

# **GALLATIN STATE OF THE WATERS REPORT**

## ***2015***



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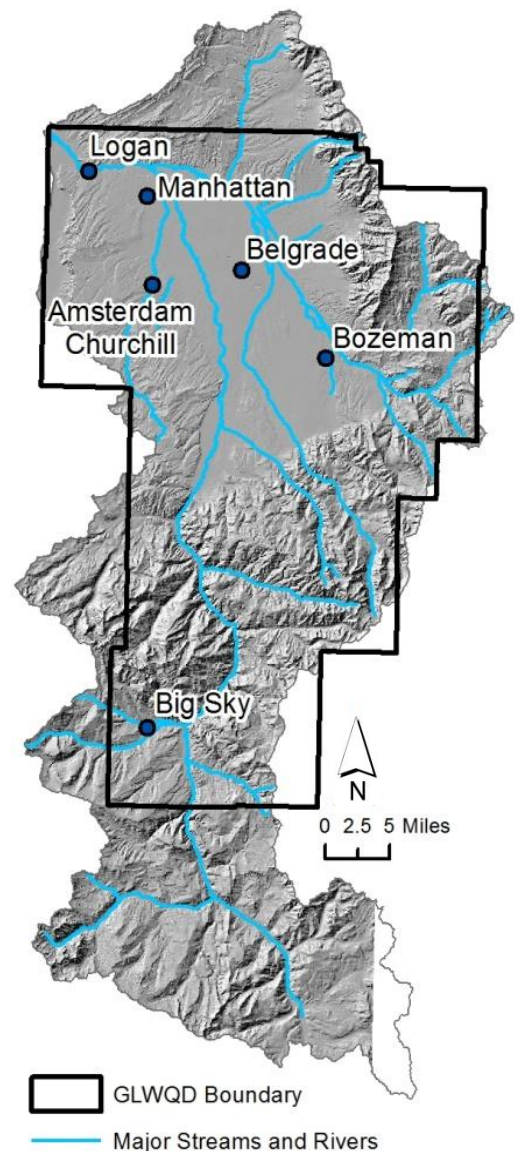
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# Executive Summary

The [Gallatin Local Water Quality District](#) (GLWQD) is a non-regulatory department of Gallatin County, Montana with a mission to protect, preserve, and improve water quality within the District. Created in 1997 by resolution of the Gallatin County Commission, GLWQD focuses on three main areas related to groundwater and surface water: research and monitoring, education and outreach, and information collection and dissemination. This is the first State of the Waters Report created by GLWQD with the intent to provide the public with a summary of recent major GLWQD projects and the current status of hydrologic conditions to demonstrate any trends in water quality and water quantity that are notable over the period for which data are available. This report will be updated and provided to the public every five years.

Contained within this report you will find a brief [introduction](#) describing the Gallatin watershed in which we all live, work, and recreate. The [Groundwater Section](#) of the report is focused on the geology of the area and how this relates to groundwater levels in local aquifers. It also contains a description of the GLWQD Groundwater Monitoring Well Network, which is used to evaluate changes in groundwater levels and water quality over time, and provides a summary of groundwater quality trends from the GLWQD groundwater database. The report then highlights major groundwater and surface water projects and programs conducted by GLWQD. Groundwater projects include: The Gallatin Groundwater Project, which evaluated nitrate levels in several high density septic system areas in the valley, and a screening project for pharmaceuticals in groundwater and surface water in the GLWQD. The [Surface Water Section](#) of the report includes: Urban Stream Monitoring and Citizen Science, and information about screening for *E. coli* bacteria in Bozeman's Urban Streams. The [Contaminated Sites Section](#) of the report provides background and status on two Superfund sites in the GLWQD. Finally, there are descriptions of [other projects](#) GLWQD is currently involved with or anticipates working on in the near future. These will be summarized in the 2020 State of the Waters Report. There is also a listing of additional resources.

The 2015 State of the Waters Report does not include all projects GLWQD has conducted or collaborated on in the last fifteen years, or even all ongoing activities. As always, the GLWQD is here to help preserve, protect, and improve water quality. Resources for the public including [Well Educated well test kits](#) for sampling your domestic well, fact sheets, and informational brochures are available through our office and on our [website](#). For more information, contact the GLWQD office at (406) 582-3168.



**Figure 1.** The GLWQD boundary (black line) and the Gallatin River watershed.

*This report is to be used for general informational purposes only, and is not to be construed to be regulatory in nature.*

