

Lexley Acres Mobile Home Park
PWSID #MT0000461

**SOURCE WATER DELINEATION AND
ASSESSMENT REPORT**

Prepared by:
Gallatin Local Water Quality District
Bozeman, Montana

August 2002

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

Prepared for:

Lexley Acres Mobile Home Park
6071 Jackrabbit Lane
Belgrade, Montana 59714
(406) 388-6095

Jerry Swenson, Owner

August 14, 2002

Prepared by: Tammy Crone, Water Quality Specialist and Alan English, Manager

Gallatin Local Water Quality District
311 W. Main Street, Courthouse, Rm. 311
Bozeman, MT 59715
Phone: (406) 582-3148 Fax: (406) 582-3095

Table of Contents

ACKNOWLEDGMENTS AND CONTACTS VI

GLOSSARY OF TERMS* VII

INTRODUCTION AND BACKGROUND..... 1

 PURPOSE..... 1

 LIMITATIONS 1

 THE COMMUNITY 1

 GEOGRAPHIC SETTING 2

 GENERAL DESCRIPTION OF THE SOURCE WATER 2

 DESCRIPTION OF PUBLIC WATER SUPPLY SYSTEM 3

 WATER QUALITY 4

 INFLUENCING FACTORS 5

DELINEATION OF GROUND WATER SOURCES 5

 SOURCE WATER PROTECTION MANAGEMENT AREAS..... 5

 HYDROGEOLOGIC LITERATURE REVIEW 6

 CONCEPTUAL MODEL AND ASSUMPTIONS 7

 DESCRIPTION OF WELLS 7

 METHODS 9

 SPREADSHEET INPUT VALUES..... 9

 DELINEATION RESULTS..... 10

 LIMITING FACTORS 10

POTENTIAL CONTAMINANT SOURCE INVENTORY 11

 INVENTORY OVERVIEW 11

 DEVELOPMENT OF DISTRICT WIDE POTENTIAL CONTAMINANT SOURCE GIS DATABASE 11

 INVENTORY RESULTS – CONTROL ZONES AND INVENTORY REGION 12

 INVENTORY RESULTS – RECHARGE REGION 13

 INVENTORY RESULTS – SURFACE WATER BUFFER 14

 INVENTORY UPDATE 14

 INVENTORY LIMITATIONS 14

SUSCEPTIBILITY ASSESSMENT..... 14

 SUSCEPTIBILITY ASSESSMENT METHODS 14

 SUSCEPTIBILITY ASSESSMENT RESULTS 15

 SIGNIFICANT POTENTIAL CONTAMINANT SOURCES 17

 LIMITING FACTORS 18

REFERENCES..... 19

APPENDIX A A

 FIGURES A

APPENDIX B B

 WELL LOGS AND PHOTOGRAPHS B

APPENDIX C C

 SANITARY SURVEY REPORT C

APPENDIX D D

TIME OF TRAVEL SPREADSHEETS D

APPENDIX E **E**

SUSCEPTIBILITY ASSESSMENT WORKSHEETS.....E

APPENDIX F**F**

LISTING OF POTENTIAL CONTAMINANT SOURCES:.....F

Figures:

- [Figure 1: Belgrade, Montana Vicinity Map](#)
- [Figure 2: Aerial Photo of Lexley Acres Site with Well Locations and 100' wellhead protection zone.](#)
- [Figure 3: Delineation Regions, Lexley Acres PWS Wells](#)
- [Figure 4: USGS Land Use - Inventory Region](#)
- [Figure 5: Significant Potential Contaminant Source - Inventory Region](#)
- [Figure 6: USGS Land Use - Recharge Region and Surface Water Buffers](#)
- [Figure 7: Significant Potential Contaminant Sources - Recharge Region](#)
- [Figure 8: Septic System Density - Recharge Region](#)
- [Figure 9: Nonpoint Sources - Surface Water Buffer](#)
- [Figure 10: Septic System Density - Surface Water Buffer](#)
- [Figure 11: Generalized Surficial Geology and Regional Ground Water Flow Patterns for the Lexley Acres Area.](#)

Tables:

TABLE 1: IDENTIFICATION AND CROSS REFERENCE OF LEXLEY ACRES PWS WELLS 4

TABLE 2: LIST OF HYDROGEOLOGIC INVESTIGATIONS AND MAPS COVERING THE BELGRADE AREA.... 6

TABLE 3: SUMMARY OF WELL LOG INFORMATION AND LOCATION FOR LEXLEY ACRES PWS WELLS . 8

TABLE 4: SPREADSHEET INPUT PARAMETERS USED TO DELINEATE CAPTURE ZONES 9

TABLE 5.: SIGNIFICANT POTENTIAL CONTAMINANT SOURCES IN THE CONTROL ZONE AND INVENTORY REGION FOR LEXLEY ACRES MOBILE HOME PARK. 13

TABLE 6: HAZARD OF POTENTIAL CONTAMINANT SOURCES..... 15

TABLE 7: RELATIVE SUSCEPTIBILITY TO SPECIFIC CONTAMINANT SOURCES 15

TABLE 8: SUSCEPTIBILITY ASSESSMENT FOR SIGNIFICANT POTENTIAL CONTAMINANT SOURCES IN THE CONTROL ZONE AND INVENTORY REGION FOR LEXLEY ACRES 16

APPENDICES

- Appendix A: Figures 1 through 11
- Appendix B: Well Logs and Photographs
- Appendix C: January 2001 Sanitary Survey
- Appendix D: 1-Year and 3-Year Time of Travel Spreadsheet Outputs

Appendix E: Susceptibility Assessment Worksheets

Appendix F: Listing of Potential Contaminant Sources-Inventory Region

LIST OF TABLES

Table 1. Identification and cross reference of Lexley Acres PWS wells	4
Table 2. List of hydrogeologic investigations and maps covering the Belgrade area	6
Table 3. Summary of well log information and location for Lexley Acres PWS wells	8
Table 4. Spreadsheet input parameters used to delineate capture zones	9
Table 5. Significant potential contaminant sources in the Control Zone and Inventory Region for Lexley Acres Mobile Home Park	13
Table 6. Hazard of potential contaminant sources	15
Table 7. Relative susceptibility to specific contaminant sources	15
Table 8. Susceptibility assessment for significant potential contaminant sources in the Control Zone and Inventory Region for Lexley Acres	16

ACKNOWLEDGMENTS AND CONTACTS

This Delineation and Assessment Report was prepared for the Lexley Acres Mobile Home Park Public Water Supply (PWS), and the Montana Department of Environmental Quality (DEQ)-Source Water Protection Program. The report was prepared by the Gallatin Local Water Quality District (GLWQD), with funding support from the DEQ Source Water Protection Program under contract number 202092. Mr. Jerry Swenson, the owner and operator of the Lexley Acres PWS, assisted in preparation of this report by providing information on the PWS and conducting a field inspection of the PWS with the GLWQD. The fieldwork and report preparation were completed in August 2002. The following contact information for the Lexley Acres PWS is provided for reference:

PWSID: 00461
County: Gallatin
Operator: Jerry Swenson
Address: 6071 Jackrabbit Lane, Belgrade, MT 59714
Phone Number: (406) 388-6095

The following contact information is provided for the Gallatin Local Water Quality District:

Prepared By: Tammy Crone, Water Quality Specialist and Alan English, Manager
Agency: Gallatin Local Water Quality District.
Address: 311 West Main Street, Room 311, Bozeman, MT 59715
Phone Number: (406) 582-3148

Questions regarding the DEQ Source Water Protection Program should be addressed to DEQ at the following address and phone number:

Contact: Mr. Joe Meek
Agency: DEQ-Source Water Protection Program
Address: P.O. Box 200901, Helena, MT 59620-0901
Phone Number: (406) 444-4806

GLOSSARY OF TERMS*

Acute Health Effect: An adverse health effect in which symptoms develop rapidly.

Alkalinity: The capacity of water to neutralize acids.

Aquifer: A water-bearing layer of sediment or rock that will yield water in usable quantity to a well or spring.

