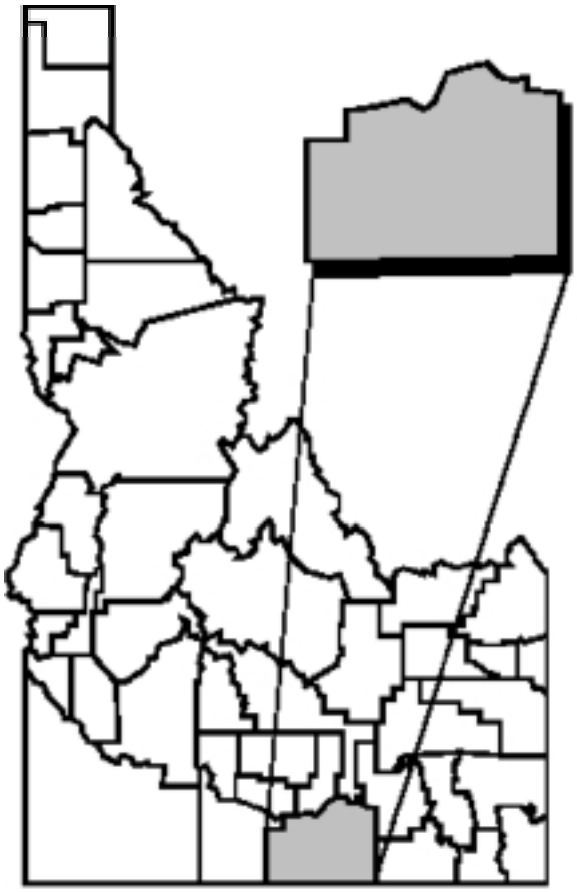

Cassia County Groundwater Quality Management Plan

June 2004

This plan meets the requirement set forth in Policy PM00-04 to address the Burley/Marsh Creek area of concern.

See the Appendix for the list of Cassia County Groundwater Quality Advisory Committee and Technical Advisory Committee members who contributed their time to the creation of this report.

For any questions regarding this report, contact Kathy Hieb, IDEQ engineering consultant, at 208-733-7393, or Bill Allred, IDEQ Twin Falls Regional Office, at 208-736-2190. More information can be found in the IDEQ webpage at http://www.deq.state.id.us/water/water1.htm#/groundwater; scroll to "Nitrates", then technical/geographical reports.

EXECUTIVE SUMMARY

Elevated nitrate levels can pose a health problem in both humans and animals. It can also be an indicator of other water quality problems. Nitrate levels tend to increase with other contaminants, such as when fertilizer or septic waste reaches a water supply. The federal regulatory level for nitrate concentration in human drinking water is 10 milligrams per liter (mg/l). Nitrate levels above this regulatory level have been associated with methemoglobinemia, which is the inability to absorb oxygen in the blood system. Methemoglobinemia is usually discussed with respect to risk in newborns and infants up to 6 months of age. However, adults with reduced stomach acidity, and people deficient in a particular enzyme, are also at risk. Several studies are underway to explore the possible link between long-term exposure to elevated nitrates and the incidence of health problems such as non-Hodgkin lymphoma, miscarriages, diuresis and hemorrhaging of the spleen. High-nitrate water is generally a health hazard to animals only when used with high-nitrate feed. Short-term use of water up to 40 mg/l nitrate is generally considered acceptable for animals.

The Idaho Department of Environmental Quality (IDEQ) formed the Ground Water Monitoring Technical Committee to compile the state's groundwater nitrate data. This committee delineated and identified twenty-five areas with elevated nitrate using groundwater data collected through 1999. Each of these areas had 25% or more of the sample wells exceeding 5 mg/l nitrate. These twenty-five areas were then ranked to determine the severity of the nitrate problem and to establish a work priority for agency resources. Ranking criteria consisted of population, existing water quality, water quality trends, and beneficial uses. The Burley/Marsh Creek area was placed as #3 on this Nitrate Priority list.

To address this issue, the IDEQ formed the Cassia County Groundwater Quality Advisory Committee, to design a management plan to prevent future nitrate level increases. The Committee decided to write a plan addressing the nitrate levels in the entire county rather than just the Burley/Marsh Creek area. This plan is intended to be a communication tool, not an enforcement tool. It will provide direction and guidance to the community and its leaders.

The Committee identified land use activities that could potentially affect nitrate levels in the county groundwater. In addition to regulations in place, recommendations for some activities are provided in this document. In no particular order, these activities can be summarized as follows:

- Residential – Owners of existing systems are encouraged to conform to guidelines and regulations established for new construction of wells and septic systems. Unused wells should be abandoned according to regulations. Residential landscaping and animal pasture activities should follow the suggestions in the agriculture and animal feeding operation portions of this document.

- Public-owned areas – Officials responsible for these areas should follow the recommendations in the Residential section of this plan.

- Municipal systems – Local authorities need to recognize that land uses in the drinking water protection areas can impact the quality of municipal drinking water.

- Agriculture – Irrigation and nutrient management must be considered together to reduce leaching of nutrients to groundwater.

- Animal feeding operations – Suggestions are given for surface water, wastewater, solid manure, and feedyard surfaces. Composting is recommended. This section of the plan applies to all sizes of animal feeding facilities.

- Recharge – Great care must be given to both natural and artificial recharge efforts.

The Committee will cooperate with the IDEQ, the Idaho State Department of Agriculture (ISDA), and the Idaho Department of Water Resources (IDWR) to implement projects supporting the goals in this plan. The Committee supports other groups and agencies that perform surveys, make presentations, and provide information relating to groundwater quality. Education, public awareness, and adoption of recommendations are key to this plan's success.

At this time, adoption of this plan is strictly voluntary. The IDEQ will continue to compile and analyze groundwater monitoring data collected by all the state agencies. The effectiveness of this voluntary plan will be evaluated, and possible changes may be discussed. If improvements to groundwater nitrate concentrations are noted, then regulatory intervention may be avoided.

(Note: In this document, whenever the term "nitrate" is used, it refers to the more scientifically correct term "nitrate as nitrogen" or "nitrate-nitrogen".

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Cassia County
Groundwater Quality Management Plan

Section I: Background

A. Introduction

In 1999-2000, the Department of Environmental Quality studied groundwater analyses from around the state with a focus on nitrate. Areas within the state were then placed on a Nitrate Priority Area list. Positions on this list were based on population, groundwater quality, the trend of the nitrate analysis, and other beneficial uses of the groundwater. The Burley/Marsh Creek area was ranked the third highest area of concern in the state. (Detailed information is provided in the Appendix.**)**

The Burley/Marsh Creek area is within Cassia County, located in the high desert of south-central Idaho. The area is bounded by the Albion Range and Rock Creek Hills on the southeast and southwest. The Snake River provides a physical boundary for the county line on the northern edge. The area slopes northward from an elevation of about 4,600 feet at Oakley to 4,150 feet at Burley.

Wells in the Burley/Marsh Creek area extract water from basalt of the Snake River Group to the northeast and east and possibly the Idavada volcanics to the south.

Fifty-five years of records (August 1948 - March 2003 from the Western Regional Climate Center) show the annual precipitation in Burley to be 9.91 inches and 10.90 inches in Oakley.

B. Authorities

1. The *Idaho Department of Environmental Quality (IDEQ) is designated as the primary agency* to coordinate and administer groundwater quality protection programs for the state (Ground Water Quality Protection Act of 1989, Idaho Code 39-120). Various state and local agencies have responsibilities for and are involved in implementing the Ground Water Quality Plan (adopted in 1992 and amended in 1996).

2. The *Groundwater Quality Rule* (IDAPA 58.01.11.400.02 and IDAPA 58.01.11.400.03) sets forth a number of alternative actions that the IDEQ may follow when a numerical groundwater quality standard has been exceeded, as well as when one has not been exceeded but significant degradation of the groundwater has been detected. The groundwater quality standard addressed in this plan is the primary (health based) drinking water standard of 10 mg/l nitrate.

3. In March 2000, the *Policy for Addressing Degraded Ground Water Quality Areas (Policy No. PM00-04)* was published.

   - One of the purposes of this policy is to set forth a process to identify, designate, and delineate areas where groundwater quality is significantly degraded as defined by rule.

   - Another purpose of *Policy Memo PM00-04* is to develop groundwater quality management strategies for improving groundwater quality in high priority areas based on current categorization and applicable standards with the use of local input. The Cassia County Groundwater Quality Advisory Committee (hereafter referred to the "the Committee") was formed as a pro-active measure to improve local groundwater quality through the adoption of the recommendations in this plan.

4. The IDEQ formed the Ground Water Monitoring Technical Committee to compile the state's groundwater data. This committee is comprised of technical representatives from local, state, and federal agencies and interested parties. In 2000, this committee delineated and identified twenty-five areas with elevated nitrate using groundwater data collected through 1999. To be included on this list, 25% of more of the sample wells needed to exceed 5 mg/l of nitrate.

   The twenty-five nitrate priority areas were then ranked to determine the severity of the nitrate problem and to establish a work priority for agency resources. Ranking criteria consisted of population, existing water quality, water quality trends, and beneficial uses. The ranking list was finalized in December 2001. For more information, refer to the following web site: http://ww2.state.id.us/deq/water/gw/nitrate/nitrate_ranking.htm. The Burley/Marsh Creek area was placed as #3 on this Nitrate Priority list.

5. *Cassia County Groundwater Quality Advisory Committee*

   The Committee consists of local area residents and government agencies representing a broad range of interests within the county. The IDEQ is the lead agency assisting the committee in developing a management plan to address the groundwater degradation in the county. Other agencies or groups providing technical support include:

   - Idaho State Department of Agriculture (ISDA)
   - Idaho Department of Water Resources (IDWR)
   - Idaho Rural Water Association (IRWA)
   - South Central District Health (Public Health)

- University of Idaho Cooperative Extension system (UI)
- Idaho's Well Drillers Association
- Idaho Crop Production Association

The Committee has met in open public forums since August 2002 to form the recommendations in this document. The Committee has agreed to promote and encourage a voluntary approach for addressing the groundwater contamination in the county.

Section II: Management Plan Goal

The ultimate goal of this plan is to reduce the levels of nitrate in the groundwater for the entire Cassia County. Data collected as of 1999 showed the Burley/Marsh Creek nitrate levels to average 6.36 mg/l with 17% of the wells exceeding the federal drinking water standard of 10 mg/l. It is anticipated that activities recommended herein should, within a reasonable time, lower the nitrate levels in the county's groundwater. Reducing nitrate levels may be a long-term process; therefore, the monitoring for this plan is anticipated to take years in order to determine a trend.

Another goal of this plan is to educate domestic well owners on the ground water quality of their individual wells. Well owners need to understand that it is their responsibility to have their ground water tested to determine potential health risks. Domestic wells do not require the governmental oversight and regular sampling that public water systems wells do. Domestic wells are included in some groundwater studies, and those well owners will be provided with their ground water data. It is generally recommended that homeowners test their wells for nitrate and bacteria. The cost to a domestic well owner is reasonable (2004 - about $20/constituent sampled), and laboratories are easily accessible (contact Public Health at 678-8221). Depending on these initial results, additional testing may be recommended.

Section III: Management Plan Approach

A. Introduction

1. This voluntary approach is based on the premise that the majority of people, when educated, will be willing to modify their activities in order to reduce nitrate loadings to the groundwater. The Committee believes that:

    a. Residents may choose to address the nitrate problem with more innovative solutions than a blanket regulation would provide.

    b. People will feel they are making choices rather than being forced to participate in a government program.

c. The voluntary approach provides the opportunity to encourage participation from those who are not currently regulated.

2. Periodically the state agencies and the Committee will jointly evaluate the progress and success of this management in reducing the nitrate levels in the county's groundwater. The Idaho Department of Environmental Quality (IDEQ) will provide oversight.

3. If the voluntary approach results in satisfactory progress towards reducing nitrate levels in the groundwater, mandatory requirements may not be necessary.

B. Groundwater Contamination Concerns

The Committee identified the land uses listed in the following table as those with potential to affect groundwater nitrate levels. They are listed in no particular order. Some land uses are already regulated to varying degrees by the government. In some cases, changes in governmental regulations are recommended. Best management practices and/or advice will be offered for land uses that are controlled voluntarily. Regardless of current regulation, the Committee has prioritized those land uses that would benefit from discussion.

Table 1: Cassia County Land Uses with Potential to Affect Groundwater Nitrate Levels:

Land Uses	Regulated	Voluntary	Committee Priority
Residential:			
Existing wells		X	X
New wells and septic systems	X		
Existing septic systems		X	X
Abandoned wells	X		X
Lawn/garden		X	X
Animal pasturing		X	X
Public-owned areas:			
Wells	X		
Septic systems	X		
Lawn/garden	X	X	X
Municipal systems:			
Drinking water	X		
Land application	X		
Agriculture:			
Cropland	X	X	X
Abandoned wells	X		X
Animal feeding operations:			
Small	X	X	X
Large	X	X	X
Recharge:			
Natural and artificial	X	X	X

Section IV: Objectives of this Management Plan

The Committee has set the following objectives:

1. Implement the management plan in a manner that encourages voluntary actions by members of the community to protect groundwater quality in Cassia County, so that a regulatory approach is not necessary.

2. Reducing nitrate loading to the groundwater without adversely affecting the economy.

3. Make the plan a communication tool that provides direction and guidance to the community and its leaders about the basic steps needed to prevent future nitrate level increases.

Section V: Methods for Implementing the Management Plan

The Committee considers the following methods most appropriate for implementing a voluntary action plan:

1. Representatives from IDEQ and volunteer committee members will make use of the following materials to make presentations at various events throughout the county:

    - This management plan.

    - The Committee developed a brochure specific to homeowners with existing wells. Brochures and other information have been collected for septic systems (IDEQ – "A Homeowners Guide to Septic Systems"), lawn/garden care (UI – "Watering Home Lawns and Landscapes"), and the health hazards of nitrate (UI – "Nitrate and Groundwater").

    - A poster board display was made which describes nitrate issues statewide and in Cassia County.

2. The Idaho Department of Environmental Quality has purchased a water quality test kit for the analysis of drinking water. A one-time only free water testing service at various sites throughout the county is being planned for Spring/Summer 2004. IDEQ and volunteer committee members will conduct this testing.

3. The Committee feels that education of youth is essential for this plan's success. With approval from the School District, the Committee would like to make presentations and send home information with school students. It is anticipated that sixth grade students would receive the bulk of this information.

4. The Committee would like to sponsor projects that will help reduce the nitrate levels in groundwater. The group is already interested in the Home*A*Syst program and various ventures using grant money, such as that offered by the Federal Clean Water Act – Section 319.

5. Another project being considered is the preparation of newspaper articles with educational information.

Section VI: Land Use Issues/Problems and Recommendations

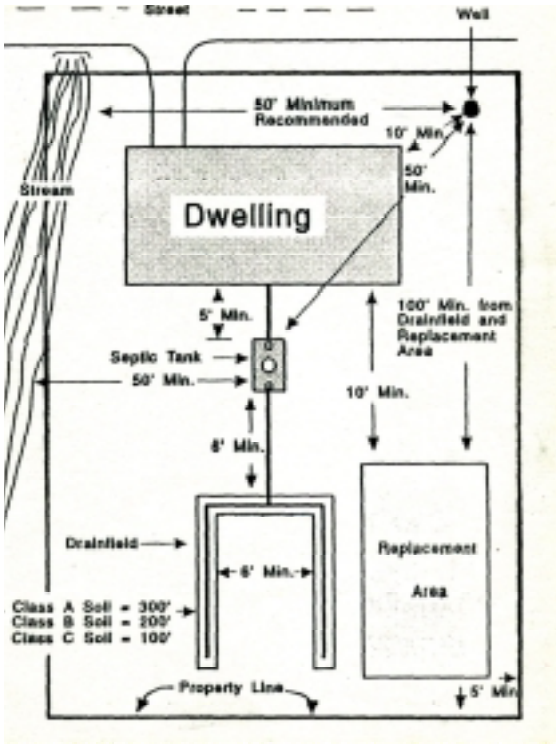
Land use: Residential

Wells (existing, new, and abandoned), septic systems, lawn/garden activities, and animal pasturing make existing and proposed residential development a potentially important localized source of groundwater nitrate contamination.

Many individual wells in the county were constructed before current requirements came into effect. These wells have the potential of contamination groundwater in a variety of ways. For example, contaminated water may move down an improperly sealed well casing from the land surface to groundwater. Another common problem occurs when wells drawing groundwater from different depths carry contaminants between aquifers. Wells that are no longer being actively used should be abandoned according to Idaho Department of Water Resources (IDWR) guidelines (IDAPA 37.03.09 Rule 25 Section 12-Abandoning of Wells).