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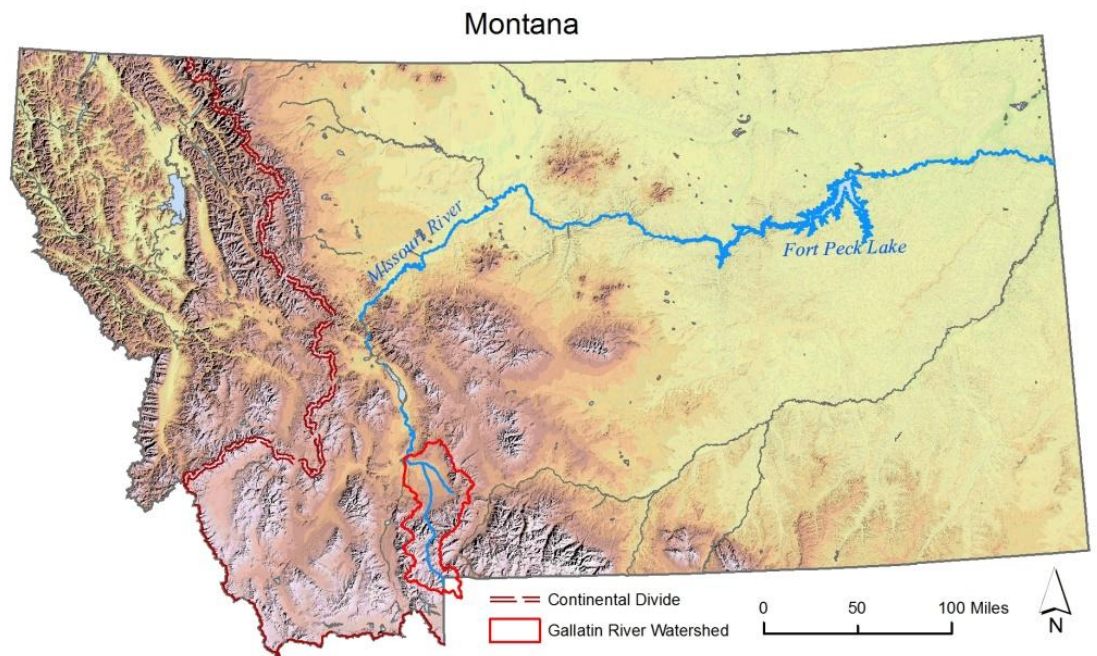
## Introduction

The Gallatin River Watershed consists of all the land area draining to the West Gallatin River and the East Gallatin River, which combine to form the Gallatin River. The Gallatin River is part of the Missouri River headwaters (**Figure 2**) where the Madison, Jefferson, and Gallatin Rivers converge near the town of Three Forks. The watershed is part of the Greater Yellowstone Ecosystem and is home to the towns and areas of Bozeman, Belgrade, Big Sky, Manhattan, Logan, Amsterdam-Churchill and Four Corners. The population within the watershed is estimated to be around 91,000 and growing (U.S. Census Bureau 2010, 2014). The Gallatin Local Water

Quality District (GLWQD) boundary is within Gallatin County, and covers much of the watershed. The information described in this report is focused within the GLWQD boundary (**Figure 1**, opposite).

Agriculture is the historical economic driver in the area and continues to be a part of the modern economy. The watershed is also widely known for

recreational and tourism opportunities. With a thriving economy and increasing population in this semi-arid Rocky Mountain watershed, pressures on water resources are changing. Although agriculture remains a major water user, residential and commercial demand for water is increasing as the valley population continues to grow. Between 1990 and 2010, the population of Gallatin County increased by approximately 77% (U.S.



**Figure 2.** The Gallatin River Watershed is located in southwestern Montana, and is part of the headwaters of the Missouri River.



Census Bureau 1995, 2014). This has resulted in an increase in the number of individual wells and septic systems, some at high density levels. In many areas, residential and commercial land uses are increasing while agricultural land use is decreasing. Shifting land use patterns can alter groundwater and surface water levels and have the potential to affect water quality in positive or negative ways. Continued environmental monitoring is essential to understand these changes.

