Lower Yakima Valley Groundwater Quality

Preliminary Assessment and Recommendations Document

Prepared By

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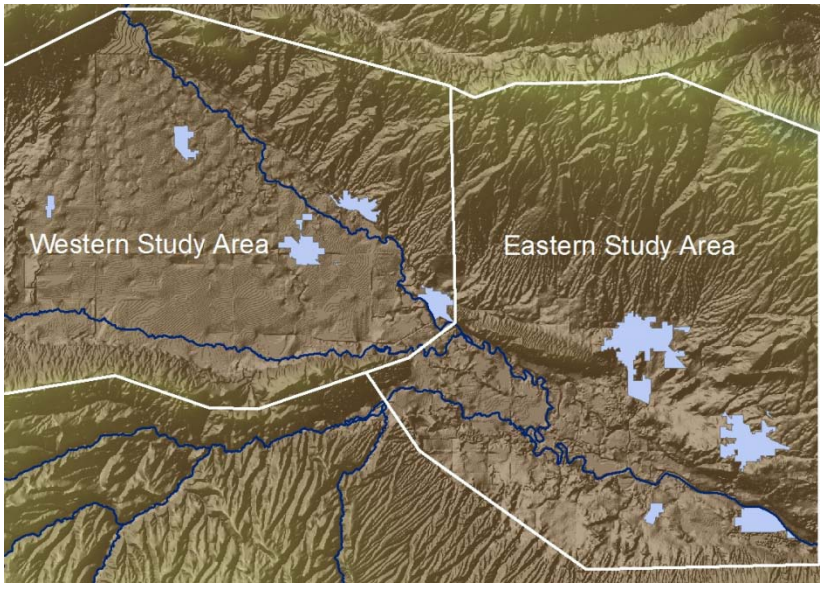
Background

In 2008, the Yakima Herald Republic ran a series of articles titled "Hidden Wells, Dirty Water[1]" in which it examined a long history of regulatory confusion and inaction in connection with groundwater contamination affecting public and private drinking water wells primarily in the Lower Yakima valley. In addition, the reporter for the Yakima Herald Republic requested that the EPA consider invoking Section 1431 of the Safe Drinking Water Act to address the groundwater issue. EPA responded that it was interested in applying the collective resources and tools of all the agencies that have a role in groundwater management as a first step. Although invoking Section 1431 of the Safe Drinking Water Act may not achieve a number of goals implicit in the articles due to the complexities of the Lower Yakima Valley nitrate problem, it may well be a useful tool for further exploring the problem and addressing certain aspects. In addition, EPA suggested a public meeting or forum to begin to address these issues and subsequently contacted various agencies to facilitate the public meeting.

As a result of that meeting, a subgroup consisting of representatives from state and local agencies, EPA, and the community was formed to create a report with an overview of conditions in the area. The purpose of the report is to provide recommendations to federal, state, local officials for consideration and further action based upon an initial assessment of available information and data on nitrates and groundwater contamination. This report is designed to be the foundation from which recommendations and strategies can be developed. It is also designed to help identify actions that can be taken to address and improve groundwater quality problems in the Lower Yakima Valley.

Scope of the Report

This report covers two areas of the Lower Yakima Valley (identified in the graphic below) where there are immediate health concerns related to nitrate and bacterial contamination for those relying on groundwater as their source of drinking water. These areas include portions of the Toppenish basin (western study area) and the Benton basin (eastern study area) along the Yakima River. This report relies on data covering both study areas gathered from 1990-2008. These datasets were selected because they are essentially from the same time period, use similar methods and the result can be spatially located and evaluated. However, a number of studies have been done in this area since the 1970s. A summary of the pertinent studies is provided in Appendix E.



The existing studies and related water quality data indicate that nitrate and bacterial contamination of groundwater exist in the Lower Yakima Valley. In some areas

[1] Yakima Herald Republic, "Hidden Wells, Dirty Water", Leah Beth Ward, October 12, 2008.

nitrate levels are in excess of the state drinking water maximum contaminant level (MCL) of 10 mg/L. In other areas the concentration is elevated (above 2 mg/L) but not above the MCL. Concentrations above 0.3 mg/L indicate[2] some process is leading to increased nitrogen in groundwater beyond what would be observed in a pristine watershed. Land use modifications which result in increased nitrogen include activities that involve organic waste products of fertilizer.

Over 2,000 people in the area are exposed to nitrate over the maximum contaminant level (MCL) through their drinking water. While not all groundwater supplies have been impacted, many residents rely on private wells that are in the most vulnerable portions of the aquifer. Approximately 12% of domestic well users are exposed to nitrate levels in their drinking water that exceed the health-based standard of 10 mg/L.

Exposure to levels of nitrate in drinking water that exceed health based standards poses a threat to human health. Nitrate is an acute contaminant, which means a single exposure can affect a person's health. It reduces the ability of red blood cells to carry oxygen. In most adults and children these red blood cells rapidly return to normal. However, in infants it can take much longer for the blood cells to return to normal. Infants who drink water with high levels of nitrate (or eat foods made with nitrate-contaminated water) may develop a serious health condition due to the lack of oxygen which, if left untreated, may cause death. This condition is called methemoglobinemia or "blue baby syndrome."

Some studies have found an increased risk of spontaneous abortion or certain birth defects if the mother drank water high in nitrate.

Data also shows that some private drinking water supplies are contaminated with bacteria (*Total coliform, fecal coliform, e. coli. bacteria*). Some strains of E. coli bacteria can cause severe illness. Infection with these strains of E. coli often causes severe bloody diarrhea and abdominal cramps; sometimes the infection causes non-bloody diarrhea. In some people, particularly children under 5 years of age and the elderly, infection caused by certain E. coli bacteria can also cause a complication called hemolytic uremic syndrome, which can be fatal.

Water quality issues related to groundwater in the Lower Yakima River can impact surface water. The Lower Yakima River is listed on the Department of Ecology's 303(d) list for violations of numerous Water Quality Standards (WQS). Listings of pH and Dissolved Oxygen are related directly to surface water nutrient levels and the growth and decay of aquatic organisms in surface waters. Ecology is required to develop Total Maximum Daily Loads (TMDLs) or action plans to obtain future compliance with WQS related to surface water. Connection between surface water and groundwater exists, and there is a potential for nutrients to move from ground to surface waters. Some proposed actions may well be beneficial to addressing both issues. It is important to keep in mind this broader context when addressing groundwater nutrients.

Summary of Recommendations

This report includes a series of observations and recommendations intended to help decision makers and the community evaluate the technical and financial needs associated with any particular strategy. Ultimately, a successful strategy will not only look to find long term and short term water quality solutions; it will be based on actions that can be implemented at the local level. Such a strategy should be developed in an open, public and inclusive manner and should consider the needs of all affected parties and communities.

[2] U.S. Geological Survey, Steve Cox, personal communication

Beginning with the December 2008 public forum, community members and agency staff have provided recommendations they would like to see implemented or supported by agency officials, agricultural interests and community members. Education and outreach are key components to all of the recommendations. These recommendations include:

- Education and outreach regarding nitrates and bacteria
- Expand list of contaminants of concern beyond nitrates to include other contaminants
- Develop a conceptual site model for the Lower Valley
- Determine the sources of contamination
- Include the Moxee area and perhaps all of the Valley including portions of Benton and Kittitas County
- Identify agricultural operations that use flood irrigation
- Develop a nitrogen loading model for the Yakima basin
- Identify and implement appropriate enforcement actions
- Assessment of agricultural applications of nitrogen fertilizers and Best Management Practices
- Include cumulative risk assessment and factor in synergistic health effects
- Explore the concept of developing a groundwater management area as one potential funding option.
- Use current document as the foundation to continue to build upon ideas and modify as new information becomes available.
- Where feasible, shift residents to public water systems
- Acknowledge the connection between groundwater and surface water
- Involvement of the Yakima Health District
- Development of measures of success

Developing a Strategy for Progress

The report also identifies a number of "needs" that should be addressed when implementing any of the recommendations listed above. These needs are important to any plan supporting the overall goal of improved water quality. These needs include:

1. Better characterization of vulnerable groundwater supplies,
2. Improve water quality monitoring and coordination of data that can identify trends in water quality,
3. Funding options to support lower valley initiatives to better manage potential contaminant sources and improve groundwater quality, and
4. A mechanism to coordinate future efforts and implement actions that result in improved water quality.

Success relies heavily on commitments from federal, state, local, and tribal governments. Success also depends on the support and involvement of the residents of the Lower Yakima Valley. As demonstrated in other areas of Washington, progress is often made when issues are tackled through a coordinated,

public process which allows for consideration of all interests and concerns. The demographics of the Lower Yakima Valley require that final implementation of any or all the recommendations either contained in this document or developed as a result of subsequent actions by stakeholders consider an element of environmental equity that takes into account, cultural, economic, and geographic factors.

This report consists of an initial assessment of groundwater areas impacted by nitrate and bacteria along with an assessment of past and present land use activities likely to have contributed to increased nitrate and bacteriological levels in groundwater and recommendations on potential mechanisms to address these potential sources of contamination. It also consists of a summary of existing governmental mechanisms that are available (federal, state, local, tribal) to mitigate nitrate and bacteriological occurrences in the affected area(s). A section on potential funding mechanisms that may support mitigation efforts identified in the findings and recommendations section.

This report includes an initial analysis of water quality data, as well as a review of the area's land use and activities that may have contributed to water quality problems. It includes a review of current regulations and management authorities, and a review of elements which should be considered when building an action plan to improve water quality in the valley

Introduction

In 2008, the Yakima Herald Republic ran a series of articles entitled "Hidden Wells, Dirty Water[1]" that described a long history of regulatory confusion and inaction in connection with groundwater contamination affecting public and private drinking water wells primarily in the Lower Yakima Valley. In addition, the reporter for the Yakima Herald Republic requested that the United States Environmental Protection Agency (EPA) consider invoking Section 1431 of the Safe Drinking Water Act to address the groundwater issue.

EPA responded to the media coverage that it was interested in applying the collective resources and tools of all the agencies that have a role in groundwater management as a first step. Although invoking Section 1431 of the Safe Drinking Water Act may not achieve a number of goals implicit in the articles due to the complexities of the Lower Yakima Valley nitrate problem, it may well be a useful tool for further exploring the problem and addressing certain aspects. In addition, EPA facilitated a public meeting where they, state and local agencies began to address these issues.

As a result of that meeting, a subgroup consisting of representatives from state and local agencies, EPA and the community was formed to create a report with an overview of conditions in the area. This report summarizes information regarding nitrates and bacteria pollution in groundwater in the Lower Yakima Valley.

It is the authors' intent that federal, state, and local officials and the community of the Lower Yakima Valley refer to the report when considering further action to address nitrates and other forms of groundwater contamination. This report also identifies alternatives for coordinating action between agencies to improve the response to groundwater quality problems in the Lower Yakima Valley. The main objective of any of the processes discussed below is to establish a comprehensive program to manage the application of nutrients (or nitrogen) to the land in order to eliminate sources of groundwater pollution.

[1]Yakima Herald Republic, "Hidden Wells, Dirty Water", Leah Beth Ward, October 12, 2008.

Area Overview

General Area Information

The Yakima River runs through the middle of the area and forms the boundary of the Yakama Reservation within the southwest half of the Lower Yakima Valley. For this discussion the entire area is referred to as the Lower Yakima Valley. It has been subdivided into two portions. These reflect geographic, geological and geopolitical constraints and correspond to divisions reflected in the historical water quality data set. The executive summary provides a map of the area with the two subdivisions referred to as the western and eastern study areas. (These roughly mirror the areas designated as upper and lower study areas in the 2002 Valley Institute for Research and Education groundwater study, and correspond to the Toppenish and Benton basins referenced in other studies.)

Agriculture is the primary economic and land use activity in the area. Approximately 70-80% of the area is used for agriculture. Most cropland in the area is irrigated. The major irrigation districts in the area include the Roza, Sunnyside Valley, Wapato Irrigation Project, Grandview and Zillah. Major commodities grown in the valley include apples, pears, cherries, peaches, vegetables, hay, mint and hops. Dairy operations were greatly expanded starting in the late 1980's. Also, animal feeding operations operate at various sizes from very small home lots to large commercial feedlots. The dairies and animal feeding operations are concentrated in the lower parts of the valley in and around the cities of Sunnyside, Grandview, Mabton and Granger, although some occur in more disperse parts of the valley on the Yakama Indian Reservation.

This document describes groundwater related information for two areas of the Lower Yakima Valley. These include portions of the Toppenish basin (western study area) and the Benton basin (eastern study area) along the Yakima River. Together, both areas cover approximately 368,600 acres within Yakima County. The 2008 estimate of population for the area is 71,400 of which 34% live in unincorporated areas and generally are not served by public water supplies. The major public water systems for the area serve an estimated population of 47,000 and are a mix of both larger group A (86 systems) and smaller group B (230 systems)[2].

Western Study Area - The Toppenish Basin

This area consists of lands within and under the jurisdiction of the Yakama Nation. Land use is mixed and with open range and agriculture predominating.

The Western Study Area lies entirely within the Toppenish Basin. The basin is bordered on the north by the Ahtanum Ridge, on the south by the Toppenish Ridge, and bisected by the Wapato Syncline. There are two main aquifers underlying the area. These include a surficial unconfined to semi-confined alluvial aquifer and basalt aquifers underlying the sedimentary deposits. The basalt is believed to be semi-isolated from the surficial aquifer and stream systems. Groundwater flow within both aquifers generally follows topography with natural recharge occurring within the headlands and on the sides of the valley and discharge occurring to the Yakima River. This produces a major flow direction from northwest to southeast, and a minor component flowing northeast to southwest and southwest to northeast. It is likely

[2] Data from Washington Department of Health Public Water Systems Database – Sentry (6/09)

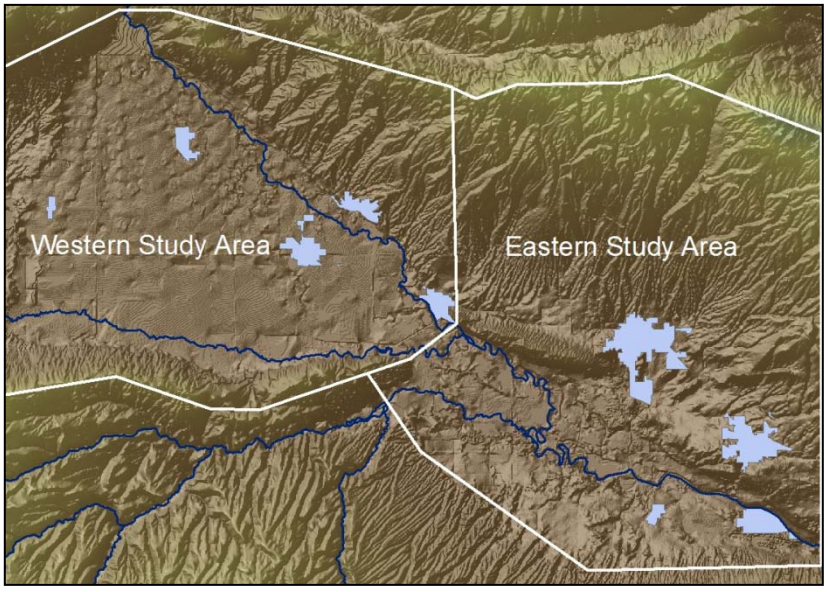
that the minor components of flow are significantly enhanced by irrigation practices upland from the Yakima River.

Eastern Study Area – The Benton Basin

This includes the non-reservation lands along the river and to the southeast side of the valley. Approximately 60% of the valley population resides in this area. The area includes the communities of Sunnyside, Granger, Grandview, and Mabton.

The Eastern Study Area lies in the southeastern part of the Lower Yakima Valley. The western boundary of the basin abuts the eastern boundary of the Toppenish Basin. The southern boundary is bordered by the Horse Heaven Hills and the northeastern boundary generally follows the northern flank of the Cold Creek Syncline. Like the Toppenish basin there appears to be two discrete aquifers systems; an unconfined and/or semi-confined alluvial aquifer, and a deeper basalt aquifer. Groundwater flows follow topography with natural recharge occurring within the headlands and discharge occurring towards the Yakima River. In this area predominant ground water flow is from the northwest toward the southeast. Locally, the flow direction is modified by geologic structures and by drains, ditches, canals and other hydrologic features.

Figure 1: Lower Yakima Valley Study Areas



Environmental Justice

Environmental justice is defined by the EPA as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." This report concludes that a lack of coordination amongst agencies with limited authorities for addressing groundwater conditions in the Lower Yakima Valley has lead to confusion amongst members of the public about their options for addressing environmental concerns in the area. This, in itself, represents an environmental justice concern. Additionally, the demographic conditions of the Lower Yakima Valley transposed against the conditions of groundwater pollution create inequities of representation and communication regarding solutions for people to protect themselves from groundwater pollution.

Part of our shared goal is to see that all persons have access to safe drinking water supplies. This includes incorporating environmental justice considerations into the water quality improvement process to ensure that all communities have the same degree of protection from environmental and health hazards.

Attention to environmental justice concerns is necessary because actions to improve water quality that adequately protect the general population, may not always protect discrete segments of the population. Communities face different levels of environmental harms and risks depending on cultural practices, diet, and where they live, work, and play. Further, higher-risk populations, communities with environmental justice concerns, and disadvantaged groups, often face barriers in trying to address concerns within their communities. Such environmental justice concerns are particularly relevant for rural communities, and in this case a predominantly agricultural based community. The following are potential obstacles to public participation and factors that result in differential risks among vulnerable communities:

- Competing priorities and multiple challenges
- Lack of personal or community resources (e.g., financial, information, political experience)
- Inadequate access to infrastructure such as housing, utilities, communication, and transportation
- Language barriers (non-English speaking or non-fluency)
- Cultural or other barriers to participation in government processes
- Residents who are not property owners (e.g., tenants and agricultural workers)
- Cumulative risks from exposure to multiple sources of pollution

Environmental Considerations

Not all water supplies in the area have been impacted. Public water systems are regularly monitored for suspected contaminants. They must meet national and state drinking water standards, and public systems that use contaminated water are required by law to treat the water, thus maintaining a safe supply of drinking water to its customers. Until treatment has been installed, or if the treatment isn't working, public water systems must notify their users if nitrate levels exceed the standard.

Many families of the Lower Yakima Valley are served by private wells and do not have access to public water systems. Regular testing of drinking water is not required for private water wells. Testing is generally only required when new wells are constructed or when property is transferred or sold. Private wells do not fall under direct state or local authority for the on-going management of drinking water, however, enforcement of state groundwater standards could protect groundwater so that it can be safe as a drinking water source. There is sufficient data to suggest that many of these well water supplies are at

risk, even if they do not currently exceed a drinking water standard. The Valley Institute for Research and Education collected data from the wells of low income households in 2001 and 2002. In some areas, up to 40% of the wells sampled were above 5 mg/L nitrate, a level that is recognized as a concern.

Many potential concerns exist for those who rely on private well water. Residents may not know the quality of the drinking water within their homes. Residents may not use tested wells, and if so, they may not know how to interpret the test results. Many residents are renters and are not the property or well owners. The well owner of record may not be the current property owner. Current property owners may not live on the property. In addition to health concerns, residents and property owners may have fears and questions about the implications of having a contaminated well (in terms of liability, responsibility, property values, and the implications for access to safe and affordable housing)

Community Considerations:

In Yakima County, poverty impacts greater than 20% of the population and a little over 30% of adults have less than a high school diploma. In addition, 41.1% of the population is Hispanic/Latino, which is more than four times the state average (9.8%). American Indians and Alaskan Natives comprise 5.2% of the county's population, which is three times the state average (1.7%).

English is not the primary language (written or spoken) in many households in the Lower Yakima Valley. Existing outreach materials in Spanish and other languages are limited and focused for specific audiences and purposes (coliform boil water notices, nitrate advisories for high risk populations). New materials may need to be developed to address specific needs of the lower valley residents. Written materials and web based information may not be the best way to access the most "at risk population".

Outreach considerations should include:

- Coordination with the Yakama Indian Nation and Indian Health Service will be critical due to overlapping interests and adjacent populations.
- Coordination with local community groups as well as agricultural and related business groups will be needed. Their interests are diverse and their perspectives on some of the underlying issues may appear to be at odds.
- Cooperation, coordination, and clear and consistent messages about shared goals are needed to support effective public health education and outreach activities.

Health Effects of Nitrates and Bacteria in Drinking Water

Based on available data, there are two main contaminants of concern found in some drinking water wells in the Yakima Valley: nitrate and bacteria.

Over 2,000 people in the area are exposed to nitrate over the maximum contaminant level (MCL) through their drinking water. (Population of area is 71,400, 34% of these residences are on private wells, about 12% of private wells exceed the nitrate MCL). Nitrate is a colorless, odorless chemical found in most fertilizers, manure, liquid waste from septic tanks, and food processing waste. Rain or irrigation water can carry nitrate down through the soil into ground water. Drinking water wells may contain nitrate if they draw from this ground water.

Nitrate is an acute contaminant, which means a single exposure can affect a person's health. It reduces the ability of red blood cells to carry oxygen. In most adults and children these red blood cells rapidly return to normal. However, in infants it can take much longer for the blood cells to return to normal. Infants who drink water with high levels of nitrate (or eat foods made with nitrate –contaminated water) may develop a serious health condition due to the lack of oxygen and, if untreated, may die. This condition is called methomoglobinemia or "blue baby syndrome". Some scientists think diarrhea can make this problem even worse.

Some studies have found an increased risk of spontaneous abortion or certain birth defects if the mother drank water high in nitrate. Women who are pregnant or trying to become pregnant should not consume water with more than 10 mg/L of nitrate. Low levels of nitrate have been found in breast milk, but the levels are not high enough to cause "blue baby syndrome". Adults with reduced stomach acidity, and individuals deficient in the enzyme that changes methemoglobin back to normal hemoglobin are susceptible to methemoglobinemia.

