Goal 2: Beneficially utilize nutrients at CAFOs and prevent leaching of nutrients to groundwater.

Objectives: In each 4-year period: 100% of all nutrient applications at CAFOs are done at or below the agronomic rates approved in the respective CAFOs AWMP or other ODA-approved rate plan. ODA will survey CAFOs for their current irrigation management practices to track changes and improvements in CAFO irrigation management systems.

Strategy 2.1. Manure and Process Wastewater Utilization. Manure liquids and solids are beneficially utilized as a nutrient source for growing crops. Combinations of the BMPs are implemented to prevent leaching of nitrates to the groundwater. Additional CAFO-specific nutrient management requirements are contained in the facility's approved Animal Waste Management Plan and Oregon CAFO permit. CAFOs apply nutrients at or below the agronomic rates in their ODA approved AWMP. CAFOs utilize a suite of BMPs that are outlined in their ODA-approved AWMP.

Actions:

- Analyze manure and process wastewater for its nutrient value for use when applying to crops.
- Time nutrient applications to coincide with crop uptake requirements.
- Account for any additional nutrients in irrigation water when determining amount of manure and process wastewater to apply to crop systems.
- Account for the nutrient value of all manure and process wastewater or other nutrient source spread on a field. CAFOs cannot exceed the agronomic application rates listed in the ODA-approved AWMP.
- Irrigation water management practices to prevent transport of soluble nutrients as contained in their ODA approved AWMP
- Implement a rotational crop cycle with deep-rooted crops (>3ft rooting depth) to manage nitrates that may have moved past the root zones of shallower rooted crops. Utilizing this deeper nitrate makes it unavailable for leaching to groundwater.
- Employ real-time monitoring and precision agriculture techniques.
- Conduct frequent soil sampling including pre-side dress soil nitrate test (for corn) and end of growing season post-harvest soil tests to evaluate nitrate levels remaining in soil and plan strategies for the next crop cycle.

Responsible Entity: CAFO Operators
Schedule: Ongoing; these actions are already required and being implemented

Strategy 2.2: Irrigation Management. Irrigation applications of water and process wastewater are managed to prevent leaching of nitrates to the groundwater utilizing crop sensors that provide real-time moisture information to maximize irrigation use and efficiency as well as nutrient management. Knowing the soil moisture assists in preventing leaching of nitrates.

Actions:

- At least annually, and prior to the start of irrigation season, CAFOs review the irrigation water management section of their ODA-approved AWMP so that subsequent irrigation operations do not exceed the soil intake rate or provide more water than the rooting depth profile can store.
- CAFOs implement combinations of BMPs, or strategies, when irrigating such as:
  1. Develop operation and maintenance schedules for irrigation equipment to ensure water is applied at correct rates.
  2. Maintain irrigation equipment.
  3. Use soil moisture monitoring systems, real-time monitoring, precision agriculture techniques, and/or other technologies.

4. Balance irrigation applications with crop needs and soil characteristics throughout the irrigation season.
5. Use dammer-diker, or similar type of implement where possible with row crops on sloped fields to help control irrigation run-off and prevent ponding at low spots, thus subsequently help prevent leaching of nutrients from those areas.
6. Convert to more efficient irrigation systems and practices with a lower potential to leach excess water to the groundwater.

Responsible Entity: CAFO Operators
Schedule: 2020

Goal 3: Keep current with CAFO BMPs and provide CAFO education outreach.

Objective: In each 4-year period provide a written summary of any updated CAFO BMPs information and of activities accomplished to develop and/or deliver CAFO education outreach.

Strategy 3.1: Keep current with CAFO BMPs, emerging technologies and monitoring advances.

Actions:

- Periodically review, research, and identify emerging BMPs and technologies that will improve waste management practices within CAFOs.
- CAFOs annually review their ODA-approved AWMP to make sure that is reflective of the actual operations at the CAFO. AWMP amendments are necessary to include any new BMPs or changes to existing BMPs.
- Attend CAFO manure management conferences.
- Review scientific literature and studies relating to CAFO operations such as groundwater quality management, cropping system nutrient utilization, irrigation water management system, and advances in soil and crop systems monitoring techniques.

Responsible Entity: CAFO Operators and technical service providers
Schedule: 2020

Strategy 3.2: Develop and implement ongoing CAFO education outreach.

Actions:

- ODA provides upon request on site planning assistance and educational reviews to AFOs and CAFOs. This provides an operation the opportunity to assess current or proposed BMPs effectiveness in groundwater protection. SWCD and NRCS are also available to provide individual farm evaluations of CAFOs to assess the adequacy of groundwater protection measures.
- Develop a brochure that explains when a CAFO permit is required, and also maintain this information on a web site.
- ODA will develop and maintain a web page with a contact list of individuals and agencies with technical expertise in design, construction, and operation of CAFOs.
- SWCD, NRCS, and ODA will develop and maintain a list of web links that directs CAFOs to BMP information.
- Develop a public outreach plan to educate the public about the BMPs that CAFOs implement to protect surface and groundwaters.

Responsible Entity: ODA and CAFO Operators
Schedule: 2020

3.5 Livestock Operations

3.5.1 Overview:

Livestock operations constitute an important agricultural activity in the GWMA that support local markets and the economy. Livestock operations range from large irrigated pastures grazed year round or in rotation with other pastures to small rural properties that may have a few animals year around. It would also include seasonal grazing of crop aftermath.

For this action plan, livestock will be defined as domesticated animals being raised or fed within the LUBGWMA in pastures, rangeland, or confinement areas except for animals in permitted CAFOs. For more information about CAFOs see the CAFO section of this action plan and the ODA CAFO Program web site at: http://www.oregon.gov/oda/programs/NaturalResources/Pages/CAFO.aspx.

Livestock operations include, but are not limited to: cattle and calves, horses, ponies, donkeys and mules, sheep, goats, llamas, swine, chickens, and fowl. All livestock operations are regulated by local Agriculture Water Quality Management Area Rules, and are prohibited from discharging pollution to surface or groundwater.

There is an estimated 16,000 acres of irrigated pasture in the GWMA. Using an animal density of 0.5 animals per acre* there is an estimated 8000 cattle and horses in the GWMA. There is no way, at this time, to estimate the number of smaller animals - goats, sheep, pigs, etc.

The waste (manure) from livestock operations is a potential source of nitrate available for leaching into groundwater. Generally, on a well-managed irrigated pasture, the nutrients in manure are utilized to sustain the growing vegetation, with little available to be leached to groundwater. Areas where animals are concentrated on bare or sparsely vegetated ground, especially if irrigated or where water is ponded, pose the greatest threat for excess nutrients to leach to shallow groundwater.

* *Estimation of Nitrogen Sources, Nitrogen Applied, and Nitrogen Leached to Groundwater in the Lower Umatilla Basin Groundwater Management Area*, June 13, 2011

3.5.2 Inventory of Livestock Operation Sources:

Potential livestock sources of nitrate in the groundwater include:

- Pasture Management
- Solid Manure Management
- Confinement Area Management
- Irrigation Management
- Wastewater Runoff
- Stormwater Runoff

Pasture Management

A grazing management system should promote and maintain adequate vegetative cover, for protection of water quality, by consideration of intensity, frequency, duration, and season of grazing. Allowing excess manure to build up in a pasture will allow nutrients to accumulate in the soil making them available to leach or run off to surface water when irrigation or precipitation occurs. Exceeding the carrying capacity of a pasture can enable animals to over-graze grasses reducing their ability to utilize manure for plant growth. This leads to an accumulation of nitrates that is then available for leaching to groundwater.

Recommended Management Practices

- Follow generally accepted pasture management practices to avoid over-grazing of pastures. Include pasture maintenance and renovation, pasture rotation, and winter grazing management.
- Encourage pasture, nutrient, and irrigation management practices for long-term viability and to prevent possible groundwater contamination.

