36.9**	**37.9**	**37**	**38.3**	**37.8**	**38.1**	ns	**40.2**	**38.8**	39.3	**39.2**	**37.9**	**38.7**	28	40.2	33.5	34.7
UMA088	11	12	14	15.2	14.9	14.9	16.4	17.9	16.3	16.4	15.8	16.5	18.5	17.9	17.5	ns	ns	ns	ns	ns	ns	14	18.5	15.60	16.0
UMA094	13	10	11	6.57	6.17	6.32	6.78	7.09	6.98	7.16	6.79	6.78	7.16	7.56	8.01	7.66	7.62	ns	4.24	7.3	6.84	4.24	11	7.28	7.42
UMA096	**25**	**31**	28	28.4	30.5	33.2	30.2	18.8	26.6	31.4	32.8	34.0	29	19.7	12.8	25.5	31.5	32.4	30.3	19.9	18.5	12.8	34.0	29.3	27.8
UMA103	17	21	20	21.6	20.5	19.3	19.4	18.7	20.1	22.6	22.2	23.3	20.4	13.9	20	ns	ns	ns	26.6	23.3	18.7	13.9	26.6	19.1	19.9
UMA109	2.5	1.9	4.7	4.6	4.86	6.43	5.80	5.33	4.96	5.32	5.02	5.71	4.15	3.88	4.43	4.53	4.79	4.51	3.19	3.16	3.72	2.8	6.43	4.65	4.53
UMA110	6.8	5.9	5.7	5.72	5.27	3.22	4.45	5.5	3.48	3.09	2.63	2.95	4.64	5.63	4.85	4.41	3.74	4.40	5.45	5.17	4.68	2.63	9.3	5.69	5.37
UMA112	5	4.6	2.7	4.49	4.44	4.19	4.68	4.63	4.78	4.28	4.32	4.51	4.12	4.01	3.73	3.68	3.68	3.65	3.47	3.72	3.22	2.7	6.9	4.19	3.99
UMA116	3.1	3	4.3	4.38	3.99	4.56	4.49	4.26	4.18	4.85	4.75	4.81	4.07	3.23	3.43	4.58	4.61	4.43	3.97	3.29	3.61	3.23	5.08	4.30	4.33
UMA119	6.6	6.8	15	8.27	21.2	19.9	11.4	5.58	12.4	16.1	19	16.1	9.16	8.05	13.3	17.9	20.5	11.7	12.6	8.31	9.97	3.5	22.4	11.9	13.1
UMA122	8.1	9.7	14	25.9	25.2	30.8	32.2	23.5	26.1	25.9	29.7	30	31.8	26.9	**28.6**	28.1	29.0	32.0	32.8	28.7	27.8	11.9	34.4	22.1	24.6
UMA133	21	17	29	22.9	21.7	15.8	17.3	16.1	19.0	20	18.8	16.4	14	15.8	16	17.1	17.2	15.5	14.1	13.3	15.2	11.9	32	24.2	21.0
UMA144	2.9	4.9	18	13.6	16.2	11.6	10.0	9.36	9.88	12.5	14.8	14.3	10.5	8.30	7.74	8.59	12.1	9.85	9.34	9.81	9.16	1.46	20	12.2	12.2
UMA156	13	10	24	26.4	26.0	17.8	14.4	10	22.0	27.3	27	17.4	14.9	12.0	17.3	22.5	27.0	17.7	11.9	10.8	17.7	8	32	22.8	20.7
UMA160	0.06	0.02	0.02	<0.0050	<0.0050	0.0063	0.0077	0.151	9.67	<0.0050	8.46	5.84	7.99	15.4	13.6	2.74	1.52	0.0245	12.7	18.5	14.4	0.0052	18.5	0.02	4.27
UMA168	4.7	3.6	3.6	3.44	2.94	3	2.92	2.99	3.45	3.62	2.1	3.55	3.2	3.36	3.95	4.11	2.71	3.79	3.42	3.22	4.21	1.81	4.21	2.97	3.06
UMA180	0.14	0.7	1.3	3.19	3.36	5.53	8.56	7.32	4.37	3.86	3.48	5.52	5.37	5.24	2.75	3.58	3.70	3.88	3.88	3.81	2.82	1.3	8.56	4.12	4.07
UMA185	0.13	0.11	0.14	ns	0.140	ns	0.149	ns	0.149	0.149	0.138	0.145	0.151	0.152	0.149	0.147	0.146	0.146	0.145	0.150	0.161	0.12	0.161	0.14	0.14
UMA187	0.02	<0.02	<0.02	ns	<0.0050	0.0202	<0.0050	<0.0050	0.0059	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0059	0.0202	<0.0050	0.01
UMA190	0.89	0.55	2.7	3.31	6.23	2.03	1.17	1.77	7.80	5.3	2.39	1.88	1.73	0.655	5.21	ns	2.43	4.92	2.41	1.5	5.30	0.612	7.8	2.22	2.73
UMA191	0.37	0.87	0.9	1.1	1.27	3.14	1.37	0.954	1.00	0.712	1.42	1.19	2.07	0.160	0.523	0.521	0.869	2.62	0.769	0.239	0.179	0.16	3.14	1.14	1.12
UMA198	5.8	7.9	14	21	20.4	19	15.8	24.1	16.9	15.8	15.2	7.16	28.7	26.8	20.7	16.6	16.5	**42.6**	36.1	32.6	32.6	7.16	42.6	16.3	19.8
UMA201	12	11	17	24.8	23.8	21.7	24.5	23.2	21.2	20.7	20.2	22.8	18.6	24.3	24.5	23.9	21.6	22.1	20.4	16.2	18.2	16.2	29.4	21.6	21.7
Maximum per sampling event	**25**	**31**	**29**	**34.4**	**34**	**35.1**	**36.6**	**36.3**	**36.9**	**37.9**	**37.0**	**38.3**	**37.8**	**38.1**	**28.6**	**40.2**	**38.8**	**42.6**	**39.2**	**37.9**	**38.7**				
Median per sampling event	5.0	6.2	6.7	6.7	6.2	6.3	6.8	6.9	7.0	6.8	6.5	6.1	6.2	5.7	6.9	5.6	4.7	6.6	6.2	7.0	6.8				
Average per sampling event	7.2	7.7	10.2	11.0	11.0	10.1	10.0	9.6	10.0	10.8	10.7	10.7	10.3	9.7	9.1	10.3	10.2	11.2	10.9	10.1	10.12				