For more information about the health effects of nitrates in drinking water, see Appendix B, Nitrates and Drinking Water.

Some scientists have questioned the role of nitrate-contaminated water as a cause of methemoglobinemia, noting that other chemicals found in drinking water, and bacterial infections, may also be important factors in the occurrence of the condition. The Department of Health conducted a study in central Washington to better understand the levels of exposure to chemicals that may contribute to levels of methemoglobin in infants. The results indicate a relationship between exposure to relatively low levels of nitrate in drinking water and an increase in the level of methemoglobin. However, levels of methemoglobin were found to be lower than the level that would cause a case of blue-baby syndrome (VanDerslice, 2007). This report can be accessed at the following web site:

https://fortress.wa.gov/doh/wtn/WTNPortal/Reports/STAR82978101FinalReport.pdf

Bacteria, including total coliforms, fecal coliforms, and E.coli. have been detected in some area wells. Fecal coliform and E. coli only come from the digestive tracts or humans or animals. Although most strains of E. coli bacteria are harmless and live in the intestines of healthy humans and animals, there are strains that are harmful to humans; they can cause severe illness. Infection with these strains of E. coli often causes severe bloody diarrhea and abdominal cramps; sometimes the infection causes non-bloody diarrhea.

In some people, particularly children under 5 years of age and the elderly, infection caused by certain E. coli bacteria can also cause a complication called hemolytic uremic syndrome, in which the red blood cells are destroyed and the kidneys fail. About 2%-7% of infections lead to this complication. In the

United States, hemolytic uremic syndrome is the principle cause of acute kidney failure in children, and most cases of hemolytic uremic syndrome are caused by a strain of E. coli. Hemolytic uremic syndrome is a life-threatening condition usually treated in an intensive care unit. Blood transfusions and kidney dialysis are often required. With intensive care, the death rate for hemolytic uremic syndrome is 3%-5%.

Land Uses and Potential Sources of Groundwater Pollution

Dairies and Livestock Feedlots

Given the amounts generated and the areas to which it is applied, current management of animal waste may be a contributor to elevated nitrates in groundwater within the Lower Yakima Valley. Currently, 69 dairies are registered with the WSDA in the Lower Yakima Valley. These facilities operated with approximately 139,000 milking animal units. Waste from these operations is defined under Washington State statute as a beneficial nutrient as long as it is managed in an environmentally responsible manner.

Table 1: Acreage and Nitrogen Production of Lower Yakima Valley Dairy Operations

Facility Data	Small Dairies	Medium Dairies	Permitted CAFO Dairies	Large CAFO's	All Dairies
Number Dairies	4	21	5	43	**68**
Acres Owned	481	3,528	2,485	15,438	**19,447**
Acres Leased	0	1,825	1,130	6,579	**8,404**
Total Controlled	481	5,353	3,615	22,017	**27,851**
Total N Produced (lbs)/yr	**201,037**	**3,877,516**	**5,810,858**	**30,088,3020**	**34,166,855**

Manure and other animal wastes can supply nutrients to crops because they contain nitrogen and other elements essential to plant growth. The recycling of animal nutrients to increase soil fertility and crop yield is a historic practice.

Crop production has benefited from supplementing or replacing inorganic fertilizer with animal waste which includes nitrate. The application of livestock waste to farmland to grow crops, management of waste storage structures, and handling of nutrient-containing water through feedlot surfaces are conducted according to guidelines provided by existing regulations and policies intended to limit waste discharge to surface waters and groundwater.

Although livestock wastes contain low concentrations of nitrogen relative to inorganic fertilizer, it is difficult to estimate nitrogen loading to soil, air and water from manure application without sufficient analysis of nitrogen content in these waste streams. These are subject to some nitrogen loss to air and soil under natural conditions. Despite this, if animal waste is applied to land exceeding the agronomic rate, soluble nitrate will be transported to the groundwater by means of water movement downward through and past the root zone. As such, further examination of the relationship between livestock nutrient management and groundwater quality should be examined.

Dairies are required to manage their wastes according to Nutrient Management Plans which are kept on location at the dairy. The Washington Department of Agriculture conducts on-site inspections to ensure that the Plans are followed and has taken enforcement actions in some situations where nutrients were over-applied.

Any improperly decommissioned wells beneath livestock operations, including crop fields onto which waste is applied, could provide a direct conduit for contaminants to reach the ground water.

Irrigated Agriculture

The practice of surface application of commercial inorganic nitrogen fertilizers and animal waste as nutrients in irrigated portions of the Lower Yakima Valley may be a contributing source of nitrate in groundwater. Inorganic fertilizers contain high amounts of nitrogen. Nitrogen that plants do not utilize can leach into groundwater. Practices involving the use of nitrogen as a crop fertilizer improved significantly over the last several decades, but there remains potential for improvement. It is likely that both historic and current use of nitrogen fertilizers in the Lower Yakima Valley contributed to the current issues related to groundwater quality. However, given the current catalogue of data it is extremely difficult to gage the historic contribution and to accurately assess the potential contribution of on-going activities. In general the agricultural community recognizes that farming practices result in economic and environmental benefits and may also have environmental impacts.

Irrigated agriculture requires some degree of "leaching" to remove salts from the soil column in order to maintain crop health. The risk of nitrogen leaching below the root zone can be significantly reduced through the implementation of appropriate Best Management Practices (BMPs). BMP's can focus on one or several factors that can reduce the potential for nitrogen movement through the soil column into the underlying groundwater. Generally the areas of focus are:

1. Nitrate source control – Sources of nitrate include fertilizers, organic sources such as process water and manure, and irrigation water. The amount of nitrate applied to fields may substantially affect nitrate loading to groundwater.
2. Nitrate transport control - Nitrate may move from the surface through the soil profile to the groundwater table only if carried or transported by water.
3. Improvement in the understanding of site conditions - Site conditions relevant to deep nitrate migration include environmental factors such as precipitation, soil texture and structure, aquifer characteristics, etc., the presence and type of irrigation systems and crop type.
4. As appropriate, based on available information, BMP's that are expected to significantly reduce contaminant loading will be identified and implemented.

Urban and Rural Residential

Residential land use is also a potential contributor to overall ground water quality degradation. In addition, old or poorly constructed drinking water wells are more vulnerable to becoming contaminated from nearby sources of contamination. Factors that may contribute to this condition include fertilizer use, septic systems, improper wellhead protection, abandoned wells, poor well construction, and land development. During the past 28 years the rural population in the Lower Yakima Valley has grown 38%. It should be noted, however, that there are widespread areas of contamination that are upgradient of residential areas.

Voluntary actions of residents and home owners can reduce the vulnerability of wells to contamination. The chances of these activities happening increases with the awareness of drinking water vulnerability. This generally consists of an education and outreach plan, creation of a directory of resources on drinking water safety that is easily accessed by the public.

Recently, the Washington State Department of Health (WDOH) developed and distributed educational materials on the health effects of high nitrate levels in drinking water. In addition, Ecology provided lists

of certified laboratories that can test private wells for nitrates and pathogens. The Washington Department of Ecology (Ecology) also provided funding to conduct this testing for low income, private well users.

The following factors should be considered in the context of an outreach program:

- Inadequate sanitary connections between the wellhead and irrigation systems
- The existence of poorly abandoned and decommissioned wells that may act as potential conduits for nitrate to travel directly into underground water sources
- The existence of abandoned agricultural wells, such as irrigation wells, that may act as a potential conduits for nitrate to travel directly into underground water resources
- The existence of poorly constructed wells with in-adequate well seals that may allow surface contamination into underlying drinking water sources
- The existence of poorly maintained septic systems that may fail to provide adequate treatment of on-site sewage waste
- Poorly located wells and inadequate wellhead protection that may allow for the contamination of underlying groundwater
- Proper use and storage of fertilizers and/or garden pesticides that may impact groundwater.

Additionally, under this land use consideration is the management of non-commercial application of organic and synthetic nutrients such as lawn fertilizers which typically do not fall under current nutrient management plans. Many residents in urban areas are on public water that is required to deliver water that is below the maximum contaminant level.

Sprayfields and Wastewater Management

Sprayfields and land application of wastewater is conducted through permits issued by Ecology. There are seven non-dairy facilities in the Lower Yakima Valley that have individual state waste discharge permits. There is one non-dairy livestock operation and five dairies that Ecology lists on a general state waste discharge permit. Two individual state waste discharge permits allow use of sprayfields, and the rest utilize lined and aerated evaporation lagoons. The two sprayfields covered by permits limit nitrogen and other potential pollutant applications for 600 acres of land to approximately 240,000 pounds per year during growing season months.

Ecology regulates the application of biosolids to crops in some areas of the Lower Yakima Valley. Ecology requires soil nitrogen monitoring for biosolids application and sprayfields. For non-livestock state waste discharge permits, Ecology does not allow application of biosolids or wastewater to cropland that has received more nitrogen than permits allow. In addition, Ecology requires these facilities to conduct groundwater monitoring and corrective action if groundwater quality standards are violated.

Land application of process wastewater can be an effective process in the reuse and recovery of nutrients and water. Many times, the nutrients contained in these land applications are conducted to enhance the growth of a crop. Land application management practices are intended to protect the existing and future beneficial uses of groundwater and soil. However, the use of sprayfields to manage wastewater remains a potential source for nitrogen contamination.

Scope of Review, Analysis and Observations

Overview of Historical Water Quality Data

For the purposes of this initial review four primary data sources were examined:

1. The 2001-2002 study conducted by the Valley Institute for Research and Education (VIRE),
2. USGS ground water sampling conducted in 1991-92 and 2003-04,
3. Washington State Department of Ecology sampling conducted as part of the Agricultural Chemical Pilot Study conducted in 1988, and
4. WDOH public water supply data collected routinely from 1990 – 2008.

There have been numerous water quality investigations within the Lower Yakima Valley over the years. This review relies on the four primary investigations listed above. These were selected because they cover the area, are essentially from similar time periods, use similar methods and the result can be spatially located and evaluated. Each set of data reflects unique study goals and constraints which can limit the ability to "homogenize" the data into a single cohesive set. These four studies do reflect a large data set and have enough similarities they provide an overview of groundwater conditions. What they do not have is overlapping sampling points that can provide strong trend data or direct correlations with specific land uses or changes in land use that have occurred over the years. Even though these studies were not designed to identify trends, they document impact to surface and groundwater quality due the presence of both nitrate and bacteria and in the case of surface water, both legacy and currently used pesticides.

Water Quality Investigations, Datasets and Uncertainty

Data from private wells is collected and managed differently than from public water supplies. Operators test public water systems regularly for nitrate and bacteria. That data is reported to WDOH and maintained in the Sentry Database. Monitoring is a part of a public water system's obligations under the State Drinking Water Regulations. Private water wells do not fall under these regulations. Although state laws are in place to protect groundwater, private wells used for drinking water are not subject to state regulation beyond construction and decommissioning. There are no standard monitoring requirements for private wells used for drinking water. While the State Department of Ecology and Health recommend periodic testing of private wells for bacteria and nitrates – there is no state authority to require it.

There is no central repository for water quality data from private wells. Sample results commissioned by an individual for a private well remain private information. The results are the property of the individual who ordered the tests. The exception to this is special investigations where a third party samples private wells as part of a focused coordinated investigation. This is how the USGS and VIRE groundwater studies incorporated private well into their studies.

The causes of well contamination are complex and often site-specific. They are linked to a variety of sources and pathways for pollutant transport. Risk factors for pollutant transport include proximity to a potential source, well construction, location, depth and age.

Observations and Analysis

Based on available data, approximately 12% of wells sampled in the Lower Yakima Basin exceeded the Maximum Contaminant Level (MCL) for nitrate of 10 mg/L. Approximately 21% of wells sampled showed elevated nitrogen levels in the range of 5-9.9%, and 67% of wells were less than 5mg/l. Not all wells have been sampled in the Lower Yakima Valley. Areas with elevated nitrate concentrations include locations in both the upper and lower study area; however, wells in the lower study area (Sunnyside, Mabton, Grandview) generally exhibited higher nitrate concentrations than those in the upper study area (Toppenish, Wapato, Zillah).

Nitrate-nitrogen concentrations are greatest in shallow groundwater. A significant decrease in nitrate-nitrogen concentrations is found in groundwater samples collected from depths below 300 feet. The highest percentage of samples exceeding state Drinking Water Standards (l0 mg/l nitrate-nitrogen) are obtained from shallow wells (less than 300 feet deep). Most private domestic drinking water wells appear to be shallow wells.

The population in the Lower Yakima Valley is served by a mix of public and private water supplies. The public systems primarily serve the large communities and the private wells are used in the more rural areas. It is estimated that approximately one third of valley residents rely on private wells for drinking water (~24,000 residents)[3]. Many private wells in the area draw from the shallow portion of the surficial aquifer for drinking water, while public systems tend to rely on deeper wells or a mix of sources. The reviewed historical water quality data suggests that a significant number of residents that rely on these individual wells in the Lower Yakima Valley may be exposed to drinking water which exceeds the nitrate-nitrogen drinking water MCL. There is some data to suggest that in addition to nitrate

[3] Washington State Office of Management and Budget April 1 Intercensal and Postcensal Estimates of the Total Resident Population by Year for the State, Counties, Cities the Unincorporated Areas, and Incorporated Areas: 1968 to 2008 and Washington State Department of Health Population served data Sentry database-2009

contamination the most vulnerable wells are also at risk to bacterial contamination (Total coliform and fecal coliform bacteria).

Agricultural practices, the use of fertilizer and the management of manure are linked to nitrate loading and incidents of nitrate contamination in groundwater. They can be significant inputs of nitrogen into the environment, but they may not be the only source. Other sources include on-site waste disposal systems along with residential and urban use of fertilizers can contribute to local nitrate hot spots. Failing waste water disposal systems can also be a localized source of bacterial contamination.

Preliminary Assessment – Nitrate

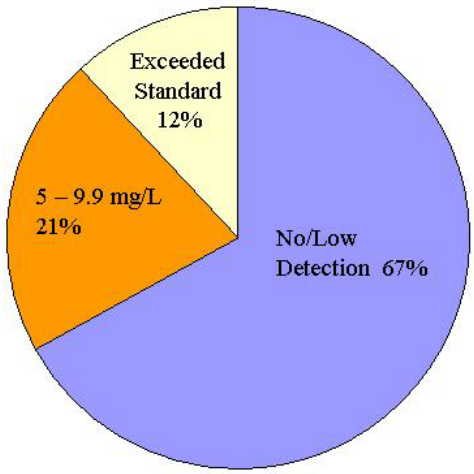
Using the information from the four selected data sets, the combined database contains 1726 independent nitrate sample collected from 453 well sites and 515 independent bacteriological samples from 322 wells. These were collected throughout the study area from the early 1990's through June 2005. The wells included in the combined data set are not evenly distributed throughout the project area nor are they distributed even across the time period. A majority of the wells are located in the lower portion of the study area and generally reflect more recent data.

When using the combined data set it is not possible to track the well distribution by well use (i.e. domestic, public water supply, monitoring); however simple estimates suggest that 72% of the wells sampled served domestic households, 20% were public water supply wells with the remaining 8% classed as other (monitoring wells, stock watering wells, irrigation wells).

Table 2: Identified Uses for Wells in Assessment

Study Area	Domestic Wells	Public Water Supply Wells	Other	Total
Upper	107 (61%)	56 (32%)	13 (7%)	176
Lower	221 (80%)	37 (13%)	19 (7%)	277
Total	328 (72%)	93 (21%)	33 (7%)	453

Figure Two: Nitrate Detection in Wells



The results of the analysis of the combined dataset indicate that of the 453 wells sampled, 55 wells, or 12%, exceeded the state drinking water standard for nitrate (10 mg/L) at least once during the period 1990 - 2008. Several of these wells exceeded the standard on numerous occasions. Ninety-eight out of 453, or 21 %, of these wells had at least one nitrate sample between 5 and 9.9 mg/L during the 1990 -2008 period.

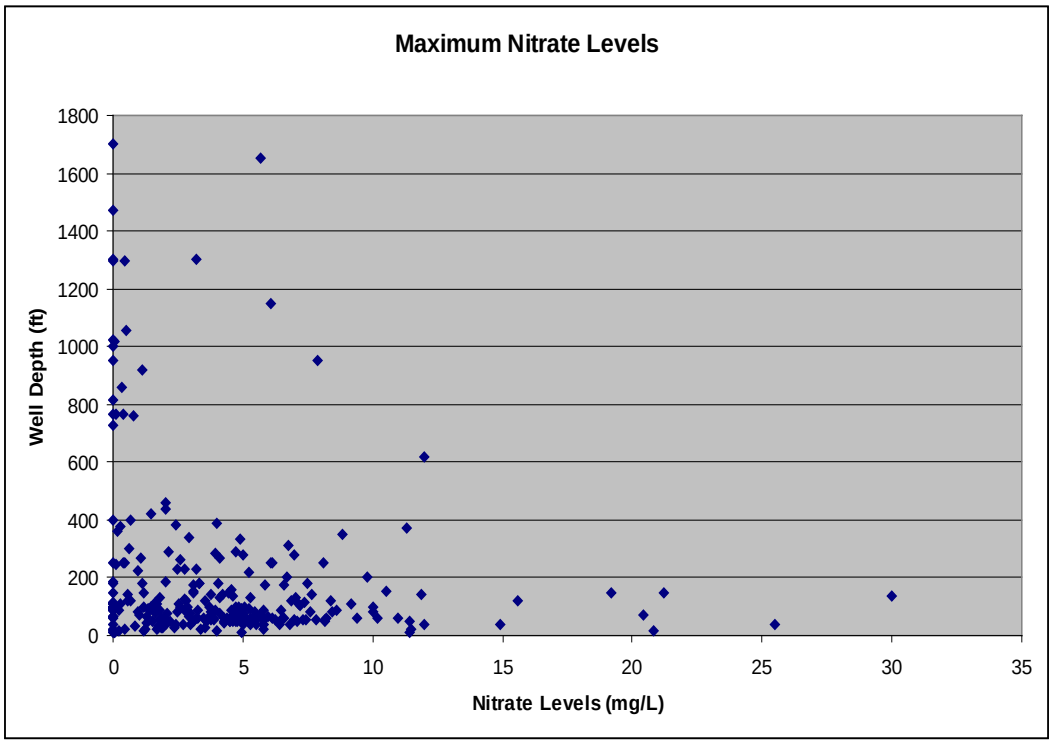
Nitrate-Nitrogen Occurrence in Groundwater Related to Well Depth

A correlation between nitrate concentration and well depth has been observed in the lower Yakima Valley and other areas of the state where nitrate in groundwater is a concern. The correlation is particularly true in agricultural areas where shallow groundwater is recharged with irrigation water from agricultural lands.

Figure three illustrates relationship between nitrates and well depth in the Lower Yakima Valley. The results reflect using depth and maximum nitrate concentration detected in a well during the period 1990 - 2008. The general correlation between depth and nitrate holds true for the Lower Yakima Valley. However, the results differ somewhat from the Mid- Columbia assessment in that there appears to be a slightly greater impact on deeper wells in the Lower Yakima Valley.

Several reasons may account for this including well construction, differences in basin geology, age of wells, presence of unused wells, lack of backflow prevention devices installed on wells, or lack of a fully confining geologic layer in portions of the study area. Nitrate is a contaminant that moves with groundwater. This coupled with the deep zone of unconfined and semi-confined sediments in the Lower Yakima Valley may be enough of a factor to account for deeper impact of nitrate.

Figure 3: Nitrate Concentration Related to Well Depth



Most of the large public water supply wells are drilled deep to maximize the volume of water needed to meet year round demand. However, because of construction costs, most private wells are generally not drilled beyond the point where groundwater is first encountered. It is expensive to drill deeper. This practice tends to make the private wells more vulnerable to surface sources of contamination including nitrates.

Trends in Nitrate-Nitrogen Concentrations

The combined dataset lacks sufficient population to determine nitrate trends in groundwater. There has been little repeat sampling of private wells over the period of 1990- 2008. While most public water systems do have repeat samples at the sample location over time, they are generally deeper wells and do not reflect the highest risk sources. Where shallow public supply wells have shown impacts of elevated nitrates, they are often taken off line and reserved as emergency sources, or treatment is installed. Under those conditions, the raw source water from the wells is no longer sampled regularly, and trend data is not collected.

The natural level of nitrate in ground water is expected to be less than 0.3 mg/L. Many samples from pristine areas of the Yakima Valley have results in this range or below. Concentrations above 0.3 mg/L indicate additional nitrogen has been introduced from some land use that involves organic waste products or fertilizer. With the introduction of agriculture over the last 100 years nitrates levels have risen in some areas of the valley. This is consistent with the number of shallow wells in the valley that show elevated nitrates. However, the cause and effect relationship that trend data could highlight is difficult to document with data points that change from year to year or project to project. Water quality changes at a single point over time have the potential to show how changes in land use and management may be affecting groundwater quality. The combined data set has few time series data points among the most vulnerable wells.

The variability in nitrate concentrations in the combined data set for the study area reveals no clear uniform trend (increasing, decreasing, or stable) in the general nitrate concentrations in groundwater during the period 1990 - 2008. But as was noted earlier, the lack of any identifiable trend may be an artifact of the combined data set or the limited duration of the original studies. The combined dataset clearly illustrates “hotspots”. They do not show how those hot spots have responded or may respond to land use and management changes over time.

Preliminary Assessment – Bacteria

Bacteriological sampling of groundwater has occurred throughout the study area since the 1990’s. The overall number of samples is significantly less than collected for nitrate. There are three main sources of bacteria data used in the assessment, data collected from public water supply wells as part of the WDOH’s public water supply monitoring program, data collected by the United States Geological Survey (USGS) during the course of several water quality investigations, and data collected as part of the Valley Institute for Research and Education 2002 study.