Locating a septic system or other contamination source too close or up gradient from a poorly sealed well may cause the well to capture contaminated water and allow contaminated water to move further into the aquifer or between aquifers. The standard household septic system is not designed to effectively treat wastewater for nitrates. Properly operating systems deliver a certain amount of nitrate to the groundwater (an average of about 45 mg/l nitrate-nitrogen). In low-density settings, the impact to the groundwater is low because of dilution by the groundwater and the small volume of discharge spread over a large area. However, as densities increase, the combined discharge volume increases, thus overcoming the groundwater's ability to dilute the wastes, and increases the potential for noticeable groundwater contamination.

The following diagram illustrates the distance recommendations for wells and septic systems.



Lawn/garden activities and animal pasturing can also deliver nitrate to the groundwater. Not understanding the diagnosis and treatment of yard problems can result in excess or improper timing of fertilization and/or irrigation. Not knowing how to separate waters, feed, and waste products associated with large animals can also cause groundwater contamination. Residential landscaping and animal activities should follow the suggestions in the agriculture and animal feeding operation portions of this document.

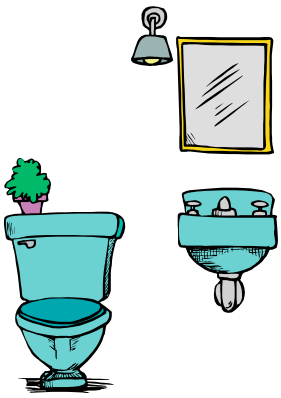
Wells, septic systems, lawn/garden activities, and animal pasturing are discussed individually in the following sections.

Table 2: Residential - Wells - Existing:

About 56% (Idaho Department of Commerce - County Profiles of Idaho - 2000 data) of Cassia residents rely on their own domestic wells for drinking water.

The Committee recommends that all existing wells be brought up to today's standards to protect everyone’s drinking water.

Issue/problem	Recommendations
Unknown water quality.	<u>Water testing:</u> a) Test the water for nitrate and bacteria annually. b) Use a certified lab – follow their instructions for sample collection. c) Discuss the results with Public Health (678-8221). <u>Well information:</u> a) Look for well log at home, office, safe deposit box, etc. b) Contact IDWR (736-3033), neighbors, well driller, or the electrician for information. Hint: Look for a label on the well's electrical box for contact information. c) If no well information is found, have the well inspected by a well driller. Get a copy of today's standards from IDWR and ask the driller to compare your well's construction to this list. <u>If there is a construction problem:</u> a) Consult IDWR (736-3033) before doing any modifications to the well. b) Contact Public Health (678-8221) before making changes to the septic system.
Well and/or septic system location unknown.	
Well is within 50 feet of surface water or a septic tank.	
Well is within 100 feet of a drainfield.	
Unusual changes in the water: *seasonal differences of any kind *strange sounds from well (especially during irrigation season) *color, taste, or smell *volume of water	
Homeowner inspection reveals: *holes or cracks in cap or casing *cap is not tightly attached *casing is in a pit or basement *casing is not more than 12 inches above historical flood level *running water can be heard *no backflow prevention devices are installed *well is more than 20 years old *well was not drilled (It is a sandpoint or hand dug well.)	
Liquid or solid chemicals are within 50 feet of well.	a) Move them away from the well now! b) Ask IDEQ (736-2190) what to do with the contaminated soil under these storage areas. c) Test your water as described above.
Chemigation is used.	Install back-flow prevention devices.



The Appendix contains a brochure developed by this Committee entitled "Private Well Owners".

<u>Table 3: Residential - New Wells and Septic Systems:</u>

Issue/problem	Recommendations
Where should a new well or septic system be located?	*Private residence:* a) Well drillers, Public Health (678-8221), Home*A*Syst (338-5900), and Planning and Zoning have information that can help you site the well and septic system.

Issue/problem	Recommendations
	Subdivision: a) Get information from Public Health (678-8221) on Nutrient Pathogen study requirements.
Who should install them?	a) Ask neighbors for recommendations. b) Verify that the driller has proper credentials.

Table 4: Residential - Existing Septic Systems:

Issue/problem	Recommendations
Homeowner does not know where the tank and drainfield are located.	a) *New owners* – Septic tank inspection and pumping were required before a loan could be approved. Ask your real estate agent or title company for documentation. b) *Long-term owners* – *If you haven't had your system pumped and inspected in the last 3 – 5 years, it's time to do it again. *Sources of information about your system include: previous owners, neighbors, a recommended septic tank service. c) If the inspection shows a problem, contact Public Health (678-8221). Correct it as soon as possible.
The last septic tank pumping and inspection are unknown.	
Septic system maintenance procedures are unknown.	Follow the maintenance guidelines from Public Health (678-8221).
The well is within 50 ft of the septic tank or within 100 ft. of the drainfield.	Test your water and follow the suggestions described in the above table "Wells – existing".

The Appendix contains the Idaho Department of Environmental Quality's publication "A Homeowner's Guide to Septic Systems".

Table 5: Residential - Abandoned Wells:

Issue/problem	Recommendations
Use discontinued: *poor water quality *low volume *bad construction	Contact IDWR (736-3033) and use their procedures for properly abandoning a well.

Table 6: Residential - Lawn/Garden:

Issue/problem	Recommendations
Irrigation	a) Overapplication of water is common. It moves water past the root zone and into the groundwater. b) Calculate your application rate (Appendix – UI "Watering Home Lawns and Landscapes"). c) Compare your application rate to the standard tables from the UI Cassia County Extension office (878-9461) or on-line at the AGRIMET site (www.usbr.gov). A general guideline is one inch every couple of days. d) Lawn - Water a lawn when footprints stay for more than a few seconds. e) Garden – Push your finger into the soil. If it comes out relatively dry, it is time to water. f) Watering slow and deep will encourage root growth of lawns and plants. Weeds prefer the frequent and shallow watering. g) Mulching will reduce water requirements. h) Irrigate at night or in the mornings when evaporation rates are lowest. i) Maintain the entire irrigation system.
Mowing	a) Lawns cut too short: * invite weeds * retard the development of strong roots * will not be able to hold as much water b) Leave at least some of the grass clippings on the lawn to provide fertilizer and hold moisture. c) Put the remaining grass clippings into a compost pile.
Compost	a) Make your own compost out of grass clippings, yard debris, and fruit/vegetable wastes. b) Make/buy a bin and keep it more than 50 feet away from a well or surface water. c) Turn the pile often. d) Do not add pet waste. e) Some large animal waste is ok. f) For advice contact: UI Cassia County Extension office (878-9461).
Fertilizer application	a) Get a soil test every 3 years. b) Get a soil test kit from a garden supply store or the UI Cassia County Extension office (878-9461). c) Review the results with a professional. d) Add your own compost if possible. e) If chemicals are used, follow all of the directions as to amount and timing of application and subsequent watering.

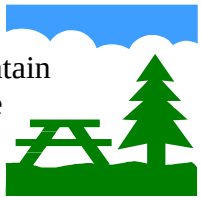
Issue/problem	Recommendations
Bugs and pests	a) Use the least toxic solution. b) Physically remove the bugs if possible. c) If you need to use chemicals, follow label directions carefully. d) Clean up debris and add to compost pile to reduce habitat and nesting sites.

See the Appendix for the University of Idaho publication "Watering Home Lawns and Landscapes".

Table 7: Residential – Animal Feeding Operations:

Issue/problem	Recommendations
Animal pasturing	Following the recommendations in the Agriculture and Animal Feeding Operations portion of this plan.

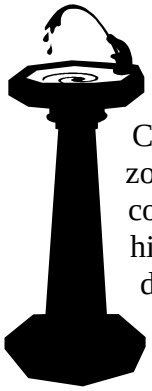
Land use: Public-owned areas



There are a number of public-owned areas in the county. These include: parks; schools; office buildings; and ball fields. Most of these contain wells, septic systems, and lawn/gardens. Officials responsible for these areas should be acquainted with recommendations in the Residential portion of this plan so they can be good stewards of the environment.

Land use: Municipal systems
- Drinking Water

About 44% (Idaho Department of Commerce - County Profiles of Idaho - 2000 data) of the Cassia residents rely on municipal systems for their drinking water. All of the municipal systems in Cassia County use groundwater as their sole source of drinking water. Municipal drinking water systems are provided by the cities of: Burley; Declo; Albion; and Oakley.



The Idaho Department of Environmental Quality, in compliance with the 1997 revisions to the "Safe Drinking Water Act" has completed Source Water Assessments for all municipal drinking water systems in Cassia County. These assessments identify public drinking water sources, delineate zones of groundwater contribution to those sources, identify "potential" contamination sources within those areas and rate those sources on a scale of high, medium or low in terms of their vulnerability to contamination. These delineations represent sensitive areas (Drinking Water Protection Areas) in which it is assumed that, should a contaminant enter the groundwater within them it is likely to adversely affect drinking water quality of those systems drawing water from them.

These delineated sources of municipal drinking water are recognized as special and sensitive areas in Cassia County. This committee therefore makes the recommendations in the following table.

Table 8: Municipal Systems - Drinking Water:

Issue/problem	Recommendations
Land uses within areas that supply municipal drinking water.	Local authorities need to recognize that land uses in these special areas can impact the quality of municipal drinking water.
	Land uses should continue to be monitored.
	The potential for increased contamination must be considered before making land use changes. A computer program, Geographic Information System (GIS), has been provided to county officials to provide information during these decision-making processes.

The Source Water Assessments for Cassia County municipal drinking water systems are available from the Idaho Department of Environmental Quality office in Twin Falls (736-2190). "Delineation and Potential Contaminant Source Location Maps" for Cassia County are found in the Appendix.

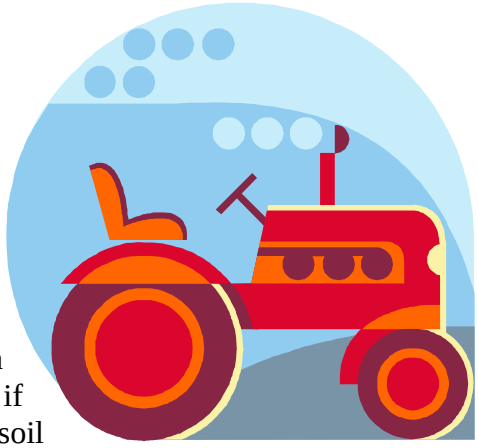
Land use: Municipal Systems

- Wastewater Land Application

Municipal land application is one of the few sources of nitrate that is already under direct regulatory requirements. Waste treatment facilities are required to obtain a National Pollution Discharge Elimination Systems (NPDES) permit from the Environmental Protection Agency (EPA) to discharge into waters of the state. If the wastewater is applied to land, a Waste Water Land Application Permit (WWLAP) is required from the Idaho Department of Environmental Quality.

Land use: Agriculture

- Croplands



Agriculture is the dominant land use in the county with approximately 266,095 acres under irrigation (Idaho Department of Commerce - County Profiles of Idaho - 1997 data). The major sources of nitrate from agricultural activities come from all forms of fertilizers, legumes and mineralization of organic matter. Nitrogen not utilized by plant growth is stored in the soil and can be leached to groundwater as nitrate, if sufficient water is available to move it through the soil profile. This water may be due to over- application or mis-timed irrigation, or from natural precipitation. Both irrigation and nutrient management must be considered to address the nitrate leaching concerns in irrigated agriculture.

Table 9: Agriculture – Croplands:

Issue/problem	Recommendations
Irrigation scheduling	1) Balance irrigation applications with crop needs and soil characteristics throughout the irrigation season. 2) Consult with one of the numerous sources of daily or weekly irrigation information: * AGRI-MET web page (www.usbr.gov) * UI Cassia County Extension office (878-9461)
Irrigation equipment	Continually maintain the entire irrigation system.
Applying fertilizer, manure, or compost	1) Make sure a soil test and/or plant tissue test is performed. Don't let anyone apply nitrogen to your crops without this information! 2) Test for nutrient content of manure or compost. 3) Get more than one professional opinion: * UI Cassia County Extension office (878-9461) * Soil Conservation Districts (678-1255) * Fertilizer salesman * Crop fieldmen 4) Apply fertilizer, manure, or compost: * at the proper time * at the proper rate * followed by proper irrigation
Crop rotations	Use crop rotations that will salvage residual nutrients, including those from previous nitrogen-fixing crops.

Sources of information for agriculture

One office houses the following agencies at the Burley Service Center of the United States Department of Agriculture: 678-1255

Natural Resource Conservation Service (NRCS) (formerly SCS)
Farm Service Agency (formerly ASCS)
East and West Cassia Soil Conservation Districts (SCDs)

Idaho Assoc. of Soil Conservation Districts (IASCD) in Boise 338-4321

Idaho Department of Agriculture (ISDA) in Boise 332-8599

University of Idaho - Cassia County Extension office
Extension Educator 878-9461

Cassia County Planning & Zoning 878-7302

Land use: Agriculture

– Abandoned Wells

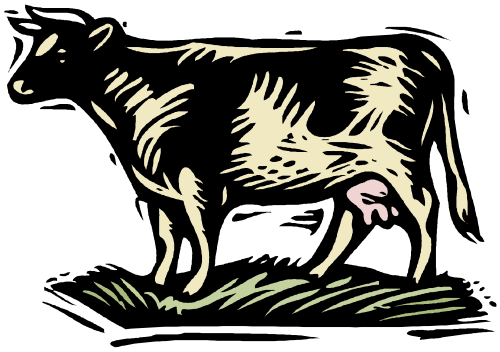
Over the years, a number of wells have been abandoned in agricultural areas for a variety of reasons. Although generally overlooked and forgotten, these wells provide a direct connection to the drinking water supply. Abandoned wells must be properly closed in order to stop continued/future contamination.

Table 10: Agriculture - Abandoned Wells:

Issue/problem	Recommendations
Use discontinued: *poor water quality *low volume *bad construction	Contact IDWR (736-3033) and use their procedures for properly abandoning a well.

Land use: Animal feeding operations

An Animal Feeding Operation (AFO) is officially defined as the holding or confining of animals in buildings, pens or lots. Nutrient management plans are required of the dairy industry. So, far, these plans have not been required for ranching operations. In addition to these dairy plans, numerous regulations for protecting groundwater are in place for larger AFOs regarding solid and liquid effluents.



Consideration must also be given to those living on an acreage (2-5 acres) who raise just a few animals for 4-H projects, riding pleasure, supplemental food sources, etc. Many of the same groundwater concerns exist for these smaller operations, yet they do not fall under state or federal regulations. Best Management Practices for these unregulated acreages should also be followed. Those practices of most interest to the acreage owner are related to surface water and composting of waste material.

Table 11: All Animal Feeding Operations:

Issue/problem	Recommendations
What regulations apply?	Depending on the location and number of animals, regulations may exist for the: subdivision – read your covenants; county – contact County Planning and Zoning (878-7302); and/or the state – contact the Idaho Department of Agriculture (332-8500).

Table 12: Small Animal Feeding Operations:

Issue/problem	Recommendations
Surface Water	1) *Runoff* – Grade the animal areas so that "good" water (runoff from clean surfaces and storm waters) can not contact manure or stored feed products. 2) *Mixing of waters* – If "dirty" water (carrying food or animal waste) and storm waters become mixed, this water should be diverted and treated, not just ponded.
Composting	Manure, excess bedding materials, and yard waste should be formed into a compost pile at a high point in the area. Composting benefits include: stabilization of nutrients; a lower salt index; and a more consistent product. For more information, contact the UI Cassia County Extension office (878-9461).

Table 13: Large Animal Feeding Operations:

Issue/problem	Recommendations
Surface Water	1) *Runoff* – Grade the animal areas so that "good" water (runoff from clean surfaces and storm waters) can not contact manure or stored feed products. 2) *Mixing of waters* - If "dirty" water (carrying food or animal waste) and storm waters become mixed, this water should be diverted and treated, not just ponded.
Composting	Manure, excess bedding materials, and yard waste should be formed into a compost pile at a high point in the area. Composting benefits include: stabilization of nutrients; a lower salt index; and a more consistent product. For more information, contact the UI Cassia County Extension office (878-9461).
Wastewater Effluent	1) *New lagoons and conveyance facilities* – should be designed and constructed in accordance with state standards to minimize leakage of stored wastewater. 2) *Existing lagoons and conveyance facilities* – should be redesigned and/of modified to meet state standards to minimize leakage of stored wastewater. 3) *Lagoons and conveyance facilities* should be designed for surface water runoff, corral water, and waters that have contacted manure or feed. 4) *Analysis* – occasionally have the lagoons tested for nutrients. 5) *Irrigation* – Irrigate these waters to provide both a hydraulic and nutrient balance. (Follow the recommendations in the agriculture portions of this plan.) 6) *Cleaning out pond sediments* - Best Management Practices (BMPs) cited in the facility Nutrient Management Plan, or applicable regulations, should be followed when cleaning out sediments from lagoons and holding ponds to prevent damage to the seals or structures.