Solid Manure Management

Allowing manure to accumulate or storing manure where precipitation or irrigation water is allowed to percolate through the manure will leach nutrients into the groundwater. Solid manure exported or properly stored and applied at agronomic rates. Proper storage includes covering manure piles in months when precipitation could transport nutrients, organic material and bacteria in the manure to surface or groundwater.

Recommended Management Practices

- Practice proper manure management techniques that include the proper collection, storage of manure, waste water control and application techniques.
- Follow the recommendations on fertilizing and irrigation practices outlined in the irrigated agriculture portion of the action plan.
- Divert clean surface water and stormwater runoff away from confinement areas where they can come in contact with manure and stored feed products.

Confinement Area Management

Concentrating animals in small areas can lead to bare ground, manure accumulation, and wet areas that will make nutrients available for leaching in to groundwater. Recommended management practices include the following:

- The surface of the confinement area (corral, feedlot, loafing area) should be prepared by compaction, shaping, sloping, or adding impervious material that allows water and nutrients to drain to a safe area. A surface seal of compacted organic matter and soil can inhibit movement and leaching of effluent through the seal.
- Minimize wastewater by providing dry manure storage facilities and diverting surface runoff.
- Care should be taken to avoid locating confinement areas near wellheads.

Irrigation Management

Application of irrigation water to pastures, like any other agricultural operation, can lead to over-application or uneven application that could make nutrients available for leaching into groundwater. Small acreages are often flood irrigated on a fixed schedule. Pastures often lack irrigation systems that allow for precision application of water. Recommended management practices include the following:

- On occupied pastures, practice irrigation scheduling, including amount and timing, and equipment maintenance, to apply the proper amount of water to pastures for optimum forage production without runoff or ponding.
- Convert flood irrigation systems to precision irrigation systems to improve irrigation efficiency and reduce runoff or ponding.

3.5.3 Livestock Goals, Objectives, Strategies, and Actions

These goals and the associated strategies focus on addressing the potential of nitrate contamination of groundwater caused by livestock in the GWMA. Education and outreach is the primary mode for helping producers understand the best and most economical means for making any necessary changes to reduce nitrate loading to groundwater.

Goal 1: Reduce groundwater nitrate concentrations caused by livestock.

Goal 2: Organize outreach and education efforts to increase community awareness of groundwater vulnerability and best management practices for livestock operations.

Goal 3: Identify best management practices (BMP) effectiveness and best management practice adoption of updated BMP's

Goal Strategies and Actions

Goal 1: Reduce groundwater nitrate concentrations caused by livestock.

Objectives:

- By 2020, determine sub-regions of the GWMA with high risk of groundwater contamination from livestock operations.

Strategy 1.1 ODA and the SWCDs will complete a comprehensive inventory of large and small livestock operations including acreage, irrigation methods and drainage paths.

Actions:

- Inventory large and small livestock operations.
- Inventory livestock operations manure and irrigation management
- Assess information to determine sub-regions of the GWMA with highest risk of groundwater contamination from livestock operations.

Responsible Entity: ODA, Morrow and Umatilla SWCDs
Schedule: 2020

Strategy 1.2 Select and implement a Focus Area (FA) in the GWMA.

Actions*:*

- Based on initial inventory, the SWCDs will select a sub-region determined to be a high risk of groundwater pollution
- The intent in selecting Focus Areas is to deliver systematic, concentrated outreach and technical assistance in small geographic areas through the SWCDs and other partners.
- Working within a Focus Area is not intended to prevent implementation within the remainder of the GWMA. The remainder of the GWMA will continue to be addressed through general outreach and technical assistance.

Responsible Entity: ODA, Morrow and Umatilla SWCDs
Schedule: 2020

Goal 2: Organize outreach and education efforts to increase community awareness of groundwater vulnerability and best management practices for livestock operations.

Objectives:

- In three years, a survey of livestock producers and field representatives in the GWMA shows that 90% are aware of the GWMA and 25% are taking steps to protect groundwater.
- By 2020, the number of livestock operations converting from flood irrigation to sprinklers have increased by 20%.

Strategy 2.1 Write and publish articles to promote and improve the livestock producer's awareness of water quality issues in the GWMA.

Actions:

- Implement LUBGWMA Outreach Plan.
- Organize and deliver workshops and demonstration projects aimed at livestock producers to show BMP implementation and foster improved BMP use.
- Work with the Umatilla and Morrow County Land Use Departments to review and update county livestock ordinances for compatibility with GWMA goals.
- Once a year, provide an update on the status of the Lower Umatilla Basin GWMA and associated water quality data in each of the Umatilla & Morrow County SWCD newsletters. This should begin in the first state fiscal year after DEQ approves and implements the Local Action Plan.
- Publish two media articles or public service announcements per year in the LUBGWMA about FA activities and successful agricultural resource management practices.
- Work with Irrigation Districts to continue upgrading delivery systems and conversion of flood irrigation to sprinkler and drip systems.
- Work with ROGS committee to address livestock operations in small acreage rural residential settings.

Responsible Entity: Morrow and Umatilla SWCDs
Schedule: 2020

Strategy 2.2 Share information and coordinate with agribusiness, producers, and producer groups to promote groundwater quality.

Actions

- Meet with agribusiness field representatives active in the LUBGWMA to review the groundwater nitrate issue and share appropriate outreach materials from ODA, DEQ, SWCDs, OSU Extension Service, and other appropriate sources. This should occur once every two years. Some possible ways to meet with field representatives include:
  - Grower meetings, Hermiston Farm Fair.
  - Individual company meetings.
  - Oregon Agriculture Chemical and Fertilizer safety training workshops.
  - Breakfast or lunch for local field representatives sponsored by local SWCDs and partners such as ODA, OSU Extension Service, and Natural Resource Conservation Service.
- Each SWCD will deliver one groundwater quality presentation (either as a stand-alone presentation or part of a broader presentation) at one Ag-related or producer group meeting per year.
- Target one producer group per year and distribute OSU Extension Service best management practice (BMP) descriptions to producers and field representatives.
- Make at least 20 groundwater quality contacts per year within the areas served by the Umatilla and Morrow SWCDs.
- Deliver compliance and BMP implementation % and success rates discovered in initial FA implementation. Have operators located in FA describe process from their perspective.

Responsible Entity: Morrow and Umatilla SWCDs
Schedule: 2020

Strategy 2.3 Encourage conversion of flood irrigation systems to more efficient systems.

Actions:

- Work with Irrigation Districts and irrigators to continue upgrading delivery systems and conversion of flood irrigation to more efficient systems. Assist landowners in obtaining financial support for conversion of flood irrigation to more efficient systems.

Responsible Entity: Morrow and Umatilla SWCDs
Schedule: 2020

Goal 3: Identify best management practices (BMP) effectiveness and best management practice adoption of updated BMP's

Objectives:

- ODA and SWCDs will survey local livestock owners for currently used BMPS, evaluate and publish results to the livestock community.

Responsible Entity: ODA, Morrow and Umatilla SWCDs
Schedule: 2020

Strategy 3.1 Write and publish articles to promote and improve the livestock producer's awareness of current BMPs in the GWMA.

Actions:

- Organize and deliver workshops and demonstration projects aimed at livestock producers to show BMP implementation and foster improved BMP use.
- Review county livestock ordinances for compatibility with GWMA goals.
- Collaborate with OSU, SWCDs on the updated list of BMPS that should be utilized more frequently to protect groundwater quality.
- Survey (2nd time) local livestock owners of updated BMPS, evaluate and publish results to the livestock community and document changes.