A review of the data indicates an overall tendency for shallow wells to exhibit a greater potential for bacteria impact than deeper wells. Bacteria were detected in one well deeper than 300 feet (of the 112 reviewed for which well depth data was available). However, for wells 300 feet or less in depth 22 or 19% demonstrated a detection of bacteria. A map presenting *E. coli* and fecal coliform bacteria results (see appendix C) illustrates historic detections based on the data set used.

Normally, bacteria are not a contaminant detected in groundwater because aquifer conditions are not conducive to its survival. However, there are conditions under which bacteria can make its way into the water supply (either through the distribution system or from the source itself). These include:

1. Unsanitary wellhead conditions that allow dirt, surface water, insects, debris and small animals to enter the wellhead.
2. Breaks or leaks in the service lines that allow shallow contaminants and bacteria to be drawn into the water lines.

3. Local sources of bacterial contamination, usually in the immediate area around the well, or a large nearby source such as a leaking landfill or cesspool.
4. Improper disinfection after construction and repairs.
5. Substandard well construction may allow surface contaminants to enter the well.

Existing Regulatory Framework and Authorities

One of the major frustrations expressed during the public meeting held on December 4, 2008 was confusion regarding where authorities lie with federal, state, and local agencies in regards to water quality protection, regulation of potentially impacting land use activities, and protection of public health. In order to begin to address these concerns and establish a knowledge base for any future effort designed to address groundwater quality it is necessary to review where current authorities exist. Table 3 below provides a brief summary of major authorities.

Table 3: Nitrate and Bacteria Sources and Authorities to Address Them

Sources	Institution-Individual	Responsibility	Statutory Authority
Location or expansion of Agricultural Operations (including dairies)	Yakima County	Update CARA/CAO when SB 5248 expires Update comprehensive plan now	RCW 36.70A
Non-dairy Agricultural Operations Manure application	Yakima County	CARA/CAO update when SB 5248 expires Comprehensive plan updates	RCW 90.48.080
Agricultural operations	Ecology	Jurisdiction over activities which contribute pollutants to ground and surface waters	RCW 90.48.030 RCW 90.48.080
Permitted dairies, other permitted animal feeding operations	Ecology	Jurisdiction over facilities that discharge or propose to discharge to surface or groundwater	RCW 90.64.120 RCW 90.48.030 RCW 90.48.080
Dairies and dairy manure applications	WSDA (No authority on Tribal Lands)	Inspect facilities every 22 months Survey for evidence of violations Identify corrective actions for actual or imminent discharges that violate or could violate the state's water quality standards	RCW 90.64.023
Dairies and dairy manure applications (cont.)	WSDA	Monitor the development and implementation of dairy nutrient management plans Identify dairy producers who would benefit from technical assistance programs Refer producers for technical assistance to conservation district-may use NRCS or private consultant Conduct inspections as necessary to ensure compliance with state and federal water quality requirements Dairy inspection can be prioritized based on special needs Compliance/Enforcement Investigate complaints	RCW 90.64.023
CAFOs – Facilities covered by	Ecology (EPA on Tribal	NPDES Permit	RCW 90.48.130 33 USC sec 1311

Sources	Institution-Individual	Responsibility	Statutory Authority
CAFO/NPDES permit (including dairies)	Lands)		
AFOs & CAFOs (non-permitted and permitted animal feeding operations)	Public	Third party right to sue for CAFO discharge without a permit Third party right to sue for permitted CAFO violating permit conditions subject to Clean Water Act citizen suit process	Clean Water Act citizen suit provisions 33 USC sec 1365
AFOs – manure (non-dairy, non-permitted)	Ecology	Address and prevent discharges to ground and surface water	RCW 90.48.030 RCW 90.48.080
AFOs – manure (non-dairy, non-permitted)	Conservation Districts/NRCS (no regulatory authority-technical assistance only)	Prioritize work to address biggest problem in district protect and promote public health and safety of the state	RCW 89.08.010
Septic Systems Individual/Residential	Yakima County	Must connect to public sewerage system unless not available Requirements for individual systems specified and to be in conformance with State Department of Health	Yakima County Municipal Code – Title 12, Chapter 12.05
Septic Systems Community/LOSS	WA DOH	Approve and permit large on-site septic systems	WAC 246-272B
Residential fertilizer/golf courses	City/County	Local fertilizer ordinance/CARA/CAO	Yakima County Ordinance No. 13-2007
Anaerobic Digesters	Ecology, Yakima Health, WSDA responsible for participating dairies	May need waste disposal permit	RCW 70.95.330
Underground injection control wells	Ecology	Enforcement of UIC Program	90.48.080 WAC 173-218 WAC 173-200
State Waste Discharge Permits -Food processor's land application of waste Municipal Wastewater - Discharge to land -Dairies with State Waste Discharge Permits	Ecology	Implement a state waste discharge permit program, applicable to the discharge of waste materials from industrial, commercial, and municipal operations into ground and surface waters of the state	WAC 173-216

Sources	Institution-Individual	Responsibility	Statutory Authority
Not limited to specific types of sources	EPA	EPA has authority to take action in situations where a contaminant is present in or likely to enter an underground source of drinking water, and the contaminant may present an "imminent and substantial endangerment" to human health.	SDWA Section 1431,

Table 3 - Nitrate and Bacteria Sources and Authorities to Address Them…continued

General Water Quality Protection

In Washington State, the primary agency responsible for the protection of both ground and surface water quality is Ecology. Ecology's Water Quality Program operates according to several laws and rules. Primarily, the program operates under Chapter 90.48 RCW, and also called the Water Pollution Control Act. Under this law, Ecology is given authority to implement measures to protect both ground and surface waters from pollutants. Ecology used the authority granted in the statute to develop regulations pertaining to the protection of ground and surface water quality, permitting of discharging activities, and financing of water quality protection activities. The protection of ground water quality is addressed in Chapter 173-200 WAC, *Water quality standards for ground waters of the state of Washington.* This regulation lists water quality criteria (numerical limits for specific contaminants) that apply to all groundwaters of the state. These criteria are used when evaluating the performance of permitted discharge activities (such as sprayfields and holding ponds), BMP implementation, or when conducting clean-up activities at historical or current waste sites.

State and Federal Discharge Permits

Ecology issues State Waste Discharge Permits when land is used for disposal of wastewater. These may be issued to a specific entity with conditions designed to protect water quality, or a group of entities with shared discharge characteristics and set of conditions. These are termed as "general permits". NPDES (National Pollution Discharge Elimination System) permits are issued by Ecology under authorities granted to it by the EPA. Generally, these types of permits are issued to industries and municipalities for treated discharges into surface waters such as Sulphur Creek Wasteway or the Yakima River.

Permits issued by Ecology describe penalty provisions which may be put into effect if discharge limitations (or other conditions specified in the permit) are not met. Repeated violations of the permit can result in closure of the discharging activity and fines for potential clean-up activities.

Dairies and Animal Feedlots

The Dairy Nutrient Management Act (DNMA), Chapter 90.64 RCW, was enacted in 1998 and applies to all cow dairies, regardless of size, that are licensed by the state to sell milk. Enforcement under the DNMA is the responsibility of WSDA. Enforcement tools are from the state Water Pollution Control Act, Chapter 90.48 RCW.

The DNMA requires that all dairy farms develop and implement a nutrient management plan (plan) to prevent the discharge of livestock nutrients to surface and ground waters of the state. The plans are required to be maintained on the farm for review by inspectors. The DNMA requires that all dairies be inspected for implementation of their nutrient management plans and to ensure protection of waters of the state. Plans are required to be developed using the technical standards developed by the federal Natural

Resource Conservation Service (NRCS). Local Conservation Districts typically provide the dairies with technical assistance and planning services and are required to approve and certify all plans.

The required elements of the plans address the collection, storage, transfer and application of manure, waste feed and litter, and any potentially contaminated runoff at the site. The primary goals of the plans are to protect water quality from dairy nutrient discharges. Excess nutrients must be exported off site. Plans focus on management of nitrogen, and phosphorus as well as preventing bacteria and other pollutants, such as sediment, from reaching surface or ground water.

WSDA inspects all dairies in the Lower Yakima Valley at least once every 22 months. The inspector evaluates the facility and site conditions, nutrient management practices and record keeping for any risk of nutrients or bacteria impacting surface or ground water quality. Each fall, a selected group of dairies are assessed for conditions of their lagoons and lagoon capacity going into the winter period. In addition, WSDA investigates water quality related complaints about dairies. In all cases, where violations are discovered or a potential to pollute is documented, compliance actions are taken and follow up inspections are made to ensure the problem is addressed.

Concentrated Animal Feeding Operations

Federal rules, Title 40 Part 122, under the federal Clean Water Act define dairies with 750 or more animals and feedlots with 1000 or more animals as Large Concentrated Animal Feeding Operations (CAFO). Large CAFOs are further defined as point sources of water pollution and subject to the National Pollutant Discharge Elimination System (NPDES) permit. However, unlike other point sources that have continuous or regular discharges to surface waters, CAFOs are not considered to automatically have a surface water discharge. Consequently, they may be required to obtain an NPDES CAFO permit only if they have a discharge or potential to discharge.

In Washington, the NPDES permit program, including the CAFO permit, is the responsibility of Ecology. Ecology develops and administers the CAFO permit, decides when a facility is required to apply for a permit, approves the nutrient management plan that is required under the permit and is responsible for enforcing the permit. Ecology issued a CAFO General permit in 2006 that currently covers 5 of the 69 dairies in Yakima County. Coverage is based on previous documentation of a discharge. None of the 11 small or medium sized dairies in the county are considered CAFOs and are not covered by the CAFO permit. There is one permitted feedlot currently in the county.

In 2003, state inspection resources were reduced and responsibility for the DNMA moved from Ecology to WSDA. The two agencies signed a Memorandum of Understanding (MOU) to guide coordination and cooperation between the two agencies for dairies, CAFOs and other Animal Feeding Operations. Because Ecology lost some inspection and technical resources dedicated to livestock work, a key element of the MOU was for WSDA inspectors to provide field inspections and technical assistance to Ecology for CAFO and other AFO related water quality activities. The two agencies continue to coordinate on livestock and manure related complaints and in implementing the CAFO permit. An updated MOU was signed in 2009.

Local Water Quality Regulatory Authority

Yakima County's authority to regulate groundwater quality is principally based on federal and state-delegated responsibilities. Much of the land development component of the County's authority to address water quality is found in RCW 36.70A, the 1990 Washington State Growth Management Act (GMA). The GMA set forth thirteen statewide planning goals, including one specific to the *Environment: "Protect the environment and enhance the state's high quality of life, including air and water quality and the*

availability of water." The GMA requires counties and cities planning under the act to adopt comprehensive plans and development regulations consistent with the GMA.

Yakima County enacted its comprehensive plan (Plan 2015) in 1997 (see Appendix Two). Adopted County goals and policies related to water quality and the scope of the Lower Valley Water Quality Study are included in three Plan Elements (see attachment): Natural Setting, Land Use and Utilities. Plan 2015 goals and policies are given regulatory authority through various titles of Yakima County Code, notably: County and Urban Area Zoning Ordinances (RCW 36.70A / YCC Titles 15 and 15A), Critical Areas Ordinances (RCW 36.70A / WAC 365-190 / YCC Titles 16A and 16C), Shoreline Master Program (RCW 90.58 / WAC 173-19-26 / YCC Title 16D, Subdivision Ordinance RCW 58.17 / YCC Title 14; and SEPA (RCW 43.21C /WAC 197-11 / YCC Title 16). The International Construction Codes and Fire Codes adopted by Yakima County as YCC Title 13 are also used to implement portions of the Critical Areas Ordinances related to flood hazard regulations and Critical Aquifer Recharge Areas (CARAs).

The Yakima County Zoning Ordinance (YCC Title 15) adopted in 2000 provides for a number of uses that are addressed in this report. Chapter 15.18 contains a table of allowable land uses (see attachment) listing specifically what land uses are allowed within the unincorporated parts of Yakima County (including fee-owned land outside the closed area of the Yakama Nation). Uses are subject to levels of review: Type I permitted; Type II administrative review; Type III conditional; Type IV quasi-judicial review; or not permitted within a particular zoning district.

The Agriculture (AG) Zoning District is by far the most prevalent use district in the Lower Yakima Valley, followed by the Remote/Extremely Limited Development Potential (R/ELDP) district on the ridges and along the Yakima River, Valley Rural (VR) on the valley floor and some Rural Transitional (RT) Zoning Districts near the cities and towns. The AG zone allows a broad array of agricultural uses under Type I review, including: Animal Feeding Operations, land application of soil amendments or agricultural waste at agronomic rates. CAFOs are allowed in the AG and R/ELDP zones under Type II review and by Type III hearing review in the VR. The Title 15 definition of CAFO may differ somewhat from the more nuanced state use of the term. New or expanding CAFOs, feedlots and other agricultural uses may be subject to environmental review under the State Environmental Policy Act (SEPA) depending upon the size of the proposal and whether the project falls below SEPA's flexible exemption thresholds.

The Zoning Ordinance implements a number of Plan 2015 policies intended to reduce the number of individual wells approved in the higher density RT zone or in VR clustered subdivisions.

Yakima County addresses Critical Aquifer Recharge Areas through its amended Critical Areas Ordinance (YCC Titles 16A & 16C) and the International Fire Code (IFC) adopted by the County under YCC Title 13.

Federal Authority

EPA has broad authority, under SDWA 1431, to address contamination in an underground source of drinking water where EPA determines that it may present an imminent and substantial endangerment to the health of persons. Where drinking water in private wells contains nitrate above the MCL is sufficient to support such a determination by EPA. This authority allows EPA to take action, including collecting samples to investigate the sources of the contamination. In addition, where appropriate, EPA may issue orders to require provision of alternative water supplies by persons who caused or contributed to such conditions.

In accordance with this authority, EPA has found that contaminants are likely to enter a public drinking water system or source of drinking water, the contaminant may be dangerous to human health, and local and state authorities have not been able to remedy this issue.

Framework for Coordinated Agency and Stakeholder Participation

In order to effectively address the elevated nitrate concentrations in groundwater it will be necessary to coordinate efforts of a variety of stakeholder groups, local jurisdictions, federal, tribal, state, and local agencies, all working in a transparent public process. The study area includes a portion of the Yakama Indian reservation, and the Yakama Nation is a federally recognized Indian Tribe with sovereign rights. The Yakama Nation's role and involvement as a sovereign nation will have to be explored prior to implementing any of the options described below.

State agencies possess significant legal authority for ground water protection, though EPA has broad authority as well, and is presently providing a majority of financial resources to respond to the problem. In addition, history has demonstrated that changes in nitrate loading activities are most likely to be effective if the public and private entities involved help develop alternatives to current practices.

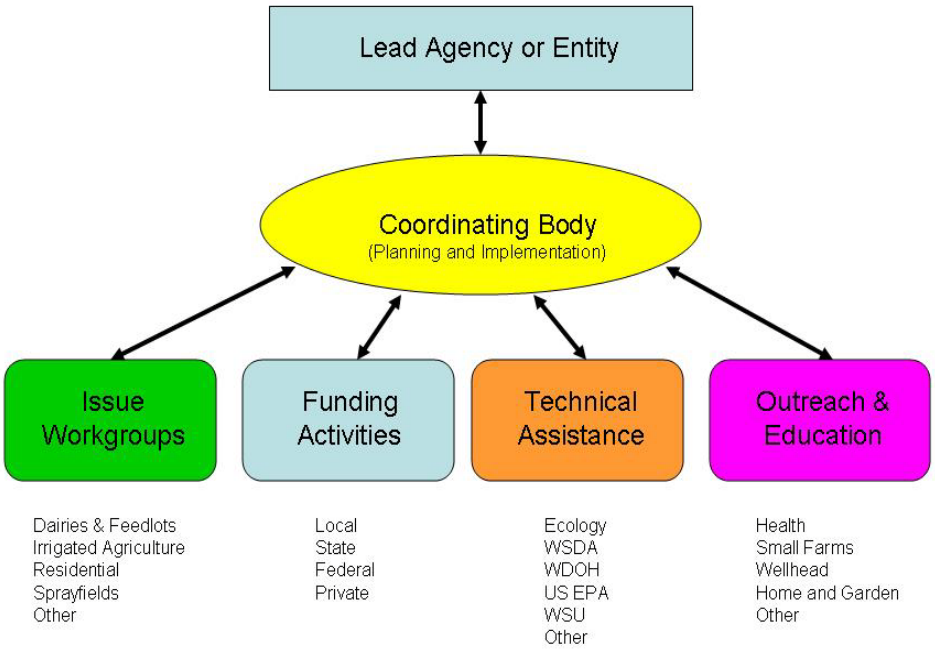


Figure 4: Concept Mechanism for Public Process

Figure four provides a conceptual organizational structure that may facilitate activities as grant funding, technical assistance, and education and outreach while providing for public participation and cooperation.

This structure also has the advantage of providing an organized and effective approach to bring decision making authorities into the process.

Several options exist for establishing stakeholder and local community involvement in a coordinated groundwater quality effort in the Lower Yakima Valley. Based on past and current available programs the following represents some viable options for the establishment of a coordinated stakeholder and agency participation process. This list is not intended to represent all of the options available.

Groundwater Management Area

The establishment of a groundwater management area (GWMA) is one of the major options considered for the establishment of a coordinating body for the Lower Yakima Valley. Provisions for a GWMA can be found in Chapter 173-100 WAC. Significant involvement from local government and stakeholder groups is essential to ensuring the success of any plan to improve ground water quality. The process by which a GWMA is established and activities implemented requires local government participation and stakeholder involvement. Second, by conducting ground water quality improvement activities within a pre-existing framework the avenue for funding beyond the awarding of grants is greatly increased. Third from an administrative perspective, by conducting ground water quality improvement activities within an established framework that has been codified, the validity of the product will be less likely to be challenged. In order to decrease development time, if selected, the working group recommends adjusting the process as needed to ensure the following:

- The process be focused on addressing clear, well articulated priority issues and the development of communication mechanisms which will allow federal, tribal, state, and local authorities to begin implementation of corrective measures 'in a timely manner;
- Public health issues are addressed;
- Key entities are represented and their contribution to the overall improvement of ground water quality identified;
- Actions developed during the GWMA process to improve ground water quality and which have consensus can be implemented prior to certification of the GWMA; and
- State agencies have an identified role in the process to foster ground water quality improvement in a timely manner.

A GWMA can be proposed by any county, city, town, or any other entity having its own incorporated government for local affairs including public utility districts, health departments or districts, water districts, irrigation districts, sewer districts, conservation districts, or ground water user groups. Additionally, Ecology or other state agency may upon its own initiative propose a GWMA. Proposals are to be submitted to Ecology along with probable boundaries of the GWMA. Included in the proposal is a recommendation as to the lead agency through which subsequent activities will take place. If agreement as to the lead agency cannot be achieved, Ecology shall attempt to mediate an agreement.

After a proposal is received and agreements as to the lead agency secured, a public meeting must be held to both inform the public as to the specifics of the GWMA proposal and solicit public comment.

Ecology must review the technical adequacy of the proposal for designation and the comments received as a result of public hearing(s). If they determine that the proposal is in the best interest of the public, it

shall identify the area as a probable GWMA. Ecology will then appoint a lead agency and, in cooperation with that agency, establish a schedule for implementing the GWMA process. Included in the schedule will be an assessment of the relative priority areas within the probable GWMA boundaries, the availability of state resources to support local efforts and an assessment as to the severity of the problem(s) which led to a GWMA proposal.

The lead agency in cooperation with Ecology will appoint members of a Ground Water Advisory Committee (GWAC) which will be responsible for overseeing the development of the ground water management program. Membership of this committee is to be drawn from a variety of stakeholders. Upon establishment of the Ground Water Advisory Committee (GWAC), public meetings will be held to:

- Identify goals for an overall action plan and for individual sectors
- Identify how the identified goals are to be achieved
- Brainstorm alternative approaches for addressing the nitrate issue
- Identity the probable activities contributing to the identified problem(s)
- Identify how activities could be done differently to prevent ground water contamination
- Develop an action plan
- Define tasks, duties, roles and responsibilities of parties responsible for implementing the action plan
- Identify how the action plan will be implemented
- Develop a schedule for implementing the action plan
- Define measures that indicate whether the action plan was a success

Upon completion of the action plan, the lead agency would hold a public hearing on the plans findings and recommendations, The lead agency will consolidate the findings and submit them to the GWAC for resolution (if necessary). Upon resolution of any outstanding issues Ecology would certify the GWMA. Following certification, state agencies and affected local governments shall adopt or amend regulations, ordinances, and/or programs for implementing provisions of the ground water management plan.

Special Protection Area

Chapter 173-200-090 WAC provides for the establishment of a "Special Protection Area" (SPA) under the State's groundwater quality standards. Originally, this provision was added to protect groundwater of high quality from the potential of degradation or further degradation. However, section (3) (b) provides for the establishment of an SPA based upon the need for protection due to vulnerability to pollution because of hydrologic characteristics. Examination of this language indicates that it may be an option to establish a coordinating entity within the Lower Yakima River Basin.

The process by which a SPA is established is outlined in the regulation and does require the submittal of a petition to Ecology by a federal agency, another state agency, Indian Tribe or local government.

Currently, Ecology has not implemented a SPA within the State of Washington. In order to do so, a process would have to be outlined based upon the requirements set forth in Section 4 of the regulation. There may be significant advantages to establishing a SPA over a GWMA in that it may not require as extensive a process and may be less costly. However, that would have to be determined in outlining the initial process by which a SPA would be established.