## Groundwater

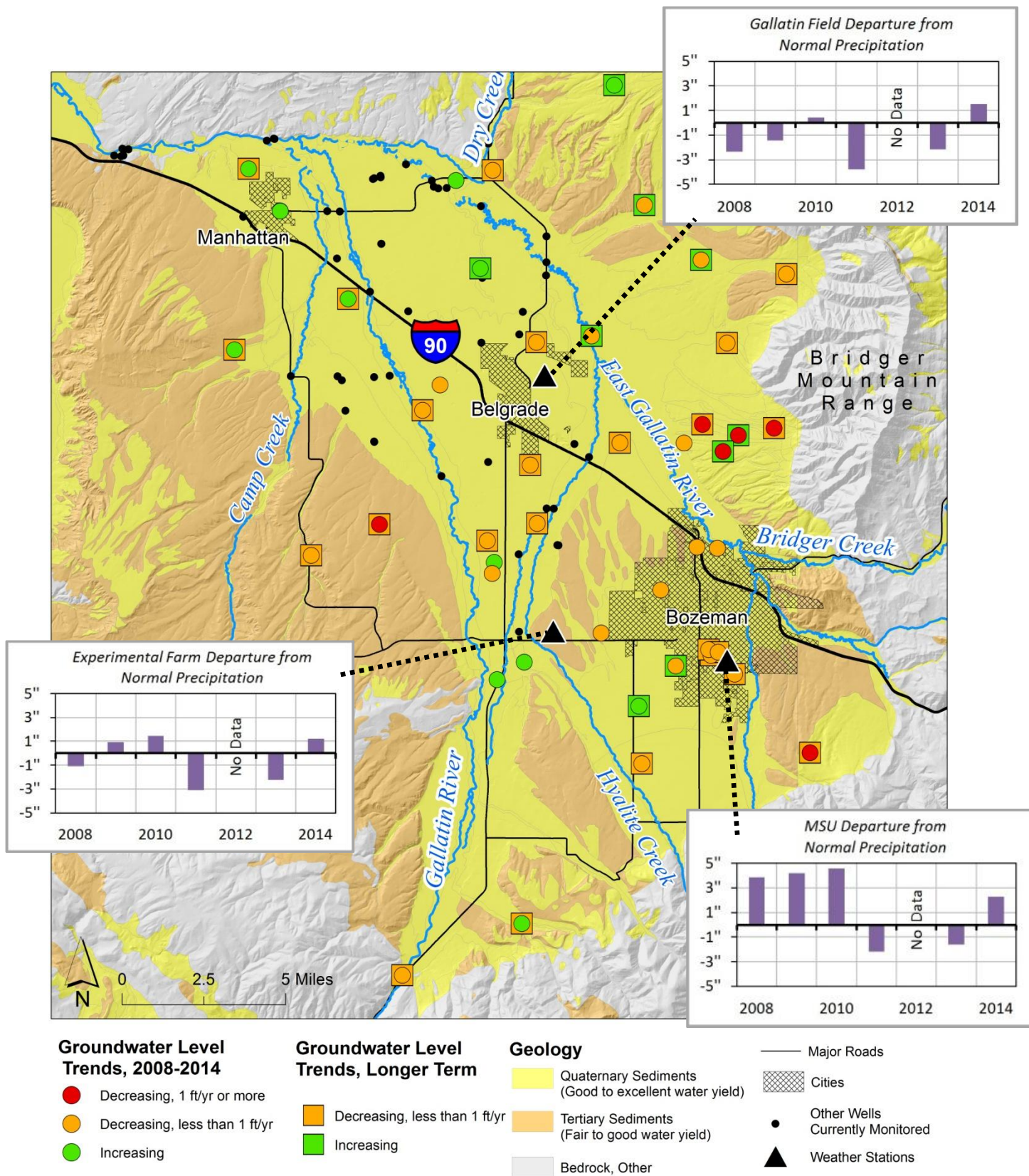
### Geology and Groundwater Level Changes

The [GLWQD monitoring well network](#) is a tool for detecting long-term trends in both water quantity and quality within the GLWQD. This information is crucial to understanding what is happening to water levels throughout the network and to help make informed water management decisions. The network consists of 48 actively monitored wells. The water level trends in these wells for the entire period in which they have been monitored, which varies greatly from well to well, are represented in **Figure 3** by colored squares. The trends in water levels during the period of 2008-2014 are also included in **Figure 3**, represented as colored circles overlain on the squares. This seven-year period of record is short, but is intended to show a parallel comparison between wells. These trends were developed using minimum and maximum groundwater elevation measurements for each available year and were categorized into 'decreasing slightly' (average rate less than 1 ft/yr decrease), 'decreasing' (average rate greater than 1 ft/yr decrease), and 'increasing' (average rate is any increase at all).

*As additional data is collected in these monitoring wells in the future, trends in water levels are subject to change.*

The shallow, unconfined aquifer in the central part of the Gallatin Valley is composed of alluvial and colluvial material (deposited by rivers and gravity, respectively) from a geologic time called the Quaternary (yellow area in **Figure 3**). Water here is often found not far below the ground surface (usually less than 100 feet). The GLWQD has many monitoring wells in this material, and this is also where the majority of the population of the Gallatin Valley lives and withdraws water for domestic use. Although in some locations there are intermittent clay lenses or layers of other small-grained (fine) sediments that might alter the movement and yield of water, many of these Quaternary sediments are excellent at storing and transmitting water because of the coarseness of the material. Recharge to shallow aquifers in these sediments comes from precipitation, infiltration from irrigation canals and ditches, and runoff from snowmelt in the adjacent mountains. Geologic deposits on the west side of the Gallatin Valley near Amsterdam and Churchill consist of older deposits, from a geologic time called the Tertiary (as mapped by Vuke et al., 2014), that usually have characteristics that result in fair to good water yield (orange area in **Figure 3**). GLWQD has few monitoring wells in this area. The majority of this area remains in agricultural production. The gray areas in **Figure 3** represent bedrock or other aquifers that have variable water yield. GLWQD has no monitoring wells in these areas.

Many wells have decreasing trends over the time period, while others have increasing trends, but it is important to remember that these are not necessarily indicative of what will happen in the future. Additionally, the information shown in **Figure 3** is not necessarily representative of what is happening in *all* wells in a given area. The total depths of wells are not all the same, and although geology is generalized on the map, wells are sometimes tapped into different underlying geology, such as the cluster of five wells shown on **Figure 3** just west of the Bridger Mountain Range, and east of the East Gallatin River. ***Seasonal and annual variability in water levels does occur, and is related to spring snowmelt and precipitation, and longer term wet and dry climate cycles.*** Groundwater withdrawals also alter water levels. In other words, many factors affect groundwater levels.