Best Management Practices (BMPs): Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from non-point sources.

Coliform Bacteria: A class of bacteria found in the intestinal tracts of animals. Their presence in ground water is an indicator of the possibility of contamination by pathogenic organisms.

Confined Aquifer: A fully saturated aquifer overlain by a confining unit such as a clay layer. The static water level in a well completed in a confined aquifer is at an elevation that is equal to or higher than the base of the overlying confining unit.

Confining Unit: A geologic formation that inhibits the flow of water.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): Enacted in 1980. CERCLA provides a Federal "Superfund" to clean up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. Through the Act, EPA was given power to seek out those parties responsible for any release and assure their cooperation in the cleanup.

Delineation: A process of mapping source water management areas.

Hardness: Characteristic of water caused by presence of various chemical compounds. Hard water may interfere with some industrial processes and prevent soap from lathering.

Hazard: A measure of the potential of a contaminant leaked from a facility to reach a public water supply source. Proximity or density of significant potential contaminant sources determines hazard.

Hydraulic Conductivity: A coefficient of proportionality describing the rate at which water can move through an aquifer.

Inventory Region: A source water management area that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified ground water travel time.

Maximum Contaminant Level (MCL): Maximum concentration of a substance in water that is permitted to be delivered to the users of a public water supply. Set by EPA under authority of the Safe Drinking Water Act.

Nitrate: An important plant nutrient and type of inorganic fertilizer. In water, the major sources of nitrate pollution are septic tanks, sanitary sewers, feed lots and fertilizers.

Nonpoint Source Pollution: Sources such as stormwater runoff that are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specified outlet.

Pathogens: Organisms capable of producing disease.

Point Source: A stationary location or fixed facility from which pollutants are discharged.

Public Water System: A system that provides piped water for human consumption to at least 15 service connections or regularly serves 25 individuals.

Pumping Water Level: Water level elevation in a well when the pump is operating.

Recharge Region: Source water management region that is generally the entire area that could contribute water to an aquifer used by a public water system. Includes areas that could contribute water over long time-periods or under different water usage patterns.

Resource Conservation and Recovery Act (RCRA): Enacted by Congress in 1976. RCRA's primary goals are to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner.

Source Water Protection Area: For surface water sources, the land and surface drainage network that contributes water to a stream or reservoir used by a public water supply. For ground water sources, the land surface overlying the portion of an aquifer that contributes water to a well.

Static Water Level (SWL): Water level elevation in a well when the pump is not operating.

Susceptibility (of a PWS): The potential for a public water system to draw water with contamination at concentrations that would pose concern. Susceptibility is evaluated at the point immediately preceding treatment or, if no treatment is provided, at the entry point to the distribution system.

Synthetic Organic Compounds (SOC): Man-made organic chemical compounds such as herbicides and pesticides.

Total Dissolved Solids (TDS): The dissolved solids collected after a sample of a known volume of water is passed through a very fine mesh filter.

Transmissivity: The ability of an aquifer to transmit water.

Unconfined Aquifer: An aquifer containing water that is not under pressure. The water table is the top surface of an unconfined aquifer.

Volatile Organic Compounds (VOC): Any organic compound that evaporates readily to the atmosphere.

INTRODUCTION AND BACKGROUND

Purpose

This report is intended to meet the technical requirements for the completion of the delineation and assessment report for the Lexley Acres Mobile Home Park public water supply (PWS) as required by the Montana Source Water Protection Program (DEQ, 1999) and the Federal Safe Drinking Water Act (SDWA) Amendments of 1996 (P.L. 104-182).

The Montana Source Water Protection Program assists public water supplies with developing a practical and cost-effective approach to protecting the water supply from contamination. A major component of the Montana Source Water Protection Program is “delineation and assessment”. **Delineation** is a process of mapping source water protection areas, which are areas that contribute water to the water system. **Assessment** involves identifying locations or regions within source water protection areas where contaminants may be generated, stored, or transported, and then determining the relative potential for those contaminants to reach the drinking water source(s). The primary purpose of this source water delineation and assessment report is to provide information that can aid the Lexley Acres PWS with completion of a **Source Water Protection Plan** to protect its drinking water sources from contamination.

Limitations

This report was prepared to assess threats to the Lexley Acres Mobile Home Park PWS, and is based on 1) published information, 2) information obtained from the owner/operator of the public water supply, and 3) information collected by the Gallatin Local Water Quality District. The terms “drinking water supply” or “drinking water source” refer specifically to the source of the Lexley Acres Mobile Home Park public water supply and not any other public or private water supply.

While reasonable efforts were made to identify potential or existing sources of ground water or surface water contamination in the Lexley Acres area, additional potential or existing sources may exist. Only documented or known potential sources of contamination in areas that contribute water to the PWS are considered. The terms “contaminant” and “toxin” are used in this report to refer to constituents for which maximum contaminant levels (MCLs) have been specified under the national primary drinking water standards, and to certain constituents that do not have MCLs but are considered to be significant health threats.

The Community

Lexley Acres Mobile Home Park has approximately 200 residents and is located at the south edge of Belgrade, just outside the Belgrade City Limits. A map showing the Belgrade vicinity and the location of Lexley Acres is provided in Appendix A, [Figure 1](#). Constructed in 1970, the park served as a combined mobile home park and campground/RV park until 2001. In 2001 the campground/RV park service was discontinued. The Lexley Acres PWS is classified as a community water supply due to the permanent and full-time nature of the population served.

The Belgrade area has experienced rapid growth over the past decade. The current population is 5,728, based on the 2000 U.S. Census. Belgrade has a strong, diverse local economy relying mostly on small businesses. It also serves as a bedroom community of Bozeman, with many of the folks that live in Belgrade, working in Bozeman. Retail trade; professional, scientific and technical services; along with accommodation and food services are the main economic base. There are several small areas of industrial activity located at southern and northeastern portions of the city, including the Louisiana Pacific lumber mill, and several large gravel pits.

Lexley Acres Mobile Home Park is situated at the corner of Frank Road and Jackrabbit Lane (Highway 89) in the urban fringe at the southern end of Belgrade. Land uses to the north are commercial and urban, whereas land uses to the south are semi-rural with a mixture of small acreage pasture and crop land and unsewered residential and commercial development. There is an increase in unsewered commercial development to the south and east.

There are 4 major transportation corridors in the Belgrade area: Interstate 90 and Highway 10 (Frontage Road) bisect the community from southeast to northwest, Highway 89 (Jackrabbit Lane) extends south to Four Corners, and a railroad, serviced by Montana Rail Link, extends southeast to northwest through town, following the Frontage Road. Gallatin Field, a regional airport, is located on the east side of Belgrade and is serviced by several major airlines, freight carriers and several private aircraft services.

Ground water use in the immediate vicinity of Lexley Acres Mobile Home Park is limited to domestic use and light commercial use. Three irrigation ditches are located along the eastern, southern, and western borders of the park. All domestic water use for the Belgrade area is provided from ground water via individual wells or community drinking water systems.

Wastewater disposal around Lexley Acres is a mix of community septic systems and individual, single lot septic systems. Wastewater treatment and disposal within the city limits is provided by the City of Belgrade. The wastewater is piped to a lagoon system located northeast of the City for treatment and disposal. The lagoon system is located about 2.5 miles northeast of Lexley Acres and is down gradient (down flow) of the wells supplying water to Lexley Acres, posing no concern to the system. A community septic system for the Starr Mobile Home Park, located just south of Lexley Acres is directly up-gradient of Lexley Acres well #3, and poses a risk to the water system.