The establishment of a SPA could provide official status to a coordinating body for the purposes of seeking current and future funding to accomplish the primary goals related to improved water quality in the area. Further examination of the use of Chapter 173-200-090 WAC should be considered.

Watershed Management Plan

Currently there exists a Yakima Basin Water Resources Agency. The goal of this organization is to "achieve a wise, balanced and full beneficial use of Yakima River Basin water resources, among all interests, with full consideration to present and future water resource needs through ongoing public involvement". Many of the Agency's goals appear to be in line with the outlined needs and goals contained in this document, such as:

- Provide assistance, support and maintain a close working relationship with the Water Resources Advisory Committee (WRAC) in the development and implementation of the Watershed Plan.
- Pursue opportunities to provide local funding for implementation of the Watershed Plan and specific projects.
- Identify and pursue state and federal funding for implementation of the Watershed Plan and specific projects.
- Communicate and educate the public concerning the Watershed Plan, its importance to the basin, and its accomplishments.
- Maintain active coordination and diverse involvement in the monitoring of the Watershed Plan implementation through the development of a Detailed Implementation Plan (DIP).
- Broaden the scope of government involvement in water resource management and membership in the organization.
- Coordinate with those activities, which will continue to enhance water resources in the basin, including other water resource implementation and planning efforts such as the Yakima Basin Fish and Wildlife Recovery Board

A careful review of Chapter 6 of the Watershed Plan, which was established under authority of Chapter 90.82 RCW for the Yakima River basin in WRIAs 37, 38 and 39, specifies many of the same items identified previously as needs and/or goals for the protection of groundwater not only in the study are but within the watershed. Since this is an existing entity already, a review of its use for addressing the water quality issues within the basin should be made.

Aquifer Protection Area

Under Chapter 36 RCW, Counties, authority is granted to county governments to establish an Aquifer Protection Area for the purpose of protecting of subterranean water from pollution or degradation. The purpose of this chapter is to allow the creation of aquifer protection areas to finance the protection, preservation, and rehabilitation of groundwater, and to reduce special assessments imposed upon households to finance facilities for such purposes. Under this authority the county may create an aquifer protection area for the purpose of funding protection, preservation, and rehabilitation activities related to the protection of groundwater.

When a county legislative authority proposes to create an aquifer protection area it must conduct a public hearing on the proposal. Notice of the public hearing shall be published at least once, not less than ten days prior to the hearing, in a newspaper of general circulation within the proposed aquifer protection area. The public hearing may be continued to other times, dates, and places announced at the public hearing, without publication of the notice.

After the public hearing, the county legislative authority might find that the creation of the aquifer protection area would be in the public interest. The county legislative authority may then adopt a resolution causing a ballot proposition to be submitted to the registered voters residing within the proposed aquifer protection area. The ballot proposition would authorize the creation of the aquifer protection area, if the county legislative authority finds that the creation of the aquifer protection area is warranted. The resolution shall:

- Describe the boundaries of the proposed aquifer protection area;
- Find that its creation is in the public interest;
- State the maximum level of fees for the withdrawal of water, or on-site sewage disposal, occurring in the aquifer protection area, or both; and
- Describe the uses for the fees

An aquifer protection area shall be created by ordinances of the county if the voters residing in the proposed aquifer protection area approve the ballot proposition by a simple majority vote.

The management approaches presented above are examples only, and are for consideration of those working on solutions to this issue. It is likely that a solution for the Lower Yakima Valley will be a tailored solution using elements of the options listed above.

Establishment of a Total Daily Maximum Load (TMDL)

Shallow groundwater is the primary source of nitrogen loading to irrigation return flow drains. A recent summary of data collected by the Roza Sunnyside Board of Joint Control water quality program showed that the Granger Drain and Sulphur Creek wasteway exports more nitrogen per acre in the form of nitrate/nitrite than other watersheds. In addition, the Yakima Eutrophication Study recently published by the USGS notes that most reaches of the Lower Yakima River are eutrophic. They also note that nitrogen can be a limiting nutrient in parts of the Lower Yakima River. A TMDL would set load allocations for nutrients returning to the Yakima River in irrigation return flows, from permitted point sources, and from groundwater pathways. In order to meet water quality standards, the TMDL would provide widespread support of Best Management Practices that assure reductions in groundwater pollutant loading. Enforcement of the TMDL would have the weight of the Clean Water Act to support and can be developed relatively quickly with existing high quality data.

Sole Source Aquifer Program

The Sole Source Aquifer (SSA) Protection Program is authorized by Section 1424(e) of the Safe Drinking Water Act of 1974 (Public Law 93-523, 42 U.S.C. 300 et seq.), which states:

> *"If the Administrator determines, on his own initiative or upon petition, that an area has an aquifer which is the sole or principal drinking water source for the area and which, if contaminated, would create a significant hazard to public health, he shall publish notice of that*

determination in the Federal Register. After the publication of any such notice, no commitment for federal financial assistance (through a grant, contract, loan guarantee, or otherwise) may be entered into for any project which the Administrator determines may contaminate such aquifer through a recharge zone so as to create a significant hazard to public health, but a commitment for federal assistance may, if authorized under another provision of law, be entered into plan or design the project to assure that it will not so contaminate the aquifer."

EPA defines a sole or principal source aquifer as one which supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. EPA guidelines also stipulate that these areas can have no alternative drinking water source(s) which could physically, legally, and economically supply all those who depend upon the aquifer for drinking water. For convenience, all designated sole or principal source aquifers are usually referred to simply as "sole source aquifers."

Although the agency has statutory authority to initiate SSA designations, EPA typically responds to petitions. Any person may apply for SSA designation. A "person" is any individual, corporation, company, association, partnership, state, municipality, or federal agency. A petitioner would provide EPA with hydrogeologic and drinking water usage data, and other technical and administrative information required for assessing designation criteria.

SSA designations help increase public awareness on the nature and value of local ground water resources by demonstrating the link between an aquifer and a community's drinking water supply. Often, the realization that an area's drinking water originates from a vulnerable underground supply can lead to an increased willingness to protect it. The public also has an opportunity to participate in the SSA designation process by providing written comments to EPA or by participating in an EPA-sponsored public hearing prior to a designation decision.

Funding Considerations

Depending upon the strategies, projects and the scope of tasks that are selected to accomplish the goals it will be necessary to seek appropriate, adequate, and sustainable funding. Tasks which lead to the development of a comprehensive groundwater protection plan, an ambient groundwater monitoring system, or development of new land use best management practices will require additional funding in addition to that which is currently allocated toward such activities. To begin the discussion regarding current and future funding needs, sources for that funding should be investigated. These may include:

- Direct appropriations from the Washington State Legislature for specific projects, including comprehensive plan development and water purification projects;
- Appropriations from the Washington State Legislature for state agency budgets (Ecology, WDOH, WSDA and Conservation Districts). This would provide funding and/or staffing that could be utilized through existing state programs to implement elements of the plan;
- Grants or low interest loans from existing funding programs, such as the Public Works Trust Fund, the State Revolving Fund for drinking water and many other sources, may be used for funding management actions (however, private wells and Group B public water systems are generally not eligible for such programs);
- Local tax levy's developed as a result of the creation of local districts or Aquifer Protection Areas;
- Private sector in response to enforcement action at selected facilities

- Private sector funds, for voluntary projects at selected sites. Where appropriate and possible, these might be supplemented by public funds to facilitate and expand the beneficial effects.

Recommendations

There is a need for a long term comprehensive strategy that focuses on assuring long term access to safe and reliable drinking water supplies for valley residents. This strategy must:

a. Protect existing drinking water supplies from contamination that may render them unsafe or unreliable.

b. Assist residents whose supplies have been contaminated to access safe and reliable supplies.

c. Consider options to encourage appropriate expansion of public water supplies to those areas that are currently dealing with contaminated private supplies.

The majority of recommendations can be organized into categories, which include some short-term actions and steps that can be completed fairly soon. While other categories of recommended actions require a longer time frame and are dependent upon respective government agencies developing a framework from which the public, agricultural interests, federal, state, Tribal, and local governments, can work together to identify strategies that can reduce nitrate and bacterial contamination in groundwater.

Categories of action include:

- Education and outreach to help the public make informed choices
- Well testing
- Identify the sources of contamination
- Stop/mitigate the sources of nitrate and bacterial contamination
- Enforce the existing laws
- Learn more about the issues

Recommendations that pertain to how the agencies plan and collaborate together listed separately under the heading “Management and Planning Activities.”

Short-term Actions

Recommendations falling under the categories of education and outreach and well testing can be accomplished in the short-term and are listed below. (It should be noted that the Washington State

Departments of Health and Ecology have completed several activities that addressed elements of public health education.)

Public Health Education and Outreach

- Begin an outreach and education initiative for valley residents about private wells, water quality, testing and the health risks associated with the most common and acute groundwater contaminants.
- Use existing, and where appropriate develop materials related to treatment options and responses for individuals with contaminated water systems. (English and Spanish)
- Residents who rely on private water wells for drinking water are be encouraged to annually test their water for nitrates and bacteria. Information will be provided on practices they can undertake to minimize and manage the risk associated with nitrate/bacteria contaminated well water. Also the feasibility of alternate water supplies or methods of residential water treatment should be investigated. This should include information on the importance of proper well construction and maintenance.
- The State Health Officer, in consultation with and in support of the local health jurisdiction, will explore opportunities to work with local health care providers to provide additional information on 1) risks associated with nitrate and bacteria contaminated drinking water and 2) appropriate clinical testing and reporting protocols that can provide the best health protection to those living and working in the Lower Yakima Valley.
- The WDOH, in consultation with and in support of the local health jurisdiction, will explore opportunities to provide information to new parents living in the Lower Yakima Valley that will best protect the health of newborn infants from the harmful effects of contaminated well water.
- The WSDA in concert with local Conservation Districts and WSU-Cooperative Extension Service will implement educational activities specifically directed to regulated activities associated with nutrient application management techniques which reduce nitrogen overloading.
- Ecology and Conservation Districts will work with farmers who use flood irrigation to shift them into sprinkler irrigation, or irrigation water management (IWM) techniques through low cost loans and grants.

Short to Mid-term Actions

These actions can be initiated now; however, they cannot be completed within a six (6) month timeframe or less. Actions that may take 6 months or longer to complete include some well testing where samples have to be analyzed at a laboratory, implementation of certain regulatory solutions, and follow through with the enforcement processes. A list of short to mid-term recommended actions are listed below.

Private Industry Actions

- Private industry, including agricultural chemical dealers, field representatives, private consultants and food processors, should take a lead role in working with producers to promote practices to reduce excess nitrogen loading.
- Recommend that private industry consult with the Conservation Districts, NRCS, Washington State Dairy Federation, Washington State Cattlemen's Association, Farm Bureau and the

Washington State University – Cooperative Extension to assess impacts from current agricultural practices.

- Other large potential sources of nitrate loading such as public golf courses, Port Districts and the tree fruit industry should also consult with the agencies and organizations listed above to use the most effective BMPs to reduce and eliminate nitrate loading in the soil profile.

Local and State Actions to Assist Private Industry

- Assessment of agricultural applications of nitrogen fertilizers and BMP's - *The* WSDA, in conjunction with Washington State University Cooperative Extension, and the Conservation Districts within the Lower Yakima Valley should begin an assessment of application rates of nitrogen fertilizers, manure and other animal waste, and wastewater to various crop types in order to determine areas of past, current, and potentially future nitrogen overloading.
- Continue the development; implementation; and testing of agricultural Best Management Practices (BMP) and that will reduce nitrogen applications for crop specific agronomic rates. Specific elements should include:
    - Increase the activities of Conservation Districts, the Natural Resources Conservation Service and Washington State University-Cooperative Extension to promote implementation of irrigated agriculture Best Management Practices;
    - Develop and implement uniform crop nitrogen recommendations based on specific crops, soils, and climate; and,
    - Design and implement pilot studies focusing on innovative farm techniques which reduce nitrogen loading to crops and monitor results for future expansion of findings.

Short to Longer-term Actions

These are actions that can be initiated in the short-term; however, they need quite a bit of time before they can be completed. Recommended actions requiring a longer time-frame generally come under the following categories: identifying and mitigating sources; and learning more about the situation. Learning more about the groundwater contamination situation could also include more studies, expanding the list of contaminants monitored, and or expanding the scope of the study to include a much larger boundary. Actions under these categories can require timeframes that extend beyond 1 or 2 years. Recommended actions that require more time to complete are listed below.

- Recommend designating the area for special protection. Options for this designation are contained in the *Framework for Coordinated Agency Stakeholder Participation* section of this report. This will open a potential conduit for State funding.
- Recommend local entities look for opportunities and consult with the WDOH and the local health jurisdiction regarding consolidation of private contaminated wells into public water systems.
- Evaluate which current regulatory authorities are working and whether modifications or new regulatory authorities are needed.
- Add phosphates to the list of concerns, along with antibiotics and hormones.
- Include cumulative risk assessment which also factors in synergistic health effects.
- Broaden the scope of the study to include the Moxee area and perhaps all of Yakima Valley.

- Continue to support and develop new projects to link land use within the Lower Yakima Valley to areas of identified nitrate and bacteriological contamination by sampling for a wide range of environmental contaminants (e.g., metals, pathogens, antibiotics, and hormones) that can help in identifying the sources of the contamination in groundwater supplies.
- Use an Adaptive Management framework to identify new sources, improve and test various BMPs and techniques as new information becomes available
- Characterize the nature and extent of contamination in the Lower Yakima Valley:

    1. Develop a conceptual site model to provide a clear understanding of the existing environmental problems related to nitrates and bacteriological contamination of groundwater supplies within the Lower Yakima Valley. This will include an analysis that shows the relative annual nitrate generation of each significant nitrate source. The approach used by the State of Idaho for their nitrate priority areas may be used to support this effort.
    2. Assemble the geologic work to date to provide a better understanding of the groundwater flow within the Lower Yakima Valley.
    3. Continue to collect and incorporate existing data into a shared database to support a broader understanding of the impact of contamination of groundwater supplies within the Lower Yakima River Valley. Specific attention should be paid to opportunities to improve trend data in the lower study area.

Management and Planning Recommendations

Below are a number of recommendations that pertain to work that the agencies must complete in order to move forward. These actions are important and support coordination and collaboration among all levels of government.

- The Yakima Health District needs to be actively involved and engaged in this process.
- *Regulatory Actions* - Review all levels of permits, i.e., county, state and federal.
- *Development of a Management Framework* - State and federal agencies should work together and with local authorities to adopt, support and establish a management framework that provides oversight for future studies and/or implementation of activities that maybe designed to improve water quality such as targeted modifications to land use or decommissioning of vulnerable wells.
- *Development of a Standardized Data Set* - Ecology and Health should continue to collect and incorporate existing nitrate data into a shared database support a broader understanding of the impact of contamination of groundwater supplies within the Lower Yakima valley. Specific attention should be paid to opportunities to improve trend data in the eastern study area.
- The government agency authors of this document will share available data with each other free of charge and in a timely fashion upon request.

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Appendix A - Yakima County Plan 2015

WATER RESOURCE RELATED *PLAN 2015* GOALS & POLICIES

***WATER* QUALITY AND QUANTITY**

Critical Areas: Groundwater and Critical Aquifer Recharge Areas (CARAs)

PURPOSE STATEMENT NS 9

Groundwater is the primary source of drinking water for most rural County residents. The City of Yakima is the only city within Yakima County that uses surface water as a primary source (Naches River). All other jurisdictions currently use groundwater (wells) as their primary source of water. Once groundwater is contaminated it is difficult, costly, and often impossible to clean up. Some contaminants like microbial organisms can cause sickness and discomfort while others like organic chemicals, inorganic metals, and radio-nuclides can cause neurological disorders, cancer, mutations and death.

Wells provide a potential source of contamination of both the shallow and deeper aquifers. The proliferation of individual domestic and irrigation wells increases the risk that contamination may find its way into the groundwater. Although the quality of groundwater resources used for drinking water in Yakima County is generally good, the potential for problems exists because many wells tap shallow aquifers (less than 100 feet) which are extremely susceptible to surface contamination. The following goal and policies address these concerns by encouraging the identification of aquifers and taking steps to reduce potential contamination.

GOAL NS 9: Maintain and manage the quality of the groundwater resources in Yakima County as near as possible to their natural conditions and in compliance with state water quality standards.

POLICIES:

NS 9.1 Identify and map important aquifers, critical aquifer recharge areas, and surface waters.

NS 9.2 Develop performance standards and regulate uses for activities which adversely impact water quantity and quality in aquifers, wetlands, watersheds and surface waters.

NS 9.3 Evaluate the potential impact of development proposals on groundwater quality, and require alternative site designs to reduce contaminant loading where site conditions indicate that the proposed action will measurably degrade groundwater quality.

NS 9.4 Continue data collection and evaluation efforts to better understand the County's groundwater system and its vulnerability to contamination.

NS 9.5 encourage the retention of natural open spaces in development proposals overlying areas highly susceptible for contaminating groundwater resources.

NS 9.6 Conduct and support educational efforts which inform County citizens of measures they can take to reduce contaminant loading of groundwater systems.

NS 9.7 Encourage development and expansion of community public water systems to lessen the reliance on individual wells.

NS 9.8 Ensure that abandoned wells are closed properly.

NS 9.9 Ensure sufficient water quantity exists to support land use activities.

1.1.1 Critical Areas: Surface Water

1.1.2 Purpose Statement Ns 10, 11 & 12 – all caps?

The Yakima River and its many tributaries are perhaps the most dynamic and used natural features in Yakima County. Throughout its 200-mile course, water from the Yakima is withdrawn to feed agricultural operations that drive our economy. Irrigation and other water uses developed both inside and outside the Yakima Irrigation Project, developed under the 1903 Reclamation Act, are relatively unique in that all of the water for irrigation is generated, stored and distributed in the Valley. The tributaries, the Naches River and the Yakima River are used as the conduit for the water distributions system in the Valley. The Yakima River is used as the trunk of the water distributions system, is the most important component of the Yakima Project, and probably is the most important piece of infrastructure in the Valley. Agriculture, industry, recreation and the Cities within the basin are dependent on this distribution system for water supply for domestic, industrial, agricultural and residential uses. The demands of this economy are continuing to increase, while existing operations return flows of a far lesser quality. The combined historic actions of over withdrawal, pollution and vegetation removal have produced a waterway that exits Yakima County completely altered from the condition in which it begins near Snoqualmie Pass. To deal with the situation, efforts by many parties have been made to improve stream corridors within the County, especially in the areas of water quality and habitat. The following goals and policies address actions and attitudes that should guide decisions related to surface water.

GOAL NS10: Enhance the quantity and quality of surface water.

POLICIES:

NS 10.1 Improve water conservation through education and incentives.

NS 10.2 Protect water quality from the adverse impacts associated with erosion and sedimentation.

NS 10.3 Encourage the use of drainage, erosion and sediment control practices for all construction or development activities.

GOAL NS 11: Identify future needs and promote increased water supplies through coordinated development and conservation efforts.

POLICY:

NS 11.1 Support local and regional cooperative efforts which help to accomplish this goal.

GOAL NS 12: Restore, maintain or enhance the quality of the Yakima River Basin's surface water.

POLICIES:

NS 12.1 Maintain local control over water quality planning by: 1) providing guidance to state and federal agencies regarding water quality issues, priorities and needs; and 2) demonstrating progress in accomplishing the goals and objectives of locally developed water quality plan, thereby pre-empting externally-imposed solutions to water quality problems as much as possible.

NS 12.2 Make use of local and regional data sources to assess water quality progress.

NS 12.3 Participate in water quality improvement planning and implementation efforts by local, regional, state, federal, and tribal agencies, as well as coalitions such as local watershed planning efforts.

1.1.2.1.1.1 –

1.1.2.1.1.2 RURAL LANDS

Rural areas in Yakima County are areas that exhibit open space qualities, buffer between urban lands and resource lands, provide non-resource areas for future urban expansion and retain the rural/agrarian character of the County while offering a variety of lifestyle choices for the residents of Yakima County. Rural area characteristics may include:

1. Limited public services.
2. Areas of transition between urban, natural resource and critical area lands.
3. Non-resource areas for future urban expansion.
4. Small scale agriculture and forestry operations.
5. Home occupations and cottage industries provided they do not adversely affect the surrounding uses and the environment.
6. Industrial and commercial uses which do not require urban level services provided they are compatible with densities and land uses of rural areas.
7. Industries in rural areas related to and dependent upon natural resources like timber, agriculture and minerals.
8. Development densities that support and maintain rural area characteristics.

PURPOSE STATEMENT LU-R 1

The most compelling reason people give for moving to Yakima County is the rural lifestyle it offers. "Rural" means many things: open space, various lifestyle options, the presence of agriculture and livestock, to name a few. This goal and related policies recognize the importance of maintaining the County's rural character and uses.

GOAL LU-R 1: Maintain the rural character of the County.

PURPOSE STATEMENT LU-R 3

This goal and its policies address "rural" from a service and density perspective. It defines what type of public services (roads, water, sewer) can be expected, and what densities (number of houses per acre) may be allowed so that rural areas remain rural.

GOAL LU-R 3: Define the limits of services available to support a rural way of life.

LU-R 3.1 Environmental, health and safety concerns will be a part of the criteria used to determine the intensity to which a specific parcel can be used.

LU-R 3.3 Sewer lines should not be extended into rural areas except to remedy documented groundwater contamination problems or to correct documented existing or impending health hazards. The County will operate satellite wastewater collection and treatment systems for clustered projects with 5 or more connections. Projects with 5 to 8 connections may use individual on-site systems if public water is available.

LU-R 3.4 Existing public water systems should be used if available and capacity exists. In Rural Areas where an existing system is not available, and where density allocation/cluster development is proposed, community wells will be required for new development. Yakima County or another approved, qualified Satellite System Management Agency will operate and manage water systems with 5 to 8 connections/lots. Yakima County or other established water service provider that is an approved and qualified Satellite System Management Agency will be the sole owner and manager for water systems with nine or more connections.