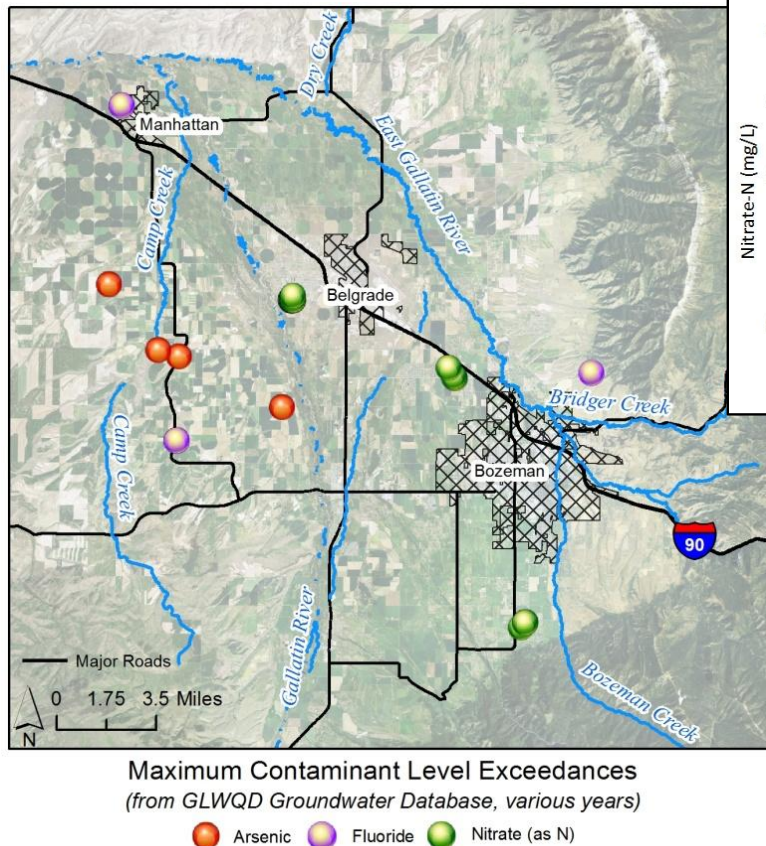


**Figure 3.** Groundwater level trends in monitoring wells for 2008-2014 throughout the Gallatin Valley are shown on the map as colored circles. Inset graphs show departure from normal (departure from average) annual precipitation for 2008-2014. Older data exists for some of these wells; these water level trends are shown on the map as colored squares. Data sources: [Montana Bureau of Mines and Geology Groundwater Information Center](#); Vuke et al., 2014; Berg et al., 2000; [NOAA National Centers for Environmental Information](#). Interpretations are subject to change or update without notice.

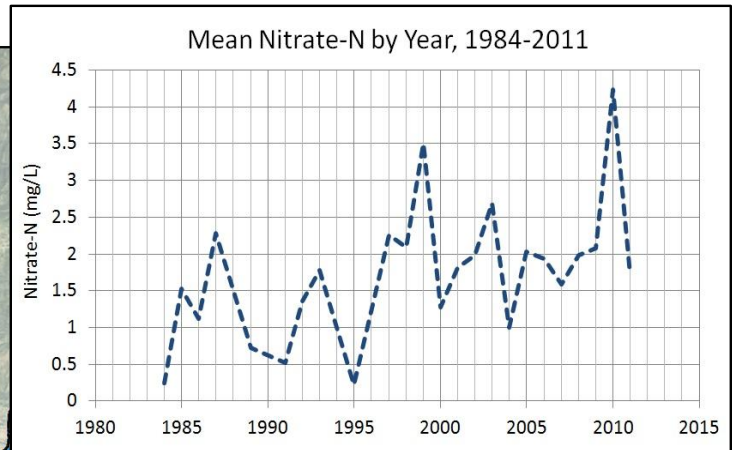


# Groundwater Quality

Groundwater quality data is maintained in the GLWQD groundwater quality database and includes data from some domestic wells, the GLWQD groundwater monitoring well network, and other monitoring wells. Water quality sampling is conducted less frequently than water level monitoring, as more time and expense is required. Samples exceeding drinking water quality standards within these wells are described in this section. Nitrate-N, arsenic, and fluoride were found at levels above their respective U.S. Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCL) in the Gallatin Valley at various points in time over the past several decades (**Figure 5**).



**Figure 5.** Locations in the Gallatin Valley where U.S. EPA Drinking Water Standards have been exceeded in samples from groundwater wells at one or more points in time.