Issue/problem	Recommendations
	7) *Storing pond sediments* – Follow the recommendations below for Solid Manure Management.
Solid Manure Management	1) *Manure storage* – Manure should be stored at a site which will minimize storm runoff and ponding. It should also be conveniently located in regards to equipment access and other compost materials. 2) *Compost* – Manure, excess bedding materials, and yard waste should be formed into a compost pile at a high point in the area. Composting benefits include: stabilization of nutrients; a lower salt index; less material; easier handling; and a more consistent product. For more information, contact the UI Cassia County Extension office (878-9461). 3) *Analysis* – Analyze the manure/compost for its nutrient values before applying to crops.
Feedyard Surfaces	1) *Drainage* – Direct the drainage to adequately constructed effluent facilities. 2) *Surface seal* – Maintain the surface seal while removing manure and scraping the feedlot pens. 3) *Grades* – maintain grades on existing corrals to provide drainage and prevent ponding within the corrals. 4) *Upgrades* – Upgrade facilities to meet accepted BMPs.

Land use: Recharge

Recharge is defined as the replenishment of ground water in an aquifer. It can be either natural or artificial. Examples of naturally occurring recharge include water leaching from canals, ponds, streams, lakes, or any low lying area. Artificial recharge is associated with man-made projects such as injection wells or constructed pond systems. These man-made projects are carefully monitored and require governmental permits. Depending on the specific conditions, recharge may either improve or degrade the groundwater quality.

Section VII: Implementation Tasks

A. General

1. Implementation will initially rely on education. In addition to writing this plan, the Committee developed a brochure titled “Private Well Owners”. Publications from the Idaho Department of Environmental Quality (“Homeowner’s Guide to Septic Systems”) and the University of Idaho (“Watering Home Lawns and Landscapes” and “Quality Water for Idaho – Nitrate and Groundwater”) will also be distributed. Contact information for the Home*A*Syst program materials will also be made available.

2. It is assumed that once people are aware of the environmental consequences of certain practices and situations they will seek alternatives to reduce the likelihood of groundwater contamination.

3. Further implementation of this plan will largely be accomplished through the efforts of a number of governmental groups and agencies.

4. The Committee encourages the continued efforts to monitor groundwater and to gather information pertinent to practices and activities that will protect groundwater.

5. The Committee supports the Federal Clean Water Act – Section 319 venture now (February 2004) in the proposal phase. Encouragement is also given to the implementation of Best Management Practice projects initiated by groups such as the Soil Conservation Districts (SCDs), Natural Resource Conservation Service (NRCS), and the Soil Conservation Commission (SCC). These projects can also involve the Idaho Department of Environmental Quality (IDEQ), Idaho Department of Water Resources (IDWR), Idaho State Department of Agriculture (ISDA), University of Idaho (UI), and local canal companies.

6. The Committee supports the implementation of the Idaho Association of Soil Conservation District's Home*A*Syst program.

B. Implementation Funding

1. Minimal funding is currently available specifically for the implementation of this management plan.

2. Although dedicated funds are not available, there are a number of grant funding sources and low-interest loans available for addressing certain aspects of the plan. All these funding options have their own eligibility requirements, application procedures, and conditions for application. Most grants and loans are competitive in nature and proposed projects compete with other proposals submitted throughout the state or nation.

3. Specific projects, such as those funded by Federal Clean Water Act – Section 319 money, will provide education and demonstrate best management practices that will improve local groundwater. In these projects, in-kind money or services would likely be provided by groups such as:

    a. Idaho Department of Environmental Quality (IDEQ) – The IDEQ administers the Idaho State Groundwater Quality Protection Act and implements the groundwater quality protection requirements for federal and state agencies, cities, counties, industry, and citizens. Monitoring and assessment of groundwater data is one of the primary areas of work.

b. Idaho State Department of Agriculture (ISDA) – In addition to monitoring, the ISDA is involved with the identification of existing agricultural management practice problems. They develop and implement alternatives for such practices.

c. Idaho Department of Water Resources (IDWR) – This department administers surface and ground water programs and activities that are predominately related to water supply issues. The IDWR also has responsibilities for ground water quality in areas such as Statewide Monitoring, Managed Recharge, and Injection Wells.

d. Soil Conservation Districts (SCDs) – SCDs are administered and coordinated by the Idaho Soil Conservation Commission.

e. Natural Resource and Conservation Service (NRCS) – This agency is managed by the United States Department of Agriculture. The NRCS provides technical and financial assistance that will help land operators in the planning and implementation of nutrient, pest and irrigation management plans designed to protect groundwater.

f. The University of Idaho (UI) – The University of Idaho develops publications and provides education on a wide range of topics. Local assistance can be found at the UI Cassia County Extension office.

Section VIII: Evaluation of Management Plan Progress and Success

Ultimately the goal of this plan is to reduce the contamination of nitrate in the aquifer supplying Cassia County. Due to the slow nature of ground water movement, it is not anticipated that quantitative reductions in nitrate levels will occur in the early implementation phases of the plan. Therefore, short-term goals are primarily qualitative in nature. These goals are essentially educational in nature, with emphasis on grade school students (with school district approval). In the long-term, continued sampling and data evaluation by IDEQ should show the positive results of a more knowledgeable community. The following table shows the schedule of the activities anticipated by the Committee.

Table 14: Implementation Project Schedule:

Time Frame		Topic	Responsible Party
2004	Annual		
X		Purchase a portable testing unit and sample bottles for analyzing nitrate in drinking water samples.	IDEQ
X		Advertise and then provide free nitrate analysis of domestic well water at multiple sites throughout the county.	IDEQ and Committee volunteers

Time Frame		Topic	Responsible Party
2004	Annual		
X		Make educational presentations to local groups using the following materials: ▪ this management plan ▪ a brochure written by this committee ▪ publications from UI and IDEQ ▪ poster board display	IDEQ and Committee volunteers
X	X	Ask for approval from the school district to make presentations and send home information with students.	IDEQ and Committee volunteers
	X	Receive updates on local Federal Clean Water Act – Section 319 ventures, if funded.	Various agencies
	X	Receive updates on the status of the Home*A*Syst program.	Idaho Association of Soil Conservation Districts

Appendix A - Management Plan Support and Approval

The Idaho Department of Environmental Quality (IDEQ) formed the Cassia County Groundwater Quality Advisory Committee in Fall 2002 to address elevated levels of nitrate in the area's groundwater. Members of this committee brought with them a variety of talents and areas of expertise. A number of state agency personnel and members of the private business sector provided technical information.

With this additional knowledge, the committee was able to identify potential activities that contribute to nitrate in groundwater. Work sessions over the next eighteen months resulted in the development of recommendations designed to reduce the amount of nitrate reaching the groundwater. This document is referred to as the "Cassia County Groundwater Quality Management Plan".

We, as a collective, approve of this document and strongly recommend adoption by our fellow citizens.

The Cassia County Groundwater Quality Advisory Committee

Appendix B

Committee Members

Charlotte Armstrong – Concerned Citizen of Cassia County
Tom Armstrong – Concerned Citizen of Cassia County
Randy Bingham – Burley irrigation district
Paul Christensen – Cassia County Commissioner
Teresa Darrington – farmer/dairy owner
Gene Fries – City of Declo
Weston Hawkes – City of Oakley
Jack Hill – Cassia County Planning and Zoning
Kris Hondo – farmer/National Farmers Union
Robert Inouye – Tessenderlo Kerley, Ind. & Kodiak Drilling
Terri Kidd – Concerned Citizen of Cassia County
Rod Lake – Cassia County Planning and Zoning
Alicia Lane – Bureau of Reclamation
Glen Larson – Mid-Snake Watershed Advisory Group
Carmen Logan – Idaho Department of Water Resources
Bill Loughmiller – farmer/Mini-Cassia Chamber
Kerry McMurray – Cassia County Administrator
Tim Miller – Bureau of Reclamation
Alvin Neddo – Raft River Flood District
Lew Pence – Mid-Snake Regional Water Resource Committee
Jack Peterson – West Cassia Soil Conservation District
Dale Pierce – Cassia Planning and Zoning
Dallin Reese -farmer
Shirley Danner – former Cassia County Commissioner
Jim Snyder – Bureau of Reclamation
Brent Stoker – farmer/dairy owner/West Cassia Soil Conservation District
Gary Turner – Idaho Farmers Union
Stewart Waldemar – City of Albion
Clark Ward – Almo area ranchers

Technical Advisory Committee

Bill Allred – Idaho Department of Environmental Quality
Dave Anderson - Idaho Department of Environmental Quality
Scott Arnell – Public Health
Joe Baldwin - Idaho Department of Environmental Quality
John Bokor – Idaho Rural Water Association
Barry Burnell - Idaho Department of Environmental Quality
Lin Campbell – Idaho Department of Water Resources
Rick Carlson – Idaho State Department of Agriculture
Gary Funderburg – Idaho Department of Water Resources
Richard Garrard – UI Cassia Extension System
Bill Hazen – UI Cooperative Extension System
Lance Holloway - Idaho State Department of Agriculture
Kathy Hieb – Idaho Department of Environmental Quality Engineering Consultant
Dale Pippitt – Idaho Well Driller's Association
Dinah Reaney - Idaho Department of Environmental Quality
Rex Schorzman – Paul Chemical and Fertilizer
Mike Thomas - Idaho Department of Environmental Quality
Matt Thompson - Idaho State Department of Agriculture

Appendix C – Acronyms and Glossary

AFO	Animal Feeding Operation
BMP	Best Management Practice
EPA	United States Environmental Protection Agency
FFA	Future Farmers of America
GW	Ground Water or Groundwater
IASCD	Idaho Association of Soil Conservation Districts
IDEQ	Idaho Department of Environmental Quality
IDOC	Idaho Department of Commerce
IDWR	Idaho Department of Water Resources
IRWA	Idaho Rural Water Association
ISCC	Idaho Soil Conservation Commission
ISDA	Idaho State Department of Agriculture
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resource Conservation Service
PH	Public Health Department
SCD	Soil Conservation District
U of I	University of Idaho
UI	University of Idaho
WWLAP	Wastewater Land Application Permit

Animal Feeding Operation – AFO – The holding of any number of animals in buildings, pens or lots.

Agricultural activity/Agriculture – Any activity conducted on land or water for the purpose of producing an agricultural commodity, including crops, livestock, trees, and fish.

Ambient – The water quality at a specific location at the time sampled.

Anti-backflow (anti-backsiphoning) device – A check valve or other mechanical device to prevent the unwanted reverse flow of liquids back down a water supply pipe into a well.

Aquifer – A geological formation of permeable saturated material, such as rock, sand, gravel, etc., capable of yielding economically significant quantities of water to wells and springs.

Background concentration – is defined in two different ways:

- Natural background ground water quality – The groundwater quality unaffected by man.

- Site background groundwater quality – the water quality directly upgradient of a site.

Best management practice (BMP) – A practice or combination of practices determined to be the most effective and practical means of preventing or reducing contamination to groundwater and/or surface water from nonpoint and point sources to achieve water quality goals and protect the beneficial uses of the water.

Chemigation – Adding a chemical to an irrigation system for distribution to the crops.

Compost – A biologically stable material derived from the biological decomposition of organic matter.

Coliform – A type of bacteria found in water whose presence in drinking water assumes the risk of contracting a water-borne illness.

Contaminant – Any chemical, ion, radionuclide, synthetic organic compound, microorganism, waste or other substance which does not occur naturally in groundwater or which naturally occurs at a lower concentration.

Crops needs – Factors required by a crop in order to grow. These include water, nutrients, and sunlight.

Crop root zone – The zone that extends from the surface of the soil to the depth of the deepest crop root and is specific to a species of plant, group of plants or crop.

Crop uptake – Water and nutrients actually used by the crop.

Degradation – The lowering of groundwater quality as measure in a statistically significant and reproducible manner.

Denitrification – The changing of nitrate into nitrogen gas which then escapes to the air.

Downgradient – A location downstream with regard to the groundwater direction.

Drinking water standards (Federal and State) – There are two types of standards. Primary standards protect human health, while secondary standards protect the aesthetic quality of drinking water. Nitrate is both a federal and state primary drinking water standard.

Effluent – solid or liquid – Any waste material moving away from its point of origin.

Fertilizer – Any substance containing one or more plant nutrients which is used for its plant nutrient content and/or for promoting plant growth, including limes, gypsum and manipulated animal and vegetable manure.

Groundwater – Any water of the state that occurs beneath the surface of the earth in a saturated geological formation of rock or soil.

Groundwater quality standard – Values, either numeric or narrative, assigned to any contaminant for the purpose of establishing minimum levels or protection.

Infiltration rate – The rate at which water seeps into the soil.

Irrigation water management – Determining and controlling the rate, amount and timing or irrigation water in a planned and efficient manner.

Leach – Water passing the root zone into the soil below, sometimes reaching the groundwater.

Legume – Crops that have nodules on the roots that contain bacteria that are able to convert nitrogen in the air into a usable form for the plant.

Liquid manure – A mixture of water and manure that can be pumped, generally less than 10 percent solids.

Livestock wastes – A term sometimes applied to manure that may also contain bedding, spilled feed, water or soil. It also includes wastes not particularly associated with manure, such as milking center or washing wastes, milk, hair, feathers or other debris.

Local government – Cities, counties and other political subdivisions of the state.

Manure – The fecal and urinary excretions of livestock and poultry.

Milligrams per liter (mg/l) – The weight of a substance measured in milligrams contained in one liter.

Mineralization – Decomposition; or the slow release of nitrogen through the conversion of organic nitrogen to inorganic nitrogen.

Nitrate – The most common contaminant identified in groundwater. This form of nitrogen is available to the crop. It often originates from nitrate in fertilizer or wastes at the soil surface or from naturally occurring processes in the soil, such as the mineralization of organic nitrogen.

Nitrogen-fixing crop – A crop that is able to take nitrogen from the air and convey it to soil microorganisms for their consumption.

Nonpoint source – Entry of effluent into a water body in a diffuse manner so there is no definite point of entry.

Nutrient – Any substance applied to the land surface or to plants that is intended to improve germination, growth, yield, product quality, reproduction, or other desirable characteristics of plants.

Nutrient management – Managing the amount, form, placement and timing of the plant nutrient applications.

Nutrient management plan – A plan for managing the amount, placement, form and timing of the land application of nutrients and soil amendments.

Nutrient-pathogen study – A study whose primary purpose is to determine the linkage between nutrients and pathogens, particularly how they enter surface water or groundwater.

Organic matter –These are substances of biological origin containing carbon. Up to a point, they are desirable in the soil.

Organic nitrogen – Most of the nitrogen in the soil is bonded to carbon in living and decaying cells of plants, microorganisms or small animals. This form of nitrogen is unavailable to plants until the mineralization process takes place.

Point source – The release of a contaminant or pollutant, often in concentrated form, from a conveyance system or discrete source, such as a pipe, into a water body.

Pond – A water impoundment made by constructing a dam or an embankment or by excavating a pit or dugout.

Qualitative evaluation – An evaluation process that emphasizes the artistry of a process or project.

Quantitative evaluation – An evaluation process that emplasizes concrete data.

Process water – Water that is used within a facility or an animal feeding operation for the clean-up of equipment, the facility, or the animals. This water is treated prior to irrigation on fields.

Recharge area – An area in which water infiltrates into the soil or geological formation from precipitation, irrigation practices and seepage from creeks, streams, lakes etc. and percolates to one or more aquifers.

Residual nitrogen/nutrients – Residual nitrogen is the unused nitrogen left in the soil after a crop is harvested.

Root zone – The zone within a soil profile where the roots predominate; normally, 0 – 9 inches of soil depth.

Soil characteristics – Parameters that can be used to describe or quantify the basic characteristics of a soil, often generated from lab tests.

Soil profile – A vertical section of soil made up of distinct horizontal layers.

Solid manure storage – A storage unit in which accumulations of bedded manure or solid manure are stacked before subsequent handling and field spreading.

Upgradient – Immediately above the zone of impact or just upstream from a point or area of impact.

Volitilization – The loss of gaseous components, such as ammonium nitrogen, from animal manure

Waste storage pond – An impoundment made by excavation or earthfill for temporary storage of animal or other agricultural waste.

Waste treatment lagoon – An impoundment made by excavation or earthfill for biological treatment of animal or other agricultural wastes.

Wastewater – AFO's - Water used within a facility or an animal feeding operation whose major components include manure and/or urine.

Wastewater – Wastewater land application – Water that has been sent from the facility to a treatment system prior to land application.

Water quality – The excellence of water in comparison with its intended use or uses.

Well bore – A well bore is the actual hole dug by a well drilling rig.

Well cap – A manufactured device installed at the top of a well casing which creates an air and watertight sanitary seal to prevent surface water and contaminants from gaining access to the groundwater supply.

Wellhead – The physical structure, facility, or device at the land surface from or through which groundwater flows or is pumped from subsurface, water-bearing formations.

Appendix D - Resources and Information

University of Idaho
College of Agriculture

Cooperative Extension System
Agricultural Experiment Station

Current Information Series No. 872

Quality Water for Idaho

Nitrate and Groundwater

Robert L. Mahler, Ernestine Porter and Roy Taylor

Nearly 95 percent of Idahoans rely on groundwater as their source of drinking water. Nationally, groundwater provides about 50 percent of drinking water. Thus, protection of groundwater from contamination by any substance that might cause health problems is a serious concern.