PURPOSE STATEMENT LU-R 5

Plan 2015 offers residents a variety of lifestyle choices in the rural areas. In order to define and establish physical boundaries for those choices, the plan analyzed current rural land use patterns in terms of how land has developed, what services are (or aren't) in place, and estimated potential service problems. Based on that analysis, four patterns emerge: Rural Settlements (unincorporated "communities" such as Buena, Outlook, Tampico, Gromore), Rural Transitional (e.g., North Selah, Suntides), Rural Self-Sufficient (e.g., West Valley, Cottonwood Canyon, Lower Wenas Valley), and Remote Rural/Extremely Limited Development Potential Areas (e.g., Cleman Mountain, Rattlesnake Hills). The following goal and policies define each pattern.

GOAL LU-R 5: Provide a variety of residential lifestyles in the Rural area.

POLICIES:

LU-R 5.1 Designate a variety of rural residential zones based on carrying capacity of the land, protection of the area's rural qualities, and availability of basic services.

LU-R 5.2 All land within the rural area should be categorized into the following classifications:

Rural Settlement areas;
Rural Transitional areas;
Self-Sufficient areas; and
Remote Rural/Extremely Limited Development Potential areas.

LU-R 5.5 Re-evaluate and, as necessary, re-designate and rezone Rural Settlement and Rural Transitional areas to be within logical outer boundaries consistent with RCW 36.70A(5)(d) (LAMIRDs) not later than two years after adoption of the updated comprehensive plan.

PURPOSE STATEMENT LU-R 7

In the past, the County has had to correct public service problems in Rural Settlements at general taxpayer expense. In order to anticipate and avoid similar problems in the future, this goal and its

policies allow urban-level growth in Rural Settlements only if existing public services will support that growth.

GOAL LU-R 7: Minimize the need for public investment in rural settlement areas.

POLICIES:

LU-R 7.1 The Rural Settlement Zoning classification should allow for continued development based on service availability (i.e., hard surfaced roads, public water, public sewer equals urban type lots). If urban type services are not available then development should be limited to self-sufficient or transitional type development standards which may include community water and/or sewer systems with operation, management and ownership as provided for in policies LU-R 3.3 and 3.4.

LU-R 7.2 Allow for new residential development in Rural Settlement areas at up to four units per acre where services are available.

1.1.1.1.1.1.1 RURAL TRANSITIONAL AREAS

PURPOSE STATEMENT LU-R 8

Certain rural areas have developed to nearly urban (suburban) levels. This goal encourages growth to continue in these "transitional" areas in order to reduce growth pressures in less populated agricultural resource and rural areas where infrastructure, public services and facilities are more difficult or expensive to provide. The clustering and open space options found in these policies will help maintain a sense of rural character while these lands remain outside Urban Growth Areas. The policies also provide incentives to accommodate economically feasible future urban conversion when additional urban land is needed. Transitional areas are also intended to minimize public service expenditures by encouraging infill and redevelopment of individual lots. Rural Transitional policies provide for an overall residential density of one unit per 2.5 acres, with a density bonus of one unit per each two acres with clustering.

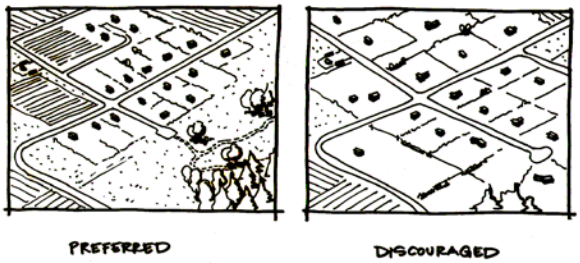
GOAL LU-R 8: Sustain rural character and lifestyle choices by focusing most rural development into existing transitional areas.

POLICIES:

LU-R 8.1 Encourage infill and redevelopment of individual lots.

LU-R 8.2 Provide for a maximum density of one unit per 2.5 acres in rural transitional areas, except when the clustering option is exercised.

LU-R 8.3 Encourage cluster developments using density incentives and long platting procedures.



Encourage Cluster Developments. (LU-R 8.3)

LU-R 8.3.1 Allow a maximum density of 1 unit per 2 acres when development is clustered.

LU-R 8.3.2 Provide site review to ensure adequate setbacks, buffering of adjoining uses, and sensitivity to physical features.

LU-R 8.3.3 Encourage use of adjacent or nearby community water systems and developed road networks.

LU-R 8.3.4 Maintain at least 50% of the clustered parcel in open space, either as part of a large residential lot, or under the control of an individual, a homeowners' association or other responsible entity. Covenants may be required to assure control of noxious weeds, fire hazards, abandoned orchards, and other nuisances. The balance of the property may not be further divided once the 1 unit per 2 acre density is reached, until such time as the property is included in an Urban Growth Area.

PURPOSE STATEMENT LU-R 9

Under state law, adequate infrastructure (roads, water, sewer) must be in place to meet the needs of new development. This eliminates the "catch up" scenario, where a development is built and needed services follow later at general taxpayer expense. Under this goal, adequate infrastructure must keep pace with development. To attain this goal, transitional policies incorporate cost-effective development policies related to community water systems and preferential use of developed road network.

GOAL LU-R 9: Minimize public expenditures by coordinating land use patterns with public infrastructure investment.

POLICIES:

LU-R 9.1 Appropriate public water systems and interior roadways must be provided in new subdivisions.

LU-R 9.3 Transitional areas should be served by community wells and, where appropriate, community septic systems with operation, management and ownership of the systems as provided in Policies LU-R 3.3 and 3.4.

WATER SUPPLY AND SEWAGE DISPOSAL

PURPOSE STATEMENT UT 4

Plan 2015 should define where water and sewer systems are appropriate. Then depending upon density and location of future development, different solutions for utility provision can be provided. The following policies offer guidance regarding what type of systems are appropriate for each land use category.

GOAL UT 4: Ensure that water supply and sewage disposal facilities throughout the County support the desired land use, and are consistent with other goals, policies and objectives of *Plan 2015.*

POLICIES:

UT 4.1 Follow the guidance in Table I-2, the Development Matrix for Ownership and Management of Satellite Water and Sewer Systems, to ensure that the level of water and sewer service is appropriate and consistent with the land use goals and policies for each area of the County.

UT 4.2 Specific physical location and site suitability should determine which of the "required" water and sewer utilities listed in Table I-2 is the most appropriate.

UT 4.4 Existing water companies, water districts, and sewer districts should be used if they have capacity to serve, but new districts and companies should be prohibited or at least discouraged.

TABLE I-2: DEVELOPMENT MATRIX FOR OWNERSHIP AND MANAGEMENT OF SATELLITE WATER AND SEWER SYSTEMS

Number of Lots/Connections	2	3- 4	5- 8	9+
WATER				
URBAN	3 Options: City; Existing Public Water System,** Exempt*	3 Options: City; Existing Public Water System**; Yakima County under state -approved SMA program***		
RURAL	3 Options: Existing Public Water System**; Private Exempt*	2 Options: Existing Public Water System**; New Public Water System**	3 Options: Existing Public Water System**; County under state approved SMA program***; Non-County SMA	State approved SMA***
SEWAGE				
URBAN	City, County or Other State Approved Operator			
RURAL	Individual on-site septic only		2 Options: County; or individual on-site septic if public water is available	County

** <u>Exempt</u> means that the public water system is exempt from being owned/operated by a city or the County, as provided for under Policy note #7 below. Systems serving two lots/connections are also exempt from state DOH requirements.*

*** <u>Existing & New public water system</u> means state-approved water system.*

**** Nob Hill Water Association and Yakima County are currently the Washington State Dept. Of Health approved SMAs.*

Policy Notes:

1. UGA boundaries and rural land use categories will determine which of the required water and sewer utilities are most appropriate.
2. Existing public water systems and sewer districts should be used if they have capacity and ability to serve. New public water purveyors should be discouraged.
3. Minimum Fire Flow (for houses under 3600 sq ft): Ability to deliver 1,000 gallons per minute for 30 minutes, @ 20 psi. Urban: Require minimum fire flow for 3 or more lots. Rural: Require minimum fire flow water where 5 or more lots are created, if any lot is less than 1/3 acre, or for any development where 9 or more dwelling units or lots are created.
4. The size of individual lots must be at least 1/3 to 1/2 acre depending on soils, even when public water supply is available, unless a community sewer system is used. Public management and operation of a community sewer system is required by state law, except as approved by the Dept. of Ecology (see WAC 173-240-104).
5. Urban only: Yakima County will only own or operate community water systems of 3 or more connections/lots; systems with 2 lots/connections will be required, where appropriate, but these systems are exempt from state public water system requirements.
6. Rural only: Yakima County or another approved and qualified Satellite System Management Agency (SMA) will operate and manage water systems with 5-8 connections/lots. The County or other SMA (see LU-R 3.4) will be the sole owner and manager for water systems with nine or more connections. Public water systems serving 3 to 4 lots/connections will be required, as appropriate, but systems serving two lots/connections are exempt from state public system water requirements.
7. The Satellite System Management Agency (SMA) must be an established water service provider that has been approved by the State of Washington. If one is not available, the Washington State Department of Health may conditionally approve a community water system, provided that it has the financial resources and sufficient management to provide safe and reliable service, and meets other requirements of RCW 70.119A.060.

PURPOSE STATEMENT UT 5

A built in system of checks and balances to measure anticipated future development needs against the available water supply should be implemented. These policies develop guidelines to promote a checks and balances system while encouraging efficient water use and water resource planning.

GOAL UT 5: Ensure that future development does not exceed the available amount of raw water.

POLICIES:

UT 5.1 Encourage water resource planning to promote more efficient management of both ground and surface water resources.

{Amended 12/98. Previous Policy UT 5.2 deleted, policies UT 5.2 through UT 5.4 renumbered.}

UT 5.2 Develop specific guidelines for determining the adequacy of water supplies proposed to serve new parcels and new structures and uses on existing parcels.

UT 5.3 In conjunction with the Yakima River Watershed Council and the irrigation districts, evaluate the implications of the use of irrigation water for residential landscaping.

UT 5.4 File on inappropriate water rights within urban growth and transitional areas.

PURPOSE STATEMENT UT 6

Rural area residents depend on groundwater as their source of drinking water. Yet groundwater contamination is a major concern in the County. The purpose of this section is to minimize the risk to groundwater for new development, and to identify and mitigate existing threats to the quality of groundwater.

GOAL UT 6: Protect the quality of groundwater used for domestic water supplies.

POLICIES:

UT 6.1 Enforce existing regulations regarding well construction and abandonment.

UT 6.2 Implement a long-term groundwater quantity and quality monitoring program for basins that provide domestic water supplies.

UT 6.3 Minimize impacts of development and agricultural practices on groundwater supplies.

UT 6.4 Establish and enforce septic tank regulations.

UT 6.5 Develop and enforce a wellhead protection program.

PURPOSE STATEMENT UT 8

A key component of water quality management is to ensure the health, safety and welfare of Yakima County residents. To this end, existing problems must be mitigated and new water and sewer systems must be installed in a manner which minimizes the risk to public health and safety. This goal and its policies encourage water quality management to meet this objective.

GOAL UT 8: Ensure the safety of public and private potable water systems.

POLICIES:

UT 8.1 Implement a satellite management program for new or failing water systems.

UT 8.2 Ensure that water service for new development complies with all applicable laws and regulations, including operating under an approved water system plan.

UT 8.3 Review water plans to ensure that they are compatible with land use planning.

UT 8.4 Require water systems to satisfy current regulations when expanding service to additional customers, with the new customers paying for their fair share of the cost of meeting current standards or reducing the level of service available to existing customers (e.g., provide funds for future replacement of undersized lines, looping systems to increase fire flow pressure, loss in pressure on maximum demand day).

UT 8.5 Support the efforts of privately-owned public water systems to bring systems up to public standards, at which point the County will consider owning and operating them, if requested. {Amended 12/98}

PURPOSE STATEMENT UT 11

To protect the health, safety and welfare of its citizens, Yakima County should ensure the quantity and quality of its water resources. This goal and its policies address this issue by requiring specific development standards for water and sewer services throughout the County.

GOAL UT 11: Protect surface and ground water quality and quantity.

POLICIES:

UT 11.1 Development proposed for individual wells and septic systems should be allowed only at densities which meet self sufficiency standards.

UT 11.2 The intensity to which a specific parcel can be used should be determined, to a large degree, by regulations pertaining to environmental, health, and safety concerns.

UT 11.4 Encourage the appropriate use of community/public water and sewerage systems in Rural Transitional areas and other areas where small lots are allowed.

URBAN WATER

PURPOSE STATEMENT UT 12

To protect the health, safety and welfare of its citizens, Yakima County should ensure the quantity and quality of its water resources. This goal and its policies address this issue by requiring specific development standards for water and sewer services in unincorporated urban areas.

GOAL UT 12: Ensure protection of public health, safety and welfare by safeguarding surface and groundwater resources.

POLICIES:

UT 12.1 Require connection to public drinking water supplies where available.

UT 12.2 Establish a well tracking program for all wells with a projected yield less than the threshold for a water right permit under state law.

UT 12.3 Establish minimum water quality and quantity standards for community wells.

UT 12.4 Encourage use of community (public) water supply wells where area wide public water supply systems are not available.

UT 12.5 Establish well location and construction standards that will facilitate future interconnection with other public water supply systems.

UT 12.6 Establish community well monitoring/testing, operation and maintenance programs.

UT 12.7 Encourage development or consolidation of public water supplies through:

- County application for water rights from the state for cluster development;
- Developing financing mechanisms for public water supplies;

- Establishing latecomer agreements to compensate and encourage use of existing public water supplies.

RURAL WATER

PURPOSE STATEMENT UT 13

To protect the health, safety and welfare of its citizens, Yakima County should ensure the quantity and quality of its water resources. This goal and its policies address this issue by requiring specific development standards for water and sewer services in rural areas.

GOAL UT 13: Ensure groundwater resources are safeguarded to protect public health and welfare.

POLICIES:

UT 13.1 Limit number of wells penetrating the aquifer to protect groundwater quality and supply.

UT 13.2 Encourage use of community (public) water supply.

UT 13.3 Establish monitoring/testing and maintenance program for community wells.

UT 13.4 Establish a well tracking program for all wells under 5,000 gallons per day.

UT 13.5 Establish well location standards.

UT 13.6 Establish construction standards for community wells.

UT 13.7 Evaluate Ecology's well construction standards.

UT 13.8 Encourage development and consolidation of community water supplies through:

- County application for water rights for cluster development;
- Establishing financing methods for public water supply;
- Developing latecomers' fees to compensate/encourage use of existing public water supplies.

Appendix B - Nitrates and Drinking Water

Washington Department of Health Fact Sheet

How can nitrate get into my well water?

Nitrate is a chemical found in most fertilizers, manure and liquid waste discharged from septic tanks. Natural bacteria in soil can convert nitrogen into nitrate. Rain or irrigation water can carry nitrate down through the soil into groundwater. Your drinking water may contain nitrate if your well draws from this groundwater.

How does nitrate affect health?

Nitrate is an acute contaminant, which means a single exposure can affect a person's health. It reduces the ability of red blood cells to carry oxygen. In most adults and children these red blood cells rapidly return to normal. However, in infants it can take much longer for the blood cells to return to normal. Infants who drink water with high levels of nitrate (or eat foods made with nitratecontaminated water) may develop a serious health condition due to the lack of oxygen. This condition is called methemoglobinemia or "blue baby syndrome." Some scientists think diarrhea can make this problem even worse.

Low levels of nitrate in water will not have a long-lasting effect on your baby. If your baby does not have any of the symptoms of "blue baby syndrome," you do not need to have a doctor test for methemoglobinemia.

How is nitrate in drinking water regulated?

Washington's drinking water quality standard for nitrate is 10 milligrams per liter (mg/L), or 10 parts per million (ppm). State law requires public water systems to sample for many contaminants, including nitrate, on a regular basis. Public water systems with nitrate levels over 10 ppm must notify the people who receive water from them.

Signs of "blue baby syndrome"

An infant with moderate to serious "blue baby syndrome" may have a brownish-blue skin tone due to lack of oxygen. This condition may be hard to detect in infants with dark skin.

An infant with mild to moderate "blue baby syndrome" may have symptoms similar to a cold or other infection (fussy, tired, diarrhea or vomiting). While there is a simple blood test to see if an infant has "blue baby syndrome," doctors may not think to do this test for babies with mild to moderate symptoms.

What to do about "blue baby syndrome"

If your baby has a brownish-blue skin tone, take him/her to a hospital immediately. A medication called "methylene blue" will quickly return the baby's blood to normal.

Preventing “blue baby syndrome”

The best way to prevent “blue baby syndrome” is to avoid giving your baby water that may be contaminated with nitrate and foods that are high in nitrate. Infants less than one-year-old should not be given drinking water with nitrate levels more than 10 ppm. High-nitrate vegetables such as beets, broccoli, carrots, cauliflower, green beans, spinach and turnips should not be offered until after six months of age.

Nitrate levels in well water can vary throughout the year. If you have a private well and the nitrate level is above five mg/L or if you haven’t tested your well, you may want to use bottled water for your baby’s foods and drinks. Although boiling water kills bacteria, it will not remove chemicals such as nitrate. In fact, boiling may actually increase the nitrate level.

Will breast-feeding give my infant “blue baby syndrome”?

Low levels of nitrate have been found in breast milk, but the levels are not high enough to cause “blue baby syndrome.”

Can nitrate affect adults?

Although red blood cells in older children and adults quickly return to normal, some health conditions make people susceptible to health problems from nitrate. They include:

• Individuals who don’t have enough stomach acids.
• Individuals with an inherited lack of the enzyme that converts affected red blood cells back to normal (methemoglobin reductase).

Some studies have found an increased risk of spontaneous abortion or certain birth defects if the mother drank water high in nitrate. Women who are pregnant or trying to become pregnant should not consume water with more than 10 mg/L of nitrate.

How can I tell if my well water has nitrate?

Shallow wells, poorly sealed or constructed wells, and wells that draw from shallow aquifers are at greatest risk of nitrate contamination. Manure and septic-tank waste may also contain disease-causing bacteria and viruses.

If you own a private well and are unsure about your water quality, you should test for coliform bacteria and nitrate. Your county health department can tell you where you can get your water tested and may have specific recommendations for testing. Many certified labs in Washington charge $20 to $40 per test. If your nitrate test results are over 8 mg/L, we recommend annual testing. If results are less than 8 mg/L, we recommend you test every three years. (Also see ***Important Information for Private Well Owners***, DOH Pub. #331-349).

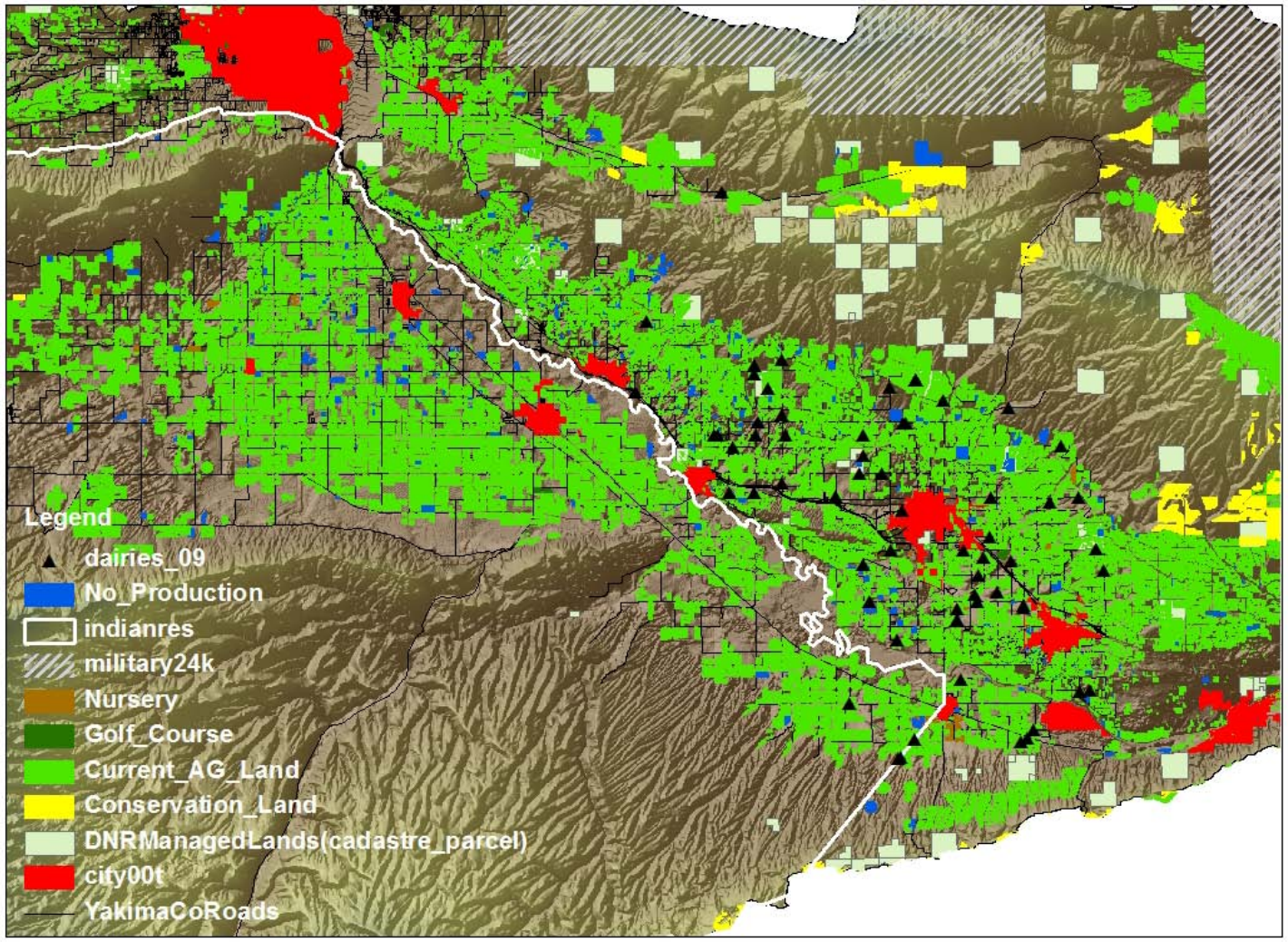
Where can I get more information?