Responsible Entity: Morrow and Umatilla SWCDs
Schedule: 2020

Strategy 3.2 Develop methodology to assist landowners to evaluate the proper carrying capacity of pastures.

Actions:

- Assist landowners determine carrying capacity of pasture by evaluating soil and pasture health.
- Use soil sampling and tissue sampling techniques to determine individual pasture health based on soil fertility and plant health (organic matter, protein and carbohydrate content).

Responsible Entity: Morrow and Umatilla SWCDs
Schedule: 2020

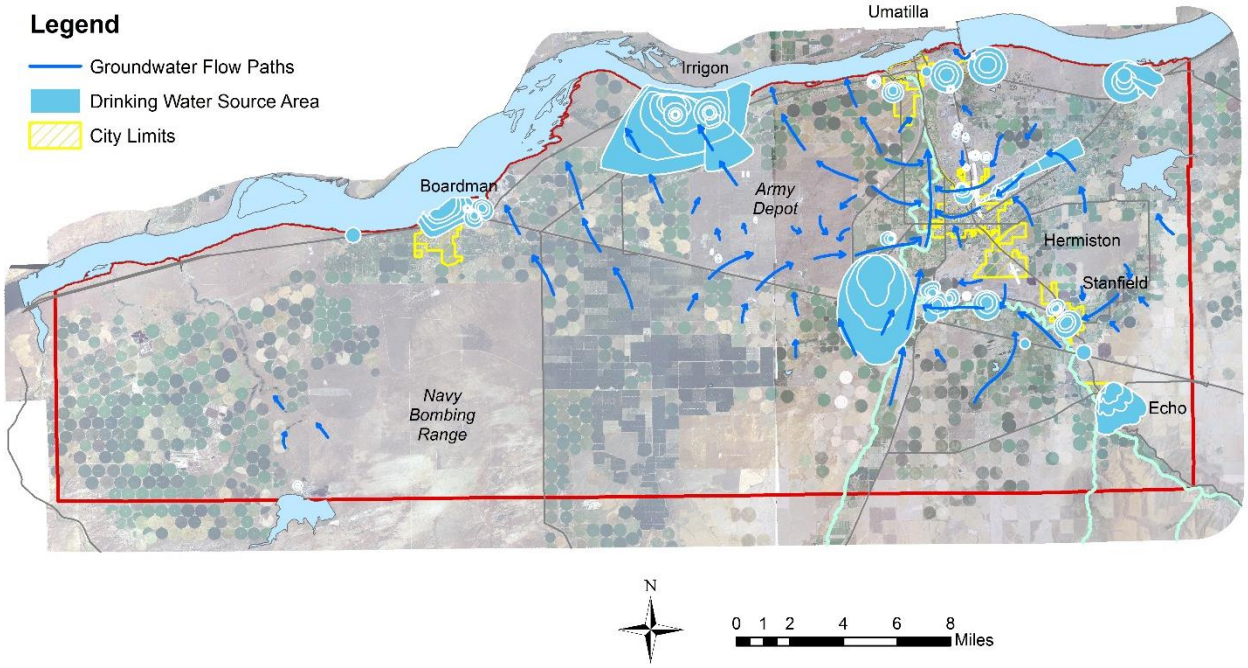
3.6 Public Water Systems

3.6.1 Overview

There are 81water systems (both active an inactive) that historically and/or currently provide drinking water to the people living in the GWMA. Public water systems are defined as having either more than three connections or serving greater than 10 people. Most of the public systems in the region depend on the shallow aquifer to provide a clean, steady supply of water.

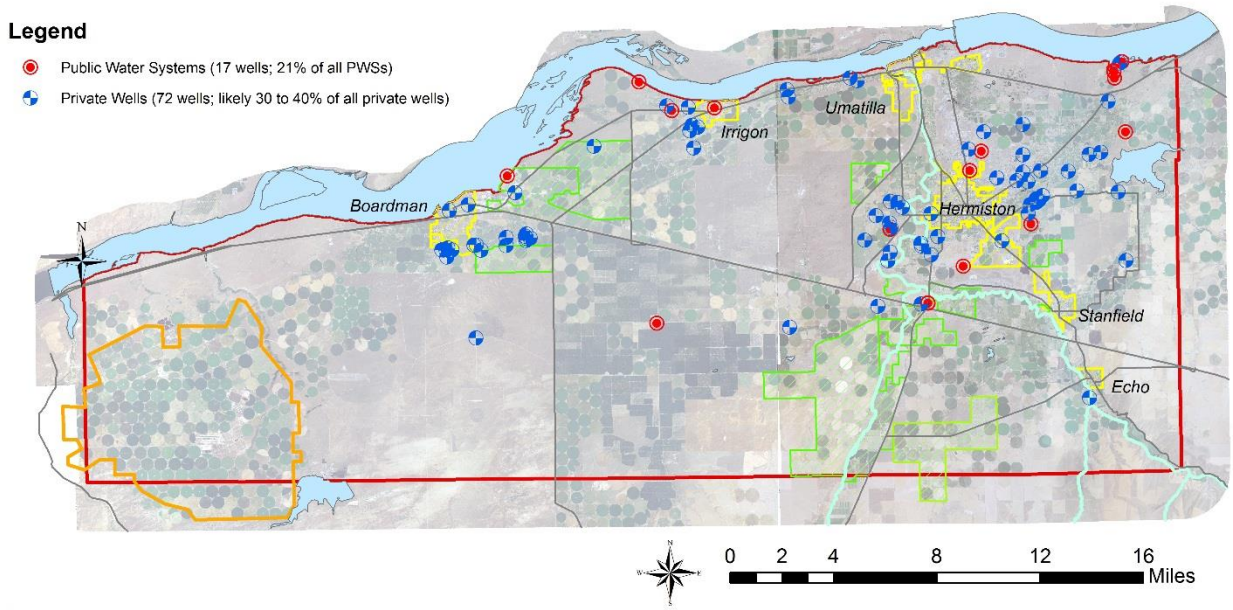
There is a blend of both large and small public water systems in the region. There are 19 larger public water systems (systems serving at least 25 people or having 15 connections) such as the City of Hermiston, serving over 15,000 people, and Westland Estates Water System, serving about 60 people. The remainder of public water

systems consists of 15 smaller state regulated systems, such as trailer parks or small businesses, which serve fewer than 25 people or have less than 15 connections. The majority of water systems are located in or near municipalities located in the northeastern portion of the GWMA.



Public water supply systems are concerned about nitrate because they are required to provide safe water that meets federal drinking water standards. Public water systems in the GWMA have tested positive for nitrate levels greater than 7 mg/L in the past five years (Oregon Health Authority, 2011 through 2016). The location of public and private drinking water wells that have exceeded the nitrate drinking water standard at least once are shown in the next figure.

Public and Private Drinking Water Wells that Have Exceeded the Nitrate Drinking Water Standard
Lower Umatilla Basin Groundwater Management Area



Notes:
Public wells include both active and inactive Public Water Systems monitored by Oregon Health Authority. Of the 181 PWSs in Umatilla and Morrow County, 18 (10%) have exceeded the nitrate drinking water standard at least once. 17 of these wells (94%) are within the LUBGWMA. Of the 81 PWSs in the LUBGWMA, 17 (21%) have exceeded the standard at least once. These percentages do not take into account which aquifer these wells tap. Because some PWS wells are likely completed in the basalt aquifer, the percentage of PWS wells with high nitrate that utilize only the alluvial aquifer is likely higher than 21%.

Private wells on this map include 50 wells from the Real Estate Transaction database, 14 wells from the regular LUBGWMA Network wells, 7 domestic wells that were included in the 2009 Synoptic Sampling Event, and the Navy Bombing Range well. Approximately 10% of the RET results show nitrate values over the standard. Because the RET database is known to contain results from treated samples and basalt wells, it is likely not a good indicator of the magnitude or extent of nitrate contamination. Approximately 42% of the domestic wells in the LUBGWMA network show nitrate values over the standard. Approximately 30% of the domestic wells sampled during the 2009 Synoptic Sampling Event showed nitrate values over the standard.