One potential groundwater contaminant is nitrate (NO_3). In general, recent surveys in Idaho have found very few rural water wells with nitrate levels higher than the National Public Health Service drinking water standard.

Health Concerns

Human — Humans ingest nitrate in food and water. In older children and adults, nitrate is ingested, absorbed from the digestive tract and excreted rapidly in the urine. Healthy human adults can consume fairly large amounts of nitrate with little if any known short-term adverse effects. The health effects of chronic, long-term consumption of high levels of nitrate are uncertain. They are the subject of several current research studies.

Infants younger than 6 months are believed to be susceptible to nitrate poisoning. Bacteria present in their digestive systems at birth can change nitrate to toxic nitrite (NO_2). Newborn infants have little acid in their digestive tracts, and they depend on these bacteria to help digest food. Generally, by the time infants reach 6 months, hydrochloric acid levels increase in their stomachs and kill most of the bacteria that convert nitrate to nitrite.

Once formed, the nitrite is absorbed and enters the bloodstream. There it reacts with the oxygen-carrying hemoglobin to form a new compound called methemoglobin. This compound interferes with the blood's ability to carry oxygen. As oxygen levels decrease, babies may show signs of suffocation. This condition is called "methemoglobinemia."

The major symptom of methemoglobinemia is bluish skin color, most noticeably around the eyes and mouth. Death can occur when 70 percent of the hemoglobin has been converted to methemoglobin. Treatment must begin quickly.

Infant deaths from methemoglobinemia, sometimes called "blue baby syndrome," are rare. Some documented deaths have been linked to high levels of nitrate in well water. Doctors now recommend using bottled water to make formula when nitrate levels exceed the U.S. Public Health Service drinking water standard of 10 parts per million (ppm NO_3-N).

Nitrate may also interact with organic compounds (secondary amines) to form N-nitrosamines, which are known to cause cancer. Many organic compounds could link with nitrate to form N-nitrosamines, including some pesticides. This may be important because wells with high nitrate levels are often vulnerable to pesticide contamination. Neither the immediate nor the chronic health effects of N-nitrosamines in humans are well understood.

Livestock — Nitrate poisoning is most likely to occur in ruminant animals such as cattle and sheep. Bacteria in the rumen convert nitrate to toxic nitrite. Monogastric animals such as swine and chickens have no rumen. Most nitrate is rapidly eliminated in their urine.

Although some plants naturally contain potentially harmful levels of nitrate, water rarely does. High-nitrate water is generally a health hazard to animals only when used with high-nitrate feeds.

Symptoms of methemoglobinemia in animals include lack of coordination, labored breathing, blue coloring of mucous

Guidelines for use of water with known nitrate content.

Nitrate-Nitrogen (NO_3-N)	Nitrate (NO_3)	Interpretation*
(ppm)	(ppm)	
0 to 10	0 to 44	Safe for humans and livestock.
11 to 20	45 to 88	Generally safe for human adults and livestock. Do not use for human infants.
21 to 40	89 to 176	Short-term use acceptable for human adults and all livestock unless food or feed sources are very high in nitrate. Long-term use could be risky. Do not use for human infants.
41 to 100	177 to 440	Moderate to high risk for human adults and young livestock. Probably acceptable for mature livestock if feed is low in nitrate. Do not use for human infants.
over 100	over 440	Do not use.

*Interpretations are primarily based on short-term effects. Chronic, long-term risks are not fully understood.

membranes, vomiting and abortions. Dairy cows may produce less milk without showing any physical symptoms. If animals show signs of nitrate poisoning or a problem is suspected, consult a veterinarian to determine if nitrate is the problem and, if necessary, to administer an antidote.

Water Testing

If nitrate is suspected in drinking water of humans or livestock, begin a routine water sampling and testing program to monitor nitrate levels. Nitrate is detectable in water only by chemical testing. It is colorless, odorless and tasteless. In Idaho, the Department of Health and Welfare, the University of Idaho and several private testing laboratories can test for nitrate.

Most laboratories usually report nitrate content in parts per million (ppm) of nitrate-nitrogen (NO_3-N). Occasionally a lab will report results in ppm NO_3. To interpret the results, you must know the form in which they are reported. To convert NO_3-N to NO_3, multiply by 4.4. For example, 10 ppm NO_3-N equals 44 ppm NO_3.

Nitrates in Groundwater

Even though naturally occurring and introduced nitrate is a common groundwater contaminant in the United States, the severity of nitrate contamination is hard to assess. Researchers agree that nitrate concentrations in unpolluted groundwater seldom exceed the National Public Health Service 10 ppm NO_3-N standard. Recent United States Geological Survey data show that almost every state has areas where nitrate levels exceed the standard. However, a recent Environmental Protection Agency study found that only 2.7 percent of rural wells exceeded the standard. Several recent studies in the Great Plains and Midwest have found localized areas where nitrate concentrations in groundwater have been increasing.

Sources of Nitrate in Groundwater

Cultivated soil usually contains between 1,500 and 4,000 pounds of organically bound nitrogen per acre. Plants are unable to use organic nitrogen directly. But as organic matter decomposes, it releases nitrogen in forms plants can use, primarily as nitrate (NO_3). This conversion of organic nitrogen into inorganic, plant-available forms occurs in natural ecosystems (forest or grassland, for example) as well as in agriculture.

The forms of organic nitrogen fertilizers used in agriculture include animal manures, human wastes, composts, sewage sludge, legume crops and green manure crops. Chemical nitrogen fertilizers contain inorganic nitrogen, usually as nitrate and/or ammonium (NH_4).

Plants do not necessarily use all the nitrate in chemical fertilizers or all the nitrate produced when organic matter decomposes. When the nitrogen supply is greater than the amount plants use, nitrate can accumulate in the soil and be lost from the system. In today's agriculture, with greater nitrogen inputs for higher crop yields, efficiencies of nitrogen use may be lower and the potential for losses may increase.

In some natural ecosystems, nitrogen is almost always in short supply, and little is lost from the system. But in other natural ecosystems, nitrogen is abundant and the potential for loss is high.

Nitrate can be lost from the system in a variety of ways. From the standpoint of groundwater quality, leaching into groundwater is the only concern. Leaching is the downward movement of water and nitrate through the soil. The potential for nitrate leaching varies with soil type and amount of water in precipitation or irrigation. For example, sandy soils under high precipitation or irrigation have a high leaching potential.

Because the downward movement of nitrate through soils was taking place even before the presence of humans, it is unrealistic to expect to stop it entirely. However, careless use of fertilizer and improper management of other nitrogen sources can increase the rate of movement and the magnitude of loss. They must be avoided.

Summary

Both nature and people can be responsible for nitrate found in groundwater. Of the human activities that contribute nitrate, agriculture, garbage disposal and human waste disposal are by far the largest sources. Society's alteration of the environment to produce food and to dispose of wastes has likely resulted in increased rates of nitrate movement in soil and in greater nitrate losses to groundwater. Farmers and other individuals can use management practices to minimize the leaching of nitrate from soils without severe economic consequences.

Whatever the source of nitrate, we need to be concerned about minimizing its movement into our groundwater. Although we do not have a complete picture of groundwater contamination by nitrate, we do know the problem is growing.

The Authors — Robert L. Mahler is soil scientist and Extension water quality coordinator, Ernestine Porter is Extension textiles and clothing specialist and Roy Taylor is Extension agricultural engineer, all in the University of Idaho College of Agriculture, Moscow.

Adapted from Kansas State University Cooperative Extension Service Bulletin MF-857.

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8,000, September 1990

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PRIVATE WELL OWNERS

Responsibilities

If you have your own well you are responsible for the maintenance of your well system and for ensuring that your water is safe to drink. There are no government entities that will come to your house to test your water to make sure that it is safe for human consumption if you own a domestic well. This is your responsibility. Don't worry. You will not have to spend a lot of time learning how to make sure your water is safe to drink. There are professionals to assist you with that knowledge.

The above photo was taken at a home in the local area. Was it yours? Or your neighbors?

Well Maintenance

There are two basic tasks that you should do to take care of your well; 1) periodically test your water and 2) protect your wellhead. You should perform a few water tests – *at least once a year*. Contact the Public Health office (678-8122 in Burley or 734-5900 in Twin Falls) for their current recommendations.

Periodic Testing

Nitrate Sampling

Nitrate levels above the regulatory level of 10 mg/L of nitrate-nitrogen have been associated with methemoglobonemia, which is the inability to absorb oxygen in the blood. Current research is looking into other health issues.

Boiling your water does NOT remove nitrates, rather it concentrates them.

Bacteria testing

If your test is positive, opportunistic bacteria may be present as well as other organisms that can cause gastrointestinal problems such as giardiasis, amoebic dysentery, and typhoid. Don't panic, bacterial contamination is very common. Call the Public Health office for instructions on disinfecting a well and emergency disinfection of drinking water.

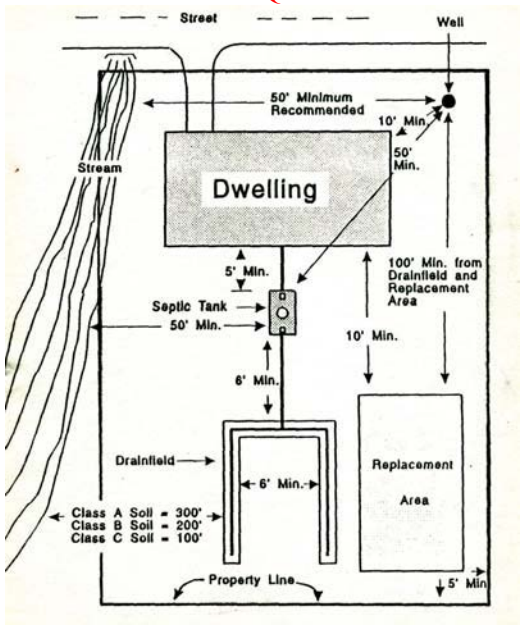
Testing costs

Most lab tests cost less than $20 each. Contact the Public Health office for instructions and sample bottles.

Protecting Your Wellhead

* Hire a licensed well driller for any new well construction, modification, or abandonment and closure.
* Keep accurate records of any well maintenance, such as disinfection, sediment removal, pump replacement, or plumbing modifications that may require the use of chemicals in the well.
* Avoid mixing or using fertilizers, herbicides, insecticides, degreasers, fuels, motor oil, and other pollutants near the well.
* Don't allow backsiphoning when mixing pesticides, fertilizers or other chemicals. Don't put the hose inside the tank or container.
* Always maintain a minimum of 50 feet between the wellhead and the septic tank and 100 feet between the wellhead and the drainfield.

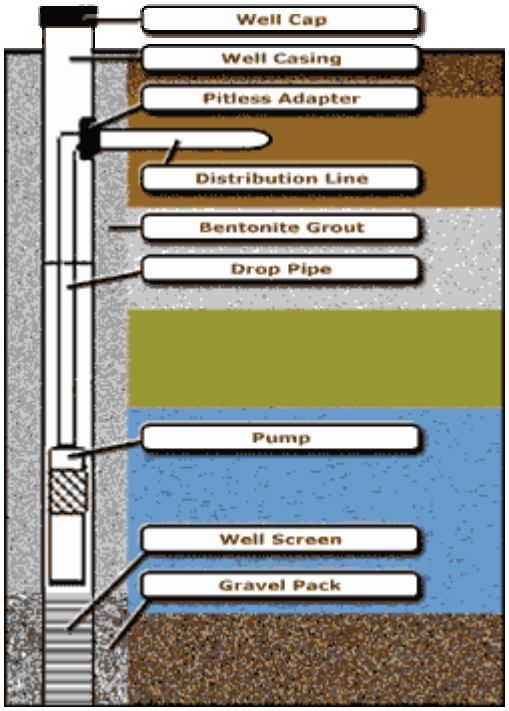
DISTANCE REQUIREMENTS



* Periodically inspect exposed parts of the well for problems, such as: cracked, corroded, or damaged well casing; broken or missing well cap; and settling and cracking surface seals.
* The area around the well should be sloped to drain surface water away from the well.
* When landscaping, keep the top of your well at least 12 inches above the ground.

* Be careful when working or mowing around your well. A damaged casing could jeopardize the sanitary protection of your well. Don't pile snow, leaves or other materials around your well.
* The well's casing should extend a minimum of 18 feet below the ground surface and preferably be driven into an impermeable layer.

DIAGRAM OF A WELL



* Existing wells in areas with a history of flooding should have the casing elevated at least two feet above the highest known flood level and also should have a water tight sanitary seal at the top of the grouted casing.
* Install a well cap or sanitary seal that prevents animal or other vermin from getting into your well, and prevent unauthorized use of, or entry into, the well.
* A sanitary seal or concrete platform should be set around the wellhead to keep pollutants from entering the well bore.
* Do not cut the well casing below the ground surface.
* Be sure to have a check valve on your lawn watering systems to prevent backflow.
* When your well has come to the end of its serviceable life, contact the Department of Water Resources and have your qualified well driller properly decommission your old well after constructing your new well.

Home Treatment Systems

What should you do if you have problems with your water quality? It is important first to distinguish between water quality problems that may be harmful to your health, and water quality problems that are only aesthetic problems. Hard water is a common aesthetic problem. When deciding which home water treatment system to install **remember that no one treatment unit can solve all water quality problems.**
* Water testing will confirm your water treatment needs.
* You may need to combine treatment systems.
* Investigate what treatment systems are available.
* Several treatment systems are widely available locally (reverse osmosis, softeners, countertop devices such as PUR and BRITA filters).
* Consider capacity, special features, and company service – as well as price – when you make your choice.

BEWARE OF FALSE ADVERTISERS!

* Contact the National Sanitation Foundation (www.nsf.org) to make sure the treatment system is certified to perform as stated or has its seal of approval.
* If you are concerned about a company and its sales practices, contact the Better Business Bureau (1-800-218-1011 or www.magicvalley.bbb.org).

More information:

* **Department of Environmental Quality**
http://www2.state.id.us/deq

* **Environmental Protection Agency**
http://www.epa.gov/safewater/dwhealth.html

* **Farm*A*Syst**
http://www.wisc.edu/farmasyst

* **Home*A*Syst**
http://www.idahoag.us/gw/homeasyst.tm

* **Idaho Department of Water Resources**
http://www.idwr.state.id.us

* **National Sanitation Foundation**
http://www.nsf.org

* **U.S. Geological Survey**
http://www.usgs.gov

* **Well Owner**
http:/www.wellowner.org

* **University of Idaho Water Quality**
http://www.uidaho.edu/wq

* **Idaho One Plan**
http://www.oneplan.org

* **Idaho State Department of Agriculture**
http://www.agri.state.id.us

This brochure is provided by the Cassia County Groundwater Quality Advisory Committee - 2003

A Homeowner's Guide to Septic Systems

Idaho Department of Environmental Quality
1410 N. Hilton
Boise, ID 83706

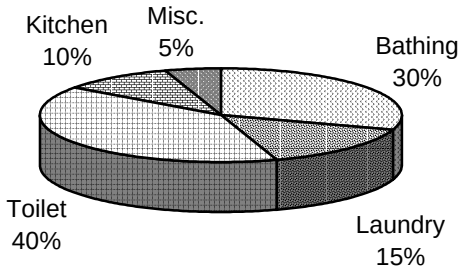
January 2001

Do you have a home septic system? As an Idaho resident, there is a good chance you do—thirty-six percent of Idaho's homes, or about 210,000 residences, use septic systems to treat their sewage. These systems discharge more than 53 million gallons of wastewater into Idaho's soils annually, and this figure grows each year. In 1999, Idaho's seven health districts issued over 6,100 permits for new septic systems.

Septic systems dispose of household sewage, or wastewater, generated from toilet use, bathing, laundry, and kitchen and cleaning activities. Because septic systems are underground and seldom require daily care, many homeowners rarely think about routine operations and maintenance. However, if a septic system is not properly designed, located, constructed, and maintained, groundwater may become contaminated.

Household Wastewater

Households that are not served by public sewers depend on septic tank systems to treat and dispose of wastewater. Household wastewater carries with it all wastes that go down the drains in our homes, including human waste, dirt, food, toilet paper, soap, detergents, and cleaning products. It contains dissolved nutrients, household chemicals, grease, oil, microorganisms (including some that cause disease), and solid particles. If not properly treated by your septic system, chemicals and microorganisms in wastewater can travel through the soil to groundwater and pose a health hazard.



The average person uses between 50 and 75 gallons of water per day; mostly in the bathroom. Reducing your water use will help your septic system to work more efficiently.

Your Septic System

A conventional septic system has three working parts: a septic tank, a drainfield, and surrounding soil.