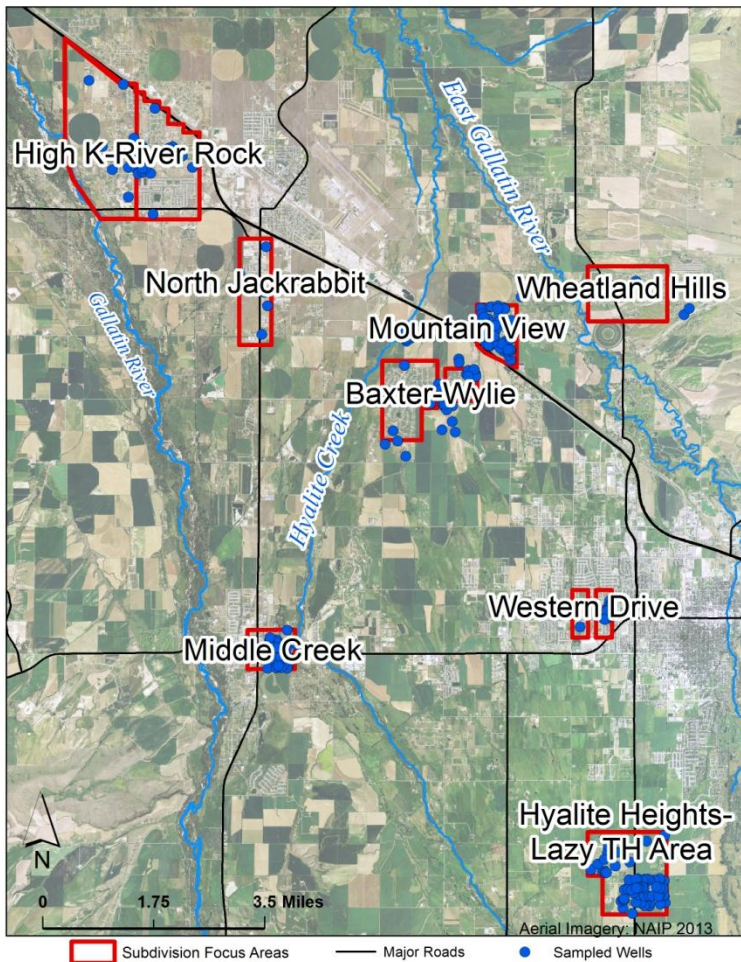
**Figure 4.** Mean nitrate-N by year based on available information in the GLWQD groundwater database.

Nitrate levels appear to be slowly increasing in the valley, although mean levels remain below the MCL of 10 mg/L (**Figure 4**). More information on nitrate and its sources can be found in the [High Density Septic Systems Section](#) on page 7.

Volatile Organic Compounds (VOCs) are naturally occurring in the environment, but are also emitted by a wide array of products, including paints and lacquers, cleaning supplies, pesticides, and building materials. VOCs are groundwater contaminants of concern because

of their potential toxicity and tendency to persist in and migrate with groundwater. Thirty six wells were sampled to identify areas in the Gallatin Valley where groundwater may be contaminated with VOCs. Samples were analyzed for 85 organic compounds, and indicated that VOCs are not widely or significantly impacting groundwater quality in the GLWQD. The only wells testing positive for tetrachloroethene (also known as PCE) were shallow monitoring wells down-gradient of the Bozeman Solvent Site, a State Superfund site with a Controlled Groundwater Area within the Bozeman city limits (for more information, see the Contaminated Sites Section on page 10 in this report). Chloroform is a byproduct of chlorinating water, and was detected in two wells within Bozeman city limits. Chloroform levels in these two wells were much less than the Montana Maximum Contaminant Level (MCL) and consistent with levels found in City of Bozeman drinking water following the chlorination process, therefore the results are likely associated with using chlorinated water for lawn irrigation.

## High Density Septic System Areas



**Figure 6.** Subdivision focus areas (red polygons) that were sampled for the Gallatin Groundwater Project were used to assess the impact of high density septic systems on groundwater quality.

mg/L (2 mg/L is usually considered naturally occurring), while four percent had nitrate-N exceeding the U.S. EPA MCL of 10 mg/L. Nitrate isotope analysis indicates the common source of groundwater nitrate in the areas sampled is septic waste and/or soils, though fertilizer use, or legacy agricultural fertilizer use, may be a factor in some areas. The only area out of the eight studied that had multiple lines of evidence indicating wastewater influence on groundwater was the Western Drive area. High nitrate in subdivision focus areas was not found to be a widespread problem in 2013, yet there are localized areas of concern. Our results show that nitrate appears to be generally increasing in the areas assessed. With residential development projected to continue, groundwater quality concerns related to high density septic system areas may become more widespread. We recommend taking steps to properly maintain septic systems, appropriately fertilize lawns and gardens, and avoid excessive watering as efforts to reduce or minimize future additions of nitrate to groundwater. For the full project report click [here](#).