Nitrate is difficult and expensive to remove from public drinking water systems. Therefore, measures to prevent nitrate contamination can help meet health standards while reducing the need for expensive treatment. The presence of nitrate in drinking water indicates higher vulnerability to other contaminants such as herbicides, insecticides, and bacteria. DEQ and Oregon Health Authority Drinking Water Services have completed Source Water Assessments for the public water systems in the GWMA. These assessments clearly identify the area from which public systems get their water and include an inventory of potential risks and risk ratings within that area.

The established methodology of the Source Water Assessments provides a tool to examine all potential risks to groundwater for a limited area within the GWMA. Although not confirmed, some of the same risks may exist for people who rely on household wells. The Source Water Assessment work provides valuable information that, although specific to a defined portion of the GWMA, can be a useful tool for overall evaluation of groundwater risk in the area.

3.6.2 Inventory of Potential Risks to Public Water Supplies

The Source Water Assessment delineation identifies the area from which a well draws its water. Time of travel zones were developed to give a tangible indication of how quickly contamination could reach the water distribution network. There are two-, five-, 10-, and 15-year time of travel zones. According to the models used, a drop of water that enters the aquifer within the two-year time of travel zone could potentially reach the drinking water supply within two years, in the five-year zone it will take five years, and so on.

The Source Water Assessment inventory of potential contaminant sources is designed to identify and locate significant potential sources of contamination within the drinking water protection area. The sites and areas identified are only potential sources of contamination to the drinking water, and water quality is not likely to be impacted if contaminants are managed properly. Potential contaminant sources are assigned a risk rating of high, medium, or low to indicate the level of potential risk to the water supply. The risk ratings were developed by the EPA. These ratings are not site specific, but are based on the general nature of the land use activity

Within the area that is relatively close to the wells, where it is estimated that a contaminant could reach the water supply within a five-year time frame. There are different types of potential contaminant sources in the GWMA that are considered a high or medium risk (Oregon Health Authority and Oregon Department of Environmental Quality, 1999-2005).

The most common potential contaminant sources identified in the assessments of the public water systems include agriculture (irrigated and non-irrigated), heavily used transportation corridors, large onsite septic systems, wells/abandoned wells, and high-density housing with septic systems. With the exception of transportation corridors, all of these are potential sources of nitrate. Potential sources of nitrate are the same for public water supplies as in other areas of the GWMA and have been discussed in previous sections. There are many additional potential risks to drinking water safety including hazardous waste or fuel spills on heavily used highways or railroads, releases from vehicle and equipment repair facilities, leaks from current and past fuel or chemical storage tanks, and contaminants released from a variety of commercial enterprises.

The source water assessment evaluates the soil sensitivity of the soils present in the delineated drinking water source area (DWSA). Soil sensitivities are determined based on time of travel rates in terms of hours. Groundwater under soils with higher sensitivities are more likely to become contaminated than groundwater under soils with lower sensitivities. Water soluble chemicals, such as nitrate, are more prone to moving through the soil. A Public Water System may have few sources inside its 10-year time-of-travel zone, but still be affected by long-term regional problems. Previous studies have shown that agriculture is typically a larger nitrate source than urban development and onsite septic systems (Ceplecha et al 2004, McMahon et al 2008), but both are important contributors of nitrate (Mueller et al 1995). Even relatively low densities of septic systems (0.2 systems per acre) can cause violations of the nitrate drinking water criterion when there is little recharge from other sources (Bauman and Schafer 1985). Nitrate impacts of septic system could be exacerbated by the presence of antibiotics in the effluent if denitrifying bacteria are damaged, inhibiting the potential for nitrate to be reduced into a less harmful form of nitrogen (Underwood et al 2011).

3.6.3 Public Water Supply Goals, Objectives, Strategies, and Actions

The Source Water Assessment information provided a thorough evaluation of the potential contamination sources in the region and ensured that the strategies are targeted to the most pressing risks. The goals' strategies and actions of potential risks to public water supplies focus on pollution prevention to: protect the drinking water source, meet water quality standards, avoid costly remediation, prevent the burden of finding a new source, and uphold the community's reputation for having a clean drinking water supply.

Goal 1: Develop nitrogen mass balance model for the LUBGWMA.

Goal 2: Increase public awareness of groundwater vulnerability, what can be done to protect drinking water, and resources available to aid protection efforts.

Goal 3: Recognize and promote actions that are being taken to protect drinking water.

Goal 4: **Supplement existing employee training programs, provide GWMA-specific information to trainers, and seek out technical assistance opportunities related to drinking water protection.**

Goal 5: **Encourage land use planning and public health procedures that prevent or minimize groundwater contamination.**

Goal 6: **Work with regulatory authorities to provide prioritized, focused, and customized efforts for regulated and permitted activities within the five year time of travel drinking water protection areas.**

Goal 7: **Evaluate remediation feasibility to dilute nitrogen hotspots in groundwater and source water protection.**

Goal Strategies and Actions

Goal 1: Develop nitrogen mass balance model for the LUBGWMA.

Objectives:
- Model nitrogen budget and transport in the LUBGWMA through sample data and proxy data.

Strategy 1.1
Work with EPA researchers to identify data and complete a nitrogen mass balance model for the LUBGWMA.

Actions:
- Evaluate land-use, CAFOs, N deposition, stream chemistry, and crop-level and county-level fertilizer use to assess the N inputs, exports and retention in the LUBGWMA.

Responsible Entity: EPA, DEQ, OHA, ODA
Schedule: 2020

Goal 2: Increase public awareness of groundwater vulnerability, what can be done to protect drinking water, and what resources are available to aid protection efforts.

Objectives:
- Increase GWMA population awareness of groundwater vulnerability and groundwater protection activities.
- Increase the number of residents and targeted businesses that have changed at least one practice to improve groundwater protection and/or water conservation.

Strategy 2.1
Public Water Systems notify state and local emergency response planners of the locations of their Drinking Water Source Areas and ensure that water system operators are notified in case of a spill or other emergency that may impact the water supply.

Actions:
- OHA and DEQ prepare and distribute a “tipsheet” including a list with contact information for all agencies involved with spill response, links to GIS-based maps of the Drinking Water Source Areas in the region, and triggers for reporting spills to first responders.
- Public Water Systems coordinate with state, regional, and local emergency responders to identify and address gaps in communication related to spill response.

- Public Water Systems keep information current and make contacts every 2-3 years.
- Public Water Systems request spill response maps from OHA as needed.

Responsible Entity: OHA and DEQ
Schedule: 2020

Strategy 2.2
Municipal Public Water Systems distribute GWMA-specific educational materials and drinking water protection materials focused on new development through local planning departments, with permit applications, and at public works offices.

Actions:
- Every two years, review available information and develop new GWMA-specific materials as necessary.
- Identify distribution methods and locations, get approval, and continue distribution through OSU Extension, planning department counters, public water suppliers and other appropriate mechanisms.

Responsible Entity: Municipal Public Water Systems
Schedule: 2020

Strategy 2.3
Public Water Systems erect signs along major roadways to inform people that they are entering a drinking water supply area and provide a contact number for more information.

Actions:
- Public Water Systems work with stakeholders to determine what information to include and design signs.
- Establish informational phone number to include on the sign.
- Contact public works departments, determine locations for signs, contact appropriate jurisdictions for approval, and erect signs.
- Explore OHA grant funding to implement strategy.
- OHA/DEQ provide assistance as needed.