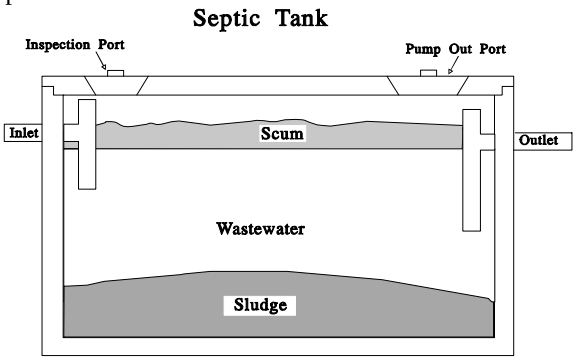
Septic Tank

Septic tanks can be made of concrete, fiberglass, or plastic and must be approved by the state. Minimum sizes of tanks have been established for residences based on the number of bedrooms in the dwelling. In Idaho, a 1,000-gallon septic tank is required for homes with three or four bedrooms. Larger tanks are required for larger homes. Local district health departments issue permits for septic systems and specify the minimum size tank. Some systems installed before the current rules and regulations may have smaller septic tanks.

A septic tank has three main functions:

- to remove as many solids as possible from household wastewater before sending the liquid, called “effluent,” to a drainfield;
- to decompose solids in the tank; and
- to store solids that do not decompose.

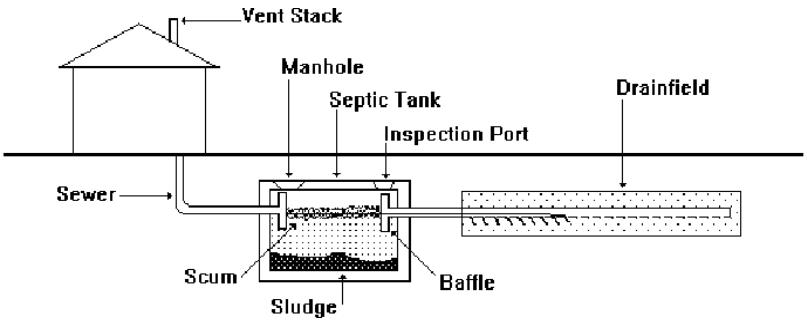
When raw wastewater enters the tank, heavy solids sink to the bottom of the tank as sludge. Light solids, such as grease and paper, float to the surface as scum. During the wastewater storage period, bacteria digest organic material in the wastewater. During this process, the solid material is reduced in volume and composition. Solids that do not decompose accumulate in the tank and eventually must be pumped out.



Tees, or baffles, are provided at the tank’s inlet and outlet pipes. The inlet tee slows the incoming wastes and reduces disturbance of the settled sludge. The outlet tee keeps the solids and scum in the tank. As new wastewater enters the tank through the inlet tee, an equal amount of wastewater is pushed out of the tank through the outlet tee. The effluent that leaves the tank has been partially treated but still contains disease-causing bacteria and other pollutants.

Drainfield

Each time raw wastewater enters the tank it forces an equal amount of effluent into a drainfield. A standard drainfield is composed of a series of perforated pipes buried in gravel-filled trenches in the soil. The effluent seeps out of the perforated pipes and percolates through the gravel to the soil.



Soil

The soil below the drainfield provides the final treatment and disposal of the septic tank effluent. After the effluent has passed into the soil, most of it percolates downward and outward, eventually entering the groundwater. Soils are critical to the treatment of septic tank wastewater.

A system that is not functioning properly will release nutrient-rich and bacterial-laden wastewater into the groundwater and/or surface water. These contaminated waters pose a significant public health threat to people that come into contact with them. Wastewater that moves with groundwater can transport bacteria considerable distances. This can result in a threat to public health and adversely affect the quality of ground and surface waters.

Caring for Your Septic System

Installing Your System

In order to have a septic system installed on your property, you must first obtain a permit. Permit applications are available from your local district health department. Next, you must have a site evaluation performed. Make arrangements for this with your district health department and with a licensed septic system installer. Note that not all property is suitable for septic systems, so some permits may be denied. It is recommended that you have a site evaluation performed before you purchase property. Finally, have your system installed by a licensed installer and inspected by your local health district. Provide regular, preventative, maintenance to keep your system running smoothly.

Inspecting Your System

When too much sludge and scum are allowed to accumulate in your tank, the incoming sewage will not have enough time in the septic tank for solids to settle. Solids may flow to the drainfield and clog the pipes, causing the sewage to overflow to the ground surface, where it exposes humans and animals to disease-causing organisms. To prevent this from happening, it is very important to inspect your tank regularly and have it serviced when needed. All tanks have accessible manholes for inspecting and pumping. Some excavation work may be needed to uncover the manhole.

Properly designed tanks should have enough capacity for three to eight years of use before needing service. This is dependent upon the amount of wastewater generated. It is recommended that an average family of four have its septic tank pumped out every three to five years. Don't wait for signs of system failure to have your tank pumped. Your tank should be checked annually to measure sludge and scum levels. A licensed septic tank pumper can provide a septic tank inspection and recommend when the tank should be pumped. A tank inspection should include measuring the depth of scum and sludge and inspecting the tees in the septic tank.

If you do the inspection yourself, it is important to understand that septic tanks always appear full because both the inlet and the outlet are at the top of the tank. What you will need to know is how much of the tank's volume is being taken up by scum and sludge. When sludge and scum take up more than 35 percent of the tank volume, these solids need to be removed by pumping. A pole wrapped in a course weave cloth can be used to check the sludge depth. An extension on the pole can be used to measure the scum depth. Record these measurements as part of your pumping records. To check the tees, uncover the inspection ports.

Never allow anyone to enter your septic tank. Dangerous gases and the lack of oxygen can kill in minutes.

While it is impractical to inspect the pipes in your drainfield, it is important to watch for drainfield failure or overuse. See "Warning Signs of System Failure" in this booklet for information.

Maintaining Your System

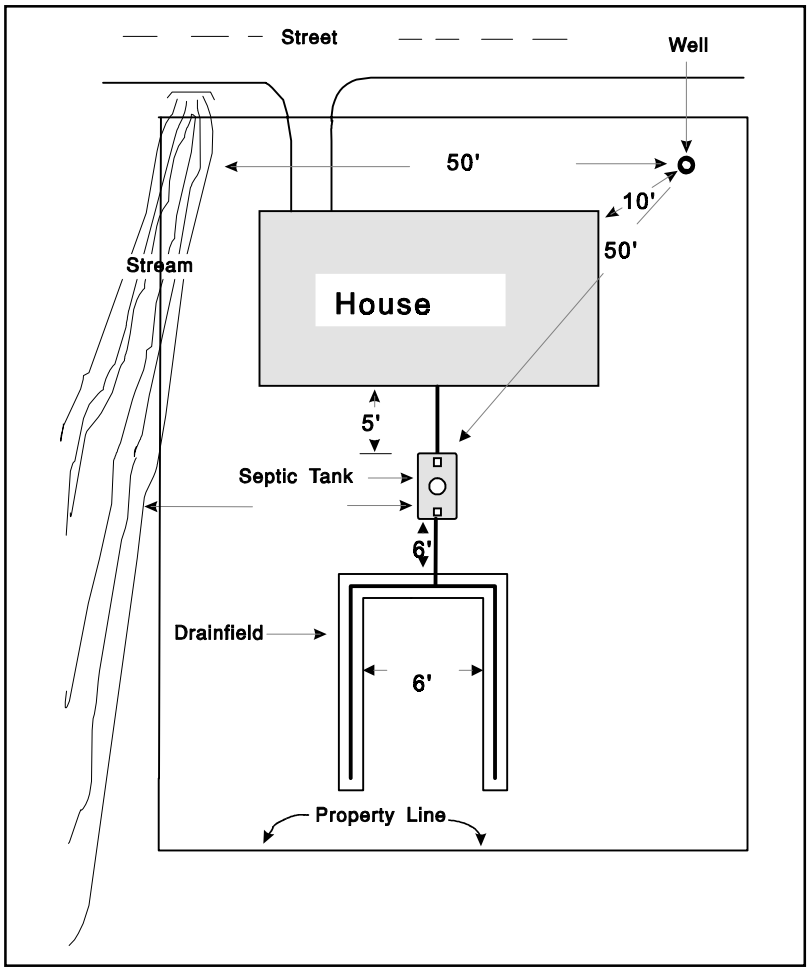
Pumping your septic tank every three years (or as determined by your inspections) will remove accumulations of solids, help keep the drainfield from becoming clogged, and help prevent you from experiencing sewage backups or septic system failure. An accumulation of sludge exceeding 35% of the total water depth in the septic tank could cause solids to enter the drainfield and clog the system. Hire a licensed septic tank pumper to pump your tank for you.

Mapping Your System

In order to take proper care of your septic system, you must know the location of the septic tank and drainfield. The location of your septic tank can be determined from plot plans, septic system inspection records, architectural or landscape drawings, or from observations of the house plumbing. If you do not have access to drawings, find where the sewer pipe leaves your house. Some installers mark the location where the waste pipe comes out of the house with an "S" on the foundation. You may want to do this as well. Probe in the ground 10 to 15 feet directly out from the location where the pipe leaves your house to find your tank.

Once the septic tank has been located, make several plot plan diagrams (with measurements) that include a rough sketch of your house, septic tank cover, drainfield area, well, and any other permanent reference points (such as trees or large rocks) and place them with your important papers. You'll find a sample system diagram on the next page, and a place to draw your own inside the front cover of this booklet. You may also want to hang a diagram in your garage and provide one to your local district health office.

Maintain a permanent record of any septic system maintenance, repair, sludge and scum levels, pumping, drainfield condition, household backups, and operations notes.



Create a septic system diagram, similar to this one, for your system.

Warning Signs of System Failure

While proper use, inspections, and maintenance should prevent most septic tank problems, it is still important to be aware of changes in your septic system and to act immediately if you suspect a system failure. There are many signs of septic system failure:

- surfacing sewage or wet spots in the drainfield area;
- plumbing or septic tank backups;
- slow draining fixtures;
- gurgling sounds in the plumbing system;
- sewage odors in the house or yard (note that the house plumbing vent on the roof will emit sewage odors and this is normal); and
- tests showing the presence of bacteria in well water.

If you notice any of these signs, or if you suspect your septic tank system may be having problems, contact a licensed septic system professional or your local district health agency for assistance.

Septic System Dos and Don'ts

Proper operation of a septic system can prevent costly repairs or replacement. Observing the following guidelines will help to keep your system running efficiently.

<u>Do</u>

- …practice water conservation. The more wastewater you produce, the more wastewater your system must treat and dispose. By reducing and balancing your use, you can extend the life of your system and avoid costly repairs.
    - Use water saving devices such as low flow showerheads.
    - Repair leaky faucets and plumbing fixtures immediately.
    - Reduce toilet reservoir volume or flow.
    - Take short showers.
    - Take baths with a partially filled tub.
    - Wash only full loads of dishes and laundry.
    - Shut off the water while shaving or brushing your teeth.
    - Balance your water use (e.g., avoid washing several loads of laundry in one day).
- …keep accurate records. Know where your septic tank is, keep a diagram of its location using the space provided in this booklet, and keep a record of system maintenance.
- …inspect your system annually. Check the sludge and scum levels inside the tank and periodically check the drainfield for odors, wet spots, or surfacing sewage.
- …pump your system routinely. Pumping your septic tank is probably the single most important thing you can do to protect your system.
- …keep all runoff away from your system. Water from roofs and driveways should be diverted away from the septic tank and drainfield area. Soil over your system should be mounded slightly to encourage runoff.
- …protect your system from damage. Keep vehicles and livestock off your drainfield. The pressure can compact the soil or damage the pipes. Before you dig for any reason, check the location of your system and drainfield area.
- …landscape your system properly. Plant grass over the drainfield area. Don't plant trees or shrubs or place impermeable materials, such as concrete or plastic, over the drainfield.
- …use cleaning chemicals in moderation and only according to manufacturer's directions.

Don't

- …flood irrigate over your system or drainfield area. The best way to irrigate these areas is with sprinklers.
- …use caustic drain openers for clogged drains. Use boiling water or a drain snake to clean out clogs.
- …enter a septic tank. Poisonous gases or a lack of oxygen can be fatal.
- …use septic tank additives. They are not necessary for the proper functioning of your tank and they do not reduce the need for pumping. In fact, some additives can even harm your system.
- …flush harmful materials into your tank. Grease, cooking oil, coffee grounds, sanitary napkins, and cigarettes do not easily decompose in septic tanks. Chemicals, such as solvents, oils, paints, and pesticides, are harmful to your systems operation and may pollute groundwater.
- …use a garbage disposal. Using a garbage disposal will increase the amount of solids entering the septic tank and will result in the need for more frequent pumping.

Map your septic system here

For More Information

If you need to obtain a permit for a new or replacement septic system, or if you have questions about septic systems and their operation and maintenance, please contact your local health district.

Panhandle District Health Department
1295 Ironwood Court
Coeur d' Alene, ID 83814
208-667-9513

North Central District Health Department
215 10th Street
Lewiston, ID 83501
208-799-0353

Southwest District Health Department
920 Main Street
Caldwell, ID 83605
208-455-5400

Central District Health Department
707 N. Armstrong Place
Boise, ID 83704
208-327-7499

South Central District Health Department
1020 Washington Street North
Twin Falls, ID 83303
208-734-5900

Southeastern District Health Department
1901 Alvin Ricken Drive
Pocatello, ID 83201
208-239-5270

District 7 Health Department
254 "E" Street
Idaho Falls, ID 83402
208-523-5382

University of Idaho
College of Agricultural and Life Sciences

CIS 1098

Watering
HOME LAWNS AND LANDSCAPES

Plants must have water to survive and flourish. Living, active plant tissues are usually 85 or 90 percent water, and even seeds, the least active form of plants, must contain 5 to 9 percent water to be viable. Plants use water for many things, among them, supporting their leaves so that they expose the maximum area to light for photosynthesis, transporting nutrients, and evaporative cooling. In the soil, nutrients must be dissolved in water before plant roots can absorb them.

Correct watering makes good economic sense. Landscapes add value to a house, and correct watering will enhance landscape growth. Wise water use is becoming more important every year in Idaho, where good quality water is a limited resource in many urban areas. Correct watering minimizes the use of water, or allows the same amount of water to serve more landscape plants. Based on water cost and use patterns in Boise, our analysis shows that overwatering can add $75 to $150 annually to the cost of water for a typical urban household, depending on lot size and watering practices.

Effects of Overwatering

Although water is essential to plants, too much of it can be harmful. Overwatering encourages disease development; inhibits uptake of nutrients such as iron, causing iron chlorosis; and contributes to the leaching of soluble fertilizer and lawn chemicals to groundwater, particularly in sandy soils.

Overwatering can damage plants because oxygen is only partially soluble in water. Air-filled pores in the soil ensure a supply of oxygen is available to dissolve in the water film around plant roots. When water fills the soil pores, displacing air, the roots find insufficient oxygen for normal growth and may die of asphyxiation. Insufficient oxygen levels also can stunt root system development, making the plant more susceptible to moisture stress later in the season even though early season water was excessive.

Effects of Water Stress

Underwatering also can contribute to disease development and cause thin stands of sickly looking grass and weak, unattractive landscape plants. Typical symptoms of water stress are drooping, soft stems and leaves and curling or rolling leaf edges. The edges of deciduous leaves may dry out and turn brown due to tissue death, while evergreen leaves, such as those of the rhododendron, may scorch in winter. Flowers are smaller and fewer with inadequate watering, causing lower yields on fruit trees. Plants do best if they never undergo water stress, but adequate moisture is especially important during critical growth stages such as seed germination, flowering, and fruit set. Trees, bushes, and vines bearing fruit require more water than those without fruit.

Windbreaks, weed control, mulches, and compost all tend to conserve water

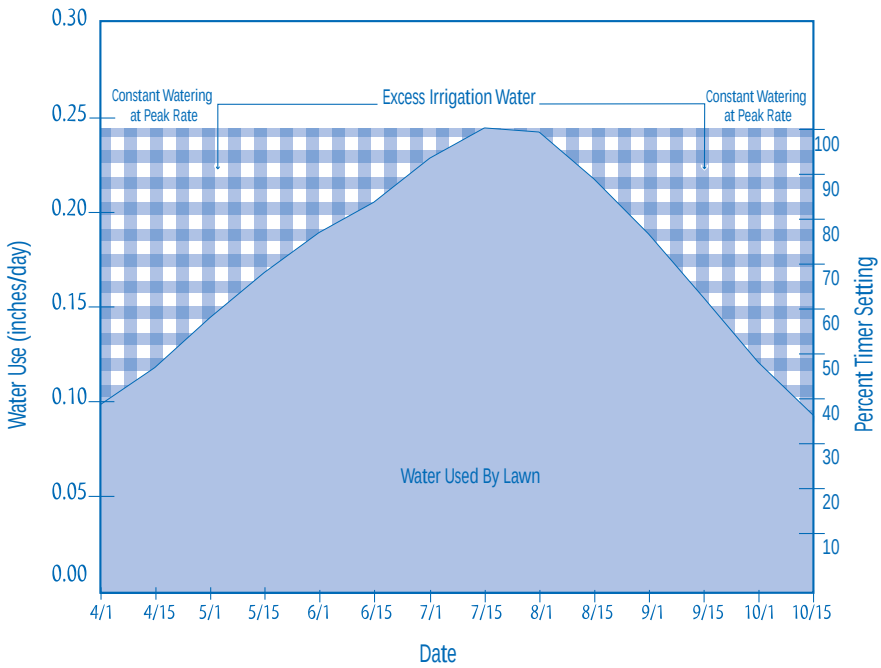
Inadequate soil moisture is often a major cause of winter damage. All plants, particularly evergreens, use water during winter, so it is important for plants to go into the winter with the soil adequately wetted to the depth of rooting. This is usually 2 to 3 feet for shrubs and small trees and 4 to 5 feet for larger trees. Under inadequate snow cover or dry conditions, winter watering may be required if the ground is not frozen.