The Gallatin Groundwater Project, funded by a Clean Water Act 319 Grant from the Montana Department of Environmental Quality (DEQ) assessed cumulative impacts from high density septic systems on groundwater quality, specifically nitrate levels. Historical data evaluation, spatial analysis of nutrient loading to groundwater, and water quality sampling were used to identify areas of potential groundwater contamination and to characterize groundwater quality as a result of cumulative impacts from individual septic systems and public sewage systems within the GLWQD. Eight areas were selected for study based on a screening process and available funding; however **there are other areas in the Valley with high density septic systems that were not evaluated during this project.**

Over two hundred wells from eight areas with high density septic systems in the Gallatin Valley were sampled (**Figure 6**). Fifty-two percent of samples had nitrate-N above 2

*Nitrate is a naturally occurring form of nitrogen that is odorless and tasteless. Sources include decaying plant material, septic systems, fertilizer, manure, or airborne nitrogen from industry and vehicles. Nitrate moves easily with water in the environment. Nitrate is a drinking water concern at high levels, but is also an indicator that other contaminants, such as pesticides or pathogens, may be present.*



# Pharmaceuticals in Groundwater and Surface Water

A study assessing the distribution of pharmaceuticals and personal care products (PPCPs), along with endocrine disrupting compounds (EDCs), was conducted in conjunction with the Montana Bureau of Mines and Geology (MBMG). PPCPs and EDCs are considered emerging contaminants, meaning little is known about the presence of these compounds in water resources, or the effects they may have on human health and the environment. The EPA has not yet developed MCLs for most of these compounds. The presence of personal care products and medications in surface water and groundwater indicates human wastewater influence. This project screened for the occurrence of these compounds in groundwater and surface water throughout the Gallatin Valley from 42 wells and 10 surface water locations. The study also assessed the efficiency of various wastewater treatment approaches to remove these compounds.

*Pharmaceuticals and personal care products (PPCPs), including endocrine disrupting compounds (EDCs), were screened for in the waters of the Gallatin Valley.*

*The majority of surface water and groundwater samples had one or more detections for the compounds tested.*

*Wastewater treatment systems are not designed to remove these compounds. Municipal wastewater treatment plants did a better job of removing compounds than septic systems.*

*The occurrence of these compounds in the Gallatin Valley is similar to what was found in studies in the Missoula and Helena Valleys.*

One or more PPCP or EDC detections were found in the majority of groundwater and surface water samples. Detections included caffeine, bisphenol-A (also known as BPA, it is a chemical widely used to produce certain types of plastics and resins), ibuprofen (common anti-inflammatory drug), sulfamethoxazole (a common antibiotic), and many more. Only 32 compounds were tested for, but many more may be present.

Wastewater treatment systems are not designed to treat wastewater for anything other than nutrients (nitrogen and phosphorus) and pathogens, so it is not surprising that they inadequately remove PPCPs and EDCs. The study found that advanced wastewater treatment systems (i.e. municipal) are more effective at removing PPCPs and EDCs than septic systems.

Final data analysis and report preparation is in progress with the MBMG.

*In order to help keep PPCPs and EDCs out of water resources and drinking water supplies, follow proper drug disposal guidelines:*

- *Do not flush prescription drugs down the toilet unless patient information instructs to dispose of unused product this way.*
- *Dispose of unused pharmaceuticals at the drug disposal box at the Gallatin County Law and Justice Center.*



*Researchers collected samples from groundwater, surface water, septic systems, and wastewater treatment plants to assess the pervasiveness of PPCPs and EDCs in water resources of the Gallatin Valley.*



# Surface Water

## Urban Stream Monitoring and Citizen Science



*Stream Team members collect water samples, flow measurements, and gather other important information to help evaluate the health of Gallatin streams.*

Two streams that have been monitored for several consecutive years by the GLWQD and Stream Teams are [Mandeville Creek](#) and [Bozeman Creek](#). Mandeville Creek is a small spring-fed stream that flows through the MSU campus before being piped underground and resurfacing at Bozeman High School. For every year between 2009 and 2014, mean total nitrogen and total phosphorus levels in this creek have exceeded Montana Department of Environmental Quality (DEQ) standards. Bozeman Creek, a stream that flows out of the Gallatin Mountain Range, exceeded total nitrogen as well as *E. coli* bacteria standards at all sites sampled during 2012 and 2013. For more in-depth information on *E. coli* monitoring, see the next report section.

Nitrogen and phosphorus are nutrients that are essential for aquatic plants to survive. However, high levels can be detrimental to stream health by increasing algal growth, which can decrease oxygen in the water and in turn, harm fish and other aquatic life. Excessive buildup of algae can also lead to decreased fish spawning and aquatic insect habitat.

*To minimize nutrient pollution in our local rivers and streams, there are a variety of things you can do to help:*

- *Maintain native vegetation along stream banks*
- *Keep grass clippings and yard waste away from streams*
- *Pick up after your pet*
- *Keep livestock away from stream banks or construct defined access points for livestock watering*
- *Ensure your septic system is functioning properly (i.e. pumping and inspections)*

The Gallatin Stream Team program, developed by GLWQD and coordinated with the Greater Gallatin Watershed Council, is a citizen-based monitoring program. This program collects water quality data from local streams to assist in understanding baseline conditions and to inform watershed planning. Volunteers have been collecting data since 2008. This program provides anyone who has an interest in water quality sampling and monitoring with an opportunity to participate in an important data collection effort in the Gallatin watershed. Teams collect water samples and take water quality measurements following standardized methods from several targeted local streams each summer. The volunteer commitment involves a one day training and three additional data collection days throughout the summer.