Basalt Aquifer

Well ID	Oct-91 (1st bimonthly event)	Jul-92 (synoptic event)	Jan-98 (1st event after Action Plan adoption)	Jan-01	Mar-01	May-01	Jul-01	Sep-01	Nov-01	Jan-02	Mar-02	May-02	Jul-02	Sep-02	Nov-02	Jan-03	Mar-03	May-03	Jul-03	Sep-03	Nov-03	Minimum value per well; 1998 thru 2003	Maximum value per well; 1998 thru 2003	Median value per well; 1998 thru 2003	Average per well; 1998 thru 2003
UMA028	2.2	2.2	5.3	**13.0**	**12.7**	12.3	10.3	9.38	11.7	**12**	**11.4**	10.6	8.31	7.59	8.15	8.48	**8.13**	7.54	6.54	5.8	**6.26**	5.1	13	8.94	9.04
UMA029	**37.0**	**31.0**	**49.0**	ns	ns	**45.2**	**46.6**	**33.7**	**45.7**	ns	ns	**49.6**	**48.6**	**49.2**	**49.3**	**52.1**	ns	**33.5**	**51.8**	**49.5**	ns	33.5	52.1	46.3	45.2
UMA047	2.5	2.6	3	3.08	2.99	3.07	3.24	3.22	3.24	3.31	3.19	3.38	3.43	3.4	3.31	3.29	3.44	3.41	3.50	3.49	ns	2.99	3.50	3.18	3.20
UMA106	0.8	0.75	0.52	0.489	1.40	0.759	0.83	0.861	1.49	0.743	0.469	0.595	0.894	0.552	1.25	ns	0.574	0.965	1.1	0.944	1.85	0.469	1.85	0.83	0.87
UMA164	2.8	2.9	3.6	4.27	ns	4.56	4.56	na	ns	ns	4.27	4.58	4.27	4.13	3.97	4.18	4.14	4.3	4.14	3.98	3.9	2.04	4.58	4.22	4.10
Maximum per sampling event	**37.0**	**31.0**	**49.0**	**13.0**	**12.7**	**45.2**	**46.6**	**33.7**	**45.7**	**12.0**	**11.4**	**49.6**	**48.6**	**49.2**	**49.3**	**52.1**	**8.13**	**33.5**	**51.8**	**49.5**	**6.26**				
Median per sampling event	2.5	2.6	3.6	3.7	3.0	4.6	4.6	6.3	7.5	3.3	3.7	4.6	4.3	4.1	4.0	6.3	3.8	4.3	4.1	4.0	3.9				
Average per samping event	9.1	7.9	12.3	5.2	5.7	13.2	13.1	11.8	15.5	5.4	4.8	13.8	13.1	13.0	13.2	17.0	4.1	9.9	13.4	12.7	4.0				