If you get your water from a public water system, call your water utility or the Washington State Department of Health, Office of Drinking Water at 1-800-521-0323 or visit us online at http://www.doh.wa.gov/ehp/dw/. If you have a private well, call your local health department.

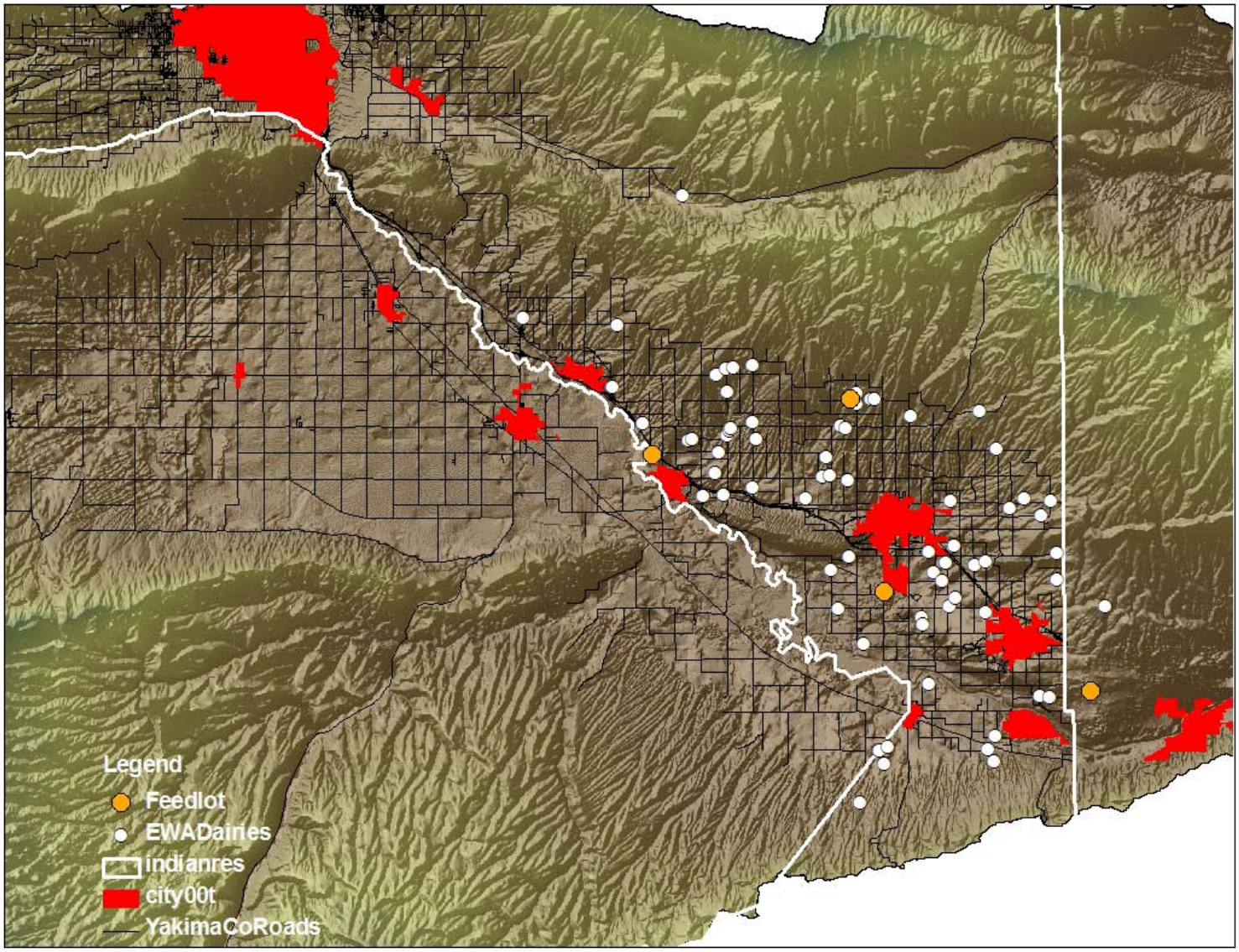
For a list of certified labs, visit the Washington State Department of Ecology online at http://www.ecy.wa.gov/apps/eap/acclabs/labquery.asp Under "Location," select your state, city and county. Scroll down and click on "Show results." Click on the name of a lab to see the tests it performs. Call the lab to make sure it is accredited for drinking water analysis of nitrate.

Appendix C - Maps of Study Area

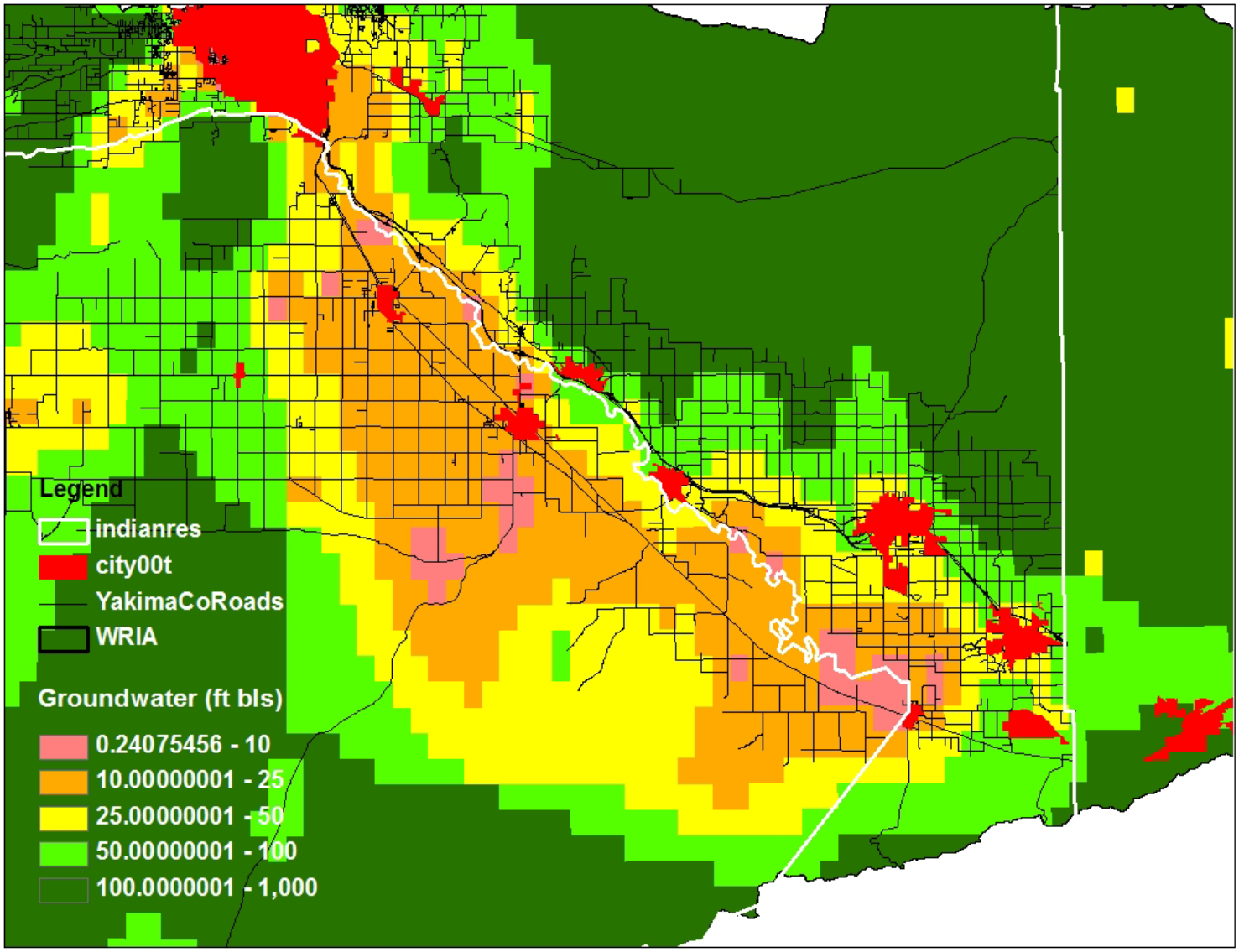
Lower Yakima Basin Land Use



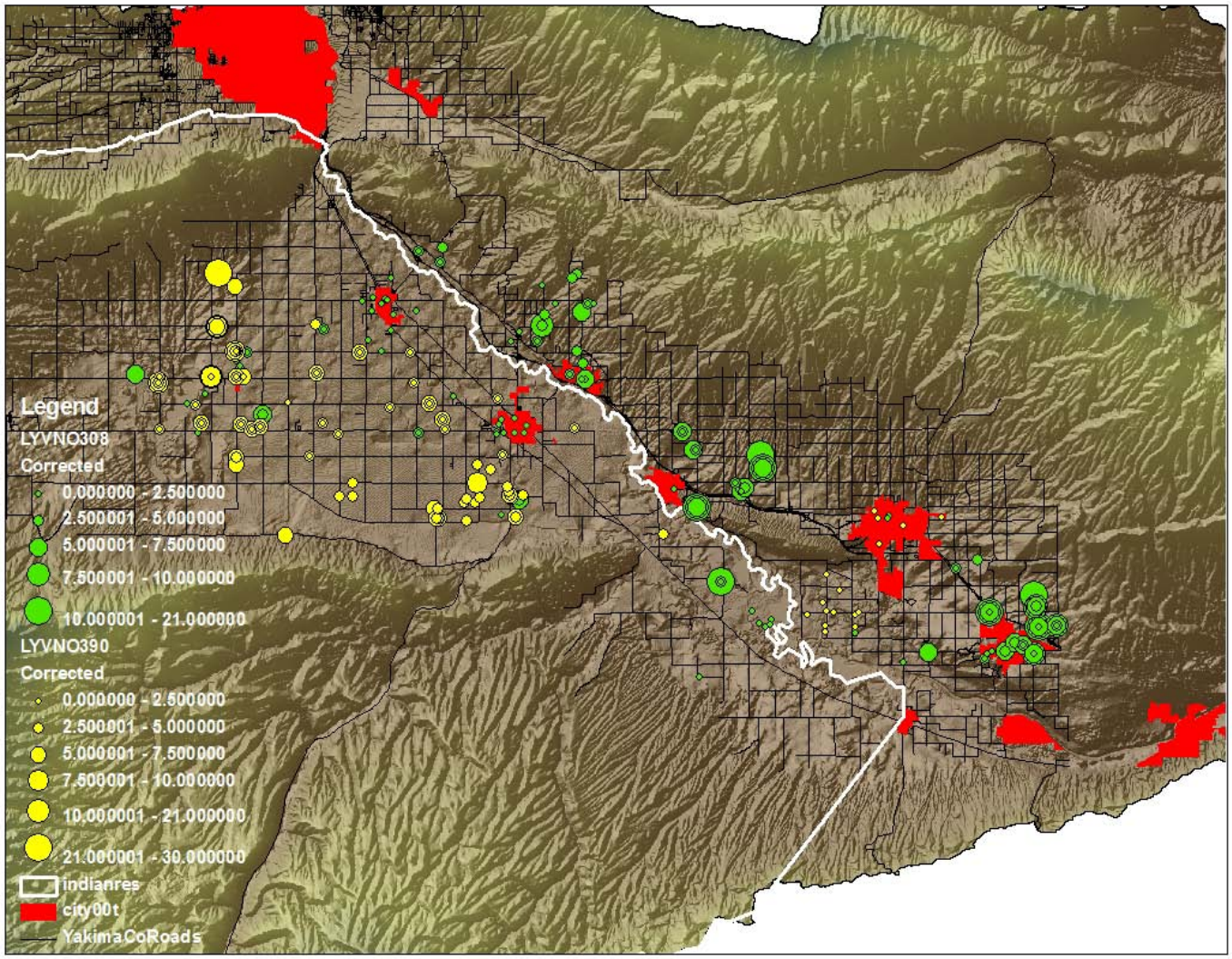
Dairies and Feedlots Within Study Area



Current Groundwater Occurrence

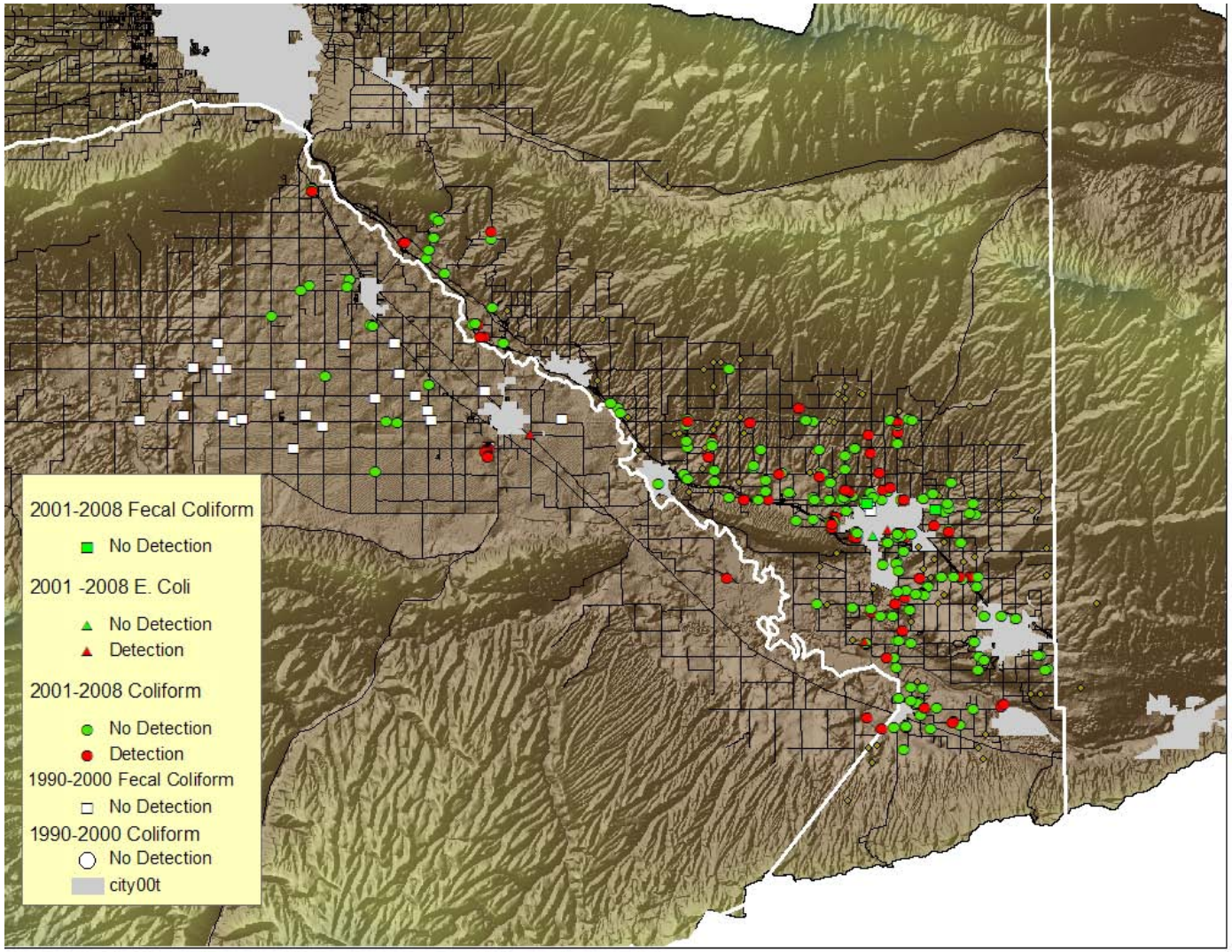


Documented Nitrate Levels



LYNO390 represents data collected between 1990 and 2000, results are presented as mg/L Nitrate or Total Nitrate, LYNO308 represents data collect between 2001 and present, results are presented as mg/L Nitrate or Total Nitrate.

Historic Bacteriological Sampling Results



Appendix D - Potential Source of Groundwater Contamination

Source	Pathway	Contaminants	Cause
Agriculture			
Farming	Land application fertilizers	NO_3-N	Application exceeds agronomic rate
	Irrigation return flows from drains	NO_3-N, salts, pathogens	
Dairies	Lagoons	NO_3-N, TKN, salts, pathogens	Improper construction or management
	Drainage from process water transfer	NO_3-N, TKN, salts, pathogens	Improper construction or management
	Stormwater containment	NO_3-N, TKN, salts, pathogens	Improper construction or management
	Land application of manure	NO_3-N, salts, pathogens	Application exceeds agronomic rates, improper management
Feedlots	Stormwater impoundments	NO_3-N, TKN, salts, pathogens, pharmaceuticals	Improper construction or management
Agricultural Wells	Backflow into Well & Leakage around annulus	NO_3-N, salts, pesticides	Improper well construction. Lack of wellhead protection
Septic Tank/Leachfields		NO_3-N, TKN, salts, pathogens, pharmaceuticals	Improper construction, overloading of leachfield, improper maintenance
Domestic Wells	Backflow into well	NO_3-N, TKN, salts, pathogens, pharmaceuticals	Inadequate backflow prevention
	Leakage around well annulus	NO_3-N, salts, pathogens, pharmaceuticals, pesticides	Improper well construction, failure of well seal
Abandoned Wells	Movement of water between aquifers or from surface	NO_3-N, salts, pathogens, pharmaceuticals, pesticides	Lack of, or improper well closure

Appendix E - Summary of Related Studies in the Lower Yakima Valley

1973-74 USGS Study: *" Quality of Surface Water and Ground Waters , Yakama Indian Reservation",* USGS Report 77-128 by M.O. Fretwell and Prepared in cooperation with the Yakama Tribal Council				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
This study was done to provide general water-quality information and to aid the council in water-resources management. Objectives include the following: ♦Evaluate surface & GW throughout the reservation ♦determine the nature of existing or potential water-quality problems ♦Define the water quality in terms of suitability for various uses.	The Yakama Indian Reservation covers about 2,100 mi^2 in south-central Washington. The reservation is bounded on the west by the crest of the Cascade Range, on the east by the Yakima River, on the south by the crest of Simcoe Mountains and Horse Heaven Hills, and on the north by Klickton Divide, Darling Mountain, and the S Forth and main stem of Ahtanum Creek. Study was 1 year in duration from 11/73 to 10/74. Surface Water focus: Out of 29 sampling sites in the SW quality network, 18 were on mountain streams (3 intermittent), 6 were on lowland streams, 4 on drains, and 1 on a canal. The sites were selected as representative of anticipated water-quality extreme, summations of subbasins, and major points of use. **SW**	Surface Water Quality Found 2,4 –D at conc. of .07 ug/l. Herbicide at that time used on grain crops. ♦Water from all the mountain streams had average conc. of <0.3 mg/l nitrate. Eight of the lowland streams and drains had conc. averaging >0.3 mg/l. ♦All of the mountain streams, except Logy Creek and S. Fork Simcoe Creek, were bacteriologically suitable for irrigation, recreational use and for raw source water for treated DW supplies. Ground Water Quality Groundwater quality was evaluated by basin -- Ahtanum Creek, Toppenish Creek, Satus Creek and Klickitat River. Groundwater is found in unconsolidated formations (Alluvium and Ellensburg Formations) and basalt.	Water from only 8 springs and 3 wells had one or more fecal colonies per 200 ml; and samples from adjacent wells did not indicate widespread contamination. The most likely source of bacteria in the wells is direct local contamination from coliform-bearing surface water running down along the inside or outside of the well casing. The areas near the springs with fecal-coliform bacteria are all frequented by cattle, which often walk directly through the spring water and are probably the direct source of contamination. Fecal-coliform bacteria found in South Fork Ahtanum Creek were higher than in the North fork Ahtanum Creek and probably due to a greater number of range	The reservation is drained by 4 major streams. Principal drainage basins: Ahtanum Creek Basin Toppenish Creek Basin Satus Creek Upper Klickitat River Basis The divides of the major stream basins are also the GW divides. Within the basins GW occurs in significant quantities in 3 major geologic units—the basalt, the Ellensburg Formation, and the alluvium. ♦Ahtanum Creek water is used and reused for irrigation, and irrigation ditches interlace the valley. Much of the drainage water is returned to Ahtanum Creek.