Geographic Setting

Belgrade is located in northern Gallatin County, in the north-central portion of the Gallatin Valley. The Gallatin Valley occupies the eastern half of the Three Forks structural basin, which is a broad intermontane basin within the Rocky Mountains. Mountains surround the valley to the north, east, and south. The Madison Plateau forms the western boundary of the Gallatin Valley, separating it from the western half of the Three Forks Basin. The Madison Plateau is a broad, low relief topographic feature that separates the Gallatin River Drainage basin from the Madison River drainage basin. The Gallatin Valley is part of the Upper Missouri River Sub-major drainage basin. Surface water drains from the surrounding mountains via the East Gallatin River (HUC10020008 MT41H003) located north of Belgrade and the West Gallatin River (HUC 10020008 MT41H001) located to the southwest. There are numerous irrigation ditches that transport surface water from these rivers and other smaller streams to agricultural land throughout the Gallatin Valley, including the Belgrade area.

Lexley Acres Mobile Home Park is at approximately 45.5° north latitude and is about 4,451 feet above mean sea level. The average high and low temperatures for Belgrade are 27.6° Fahrenheit (F) and 4.4° F for January and 85.5° F and 49.2° F for July. The climate is semi-arid with precipitation averaging 13.8 inches per year, concentrated in the months of May through September. Snowfall averages 48.3 inches per year. The average growing season is 107 days.

General Description of the Source Water

The wells at Lexley Acres obtain ground water from the Gallatin Valley Aquifer. The aerial extent of the aquifer system is about 450 square miles, with a length of about 25 miles from north to

south, and a width of up to 20 miles from east to west. The aquifer is bounded to the north by the uplifted bedrock of the Horseshoe Hills, to the East and South by the Bridger and Gallatin Mountain ranges respectfully, and to the west by the Madison Plateau. Regional ground-water flow within the aquifer is generally from southeast to northwest. However, in the Belgrade area the regional flow direction is from south to north. The Gallatin Valley Aquifer is more accurately described as an aquifer system. This aquifer system was first described in detail by Hackett et al. (1960), who divided the aquifer into 12 subareas. Lexley Acres is located within the Belgrade subarea, which is a broad alluvial plain underlain mainly by cobbles, gravels, and sands deposited by the ancestral West Gallatin River.

Description of Public Water Supply System

Lexley Acres serves about 200 residents through 100 service connections. There are six wells on the property. Two of these wells are reported to be inactive by the system operator, but they are not abandoned or disconnected from the distribution system. A color infrared aerial photograph showing the Lexley Acres area and the locations of the wells is provided in Appendix A, [Figure 2](#). Appendix B contains well logs for all six of the wells connected to the system and photographs of five of the six wells, and some of the associated facilities. Well #1 is under the house occupied by the owner/operator, and could not be photographed.

In an effort to correctly match the well locations with well logs, and the correct PWS source ID numbers, the following information was reviewed:

- 1) PWS file obtained from the Gallatin County Environmental Health Division
- 2) MBMG Ground Water Information Center (GWIC) database
- 3) Most recent Sanitary Survey, completed January 3, 2001 by The Cadmus Group, Inc.
- 4) A site visit and wellhead inspection by GLWQD staff with the owner/operator.

Discrepancies with on-site well numbering were noted along with errors in the GWIC database. For example, the log for the oldest well in the system (M90877) reported the well in Section 2 rather than Section 11 of the Township. The available information and the site visit were used to correctly match well log records with the physical locations of each well. The well locations were previously documented by the GLWQD using a Global Positioning System (GPS) receiver, with locations accurate to within two meters. ***To avoid further confusion the wells were renumbered for this report, based on completion date. Table 1 identifies the corrected well numbers, PWS Source ID number, and MBMG GWIC ID numbers used for this report.***

The January 3, 2001 Sanitary Survey completed by The Cadmus Group, Inc., provides a description of the distribution system for the mobile home park. A copy of the sanitary survey is provided in Appendix C for review. To remain consistent with the new numbering of the wells in this report, and identified in Table 1, the well numbers identified in the sanitary survey have been changed in this report to reflect that. The distribution system is 1.5 inch and 2 inch PVC piping that loops through the system and has numerous dead ends. Pressure systems are located throughout the mobile home park. The pump house for well #4 has 5 captive air pressure tanks in an insulated metal shed with a space heater. The pump house for well #2 and well #6 has 9 captive air pressure tanks. The pump house for well #3 contains 3 captive air pressure tanks in a metal shed enclosure and is heated with a space heater. The old laundry storage building contains a ~150 gallon air pressure tank that services well #5. Currently there is no treatment of the well water prior to distribution. A liquid chlorine injector system was installed on well #4 but was not being used at the time of the sanitary survey. This system has since been removed from well #4. A pellet chlorinator is installed on well #6 and is not being used at this time.

Table 1: Identification and Cross Reference of Lexley Acres PWS Wells

Well #	1	2	3	4	5	6
Source ID #	006	004	003	005	002	007
GWIC #	90877	91042	91039	91040	91038	149148
Completion Date	3/23/61	4/16/70	4/9/70	7/15/71	2/29/72	7/15/94
Total Depth	76'	81'	81'	64.5'	98'	123'
Casing Depth	76'	79'	79.5'	63.5'	88.5'	105'
Completion Depth	76'	79'	79.5'	No record	88.5'	103' – 118'
Static Water Level	47'	57'	56.5'	14'	48'	38'
Physical Location	Residence/Office	Lot #41, inside pump house	Lot #61, SE corner	Lot #1, SW corner	Lot #88, parking lot	Lot #41, next to pump house
Use Status	Inactive	Inactive	Active	Active	Active	Active
Cadmus Sanitary Survey Well #	5	2	3	1	4	6
PWS Inventory Database Well #	5	3	2	4	1	No record
Disinfection Method	None	None	None	None	None	Pellet Chlorinator
Comments	TRS inaccurate on well log. Gallatin Co. Assessor's Office confirmed the date of residence construction on property was 1961.	Confirmed via original well driller's log and Cadmus sanitary survey.	Confirmed via original well driller's log.	Well with shallow depth and SWL. Confirmed based on SWL measurement by GLWQD staff and proximity of well to irrigation ditch.		Location confirmed via PWS owner/operator and Cadmus Sanitary Survey.

Water Quality

Every PWS is required to perform monitoring for contamination to their water supply. Water is typically monitored for total coliform, fecal coliform, nitrates, metals and chemicals. The monitoring schedule depends on the population served, the number of wells and the source water for the PWS. DEQ defines monitoring programs and protocols that are specific to each PWS. The water at Lexley Acres Mobile Home Park was not routinely monitored for compliance with drinking water standards from 1996-1998 and an Administrative Order on Consent (FID #377) was executed in February 2001 by DEQ for the following violations: (a) failure to monitor nitrate, VOC, IOC, SOC and LC, (b) failure to report to DEQ, notify the public, and submit verification of public notices to DEQ. The owner/operator of Lexley Acres was ordered to

contract with an outside Certified Operator for this public water supply system at least through December 2002.

The only regulated contaminant detected in the water supply in the last five years was di(2-ethylhexyl)phthalate. Di(2-ethylhexyl)phthalate was detected in water samples collected from well #2 in 2001 at 6.1 µg/l (ppb). The maximum contaminant level (MCL) is 6.0 µg/l (ppb). This contaminant is associated with plastics manufacturing. The bladders and some pump parts for this well have been replaced in an attempt to address the problem. Recent SOC test results from water samples collected from the well in May 2002, show the level of di(2ethylhexyl)phthalate at 1.9 µg/l (ppb), suggesting a source remains. The source may be related to plasticizer leaching from the plastic distribution system pipe or possibly from fragrance used in household cleaning products (i.e., household bleach). There may also be some upgradient source of phthalates discharging to the subsurface.

There are several leaking underground storage tank (LUST) sites located to the south of Lexley Acres Mobile Home Park. Compliance monitoring data contained in the DEQ PWS database does not contain any records showing detection of fuel related contaminants in the system.

Influencing Factors

Starr Mobile Home Park is located immediately south of Lexley Acres. A 46-unit expansion of the Starr Mobile Home Park included the construction and installation of a second waste water treatment system in October 1999, which consisted of septic tanks, collection system, lift station recirculating sand filter, and pressure dosed drain field. A site visit to Lexley Acres by the Gallatin Local Water Quality District verified that this new waste water system was approved and installed less than 100 feet directly upgradient of Lexley Acres PWS well #3 ([Figure 2](#), Appendix A). In addition, the older waste water system drainfield for Starr Mobile Home Park is immediately adjacent to the Mammoth irrigation ditch. This ditch is adjacent to the western edge of Lexley Acres Mobile Home Park.