Notes:

na = not analyzed

ns = not sampled

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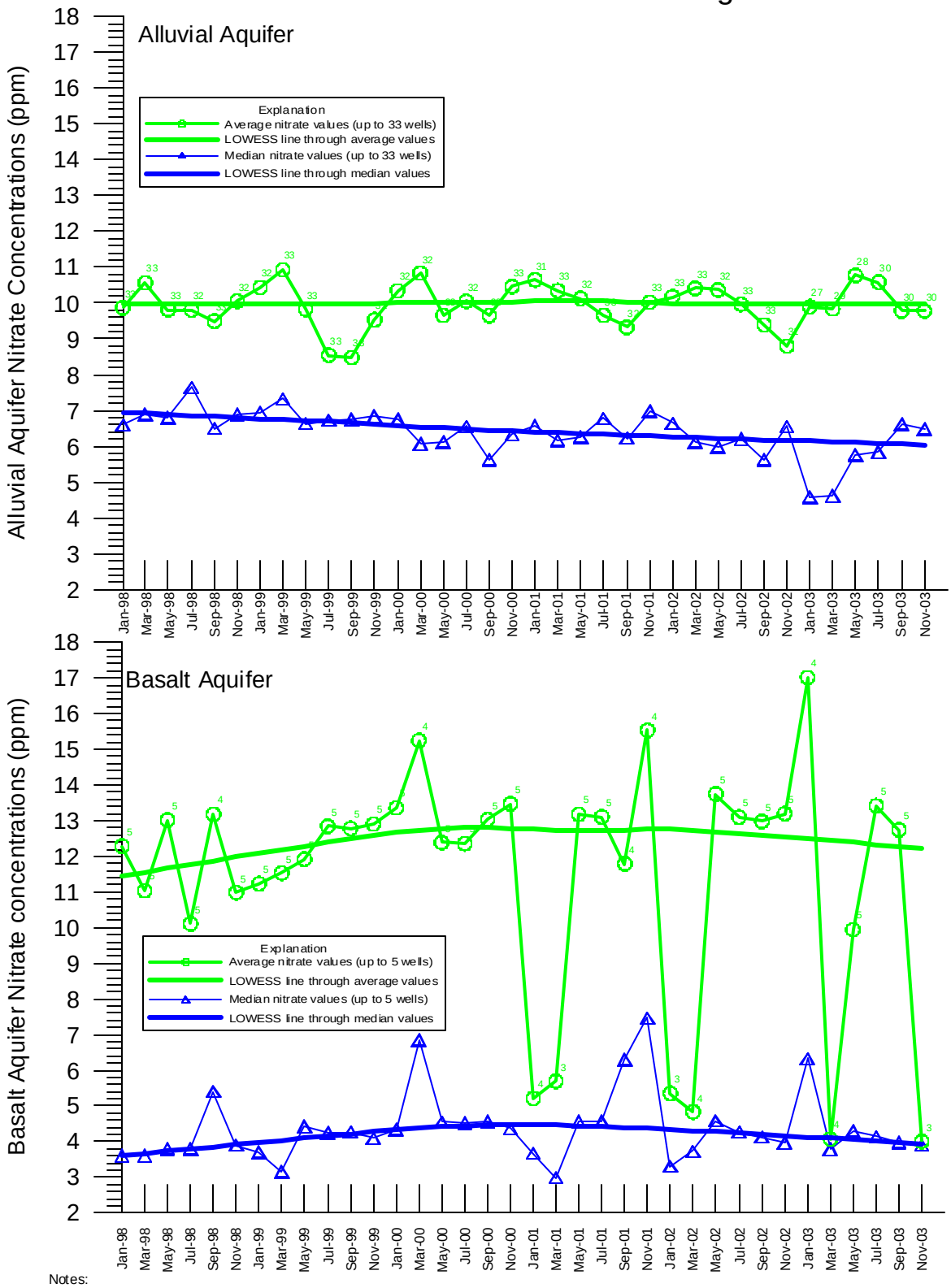
Figure 1
Summary of Nitrate Concentrations
Lower Umatilla Basin Groundwater Management Area