Factors that Influence Water Need

Proper irrigation replaces both soil water that evaporates from the soil surface (evaporation) and water released into the air through plant pores (transpiration). Evapotranspiration (ET) is the term used for the combined losses. ET depends on the growth stage, size, and type of plant; weather conditions; and available water in the soil.

Lawn and landscape water use begins to rise as plants break dormancy in early spring. As the weather warms and new vegetation develops, water use increases. Use remains high through mid summer and then drops off in August and September (figure 1). Large, daily variations between cool, cloudy days (low water use) and hot, windy days (high water use) can be up to 0.2 inches. As a result, water needed after a week of cool, cloudy weather can be much different from water needed after a week of hot, windy weather. Windbreaks, weed

Figure 1: 11-year seasonal water use pattern for lawns in southwestern and southcentral Idaho.



control, mulches, and compost added to improve soil structure all help to hold water and decrease the need for frequent irrigation.

Irrigation Systems

Decisions about how often and how long to irrigate depend somewhat on the nature of your water delivery and your type of irrigation system. For example, if you get water delivery only once per week, then your irrigation method must be able to apply all the water needed to refill the soil profile during the time when water is available. This may mean flood irrigating lawn and garden areas. A homeowner with well or municipal water may choose to irrigate on a more optimal schedule, possibly two or three times per week.

Flood Irrigation

Flood irrigation of leveled lawns or furrowed gardens may be required if you need to spread water quickly over the property in a deep but infrequent irrigation mode, such as when water is available just one day a week. This method requires little equipment, but gives a less uniform irrigation and less efficient use of water than do sprinkler systems. About the only decision you need to make is how long to allow water to flow onto each area. Because of the complexity of surface irrigation, experience is the best guide to avoid over- or underwatering.

Hose-Move System

In many lawns, irrigation water is applied by single sprinklers attached to moveable hoses. This is an inexpensive but labor-intensive system, and the labor requirements usually result in deep, infrequent watering. You can use this system quite successfully if you match the frequency and depth of watering to soil water-holding capacity and plant water use.

Single sprinklers apply water in a pattern much like that in figure 2. For uniform applications, you should locate the sprinkler so that the edge of a wetted circle overlaps the last (or next) wetted area (figure 2).

Because the irrigation pattern depends on proper water pressure, adequate hose size is important. A $^{5}/_{8}$-inch diameter hose will usually supply one sprinkler if the hose is no longer than 150 feet. To serve two or three sprinklers, or for longer distances, a $^{3}/_{4}$-inch hose is required for adequate water supply and pressure.

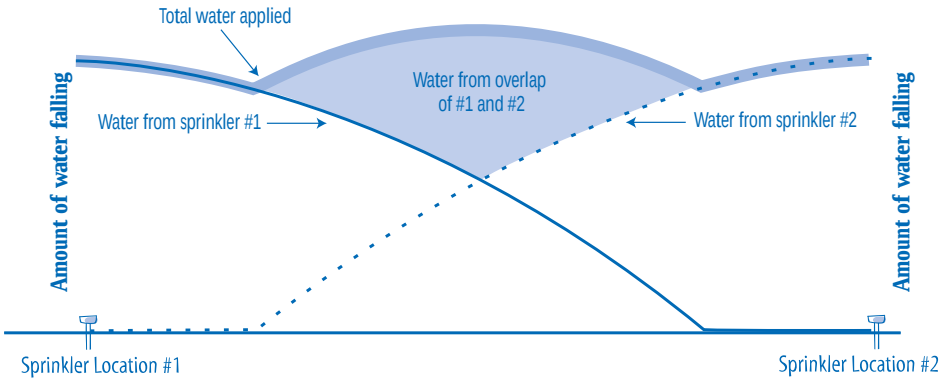
Automatic Sprinkler Systems

Where water is available any time from wells or other pressurized systems, an automatic sprinkler system with buried pipes and sprinklers can produce a uniformly watered lawn in a minimal amount of time. It has the flexibility of delivering on schedules ranging from shallow and frequent to deep and infrequent. In general, for all but very sandy soils, watering two or three times per week to the root system depth to replace water used since the last watering works well. Very sandy soils may require watering every two days.

Systems for Public Areas

Many public areas irrigated by automatic sprinkler systems, such as parks and golf courses, are irrigated nightly with an irrigation of about 0.25 to 0.3 inches to just meet the daily ET. This

Figure 2: Sprinkler overlap strategy to provide uniform watering.



schedule avoids irrigating during the day when people are present. Small, frequent irrigations to refill the soil profile also avoid saturating the soil surface, which can make it more prone to compaction. This type of turf management is usually not desirable for homeowners because, although it produces an attractive lawn, it requires frequent fertilization and mowing.

Determining Sprinkler Application Rate

To determine if you are adding the proper amount of water, check the depth of water applied by an irrigation of a specific duration. For example, if your sprinkler system runs for 20 minutes every night, how much water is it applying?

To find out, set out some empty cans or other parallel-walled containers at regular intervals between two sprinkler heads or within the wetting pattern of a single portable sprinkler. Turn on the water for 20 minutes. After watering, measure the depth of water collected in each can and calculate the average (total depth water collected divided by the number of cans). Multiply this average depth by 3 to give application rate in inches per hour (20 minutes x 3 = 60 minutes, or 1 hour).

For example, if the average depth of water in the cans was $^1/_4$ inch after 20 minutes, the application rate in inches per hour would be $^1/_4$ x 3, or $^3/_4$ inch per hour. This number could then be used to determine how long the system should run to apply the required amount of water.

On a hose-move system, measure the depths of water collected in cans located from 5 to 15 feet away from the sprinkler. Average the depths and proceed as above.

Determining How Much to Water and When

Usable soil water, which is a function of soil texture (the amount of sand, silt, and clay in the soil), and plant rooting depth determine the maximum amount of water that plants will use between irrigations. Soil texture can be obtained from your local USDA Natural Resources Conservation Service office or from University of Idaho Extension personnel in your county. A very sandy soil may hold only about 0.2 inches of usable water per foot of plant rooting depth, while a silt loam or clay loam soil may hold 1 to 1.3 inches of usable water per foot (table 1).

Table 1. Usable water for various textural classes of soils.

Soil texture class	Usable water (inches/foot)
Sand (almost pure sand)	0.2
Sandy loam, sandy clay loam	0.75
Loam	1.0
Silt loam	1.1
Silt	1.1
Clay loam, silty clay loam	1.1
Silty clay	1.0
Clay	1.0

Source: Modified from Ashley, R. O., W. H. Neibling, and B. A. King. 1997. Irrigation Scheduling Using Water-Use Tables. CIS 1039. Moscow, ID: University of Idaho Cooperative Extension System and Agricultural Experiment Station.

Most lawn grasses have a root zone of between 1 (bluegrass) and 2 (fescues) feet, while trees and shrubs may root to a depth of 3 to 6 feet, with the majority of the roots in the top 2 feet of soil. Hardpan, a compacted soil layer, will restrict rooting depth. Usable water and plant rooting depth can be used to determine the maximum amount of water to apply to a lawn. For example, for a mature fescue lawn growing in a sandy loam soil you would apply a maximum of 0.75 inches/foot (from table 1) times 2 feet rooting depth for a total of 1.5 inches.

Using the Feel and Appearance Method

Methods for determining when and how much to water range from general guidelines to the use of sophisticated soil moisture measurement devices. Homeowners can successfully use the soil "feel and appearance" method with a little practice (table 2). This method involves conducting three simple tests on a handful of soil. Sampling should be done at one-third the rooting depth, 4 inches for lawns and 8 inches for trees and shrubs. Because of the triangular water extraction pattern with depth (figure 3), sampling at one-third of the rooting depth gives the average soil moisture in the plant root zone. Roots will extend deeper than 12 inches for grass and 24 inches for shrubs and trees, but most water uptake comes from above these depths.

First, run a ball test (BT). Form a ball by squeezing a handful of soil in your hand. Observe what happens when you break the ball between your thumb and forefinger, and locate the best description in the BT rows under the proper soil type. For example, if a sandy loam soil from your lawn forms a weak ball with a distinct fingerprint outline and soil particles stick to your hand, 0.4 inch of usable water remains and irrigation should occur in about 1.5 days at midsummer.

For the ribbon test (RT), roll out soil between your thumb and forefinger, keeping them about $^1/_8$ inch apart so that they exert little pressure on the soil. If a silt loam soil ribbons out about $^1/_2$ inch and moist soil particles are left on your thumb, about 0.6 inch of water remains for your lawn's use.

The open palm test (OPT) is used only for silts, loams, and clays. Gently roll out a ball of soil between open palms.

Figure 3. Plant roots extract water from the soil in a triangular pattern, with the average extraction occuring about a third of the way into the plant root zone.

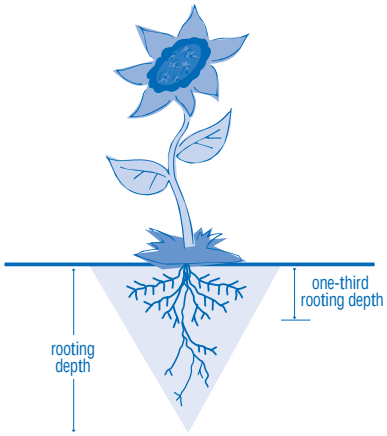


Table 2. Inches of usable water remaining in one foot of soil and days before irrigation is required at mid season in southern Idaho.

	Lawn and garden		Trees and shrubs	
	Usable water remaining (inches/foot)	Days to irrigate at mid-season[1]	Usable water remaining (inches/foot)	Days to irrigate at mid-season[1]
Loam, silt loam, clay loam soil texture				
BT: Forms a ball readily, holds its shape. No moist feeling is left on hand nor will any soil fragments cling to palm. Ball is very brittle and breaks readily. Soil falls or crumbles into small granules when broken. RT: Will not ribbon—soil too crumbly. OPT: Sample very crumbly; readily dissolves into individual particles.	0		0	
BT: Forms firm ball. Finger marks imprint on ball. Hand feels damp, but not moist. Soil doesn't stick to hand. Ball is pliable. When broken, ball shatters or falls into medium-size fragments. RT: Ribbons out 1/4-inch or just barely ribbons. OPT: Soil breaks down into granules and is a little crumbly. Continues to crumble until a tiny round ball is left in palm.	0.3	1	0.6	2
BT: Damp and heavy; slightly sticky when squeezed. Forms tight plastic ball. Shatters with a burst into large particles when broken. Hand is moist. RT: Ribbons out 1/2-inch. Moist soil particles left on thumb. OPT: Sample can be molded into a round ball; somewhat plastic; will not shatter readily.	0.6	2	1.2	4
BT: Wet, sticky, doughy, and slick. A very plastic ball is formed. Handles like stiff bread dough or modeling clay; not muddy. Leaves water on hand. Ball will change shape and cracks will appear before breaking. RT: Ribbons readily if not too wet. OPT: Forms a tight ball. Will work into a long round pencil-like shape.	1.1	4	2.2	8
Sandy loam and loamy sand soil texture				
BT: Forms very weak ball. If soil well broken up, it will form more than one ball upon squeezing. Fingerprint outline barely discernible. Soil grains will stick to hand. RT: No ribboning. Soil particles will just cease to lie down. Patchy soil layer on thumb.	0		0	
BT: Forms weak, brittle ball. Fingerprint outline not as distinct. Soil particles will stick to hand in a patchy pattern. RT: No ribboning. Soil particles will stick to thumb in a patchy layer.	0.2	1	0.4	1.5
BT: Forms weak ball. Distinct fingerprint outline on ball. Soil particles stick to palm. RT: No ribboning. Soil particles will stick to thumb during ribboning process in a distinct layer over surface of thumb.	0.4	1.5	0.8	3
BT: Upon squeezing, no free water appears on ball, but wet outline of ball is left on hand. Ball has some stickiness and a sharp fingerprint outline is left on it. RT: No ribboning. Soil particles will form smooth layer on thumb.	0.75	3	1.5	6

Notes: Sample at 4 inches deep for lawn and garden, 8 inches deep for trees and shrubs. Assume a 1-foot root zone on lawn and garden, 2 feet on trees and shrubs, and the usable water values from table 1.

[1]For days to the next irrigation in northern Idaho, multiply by 1.18.

Feel and appearance tests

BT (Ball Test)—Form a ball by squeezing a handful of soil hard in your fist. Observe the effect when you break the ball between your thumb and forefinger.

RT (Ribbon Test)—Roll out the soil between your thumb and forefinger, keeping your thumb and forefinger 1/8 inch apart so that you exert little pressure on the soil.

OPT (Open Palm Test)—Gently roll a ball of soil between your open palms.

If you form a tight ball and can work it into a long, pencil-like shape, about 1.1 inches of water are left for use by your lawn.

Use the information on inches of usable water remaining in conjunction with the water use curve (figure 1) to forecast the days until you need to water and how much to water. This can be done anytime during the growing season.

For example, suppose it's early season in southern Idaho.

Step 1. Run a feel and appearance test to find out how much usable water is in your soil:

The results of the feel and appearance method on a soil sample from your lawn, taken 4 inches deep, are the following: "BT: Wet, sticky, doughy, and slick. A very plastic ball forms. The soil handles like stiff bread dough or modeling clay and isn't muddy. The soil leaves water on your hand, and the ball changes shape and cracks appear before the ball breaks. RT: Ribbons readily. OPT: Forms a tight ball. Will work into a long, round pencil-like shape." From table 2, you would see that 1.1 inches of usable water remain in the soil.

Step 2. Use figure 1 to find out how much water your lawn uses at this time of year:

From figure 1, you can assume that water use will be about 0.1 inch/day.

Step 3. Calculate days until the next irrigation (inches usable water remaining ÷ inches of water use per day):

Given your results in steps 1 and 2, days until the next irrigation would then be

1.1 inches ÷ 0.1 inches/day = 11 days

Step 4. Use information from table 1 to determine how much water to add back to the soil:

If the soil is silt loam, 1.1 inches of water should be applied to fill the soil to capacity.

Step 5. Correct for various water losses that occur during watering:

Since only a portion of the water pumped (about 80% for sprinklers) ends up in the plant root zone for use by the plant, you will need to apply more than 1.1 inches. Actual irrigation depth required to re-fill the root zone is then

1.1 inches ÷ 0.8 = 1.4 inches.

Water added in excess of 1.4 inches is wasted and has the potential to move soluble herbicides and pesticides below the root zone.

Table 2 also gives days until irrigation is needed at mid-season (four days in the above example). These numbers are based on averages from 11 years of weather data in southern Idaho.

ET for northern Idaho conditions is about 85 percent of southern Idaho values during mid-season. Therefore, the number of days until the next irrigation should be increased 1.18 times for northern Idaho. These numbers are based on average conditions. By checking the soil before every scheduled irrigation, any tendency to over or under-irrigate can be spotted and the water application rate modified.

General Watering Guidelines

Apply enough water during each irrigation to replenish the water used by the plants between irrigations. The best practice is to thoroughly soak the soil, then irrigate again only when necessary. For most lawn or garden conditions, this means you should never add more than 1.1 inches of water to silt loam soils or $^3/_4$ inch to sandy soils in a single irrigation. Shrubs and trees can accommodate about twice as much. Because trees and grass both use water, a grassy area beneath a tree will require about twice as much water as other parts of the lawn. This means adding extra water by sprinkler or garden hose.

For most lawns, avoid frequent irrigation with small amounts of water. Because the entire root zone is not refilled, this practice results in shallow-rooted lawns, excessive evaporation without deep wetting in the root zone, and possibly excessive build-up of salts. Frequent applications of water may also encourage root rots and other diseases because the plant and soil surfaces are always moist.

The ideal time to irrigate is early morning.

Time of Day to Irrigate

The ideal time to irrigate is early morning. Avoid evening irrigation in warm weather because it leaves plants wet overnight. This encourages fungal diseases. Automatic systems can be set to start irrigating after midnight when the disease hazard is less, traffic is absent, water pressure is highest and most stable, and the wind is usually calm.