1973-74 USGS Study: *" Quality of Surface Water and Ground Waters , Yakama Indian Reservation",* USGS Report 77-128 by M.O. Fretwell and Prepared in cooperation with the Yakama Tribal Council				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
	samples were analyzed for specific conductance, nitrite+nitrate conc, and fecal-coliform bacteria. [Site 4 on main canal sampled monthly for 6 months for 14 varieties of pesticides. Also a Groundwater focus: GW quality was analyzed relative to the water's occurrence are—within the four major drainage basins—and its occurrence within the principal aquifers. Samples were collected from about 480 wells and springs throughout the reservation. GW samples were analyzed for specific conductivity, nitrite+nitrate, fecal-coliform, and a few other chemicals.	Nitrate concentrations >10 mg/l were observed in the Ellensburg formation of Ahtanum Creek; the Alluvium of the Toppenish Creek Basin. However, the conc. did not exceed 20 mg/l. High conc. were found in Satus Creek (Alluvium 170 mg/l) and 67 mg/l in the Ellensburg formation. Fecal coliform was found in only one well in the Alluvium of the Toppenish Creek Basin. Fecal coliform was also present in the basalt of the Satus Creek and the Klickitat River Basin. Fecal Coliform was not found in the Ahtanum Creek; the basalt and Ellensburg formation of the Toppenish Creek Basin; the Alluvium of Satus Creek and the Klickitat River Basins.	cattle, and to the few small farms along the S. Fork Ahtanum Creek. . Higher conc. in Main Canal probably due to numerous municipal, agricultural, and industrial sources of bacteria in the vicinity of Yakima such as sewage treatment plants, slaughter house, meat-packing plants, and feedlots. (Many of these wastes find their way to the Yakima River, and thence to the Main Canal.) Agricultural fertilizers and animal wastes are probably the major cause of the increase in Toppenish Creek. Fecal coliform higher in Logy and Dry Creeks due to range cattle or sheep or wild ducks…	

1989 Study: "Selected Water – Quality Data for the Toppenish Creek Basin, Yakima Indian Reservation, Washington 1989" by Payne and S. S. Sumioka, USGS				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
♦Present data on N and indicator bacteria in GW. ♦ Collect SW data to determine effect of GW discharge on water quality of drains and streams. Also wanted to: ♦Determine the GW quality in the basin. ♦Relate GW quality conditions to geohydrology ♦Relate GW quality conditions to Geohydrology ♦Attempt to identify source areas and flow paths of contaminants causing current and potential water-quality problems. ♦Present results of study in reports and public meetings.	♦Toppenish Creek Basin in S. Central Washington. ♦Collected water samples from 487 wells and from 50 sites on creeks & surface drains during the summer & fall of 1989. ♦Covers 630 mi^2 and area lies entirely within the Yakama Reservation. Bounded on the N and S by the Ahtanum and Toppenish Ridges, respectively. ♦Western part of the basis in mostly irrigated agricultural land. ♦Major crops grown in the basin include apples, pears, hops, grapes, potatoes, corn, asparagus, mint, and alfalfa. ♦Sampled for: N, fecal-coliform, fecal-streptococcal, E. coli, trace metal & pesticides.	♦Nitrite + nitrate nitrogen conc. Ranged from <0.1 mg/L in GW; and from <0.1 mg/L to 6.0 mg/L in SW samples. ♦Bacteria detected at 66 GW sites and in samples from all of the SW sites. ♦Fecal-coliform bacteria present in samples from 8 GW sites and in samples from all SW sites. ♦Fecal-streptococcal bacteria were found at 64 GW sites and at all SW sites. ♦E. coli were found at 7 GW sites and at all SW sites.	♦Fecal-streptococcal bacteria are used to indicate the sanitary quality of the water and to verify the presence of fecal-coliform bacteria. Because fecal-streptococcal bacteria are found in the intestines of non-human warm-blooded animals, they are useful in detecting contamination by cattle, feedlots, or farmland.	

1990 Ecology Study: "Washington State Agricultural Chemicals Pilot Study, Final Report" by Denis Erickson and Dale Norton, Washington State Department of Ecology and the Washington Department of Agriculture				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: hydrogeology**
This study provides reconnaissance information on the presence and concentration of pesticides in Washington's GW.	The study consists of sampling GW from three areas, each considered vulnerable to GW contamination from agricultural chemicals. The study areas range in size from 6.5 to 34 square miles and are located in Whatcom, Franklin, and Yakima Counties. Twenty-seven shallow wells in each study area were tested for 46 pesticides.	The findings based on 2 sampling events from each study area, indicate that pesticide residues have migrated to shallow GW in these areas. Of the 81 wells sample, 23 wells showed at least one pesticide during the initial sampling. All occurrences were verified with only 3 exceptions during the second sampling round.		

2002 Study: "Quality of Ground Water in Private Wells in the Lower Yakima Valley, 2001-02" by Ron Sell & L. Knutson, December 2002, Valley Institute for Research and Education				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Sources of Contamination**	**Discussion re: Hydrogeology**
♦ VIRE conducted free water testing for low-income residents of the valley to apprise participants of the quality of their drinking water. ♦Gather baseline data on the quality of the GW in the area.	♦Tested 249 private wells of low-income residents of the Lower Yakima Valley. ♦Sampled for: Nitrate + nitrite nitrogen, coliform and E. coli bacteria, arsenic, and (Cl, NH_3, pH, specific conductivity, Temperature, dissolved oxygen and Fe^{+2}) ♦Study area comprises the portion of the Lower Yakima Valley bounded on the N by Rattlesnake Ridge, the S by	♦Quality of GW significantly better in the northern portion of the study area (Region 1: Buena, Parker, Toppenish, Wapato and Zillah) than the southern portion (Region 2: Granger, Grandview, Outlook, Mabton, Sunnyside). ♦Wells in Region 1 all below the EPA MCL. ♦21% of wells (40 wells) in Region 2 above the EPA MCL. Mean values for NH3, Cl and Specific Conductivity higher in Region 2. 9 of these wells had conc. >20.0 mg/l. 25 of the 40 wells with exceedances were located N of the I-82 freeway between Granger and the county line E of Sunnyside. An additional 9 wells with nitrate	♦ The identification of sources and of flow of contaminants was outside the scope of this study but, nationwide, excessive use of nitrogen fertilizers is the most common cause of nitrate contamination in GW. Nitrate leaching under irrigation has become a major environmental	♦Geohydrologic study focused on 3 factors which may influence well contamination: -Surficial sediment type -Well & aquifer characterization -Surficial drainage considerations. ♦ Group wells by Surfical Sediment type. See P. 19 Premise – Do fine-grained sediments

2002 Study: "Quality of Ground Water in Private Wells in the Lower Yakima Valley, 2001-02" by Ron Sell & L. Knutson, December 2002, Valley Institute for Research and Education				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Sources of Contamination**	**Discussion re: Hydrogeology**
	Horse Heaven Hills, the E by the Yakima County line and the west by the Toppenish Creek Basin. ♦The Lower Yakima Valley is one of the most intensely irrigated and diverse agricultural areas in the U.S. ♦Agriculture is the primary activity in area and includes the growing of apples, grapes, silage corn, hops, alfalfa, cherries, asparagus, hay, pears, spearmint, wine grapes, spring wheat, grain and sweet corn and pasture for livestock. ♦Majority of irrigated acreage is watered by permanent and portable sprinklers and rill irrigation (info from SYCD). ♦Yakima County has more than 70 dairies, 62,000 milk cows. Over 90% of the dairies are located in the study area with the majority concentrated in the Sunnyside area which also includes many AFOs. (DOE)	conc. > 10 mg/l were located S and E of Mabton. Wells with nitrate levels that >20.0 mg/l were located N of Outlook and Sunnyside and S and SE of Mabton. The well with the highest nitrate level (55.2 mg/l was located N of Sunnyside. ♦Examination of well drillers' logs in Region 2 indicated that some wells were inadequately cased and sealed which facilitated contamination. ♦A higher percent of wells were contaminated with coliform bacterial in Region 1 (41%) than in Region 2 (22%). Coliform bacteria were found in 22 of the wells in Region 1 and 42 of the wells in Region 2. E. coli was identified in 1 well in Region 1 and in 3 wells in Region 2. (Participants who tested + for E coli were given a decontamination procedure from t he WaDOH. ♦None of the 74 wells tested for As exceed the MCL of 50 (8 exceed the new MCL of 10 ug/l. ♦Quality of GW significantly better in the northern portion of the study area (Region 1: Buena, Parker, Toppenish, Wapato and Zillah) than the southern portion (Region 2: Granger, Grandview, Outlook, Mabton, Sunnyside). ♦Proximity of contaminated wells in some areas suggests that the GW may be contaminated although other causes may include poor construction or maintenance of wells.	concern. Improperly constructed or maintained septic systems also contribute to nitrate pollution. Of the 243 wells tested for ammonia, it was detected in 2 wells (4%) in Region 1 and 35 wells (19%) in Region 2. The occurrence of ammonia in GW suggests contamination from human and animal wastes. (Since this cation does not readily move through soil into GW, its presence indicates the source is nearby. (p. 15)	(silt-sized) hold nitrates loosely where they might be flushed downward into unconfined aquifer or a recharge area for a confined aquifer? 2 main aquifers exist within the Ellensburg Formation – upper and lower. While ditches and gullies have the potential to affect nitrate levels in wells, not every nearby well displayed high levels and not enough wells were sampled. Recommendation: in the future, after a flash flood or large ditch break, wells downstream should immediately be tested for contamination.

2002 Study: "Quality of Ground Water in Private Wells in the Lower Yakima Valley, 2001-02" by Ron Sell & L. Knutson, December 2002, Valley Institute for Research and Education				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Sources of Contamination**	**Discussion re: Hydrogeology**
		♦32 wells in Region 1 were located in the Toppenish Creek Basin area previously sampled by the USGS. A comparison of the nitrate results for these wells with results obtained in the same area a decade ago indicates that nitrates conc. have changed little since then. It appears that land use and population density have remained about the same. Nitrate conc. For the 32 wells ranged from <0.07 mg/l to 5.88 mg/l. ♦Significant impairment of GW quality was evident in Region 2.		

Recommendations from 2002 VIRE Study:

1. Findings justify the creation of a GWMA.
2. Community Outreach and Education on vulnerability of GW.
3. Expand sampling for Arsenic.
4. Provide bilingual information to all new well owners on how to inspect and maintain the integrity of their well head.
5. Provide assistance to well owners in decontaminating wells with bacteria.
6. Improve quality and availability of well drillers' logs.
7. New wells should be cased and grouted to exclude water from shallow, more contaminated aquifers.

2003 Ecology Study: "Groundwater Quality in the Central Ahtanum Valley, Yakima County, March 2001 – December 2002" by Washington State Department of Ecology				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
Report summarizes a 2-year sampling effort to evaluate GW quality conditions in the central Ahtanum Valley, of Yakima County. Objectives included: ♦Establish an ambient GW monitoring network which will be used to update past monitoring results and to provide a means of assessing GW quality changes resulting from on-going urbanization or agricultural activities. ♦Determine if nitrate+nitrate-N conc. Vary seasonally and whether they have increased, decreased, or remained the same since Sept. 1992.	Ahtanum Valley, Yakima County ♦This area encompasses an area of approximately 160 square miles and includes a portion of the City of Yakima and the outlying communities of Tampico, Wiley City, and Ahtanum. ♦14 wells were monitored quarterly during the period 3/2001 to 12/2002 for temperature, specific conductivity, pH, dissolved oxygen, and GW level. ♦Water samples were analyzed for total persulfate nitrogen, nitrate+nitrite-N, total and fecal coliform bacteria, chloride, total iron, and total manganese.	♦22% of collected samples, and 8 of 13 wells evaluated, exceeded MCL criteria for total coliform bacteria. ♦5 wells exceeded the MCL critiera for total iron during at least one sampling event. ♦The highest nitrate+nitrite-N conc. (7.1 mg/l) was observed in the non-sewered, rapidly urbanizing area west of the city of Yakima. This suggests that on-site wastewater disposal and/or other activities, such as the use of nitrogen fertilizers, have locally impacted GW quality. ♦Trends in GW nitrate+nitrite-N conc. from 3 independent sampling events (6/73 – 99 wells; 9/92 – 16 wells; and 9/02 – 13 wells indicate an increase in nitrate+nitrite-N conc. However, lack of uniformity in well locations and sampling depths across the data sets may introduce variability.	Nitrate concentrations were generally higher in wells located on the upland terraces than those located in the Ahtanum Creek or Wide Hollow Creek valley bottoms. High nutrient conc. in GW may indicate contamination by animal waste or sewage, nitrogen-rich fertilizers or industrial discharges.	The geologic materials underlying the Ahtanum Valley may be aggregated into 4 principal groups; Miocene age basalts, Miocene continental sediments, Pliocene continental sediments, and Quaternary age sediments/recent alluvium. Each of these principal rock types contains aquifers that are capable of supplying GW to wells. Most domestic wells within the valley interior are completed in either the thicker sections of recent alluvium, the cemented gravel unit, or in the more permeable zones of the Ellensburg Formation. These aquifers are recharge through several mechanisms including downward percolation of local precipitation, leakage from unlined irrigation ditches or streams, percolation of unconsumed irrigation water, and by upward discharge from the underlying basalt units.

2003 Ecology Study: "Groundwater Quality in the Central Ahtanum Valley, Yakima County, March 2001 – December 2002" by Washington State Department of Ecology				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
		♦The data from this sampling event suggested that the seasonal differences between sampling events was minor.		Area GW generally moves from upland recharge zones along the ridge tops and flanks toward the valley interior, and laterally toward natural points of discharge along area streams and the Yakima River.

2003 Heritage College Study: "Sunnyside Groundwater Study, Final Report", August 13, 2003				
Purpose	**Area of Focus**	**Key Findings**	**Conclusions re: Source of Contamination**	**Conclusions re: Hydrogeology**
Note: This was a student training exercise to investigate GW quality. Note: The findings of this study support findings of other studies, i.e., the presence of bacteria and nitrates. However, the supporting data is not transparent and the quality assurance and quality controls adhered to in this study are of concern.	Heritage College conducted a field investigation of GW quality in the area of extending from Zillah to Sunnyside Washington. 54 wells were sampled. However, fewer wells were sampled in the winter because they were taken out of service for the season. The study area contains approximately 300 mi^2 of land from the east back of the Yakima River to the edge of the irrigated land further east. This area contains at least 89 dairies and feedlots.	♦Nitrate concentrations are elevated in 3 areas of the region. ♦Coliform bacteria are present in a significant number of wells in the region. . ♦Total dissolved solids (TDS) were correlated with the nitrate concentrations. (They exhibited same pattern of elevated concentrations.		N/A

2003 Heritage College Study: "Sunnyside Groundwater Study, Final Report", August 13, 2003				
Purpose	**Area of Focus**	**Key Findings**	**Conclusions re: Source of Contamination**	**Conclusions re: Hydrogeology**
	Monthly sampling campaigns were conducted from June 2001 to October 2002. Measured conc. of nitrate-nitrite-nitrogen, phosphate, total dissolved solids, dissolved oxygen, and alkalinity.			

2006 USGS Study: "Hydrogeologic Framework of Sedimentary Deposits in Six Structural Basins, Yakima River Basin, Washington" Report 2006-5116 by M. A. Jones, J.J. Vaccaro, and A.M. Watkins, USGS (Written in cooperation the Bureau of Reclamation, Washington Department of Ecology and the Yakama Nation)				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
Demands on groundwater and surface water in the basin, which began in 1848, increased dramatically in the 1990s related to fisheries, agriculture and other human activities and protection of salmonids under the Endangered Species Act. This study had the following objectives – to describe fully the groundwater flow system and its interaction with and relation to surface water; and to integrate this information into a tool, a numerical model. The model of flow systems and the results of	Scope: To delineate the hydrogeologic framework for the groundwater flow system of the sedimentary deposits in six structural basins in the Yakima River Basin. Information from 4,700 well records was examined using geochemical, geophysical, geologist and driller's logs. The investigators also examined surficial geology, previously constructed maps and well interpretations.	Findings: 6 structural basins were delineated – from north to south they are Roslyn, Kittitas, Selah, Yakima, Toppenish and Benton. Sedimentary deposits overlie consolidated rocks ranging from metamorphic to basalts in the north to basaltic lava flows from the Columbia River Basaltic Group to the central east and southwestern portions of the basin. There are 8 major rivers and numerous smaller streams tributary to the Yakima River. Mean annual precipitation is	The Yakima River Basin is divided into six structural basins, each containing unconsolidated sedimentary formations and underlain by consolidated rock between 700 and 2000 feet deep. Any contamination released to the surface is apt to seep through the unconsolidated sand and gravel formations to the shallow groundwater. Depending on the presence of confining layers, this contamination could eventually reach deeper drinking water sources. Also,	There are six structural basins, separated by anticlines or folded rock. Because of this contamination found in one structural basin is not apt to be in hydraulic communication with the other basins, so any Yakima valley-wide trends are tied to the structural basins. All of this data is supposed to be in GIS. Who all have access?

2006 USGS Study: "Hydrogeologic Framework of Sedimentary Deposits in Six Structural Basins, Yakima River Basin, Washington" Report 2006-5116 by M. A. Jones, J.J. Vaccaro, and A.M. Watkins, USGS (Written in cooperation the Bureau of Reclamation, Washington Department of Ecology and the Yakama Nation)				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
the study are to be used to guide and support actions taken by management agencies with respect to groundwater availability and to provide information to other stakeholders and other interested parties. The numerical model would be developed later.		around 8.7 million acre-feet. 53% of this is lost to evapo-transpiration. The reclamation project demands 2.5 million acre-feet. 1.1 million acre-feet are stored in 5 Reclamation reservoirs.	these contaminants could reach deeper drinking water if the wells are not constructed to isolate upper groundwater from deeper groundwater.	

2008 USGS Study: "Extent and Depth to Top of Basalt and Interbed hydrogeologic Units, Yakima River Basin Aquifer System, Washington" Report 2008-5045 by M.A. Jones and J.J. Vaccaro, USGS				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
This study was launched in June of 2000 to obtain an understanding of the ground-water flow system and its relation to the surface-water resources needed to implement water resources management strategies in the basin. The study was also done to provide baseline information for a management tool—numerical model. The conceptual model of the flow system and the results of the	The Yakima River Basin aquifer system. The basin includes 3 Washington State Water Resource Inventory Areas (WRIA --#37, 38, &39), part of the Yakama Nation lands, and 3 ecoregions (Cascades, Eastern Cascades, and Columbia Basin) The basin includes parts of 4 counties (Klickitat, Kittitas, Yakima, and Benton). Almost all of Yakima County and more than 80% of Kittitas County	The Yakima River Basin aquifer system in S. Central Washington encompasses an area of about 6,900 mi2 including the entire Yakima River Basin and lands to the east extending to the Columbia River. The 5 hydrogeologic units delineated, from top to bottom, are the: Saddle Mountains Mabton Wanapum Vantage	Not Applicable in this Study	Basalt formations (consolidated formations) are a productive source of groundwater for the Yakima River Basin. Two units are described that are germane to the Yakima Valley groundwater concerns are – the Mabton unit and the Wanapum unit. The Mabton extends from 80 to 2000 feet below surface. The Wanapum unit extends from the surface to 2050 feet below surface. The significance is that the

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study were supposed to be used to support actions taken by management agencies with respect to GW availability and to provide information to other stakeholders and interested parties.	lie within the basin, and about 50% of Benton County is in the basin.	Grande Ronde The depth and range are provided in the study.		basalt represents the underlying formation for most of the Yakima River Basin and that the basalt carries and transmits groundwater just as unconsolidated sands and gravels. This also means it must be protected as well.

January 2008 Sampling of Outlook Elementary School				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
Address high nitrate concentrations	Outlook Elementary School	Nitrate Concentrations elevated above drinking water standards	N/A	N/A

August 2008 El Proyecto Bienestar: EPA CARE grant Results (Connex College Summer Program Students)				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
♦Provide hands on experience to Connex College students ♦Sample private wells ♦Participants used sterile cups provided and were asked to return them to KDNA radio station. ♦Used LaMotte water testing kit for nitrate-nitrogen. ♦Results were mailed to participants.	♦Sunnyside and Granger	♦27 participants ♦22 of the 27 participants had not had their wells tested in the last 5 years. ♦60 samples were provided by the community. ♦The results were qualitative from test kits; and 10 % of the samples had elevated nitrate concentrations.	N/A	N/A

August 2008 USGS Study: "Distribution of Elevated Nitrate Concentrations in Ground Water in Washington State", by USGS				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
This study was designed to estimate the probability of detecting elevated nitrate in GW in Washington State. The GUS GS and WaDOH collaborated to examine water-quality data from public water systems and develop models that calculate the probability of detecting elevated nitrate conc. in GW.	Washington State	♦Shallow wells in areas with a high percentage of agricultural land use and (or) high population density are most likely to have elevated nitrate conc. in the water. Maps showing the estimated probability of elevated nitrate conc. indicate that the agricultural regions are most at risk followed by urban areas. Areas of the State that are	Nitrate conc. in GW are elevated in parts of the U>S> as a result of various land-use practices, including fertilizer application, dairy operations and ranching, and septic-system use. Shallow wells generally are more vulnerable to nitrate contamination than deeper wells.	Not Applicable in this study. (Study created vulnerability maps using logistic regression, the occurrence of elevated nitrate conc. in samples from public supply wells and related the occurrences to natural and human-caused factors to assess GW vulnerability to nitrate.

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Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
Maps were then developed to estimate GW vulnerability to nitrate in areas where limited data are available.		not affected by agricultural or urban activities had much lower probabilities of detecting elevated nitrate conc. Shallow wells (145 feet deep or less) in agricultural areas of eastern Washington have a >than 90% probability of nitrate conc. exceeding 2 mg/l on the vulnerability map of WA. Maps generated show that in order to have a 90% chance of obtaining water with		

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Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
		nitrate conc. < 2 mg/L, wells need to exceed 750 feet in agricultural regions and 400 feet in urban areas.		