Notes:
(1) An average value (or arithmetic mean) is obtained by adding several values together and dividing the sum by the number of values.
(2) A median value is the middle number in a sequence of ranked values, or the average of the two middle numbers when a sequence has an even number of values.
(3) LOWESS is a data smoothing technique used to illustrate the general structure of a data set.
(4) The number of wells sampled is indicated beside each circle symbol.

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4.3 Monitoring at Food Processor Process Water Land Application Sites

The Action Plan requires that a trend analysis of groundwater monitoring data from food processor wastewater land application sites be conducted. Specifically, the goal of Section VII, Item G.3.b is that by December 2001, "monitoring data shows improving groundwater quality trends for nitrate" and that permitees are "meeting permit conditions and objectives". It should also be noted that Section VIII, Item A.3 states "since it is not anticipated that quantitative reductions in nitrate levels will take place early in the implementation phases of the plan, qualitative measures will also be established to evaluate the progress and success of the Action Plan."

There are six facilities (consisting of 10 sites) within the LUB GWMA that land applied food processing water in 2001, and are thus targeted by this goal. The nitrate trends at 113 wells located at the 10 sites were evaluated. Of the 113 wells evaluated, approximately 64% have increasing trends, 7% have decreasing trends, 3% have flat trends, and 27% have statistically insignificant trends. It should be noted that these wells are located upgradient, downgradient, cross gradient, and within these land application sites.

The hydrogeology at these sites has been evaluated so that detailed comparisons can be made between upgradient and downgradient wells. Most sites have averages greater than the 7 mg/l Action Plan goal. Nitrate concentrations are increasing at most wells, and at most sites. There are, however, wells and sites where nitrate concentrations are decreasing. Identifying what combination of factors produces improving water quality trends, then applying those factors elsewhere, should result in improving water quality trends across the GWMA.

A report is being prepared which discusses, in detail, the trend analysis and draws conclusions regarding upgradient and downgradient concentrations and trends. This report will be discussed in the next progress report.

4.4 Monitoring at the US Army Umatilla Chemical Depot Washout Lagoons

The following information, which generally summarizes the groundwater treatment system, appears in the 2002 Annual Monitoring Report for the Explosives Washout Lagoons Groundwater Treatment by SCS Engineers.

- In general, the overall footprint of the most highly contaminated zones continues to decrease in size, indicating the effectiveness of the groundwater extraction and treatment system. There are, however, uncertainties regarding the complete capture of the RDX plume. While concentrations in the heart of the plume continue to be reduced, some spreading may be occurring on the margins of the plume, where some contaminant concentrations are increasing. This effect is particularly noticeable to the east of the Lagoons. There are uncertainties regarding how this portion of the plume relates to the central portion because of a general lack of data points between the two areas.

Additional information from the Report includes the following:

- Contaminated groundwater is pumped from two extraction wells and piped to a central treatment plant, run through carbon adsorbers, and returned to the ground through two separate infiltration fields for percolation into the soil. Monitoring wells installed around the treatment system are sampled quarterly to monitor the remediation progress. Semi-annual water quality samples are collected at the effluent sample port. The samples are analyzed for explosives[3], metals, anions, alkalinity, and TDS.
- In mid-April 2002, treated groundwater was redistributed between the three infiltration fields in an attempt to address an observed loss of capture in the northeastern portion of the RDX plume. The redistribution was observed to have little short-term effects, but was continued to evaluate long-term effects.
- During the 2001/2002 O&M period (September 2001 through October 2002), the TNT influent concentration remained generally uniform (typically between 24 ug/l and 29 ug/l), although the average concentration was significantly reduced from previous years.
- During the 2001/2002 O&M period, the RDX influent concentration fluctuated between 34 ug/l and 115 ug/l, which is less than previous years.
- For the first time since the system began operating, the influent concentrations appear to have leveled off.