Using Automatic Sprinklers

Make sure you have a properly designed irrigation system. If heads are improperly spaced, nozzles

improperly sized, or pressure too low or high, uniform distribution of water will be impossible. The result will be areas of over- and underwatering.

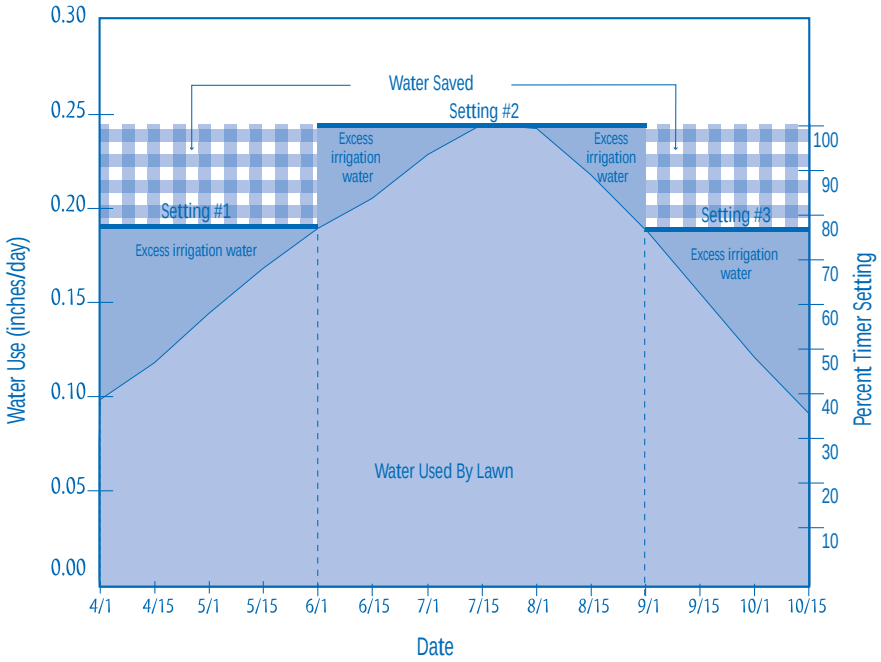
Sprinkler systems are designed for peak, mid-season use and must be adjusted for off-peak spring or fall operation. A reasonable practice is to change sprinkler settings monthly or, at the least, three times during the growing season (figure 4). Most modern irrigation system controllers use a "percent timer" setting to make changes in water added per irrigation easier. The percent setting is the fraction of the maximum system application rate that is applied. The setting should be low in early season, increase to a maximum by mid season, and then decrease in the fall, with the general change in setting following the curve in figure 1. Frequent system adjustment provides the best use of applied water (figure 5).

Sprinklers should never apply more water than soil in the root zone can hold. Operate the sprinklers to replace the water used since the last irrigation (generally 30 to 60 minutes per zone). If appreciable run-off starts in less than 30 minutes, modify the sprinkler system for a lower application rate. Sprinkler heads are available for low application rates and good distribution. A temporary solution is to shut off the water when runoff starts, and complete the application later.

Irrigations of equal amounts of water at equal intervals are seldom correct for all plants being watered. The best solution is a combination of several light irrigations for the turf and a less frequent, heavier irrigation for deeper-rooted plants, all properly timed. Most modern lawn water controllers can accommodate one watering schedule and irrigation depth for the lawn and another for trees and shrubs. To properly take advantage of this capability, trees and shrubs must be plumbed as one set of zones and the lawn as another set. In many controllers, that means the area to be watered on a lawn schedule could be connected to "program A" zones and trees and shrubs to "program B" zones. If you have an older controller without dual program capability, you should consider updating since water savings can usually pay for the new unit in about two years.

Some new equipment uses a soil water sensor to control lawn sprinklers. One, the Water Watcher by Turftech, has a soil sensor that measures average soil moisture in the top 6 inches of the root zone. A control box on the sensor connects to the sprinkler system. If the soil is wetter than a pre-set level, the control box prevents the sprinkler system from turning on. Once the soil dries below the pre-set level, the system is allowed to run. This system automatically avoids over- or underwatering. Cost is approximately $100 for the sensor and control box.

Figure 4: Using three sprinkler control settings to approximate seasonal variations in water use saves water over using just one peak setting.



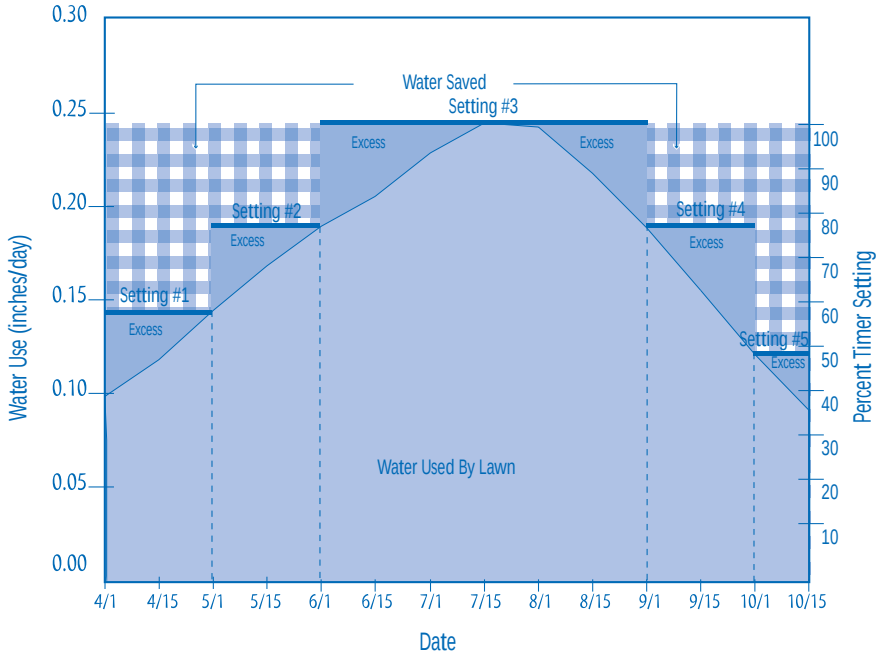
Shrubs and trees often show symptoms of water shortage only after damage has been done.

Irrigating Your Trees and Shrubs

Leaves of woody plants that are improperly irrigated become yellowish-green, stunted, curled, or brown-tipped and may fall prematurely. Since shrubs and trees often show symptoms of water shortage only after damage has been done, you will need to know the soil-water condition 2 or 3 feet beneath the soil surface, particularly early in the season. If early season deep moisture is adequate, then irrigation based on measurements at 8 inches for the rest of the year should be applied. Ideally, deep moisture should be checked once or twice during the season just to ensure that it is adequate. You can use a soil tube or probe, but the best and easiest way to check is with a soil-water measuring instrument such as a tensiometer (figure 6).

Tensiometers measure the work a plant must do to remove water from the soil. They read near 0 after an irrigation when the soil is nearly saturated and very little work is required to remove water. As the soil dries, readings increase. Tensiometers should be installed at soil depths of 24 to 36

Figure 6: Setting sprinkler controls to approximate seasonal variation in lawn water use using five settings for the summer saves water.



inches under trees and 12 to 24 inches under shrubs. The most critical factor in tensiometer installation is to ensure good contact between the ceramic cup at the bottom of the tensiometer and the soil. If you follow the manufacturer's installation and maintenance suggestions carefully, this device will work well for many years. Because these devices contain water, they need to be removed in the fall and stored in a nonfreezing area.

Tensiometers should always be read about the same time of day. When the instrument gauge shows a moderately dry reading (30 on sands to 70 on silt loam soils), apply water based on the guidelines discussed above to rewet the soil. Recheck the gauge 12 to 24 hours after irrigating. If the reading is 5 to 15, your irrigation was correct. If the reading is 0 to 5, use a shorter application next time. If the reading is more than 15, your next irrigation should be longer.

If irrigating flowers, gardens, or trees with a hose, bubblers, or trickle system, apply enough water to soak down to full root depth. One or 2 inches will probably suffice for flowers and vegetables, but 4 or 5 inches are needed in a tree basin. If the basin is shallow, fill it with water, and keep it full for one to two hours without overflowing.

Newly transplanted trees may need more frequent irrigation until they become well established. At the time of tree planting, water sufficiently to ensure that air pockets in the soil around the root ball are filled with water. This helps the soil to settle, providing better support against the wind, and provides better soil/root contact. Because the root ball usually contains only about 10 percent of the roots originally formed by the tree, it must be kept moist during the first growing season to avoid water stress. In subsequent growing seasons, the root system will have developed so trees can be watered deeper and less frequently. When possible, transplant trees in early spring or fall. The cooler weather produces less demand for water, and root growth occurs before the next high-water-demand season.

Figure 6: Tensiometers determine when irrigation is required. Cost is approximately $30 to $50 each, depending on the length of the tube.

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Appendix E – Figures and Tables

FIGURE 1

Group 1 Nitrate Priority Areas 2002

RANK/AREA	AREA NAME	Population (Est.)	Area in Acres	Total Samples	PWS	%$10 mg/l Nitrate	%$5 mg/l Nitrate	%$2 mg/l Nitrate	Min Nitrate (mg/l)	Max Nitrate (mg/l)	Average Nitrate (mg/l)	Land Use	TREND	SCORE
1	Weiser	5853	31479	65	11	45%	73%	88%	0.00	29.50	9.90	Irrigate	Incr.	**27.9**
2	Twin Falls	47,687	244229	303	59	6%	44%	93%	0.00	30.50	5.30	Irrigate	Incr.	**26.7**
3	Burley/Marsh Creek	11,787	169563	234	33	17%	60%	88%	0.00	20.00	6.36	Irrigate	Incr.	**26.5**
4	Lower Boise/Canyon County	80,806	238149	640	149	9%	32%	63%	0.00	33.40	4.20	Irrigate	Incr.	**23.8**
5	Camas Prairie	686	187001	120	5	24%	52%	77%	0.00	79.50	8.70	Dry Ag.	Incr.	**23.5**
6	Grand View	450	13987	21	2	29%	67%	76%	0.00	26.00	8.90	Irrigate	Incr.	**22.8**
7	Fort Hall	1000	32323	63	8	25%	60%	83%	0.10	24.00	8.30	Irrigate	No Chg.	**20.2**
8	Ashton, Drummond, Teton R.	1724	146170	120	0	15%	74%	95%	0.10	38.20	7.40	Irrg/Dry Ag	No Chg.	**20.1**
9	Rupert	25,132	116780	236	29	8%	44%	78%	0.00	100.00	5.60	Irrigate	No Chg.	**19.6**
10	Payette	2725	30509	74	15	20%	53%	70%	0.00	23.40	6.50	Irrigate	No Chg.	**18.1**
11	Eagle/Star	100	1739	19	0	47%	58%	58%	0.00	45.20	11.63	Irrigate	No Chg.	**17.8**
12	Homedale\Marsing	840	50914	70	3	27%	30%	41%	0.00	38.20	5.85	Irrigate	No Chg.	**17.0**
13	Hammett	1657	14416	15	4	0%	38%	63%	0.00	8.90	4.00	Irrg/Rng	Incr.	**16.2**
14	Bruneau	100	24255	10	3	40%	40%	50%	0.00	110.00	17.49	Irrig/Rng	No Chg.	**15.0**
15	Lapwai Creek	600	17587	4	4	25%	50%	100%	2.60	15.00	7.20	Dry Ag	No Chg.	**15.0**
16	St. Anthony	2000	6725	14	0	29%	36%	43%	0.90	37.90	7.60	Irrigate	No Chg.	**14.6**
17	Pocatello	63,527	22576	62	0	3%	26%	87%	0.90	14.50	3.80	Urban	No Chg.	**14.3**
18	Soda Springs/Bear River	5942	310611	76	44	5%	22%	62%	0.00	24.00	3.90	Dry Ag	No Chg.	**13.8**
19	Mountain Home	262	11223	23	22	13%	35%	74%	1.10	28.00	5.40	Irrg/Rng	No Chg.	**13.5**
20	Hibbard	1409	10907	64	16	6%	19%	63%	0.00	25.90	3.70	Irrigate	No Chg.	**12.8**
21	Mud Lake	523	36417	37	3	5%	41%	68%	0.00	14.00	3.90	Irrigate	No Chg.	**11.9**
22	Preston/Cache Valley	620	129115	61	10	5%	23%	54%	0.00	18.70	3.20	Irrigate	No Chg.	**11.7**
23	Genesee/Cow Creek	775	18439	3	2	0%	67%	67%	0.88	7.10	4.53	Dry Ag.	No Chg.	**11.7**
24	Boise/Meridian	225,383	18032	197	0	3%	30%	83%	0.00	18.00	4.10	Urban, Irrg	Decr.	**11.5**
25	Bliss	50	6806	18	39	5%	39%	67%	0.00	12.20	3.90	Irrigate	No Chg.	**10.8**

PWS = Public Water System
mg/l = Milligrams per Liter

Land Uses are abbreviated to represent
Irrigated & Dry Agriculture and Range
Trends are abbreviated to represent Increasing, Decreasing and No Change