The proximity of these waste water system drainfields to a surface water source and a drinking water supply well for Lexley Acres presents concerns for this PWS. Additionally, development will continue to occur upgradient of Lexley Acres public water supply bringing with it an increase in community and individual septic systems. In order to prevent potential contamination problems, Lexley Acres could evaluate abandoning well #3 and drilling a replacement well in another location. They could also evaluate increasing monitoring activities for well #4 which is located just to the east of the Mammoth irrigation ditch.

The City of Belgrade is currently in the process of expanding water service to the area south of Interstate 90. According to the manager for the City of Belgrade, Joe Menicucci, service will be provided incrementally to all businesses and residents in this area over several years once the new water supply well is drilled. The owners of the Lexley Acres Mobile Home Court may want to consider hooking on to city water at that time.

DELINEATION OF GROUND WATER SOURCES

Source Water Protection Management Areas

The source water protection areas, the land areas that contribute water to Lexley Acres, are identified in this section. Maps showing the **Source Water Protection Areas** determined for the Lexley Acres wells are provided in Appendix A, Figures 2-10. Three management areas are

identified within the source water protection areas. These three regions are 1) the control zone, 2) the inventory region, and 3) the recharge region. The control zone, is an area with a radius of 100-feet, centered around the wellhead. The inventory region represents the land surface overlying the most likely zone of contribution of ground water flowing towards the well, based on a three-year ground water time-of-travel. Analytical equations describing ground water flow using estimates of pumping and aquifer characteristics and simple hydrogeologic mapping were used to calculate the ground water time-of-travel distances. The recharge region represents the entire portion of the aquifer system that may contribute ground water to Lexley Acres. Surface water buffers are included for the West Gallatin River, Big Bear Creek and South Cottonwood Creek, and three irrigation ditches that flow through the Lexley Acres area. The three irrigation ditches are located within close proximity to Lexley Acres; one ditch runs along the eastern boundary of the park, a second just to the south, and a third along the park's western boundary. A ½ mile buffer was mapped around each of these surface water bodies, with the buffer zone extending 10 miles upstream from the inventory region for the West Gallatin River and to the headwaters of Big Bear Creek and South Cottonwood Creek.

Hydrogeologic Literature Review

Lexley Acres Mobile Home Park is situated in the north-central portion of the Gallatin Valley. A detailed hydrogeologic investigation of the Gallatin Valley aquifer system, including the Belgrade area, was completed by Hackett et al. (1960). This report includes the first published surficial geologic map of the Gallatin Valley (Hackett et al. 1960, Plate 2), and remains the most detailed hydrogeologic investigation conducted in the area to date. Ground-water flow patterns within the Valley were re-evaluated by Slagel (1995). Well log records were statistically evaluated by Dixon and Custer (1999) to evaluate hydraulic conductivity properties for the aquifer. Water-level measurements and extensive water-quality sampling was conducted by Kendy (2001) to determine sources of recharge, and sources of nitrate for the aquifer system. A more detailed surficial geologic map of the Eastern half of the Gallatin Valley was completed by Lonn and English (2002). Information on the above reports and maps is summarized in Table 2 below.

Table 2: List of Hydrogeologic Investigations and Maps Covering the Belgrade Area

Author, Year, and Title	Area Covered	Project Purpose
1. Dixon, S. A., and Custer, S. G., 1999. Lithostratigraphic and hydrostratigraphic units of the Gallatin Local Water Quality District, Gallatin County, Montana. 1 p.	Gallatin Local Water Quality District	Evaluate regional aquifer properties using drillers logs
2. Hackett, O. M., Visher, F. N., McMurtrey, R. G., and Steinhilber, W. L., 1960. Geology and ground water resources of the Gallatin Valley, Gallatin County, Montana: U.S. Geological Survey Water-Supply Paper 1482, 282 p.	Gallatin Valley	Regional geology and water resource assessment
3. Kendy, E., 2001. Magnitude, extent, and potential sources of nitrate in ground water in the Gallatin Local Water Quality District, southwestern, Montana, 1997-98: U.S. Geological Survey Water-Resources Investigations Report 01-4037, 66 p.	Gallatin Local Water Quality District	Evaluate sources of recharge and sources of nitrate in ground water
4. Lonn, J. D., and English, A. R., 2002. Preliminary geologic map of the eastern part of the Gallatin Valley, Montana: Montana Bureau of Mines and Geology Open File Report 457, Butte, Montana.	Eastern half of the Gallatin Valley	Map surficial geology of the valley fill deposits
5. Slagle, S. E., 1995. Geohydrologic conditions and land use in the Gallatin Valley, southwestern Montana, 1992-93: U. S. Geological Survey Water-Resources Investigations Report 95-4034 2 p.	Gallatin Valley	Assessment of changes in water resources since 1960

Conceptual Model and Assumptions

The wells at Lexley Acres are completed in an unconsolidated alluvial aquifer referred to as the Gallatin Valley Aquifer. This aquifer is composed of a complex mixture of sediments deposited by fluvial (river), lacustrine (lake), and eolian (wind) processes during the Tertiary and Quaternary geologic periods. The unconsolidated alluvial sediments rest on a bedrock floor that probably has significant topographic relief, based on the structural complexity of the surrounding exposed bedrock.

Hackett et al. (1960) divided the Gallatin Valley aquifer system into a number of hydrogeologic subareas that had unifying hydrogeologic characteristics. Lexley Acres is situated within the "Belgrade subarea". In this area the alluvium was deposited by the ancestral West Gallatin River, and consists mainly of cobbles and gravels with discontinuous layers of sand, silt, and clay. Well logs in the area sometimes report "cemented" layers within the alluvial material. These cemented layers may represent caliche horizons; layers with secondary cementation by calcium carbonate. The caliche horizons were probably formed within ancient soil horizons that developed on the valley floor and were later buried by younger alluvial sediments. The caliche horizons and layers of clay and silt probably restrict vertical ground water movement.

The thickness of the alluvial aquifer in the Lexley Acres area is estimated to be about 250 feet, based on test wells drilled by Hackett et al (1960). One of their test wells was drilled three miles south of Lexley Acres and hit bedrock at 137 feet below ground surface (bgs). Another test well was drilled two miles north of Lexley Acres and was completed to 400 ft bgs, without hitting bedrock. The total depth of the wells at Lexley Acres ranges from 65-feet to 123 feet. Based on the estimated total depth of the alluvium, the Lexley Acres wells are completed in the upper third to upper half of the aquifer. The well logs for the Lexley Acres wells show alternating layers of gravel, sand, and clay. The log for well #6 reports a lime cemented layer at 59-64 feet bgs. Based on the available hydrogeologic literature and the well logs for the wells at Lexley Acres, the aquifer may be semi-confined. However, because there is no direct evidence indicating semi-confining conditions, the aquifer is assumed to be unconfined for purposes of this report.

The aerial extent of the aquifer is significant. The eastern, western, and northern boundaries are more than 3 miles from the site, and the upgradient southern boundary is more than 10 miles from the site. Given the great distances to any of the aquifer boundaries, it is unlikely that the capture zones for the wells reach any of the boundaries of the aquifer.

Regional ground-water flow patterns based on the work of Slagel (1995) suggest that the direction of ground-water flow is generally due north in the area of Lexley Acres. The gradient of the water table based on Slagle (1995) is about 0.0064 ft/ft. Because the Lexley Acres site is out in the central portion of a relatively large valley aquifer, this gradient is assumed to be relatively constant. The map shown in Appendix A, [Figure 11](#) is adapted as the conceptual model of the ground water flow direction and hydraulic gradient for the Lexley Acres wells.