[3] Explosives include 1,3,5-Trinitrobenzene (TNB), 2,4,6-Trinitrotoluene (TNT), 2,4-Dinitrotoluene (2,4-DNT), and hyxahydro-1,3,5-trinitro-1,3,5-triazine (RDX).

- Since the groundwater remediation plant began operation in December 1996, the levels of most explosives in the groundwater at most of the extraction and monitoring wells have been decreasing.
- RDX concentrations have increased at three wells located approximately ½ mile east of the treatment plant that are used to monitor the east side of the RDX plume.
- RDX concentrations have significantly decreased at two wells located in the central portion and southwestern side of the RDX plume.
- RDX, the most mobile of the contaminants, has the largest plume. RDX appears to have spread beyond the Explosives Washout Lagoons.
- The TNT plume extends over a smaller area, and is centered under the Explosive Washout Lagoons. Apparent TNT "hot spots" away from the Washout Lagoons identified in October 2001 were not confirmed during the April 2002 sampling event.
- SCS recommended the installation of an additional monitoring well and an evaluation of the capture zone using a reverse particle tracking groundwater flow path analysis.

The following information, which generally summarizes the groundwater treatment system, appears in the 2003 Annual Monitoring Report for the Explosives Washout Lagoons Groundwater Treatment by SCS Engineers.

- Data collected during this reporting period indicate that the treatment plant is performing adequately and effectively treating the extracted groundwater. Groundwater monitoring data indicate, however, that the extraction system may not be containing the entire plume of contaminated groundwater.

Additional information from the Report includes the following:

- In mid-April 2002, treated groundwater was redistributed between the three infiltration fields in an attempt to address an observed loss of capture in the northeastern portion of the RDX plume. The redistribution was observed to have little short-term effects, but was continued to evaluate long-term effects.
- During the 2002/2003 O&M period (September 2002 through October 2003), the TNT influent concentration remained generally uniform (typically between 19 ug/l and 26 ug/l), although the average concentration was significantly reduced from previous years.
- During the 2002/2003 O&M period, the RDX influent concentration fluctuated between 21 ug/l and 90 ug/l, which is less than previous years.
- Since the groundwater remediation plant began operation in December 1996, the levels of most explosives in the groundwater at most of the extraction and monitoring wells have been decreasing.
- RDX concentrations have decreased at three wells located approximately ½ mile east of the treatment plant that are used to monitor the east side of the RDX plume. (These wells exhibited an increase in RDX during the previous O&M period).
- A new well was installed further east of the wells monitoring the east side of the RDX plume. This well was sampled in November 2003 and exhibited 1.95 ug/l RDX. The report concludes "this point adequately defines the eastern edge of the RDX plume".
- RDX concentrations have significantly decreased at two wells located in the central portion and southwestern side of the RDX plume.
- RDX, the most mobile of the contaminants, has the largest plume. RDX appears to have spread beyond the Explosives Washout Lagoons.
- The TNT plume extends over a smaller area, and is centered under the Explosive Washout Lagoons. Apparent TNT "hot spots" away from the Washout Lagoons identified in October 2001 were not confirmed during subsequent sampling event.
- SCS recommended the installation of additional monitoring wells near the northeastern boundary of the RDX plume as well as an evaluation of the capture zone using a reverse particle tracking groundwater flow path analysis.

4.5 Isotopic / Age Dating Project

In November 2002, Curt Black of EPA Region X (in cooperation with DEQ, OWRD, and ODA) submitted a Regional Applied Research Effort proposal (an internal EPA program) requesting funds to develop and utilize isotopic and tracer tools to evaluate the source, timing, and movement of nitrate in areas like the LUB GWMA. The goals of this project include:

(1) ***Identify the source or sources of nitrate***. Determination of the origin of nitrate in a sample has been demonstrated in other areas using isotopic analysis. The identification of the principal source(s) of nitrate in the LUB GWMA should allow focusing of efforts aimed at changing management practices where they will have the greatest result.

(2) ***Distinguish between legacy problems and present nitrate sources.*** By identifying age, we can assess whether we're still monitoring the vadose zone legacy or we're measuring more recent sources. If the results show more recent sources, it will be an indication of the need to revisit the BMPs presently considered to be protective of groundwater quality.