Responsible Entity: Municipal Public Water Systems
Schedule: 2020

Strategy 2.4
Develop a social marketing template based on focus group outcomes and distribute information to residents, commercial and industrial businesses, and farmers informing them of their location within the GWMA and the Drinking Water Source Area of a public water system and identify things they can do to help protect the resource.

Actions:
- Review results from the residential and agricultural focus groups.
- Divide target markets into categories and tailor messages and mechanisms for distribution based on group characteristics.
- Obtain information specific to different land uses that could contribute to groundwater contamination.
- Identify appropriate distribution channels (mailings, workshops, planning counters, etc.).
- Public Water Systems work with County to develop address list of residents with on-site systems in high risk areas (such as 5-year time of travel zones, older systems, etc.) and obtain booklet
- Public Water Systems coordinate with DEQ to distribute a booklet on proper septic system care, maintenance, and inspection to rural residents within the five-year time of travel zones of drinking water protection areas. Ensure that each household in the defined high risk areas receives this booklet

Responsible Entity: Municipal Public Water Systems
Schedule: 2020

Strategy 2.5
OHA and DEQ document all available funding sources to address drinking water protection issues and share this information with water system operators, public officials, and interested residents (This strategy is a precursor to many other strategies).

Actions:
- Identify all sources and prepare matrix of funding sources.
- Make information available to water system operators via website or mailing.
- Update previously developed funding matrix.
- Public Water Systems consult with OHA and DEQ as needed to secure groundwater protection grant funding.
- OHA and DEQ provide individualized technical assistance to Public Water Systems (prioritizing with Community and Non-transient Non-Community systems) to promote specific best management practices and adequate funding.
- Inform GWMA coordinator of OHA Drinking Water Protection Grant LOI application period dates.

Responsible Entity: OHA and Municipal Public Water Systems
Schedule: 2020

Goal 3: Recognize and promote actions that are being taken to protect drinking water.

Objectives: OHA and DEQ establish and/or maintain programs to actively engage Public Water Systems and stakeholders in drinking water protection actions.

Strategy 3.1
DEQ oversees the Tim Bunnell Community Hero Awards Program for public water system operators that are leaders in protecting drinking water.

Actions:
- Identify partners and collaborate with them to advertise award and request nominations.
- Present award and advertise results.

Responsible Entity: DEQ and Municipal Public Water Systems
Schedule: 2020

Goal 4: Supplement existing employee training programs and provide GWMA-specific information to trainers, and seek out technical assistance opportunities related to drinking water protection.

Objectives:
- Contact the high and medium risk businesses within the 5-year time of travel zones about the GWMA. Encourage those businesses to change at least one practice that will better protect groundwater.
- Increase the number of high and medium risk businesses in the five-year time-of-travel that have drinking water protection information included in training.

Strategy 4.1

DEQ works with existing land management, watershed management, and pollution prevention groups to increase awareness about groundwater contamination in the GWMA and promote practices to reduce risk.

Actions:

- Identify or establish Pollution Prevention groups in/for Umatilla and Morrow counties.
- Brainstorm project ideas with partners to increase residents' adoption of best practices
- Gain support and research funding for development of regional pollution prevention team to address issues in GWMA; prepare supporting documents.
- Obtain support from jurisdictions for expanded pollution prevention efforts in the region through presentations and staff contacts, secure funding and in-kind support.
- Invite staff and professionals to be involved in pollution prevention the actions.

Responsible Entity: Oregon DEQ
Schedule: 2020

Strategy 4.2
Provide forums designed to make technical assistance and training opportunities available to water systems, local government officials, and planning staff to reduce contamination risks within established drinking water source areas.

Actions:

- OHA and DEQ Drinking Water staff continue to work with public water systems to deliver training sessions for area planners and community leaders (sponsored by water system).
- OHA and DEQ organize an annual meeting of public water systems within the GWMA to update them on Local Action Plan accomplishments and engage them in next steps.
- OHA and DEQ Drinking Water staff will partner with public water systems to provide drinking water protection materials for local businesses to use in employee training programs.

Responsible Entity: OHA and DEQ
Schedule: 2020

Strategy 4.3
Continue to partner with agricultural organizations to promote on-farm technical assistance to landowners regarding risks to public water supplies within the GWMA's Drinking Water Source Areas.

Actions:

- Drinking Water staff meet with County SWCDs, ODA, NRCS staff, and OSU Extension staff working within GWMA to develop project proposal, including scope of work and funding source(s).
- Partners with agriculture interests (such as ODA, NRCS, etc.), with support from Drinking Water staff, advertise opportunity for farmers to participate in on-farm assistance.
- Partners provide assistance and maintain relationship with participating farmers to monitor results.

Responsible Entity: OHA, County SWCDs, ODA, NRCS staff, and OSU Extension
Schedule: 2020

Strategy 4.4
Establish a mentoring program with large businesses helping smaller, less regulated businesses in drinking water source areas within the GWMA.

Actions:

- Research successful mentoring programs and develop appropriate materials.

  - Deliver presentation on mentoring program to business coalitions/Chamber of Commerce to gain support.
  - Develop plan for conducting outreach to businesses to encourage participation in mentoring effort.
- Share spill response resources with businesses and sponsor joint employee training workshops.

Responsible Entity: DEQ
Schedule: 2020

Goal 5: Encourage land use planning and public health procedures that prevent or minimize groundwater contamination

Upon request, OHA can provide water systems with drinking water source area maps/and/or provide a location for statewide drinking water source area layer download location.

Zoning/Health Ordinance Objective

- DEQ and OHA will partner with local staff to inform all local jurisdictions in the GWMA about possible zoning/health ordinance changes and provide examples.

Strategy 5.1
Where applicable, work with local jurisdiction(s) to establish drinking water protection overlays in the 5-year time of travel zones of the Community and Non-Transient, Non-Community water systems in the GWMA.

Actions:

- Establish a contact list of planning staff and elected officials in the GWMA.
- Meet with city and county planners to present examples of drinking water protection overlays. Upon request provide public water systems guidance with example overlay zones.
- Upon request, assist local and county government staff in proposing overlay zone to planning commissions and elected officials.

Responsible Entity: DEQ and OHA
Schedule: 2020

Strategy 5.2
Provide information to staff and local officials about model ordinances available to governing bodies to implement drinking water protection measures.

Actions:

- Compile information about the costs of drinking water contamination, examples of ordinances other than overlay zones, and information detailing examples of communities that had to address contaminated drinking water.
- Contact public officials and staff and arrange a time to discuss potential drinking water protection measures.
- Meet with cities and counties to identify barriers to implementation and propose solutions to address these issues.

Responsible Entity: DEQ and OHA
Schedule: 2020

Strategy 5.3
PWS(s) request that all county and city planning departments in the GWMA notify water systems of proposed development actions in the five-year time-of-travel zones or provide operators with web-site information where they can access development information.

Actions:
- PWS(s) compile contact information of all county and city planning staff and create detailed maps of the five-year time-of-travel zones within each jurisdiction.
- Obtain support from water system operators and public works directors and provide information to planning staff.
- Monitor development actions within the five-year time-of-travel zones.

Responsible Entity: Municipal Water Systems
Schedule: 2020

Goal 6: Work with state agencies to provide prioritized, focused, and customized pollution reduction efforts for regulated and permitted activities within the five year time of travel zone in drinking water source areas in the GWMA.

- State agencies such as the Water Resources Department (OWRD), DEQ, OHA, ODA, and the Department of Geology and Mining Industries (DOGAMI) have initiated steps to focus efforts in the GWMA.

Strategy 6.1
Partner with the OWRD to better understand the location and concentration of temporarily and permanently abandoned wells in the five-year time of travel drinking water source areas. Help the OWRD to prioritize efforts to address temporary and permanent well decommissioning.