Description of Wells

Lexley Acres Mobile Home Park is served by six wells. Two of these wells (#1 and #2) are currently not in use. However, they have not been abandoned or disconnected from the distribution system. The locations of the wells are shown in Appendix A, [Figure 2](#). A summary of the well information is provided in Table 3. Appendix B contains copies of the drillers' well logs obtained from GWIC along with photographs for five of the six wells.

Well #1 (Source #006). This well is located in the crawl space of the residence/office for the mobile home park. The well is inactive but not abandoned. This 6-inch well was drilled to 76 feet in 1961. It is cased to 76 ft. Pump test at time of construction yielded 30 gpm.

Well #2 (Source #004). The wellhead is located in a metal enclosure next to Lot #41. This 6-inch well was drilled to 81 ft in 1970. The well is cased to 79 ft. A bail/pump test conducted at time of construction yielded 48 gpm. The well is not in use and has not been abandoned.

Well #3 (Source #003). Located next to Lot #61 at the southeast corner of the park. This 6-inch well was drilled to 81 ft in 1970. The well is cased to 79.5 ft. The bail/pump test yielded 48 gpm. This well is currently disconnected from the system but still serves the residence of the park owner/operator.

Well #4 (Source #005). This well is located in Lot #1 at the southwest corner of the park. This 6-inch well was drilled to 64.5 ft in 1971. The well is cased to 63.5 ft. A pump test conducted at the time of construction yielded 30 gpm.

Well #5 (Source #002). Located in the parking lot next to Lot #88 in the northeast portion of the park. This is a 6-inch well drilled to 98 ft in 1972. The well is cased to 88.5 ft. The bail/pump test yielded 48 gpm at the time of construction.

Well #6 (Source #007). This well is located in Lot #41 next to the pump house containing well #3. This is an 8-inch well drilled to 123 ft in 1994. The well is cased to 105 ft, screened from 103 to 118 ft, and grouted to 25 ft. A 24-hour pump test yielded 300 gpm.

Table 3: Summary of Well Log information and Location for Lexley Acres PWS Wells

Information	Well #1	Well #2	Well #3	Well #4	Well #5	Well #6
PWS Source Code #	006	004	003	005	002	007
Well Location	Lat: 45.7736 Long: -111.1877	Lat: 45.7591 Long: -111.1879	Lat: 45.7591 Long: -111.1879	Lat: 45.7591 Long: -111.1879	Lat: 45.7591 Long: -111.1879	Lat: 45.7591 Long: -111.1879
GWIC #	90877	91042	91039	91040	91038	149148
Water Right #	n/a	n/a	n/a	n/a	n/a	92512
Date Well was Completed	3/23/61	4/16/70	4/9/70	7/15/71	2/29/72	7/15/94
Total Depth	76 ft	81 ft	81 ft	64.5 ft	98 ft	123 ft
Perforated Interval	Open bottom	Open bottom	Open bottom	Not recorded	Open bottom	103' -- 118'
Static Water Level	47.0 ft	57.0 ft	56.5 ft	14.0 ft	48.0 ft	38.0 ft
Pumping Water Level	76.0 ft	64.0 ft	60.50 ft	64.5 ft	52.0 ft	61.8 ft
Drawdown	29	7	4	50.5	4	23.8
Test Pumping Rate	30 gpm	48 gpm	48 gpm	30 gpm	48 gpm	300 gpm
Specific Capacity	1.0 gpm/ft	6.9 gpm/ft	12 gpm/ft	0.6 gpm/ft	12 gpm/ft	12.6 gpm/ft

Methods

A spreadsheet obtained from the DEQ Source Water Protection Program was used to calculate time of travel (TOT) distances for the active wells at Lexley Acres. This spreadsheet uses an analytical equation that describes ground-water flow, commonly referred to as the Uniform Flow Equation. The spreadsheet calculates the dimensions of the capture zones for each well based on aquifer properties and well construction information entered into the spreadsheet. The orientation of the capture zones is based on the ground-water flow map by Slagel (1995).

Spreadsheet Input Values

The input values for the TOT calculation spreadsheet used for the Lexley Acres delineations are summarized in Table 4 below. The hydraulic gradient was calculated by measuring the distance between potentiometric contours using Slagel (1995), and dividing by the change in elevation. This value is considered to be reasonable and relatively constant based on the regional scale of the aquifer and the position of Lexley Acres out in the middle of the basin.

The saturated thickness of the aquifer used in the spreadsheet was determined by taking the total depth of each well and subtracting out the static water level depth reported on the drillers logs. This method gives a lower value of the aquifer thickness than the estimated actual saturated thickness of 200 feet (assuming static water level of about 50 feet). Using the lower value for aquifer thickness results in a higher ground-water velocity and greater time of travel distances. This approach should allow for some error in estimating aquifer properties that could produce a shorter than actual time of travel distance. The transmissivity values shown in Table 4 were calculated using the hydraulic conductivity value that was estimated, and the saturated thickness penetrated for each well. The value used for hydraulic conductivity is considered to be very conservative. Higher values are likely in the area, but using a lower value causes the spreadsheet to calculate a larger zone of contribution. The best information available in the Belgrade area to determine a reasonable value of hydraulic conductivity was from Hackett et al., 1960 (table 12). In this table results of 13 aquifer tests in the Belgrade area are summarized. For all but two of these tests, the actual thickness of the aquifer was unknown, so only transmissivity values are reported. The two reported hydraulic conductivity values were 600 ft/day, with aquifer thicknesses of 11 feet and 58 feet.

Table 4: Spreadsheet Input Parameters Used to Delineate Capture Zones

Input Parameter	Range of Values and Units	Values Used (for each well if more than one)			
		Well #3	Well #4	Well #5	Well #6
PWS Source Code		003	005	002	007
Transmissivity		3,651 ft ² /day	3,576 ft ² /day	7,450 ft ² /day	12,665 ft ² /day
Thickness		24.5 ft	24 ft	50 ft	85 ft
Hydraulic Conductivity		150 ft/day	150 ft/day	150 ft/day	150 ft/day
Hydraulic Gradient		0.0064 ft/ft	0.0064 ft/ft	0.0064 ft/ft	0.0064 ft/ft
Flow Direction		North	North	North	North
Effective Porosity%	10-20	15	15	15	15
Pumping Rate (ft ³ /day)	Reported	9,241	5,774	9,241	57,754
1-Year TOT*	N/A	365 days	365 days	365 days	365 days
3-Year TOT*	N/A	1,095 days	1,095 days	1,095 days	1,095 days

Delineation Results

The three-year time of travel distances, the downgradient stagnation point distances, and the lateral flow limits obtained from the TOT spreadsheet vary slightly based on the pumping rate of the wells. The spreadsheet results are included in Appendix D. The greatest time of travel distances were obtained for well #6, with a one year TOT of distance of about 2,700 feet and a three year TOT distance of 7,440 feet. Initially each capture zone was mapped by using Arcview GIS to plot the calculated TOT distances for each well. The resulting areas overlapped, so a combined zone of contribution was drawn that fully included all of the calculated areas. The width of the combined zone of contribution is slightly greater than that calculated, which should allow for some margin of safety if ground water flow directions do change slightly on a seasonal basis.

The combined time of travel boundary for the four active wells at Lexley Acres was plotted over an orthophoto quadrangle map to define the land area included within the boundary. This is shown on [figure 3](#), [figure 4](#), and [figure 5](#), Appendix A. The recharge area boundary was determined by initially drawing lines away from the zones of contribution with a 15 degree spread to account for changes in ground water flow direction. This boundary was then modified where it intercepted the boundaries of the aquifer to the south and west. The final recharge area boundary is shown on [Figure 3](#), [Figure 6](#), [Figure 7](#), and [Figure 8](#), Appendix A.

The surface water buffer regions were obtained by first digitizing the locations of the surface water bodies using ArcView™, and the orthophoto basemap. The irrigation ditches that flow through the Lexley Acres area were traced back to the Gallatin River. After the ditches and the river were digitized, ArcView™ was used to draw a ½-mile buffer around the surface water features. The final surface water buffer region is shown in [Figure 3](#), [Figure 6](#), [Figure 9](#), and [Figure 10](#), Appendix A.