Ultimately, the information gathered (i.e., water chemistry, isotopic signature, and age) would be used to gauge the source, timing, and movement of the contamination. Potential conclusions from the study could be along the lines of "This contamination is primarily from inorganic fertilizer applied 30 years ago", or "This contamination is primarily from septic systems discharging over the last 5 years".

In March 2003, the proposal was funded. In November 2003, a scoping meeting was held in Hermiston at which the local, state, and federal agencies involved (i.e., DEQ, ODA, SWCD, EPA, USGS) discussed the project with LUB GWMA committee members and other interested parties for the purpose if identifying potential sites for investigation. Three potential sites for investigation were identified at the scoping meeting. Sampling was planned for 2004. Results of the sampling will be provided in the next progress report.

5.0 RESEARCH NEEDS FOR HYDROGEOLOGIC CHARACTERIZATION

From July 30, 2001 to August 2, 2001, a field visit of the Lower Umatilla Basin Ground Water Management Area (LUB GWMA) was conducted to identify research needs related to nitrate pollution of the GWMA.

The field visit was conducted by Tom Straughan (ODA water quality planner), Ray Denny (program manager for Umatilla SWCD), Phil Richerson (DEQ nonpoint source hydrogeologist), and Erick Burns (ODA hydrogeologist). Sites visited include many of the monitoring well locations, permitted confined animal feeding operation (CAFOs), and the Hermiston Agricultural Research and Extension Center. Don Horneck and George Clough represented OSU Extension for a half-day meeting designed to identify research needs.

Those research needs identified fell into two broad categories: 1) hydrogeologic character of the GWMA, and 2) BMP implementation. The first category encompasses those research topics that will allow interpretation of nitrate trend data. This is critical since there currently are severe limitations to the ability to predict when and how observed nitrate data relate to improvement of water quality within the GWMA. The hydrogeologic research needs are discussed below. The second category is an important aspect of action plan implementation and will allow spatial analysis of management factors as they relate to water quality. The BMP research needs are discussed in Section 3.3. The research topics listed below may be used as an overall research plan. Each item will improve the utility of the other items, and in only rare instances will the research efforts be redundant at all. It is recommended that most of the items be accomplished, followed by re-assessment of the research plan.

A primary concern of both landowners and regulators was premature interpretation of BMP implementation effect on water quality change. In order to understand when, where, and how to look for water quality improvements, an adequate understanding of travel time through the groundwater system is necessary. Such information is currently not available for the GWMA.

This research topic focuses on hydrogeologic characterization of the groundwater management area. Travel time and geochemical character of the hydrogeologic system are critical pieces of information for making assessment of when water quality improvements are expected.

a. Analyze current monitoring well network for additional analytes that will improve our understanding of the hydrogeologic system and potential nitrate sources (e.g., isotopic analysis, redox potential, etc.).

An increasing number of studies are utilizing geochemical indicators to evaluate travel time of groundwater. These indicators should be analyzed for potential usefulness in the current monitoring network. Since these wells are already sampled regularly, costs should be nominal (i.e., only for analyses).

Isotopic analysis of various chemical constituents may allow estimation of groundwater age or of likely nitrate source (e.g., septic tanks, manure, and commercial fertilizer). An understanding of the age of the groundwater in various parts of the basin will allow estimates of time until BMP implementation will be detected at each well. Evaluation of likely sources of pollution will allow BMPs to be focused where they will do the most good.

Other geochemical indicators may also prove useful (e.g., redox potential, Cl/N ratios, etc.) for detecting water quality improvements (resulting from BMP implementation) or for understanding why some wells are consistently lower in nitrate concentration. While nitrate is very mobile in groundwater, in some geochemical environments, it is likely not conservative. [Primary candidates for work are DEQ, OSU Ext, OSU Bioresource Engineering, OSU Forest Engineering, or other departments or universities exhibiting sufficient expertise.]

b. Re-sample the 200+ wells sampled during the synoptic sampling round in 1992.

2002 will be the tenth year since the synoptic round of well sampling across the entire GWMA. Re-sampling of these wells in 2002 will allow a comparison of a large number of data points ten years later. The large number of data points will allow statistics to be applied to give an indication of whether the GWMA nitrate concentrations are generally higher or lower than they were ten years ago.

If additional analytes will prove beneficial (see *a*. above), then these should be added to the synoptic sampling round. For this reason, it may be beneficial to accomplish *a*. (above) first (i.e., it would minimize cost to know which additional analytes are most likely to succeed). [Primary candidate for work is DEQ.]