*If you are interested in joining the Gallatin Stream Team Program and getting your feet wet with a fun and important data collection effort, check out the Stream Team website [here](#) or e-mail [info@greatergallatin.org](mailto:info@greatergallatin.org).*

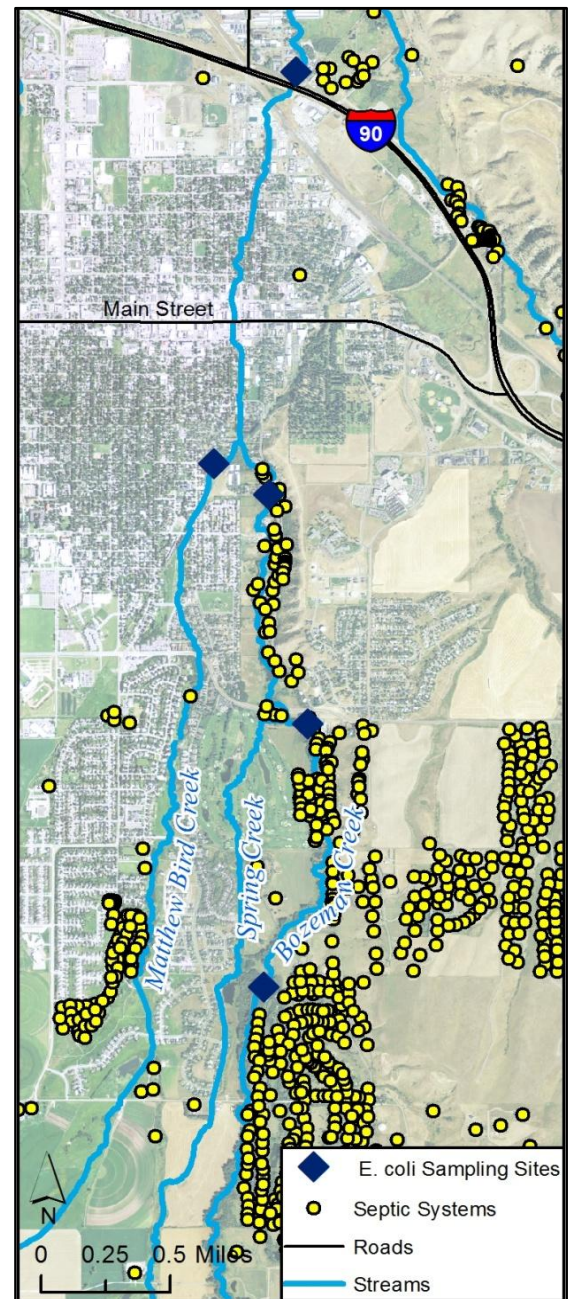
## *E. coli* in Bozeman's Urban Streams

*E. coli* bacteria are commonly present in surface water from fecal matter entering streams, and suggest the possible presence of other pathogens in the water. Sources of *E. coli* can include pets, wildlife, livestock, septic systems and other sources of human waste.

Assessment of elevated *E. coli* levels, and screening for fecal contamination sources, was conducted in 2015 in cooperation with the City of Bozeman and Gallatin County Environmental Health Services. This work followed up on previous *E. coli* sampling efforts. Microbial source tracking (MST) uses genetic biomarkers to help determine the sources (human, dog, or other) of the fecal contamination in the water. Samples were collected at five locations throughout Bozeman's residential and downtown areas, several of which had previously been sampled for *E. coli* and nutrients, in addition to new sites that bracketed areas of high septic density (**Figure 7**). Results show higher *E. coli* concentrations in July compared to August and September at all Bozeman Creek sites. Matthew Bird Creek did not follow this pattern but instead had high concentrations of *E. coli* during all three sampling events. MST results indicated human fecal contamination was present from the samples collected at all five sites during the July sampling event, while dog fecal contamination was present at three of five sites during the same sampling event. Other sources of fecal contamination (such as wildlife and waterfowl) are likely present as well but were not tested for as part of this project. August and September MST results were highly variable. These results will guide additional data collection and help inform the next steps to reduce pathogen and nutrient pollution in Bozeman Creek.

To minimize bacterial contamination sources, pick up and throw away pet waste, and ensure your septic system is functioning properly.

**Figure 7 (right).** Sampling locations (blue diamonds) used in the 2015 *E. coli* and microbial source tracking study, shown with locations of septic systems (yellow dots). Most of these septic systems are outside of Bozeman city limits.