Limiting Factors

The values used for aquifer properties can significantly change the calculated time of travel distances. The primary limiting factor associated with the capture zone (three year TOT) delineations is the accuracy of the aquifer properties used (Table 4). The gradient value used is considered to be fairly close. It is consistent with the gentle topography of the area, and obtained from a reliable source. The gradient value may have some error associated with measuring the map distance on a small scale map. The hydraulic conductivity value is a critical value used in the spreadsheet calculations. In the natural setting it varies significantly both horizontally and vertically. The value used is considered conservative in terms of being lower than the actual average value, which results in a larger delineation area. This approach was used to make sure that a reasonable management area was delineated. The effective porosity value (percent interconnected open pore spaces) is considered reasonable for an unconsolidated alluvial aquifer, but no site specific testing information is available. The value of 15% that was used is a typical average for the geologic setting at Lexley Acres. The flow direction is considered to be reliable, based on the detailed work completed by Hackett et al. (1960) in the area, and the follow-up mapping by Slagle (1995), which are in agreement in the Belgrade area.

Although TOT calculations were only completed for the four active PWS wells at Lexley Acres, the final 3-Year TOT zone of contribution is considered to be inclusive of the zones of contribution that would be obtained for the two inactive wells. The combined zone of contribution used is slightly wider and larger than the footprint of the individual delineated areas, allowing for some minor variations in local ground-water flow patterns.

POTENTIAL CONTAMINANT SOURCE INVENTORY

Inventory Overview

A recently completed potential contaminant source database covering the entire Gallatin Local Water Quality District was used to evaluate potential sources of contamination to the Lexley Acres PWS wells. The database was constructed by the Gallatin Local Water Quality District with funding provided by DEQ (contract 201040). The final product was a Geographical Information System (GIS) spatial database constructed using ArcView™ software. The GIS data was used to produce maps showing potential sources of contaminant to the Lexley Acres PWS wells. The significant potential contaminants in the Lexley Acres Mobile Home Park inventory region are nitrate, pathogens, fuels, solvents, herbicides, pesticides, and metals. The inventory for Lexley Acres Mobile Home Park focuses on all activities in the control zone, certain sites or land use activities in the inventory region, and general land uses and large facilities in the recharge region.

Development of District Wide Potential Contaminant Source GIS Database

All reasonably available existing databases were used to identify businesses and land uses that are potential sources of contaminants within the inventory region. A “windshield survey” was then conducted to verify the locations of potential contaminant sources and build GIS data layers in the field. GeoLink™ software was used to link a GPS receiver to a laptop to collect the information for each site and establish the geographic position. The GeoLink™ software allowed for entry of contaminant source information in the field, differential correction of GPS location data, and conversion of the information into GIS shapefiles for use in ArcView™ GIS software. In addition, several layers (shapefiles) were obtained from other sources and incorporated into the project. The following sources of information were used to develop the District wide Potential Contaminant Source GIS database:

1. Urban and agricultural land uses were identified from land cover data obtained from the Gallatin County GIS Department, based on data obtained from the USGS Geographic Information Retrieval and Analysis System.
2. EPA's Envirofacts System was queried to identify EPA regulated facilities. This system accesses the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory (TRI), Permit Compliance System (PCS), and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS). The available reports were browsed for facility information including the Handler/Facility Classification to be used in assessing whether a facility is a significant potential contaminant source.
3. DEQ databases were queried using the NRIS MAPPER to identify Underground Storage Tanks (UST), Leaking Underground Storage Tanks (LUST), hazardous spill site locations, landfills, mines (active, abandoned, comprehensive and high priority), controlled ground water areas, crude oil pipelines, RV dump sites, permitted wastewater dischargers.
4. While no known database could be located for above ground storage tanks (ASTs), these were identified during the windshield survey since numerous farms and ranches utilize these storage tanks for fuel usage.

5. Septic systems in the inventory region were identified from a database developed by Steve Custer, Earth Science Department at Montana State University in conjunction with the Gallatin Local Water Quality District.
6. Land application areas approved for subsurface injection of biosolids from the Bozeman Waste Water Treatment Plant and septage land application sites approved for surface disposal of septic tank pumpings were mapped using GIS by a student from MSU, funded by the Gallatin Local Water Quality District.
7. A listing of wastewater and stormwater discharge permits (MPDES) within the inventory region was obtained from the DEQ Water Protection Bureau.
8. **Reference USA** (www.referenceusa.com), a business phone directory, was queried to identify businesses that generate, use, or store chemicals in the inventory region. Equipment manufacturing and/or repair facilities, printing or photographic shops, paint shops, dry cleaners, farm chemical suppliers, and gasoline suppliers, and petroleum product distributors were targeted by SIC code.
9. A GIS layer for major roads and rail transportation routes was obtained from the Gallatin County GIS Department.
10. A listing of Class V injection wells was obtained from the Montana EPA office
11. A spreadsheet database containing location information and general information on abandoned mines within the inventory region was obtained from the Montana Bureau of Mines and Geology.

Inventory Results – Control Zones and Inventory Region

Using the database created, all significant potential contaminant sources were identified within the control zones and delineated 3-Year TOT region for the Lexley Acres wells. Land uses and facilities that generate, store, or use large quantities of hazardous materials were inventoried within the recharge region. Sources of pathogens and nitrate were inventoried within the surface water buffer region. Potential contaminant sources are designated as significant if they fall into one of the following categories:

- | | |
|--|---|
| 1. Large quantity hazardous waste generators | 8. Animal feeding operations |
| 2. Landfills | 9. Wastewater lagoons or spray irrigation |
| 3. Hazardous waste contaminated sites | 10. Septic systems |
| 4. Underground storage tanks | 11. Sewered residential areas |
| 5. Leaking underground storage tanks | 12. Storm sewer outflows |
| 6. Major roads or rail transportation routes | 13. Floor drains, sumps, or dry wells |
| 7. Cultivated cropland | 14. Abandoned or active mines |

In addition, above ground storage tanks (AST) were considered significant potential contaminant sources due to the volume of fuels stored. Inventory results for the control zone (100 ft radius around each well) and the inventory region (3-year TOT delineation) are listed in Table 5, and shown on a map in [Figure 2](#) and [Figure 5](#), Appendix A. Land use in the 100-foot radius control zone around each of the 4 active wells is unsewered residential. There is an irrigation canal and highway right-of-way in the control zone of Well #5. The Starr Mobile Home Park wastewater treatment system is less than 100 feet from Well #3. The right-of-way for Frank Road is within the control zone of Wells #2, #3, #4 and #6.

Land use within the inventory region is predominantly dryland pasture, with less than 50% irrigated cropland and less than 50 septic systems in the unsewered residential and unsewered commercial areas ([Figure 4](#) and [Figure 5](#), Appendix A). There are several significant potential contaminant sources in the inventory region. The septic system serving Lexley Acres has multiple tanks and drainfields serving 100 living units on 19 acres. The septic system for Star Mobile Home Park is located less than 100-feet upgradient from Lexley Acres Well #3. Both septic systems are a concern due to the potential for contamination from pathogens and nitrate. Leaks or spills could occur at one AST currently in use in the inventory region. Two inactive USTs in the inventory region have no known leaks. There are two right-of-ways (Jackrabbit Lane and Frank Road) in the 1-year time-of-travel (TOT), each with the potential for hazardous materials spills from trucks and other motor vehicles. Runoff from upgradient irrigated cropland and pastures into the irrigation canals are a concern. SOC and nitrates are the most likely contaminant in runoff from these land uses. The irrigation ditch located next to Jackrabbit Lane could serve as a direct conduit for transporting hazardous chemicals should a spill occur along Jackrabbit Lane. There are 5 commercial businesses located upgradient from the Lexley Acres PWS wells that use various chemicals.

Table 5.: Significant potential contaminant sources in the control zone and inventory region for Lexley Acres Mobile Home Park.