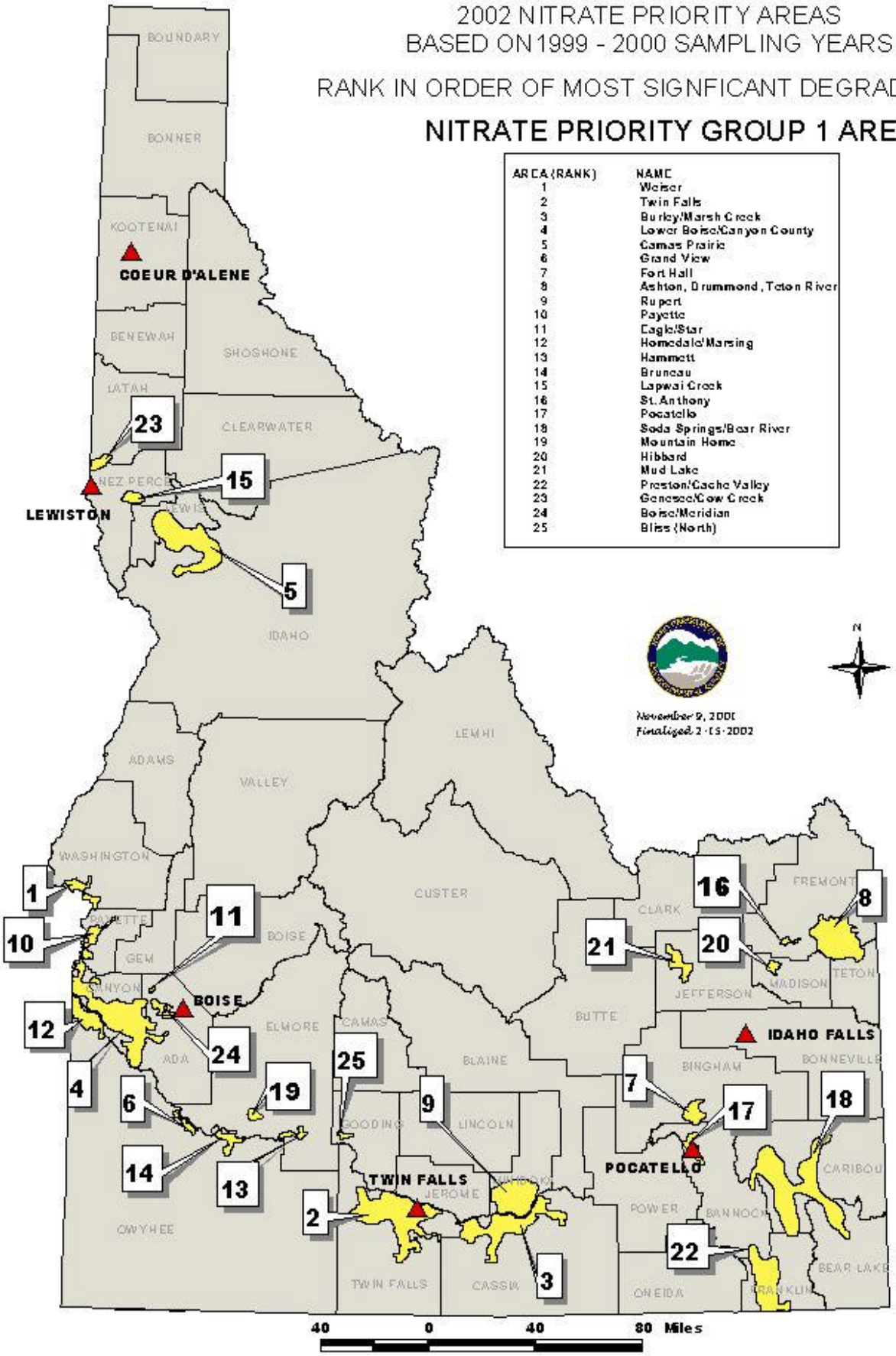
Figure 2

2002 NITRATE PRIORITY AREAS
BASED ON 1999 - 2000 SAMPLING YEARS

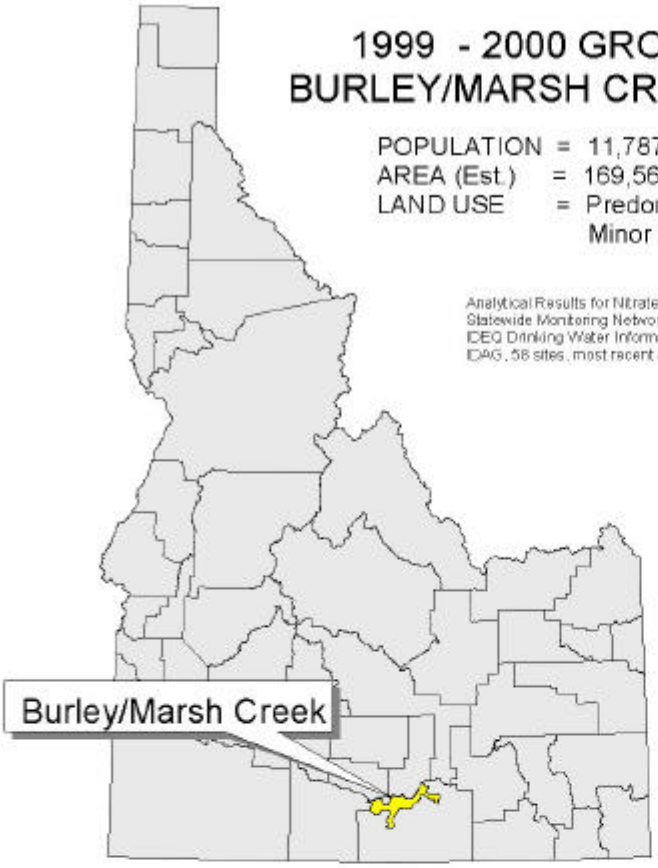
RANK IN ORDER OF MOST SIGNFICANT DEGRADATION

NITRATE PRIORITY GROUP 1 AREAS

AREA (RANK)	NAME
1	Weiser
2	Twin Falls
3	Burley/Marsh Creek
4	Lower Boise/Canyon County
5	Camas Prairie
6	Grand View
7	Fort Hall
8	Ashton, Drummond, Teton River
9	Rupert
10	Payette
11	Eagle/Star
12	Homedale/Marsing
13	Hammett
14	Bruneau
15	Lapwai Creek
16	St. Anthony
17	Pocatello
18	Soda Springs/Bear River
19	Mountain Home
20	Hibbard
21	Mud Lake
22	Preston/Cache Valley
23	Genesee/Cow Creek
24	Boise/Meridian
25	Bliss (North)



1999 - 2000 GROUP 1 NITRATE PRIORITIZATION
BURLEY/MARSH CREEK PRIORITY AREA #3* (RANKED)



POPULATION = 11,787 (Est.)
AREA (Est.) = 169,563 Acres
LAND USE = Predominantly Irrigated Agriculture,
Minor Amounts of Dry Agriculture, Urban and Range Land

Analytical Results for Nitrate Data Sources:
Statewide Monitoring Network USGS/IDWR, 143 sites, most recent analysis used
IDEQ Drinking Water Information System (DWIMS), 33 PWS, 1999-2000 data, highest value used
IDAG, 58 sites, most recent analysis used

Nitrate Values (mg/l)	Number of Sites
>=10	40
5 - 9.99	100
2 - 4.99	65
< 2	29

MAXIMUM VALUE = 20.0
MINIMUM VALUE = 0.0
MEDIAN = 5.8
AVERAGE = 6.4
MODE = 3.2

TOTAL NUMBER OF SITES = 234
TOTAL NUMBER OF PWS SITES = 33

No. Sites Nitrate >= 2 mg/l = 205
No. Sites Nitrate >= 5 mg/l = 140
No. Sites Nitrate >= 10 mg/l = 40

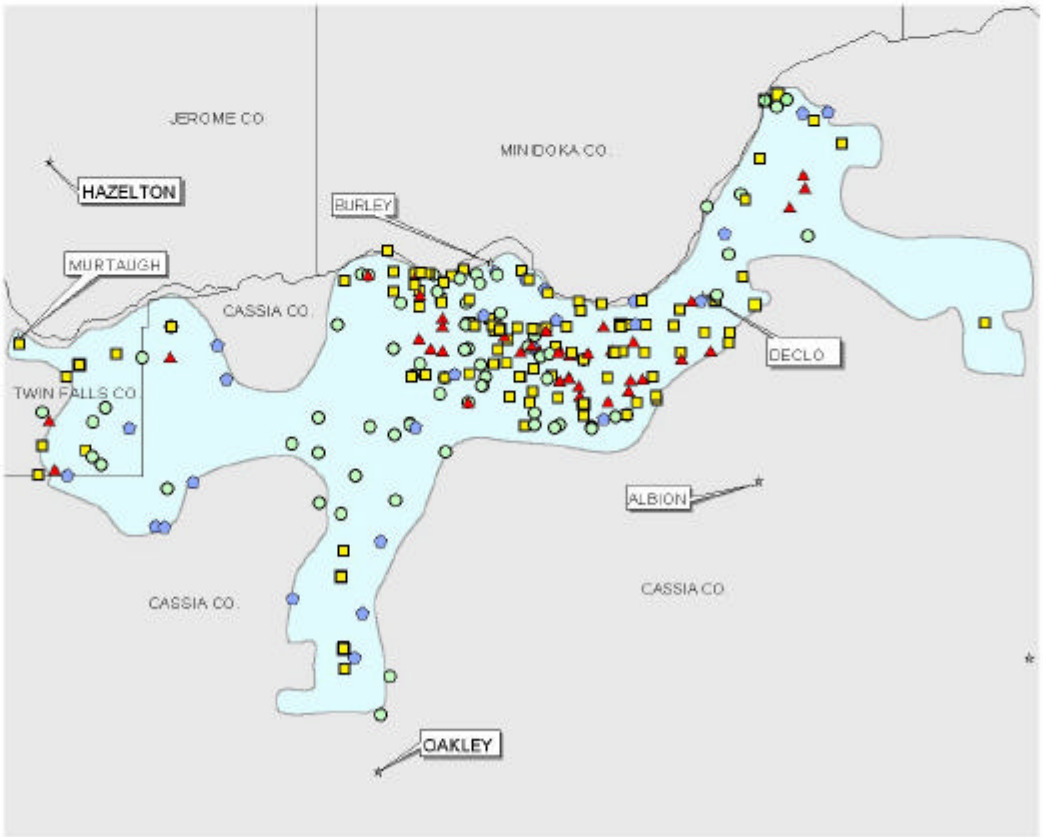
*Previously referred to as Area 17 for trend analysis

Nitrate Analytical Results - Statewide, USGS, IDAG, PWS

- ▲ >=10 mg/l
- ■ 5 - 9.99 mg/l
- ○ 2 - 4.99 mg/l
- ⬟ <2 mg/l

Nitrate Priority Area 3 Burley/Marsh Creek

USGS = United States Geological Survey
IDAG = Idaho Department of Agriculture
IDEQ = Idaho Department of Environmental Quality
IDWR = Idaho Department of Water Resources
PWS = Public Water System
REG/LOC = Regional/Local Monitoring Studies, various agencies
mg/l = milligrams per liter



NITRATE PRIORITY AREA # 3
BURLEY/MARSH CREEK

Nitrate Concentrations: (mg/l)

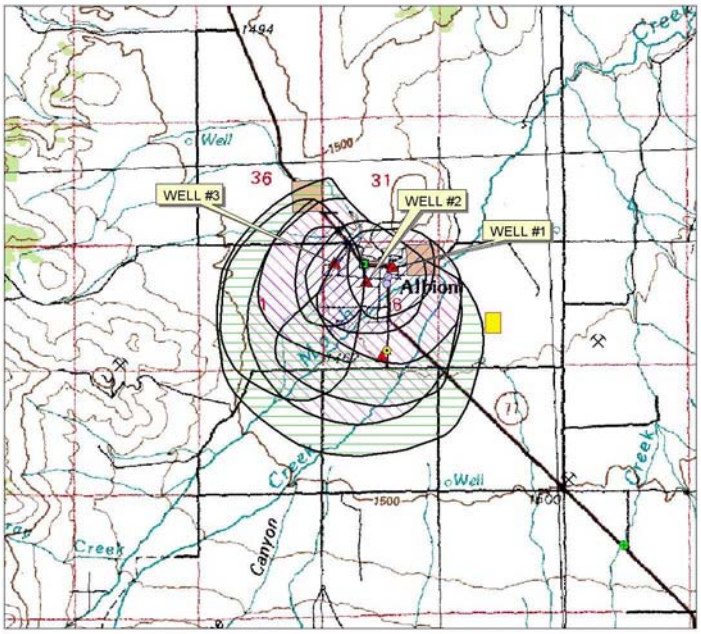
Minimum Value	0
Maximum Value	20.0
Average Value	6.4
No. Samples ≥ 10	40
No. Samples 5 – 9.99	100
No. Samples 2 – 4.99	65
No. Samples < 2	29
No. Samples ≥ 2	205
No. Samples ≥ 5	140
No. Samples ≥ 10	40
% Samples ≥ 2	86%
% Samples ≥ 5	60%
% Samples ≥ 10	17%
Total Samples	234
No. PWS Samples	33
No. SMN Samples	143
No. IDAG Samples	58
No. REG/LOC Samples	0

PWS = Public Water Systems
SMN = State Wide Monitoring Network
IDAG = Idaho Dept. of Agriculture Studies
REG/LOC = Regional/Local Monitoring DEQ, USGS, and DEQ/IDAG Projects

Monitoring Projects:

USGS NAWQA Study – National Water Quality Assessment Program
Various IDAG studies using most recent data.

City of Albion Delineation Maps and Pontential Contaminant Source Locations



0 1 2 3 4 5 Miles

Legend

Time of Travel Zones
- 0-3 Year
- 3-6 Year
- 6-10 Year
- Wellheads (PWS)
- Toxics Release Inventory - 1998
- CERCLA SITES
- RCRA Sites
- Business Mailing List
- AST Locations
- Recharge Points
- Deep Injection Wells
- Group 1 Sites

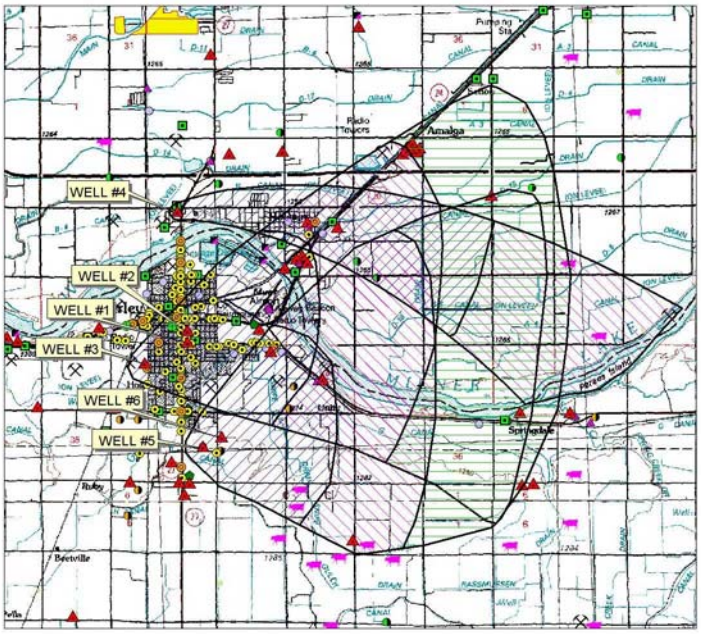
Dairy Locations
- Active
- Proposed

UST Sites
- Closed
- Open
- SARA Title III Sites
- LUST Sites
- NPDES Locations
- Cyanide Sites
- LandFills
- Waste Water Land App
- Mine Locations

N

PWS# 5160001

City of Burley Delineation Maps and Pontential Contaminant Source Locations



Legend

Time of Travel Zones
- 0-3 Year
- 3-6 Year
- 6-10 Year
- Wellheads (PWS)
- Toxics Release Inventory - 1998
- CERCLA SITES
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Dairy Locations
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- Proposed

UST Sites
- Closed
- Open
- SARA Title III Sites
- LUST Sites
- NPDES Locations
- Cyanide Sites
- LandFills
- Waste Water Land App
- Mine Locations

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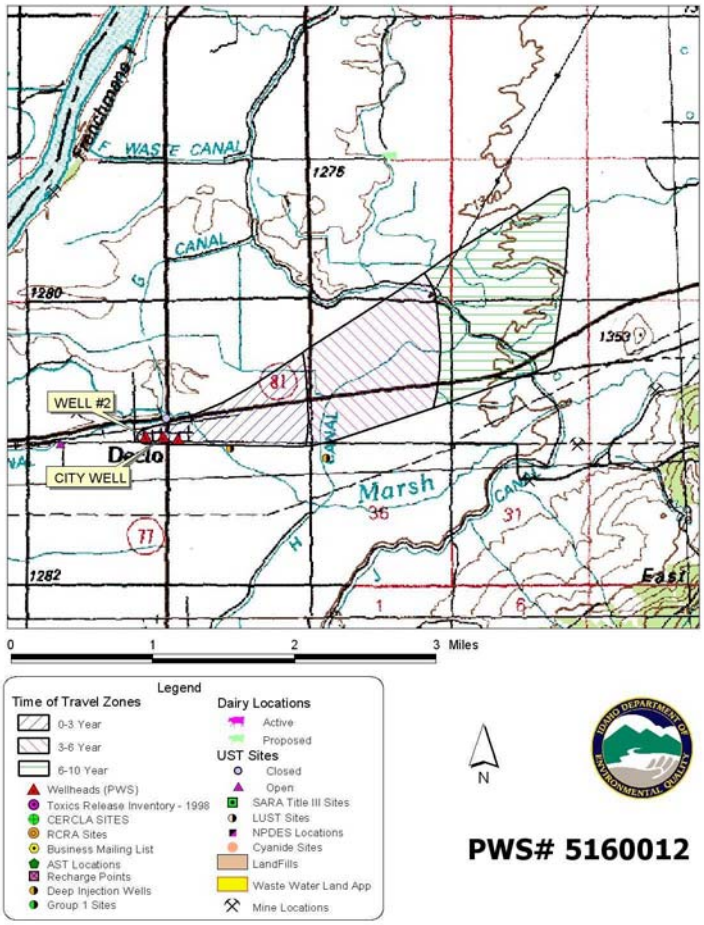
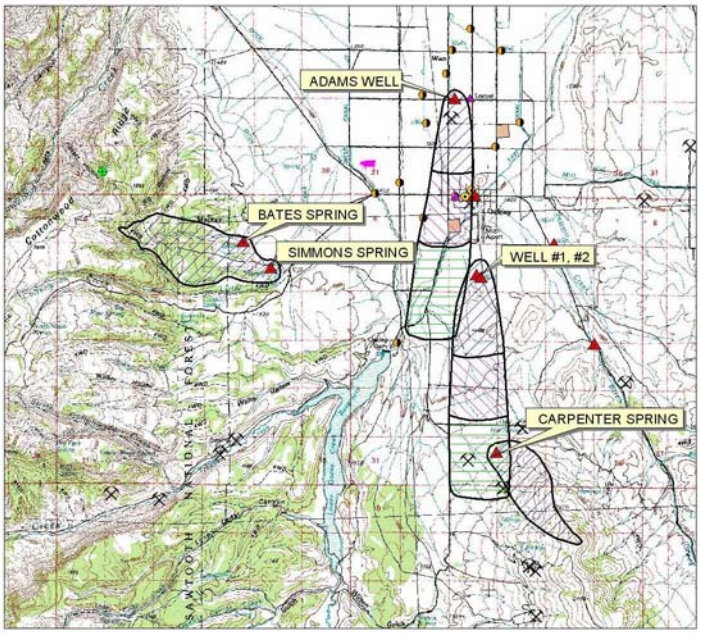
PWS# 5160008

City of Declo Delineation Maps and Pontential Contaminant Source Locations



PWS# 5160012

City of Oakley and Oakley Valley Water Corp. Delineation Maps and Pontential Contaminant Source Locations



0 1 2 3 4 5 Miles

Legend

Time of Travel Zones
- 0-3 Year
- 3-6 Year
- 6-10 Year
- Wellheads (PWS)
- Toxics Release Inventory - 1998
- CERCLA SITES
- RCRA Sites
- Business Mailing List
- AST Locations
- Recharge Points
- Deep Injection Wells
- Group 1 Sites

Dairy Locations
- Active
- Proposed

UST Sites
- Closed
- Open
- SARA Title III Sites
- LUST Sites
- NPDES Locations
- Cyanide Sites
- LandFills
- Waste Water Land App
- Mine Locations

N

PWS# 5160031
and
PWS #5160035