Actions:
- Contact the OWRD to discuss ways to collaborate on identifying wells that should be permanently and properly decommissioned.
- Establish a method to prioritize 'higher risk' wells.
- Identify funding sources for the permanent abandonment/decommissioning of 'higher risk' wells.

Responsible Entity: OWRD
Schedule: 2020

Strategy 6.2
Public water systems and agency partners will alert DEQ to the presence of confirmed leaking underground storage tanks and underground storage tanks of unknown status within public water system five-year time-of-travel zones in drinking water source areas.

Actions:
- Contact responsible entity at regional DEQ office about the known leaking underground storage tanks.
- Bring DEQ personnel to working group and GWMA Committee meetings to talk about the Underground Storage Tank program.
- DEQ enforces clean-up of leaking underground storage tanks.

Responsible Entity: DEQ
Schedule: 2020

Strategy 6.3
OHA and DEQ continue to notify DOGAMI of all sand and gravel mining operations within Drinking Water Source Areas in the GWMA and work with DOGAMI to provide operators information on best management practices to reduce risks to groundwater contamination.

Actions:
- Compile up-to-date groundwater protection mining BMP information, contact DOGAMI and provide them with maps and information about high priority operations.
- Partner with DOGAMI to focus efforts on operations within drinking water source areas.
- Ensure OHA drinking water staff continue to be formal reviewers on mining permit applications.

Responsible Entity: DEQ and OHA
Schedule: 2020

Strategy 6.4
DEQ will continue to: 1) provide ODA updated maps and GIS layers of the drinking water source areas and the CAFO sites within the 5-year time of travel zones in the GWMA to help ensure compliance with permits; 2) provide updated information to ODA about the GWMA that can be shared with CAFO operators during site visits.

Actions:
- Update CAFO BMP information, contact ODA, and give them an updated map of PWS and 5-year time-of-travel and information about high priority operations and recent water quality concerns.
- Work with ODA to encourage regular, routine site visits to these CAFOs and inform operators of their location within drinking water source areas in the GWMA.

Responsible Entity: DEQ
Schedule: 2020

Strategy 6.5
DEQ in collaboration with OHA drinking water staff evaluates the factors influencing nitrate risks in the GWMA for the public water supply wells not already examined and included in the 2011 report, "Factors Influencing Nitrate Risks at Oregon Public Water Systems" Actions:
- Using the methodology in the DEQ, 2011 report, evaluate the soil sensitivity (a combination of the soil's leaching potential and sorption potential) and produce soil sensitivity maps for each public water system in the GWMA.
- Determine the percent of the total area in each soil sensitivity category.
- Analyze the nitrate-N data to determine the influence of aquifer vulnerability (a combined rating of aquifer confinement and well construction), aquifer confinement, well construction in confined aquifers, and soil sensitivity on the median and 90th percentile nitrate-N values for each well.
- Analyze the Nitrate-N values (median and 90th percentile for each public supply well) in unconfined and semi-confined aquifers against the percentage of the Time-of-Travel (TOT) zones' total area that has soil sensitivity greater than Low (i.e. % area in Moderate, High, and Very High categories.)
- Using soil sensitivity maps, aquifer and hydrogeology characteristics, or models such as NLEAP, prioritize the most vulnerable locations for management changes.

Responsible Entity: DEQ and OHA
Schedule: 2020

Goal 7: Evaluate remediation feasibility to dilute nitrogen hotspots in groundwater and source water protection.

Objectives:

- Evaluate feasibility of remediation of nitrates in groundwater to address hotspots and/or source water protection.

Strategy 1.1
Work with hydrogeologists to study and evaluate remediation feasibility.

Actions:

- Study and evaluate groundwater remediation feasibility to address nitrates in the LUBGWMA.

Responsible Entity: DEQ, OHA
Schedule: 2020

4.0 Implementation: Measuring Success through Plan Implementation Performance (PIP) Indicators and Groundwater Monitoring

The ultimate goal of the Local Action Plan is to improve the overall groundwater quality by obtaining declining nitrate concentrations of less than 7 mg/L throughout the region. The achievement of this goal necessitates active involvement from many difference entities, assessment of progress in implementing strategies, and finally, measuring groundwater quality.

4.1 Implementation Participants

Implementation of the strategies identified in Section 3 is critical to the overall success of the Local Action Plan and the eventual decline of nitrate levels in the GWMA. Implementation relies on voluntary actions among the agencies and land use groups in the region. This voluntary approach is built on the belief that local jurisdictions in the area are best suited to develop and implement actions to reduce risks to groundwater quality.

Forward movement will require coordinating oversight from the Lead Agency and other entities willing and able to coordinate specific portions of the Local Action Plan. Implementation of the strategies is highly dependent on allocation of staff resources and funding. Using a voluntary approach has benefits and challenges. There has been considerable support from many local governments and individuals to restore groundwater quality to a safer level. However, because of time and resource constraints, these same entities are often under great pressure to complete many mandatory activities prior to implementing voluntary and non-regulatory tasks. An active Lead Agency should offer support and guidance to those entities and individuals who are the best fit for implementing various sections of the Local Action Plan.

At a time when federal, state, and local budgets are already stretched, many of the strategies will rely on a potential implementing entity or partnering entities either adding the task to their existing workloads, pooling funds from several jurisdictions/agencies to accomplish a set of tasks, and/or finding grant funding to accomplish one or more tasks. Potential grant funding can come from a variety of different resources.

It is recommended that the DEQ and ODA continue to allocate staffing for the long-term assessment of the GWMA and prioritize staff resources, grant funding, and legislative funding that will assist in the effort to lower drinking water risks to the residents in the Basin.

ODA's willingness to work with the local SWCDs and DEQ to identify priority actions and develop funding requests and allocations will assist with the progress in implementing the Local Action Plan. It is recommended that ODA continue with efforts to implement the Willow Creek and Umatilla Agricultural Water Quality Management Area Plan through achievement of the Plan Implementation Performance (PIP) goals of this Local Action Plan.

OSU and OSU Extension Service in Hermiston bring important research to the region and direct contact with Operators in the GWMA through outreach and education efforts. These agencies should seek and procure funding for continued success in Plan Implementation Performance. OHA is encourage to work with local drinking water utilities in long-term planning to decrease risk to public and private water supplies. OWRD is encourage to engage in groundwater quality through regulation of groundwater quantity.

Project work plans will be developed for activities that describe specific objectives, tasks, and methodologies to obtain and interpret data, deliverables, schedules, and the agencies to implement the strategy. Results of the analysis will be presented in progress reports that document the successful implementation of these projects by local citizen participation with support from cooperating state and local agencies

4.2 Plan Implementation Performance (PIP) Indicators

The GWMA Committee also plays a key role in the implementation process, evaluating the Local Action Plan success, and recommending adjustments to the Plan on an annual basis. The GWMA Committee will continue to meet regularly. DEQ will provide the Committee with updates on monitoring results and trends. DEQ, ODA, Morrow SWCD (the lead agency), and the GWMA sub-committees will provide updates to the full Committee on progress made towards implementation of the strategies and actions in the Local Action Plan.

Each strategy identified in Section are to be matched with Measures of Implementation and Potential (or recommended) Implementing Entities. Measures of Implementation are outcome indicators or the methods used to track the actual implementation of the strategies and an indication of when the activity should be completed. Potential Implementing Entities are the recommended organizations, agencies, jurisdictions, or groups that have the authority and/or capacity, could develop the ability, or could form partnerships to implement actions.

4.2.1 PIP Timeline and Benchmarks

The measures of plan implementation performance (PIP) and implementing entities for each strategy provide an evaluative mechanism to determine progress and set benchmarks for tracking the plan implementation performance (PIP) of the GWMA Local Action Plan. These measures of implementation will provide a tool for future tracking and reporting on plan implementation and for identifying ways to adapt the plan if necessary. For more detailed explanations of the strategies and related information, see Section 3.