Source	Contaminants	Description
Starr Mobile Home Park septic system	Pathogens and nitrates	Located less than 100 feet upgradient of Well #3, Lot #61. Within 1 year TOT.
Lexley Acres Mobile Home Park septic system	Pathogens and nitrates	High septic density on the property (serving 100 units on 19 acres).
Irrigation ditches	Various organic chemicals and nitrates	Within 1 year TOT. Transportation and seepage of pesticides, herbicides and nitrate. Conduit for hazardous spills along highway right-of-way.
Transportation routes (Jackrabbit Lane, Frank Rd.)	Spills of various chemicals	Truck transportation of hazardous materials. Within 1 year TOT.
Urban land use (residential and commercial)	Spills of various chemicals	Cumulative effects of small amounts of spilled chemicals infiltrating to aquifer. Within 1-3 year TOT.
Septic systems	Pathogens and nitrates	Leaks from deteriorated or broken pipes. Within 1 year and 1-3 year TOT.
Agricultural land use	Pathogens and nitrates, pesticides and herbicides	Grazing/pasture land and irrigated crop land in the inventory region. Within 1 year and 1-3 year TOT.
USTs (Inactive)	VOCs/fuels	Within 1 year TOT. Inactive with no known leaks. See list in Appendix F.
AST	VOCs/fuels	Within 1-3 year TOT. See list in Appendix F.

Inventory Results – Recharge Region

Inventory data for the recharge region are shown on [Figure 6](#), [Figure 7](#), and [Figure 8](#), Appendix A. The land use in this region is mostly agriculture; irrigated land and grazing land which can contribute nitrate and fertilizers to the recharge region. There is an increase in rural residential development occurring in the area. Additional significant sources for pathogens and nitrate include 21 agriculture feed lots, 2 sewage treatment lagoons for Forest Park Trailer Court, 1 sewage disposal system for the Valley Ice Garden, and 2 RV dump sites at the Bozeman KOA and Buffalo Station. There are over 1000 individual and community septic systems in the recharge region with 4 areas of moderate to heavy density. There are 100 AST sites, 90 UST sites (of which 20 sites are currently active), and 2 leaking UST sites. Five injection well sites

are also located in the recharge region. Due to the number, fuel storage tanks are a significant potential contaminant source of VOCs. Ten surface mines (active and inactive), gravel pits and hot springs were identified. There are no licensed Class 2 or Class 3 landfills in the region.

Inventory Results – Surface Water Buffer

Acute significant potential contaminant sources for the surface water buffer area are pathogens and nitrates. These contaminants come from septic systems, land application of biosolids or septage, and agricultural land uses that may also contribute pesticides and herbicides to surface waters. Inventory data for the surface water buffer area are shown in [Figure 9](#), Appendix A.

Land use in the surface water buffer zone is mainly agriculture crop and pasture consisting of irrigated land and grazing land ([Figure 6](#), Appendix A). Remaining land use consists of unsewered residential, commercial and mixed urban including evergreen forest and a small area of confined feeding. Ten animal feedlots are identified in the buffer zone, but none are permitted confined animal feeding operations. There is 1 permitted septage application site, 1 community sewage disposal systems, 2 sewage treatment settling ponds, and 1 RV dump station located in the surface water buffer zone. On-site sewage systems within the surface water buffer are presented in [Figure 10](#), Appendix A. Most of the area has low density of septic systems, although there are four areas with moderate to high density.

Inventory Update

The certified operator should update the potential contaminant source inventory every year. Changes in land uses or potential contaminant sources should be noted and additions made as needed. Significant growth is expected along Highway 89 (Jackrabbit Lane) between Belgrade and Four Corners, and in the area just south of Belgrade. This development will be a mix of residential, commercial, and probably light industrial. For this reason it is highly recommended that potential sources of contamination to the Lexley Acres wells be monitored. The certified operator should contact the Gallatin Local Water Quality District to determine if they can assist with review their potential contaminant source inventory GIS database of the District. The complete inventory for the Lexley Acres Mobile Home Park will be submitted to DEQ every five years to ensure re-certification of the source water delineation and assessment report.

Inventory Limitations

The accuracy of the inventory is limited by the accuracy of the information in databases and given in person used for the assessment. The windshield survey provides a level of quality assurance that the information presented reflects current conditions at the time of preparation of this report. The inventory is based on the assumption that the aquifer is homogeneous and exhibits uniform characteristics, which is highly unlikely.

SUSCEPTIBILITY ASSESSMENT

Susceptibility Assessment Methods

Susceptibility is defined as the potential for a water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. Susceptibility is assessed in order to prioritize potential pollutant sources for management actions by Lexley Acres Mobile Home Park. The goal of Source Water Management is to protect the source water by 1) controlling activities in the control zone, 2) managing significant potential contaminant sources in the inventory region, and 3) ensuring that activities in the recharge region pose minimal threat to the source water. Management priorities in the Inventory Region are

determined by ranking the significant potential contaminant sources identified in the previous chapter according to susceptibility. Alternative management approaches that could be pursued by the Lexley Acres Mobile Home Park to reduce susceptibility are recommended. Worksheets for determining susceptibility are provided in Appendix E.

Hazard ratings are assigned to each point source potential contaminant based on its location within the 1 to 3 year time-of-travel delineation. For nonpoint sources and land use, hazard ratings are assigned based on the density of potential contaminant sources within a specified area (Table 6). Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers that decrease the likelihood that contaminated water will flow to Lexley Acres Mobile Home Park wells (Table 7). Hazard is rated by the proximity of a potential contaminant source to the wells. Susceptibility ratings are presented individually for each significant potential contaminant source and each associated contaminant (Table 8).

Table 6: Hazard of Potential Contaminant Sources

Source of Water	Potential Contaminant Source	High Hazard	Moderate Hazard	Low Hazard
Surface Water (SW)	All Sources	Potential for direct discharge to Source Water	Potential for discharge to GW that is hydraulically connected to SW	Potential contaminant sources present within the watershed
Ground Water (GW) Unconfined	All Sources	Within 1-year TOT	Between 1 to 3 years TOT	Over 3 years TOT
GW Confined	All Sources	PWS well; no seal through confining layer	Other wells (Inventory Region): No seal through confining layer	All wells (Inventory Region): Sealed through confining layer
GW and SW	Septic Systems	More than 300 per square mile	50-300 per square mile	Less than 50 per square mile
GW and SW	Municipal Sanitary Sewer	More than 50% of region	20 to 50% of region	Less than 20% of region
GW and SW	Cropped Agricultural Land	More than 50% of region	20 to 50% of region	Less than 20% of region

Table 7: Relative Susceptibility to Specific Contaminant Sources

Presence of Barriers	High Hazard	Moderate Hazard	Low Hazard
No Barriers	Very High Susceptibility	High Susceptibility	Moderate Susceptibility
One Barrier	High Susceptibility	Moderate Susceptibility	Low Susceptibility
Multiple Barriers	Moderate Susceptibility	Low Susceptibility	Very Low Susceptibility

Susceptibility Assessment Results

Table 8 presents the susceptibility assessment results for all four wells to significant potential contaminants within the control zone and inventory region. The susceptibility assessment for each of the four Lexley Acres wells is identical with the exception of Well #3 and its spatial relationship to the septic system of Star Mobile Home Park. Lexley Acres is not considered

susceptible to individual point sources in the recharge region because dispersion and dilution of contaminants should reduce concentrations of contaminants below levels associated with adverse health affects.