This task was completed in September and October 2003. Results are discussed in Section 4.2.

c. Vadose zone sampling.

Vadose zone sampling was accomplished early during the action plan implementation. Additional vadose zone sampling may prove beneficial, but research objectives need to be clearly identified. Reductions in amounts of applied irrigation and fertilizer have a synergistic effect that may provide misleading results. Also, vadose sampling will be expensive if the goal is to provide statistically relevant results to be applied at the basin scale. [Primary candidates for work are DEQ, OSU Ext, OSU Bioresource Engineering, and OSU Soil Sciences.]

d. Hydraulic aquifer testing (i.e., hydraulic conductivity determination).

Pump and slug testing are standard tools used in hydrogeology. Estimates of hydraulic conductivity would prove very beneficial in formulation of conceptual models of the flow in the GWMA. Further, this data can be used at future dates for development of numerical models. Unfortunately, there are a number of technical challenges associated with use of the existing monitoring network, and aquifer testing is relatively expensive (especially if the goal is to characterize the entire GWMA). [Primary candidates for work are DEQ or a contracted consultant.]

e. Development of new statistical tools for analysis of trend data.

Preliminary statistical analysis of Northern Malheur County GWMA data indicated that more advanced statistical tools need to be developed to assign numeric values to pollutant trends in the GWMAs. Confidence that current tools will allow evaluation of probable final nitrate concentrations in groundwater is very low.

If proper statistics can be developed, analysis of the Malheur nitrate and Dacthal data together may provide some method of estimating system response time to BMP implementation. If this proves to be the case, it may be beneficial to attempt to identify some chemical in the LUB GWMA that may also provide a temporal signature that coincides with BMP implementation. [Primary candidates for work are DEQ and OSU Mathematics (or others).]

f. Case-by-case evaluation of anomalously high nitrate concentrations.

A few wells were noted to have anomalously high nitrate levels (e.g., there is a basalt well that would normally be assumed to have high protection against agricultural or septic tank pollution). These wells might benefit from a more detailed inspection to ensure that there are no well construction or siting problems that invalidate their use as a GWMA monitoring well. It is anticipated that these additional inspection items will be low cost actions (e.g., sending a camera down the borehole to ensure there is no cross-connection of aquifers). Anomalous high pollutant levels may have large impacts on trend analyses depending on the types of statistics that are employed. [Primary candidate for work is DEQ.]

g. Spatial analysis of other vulnerability factors (e.g., soil type, septic density, distance from irrigation canals, etc.).

Site visits to wells indicated that many of the possible confounding factors for aquifer vulnerability were not easy to assess. In order to evaluate these factors, it may be desirable to be able to perform spatial analysis between high concentration wells and factors that may affect aquifer vulnerability. This item might best be accomplished following geochemical analysis of monitoring wells and documentation of BMP implementation. This will ensure the analysis of the other vulnerability

factors occurs in the proper context. [Primary candidates for work are DEQ, OSU Ext, OSU Bioresource Engineering, and OSU Soil Sciences.]

h. Evaluation of groundwater / surface water interaction.

Although not identified during the field visit discussed above, an evaluation of the interaction of groundwater and surface water could be very useful. An increased knowledge of groundwater surface water interaction (throughout the basin as a whole and at specific locations) could shed light on issues where surface water issues and groundwater issues intersect (e.g., Total Maximum Daily Loads for surface water bodies versus GWMA needs, BMPs protective of surface water quality but detrimental to groundwater quality). A comprehensive groundwater study that will characterize the groundwater system (including surface water interaction) for the entire Umatilla River basin is desired. Funding partners are being pursued to allow this project to proceed. [OWRD and USGS are the agencies that will lead this investigation.]

6.0 December 2005 Goals

Section VIII of the Action Plan identifies qualitative and quantitative measures to be used to evaluate the progress and success of the Action Plan. Specific goals were identified in the Action Plan as having December 2005 deadlines. These goals relate to the five contributors of nitrate, and are reiterated below.

6.1 Irrigated Agriculture

Goal

By December of 2005, 85% of the irrigated acreage is implementing an accepted system of BMPs or are covered by an implementation plan and the recommendations are in place and being used. Responsible parties – SWCDs, NRCS, OSU Extension, and private agricultural service providers.