4.2.2 Groundwater Monitoring

Even though the area-wide trend continues to increase at a small rate, it is expected that through continued refinement and implementation of BMPs as well as through mitigation efforts, groundwater nitrate concentrations will eventually begin to decrease. There is no decision matrix in rule or statute for a method to determine when the "less than 7 mg/L" threshold has been accomplished, thus each GWMA Committee can select the tool that makes sense for their situation. There will be several types of groundwater monitoring occurring to evaluate the changes of nitrate as a whole in the Lower Umatilla Basin GWMA. Some sources are viewed as primary sources of information while others are viewed as supplemental sources of information. These data sources are discussed below.

4.2.2.1 Primary Monitoring Data

LUBGWMA Well Network
DEQ conducted a large reconnaissance sampling event (involving 198 wells) as part of the initial hydrogeologic characterization of the region in 1990 and 1991. DEQ selected 40 of these wells and established the "bi-monthly" network to determine seasonal variability and trends over time. The first bi-monthly sampling event was conducted in September 1991. Samples were collected from this well network every other month (i.e., January, March, May, July, September, and November) through 2010, when budget shortfalls caused DEQ to scale back the network. An evaluation of existing data was conducted to determine which months could be dropped from the sampling schedule with the least effect on the data set as a whole, and the ability to detect trends. It was determined that the best months to drop from the sampling schedule were January and July. Groundwater samples continue to be collected every March, May, September, and November from the well network.

Over time, nine wells have been dropped from the network for a variety of reasons beyond DEQ's control. There are currently 31 of the original 40 wells still being sampled. Two additional wells in the Irrigon area were added to the network in March 2013. Most of the wells in the LUBGWMA well network are private domestic wells, but there are two irrigation wells in the network. This network's dataset is a primary source of information to be used to evaluate regional trends, particularly in and around rural residential development.

Food Processing Wastewater Land Application Sites
DEQ requires the installation and quarterly sampling of groundwater monitoring wells in and around 11 sites operated by five facilities in the LUB GWMA where food processing wastewater is stored and treated through land application. Some of these wells have been sampled since 1987. Most wells have been installed and sampled since the mid-1990s. A comparison of upgradient to downgradient wells at a site allows an assessment of nitrate contribution from the site.

Because many of these land application sites are located in agricultural areas, the upgradient wells at these facilities are some of the best sources of information currently available to evaluate potential contributions from adjacent traditional irrigated agricultural fields. These networks are a primary source of information to be used to evaluate groundwater quality trends in and around food processing wastewater land application sites.

CAFO Waste Storage and Land Application Sites
ODA requires the installation and periodic sampling of groundwater monitoring wells in and around three facilities in the LUB GWMA where animal waste is stored and treated through land application.
These wells are a primary source of information to be used to evaluate groundwater quality trends in and around CAFO waste storage and land application sites.

4.2.2.2 Supplemental Monitoring Data

Synoptic Sampling Events
Since declaration of the LUBGWMA, DEQ has conducted four synoptic sampling events: in 1992, 2003, 2009, and in late 2015 / early 2016. Each of these events involved the sampling of about 100 to 200 wells in as short a time as possible (typically a few months) to give a "snapshot" of regional nitrate concentrations. A comparison of concentrations between synoptic sampling events allows an evaluation of nitrate changes over a larger area than the primary data sources discussed above, but is less statistically robust.

Public Water Systems
As discussed in previous sections, 17 Public Water System wells (21% of all PWSs in the LUBGWMA) have had nitrate concentrations at or above the 10 mg/L drinking water standard at least once. PWSs are not legally allowed to deliver water that exceeds the standard. When nitrate concentrations exceed the standard, PWSs are required to increase the frequency of sampling and, if nitrate exceedances persist, mitigate the problem. Mitigation is accomplished by blending with a low-nitrate source water, drilling new or deeper wells to find low-nitrate groundwater, or installing a nitrate treatment system.

PWSs regularly test the quality of the water they deliver to customers, but test the untreated source water less often. Because PWSs are not legally allowed to deliver water with more than 10 mg/L nitrate (and therefore do some type of mitigation relatively soon after an exceedance occurs), it is unusual to have large data sets of detectable nitrate concentrations from PWSs. Therefore, nitrate data from PWSs can be used to supplement other sources of information that identify locations where nitrate concentrations are elevated, but are not likely to be useful for the calculation of trends.

Real Estate Transaction Data

Every time a property with a private domestic well is transferred, the owners are required to test the well for nitrate, arsenic, and total coliform bacteria, then send the results to the Oregon Health Authority. Because of limitations of the data (e.g., there is little Quality Assurance /Quality Control on the collection and reporting of these samples, the aquifer tapped by these wells is unknown, and some treated samples are included in the database) these results should be treated as qualitative information. Therefore, nitrate data from private domestic wells can be used to supplement other sources of information that identify locations where nitrate concentrations are elevated, but are not likely to be useful for the calculation of trends.

5.0 References and Appendix

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Registered Professional Geologist Seal

In accordance with Oregon Revised Statutes Chapter 672.505 to 672.705, specifically ORS 672.605 that states:

"All drawings, reports, or other geologic papers or documents, involving geologic work as defined in ORS 672.505 to 672.705 which shall have been prepared or approved by a registered geologist or a subordinate employee under the direction of a registered geologist for the use of or for delivery to any person or for public record within this state shall be signed by the registered geologist and impressed with the seal or the seal of a nonresident practicing under the provisions of ORS 672.505 to 672.705, either of which shall indicate responsibility for them.",

I hereby acknowledge that the document cited below was prepared by me.

Document Title:	Chapter 2 of the Lower Umatilla Basin Groundwater Management Area Local Action Plan
Document Author(s):	Phil M. Richerson
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Name of Oregon RPG:	Phil M. Richerson (G1906)
Signature of Oregon RPG:	_____
Date of Seal:	_____

Statistician's Comments and DEQ's Response

The OSU statistician reviewed four specific reports and provided multiple comments and recommendations. Each comment and recommendation is fully addressed in DEQ's response to the report. Section 6 (the "Discussions and Recommendations" section) of the statistician's report is reiterated below. A discussion of how DEQ is addressing these comments then follows.

Discussion and Recommendations

There are three main statistical issues that I see as having the biggest impact on the overall message conveyed by these documents: (1) the lack of probability sampling (or in its place substantive arguments about the representativeness of the sampled wells); (2) the oversimplification of results by tabulations of increasing/decreasing trends without accounting for their magnitude and/or practical significance and (3) a lack of focus on the 2000 to 2009 time period for critical evaluation of the efficacy of the Action Plan. Unaddressed, these three issues combine to provide an overall negative view of the LUBGWMA in terms of nitrate concentrations. It remains unclear what the true picture of nitrate concentrations in the GWMA is today, but I believe that much of what the DEQ has reported over the last ten years should be tempered and qualified by language that reflects some of the issues I have described in this report. I provide recommendations corresponding to each of these main issues below. More than a re-analysis of the statistics, the DEQ reports could benefit from clear enumeration of all the assumptions that go into drawing inferences from sampled wells to the entire GWMA, that are involved with tabulating results and that justify the appropriate time frame for analysis.

0.1 The lack of probability sampling to select wells into the bi-monthly well network, the synoptic sampling event network or any of the remaining sub-area networks.