1973-74 USGS Study: " Quality of Surface Water and Ground Waters , Yakama Indian Reservation", USGS Report 77-128 by M.O. Fretwell and Prepared in cooperation with the Yakama Tribal Council				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
This study was done to provide general water-quality information and to aid the council in water-resources management. Objectives	The Yakama Indian Reservation covers about 2,100 mi^2 in south-central Washington. The reservation is bounded on the west by			The reservation is drained by 4 major streams. Principal drainage basins: Ahtanum Creek Basin

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August 2008 USGS Study: "Distribution of Elevated Nitrate Concentrations in Ground Water in Washington State", by USGS				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
include the following: ♦Evaluate surface & GW throughout the reservation ♦determine the nature of existing or potential water-quality problems ♦Define the water quality in terms of suitability for various uses.	the crest of the Cascade Range, on the east by the Yakima River, on the south by the crest of Simcoe Mountains and Horse Heaven Hills, and on the north by Klickton Divide, Darling Mountain, and the S Forth and main stem of Ahtanum Creek. Study was 1 year in duration from 11/73 to 10/74. Out of 29 sampling sites in the SW quality network, 18 were on mountain streams (3			Toppenish Creek Basin Satus Creek Upper Klickitat River Basis

August 2008 El Proyecto Bienestar: EPA CARE grant Results (Connex College Summer Program Students)				
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Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
	intermittent), 6 were on lowland streams, 4 on drains, and 1 on a canal. The sites were selected as representative of anticipated water-quality extreme, summations of subbasins, and major points of use. Each sample was analyzed for specific conductance, nitrite+nitrate conc, and fecal-coliform bacteria			

1989 Study: "Selected Water – Quality Data for the Toppenish Creek Basin, Yakima Indian Reservation, Washington 1989" by Payne and S. S. Sumioka, USGS				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
♦Present data on N and indicator bacteria in GW. ♦ Collect SW data to determine effect of GW discharge on water quality of drains and streams. Also wanted to: ♦Determine the GW quality in the basin. ♦Relate GW quality conditions to geohydrology ♦Relate GW quality conditions to Geohydrology ♦Attempt to identify source areas and flow paths of contaminants causing current and potential water-quality problems. ♦Present results of study in reports and public meetings.	♦Toppenish Creek Basin in S. Central Washington. ♦Collected water samples from 487 wells and from 50 sites on creeks & surface drains during the summer & fall of 1989. ♦Covers 630 mi^2 and area lies entirely within the Yakama Reservation. Bounded on the N and S by the Ahtanum and Toppenish Ridges, respectively. ♦Western part of the basis in mostly irrigated agricultural land. ♦Major crops grown in the basin include apples, pears, hops, grapes, potatoes, corn, asparagus, mint, and alfalfa. ♦Sampled for: N, fecal-coliform, fecal-streptococcal, E. coli, trace metal & pesticides.	♦Nitrite + nitrate nitrogen conc. Ranged from <0.1 mg/L in GW; and from <0.1 mg/L to 6.0 mg/L in SW samples. ♦Bacteria detected at 66 GW sites and in samples from all of the SW sites. ♦Fecal-coliform bacteria present in samples from 8 GW sites and in samples from all SW sites. ♦Fecal-streptococcal bacteria were found at 64 GW sites and at all SW sites. ♦E. coli were found at 7 GW sites and at all SW sites.	♦Fecal-streptococcal bacteria are used to indicate the sanitary quality of the water and to verify the presence of fecal-coliform bacteria. Because fecal-streptococcal bacteria are found in the intestines of non-human warm-blooded animals, they are useful in detecting contamination by cattle, feedlots, or farmland.	

2002 Study: "Quality of Ground Water in Private Wells in the Lower Yakima Valley, 2001-02" by Ron Sell & L. Knutson, December 2002, Valley Institute for Research and Education				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Sources of Contamination**	**Discussion re: Hydrogeology**
♦ VIRE conducted free water testing for low-income residents of the valley to apprise participants of the quality of their drinking water. ♦Gather baseline data on the quality of the GW in the area.	♦Tested 249 private wells of low-income residents of the Lower Yakima Valley. ♦Sampled for: Nitrate + nitrite nitrogen, coliform and E. coli bacteria, arsenic, and (Cl, NH_3, pH, specific conductivity, Temperature, dissolved oxygen and Fe^{+2}) ♦Study area comprises the portion of the Lower Yakima Valley bounded on the N by Rattlesnake Ridge, the S by Horse Heaven Hills, the E by the Yakima County line and the west by the Toppenish Creek Basin. ♦The Lower Yakima Valley is one of the most intensely irrigated and diverse agricultural areas in the U.S. ♦Agriculture is the primary activity in area and includes the growing of apples, grapes, silage corn, hops, alfalfa, cherries, asparagus, hay, pears, spearmint, wine grapes, spring wheat, grain and sweet corn and pasture for livestock. ♦Majority of irrigated acreage is	♦Quality of GW significantly better in the northern portion of the study area (Region 1: Buena, Parker, Toppenish, Wapato and Zillah) than the southern portion (Region 2: Granger, Grandview, Outlook, Mabton, Sunnyside). ♦Wells in Region 1 all below the EPA MCL. ♦21% of wells (40 wells) in Region 2 above the EPA MCL. Mean values for NH3, Cl and Specific Conductivity higher in Region 2. 9 of these wells had conc. >20.0 mg/l. 25 of the 40 wells with exceedances were located N of the I-82 freeway between Granger and the county line E of Sunnyside. An additional 9 wells with nitrate conc. > 10 mg/l were located S and E of Mabton. Wells with nitrate levels that >20.0 mg/l were located N of Outlook and Sunnyside and S and SE of Mabton. The well with the highest nitrate level (55.2 mg/l was located N of Sunnyside. ♦Examination of well drillers' logs in Region 2 indicated that some wells were inadequately cased and sealed which facilitated contamination. ♦A higher percent of wells were contaminated with coliform bacterial in Region 1 (41%) than in Region 2 (22%). Coliform bacteria were found in 22 of the wells in Region 1 and 42 of the wells in Region 2. E. coli was identified in 1 well in Region 1 and in 3 wells in Region 2. (Participants who tested + for E coli were given a decontamination procedure from t he	♦ The identification of sources and of flow of contaminants was outside the scope of this study but, nationwide, excessive use of nitrogen fertilizers is the most common cause of nitrate contamination in GW. Nitrate leaching under irrigation has become a major environmental concern. Improperly constructed or maintained septic systems also contribute to nitrate pollution. Of the 243 wells tested for ammonia, it was detected in 2 wells (4%) in Region 1 and 35 wells (19%) in Region 2. The occurrence of ammonia in GW suggests contamination from human and animal wastes. (Since this cation does not readily move through soil into GW, its	♦Geohydrologic study focused on 3 factors which may influence well contamination: -Surficial sediment type -Well & aquifer characterization -Surficial drainage considerations. ♦ Group wells by Surfical Sediment type. See P. 19 Premise – Do fine-grained sediments (silt-sized) hold nitrates loosely where they might be flushed downward into unconfined aquifer or a recharge area for a confined aquifer? 2 main aquifers exist within the Ellensburg Formation – upper and lower. While ditches and gullies have the potential to affect nitrate levels in wells, not every nearby well displayed high levels

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Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Sources of Contamination**	**Discussion re: Hydrogeology**
	watered by permanent and portable sprinklers and rill irrigation (info from SYCD). ♦Yakima County has more than 70 dairies, 62,000 milk cows. Over 90% of the dairies are located in the study area with the majority concentrated in the Sunnyside area which also includes many AFOs. (DOE)	WaDOH. ♦None of the 74 wells tested for As exceed the MCL of 50 (8 exceed the new MCL of 10 ug/l. ♦Quality of GW significantly better in the northern portion of the study area (Region 1: Buena, Parker, Toppenish, Wapato and Zillah) than the southern portion (Region 2: Granger, Grandview, Outlook, Mabton, Sunnyside). ♦Proximity of contaminated wells in some areas suggests that the GW may be contaminated although other causes may include poor construction or maintenance of wells. ♦32 wells in Region 1 were located in the Toppenish Creek Basin area previously sampled by the USGS. A comparison of the nitrate results for these wells with results obtained in the same area a decade ago indicates that nitrates conc. have changed little since then. It appears that land use and population density have remained about the same. Nitrate conc. For the 32 wells ranged from <0.07 mg/l to 5.88 mg/l. ♦Significant impairment of GW quality was evident in Region 2.	presence indicates the source is nearby. (p. 15)	and not enough wells were sampled. Recommendation: in the future, after a flash flood or large ditch break, wells downstream should immediately be tested for contamination.

2006 USGS Study: "Hydrogeologic Framework of Sedimentary Deposits in Six Structural Basins, Yakima River Basin, Washington" Report 2006-5116 by M. A. Jones, J.J. Vaccaro, and A.M. Watkins, USGS (Written in cooperation the Bureau of Reclamation, Washington Department of Ecology and the Yakama Nation)				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
Demands on groundwater and surface water in the basin, which began in 1848, increased dramatically in the 1990s related to fisheries, agriculture and other human activities and protection of salmonids under the Endangered Species Act. This study had the following objectives – to describe fully the groundwater flow system and its interaction with and relation to surface water; and to integrate this information into a tool, a numerical model. The model of flow systems and the results of the study are to be used to guide and support actions taken by management agencies with respect to groundwater availability and to provide information to other stakeholders and other interested parties. The numerical model would be developed later.	Scope: To delineate the hydrogeologic framework for the groundwater flow system of the sedimentary deposits in six structural basins in the Yakima River Basin. Information from 4,700 well records was examined using geochemical, geophysical, geologist and driller's logs. The investigators also examined surficial geology, previously constructed maps and well interpretations.	Findings: 6 structural basins were delineated – from north to south they are Roslyn, Kittitas, Selah, Yakima, Toppenish and Benton. Sedimentary deposits overlie consolidated rocks ranging from metamorphic to basalts in the north to basaltic lava flows from the Columbia River Basaltic Group to the central east and southwestern portions of the basin. There are 8 major rivers and numerous smaller streams tributary to the Yakima River. Mean annual precipitation is around 8.7 million acre-feet. 53% of this is lost to evapo-transpiration. The reclamation project demands 2.5 million acre-feet. 1.1 million acre-feet are stored in 5 Reclamation reservoirs.	The Yakima River Basin is divided into six structural basins, each containing unconsolidated sedimentary formations and underlain by consolidated rock between 700 and 2000 feet deep. Any contamination released to the surface is apt to seep through the unconsolidated sand and gravel formations to the shallow groundwater. Depending on the presence of confining layers, this contamination could eventually reach deeper drinking water sources. Also, these contaminants could reach deeper drinking water if the wells are not constructed to isolate upper groundwater from deeper groundwater.	There are six structural basins, separated by anticlines or folded rock. Because of this contamination found in one structural basin is not apt to be in hydraulic communication with the other basins, so any Yakima valley-wide trends are tied to the structural basins. All of this data is supposed to be in GIS. Who all have access?

2008 USGS Study: "Extent and Depth to Top of Basalt and Interbed hydrogeologic Units, Yakima River Basin Aquifer System, Washington" Report 2008-5045 by M.A. Jones and J.J. Vaccaro, USGS				
Purpose	**Area of Focus**	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
This study was launched in June of 2000 to obtain an understanding of the ground-water flow system and its relation to the surface-water resources needed to implement water resources management strategies in the basin. The study was also done to provide baseline information for a management tool—numerical model. The conceptual model of the flow system and the results of the study were supposed to be used to support actions taken by management agencies with respect to GW availability and to provide information to other stakeholders and interested parties.	The Yakima River Basin aquifer system. The basin includes 3 Washington State Water Resource Inventory Areas (WRIA --#37, 38, &39), part of the Yakama Nation lands, and 3 ecoregions (Cascades, Eastern Cascades, and Columbia Basin) The basin includes parts of 4 counties (Klickitat, Kittitas, Yakima, and Benton). Almost all of Yakima County and more than 80% of Kittitas County lie within the basin, and about 50% of Benton County is in the basin.	The Yakima River Basin aquifer system in S. Central Washington encompasses an area of about 6,900 mi2 including the entire Yakima River Basin and lands to the east extending to the Columbia River. The 5 hydrogeologic units delineated, from top to bottom, are the: Saddle Mountains Mabton Wanapum Vantage Grande Ronde The depth and range are provided in the study.	Not Applicable in this Study	Basalt formations (consolidated formations) are a productive source of groundwater for the Yakima River Basin. Two units are described that are germane to the Yakima Valley groundwater concerns are – the Mabton unit and the Wanapum unit. The Mabton extends from 80 to 2000 feet below surface. The Wanapum unit extends from the surface to 2050 feet below surface. The significance is that the basalt represents the underlying formation for most of the Yakima River Basin and that the basalt carries and transmits groundwater just as unconsolidated sands and gravels. This also means it must be protected as well.

August 2008 USGS Study: "Distribution of Elevated Nitrate Concentrations in Ground Water in Washington State", by USGS				
	Area of Focus	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
This study was designed to estimate the probability of detecting elevated nitrate in GW in Washington State.	Washington State	♦Shallow wells in areas with a high percentage of agricultural land use and (or) high population density are	Nitrate conc. in GW are elevated in parts of the U>S> as a result of various land-use practices, including fertilizer	Not Applicable in this study. (Study created vulnerability maps using logistic regression, the occurrence of

August 2008 USGS Study: "Distribution of Elevated Nitrate Concentrations in Ground Water in Washington State", by USGS				
	Area of Focus	**Key Findings**	**Discussion re: Source of Contamination**	**Discussion re: Hydrogeology**
The GUS GS and WaDOH collaborated to examine water-quality data from public water systems and develop models that calculate the probability of detecting elevated nitrate conc. in GW. Maps were then developed to estimate GW vulnerability to nitrate in areas where limited data are available.		most likely to have elevated nitrate conc. in the water. Maps showing the estimated probability of elevated nitrate conc. indicate that the agricultural regions are most at risk followed by urban areas. Areas of the State that are not affected by agricultural or urban activities had much lower probabilities of detecting elevated nitrate conc. Shallow wells (145 feet deep or less) in agricultural areas of eastern Washington have a >than 90% probability of nitrate conc. exceeding 2 mg/l on the vulnerability map of WA. Maps generated show that in order to have a 90% chance of obtaining water with nitrate conc. < 2 mg/L, wells need to exceed 750 feet in agricultural regions and 400 feet in urban areas.	application, dairy operations and ranching, and septic-system use. Shallow wells generally are more vulnerable to nitrate contamination than deeper wells.	elevated nitrate conc. in samples from public supply wells and related the occurrences to natural and human-caused factors to assess GW vulnerability to nitrate.

Appendix F - Responsiveness Summary

On October 21st, 2009, the agencies responsible for this report hosted a public meeting to collect feedback from community members and to discuss options for coordinating a response to groundwater pollution in the Lower Yakima Valley. Written comments were accepted until November 30th, 2009.

Many people provided comments at the public meeting by speaking or by writing on note cards. Three sets of written comments were provided during the public comment period. Many comments provided at the public meeting related to the meeting itself or to overall agency accountability.

This responsiveness summary provides the agencies' response to comments regarding the report. Comments are grouped by topic and presented in bold. Agency responses are provided below.

Topic: Disappointment with Agencies

"Why do we have to prod agencies to do their job?"

"Not interested in returning to anymore meetings until the agencies accept the responsibility. We need ENFORCEMENT not Education! surgery NOT Bandaids"

"Is this not just another endless staff study report that validates pasted assessments, analysis and researches conducted over the past 20 years restating the same critical issues concerning the health and safety of our community? "

Agency staff received written and verbal comments from community members throughout the development of the report. Many comments expressed concern with a lack of agency accountability regarding enforcement of water quality laws and enforcement of groundwater pollution sources. Also, many comments expressed concern that the report was "just another report" and it would delay action to protect and restore ground water quality.

Since December 2008, agencies have worked together to address groundwater contamination in the Lower Yakima Valley. The report, *Lower Yakima Valley Groundwater Quality- Preliminary Assessment and Recommendations Document*, provides a starting point to move forward beyond "just another report". The report recognizes that a new direction for agency coordination and action must be taken to address groundwater contamination and its sources in the Lower Yakima Valley.

The EPA has provided environmental assessment and community facilitation resources in response to naming the area an Environmental Justice Showcase for EPA Region 10. In addition, they have made a commitment to provide enforcement resources to back up the Safe Drinking Water Act and Clean Water Act.
The Department of Ecology provided funds for sampling low income wells in the Lower Yakima Valley, provided half time of two members of its Water Quality Program staff to assist with groundwater clean up actions and has signed a new Memorandum of Understanding with the Department of Agriculture in order to better describe enforcement obligations related to livestock industries.
In January 2009, the Yakima County Board of Commissioners informed the director of the Department of Ecology that they are want to be the lead agency for a Ground Water Management Area. This may provide a local coordinating body to address concerns expressed in the report.

Topic: Enforcement

We need enforcement actions

Washington State enacted a (3) strikes and you're out law...impose such a law against perpetrators of environmental harm.

How about a Victim's Well Compensation Act towards the violators of a mass clean-up. That's where the offender(s) must pay for the clean up of land(s) and not limited to compensation of use of land but also water rights and expenses for losses incurred.

When does the Yakima Valley become a Superfund areas to clean the wells and if possible?

People want enforcement but what are they supposed to enforce? What are the pollution sources? I believe this is what has to happen; first is determine where the pollution is coming from. Is the water quality getting better or worse? We should have the resources and answers to the sources of nitrates and bacteria counts in the water. Should every drinking well be certified?

Can SPA or APA establish enforceable land use on BMPs?

Will Ecology find and enforce correction of wells that are not properly sealed?

The EPA and Department of Ecology are committed to enforcing rules that protect groundwater. The EPA announced in 2009 that it is committed to enforcement efforts related to the Clean Water Act and the Safe Drinking Water Act.
In 2009, the Department of Ecology and Department of Agriculture completed a revised Memorandum of Understanding that provides direction for enforcing laws and rules that manage livestock and water quality.
Ecology enforces correction of wells that are not properly constructed or that are improperly abondonded. This enforcement is often conducted when Ecology receives complaints for specific locations. Citizens that know of specific locations where abandoned or poorly constructed (not properly sealed) wells are located should contact the Department of Ecology with a complaint.

Declaring the lower Valley a superfund site is not feasible at this time. It does not meet the requirements for Superfund status. Nitrates are not regulated by the rules and regulations that prompt Superfund and superfund type activities.

A Special Protection Area (SPA) could have enforceable land use BMPs. Currently, the Department of Ecology is developing a cattle grazing BMP manual. This manual may be expanded to include other livestock management BMPs regardless of the formation of a SPA.

Topic: Health Effects

I am requesting that research entitled, Final Report: Dose-Response of Nitrate and Other Methemoglobin Inducers on Methemoglobin Levels of Infants be included in its complete form as an attachment.

I have worked as a hospital staff nurse in the upper and lower Yakima Valley for over thirty years. I have cared for many sick children and I never saw testing for methemoglobin levels in these patients. I have worked on maternity units in four Yakima Valley hospitals and we never told new parents about the dangers of using un-tested well water for infant feedings.

Given the fact that 7 out of the 558 infants in the above study had methemoglobin levels greater than 4% I recommend that the Lower Yakima Valley Groundwater Study should propose immediate implementation of:

1. Mandatory testing for elevated methemoglobin levels by health care providers who treat infants who drink well water and have diarrheal illnesses.

2. Mandatory reporting of elevated methemoglobin levels.

3. Mandatory teaching for new parents about the dangers of using un-tested well water for infant feeding. (The EPA has developed a very useful tool for this purpose entitled: Nitrates and Nitrites: TEACH Chemical Summary. It is available at www.epa.gov/teach/chem_summ/Nitrates_summary.pdf)

If my recommendations cannot be included in the final report please include this letter as an attachment. I thank you for all the hard work that goes into this very important document.

The authors added a section to the final report regarding health effects of nitrates. The report will reference the infant health study. The three numbered recommendations are relevant for Department of Health and local health jurisdictions such as Yakima County Health District and Indian Health Services.

The following sentence was added to the clinical testing recommendation in the body of the report "This should include testing and reporting for elevated methemoglobin infants who drink private well water and are treated for diarrheal illnesses." Although all of the recommendations were not added to the report, *they will be published as they appear above in this responsiveness summary.*

Topic: Options

Options analysis needs to include a ranking based on an agreed set of objectives. Ranking matrix.

What does the County assess to fund APA? Homes only? or can ag land be assessed? industry?

Thank you for these comments. A ranking matrix may be an important decision making tool. Fortunately, the agencies and community have more that one option. For example, Yakima County is requesting the formation of a Groundwater Management Area. The Department of Ecology can support this in several ways. One, the state could answer a petition to create a Special Protection Area in to assist implementation of GWMA actions. In addition, as the Department of Ecology completes a TMDL related to nutrients, it will coordinated implementation actions with the GWMA staff to insure efficient implementation of nutrient reducing BMPs.

The county would work with property owners to decide what to assess in order to fund and APA.

General Topic:

I would like to know how come CAFOs and Dairys are the first to be blamed?

What proof is there that the contamination wasn't a natural source of high nitrates?

Has there been any research to the relation of septic systems to the private wells?

The report Lower Yakima Valley Groundwater Quality-Preliminary Assessment and Recommendation Document does not assign blame to any one source. It does list potential sources of and potential pathways for nitrates and bacteria to groundwater.
Regarding the natural background of nitrates in groundwater, our report now represents that the natural background level of nitrate in Lower Yakima Valley groundwater is less than 0.3 mg/L.

There has not yet been any research in the Lower Yakima Valley to specifically link septic systems to private wells. Generally, septic systems do not cause regional groundwater pollution at the level observed in the Lower Yakima Valley. Septic systems are more often associated with localized pollution.

Presently, EPA is conducting a study using a Geographic Information System (GIS) and well sampling to determine relationships between land use, such as septic systems, and the source of nitrates in contaminated wells.

It states that the 61 facilities in Yakima have approximately 290,000 animal units. That number is actually closer to the entire state than just Yakima. It is an error we somehow missed earlier and have corrected for the final report.

The number of animal units for the county (the same number that was used to develop Table 1 on that same page) should say 138,797 animal units.

The final report now represents that there are 68 dairies in the Lower Yakima Valley and approximately 139,000 milking animal units. This does not include the dairies and feedlots on the Yakama Nation Reservation.