6.2 Rural Residential

Goal

By December of 2005, through a random survey, 80% of area residents are aware of the groundwater nitrate problem and know of at least one activity or practice that contributes to the problem. 50% of those surveyed can cite at least one activity or practice they have changed because of their awareness of its impact on groundwater quality. Responsible parties – Local governments, SWCD and OSU Extension Service.

Goal

By December of 2005, areas in the lower basin have been identified where high densities of septic systems may impact groundwater quality. Responsible parties – local governments and DEQ.

6.3 Food Processor Process Water

Goal

By December of 2005, monitoring data shows improving groundwater quality trends for nitrate and meeting permit conditions and objectives. Responsible parties – DEQ and food processor permitees.

6.4 CAFOs

Goal

By December of 2005, 75% of CAFOs are implementing an accepted system of BMPs or are covered by an implementation plan. Responsible parties – ODA, SWCDs, NRCS, OSU Extension, and private agricultural service providers.

6.5 Umatilla Chemical Depot Washout Lagoons

Goal

By December of 2005, monitoring data should show that the treatment system is working as expected and that reinjection water is not migrating beyond the capture zone of the treatment system. Responsible parties – US Army and DEQ.

7.0 PAST AND CURRENT RECOMMENDATIONS

This section of the report identifies past recommendations that have been, at least partially, addressed as well as recommendations for the future. Some recommendations appear in both sections because they have been partially, but not completely, addressed.

7.1 Past Recommendations That Have Been Accomplished

- Completion of the follow up survey to the baseline rural residential survey conducted in 1999 (Section VIII, item G.2.b)
- DEQ and others should pursue funding for the research needs identified for BMP determination and implementation as well as the hydrogeologic characterization of the GWMA (partially completed).
- Consider a more proactive approach to education efforts such as a door-to-door information campaign, direct mailing, and/or meetings specific to the Spanish-speaking population. The proactive approach to education has been discussed and plans are being made to implement such a program.
- Begin efforts to encourage routine maintenance of septic systems and to encourage periodic inspections and replacement or upgrading of septic systems.
- Begin efforts to address rural residential animal pastures per items VII.D.5a & b.
- DEQ should do a better job at reviewing documents submitted by food processor facilities in a timely manner and providing comments that will assist the food processor facilities meet their permit conditions and objectives.
- Food processor facilities continue to strive to meet permit conditions and objectives.
- Develop an inventory of CAFOs in the LUB GWMA.

7.2 Recommendations for the Future

- DEQ and others should further investigate the anomalously high nitrate values at several network wells.
- All interested and affected parties should work towards accomplishing the December 2005 goals.
- DEQ and others should pursue funding for the research needs identified for BMP determination and implementation as well as the hydrogeologic characterization of the GWMA.
- DEQ should work towards implementing an economical alternative septic system demonstration project.
- Develop a plan to document how well activities, practices and alternative practices recommended in the Action Plan are being adopted. Include what is meant by an "accepted system of BMPs". Include specifics on types of practices, aerial extent, location, time of adoption, continued use of recommendations and other factors relevant to document progress in implementing the action plan.
- Explore the possibility of performing deep soil sampling at locations where high nitrates have been detected.
- Completion of a Memorandum of Agreement between the SWCDs, ODA and DEQ along with a work plan for activities associated with this action plans implementation (Section VII, item A.3).
- DEQ should get additional educational materials produced in Spanish and make them available to the Spanish-speaking population within the GWMA.
- Develop Public Information and Education plans which emphasize groundwater quality protection in the LUB GWMA.
- Direct more education to growers regarding nutrient management to help reduce over-fertilization.
- Direct more general education on maintenance and management of wheel and permanent set irrigation systems.
- Either define an "acceptable system of BMPs" for irrigated agriculture or redefine the 2005 irrigated agriculture goal.
- Implement a more proactive approach to education efforts such as a door-to-door information campaign, direct mailing, and/or meetings specific to the Spanish-speaking population.
- Continue efforts to encourage routine maintenance of septic systems and to encourage periodic inspections and replacement or upgrading of septic systems.
- Continue efforts to address rural residential animal pastures per items VII.D.5a & b.

7.3 Recommendations for Changes to the Action Plan

There are no recommended changes to the Action Plan at this time.