> *The lack of probability sampling is difficult to overcome from a statistical perspective. Nevertheless, some work could be done to evaluate and compare characteristics (i.e., not just nitrate concentrations) of the wells in the bi-monthly network with those included in the synoptic sampling events and even those not included in either sample. This could provide a least a little assurance that the bi-monthly network wells are representative of the GWMA as a whole. Or, it could provide some insight into the ways in which those wells* are not *representative of the GWMA so that adjustments could be considered to account for those differences. In either case, all generalizations from a sample of wells to the GWMA as a whole must be tempered by the fact that no probability sampling was used and that it can therefore not be assumed that the sampled represents the unobserved wells in the entire management area. All of the DEQ reports would benefit from a clear discussion of the extent to which sampled wells adequately represent the entire GWMA, and this must involve a reconsideration/evaluation of the original selection of the wells into the different sampling networks.*

0.2 The over-simplification inherent in tabulations of increasing/decreasing (linear) trends and the minimal accounting for alternative sources of variation in making those increasing/decreasing determinations.

> *Evaluation of change at a particular well should involve an accounting of sources of variation (e.g., seasonality at the well), the magnitude of the change and the practical significance of the change. There should be some discussion about defining what is meant by a meaningful, scientific change in nitrate concentration, recognizing that such a definition might be different at different wells. For example, at a well with historically low values (i.e., below the 7 mg/L trigger), a practical change may be different than it would be for a well with historically high values (i.e., above the trigger). Clear details about, and agreement upon what constitutes a "substantial" change in nitrate concentration would be useful for future reports, and justification for the appropriate cut-off for declaring "statistical significance" should be provided. Qualitative evaluation of the lowess lines is quite informative, though hard to generalize beyond the sampled wells. If we are willing to assume that observations from different wells within the bi-monthly*

well network (or within the synoptic sampling event network) are statistically independent, we could use a statistical test for paired comparisons, such as the Wilcoxon Signed Rank test, to compare nitrate concentrations in 2009 with those in 2000. Alternatively, Mixed effects regression models could be fit to account for covariate information (e.g., land-use, geology and the like), other sources of variation and/or spatial/serial autocorrelation while providing an overall estimate of change in nitrate concentrations over an appropriate time window. Most importantly, by simply making a tabulation of increases/decreases DEQ puts a well that had an increase in nitrate concentration of 5 ppm over a 10 year period (say from a level of 10 ppm to one of 15 ppm) on the same footing as a well that had an increase in nitrate concentration of 0.6 ppm over the same period (say from 2.1 ppm to 2.7 ppm), and this tends to misrepresent the situation.

0.3 A lack of focus on the 2000 to 2009 time-frame for evaluating the efficacy of the Action Plan.

For evaluating the efficacy of the Action Plan, the focus should be on the period of time since 2000. Using data between 1997 and 2000 to establish a "baseline" for nitrate concentrations may be useful, but I don't see the benefit of going all the way back to 1991. I suggest using lowess to model behavior at wells starting in 2000, and then taking a closer examination of those wells that do show high and/or increasing nitrate concentrations as compared to those that do not. This can provide some insight into the types of wells in the broader GWMA that might also be problematic, so that future components of the Action Plan could target those problematic wells.

DEQs Response to Recommendation 0.1

DEQ does not have the resources to redesign the well networks using a probabilistic approach. However, we can use the data we already have to give us as much insight as possible, and also improve on what we have going forward. DEQ's view is that while the well networks are not perfect, they do provide a good representation of the land uses that contribute to the groundwater nitrate contamination in the LUBGWMA. We acknowledge that probabilistic sampling is an assumption of many statistical analyses. We acknowledge that the well networks used by DEQ and their permittees utilize other criteria for well selection/location, and that we should acknowledge the differences in rationale used in developing the well networks. We also acknowledge that the well networks we use change over time with wells being dropped and added for various reasons throughout the years. This variability in the networks can complicate and limit the analyses that can be done.

DEQ acknowledges that the synoptic well network, the bi-monthly well network, and the well networks of permitted facilities were not set up using probabilistic sampling. Instead, wells for both DEQ networks were selected based on their hydrogeological placement, geographic location, groundwater chemistry characteristics, and sampling logistics. These well networks rely heavily on domestic water supply wells, in part because DEQ did not have the resources to install a monitoring well network, and in part because these wells represent the water that people are drinking. The bi-monthly well network is comprised mostly of domestic drinking water wells but also contains five irrigation wells. The synoptic well network is also comprised predominantly of domestic wells. Because domestic wells with moderate to high nitrate concentrations (or other anthropogenic contamination) were preferentially selected to be a part of the bi-monthly network, the network is likely biased towards rural residential areas that already had significant groundwater contamination. The long-term effect of this focus is expected to be a downward trend that is easier to detect, because starting concentrations were already high. Monitoring well networks associated with the land application of food processing wastewater were designed to quantify the quality of water upgradient and downgradient of the land application sites. These networks are located predominantly in agricultural areas, so those networks are likely biased towards monitoring the effects of land application of wastewater and, particularly at the upgradient wells, traditional agricultural practices.

The fact that sources of nitrate contamination are not static over time also complicates the issue of well network representativeness. For example, the largest CAFO in the area at the time of Action Plan adoption (C&B Livestock) no longer exists, while a much larger CAFO (Three Mile Canyon Farms) now exists west of the bi-monthly well network. Three Mile Canyon Farms has its own network of wells.

DEQ's view is that the LUBGWMA well network is skewed towards rural residential land uses, but does monitor a mix of land uses that contribute to the groundwater nitrate contamination, and is adequate to answer the question posed in the first Action Plan (i.e., are area-wide nitrate concentrations decreasing?). However, adding additional wells to the network and/or including data from other regularly sampled wells would allow a more thorough evaluation of area-wide nitrate concentrations and trends. It is worth noting that the first LUBGWMA Action Plan identifies the bi-monthly well network as the source of the data to be used in the area-wide trend analysis. The first Action Plan also identifies the food processor well networks as the source of data to be used to evaluate trends at those sites. This (the second) Local Action Plan expands the sources of data to be used in the overall analysis of regional trends to include monitoring wells at food processing sites, permitted CAFO land application sites, permitted landfills, and at all of the public water supply wells that pull water from the alluvial aquifer.

DEQs Response to Recommendation 0.2

As recommended, the Wilcoxon Signed Rank test was used to compare the medians of the four synoptic sampling events. In addition, the Mann-Whitney test was also used to compare the medians of the four events. Results from both tests indicate the 1992 event is statistically different (i.e., lower) than the 2003, 2009, and 2015 events at a 95% confidence level. The tests also indicated there is no statistically significant difference between the 2003, 2009, and 2015 events. Discussion of additional statistical evaluations are provided in Section 2.4.4.

Readers interested in the full discussion of the "magnitude/practical significance" issue are encouraged to read the report and response. However, the summary of DEQ's response to the "magnitude" issue is that the point is well taken, but it does not change the overall conclusion of generally increasing nitrate trends because there are more increasing trends than decreasing trends when viewed as a whole or when compared to trends of similar magnitude. The summary of DEQ's response to the "practical significance" issue is that as a regulatory agency, we are often required to determine compliance. In this case, DEQ uses statistical significance as a "bright line" for evaluating compliance. This could mean something can have statistical significance and regulatory significance but be practically insignificant. This is a double-edged sword: a statistically significant trend that is slightly increasing does not meet the compliance goal but a slightly decreasing trend does. Either trend might arguably be called practically insignificant.

DEQs Response to Recommendation 0.3

Readers interested in the full discussion of the "time frame" issue are encouraged to read the report and response. However, the summary of DEQ's response to the "time frame" issue is that DEQ's view is the goal's intent is to evaluate changes in groundwater quality resulting from changes in land use practices. Since changes in land use began years prior to signing the plan, the entire data set should be used to evaluate water quality trends. However, it does not change the overall conclusion of generally increasing nitrate trends because trends calculated using the entire data set or just the data collected since 2000 both show the regional trend is slightly increasing through May 2016.