## Contaminated Sites

### Idaho Pole Company Site

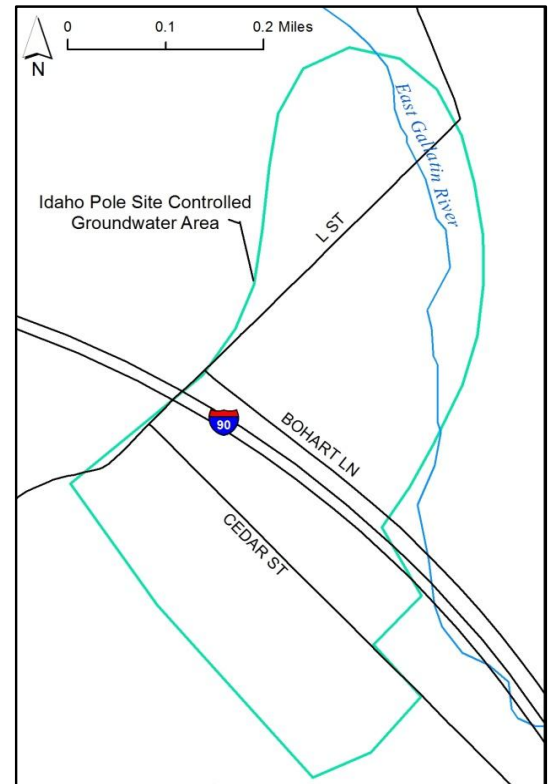
The Idaho Pole Company Site is a federal Superfund site located near the north side of Bozeman (**Figure 8**), near Cedar Street and Interstate-90. The Idaho Pole Company operated a wood treating facility at the site



from 1945 to 1997. Plant operations included using creosote and pentachlorophenol (PCP) to preserve wood. These operations resulted in releases of PCP in excess of the U.S. EPA MCL (1 µg/L) and other contaminants to soil and groundwater. Cleanup actions are ongoing and include a groundwater remediation system completed in 1997 to accelerate the removal of contaminants from the groundwater. Additional remediation techniques are being evaluated to expedite cleanup.

A Montana Department of Natural Resources and Conservation (DNRC) Controlled Groundwater Area (CGWA) was created in 2001 with a buffer around the contaminated area to prevent construction of new wells in the vicinity. Contaminated groundwater is continuing to be pumped and treated until water quality has been restored to its intended use as a drinking water source. Additional information is available from the U.S. EPA [here](#).

**Figure 8 (right).** The Idaho Pole Company Site Controlled Groundwater Area. Here, groundwater generally moves from south to north. The source of the contamination is near Cedar Street, in the southern portion of the CGWA.



## Bozeman Solvent Site

The Bozeman Solvent Site (BSS) is a Montana State Superfund facility, located in Bozeman, north of West Main Street and between North 19th Avenue and North 15th Avenue. Soil and groundwater at BSS have been contaminated by tetrachloroethene (PCE), used at a former dry cleaning business located in the Hastings Shopping Center (formerly known as the Buttrey Shopping Center). PCE primarily entered the groundwater via a leaking sewer line and a septic system. A CGWA was created by Montana DNRC in 1998. The CGWA includes the area under Hastings Shopping Center and extends north of the East Gallatin River (**Figure 9**), although the actual contaminated area is a smaller area within the CGWA boundary.



Although there is variability in PCE concentrations between different groundwater sampling events, some wells exhibit concentrations above the Montana DEQ Numeric Water Quality Standards for human health (5 µg/L), while many other wells have concentrations below the standard, or even below detectable levels. Generally, PCE concentrations at the Bozeman Solvent Site are declining and an enhanced bioremediation approach to clean up groundwater is being conducted. Additional information is available from the Montana DEQ [here](#).

**Figure 9 (left).** The Bozeman Solvent Site Controlled Groundwater Area. Groundwater generally moves from south to north. The source of the contamination is in the southern part of the area, under the Hastings (formerly Buttrey) Shopping Center on Main Street.

## Other Projects and Resources

Various projects and programs are on the docket for upcoming years to help preserve, protect, and improve water quality within the GLWQD. Continued groundwater level monitoring will be continued in the 48 well network on a quarterly basis at a minimum. Groundwater quality data will also be continually collected in the coming years in these wells. Other groundwater and stream data not described in detail in this report have recently been collected as part of the [Montana Bureau of Mines and Geology \(MBMG\) Groundwater Investigation Program \(GWIP\)](#). As the [current GWIP project](#) in the Gallatin Valley comes to an end, detailed reports and information will be produced by MBMG. A GWIP project is also being conducted in the [Big Sky](#) area and will be completed in 2016.

The GLWQD is working with the [City of Bozeman](#) to assess the biological and nutrient status of the East Gallatin River, and to develop an urban stream gaging network to assess stream flows and water quality in Bozeman's urban area.

An investigation into the extent that groundwater exceeds the [U.S. EPA Drinking Water Standard](#) for arsenic is slated to begin in early 2016 and it will provide information on the geographic distribution of arsenic in the Amsterdam-Churchill area.

As always, the GLWQD is here to help preserve, protect, and improve water quality. Resources for homeowners and residents including Well Educated well test kits for sampling your domestic well, [fact sheets](#), [and informational brochures](#) are available through our office and on the web. If you have questions or comments, do not hesitate to call or email staff at GLWQD.

## Additional Resources

[Gallatin River Task Force](#)

[Greater Gallatin Watershed Council](#)

[Montana Bureau of Mines and Geology \(MBMG\) Groundwater Information Center](#)

[Montana Department of Environmental Quality \(DEQ\)](#)

[Montana Department of Natural Resources and Conservation \(DNRC\)](#)

[US Geological Survey \(USGS\) Current Water Data for Montana](#)

## Contact Information

*For more information, please contact:*

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