Table 8: Susceptibility assessment for significant potential contaminant sources in the Control Zone and Inventory Region for Lexley Acres

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management
Star Mobile Home Park Septic System	Pathogens and Nitrate	Leaks	High	None	Very High	Consider abandonment of Well #3.
Lexley Acres Mobile Home Park Septic Systems	Pathogens and Nitrate	Leaks	High	None	Very High	Consider resident education campaign on proper use of waste disposal systems. Consider connection to City of Belgrade public wastewater disposal system when available to area.
Irrigation Ditches	Pathogens, Nitrate, Pesticides, Herbicides	Nonpoint source conc. and seepage	High	Seasonal use only.	High	Encourage use of BMPs by landowners along the ditches.
Transportation Routes	Various Chemicals	Spills	High	Spill Response Plan, Belgrade Rural Fire	High	Maintain and update Spill Response Plan.
Urban Land Use	Various Chemicals	Small spills	Moderate	Small quantities	Moderate	Educate the community on BMPs for household hazardous waste
Septic Systems	Pathogens and Nitrate	Leaks	Low	None	Moderate	Manage density with land use planning. Prioritize connection of moderate- to high-density areas to sanitary sewer.
Agriculture Land Use	Pathogens and Nitrates, Pesticides and Herbicides (SOCs)	Nonpoint source conc.	Moderate	None	High	Reinforce BMP education for community.
USTs	Fuels (VOCs)	Leaks	High	Inactive sites	High	BMPs and compliance with regulations.
ASTs	Fuels (VOCs)	Leaks, Spills	Moderate	None	High	BMPs

The City of Belgrade is in the process of expanding public water service to residents and commercial businesses south of Interstate 90. Plans are in place to drill a new city well before the end of the year. However, hook-up services will be offered incrementally for the first few

years. It is recommended that Lexley Acres switch to city water services once they become available to the mobile home park.

Significant Potential Contaminant Sources

The following significant potential contaminant sources are located within the control zone and/or inventory region for the Lexley Acres wells. A listing of underground storage tank sites and selected business is also included in Appendix E.

Star Mobile Home Park Septic System – Hazard is ranked high because this system is within the 1-year time-of-travel and is in the control zone for Well #3. This well is located less than 100 feet down-gradient from the septic system. Susceptibility for all four wells is ranked very high because there are no barriers. Lexley Acres management may want to consider abandoning Well #3 for these reasons, increase sampling frequency for bacteria, and hook-up to city public water services once extended to this area.

Lexley Acres Mobile Home Park Septic System – Hazard is ranked high because of very high septic system density (approximately 100 living units served by multiple septic tanks and drainfields on 19 acres). Lexley Acres management may want to consider providing educational information to the mobile home park residents on the proper use of their waste disposal systems to prevent septic system failures. Educational assistance could be provided by the Gallatin Local Water Quality District and/or the Gallatin County Environmental Health Department. As the City of Belgrade continues to grow, community sewer services may expand south of I-90. Lexley Acres management should consider connecting to city sewer services once extended to this area.

Irrigation Ditches – Hazard is ranked high because these ditches are within the 1-year time-of-travel for all the wells. Susceptibility is ranked high because there is only one barrier. Since these ditches only contain flowing water on a seasonal basis from Spring through Fall, their ability to transport potential nonpoint source contaminants is non-existent during the winter months. A management option would be to encourage the use of BMPs by landowners of the properties the irrigation ditches travel through.

Transportation Routes – This hazard is ranked high because Jackrabbit Lane and Frank Road both pass within the 1-year time-of-travel of the wells. The City of Belgrade has a spill response plan that is carried out by the Belgrade City/Rural Fire District. Since a spill response plan is considered a barrier, the susceptibility to this contaminant source is ranked high. Maintaining and updating the spill response plan on a regular basis is one important management option.

Urban Land Use – This hazard is ranked moderate since there are numerous residential and commercial land uses within the 1- to 3-year time-of-travel for these wells. Spills of various chemicals from these commercial and residential sources are likely to be small. This is considered a barrier since dilution would probably prohibit these sources from reaching levels exceeding a public health risk. With one barrier, the susceptibility is ranked moderate. Education and outreach to the public about proper disposal and use of household hazardous waste is a management option.

Septic Systems – Hazard is ranked low. Aside from the circumstances with the Star Mobile Home Park septic system, the septic system density in the inventory region is considered low with less than 50 individual/community systems per square mile. Since there are no barriers, the susceptibility is ranked high. Management options include land use planning for the area to prevent moderate to high septic density and extending sanitary services to the area.

Agricultural Land Use – A hazard ranking of moderate is assigned to this potential nonpoint source of contaminants because it constitutes 20-50% of the land use in the inventory region. Susceptibility is ranked high because there are no barriers. A management option is to educate landowners and reinforce the use of BMPs. Because of the continued development in this area, it is likely that agricultural land use will fall to below 20% in the future.

Underground Storage Tanks (USTs) – Hazard is ranked high since these USTs are located in the 1-year time-of-travel. These USTs are considered inactive and it is assumed that the owner is in compliance with leak detection and leak prevention regulations for the State of Montana. Susceptibility is then ranked High. Management options include maintaining compliance with state leak detection/prevention regulations and considering removal of the tanks from the site.

Above Ground Storage Tanks (ASTs) – The hazard is ranked moderate because the tanks are located within the 1-3 year time-of-travel. Susceptibility is ranked high because there are no barriers. Management options would include BMPs for maintenance and care of these tanks in order to prevent leaks.

Limiting Factors

Past water quality monitoring results may be taken into consideration when determining hazard rankings and susceptibility of a public water supply to contamination. However, monitoring results may not indicate an elevation in nitrates, the presence of coliform bacteria or other contaminants, even if they do exist. Several factors to consider for this include dilution effects, linear ground water flow, limited vertical mixing, and sample size relative to daily water use.

For Lexley Acres PWS, except for the elevated phthalates previously detected in several samples, past monitoring results of water quality have shown no increase in nitrate levels over time or coliform bacteria hits. However, the susceptibility of the PWS to nitrate, coliform or chemical contamination remains moderate to very high due to the factors indicated above.

REFERENCES

Custer, S. (2000) Septic Suitability Assessment Database: ArcView GIS Shapefiles of Surface Geology and Related Data, Gallatin County, Montana. Prepared for the Gallatin Local Water Quality District., Bozeman, Montana.

DEQ (1999) Source Water Protection Program, Department Circular PWS 6-Source Water Protection Delineation: Department of Environmental Quality, Helena, Montana.

Hackett, O. M., F. N. Visher, R. G. McMurtrey, and W. L. Steinhilber (1960), Geology and Ground-Water Resources of the Gallatin Valley, Gallatin County, Montana: U.S. Geological Survey Water-Supply Paper 1482.

Kendy, E. (2001), Magnitude, extent, and potential sources of nitrate in ground water in the Gallatin Local Water Quality District, Southwestern Montana, 1997-98: U.S. Geological Survey Water-Resources Investigations Report 01-4037, Helena, Montana.

Lon, J. and A. English (2001) Surficial Geology Map of the Gallatin Valley (Final draft). Montana Bureau of Mines and Geology, Butte, Montana and Gallatin Local Water Quality District, Bozeman, Montana.

Slagle, S. E. (1995) Geohydrologic Conditions and Land Use in the Gallatin Valley, Southwestern Montana, 1992-1993. U.S. Geological Survey Water-Resources Investigations Report 95-4034.

U.S. Census Bureau Economic Census (1997).

U.S. Census Bureau Population Census (2000).

Appendix A

Figures

Figure 1: Belgrade, Montana Vicinity Map

Figure 2: Aerial Photo of Lexley Acres Site with Well Locations and 100' wellhead protection zone.

Figure 3: Delineation Regions, Lexley Acres PWS Wells

Figure 4: USGS Land Use - Inventory Region

Figure 5: Significant Potential Contaminant Source - Inventory Region

Figure 6: USGS Land Use - Recharge Region and Surface Water Buffers

Figure 7: Significant Potential Contaminant Sources - Recharge Region

Figure 8: Septic System Density - Recharge Region

Figure 9: Nonpoint Sources - Surface Water Buffer

Figure 10: Septic System Density - Surface Water Buffer

Figure 11: Generalized Surficial Geology and Regional Ground Water Flow Patterns for the Lexley Acres Area.

Appendix B

Well Logs and Photographs

Appendix C

Sanitary Survey Report January 2001

Appendix D

Time of Travel Spreadsheets

Results for Lexley Acres

Appendix E

Susceptibility Assessment Worksheets

Appendix F

Listing of Potential Contaminant Sources:

Inventory Region